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Purpose:
The research hypothesis being tested is that a telemammography system provides a mechanism for digitizing, transmitting, archiving, and displaying mammograms so that a trained radiologist utilizing grayscale monitors (2k x 2k x 8/12 bits) can interpret the images with an accuracy level sufficient for primary diagnosis.

Scope:
A series of retrospectively collected 200 normal mammograms and 200 abnormal mammograms containing a single lesion including masses, calcifications, and asymmetric densities were collected. The ROC study, which used 12 readers compares analog screen-film mammograms and the mammograms which are digitized at 50 microns spot size. The digitized mammograms were displayed on a 2k x 2k x 8/12 bit grayscale workstation using two monitors. An evaluation performance is being conducted using the metrics of throughput and throughput-to-cost-ratio.

Results:
For all readers the results of the ROC analog images varied 10% from the 0.83 area under the ROC curve, which reflects proper case selection. The throughput analysis of the analog images showed that the technologist was the bottleneck (0.041) jobs/minute) and the throughput to cost ratio was 0.001203. While the ROC analysis results on the workstations are not very different the users found the display workstation graphics cumbersome.

Conclusion:
To be clinically useful, telemammography must provide user-friendly, rapid-throughput soft-copy interpretation of digitized screen-film mammograms.

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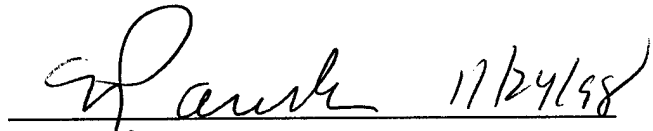

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November 1998

TELEMAMMOGRAPHY SYSTEM: A MODEL FOR A REGIONAL SYSTEM

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PURPOSE:

The research hypothesis being tested is that a telemammography system provides a mechanism for digitizing, transmitting, archiving, and displaying mammograms so that a trained radiologist utilizing grayscale monitors (2k x 2k x 8/12 bits) can interpret the images with an accuracy level sufficient for primary diagnosis. A new metric for measuring the performance of telemammography systems has been developed, throughput/cost ratio. This metric provides a measure for comparing analog to digital mammography systems. This metric has been employed in comparing manufacturing processes, i.e. jobs/sec/cost. A ROC curve analysis (1-6) is utilized to compare the accuracy of interpretation of analog images versus digitized images.

The hypothesis is being tested by utilizing a laser film digitizer with a 50-micron pixel size and by performing ROC studies to compare conventional analog screen-film mammography with digitized screen-film mammograms displayed on grayscale workstations (two monitors, each 2k x 2k x 8/12 bits). The wide area network (WAN) being utilized are terrestrial and satellites links. The goal of this study is to determine the requirements to deliver high quality, high resolution mammography images from remote locations that may not have a terrestrial data communications infrastructure available.

DESCRIPTION OF EXPERIMENTAL PROCEDURES:

A series of retrospectively collected 200 normal mammograms and 200 abnormal mammograms containing a single lesion including masses, calcifications, and asymmetric densities (focal area of asymmetry or architectural distortion) were collected for conducting a ROC analysis. The mammographic and pathologic findings were classified using the terminology of the American College of Radiology Lexicon. The ROC study, which used 12 readers compares analog screen-film mammograms and the mammograms which were digitized at 50 microns spot size. The digitized analog screen-film mammograms were archived into a database. A comparison ROC curve analysis of the digitized mammograms is being conducted

by displaying them on a 2k x 2k x 8/12 bit grayscale workstation using two monitors. An evaluation performance is being conducted using the metrics of throughput and throughput-to-cost-ratio. The throughput and throughput/cost ratio is based on the method of Jackson Network Analysis and has been completed on the analog system. The calculations are based on a resource allocation table in which the average time required for each step is measured as applicable for each resource. A satellite transmission of mammograms is underway between the University of Virginia, the Cleveland Clinic Foundation, and the NASA Lewis Research Center (ACTS Project).

A softcopy display protocol has been developed and is being implemented to review the images in a similar format to the manner in which they are interpreted on a viewbox.

SUMMARY OF RESULTS TO DATE:

An ROC analysis has been conducted on the 400 analog screen film mammograms. For all readers the results of the ROC analog images varied 10% from the 0.83 area under the ROC curve, which is a desirable result, reflecting proper case selection. An ROC analysis is underway for the two monitor, grayscale 2k x 2k workstation display of the digitized mammograms. The results of the throughput analysis of the analog images showed that the technologist was the bottleneck (0.041 jobs/minute) and the throughput to cost ratio was 0.001203. Our measure of luminance of the workstation shows the average luminance level to be 60-80 foot-lamberts compared to 400 to 600 foot-lamberts (with film) that of the mammography viewbox. The contrast range for the grayscale display is 18-20% lower than that of analog images.

The use of the soft-copy display stations has thus far been discouraging. While the ROC analysis results are not that different, the users are vocal in their disappointment in the display workstation graphics. Viewing times are in the range of 8 to 10 minutes for screening (with four views). The digitized images, with proper window/level settings can be made diagnostic, but the trade-off is that it takes time. This would suggest that a perceptually linearized display should be presented to the user.

On the basis of our studies to date, to be clinically useful, telemammography must provide user-friendly, rapid-throughput soft-copy interpretation of digitized screen-film mammograms. Telemammography could enable second-opinion interpretation by providing that mammography expertise available from community practices.

CONCLUSIONS:

The resulting soft-copy display protocol for the digitized screen film mammograms reduces the reading throughput by a factor of one-half. The digitized screen film images (4k x 4k x 12 bits) presents a difficult display protocol for a 2k x 2k x 8/12 bits monitor. Additional challenges to display are the presentation of 4 images on 2 monitors as well as the review of prior images for comparison. Because of the lower contrast range of the grayscale displays, image

processing (window and level functions) is needed on the softcopy.

METHODS:

Image Selection.

A database of 200 normal screen-film mammography examinations and 200 abnormal screen-film mammography examinations have been collected. Each examination contains the following: image study performed; results; description of mammographic findings if abnormal (using the BIRADS); pathology report of biopsy performed; demographics; and radiation exposure. The abnormal films comprise a representative sample of pathological diagnosed breast lesions in the population served by the University of Virginia and Medical College of Virginia. Lesions were classified according to the BIRADS lesion for breast density and finding description by an expert panel. The normal films have been substantiated by normal clinical follow-up of at least 2 years' duration and are matched to the overall parenchymal density of the abnormal films. All patient data and names were blocked and a case number was assigned to each.

Appendix I contains a listing of each case, by case number, in the first column. The second column lists each case by the pathology report. Column 3 lists the response by the expert panel to the question of diagnosis of the image. Column 4 is the expert panel response to the question of micro-calcifications; column 5 is the expert panel response to the question of mass present; and column 6 is the expert panel response to the question of focal area of asymmetry or architectural distortion.

DIGITIZED IMAGE DATABASE

The collected database of analog mammographic films was converted into digital arrays using a laser film digitizer with a 50 micron pixel spot size and 12 bits per pixel (Lumisys, Sunnyvale, CA, Model 150 with a 50-micron spot size). The laser film digitizer was connected to a sun workstation (SPARC Model 40) and connected to an internet connectivity. All patient data was removed and a case number assigned to each digitized case. This image database is on an MOD optical disc and portions are recorded on a CD-ROM for use by other researchers. The digitized images are archived into a database and archived on both a hard drive disk and a Tape drive.

The laser film digitizer uses an analog film SMPTE pattern once a week to provide an adequate quality control. Additionally, the laser film digitizer is calibrated once a week using the protocol provided by the manufacturer. Each digitized image was displayed on a grayscale display workstation to assure proper digitization of the screen-film images.

We have performed histogram analysis on a sampled population of the digitized image database. As expected of laser film digitizers, the dynamic range of the gray scale was narrow. To insure that soft-copy readings would provide a reasonable dynamic range, we displayed each

digitized mammogram and adjusted the interactive window/level settings to insure a proper soft-copy display. To insure that the digitized images "looked like" the original screen-film mammograms, we set the window/level settings and printed out the digitized images on both the Koday and AGFA laser film printers. Appendix II provides a sample of this work illustrating both the original and the corresponding laser digitized screen-film. The border of the digitized screen film mammogram can be seen on the laser printed digitized image. No ROC readings were conducted on these laser printed films. Rather, they were used only as a quality control protocol.

IMAGE GRADING AND READING.

The readers use a 5-point graded response. Each reader completed a worksheet form for each image, requiring a response to the following four questions by circling the selected graded response. The pathology reports of the biopsies served as ground truth.

Masses:

1. (definitely not present): 2. (probably not present);
3. (equivocal; 4. (probably present); 5. (definitely present)

Microcalcifications:

1. (definitely not present); 2. (probably not present);
3. (equivocal); 4. (probably present); 5. (definitely present).

Focal areas of asymmetry or architectural distortion:

1. (definitely not present); 2. (probably not present);
3. (equivocal); 4. (probably present); 5. (definitely present).

Diagnosis of image:

1. (definitely benign); 2. (probably benign);
3. (equivocal); 4. (probably malignant); 5. (definitely malignant)

Images were presented to the set of readers first as analog mammographic films. The films were hung in sets on several rollerscopes in both departments. The readers read each image and responded to the above four questions. The readers may utilize a magnifying glass as an option if they wish. The readers are now reading the digitized film images on a grayscale workstation. It is believed that enough time has passed from the analog screen film readings that the readers will not remember the cases.A random number generator is being used to modify the order of presentation on the grayscale display as compared to the presentation of the analog mammography images. Reader data is recorded in a notebook, one page per mammographic exam. The reader data is then entered into a database and a ROC analysis performed for each of the four questions responded to by the readers.

We are disappointed with the interactive user operation of the soft-copy display

workstation. The chief difficulty is the 7 to 10 minutes for reading each case. In part this long time is a result of not having an automatic method for adjusting each window/level case setting. The radiologist is required to load the case into the display buffer (4 to 5 minutes from CD-ROM storage), then set the window/level adjustment, and then read-out the case. This technology bottleneck has seriously limited those radiologists required to read the soft-copy display in order to compare their results to the original screen-film images. In addition, we often suffer display station crashes, necessitating a restart for the soft-copy display.

STATISTICAL CONSIDERATIONS

In selecting the sample size, we have used two methods to increase the reliability of the calculation. In the first method, we have chosen type I error to be equal to 0.05 (1.96) for a two tailed test and type 11 error to be equal to 0.20 (0.84). Hence the power index (PI) is 2.8. The sample size is given by n equal to ((PI x SE/ (Al - A2)) squared, where Al is the area under the ROC curves for analog films and A2 is the area under the ROC curves for digitized and grayscale displayed images. We estimate the standard error to be 0.5 for 12 readers, all of whom provide primary coverage in mammography. We assume the differences in the means of the areas under the two ROC curves to be 10%. Then the number of samples per population is 196 or approximately 200 pairs of images. Hence we require 200 normal and 200 abnormal mammograms.

In a second method that confirms the findings of the first approach, we assume the following; alpha error 0.05, beta error 0.2, power 80%, and the expercted difference between the areas underneath the ROC curves for the digital (A2), and analog (Al) mammographic films as 0.1. This expected difference is the minimum difference that we consider clinically important. Specifically, we are estimating Al to be 0.85 and A2 to be 0.75. Since each reader will review the same sample of cases, we will use a correlation coefficient conservatively estimated at 0.3. Using the methods of Hanley and McNeil and a two-sided test of significance, we calculate that with a single reader we will require 120 cases each of abnormal and normal films. Thus, if the difference between Al and A2 is as estimated above, we will have a greater than 80% chance with a single reader of detecting a statistically significant difference in diagnostic performance with 120 pairs of normal and abnormal cases. Using additional readers (12 total) and cases (200 each of normal and abnormal) will give us a greater likelihood of detecting a significant difference.

A ROC curve analysis of the reader data is accomplished by using applications software provided by Charles Metz of the University of Chicago/University of Piftsburgh. The software is operational on a SUN workstation at UVA. Two ROC curves for each reader for each of the four reader questions will be generated, one for the analog mammographic films and one for the digitized mammograms displayed on the grayscale display workstations on our AGFA image display workstation. The index of performance will be the area under the ROC curve for each reader. In the event of a degenerate ROC curve, we analyzed the data using two approaches. One approach utilized the Wilcoxon statistic to estimate the area underneath the ROC curve and

the standard error. The second approach involved a third-order spline curve-fitting software program implemented at the University of Virginia.

The ROC analysis, thus far completed, is shown in Appendix III, ROC Analysis. A table is shown as to the Reader List. Readers listed as 3, 5, 7, 12 have left the study. These readers have been contacted but we only have one workstation, now located at the University of Virginia. We have been approved, at not funding increase, to extend the study until March, 1999. We hope to obtain more readings from the display station in spite of its serious limitations.

MAMMOGRAPHY GRAYSCALE READING WORKSTATION

The grayscale workstation for the project is a AGFA review station (IMPAX, RS3000, Ridgefield NJ) which is comprised of a SUN Ultra 2 with 192 Mbytes of RAM, 4 Gbytes of internal HD storage, two DOME high-resolution video cards, and two high-resolution (2k x 2.5k) Orwin grayscale monitors. The system is running Solaris 2.5, with Common Desktop Environment installed and uses the Motif Graphical User Interface. The Review station software is DICOM 3.0 compliant.

We added a Radion 4Gbyte external hard disk drive for storing images from the current reading set, and a Pinnacle Micro Vertex 2.3 Gbyte Magneto-Optical drive as a transfer/backup device.

A separate instance of the SMV software was started on the desktop of each monitor, and expanded to full screen. This allowed two images to be displayed at once. Initially, the LMLO image was displayed on the left monitor, and the RMLO was displayed on the right monitor. This was followed by the LCC and the RCC, respectively, and then images were displayed as requested by the radiologist reader.

DISPLAY WORKSTATION SOFTWARE

The software being used is SMV, a program wriften by Prof Marty Stanton of Brandeis University. Originally designed for crystallography work, Prof Stanton adapted it to the needs of the Telemammography project by giving it the ability to directly read the images created by the Lumisys 150 laser film digitizer. This made it possible to display the images without going through the intermediate step of converting our data to the DICOM format needed by the IMPAX database of the AGFA review station.

SMV supports all of the image processing techniques needed for the display of the mammography images, including panning, zooming, window-leveling, and grayscale inverting. It also provides features that were used extensively to prepare the images for display, particularly rotation and cropping.

Two factors had to be considered when preparing the images for display. One was that patient information recorded on the mammography film, as well as indication of the source hospital for the films, had to be masked. The other was that a reduction in the overall size of the images was desirable, to decrease storage requirements and reduce the amount of time required to load and display the image. To address both of these concerns, SMV's cropping feature was used to reduce the image to just the part of the film that actually held the image of the breast. This greatly improved performance of the system, as well as satisfying the protocol requirement that no patient or hospital information be visible to the reader.

DISPLAY PROTOCOLS FOR WORKSTATION

The Display Protocol for the AGFA workstation consists of four displays: Display A (LMLO on left screen and RMLO on right screen); Display B (LCC on left screen and RCC on right screen); Display C (LMLO on left screen and LCC on right screen); and Display D (RMLO on left screen and RCC on right screen). Display A and B were presented to the reader and if requested then Display C and Display D were also presented.

FUTURE EFFORTS

During the extended, non-additional funding period, we will accomplish the following:

1. Complete reading the majority of the 400 cases on the AGFA soft-copy display workstation.

2. Complete the ROC analysis

3. Complete the NASA ACTS telemammography readings.

4. Complete the throughput workflow and modeling analysis.

NASA-LERC ACTS TELEMAMMOGRAPHY PROJECT

The ACTS telemammography project a joint effort between NASA's Lewis Research Center, the Cleveland Clinic, and the University of Virginia Department of Radiology. ACTS is NASA's Advanced Communications Technology Satellite. Earth stations have been installed at the three locations. Unix workstations are connected to the earth stations at each location. The purpose of the project is to test the efficacy of using a satellite link as a means of transmitting mammography images to distant locations. The experimenters are transmitting digitized mammography images via ACTS satellite between UVa, NASA-LERC and the Cleveland Clinic with various techniques and levels of compression. Radiologists at Cleveland Clinic are examining the images to determine their quality and diagnostic effectiveness. The current phase of this project is expected to run through the spring of 1999.

THROUGHPUT ANALYSIS

The performance metrics being used in our Telemammography modeling are diagnostic accuracy and throughput. Diagnostic accuracy is obtained by a ROC analysis. The area under the ROC curve is the probability of correctly distinguishing - on the basis of the diagnostic test results alone - a randomly selected disease case from a randomly selected non-diseased case. Throughput is defined as the rate jobs-per-minute) at which requests can be serviced by the system. The throughput of a system generally increases as the load on the system initially increases, without the addition of more resources; after a certain load, the throughput stops increasing due to one or more bottlenecks. Throughput analysis is accomplished by listing the resources used and the steps required to complete one job together with the average time per step. The resource with the smallest jobs-per-minute over the complete job, is termed the bottleneck resource.

Table 1 and Table 2 are the resource utilization tables used for conducting throughput analysis, generated for MCV (Medical College of Virginia) and Stony Point (an MCV outpatient clinic), both in the Breast Imaging Section of the Department. The resources being modeled in Table 1 and Table 2 are: The Clerk, the Technologist, the Imaging modality, the Film Processor, the File Room, the Resident, and the Radiologist. At each step, the average time to complete the step is measured (minutes). The Throughput for each resource is calculated and recorded at the bottom of each table. For example, in Table 1, the throughput of the Tech is calculated by $1/(13.2 + 4.7 + 1.6 + 5.13) = 0.041$ jobs-per-minute. This calculation assumes that the Tech is working at 100% capacity and can work no faster. In Table 1, the system bottleneck is the Tech since 0.041 jobs-per-minute is the smallest throughput. Likewise, in Table 2, the Tech is again the bottleneck at 0.071 jobs-per-minute.

One of the tasks to be accomplished is the use of modeling techniques for a regional telemammography system. This section of our report describes the modeling schemes we have developed.

Table 1: MCV

STEP	CLERK	TECH	MODALITY	FILM PROCESSOR	FILM ROOM	RESIDENT	RADIOLOGIST
REGISTRATION	11.5	0	0	0	0	0	0
PRIOR FILM AND/OR FILM RETRIEVAL	0	0	0	0	1.75	0	0
IMAGE ACQUISITION	0	13.2	13.2	0	0	0	0
FILM PROCESSED	0	4.7	0	4.7	0	0	0
QUALITY ASSURANCE	0	1.6	0	0	0	0	0
PRE-ACQUISITION AND PROCESS	0	5.13	5.13	5.13	0	0	0
FILM HUNG	0	0	0	0	0.39	0	0
REVIEW OF CLINICIAN INFORMATION	0	0	0	0	0	0.25	0
FILMS READ	0	0	0	0	0	0.62	0.62
ADDITIONAL VIEWS, STUDIES							
WRITE EARLY READING	0	0	0	0	0	0.34	0
REPORT DICTATION	0	0	0	0	0	1.22	0
NOTIFY CLINICIAN	0	0	0	0	0	1.43	0
REVIEW RESULTS WITH PATIENT	0	0	0	0	0	0	1.34
COMPARISON WITH PRIOR FILM	0	0	0	0	0	0	0.44
DICTATE ADDENDUM TO REPORT	0	0	0	0	0	0	0.81
FILING OF REPORT	0	0	0	0	0.46	0	0
THROUGHPUT	0.067	0.041	0.055	0.102	0.384	0.259	0.311

Bottleneck is the Technogist (0.41 jobs per minute).

Table 2: Stony Point

STEP	CLERK	TECH	MODALITY	FILM PROCESSOR	FILM ROOM	RESIDENT	RADIOLOGIST
REGISTRATION	13.6	0	0	0	0	0	0
PRIOR FILM AND/OR FILM RETRIEVAL	0	0	0	0	0.38	0	0
IMAGE ACQUISITION	0	7.3	7.3	0	0	0	0
FILM PROCESSED	0	4.7	0	5	0	0	0
QUALITY ASSURANCE	0	0.48	0	0	0	0	0
PRE-ACQUISITION AND PROCESS	0	1.3	1.3	1.3	0	0	0
FILM HUNG	0	0	0	0	0.52	0	0
REVIEW OF CLINICIAN INFORMATION	0	0	0	0	0	0.3	0
FILMS READ		0	0	0	0	0.96	0.96
ADDITIONAL VIEWS, STUDIES							
WRITE EARLY READING	0	0	0	0	0	0.35	0
REPORT DICTATION	0	0	0	0	0	1.09	0
NOTIFY CLINICIAN	0	0	0	0	0	0.14	0
REVIEW RESULTS WITH PATIENT	0	0	0	0	0	0	0.84
COMPARISON WITH PRIOR FILM	0	0	0	0	0	0	0.63
DICTATE ADDENDUM TO REPORT	0	0	0	0	0	0	0
FILING OF REPORT	0	0	0	0	0.43	0	0
THROUGHPUT	0.074	0.07	0.116	0.159	0.757	0.353	0.412

Bottleneck is the technologist (0.071 jobs per minute

MODELING

A good model of an examination will predict the usefulness of the exam. The parameters of the model will have to be estimated. A good model will reduce the data required to determine diagnostic accuracy, throughput, and cost.

1. ROC Analysis

Analysis is based upon a two-by-two contingency table (Figure 1). The symbols are: ab is abnormal and nl is normal; AB is abnormal and NL is normal. We note that P(AB/ab) + P(NL/ab) = 1 and that PAB/nl) + P(NL/nl) = 1. Thus, of the four conditional probabilities, two of them are linearly independent. An ROC analysis is conducted by estimating two conditional probabilities, based upon an observation variable (Figure 2). The ROC graph (Figure 3) is generated by moving the value of the decision threshold, X_c across the range of the observational variable X_p

Output

Input	AB	NL
ab	P(AB/ab) True positive	P(NL/ab) False negative
nl	P (AB/nl) False positive	P(NL/nl) True negative

Figure 1
Two-By-Two Contingency Table

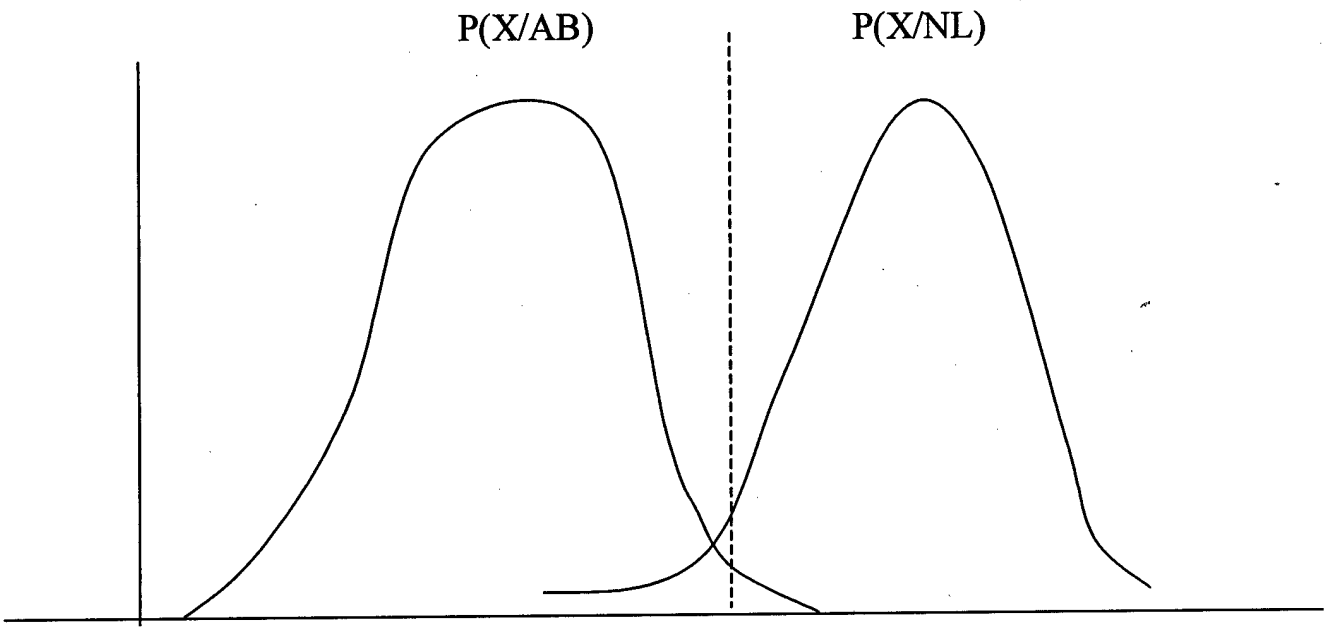


Figure 2

Model of ROC. The value of Xc is moved across the range of the observation variable, generating the ROC graph

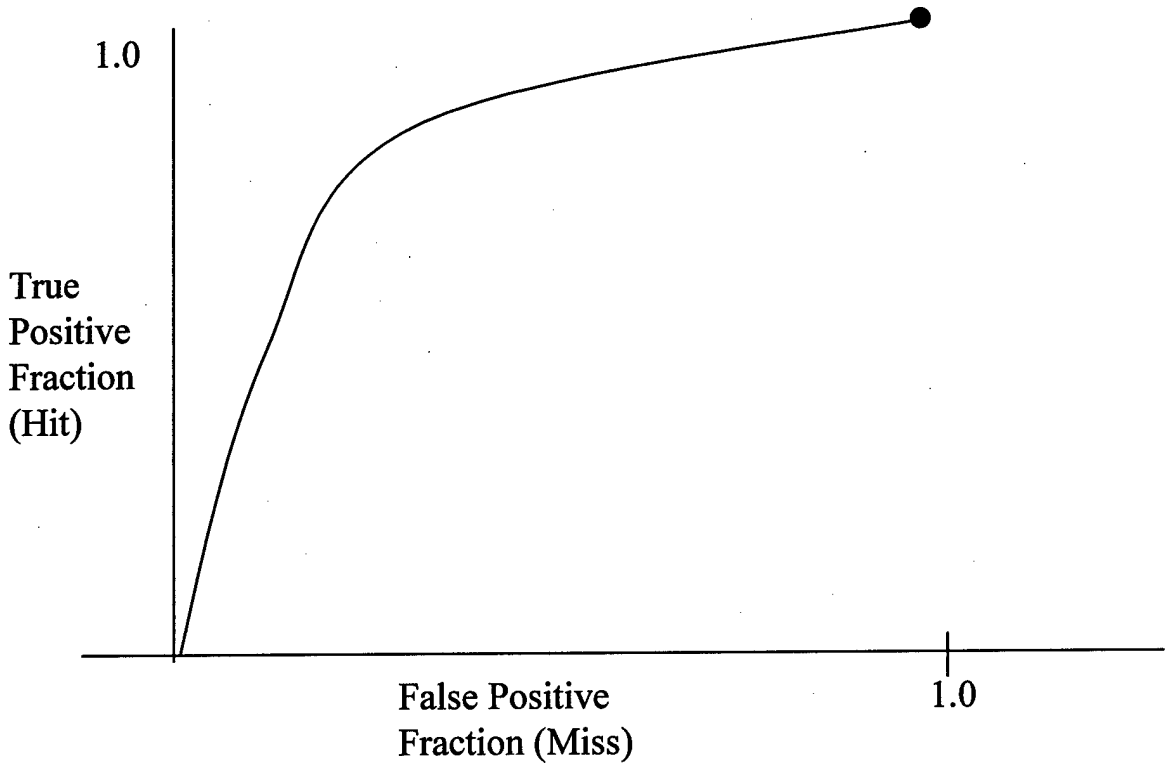


Figure 3
ROC Graph

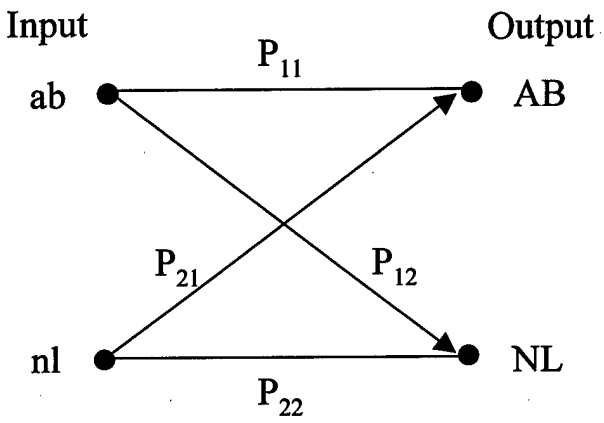
The steps in conducting an ROC analysis are well known (8-21). The 2 x 2 contingency table is carefully defined. A statistical power is initially selected and the number of samples and readers are calculated. The number of samples (cases) are selected so that one-third are very difficult to read, one-third are very hard to read, and one-third are fairly hard to read. A 5-point multiscale reading is performed on each case by each reader for specific image features. There are a number of available ROC software programs that will process the multiscale reading data to provide the ROC graph. The area under each reader's ROC graph is the index of performance (the probability that a random selected patient undergoing the results of the examination will be a correct true-positive).

The advantages of ROC analysis are several. It is a well-known tool, often used by radiologists. Software exists which will generate the ROC graph from multi-scale readings by each reader. The area under the ROC graph is used as an index of reader performance. The disadvantages of ROC analysis is that it remains a binary decision model. It is difficult to incorporate population statistics (prior). The ROC analysis is sensitive to modifying the readers or cases.

2. Matrix Modeling

A binary examination described by a two-by-two contingency table may be placed into a matrix model (Figure 4). The binary decision model as illustrated has two input states (normal, abnormal) and two output states (normal, abnormal). The advantage of the matrix representation is the useful manipulation of the matrices in describing probablistic outcomes of multiple examinations. For example, Figure 5 illustrates the results of cascading two examinations while Figure 6 illustrates a decision tree model of the two cascaded examinations. The results of cascading two examinations show that the resultant transition probabilities are less than that of each individual examination - a result sometimes called "leading information." In Figure 6, the a priori probabilities are P(1) and P(2). For example P(7/1) is given by: $P(7/1) = P_{13}P_{57} + P_{14}P_{67} = P_{17}$.

A model of double reading is illustrated in Figure 7. In double reading, reader 1 and reader 2 independently read the results of the examination. They then compare their outcomes using a decision rule. Table 3 defines the set of possible reader outcomes for each reader. Tables 4 and 5 provide a decision rule that defines the conditions under which the readers are said to be equal or different. A more conservative decision rule would be to say that the two readers are equal if they achieve identical outcomes and that the two readers are different if they do not have identical outcomes. It is believed by some researchers that computer aided decision algorithms could serve as a partial second reader.



$P_{11} = P(AB/ab)$ $\quad P_{12} = P(NL/ab)$

$P_{21} = P(AB/nl)$ $\quad P_{22} = P(NL/nl)$

$$\begin{bmatrix} P_{11} & P_{12} \\ P_{21} & P_{22} \end{bmatrix}$$

Figure 4
Matrix Modeling
of an Examination

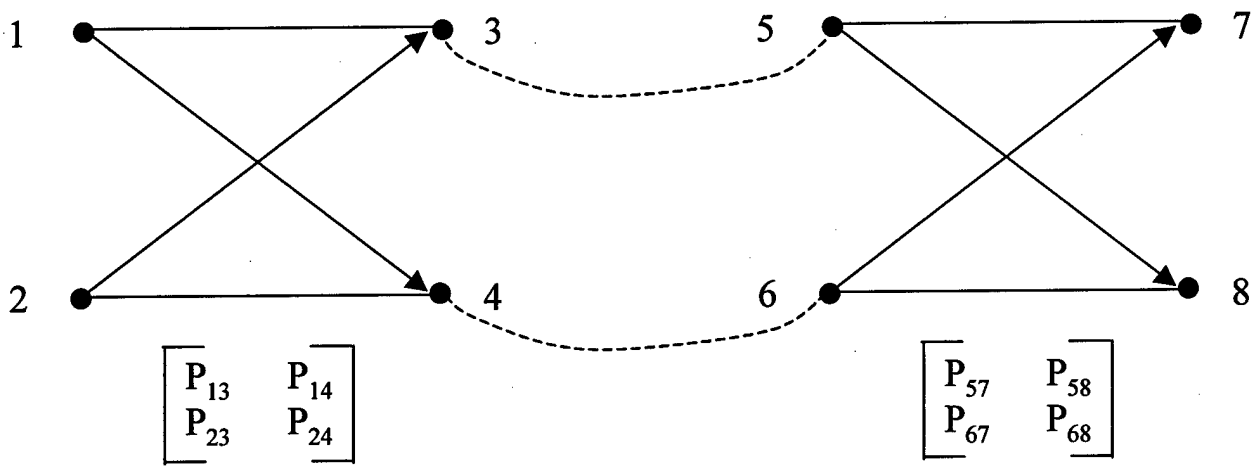


Figure 5
Modeling of Cascaded Examination

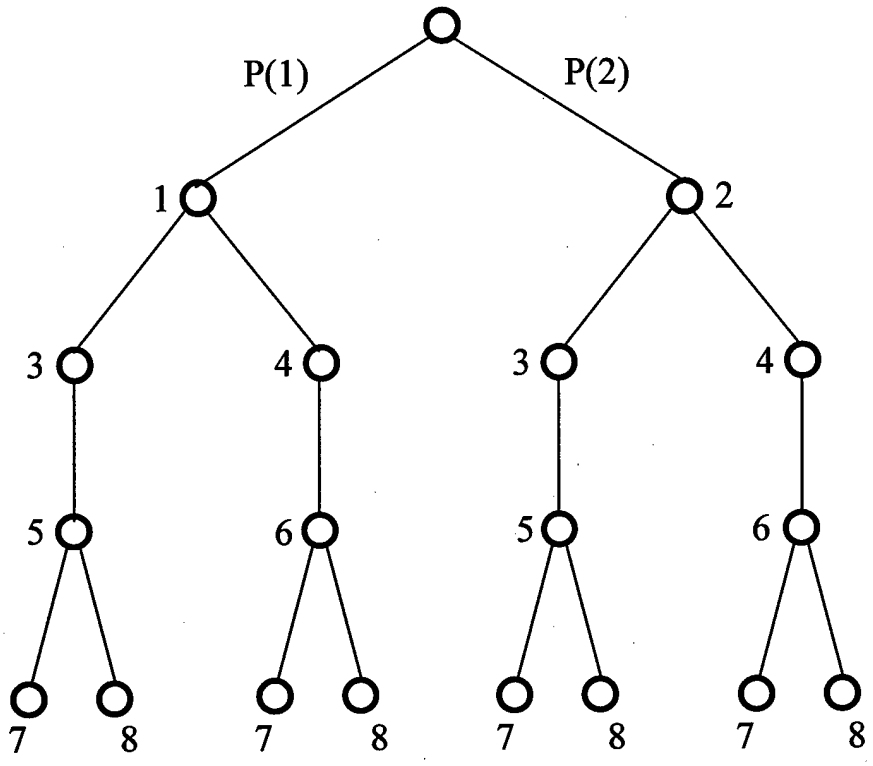


Figure 6
Decision Tree Modeling
of Cascaded Examinations

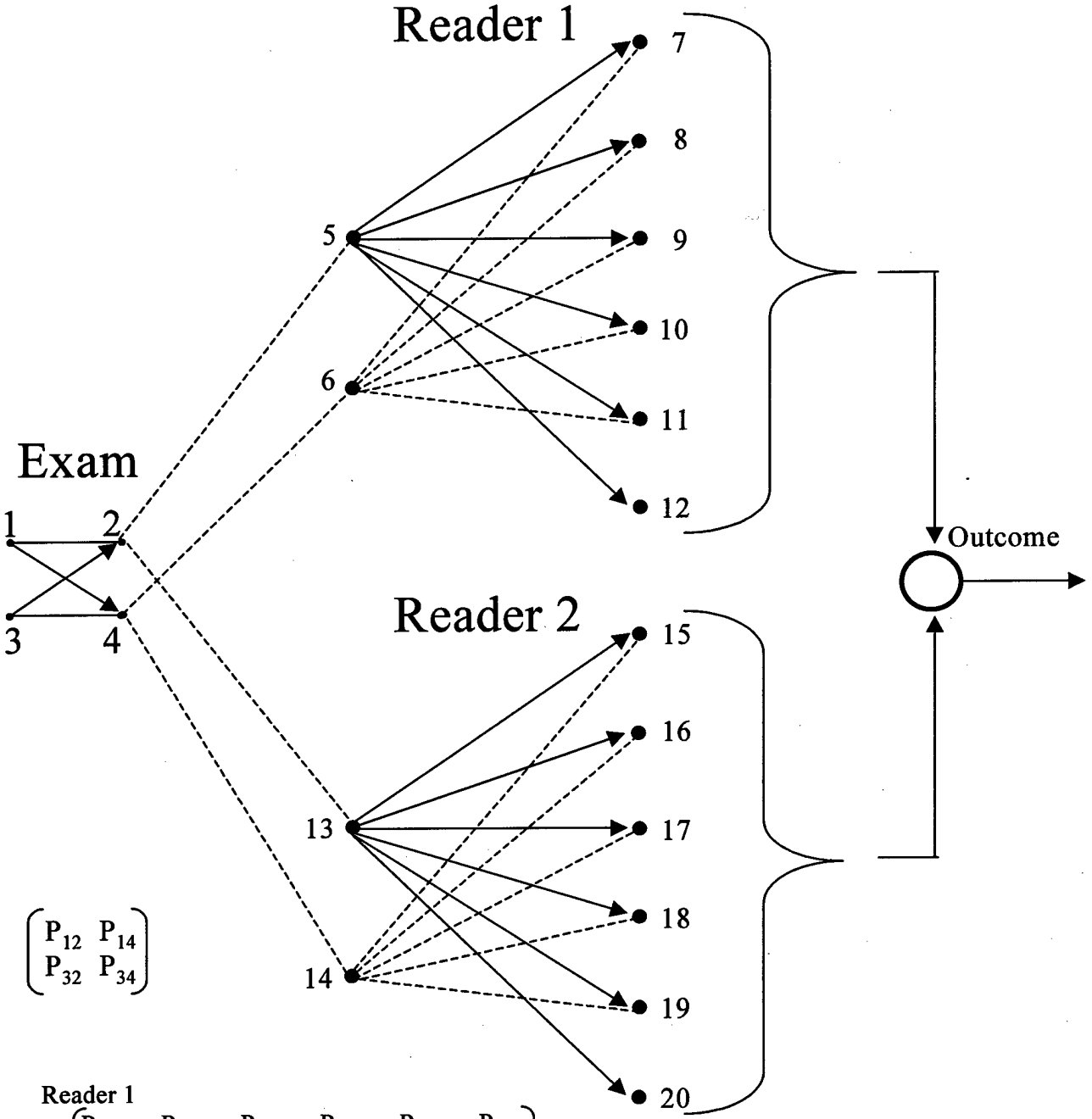


Figure 7
Model of Double Reading

Table 3
Reader Outcome for
Modeling of Double Reading

Outcome States	Meaning Assigned
7 or 15	Patient recalled
8 or 16	Patient negative (return 1 year)
9 or 17	Benign findings (return 1 year)
10 or 18	Probably benign (return 6 month)
11 or 19	Suspicious finding (do biopsy)
12 or 20	Malignant, highly suspicious (do biopsy)

Table 4
Decision Rule for Two Readers Outcomes to Be Said Equal

Outcome:

- Negative and benign
- Suspicious and malignant
- Probably benign

Table 5
Decision Rule for Two Readers Outcomes to Be SaidDifferent

Outcome:

- Benign and probably benign
- Probably benign and suspicious finding
- Negative and suspicious finding
- Benign and suspicious
- Negative and malignant
- Benign and malignant
- Probably benign and malignant

The sequence of outcomes from the decision rule, based upon the results of both readers, can be assumed to be an n-sequence of the symbol set (0,1) where the alphabet symbol of "0" means equal results and the alphabet symbol of "1" means different results from the two readers. If these results are observed for a very long time, the sequence of symbols (with probability one) will be "typical." That is, the resultant sequence of outcomes from the decision rule is ergodic. This implies that a n-sequence of outcomes, as n increases, will result in typical sequences (those close to the expected value) and the rest being non-typical (those with probabilities approaching zero as n increases)

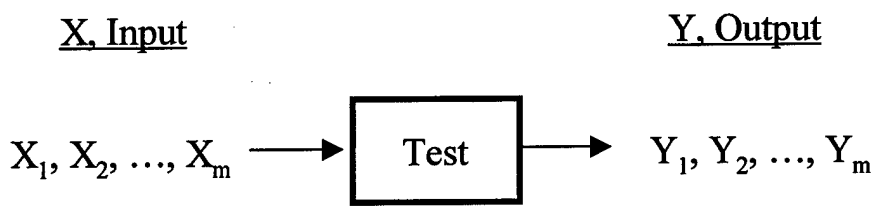
3. Uncertainty Modeling

Uncertainty modeling is a probablistic scheme (Figure 8) in which there is a sequence of trials (say n) and conclusions are drawn on the resultant n-sequences being close to there expected values (9). The concept of *typical sequence*, as introduced by Wolfowitz (10), who called them X sequences, and as used by Ash (11), is related to the asymptotic behavior of its independent, identically distributed random variables (12-15). Let Y be the random variable taking on the values of (y_1, y_2)(for the outcome of the FBDM test) or (y_1, y_2, y_3, y_4, y_5) (for the outcome of the readers from a multiscale reading, respectively). Suppose that the experiment associated with Y is performed "n" times. That is , a sequence will be generated of Y_1, Y_2, ... Y_n of independent, identically distributed random variables, each having the same probability distribution as Y. If we define a function $f_i=f_i(Y_1, Y_2, ..., Y_n)$ to be the number of times the symbol y_i occurs in the sequence Y_1, Y_2, ... Y_n, then y_i will f_i has a binomial distribution with parameters n and p_i. We identify a "typical" sequence as those sequences in which f_i is "close" to np_i for every i where np_i is the number of times that the expected value of y_i will occur in the n-sequence. Then we note that the set of nontypical sequences has a small probability of occurrence. Thus in a typical sequence, each symbol y_i occurs approximately with its expected frequency of np_i. The formal definition is the following. Given c>0, choose any positive number k such that $1/k)^2 <^c/M$ where M is the number of symbols or values that the random variable Y takes on. Let $b = (b_1, b_2, ..., b_n)$ be a sequence of symbols, each bi being one of the symbols of the set (Y_1, Y_2, ... Y_m). We say the sequence b is typical if

$$/f_i(b) - np_i/\sqrt{(np_i (1-p_i)]} <k$$

It can be shown that the following is true: (a) the set of nontypical sequences of length "n" has a total probability <c; and (b) the number of typical sequences of length "n" is $2^{n(H+r}n)$, where r_n approaches zero exponentially as n grows large and (c),

$$H = (f_i(b)\log p_1 + f_2(b) \log p_2 + ...+ f_M(b) \log p_m)$$



$$H(X) \qquad H(X,Y) \qquad H(Y)$$

$$I(X;Y) = H(X) - H(X/Y)$$

$$= H(X) = H(Y) - H(X,Y)$$

Figure 8
Uncertainty Measures

If the output symbols are $X_1, X_2, \ldots, X_M$, and the out symbols are $y_1, y_2, \ldots, y_L$ and the transition probabilities are $[a_{ij}]$, where $a_{ij} = P(y_j/x_i)$, i = 1, ..., M and j = 1, ..., L, then the joint distribution of the input X and output Y is given by

$$P(X = x_j, Y = y_j) = P(x_i)P(y_j/x_i), \text{ i = 1, 2, ..., M, and j = 1, 2, ..., L}$$

and the distribution of Y is given by

$$P(y_j) = P(X_1)P(y_j/x_1) + P(x_2)P(y_j/x_2) + \ldots + P(x_M)P(y_j/x_M).$$

For M=2 and L=5, then $P(Y = y_j) = P(x_1)P(y_j/x_1) + P(x_2)P(y_j/x_2)$, j = 1, ..., 5. If the experiment is repeated "n" times, then if $b = (b_1, b_2, \ldots, b_n)$ is a sequence of resultant n-symbols, each b_i being one of the elements $(y_1, y_2, \ldots, y_5)$, then we say that the n-sequence is typical if it satisfies the above definition.

The significance of the use of *typical sequences* is in analyzing the model of the diagnostic test and reader responses. Typical sequences reduce the number of n-sequences that require analysis. For a large n (number of independent trials), there are approximately $2^{nH(X)}$ typical input n-sequences, each with probability roughly $2^{-nH(X)}$. Similarly ther are $2^{nH(Y)}$ typical output n-sequences and $2^{nH(X,Y)}$ typical pairs of input and output n-sequences. A typical pair may be generated by first selecting a typical output n-sequence y and then selecting a typical input n-sequence x such that (x,y) is a typical pair. Since the number of typical output sequences is $2^{nH(Y)}$ and the number of typical pairs is $2^{nH(X,Y)}$, then for each typical output sequence y, there are

$$2^{nH(X,Y)-H(Y)} = 2^{nH(X/Y)}$$

input sequences x such at (x,y) is a typical pair. That is, if a typical sequence y is presented then the number of typical input sequences possible are approximately $2^{nH(X/Y)}$ (not $2^{nH(X)}$) each with approximately the same probablity, $2^{-nH(X/Y)}$. This is important since it reduces the number of n-sequences that are to be analyzed. Hence, if the experiment is conducted say 100 times (n=100 or reading out 100 cases) then we can expect approximately $2^{100H(X/Y)}$ typical sequences, each with approximate probability of $2^{-100H(X/Y)}$. It is known that, given the transition probabilities (such as obtained from an ROC analysis), then by varying the input distribution P(X), one can obtain a maximum of the mutual information, I(X;Y) = H(X) + (H(Y) - H(X/Y), between the input, X, and the output, Y, which is called the channel capacity, C. Hence, given the transition probabilities between input and output, (P_{ij}), there exists an input distribution P(X) such that the mutual information between X and Y, I(X;Y), is a maximum. The result suggests that for a given input distribution P(X), the a *priori* distribution, the transition probabilities may be changed to better approach the channel capacity, C.

If we are modeling an examination, then Figure 9 illustrates the relations between different uncertainty measures. These measures are given by:

$$H(X) = -\sum P_i \log P_i$$

$$H(Y) = -\sum P_j \log P_j$$

and

$$H(X,Y) = -\sum_i \sum_j P(X_i, Y_j) \log P(X_i, Y_i)$$

The mutual information between (X,Y) is given by

$$I(X;Y) = H(X) - H(X/Y)$$

$$= \sum_i \sum_j P(X_i, Y_j) \log \frac{P(X_i, Y_i)}{P(X_i)}$$

$$= \sum_i \sum_j P(X_i, Y_j) \log \frac{P(X_i, Y_i)}{P(X_i)\, P(Y_j)}$$

Figure 9 illustrates a graphical schematic of these relationships.

Figure 10 is a model of double reading as previously cited. We are interested in the mutual information, I (A; B, C, D, E). This is the mutual information regarding "A" on condition of the occurrence of (B, C, D, E). It is given by:

$$I(A; B, C, D, E) = I(A/C) + I(A; B/C) + I(A; D/B)\, I(A; D/C) + I(A; E/B) + I(A; E/C) + I(A; E/D).$$

The conditional mutual information terms, such as I (A; D/C), is the average amount of information about the set "A" provided by an observation from the set "D" <u>after</u> an observation from the set "C".

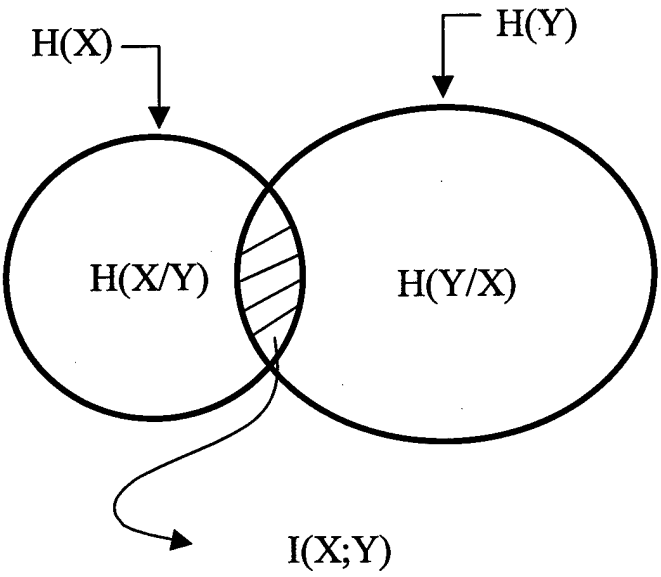


Figure 9
Uncertainty Measures

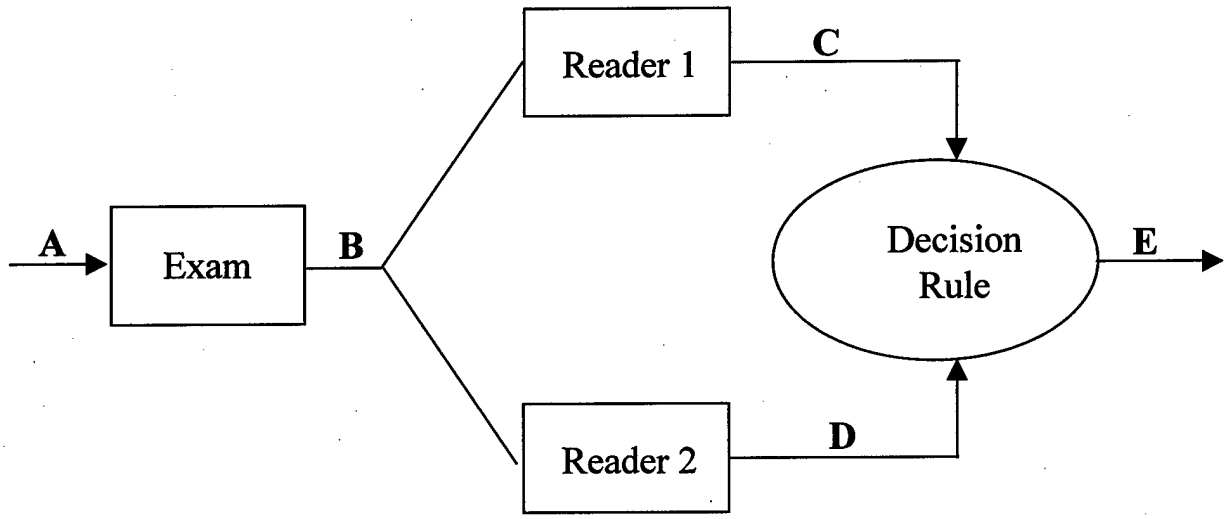


Figure 10
Modeling of Double Reading

Figure 11 is a model for display protocols (either laser printed film or soft copy, the grayscale workstation) for digital mammography. Then the occurrence of (B, C, D, E, F, G) that tells us about the set "A" is the following:

$$I(A; B, C, D, E, F, G) = I(A; C) + I(A; B/C) + I(A; D/B) + I(A; D/C) + J(A; E/B) + I(A; E/C) + I(A; E/D) + I(A; F/B) + I(A; F/C) + I(A; F/D) + I(A; F/E) + I(A; G/B) + I(A; G/C) + I(A; G/D) + I(A; G/E) + I(A; G/F).$$

The necessary parameters for this model are conditional probabilities. The value of I (A; B,C,D,E,F,G) tells us the number of typical sequences in an n-sequence as well as their probability of occurrence. The decomposition of I (A; B, C, D, E, F, G) into simpler terms, such as I (A; G/F) provides for a much simpler model.

We have extended our mammography workflow modeling to include specific tasks as seen at several sites (Figures 12-14). Figure 15 illustrates the types and amounts of resources used at each step of the patient workflow tasks. Figure 16 illustrates the tasks and sequence in which they occur.

The screening mammography workflow is dependent upon the technology that is being utilized - screen-film, digital, or both. The nature of the setting – private or academic – will also impact the workflow.

SCREEN-FILM MAMMOGRAPHY WINDOW

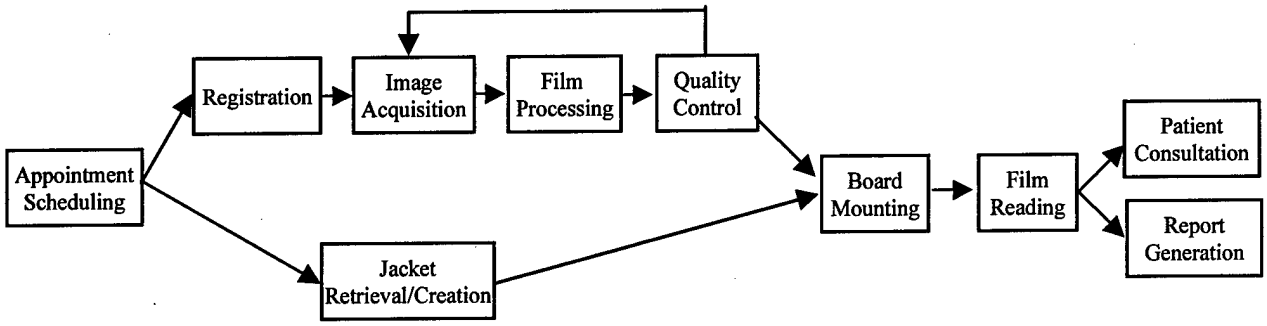


Figure 12. Screen-Film Screening Steps

DIGITAL MAMMOGRAPHY WORKFLOW

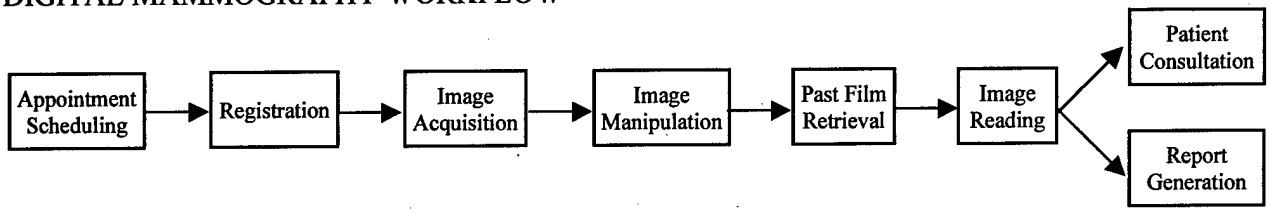


Figure 13. Digital Screening Steps

SCREEN-FILM TO DIGITAL MAMMOGRAPHY WORKFLOW

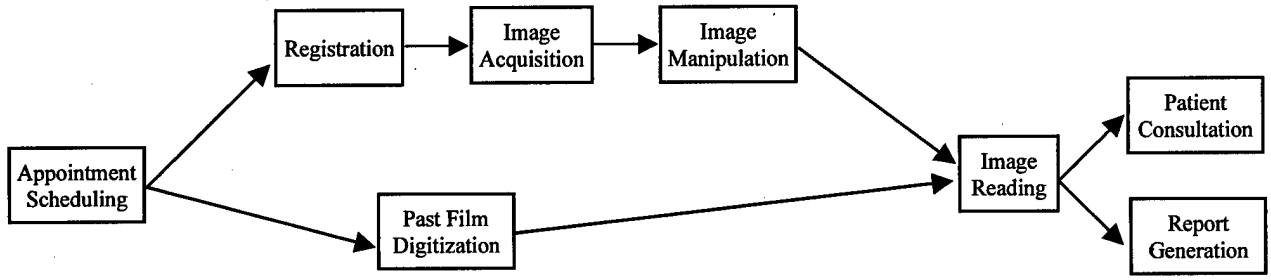


Figure 14. Screening Steps for Settings Transitioning from Screen-Film to Digital

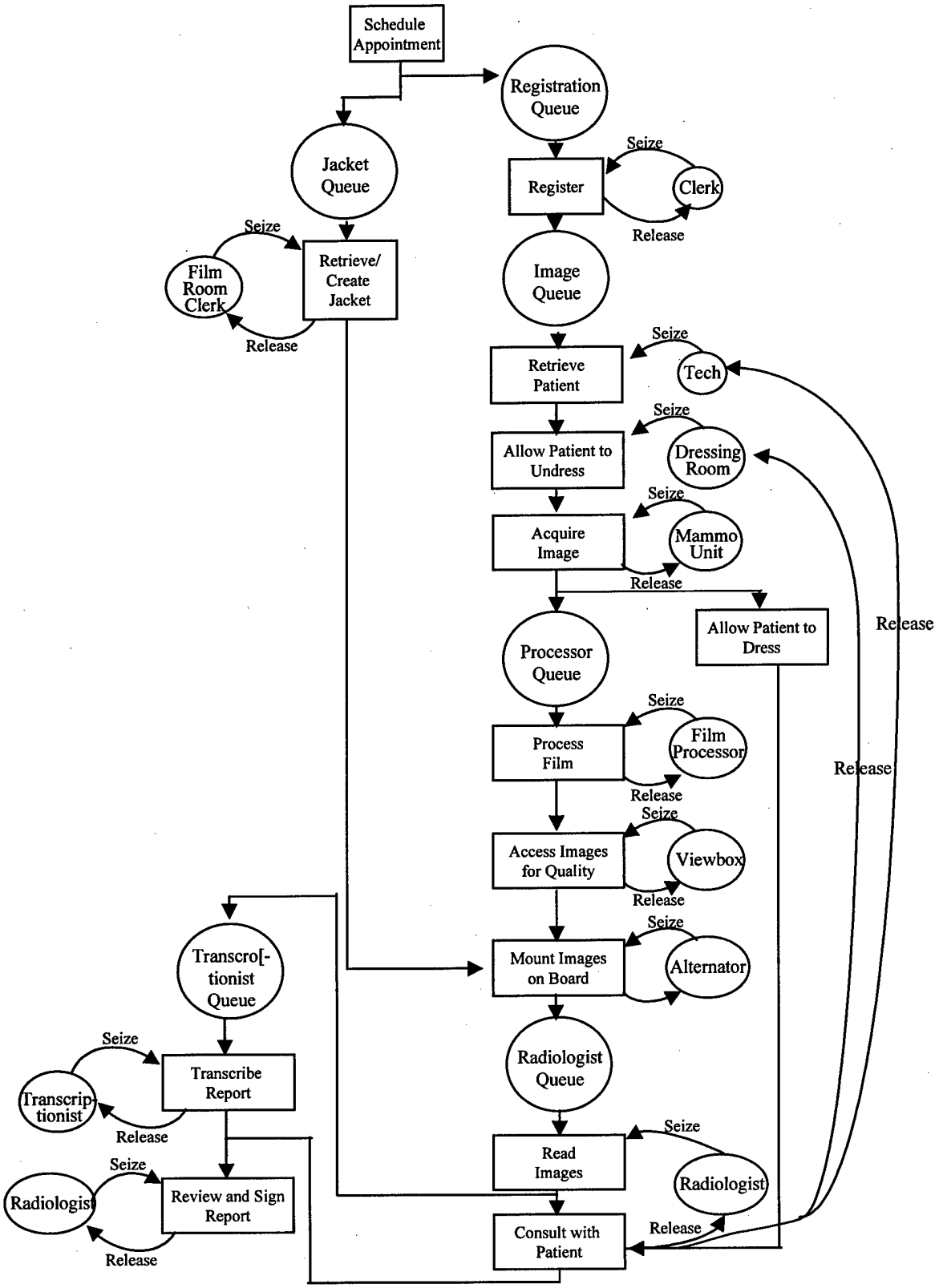
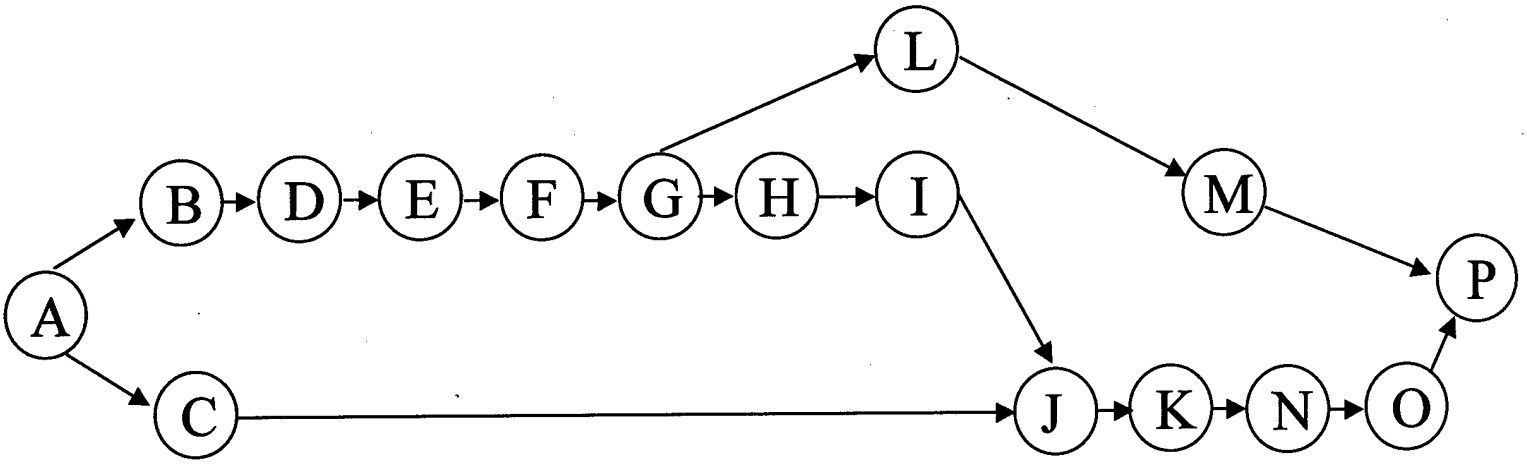


Figure 15. Resource Utilization



TASKS	DESCRIPTION	PRECEDING EVEN
A	Schedule appointment	None
B	Register patient	A
C	Retrieve/create jacket	A
D	Prepare mammography unit and dressing room	B
E	Escort patient to dressing room	D
F	Allow patient to undress	E
G	Acquire images	F
H	Process film	G
I	Assess images for quality	H
J	Mount past and present films	C,J
K	Read images	J
L	Allow patient to dress	G
M	Consult with patient	K,L
N	Dictate report	K
O	Transcribe report	N
P	Review and sign report	M,O

Figure 16

THROUGHPUT ANALYSIS

The three techniques for performance measurement of a system are analytical modeling, simulation, and measurement of an actual system (16). The major consideration in deciding which evaluation technique to use is the life-cycle stage in which the system resides. Measurements are possible if technology similar to the system being evaluated already exists. If the system under study is new, then only analytical modeling and simulation methods are possible. Simulation is difficult and time-consuming to accomplish. For the mammography systems, the only reasonable evaluation technique is analytical modeling. The performance metrics being used in our modeling of these systems are throughput and diagnostic accuracy. Throughput is defined as the rate (jobs-per-minute) at which requests can be serviced by the system. The throughput of a system generally increases as the load on the system initially increases, without the addition of more resources; after a certain load, the throughput stops increasing due to one or more bottlenecks. Throughput analysis is accomplished by listing the resources used and the steps required to complete one job. The resource with the highest total service demand has the highest utilization and is called the bottleneck resource.

Table 1 and Table 2 (17) are the resource utilization tables generated for two throughput and bottleneck analyses. The top row of each table lists the resources being modeled. The rows of tables are the steps required to complete one reading. The bottom rows (throughput per minute) are generated by alternately assuming that each resource in the columns is operating as rapidly as it possibly can.

The bottleneck analysis described above is based on Little's Law (18) of mean value queuing analysis. Little's Law states that the mean number of jobs in a system equals the mean throughput rate multiplied by the mean time in the system. We have conducted similar studies for screen-film mammography. Table 1 (labeled "MCV") is a Resource Utilization table for mammography at the Medical College of Virginia (provided by Dr. Ellen Shaw de Paredes) and Table 2 (labeled "SP") is for an outpatient Breast Imaging Center.

The throughput analysis is conducted by obtaining the upper and lower bound (Figure 17) on the actual throughput as a function of one or more of the resources. Upper and lower bounds are required to understand the otherwise complex analysis of the actual throughput. If the radiologist is selected as the independent variable (increasing the number of radiologists), then the upper bound on the throughput is given by

$$\text{Upper Bound} = \min[1T_{sys}, N/(T_{sys} + T_{reader})]$$

where T_{sys} is the time used by the system less the radiologist and resident time and T_{reader} is the time used by the radiologist and the resident reading out the cases (while system is waiting). Then $1/T_{sys}$ is the maximum throughput. The term $N/(T_{sys} + T_{reader})$ relating increases in the number of radiologists (and residents) increases linearly with N until it reaches $1/T_{sys}$, after which the system cannot increase its throughput no matter how many radiologists (and residents) are added to the reading room. This is the case when the radiologist is unable to do any other work above the throughput limit because the system is then queuing examinations. We note that as N

increases (N could be other resources such as technologists), then there is a method for calculating the lower bound on the throughput. That is,

$$\text{Lower Bound of Throughput} = N/(NT_{sys} + T_{reader}).$$

This will occur when the system is busy doing other things and the newest case is last in the queue to receive service. Figure 17 illustrates this analysis of throughput.

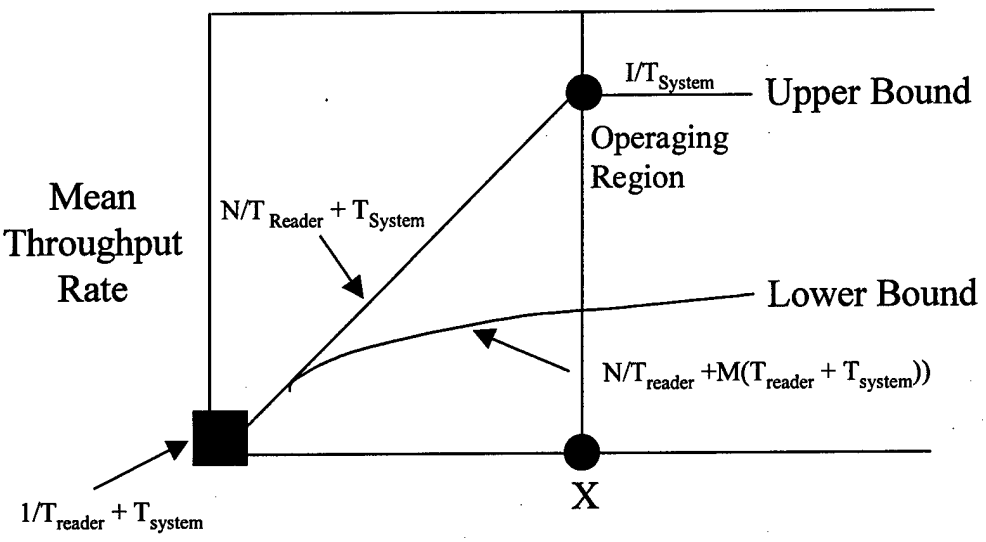


Figure 17
Throughput Analysis

SUMMARY

We have reviewed modeling of mammography examinations. Modeling is essential due to the large number of variables. However, a carefully selected model will require only the estimation of the model parameters. Of the models we have described, the uncertainty modeling is superior owing to its restrained relationships and requiring only the estimation of conditional probabilities. The throughput analysis is a method that is simple to utilize in estimating workflow.

CONCLUSIONS

1. Reading of the screen-films is far simpler than the soft-copy reading of the digitized images.

   This is largely due to the lack of user friendly interface systems on the soft-copy display.

   It is also due to the increased time required to read soft-copy displays.

2. For those ROC's thus far analyzed, there is approximately a 8 to 10% decrease in diagnostic reading of soft-copy displays.

   Since the readers did well on the analog screen-film examinations, it is likely that the problem resides in the proper display protocols for the soft-copy displays

   The display protocols on the soft–copy display require 7 to 12 minutes to read a case.

LAY PUBLIC ABSTRACT

Telemammography is the transmission and interpretation of digitized mammographic images. The use of telemammography will allow for interpretation of on-site mammograms from distant areas by expert radiologists at a central site. This can potentially increase the access to mammography for many women.

We are testing a telemammography system utilizing digitized mammograms that are transmitted through telephone lines or satellites and are interpreted on computer workstations. The goal of this study is to determine the requirements to deliver high quality mammographic images from remote locations.

To test the system we have collected 400 normal and abnormal mammograms which have been interpreted by 12 radiologists. The radiologists are interpreting the studies on film as well as computer workstations, and we are comparing their accuracy with two methods.

We also are assessing the performance of the system by comparing the patient workflow when their mammograms are performed using routine mammographic film versus digitized mammograms.

We have found that reading mammograms on the workstations versus on film reduces the patient throughput. Also because of the decreased brightness of images on the workstations versus viewing films on traditional light boxes, the display of some images is difficult.

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APPENDIX I

List of Mammography Screen Film Cases by Case Number, Pathology, and the Expert Panel Readings for Diagnosis, Microcalcifications, Mass, and Focal Areas of Asymmetry

PATHOLOGY REPORT

Case #	Group	Diagnosis	Micro-Calcifications	Mass	Focal area of Asymmentry or Architectural Distortion
1	Normal	Normal	Normal	Normal	Normal
2	Normal	Normal	Normal	Normal	Normal
3	Abnormal	Malignant	Abnormal	Normal	Abnormal
4	Abnormal	Benign	Abnormal	Normal	Normal
5	Abnormal	Malignant	Abnormal	Normal	Normal
6	Abnormal	Benign	Abnormal	Normal	Normal
7	Abnormal	Benign	Normal	Abnormal	Normal
8	Abnormal	Benign	Abnormal	Normal	Normal
9	Normal	Normal	Normal	Normal	Normal
10	Normal	Normal	Normal	Normal	Normal
11	Normal	Normal	Normal	Normal	Normal
12	Abnormal	Malignant	Normal	Abnormal	Normal
13	Abnormal	Malignant	Normal	Abnormal	Abnormal
14	Abnormal	Malignant	Abnormal	Normal	Normal
15	Normal	Normal	Normal	Normal	Normal
16	Normal	Normal	Normal	Normal	Normal
17	Abnormal	Benign	Normal	Abnormal	Normal
18	Abnormal	Malignant	Abnormal	Normal	Normal
19	Abnormal	Malignant	Abnormal	Normal	Normal
20	Abnormal	Malignant	Normal	Abnormal	Normal
21	Normal	Normal	Normal	Normal	Normal
22	Normal	Normal	Normal	Normal	Normal
23	Abnormal	Benign	Normal	Abnormal	Normal
24	Abnormal	Benign	Normal	Normal	Abnormal
25	Normal	Normal	Normal	Normal	Normal
26	Normal	Normal	Normal	Normal	Normal
27	Abnormal	Benign	Abnormal	Normal	Normal
28	Normal	Normal	Normal	Normal	Normal
29	Abnormal	Benign	Normal	Abnormal	Normal
30	Abnormal	Benign	Normal	Abnormal	Normal
31	Normal	Normal	Normal	Normal	Normal
32	Abnormal	Benign	Normal	Normal	Abnormal
33	Abnormal	Benign	Abnormal	Normal	Normal
34	Normal	Normal	Normal	Normal	Normal

PATHOLOGY REPORT

Case #	Group	Diagnosis	Micro-Calcifications	Mass	Focal area of Asymmentry or Architectural Distortion
35	Normal	Normal	Normal	Normal	Normal
36	Abnormal	Benign	Normal	Normal	Abnormal
37	Abnormal	Benign	Abnormal	Normal	Normal
38	Normal	Normal	Normal	Normal	Normal
39	Normal	Normal	Normal	Normal	Normal
40	Abnormal	Benign	Abnormal	Normal	Normal
41	Abnormal	Benign	Abnormal	Normal	Normal
42	Normal	Normal	Normal	Normal	Normal
43	Normal	Normal	Normal	Normal	Normal
44	Normal	Normal	Normal	Normal	Normal
45	Abnormal	Malignant	Normal	Normal	Abnormal
46	Normal	Normal	Normal	Normal	Normal
47	Normal	Normal	Normal	Normal	Normal
48	Normal	Normal	Normal	Normal	Normal
49	Normal	Normal	Normal	Normal	Normal
50	Normal	Normal	Normal	Normal	Normal
51	Abnormal	Benign	Abnormal	Normal	Normal
52	Normal	Benign	Normal	Normal	Normal
53	Normal	Normal	Normal	Normal	Normal
54	Normal	Normal	Normal	Normal	Normal
55	Abnormal	Benign	Normal	Abnormal	Normal
56	Abnormal	Benign	Abnormal	Normal	Normal
57	Abnormal	Benign	Normal	Abnormal	Normal
58	Normal	Normal	Normal	Normal	Normal
59	Normal	Normal	Normal	Normal	Normal
60	Normal	Normal	Normal	Normal	Normal
61	Abnormal	Benign	Abnormal	Normal	Normal
62	Normal	Normal	Normal	Normal	Normal
63	Normal	Normal	Normal	Normal	Normal
64	Normal	Normal	Normal	Normal	Normal
65	Abnormal	Benign	Normal	Abnormal	Normal
66	Normal	Normal	Normal	Normal	Normal
67	Normal	Normal	Normal	Normal	Normal
68	Abnormal	Malignant	Abnormal	Normal	Normal

PATHOLOGY REPORT

Case #	Group	Diagnosis	Micro-Calcifications	Mass	Focal area of Asymmentry or Architectural Distortion
69	Abnormal	Benign	Normal	Abnormal	Normal
70	Normal	Normal	Normal	Normal	Normal
71	Abnormal	Benign	Abnormal	Normal	Normal
72	Abnormal	Malignant	Abnormal	Normal	Normal
73	Normal	Normal	Normal	Normal	Normal
74	Abnormal	Malignant	Abnormal	Normal	Normal
75	Normal	Normal	Normal	Normal	Normal
76	Normal	Normal	Normal	Normal	Normal
77	Normal	Normal	Normal	Normal	Normal
78	Abnormal	Benign	Normal	Abnormal	Normal
79	Abnormal	Benign	Normal	Abnormal	Normal
80	Abnormal	Malignant	Normal	Abnormal	Normal
81	Abnormal	Malignant	Abnormal	Normal	Normal
82	Abnormal	Benign	Abnormal	Normal	Normal
83	Normal	Normal	Normal	Normal	Normal
84	Normal	Normal	Normal	Normal	Normal
85	Normal	Normal	Normal	Normal	Normal
86	Abnormal	Malignant	Normal	Abnormal	Normal
87	Abnormal	Malignant	Abnormal	Normal	Normal
88	Abnormal	Benign	Abnormal	Normal	Normal
89	Abnormal	Benign	Normal	Normal	Abnormal
90	Abnormal	Benign	Normal	Abnormal	Normal
91	Abnormal	Malignant	Abnormal	Normal	Normal
92	Normal	Normal	Normal	Normal	Normal
93	Normal	Normal	Normal	Normal	Normal
94	Abnormal	Malignant	Abnormal	Abnormal	Normal
95	Abnormal	Malignant	Normal	Abnormal	Normal
96	Normal	Normal	Normal	Normal	Normal
97	Normal	Normal	Normal	Normal	Normal
98	Normal	Normal	Normal	Normal	Normal
99	Normal	Normal	Normal	Normal	Normal
100	Abnormal	Malignant	Normal	Abnormal	Normal
101	Normal	Normal	Normal	Normal	Normal

PATHOLOGY REPORT

Case #	Group	Diagnosis	Micro-Calcifications	Mass	Focal area of Asymmentry or Architectural Distortion
102	Abnormal	Malignant	Normal	Normal	Abnormal
103	Abnormal	Malignant	Abnormal	Normal	Normal
104	Abnormal	Malignant	Normal	Abnormal	Normal
105	Normal	Normal	Normal	Normal	Normal
106	Abnormal	Benign	Normal	Abnormal	Normal
107	Normal	Normal	Normal	Normal	Normal
108	Abnormal	Malignant	Normal	Normal	Abnormal
109	Abnormal	Malignant	Abnormal	Normal	Normal
110	Normal	Normal	Normal	Normal	Normal
111	Abnormal	Malignant	Normal	Normal	Abnormal
112	Normal	Normal	Normal	Normal	Normal
113	Abnormal	Malignant	Normal	Normal	Abnormal
114	Abnormal	Malignant	Abnormal	Normal	Normal
115	Normal	Normal	Normal	Normal	Normal
116	Normal	Normal	Normal	Normal	Normal
117	Normal	Normal	Normal	Normal	Normal
118	Abnormal	Benign	Normal	Abnormal	Normal
119	Normal	Normal	Normal	Normal	Normal
120	Normal	Normal	Normal	Normal	Normal
121	Normal	Normal	Normal	Normal	Normal
122	Normal	Normal		Normal	Normal
123	Abnormal	Benign	Abnormal	Normal	Normal
124	Abnormal	Malignant	Abnormal	Normal	Normal
125	Abnormal	Benign	Abnormal	Normal	Normal
126	Abnormal	Benign	Normal	Normal	Abnormal
127	Normal	Normal	Normal	Normal	Normal
128	Abnormal	Benign	Abnormal	Normal	Normal
129	Abnormal	Malignant	Abnormal	Normal	Normal
130	Normal	Benign	Normal	Normal	Normal
131	Normal	Benign	Normal	Normal	Normal
132	Abnormal	Benign	Abnormal	Normal	Normal
133	Abnormal	Malignant	Abnormal	Normal	Normal
134	Abnormal	Benign	Abnormal	Normal	Normal

PATHOLOGY REPORT

Case #	Group	Diagnosis	Micro-Calcifications	Mass	Focal area of Asymmentry or Architectural Distortion
135	Normal	Benign	Normal	Normal	Normal
136	Normal	Benign	Normal	Normal	Normal
137	Normal	Benign	Normal	Normal	Normal
138	Abnormal	Malignant	Normal	Abnormal	Normal
139	Abnormal	Malignant	Normal	Normal	Abnormal
140	Normal	Benign	Normal	Normal	Normal
141	Normal	Benign	Normal	Normal	Normal
142	Abnormal	Malignant	Normal	Abnormal	Normal
143	Abnormal	Malignant	Normal	Abnormal	Normal
144	Abnormal	Benign	Abnormal	Normal	Normal
145	Normal	Benign	Normal	Normal	Normal
146	Abnormal	Malignant	Normal	Abnormal	Normal
147	Normal	Benign	Normal	Normal	Normal
148	Normal	Benign	Normal	Normal	Normal
149	Normal				
150	Normal	Benign	Normal	Normal	Normal
151	Abnormal	Benign	Normal	Abnormal	Normal
152	Normal	Benign	Normal	Normal	Normal
153	Abnormal	Malignant	Normal	Abnormal	Normal
154	Normal	Benign	Normal	Normal	Normal
155	Normal	Benign	Normal	Normal	Normal
156	BIRADS ERR				
157	Normal	Benign	Normal	Normal	Normal
158	Normal	Benign	Normal	Normal	Normal
159	Normal	Benign	Normal	Normal	Normal
160	BIRADS ERR				
161	Abnormal	Benign	Abnormal	Normal	Normal
162	Normal	Benign	Normal	Normal	Normal
163	BIRADS ERR				
164	Abnormal	Malignant	Normal	Normal	Abnormal
165	Normal	Benign	Normal	Normal	Normal
166	Abnormal	Benign	Normal	Normal	Normal
167	Normal	Benign	Normal	Normal	Normal

PATHOLOGY REPORT

Case #	Group	Diagnosis	Micro-Calcifications	Mass	Focal area of Asymmentry or Architectural Distortion
168	BIRADS ERR				
169	Abnormal	Benign	Abnormal	Normal	Normal
170	Abnormal	Malignant	Normal	Abnormal	Normal
171	Normal	Normal	Normal	Normal	Normal
172	Normal	Normal	Normal	Normal	Normal
173	Normal	Normal	Normal	Normal	Normal
174	BIRADS ERR				
175	Abnormal	Malignant	Normal	Abnormal	Normal
176	Normal	Normal	Normal	Normal	Normal
177	Normal	Normal	Normal	Normal	Normal
178	BIRADS ERR				
179	Abnormal	Benign	Abnormal	Normal	Normal
180	Normal	Normal	Normal	Normal	Normal
181	Abnormal	Benign	Normal	Abnormal	Normal
182	Normal	Normal	Normal	Normal	Normal
183	Normal	Normal	Normal	Normal	Normal
184	Normal	Normal	Normal	Normal	Normal
185	Normal	Normal	Normal	Normal	Normal
186	Abnormal	Benign	Abnormal	Normal	Normal
187	Abnormal	Malignant	Normal	Abnormal	Normal
188	Abnormal	Malignant	Normal	Abnormal	Normal
189	Normal	Normal	Normal	Normal	Normal
190	Normal	Normal	Normal	Normal	Normal
191	Abnormal	Benign	Abnormal	Normal	Normal
192	Abnormal	Malignant	Abnormal	Normal	Normal
193	Normal	Normal	Normal	Normal	Normal
194	BIRADS ERR				
195	Abnormal	Malignant	Normal	Abnormal	Normal
196	Abnormal	Malignant	Normal	Abnormal	Normal
197	Normal	Normal	Normal	Normal	Normal
198	Normal	Normal	Normal	Normal	Normal
199	Normal	Normal	Normal	Normal	Normal
200	Abnormal	Benign	Normal	Normal	Normal

PATHOLOGY REPORT

Case #	Group	Diagnosis	Micro-Calcifications	Mass	Focal area of Asymmentry or Architectural Distortion
201	Normal	Benign	Normal	Normal	Normal
202	BIRADS ERR				
203	Normal	Benign	Normal	Normal	Normal
204	Normal	Benign	Normal	Normal	Normal
205	BIRADS ERR				
206	BIRADS ERR				
207	Normal	Benign	Normal	Normal	Normal
208	Abnormal	Benign	Normal	Abnormal	Normal
209	Normal	Benign	Normal	Normal	Normal
210	Abnormal	Malignant	Abnormal	Normal	Normal
211	Normal	Benign	Normal	Normal	Normal
212	BIRADS ERR				
213	Normal	Benign	Normal	Normal	Normal
214	Abnormal	Malignant	Abnormal	Normal	Normal
215	Normal	Benign	Normal	Normal	Normal
216	Abnormal	Malignant	Abnormal	Normal	Normal
217	Normal	Benign	Normal	Normal	Normal
218	Normal	Benign	Normal	Normal	Normal
219	Abnormal	Malignant	Abnormal	Normal	Normal
220	Normal	Benign	Normal	Normal	Normal
221	Normal	Benign	Normal	Normal	Normal
222	BIRADS ERR				
223	Normal	Benign	Normal	Normal	Normal
224	Normal	Benign	Normal	Normal	Normal
225	Normal	Benign	Normal	Normal	Normal
226	Normal				
227	Normal	Benign	Normal	Normal	Normal
228	Abnormal	Malignant	Abnormal	Normal	Normal
229	Normal	Benign	Normal	Normal	Normal
230	Abnormal	Benign	Normal	Normal	Abnormal
231	Abnormal	Malignant	Normal	Abnormal	Normal
232	Normal	Benign	Normal	Normal	Normal
233	Abnormal	Malignant	Normal	Abnormal	Normal

PATHOLOGY REPORT

Case #	Group	Diagnosis	Micro-Calcifications	Mass	Focal area of Asymmentry or Architectural Distortion
234	Abnormal	Benign	Normal	Normal	Abnormal
235	Normal	Normal	Normal	Normal	Normal
236	Normal	Normal	Normal	Normal	Normal
237	Abnormal	Malignant	Abnormal	Normal	Normal
238	Abnormal	Malignant	Abnormal	Normal	Normal
239	Normal	Normal	Normal	Normal	Normal
240	Normal	Normal	Normal	Normal	Normal
241	BIRADS ERR				
242	Normal	Normal	Normal	Normal	Normal
243	Abnormal	Malignant	Normal	Abnormal	Normal
244	Abnormal	Malignant	Normal	Abnormal	Normal
245	Normal	Normal	Normal	Normal	Normal
246	BIRADS ERR				
247	Abnormal	Benign	Abnormal	Normal	Normal
248	BIRADS ERR				
249	Abnormal	Malignant	Abnormal	Normal	Normal
250	Abnormal	Benign	Abnormal	Normal	Normal
251	Abnormal	Malignant	Normal	Abnormal	Normal
252	Normal	Normal	Normal	Normal	Normal
253	Abnormal	Malignant	Normal	Abnormal	Normal
254	Abnormal	Malignant	Abnormal	Normal	Normal
255	Normal	Normal	Normal	Normal	Normal
256	Normal	Normal	Normal	Normal	Normal
257	Abnormal	Malignant	Abnormal	Normal	Normal
258	Normal	Normal	Normal	Normal	Normal
259	Abnormal	Benign	Normal	Abnormal	Normal
260	Normal	Normal	Normal	Normal	Normal
261	Abnormal	Benign	Abnormal	Normal	Normal
262	Normal	Normal	Normal	Normal	Normal
263	Abnormal	Malignant	Normal	Abnormal	Normal
264	Abnormal	Benign	Abnormal	Normal	Normal
265	Abnormal	Malignant	Abnormal	Normal	Normal
266	Normal	Normal	Normal	Normal	Normal

PATHOLOGY REPORT

Case #	Group	Diagnosis	Micro-Calcifications	Mass	Focal area of Asymmentry or Architectural Distortion
267	Normal	Benign	Normal	Normal	Normal
268	Abnormal	Benign	Normal	Normal	Abnormal
269	Normal	Benign	Normal	Normal	Normal
270	Abnormal	Malignant	Abnormal	Normal	Normal
271	Abnormal	Malignant	Abnormal	Normal	Normal
272	Normal	Benign	Normal	Normal	Normal
273	Abnormal	Malignant	Abnormal	Normal	Normal
274	Normal	Benign	Normal	Normal	Normal
275	Abnormal	Malignant	Abnormal	Normal	Normal
276	Abnormal	Malignant	Abnormal	Normal	Normal
277	Normal	Benign	Normal	Normal	Normal
278	Normal	Benign	Normal	Normal	Normal
279	Normal	Benign	Normal	Normal	Normal
280	Normal	Benign	Normal	Normal	Normal
281	Normal	Benign	Normal	Normal	Normal
282	Abnormal	Benign	Abnormal	Normal	Normal
283	Abnormal	Malignant	Abnormal	Normal	Normal
284	Abnormal	Malignant	Abnormal	Normal	Normal
285	Normal	Benign	Normal	Normal	Normal
286	Normal	Benign	Normal	Normal	Normal
287	Abnormal	Malignant	Normal	Abnormal	Normal
288	Abnormal	Benign	Abnormal	Normal	Normal
289	Normal	Benign	Normal	Normal	Normal
290	Abnormal	Malignant	Normal	Abnormal	Normal
291	Normal	Benign	Normal	Normal	Normal
292	Normal	Benign	Normal	Normal	Normal
293	Abnormal	Malignant	Abnormal	Normal	Normal
294	Normal	Benign	Normal	Normal	Normal
295	Abnormal	Benign	Abnormal	Normal	Normal
296	Abnormal	Benign	Normal	Abnormal	Normal
297	Normal	Benign	Normal	Normal	Normal
298	Normal	Benign	Normal	Normal	Normal
299	Abnormal	Malignant	Abnormal	Normal	Normal

PATHOLOGY REPORT

Case #	Group	Diagnosis	Micro-Calcifications	Mass	Focal area of Asymmentry or Architectural Distortion
300	Normal	Normal	Normal	Normal	Normal
301	Abnormal	Malignant	Abnormal	Normal	Normal
302	Normal	Normal	Normal	Normal	Normal
303	Normal	Normal	Normal	Normal	Normal
304	Abnormal	Malignant	Abnormal	Normal	Normal
305	Abnormal	Benign	Abnormal	Normal	Normal
306	Abnormal	Benign	Normal	Abnormal	Normal
307	Normal	Normal	Normal	Normal	Normal
308	Abnormal	Malignant	Normal	Normal	Abnormal
309	Abnormal	Malignant	Normal	Abnormal	Normal
310	Normal	Normal	Normal	Normal	Normal
311	Abnormal	Malignant	Normal	Abnormal	Normal
312	Abnormal	Malignant	Normal	Abnormal	Normal
313	Normal	Normal	Normal	Normal	Normal
314	Abnormal	Malignant	Abnormal	Normal	Normal
315	Normal	Normal	Normal	Normal	Normal
316	Abnormal	Malignant	Normal	Abnormal	Normal
317	Normal	Normal	Normal	Normal	Normal
318	Normal	Normal	Normal	Normal	Normal
319	Normal	Normal	Normal	Normal	Normal
320	Abnormal	Benign	Abnormal	Normal	Normal
321	Normal	Normal	Normal	Normal	Normal
322	Abnormal	Malignant	Abnormal	Normal	Normal
323	Abnormal	Malignant	Abnormal	Normal	Normal
324	Abnormal	Benign	Abnormal	Normal	Normal
325	Abnormal	Benign	Normal	Normal	Abnormal
326	Normal	Normal	Normal	Normal	Normal
327	Normal	Normal	Normal	Normal	Normal
328	Abnormal	Benign	Abnormal	Normal	Normal
329	Normal	Normal	Normal	Normal	Normal
330	Abnormal	Benign	Normal	Abnormal	Normal
331	Normal	Normal	Normal	Normal	Normal
332	Normal	Normal	Normal	Normal	Normal

PATHOLOGY REPORT

Case #	Group	Diagnosis	Micro-Calcifications	Mass	Focal area of Asymmentry or Architectural Distortion
333	Abnormal	Malignant	Normal	Abnormal	Normal
334	Abnormal	Malignant	Normal	Normal	Abnormal
335	Abnormal	Malignant	Normal	Abnormal	Normal
336	Abnormal	Malignant	Normal	Abnormal	Normal
337	Abnormal	Benign	Abnormal	Normal	Normal
338	Normal	Benign	Normal	Normal	Normal
339	Normal	Benign	Normal	Normal	Normal
340	Normal	Benign	Normal	Normal	Normal
341	Abnormal	Malignant	Abnormal	Normal	Normal
342	Normal	Benign	Normal	Normal	Normal
343	Normal	Benign	Normal	Normal	Normal
344	Normal	Benign	Normal	Normal	Normal
345	Normal	Benign	Normal	Normal	Normal
346	Abnormal	Malignant	Abnormal	Normal	Normal
347	Normal	Benign	Normal	Normal	Normal
348	Abnormal	Benign	Normal	Abnormal	Normal
349	Normal	Benign	Normal	Normal	Normal
350	Normal	Benign	Normal	Normal	Normal
351	Normal	Benign	Normal	Normal	Normal
352	Normal	Benign	Normal	Normal	Normal
353	Normal	Benign	Normal	Normal	Normal
354	Normal	Benign	Normal	Normal	Normal
355	Normal	Benign	Normal	Normal	Normal
356	Abnormal	Malignant	Abnormal	Normal	Normal
357	Normal	Benign	Normal	Normal	Normal
358	Normal	Benign	Normal	Normal	Normal
359	Abnormal	Malignant	Normal	Abnormal	Normal
360	Normal	Benign	Normal	Normal	Normal
361	Abnormal	Malignant	Normal	Abnormal	Normal
362	Abnormal	Malignant	Abnormal	Normal	Abnormal
363	Abnormal	Malignant	Normal	Normal	Abnormal
364	Abnormal	Malignant	Abnormal	Normal	Abnormal
365	Abnormal	Malignant	Normal	Abnormal	Normal

PATHOLOGY REPORT

Case #	Group	Diagnosis	Micro-Calcifications	Mass	Focal area of Asymmentry or Architectural Distortion
366	Normal	Normal	Normal	Normal	Normal
367	Normal	Normal	Normal	Normal	Normal
368	Abnormal	Malignant	Abnormal	Normal	Normal
369	Abnormal	Malignant	Normal	Abnormal	Normal
370	Abnormal	Malignant	Normal	Normal	Abnormal
371	Abnormal	Benign	Normal	Abnormal	Normal
372	Abnormal	Malignant	Abnormal	Normal	Normal
373	Normal	Normal	Normal	Normal	Normal
374	Normal	Normal	Normal	Normal	Normal
375	Normal	Normal	Normal	Normal	Normal
376	Abnormal	Benign	Abnormal	Normal	Normal
377	Abnormal	Benign	Abnormal	Normal	Normal
378	BIRADS ERR				
379	Abnormal	Benign	Abnormal	Normal	Normal
380	Abnormal	Benign	Normal	Abnormal	Normal
381	Abnormal	Benign	Normal	Abnormal	Normal
382	Normal	Normal	Normal	Normal	Normal
383	Normal	Normal	Normal	Normal	Normal
384	Abnormal	Benign	Abnormal	Normal	Normal
385	Normal	Normal	Normal	Normal	Normal
386	Normal	Normal	Normal	Normal	Normal
387	Abnormal	Malignant	Abnormal	Normal	Normal
388	Abnormal	Benign	Normal	Normal	Abnormal
389	Abnormal	Benign	Normal	Abnormal	Normal
390	Normal	Normal	Normal	Normal	Normal
391	Abnormal	Malignant	Normal	Abnormal	Normal
392	Normal	Normal	Normal	Normal	Normal
393	Normal	Normal	Normal	Normal	Normal
394	Normal	Normal	Normal	Normal	Normal
395	Normal	Normal	Normal	Normal	Normal
396	Normal	Normal	Normal	Normal	Normal
397	Normal	Normal	Normal	Normal	Normal
398	Normal	Normal	Normal	Normal	Normal

PATHOLOGY REPORT

Case #	Group	Diagnosis	Micro-Calcifications	Mass	Focal area of Asymmentry or Architectural Distortion
399	Normal	Benign	Normal	Normal	Normal
400	Abnormal	Benign	Abnormal	Normal	Normal
401	Abnormal	Benign	Normal	Abnormal	Normal
402	Abnormal	Benign	Normal	Normal	Abnormal
403	Abnormal	Benign	Abnormal	Normal	Normal
404	Abnormal	Benign	Normal	Normal	Abnormal
405	Abnormal	Benign	Abnormal	Normal	Normal
406	Abnormal	Benign	Normal	Normal	Abnormal
407	Abnormal	Benign	Normal	Normal	Abnormal
408	Abnormal	Benign	Normal	Normal	Abnormal
409	Abnormal	Benign	Abnormal	Normal	Abnormal
410	Abnormal	Malignant	Normal	Abnormal	Normal
411	Normal	Benign	Normal	Normal	Normal
412	Abnormal	Benign	Abnormal	Normal	Normal
413	Abnormal	Benign	Normal	Abnormal	Normal
414	Abnormal	Benign	Normal	Abnormal	Normal
415	Abnormal	Malignant	Abnormal	Normal	Normal
416	Abnormal	Benign	Normal	Abnormal	Normal
417	Normal	Benign	Normal	Normal	Normal
418	Normal	Benign	Normal	Normal	Normal
419	Normal	Benign	Normal	Normal	Normal
420	Normal	Benign	Normal	Normal	Normal
421	Normal	Benign	Normal	Normal	Normal
422	Normal	Benign	Normal	Normal	Normal
423	Normal	Benign	Normal	Normal	Normal
424	Normal	Benign	Normal	Normal	Normal
425	Normal	Benign	Normal	Normal	Normal
426	Normal	Benign	Normal	Normal	Normal
427	Normal	Benign	Normal	Normal	Normal
428	Abnormal	Malignant	Normal	Normal	Abnormal
429	Abnormal	Benign	Abnormal	Normal	Normal
430	Abnormal	Malignant	Abnormal	Normal	Normal
431	Abnormal	Malignant	Normal	Normal	Abnormal

PATHOLOGY REPORT

Case #	Group	Diagnosis	Micro-Calcifications	Mass	Focal area of Asymmentry or Architectural Distortion
432	Abnormal	Benign	Normal	Abnormal	Normal
433	Abnormal	Benign	Abnormal	Normal	Normal
434	Abnormal	Malignant	Abnormal	Abnormal	Normal
435	Abnormal	Malignant	Abnormal	Normal	Normal
436	Abnormal	Malignant	Abnormal	Normal	Normal
437	Abnormal	Malignant	Abnormal	Normal	Normal
438	Abnormal	Malignant	Abnormal	Normal	Normal
439	Abnormal	Benign	Abnormal	Abnormal	Normal
440	Abnormal	Benign	Abnormal	Abnormal	Normal
441	Abnormal	Benign	Normal	Abnormal	Normal
442	Abnormal	Benign	Abnormal	Abnormal	Normal
443	Abnormal	Benign	Abnormal	Normal	Normal
444	Normal	Normal	Normal	Normal	Normal
445	Normal	Normal	Normal	Normal	Normal
446	Normal	Normal	Normal	Normal	Normal
447	Normal	Normal	Normal	Normal	Normal
448	Normal	Normal	Normal	Normal	Normal
449	Normal	Normal	Normal	Normal	Normal
450	Normal	Normal	Normal	Normal	Normal
451	Normal	Normal	Normal	Normal	Normal
452	Normal	Normal	Normal	Normal	Normal
453	Normal	Normal	Normal	Normal	Normal
454	Normal	Normal	Normal	Normal	Normal
455	Normal	Normal	Normal	Normal	Normal
456	Normal	Normal	Normal	Normal	Normal
457	Normal	Normal	Normal	Normal	Normal
458	Normal	Normal	Normal	Normal	Normal
459	Normal	Normal	Normal	Normal	Normal
460	Normal	Normal	Normal	Normal	Normal
461	Normal	Normal	Normal	Normal	Normal
462	Normal	Normal	Normal	Normal	Normal
463	Normal	Normal	Normal	Normal	Normal
464	Normal	Normal	Normal	Normal	Normal

PATHOLOGY REPORT

Case #	Group	Diagnosis	Micro-Calcifications	Mass	Focal area of Asymmentry or Architectural Distortion
465	Abnormal	Malignant	Abnormal	Normal	Normal
466	Abnormal	Benign	Normal	Abnormal	Normal
467	Abnormal	Benign	Normal	Normal	Abnormal
468	Abnormal	Malignant	Abnormal	Abnormal	Normal
469	Abnormal	Malignant	Normal	Abnormal	Normal
470	Abnormal	Malignant	Abnormal	Abnormal	Normal
471	Abnormal	Benign	Abnormal	Normal	Normal
472	Normal	Normal	Normal	Normal	Normal
473	Normal	Normal	Normal	Normal	Normal
474	Normal	Normal	Normal	Normal	Normal
475	Normal	Normal	Normal	Normal	Normal
476	Normal	Normal	Normal	Normal	Normal
477	Normal	Normal	Normal	Normal	Normal
478	Normal	Normal	Normal	Normal	Normal
479	Normal	Normal	Normal	Normal	Normal
480	Normal	Normal	Normal	Normal	Normal
481	Normal	Normal	Normal	Normal	Normal
482	Normal	Normal	Normal	Normal	Normal
483	Abnormal	Benign	Normal	Abnormal	Normal
484	Abnormal	Benign	Normal	Abnormal	Normal
485	Abnormal	Malignant	Normal	Abnormal	Normal
486	Abnormal	Malignant	Abnormal	Normal	Normal
487	Abnormal	Benign	Normal	Abnormal	Normal
488	Abnormal	Benign	Normal	Abnormal	Normal
489	Abnormal	Benign	Abnormal	Normal	Normal
490	Normal	Normal	Normal	Normal	Normal
491	Normal	Normal	Normal	Normal	Normal
492	Normal	Normal	Normal	Normal	Normal
493	Normal	Normal	Normal	Normal	Normal
494	Normal	Normal	Normal	Normal	Normal
495	Normal	Normal	Normal	Normal	Normal
496	Normal	Normal	Normal	Normal	Normal
497	Abnormal	Benign	Normal	Normal	Normal

PATHOLOGY REPORT

Case #	Group	Diagnosis	Micro-Calcifications	Mass	Focal area of Asymmentry or Architectural Distortion
498	Normal	Normal	Normal	Normal	Normal
499	Normal	Normal	Normal	Normal	Normal
500	Normal	Normal	Normal	Normal	Normal
Case #	Type	Ground Truth, Diag	Ground Truth, uCa	Ground Truth, Mass	Ground Truth, FAD

Typical Reader Response

	A	D	E	F	G	H
1	**Case Number**	**Normal: Abnormal: Mass**	**Normal: Abnormal: uCa**	**Normal: Abnormal: FAD**	**Benign: Malignant: Diagnosis**	
2	1	N	N	N	B	1
3	2	N	N	N	B	1
4	3	N	A	A	M	1
5	4	N	A	N	B	1
6	5	N	A	N	M	1
7	6	N	A	N	B	1
8	7	A	N	N	B	1
9	8	N	A	N	B	1
10	9	N	N	N	B	1
11	10	N	N	N	B	1
12	11	N	N	N	B	1
13	13	A	N	A	M	1
14	15	N	N	N	B	1
15	16	N	N	N	B	1
16	17	A	N	N	B	1
17	18	N	A	N	M	1
18	19	N	A	N	M	1
19	20	A	N	N	M	1
20	21	N	N	N	B	1
21	22	N	N	N	B	1
22	23	N	N	A	B	1
23	24	N	N	A	B	1
24	26	N	N	N	B	1
25	27	N	A	N	B	1
26	28	N	N	N	B	1
27	29	A	N	N	B	1
28	30	A	N	N	B	1
29	31	N	N	N	B	1
30	32	N	N	A	B	1
31	33	N	A	N	B	1
32	34	N	N	N	B	1

Typical Reader Response

	A	D	E	F	G	H
1	**Case Number**	**Normal: Abnormal: Mass**	**Normal: Abnormal: uCa**	**Normal: Abnormal: FAD**	**Benign: Malignant: Diagnosis**	
33	35	N	N	N	B	1
34	36	N	N	A	B	1
35	37	N	A	N	B	1
36	38	N	N	N	B	1
37	39	N	N	N	B	1
38	40	N	A	N	B	1
39	43	N	N	N	B	1
40	44	N	N	N	B	1
41	45	N	N	A	M	1
42	46	N	N	N	B	1
43	47	N	N	N	B	1
44	48	N	N	N	B	1
45	50	N	N	N	B	1
46	51	N	A	N	B	1
47	52	N	N	N	B	1
48	53	N	N	N	B	1
49	54	N	N	N	B	1
50	55	A	N	N	B	1
51	56	N	A	N	B	1
52	57	A	N	N	B	1
53	58	N	N	N	B	1
54	59	N	N	N	B	1
55	60	N	N	N	B	1
56	62	N	N	N	B	1
57	63	N	N	N	B	1
58	64	N	N	N	B	1
59	65	A	N	N	B	1
60	67	N	N	N	B	1
61	68	N	A	N	M	1
62	69	A	N	N	B	1
63	70	N	N	N	B	1

Typical Reader Response

	A	D	E	F	G	H
1	**Case Number**	**Normal: Abnormal: Mass**	**Normal: Abnormal: uCa**	**Normal: Abnormal: FAD**	**Benign: Malignant: Diagnosis**	
64	71	N	A	N	B	1
65	72	N	A	N	M	1
66	73	N	N	N	B	1
67	75	N	N	N	B	1
68	76	N	N	N	B	1
69	77	N	N	N	B	1
70	78	A	N	N	B	1
71	79	A	N	N	B	1
72	80	A	N	N	M	1
73	81	N	A	N	M	1
74	82	N	A	N	B	1
75	83	N	N	N	B	1
76	84	N	N	N	B	1
77	85	N	N	N	B	1
78	86	A	N	N	M	1
79	88	N	A	N	B	1
80	89	N	N	A	B	1
81	90	A	N	N	B	1
82	91	N	A	N	M	1
83	92	N	N	N	B	1
84	93	N	N	N	B	1
85	94	A	A	N	M	1
86	95	A	N	N	M	1
87	96	N	N	N	B	1
88	97	N	N	N	B	1
89	98	N	N	N	B	1
90	99	N	N	N	B	1
91	100	A	N	N	M	1
92	101	N	N	N	B	1
93	102	N	N	A	M	1
94	103	N	A	N	M	1

Typical Reader Response

	A	D	E	F	G	H
1	**Case Number**	**Normal: Abnormal: Mass**	**Normal: Abnormal: uCa**	**Normal: Abnormal: FAD**	**Benign: Malignant: Diagnosis**	
95	104	A	N	N	M	1
96	105	N	N	N	B	1
97	106	A	N	N	B	1
98	107	N	N	N	B	1
99	112	N	N	N	B	1
100	113	N	N	A	M	1
101	114	N	A	N	M	1
102	115	N	N	N	B	1
103	116	N	N	N	B	1
104	117	N	N	N	B	1
105	118	A	N	N	B	1
106	119	N	N	N	B	1
107	120	N	N	N	B	1
108	121	N	N	N	B	1
109	122	N	N	N	B	1
110	123	N	A	N	B	1
111	124	N	A	N	M	1
112	125	N	A	N	B	1
113	126	N	N	A	B	1
114	128	N	A	N	B	1
115	129	N	A	N	M	1
116	130	N	N	N	B	1
117	131	N	N	N	B	1
118	132	N	A	N	B	1
119	133	N	A	N	M	1
120	134	N	A	N	B	1
121	136	N	N	N	B	1
122	137	N	N	N	B	1
123	138	A	N	N	M	1
124	139	N	N	A	M	1
125	141	N	N	N	B	1

Typical Reader Response

	A	D	E	F	G	H
1	**Case Number**	**Normal: Abnormal: Mass**	**Normal: Abnormal: uCa**	**Normal: Abnormal: FAD**	**Benign: Malignant: Diagnosis**	
126	142	A	N	N	M	1
127	143	A	N	N	M	1
128	144	N	A	N	B	1
129	146	A	N	N	M	1
130	149	N	N	N	B	1
131	150	N	N	N	B	1
132	151	A	N	N	B	1
133	152	N	N	N	B	1
134	153	A	N	N	M	1
135	154	N	N	N	B	1
136	155	N	N	N	B	1
137	157	N	N	N	B	1
138	158	N	N	N	B	1
139	159	N	N	N	B	1
140	161	N	A	N	B	1
141	164	N	N	A	M	1
142	165	N	N	N	B	1
143	166	N	N	A	M	1
144	167	N	N	N	B	1
145	169	N	A	N	B	1
146	170	A	N	N	M	1
147	171	N	N	N	B	1
148	172	N	N	N	B	1
149	173	N	N	N	B	1
150	175	A	N	N	M	1
151	176	N	N	N	B	1
152	177	N	N	N	B	1
153	180	N	N	N	B	1
154	181	A	N	N	B	1
155	182	N	N	N	B	1
156	183	N	N	N	B	1

Typical Reader Response

	A	D	E	F	G	H
1	**Case Number**	**Normal: Abnormal: Mass**	**Normal: Abnormal: uCa**	**Normal: Abnormal: FAD**	**Benign: Malignant: Diagnosis**	
157	184	N	N	N	B	1
158	185	N	N	N	B	1
159	186	N	A	N	B	1
160	187	A	N	N	M	1
161	188	A	N	N	M	1
162	189	N	N	N	B	1
163	190	N	N	N	B	1
164	191	N	A	N	B	1
165	192	N	A	N	M	1
166	193	N	N	N	B	1
167	195	A	N	N	M	1
168	196	A	N	N	M	1
169	197	N	N	N	B	1
170	198	N	N	N	B	1
171	199	N	N	N	B	1
172	200	A	A	N	M	1
173	201	N	N	N	B	1
174	203	N	N	N	B	1
175	204	N	N	N	B	1
176	207	N	N	N	B	1
177	209	N	N	N	B	1
178	210	N	A	N	M	1
179	211	N	N	N	B	1
180	213	N	N	N	B	1
181	214	N	A	N	M	1
182	216	N	A	N	M	1
183	217	N	N	N	B	1
184	218	N	N	N	B	1
185	219	N	A	N	M	1
186	220	N	N	N	B	1
187	221	N	N	N	B	1

Typical Reader Response

	A	D	E	F	G	H
1	**Case Number**	**Normal: Abnormal: Mass**	**Normal: Abnormal: uCa**	**Normal: Abnormal: FAD**	**Benign: Malignant: Diagnosis**	
188	223	N	N	N	B	1
189	224	N	N	N	B	1
190	225	N	N	N	B	1
191	226	N	N	N	B	1
192	227	N	N	N	B	1
193	228	N	A	N	M	1
194	229	N	N	N	B	1
195	230	N	N	A	B	1
196	231	A	N	N	M	1
197	232	N	N	N	B	1
198	233	A	N	N	M	1
199	234	N	N	A	B	1
200	235	N	N	N	B	1
201	236	N	N	N	B	1
202	237	N	A	N	M	1
203	238	N	A	N	M	1
204	239	N	N	N	B	1
205	240	N	N	N	B	1
206	242	N	N	N	B	1
207	243	A	N	N	M	1
208	244	A	N	N	M	1
209	245	N	N	N	B	1
210	247	N	A	N	B	1
211	249	N	A	N	M	1
212	250	N	A	N	B	1
213	251	A	N	N	M	1
214	252	N	N	N	B	1
215	253	A	N	N	M	1
216	255	N	N	N	B	1
217	256	N	N	N	B	1
218	257	N	A	N	M	1

Typical Reader Response

	A	D	E	F	G	H
1	**Case Number**	**Normal: Abnormal: Mass**	**Normal: Abnormal: uCa**	**Normal: Abnormal: FAD**	**Benign: Malignant: Diagnosis**	
219	258	N	N	N	B	1
220	259	A	N	N	B	1
221	260	N	N	N	B	1
222	262	N	N	N	B	1
223	263	A	N	N	M	1
224	265	N	A	N	M	1
225	266	N	N	N	B	1
226	267	N	N	N	B	1
227	268	N	N	A	B	1
228	269	N	N	N	B	1
229	270	N	A	N	M	1
230	271	N	A	N	M	1
231	272	N	N	N	B	1
232	273	N	A	N	M	1
233	274	N	N	N	B	1
234	276	N	A	N	M	1
235	277	N	N	N	B	1
236	278	N	N	N	B	1
237	279	N	N	N	B	1
238	280	N	N	N	B	1
239	281	N	N	N	B	1
240	282	N	A	N	B	1
241	283	N	A	N	M	1
242	284	N	A	N	M	1
243	285	N	N	N	B	1
244	286	N	N	N	B	1
245	287	A	N	N	M	1
246	288	N	A	N	M	1
247	289	N	N	N	B	1
248	291	N	N	N	B	1
249	292	N	N	N	B	1

Typical Reader Response

	A	D	E	F	G	H
1	**Case Number**	**Normal: Abnormal: Mass**	**Normal: Abnormal: uCa**	**Normal: Abnormal: FAD**	**Benign: Malignant: Diagnosis**	
250	293	N	A	N	M	1
251	294	N	N	N	B	1
252	295	N	A	N	B	1
253	296	A	N	N	B	1
254	297	N	N	N	B	1
255	298	N	N	N	B	1
256	301	N	A	N	M	1
257	302	N	N	N	B	1
258	303	N	N	N	B	1
259	304	N	A	N	M	1
260	305	N	A	N	B	1
261	307	N	N	N	B	1
262	309	A	N	N	M	1
263	310	N	N	N	B	1
264	311	N	N	A	M	1
265	313	N	N	N	B	1
266	315	N	N	N	B	1
267	316	A	N	N	M	1
268	318	N	N	N	B	1
269	319	N	N	N	B	1
270	320	N	A	N	B	1
271	321	N	N	N	B	1
272	322	N	A	N	M	1
273	323	N	A	N	M	1
274	326	N	N	N	B	1
275	327	N	N	N	B	1
276	328	N	A	N	B	1
277	329	N	N	N	B	1
278	330	A	N	N	B	1
279	331	N	N	N	B	1
280	332	N	N	N	B	1

Typical Reader Response

	A	D	E	F	G	H
1	**Case Number**	**Normal: Abnormal: Mass**	**Normal: Abnormal: µCa**	**Normal: Abnormal: FAD**	**Benign: Malignant: Diagnosis**	
281	333	A	N	N	M	1
282	334	N	N	A	M	1
283	337	N	A	N	B	1
284	338	N	N	N	B	1
285	339	N	N	N	B	1
286	340	N	N	N	B	1
287	342	N	N	N	B	1
288	343	N	N	N	B	1
289	393	N	N	N	B	1
290	394	N	N	N	B	1
291	395	N	N	N	B	1
292	397	N	N	N	B	1
293	399	N	N	N	B	1
294	400	N	A	N	B	1
295	401	A	N	N	B	1
296	402	N	N	A	B	1
297	404	N	N	A	B	1
298	407	N	N	A	B	1
299	408	N	N	A	B	1
300	409	N	A	A	B	1
301	410	A	N	N	M	1
302	412	N	A	N	B	1
303	413	A	N	N	B	1
304	414	A	N	N	B	1
305	415	N	A	N	M	1
306	416	A	N	N	B	1
307	418	N	N	N	B	1
308	419	N	N	N	B	1
309	421	N	N	N	B	1
310	422	N	N	N	B	1
311	423	N	N	N	B	1

Typical Reader Response

	A	D	E	F	G	H
1	**Case Number**	**Normal: Abnormal: Mass**	**Normal: Abnormal: uCa**	**Normal: Abnormal: FAD**	**Benign: Malignant: Diagnosis**	
312	424	N	N	N	B	1
313	425	N	N	N	B	1
314	426	N	N	N	B	1
315	427	N	N	N	B	1
316	429	N	A	N	B	1
317	430	N	A	N	M	1
318	431	N	N	A	M	1
319	432	A	N	N	B	1
320	433	N	A	N	B	1
321	434	A	A	N	M	1
322	435	N	A	N	M	1
323	436	N	A	N	M	1
324	437	N	A	N	M	1
325	438	N	A	N	M	1
326	439	A	A	N	B	1
327	440	A	A	N	B	1
328	442	A	A	N	B	1
329	443	N	A	N	B	1
330	445	N	N	N	B	1
331	446	N	N	N	B	1
332	447	N	N	N	B	1
333	448	N	N	N	B	1
334	450	N	N	N	B	1
335	451	N	N	N	B	1
336	452	N	N	N	B	1
337	453	N	N	N	B	1
338	455	N	N	N	B	1
339	457	N	N	N	B	1
340	458	N	N	N	B	1
341	459	N	N	N	B	1
342	461	N	N	N	B	1

Typical Reader Response

	A	D	E	F	G	H
1	**Case Number**	**Normal: Abnormal: Mass**	**Normal: Abnormal: uCa**	**Normal: Abnormal: FAD**	**Benign: Malignant: Diagnosis**	
343	463	N	N	N	B	1
344	464	N	N	N	B	1
345	466	A	N	N	B	1
346	467	N	N	A	B	1
347	**Totals**					total=345
348						
349	Total Normal	285	261	319	261	
350	Total Abnormal	60	84	26	84	

APPENDIX II

Original screen-film mammography image compared to laser film printed image of laser digitized image.

Reference to films:

Non-Digitized (Analog)

Removed from patient x-ray jacket

#1 = Original
#2 = Original
#3 = Original

Now Have:

Copies of Digital Images that were digitized from originals (Analog) #1, #2, and #3

12 bit images

#4 = digital image of original #1 by 2180 H Kodak Laser Printer
#5 = digital image of original #2 by 2180 H Kodak Laser Printer
#6 = digital image of original #3 by 2180 H Kodak Laser Printer

8 bit images

#7 = digital image of original #1 by AGFA 5200 Laser Printer
#8 = digital image of original #2 by AGFA 5200 Laser Printer
#9 = digital image of original #3 by AGFA 5200 Laser Printer

Note: Numbers: 1, 2, and 3 indicate non-digitized (Analog) images that were removed from patient's original x-ray film folders (jackets)

Note: Numbers: 4, 5, 6, 6, 8, and 9 indicate images made from the digital images of # 1, 2, and 3

APPENDIX III

ROC Analysis

Results for

Reader #2

Reader #3

Reader #4

Reader #5

Reader #6

Reader #7

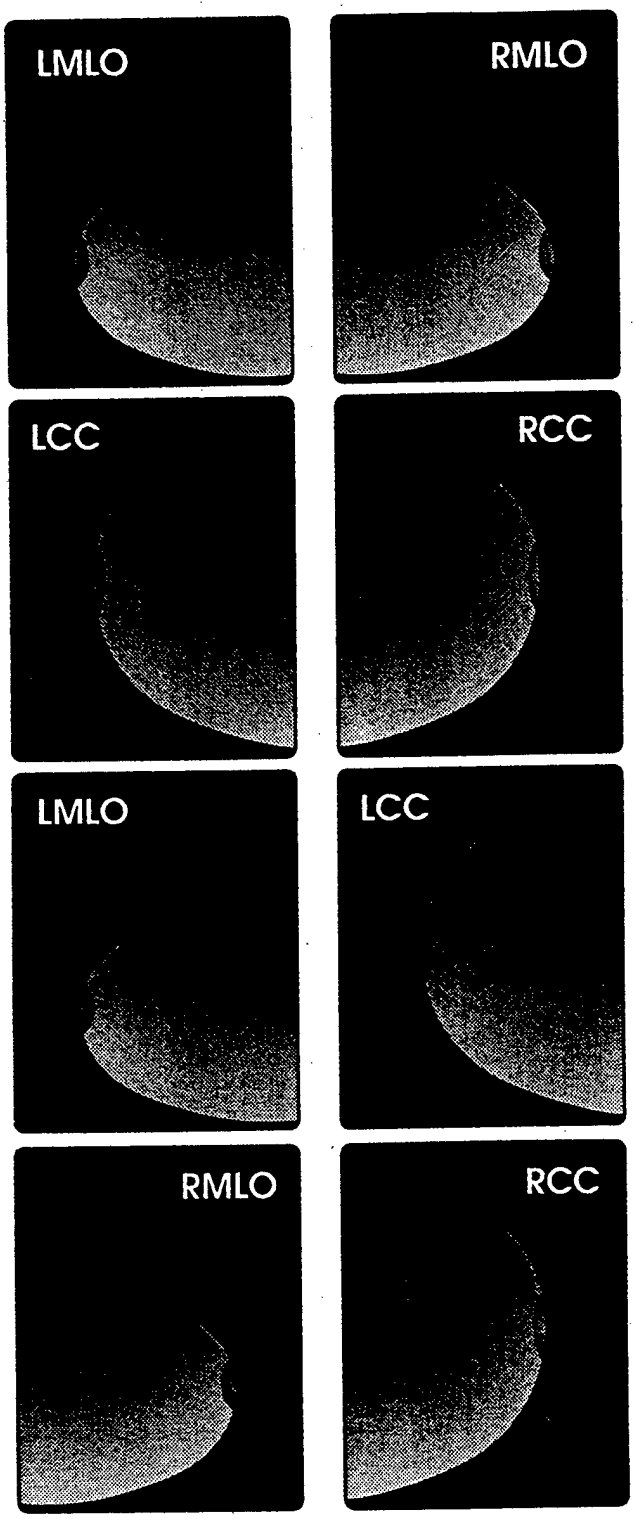
Reader #8

Reader #9

Reader #11

Reader #14

Reader Number	Reader List Screen-Films Read	Digital Soft Copy Read
2	382	297
3	329	0
4	398	373
5	326	0
6	384	180
7	330	0
8	330	0
9	330	0
10	229	0
11	268	84
12	069	0
13	098	0
14	277	362
15	0	91



Display A

Display B

Display C

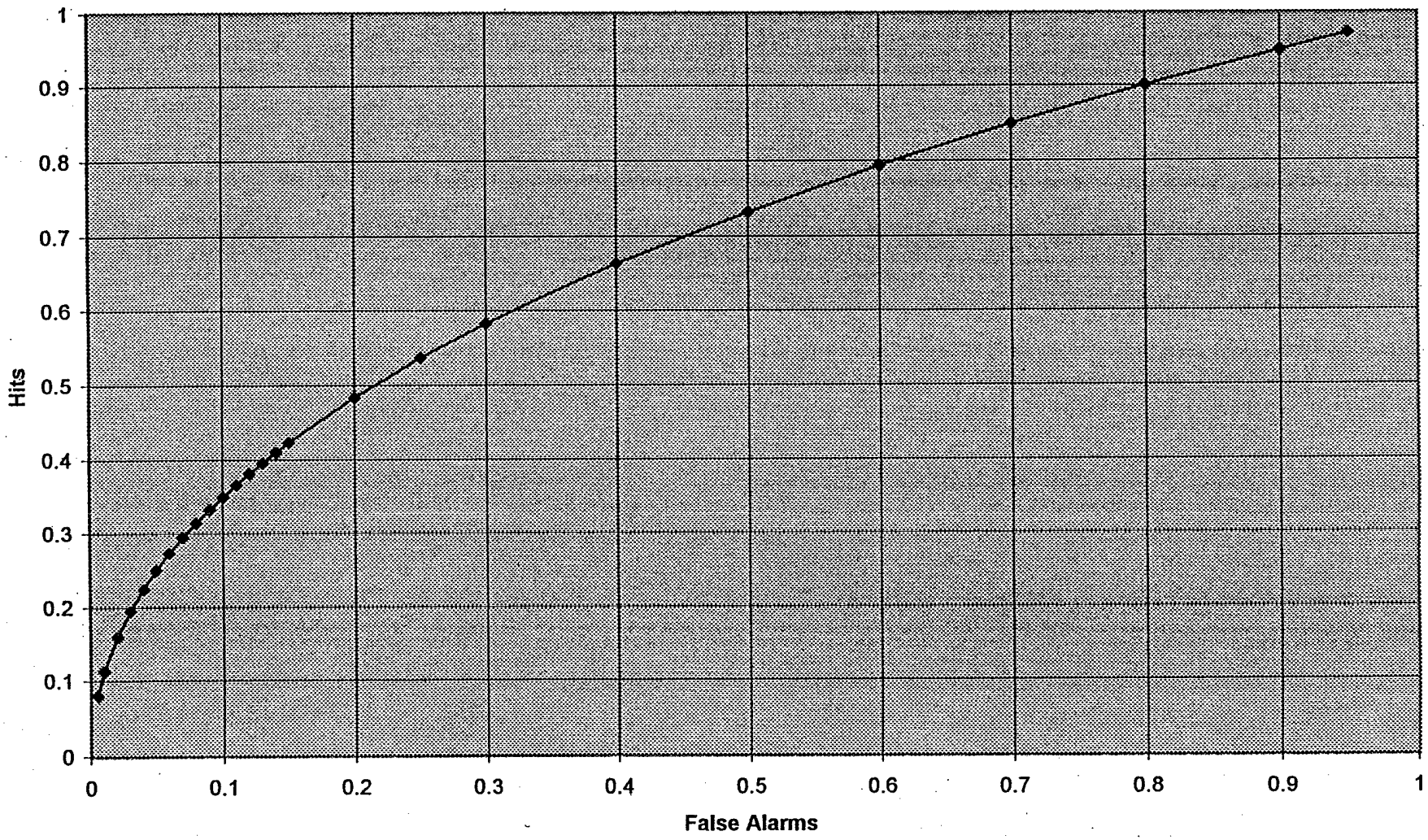
Display D

Reader02 Digital

Totals	Type	Mass	Calc	Fad	Diag
Total Normal	144	241	216	270	215
Total Abnormal	152	55	80	26	81

	Resp =	Resp = 2	Resp = 3	Resp = 4	Resp = 5
Resp, Mass, N	71	94	47	9	20
Resp, Mass, A	4	3	3	4	41
Resp, Ca, N	162	17	3	7	27
Resp, Ca, A	25	1	0	2	52
Resp, FAD, N	135	44	35	23	33
Resp, FAD, A	8	7	4	2	5
Resp, Diag, B	19	81	92	19	4
Resp, Diag, M	0	10	31	26	14

Totals	Type	Mass	Reader02 Analog Calc	FAD	Diag
Total Normal	144	241	216	270	215
Total Abnormal	152	55	80	26	81
	Resp = 1	Resp = 2	Resp = 3	Resp = 4	Resp = 5
Resp, Mass, N	58	73	93	10	7
Resp, Mass, A	4	1	6	8	36
Resp, Ca, N	173	22	12	3	6
Resp, Ca, A	8	7	4	11	50
Resp, FAD, N	153	48	15	22	32
Resp, FAD, A	4	2	4	5	11
Resp, Diag, B	25	79	99	12	0
Resp, Diag, M	0	5	41	25	10


Reader 02 Analog ROC: Type=Mass N=400 Area=.6871 STD Area=.0274
Hits
False Alarms
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1

□□
Do you want to use data from a previously created input file for the next run?
(Y/N, or Q to quit)
enter INPUT file name:
Do you want to save an output file for plotting the ROC curve?
(Y/N, or R to restart)
□□ □ DATE -
10/21/1997
TIME -
15:12:32

R O C F I T (IBM VERSION 1.2) :

M A X I M U M L I K E L I H O O D E S T I M A T I O N
O F A B I N O R M A L R O C C U R V E
F R O M R A T I N G D A T A

DATA DESCRIPTION: Reader 02 - ROC for Mass - Analog

DATA COLLECTED IN 5 CATEGORIES
WITH CATEGORY 5 REPRESENTING STRONGEST EVIDENCE OF POSITIVITY
(E.G., THAT ABNORMALITY IS PRESENT).

NO. OF ACTUALLY NEGATIVE CASES = 201.
NO. OF ACTUALLY POSITIVE CASES = 198.

RESPONSE DATA:

CATEGORY	1	2	3	4	5
ACTUALLY NEGATIVE CASES	51.	60.	73.	5.	12.
ACTUALLY POSITIVE CASES	23.	44.	58.	20.	53.

OBSERVED OPERATING POINTS:

FPF:	.000	.060	.085	.448	.746	1.000
TPF:	.000	.268	.369	.662	.884	1.000

INITIAL VALUES OF PARAMETERS:
A= .6248 B= .7673
Z(K)= -.662 .131 1.375 1.558
LOGL= -578.5890
GOODNESS OF FIT --
CHI SQUARE= 17.0981 WITH 2 DEGREES OF FREEDOM, P= .0002

PROCEDURE CONVERGES AFTER 4 ITERATIONS.

FINAL VALUES OF PARAMETERS:
A= .6203 B= .7865
Z(K)= -.683 .181 1.276 1.577
LOGL= -574.2211
GOODNESS OF FIT --
CHI SQUARE= 5.5634 WITH 2 DEGREES OF FREEDOM, P= .0619

VARIANCE-COVARIANCE MATRIX:

A	.0106	.0025	.0048	.0044	.0039	.0037
B	.0025	.0063	.0026	.0003	-.0042	-.0058
Z(1)	.0048	.0026	.0090	.0048	.0020	.0012
Z(2)	.0044	.0003	.0048	.0070	.0049	.0046
Z(3)	.0039	-.0042	.0020	.0049	.0129	.0133
Z(4)	.0037	-.0058	.0012	.0046	.0133	.0174

CORRELATION MATRIX:

A	1.0000	.3041	.4910	.5166	-.4639	-.5589
B	.3041	1.0000	.3422	.0461	.1835	.0986
Z(1)	.4910	.3422	1.0000	.5999	.5124	.4170
Z(2)	.5166	.0461	.5999	1.0000	.5124	.4170
Z(3)	.3380	-.4639	.1835	.5124	1.0000	.8862
Z(4)	.2696	-.5589	.0986	.4170	.8862	1.0000

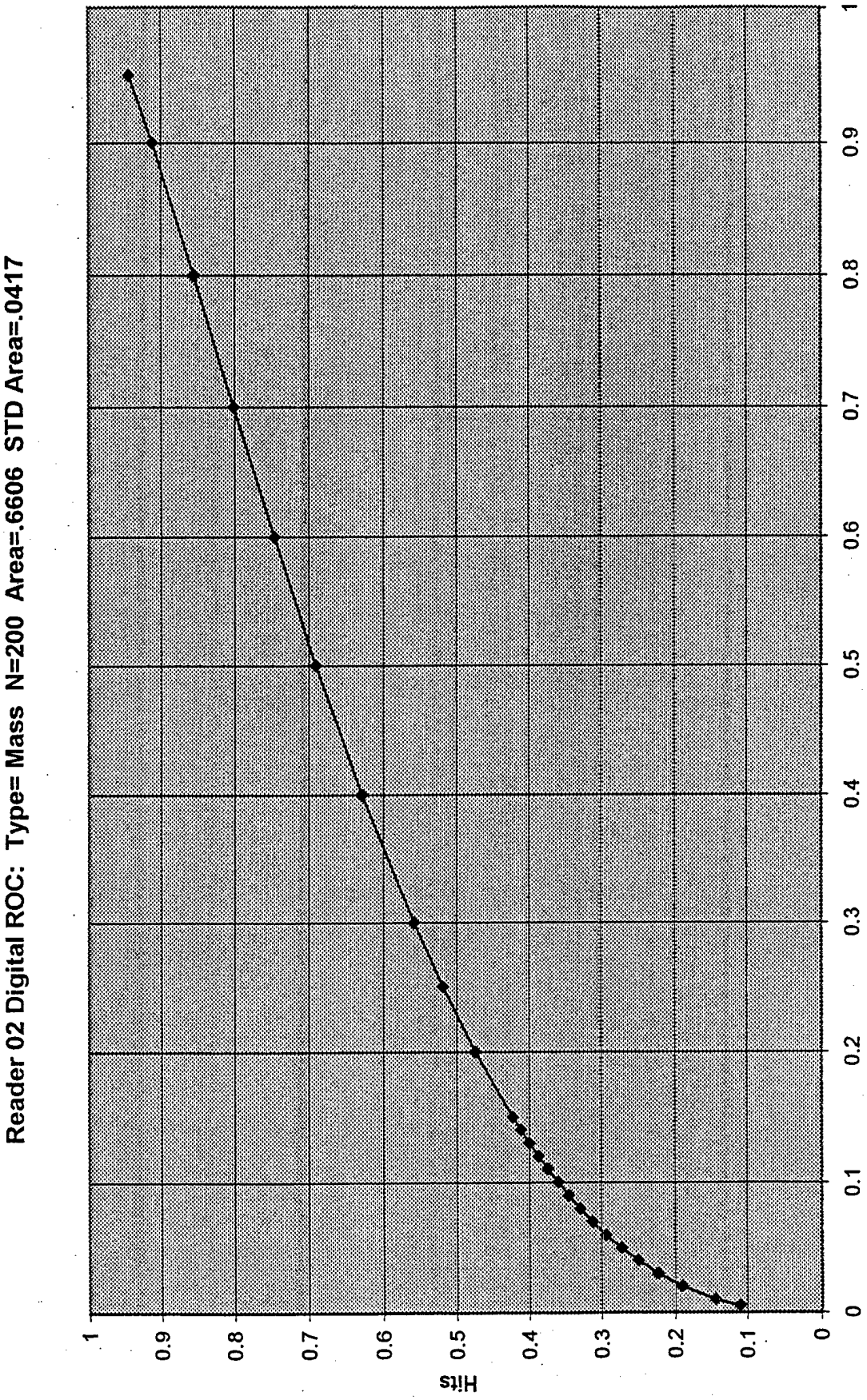
AREA = .6871 STD. DEV.(AREA) = .0274

ESTIMATED BINORMAL ROC CURVE, WITH LOWER AND UPPER BOUNDS ON ASYMMETRIC 95% CONFIDENCE INTERVAL FOR TRUE-POSITIVE FRACTION AT EACH SPECIFIED FALSE-POSITIVE FRACTION:

FPF	TPF	(LOWER BOUND,	UPPER BOUND)
.005	.0799	(.0363 ,	.1546)
.010	.1132	(.0587 ,	.1966)
.020	.1598	(.0940 ,	.2501)
.030	.1951	(.1231 ,	.2880)
.040	.2245	(.1487 ,	.3185)
.050	.2503	(.1719 ,	.3443)
.060	.2733	(.1932 ,	.3671)
.070	.2944	(.2131 ,	.3876)
.080	.3138	(.2318 ,	.4063)
.090	.3320	(.2495 ,	.4236)
.100	.3491	(.2663 ,	.4398)
.110	.3652	(.2823 ,	.4550)
.120	.3806	(.2977 ,	.4694)
.130	.3952	(.3125 ,	.4830)
.140	.4093	(.3267 ,	.4961)
.150	.4227	(.3404 ,	.5086)
.200	.4834	(.4029 ,	.5646)
.250	.5359	(.4574 ,	.6130)
.300	.5825	(.5060 ,	.6559)
.400	.6633	(.5901 ,	.7307)
.500	.7325	(.6622 ,	.7945)
.600	.7937	(.7265 ,	.8499)
.700	.8491	(.7861 ,	.8983)
.800	.9001	(.8439 ,	.9399)
.900	.9483	(.9040 ,	.9745)
.950	.9722	(.9387 ,	.9888)

ESTIMATES OF EXPECTED OPERATING POINTS ON FITTED ROC CURVE, WITH LOWER AND UPPER BOUNDS OF ASYMMETRIC 95% CONFIDENCE INTERVAL ALONG THE CURVE FOR THOSE POINTS:

EXPECTED OPERATING POINT (FPF , TPF)	LOWER BOUND (FPF , TPF)	UPPER BOUND (FPF , TPF)
(.0573, .2675)	(.0332, .2050)	(.0936, .3384)
(.1010, .3508)	(.0670, .2884)	(.1460, .4175)


Reader 02 Digital ROC: Type= Mass N=200 Area=.6606 STD Area=.0417
Hits
False Alarms
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1

```
Do you want to use data from a previously created input file for the
next run?
(Y/N, or Q to quit)
enter INPUT file name:
Do you want to save an output file for plotting the ROC curve?
(Y/N, or R to restart)
                                                              DATE -
11/ 3/1998
                                                            TIME -
10:39:20
              R O C F I T  (IBM VERSION 1.2) :

    M A X I M U M   L I K E L I H O O D   E S T I M A T I O N
         O F   A   B I N O R M A L   R O C   C U R V E
               F R O M   R A T I N G   D A T A


     DATA DESCRIPTION: Reader 02 Digital Mass resp for 296 cases
available

     DATA COLLECTED IN  5 CATEGORIES
     WITH CATEGORY  5 REPRESENTING STRONGEST EVIDENCE OF POSITIVITY
     (E.G., THAT ABNORMALITY IS PRESENT).

     NO. OF ACTUALLY NEGATIVE CASES =  241.
     NO. OF ACTUALLY POSITIVE CASES =   55.

     RESPONSE DATA:
      CATEGORY                    1      2      3      4      5
      ACTUALLY NEGATIVE CASES    71.    94.    47.     9.    20.
      ACTUALLY POSITIVE CASES     4.     3.     3.     4.    41.

     OBSERVED OPERATING POINTS:
      FPF:  .000  .083  .120  .315  .705 1.000
      TPF:  .000  .745  .818  .873  .927 1.000

           INITIAL VALUES OF PARAMETERS:
     A=  1.2792    B=   .3812
     Z(K)=  -.540   .480  1.173  1.385
     LOGL=  -383.9077
     CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
      BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.

     PROCEDURE CONVERGES AFTER   4 ITERATIONS.

           FINAL VALUES OF PARAMETERS:
     A=  1.2917    B=   .4382
     Z(K)=  -.536   .474  1.152  1.412
     LOGL=  -383.4332
     CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
      BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.


           VARIANCE-COVARIANCE MATRIX:
     A        .0461   .0148   .0023   .0021   .0018   .0015
```

B	.0148	.0159	.0011	.0000	-.0017	-.0031
Z(1)	.0023	.0011	.0072	.0032	.0022	.0018
Z(2)	.0021	.0000	.0032	.0070	.0049	.0044
Z(3)	.0018	-.0017	.0022	.0049	.0105	.0096
Z(4)	.0015	-.0031	.0018	.0044	.0096	.0137

CORRELATION MATRIX:

A	1.0000	.5450	.1262	.1148	.0832	.0600
B	.5450	1.0000	.1012	.0038	-.1314	-.2086
Z(1)	.1262	.1012	1.0000	.4529	.2472	.1861
Z(2)	.1148	.0038	.4529	1.0000	.5694	.4491
Z(3)	.0832	-.1314	.2472	.5694	1.0000	.8001
Z(4)	.0600	-.2086	.1861	.4491	.8001	1.0000

AREA = .8816 STD. DEV.(AREA) = .0343

ESTIMATED BINORMAL ROC CURVE, WITH LOWER AND UPPER BOUNDS ON ASYMMETRIC 95% CONFIDENCE INTERVAL FOR TRUE-POSITIVE FRACTION AT EACH SPECIFIED FALSE-POSITIVE FRACTION:

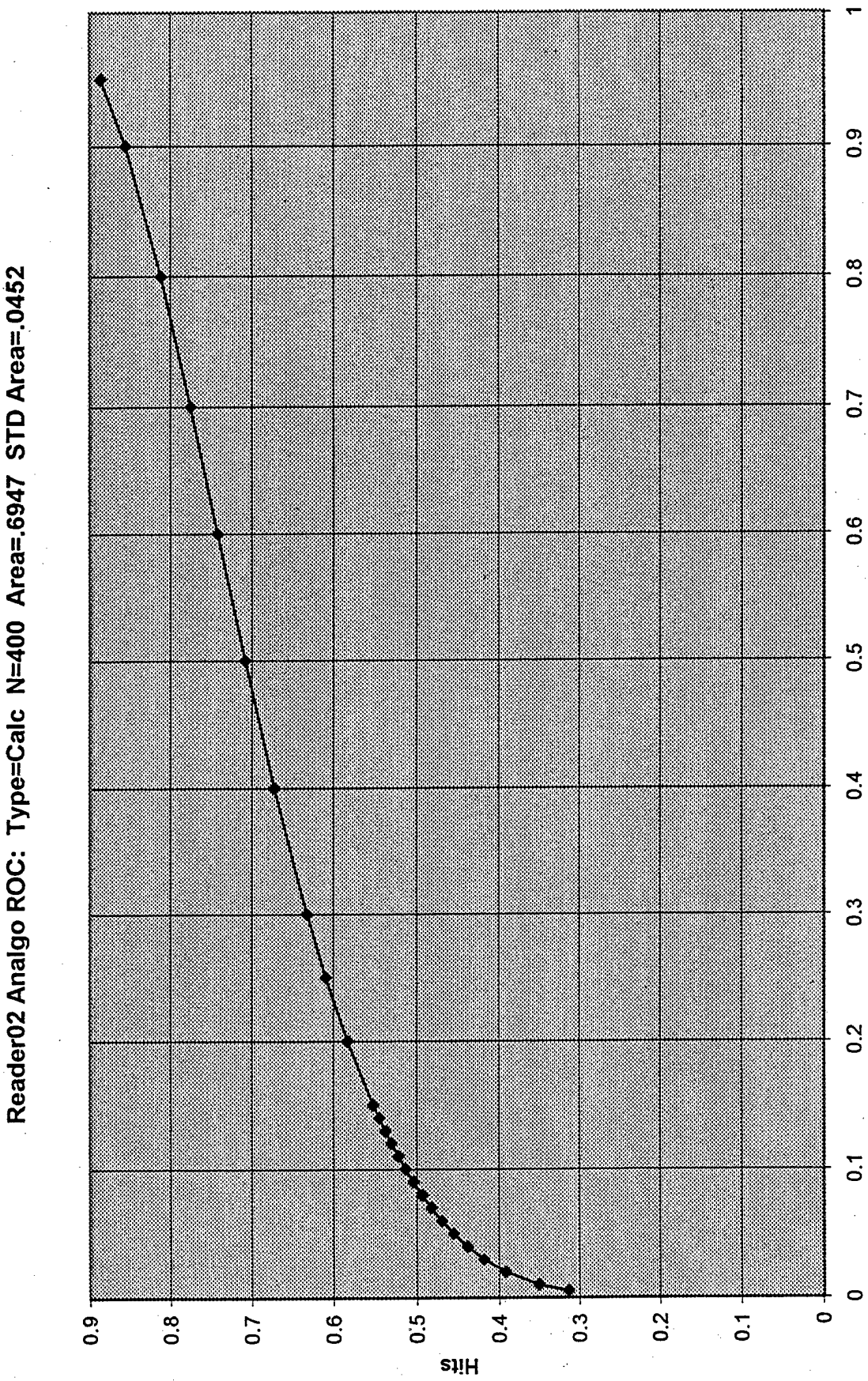
FPF	TPF	(LOWER BOUND,	UPPER BOUND)
.005	.5647	.3535	.7586
.010	.6073	.4123	.7782
.020	.6523	.4770	.7998
.030	.6799	.5172	.8137
.040	.7000	.5466	.8243
.050	.7159	.5698	.8329
.060	.7292	.5890	.8403
.070	.7405	.6052	.8468
.080	.7505	.6194	.8527
.090	.7593	.6318	.8580
.100	.7673	.6430	.8630
.110	.7746	.6531	.8675
.120	.7814	.6622	.8718
.130	.7876	.6707	.8759
.140	.7934	.6784	.8797
.150	.7989	.6857	.8833
.200	.8220	.7154	.8991
.250	.8405	.7382	.9123
.300	.8559	.7565	.9235
.400	.8812	.7853	.9420
.500	.9018	.8080	.9566
.600	.9196	.8275	.9686
.700	.9359	.8456	.9786
.800	.9516	.8640	.9869
.900	.9681	.8855	.9939
.950	.9779	.9006	.9969

ESTIMATES OF EXPECTED OPERATING POINTS ON FITTED ROC

CURVE, WITH LOWER AND UPPER BOUNDS OF ASYMMETRIC 95%
CONFIDENCE INTERVAL ALONG THE CURVE FOR THOSE POINTS:

EXPECTED OPERATING POINT (FPF , TPF)	LOWER BOUND (FPF , TPF)	UPPER BOUND (FPF , TPF)
(.0790, .7495)	(.0504, .7165)	(.1184, .7803)
(.1248, .7844)	(.0881, .7578)	(.1709, .8093)
(.3177, .8608)	(.2619, .8443)	(.3781, .8761)
(.7039, .9365)	(.6439, .9269)	(.7587, .9451)

Do you want to use data from a previously created input file for the next run?
(Y/N, or Q to quit)
Stop - Program terminated.


Reader02 Analgo ROC: Type=Calc N=400 Area=.6947 STD Area=.0452
Hits
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
False Alarms

```
Do you want to use data from a previously created input file for the
next run?
(Y/N, or Q to quit)
enter INPUT file name:
Do you want to save an output file for plotting the ROC curve?
(Y/N, or R to restart)
                                                              DATE -
11/ 3/1998
                                                            TIME -
10:39:20
              R O C F I T  (IBM VERSION 1.2) :

    M A X I M U M   L I K E L I H O O D   E S T I M A T I O N
         O F   A   B I N O R M A L   R O C   C U R V E
               F R O M   R A T I N G   D A T A


     DATA DESCRIPTION: Reader 02 Analog Calc resp for 296 cases
available

     DATA COLLECTED IN  5 CATEGORIES
     WITH CATEGORY  5 REPRESENTING STRONGEST EVIDENCE OF POSITIVITY
     (E.G., THAT ABNORMALITY IS PRESENT).

     NO. OF ACTUALLY NEGATIVE CASES =  216.
     NO. OF ACTUALLY POSITIVE CASES =   80.

     RESPONSE DATA:
      CATEGORY                    1      2      3      4      5
      ACTUALLY NEGATIVE CASES   173.    22.    12.     3.     6.
      ACTUALLY POSITIVE CASES     8.     7.     4.    11.    50.

     OBSERVED OPERATING POINTS:
      FPF:  .000  .028  .042  .097  .199 1.000
      TPF:  .000  .625  .762  .813  .900 1.000

           INITIAL VALUES OF PARAMETERS:
     A=  1.9685    B=   .8071
     Z(K)=   .845  1.298  1.732  1.915
     LOGL=  -255.8930
     CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
      BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.

     PROCEDURE CONVERGES AFTER   4 ITERATIONS.

           FINAL VALUES OF PARAMETERS:
     A=  2.0332    B=   .8618
     Z(K)=   .847  1.301  1.634  1.979
     LOGL=  -252.6468
     CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
      BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.


           VARIANCE-COVARIANCE MATRIX:
     A       .1180   .0636   .0105   .0060  -.0018  -.0150
```

B	.0636	.0451	.0029	-.0022	-.0095	-.0209
Z(1)	.0105	.0029	.0095	.0076	.0065	.0055
Z(2)	.0060	-.0022	.0076	.0127	.0118	.0117
Z(3)	-.0018	-.0095	.0065	.0118	.0183	.0195
Z(4)	-.0150	-.0209	.0055	.0117	.0195	.0311

CORRELATION MATRIX:

A	1.0000	.8724	.3151	.1545	-.0378	-.2466
B	.8724	1.0000	.1422	-.0924	-.3301	-.5576
Z(1)	.3151	.1422	1.0000	.6951	.4964	.3203
Z(2)	.1545	-.0924	.6951	1.0000	.7784	.5913
Z(3)	-.0378	-.3301	.4964	.7784	1.0000	.8161
Z(4)	-.2466	-.5576	.3203	.5913	.8161	1.0000

AREA = .9382 STD. DEV.(AREA) = .0174

ESTIMATED BINORMAL ROC CURVE, WITH LOWER AND UPPER BOUNDS ON ASYMMETRIC 95% CONFIDENCE INTERVAL FOR TRUE-POSITIVE FRACTION AT EACH SPECIFIED FALSE-POSITIVE FRACTION:

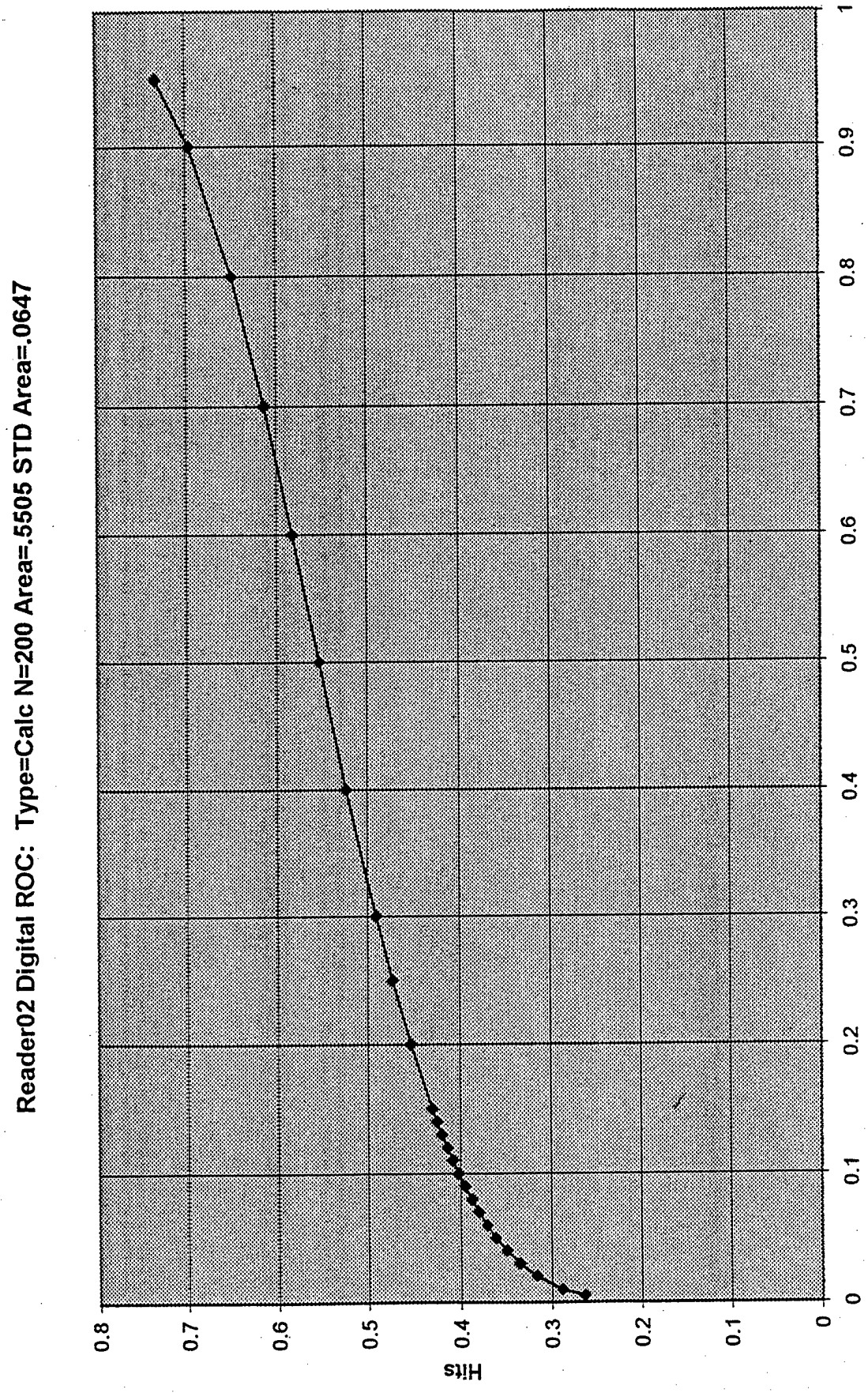
FPF	TPF	(LOWER BOUND,	UPPER BOUND)
.005	.4258	.2198	.6549
.010	.5111	.3173	.7024
.020	.6037	.4360	.7539
.030	.6598	.5117	.7866
.040	.6999	.5659	.8112
.050	.7308	.6073	.8311
.060	.7558	.6400	.8479
.070	.7767	.6667	.8624
.080	.7945	.6890	.8752
.090	.8099	.7078	.8865
.100	.8234	.7241	.8965
.110	.8355	.7383	.9056
.120	.8462	.7508	.9137
.130	.8560	.7619	.9211
.140	.8648	.7720	.9277
.150	.8729	.7810	.9337
.200	.9046	.8165	.9567
.250	.9268	.8419	.9714
.300	.9431	.8615	.9811
.400	.9653	.8909	.9918
.500	.9790	.9131	.9966
.600	.9878	.9311	.9987
.700	.9935	.9468	.9996
.800	.9971	.9612	.9999
.900	.9991	.9756	1.0000
.950	.9997	.9837	1.0000

ESTIMATES OF EXPECTED OPERATING POINTS ON FITTED ROC

CURVE, WITH LOWER AND UPPER BOUNDS OF ASYMMETRIC 95%
CONFIDENCE INTERVAL ALONG THE CURVE FOR THOSE POINTS:

EXPECTED OPERATING POINT (FPF , TPF)	LOWER BOUND (FPF , TPF)	UPPER BOUND (FPF , TPF)
(.0239, .6283)	(.0100, .5116)	(.0512, .7341)
(.0511, .7341)	(.0288, .6542)	(.0856, .8034)
(.0967, .8192)	(.0641, .7650)	(.1400, .8648)
(.1985, .9038)	(.1497, .8726)	(.2559, .9289)

Do you want to use data from a previously created input file for the next run?
(Y/N, or Q to quit)
Stop - Program terminated.


Reader02 Digital ROC: Type=Calc N=200 Area=.5505 STD Area=.0647
Hits
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
False Alarms
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1

```
Do you want to use data from a previously created input file for the
next run?
(Y/N, or Q to quit)
enter INPUT file name:
Do you want to save an output file for plotting the ROC curve?
(Y/N, or R to restart)
                                                              DATE -
11/ 3/1998
                                                            TIME -
10:39:20
              R O C F I T  (IBM VERSION 1.2) :

    M A X I M U M   L I K E L I H O O D   E S T I M A T I O N
         O F   A   B I N O R M A L   R O C   C U R V E
               F R O M   R A T I N G   D A T A


     DATA DESCRIPTION: Reader 02 Digital Calc resp for 296 cases
available

     DATA COLLECTED IN  5 CATEGORIES
     WITH CATEGORY  5 REPRESENTING STRONGEST EVIDENCE OF POSITIVITY
     (E.G., THAT ABNORMALITY IS PRESENT).

     NO. OF ACTUALLY NEGATIVE CASES =  216.
     NO. OF ACTUALLY POSITIVE CASES =   80.

     RESPONSE DATA:
      CATEGORY                    1      2      3      4      5
      ACTUALLY NEGATIVE CASES   162.    17.     3.     7.    27.
      ACTUALLY POSITIVE CASES    25.     1.     0.     2.    52.

     OBSERVED OPERATING POINTS:
      FPF:  .000  .125  .157  .171  .250 1.000
      TPF:  .000  .650  .675  .675  .688 1.000

           INITIAL VALUES OF PARAMETERS:
     A=  1.0483    B=    .5685
     Z(K)=   .674   .949  1.005  1.150
     LOGL=  -249.2581
     CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
      BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.

     PROCEDURE CONVERGES AFTER   4 ITERATIONS.

           FINAL VALUES OF PARAMETERS:
     A=   .6367    B=    .2172
     Z(K)=   .675   .940   .990  1.155
     LOGL=  -246.9307
     CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
      BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.


           VARIANCE-COVARIANCE MATRIX:
     A       .0355   .0157   .0025   .0011   .0008  -.0002
```

B	.0157	.0165	.0009	-.0007	-.0011	-.0024
Z(1)	.0025	.0009	.0086	.0074	.0072	.0066
Z(2)	.0011	-.0007	.0074	.0099	.0097	.0091
Z(3)	.0008	-.0011	.0072	.0097	.0103	.0097
Z(4)	-.0002	-.0024	.0066	.0091	.0097	.0120

CORRELATION MATRIX:

A	1.0000	.6478	.1414	.0599	.0439	-.0101
B	.6478	1.0000	.0750	-.0577	-.0841	-.1728
Z(1)	.1414	.0750	1.0000	.8018	.7660	.6527
Z(2)	.0599	-.0577	.8018	1.0000	.9595	.8322
Z(3)	.0439	-.0841	.7660	.9595	1.0000	.8697
Z(4)	-.0101	-.1728	.6527	.8322	.8697	1.0000

AREA = .7331 STD. DEV.(AREA) = .0571

ESTIMATED BINORMAL ROC CURVE, WITH LOWER AND UPPER BOUNDS ON ASYMMETRIC 95% CONFIDENCE INTERVAL FOR TRUE-POSITIVE FRACTION AT EACH SPECIFIED FALSE-POSITIVE FRACTION:

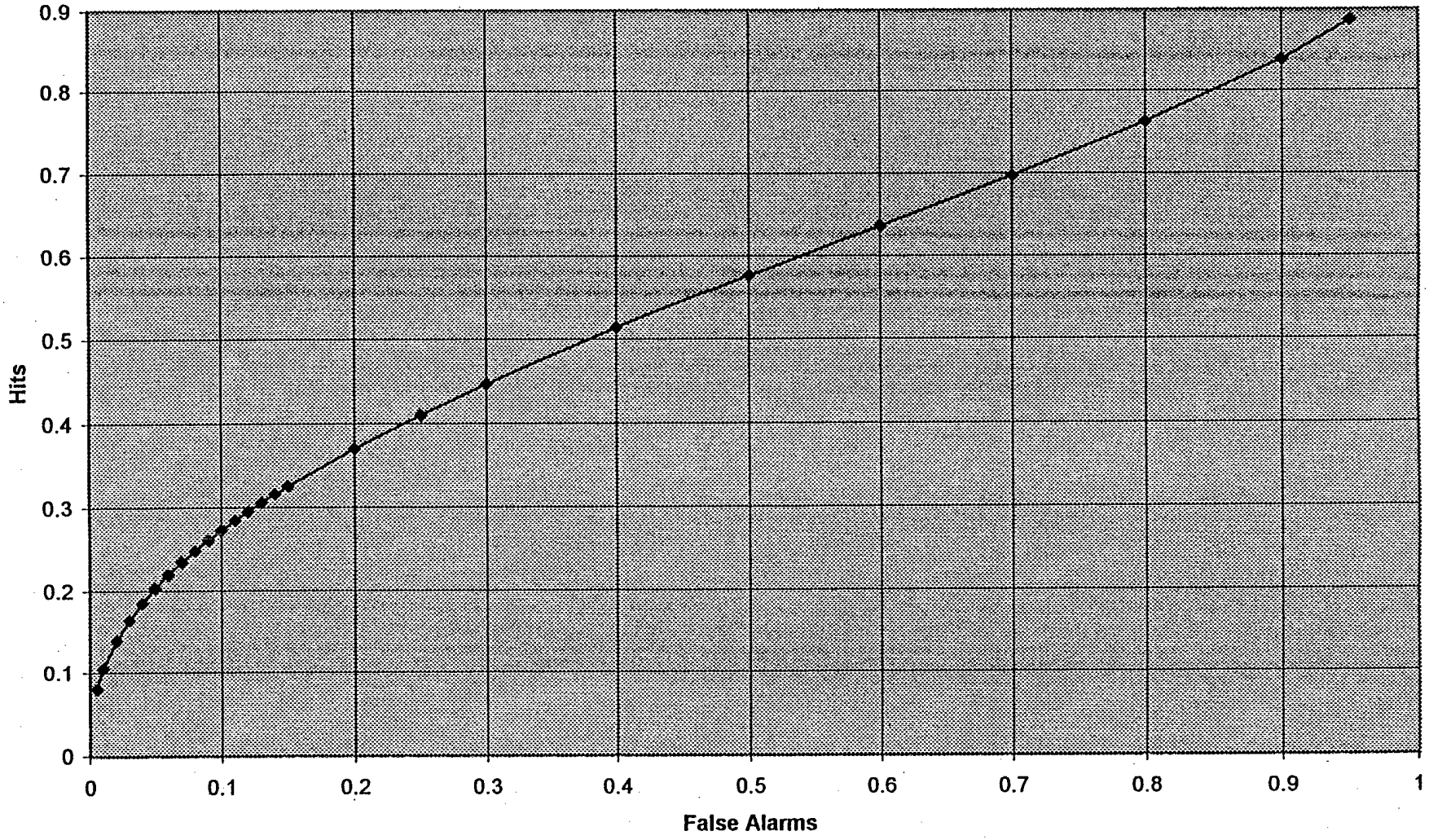
FPF	TPF	(LOWER BOUND,	UPPER BOUND)
.005	.5308	(.3372 ,	.7171)
.010	.5523	(.3762 ,	.7184)
.020	.5756	(.4187 ,	.7212)
.030	.5902	(.4450 ,	.7239)
.040	.6012	(.4642 ,	.7267)
.050	.6100	(.4792 ,	.7294)
.060	.6175	(.4916 ,	.7320)
.070	.6240	(.5020 ,	.7347)
.080	.6299	(.5110 ,	.7374)
.090	.6351	(.5189 ,	.7401)
.100	.6400	(.5258 ,	.7427)
.110	.6444	(.5321 ,	.7454)
.120	.6486	(.5376 ,	.7481)
.130	.6525	(.5427 ,	.7508)
.140	.6562	(.5473 ,	.7534)
.150	.6597	(.5515 ,	.7561)
.200	.6751	(.5680 ,	.7693)
.250	.6880	(.5795 ,	.7823)
.300	.6995	(.5878 ,	.7950)
.400	.7196	(.5988 ,	.8195)
.500	.7378	(.6054 ,	.8428)
.600	.7554	(.6096 ,	.8654)
.700	.7735	(.6121 ,	.8881)
.800	.7937	(.6132 ,	.9117)
.900	.8199	(.6127 ,	.9387)
.950	.8399	(.6111 ,	.9560)

ESTIMATES OF EXPECTED OPERATING POINTS ON FITTED ROC

CURVE, WITH LOWER AND UPPER BOUNDS OF ASYMMETRIC 95%
CONFIDENCE INTERVAL ALONG THE CURVE FOR THOSE POINTS:

EXPECTED OPERATING POINT (FPF , TPF)	LOWER BOUND (FPF , TPF)	UPPER BOUND (FPF , TPF)
(.1241, .6502)	(.0855, .6328)	(.1736, .6673)
(.1611, .6634)	(.1172, .6475)	(.2146, .6790)
(.1737, .6674)	(.1282, .6518)	(.2284, .6826)
(.2498, .6879)	(.1957, .6739)	(.3108, .7018)

Do you want to use data from a previously created input file for the next run?
(Y/N, or Q to quit)
Stop - Program terminated.


Reader 02 Analog ROC: Type=FAD N=400 Area=.5649 STD Area=.0362
Hits
False Alarms
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1

```
Do you want to use data from a previously created input file for the
next run?
(Y/N, or Q to quit)
enter INPUT file name:
Do you want to save an output file for plotting the ROC curve?
(Y/N, or R to restart)
                                                              DATE -
11/ 3/1998
                                                            TIME -
10:39:20
              R O C F I T  (IBM VERSION 1.2) :

    M A X I M U M   L I K E L I H O O D   E S T I M A T I O N
         O F   A   B I N O R M A L   R O C   C U R V E
               F R O M   R A T I N G   D A T A


     DATA DESCRIPTION: Reader 02 Analog FAD resp for 296 cases available

     DATA COLLECTED IN  5 CATEGORIES
     WITH CATEGORY  5 REPRESENTING STRONGEST EVIDENCE OF POSITIVITY
     (E.G., THAT ABNORMALITY IS PRESENT).

     NO. OF ACTUALLY NEGATIVE CASES =  270.
     NO. OF ACTUALLY POSITIVE CASES =   26.

     RESPONSE DATA:
      CATEGORY                    1      2      3      4      5
      ACTUALLY NEGATIVE CASES   153.    48.    15.    22.    32.
      ACTUALLY POSITIVE CASES     4.     2.     4.     5.    11.

     OBSERVED OPERATING POINTS:
      FPF:  .000  .119  .200  .256  .433 1.000
      TPF:  .000  .423  .615  .769  .846 1.000

           INITIAL VALUES OF PARAMETERS:
     A=  1.3239    B=  1.2078
     Z(K)=   .168   .657   .841  1.183
     LOGL=  -375.9875
     CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
      BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.

     PROCEDURE CONVERGES AFTER   4 ITERATIONS.

           FINAL VALUES OF PARAMETERS:
     A=  1.3336    B=  1.2586
     Z(K)=   .171   .637   .842  1.191
     LOGL=  -375.7867
     CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
      BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.

           VARIANCE-COVARIANCE MATRIX:
     A       .1254   .0888   .0078   .0065   .0052   .0018
     B       .0888   .1135   .0032  -.0003  -.0028  -.0087
```

Z(1)	.0078	.0032	.0059	.0043	.0038	.0032
Z(2)	.0065	-.0003	.0043	.0066	.0059	.0051
Z(3)	.0052	-.0028	.0038	.0059	.0073	.0064
Z(4)	.0018	-.0087	.0032	.0051	.0064	.0098

CORRELATION MATRIX:

A	1.0000	.7447	.2857	.2258	.1704	.0501
B	.7447	1.0000	.1252	-.0093	-.0969	-.2591
Z(1)	.2857	.1252	1.0000	.6971	.5856	.4163
Z(2)	.2258	-.0093	.6971	1.0000	.8519	.6345
Z(3)	.1704	-.0969	.5856	.8519	1.0000	.7562
Z(4)	.0501	-.2591	.4163	.6345	.7562	1.0000

AREA = .7966 STD. DEV.(AREA) = .0423

ESTIMATED BINORMAL ROC CURVE, WITH LOWER AND UPPER BOUNDS ON ASYMMETRIC 95% CONFIDENCE INTERVAL FOR TRUE-POSITIVE FRACTION AT EACH SPECIFIED FALSE-POSITIVE FRACTION:

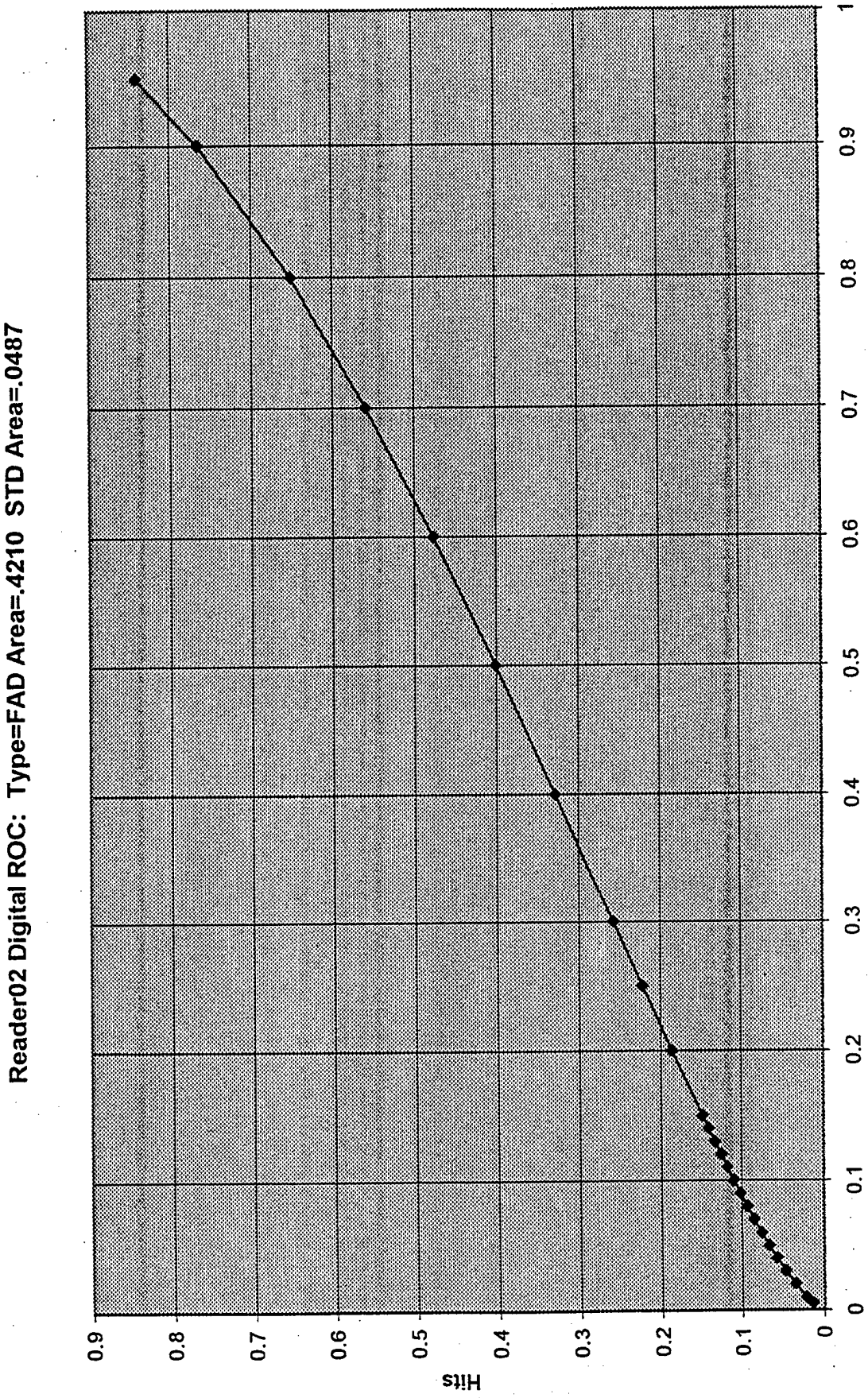
FPF	TPF	(LOWER BOUND,	UPPER BOUND)
.005	.0281	(.0007 ,	.2619)
.010	.0554	(.0033 ,	.3173)
.020	.1053	(.0135 ,	.3847)
.030	.1505	(.0291 ,	.4311)
.040	.1921	(.0485 ,	.4678)
.050	.2305	(.0706 ,	.4988)
.060	.2664	(.0947 ,	.5260)
.070	.3001	(.1199 ,	.5505)
.080	.3317	(.1459 ,	.5730)
.090	.3616	(.1721 ,	.5940)
.100	.3899	(.1982 ,	.6136)
.110	.4167	(.2241 ,	.6323)
.120	.4422	(.2495 ,	.6500)
.130	.4665	(.2743 ,	.6670)
.140	.4896	(.2983 ,	.6833)
.150	.5116	(.3215 ,	.6991)
.200	.6082	(.4245 ,	.7702)
.250	.6862	(.5065 ,	.8299)
.300	.7499	(.5715 ,	.8786)
.400	.8450	(.6681 ,	.9447)
.500	.9088	(.7388 ,	.9787)
.600	.9507	(.7956 ,	.9934)
.700	.9769	(.8447 ,	.9985)
.800	.9916	(.8896 ,	.9998)
.900	.9984	(.9341 ,	1.0000)
.950	.9997	(.9587 ,	1.0000)

ESTIMATES OF EXPECTED OPERATING POINTS ON FITTED ROC CURVE, WITH LOWER AND UPPER BOUNDS OF ASYMMETRIC 95%

CONFIDENCE INTERVAL ALONG THE CURVE FOR THOSE POINTS:

EXPECTED OPERATING POINT (FPF , TPF)	LOWER BOUND (FPF , TPF)	UPPER BOUND (FPF , TPF)
(.1169, .4346)	(.0831, .3412)	(.1596, .5318)
(.2000, .6081)	(.1564, .5251)	(.2502, .6864)
(.2621, .7026)	(.2131, .6300)	(.3163, .7679)
(.4323, .8684)	(.3742, .8238)	(.4919, .9046)

Do you want to use data from a previously created input file for the next run?
(Y/N, or Q to quit)
Stop - Program terminated.


Reader02 Digital ROC: Type=FAD Area=.4210 STD Area=.0487
Hits
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
False Alarms
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1

40

```
Do you want to use data from a previously created input file for the
next run?
(Y/N, or Q to quit)
enter INPUT file name:
Do you want to save an output file for plotting the ROC curve?
(Y/N, or R to restart)
                                                              DATE -
11/ 3/1998
                                                            TIME -
10:39:20
              R O C F I T  (IBM VERSION 1.2) :

    M A X I M U M   L I K E L I H O O D   E S T I M A T I O N
         O F   A   B I N O R M A L   R O C   C U R V E
               F R O M   R A T I N G   D A T A


     DATA DESCRIPTION: Reader 02 Digital FAD resp for 296 cases
available

     DATA COLLECTED IN  5 CATEGORIES
     WITH CATEGORY  5 REPRESENTING STRONGEST EVIDENCE OF POSITIVITY
     (E.G., THAT ABNORMALITY IS PRESENT).

     NO. OF ACTUALLY NEGATIVE CASES =  270.
     NO. OF ACTUALLY POSITIVE CASES =   26.

     RESPONSE DATA:
      CATEGORY                    1      2      3      4      5
      ACTUALLY NEGATIVE CASES   135.    44.    35.    23.    33.
      ACTUALLY POSITIVE CASES     8.     7.     4.     2.     5.

     OBSERVED OPERATING POINTS:
      FPF:  .000  .122  .207  .337  .500 1.000
      TPF:  .000  .192  .269  .423  .692 1.000

            INITIAL VALUES OF PARAMETERS:
     A=    .4108     B=  1.1749
     Z(K)=    .000    .420    .815  1.164
     LOGL=  -411.1221
     CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
      BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.

     PROCEDURE CONVERGES AFTER   4 ITERATIONS.

            FINAL VALUES OF PARAMETERS:
     A=    .4477     B=  1.2104
     Z(K)=  -.003    .434    .823  1.154
     LOGL=  -411.0256
     CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
      BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.


            VARIANCE-COVARIANCE MATRIX:
     A        .0710    .0409    .0069    .0057    .0043    .0030
```

B	.0409	.0857	.0032	-.0001	-.0036	-.0067
Z(1)	.0069	.0032	.0058	.0043	.0034	.0028
Z(2)	.0057	-.0001	.0043	.0061	.0049	.0042
Z(3)	.0043	-.0036	.0034	.0049	.0073	.0064
Z(4)	.0030	-.0067	.0028	.0042	.0064	.0095

CORRELATION MATRIX:

A	1.0000	.5250	.3392	.2762	.1905	.1150
B	.5250	1.0000	.1452	-.0043	-.1442	-.2359
Z(1)	.3392	.1452	1.0000	.7201	.5163	.3744
Z(2)	.2762	-.0043	.7201	1.0000	.7378	.5567
Z(3)	.1905	-.1442	.5163	.7378	1.0000	.7657
Z(4)	.1150	-.2359	.3744	.5567	.7657	1.0000

AREA = .6122 STD. DEV.(AREA) = .0583

ESTIMATED BINORMAL ROC CURVE, WITH LOWER AND UPPER BOUNDS ON ASYMMETRIC 95% CONFIDENCE INTERVAL FOR TRUE-POSITIVE FRACTION AT EACH SPECIFIED FALSE-POSITIVE FRACTION:

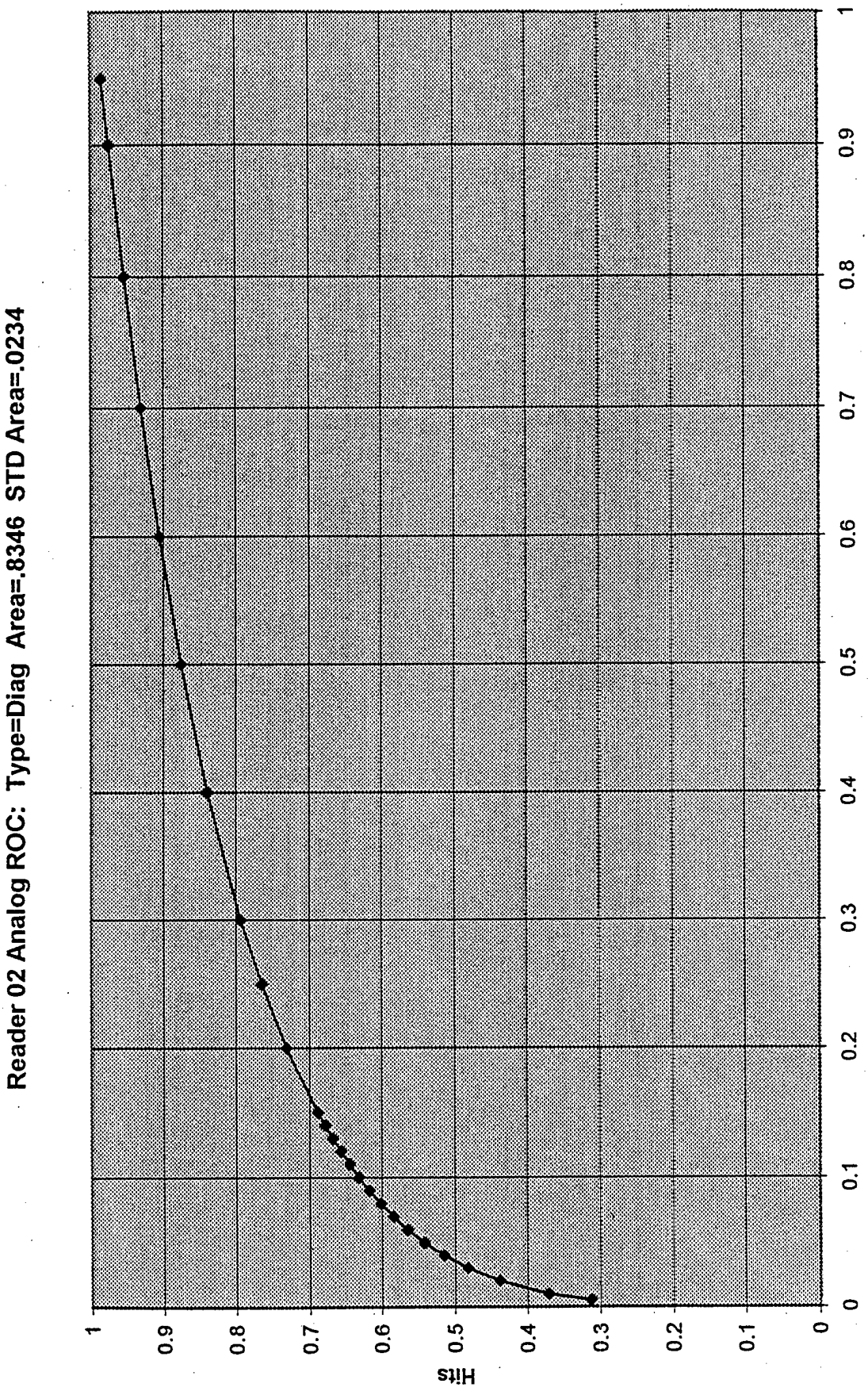
FPF	TPF	(LOWER BOUND,	UPPER BOUND)
.005	.0038	(.0000 ,	.0826)
.010	.0089	(.0002 ,	.1115)
.020	.0207	(.0012 ,	.1512)
.030	.0337	(.0030 ,	.1814)
.040	.0473	(.0058 ,	.2070)
.050	.0613	(.0095 ,	.2296)
.060	.0757	(.0141 ,	.2503)
.070	.0903	(.0195 ,	.2695)
.080	.1050	(.0258 ,	.2877)
.090	.1199	(.0328 ,	.3050)
.100	.1348	(.0406 ,	.3216)
.110	.1498	(.0489 ,	.3376)
.120	.1649	(.0579 ,	.3532)
.130	.1799	(.0674 ,	.3684)
.140	.1949	(.0774 ,	.3832)
.150	.2099	(.0878 ,	.3978)
.200	.2841	(.1442 ,	.4682)
.250	.3563	(.2042 ,	.5359)
.300	.4260	(.2638 ,	.6020)
.400	.5563	(.3740 ,	.7272)
.500	.6728	(.4703 ,	.8339)
.600	.7745	(.5568 ,	.9138)
.700	.8604	(.6389 ,	.9647)
.800	.9287	(.7219 ,	.9905)
.900	.9772	(.8149 ,	.9990)
.950	.9926	(.8734 ,	.9999)

ESTIMATES OF EXPECTED OPERATING POINTS ON FITTED ROC

CURVE, WITH LOWER AND UPPER BOUNDS OF ASYMMETRIC 95%
CONFIDENCE INTERVAL ALONG THE CURVE FOR THOSE POINTS:

EXPECTED OPERATING POINT (FPF , TPF)	LOWER BOUND (FPF , TPF)	UPPER BOUND (FPF , TPF)
(.1243, .1714)	(.0894, .1190)	(.1679, .2365)
(.2052, .2917)	(.1610, .2263)	(.2560, .3647)
(.3322, .4692)	(.2788, .3967)	(.3893, .5427)
(.5013, .6742)	(.4419, .6067)	(.5607, .7365)

Do you want to use data from a previously created input file for the next run?
(Y/N, or Q to quit)
Stop - Program terminated.


Reader 02 Analog ROC: Type=Diag Area=.8346 STD Area=.0234
Hits
False Alarms
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1

```
Do you want to use data from a previously created input file for the
next run?
(Y/N, or Q to quit)
enter INPUT file name:
Do you want to save an output file for plotting the ROC curve?
(Y/N, or R to restart)
                                                                DATE -
11/ 3/1998
                                                              TIME -
10:39:20
              R O C F I T  (IBM VERSION 1.2) :

    M A X I M U M   L I K E L I H O O D   E S T I M A T I O N
         O F   A   B I N O R M A L   R O C   C U R V E
               F R O M   R A T I N G   D A T A


     DATA DESCRIPTION: Reader 02 Analog Diag resp for 296 cases
available

     DATA COLLECTED IN  5 CATEGORIES
     WITH CATEGORY  5 REPRESENTING STRONGEST EVIDENCE OF POSITIVITY
     (E.G., THAT ABNORMALITY IS PRESENT).

     NO. OF ACTUALLY NEGATIVE CASES =  215.
     NO. OF ACTUALLY POSITIVE CASES =   81.

     RESPONSE DATA:
      CATEGORY                    1      2      3      4      5
      ACTUALLY NEGATIVE CASES    25.    79.    99.    12.     0.
      ACTUALLY POSITIVE CASES     0.     5.    41.    25.    10.

     OBSERVED OPERATING POINTS:
      FPF:  .000  .000  .056  .516  .884 1.000
      TPF:  .000  .123  .432  .938 1.000 1.000

            INITIAL VALUES OF PARAMETERS:
     A=  1.4189    B=   .9291
     Z(K)= -1.194  -.041  1.591  2.831
     LOGL=  -338.0848
     CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
      BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.

     PROCEDURE CONVERGES AFTER   5 ITERATIONS.

            FINAL VALUES OF PARAMETERS:
     A=  1.4837    B=   .9945
     Z(K)= -1.203  -.040  1.625  2.707
     LOGL=  -337.7247
     CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
      BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.


            VARIANCE-COVARIANCE MATRIX:
     A       .0452   .0185   .0042   .0063   .0057  -.0075
```

B	.0185	.0184	.0018	.0019	-.0070	-.0251
Z(1)	.0042	.0018	.0125	.0037	.0013	-.0003
Z(2)	.0063	.0019	.0037	.0072	.0030	.0012
Z(3)	.0057	-.0070	.0013	.0030	.0187	.0235
Z(4)	-.0075	-.0251	-.0003	.0012	.0235	.0726

CORRELATION MATRIX:

A	1.0000	.6406	.1766	.3476	.1971	-.1309
B	.6406	1.0000	.1160	.1637	-.3791	-.6859
Z(1)	.1766	.1160	1.0000	.3877	.0855	-.0113
Z(2)	.3476	.1637	.3877	1.0000	.2611	.0542
Z(3)	.1971	-.3791	.0855	.2611	1.0000	.6371
Z(4)	-.1309	-.6859	-.0113	.0542	.6371	1.0000

AREA = .8536 STD. DEV.(AREA) = .0272

ESTIMATED BINORMAL ROC CURVE, WITH LOWER AND UPPER BOUNDS ON ASYMMETRIC 95% CONFIDENCE INTERVAL FOR TRUE-POSITIVE FRACTION AT EACH SPECIFIED FALSE-POSITIVE FRACTION:

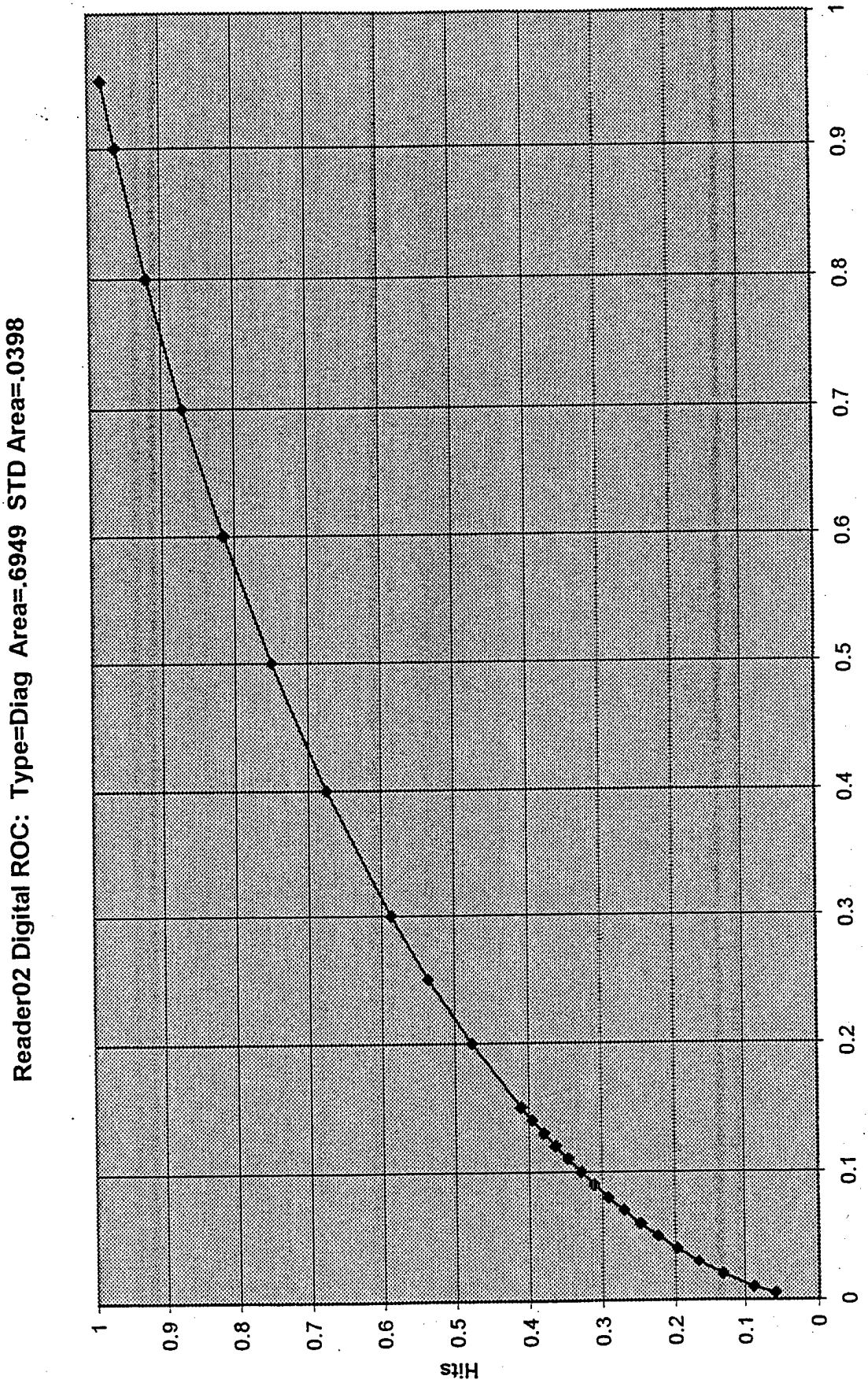
FPF	TPF	(LOWER BOUND,	UPPER BOUND)
.005	.1405	(.0543 ,	.2906)
.010	.2032	(.0958 ,	.3615)
.020	.2880	(.1626 ,	.4466)
.030	.3493	(.2167 ,	.5036)
.040	.3983	(.2629 ,	.5474)
.050	.4394	(.3032 ,	.5833)
.060	.4750	(.3391 ,	.6138)
.070	.5063	(.3714 ,	.6404)
.080	.5343	(.4008 ,	.6641)
.090	.5597	(.4277 ,	.6853)
.100	.5828	(.4525 ,	.7046)
.110	.6040	(.4754 ,	.7222)
.120	.6237	(.4967 ,	.7384)
.130	.6419	(.5166 ,	.7534)
.140	.6588	(.5353 ,	.7673)
.150	.6747	(.5528 ,	.7803)
.200	.7412	(.6270 ,	.8340)
.250	.7920	(.6849 ,	.8739)
.300	.8321	(.7317 ,	.9044)
.400	.8911	(.8037 ,	.9462)
.500	.9311	(.8570 ,	.9713)
.600	.9587	(.8984 ,	.9860)
.700	.9775	(.9315 ,	.9942)
.800	.9898	(.9586 ,	.9982)
.900	.9971	(.9808 ,	.9997)
.950	.9991	(.9905 ,	1.0000)

ESTIMATES OF EXPECTED OPERATING POINTS ON FITTED ROC

CURVE, WITH LOWER AND UPPER BOUNDS OF ASYMMETRIC 95%
CONFIDENCE INTERVAL ALONG THE CURVE FOR THOSE POINTS:

EXPECTED OPERATING POINT (FPF , TPF)	LOWER BOUND (FPF , TPF)	UPPER BOUND (FPF , TPF)
(.0034, .1135)	(.0006, .0415)	(.0147, .2474)
(.0521, .4473)	(.0292, .3449)	(.0874, .5533)
(.5159, .9361)	(.4497, .9128)	(.5816, .9543)
(.8855, .9963)	(.8375, .9931)	(.9225, .9981)

Do you want to use data from a previously created input file for the next run?
(Y/N, or Q to quit)
Stop - Program terminated.


Reader02 Digital ROC: Type=Diag Area=.6949 STD Area=.0398
Hits
False Alarms
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1

```
Do you want to use data from a previously created input file for the
next run?
(Y/N, or Q to quit)
enter INPUT file name:
Do you want to save an output file for plotting the ROC curve?
(Y/N, or R to restart)
                                                              DATE -
11/ 3/1998
                                                            TIME -
10:39:20
              R O C F I T  (IBM VERSION 1.2) :

    M A X I M U M   L I K E L I H O O D   E S T I M A T I O N
         O F   A   B I N O R M A L   R O C   C U R V E
               F R O M   R A T I N G   D A T A


     DATA DESCRIPTION: Reader 02 Digital Diag resp for 296 cases
available

     DATA COLLECTED IN  5 CATEGORIES
     WITH CATEGORY  5 REPRESENTING STRONGEST EVIDENCE OF POSITIVITY
     (E.G., THAT ABNORMALITY IS PRESENT).

     NO. OF ACTUALLY NEGATIVE CASES =  215.
     NO. OF ACTUALLY POSITIVE CASES =   81.

     RESPONSE DATA:
      CATEGORY                      1      2      3      4      5
      ACTUALLY NEGATIVE CASES     19.    81.    92.    19.     4.
      ACTUALLY POSITIVE CASES      0.    10.    31.    26.    14.

     OBSERVED OPERATING POINTS:
      FPF:   .000   .019   .107   .535   .912 1.000
      TPF:   .000   .173   .494   .877 1.000 1.000

            INITIAL VALUES OF PARAMETERS:
     A=  1.1416     B=    .9873
     Z(K)= -1.351   -.087   1.243   2.084
     LOGL=  -371.1523
     CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
      BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.

     PROCEDURE CONVERGES AFTER   4 ITERATIONS.

            FINAL VALUES OF PARAMETERS:
     A=  1.1635     B=    .9946
     Z(K)= -1.365   -.072   1.217   2.110
     LOGL=  -370.9608
     CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
      BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.


            VARIANCE-COVARIANCE MATRIX:
     A         .0323    .0127    .0043    .0060    .0055    .0008
```

B	.0127	.0158	.0022	.0018	-.0035	-.0130
Z(1)	.0043	.0022	.0145	.0036	.0015	.0001
Z(2)	.0060	.0018	.0036	.0071	.0035	.0021
Z(3)	.0055	-.0035	.0015	.0035	.0116	.0118
Z(4)	.0008	-.0130	.0001	.0021	.0118	.0327

CORRELATION MATRIX:

A	1.0000	.5613	.1988	.3937	.2843	.0257
B	.5613	1.0000	.1433	.1724	-.2617	-.5733
Z(1)	.1988	.1433	1.0000	.3532	.1166	.0067
Z(2)	.3937	.1724	.3532	1.0000	.3836	.1393
Z(3)	.2843	-.2617	.1166	.3836	1.0000	.6077
Z(4)	.0257	-.5733	.0067	.1393	.6077	1.0000

AREA = .7953 STD. DEV.(AREA) = .0305

ESTIMATED BINORMAL ROC CURVE, WITH LOWER AND UPPER BOUNDS ON ASYMMETRIC 95% CONFIDENCE INTERVAL FOR TRUE-POSITIVE FRACTION AT EACH SPECIFIED FALSE-POSITIVE FRACTION:

FPF	TPF	(LOWER BOUND,	UPPER BOUND)
.005	.0809	(.0272 ,	.1910)
.010	.1249	(.0520 ,	.2496)
.020	.1895	(.0962 ,	.3243)
.030	.2396	(.1353 ,	.3770)
.040	.2816	(.1707 ,	.4189)
.050	.3182	(.2031 ,	.4541)
.060	.3508	(.2332 ,	.4849)
.070	.3803	(.2611 ,	.5122)
.080	.4074	(.2873 ,	.5369)
.090	.4324	(.3119 ,	.5596)
.100	.4557	(.3351 ,	.5805)
.110	.4774	(.3571 ,	.5999)
.120	.4979	(.3780 ,	.6180)
.130	.5172	(.3978 ,	.6351)
.140	.5354	(.4167 ,	.6511)
.150	.5528	(.4347 ,	.6663)
.200	.6280	(.5139 ,	.7318)
.250	.6890	(.5791 ,	.7841)
.300	.7397	(.6341 ,	.8269)
.400	.8191	(.7225 ,	.8913)
.500	.8777	(.7914 ,	.9352)
.600	.9215	(.8472 ,	.9645)
.700	.9540	(.8937 ,	.9831)
.800	.9773	(.9334 ,	.9938)
.900	.9926	(.9677 ,	.9988)
.950	.9974	(.9834 ,	.9997)

ESTIMATES OF EXPECTED OPERATING POINTS ON FITTED ROC

CURVE, WITH LOWER AND UPPER BOUNDS OF ASYMMETRIC 95%
CONFIDENCE INTERVAL ALONG THE CURVE FOR THOSE POINTS:

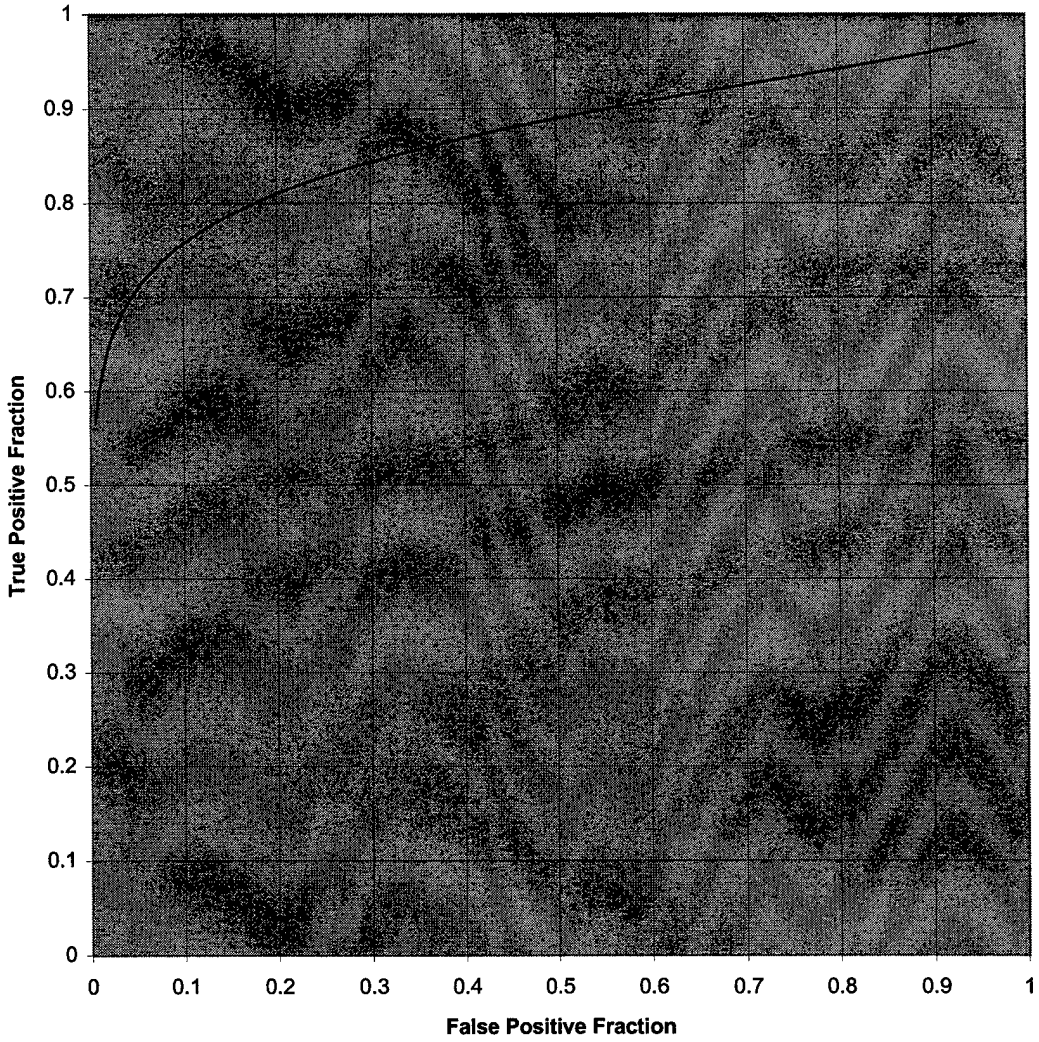
EXPECTED OPERATING POINT (FPF , TPF)	LOWER BOUND (FPF , TPF)	UPPER BOUND (FPF , TPF)
(.0174, .1748)	(.0069, .0989)	(.0396, .2800)
(.1118, .4813)	(.0767, .3987)	(.1573, .5648)
(.5288, .8917)	(.4629, .8579)	(.5940, .9192)
(.9139, .9942)	(.8705, .9889)	(.9453, .9971)

Do you want to use data from a previously created input file for the next run?
(Y/N, or Q to quit)
Stop - Program terminated.

Reader_03 Analog

Totals	Type	Ground Truth, Mass	Ground Truth, uCa	Ground Truth, FAD	Ground Truth, Diag
Total Normal	173	280	253	307	240
Total Abnormal	156	49	76	22	89
	Resp = 1	Resp = 2	Resp = 3	Resp = 4	Resp = 5
Resp, Mass, N	175	71	5	20	9
Resp, Mass, A	7	3	1	5	33
Resp, Ca, N	215	21	4	3	10
Resp, Ca, A	23	0	1	5	47
Resp, FAD, N	190	46	1	42	28
Resp, FAD, A	7	2	2	7	4
Resp, Diag, B	125	74	27	13	1
Resp, Diag, M	13	17	19	22	18

Reader 03 analog ROC Type=mass N=329 Area=.8717 STD Area=.0419



```
Do you want to use data from a previously created input file for the
next run?
(Y/N, or Q to quit)
enter INPUT file name:
Do you want to save an output file for plotting the ROC curve?
(Y/N, or R to restart)
                                                                DATE -
11/ 3/1998
                                                              TIME -
12:21: 6
              R O C F I T  (IBM VERSION 1.2) :

    M A X I M U M   L I K E L I H O O D   E S T I M A T I O N
         O F   A   B I N O R M A L   R O C   C U R V E
               F R O M   R A T I N G   D A T A


     DATA DESCRIPTION: Reader 03 Analog Mass resp for 329 cases
available

     DATA COLLECTED IN  5 CATEGORIES
     WITH CATEGORY  5 REPRESENTING STRONGEST EVIDENCE OF POSITIVITY
     (E.G., THAT ABNORMALITY IS PRESENT).

     NO. OF ACTUALLY NEGATIVE CASES =  280.
     NO. OF ACTUALLY POSITIVE CASES =   49.

     RESPONSE DATA:
      CATEGORY                    1      2      3      4      5
      ACTUALLY NEGATIVE CASES   175.    71.     5.    20.     9.
      ACTUALLY POSITIVE CASES     7.     3.     1.     5.    33.

     OBSERVED OPERATING POINTS:
      FPF:  .000  .032  .104  .121  .375 1.000
      TPF:  .000  .673  .776  .796  .857 1.000

            INITIAL VALUES OF PARAMETERS:
     A=  1.2298    B=   .3955
     Z(K)=   .318  1.168  1.262  1.851
     LOGL=  -334.4240
     CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
      BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.

     PROCEDURE CONVERGES AFTER   4 ITERATIONS.

            FINAL VALUES OF PARAMETERS:
     A=  1.2248    B=   .4116
     Z(K)=   .320  1.154  1.255  1.869
     LOGL=  -334.3403
     CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
      BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.


            VARIANCE-COVARIANCE MATRIX:
     A        .0627   .0224   .0026   .0017   .0015  -.0014
     B        .0224   .0169   .0008  -.0007  -.0011  -.0054
     Z( 1)    .0026   .0008   .0058   .0036   .0034   .0026
     Z( 2)    .0017  -.0007   .0036   .0090   .0086   .0071
     Z( 3)    .0015  -.0011   .0034   .0086   .0099   .0082
     Z( 4)   -.0014  -.0054   .0026   .0071   .0082   .0214

            CORRELATION MATRIX:
     A       1.0000   .6880   .1362   .0713   .0592  -.0388
```

B	.6880	1.0000	.0845	-.0581	-.0830	-.2826
Z(1)	.1362	.0845	1.0000	.4970	.4519	.2297
Z(2)	.0713	-.0581	.4970	1.0000	.9149	.5114
Z(3)	.0592	-.0830	.4519	.9149	1.0000	.5627
Z(4)	-.0388	-.2826	.2297	.5114	.5627	1.0000

AREA = .8713 STD. DEV.(AREA) = .0419

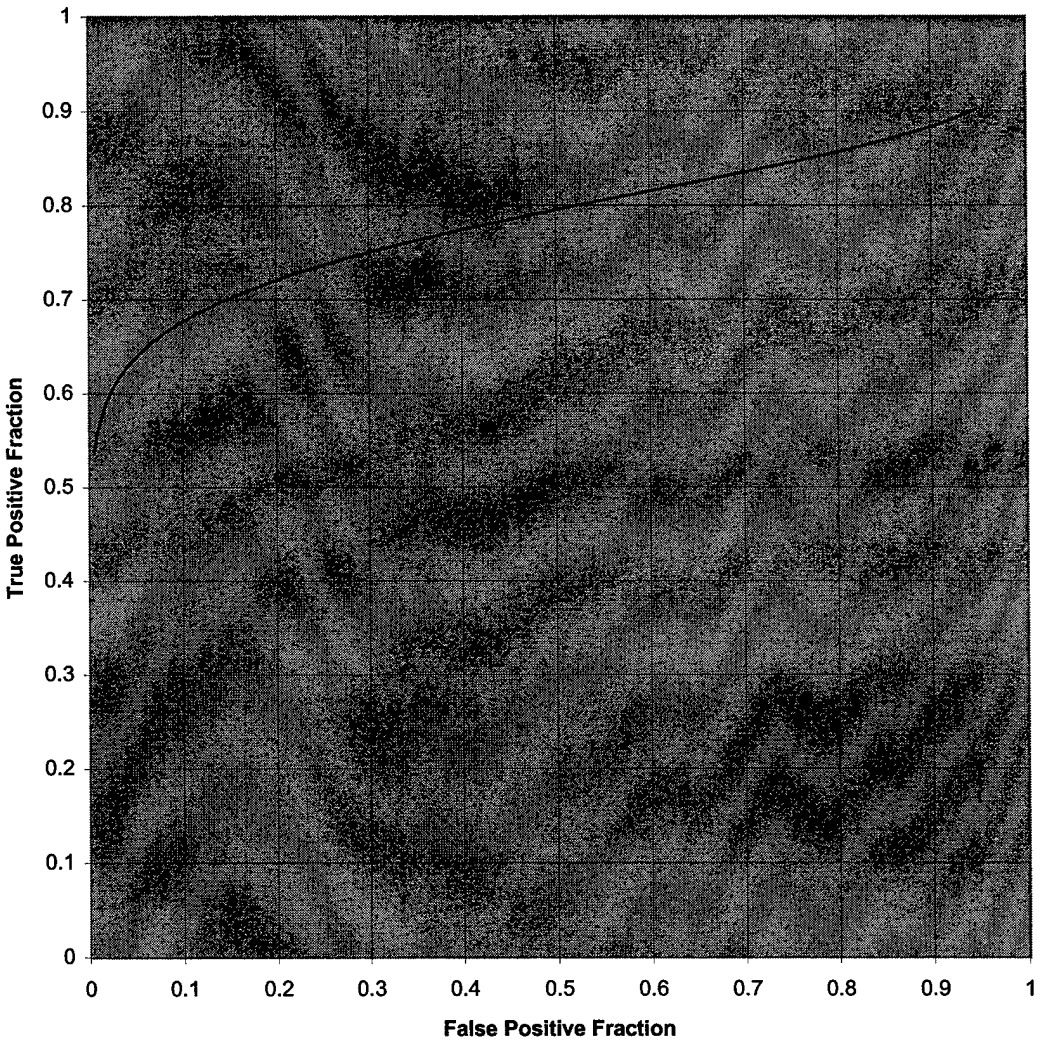
ESTIMATED BINORMAL ROC CURVE, WITH LOWER AND UPPER BOUNDS ON ASYMMETRIC 95% CONFIDENCE INTERVAL FOR TRUE-POSITIVE FRACTION AT EACH SPECIFIED FALSE-POSITIVE FRACTION:

FPF	TPF	(LOWER BOUND,	UPPER BOUND)
.005	.5653	(.3771 ,	.7396)
.010	.6053	(.4322 ,	.7596)
.020	.6478	(.4912 ,	.7825)
.030	.6738	(.5269 ,	.7978)
.040	.6929	(.5525 ,	.8096)
.050	.7080	(.5723 ,	.8194)
.060	.7206	(.5885 ,	.8279)
.070	.7315	(.6022 ,	.8354)
.080	.7410	(.6139 ,	.8421)
.090	.7495	(.6242 ,	.8483)
.100	.7572	(.6334 ,	.8540)
.110	.7642	(.6416 ,	.8593)
.120	.7707	(.6491 ,	.8642)
.130	.7767	(.6559 ,	.8689)
.140	.7824	(.6622 ,	.8733)
.150	.7876	(.6680 ,	.8774)
.200	.8102	(.6920 ,	.8954)
.250	.8283	(.7103 ,	.9100)
.300	.8436	(.7252 ,	.9222)
.400	.8688	(.7491 ,	.9418)
.500	.8897	(.7685 ,	.9569)
.600	.9081	(.7857 ,	.9690)
.700	.9251	(.8023 ,	.9789)
.800	.9419	(.8197 ,	.9871)
.900	.9601	(.8411 ,	.9939)
.950	.9714	(.8567 ,	.9969)

ESTIMATES OF EXPECTED OPERATING POINTS ON FITTED ROC CURVE, WITH LOWER AND UPPER BOUNDS OF ASYMMETRIC 95% CONFIDENCE INTERVAL ALONG THE CURVE FOR THOSE POINTS:

EXPECTED OPERATING POINT (FPF , TPF)	LOWER BOUND (FPF , TPF)	UPPER BOUND (FPF , TPF)
(.0308, .6757)	(.0156, .6322)	(.0568, .7169)
(.1048, .7606)	(.0736, .7350)	(.1446, .7848)
(.1243, .7733)	(.0901, .7496)	(.1666, .7957)
(.3744, .8628)	(.3192, .8488)	(.4322, .8759)

Do you want to use data from a previously created input file for the next run?
(Y/N, or Q to quit)
Stop - Program terminated.


Reader 03 analog ROC Type=calc N=329 Area=.7862 STD Area=.0584
True Positive Fraction
False Positive Fraction
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1

```
Do you want to use data from a previously created input file for the
next run?
(Y/N, or Q to quit)
enter INPUT file name:
Do you want to save an output file for plotting the ROC curve?
(Y/N, or R to restart)
                                                                DATE -
11/ 3/1998
                                                              TIME -
12:21: 7
              R O C F I T  (IBM VERSION 1.2) :

    M A X I M U M   L I K E L I H O O D   E S T I M A T I O N
         O F   A   B I N O R M A L   R O C   C U R V E
               F R O M   R A T I N G   D A T A


     DATA DESCRIPTION: Reader 03 Analog Calc resp for 329 cases
available

     DATA COLLECTED IN  5 CATEGORIES
     WITH CATEGORY  5 REPRESENTING STRONGEST EVIDENCE OF POSITIVITY
     (E.G., THAT ABNORMALITY IS PRESENT).

     NO. OF ACTUALLY NEGATIVE CASES =  253.
     NO. OF ACTUALLY POSITIVE CASES =   76.

     RESPONSE DATA:
      CATEGORY                      1      2      3      4      5
      ACTUALLY NEGATIVE CASES    215.    21.     4.     3.    10.
      ACTUALLY POSITIVE CASES     23.     0.     1.     5.    47.

     OBSERVED OPERATING POINTS:
      FPF:   .000  .040  .051  .067  .150 1.000
      TPF:   .000  .618  .684  .697  .697 1.000

            INITIAL VALUES OF PARAMETERS:
     A=  1.0242     B=    .3688
     Z(K)=  1.036  1.497  1.632  1.757
     LOGL=  -225.3118
     CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
      BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.

     PROCEDURE CONVERGES AFTER   5 ITERATIONS.

            FINAL VALUES OF PARAMETERS:
     A=    .8249     B=    .2857
     Z(K)=  1.039  1.434  1.566  1.813
     LOGL=  -223.2512
     CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
      BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.


            VARIANCE-COVARIANCE MATRIX:
     A        .0521    .0214    .0037    .0007   -.0007   -.0042
     B        .0214    .0148    .0010   -.0015   -.0027   -.0058
     Z( 1)    .0037    .0010    .0093    .0077    .0073    .0065
     Z( 2)    .0007   -.0015    .0077    .0131    .0126    .0120
     Z( 3)   -.0007   -.0027    .0073    .0126    .0153    .0148
     Z( 4)   -.0042   -.0058    .0065    .0120    .0148    .0220

            CORRELATION MATRIX:
     A       1.0000    .7704    .1685    .0266   -.0249   -.1240
```

B	.7704	1.0000	.0869	-.1098	-.1816	-.3196
Z(1)	.1685	.0869	1.0000	.6994	.6089	.4564
Z(2)	.0266	-.1098	.6994	1.0000	.8892	.7062
Z(3)	-.0249	-.1816	.6089	.8892	1.0000	.8039
Z(4)	-.1240	-.3196	.4564	.7062	.8039	1.0000

AREA = .7862 STD. DEV.(AREA) = .0584

ESTIMATED BINORMAL ROC CURVE, WITH LOWER AND UPPER BOUNDS ON ASYMMETRIC 95% CONFIDENCE INTERVAL FOR TRUE-POSITIVE FRACTION AT EACH SPECIFIED FALSE-POSITIVE FRACTION:

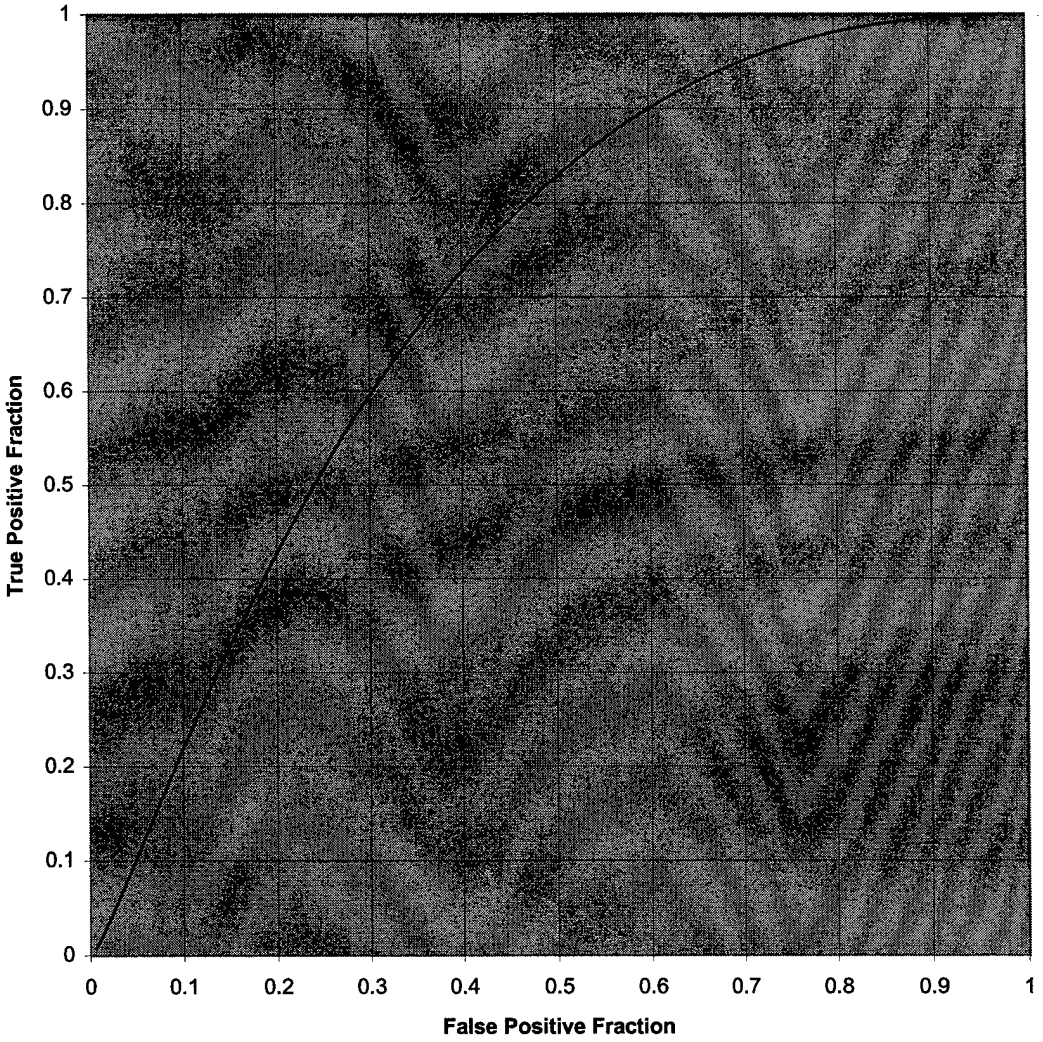
FPF	TPF	(LOWER BOUND,	UPPER BOUND)
.005	.5354	(.3808 ,	.6848)
.010	.5636	(.4231 ,	.6964)
.020	.5941	(.4674 ,	.7115)
.030	.6131	(.4936 ,	.7227)
.040	.6273	(.5121 ,	.7320)
.050	.6386	(.5262 ,	.7402)
.060	.6482	(.5375 ,	.7476)
.070	.6566	(.5469 ,	.7544)
.080	.6640	(.5549 ,	.7608)
.090	.6707	(.5618 ,	.7667)
.100	.6768	(.5678 ,	.7724)
.110	.6824	(.5732 ,	.7777)
.120	.6876	(.5780 ,	.7828)
.130	.6925	(.5823 ,	.7877)
.140	.6971	(.5863 ,	.7923)
.150	.7015	(.5899 ,	.7968)
.200	.7205	(.6044 ,	.8170)
.250	.7364	(.6152 ,	.8344)
.300	.7502	(.6236 ,	.8497)
.400	.7742	(.6368 ,	.8760)
.500	.7953	(.6471 ,	.8984)
.600	.8152	(.6561 ,	.9181)
.700	.8351	(.6646 ,	.9362)
.800	.8566	(.6736 ,	.9536)
.900	.8832	(.6848 ,	.9714)
.950	.9023	(.6932 ,	.9815)

ESTIMATES OF EXPECTED OPERATING POINTS ON FITTED ROC CURVE, WITH LOWER AND UPPER BOUNDS OF ASYMMETRIC 95% CONFIDENCE INTERVAL ALONG THE CURVE FOR THOSE POINTS:

EXPECTED OPERATING POINT (FPF , TPF)	LOWER BOUND (FPF , TPF)	UPPER BOUND (FPF , TPF)
(.0349, .6206)	(.0177, .5886)	(.0640, .6518)
(.0586, .6470)	(.0352, .6210)	(.0928, .6725)
(.0758, .6610)	(.0486, .6373)	(.1132, .6841)
(.1493, .7012)	(.1097, .6822)	(.1976, .7197)

Do you want to use data from a previously created input file for the next run?
(Y/N, or Q to quit)
Stop - Program terminated.

Reader 03 analog ROC Type=fad N=329 Area=.7318 STD Area=.0547



```
Do you want to use data from a previously created input file for the
next run?
(Y/N, or Q to quit)
enter INPUT file name:
Do you want to save an output file for plotting the ROC curve?
(Y/N, or R to restart)
                                                                DATE -
11/ 3/1998
                                                              TIME -
12:21: 7
              R O C F I T  (IBM VERSION 1.2) :

    M A X I M U M   L I K E L I H O O D   E S T I M A T I O N
         O F   A   B I N O R M A L   R O C   C U R V E
               F R O M   R A T I N G   D A T A


     DATA DESCRIPTION: Reader 03 Analog FAD resp for 329 cases available

     DATA COLLECTED IN  5 CATEGORIES
     WITH CATEGORY  5 REPRESENTING STRONGEST EVIDENCE OF POSITIVITY
     (E.G., THAT ABNORMALITY IS PRESENT).

     NO. OF ACTUALLY NEGATIVE CASES =  307.
     NO. OF ACTUALLY POSITIVE CASES =   22.

     RESPONSE DATA:
      CATEGORY                    1      2      3      4      5
      ACTUALLY NEGATIVE CASES   190.    46.     1.    42.    28.
      ACTUALLY POSITIVE CASES     7.     2.     2.     7.     4.

     OBSERVED OPERATING POINTS:
      FPF:  .000  .091  .228  .231  .381 1.000
      TPF:  .000  .182  .500  .591  .682 1.000

           INITIAL VALUES OF PARAMETERS:
     A=  1.0184    B=  1.3739
     Z(K)=   .302   .734   .745  1.334
     LOGL=  -372.1085
     CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
      BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.

     PROCEDURE CONVERGES AFTER   4 ITERATIONS.

           FINAL VALUES OF PARAMETERS:
     A=   .9435    B=  1.3392
     Z(K)=   .305   .712   .741  1.341
     LOGL=  -370.9217
     CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
      BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.


           VARIANCE-COVARIANCE MATRIX:
     A       .1309   .0930   .0079   .0059   .0057   .0007
     B       .0930   .1248   .0031  -.0007  -.0010  -.0091
     Z( 1)   .0079   .0031   .0053   .0041   .0040   .0029
     Z( 2)   .0059  -.0007   .0041   .0060   .0059   .0046
     Z( 3)   .0057  -.0010   .0040   .0059   .0061   .0047
     Z( 4)   .0007  -.0091   .0029   .0046   .0047   .0100

           CORRELATION MATRIX:
     A      1.0000   .7279   .3011   .2114   .2032   .0188
     B       .7279  1.0000   .1200  -.0257  -.0373  -.2570
```

Z(1)	.3011	.1200	1.0000	.7277	.7105	.4008
Z(2)	.2114	-.0257	.7277	1.0000	.9779	.5860
Z(3)	.2032	-.0373	.7105	.9779	1.0000	.6010
Z(4)	.0188	-.2570	.4008	.5860	.6010	1.0000

AREA = .7138 STD. DEV.(AREA) = .0547

ESTIMATED BINORMAL ROC CURVE, WITH LOWER AND UPPER BOUNDS ON ASYMMETRIC 95% CONFIDENCE INTERVAL FOR TRUE-POSITIVE FRACTION AT EACH SPECIFIED FALSE-POSITIVE FRACTION:

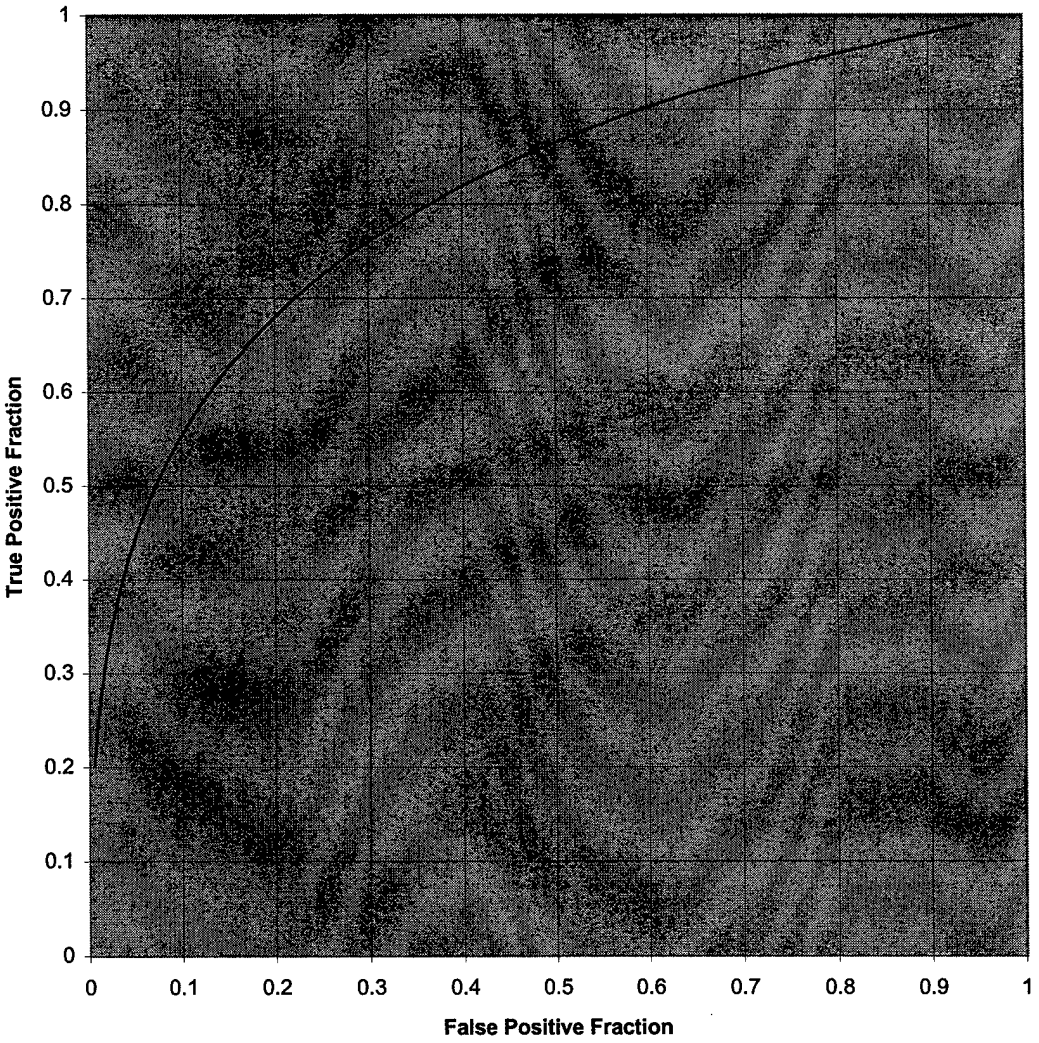
FPF	TPF	(LOWER BOUND,	UPPER BOUND)
.005	.0061	(.0001 ,	.1253)
.010	.0149	(.0004 ,	.1649)
.020	.0353	(.0023 ,	.2179)
.030	.0575	(.0062 ,	.2574)
.040	.0805	(.0122 ,	.2904)
.050	.1039	(.0202 ,	.3193)
.060	.1273	(.0300 ,	.3457)
.070	.1507	(.0414 ,	.3701)
.080	.1740	(.0542 ,	.3931)
.090	.1970	(.0681 ,	.4149)
.100	.2197	(.0830 ,	.4360)
.110	.2422	(.0987 ,	.4563)
.120	.2643	(.1150 ,	.4760)
.130	.2860	(.1317 ,	.4953)
.140	.3074	(.1487 ,	.5141)
.150	.3283	(.1658 ,	.5326)
.200	.4272	(.2501 ,	.6207)
.250	.5162	(.3270 ,	.7017)
.300	.5955	(.3943 ,	.7739)
.400	.7273	(.5043 ,	.8847)
.500	.8273	(.5926 ,	.9508)
.600	.9001	(.6689 ,	.9833)
.700	.9500	(.7391 ,	.9960)
.800	.9808	(.8075 ,	.9995)
.900	.9961	(.8799 ,	1.0000)
.950	.9992	(.9224 ,	1.0000)

ESTIMATES OF EXPECTED OPERATING POINTS ON FITTED ROC CURVE, WITH LOWER AND UPPER BOUNDS OF ASYMMETRIC 95% CONFIDENCE INTERVAL ALONG THE CURVE FOR THOSE POINTS:

EXPECTED OPERATING POINT (FPF , TPF)	LOWER BOUND (FPF , TPF)	UPPER BOUND (FPF , TPF)
(.0900, .1970)	(.0621, .1323)	(.1262, .2778)
(.2294, .4805)	(.1857, .3999)	(.2783, .5620)
(.2381, .4958)	(.1937, .4153)	(.2876, .5765)
(.3803, .7038)	(.3273, .6347)	(.4356, .7662)

Do you want to use data from a previously created input file for the next run?
(Y/N, or Q to quit)
Stop - Program terminated.

Reader 03 analog ROC Type=diag N=329 Area=.8105 STD Area=.0307



```
Do you want to use data from a previously created input file for the
next run?
(Y/N, or Q to quit)
enter INPUT file name:
Do you want to save an output file for plotting the ROC curve?
(Y/N, or R to restart)
                                                              DATE -
11/ 3/1998
                                                            TIME -
12:21: 7
              R O C F I T  (IBM VERSION 1.2) :

    M A X I M U M   L I K E L I H O O D   E S T I M A T I O N
         O F   A   B I N O R M A L   R O C   C U R V E
               F R O M   R A T I N G   D A T A


     DATA DESCRIPTION: Reader 03 Analog Diag resp for 329 cases
available

     DATA COLLECTED IN  5 CATEGORIES
     WITH CATEGORY  5 REPRESENTING STRONGEST EVIDENCE OF POSITIVITY
     (E.G., THAT ABNORMALITY IS PRESENT).

     NO. OF ACTUALLY NEGATIVE CASES =  240.
     NO. OF ACTUALLY POSITIVE CASES =   89.

     RESPONSE DATA:
      CATEGORY                    1      2      3      4      5
      ACTUALLY NEGATIVE CASES   125.    74.    27.    13.     1.
      ACTUALLY POSITIVE CASES    13.    17.    19.    22.    18.

     OBSERVED OPERATING POINTS:
      FPF:  .000  .004  .058  .171  .479 1.000
      TPF:  .000  .202  .449  .663  .854 1.000

            INITIAL VALUES OF PARAMETERS:
     A=  1.0887    B=   .7372
     Z(K)=   .052   .951  1.569  2.639
     LOGL=  -413.4673
     CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
      BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.

     PROCEDURE CONVERGES AFTER   4 ITERATIONS.

            FINAL VALUES OF PARAMETERS:
     A=  1.1018    B=   .7541
     Z(K)=   .053   .940  1.599  2.573
     LOGL=  -413.2282
     CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
      BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.


            VARIANCE-COVARIANCE MATRIX:
     A       .0295   .0120   .0047   .0040   .0018  -.0067
     B       .0120   .0120   .0016  -.0008  -.0050  -.0178
     Z( 1)   .0047   .0016   .0065   .0038   .0027   .0010
     Z( 2)   .0040  -.0008   .0038   .0083   .0070   .0073
     Z( 3)   .0018  -.0050   .0027   .0070   .0154   .0184
     Z( 4)  -.0067  -.0178   .0010   .0073   .0184   .0591

            CORRELATION MATRIX:
     A      1.0000   .6383   .3413   .2531   .0846  -.1610
```

B	.6383	1.0000	.1823	-.0772	-.3656	-.6665
Z(1)	.3413	.1823	1.0000	.5214	.2702	.0492
Z(2)	.2531	-.0772	.5214	1.0000	.6220	.3268
Z(3)	.0846	-.3656	.2702	.6220	1.0000	.6120
Z(4)	-.1610	-.6665	.0492	.3268	.6120	1.0000

AREA = .8105 STD. DEV.(AREA) = .0307

ESTIMATED BINORMAL ROC CURVE, WITH LOWER AND UPPER BOUNDS ON ASYMMETRIC 95% CONFIDENCE INTERVAL FOR TRUE-POSITIVE FRACTION AT EACH SPECIFIED FALSE-POSITIVE FRACTION:

FPF	TPF	(LOWER BOUND,	UPPER BOUND)
.005	.2002	(.1024 ,	.3394)
.010	.2569	(.1495 ,	.3947)
.020	.3273	(.2142 ,	.4591)
.030	.3757	(.2617 ,	.5018)
.040	.4134	(.3000 ,	.5346)
.050	.4448	(.3325 ,	.5617)
.060	.4717	(.3607 ,	.5850)
.070	.4955	(.3858 ,	.6055)
.080	.5168	(.4084 ,	.6239)
.090	.5361	(.4290 ,	.6406)
.100	.5538	(.4478 ,	.6560)
.110	.5701	(.4653 ,	.6703)
.120	.5854	(.4815 ,	.6836)
.130	.5996	(.4966 ,	.6961)
.140	.6130	(.5108 ,	.7078)
.150	.6256	(.5242 ,	.7189)
.200	.6798	(.5815 ,	.7669)
.250	.7235	(.6273 ,	.8057)
.300	.7601	(.6656 ,	.8378)
.400	.8189	(.7277 ,	.8880)
.500	.8647	(.7778 ,	.9249)
.600	.9019	(.8208 ,	.9522)
.700	.9328	(.8597 ,	.9722)
.800	.9587	(.8967 ,	.9864)
.900	.9807	(.9349 ,	.9956)
.950	.9904	(.9570 ,	.9985)

ESTIMATES OF EXPECTED OPERATING POINTS ON FITTED ROC CURVE, WITH LOWER AND UPPER BOUNDS OF ASYMMETRIC 95% CONFIDENCE INTERVAL ALONG THE CURVE FOR THOSE POINTS:

EXPECTED OPERATING POINT (FPF , TPF)	LOWER BOUND (FPF , TPF)	UPPER BOUND (FPF , TPF)
(.0050, .2008)	(.0011, .1154)	(.0180, .3159)
(.0549, .4585)	(.0327, .3869)	(.0875, .5315)
(.1736, .6529)	(.1316, .6018)	(.2234, .7013)
(.4787, .8558)	(.4162, .8270)	(.5418, .8812)

Do you want to use data from a previously created input file for the next run?
(Y/N, or Q to quit)
Stop - Program terminated.

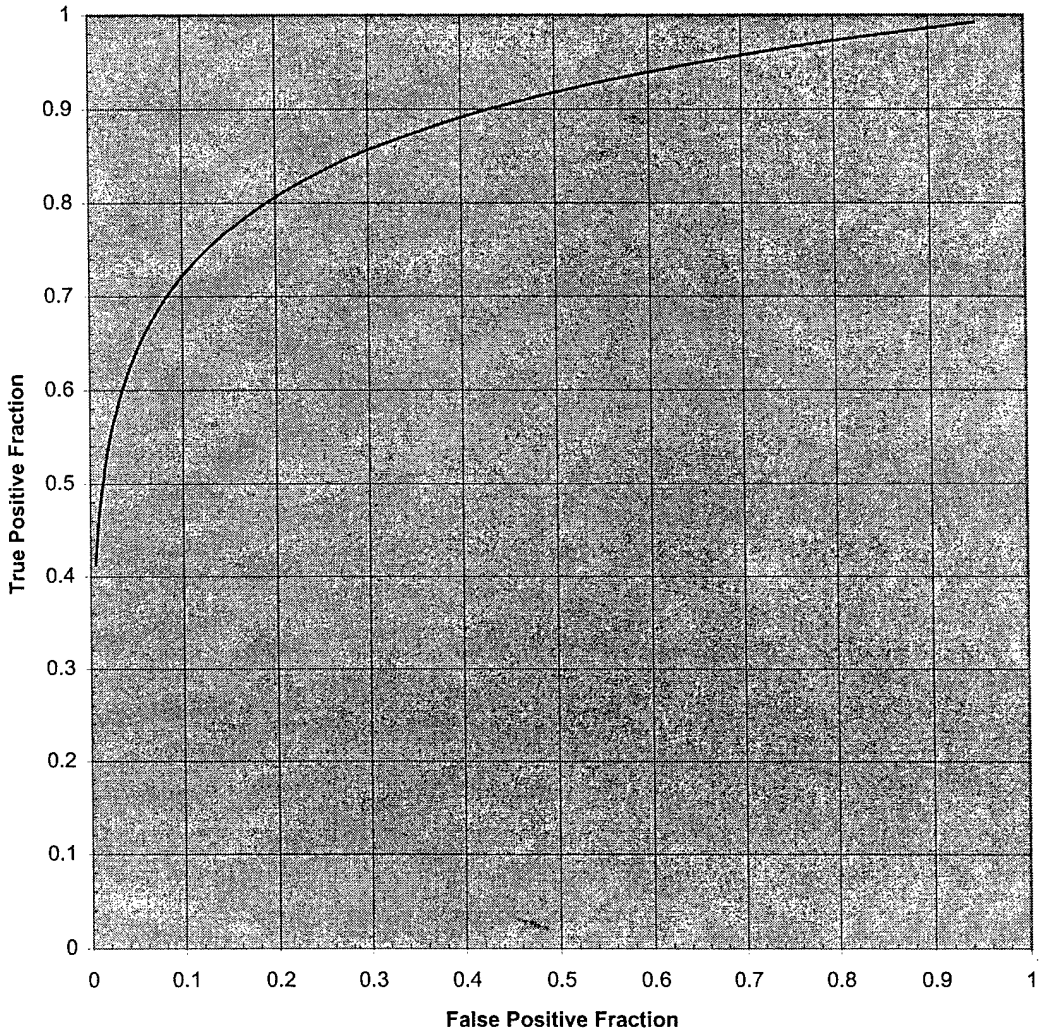
Reader 04_Analog (345 cases)

	Type	Ground Truth, Mass	Ground Truth, uCa	Ground Truth, FAD	Ground Truth, Diag
Total Normal	184	285	261	319	261
Total Abnormal	161	60	84	26	84
	Resp = 1	Resp = 2	Resp = 3	Resp = 4	Resp = 5
Resp, Mass, N	51	113	90	20	11
Resp, Mass, A	1	6	9	7	37
Resp, Ca, N	62	150	33	5	11
Resp, Ca, A	5	24	10	5	40
Resp, FAD, N	39	102	48	58	72
Resp, FAD, A	1	4	4	4	13
Resp, Diag, B	32	128	90	9	2
Resp, Diag, M	0	16	36	19	13

Reader04_Dg (345 cases)

Totals	Type	Ground Truth, Mass	Ground Truth, uCa	Ground Truth, FAD	Ground Truth, Diag
Total Normal	184	285	261	319	261
Total Abnormal	161	60	84	26	84
	Resp = 1	Resp = 2	Resp = 3	Resp = 4	Resp = 5
Resp, Mass, N	20	101	97	42	25
Resp, Mass, A	0	4	12	7	37
Resp, Ca, N	41	171	5	11	33
Resp, Ca, A	12	30	3	8	31
Resp, FAD, N	8	62	77	93	79
Resp, FAD, A	0	2	3	9	12
Resp, Diag, B	8	95	147	7	4
Resp, Diag, M	0	10	46	19	9

Reader04 Analog ROC Type=Mass N=345 Area=.8809 STD Area=.0290



```
Do you want to use data from a previously created input file for the
next run?
(Y/N, or Q to quit)
enter INPUT file name:
Do you want to save an output file for plotting the ROC curve?
(Y/N, or R to restart)
                                                              DATE -
8/16/1998
                                                              TIME - 13:
9: 7
                R O C F I T  (IBM VERSION 1.2) :

    M A X I M U M   L I K E L I H O O D   E S T I M A T I O N
         O F   A   B I N O R M A L   R O C   C U R V E
               F R O M   R A T I N G   D A T A


     DATA DESCRIPTION: Reader 04 Analog Mass for 345 cases currently
available

     DATA COLLECTED IN  5 CATEGORIES
     WITH CATEGORY  5 REPRESENTING STRONGEST EVIDENCE OF POSITIVITY
     (E.G., THAT ABNORMALITY IS PRESENT).

     NO. OF ACTUALLY NEGATIVE CASES =  285.
     NO. OF ACTUALLY POSITIVE CASES =   60.

     RESPONSE DATA:
      CATEGORY                    1      2      3      4      5
      ACTUALLY NEGATIVE CASES    51.   113.    90.    20.    11.
      ACTUALLY POSITIVE CASES     1.     6.     9.     7.    37.

     OBSERVED OPERATING POINTS:
      FPF:  .000  .039  .109  .425  .821 1.000
      TPF:  .000  .617  .733  .883  .983 1.000

           INITIAL VALUES OF PARAMETERS:
     A=  1.4413    B=   .6718
     Z(K)=  -.919   .190  1.233  1.768
     LOGL=  -453.2962
     CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
      BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.

     PROCEDURE CONVERGES AFTER   4 ITERATIONS.

           FINAL VALUES OF PARAMETERS:
     A=  1.3920    B=   .6270
     Z(K)=  -.924   .197  1.228  1.758
     LOGL=  -453.1865
     CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
      BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.


           VARIANCE-COVARIANCE MATRIX:
     A        .0445   .0165   .0024   .0027   .0026   .0011
     B        .0165   .0150   .0011   .0006  -.0015  -.0052
     Z( 1)    .0024   .0011   .0075   .0026   .0014   .0010
     Z( 2)    .0027   .0006   .0026   .0055   .0031   .0025
     Z( 3)    .0026  -.0015   .0014   .0031   .0094   .0082
     Z( 4)    .0011  -.0052   .0010   .0025   .0082   .0172

           CORRELATION MATRIX:
     A       1.0000   .6391   .1335   .1694   .1284   .0391
     B        .6391  1.0000   .1038   .0628  -.1301  -.3247
```

Z(1)	.1335	.1038	1.0000	.4097	.1681	.0837
Z(2)	.1694	.0628	.4097	1.0000	.4306	.2563
Z(3)	.1284	-.1301	.1681	.4306	1.0000	.6454
Z(4)	.0391	-.3247	.0837	.2563	.6454	1.0000

AREA = .8809 STD. DEV.(AREA) = .0290

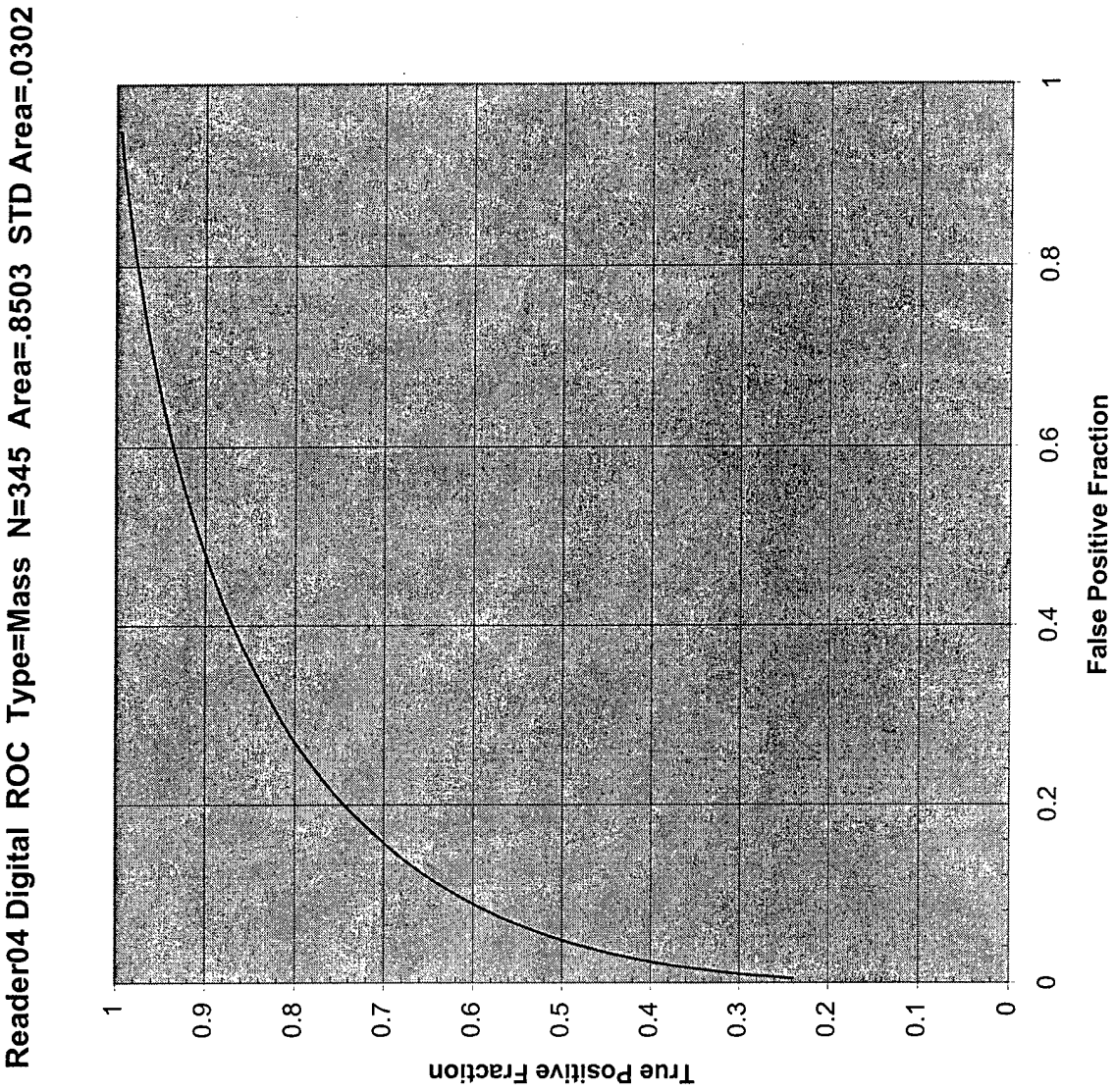
ESTIMATED BINORMAL ROC CURVE, WITH LOWER AND UPPER BOUNDS ON ASYMMETRIC 95% CONFIDENCE INTERVAL FOR TRUE-POSITIVE FRACTION AT EACH SPECIFIED FALSE-POSITIVE FRACTION:

FPF	TPF	(LOWER BOUND,	UPPER BOUND)
.005	.4116	(.2422 ,	.5997)
.010	.4733	(.3084 ,	.6429)
.020	.5414	(.3867 ,	.6900)
.030	.5841	(.4378 ,	.7196)
.040	.6156	(.4760 ,	.7416)
.050	.6407	(.5066 ,	.7593)
.060	.6616	(.5322 ,	.7743)
.070	.6796	(.5541 ,	.7873)
.080	.6953	(.5732 ,	.7987)
.090	.7093	(.5902 ,	.8090)
.100	.7219	(.6054 ,	.8184)
.110	.7333	(.6193 ,	.8270)
.120	.7438	(.6319 ,	.8349)
.130	.7536	(.6435 ,	.8422)
.140	.7626	(.6542 ,	.8491)
.150	.7710	(.6642 ,	.8555)
.200	.8063	(.7056 ,	.8827)
.250	.8338	(.7374 ,	.9038)
.300	.8562	(.7632 ,	.9208)
.400	.8913	(.8040 ,	.9464)
.500	.9180	(.8361 ,	.9645)
.600	.9395	(.8635 ,	.9775)
.700	.9573	(.8883 ,	.9869)
.800	.9726	(.9124 ,	.9935)
.900	.9859	(.9384 ,	.9978)
.950	.9923	(.9547 ,	.9992)

ESTIMATES OF EXPECTED OPERATING POINTS ON FITTED ROC CURVE, WITH LOWER AND UPPER BOUNDS OF ASYMMETRIC 95% CONFIDENCE INTERVAL ALONG THE CURVE FOR THOSE POINTS:

EXPECTED OPERATING POINT (FPF , TPF)	LOWER BOUND (FPF , TPF)	UPPER BOUND (FPF , TPF)
(.0393, .6139)	(.0219, .5510)	(.0667, .6739)
(.1098, .7331)	(.0782, .6926)	(.1496, .7707)
(.4218, .8976)	(.3658, .8804)	(.4793, .9130)
(.8223, .9757)	(.7746, .9689)	(.8631, .9812)

Do you want to use data from a previously created input file for the next run?
(Y/N, or Q to quit)
Stop - Program terminated.


Reader04 Digital ROC Type=Mass N=345 Area=.8503 STD Area=.0302
True Positive Fraction
False Positive Fraction
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0
0.2
0.4
0.6
0.8
1

```
Do you want to use data from a previously created input file for the
next run?
(Y/N, or Q to quit)
enter INPUT file name:
Do you want to save an output file for plotting the ROC curve?
(Y/N, or R to restart)
                                                              DATE -
8/16/1998
                                                              TIME -
13:13:21
                R O C F I T  (IBM VERSION 1.2) :

    M A X I M U M   L I K E L I H O O D   E S T I M A T I O N
         O F   A   B I N O R M A L   R O C   C U R V E
               F R O M   R A T I N G   D A T A


     DATA DESCRIPTION: Reader 04 Digital Mass resp for the 300 cases
available

      DATA COLLECTED IN  5 CATEGORIES
      WITH CATEGORY  5 REPRESENTING STRONGEST EVIDENCE OF POSITIVITY
      (E.G., THAT ABNORMALITY IS PRESENT).

      NO. OF ACTUALLY NEGATIVE CASES =  285.
      NO. OF ACTUALLY POSITIVE CASES =   60.

      RESPONSE DATA:
       CATEGORY                    1      2      3      4      5
       ACTUALLY NEGATIVE CASES    20.   101.    97.    42.    25.
       ACTUALLY POSITIVE CASES     0.     4.    12.     7.    37.

      OBSERVED OPERATING POINTS:
       FPF:  .000  .088  .235  .575  .930 1.000
       TPF:  .000  .617  .733  .933 1.000 1.000

            INITIAL VALUES OF PARAMETERS:
      A=  1.2825     B=    .7648
      Z(K)= -1.475  -.190   .722  1.355
      LOGL=  -468.1990
      CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
       BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.

      PROCEDURE CONVERGES AFTER   4 ITERATIONS.

            FINAL VALUES OF PARAMETERS:
      A=  1.3224     B=    .7901
      Z(K)= -1.484  -.190   .742  1.330
      LOGL=  -468.0175
      CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
       BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.


            VARIANCE-COVARIANCE MATRIX:
      A        .0418    .0185    .0027    .0033    .0034    .0023
      B        .0185    .0225    .0016    .0012   -.0007   -.0043
      Z( 1)    .0027    .0016    .0127    .0027    .0014    .0009
      Z( 2)    .0033    .0012    .0027    .0055    .0029    .0021
      Z( 3)    .0034   -.0007    .0014    .0029    .0065    .0052
      Z( 4)    .0023   -.0043    .0009    .0021    .0052    .0105

            CORRELATION MATRIX:
      A       1.0000    .6009    .1181    .2167    .2049    .1107
      B        .6009   1.0000    .0968    .1052   -.0579   -.2769
```

Z(1)	.1181	.0968	1.0000	.3287	.1557	.0769
Z(2)	.2167	.1052	.3287	1.0000	.4862	.2808
Z(3)	.2049	-.0579	.1557	.4862	1.0000	.6277
Z(4)	.1107	-.2769	.0769	.2808	.6277	1.0000

AREA = .8503 STD. DEV.(AREA) = .0302

ESTIMATED BINORMAL ROC CURVE, WITH LOWER AND UPPER BOUNDS ON ASYMMETRIC 95% CONFIDENCE INTERVAL FOR TRUE-POSITIVE FRACTION AT EACH SPECIFIED FALSE-POSITIVE FRACTION:

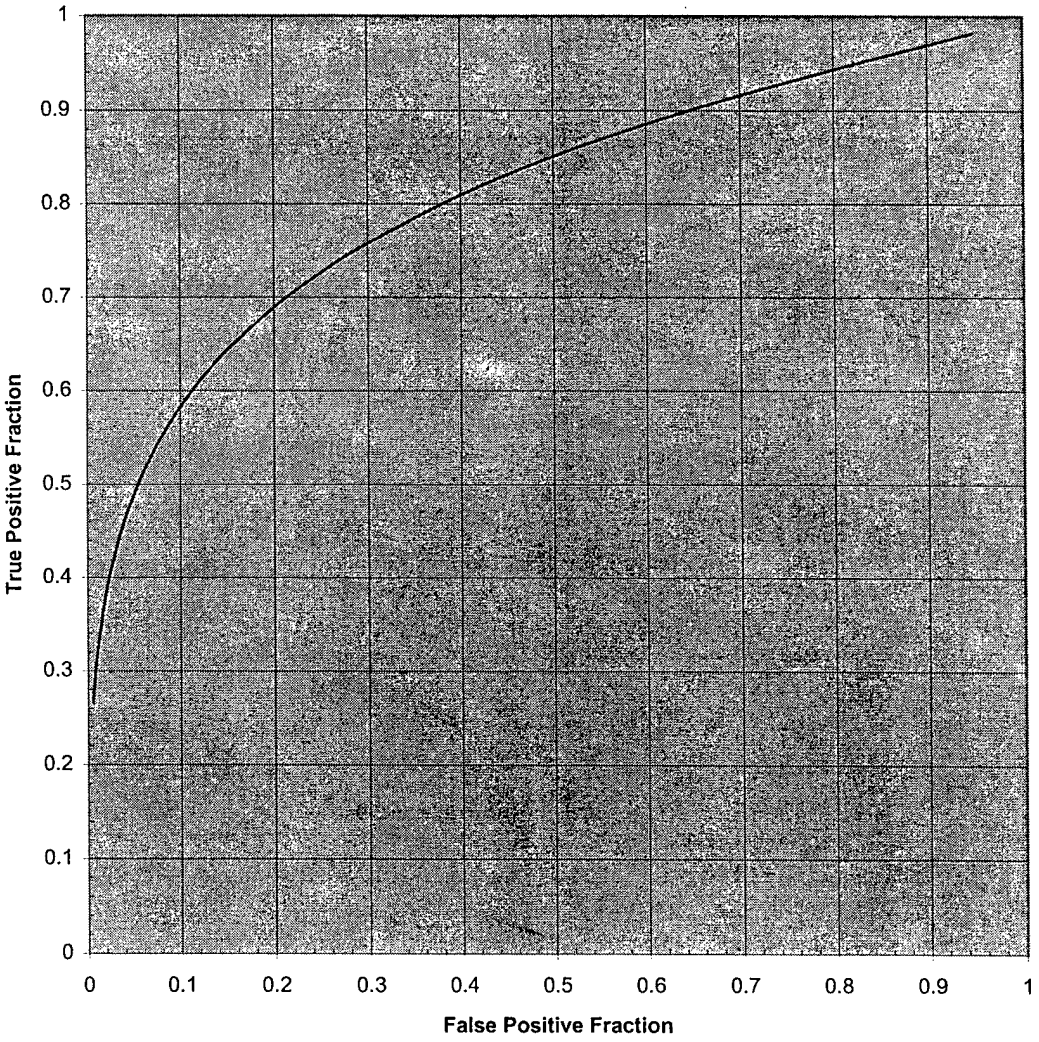
FPF	TPF	(LOWER BOUND,	UPPER BOUND)
.005	.2379	(.0932 ,	.4583)
.010	.3029	(.1438 ,	.5125)
.020	.3819	(.2161 ,	.5730)
.030	.4349	(.2704 ,	.6117)
.040	.4756	(.3146 ,	.6409)
.050	.5090	(.3521 ,	.6645)
.060	.5373	(.3847 ,	.6846)
.070	.5620	(.4137 ,	.7021)
.080	.5840	(.4396 ,	.7177)
.090	.6037	(.4632 ,	.7318)
.100	.6216	(.4847 ,	.7447)
.110	.6380	(.5044 ,	.7566)
.120	.6532	(.5227 ,	.7676)
.130	.6673	(.5396 ,	.7780)
.140	.6804	(.5554 ,	.7877)
.150	.6927	(.5702 ,	.7968)
.200	.7446	(.6320 ,	.8360)
.250	.7852	(.6796 ,	.8671)
.300	.8182	(.7179 ,	.8926)
.400	.8692	(.7768 ,	.9310)
.500	.9070	(.8216 ,	.9576)
.600	.9360	(.8583 ,	.9757)
.700	.9588	(.8902 ,	.9876)
.800	.9766	(.9197 ,	.9949)
.900	.9902	(.9494 ,	.9988)
.950	.9956	(.9664 ,	.9997)

ESTIMATES OF EXPECTED OPERATING POINTS ON FITTED ROC CURVE, WITH LOWER AND UPPER BOUNDS OF ASYMMETRIC 95% CONFIDENCE INTERVAL ALONG THE CURVE FOR THOSE POINTS:

EXPECTED OPERATING POINT (FPF , TPF)	LOWER BOUND (FPF , TPF)	UPPER BOUND (FPF , TPF)
(.0917, .6069)	(.0629, .5449)	(.1293, .6664)
(.2292, .7693)	(.1841, .7295)	(.2799, .8055)
(.5752, .9295)	(.5175, .9126)	(.6313, .9438)
(.9311, .9937)	(.8968, .9899)	(.9559, .9962)

Do you want to use data from a previously created input file for the next run?
(Y/N, or Q to quit)
Stop - Program terminated.

Reader04 Analog ROC Type=Calc N=345 Area=.8085 STD Area=.0319



```
Do you want to use data from a previously created input file for the
next run?
(Y/N, or Q to quit)
enter INPUT file name:
Do you want to save an output file for plotting the ROC curve?
(Y/N, or R to restart)
                                                              DATE -
8/16/1998
                                                          TIME - 13:
9:34
              R O C F I T  (IBM VERSION 1.2) :

    M A X I M U M   L I K E L I H O O D   E S T I M A T I O N
         O F   A   B I N O R M A L   R O C   C U R V E
               F R O M   R A T I N G   D A T A


     DATA DESCRIPTION: Reader 04 Analog Calc for 345 cases currently
available

      DATA COLLECTED IN  5 CATEGORIES
      WITH CATEGORY  5 REPRESENTING STRONGEST EVIDENCE OF POSITIVITY
      (E.G., THAT ABNORMALITY IS PRESENT).

      NO. OF ACTUALLY NEGATIVE CASES =  261.
      NO. OF ACTUALLY POSITIVE CASES =   84.

      RESPONSE DATA:
       CATEGORY                    1      2      3      4      5
       ACTUALLY NEGATIVE CASES    62.   150.    33.     5.    11.
       ACTUALLY POSITIVE CASES     5.    24.    10.     5.    40.

      OBSERVED OPERATING POINTS:
       FPF:  .000  .042  .061  .188  .762 1.000
       TPF:  .000  .476  .536  .655  .940 1.000

            INITIAL VALUES OF PARAMETERS:
      A=  1.0637    B=   .6587
      Z(K)=  -.714   .886  1.544  1.727
      LOGL=  -405.1970
      GOODNESS OF FIT --
      CHI SQUARE=    1.7163  WITH  2 DEGREES OF FREEDOM,   P=  .4239

      PROCEDURE CONVERGES AFTER   4 ITERATIONS.

            FINAL VALUES OF PARAMETERS:
      A=  1.0396    B=   .6483
      Z(K)=  -.720   .903  1.507  1.711
      LOGL=  -404.9319
      GOODNESS OF FIT --
      CHI SQUARE=    1.2423  WITH  2 DEGREES OF FREEDOM,   P=  .5373


            VARIANCE-COVARIANCE MATRIX:
      A       .0254   .0086   .0032   .0032   .0023   .0018
      B       .0086   .0097   .0015  -.0007  -.0035  -.0049
      Z( 1)   .0032   .0015   .0072   .0022   .0014   .0011
      Z( 2)   .0032  -.0007   .0022   .0078   .0065   .0063
      Z( 3)   .0023  -.0035   .0014   .0065   .0133   .0131
      Z( 4)   .0018  -.0049   .0011   .0063   .0131   .0169

            CORRELATION MATRIX:
      A      1.0000   .5453   .2340   .2253   .1276   .0865
      B       .5453  1.0000   .1783  -.0816  -.3069  -.3842
```

Z(1)	.2340	.1783	1.0000	.2879	.1424	.1017
Z(2)	.2253	-.0816	.2879	1.0000	.6357	.5459
Z(3)	.1276	-.3069	.1424	.6357	1.0000	.8723
Z(4)	.0865	-.3842	.1017	.5459	.8723	1.0000

AREA = .8085 STD. DEV.(AREA) = .0319

ESTIMATED BINORMAL ROC CURVE, WITH LOWER AND UPPER BOUNDS ON ASYMMETRIC 95% CONFIDENCE INTERVAL FOR TRUE-POSITIVE FRACTION AT EACH SPECIFIED FALSE-POSITIVE FRACTION:

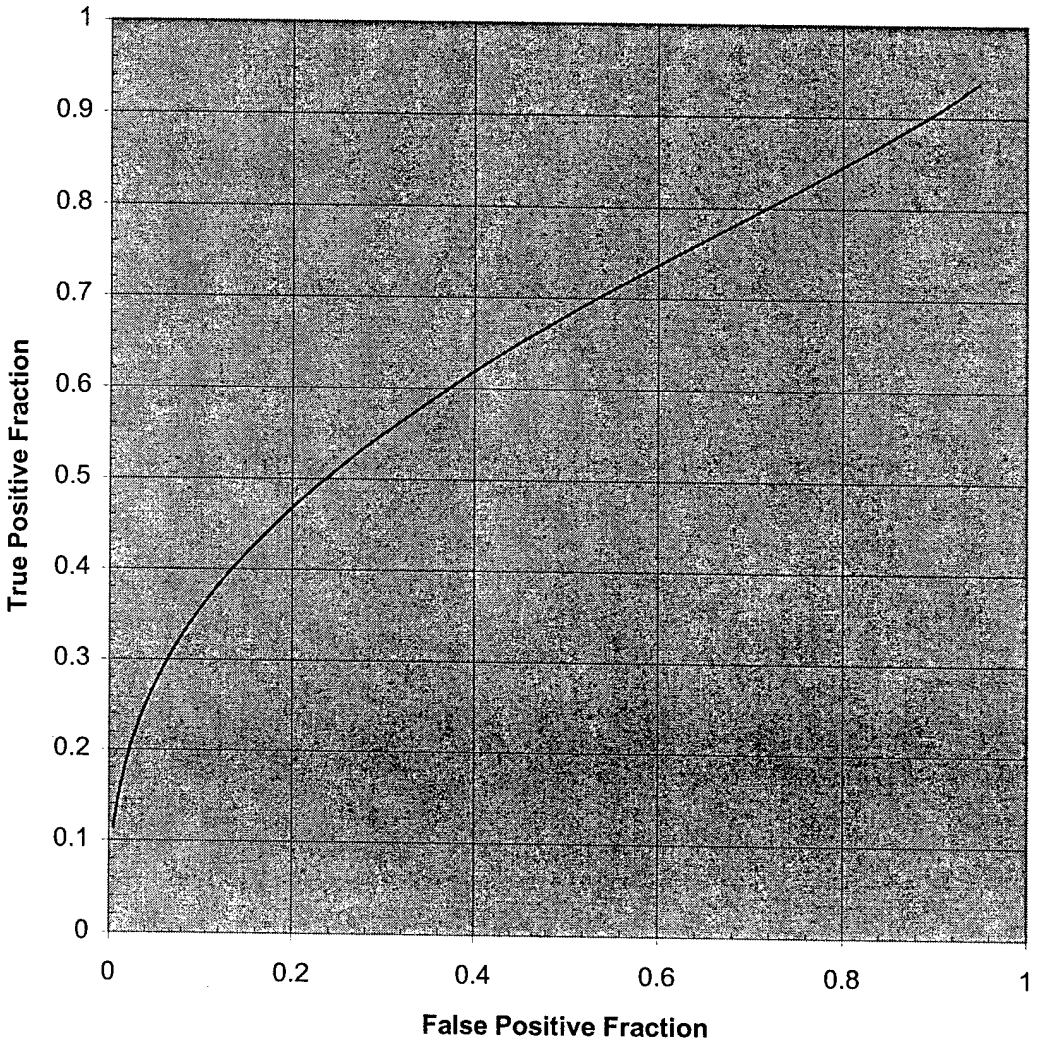
FPF	TPF	(LOWER BOUND,	UPPER BOUND)
.005	.2641	(.1468 ,	.4164)
.010	.3195	(.1971 ,	.4658)
.020	.3850	(.2615 ,	.5217)
.030	.4285	(.3065 ,	.5579)
.040	.4619	(.3420 ,	.5854)
.050	.4892	(.3715 ,	.6078)
.060	.5125	(.3969 ,	.6270)
.070	.5329	(.4193 ,	.6438)
.080	.5511	(.4394 ,	.6589)
.090	.5676	(.4576 ,	.6725)
.100	.5826	(.4742 ,	.6850)
.110	.5965	(.4896 ,	.6966)
.120	.6094	(.5038 ,	.7074)
.130	.6214	(.5171 ,	.7175)
.140	.6327	(.5296 ,	.7271)
.150	.6434	(.5414 ,	.7361)
.200	.6893	(.5917 ,	.7752)
.250	.7266	(.6321 ,	.8072)
.300	.7580	(.6660 ,	.8342)
.400	.8094	(.7213 ,	.8779)
.500	.8507	(.7664 ,	.9118)
.600	.8856	(.8056 ,	.9389)
.700	.9161	(.8418 ,	.9605)
.800	.9435	(.8772 ,	.9777)
.900	.9693	(.9157 ,	.9910)
.950	.9824	(.9396 ,	.9961)

ESTIMATES OF EXPECTED OPERATING POINTS ON FITTED ROC CURVE, WITH LOWER AND UPPER BOUNDS OF ASYMMETRIC 95% CONFIDENCE INTERVAL ALONG THE CURVE FOR THOSE POINTS:

EXPECTED OPERATING POINT (FPF , TPF)	LOWER BOUND (FPF , TPF)	UPPER BOUND (FPF , TPF)
(.0435, .4722)	(.0246, .4071)	(.0727, .5381)
(.0659, .5248)	(.0415, .4665)	(.1000, .5827)
(.1832, .6751)	(.1410, .6338)	(.2325, .7143)
(.7641, .9340)	(.7098, .9189)	(.8123, .9468)

Do you want to use data from a previously created input file for the next run?
(Y/N, or Q to quit)
Stop - Program terminated.

Reader04 Digital ROC Type=Calc N=345 Area=.6525 STD Area=.0404



```
Do you want to use data from a previously created input file for the
next run?
(Y/N, or Q to quit)
enter INPUT file name:
Do you want to save an output file for plotting the ROC curve?
(Y/N, or R to restart)
                                                              DATE -
8/16/1998
                                                            TIME -
13:13:44
              R O C F I T  (IBM VERSION 1.2) :

    M A X I M U M   L I K E L I H O O D   E S T I M A T I O N
         O F   A   B I N O R M A L   R O C   C U R V E
               F R O M   R A T I N G   D A T A


     DATA DESCRIPTION: Reader 04 Digital Calc for 345 cases currently
available

     DATA COLLECTED IN  5 CATEGORIES
     WITH CATEGORY  5 REPRESENTING STRONGEST EVIDENCE OF POSITIVITY
     (E.G., THAT ABNORMALITY IS PRESENT).

     NO. OF ACTUALLY NEGATIVE CASES =  261.
     NO. OF ACTUALLY POSITIVE CASES =   84.

     RESPONSE DATA:
      CATEGORY                    1      2      3      4      5
      ACTUALLY NEGATIVE CASES    41.   171.     5.    11.    33.
      ACTUALLY POSITIVE CASES    12.    30.     3.     8.    31.

     OBSERVED OPERATING POINTS:
      FPF:  .000  .126  .169  .188  .843 1.000
      TPF:  .000  .369  .464  .500  .857 1.000

            INITIAL VALUES OF PARAMETERS:
     A=    .4642     B=    .6116
     Z(K)= -1.006    .886    .960   1.143
     LOGL=  -387.7238
     CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
      BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.

     PROCEDURE CONVERGES AFTER   4 ITERATIONS.

            FINAL VALUES OF PARAMETERS:
     A=    .4682     B=    .6520
     Z(K)=  -.994    .856    .944   1.177
     LOGL=  -386.8398
     CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
      BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.


            VARIANCE-COVARIANCE MATRIX:
     A        .0179   .0031   .0033   .0031   .0031   .0031
     B        .0031   .0087   .0022  -.0015  -.0017  -.0026
     Z( 1)    .0033   .0022   .0087   .0019   .0017   .0014
     Z( 2)    .0031  -.0015   .0019   .0077   .0074   .0069
     Z( 3)    .0031  -.0017   .0017   .0074   .0081   .0076
     Z( 4)    .0031  -.0026   .0014   .0069   .0076   .0098

            CORRELATION MATRIX:
     A       1.0000   .2456   .2685   .2609   .2530   .2305
     B        .2456  1.0000   .2481  -.1789  -.2068  -.2795
```

Z(1)	.2685	.2481	1.0000	.2307	.2081	.1524
Z(2)	.2609	-.1789	.2307	1.0000	.9402	.7982
Z(3)	.2530	-.2068	.2081	.9402	1.0000	.8497
Z(4)	.2305	-.2795	.1524	.7982	.8497	1.0000

AREA = .6525 STD. DEV.(AREA) = .0404

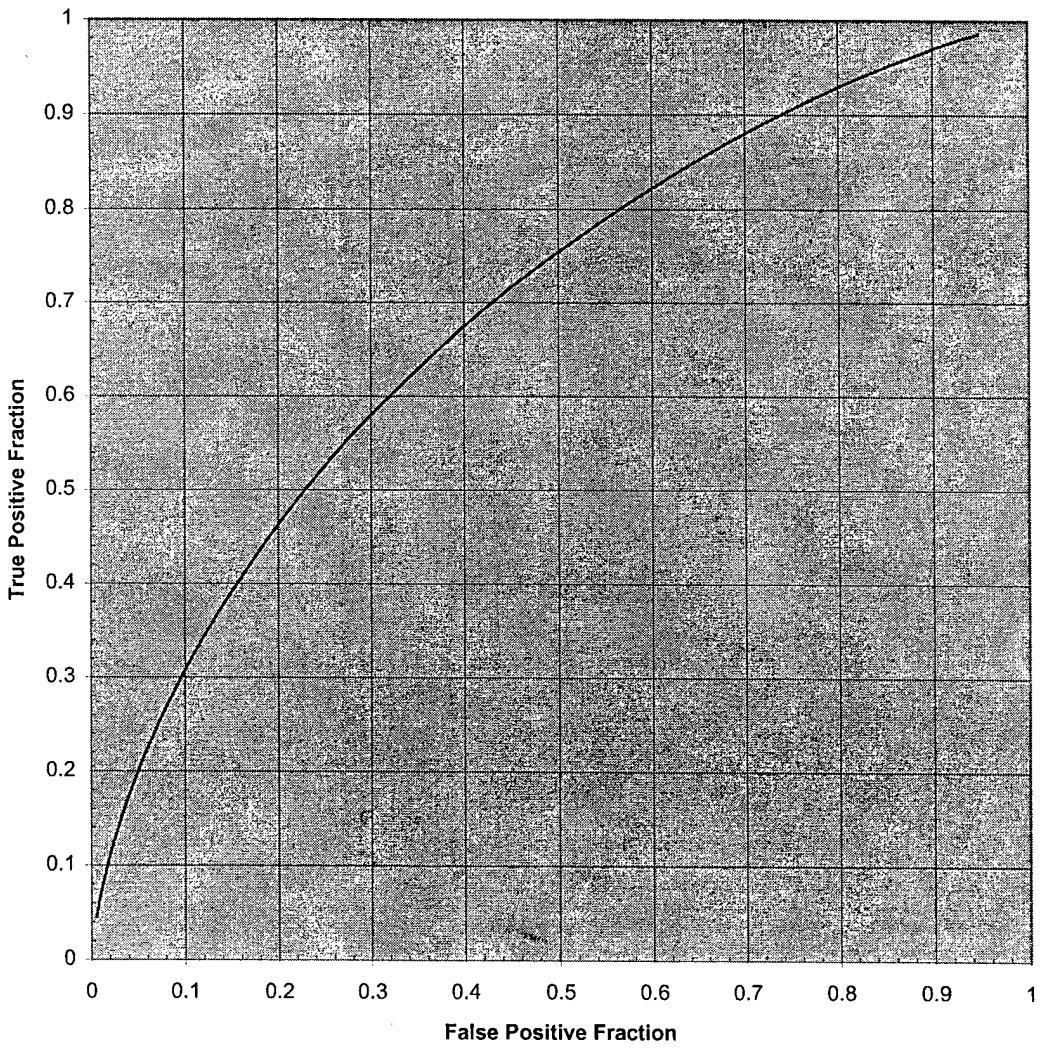
ESTIMATED BINORMAL ROC CURVE, WITH LOWER AND UPPER BOUNDS ON ASYMMETRIC 95% CONFIDENCE INTERVAL FOR TRUE-POSITIVE FRACTION AT EACH SPECIFIED FALSE-POSITIVE FRACTION:

FPF	TPF	(LOWER BOUND,	UPPER BOUND)
.005	.1128	(.0453 ,	.2323)
.010	.1471	(.0680 ,	.2720)
.020	.1918	(.1014 ,	.3196)
.030	.2241	(.1278 ,	.3519)
.040	.2503	(.1504 ,	.3773)
.050	.2727	(.1705 ,	.3986)
.060	.2926	(.1888 ,	.4171)
.070	.3106	(.2057 ,	.4337)
.080	.3270	(.2214 ,	.4488)
.090	.3423	(.2362 ,	.4626)
.100	.3566	(.2503 ,	.4755)
.110	.3701	(.2636 ,	.4877)
.120	.3829	(.2763 ,	.4991)
.130	.3950	(.2886 ,	.5100)
.140	.4066	(.3003 ,	.5204)
.150	.4178	(.3116 ,	.5303)
.200	.4679	(.3631 ,	.5751)
.250	.5114	(.4080 ,	.6141)
.300	.5504	(.4483 ,	.6491)
.400	.6192	(.5192 ,	.7117)
.500	.6802	(.5815 ,	.7675)
.600	.7367	(.6389 ,	.8188)
.700	.7910	(.6946 ,	.8667)
.800	.8454	(.7522 ,	.9119)
.900	.9039	(.8189 ,	.9551)
.950	.9383	(.8633 ,	.9765)

ESTIMATES OF EXPECTED OPERATING POINTS ON FITTED ROC CURVE, WITH LOWER AND UPPER BOUNDS OF ASYMMETRIC 95% CONFIDENCE INTERVAL ALONG THE CURVE FOR THOSE POINTS:

EXPECTED OPERATING POINT (FPF , TPF)	LOWER BOUND (FPF , TPF)	UPPER BOUND (FPF , TPF)
(.1196, .3824)	(.0852, .3351)	(.1629, .4315)
(.1725, .4414)	(.1312, .3964)	(.2214, .4872)
(.1961, .4643)	(.1522, .4201)	(.2470, .5088)
(.8399, .8679)	(.7915, .8407)	(.8803, .8917)

Do you want to use data from a previously created input file for the next run?
(Y/N, or Q to quit)
Stop - Program terminated.


Reader04 Analog ROC Type=FAD N=345 Area=.6930 STD Area=.0585
True Positive Fraction
False Positive Fraction
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1

```
Do you want to use data from a previously created input file for the
next run?
(Y/N, or Q to quit)
enter INPUT file name:
Do you want to save an output file for plotting the ROC curve?
(Y/N, or R to restart)
                                                              DATE -
8/16/1998
                                                            TIME -
13:10: 8
                R O C F I T  (IBM VERSION 1.2) :

    M A X I M U M   L I K E L I H O O D   E S T I M A T I O N
         O F   A   B I N O R M A L   R O C   C U R V E
                F R O M   R A T I N G   D A T A


     DATA DESCRIPTION: Reader 04 Analog FAD for 345 cases currently
available

      DATA COLLECTED IN  5 CATEGORIES
      WITH CATEGORY  5 REPRESENTING STRONGEST EVIDENCE OF POSITIVITY
      (E.G., THAT ABNORMALITY IS PRESENT).

      NO. OF ACTUALLY NEGATIVE CASES =  319.
      NO. OF ACTUALLY POSITIVE CASES =   26.

      RESPONSE DATA:
       CATEGORY                    1      2      3      4      5
       ACTUALLY NEGATIVE CASES    39.   102.    48.    58.    72.
       ACTUALLY POSITIVE CASES     1.     4.     4.     4.    13.

      OBSERVED OPERATING POINTS:
       FPF:  .000  .226  .408  .558  .878 1.000
       TPF:  .000  .500  .654  .808  .962 1.000

             INITIAL VALUES OF PARAMETERS:
      A=    .6827     B=    .9378
      Z(K)= -1.164  -.146    .234    .753
      LOGL=  -530.2149
      CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
       BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.

      PROCEDURE CONVERGES AFTER   3 ITERATIONS.

             FINAL VALUES OF PARAMETERS:
      A=    .6889     B=    .9298
      Z(K)= -1.164  -.148    .239    .751
      LOGL=  -530.1941
      CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
       BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.


             VARIANCE-COVARIANCE MATRIX:
      A        .0551   .0140   .0030   .0033   .0034   .0034
      B        .0140   .0530   .0026   .0008  -.0004  -.0027
      Z( 1)    .0030   .0026   .0081   .0027   .0020   .0014
      Z( 2)    .0033   .0008   .0027   .0049   .0037   .0027
      Z( 3)    .0034  -.0004   .0020   .0037   .0049   .0037
      Z( 4)    .0034  -.0027   .0014   .0027   .0037   .0060

             CORRELATION MATRIX:
      A       1.0000   .2595   .1423   .2010   .2029   .1845
      B        .2595  1.0000   .1253   .0502  -.0257  -.1524
```

Z(1)	.1423	.1253	1.0000	.4323	.3166	.1980
Z(2)	.2010	.0502	.4323	1.0000	.7422	.4906
Z(3)	.2029	-.0257	.3166	.7422	1.0000	.6695
Z(4)	.1845	-.1524	.1980	.4906	.6695	1.0000

AREA = .6930 STD. DEV.(AREA) = .0585

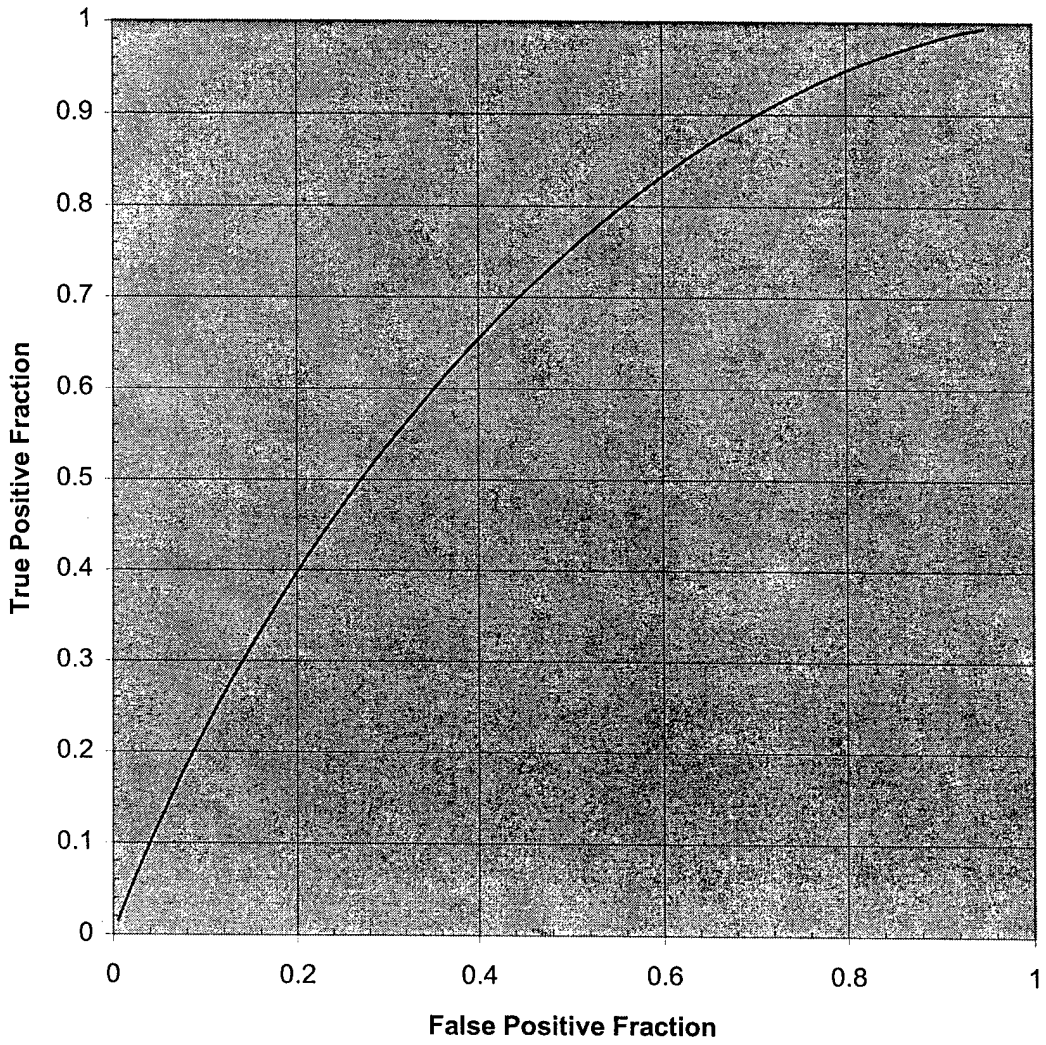
ESTIMATED BINORMAL ROC CURVE, WITH LOWER AND UPPER BOUNDS ON ASYMMETRIC 95% CONFIDENCE INTERVAL FOR TRUE-POSITIVE FRACTION AT EACH SPECIFIED FALSE-POSITIVE FRACTION:

FPF	TPF	(LOWER BOUND,	UPPER BOUND)
.005	.0440	(.0023 ,	.2833)
.010	.0702	(.0061 ,	.3286)
.020	.1110	(.0161 ,	.3822)
.030	.1445	(.0278 ,	.4182)
.040	.1738	(.0406 ,	.4463)
.050	.2002	(.0542 ,	.4698)
.060	.2245	(.0682 ,	.4901)
.070	.2471	(.0826 ,	.5083)
.080	.2684	(.0972 ,	.5247)
.090	.2884	(.1120 ,	.5399)
.100	.3075	(.1268 ,	.5540)
.110	.3257	(.1417 ,	.5673)
.120	.3432	(.1565 ,	.5798)
.130	.3600	(.1713 ,	.5917)
.140	.3761	(.1860 ,	.6031)
.150	.3917	(.2006 ,	.6140)
.200	.4627	(.2714 ,	.6633)
.250	.5247	(.3375 ,	.7065)
.300	.5799	(.3982 ,	.7458)
.400	.6750	(.5037 ,	.8154)
.500	.7545	(.5904 ,	.8747)
.600	.8223	(.6635 ,	.9231)
.700	.8802	(.7280 ,	.9595)
.800	.9294	(.7890 ,	.9838)
.900	.9700	(.8539 ,	.9966)
.950	.9867	(.8942 ,	.9993)

ESTIMATES OF EXPECTED OPERATING POINTS ON FITTED ROC CURVE, WITH LOWER AND UPPER BOUNDS OF ASYMMETRIC 95% CONFIDENCE INTERVAL ALONG THE CURVE FOR THOSE POINTS:

EXPECTED OPERATING POINT (FPF , TPF)	LOWER BOUND (FPF , TPF)	UPPER BOUND (FPF , TPF)
(.2262, .4961)	(.1831, .4399)	(.2745, .5524)
(.4054, .6795)	(.3530, .6323)	(.4595, .7239)
(.5588, .7957)	(.5043, .7577)	(.6122, .8299)
(.8777, .9617)	(.8382, .9459)	(.9100, .9735)

Do you want to use data from a previously created input file for the next run?
(Y/N, or Q to quit)
Stop - Program terminated.


Reader04 Digital ROC Type=FAD N=345 Area=.6750 STD Area=.0554
True Positive Fraction
False Positive Fraction
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0
0.2
0.4
0.6
0.8
1

```
Do you want to use data from a previously created input file for the
next run?
(Y/N, or Q to quit)
enter INPUT file name:
Do you want to save an output file for plotting the ROC curve?
(Y/N, or R to restart)
                                                              DATE -
8/16/1998
                                                              TIME -
13:14:15
                R O C F I T  (IBM VERSION 1.2) :

    M A X I M U M   L I K E L I H O O D   E S T I M A T I O N
         O F   A   B I N O R M A L   R O C   C U R V E
                F R O M   R A T I N G   D A T A


     DATA DESCRIPTION: Reader 04 Digital FAD for 345 cases currently
available

      DATA COLLECTED IN  5 CATEGORIES
      WITH CATEGORY  5 REPRESENTING STRONGEST EVIDENCE OF POSITIVITY
      (E.G., THAT ABNORMALITY IS PRESENT).

      NO. OF ACTUALLY NEGATIVE CASES =  319.
      NO. OF ACTUALLY POSITIVE CASES =   26.

      RESPONSE DATA:
       CATEGORY                    1      2      3      4      5
       ACTUALLY NEGATIVE CASES     8.    62.    77.    93.    79.
       ACTUALLY POSITIVE CASES     0.     2.     3.     9.    12.

      OBSERVED OPERATING POINTS:
       FPF:  .000  .248  .539  .781  .975 1.000
       TPF:  .000  .462  .808  .923 1.000 1.000

            INITIAL VALUES OF PARAMETERS:
      A=    .6359     B=    .8031
      Z(K)= -1.959  -.774  -.098   .682
      LOGL=  -497.0686
      CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
       BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.

      PROCEDURE CONVERGES AFTER   5 ITERATIONS.

            FINAL VALUES OF PARAMETERS:
      A=    .6813     B=  1.1201
      Z(K)= -1.961  -.770  -.103   .684
      LOGL=  -496.0947
      CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
       BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.


            VARIANCE-COVARIANCE MATRIX:
      A        .0564   .0161   .0027   .0037   .0041   .0042
      B        .0161   .0684   .0028   .0026   .0009  -.0032
      Z( 1)    .0027   .0028   .0222   .0036   .0019   .0010
      Z( 2)    .0037   .0026   .0036   .0061   .0032   .0018
      Z( 3)    .0041   .0009   .0019   .0032   .0049   .0029
      Z( 4)    .0042  -.0032   .0010   .0018   .0029   .0058

            CORRELATION MATRIX:
      A       1.0000   .2592   .0763   .2019   .2479   .2292
      B        .2592  1.0000   .0714   .1257   .0474  -.1625
```

Z(1)	.0763	.0714	1.0000	.3066	.1809	.0885
Z(2)	.2019	.1257	.3066	1.0000	.5897	.3052
Z(3)	.2479	.0474	.1809	.5897	1.0000	.5402
Z(4)	.2292	-.1625	.0885	.3052	.5402	1.0000

AREA = .6750 STD. DEV.(AREA) = .0554

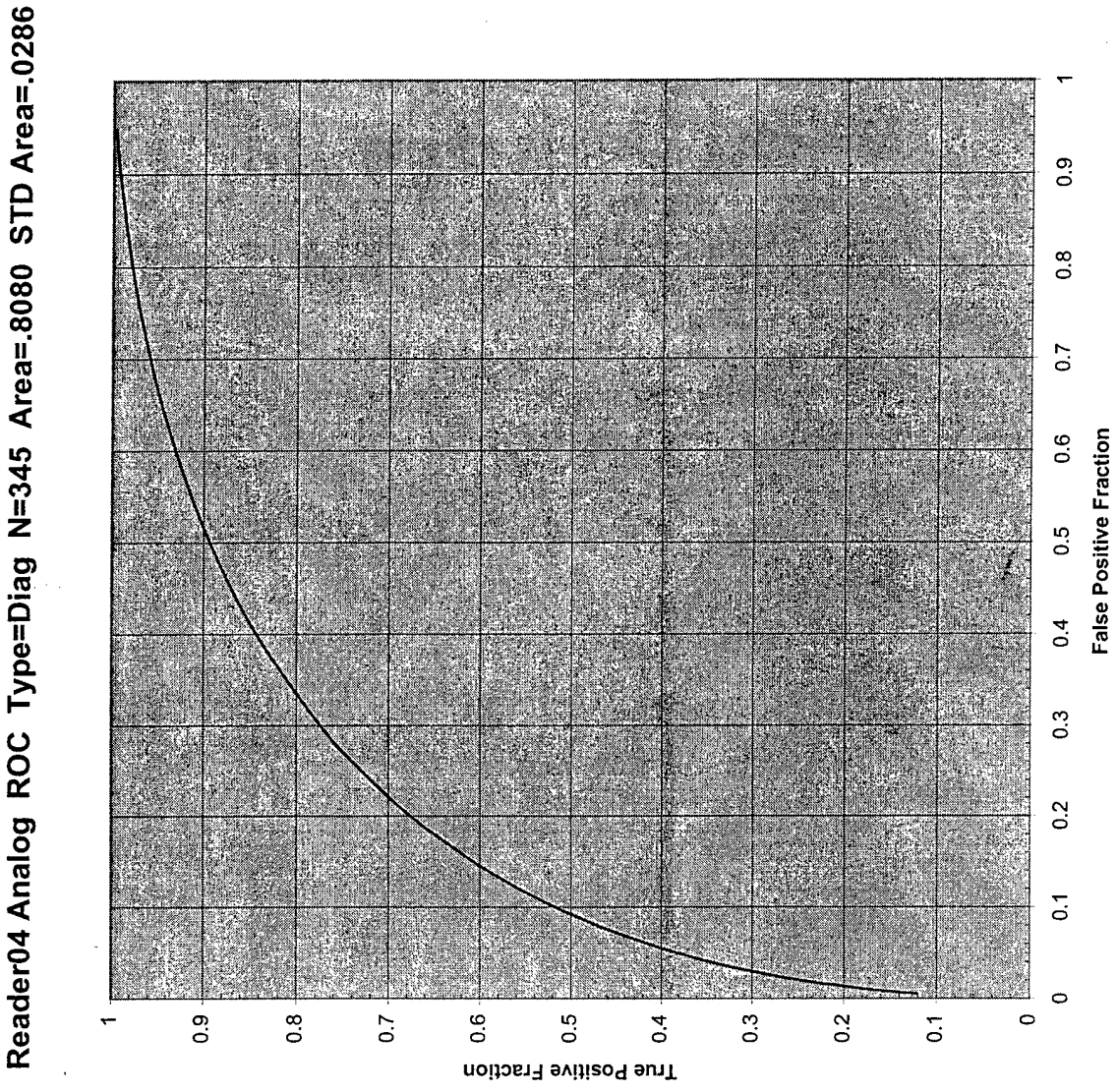
ESTIMATED BINORMAL ROC CURVE, WITH LOWER AND UPPER BOUNDS ON ASYMMETRIC 95% CONFIDENCE INTERVAL FOR TRUE-POSITIVE FRACTION AT EACH SPECIFIED FALSE-POSITIVE FRACTION:

FPF	TPF	(LOWER BOUND,	UPPER BOUND)
.005	.0137	(.0002 ,	.1780)
.010	.0271	(.0010 ,	.2228)
.020	.0527	(.0040 ,	.2794)
.030	.0770	(.0086 ,	.3192)
.040	.1003	(.0147 ,	.3510)
.050	.1227	(.0221 ,	.3781)
.060	.1444	(.0306 ,	.4019)
.070	.1655	(.0400 ,	.4234)
.080	.1860	(.0503 ,	.4430)
.090	.2059	(.0613 ,	.4612)
.100	.2253	(.0730 ,	.4782)
.110	.2442	(.0852 ,	.4943)
.120	.2627	(.0979 ,	.5095)
.130	.2808	(.1110 ,	.5241)
.140	.2985	(.1244 ,	.5380)
.150	.3157	(.1382 ,	.5514)
.200	.3970	(.2096 ,	.6123)
.250	.4706	(.2821 ,	.6660)
.300	.5376	(.3524 ,	.7149)
.400	.6547	(.4794 ,	.8017)
.500	.7522	(.5854 ,	.8743)
.600	.8326	(.6736 ,	.9305)
.700	.8976	(.7497 ,	.9688)
.800	.9478	(.8191 ,	.9902)
.900	.9829	(.8885 ,	.9987)
.950	.9942	(.9279 ,	.9998)

ESTIMATES OF EXPECTED OPERATING POINTS ON FITTED ROC CURVE, WITH LOWER AND UPPER BOUNDS OF ASYMMETRIC 95% CONFIDENCE INTERVAL ALONG THE CURVE FOR THOSE POINTS:

EXPECTED OPERATING POINT (FPF , TPF)	LOWER BOUND (FPF , TPF)	UPPER BOUND (FPF , TPF)
(.2471, .4664)	(.2024, .4005)	(.2967, .5332)
(.5411, .7872)	(.4866, .7401)	(.5948, .8289)
(.7794, .9387)	(.7314, .9150)	(.8220, .9568)
(.9751, .9980)	(.9524, .9946)	(.9879, .9993)

Do you want to use data from a previously created input file for the next run?
(Y/N, or Q to quit)
Stop - Program terminated.


Reader04 Analog ROC Type=Diag N=345 Area=.8080 STD Area=.0286
True Positive Fraction
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
False Positive Fraction
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1

```
Do you want to use data from a previously created input file for the
next run?
(Y/N, or Q to quit)
enter INPUT file name:
Do you want to save an output file for plotting the ROC curve?
(Y/N, or R to restart)
                                                              DATE -
8/16/1998
                                                             TIME -
13:10:37
              R O C F I T  (IBM VERSION 1.2) :

    M A X I M U M   L I K E L I H O O D   E S T I M A T I O N
         O F   A   B I N O R M A L   R O C   C U R V E
               F R O M   R A T I N G   D A T A


     DATA DESCRIPTION: Reader 04 Analog Diag for 345 cases currently
available

     DATA COLLECTED IN  5 CATEGORIES
     WITH CATEGORY  5 REPRESENTING STRONGEST EVIDENCE OF POSITIVITY
     (E.G., THAT ABNORMALITY IS PRESENT).

     NO. OF ACTUALLY NEGATIVE CASES =  261.
     NO. OF ACTUALLY POSITIVE CASES =   84.

     RESPONSE DATA:
      CATEGORY                    1      2      3      4      5
      ACTUALLY NEGATIVE CASES    32.   128.    90.     9.     2.
      ACTUALLY POSITIVE CASES     0.    16.    36.    19.    13.

     OBSERVED OPERATING POINTS:
      FPF:  .000  .008  .042  .387  .877 1.000
      TPF:  .000  .155  .381  .810 1.000 1.000

           INITIAL VALUES OF PARAMETERS:
     A=  1.3098    B=   .9665
     Z(K)= -1.162   .287  1.727  2.425
     LOGL=  -405.3728
     CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
      BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.

     PROCEDURE CONVERGES AFTER   4 ITERATIONS.

           FINAL VALUES OF PARAMETERS:
     A=  1.2437    B=   .9365
     Z(K)= -1.177   .305  1.684  2.423
     LOGL=  -405.0512
     CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
      BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.


           VARIANCE-COVARIANCE MATRIX:
     A        .0325   .0127   .0035   .0051   .0032  -.0021
     B        .0127   .0137   .0016   .0010  -.0061  -.0146
     Z( 1)    .0035   .0016   .0100   .0025   .0009  -.0001
     Z( 2)    .0051   .0010   .0025   .0060   .0033   .0026
     Z( 3)    .0032  -.0061   .0009   .0033   .0163   .0181
     Z( 4)   -.0021  -.0146  -.0001   .0026   .0181   .0422

           CORRELATION MATRIX:
     A       1.0000   .6024   .1954   .3650   .1395  -.0565
     B        .6024  1.0000   .1374   .1144  -.4077  -.6077
```

Z(1)	.1954	.1374	1.0000	.3171	.0719	-.0032
Z(2)	.3650	.1144	.3171	1.0000	.3365	.1618
Z(3)	.1395	-.4077	.0719	.3365	1.0000	.6922
Z(4)	-.0565	-.6077	-.0032	.1618	.6922	1.0000

AREA = .8180 STD. DEV.(AREA) = .0286

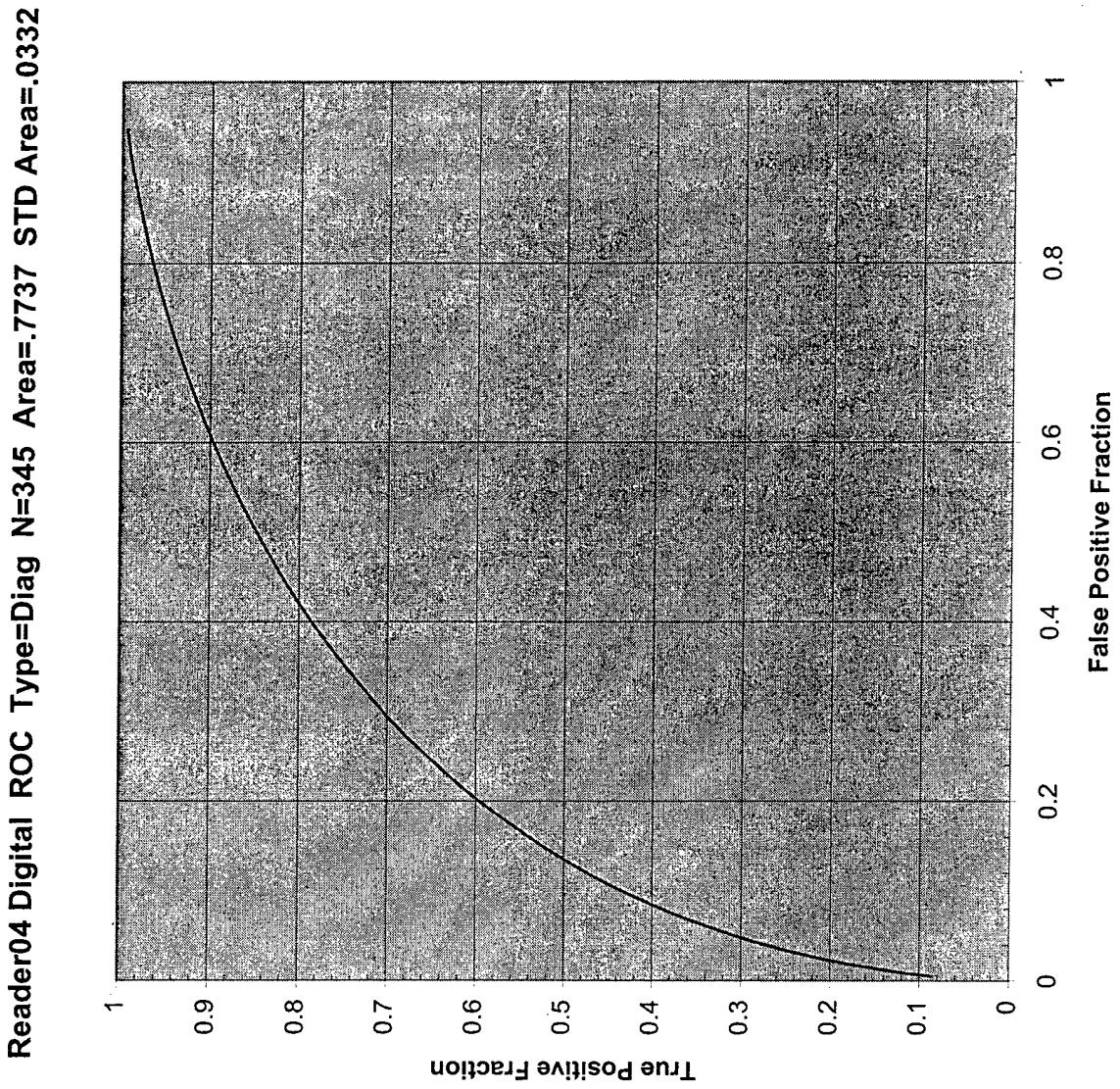
ESTIMATED BINORMAL ROC CURVE, WITH LOWER AND UPPER BOUNDS ON ASYMMETRIC 95% CONFIDENCE INTERVAL FOR TRUE-POSITIVE FRACTION AT EACH SPECIFIED FALSE-POSITIVE FRACTION:

FPF	TPF	(LOWER BOUND,	UPPER BOUND)
.005	.1212	(.0504 ,	.2429)
.010	.1748	(.0865 ,	.3058)
.020	.2482	(.1440 ,	.3831)
.030	.3022	(.1908 ,	.4360)
.040	.3460	(.2310 ,	.4774)
.050	.3832	(.2664 ,	.5118)
.060	.4158	(.2983 ,	.5414)
.070	.4449	(.3273 ,	.5676)
.080	.4711	(.3538 ,	.5910)
.090	.4952	(.3784 ,	.6124)
.100	.5173	(.4012 ,	.6319)
.110	.5378	(.4226 ,	.6499)
.120	.5569	(.4426 ,	.6667)
.130	.5749	(.4614 ,	.6824)
.140	.5917	(.4792 ,	.6971)
.150	.6076	(.4960 ,	.7110)
.200	.6757	(.5687 ,	.7699)
.250	.7298	(.6272 ,	.8160)
.300	.7743	(.6759 ,	.8531)
.400	.8430	(.7534 ,	.9080)
.500	.8932	(.8134 ,	.9449)
.600	.9306	(.8620 ,	.9694)
.700	.9586	(.9028 ,	.9850)
.800	.9789	(.9379 ,	.9942)
.900	.9927	(.9688 ,	.9988)
.950	.9973	(.9834 ,	.9997)

ESTIMATES OF EXPECTED OPERATING POINTS ON FITTED ROC CURVE, WITH LOWER AND UPPER BOUNDS OF ASYMMETRIC 95% CONFIDENCE INTERVAL ALONG THE CURVE FOR THOSE POINTS:

EXPECTED OPERATING POINT (FPF , TPF)	LOWER BOUND (FPF , TPF)	UPPER BOUND (FPF , TPF)
(.0077, .1526)	(.0024, .0804)	(.0217, .2584)
(.0461, .3694)	(.0266, .2852)	(.0758, .4605)
(.3800, .8309)	(.3236, .7925)	(.4391, .8644)
(.8805, .9905)	(.8369, .9847)	(.9151, .9943)

Do you want to use data from a previously created input file for the next run?
(Y/N, or Q to quit)
Stop - Program terminated.


Reader04 Digital ROC Type=Diag N=345 Area=.7737 STD Area=.0332
True Positive Fraction
False Positive Fraction
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0
0.2
0.4
0.6
0.8
1

```
Do you want to use data from a previously created input file for the
next run?
(Y/N, or Q to quit)
enter INPUT file name:
Do you want to save an output file for plotting the ROC curve?
(Y/N, or R to restart)
                                                                DATE -
8/16/1998
                                                               TIME -
13:14:46
              R O C F I T  (IBM VERSION 1.2) :

    M A X I M U M   L I K E L I H O O D   E S T I M A T I O N
         O F   A   B I N O R M A L   R O C   C U R V E
               F R O M   R A T I N G   D A T A


     DATA DESCRIPTION: Reader 04 Digital Diag for 345 cases currently
available

      DATA COLLECTED IN  5 CATEGORIES
      WITH CATEGORY  5 REPRESENTING STRONGEST EVIDENCE OF POSITIVITY
      (E.G., THAT ABNORMALITY IS PRESENT).

      NO. OF ACTUALLY NEGATIVE CASES =  261.
      NO. OF ACTUALLY POSITIVE CASES =   84.

      RESPONSE DATA:
       CATEGORY                    1      2      3      4      5
       ACTUALLY NEGATIVE CASES     8.    95.   147.     7.     4.
       ACTUALLY POSITIVE CASES     0.    10.    46.    19.     9.

      OBSERVED OPERATING POINTS:
       FPF:  .000  .015  .042  .605  .969 1.000
       TPF:  .000  .107  .333  .881 1.000 1.000

             INITIAL VALUES OF PARAMETERS:
      A=    .8961    B=    .8922
      Z(K)= -1.872  -.267  1.727  2.162
      LOGL=  -353.0214
      CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
       BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.

      PROCEDURE CONVERGES AFTER   5 ITERATIONS.

             FINAL VALUES OF PARAMETERS:
      A=  1.0263    B=    .9316
      Z(K)= -1.884  -.255  1.654  2.344
      LOGL=  -349.7610
      CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
       BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.


             VARIANCE-COVARIANCE MATRIX:
      A        .0295   .0096   .0034   .0047   .0048   .0017
      B        .0096   .0119   .0018   .0015  -.0053  -.0117
      Z( 1)    .0034   .0018   .0235   .0028   .0006  -.0003
      Z( 2)    .0047   .0015   .0028   .0061   .0021   .0013
      Z( 3)    .0048  -.0053   .0006   .0021   .0162   .0171
      Z( 4)    .0017  -.0117  -.0003   .0013   .0171   .0382

             CORRELATION MATRIX:
      A       1.0000   .5136   .1288   .3540   .2217   .0518
      B        .5136  1.0000   .1074   .1806  -.3839  -.5493
```

Z(1)	.1288	.1074	1.0000	.2374	.0303	-.0116
Z(2)	.3540	.1806	.2374	1.0000	.2145	.0828
Z(3)	.2217	-.3839	.0303	.2145	1.0000	.6897
Z(4)	.0518	-.5493	-.0116	.0828	.6897	1.0000

AREA = .7737 STD. DEV.(AREA) = .0332

ESTIMATED BINORMAL ROC CURVE, WITH LOWER AND UPPER BOUNDS ON ASYMMETRIC 95% CONFIDENCE INTERVAL FOR TRUE-POSITIVE FRACTION AT EACH SPECIFIED FALSE-POSITIVE FRACTION:

FPF	TPF	(LOWER BOUND,	UPPER BOUND)
.005	.0848	(.0323 ,	.1844)
.010	.1269	(.0576 ,	.2397)
.020	.1874	(.1003 ,	.3103)
.030	.2339	(.1368 ,	.3602)
.040	.2726	(.1693 ,	.4001)
.050	.3063	(.1988 ,	.4337)
.060	.3364	(.2260 ,	.4631)
.070	.3636	(.2512 ,	.4893)
.080	.3886	(.2748 ,	.5130)
.090	.4118	(.2970 ,	.5348)
.100	.4334	(.3179 ,	.5549)
.110	.4536	(.3378 ,	.5737)
.120	.4727	(.3566 ,	.5912)
.130	.4908	(.3746 ,	.6077)
.140	.5079	(.3918 ,	.6234)
.150	.5242	(.4083 ,	.6381)
.200	.5958	(.4815 ,	.7024)
.250	.6548	(.5430 ,	.7544)
.300	.7048	(.5960 ,	.7976)
.400	.7854	(.6838 ,	.8650)
.500	.8476	(.7548 ,	.9135)
.600	.8965	(.8145 ,	.9484)
.700	.9350	(.8663 ,	.9726)
.800	.9649	(.9122 ,	.9883)
.900	.9868	(.9544 ,	.9970)
.950	.9947	(.9750 ,	.9992)

ESTIMATES OF EXPECTED OPERATING POINTS ON FITTED ROC CURVE, WITH LOWER AND UPPER BOUNDS OF ASYMMETRIC 95% CONFIDENCE INTERVAL ALONG THE CURVE FOR THOSE POINTS:

EXPECTED OPERATING POINT (FPF , TPF)	LOWER BOUND (FPF , TPF)	UPPER BOUND (FPF , TPF)
(.0095, .1235)	(.0032, .0649)	(.0249, .2116)
(.0491, .3035)	(.0285, .2277)	(.0801, .3889)
(.6006, .8968)	(.5407, .8689)	(.6582, .9201)
(.9702, .9973)	(.9433, .9938)	(.9855, .9989)

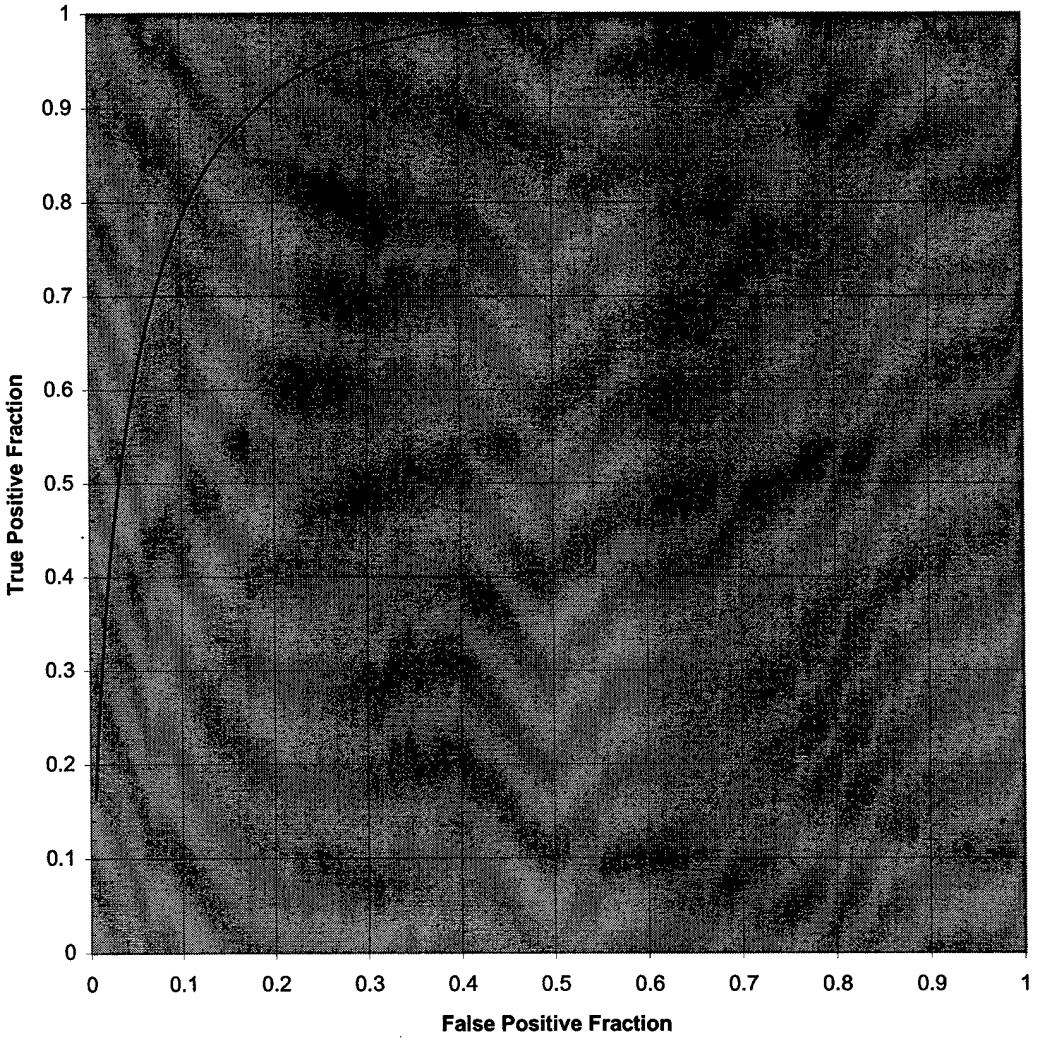
Do you want to use data from a previously created input file for the next run?
(Y/N, or Q to quit)
Stop - Program terminated.

Reader05_Analog(329cases)

Totals

	Type	Ground Truth, Mass	Ground Truth, uCa	Ground Truth, FAD	Ground Truth, Diag
Total Normal	172	279	252	307	240
Total Abnormal	157	50	77	22	89
	Resp = 1	Resp = 2	Resp = 3	Resp = 4	Resp = 5
Resp, Mass, N	165	81	11	10	12
Resp, Mass, A	1	8	1	13	27
Resp, Ca, N	174	36	3	9	30
Resp, Ca, A	13	3	1	5	55
Resp, FAD, N	244	37	6	9	11
Resp, FAD, A	14	3	1	1	3
Resp, Diag, B	105	85	22	25	3
Resp, Diag, M	5	21	12	27	24

Reader05 Analog ROC Type=Mass N=329 Area=.9322 STD Area=.0167



```
Do you want to use data from a previously created input file for the
next run?
(Y/N, or Q to quit)
enter INPUT file name:
Do you want to save an output file for plotting the ROC curve?
(Y/N, or R to restart)
                                                              DATE -
11/18/1998
                                                              TIME -
14:44:18
                R O C F I T  (IBM VERSION 1.2) :

    M A X I M U M   L I K E L I H O O D   E S T I M A T I O N
         O F   A   B I N O R M A L   R O C   C U R V E
                F R O M   R A T I N G   D A T A


     DATA DESCRIPTION: Reader 05 Analog Mass resp for 329 cases
available

     DATA COLLECTED IN  5 CATEGORIES
     WITH CATEGORY  5 REPRESENTING STRONGEST EVIDENCE OF POSITIVITY
     (E.G., THAT ABNORMALITY IS PRESENT).

     NO. OF ACTUALLY NEGATIVE CASES =  279.
     NO. OF ACTUALLY POSITIVE CASES =   50.

     RESPONSE DATA:
      CATEGORY                    1      2      3      4      5
      ACTUALLY NEGATIVE CASES   165.    81.    11.    10.    12.
      ACTUALLY POSITIVE CASES     1.     8.     1.    13.    27.

     OBSERVED OPERATING POINTS:
      FPF:  .000  .043  .079  .118  .409 1.000
      TPF:  .000  .540  .800  .820  .980 1.000

            INITIAL VALUES OF PARAMETERS:
     A=  2.3795    B=  1.2337
     Z(K)=   .231  1.184  1.413  1.717
     LOGL=  -354.2874
     CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
      BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.

     PROCEDURE CONVERGES AFTER   4 ITERATIONS.

            FINAL VALUES OF PARAMETERS:
     A=  2.5170    B=  1.3583
     Z(K)=   .233  1.175  1.354  1.760
     LOGL=  -352.6045
     CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
      BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.


            VARIANCE-COVARIANCE MATRIX:
     A       .2116   .1258   .0077   .0095   .0059  -.0087
     B       .1258   .0947   .0025  -.0008  -.0047  -.0182
     Z( 1)   .0077   .0025   .0057   .0033   .0030   .0024
     Z( 2)   .0095  -.0008   .0033   .0091   .0085   .0079
     Z( 3)   .0059  -.0047   .0030   .0085   .0106   .0101
     Z( 4)  -.0087  -.0182   .0024   .0079   .0101   .0177

            CORRELATION MATRIX:
     A      1.0000   .8885   .2207   .2180   .1257  -.1413
     B       .8885  1.0000   .1077  -.0288  -.1474  -.4452
```

Z(1)	.2207	.1077	1.0000	.4622	.3917	.2427
Z(2)	.2180	-.0288	.4622	1.0000	.8720	.6195
Z(3)	.1257	-.1474	.3917	.8720	1.0000	.7397
Z(4)	-.1413	-.4452	.2427	.6195	.7397	1.0000

AREA = .9322 STD. DEV.(AREA) = .0167

ESTIMATED BINORMAL ROC CURVE, WITH LOWER AND UPPER BOUNDS ON ASYMMETRIC 95% CONFIDENCE INTERVAL FOR TRUE-POSITIVE FRACTION AT EACH SPECIFIED FALSE-POSITIVE FRACTION:

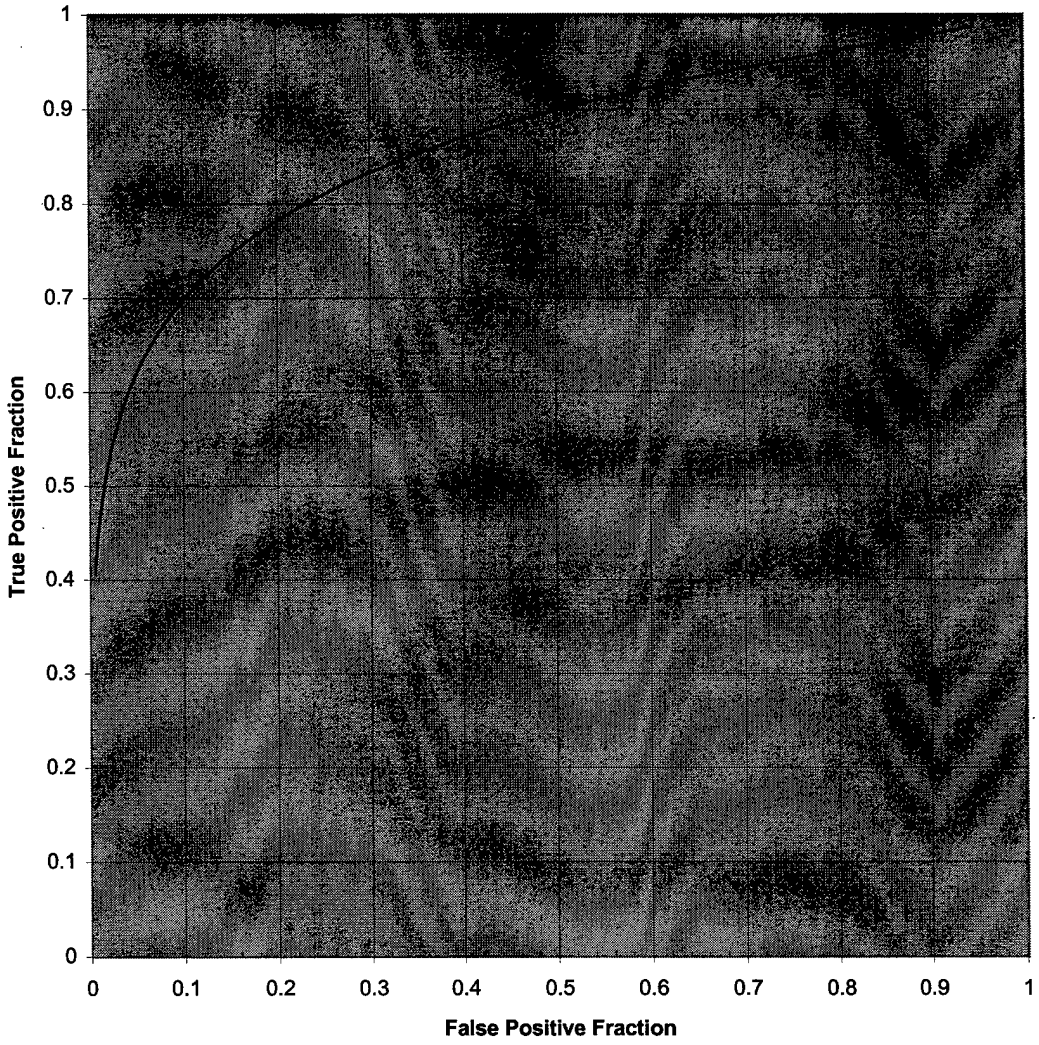
FPF	TPF	(LOWER BOUND,	UPPER BOUND)
.005	.1630	(.0328 ,	.4508)
.010	.2600	(.0847 ,	.5347)
.020	.3923	(.1907 ,	.6289)
.030	.4847	(.2845 ,	.6890)
.040	.5551	(.3642 ,	.7338)
.050	.6111	(.4312 ,	.7697)
.060	.6572	(.4877 ,	.7997)
.070	.6957	(.5354 ,	.8252)
.080	.7285	(.5761 ,	.8472)
.090	.7567	(.6110 ,	.8664)
.100	.7811	(.6411 ,	.8831)
.110	.8026	(.6674 ,	.8978)
.120	.8214	(.6904 ,	.9106)
.130	.8382	(.7108 ,	.9219)
.140	.8530	(.7290 ,	.9318)
.150	.8663	(.7453 ,	.9405)
.200	.9153	(.8070 ,	.9700)
.250	.9453	(.8484 ,	.9851)
.300	.9645	(.8785 ,	.9927)
.400	.9851	(.9199 ,	.9984)
.500	.9941	(.9469 ,	.9997)
.600	.9979	(.9657 ,	1.0000)
.700	.9994	(.9792 ,	1.0000)
.800	.9999	(.9889 ,	1.0000)
.900	1.0000	(.9957 ,	1.0000)
.950	1.0000	(.9982 ,	1.0000)

ESTIMATES OF EXPECTED OPERATING POINTS ON FITTED ROC CURVE, WITH LOWER AND UPPER BOUNDS OF ASYMMETRIC 95% CONFIDENCE INTERVAL ALONG THE CURVE FOR THOSE POINTS:

EXPECTED OPERATING POINT (FPF , TPF)	LOWER BOUND (FPF , TPF)	UPPER BOUND (FPF , TPF)
(.0392, .5505)	(.0217, .4100)	(.0670, .6850)
(.0879, .7510)	(.0599, .6570)	(.1245, .8292)
(.1200, .8214)	(.0867, .7478)	(.1614, .8798)
(.4077, .9861)	(.3513, .9772)	(.4662, .9918)

Do you want to use data from a previously created input file for the next run?
(Y/N, or Q to quit)
Stop - Program terminated.

Reader05 Analog ROC Type=Calc N=329 Area=.8639 STD Area=.0324



```
Do you want to use data from a previously created input file for the
next run?
(Y/N, or Q to quit)
enter INPUT file name:
Do you want to save an output file for plotting the ROC curve?
(Y/N, or R to restart)
                                                              DATE -
11/18/1998
                                                              TIME -
14:45:26
                R O C F I T  (IBM VERSION 1.2) :

    M A X I M U M   L I K E L I H O O D   E S T I M A T I O N
         O F   A   B I N O R M A L   R O C   C U R V E
               F R O M   R A T I N G   D A T A


     DATA DESCRIPTION: Reader 05 Analog calc resp for 329 cases

     DATA COLLECTED IN  5 CATEGORIES
     WITH CATEGORY  5 REPRESENTING STRONGEST EVIDENCE OF POSITIVITY
     (E.G., THAT ABNORMALITY IS PRESENT).

     NO. OF ACTUALLY NEGATIVE CASES =  252.
     NO. OF ACTUALLY POSITIVE CASES =   77.

     RESPONSE DATA:
      CATEGORY                      1      2      3      4      5
      ACTUALLY NEGATIVE CASES   174.    36.     3.     9.    30.
      ACTUALLY POSITIVE CASES    13.     3.     1.     5.    55.

     OBSERVED OPERATING POINTS:
      FPF:  .000  .119  .155  .167  .310 1.000
      TPF:  .000  .714  .779  .792  .831 1.000

            INITIAL VALUES OF PARAMETERS:
    A=  1.2409    B=   .5071
    Z(K)=   .497   .967  1.016  1.180
    LOGL=  -313.2130
    CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
     BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.

     PROCEDURE CONVERGES AFTER   4 ITERATIONS.

            FINAL VALUES OF PARAMETERS:
    A=  1.2739    B=   .5885
    Z(K)=   .500   .939   .992  1.193
    LOGL=  -312.6219
    CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
     BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.


            VARIANCE-COVARIANCE MATRIX:
    A        .0578   .0361   .0049   .0024   .0020   .0001
    B        .0361   .0387   .0019  -.0018  -.0025  -.0052
    Z( 1)    .0049   .0019   .0068   .0053   .0051   .0046
    Z( 2)    .0024  -.0018   .0053   .0084   .0082   .0077
    Z( 3)    .0020  -.0025   .0051   .0082   .0087   .0082
    Z( 4)    .0001  -.0052   .0046   .0077   .0082   .0106

            CORRELATION MATRIX:
    A       1.0000   .7643   .2480   .1082   .0872   .0023
    B        .7643  1.0000   .1142  -.1025  -.1334  -.2549
    Z( 1)    .2480   .1142  1.0000   .7002   .6664   .5436
```

Z(2)	.1082	-.1025	.7002	1.0000	.9600	.8175
Z(3)	.0872	-.1334	.6664	.9600	1.0000	.8549
Z(4)	.0023	-.2549	.5436	.8175	.8549	1.0000

AREA = .8639 STD. DEV.(AREA) = .0324

ESTIMATED BINORMAL ROC CURVE, WITH LOWER AND UPPER BOUNDS ON ASYMMETRIC 95% CONFIDENCE INTERVAL FOR TRUE-POSITIVE FRACTION AT EACH SPECIFIED FALSE-POSITIVE FRACTION:

FPF	TPF	(LOWER BOUND,	UPPER BOUND)
.005	.4043	(.1725 ,	.6771)
.010	.4620	(.2382 ,	.6989)
.020	.5259	(.3218 ,	.7233)
.030	.5662	(.3790 ,	.7394)
.040	.5961	(.4230 ,	.7520)
.050	.6201	(.4588 ,	.7626)
.060	.6401	(.4888 ,	.7720)
.070	.6573	(.5146 ,	.7805)
.080	.6725	(.5370 ,	.7884)
.090	.6861	(.5568 ,	.7958)
.100	.6983	(.5744 ,	.8028)
.110	.7095	(.5901 ,	.8095)
.120	.7198	(.6043 ,	.8160)
.130	.7294	(.6172 ,	.8222)
.140	.7383	(.6289 ,	.8282)
.150	.7466	(.6396 ,	.8341)
.200	.7819	(.6818 ,	.8610)
.250	.8098	(.7112 ,	.8844)
.300	.8329	(.7333 ,	.9046)
.400	.8697	(.7652 ,	.9366)
.500	.8987	(.7889 ,	.9595)
.600	.9226	(.8088 ,	.9757)
.700	.9432	(.8272 ,	.9868)
.800	.9616	(.8462 ,	.9941)
.900	.9787	(.8690 ,	.9983)
.950	.9875	(.8854 ,	.9995)

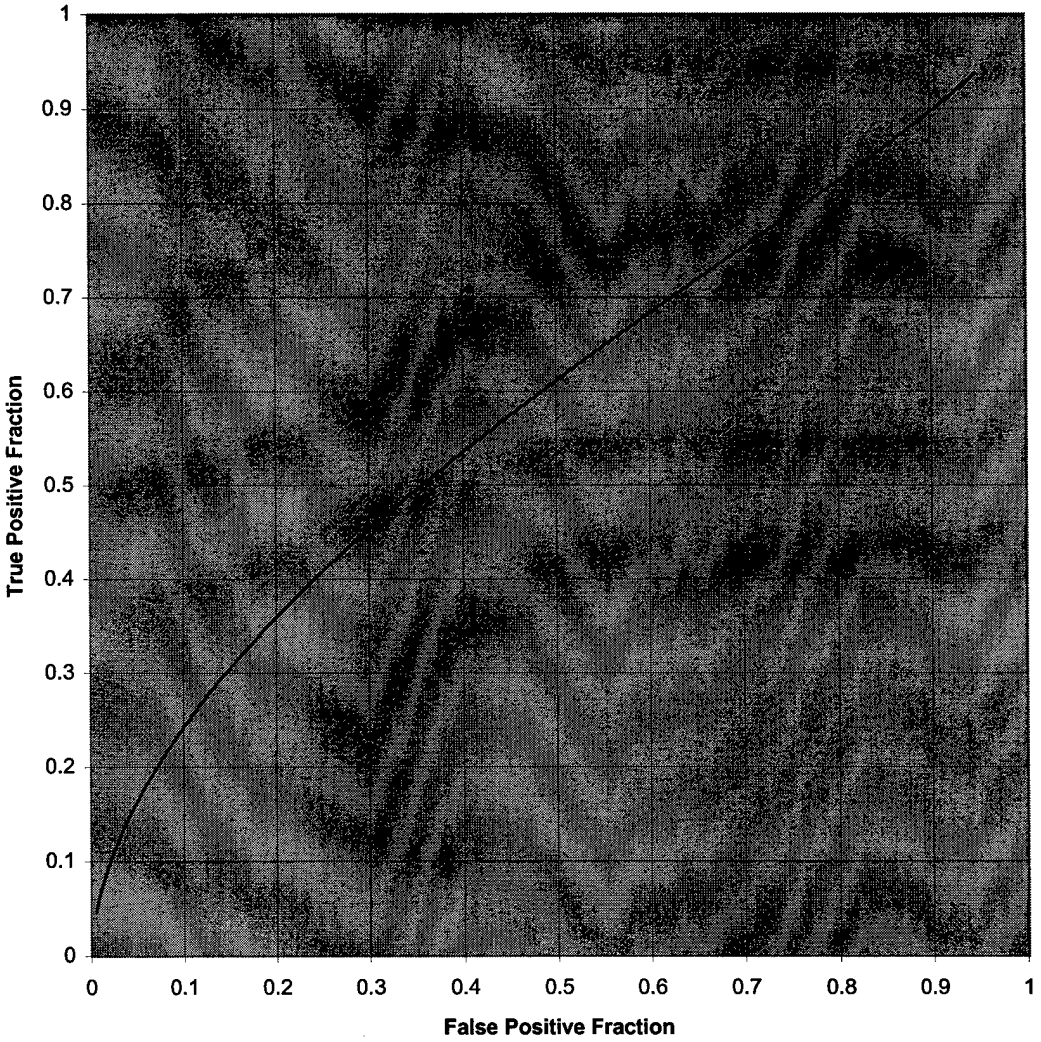
ESTIMATES OF EXPECTED OPERATING POINTS ON FITTED ROC CURVE, WITH LOWER AND UPPER BOUNDS OF ASYMMETRIC 95% CONFIDENCE INTERVAL ALONG THE CURVE FOR THOSE POINTS:

EXPECTED OPERATING POINT (FPF , TPF)	LOWER BOUND (FPF , TPF)	UPPER BOUND (FPF , TPF)
(.1165, .7163)	(.0816, .6748)	(.1608, .7551)
(.1606, .7549)	(.1199, .7198)	(.2093, .7875)
(.1739, .7647)	(.1317, .7310)	(.2239, .7959)
(.3087, .8364)	(.2541, .8118)	(.3678, .8588)

Do you want to use data from a previously created input file for the next run?
(Y/N, or Q to quit)
enter INPUT file name:
The input file ( ) CANNOT be found in your current subdirectory!
enter INPUT file name:

```
The input file (              ) CANNOT be found in your current
subdirectory!
enter INPUT file name:
```

Reader05 Analog ROC Type=FAD N=329 Area=.5887 STD Area=.1261



```
Do you want to use data from a previously created input file for the
next run?
(Y/N, or Q to quit)
enter INPUT file name:
Do you want to save an output file for plotting the ROC curve?
(Y/N, or R to restart)
                                                                DATE -
11/18/1998
                                                              TIME -
14:44:18
              R O C F I T  (IBM VERSION 1.2) :

    M A X I M U M   L I K E L I H O O D   E S T I M A T I O N
         O F   A   B I N O R M A L   R O C   C U R V E
               F R O M   R A T I N G   D A T A


     DATA DESCRIPTION: Reader 05 Analog fad resp for 329 cases

     DATA COLLECTED IN  5 CATEGORIES
     WITH CATEGORY  5 REPRESENTING STRONGEST EVIDENCE OF POSITIVITY
     (E.G., THAT ABNORMALITY IS PRESENT).

     NO. OF ACTUALLY NEGATIVE CASES =  307.
     NO. OF ACTUALLY POSITIVE CASES =   22.

     RESPONSE DATA:
      CATEGORY                    1      2      3      4      5
      ACTUALLY NEGATIVE CASES   244.    37.     6.     9.    11.
      ACTUALLY POSITIVE CASES    14.     3.     1.     1.     3.

     OBSERVED OPERATING POINTS:
      FPF:  .000  .036  .065  .085  .205 1.000
      TPF:  .000  .136  .182  .227  .364 1.000

            INITIAL VALUES OF PARAMETERS:
    A=    .2908    B=    .7736
    Z(K)=    .823  1.374  1.513  1.802
    LOGL=  -250.8848
    CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
     BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.

     PROCEDURE CONVERGES AFTER   3 ITERATIONS.

            FINAL VALUES OF PARAMETERS:
    A=    .2825    B=    .7658
    Z(K)=    .823  1.372  1.518  1.801
    LOGL=  -250.8741
    CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
     BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.


            VARIANCE-COVARIANCE MATRIX:
    A        .1957   .1132   .0066   .0010  -.0009  -.0054
    B        .1132   .1017   .0020  -.0037  -.0056  -.0101
    Z( 1)    .0066   .0020   .0066   .0050   .0047   .0041
    Z( 2)    .0010  -.0037   .0050   .0102   .0097   .0089
    Z( 3)   -.0009  -.0056   .0047   .0097   .0121   .0112
    Z( 4)   -.0054  -.0101   .0041   .0089   .0112   .0179

            CORRELATION MATRIX:
    A       1.0000   .8022   .1849   .0223  -.0183  -.0907
    B        .8022  1.0000   .0758  -.1134  -.1586  -.2371
    Z( 1)    .1849   .0758  1.0000   .6082   .5230   .3806
```

Z(2)	.0223	-.1134	.6082	1.0000	.8716	.6580
Z(3)	-.0183	-.1586	.5230	.8716	1.0000	.7572
Z(4)	-.0907	-.2371	.3806	.6580	.7572	1.0000

AREA = .5887 STD. DEV.(AREA) = .1261

ESTIMATED BINORMAL ROC CURVE, WITH LOWER AND UPPER BOUNDS ON ASYMMETRIC 95% CONFIDENCE INTERVAL FOR TRUE-POSITIVE FRACTION AT EACH SPECIFIED FALSE-POSITIVE FRACTION:

FPF	TPF	(LOWER BOUND,	UPPER BOUND)
.005	.0455	(.0031 ,	.2614)
.010	.0669	(.0078 ,	.2808)
.020	.0984	(.0190 ,	.3062)
.030	.1234	(.0311 ,	.3257)
.040	.1449	(.0434 ,	.3429)
.050	.1642	(.0556 ,	.3588)
.060	.1818	(.0674 ,	.3740)
.070	.1983	(.0788 ,	.3888)
.080	.2137	(.0897 ,	.4034)
.090	.2283	(.1000 ,	.4179)
.100	.2423	(.1098 ,	.4323)
.110	.2556	(.1191 ,	.4466)
.120	.2685	(.1279 ,	.4609)
.130	.2809	(.1361 ,	.4751)
.140	.2930	(.1439 ,	.4893)
.150	.3046	(.1513 ,	.5035)
.200	.3587	(.1823 ,	.5725)
.250	.4076	(.2063 ,	.6376)
.300	.4527	(.2255 ,	.6972)
.400	.5354	(.2555 ,	.7981)
.500	.6112	(.2795 ,	.8748)
.600	.6830	(.3008 ,	.9298)
.700	.7530	(.3218 ,	.9664)
.800	.8230	(.3447 ,	.9879)
.900	.8969	(.3746 ,	.9978)
.950	.9385	(.3984 ,	.9996)

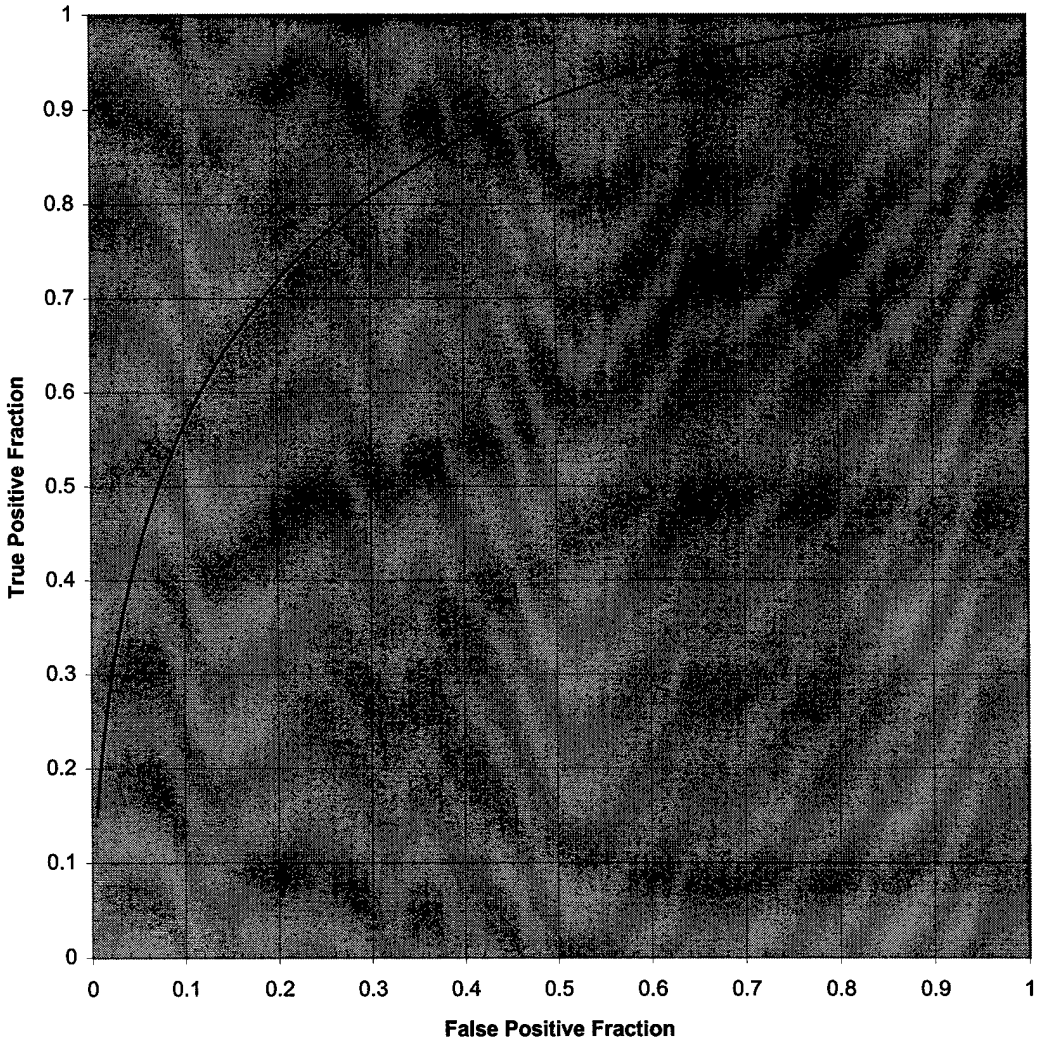
ESTIMATES OF EXPECTED OPERATING POINTS ON FITTED ROC CURVE, WITH LOWER AND UPPER BOUNDS OF ASYMMETRIC 95% CONFIDENCE INTERVAL ALONG THE CURVE FOR THOSE POINTS:

EXPECTED OPERATING POINT (FPF , TPF)	LOWER BOUND (FPF , TPF)	UPPER BOUND (FPF , TPF)
(.0359, .1364)	(.0195, .0972)	(.0619, .1852)
(.0646, .1895)	(.0415, .1480)	(.0965, .2375)
(.0851, .2212)	(.0582, .1788)	(.1203, .2689)
(.2052, .3640)	(.1630, .3193)	(.2532, .4105)

Do you want to use data from a previously created input file for the next run?
(Y/N, or Q to quit)
enter INPUT file name:
The input file ( ) CANNOT be found in your current subdirectory!
enter INPUT file name:

```
The input file (              ) CANNOT be found in your current
subdirectory!
enter INPUT file name:
The input file (              ) CANNOT be found in your current
subdirectory!
enter INPUT file name:
```

Reader05 Analog ROC Type=Diag N=329 Area=.8401 STD Area=.0258



```
Do you want to use data from a previously created input file for the
next run?
(Y/N, or Q to quit)
enter INPUT file name:
Do you want to save an output file for plotting the ROC curve?
(Y/N, or R to restart)
                                                                DATE -
11/18/1998
                                                              TIME -
14:44:18
              R O C F I T  (IBM VERSION 1.2) :

    M A X I M U M   L I K E L I H O O D   E S T I M A T I O N
         O F   A   B I N O R M A L   R O C   C U R V E
               F R O M   R A T I N G   D A T A


     DATA DESCRIPTION: Reader 05 Analog diag resp for 329 cases

     DATA COLLECTED IN  5 CATEGORIES
     WITH CATEGORY  5 REPRESENTING STRONGEST EVIDENCE OF POSITIVITY
     (E.G., THAT ABNORMALITY IS PRESENT).

     NO. OF ACTUALLY NEGATIVE CASES =  240.
     NO. OF ACTUALLY POSITIVE CASES =   89.

     RESPONSE DATA:
      CATEGORY                    1      2      3      4      5
      ACTUALLY NEGATIVE CASES   105.    85.    22.    25.     3.
      ACTUALLY POSITIVE CASES     5.    21.    12.    27.    24.

     OBSERVED OPERATING POINTS:
      FPF:  .000  .013  .117  .208  .563 1.000
      TPF:  .000  .270  .573  .708  .944 1.000

            INITIAL VALUES OF PARAMETERS:
    A=  1.3631    B=   .9165
    Z(K)=  -.157   .812  1.192  2.242
    LOGL=  -430.6153
    CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
     BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.

     PROCEDURE CONVERGES AFTER   4 ITERATIONS.

            FINAL VALUES OF PARAMETERS:
    A=  1.3603    B=   .9327
    Z(K)=  -.163   .831  1.215  2.144
    LOGL=  -430.1785
    CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
     BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.


            VARIANCE-COVARIANCE MATRIX:
    A        .0349   .0159   .0052   .0053   .0041  -.0029
    B        .0159   .0166   .0020  -.0005  -.0029  -.0141
    Z( 1)    .0052   .0020   .0066   .0035   .0028   .0013
    Z( 2)    .0053  -.0005   .0035   .0078   .0068   .0063
    Z( 3)    .0041  -.0029   .0028   .0068   .0102   .0104
    Z( 4)   -.0029  -.0141   .0013   .0063   .0104   .0321

            CORRELATION MATRIX:
    A       1.0000   .6596   .3466   .3211   .2196  -.0860
    B        .6596  1.0000   .1888  -.0431  -.2266  -.6133
    Z( 1)    .3466   .1888  1.0000   .4857   .3442   .0883
```

Z(2)	.3211	-.0431	.4857	1.0000	.7687	.3964
Z(3)	.2196	-.2266	.3442	.7687	1.0000	.5776
Z(4)	-.0860	-.6133	.0883	.3964	.5776	1.0000

AREA = .8401 STD. DEV.(AREA) = .0258

ESTIMATED BINORMAL ROC CURVE, WITH LOWER AND UPPER BOUNDS ON ASYMMETRIC 95% CONFIDENCE INTERVAL FOR TRUE-POSITIVE FRACTION AT EACH SPECIFIED FALSE-POSITIVE FRACTION:

FPF	TPF	(LOWER BOUND,	UPPER BOUND)
.005	.1486	(.0624 ,	.2912)
.010	.2090	(.1054 ,	.3564)
.020	.2892	(.1721 ,	.4344)
.030	.3467	(.2251 ,	.4866)
.040	.3925	(.2698 ,	.5269)
.050	.4309	(.3087 ,	.5601)
.060	.4641	(.3431 ,	.5885)
.070	.4935	(.3740 ,	.6135)
.080	.5198	(.4021 ,	.6358)
.090	.5436	(.4277 ,	.6559)
.100	.5655	(.4513 ,	.6744)
.110	.5856	(.4731 ,	.6914)
.120	.6042	(.4934 ,	.7071)
.130	.6216	(.5124 ,	.7218)
.140	.6378	(.5301 ,	.7356)
.150	.6531	(.5468 ,	.7485)
.200	.7175	(.6174 ,	.8030)
.250	.7678	(.6726 ,	.8452)
.300	.8083	(.7175 ,	.8786)
.400	.8696	(.7872 ,	.9268)
.500	.9131	(.8399 ,	.9579)
.600	.9448	(.8820 ,	.9776)
.700	.9678	(.9169 ,	.9896)
.800	.9840	(.9468 ,	.9963)
.900	.9947	(.9730 ,	.9993)
.950	.9981	(.9855 ,	.9998)

ESTIMATES OF EXPECTED OPERATING POINTS ON FITTED ROC CURVE, WITH LOWER AND UPPER BOUNDS OF ASYMMETRIC 95% CONFIDENCE INTERVAL ALONG THE CURVE FOR THOSE POINTS:

EXPECTED OPERATING POINT (FPF , TPF)	LOWER BOUND (FPF , TPF)	UPPER BOUND (FPF , TPF)
(.0160, .2614)	(.0063, .1668)	(.0365, .3777)
(.1122, .5898)	(.0789, .5171)	(.1545, .6596)
(.2030, .7209)	(.1577, .6642)	(.2553, .7724)
(.5649, .9348)	(.5019, .9138)	(.6264, .9516)

Do you want to use data from a previously created input file for the next run?
(Y/N, or Q to quit)
enter INPUT file name:
The input file ( ) CANNOT be found in your current subdirectory!
enter INPUT file name:

```
The input file (              ) CANNOT be found in your current
subdirectory!
enter INPUT file name:
The input file (              ) CANNOT be found in your current
subdirectory!
enter INPUT file name:
The input file (              ) CANNOT be found in your current
subdirectory!
enter INPUT file name:
```

Reader06_Analog (191 cases)

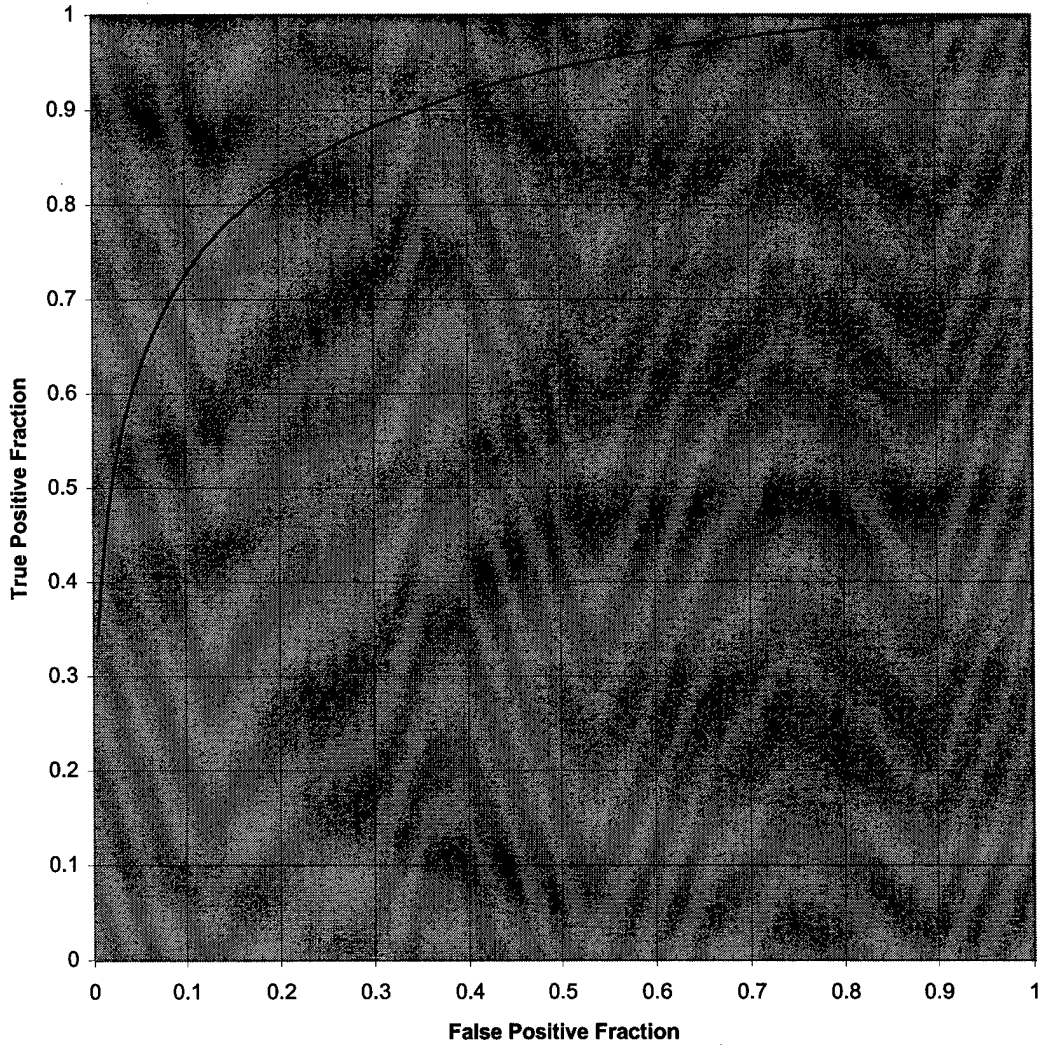
Totals

	Type	round Truth, Mas	Ground Truth, uCa	Ground Truth, FAD	round Truth, Dia
Total Normal	117	171	153	178	153
Total Abnormal	74	20	38	13	38
	Resp = 1	Resp = 2	Resp = 3	Resp = 4	Resp = 5
Resp, Mass, N	33	118	11	4	5
Resp, Mass, A	1	2	2	6	9
Resp, Ca, N	35	99	9	6	4
Resp, Ca, A	3	6	2	3	24
Resp, FAD, N	31	115	14	14	4
Resp, FAD, A	1	4	3	2	3
Resp, Diag, B	5	110	35	3	0
Resp, Diag, M	0	5	16	13	4

Reader06_Digital (191 cases)

Totals	Type	Ground Truth, Mass	round Truth, uC	Ground Truth, FAD	round Truth, Dia
Total Normal	117	171	153	178	153
Total Abnormal	74	20	38	13	38
	Resp = 1	Resp = 2	Resp = 3	Resp = 4	Resp = 5
Resp, Mass, N	18	139	7	2	5
Resp, Mass, A	0	4	6	5	5
Resp, Ca, N	15	121	8	8	1
Resp, Ca, A	0	22	3	3	10
Resp, FAD, N	17	133	20	4	4
Resp, FAD, A	0	9	3	1	0
Resp, Diag, B	2	123	25	2	1
Resp, Diag, M	0	14	13	9	2

Reader06 Analog ROC Type=Mass N=191 Area=.8958 STD Area=.0458



Do you want to use data from a previously created input file for the next run?
(Y/N, or Q to quit)
enter INPUT file name:
Do you want to save an output file for plotting the ROC curve?
(Y/N, or R to restart)

DATE - 8/28/1998

TIME - 8:49: 3

R O C F I T (IBM VERSION 1.2) :

M A X I M U M L I K E L I H O O D E S T I M A T I O N
O F A B I N O R M A L R O C C U R V E
F R O M R A T I N G D A T A

DATA DESCRIPTION: Reader 06 Analog Mass resp for 191 cases available.

DATA COLLECTED IN 5 CATEGORIES
WITH CATEGORY 5 REPRESENTING STRONGEST EVIDENCE OF POSITIVITY
(E.G., THAT ABNORMALITY IS PRESENT).

NO. OF ACTUALLY NEGATIVE CASES = 171.
NO. OF ACTUALLY POSITIVE CASES = 20.

RESPONSE DATA:

CATEGORY	1	2	3	4	5
ACTUALLY NEGATIVE CASES	33.	118.	11.	4.	5.
ACTUALLY POSITIVE CASES	1.	2.	2.	6.	9.

OBSERVED OPERATING POINTS:

FPF:	.000	.029	.053	.117	.807	1.000
TPF:	.000	.450	.750	.850	.950	1.000

INITIAL VALUES OF PARAMETERS:
A= 1.3051 B= .5187
Z(K)= -.867 1.190 1.620 1.893
LOGL= -194.4213
CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.

PROCEDURE CONVERGES AFTER 5 ITERATIONS.

FINAL VALUES OF PARAMETERS:
A= 1.5905 B= .7737
Z(K)= -.853 1.150 1.574 2.059
LOGL= -191.3606
CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.

VARIANCE-COVARIANCE MATRIX:

A	.2014	.0878	.0051	.0093	.0050	-.0077
B	.0878	.0613	.0020	.0001	-.0056	-.0193
Z(1)	.0051	.0020	.0120	.0026	.0021	.0014
Z(2)	.0093	.0001	.0026	.0148	.0126	.0111
Z(3)	.0050	-.0056	.0021	.0126	.0226	.0208
Z(4)	-.0077	-.0193	.0014	.0111	.0208	.0449

CORRELATION MATRIX:

A	1.0000	.7905	.1033	.1707	.0739	-.0804
B	.7905	1.0000	.0752	.0030	-.1507	-.3677

Z(1)	.1033	.0752	1.0000	.1956	.1254	.0606
Z(2)	.1707	.0030	.1956	1.0000	.6864	.4283
Z(3)	.0739	-.1507	.1254	.6864	1.0000	.6538
Z(4)	-.0804	-.3677	.0606	.4283	.6538	1.0000

AREA = .8958 STD. DEV.(AREA) = .0458

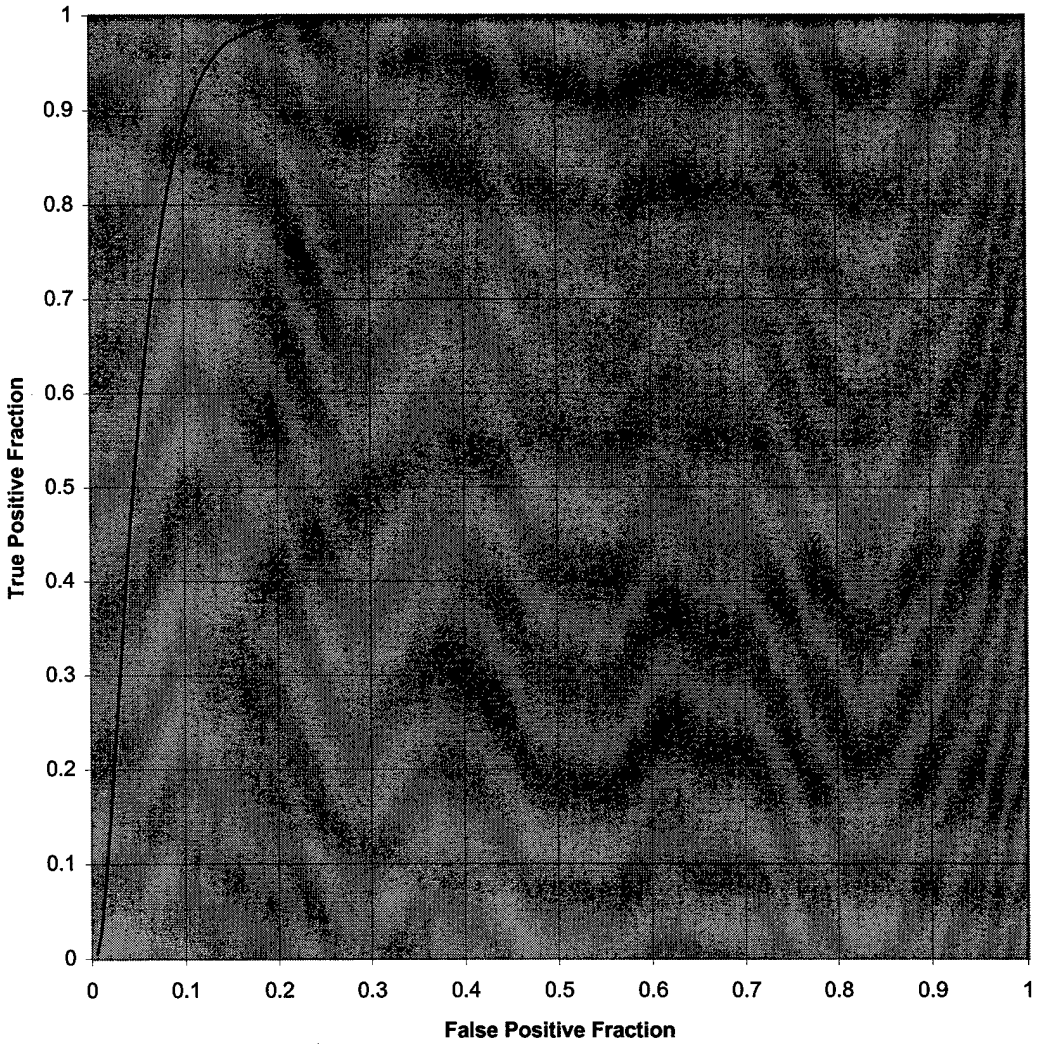
ESTIMATED BINORMAL ROC CURVE, WITH LOWER AND UPPER BOUNDS ON ASYMMETRIC 95% CONFIDENCE INTERVAL FOR TRUE-POSITIVE FRACTION AT EACH SPECIFIED FALSE-POSITIVE FRACTION:

FPF	TPF	(LOWER BOUND,	UPPER BOUND)
.005	.3436	(.1198 ,	.6445)
.010	.4169	(.1837 ,	.6850)
.020	.5005	(.2689 ,	.7319)
.030	.5537	(.3278 ,	.7630)
.040	.5932	(.3727 ,	.7870)
.050	.6246	(.4087 ,	.8068)
.060	.6507	(.4386 ,	.8236)
.070	.6731	(.4639 ,	.8383)
.080	.6926	(.4858 ,	.8513)
.090	.7099	(.5050 ,	.8629)
.100	.7254	(.5220 ,	.8734)
.110	.7394	(.5373 ,	.8828)
.120	.7522	(.5510 ,	.8915)
.130	.7639	(.5636 ,	.8993)
.140	.7748	(.5751 ,	.9066)
.150	.7848	(.5857 ,	.9132)
.200	.8263	(.6290 ,	.9394)
.250	.8574	(.6614 ,	.9574)
.300	.8820	(.6875 ,	.9700)
.400	.9185	(.7286 ,	.9854)
.500	.9441	(.7614 ,	.9932)
.600	.9630	(.7901 ,	.9972)
.700	.9770	(.8171 ,	.9990)
.800	.9875	(.8446 ,	.9997)
.900	.9951	(.8768 ,	1.0000)
.950	.9979	(.8990 ,	1.0000)

ESTIMATES OF EXPECTED OPERATING POINTS ON FITTED ROC CURVE, WITH LOWER AND UPPER BOUNDS OF ASYMMETRIC 95% CONFIDENCE INTERVAL ALONG THE CURVE FOR THOSE POINTS:

EXPECTED OPERATING POINT (FPF , TPF)	LOWER BOUND (FPF , TPF)	UPPER BOUND (FPF , TPF)
(.0197, .4989)	(.0067, .3728)	(.0501, .6250)
(.0577, .6452)	(.0308, .5575)	(.1003, .7258)
(.1250, .7582)	(.0824, .6970)	(.1809, .8119)
(.8030, .9878)	(.7382, .9814)	(.8571, .9922)

Do you want to use data from a previously created input file for the next run?
(Y/N, or Q to quit)
Stop - Program terminated.


Reader06 Digital ROC Type=Mass N=191 Area=.9451 STD Area=.0173
True Positive Fraction
False Positive Fraction
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1

```
Do you want to use data from a previously created input file for the next run?
(Y/N, or Q to quit)
enter INPUT file name:
Do you want to save an output file for plotting the ROC curve?
(Y/N, or R to restart)
                                                        DATE -  8/28/1998
                                                      TIME -  8:49: 3
            R O C F I T  (IBM VERSION 1.2) :

    M A X I M U M   L I K E L I H O O D   E S T I M A T I O N
         O F   A   B I N O R M A L   R O C   C U R V E
               F R O M   R A T I N G   D A T A


 DATA DESCRIPTION: Reader 06 Digital Mass resp for 191 cases available.

 DATA COLLECTED IN  5 CATEGORIES
 WITH CATEGORY  5 REPRESENTING STRONGEST EVIDENCE OF POSITIVITY
 (E.G., THAT ABNORMALITY IS PRESENT).

 NO. OF ACTUALLY NEGATIVE CASES =  171.
 NO. OF ACTUALLY POSITIVE CASES =   20.

 RESPONSE DATA:
  CATEGORY                    1      2      3      4      5
  ACTUALLY NEGATIVE CASES   18.   139.     7.     2.     5.
  ACTUALLY POSITIVE CASES    0.     4.     6.     5.     5.

 OBSERVED OPERATING POINTS:
  FPF:  .000  .029  .041  .082  .895 1.000
  TPF:  .000  .250  .500  .800 1.000 1.000

        INITIAL VALUES OF PARAMETERS:
 A=  1.1886    B=   .6962
 Z(K)= -1.252  1.393  1.740  1.893
 LOGL=  -155.8947
 CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
  BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.

 PROCEDURE CONVERGES AFTER   6 ITERATIONS.

        FINAL VALUES OF PARAMETERS:
 A=  4.9718    B=  2.9439
 Z(K)= -1.252  1.393  1.708  1.909
 LOGL=  -145.9707
 CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
  BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.


        VARIANCE-COVARIANCE MATRIX:
 A      3.5380  2.1296   .0082   .0865  -.0338  -.1326
 B      2.1296  1.3725   .0020   .0215  -.0616  -.1269
 Z( 1)   .0082   .0020   .0166   .0018   .0016   .0015
 Z( 2)   .0865   .0215   .0018   .0192   .0169   .0155
 Z( 3)  -.0338  -.0616   .0016   .0169   .0258   .0277
 Z( 4)  -.1326  -.1269   .0015   .0155   .0277   .0376

        CORRELATION MATRIX:
 A      1.0000   .9664   .0339   .3315  -.1119  -.3633
```

B	.9664	1.0000	.0135	.1323	-.3272	-.5581
Z(1)	.0339	.0135	1.0000	.1023	.0775	.0588
Z(2)	.3315	.1323	.1023	1.0000	.7572	.5747
Z(3)	-.1119	-.3272	.0775	.7572	1.0000	.8888
Z(4)	-.3633	-.5581	.0588	.5747	.8888	1.0000

AREA = .9451 STD. DEV.(AREA) = .0173

ESTIMATED BINORMAL ROC CURVE, WITH LOWER AND UPPER BOUNDS ON ASYMMETRIC 95% CONFIDENCE INTERVAL FOR TRUE-POSITIVE FRACTION AT EACH SPECIFIED FALSE-POSITIVE FRACTION:

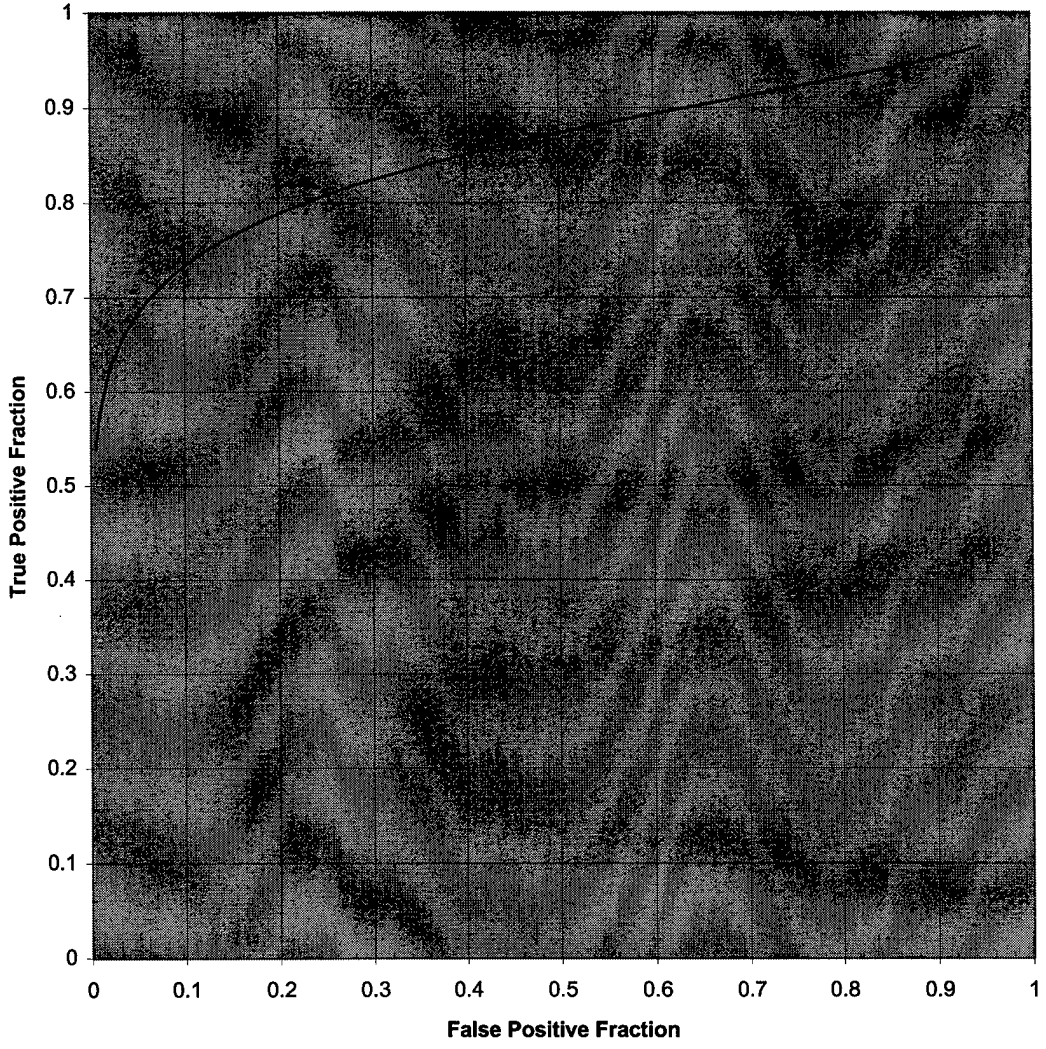
FPF	TPF	(LOWER BOUND,	UPPER BOUND)
.005	.0045	(.0000 ,	.4697)
.010	.0302	(.0000 ,	.5551)
.020	.1411	(.0051 ,	.6619)
.030	.2856	(.0376 ,	.7410)
.040	.4273	(.1083 ,	.8076)
.050	.5511	(.1996 ,	.8643)
.060	.6531	(.2899 ,	.9101)
.070	.7345	(.3681 ,	.9440)
.080	.7981	(.4323 ,	.9671)
.090	.8471	(.4842 ,	.9816)
.100	.8846	(.5265 ,	.9901)
.110	.9132	(.5614 ,	.9949)
.120	.9348	(.5909 ,	.9974)
.130	.9511	(.6161 ,	.9987)
.140	.9634	(.6380 ,	.9994)
.150	.9726	(.6573 ,	.9997)
.200	.9937	(.7286 ,	1.0000)
.250	.9986	(.7766 ,	1.0000)
.300	.9997	(.8123 ,	1.0000)
.400	1.0000	(.8639 ,	1.0000)
.500	1.0000	(.9006 ,	1.0000)
.600	1.0000	(.9286 ,	1.0000)
.700	1.0000	(.9510 ,	1.0000)
.800	1.0000	(.9695 ,	1.0000)
.900	1.0000	(.9850 ,	1.0000)
.950	1.0000	(.9921 ,	1.0000)

ESTIMATES OF EXPECTED OPERATING POINTS ON FITTED ROC CURVE, WITH LOWER AND UPPER BOUNDS OF ASYMMETRIC 95% CONFIDENCE INTERVAL ALONG THE CURVE FOR THOSE POINTS:

EXPECTED OPERATING POINT (FPF , TPF)	LOWER BOUND (FPF , TPF)	UPPER BOUND (FPF , TPF)
(.0281, .2585)	(.0110, .0386)	(.0632, .6814)
(.0439, .4781)	(.0216, .1631)	(.0819, .8084)
(.0817, .8077)	(.0479, .5277)	(.1310, .9525)
(.8947, 1.0000)	(.8412, 1.0000)	(.9338, 1.0000)

```
Do you want to use data from a previously created input file for the next run?
(Y/N, or Q to quit)
Stop - Program terminated.
```

Reader06 Analog ROC Type=Calc N=191 Area=.8550 STD Area=.0464



```
Do you want to use data from a previously created input file for the next run?
(Y/N, or Q to quit)
enter INPUT file name:
Do you want to save an output file for plotting the ROC curve?
(Y/N, or R to restart)
                                                        DATE -  8/28/1998
                                                      TIME -  8:49: 3
            R O C F I T  (IBM VERSION 1.2) :

    M A X I M U M   L I K E L I H O O D   E S T I M A T I O N
         O F   A   B I N O R M A L   R O C   C U R V E
               F R O M   R A T I N G   D A T A


     DATA DESCRIPTION: Reader 06 Analog Calc resp for 191 cases available.

     DATA COLLECTED IN  5 CATEGORIES
     WITH CATEGORY  5 REPRESENTING STRONGEST EVIDENCE OF POSITIVITY
     (E.G., THAT ABNORMALITY IS PRESENT).

     NO. OF ACTUALLY NEGATIVE CASES =  153.
     NO. OF ACTUALLY POSITIVE CASES =   38.

     RESPONSE DATA:
      CATEGORY                    1      2      3      4      5
      ACTUALLY NEGATIVE CASES   35.    99.     9.     6.     4.
      ACTUALLY POSITIVE CASES    3.     6.     2.     3.    24.

     OBSERVED OPERATING POINTS:
      FPF:  .000  .026  .065  .124  .771 1.000
      TPF:  .000  .632  .711  .763  .921 1.000

           INITIAL VALUES OF PARAMETERS:
     A=  1.1337    B=   .3923
     Z(K)=  -.743  1.154  1.512  1.941
     LOGL=  -197.5969
     CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
      BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.

     PROCEDURE CONVERGES AFTER   3 ITERATIONS.

           FINAL VALUES OF PARAMETERS:
     A=  1.1422    B=   .4062
     Z(K)=  -.740  1.146  1.508  1.968
     LOGL=  -197.5536
     CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
      BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.


           VARIANCE-COVARIANCE MATRIX:
     A        .0583   .0151   .0035   .0035   .0032   .0019
     B        .0151   .0130   .0015  -.0010  -.0028  -.0074
     Z( 1)    .0035   .0015   .0125   .0031   .0025   .0018
     Z( 2)    .0035  -.0010   .0031   .0164   .0143   .0129
     Z( 3)    .0032  -.0028   .0025   .0143   .0233   .0213
     Z( 4)    .0019  -.0074   .0018   .0129   .0213   .0430

           CORRELATION MATRIX:
     A       1.0000   .5489   .1313   .1134   .0856   .0372
```

B	.5489	1.0000	.1165	-.0705	-.1631	-.3141
Z(1)	.1313	.1165	1.0000	.2186	.1483	.0757
Z(2)	.1134	-.0705	.2186	1.0000	.7318	.4854
Z(3)	.0856	-.1631	.1483	.7318	1.0000	.6728
Z(4)	.0372	-.3141	.0757	.4854	.6728	1.0000

AREA = .8550 STD. DEV.(AREA) = .0464

ESTIMATED BINORMAL ROC CURVE, WITH LOWER AND UPPER BOUNDS ON ASYMMETRIC 95% CONFIDENCE INTERVAL FOR TRUE-POSITIVE FRACTION AT EACH SPECIFIED FALSE-POSITIVE FRACTION:

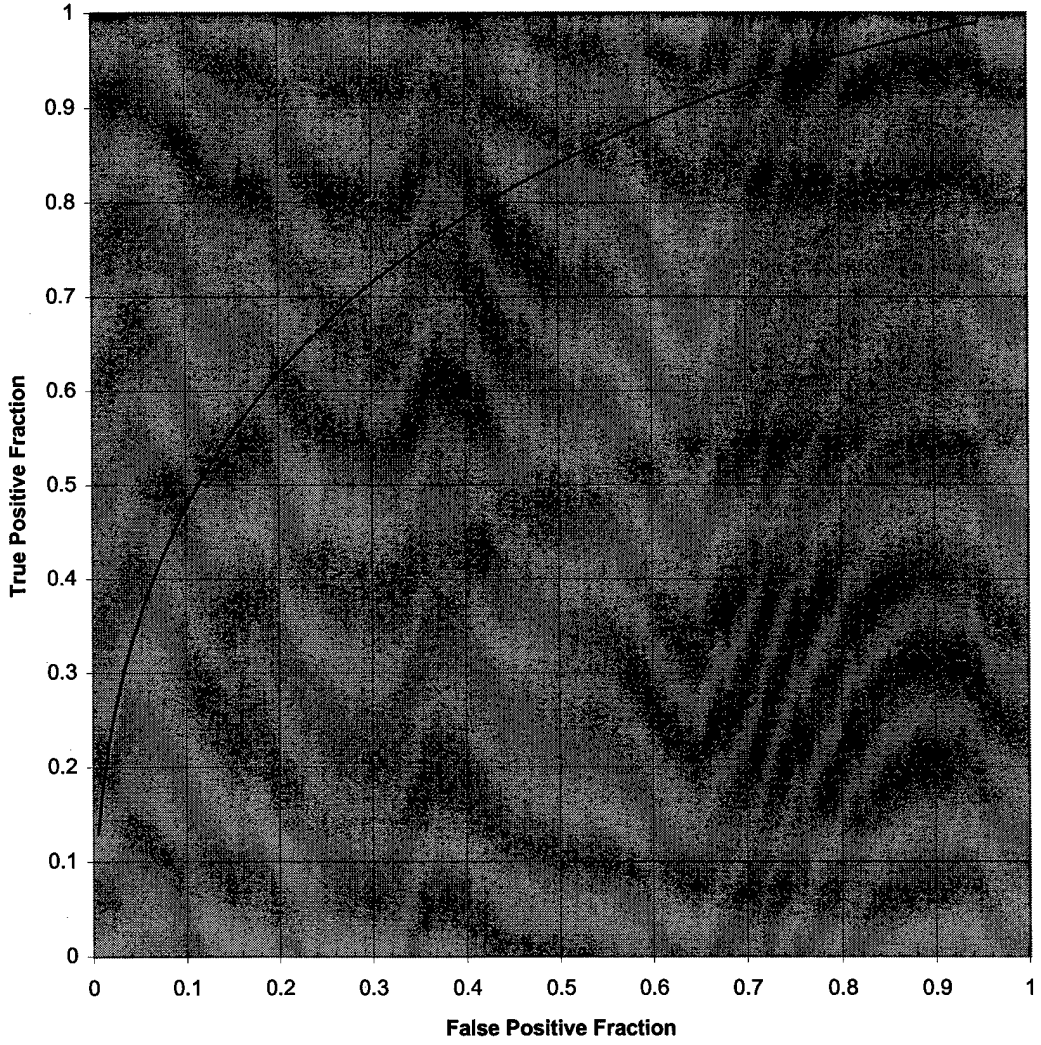
FPF	TPF	(LOWER BOUND,	UPPER BOUND)
.005	.5381	(.3406 ,	.7264)
.010	.5781	(.3911 ,	.7488)
.020	.6209	(.4462 ,	.7736)
.030	.6473	(.4804 ,	.7896)
.040	.6667	(.5055 ,	.8018)
.050	.6822	(.5254 ,	.8117)
.060	.6952	(.5419 ,	.8201)
.070	.7063	(.5560 ,	.8275)
.080	.7161	(.5682 ,	.8342)
.090	.7249	(.5792 ,	.8402)
.100	.7329	(.5890 ,	.8457)
.110	.7402	(.5979 ,	.8508)
.120	.7469	(.6061 ,	.8556)
.130	.7532	(.6136 ,	.8600)
.140	.7591	(.6207 ,	.8642)
.150	.7646	(.6272 ,	.8682)
.200	.7883	(.6548 ,	.8854)
.250	.8074	(.6765 ,	.8995)
.300	.8236	(.6945 ,	.9115)
.400	.8507	(.7239 ,	.9311)
.500	.8733	(.7482 ,	.9469)
.600	.8934	(.7698 ,	.9601)
.700	.9123	(.7906 ,	.9714)
.800	.9311	(.8123 ,	.9813)
.900	.9518	(.8385 ,	.9903)
.950	.9649	(.8574 ,	.9947)

ESTIMATES OF EXPECTED OPERATING POINTS ON FITTED ROC CURVE, WITH LOWER AND UPPER BOUNDS OF ASYMMETRIC 95% CONFIDENCE INTERVAL ALONG THE CURVE FOR THOSE POINTS:

EXPECTED OPERATING POINT (FPF , TPF)	LOWER BOUND (FPF , TPF)	UPPER BOUND (FPF , TPF)
(.0245, .6341)	(.0088, .5706)	(.0592, .6942)
(.0657, .7018)	(.0353, .6583)	(.1133, .7425)
(.1259, .7507)	(.0812, .7173)	(.1854, .7819)
(.7705, .9255)	(.6988, .9121)	(.8314, .9372)

```
Do you want to use data from a previously created input file for the next run?
(Y/N, or Q to quit)
Stop - Program terminated.
```

Reader06 Digital ROC Type=Calc N=191 Area=.7792 STD Area=.0536



```
Do you want to use data from a previously created input file for the next run?
(Y/N, or Q to quit)
enter INPUT file name:
Do you want to save an output file for plotting the ROC curve?
(Y/N, or R to restart)
                                                        DATE -  8/28/1998
                                                      TIME -  8:49: 3
            R O C F I T  (IBM VERSION 1.2) :

    M A X I M U M   L I K E L I H O O D   E S T I M A T I O N
         O F   A   B I N O R M A L   R O C   C U R V E
              F R O M   R A T I N G   D A T A


 DATA DESCRIPTION: Reader 06 Digital Calc resp for 191 cases available.

 DATA COLLECTED IN  5 CATEGORIES
 WITH CATEGORY  5 REPRESENTING STRONGEST EVIDENCE OF POSITIVITY
 (E.G., THAT ABNORMALITY IS PRESENT).

 NO. OF ACTUALLY NEGATIVE CASES =  153.
 NO. OF ACTUALLY POSITIVE CASES =   38.

 RESPONSE DATA:
  CATEGORY                    1      2      3      4      5
  ACTUALLY NEGATIVE CASES    15.   121.     8.     8.     1.
  ACTUALLY POSITIVE CASES     0.    22.     3.     3.    10.

 OBSERVED OPERATING POINTS:
  FPF:  .000  .007  .059  .111  .902 1.000
  TPF:  .000  .263  .342  .421 1.000 1.000

        INITIAL VALUES OF PARAMETERS:
 A=  1.0463    B=   .8055
 Z(K)= -1.293  1.221  1.565  2.482
 LOGL=  -161.2745
 CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
  BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.

 PROCEDURE CONVERGES AFTER   6 ITERATIONS.

        FINAL VALUES OF PARAMETERS:
 A=   .9989    B=   .8272
 Z(K)= -1.318  1.273  1.587  2.120
 LOGL=  -159.0667
 CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
  BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.


        VARIANCE-COVARIANCE MATRIX:
 A       .0781   .0301   .0083   .0103   .0076   .0004
 B       .0301   .0265   .0042  -.0021  -.0059  -.0156
 Z( 1)   .0083   .0042   .0197   .0024   .0017   .0002
 Z( 2)   .0103  -.0021   .0024   .0182   .0168   .0160
 Z( 3)   .0076  -.0059   .0017   .0168   .0244   .0238
 Z( 4)   .0004  -.0156   .0002   .0160   .0238   .0484

        CORRELATION MATRIX:
 A      1.0000   .6603   .2107   .2729   .1733   .0065
```

B	.6603	1.0000	.1817	-.0946	-.2336	-.4352
Z(1)	.2107	.1817	1.0000	.1293	.0783	.0060
Z(2)	.2729	-.0946	.1293	1.0000	.7988	.5395
Z(3)	.1733	-.2336	.0783	.7988	1.0000	.6922
Z(4)	.0065	-.4352	.0060	.5395	.6922	1.0000

AREA = .7792 STD. DEV.(AREA) = .0536

ESTIMATED BINORMAL ROC CURVE, WITH LOWER AND UPPER BOUNDS ON ASYMMETRIC 95% CONFIDENCE INTERVAL FOR TRUE-POSITIVE FRACTION AT EACH SPECIFIED FALSE-POSITIVE FRACTION:

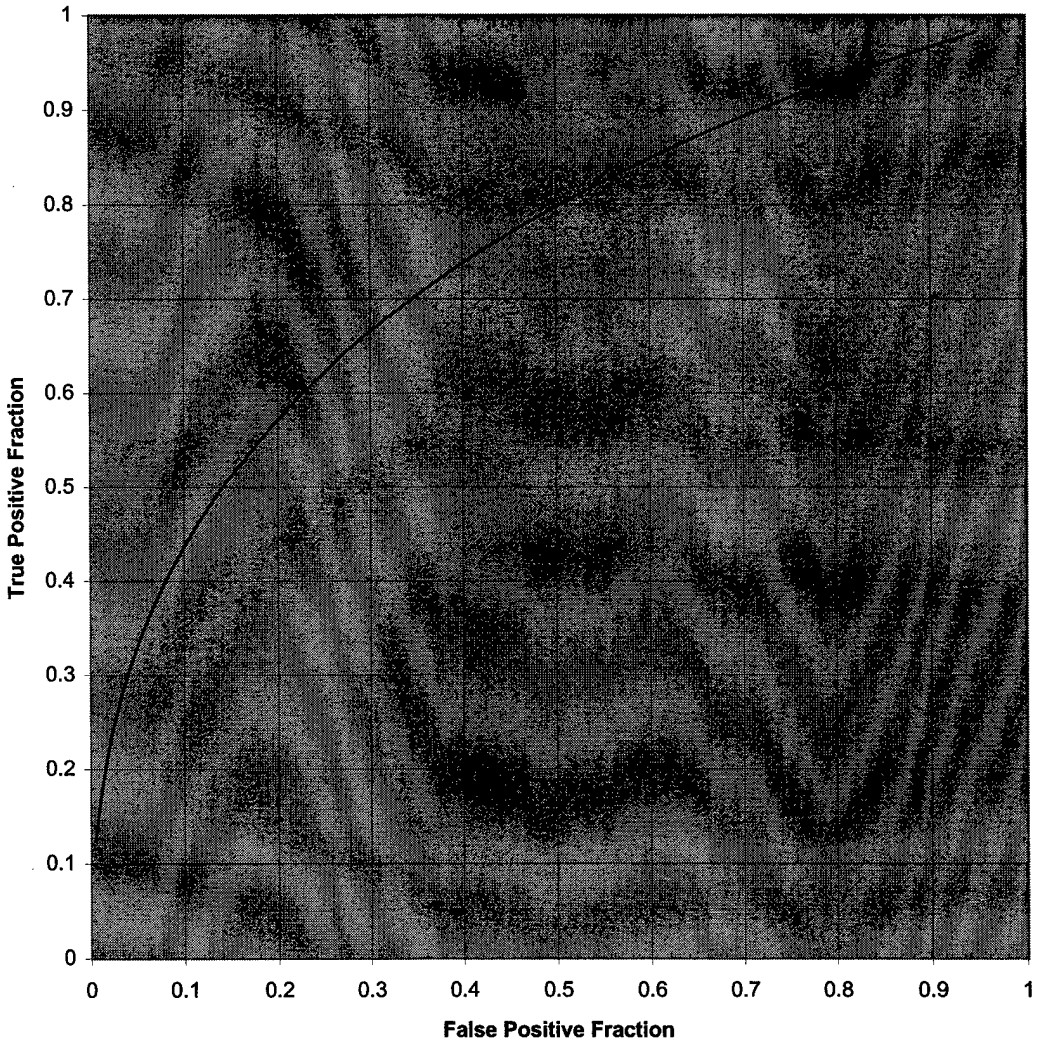
FPF	TPF	(LOWER BOUND,	UPPER BOUND)
.005	.1288	(.0401 ,	.3034)
.010	.1773	(.0686 ,	.3575)
.020	.2418	(.1139 ,	.4228)
.030	.2887	(.1508 ,	.4675)
.040	.3265	(.1825 ,	.5026)
.050	.3586	(.2105 ,	.5321)
.060	.3869	(.2357 ,	.5578)
.070	.4121	(.2586 ,	.5806)
.080	.4350	(.2796 ,	.6013)
.090	.4560	(.2991 ,	.6203)
.100	.4755	(.3172 ,	.6378)
.110	.4937	(.3342 ,	.6541)
.120	.5107	(.3502 ,	.6694)
.130	.5267	(.3653 ,	.6838)
.140	.5419	(.3796 ,	.6974)
.150	.5563	(.3932 ,	.7102)
.200	.6190	(.4527 ,	.7656)
.250	.6705	(.5018 ,	.8100)
.300	.7141	(.5440 ,	.8462)
.400	.7851	(.6147 ,	.9011)
.500	.8411	(.6741 ,	.9390)
.600	.8865	(.7271 ,	.9650)
.700	.9240	(.7771 ,	.9822)
.800	.9550	(.8270 ,	.9928)
.900	.9803	(.8821 ,	.9983)
.950	.9909	(.9165 ,	.9996)

ESTIMATES OF EXPECTED OPERATING POINTS ON FITTED ROC CURVE, WITH LOWER AND UPPER BOUNDS OF ASYMMETRIC 95% CONFIDENCE INTERVAL ALONG THE CURVE FOR THOSE POINTS:

EXPECTED OPERATING POINT (FPF , TPF)	LOWER BOUND (FPF , TPF)	UPPER BOUND (FPF , TPF)
(.0170, .2252)	(.0054, .1332)	(.0456, .3452)
(.0563, .3768)	(.0292, .2853)	(.1002, .4759)
(.1015, .4785)	(.0621, .3926)	(.1566, .5653)
(.9063, .9817)	(.8516, .9687)	(.9444, .9897)

```
Do you want to use data from a previously created input file for the next run?
(Y/N, or Q to quit)
Stop - Program terminated.
```

Reader06 Analog ROC Type=FAD N=191 Area=.7450 STD Area=.0834



```
Do you want to use data from a previously created input file for the next run?
(Y/N, or Q to quit)
enter INPUT file name:
Do you want to save an output file for plotting the ROC curve?
(Y/N, or R to restart)
                                                        DATE -  8/28/1998
                                                      TIME -  8:49: 3
            R O C F I T  (IBM VERSION 1.2) :

    M A X I M U M   L I K E L I H O O D   E S T I M A T I O N
         O F   A   B I N O R M A L   R O C   C U R V E
               F R O M   R A T I N G   D A T A


     DATA DESCRIPTION: Reader 06 Analog FAD resp for 191 cases available.

     DATA COLLECTED IN  5 CATEGORIES
     WITH CATEGORY  5 REPRESENTING STRONGEST EVIDENCE OF POSITIVITY
     (E.G., THAT ABNORMALITY IS PRESENT).

     NO. OF ACTUALLY NEGATIVE CASES =  178.
     NO. OF ACTUALLY POSITIVE CASES =   13.

     RESPONSE DATA:
      CATEGORY                    1      2      3      4      5
      ACTUALLY NEGATIVE CASES    31.   115.    14.    14.     4.
      ACTUALLY POSITIVE CASES     1.     4.     3.     2.     3.

     OBSERVED OPERATING POINTS:
      FPF:  .000  .022  .101  .180  .826 1.000
      TPF:  .000  .231  .385  .615  .923 1.000

           INITIAL VALUES OF PARAMETERS:
     A=    .7746     B=    .7389
     Z(K)=  -.938    .916  1.275  2.006
     LOGL=  -211.5228
     CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
      BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.

     PROCEDURE CONVERGES AFTER   4 ITERATIONS.

           FINAL VALUES OF PARAMETERS:
     A=    .8337     B=    .7752
     Z(K)=  -.934    .904  1.299  2.003
     LOGL=  -211.4104
     CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
      BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.


           VARIANCE-COVARIANCE MATRIX:
     A        .1361    .0446    .0055    .0060    .0052    .0019
     B        .0446    .0478    .0026   -.0007   -.0031   -.0118
     Z( 1)    .0055    .0026    .0122    .0027    .0022    .0013
     Z( 2)    .0060   -.0007    .0027    .0117    .0098    .0078
     Z( 3)    .0052   -.0031    .0022    .0098    .0162    .0131
     Z( 4)    .0019   -.0118    .0013    .0078    .0131    .0404

           CORRELATION MATRIX:
     A       1.0000    .5527    .1364    .1490    .1112    .0260
```

B	.5527	1.0000	.1075	-.0307	-.1108	-.2691
Z(1)	.1364	.1075	1.0000	.2281	.1549	.0593
Z(2)	.1490	-.0307	.2281	1.0000	.7102	.3603
Z(3)	.1112	-.1108	.1549	.7102	1.0000	.5138
Z(4)	.0260	-.2691	.0593	.3603	.5138	1.0000

AREA = .7450 STD. DEV.(AREA) = .0834

ESTIMATED BINORMAL ROC CURVE, WITH LOWER AND UPPER BOUNDS ON ASYMMETRIC 95% CONFIDENCE INTERVAL FOR TRUE-POSITIVE FRACTION AT EACH SPECIFIED FALSE-POSITIVE FRACTION:

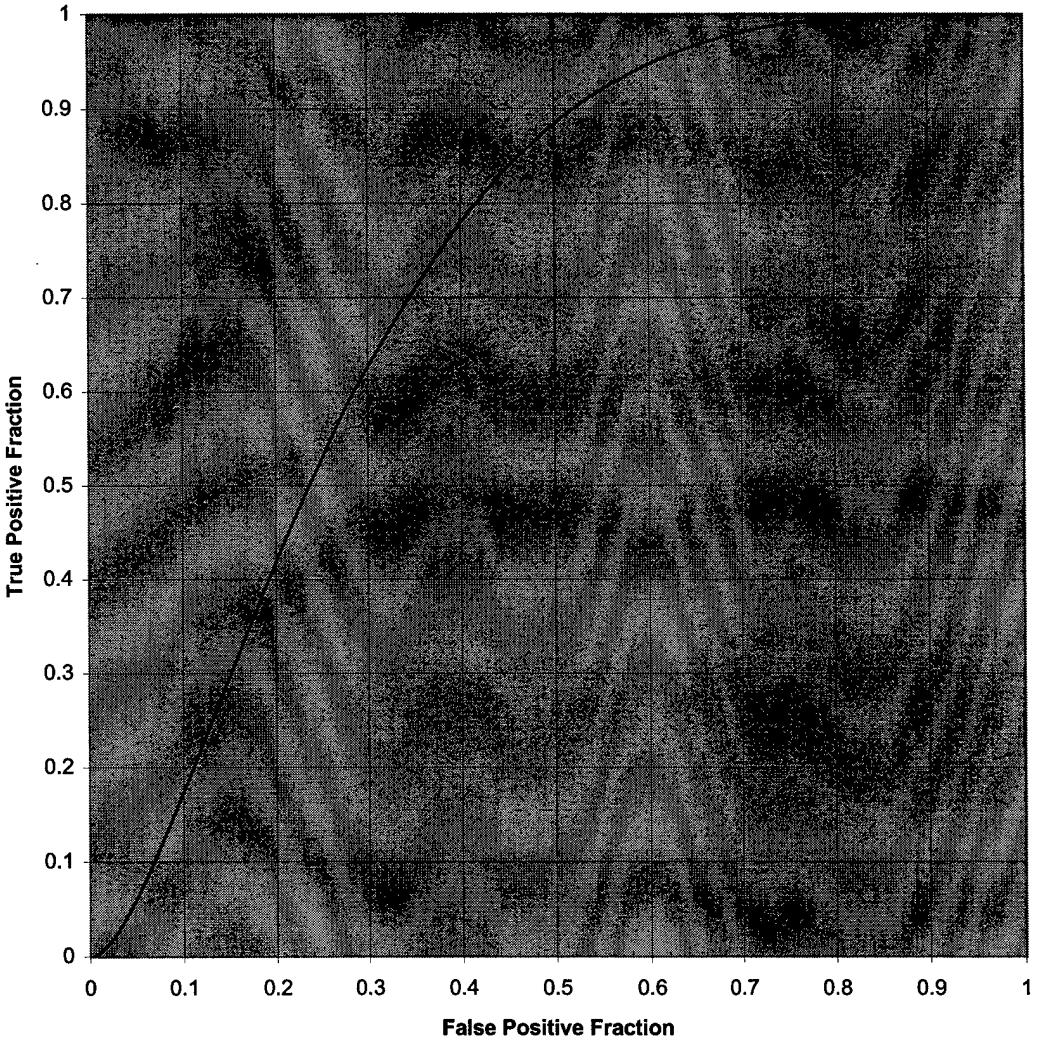
FPF	TPF	(LOWER BOUND,	UPPER BOUND)
.005	.1224	(.0183 ,	.4067)
.010	.1661	(.0345 ,	.4518)
.020	.2241	(.0631 ,	.5049)
.030	.2662	(.0883 ,	.5408)
.040	.3003	(.1111 ,	.5690)
.050	.3294	(.1320 ,	.5925)
.060	.3551	(.1513 ,	.6131)
.070	.3781	(.1694 ,	.6314)
.080	.3991	(.1864 ,	.6481)
.090	.4185	(.2023 ,	.6634)
.100	.4365	(.2175 ,	.6777)
.110	.4534	(.2318 ,	.6910)
.120	.4693	(.2455 ,	.7035)
.130	.4843	(.2586 ,	.7153)
.140	.4985	(.2710 ,	.7265)
.150	.5121	(.2830 ,	.7372)
.200	.5720	(.3364 ,	.7839)
.250	.6221	(.3815 ,	.8222)
.300	.6655	(.4207 ,	.8543)
.400	.7382	(.4874 ,	.9044)
.500	.7978	(.5440 ,	.9403)
.600	.8484	(.5954 ,	.9655)
.700	.8925	(.6451 ,	.9825)
.800	.9314	(.6970 ,	.9930)
.900	.9662	(.7590 ,	.9984)
.950	.9825	(.8025 ,	.9996)

ESTIMATES OF EXPECTED OPERATING POINTS ON FITTED ROC CURVE, WITH LOWER AND UPPER BOUNDS OF ASYMMETRIC 95% CONFIDENCE INTERVAL ALONG THE CURVE FOR THOSE POINTS:

EXPECTED OPERATING POINT (FPF , TPF)	LOWER BOUND (FPF , TPF)	UPPER BOUND (FPF , TPF)
(.0226, .2360)	(.0083, .1528)	(.0538, .3395)
(.0970, .4312)	(.0607, .3569)	(.1470, .5081)
(.1830, .5529)	(.1322, .4874)	(.2446, .6170)
(.8248, .9403)	(.7635, .9177)	(.8749, .9577)

```
Do you want to use data from a previously created input file for the next run?
(Y/N, or Q to quit)
Stop - Program terminated.
```

Reader06 Digital ROC Type=FAD N=191 Area=.7307 STD Area=.0995



```
Do you want to use data from a previously created input file for the next run?
(Y/N, or Q to quit)
enter INPUT file name:
Do you want to save an output file for plotting the ROC curve?
(Y/N, or R to restart)
                                                        DATE -  8/28/1998
                                                      TIME -  8:49: 3
            R O C F I T  (IBM VERSION 1.2) :

    M A X I M U M   L I K E L I H O O D   E S T I M A T I O N
         O F   A   B I N O R M A L   R O C   C U R V E
               F R O M   R A T I N G   D A T A


 DATA DESCRIPTION: Reader 06 Digital FAD resp for 191 cases available.

 DATA COLLECTED IN  5 CATEGORIES
 WITH CATEGORY  5 REPRESENTING STRONGEST EVIDENCE OF POSITIVITY
 (E.G., THAT ABNORMALITY IS PRESENT).

 NO. OF ACTUALLY NEGATIVE CASES =  178.
 NO. OF ACTUALLY POSITIVE CASES =   13.

 RESPONSE DATA:
  CATEGORY                    1      2      3      4      5
  ACTUALLY NEGATIVE CASES   17.   133.    20.     4.     4.
  ACTUALLY POSITIVE CASES    0.     9.     3.     1.     0.

 OBSERVED OPERATING POINTS:
  FPF:  .000  .022  .045  .157  .904 1.000
  TPF:  .000  .000  .077  .308 1.000 1.000

        INITIAL VALUES OF PARAMETERS:
 A=   .4203    B=  1.0617
 Z(K)= -1.308  1.006  1.696  2.006
 LOGL=  -164.3522
 CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
  BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.

 PROCEDURE CONVERGES AFTER   7 ITERATIONS.

        FINAL VALUES OF PARAMETERS:
 A=  1.1942    B=  1.6646
 Z(K)= -1.308  1.007  1.676  2.025
 LOGL=  -163.4719
 CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
  BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.


        VARIANCE-COVARIANCE MATRIX:
 A        .8199   .5903   .0069   .0259  -.0107  -.0242
 B        .5903   .5219   .0031   .0052  -.0278  -.0389
 Z( 1)    .0069   .0031   .0168   .0021   .0014   .0012
 Z( 2)    .0259   .0052   .0021   .0128   .0096   .0084
 Z( 3)   -.0107  -.0278   .0014   .0096   .0255   .0231
 Z( 4)   -.0242  -.0389   .0012   .0084   .0231   .0436

        CORRELATION MATRIX:
 A       1.0000   .9023   .0588   .2532  -.0741  -.1279
```

B	.9023	1.0000	.0325	.0632	-.2409	-.2578
Z(1)	.0588	.0325	1.0000	.1434	.0699	.0446
Z(2)	.2532	.0632	.1434	1.0000	.5302	.3549
Z(3)	-.0741	-.2409	.0699	.5302	1.0000	.6925
Z(4)	-.1279	-.2578	.0446	.3549	.6925	1.0000

AREA = .7307 STD. DEV.(AREA) = .0995

ESTIMATED BINORMAL ROC CURVE, WITH LOWER AND UPPER BOUNDS ON ASYMMETRIC 95% CONFIDENCE INTERVAL FOR TRUE-POSITIVE FRACTION AT EACH SPECIFIED FALSE-POSITIVE FRACTION:

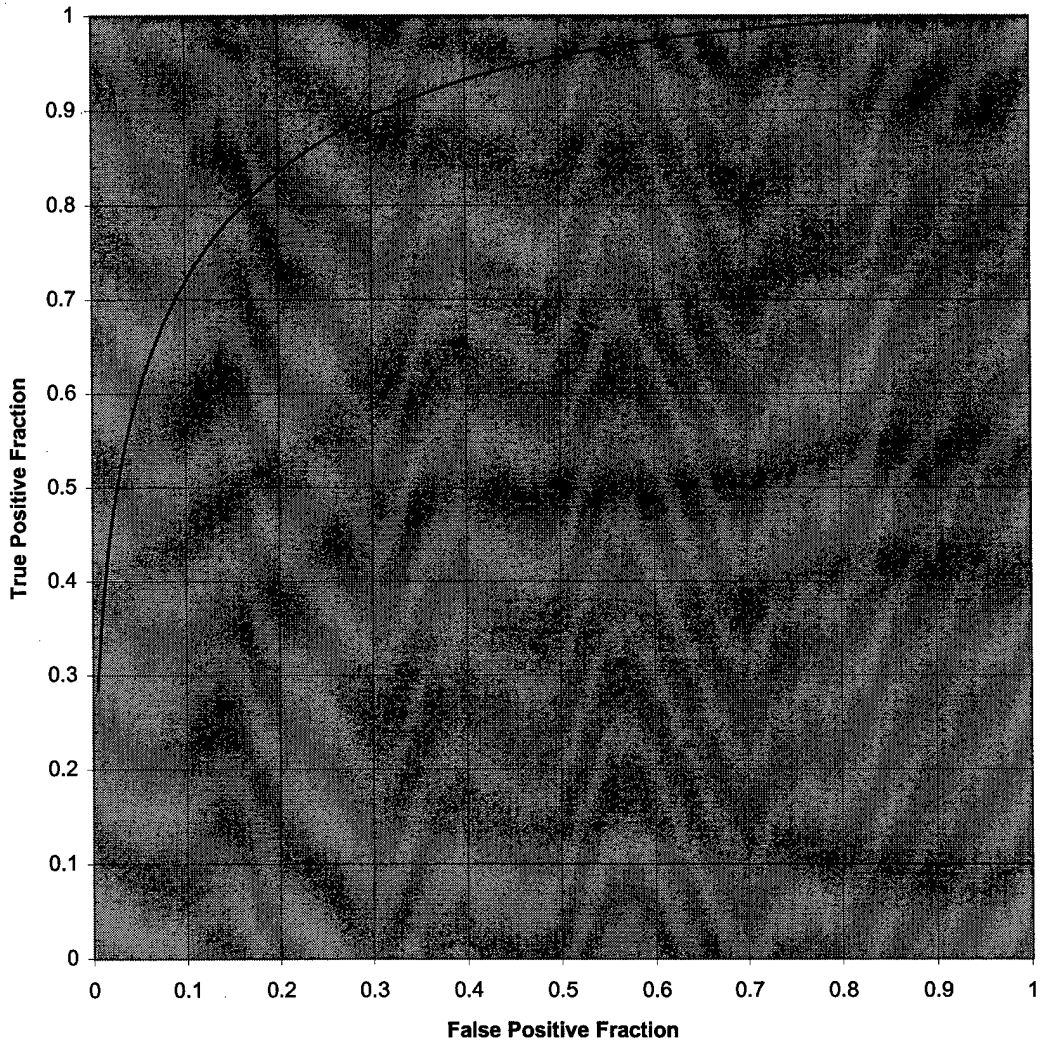
FPF	TPF	(LOWER BOUND,	UPPER BOUND)
.005	.0010	(.0000 ,	.1815)
.010	.0037	(.0000 ,	.2058)
.020	.0130	(.0001 ,	.2386)
.030	.0263	(.0006 ,	.2649)
.040	.0426	(.0020 ,	.2890)
.050	.0612	(.0047 ,	.3126)
.060	.0816	(.0090 ,	.3365)
.070	.1033	(.0150 ,	.3612)
.080	.1261	(.0226 ,	.3870)
.090	.1496	(.0315 ,	.4140)
.100	.1737	(.0415 ,	.4422)
.110	.1983	(.0521 ,	.4717)
.120	.2230	(.0631 ,	.5022)
.130	.2479	(.0741 ,	.5335)
.140	.2728	(.0849 ,	.5652)
.150	.2977	(.0955 ,	.5970)
.200	.4182	(.1413 ,	.7458)
.250	.5287	(.1762 ,	.8585)
.300	.6262	(.2036 ,	.9296)
.400	.7803	(.2462 ,	.9872)
.500	.8838	(.2808 ,	.9985)
.600	.9469	(.3126 ,	.9999)
.700	.9806	(.3451 ,	1.0000)
.800	.9953	(.3818 ,	1.0000)
.900	.9996	(.4313 ,	1.0000)
.950	1.0000	(.4714 ,	1.0000)

ESTIMATES OF EXPECTED OPERATING POINTS ON FITTED ROC CURVE, WITH LOWER AND UPPER BOUNDS OF ASYMMETRIC 95% CONFIDENCE INTERVAL ALONG THE CURVE FOR THOSE POINTS:

EXPECTED OPERATING POINT (FPF , TPF)	LOWER BOUND (FPF , TPF)	UPPER BOUND (FPF , TPF)
(.0214, .0147)	(.0075, .0021)	(.0530, .0673)
(.0469, .0553)	(.0234, .0172)	(.0865, .1413)
(.1569, .3147)	(.1095, .1972)	(.2161, .4549)
(.9045, .9996)	(.8539, .9984)	(.9409, .9999)

```
Do you want to use data from a previously created input file for the next run?
(Y/N, or Q to quit)
Stop - Program terminated.
```

Reader06 Analog ROC Type=Diag N=191 Area=.9008 STD Area=.0325



Do you want to use data from a previously created input file for the next run?
(Y/N, or Q to quit)
enter INPUT file name:
Do you want to save an output file for plotting the ROC curve?
(Y/N, or R to restart)

DATE - 8/28/1998
TIME - 8:49: 3

R O C F I T (IBM VERSION 1.2) :

M A X I M U M L I K E L I H O O D E S T I M A T I O N
O F A B I N O R M A L R O C C U R V E
F R O M R A T I N G D A T A

DATA DESCRIPTION: Reader 06 Analog Diag resp for 191 cases available.

DATA COLLECTED IN 5 CATEGORIES
WITH CATEGORY 5 REPRESENTING STRONGEST EVIDENCE OF POSITIVITY
(E.G., THAT ABNORMALITY IS PRESENT).

NO. OF ACTUALLY NEGATIVE CASES = 153.
NO. OF ACTUALLY POSITIVE CASES = 38.

RESPONSE DATA:

CATEGORY	1	2	3	4	5
ACTUALLY NEGATIVE CASES	5.	110.	35.	3.	0.
ACTUALLY POSITIVE CASES	0.	5.	16.	13.	4.

OBSERVED OPERATING POINTS:

FPF:	.000	.000	.020	.248	.967	1.000
TPF:	.000	.105	.447	.868	1.000	1.000

INITIAL VALUES OF PARAMETERS:
A= 1.1385 B= .7178
Z(K)= -1.843 .679 2.062 2.720
LOGL= -170.1710
CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.

PROCEDURE CONVERGES AFTER 7 ITERATIONS.

FINAL VALUES OF PARAMETERS:
A= 1.7216 B= .8901
Z(K)= -1.845 .680 2.073 3.355
LOGL= -163.8364
CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.

VARIANCE-COVARIANCE MATRIX:

A	.1357	.0636	.0037	.0124	-.0087	-.0882
B	.0636	.0479	.0015	.0030	-.0259	-.0966
Z(1)	.0037	.0015	.0387	.0024	.0009	-.0012
Z(2)	.0124	.0030	.0024	.0121	.0067	.0026
Z(3)	-.0087	-.0259	.0009	.0067	.0530	.0857
Z(4)	-.0882	-.0966	-.0012	.0026	.0857	.3101

CORRELATION MATRIX:

A	1.0000	.7884	.0516	.3056	-.1022	-.4301

B	.7884	1.0000	.0343	.1253	-.5131	-.7930
Z(1)	.0516	.0343	1.0000	.1103	.0194	-.0108
Z(2)	.3056	.1253	.1103	1.0000	.2646	.0421
Z(3)	-.1022	-.5131	.0194	.2646	1.0000	.6682
Z(4)	-.4301	-.7930	-.0108	.0421	.6682	1.0000

AREA = .9008 STD. DEV.(AREA) = .0325

ESTIMATED BINORMAL ROC CURVE, WITH LOWER AND UPPER BOUNDS ON ASYMMETRIC 95% CONFIDENCE INTERVAL FOR TRUE-POSITIVE FRACTION AT EACH SPECIFIED FALSE-POSITIVE FRACTION:

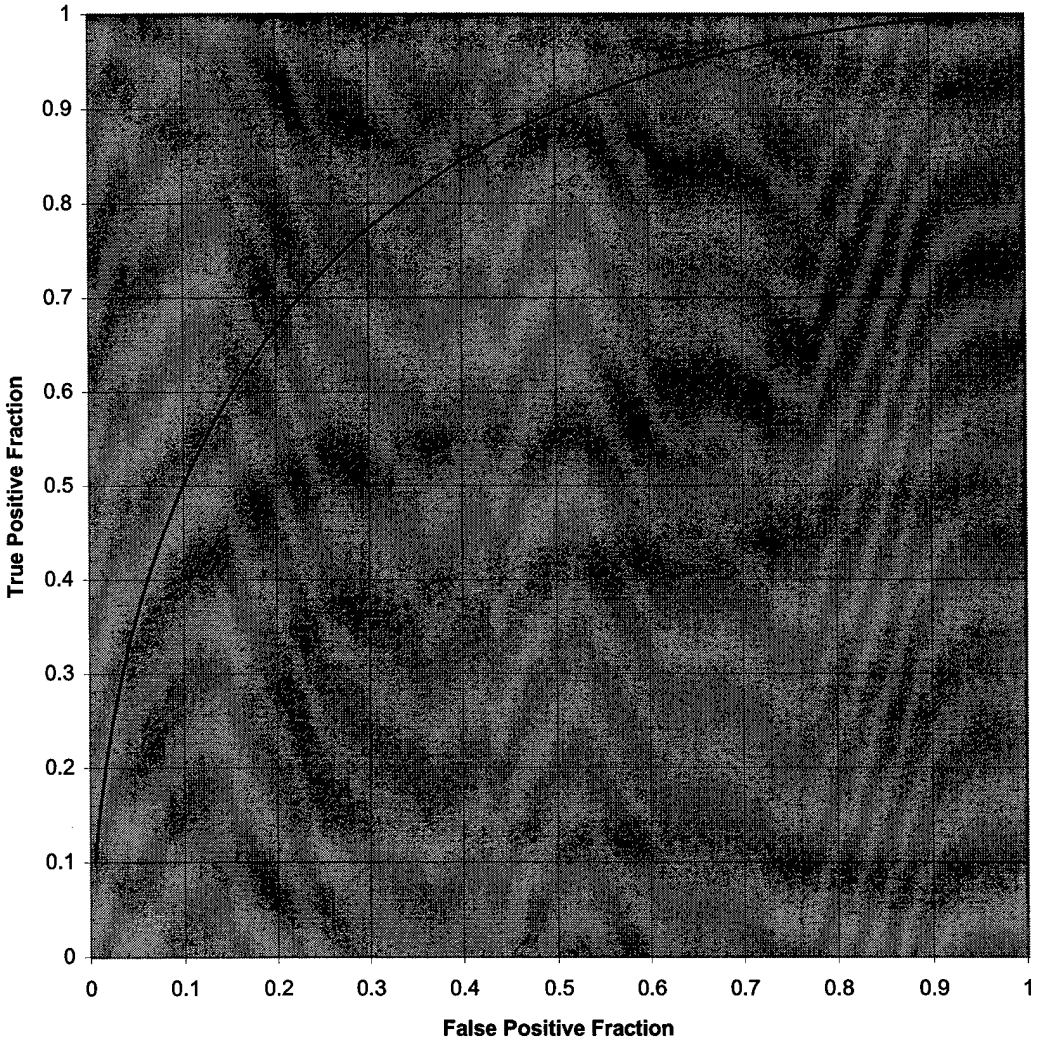
FPF	TPF	(LOWER BOUND,	UPPER BOUND)
.005	.2839	(.1025 ,	.5496)
.010	.3634	(.1668 ,	.6057)
.020	.4575	(.2580 ,	.6686)
.030	.5188	(.3240 ,	.7092)
.040	.5648	(.3756 ,	.7399)
.050	.6015	(.4178 ,	.7648)
.060	.6321	(.4533 ,	.7859)
.070	.6583	(.4837 ,	.8042)
.080	.6811	(.5101 ,	.8202)
.090	.7013	(.5334 ,	.8346)
.100	.7193	(.5541 ,	.8474)
.110	.7356	(.5728 ,	.8591)
.120	.7504	(.5897 ,	.8696)
.130	.7639	(.6051 ,	.8793)
.140	.7764	(.6192 ,	.8881)
.150	.7879	(.6322 ,	.8963)
.200	.8346	(.6851 ,	.9283)
.250	.8690	(.7246 ,	.9502)
.300	.8953	(.7559 ,	.9654)
.400	.9327	(.8041 ,	.9837)
.500	.9574	(.8412 ,	.9927)
.600	.9742	(.8721 ,	.9971)
.700	.9857	(.8994 ,	.9990)
.800	.9933	(.9250 ,	.9998)
.900	.9979	(.9514 ,	1.0000)
.950	.9993	(.9668 ,	1.0000)

ESTIMATES OF EXPECTED OPERATING POINTS ON FITTED ROC CURVE, WITH LOWER AND UPPER BOUNDS OF ASYMMETRIC 95% CONFIDENCE INTERVAL ALONG THE CURVE FOR THOSE POINTS:

EXPECTED OPERATING POINT (FPF , TPF)	LOWER BOUND (FPF , TPF)	UPPER BOUND (FPF , TPF)
(.0004, .1031)	(.0000, .0127)	(.0118, .3848)
(.0191, .4510)	(.0058, .2999)	(.0525, .6097)
(.2483, .8679)	(.1853, .8224)	(.3213, .9046)
(.9674, .9996)	(.9277, .9987)	(.9871, .9999)

```
Do you want to use data from a previously created input file for the next run?
(Y/N, or Q to quit)
Stop - Program terminated.
```

Reader06 Digital ROC Type=Diag N=191 Area=.8165 STD Area=.0504



```
Do you want to use data from a previously created input file for the next run?
(Y/N, or Q to quit)
enter INPUT file name:
Do you want to save an output file for plotting the ROC curve?
(Y/N, or R to restart)
                                                        DATE -  8/28/1998
                                                      TIME -  8:49: 3
            R O C F I T  (IBM VERSION 1.2) :

    M A X I M U M   L I K E L I H O O D   E S T I M A T I O N
         O F   A   B I N O R M A L   R O C   C U R V E
               F R O M   R A T I N G   D A T A


     DATA DESCRIPTION: Reader 06 Digital Diag resp for 191 cases available.

     DATA COLLECTED IN  5 CATEGORIES
     WITH CATEGORY  5 REPRESENTING STRONGEST EVIDENCE OF POSITIVITY
     (E.G., THAT ABNORMALITY IS PRESENT).

     NO. OF ACTUALLY NEGATIVE CASES =  153.
     NO. OF ACTUALLY POSITIVE CASES =   38.

     RESPONSE DATA:
      CATEGORY                    1      2      3      4      5
      ACTUALLY NEGATIVE CASES     2.   123.    25.     2.     1.
      ACTUALLY POSITIVE CASES     0.    14.    13.     9.     2.

     OBSERVED OPERATING POINTS:
      FPF:   .000  .007  .020  .183  .987 1.000
      TPF:   .000  .053  .289  .632 1.000 1.000

           INITIAL VALUES OF PARAMETERS:
    A=    .6959     B=    .7446
    Z(K)= -2.225    .904  2.062  2.482
    LOGL=  -147.3942
    CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
     BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.

     PROCEDURE CONVERGES AFTER   6 ITERATIONS.

           FINAL VALUES OF PARAMETERS:
    A=  1.2667     B=    .9860
    Z(K)= -2.226    .910  1.946  2.794
    LOGL=  -142.4528
    CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
     BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.


           VARIANCE-COVARIANCE MATRIX:
    A        .1422    .0751    .0051    .0167   -.0106   -.0567
    B        .0751    .0595    .0025    .0038   -.0239   -.0654
    Z( 1)    .0051    .0025    .0742    .0020    .0005   -.0013
    Z( 2)    .0167    .0038    .0020    .0139    .0092    .0063
    Z( 3)   -.0106   -.0239    .0005    .0092    .0408    .0525
    Z( 4)   -.0567   -.0654   -.0013    .0063    .0525    .1552

           CORRELATION MATRIX:
    A       1.0000    .8166    .0495    .3770   -.1392   -.3819
```

B	.8166	1.0000	.0383	.1315	-.4843	-.6804
Z(1)	.0495	.0383	1.0000	.0616	.0087	-.0120
Z(2)	.3770	.1315	.0616	1.0000	.3857	.1350
Z(3)	-.1392	-.4843	.0087	.3857	1.0000	.6601
Z(4)	-.3819	-.6804	-.0120	.1350	.6601	1.0000

AREA = .8165 STD. DEV.(AREA) = .0504

ESTIMATED BINORMAL ROC CURVE, WITH LOWER AND UPPER BOUNDS ON ASYMMETRIC 95% CONFIDENCE INTERVAL FOR TRUE-POSITIVE FRACTION AT EACH SPECIFIED FALSE-POSITIVE FRACTION:

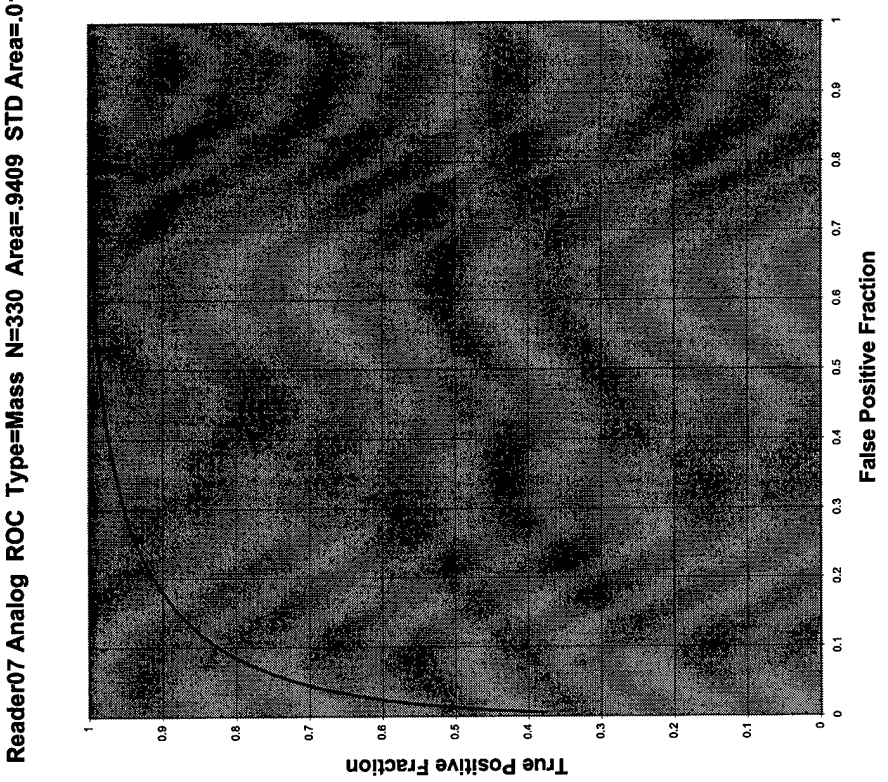
FPF	TPF	(LOWER BOUND,	UPPER BOUND)
.005	.1014	(.0211 ,	.3035)
.010	.1521	(.0454 ,	.3581)
.020	.2240	(.0920 ,	.4253)
.030	.2782	(.1341 ,	.4725)
.040	.3228	(.1721 ,	.5106)
.050	.3611	(.2062 ,	.5433)
.060	.3949	(.2372 ,	.5723)
.070	.4252	(.2653 ,	.5987)
.080	.4527	(.2909 ,	.6229)
.090	.4779	(.3143 ,	.6453)
.100	.5012	(.3359 ,	.6663)
.110	.5228	(.3558 ,	.6859)
.120	.5430	(.3743 ,	.7043)
.130	.5620	(.3915 ,	.7216)
.140	.5799	(.4076 ,	.7379)
.150	.5967	(.4226 ,	.7533)
.200	.6690	(.4862 ,	.8182)
.250	.7264	(.5363 ,	.8671)
.300	.7734	(.5778 ,	.9038)
.400	.8455	(.6455 ,	.9517)
.500	.8974	(.7011 ,	.9776)
.600	.9353	(.7503 ,	.9908)
.700	.9627	(.7964 ,	.9969)
.800	.9820	(.8423 ,	.9993)
.900	.9943	(.8928 ,	.9999)
.950	.9981	(.9243 ,	1.0000)

ESTIMATES OF EXPECTED OPERATING POINTS ON FITTED ROC CURVE, WITH LOWER AND UPPER BOUNDS OF ASYMMETRIC 95% CONFIDENCE INTERVAL ALONG THE CURVE FOR THOSE POINTS:

EXPECTED OPERATING POINT (FPF , TPF)	LOWER BOUND (FPF , TPF)	UPPER BOUND (FPF , TPF)
(.0026, .0684)	(.0002, .0123)	(.0216, .2338)
(.0258, .2572)	(.0096, .1486)	(.0606, .3968)
(.1814, .6441)	(.1270, .5564)	(.2485, .7247)
(.9870, .9997)	(.9547, .9983)	(.9971, 1.0000)

Reader 07_Analog (330 Cases)

Totals	Type	Ground Truth, Mass	Ground Truth, uCa	Ground Truth, FAD	Ground Truth, Diag
Total Normal	172	280	253	308	240
Total Abnormal	158	50	77	22	90
	Resp = 1	Resp = 2	Resp = 3	Resp = 4	Resp = 5
Resp, Mass, N	145	91	24	8	12
Resp, Mass, A	1	5	3	7	34
Resp, Ca, N	150	61	8	16	18
Resp, Ca, A	4	5	1	7	60
Resp, FAD, N	178	79	10	22	19
Resp, FAD, A	4	5	1	6	6
Resp, Diag, B	51	120	59	10	0
Resp, Diag, M	1	10	53	14	12


Reader07 Analog ROC Type=Mass N=330 Area=.9409 STD Area=.0177
True Positive Fraction
False Positive Fraction
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1

```
Do you want to use data from a previously created input file for the next run?
(Y/N, or Q to quit)
enter INPUT file name:
Do you want to save an output file for plotting the ROC curve?
(Y/N, or R to restart)
                                                        DATE - 11/19/1998
                                                      TIME - 11:28:28
            R O C F I T  (IBM VERSION 1.2) :

    M A X I M U M   L I K E L I H O O D   E S T I M A T I O N
         O F   A   B I N O R M A L   R O C   C U R V E
               F R O M   R A T I N G   D A T A

     DATA DESCRIPTION: Reader 07 Analog Mass resp for 330 cases available

     DATA COLLECTED IN  5 CATEGORIES
     WITH CATEGORY  5 REPRESENTING STRONGEST EVIDENCE OF POSITIVITY
     (E.G., THAT ABNORMALITY IS PRESENT).

     NO. OF ACTUALLY NEGATIVE CASES =  280.
     NO. OF ACTUALLY POSITIVE CASES =   50.

     RESPONSE DATA:
      CATEGORY                    1      2      3      4      5
      ACTUALLY NEGATIVE CASES   145.    91.    24.     8.    12.
      ACTUALLY POSITIVE CASES     1.     5.     3.     7.    34.

     OBSERVED OPERATING POINTS:
      FPF:  .000  .043  .071  .157  .482 1.000
      TPF:  .000  .680  .820  .880  .980 1.000

            INITIAL VALUES OF PARAMETERS:
    A=  2.1028     B=   .8971
    Z(K)=   .045  1.006  1.466  1.719
    LOGL=  -375.4041
    CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
     BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.

     PROCEDURE CONVERGES AFTER   4 ITERATIONS.

            FINAL VALUES OF PARAMETERS:
    A=  2.1762     B=   .9692
    Z(K)=   .046  1.005  1.428  1.748
    LOGL=  -374.7759
    CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
     BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.


            VARIANCE-COVARIANCE MATRIX:
    A        .1484   .0807   .0049   .0063   .0026  -.0043
    B        .0807   .0600   .0017   .0001  -.0047  -.0119
    Z( 1)    .0049   .0017   .0056   .0031   .0025   .0021
    Z( 2)    .0063   .0001   .0031   .0080   .0067   .0061
    Z( 3)    .0026  -.0047   .0025   .0067   .0116   .0111
    Z( 4)   -.0043  -.0119   .0021   .0061   .0111   .0176

            CORRELATION MATRIX:
    A       1.0000   .8552   .1700   .1834   .0634  -.0842
    B        .8552  1.0000   .0909   .0050  -.1795  -.3679
    Z( 1)    .1700   .0909  1.0000   .4599   .3080   .2107
    Z( 2)    .1834   .0050   .4599  1.0000   .6966   .5169
    Z( 3)    .0634  -.1795   .3080   .6966  1.0000   .7756
    Z( 4)   -.0842  -.3679   .2107   .5169   .7756  1.0000
```

AREA = .9409 STD. DEV.(AREA) = .0177

ESTIMATED BINORMAL ROC CURVE, WITH LOWER AND UPPER BOUNDS ON ASYMMETRIC 95% CONFIDENCE INTERVAL FOR TRUE-POSITIVE FRACTION AT EACH SPECIFIED FALSE-POSITIVE FRACTION:

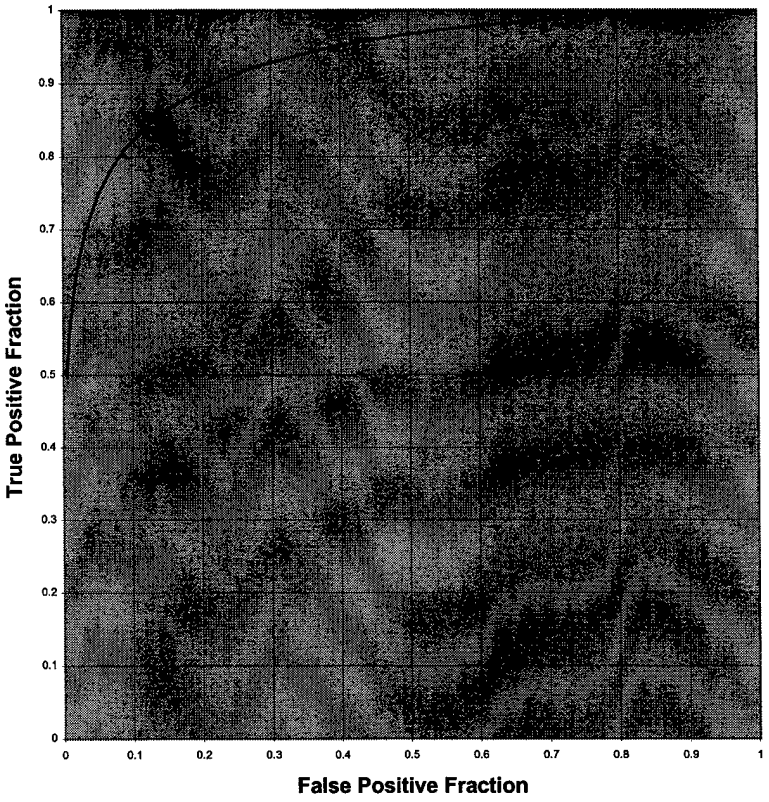
FPF	TPF	(LOWER BOUND,	UPPER BOUND)
.005	.3742	(.1517 ,	.6509)
.010	.4685	(.2447 ,	.7031)
.020	.5735	(.3695 ,	.7592)
.030	.6379	(.4541 ,	.7942)
.040	.6840	(.5167 ,	.8202)
.050	.7196	(.5654 ,	.8410)
.060	.7482	(.6045 ,	.8584)
.070	.7720	(.6366 ,	.8732)
.080	.7922	(.6634 ,	.8862)
.090	.8096	(.6862 ,	.8976)
.100	.8248	(.7059 ,	.9076)
.110	.8382	(.7230 ,	.9166)
.120	.8502	(.7381 ,	.9246)
.130	.8609	(.7515 ,	.9318)
.140	.8706	(.7635 ,	.9383)
.150	.8793	(.7743 ,	.9441)
.200	.9132	(.8161 ,	.9657)
.250	.9361	(.8452 ,	.9788)
.300	.9524	(.8671 ,	.9869)
.400	.9733	(.8992 ,	.9951)
.500	.9852	(.9224 ,	.9983)
.600	.9923	(.9406 ,	.9995)
.700	.9964	(.9559 ,	.9999)
.800	.9986	(.9694 ,	1.0000)
.900	.9997	(.9821 ,	1.0000)
.950	.9999	(.9888 ,	1.0000)

ESTIMATES OF EXPECTED OPERATING POINTS ON FITTED ROC CURVE, WITH LOWER AND UPPER BOUNDS OF ASYMMETRIC 95% CONFIDENCE INTERVAL ALONG THE CURVE FOR THOSE POINTS:

EXPECTED OPERATING POINT (FPF , TPF)	LOWER BOUND (FPF , TPF)	UPPER BOUND (FPF , TPF)
(.0402, .6850)	(.0223, .5909)	(.0683, .7684)
(.0766, .7858)	(.0506, .7215)	(.1118, .8405)
(.1574, .8853)	(.1190, .8491)	(.2032, .9149)
(.4816, .9835)	(.4236, .9767)	(.5401, .9885)

Do you want to use data from a previously created input file for the next run?
(Y/N, or Q to quit)
Stop - Program terminated.

Reader07 Analog ROC Type=calc N=330 Area=.9324 STD Area=.0187



```
Do you want to use data from a previously created input file for the next run?
(Y/N, or Q to quit)
enter INPUT file name:
Do you want to save an output file for plotting the ROC curve?
(Y/N, or R to restart)
                                                        DATE - 11/19/1998
                                                      TIME - 11:28:28
            R O C F I T  (IBM VERSION 1.2) :

    M A X I M U M   L I K E L I H O O D   E S T I M A T I O N
         O F   A   B I N O R M A L   R O C   C U R V E
               F R O M   R A T I N G   D A T A


     DATA DESCRIPTION: Reader 07 Analog calc resp for 330 cases available

     DATA COLLECTED IN  5 CATEGORIES
     WITH CATEGORY  5 REPRESENTING STRONGEST EVIDENCE OF POSITIVITY
     (E.G., THAT ABNORMALITY IS PRESENT).

     NO. OF ACTUALLY NEGATIVE CASES =  253.
     NO. OF ACTUALLY POSITIVE CASES =   77.

     RESPONSE DATA:
      CATEGORY                    1      2      3      4      5
      ACTUALLY NEGATIVE CASES   150.    61.     8.    16.    18.
      ACTUALLY POSITIVE CASES     4.     5.     1.     7.    60.

     OBSERVED OPERATING POINTS:
      FPF:  .000  .071  .134  .166  .407 1.000
      TPF:  .000  .779  .870  .883  .948 1.000

            INITIAL VALUES OF PARAMETERS:
    A=  1.8127    B=   .6715
    Z(K)=   .235   .970  1.106  1.468
    LOGL=  -346.7852
    CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
     BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.

     PROCEDURE CONVERGES AFTER   4 ITERATIONS.

            FINAL VALUES OF PARAMETERS:
    A=  1.8400    B=   .7189
    Z(K)=   .237   .960  1.088  1.481
    LOGL=  -346.5920
    CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
     BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.


            VARIANCE-COVARIANCE MATRIX:
    A        .0769   .0426   .0048   .0038   .0031  -.0005
    B        .0426   .0372   .0018  -.0009  -.0020  -.0071
    Z( 1)    .0048   .0018   .0063   .0041   .0038   .0031
    Z( 2)    .0038  -.0009   .0041   .0085   .0080   .0071
    Z( 3)    .0031  -.0020   .0038   .0080   .0093   .0083
    Z( 4)   -.0005  -.0071   .0031   .0071   .0083   .0141

            CORRELATION MATRIX:
    A       1.0000   .7955   .2179   .1494   .1176  -.0166
    B        .7955  1.0000   .1140  -.0526  -.1065  -.3107
    Z( 1)    .2179   .1140  1.0000   .5593   .4983   .3289
    Z( 2)    .1494  -.0526   .5593  1.0000   .9031   .6481
    Z( 3)    .1176  -.1065   .4983   .9031  1.0000   .7268
    Z( 4)   -.0166  -.3107   .3289   .6481   .7268  1.0000
```

AREA = .9324 STD. DEV.(AREA) = .0187

ESTIMATED BINORMAL ROC CURVE, WITH LOWER AND UPPER BOUNDS ON ASYMMETRIC 95% CONFIDENCE INTERVAL FOR TRUE-POSITIVE FRACTION AT EACH SPECIFIED FALSE-POSITIVE FRACTION:

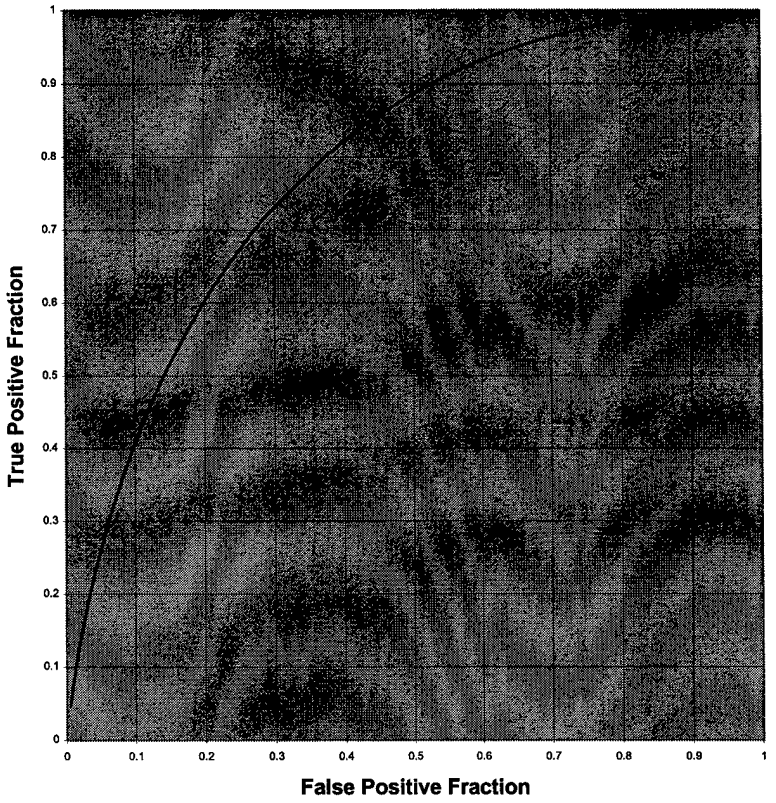
FPF	TPF	(LOWER BOUND,	UPPER BOUND)
.005	.4952	(.2590 ,	.7331)
.010	.5664	(.3488 ,	.7652)
.020	.6418	(.4548 ,	.7995)
.030	.6871	(.5222 ,	.8210)
.040	.7194	(.5712 ,	.8372)
.050	.7445	(.6091 ,	.8502)
.060	.7648	(.6397 ,	.8613)
.070	.7819	(.6650 ,	.8711)
.080	.7966	(.6864 ,	.8797)
.090	.8095	(.7047 ,	.8876)
.100	.8208	(.7207 ,	.8947)
.110	.8310	(.7347 ,	.9013)
.120	.8402	(.7471 ,	.9074)
.130	.8485	(.7582 ,	.9130)
.140	.8562	(.7682 ,	.9183)
.150	.8632	(.7773 ,	.9232)
.200	.8916	(.8123 ,	.9434)
.250	.9123	(.8367 ,	.9581)
.300	.9283	(.8552 ,	.9691)
.400	.9514	(.8824 ,	.9834)
.500	.9671	(.9026 ,	.9914)
.600	.9784	(.9191 ,	.9959)
.700	.9867	(.9339 ,	.9983)
.800	.9928	(.9479 ,	.9995)
.900	.9971	(.9630 ,	.9999)
.950	.9987	(.9724 ,	1.0000)

ESTIMATES OF EXPECTED OPERATING POINTS ON FITTED ROC CURVE, WITH LOWER AND UPPER BOUNDS OF ASYMMETRIC 95% CONFIDENCE INTERVAL ALONG THE CURVE FOR THOSE POINTS:

EXPECTED OPERATING POINT (FPF , TPF)	LOWER BOUND (FPF , TPF)	UPPER BOUND (FPF , TPF)
(.0692, .7808)	(.0433, .7284)	(.1058, .8269)
(.1383, .8549)	(.1008, .8217)	(.1843, .8837)
(.1685, .8749)	(.1271, .8462)	(.2177, .8996)
(.4064, .9525)	(.3473, .9403)	(.4678, .9626)

Do you want to use data from a previously created input file for the next run?
(Y/N, or Q to quit)
Stop - Program terminated.

Reader07 Analog ROC Type=FAD N=330 Area=.7885 STD Area=.0503



Do you want to use data from a previously created input file for the next run?
(Y/N, or Q to quit)
enter INPUT file name:
Do you want to save an output file for plotting the ROC curve?
(Y/N, or R to restart)

DATE - 11/19/1998
TIME - 11:28:28

R O C F I T (IBM VERSION 1.2) :

M A X I M U M L I K E L I H O O D E S T I M A T I O N
O F A B I N O R M A L R O C C U R V E
F R O M R A T I N G D A T A

DATA DESCRIPTION: Reader 07 Analog FAD resp for 330 cases available

DATA COLLECTED IN 5 CATEGORIES
WITH CATEGORY 5 REPRESENTING STRONGEST EVIDENCE OF POSITIVITY
(E.G., THAT ABNORMALITY IS PRESENT).

NO. OF ACTUALLY NEGATIVE CASES = 308.
NO. OF ACTUALLY POSITIVE CASES = 22.

RESPONSE DATA:

CATEGORY	1	2	3	4	5
ACTUALLY NEGATIVE CASES	178.	79.	10.	22.	19.
ACTUALLY POSITIVE CASES	4.	5.	1.	6.	6.

OBSERVED OPERATING POINTS:

FPF:	.000	.062	.133	.166	.422	1.000
TPF:	.000	.273	.545	.591	.818	1.000

INITIAL VALUES OF PARAMETERS:
A= 1.1957 B= 1.0823
Z(K)= .196 .972 1.112 1.541
LOGL= -383.9933
CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.

PROCEDURE CONVERGES AFTER 4 ITERATIONS.

FINAL VALUES OF PARAMETERS:
A= 1.2041 B= 1.1216
Z(K)= .199 .960 1.095 1.558
LOGL= -383.8640
CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.

VARIANCE-COVARIANCE MATRIX:

A	.1283	.0741	.0061	.0044	.0036	-.0003
B	.0741	.0794	.0023	-.0017	-.0029	-.0087
Z(1)	.0061	.0023	.0052	.0032	.0030	.0024
Z(2)	.0044	-.0017	.0032	.0070	.0066	.0056
Z(3)	.0036	-.0029	.0030	.0066	.0078	.0066
Z(4)	-.0003	-.0087	.0024	.0056	.0066	.0127

CORRELATION MATRIX:

A	1.0000	.7339	.2361	.1469	.1150	-.0071
B	.7339	1.0000	.1117	-.0711	-.1176	-.2752
Z(1)	.2361	.1117	1.0000	.5400	.4770	.2942
Z(2)	.1469	-.0711	.5400	1.0000	.8937	.5944
Z(3)	.1150	-.1176	.4770	.8937	1.0000	.6695
Z(4)	-.0071	-.2752	.2942	.5944	.6695	1.0000

AREA = .7885 STD. DEV.(AREA) = .0503

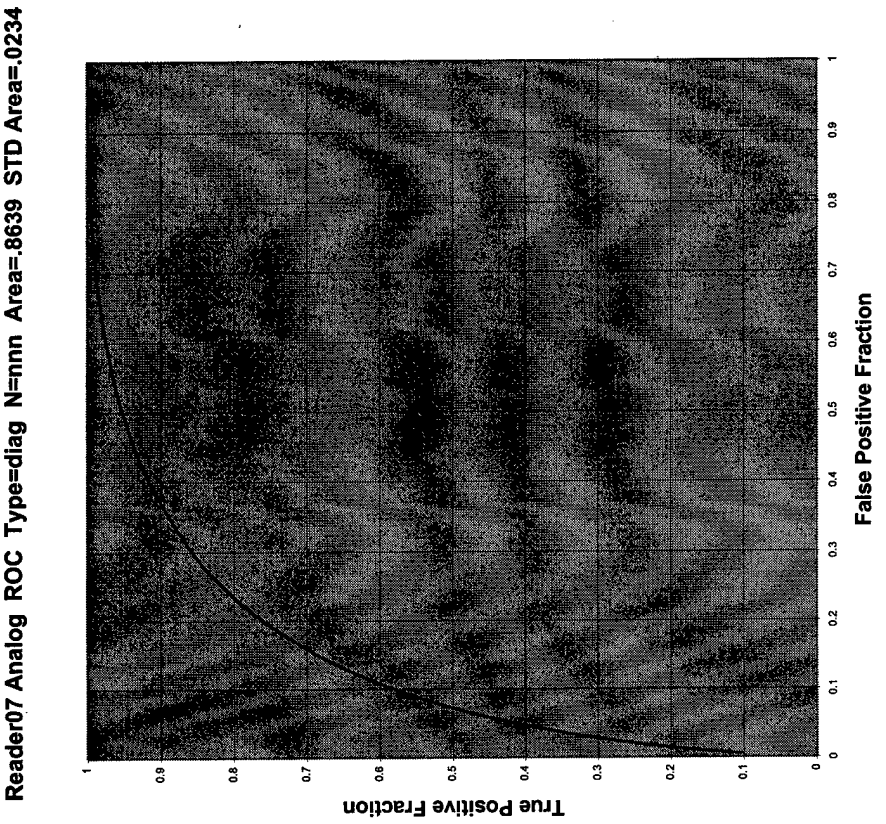
ESTIMATED BINORMAL ROC CURVE, WITH LOWER AND UPPER BOUNDS ON ASYMMETRIC 95% CONFIDENCE INTERVAL FOR TRUE-POSITIVE FRACTION AT EACH SPECIFIED FALSE-POSITIVE FRACTION:

FPF	TPF	(LOWER BOUND,	UPPER BOUND)
.005	.0460	(.0034 ,	.2546)
.010	.0799	(.0104 ,	.3086)
.020	.1357	(.0299 ,	.3752)
.030	.1825	(.0532 ,	.4217)
.040	.2237	(.0783 ,	.4590)
.050	.2607	(.1039 ,	.4909)
.060	.2946	(.1297 ,	.5190)
.070	.3258	(.1551 ,	.5446)
.080	.3549	(.1799 ,	.5681)
.090	.3821	(.2040 ,	.5900)
.100	.4077	(.2273 ,	.6106)
.110	.4318	(.2497 ,	.6301)
.120	.4547	(.2712 ,	.6485)
.130	.4764	(.2918 ,	.6662)
.140	.4970	(.3116 ,	.6830)
.150	.5166	(.3305 ,	.6991)
.200	.6027	(.4133 ,	.7703)
.250	.6729	(.4801 ,	.8279)
.300	.7312	(.5354 ,	.8737)
.400	.8213	(.6230 ,	.9367)
.500	.8857	(.6922 ,	.9717)
.600	.9316	(.7510 ,	.9892)
.700	.9634	(.8041 ,	.9968)
.800	.9841	(.8550 ,	.9994)
.900	.9959	(.9080 ,	1.0000)
.950	.9989	(.9391 ,	1.0000)

ESTIMATES OF EXPECTED OPERATING POINTS ON FITTED ROC CURVE, WITH LOWER AND UPPER BOUNDS OF ASYMMETRIC 95% CONFIDENCE INTERVAL ALONG THE CURVE FOR THOSE POINTS:

EXPECTED OPERATING POINT (FPF , TPF)	LOWER BOUND (FPF , TPF)	UPPER BOUND (FPF , TPF)
(.0597, .2936)	(.0377, .2146)	(.0906, .3839)
(.1367, .4903)	(.1024, .4137)	(.1781, .5672)
(.1685, .5506)	(.1305, .4775)	(.2130, .6221)
(.4213, .8368)	(.3671, .7948)	(.4770, .8727)

Do you want to use data from a previously created input file for the next run?
(Y/N, or Q to quit)
Stop - Program terminated.


Reader07 Analog ROC Type=diag N=nnn Area=.8639 STD Area=.0234
True Positive Fraction
False Positive Fraction
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1

Do you want to use data from a previously created input file for the next run?
(Y/N, or Q to quit)
enter INPUT file name:
Do you want to save an output file for plotting the ROC curve?
(Y/N, or R to restart)

DATE - 11/19/1998
TIME - 11:28:28

R O C F I T (IBM VERSION 1.2) :

M A X I M U M L I K E L I H O O D E S T I M A T I O N
O F A B I N O R M A L R O C C U R V E
F R O M R A T I N G D A T A

DATA DESCRIPTION: Reader 07 Analog Diag resp for 330 cases available

DATA COLLECTED IN 5 CATEGORIES
WITH CATEGORY 5 REPRESENTING STRONGEST EVIDENCE OF POSITIVITY
(E.G., THAT ABNORMALITY IS PRESENT).

NO. OF ACTUALLY NEGATIVE CASES = 240.
NO. OF ACTUALLY POSITIVE CASES = 90.

RESPONSE DATA:

CATEGORY	1	2	3	4	5
ACTUALLY NEGATIVE CASES	51.	120.	59.	10.	0.
ACTUALLY POSITIVE CASES	1.	10.	53.	14.	12.

OBSERVED OPERATING POINTS:

FPF:	.000	.000	.042	.287	.788	1.000
TPF:	.000	.133	.289	.878	.989	1.000

INITIAL VALUES OF PARAMETERS:
A= 1.5147 B= .9804
Z(K)= -.798 .560 1.732 2.866
LOGL= -391.6062
CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.

PROCEDURE CONVERGES AFTER 5 ITERATIONS.

FINAL VALUES OF PARAMETERS:
A= 1.6642 B= 1.1390
Z(K)= -.791 .537 1.865 2.495
LOGL= -385.7740
CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.

VARIANCE-COVARIANCE MATRIX:

A	.0492	.0235	.0045	.0080	.0006	-.0088
B	.0235	.0233	.0017	.0015	-.0124	-.0237
Z(1)	.0045	.0017	.0082	.0028	.0012	.0004
Z(2)	.0080	.0015	.0028	.0070	.0043	.0035
Z(3)	.0006	-.0124	.0012	.0043	.0225	.0267
Z(4)	-.0088	-.0237	.0004	.0035	.0267	.0504

CORRELATION MATRIX:

A	1.0000	.6941	.2230	.4300	.0188	-.1759
B	.6941	1.0000	.1239	.1187	-.5418	-.6905
Z(1)	.2230	.1239	1.0000	.3630	.0861	.0173
Z(2)	.4300	.1187	.3630	1.0000	.3440	.1880
Z(3)	.0188	-.5418	.0861	.3440	1.0000	.7930
Z(4)	-.1759	-.6905	.0173	.1880	.7930	1.0000

AREA = .8639 STD. DEV.(AREA) = .0234

ESTIMATED BINORMAL ROC CURVE, WITH LOWER AND UPPER BOUNDS ON ASYMMETRIC 95% CONFIDENCE INTERVAL FOR TRUE-POSITIVE FRACTION AT EACH SPECIFIED FALSE-POSITIVE FRACTION:

FPF	TPF	(LOWER BOUND,	UPPER BOUND)
.005	.1020	(.0333 ,	.2401)
.010	.1621	(.0682 ,	.3148)
.020	.2497	(.1318 ,	.4079)
.030	.3162	(.1878 ,	.4718)
.040	.3706	(.2376 ,	.5214)
.050	.4170	(.2823 ,	.5623)
.060	.4574	(.3227 ,	.5972)
.070	.4932	(.3595 ,	.6277)
.080	.5253	(.3931 ,	.6548)
.090	.5544	(.4240 ,	.6791)
.100	.5809	(.4526 ,	.7012)
.110	.6053	(.4790 ,	.7213)
.120	.6277	(.5035 ,	.7398)
.130	.6485	(.5264 ,	.7568)
.140	.6677	(.5477 ,	.7726)
.150	.6857	(.5677 ,	.7872)
.200	.7598	(.6513 ,	.8468)
.250	.8150	(.7149 ,	.8897)
.300	.8571	(.7650 ,	.9211)
.400	.9156	(.8389 ,	.9610)
.500	.9520	(.8905 ,	.9821)
.600	.9745	(.9281 ,	.9927)
.700	.9881	(.9560 ,	.9976)
.800	.9956	(.9765 ,	.9994)
.900	.9991	(.9911 ,	.9999)
.950	.9998	(.9964 ,	1.0000)

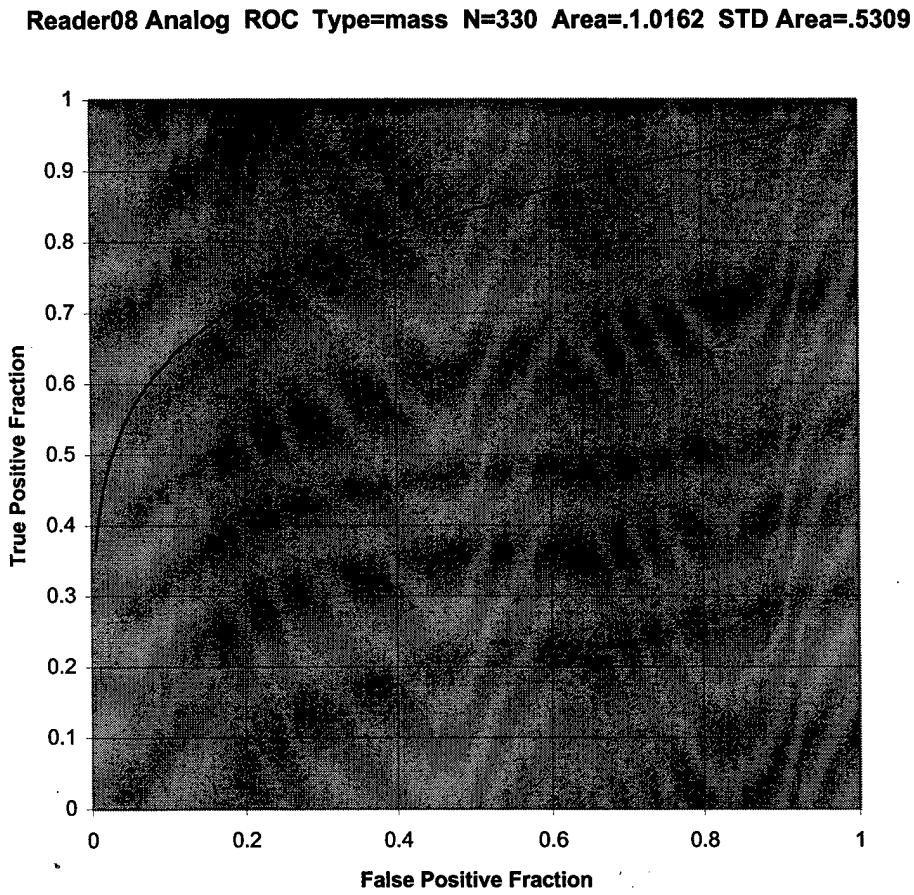
ESTIMATES OF EXPECTED OPERATING POINTS ON FITTED ROC CURVE, WITH LOWER AND UPPER BOUNDS OF ASYMMETRIC 95% CONFIDENCE INTERVAL ALONG THE CURVE FOR THOSE POINTS:

EXPECTED OPERATING POINT (FPF , TPF)	LOWER BOUND (FPF , TPF)	UPPER BOUND (FPF , TPF)
(.0063, .1195)	(.0017, .0466)	(.0199, .2494)
(.0311, .3227)	(.0154, .2133)	(.0581, .4502)
(.2956, .8537)	(.2415, .8066)	(.3547, .8925)
(.7855, .9948)	(.7303, .9909)	(.8335, .9972)

Do you want to use data from a previously created input file for the next run?
(Y/N, or Q to quit)
Stop - Program terminated.

Reader08_Analog (330 cases)

Totals	Type	Ground Truth, Mass	Ground Truth, uCa	Ground Truth, FAD	Ground Truth, Diag
Total Normal	172	280	253	308	240
Total Abnormal	158	50	77	22	90
	Resp = 1	Resp = 2	Resp = 3	Resp = 4	Resp = 5
Resp, Mass, N	242	21	4	5	8
Resp, Mass, A	8	1	3	7	31
Resp, Ca, N	232	7	2	4	8
Resp, Ca, A	32	0	0	5	40
Resp, FAD, N	250	24	11	14	9
Resp, FAD, A	11	1	3	4	3
Resp, Diag, B	174	48	16	2	0
Resp, Diag, M	22	13	21	14	20


Reader08 Analog ROC Type=mass N=330 Area=.1.0162 STD Area=.5309
True Positive Fraction
False Positive Fraction
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.2
0.4
0.6
0.8
1

1

DATE - 11/20/1998
TIME - 9:19:49

R O C F I T (IBM VERSION 1.2) :

M A X I M U M L I K E L I H O O D E S T I M A T I O N
O F A B I N O R M A L R O C C U R V E
F R O M R A T I N G D A T A

NAME OF INPUT FILE BEING USED: adiag08.txt

DATA DESCRIPTION: Reader 08 Analog diag resp for 330 cases available

OBSERVED OPERATING POINTS:
FPF: .000 .000 .008 .075 .275 1.000
TPF: .000 .222 .378 .611 .756 1.000

FINAL VALUES OF PARAMETERS:
A= 1.0162 B= .5309

CORRESPONDING AREA INDEX (A-SUB-Z) = .8153 WITH STD. DEV. = .0376.

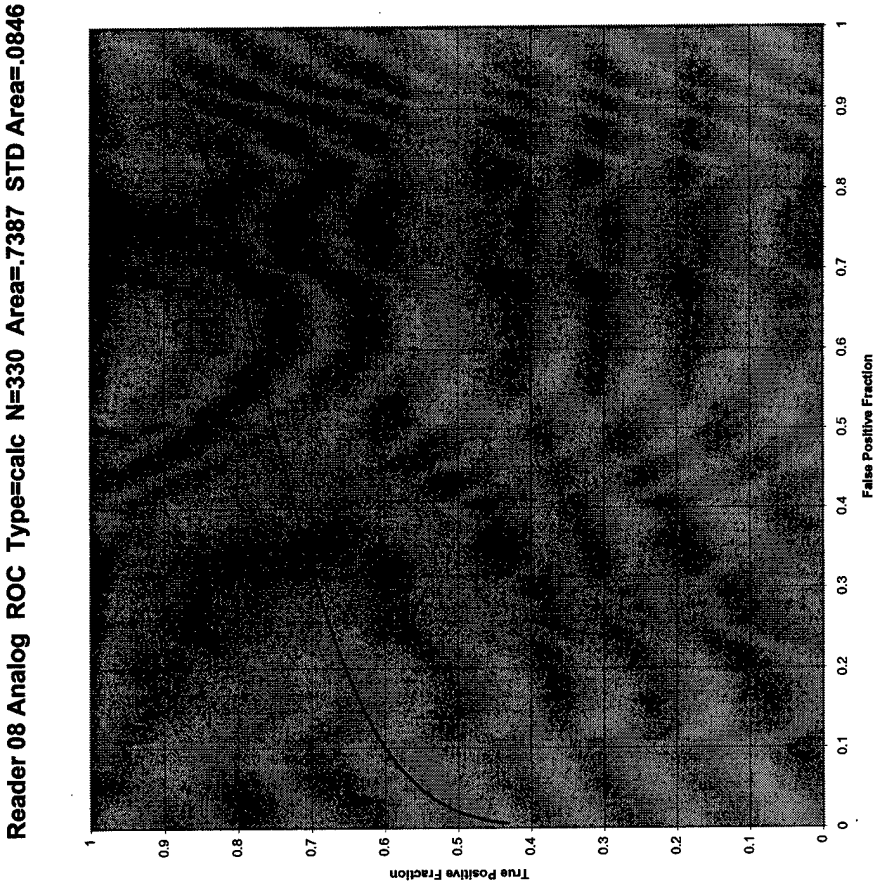
ESTIMATED BINORMAL ROC CURVE, WITH LOWER AND UPPER
BOUNDS ON ASYMMETRIC 95% CONFIDENCE INTERVAL FOR
TRUE-POSITIVE FRACTION AT EACH SPECIFIED
FALSE-POSITIVE FRACTION:

FPF	TPF	(LOWER BOUND,	UPPER BOUND)
.005	.3626	(.2364 ,	.5059)
.010	.4132	(.2907 ,	.5450)
.020	.4703	(.3540 ,	.5893)
.030	.5069	(.3950 ,	.6183)
.040	.5345	(.4258 ,	.6406)
.050	.5567	(.4505 ,	.6590)
.060	.5756	(.4712 ,	.6748)
.070	.5919	(.4890 ,	.6888)
.080	.6064	(.5047 ,	.7014)
.090	.6195	(.5186 ,	.7128)
.100	.6314	(.5312 ,	.7234)
.110	.6424	(.5427 ,	.7332)
.120	.6526	(.5532 ,	.7424)
.130	.6621	(.5630 ,	.7510)
.140	.6710	(.5720 ,	.7592)
.150	.6794	(.5805 ,	.7669)
.200	.7155	(.6164 ,	.8004)
.250	.7448	(.6448 ,	.8277)
.300	.7697	(.6687 ,	.8507)
.400	.8111	(.7082 ,	.8879)
.500	.8452	(.7413 ,	.9170)
.600	.8750	(.7714 ,	.9403)
.700	.9022	(.8004 ,	.9596)
.800	.9283	(.8308 ,	.9755)
.900	.9551	(.8669 ,	.9887)
.950	.9706	(.8921 ,	.9945)

ESTIMATES OF EXPECTED OPERATING POINTS ON FITTED ROC

CURVE, WITH LOWER AND UPPER BOUNDS OF ASYMMETRIC 95%
CONFIDENCE INTERVAL ALONG THE CURVE FOR THOSE POINTS:

EXPECTED OPERATING POINT (FPF , TPF)	LOWER BOUND (FPF , TPF)	UPPER BOUND (FPF , TPF)
(.0004, .2222)	(.0000, .1132)	(.0059, .3746)
(.0067, .3830)	(.0016, .2899)	(.0232, .4834)
(.0772, .6026)	(.0498, .5564)	(.1148, .6474)
(.2746, .7575)	(.2212, .7285)	(.3337, .7846)


Reader 08 Analog ROC Type=calc N=330 Area=.7387 STD Area=.0846
True Positive Fraction
False Positive Fraction
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1

```
Do you want to use data from a previously created input file for the next run?
(Y/N, or Q to quit)
enter INPUT file name:
Do you want to save an output file for plotting the ROC curve?
(Y/N, or R to restart)
                                                        DATE - 11/20/1998
                                                      TIME -  9:11:57
            R O C F I T  (IBM VERSION 1.2) :

   M A X I M U M   L I K E L I H O O D   E S T I M A T I O N
        O F   A   B I N O R M A L   R O C   C U R V E
              F R O M   R A T I N G   D A T A


    DATA DESCRIPTION: Reader 08 Analog calc resp for 330 cases available

    DATA COLLECTED IN  5 CATEGORIES
    WITH CATEGORY  5 REPRESENTING STRONGEST EVIDENCE OF POSITIVITY
    (E.G., THAT ABNORMALITY IS PRESENT).

    NO. OF ACTUALLY NEGATIVE CASES =  253.
    NO. OF ACTUALLY POSITIVE CASES =   77.

    RESPONSE DATA:
     CATEGORY                    1      2      3      4      5
     ACTUALLY NEGATIVE CASES   232.     7.     2.     4.     8.
     ACTUALLY POSITIVE CASES    32.     0.     0.     5.    40.

    OBSERVED OPERATING POINTS:
     FPF:  .000  .032  .047  .055  .083 1.000
     TPF:  .000  .519  .584  .584  .584 1.000

           INITIAL VALUES OF PARAMETERS:
    A=  1.5166    B=   .7803
    Z(K)=  1.385  1.596  1.671  1.858
    LOGL=  -174.3543
    CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
     BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.

    PROCEDURE CONVERGES AFTER   5 ITERATIONS.

           FINAL VALUES OF PARAMETERS:
    A=   .6729    B=   .3286
    Z(K)=  1.387  1.549  1.604  1.890
    LOGL=  -170.6075
    CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
     BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.


           VARIANCE-COVARIANCE MATRIX:
    A        .0915   .0440   .0065   .0023   .0007  -.0098
    B        .0440   .0275   .0016  -.0012  -.0023  -.0095
    Z( 1)    .0065   .0016   .0129   .0120   .0118   .0104
    Z( 2)    .0023  -.0012   .0120   .0150   .0147   .0139
    Z( 3)    .0007  -.0023   .0118   .0147   .0159   .0153
    Z( 4)   -.0098  -.0095   .0104   .0139   .0153   .0250

           CORRELATION MATRIX:
    A       1.0000   .8787   .1884   .0626   .0189  -.2049
    B        .8787  1.0000   .0856  -.0598  -.1098  -.3633
    Z( 1)    .1884   .0856  1.0000   .8662   .8199   .5815
    Z( 2)    .0626  -.0598   .8662  1.0000   .9545   .7200
    Z( 3)    .0189  -.1098   .8199   .9545  1.0000   .7670
    Z( 4)   -.2049  -.3633   .5815   .7200   .7670  1.0000
```

AREA = .7387 STD. DEV.(AREA) = .0846

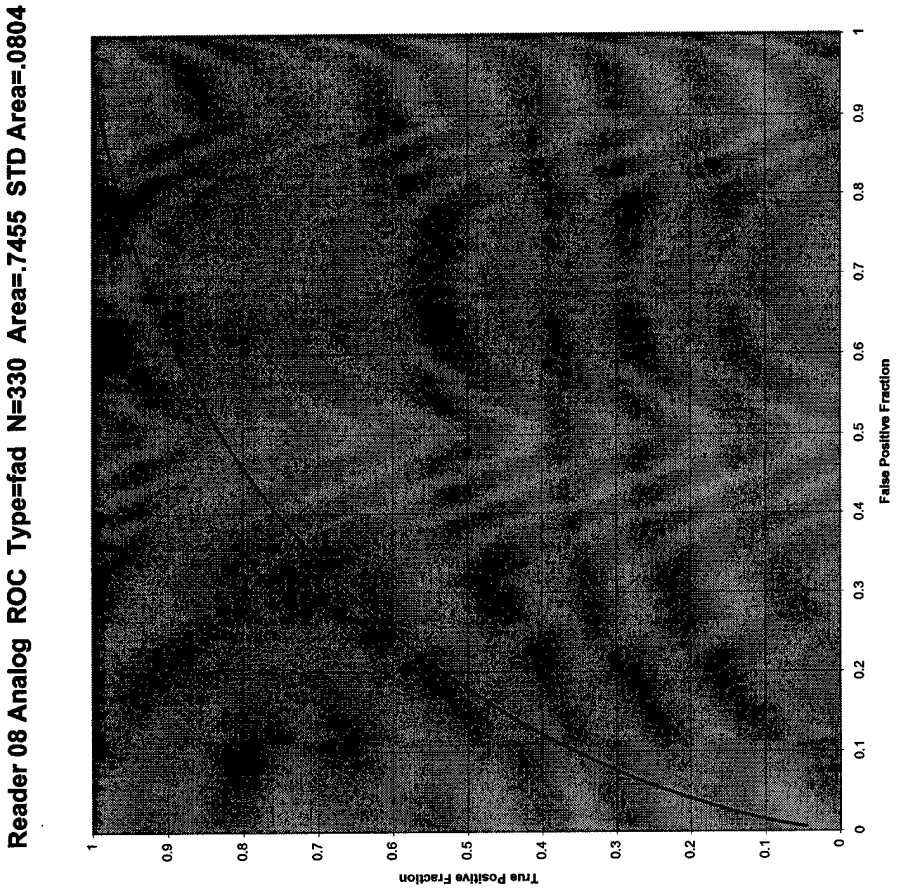
ESTIMATED BINORMAL ROC CURVE, WITH LOWER AND UPPER BOUNDS ON ASYMMETRIC 95% CONFIDENCE INTERVAL FOR TRUE-POSITIVE FRACTION AT EACH SPECIFIED FALSE-POSITIVE FRACTION:

FPF	TPF	(LOWER BOUND,	UPPER BOUND)
.005	.4310	(.2750 ,	.5989)
.010	.4635	(.3229 ,	.6087)
.020	.4991	(.3742 ,	.6242)
.030	.5218	(.4042 ,	.6375)
.040	.5388	(.4248 ,	.6497)
.050	.5526	(.4399 ,	.6611)
.060	.5643	(.4516 ,	.6720)
.070	.5745	(.4609 ,	.6822)
.080	.5836	(.4684 ,	.6919)
.090	.5918	(.4747 ,	.7012)
.100	.5994	(.4800 ,	.7100)
.110	.6063	(.4846 ,	.7184)
.120	.6128	(.4886 ,	.7265)
.130	.6189	(.4920 ,	.7341)
.140	.6247	(.4951 ,	.7415)
.150	.6302	(.4978 ,	.7486)
.200	.6541	(.5081 ,	.7801)
.250	.6741	(.5150 ,	.8065)
.300	.6917	(.5199 ,	.8293)
.400	.7223	(.5270 ,	.8669)
.500	.7495	(.5319 ,	.8972)
.600	.7752	(.5358 ,	.9225)
.700	.8010	(.5391 ,	.9443)
.800	.8288	(.5423 ,	.9635)
.900	.8630	(.5458 ,	.9809)
.950	.8875	(.5481 ,	.9894)

ESTIMATES OF EXPECTED OPERATING POINTS ON FITTED ROC CURVE, WITH LOWER AND UPPER BOUNDS OF ASYMMETRIC 95% CONFIDENCE INTERVAL ALONG THE CURVE FOR THOSE POINTS:

EXPECTED OPERATING POINT (FPF , TPF)	LOWER BOUND (FPF , TPF)	UPPER BOUND (FPF , TPF)
(.0294, .5207)	(.0139, .4801)	(.0571, .5611)
(.0544, .5580)	(.0321, .5257)	(.0875, .5898)
(.0607, .5651)	(.0368, .5339)	(.0952, .5958)
(.0827, .5859)	(.0537, .5572)	(.1221, .6142)

Do you want to use data from a previously created input file for the next run?
(Y/N, or Q to quit)
Stop - Program terminated.


Reader 08 Analog ROC Type=fad N=330 Area=.7455 STD Area=.0804
True Positive Fraction
False Positive Fraction
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1

```
Do you want to use data from a previously created input file for the next run?
(Y/N, or Q to quit)
enter INPUT file name:
Do you want to save an output file for plotting the ROC curve?
(Y/N, or R to restart)
                                                        DATE - 11/20/1998
                                                      TIME -  9:11:57
            R O C F I T  (IBM VERSION 1.2) :

    M A X I M U M   L I K E L I H O O D   E S T I M A T I O N
         O F   A   B I N O R M A L   R O C   C U R V E
               F R O M   R A T I N G   D A T A


    DATA DESCRIPTION: Reader 08 Analog FAD resp for 330 cases available

    DATA COLLECTED IN  5 CATEGORIES
    WITH CATEGORY  5 REPRESENTING STRONGEST EVIDENCE OF POSITIVITY
    (E.G., THAT ABNORMALITY IS PRESENT).

    NO. OF ACTUALLY NEGATIVE CASES =  308.
    NO. OF ACTUALLY POSITIVE CASES =   22.

    RESPONSE DATA:
     CATEGORY                    1      2      3      4      5
     ACTUALLY NEGATIVE CASES   250.    24.    11.    14.     9.
     ACTUALLY POSITIVE CASES    11.     1.     3.     4.     3.

    OBSERVED OPERATING POINTS:
     FPF:  .000  .029  .075  .110  .188 1.000
     TPF:  .000  .136  .318  .455  .500 1.000

           INITIAL VALUES OF PARAMETERS:
    A=  1.1199    B=  1.1322
    Z(K)=   .884  1.225  1.442  1.893
    LOGL=  -256.1230
    CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
     BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.

    PROCEDURE CONVERGES AFTER   4 ITERATIONS.

           FINAL VALUES OF PARAMETERS:
    A=   .9484    B=  1.0304
    Z(K)=   .886  1.200  1.436  1.914
    LOGL=  -255.8990
    CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
     BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.


           VARIANCE-COVARIANCE MATRIX:
    A        .2375   .1413   .0093   .0052   .0012  -.0103
    B        .1413   .1155   .0027  -.0013  -.0052  -.0159
    Z( 1)    .0093   .0027   .0068   .0058   .0052   .0042
    Z( 2)    .0052  -.0013   .0058   .0085   .0077   .0067
    Z( 3)    .0012  -.0052   .0052   .0077   .0108   .0096
    Z( 4)   -.0103  -.0159   .0042   .0067   .0096   .0210

           CORRELATION MATRIX:
    A       1.0000   .8531   .2320   .1168   .0237  -.1460
    B        .8531  1.0000   .0946  -.0420  -.1462  -.3223
    Z( 1)    .2320   .0946  1.0000   .7650   .6084   .3533
    Z( 2)    .1168  -.0420   .7650  1.0000   .8094   .5022
    Z( 3)    .0237  -.1462   .6084   .8094  1.0000   .6365
    Z( 4)   -.1460  -.3223   .3533   .5022   .6365  1.0000
```

AREA = .7455 STD. DEV.(AREA) = .0804

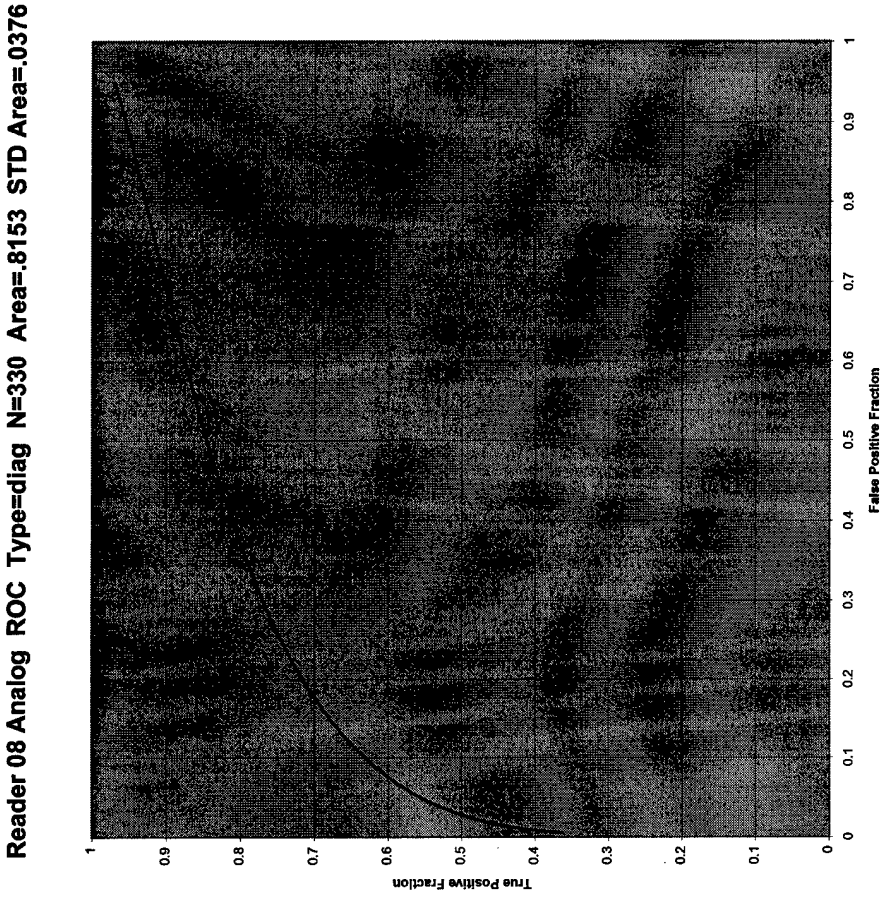
ESTIMATED BINORMAL ROC CURVE, WITH LOWER AND UPPER BOUNDS ON ASYMMETRIC 95% CONFIDENCE INTERVAL FOR TRUE-POSITIVE FRACTION AT EACH SPECIFIED FALSE-POSITIVE FRACTION:

FPF	TPF	(LOWER BOUND,	UPPER BOUND)
.005	.0440	(.0031 ,	.2495)
.010	.0737	(.0097 ,	.2875)
.020	.1214	(.0279 ,	.3361)
.030	.1611	(.0491 ,	.3721)
.040	.1960	(.0713 ,	.4029)
.050	.2276	(.0936 ,	.4307)
.060	.2566	(.1152 ,	.4567)
.070	.2835	(.1359 ,	.4815)
.080	.3087	(.1556 ,	.5053)
.090	.3324	(.1741 ,	.5284)
.100	.3548	(.1915 ,	.5508)
.110	.3762	(.2078 ,	.5726)
.120	.3965	(.2231 ,	.5937)
.130	.4159	(.2373 ,	.6142)
.140	.4345	(.2507 ,	.6341)
.150	.4524	(.2633 ,	.6533)
.200	.5324	(.3162 ,	.7392)
.250	.6001	(.3577 ,	.8084)
.300	.6585	(.3921 ,	.8623)
.400	.7542	(.4489 ,	.9337)
.500	.8285	(.4973 ,	.9715)
.600	.8867	(.5424 ,	.9896)
.700	.9317	(.5879 ,	.9971)
.800	.9653	(.6377 ,	.9995)
.900	.9884	(.7010 ,	1.0000)
.950	.9959	(.7481 ,	1.0000)

ESTIMATES OF EXPECTED OPERATING POINTS ON FITTED ROC CURVE, WITH LOWER AND UPPER BOUNDS OF ASYMMETRIC 95% CONFIDENCE INTERVAL ALONG THE CURVE FOR THOSE POINTS:

EXPECTED OPERATING POINT (FPF , TPF)	LOWER BOUND (FPF , TPF)	UPPER BOUND (FPF , TPF)
(.0278, .1530)	(.0140, .0940)	(.0515, .2323)
(.0756, .2978)	(.0506, .2295)	(.1090, .3741)
(.1152, .3868)	(.0838, .3178)	(.1541, .4596)
(.1878, .5141)	(.1473, .4477)	(.2345, .5801)

Do you want to use data from a previously created input file for the next run?
(Y/N, or Q to quit)
Stop - Program terminated.


Reader 08 Analog ROC Type=diag N=330 Area=.8153 STD Area=.0376
True Positive Fraction
False Positive Fraction
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1

DATE - 11/20/1998
TIME - 9:21:37

R O C F I T (IBM VERSION 1.2) :

M A X I M U M L I K E L I H O O D E S T I M A T I O N
O F A B I N O R M A L R O C C U R V E
F R O M R A T I N G D A T A

NAME OF INPUT FILE BEING USED: adiag08.txt

DATA DESCRIPTION: Reader 08 Analog diag resp for 330 cases available

OBSERVED OPERATING POINTS:
FPF: .000 .000 .008 .075 .275 1.000
TPF: .000 .222 .378 .611 .756 1.000

FINAL VALUES OF PARAMETERS:
A= 1.0162 B= .5309

CORRESPONDING AREA INDEX (A-SUB-Z) = .8153 WITH STD. DEV. = .0376.

ESTIMATED BINORMAL ROC CURVE, WITH LOWER AND UPPER
BOUNDS ON ASYMMETRIC 95% CONFIDENCE INTERVAL FOR
TRUE-POSITIVE FRACTION AT EACH SPECIFIED
FALSE-POSITIVE FRACTION:

FPF	TPF	(LOWER BOUND,	UPPER BOUND)
.005	.3626	(.2364 ,	.5059)
.010	.4132	(.2907 ,	.5450)
.020	.4703	(.3540 ,	.5893)
.030	.5069	(.3950 ,	.6183)
.040	.5345	(.4258 ,	.6406)
.050	.5567	(.4505 ,	.6590)
.060	.5756	(.4712 ,	.6748)
.070	.5919	(.4890 ,	.6888)
.080	.6064	(.5047 ,	.7014)
.090	.6195	(.5186 ,	.7128)
.100	.6314	(.5312 ,	.7234)
.110	.6424	(.5427 ,	.7332)
.120	.6526	(.5532 ,	.7424)
.130	.6621	(.5630 ,	.7510)
.140	.6710	(.5720 ,	.7592)
.150	.6794	(.5805 ,	.7669)
.200	.7155	(.6164 ,	.8004)
.250	.7448	(.6448 ,	.8277)
.300	.7697	(.6687 ,	.8507)
.400	.8111	(.7082 ,	.8879)
.500	.8452	(.7413 ,	.9170)
.600	.8750	(.7714 ,	.9403)
.700	.9022	(.8004 ,	.9596)
.800	.9283	(.8308 ,	.9755)
.900	.9551	(.8669 ,	.9887)
.950	.9706	(.8921 ,	.9945)

ESTIMATES OF EXPECTED OPERATING POINTS ON FITTED ROC

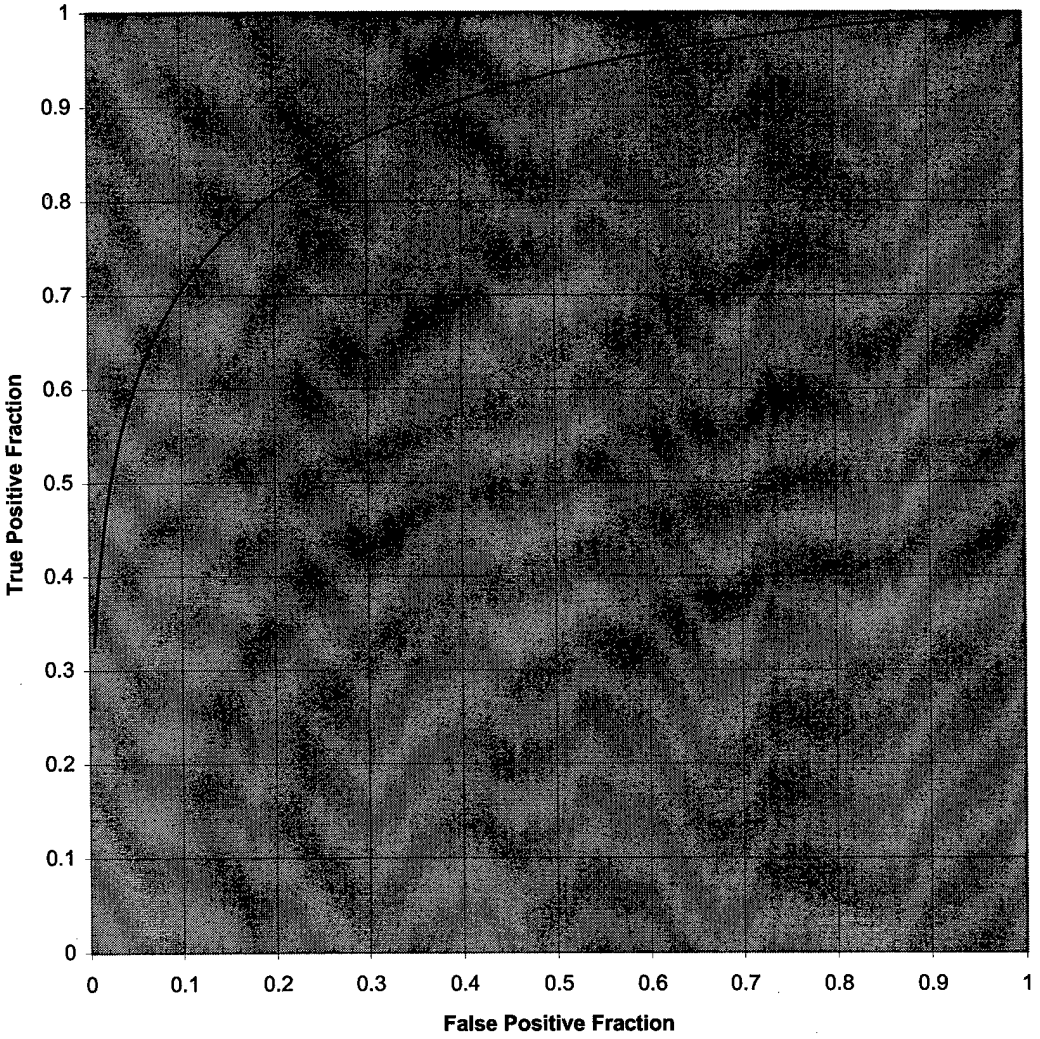
CURVE, WITH LOWER AND UPPER BOUNDS OF ASYMMETRIC 95%
CONFIDENCE INTERVAL ALONG THE CURVE FOR THOSE POINTS:

EXPECTED OPERATING POINT (FPF , TPF)	LOWER BOUND (FPF , TPF)	UPPER BOUND (FPF , TPF)
(.0004, .2222)	(.0000, .1132)	(.0059, .3746)
(.0067, .3830)	(.0016, .2899)	(.0232, .4834)
(.0772, .6026)	(.0498, .5564)	(.1148, .6474)
(.2746, .7575)	(.2212, .7285)	(.3337, .7846)

Reader 09_Analog (330 cases)

Totals	Type	Ground Truth, Mass	Ground Truth, uCa	Ground Truth, FAD	Ground Truth, Diag
Total Normal	172	280	253	308	240
Total Abnormal	158	50	77	22	90
	Resp = 1	Resp = 2	Resp = 3	Resp = 4	Resp = 5
Resp, Mass, N	182	61	27	5	5
Resp, Mass, A	6	6	9	7	22
Resp, Ca, N	234	9	0	2	8
Resp, Ca, A	23	1	2	4	47
Resp, FAD, N	259	21	10	7	11
Resp, FAD, A	14	2	2	3	1
Resp, Diag, B	117	83	40	0	0
Resp, Diag, M	8	15	41	13	13

Reader 09 Analog ROC Type=mass N=330 Area=.8858 STD Area=.0307



```
Do you want to use data from a previously created input file for the next run?
(Y/N, or Q to quit)
enter INPUT file name:
Do you want to save an output file for plotting the ROC curve?
(Y/N, or R to restart)
                                                        DATE - 11/20/1998
                                                      TIME - 12:25:29

            R O C F I T  (IBM VERSION 1.2) :

    M A X I M U M   L I K E L I H O O D   E S T I M A T I O N
         O F   A   B I N O R M A L   R O C   C U R V E
               F R O M   R A T I N G   D A T A


     DATA DESCRIPTION: Reader 09 Analog Mass resp for 330 cases

     DATA COLLECTED IN  5 CATEGORIES
     WITH CATEGORY  5 REPRESENTING STRONGEST EVIDENCE OF POSITIVITY
     (E.G., THAT ABNORMALITY IS PRESENT).

     NO. OF ACTUALLY NEGATIVE CASES =  280.
     NO. OF ACTUALLY POSITIVE CASES =   50.

     RESPONSE DATA:
      CATEGORY                    1      2      3      4      5
      ACTUALLY NEGATIVE CASES   182.    61.    27.     5.     5.
      ACTUALLY POSITIVE CASES     6.     6.     9.     7.    22.

     OBSERVED OPERATING POINTS:
      FPF:  .000  .018  .036  .132  .350 1.000
      TPF:  .000  .440  .580  .760  .880 1.000

           INITIAL VALUES OF PARAMETERS:
     A=  1.5019    B=   .7541
     Z(K)=   .385  1.116  1.803  2.101
     LOGL=  -348.2317
     GOODNESS OF FIT --
     CHI SQUARE=    1.7330  WITH  2 DEGREES OF FREEDOM,   P=  .4204

     PROCEDURE CONVERGES AFTER   4 ITERATIONS.

           FINAL VALUES OF PARAMETERS:
     A=  1.5153    B=   .7636
     Z(K)=   .388  1.106  1.783  2.158
     LOGL=  -347.8726
     GOODNESS OF FIT --
     CHI SQUARE=     .8153  WITH  2 DEGREES OF FREEDOM,   P=  .6652


           VARIANCE-COVARIANCE MATRIX:
     A       .0766   .0343   .0049   .0041  -.0007  -.0072
     B       .0343   .0255   .0015  -.0006  -.0069  -.0138
     Z( 1)   .0049   .0015   .0059   .0040   .0029   .0023
     Z( 2)   .0041  -.0006   .0040   .0085   .0068   .0065
     Z( 3)  -.0007  -.0069   .0029   .0068   .0178   .0181
     Z( 4)  -.0072  -.0138   .0023   .0065   .0181   .0313

           CORRELATION MATRIX:
     A      1.0000   .7766   .2295   .1603  -.0196  -.1471
     B       .7766  1.0000   .1196  -.0391  -.3221  -.4868
     Z( 1)   .2295   .1196  1.0000   .5596   .2796   .1708
     Z( 2)   .1603  -.0391   .5596  1.0000   .5576   .4019
     Z( 3)  -.0196  -.3221   .2796   .5576  1.0000   .7682
     Z( 4)  -.1471  -.4868   .1708   .4019   .7682  1.0000
```

AREA = .8858 STD. DEV.(AREA) = .0307

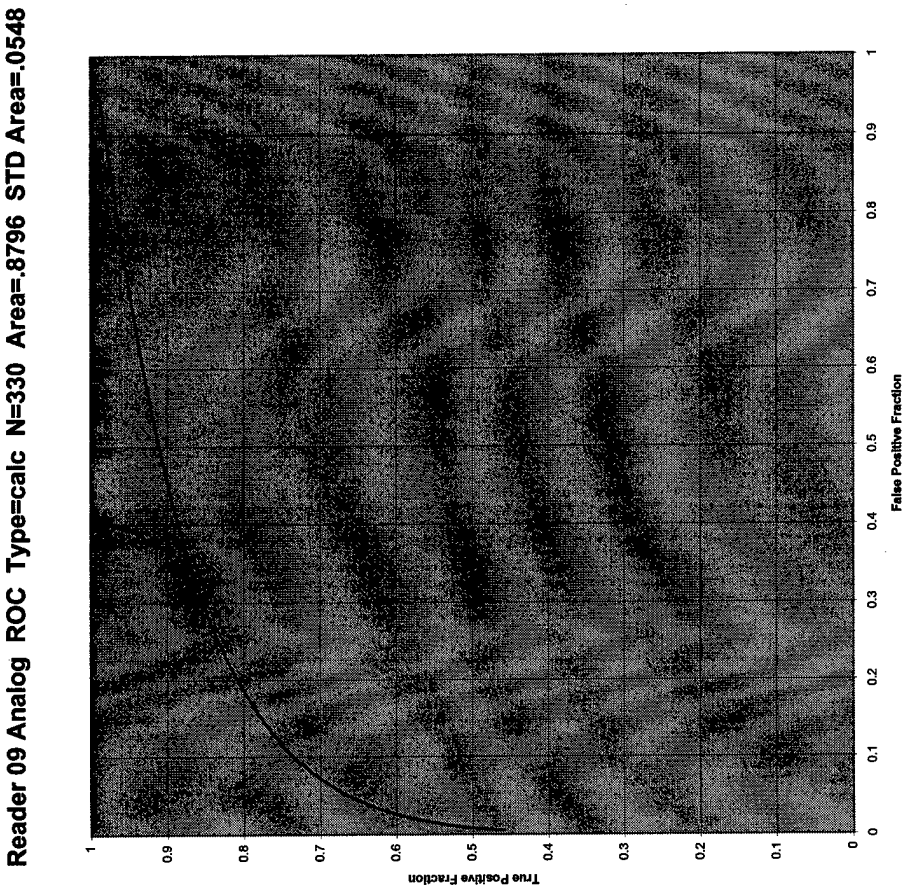
ESTIMATED BINORMAL ROC CURVE, WITH LOWER AND UPPER BOUNDS ON ASYMMETRIC 95% CONFIDENCE INTERVAL FOR TRUE-POSITIVE FRACTION AT EACH SPECIFIED FALSE-POSITIVE FRACTION:

FPF	TPF	(LOWER BOUND,	UPPER BOUND)
.005	.3256	(.1667 ,	.5252)
.010	.3968	(.2354 ,	.5785)
.020	.4787	(.3224 ,	.6384)
.030	.5314	(.3813 ,	.6771)
.040	.5707	(.4260 ,	.7063)
.050	.6022	(.4619 ,	.7302)
.060	.6284	(.4919 ,	.7504)
.070	.6510	(.5175 ,	.7680)
.080	.6708	(.5397 ,	.7836)
.090	.6884	(.5594 ,	.7976)
.100	.7042	(.5769 ,	.8103)
.110	.7185	(.5928 ,	.8218)
.120	.7317	(.6072 ,	.8324)
.130	.7438	(.6204 ,	.8422)
.140	.7550	(.6325 ,	.8513)
.150	.7654	(.6438 ,	.8597)
.200	.8086	(.6901 ,	.8942)
.250	.8414	(.7255 ,	.9195)
.300	.8676	(.7541 ,	.9386)
.400	.9069	(.7991 ,	.9645)
.500	.9351	(.8347 ,	.9802)
.600	.9562	(.8648 ,	.9897)
.700	.9723	(.8921 ,	.9952)
.800	.9845	(.9181 ,	.9983)
.900	.9937	(.9455 ,	.9996)
.950	.9972	(.9620 ,	.9999)

ESTIMATES OF EXPECTED OPERATING POINTS ON FITTED ROC CURVE, WITH LOWER AND UPPER BOUNDS OF ASYMMETRIC 95% CONFIDENCE INTERVAL ALONG THE CURVE FOR THOSE POINTS:

EXPECTED OPERATING POINT (FPF , TPF)	LOWER BOUND (FPF , TPF)	UPPER BOUND (FPF , TPF)
(.0155, .4472)	(.0061, .3455)	(.0350, .5525)
(.0373, .5612)	(.0205, .4818)	(.0641, .6382)
(.1344, .7488)	(.0992, .7030)	(.1773, .7905)
(.3492, .8886)	(.2952, .8653)	(.4064, .9090)

Do you want to use data from a previously created input file for the next run?
(Y/N, or Q to quit)
Stop - Program terminated.


Reader 09 Analog ROC Type=calc N=330 Area=.8796 STD Area=.0548
True Positive Fraction
False Positive Fraction
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1

```
Do you want to use data from a previously created input file for the next run?
(Y/N, or Q to quit)
enter INPUT file name:
Do you want to save an output file for plotting the ROC curve?
(Y/N, or R to restart)
                                                        DATE - 11/20/1998
                                                      TIME - 12:25:29

            R O C F I T  (IBM VERSION 1.2) :

    M A X I M U M   L I K E L I H O O D   E S T I M A T I O N
         O F   A   B I N O R M A L   R O C   C U R V E
               F R O M   R A T I N G   D A T A


     DATA DESCRIPTION: Reader 09 Analog Calc resp for 330 cases

     DATA COLLECTED IN  5 CATEGORIES
     WITH CATEGORY  5 REPRESENTING STRONGEST EVIDENCE OF POSITIVITY
     (E.G., THAT ABNORMALITY IS PRESENT).

     NO. OF ACTUALLY NEGATIVE CASES =  253.
     NO. OF ACTUALLY POSITIVE CASES =   77.

     RESPONSE DATA:
      CATEGORY                    1      2      3      4      5
      ACTUALLY NEGATIVE CASES   234.     9.     0.     2.     8.
      ACTUALLY POSITIVE CASES    23.     1.     2.     4.    47.

     OBSERVED OPERATING POINTS:
      FPF:  .000  .032  .040  .040  .075 1.000
      TPF:  .000  .610  .662  .688  .701 1.000

           INITIAL VALUES OF PARAMETERS:
    A=  1.3470    B=   .5471
    Z(K)=  1.439  1.657  1.757  1.858
    LOGL=  -165.2280
    CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
     BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.

     PROCEDURE CONVERGES AFTER   4 ITERATIONS.

           FINAL VALUES OF PARAMETERS:
    A=  1.3454    B=   .5618
    Z(K)=  1.441  1.669  1.723  1.889
    LOGL=  -164.0483
    CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
     BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.


           VARIANCE-COVARIANCE MATRIX:
    A        .1996   .1072   .0119  -.0013  -.0050  -.0182
    B        .1072   .0656   .0029  -.0059  -.0083  -.0170
    Z( 1)    .0119   .0029   .0137   .0124   .0122   .0114
    Z( 2)   -.0013  -.0059   .0124   .0171   .0171   .0172
    Z( 3)   -.0050  -.0083   .0122   .0171   .0185   .0189
    Z( 4)   -.0182  -.0170   .0114   .0172   .0189   .0249

           CORRELATION MATRIX:
    A       1.0000   .9365   .2280  -.0227  -.0827  -.2584
    B        .9365  1.0000   .0979  -.1750  -.2386  -.4213
    Z( 1)    .2280   .0979  1.0000   .8133   .7652   .6151
    Z( 2)   -.0227  -.1750   .8133  1.0000   .9610   .8355
    Z( 3)   -.0827  -.2386   .7652   .9610  1.0000   .8812
    Z( 4)   -.2584  -.4213   .6151   .8355   .8812  1.0000
```

AREA = .8796 STD. DEV.(AREA) = .0548

ESTIMATED BINORMAL ROC CURVE, WITH LOWER AND UPPER BOUNDS ON ASYMMETRIC 95% CONFIDENCE INTERVAL FOR TRUE-POSITIVE FRACTION AT EACH SPECIFIED FALSE-POSITIVE FRACTION:

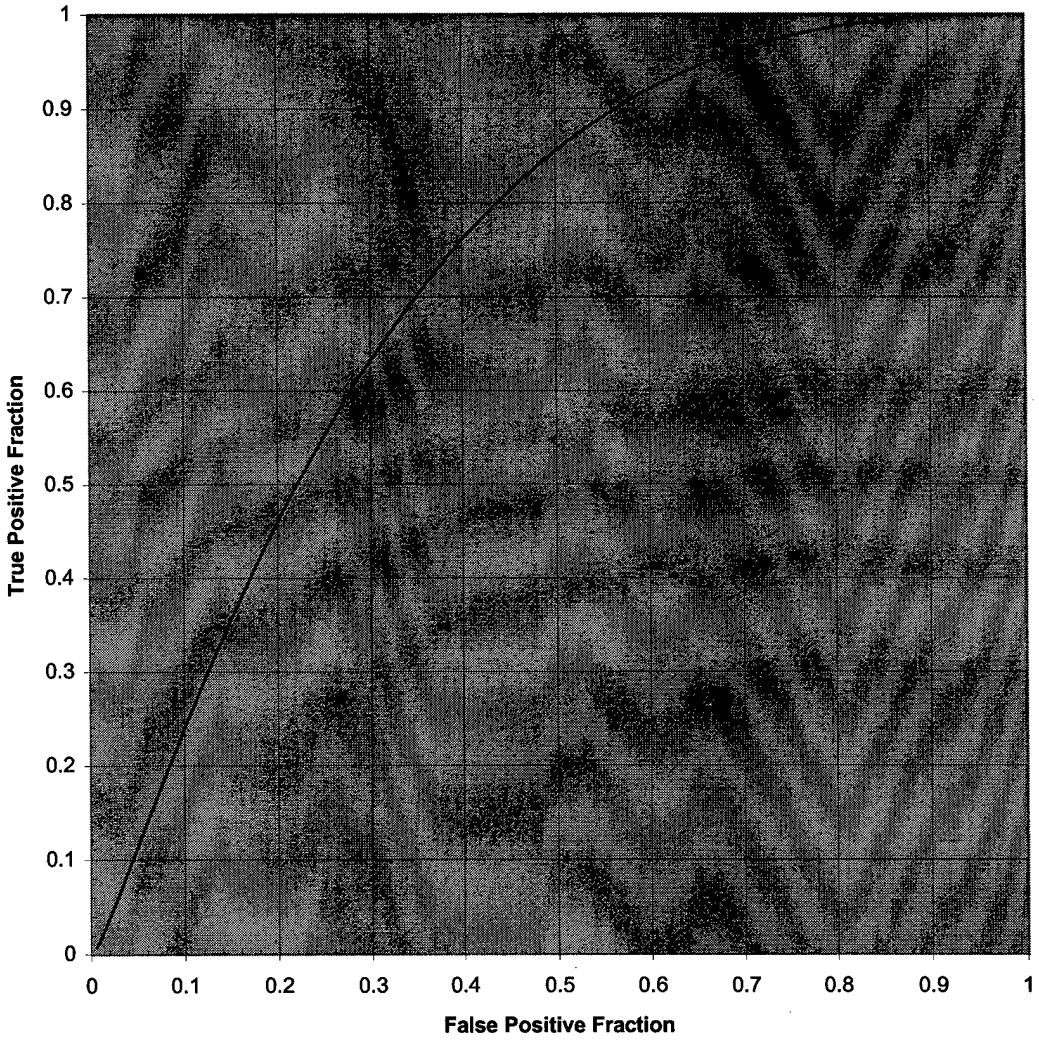
FPF	TPF	(LOWER BOUND,	UPPER BOUND)
.005	.4594	(.2526 ,	.6781)
.010	.5152	(.3351 ,	.6923)
.020	.5759	(.4280 ,	.7136)
.030	.6135	(.4830 ,	.7323)
.040	.6412	(.5195 ,	.7499)
.050	.6632	(.5454 ,	.7668)
.060	.6814	(.5644 ,	.7827)
.070	.6971	(.5789 ,	.7976)
.080	.7109	(.5903 ,	.8115)
.090	.7231	(.5994 ,	.8244)
.100	.7341	(.6069 ,	.8363)
.110	.7442	(.6132 ,	.8473)
.120	.7534	(.6185 ,	.8574)
.130	.7619	(.6232 ,	.8668)
.140	.7699	(.6272 ,	.8754)
.150	.7773	(.6308 ,	.8834)
.200	.8086	(.6444 ,	.9154)
.250	.8331	(.6538 ,	.9379)
.300	.8534	(.6609 ,	.9542)
.400	.8856	(.6719 ,	.9751)
.500	.9108	(.6807 ,	.9868)
.600	.9316	(.6886 ,	.9935)
.700	.9495	(.6964 ,	.9972)
.800	.9655	(.7048 ,	.9990)
.900	.9806	(.7157 ,	.9998)
.950	.9884	(.7241 ,	1.0000)

ESTIMATES OF EXPECTED OPERATING POINTS ON FITTED ROC CURVE, WITH LOWER AND UPPER BOUNDS OF ASYMMETRIC 95% CONFIDENCE INTERVAL ALONG THE CURVE FOR THOSE POINTS:

EXPECTED OPERATING POINT (FPF , TPF)	LOWER BOUND (FPF , TPF)	UPPER BOUND (FPF , TPF)
(.0294, .6119)	(.0140, .5440)	(.0571, .6765)
(.0425, .6471)	(.0233, .5901)	(.0726, .7010)
(.0475, .6582)	(.0271, .6040)	(.0788, .7094)
(.0748, .7040)	(.0474, .6580)	(.1129, .7469)

Do you want to use data from a previously created input file for the next run?
(Y/N, or Q to quit)
Stop - Program terminated.

Reader 09 Analog ROC Type=FAD N=330 Area=.7330 STD Area=.0862



```
Do you want to use data from a previously created input file for the next run?
(Y/N, or Q to quit)
enter INPUT file name:
Do you want to save an output file for plotting the ROC curve?
(Y/N, or R to restart)
                                                        DATE - 11/20/1998
                                                      TIME - 12:31:10

            R O C F I T  (IBM VERSION 1.2) :

    M A X I M U M   L I K E L I H O O D   E S T I M A T I O N
         O F   A   B I N O R M A L   R O C   C U R V E
               F R O M   R A T I N G   D A T A


     DATA DESCRIPTION: Reader 09 Analog FAD resp for 330 cases available

     DATA COLLECTED IN  5 CATEGORIES
     WITH CATEGORY  5 REPRESENTING STRONGEST EVIDENCE OF POSITIVITY
     (E.G., THAT ABNORMALITY IS PRESENT).

     NO. OF ACTUALLY NEGATIVE CASES =  308.
     NO. OF ACTUALLY POSITIVE CASES =   22.

     RESPONSE DATA:
      CATEGORY                    1      2      3      4      5
      ACTUALLY NEGATIVE CASES   259.    21.    10.     7.    11.
      ACTUALLY POSITIVE CASES    14.     2.     2.     3.     1.

     OBSERVED OPERATING POINTS:
      FPF:  .000  .036  .058  .091  .159 1.000
      TPF:  .000  .045  .182  .273  .364 1.000

           INITIAL VALUES OF PARAMETERS:
    A=  1.3794    B=  1.5897
    Z(K)=   .998  1.335  1.568  1.803
    LOGL=  -225.2043
    CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
     BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.

     PROCEDURE CONVERGES AFTER   5 ITERATIONS.

           FINAL VALUES OF PARAMETERS:
    A=  1.0584    B=  1.3765
    Z(K)=  1.000  1.314  1.544  1.829
    LOGL=  -224.8260
    CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
     BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.


           VARIANCE-COVARIANCE MATRIX:
    A        .4371   .2990   .0142   .0045  -.0035  -.0136
    B        .2990   .2486   .0040  -.0046  -.0116  -.0202
    Z( 1)    .0142   .0040   .0074   .0064   .0057   .0051
    Z( 2)    .0045  -.0046   .0064   .0095   .0088   .0081
    Z( 3)   -.0035  -.0116   .0057   .0088   .0124   .0116
    Z( 4)   -.0136  -.0202   .0051   .0081   .0116   .0185

           CORRELATION MATRIX:
    A       1.0000   .9072   .2495   .0697  -.0478  -.1513
    B        .9072  1.0000   .0940  -.0953  -.2092  -.2982
    Z( 1)    .2495   .0940  1.0000   .7591   .5983   .4319
    Z( 2)    .0697  -.0953   .7591  1.0000   .8108   .6118
    Z( 3)   -.0478  -.2092   .5983   .8108  1.0000   .7631
    Z( 4)   -.1513  -.2982   .4319   .6118   .7631  1.0000
```

AREA = .7330 STD. DEV.(AREA) = .0862

ESTIMATED BINORMAL ROC CURVE, WITH LOWER AND UPPER BOUNDS ON ASYMMETRIC 95% CONFIDENCE INTERVAL FOR TRUE-POSITIVE FRACTION AT EACH SPECIFIED FALSE-POSITIVE FRACTION:

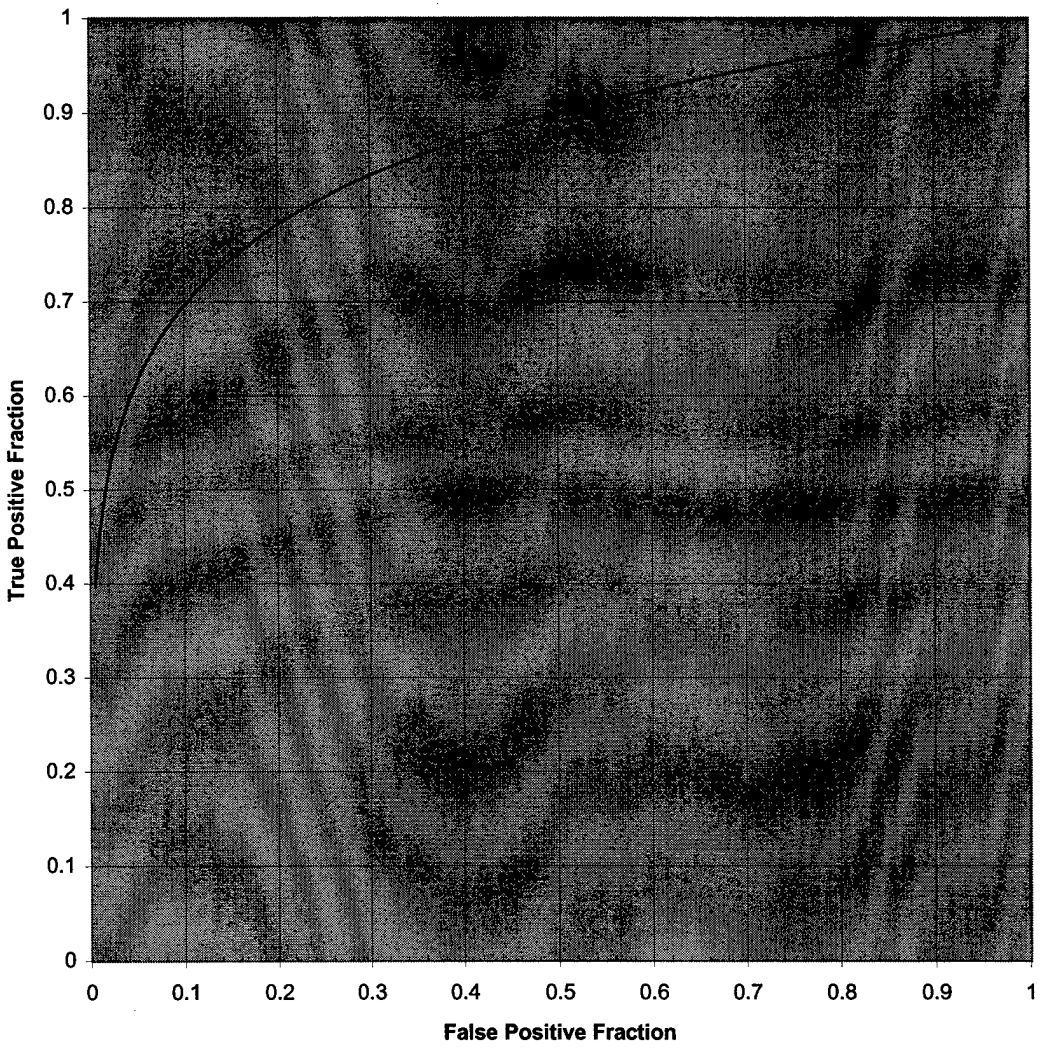
FPF	TPF	(LOWER BOUND,	UPPER BOUND)
.005	.0064	(.0000 ,	.1493)
.010	.0160	(.0004 ,	.1791)
.020	.0384	(.0029 ,	.2192)
.030	.0629	(.0084 ,	.2504)
.040	.0882	(.0172 ,	.2783)
.050	.1138	(.0286 ,	.3048)
.060	.1396	(.0421 ,	.3308)
.070	.1651	(.0570 ,	.3569)
.080	.1905	(.0727 ,	.3835)
.090	.2155	(.0887 ,	.4106)
.100	.2401	(.1045 ,	.4382)
.110	.2643	(.1198 ,	.4663)
.120	.2880	(.1346 ,	.4946)
.130	.3113	(.1486 ,	.5231)
.140	.3340	(.1618 ,	.5515)
.150	.3563	(.1743 ,	.5795)
.200	.4602	(.2268 ,	.7087)
.250	.5518	(.2674 ,	.8110)
.300	.6320	(.3010 ,	.8841)
.400	.7612	(.3570 ,	.9630)
.500	.8551	(.4062 ,	.9907)
.600	.9202	(.4534 ,	.9983)
.700	.9624	(.5025 ,	.9998)
.800	.9867	(.5580 ,	1.0000)
.900	.9976	(.6309 ,	1.0000)
.950	.9996	(.6869 ,	1.0000)

ESTIMATES OF EXPECTED OPERATING POINTS ON FITTED ROC CURVE, WITH LOWER AND UPPER BOUNDS OF ASYMMETRIC 95% CONFIDENCE INTERVAL ALONG THE CURVE FOR THOSE POINTS:

EXPECTED OPERATING POINT (FPF , TPF)	LOWER BOUND (FPF , TPF)	UPPER BOUND (FPF , TPF)
(.0337, .0723)	(.0181, .0339)	(.0592, .1375)
(.0613, .1430)	(.0390, .0858)	(.0924, .2216)
(.0945, .2266)	(.0662, .1556)	(.1307, .3130)
(.1587, .3752)	(.1213, .2911)	(.2029, .4657)

Do you want to use data from a previously created input file for the next run?
(Y/N, or Q to quit)
Stop - Program terminated.

Reader 09 Analog ROC Type=diag N=330 Area=.8645 STD Area=.0277



Do you want to use data from a previously created input file for the next run?
(Y/N, or Q to quit)
enter INPUT file name:
Do you want to save an output file for plotting the ROC curve?
(Y/N, or R to restart)

DATE - 11/20/1998
TIME - 12:32:58

R O C F I T (IBM VERSION 1.2) :

M A X I M U M L I K E L I H O O D E S T I M A T I O N
O F A B I N O R M A L R O C C U R V E
F R O M R A T I N G D A T A

DATA DESCRIPTION: Reader 09 Analog Diag resp for 330 cases

DATA COLLECTED IN 5 CATEGORIES
WITH CATEGORY 5 REPRESENTING STRONGEST EVIDENCE OF POSITIVITY
(E.G., THAT ABNORMALITY IS PRESENT).

NO. OF ACTUALLY NEGATIVE CASES = 240.
NO. OF ACTUALLY POSITIVE CASES = 90.

RESPONSE DATA:

CATEGORY	1	2	3	4	5
ACTUALLY NEGATIVE CASES	117.	83.	40.	0.	0.
ACTUALLY POSITIVE CASES	8.	15.	41.	13.	13.

OBSERVED OPERATING POINTS:

FPF:	.000	.000	.000	.167	.512	1.000
TPF:	.000	.144	.289	.744	.911	1.000

INITIAL VALUES OF PARAMETERS:
A= 1.3584 B= .7683
Z(K)= -.031 .967 2.766 2.866
LOGL= -387.8173
CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.

PROCEDURE CONVERGES AFTER 7 ITERATIONS.

FINAL VALUES OF PARAMETERS:
A= 1.2853 B= .6026
Z(K)= -.035 .983 3.076 3.908
LOGL= -373.0655
CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.

VARIANCE-COVARIANCE MATRIX:

A	.0317	.0124	.0036	.0032	-.0181	-.0331
B	.0124	.0138	.0013	-.0014	-.0438	-.0641
Z(1)	.0036	.0013	.0065	.0035	-.0005	-.0023
Z(2)	.0032	-.0014	.0035	.0090	.0117	.0136
Z(3)	-.0181	-.0438	-.0005	.0117	.2039	.2611
Z(4)	-.0331	-.0641	-.0023	.0136	.2611	.3937

CORRELATION MATRIX:

A	1.0000	.5914	.2506	.1869	-.2248	-.2962
B	.5914	1.0000	.1360	-.1216	-.8269	-.8700
Z(1)	.2506	.1360	1.0000	.4527	-.0129	-.0447
Z(2)	.1869	-.1216	.4527	1.0000	.2724	.2289
Z(3)	-.2248	-.8269	-.0129	.2724	1.0000	.9215
Z(4)	-.2962	-.8700	-.0447	.2289	.9215	1.0000

AREA = .8645 STD. DEV.(AREA) = .0277

ESTIMATED BINORMAL ROC CURVE, WITH LOWER AND UPPER BOUNDS ON ASYMMETRIC 95% CONFIDENCE INTERVAL FOR TRUE-POSITIVE FRACTION AT EACH SPECIFIED FALSE-POSITIVE FRACTION:

FPF	TPF	(LOWER BOUND,	UPPER BOUND)
.005	.3947	(.2281 ,	.5835)
.010	.4535	(.2913 ,	.6241)
.020	.5189	(.3669 ,	.6682)
.030	.5603	(.4170 ,	.6960)
.040	.5910	(.4549 ,	.7168)
.050	.6156	(.4856 ,	.7337)
.060	.6362	(.5114 ,	.7479)
.070	.6539	(.5336 ,	.7603)
.080	.6695	(.5531 ,	.7714)
.090	.6834	(.5705 ,	.7814)
.100	.6960	(.5862 ,	.7905)
.110	.7075	(.6005 ,	.7989)
.120	.7181	(.6135 ,	.8067)
.130	.7279	(.6255 ,	.8141)
.140	.7371	(.6367 ,	.8210)
.150	.7456	(.6471 ,	.8275)
.200	.7818	(.6902 ,	.8555)
.250	.8103	(.7234 ,	.8781)
.300	.8339	(.7502 ,	.8969)
.400	.8714	(.7924 ,	.9266)
.500	.9007	(.8254 ,	.9489)
.600	.9247	(.8534 ,	.9659)
.700	.9453	(.8789 ,	.9790)
.800	.9635	(.9037 ,	.9887)
.900	.9802	(.9309 ,	.9958)
.950	.9886	(.9482 ,	.9983)

ESTIMATES OF EXPECTED OPERATING POINTS ON FITTED ROC CURVE, WITH LOWER AND UPPER BOUNDS OF ASYMMETRIC 95% CONFIDENCE INTERVAL ALONG THE CURVE FOR THOSE POINTS:

EXPECTED OPERATING POINT (FPF , TPF)	LOWER BOUND (FPF , TPF)	UPPER BOUND (FPF , TPF)
(.0000, .1424)	(.0000, .0351)	(.0037, .3713)
(.0010, .2848)	(.0000, .1353)	(.0142, .4860)
(.1629, .7559)	(.1213, .7195)	(.2128, .7897)
(.5141, .9043)	(.4511, .8871)	(.5768, .9195)

Do you want to use data from a previously created input file for the next run?
(Y/N, or Q to quit)
Stop - Program terminated.

Reader11_Analog (84 Cases)

Totals

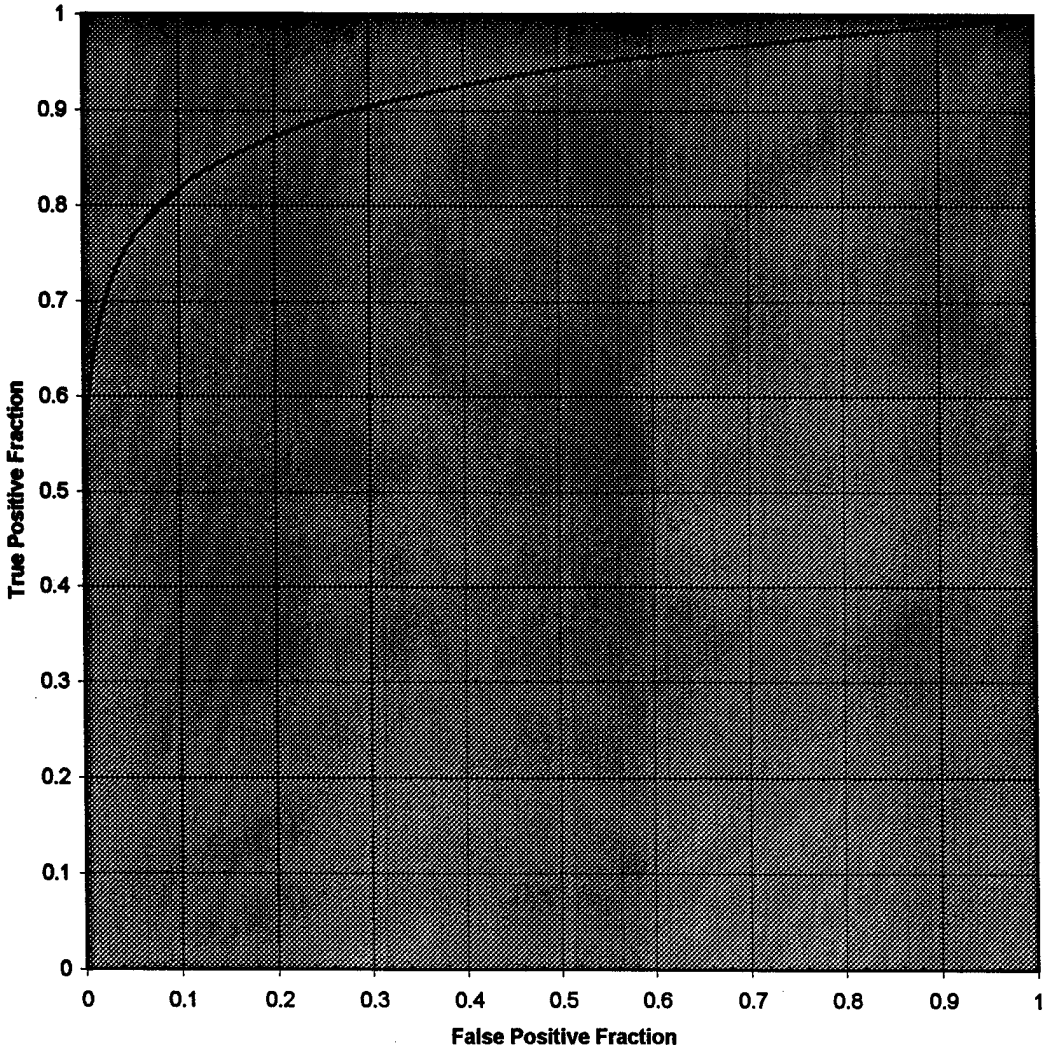
	Type	Ground Truth, Mass	Ground Truth, uCa	Ground Truth, FAD	Ground Truth, Diag
Total Normal	52	76	69	81	61
Total Abnormal	32	8	15	3	23
	Resp = 1	Resp = 2	Resp = 3	Resp = 4	Resp = 5
Resp, Mass, N	62	8	1	2	3
Resp, Mass, A	1	1	0	0	6
Resp, Ca, N	65	1	0	2	1
Resp, Ca, A	8	1	0	0	6
Resp, FAD, N	68	0	0	7	6
Resp, FAD, A	2	0	0	1	0
Resp, Diag, B	43	11	6	1	0
Resp, Diag, M	8	5	4	4	2

Reader11_Digital (84 cases)

Totals

	Type	Ground Truth, Mass	Ground Truth, uCa	Ground Truth, FAD	Ground Truth, Diag
Total Normal	52	76	69	81	61
Total Abnormal	32	8	15	3	23
	Resp = 1	Resp = 2	Resp = 3	Resp = 4	Resp = 5
Resp, Mass, N	60	4	1	3	8
Resp, Mass, A	1	0	0	0	7
Resp, Ca, N	63	1	0	0	5
Resp, Ca, A	10	0	0	0	5
Resp, FAD, N	70	0	0	6	5
Resp, FAD, A	3	0	0	0	0
Resp, Diag, B	33	14	8	5	1
Resp, Diag, M	9	4	2	4	4

Reader11 Analog ROC Type=mass N=84 Area=.9819 STD Area=.0850



```
Do you want to use data from a previously created input file for the next run?
(Y/N, or Q to quit)
enter INPUT file name:
Do you want to save an output file for plotting the ROC curve?
(Y/N, or R to restart)
                                                        DATE - 11/12/1998
                                                      TIME -  9:36:45
            R O C F I T  (IBM VERSION 1.2) :

    M A X I M U M   L I K E L I H O O D   E S T I M A T I O N
         O F   A   B I N O R M A L   R O C   C U R V E
               F R O M   R A T I N G   D A T A


     DATA DESCRIPTION: Reader 11 Analog Mass resp for 84 cases available

     DATA COLLECTED IN  5 CATEGORIES
     WITH CATEGORY  5 REPRESENTING STRONGEST EVIDENCE OF POSITIVITY
     (E.G., THAT ABNORMALITY IS PRESENT).

     NO. OF ACTUALLY NEGATIVE CASES =   76.
     NO. OF ACTUALLY POSITIVE CASES =    8.

     RESPONSE DATA:
      CATEGORY                    1      2      3      4      5
      ACTUALLY NEGATIVE CASES    62.     8.     1.     2.     3.
      ACTUALLY POSITIVE CASES     1.     1.     0.     0.     6.

     OBSERVED OPERATING POINTS:
      FPF:  .000  .039  .066  .079  .184 1.000
      TPF:  .000  .750  .750  .750  .875 1.000

            INITIAL VALUES OF PARAMETERS:
    A=  1.6573    B=    .5659
    Z(K)=    .899  1.412  1.508  1.757
    LOGL=   -58.4264
    CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
     BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.

     PROCEDURE CONVERGES AFTER   4 ITERATIONS.

            FINAL VALUES OF PARAMETERS:
    A=  1.5802    B=    .5273
    Z(K)=    .898  1.437  1.522  1.736
    LOGL=   -58.3768
    CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
     BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.


            VARIANCE-COVARIANCE MATRIX:
    A        .8191    .4044    .0197    .0029   -.0020   -.0189
    B        .4044    .2767    .0057   -.0109   -.0154   -.0308
    Z( 1)    .0197    .0057    .0279    .0214    .0206    .0188
    Z( 2)    .0029   -.0109    .0214    .0446    .0433    .0406
    Z( 3)   -.0020   -.0154    .0206    .0433    .0493    .0465
    Z( 4)   -.0189   -.0308    .0188    .0406    .0465    .0661

            CORRELATION MATRIX:
    A       1.0000    .8495    .1304    .0152   -.0099   -.0813
    B        .8495   1.0000    .0645   -.0977   -.1317   -.2279
    Z( 1)    .1304    .0645   1.0000    .6067    .5553    .4370
    Z( 2)    .0152   -.0977    .6067   1.0000    .9228    .7484
    Z( 3)   -.0099   -.1317    .5553    .9228   1.0000    .8138
    Z( 4)   -.0813   -.2279    .4370    .7484    .8138   1.0000
```

AREA = .9189 STD. DEV.(AREA) = .0850

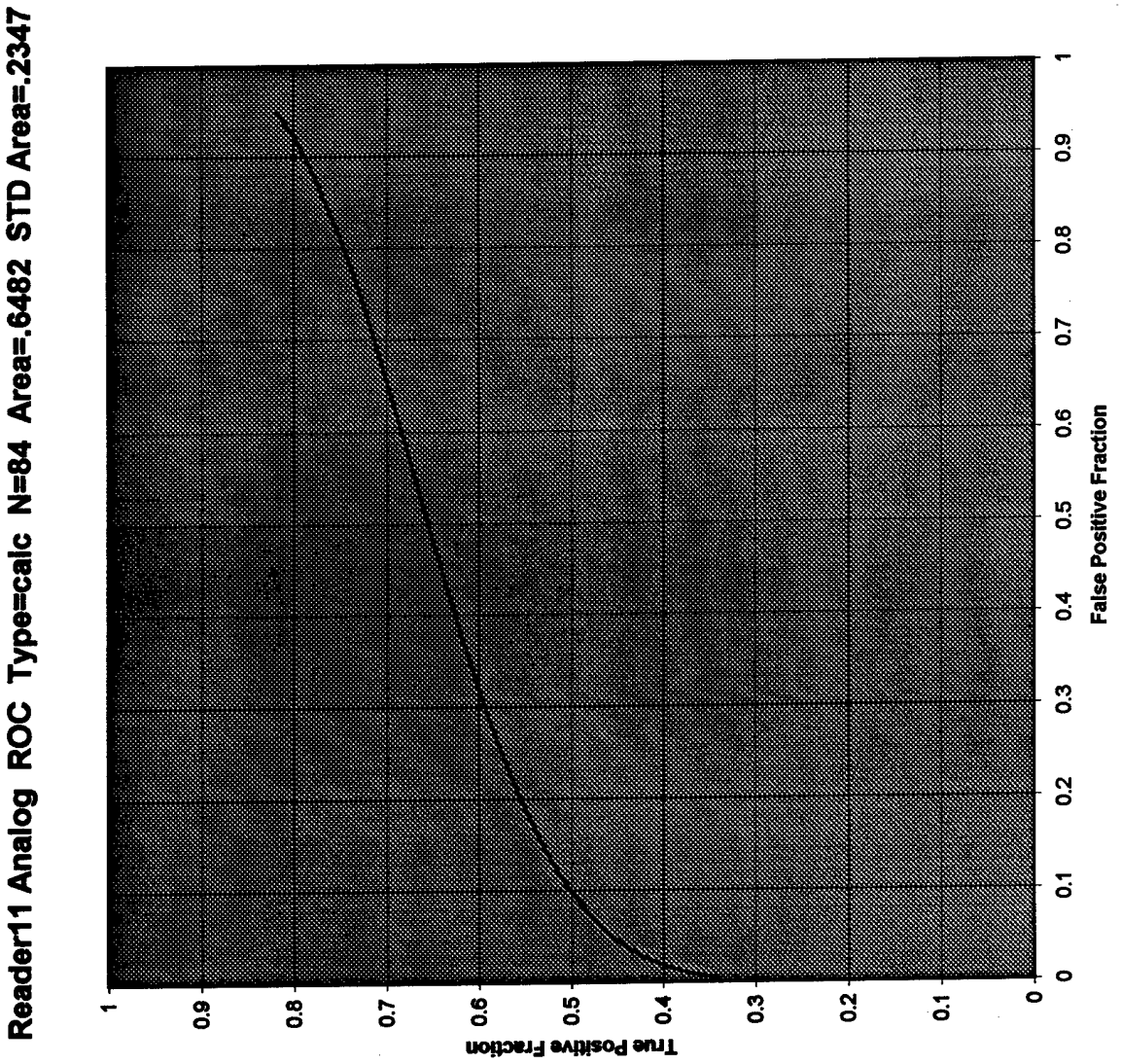
ESTIMATED BINORMAL ROC CURVE, WITH LOWER AND UPPER BOUNDS ON ASYMMETRIC 95% CONFIDENCE INTERVAL FOR TRUE-POSITIVE FRACTION AT EACH SPECIFIED FALSE-POSITIVE FRACTION:

FPF	TPF	(LOWER BOUND,	UPPER BOUND)
.005	.5878	(.1038 ,	.9558)
.010	.6381	(.1737 ,	.9502)
.020	.6905	(.2674 ,	.9468)
.030	.7218	(.3289 ,	.9473)
.040	.7444	(.3724 ,	.9494)
.050	.7620	(.4043 ,	.9523)
.060	.7765	(.4283 ,	.9556)
.070	.7887	(.4466 ,	.9589)
.080	.7993	(.4608 ,	.9622)
.090	.8087	(.4717 ,	.9654)
.100	.8171	(.4802 ,	.9685)
.110	.8247	(.4867 ,	.9713)
.120	.8316	(.4917 ,	.9739)
.130	.8380	(.4954 ,	.9764)
.140	.8439	(.4982 ,	.9786)
.150	.8494	(.5001 ,	.9806)
.200	.8721	(.5012 ,	.9884)
.250	.8897	(.4943 ,	.9931)
.300	.9039	(.4834 ,	.9960)
.400	.9260	(.4556 ,	.9987)
.500	.9430	(.4232 ,	.9996)
.600	.9567	(.3872 ,	.9999)
.700	.9683	(.3466 ,	1.0000)
.800	.9785	(.2986 ,	1.0000)
.900	.9880	(.2348 ,	1.0000)
.950	.9928	(.1869 ,	1.0000)

ESTIMATES OF EXPECTED OPERATING POINTS ON FITTED ROC CURVE, WITH LOWER AND UPPER BOUNDS OF ASYMMETRIC 95% CONFIDENCE INTERVAL ALONG THE CURVE FOR THOSE POINTS:

EXPECTED OPERATING POINT (FPF , TPF)	LOWER BOUND (FPF , TPF)	UPPER BOUND (FPF , TPF)
(.0413, .7469)	(.0125, .6551)	(.1089, .8239)
(.0640, .7816)	(.0251, .7082)	(.1385, .8431)
(.0753, .7946)	(.0321, .7271)	(.1531, .8510)
(.1846, .8658)	(.1103, .8249)	(.2841, .8996)

Do you want to use data from a previously created input file for the next run?
(Y/N, or Q to quit)
Stop - Program terminated.


Reader11 Analog ROC Type=calc N=84 Area=.6482 STD Area=.2347
True Positive Fraction
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
False Positive Fraction
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1

```
Do you want to use data from a previously created input file for the next run?
(Y/N, or Q to quit)
enter INPUT file name:
Do you want to save an output file for plotting the ROC curve?
(Y/N, or R to restart)
                                                        DATE - 11/12/1998
                                                      TIME -  9:36:45
            R O C F I T  (IBM VERSION 1.2) :

    M A X I M U M   L I K E L I H O O D   E S T I M A T I O N
         O F   A   B I N O R M A L   R O C   C U R V E
               F R O M   R A T I N G   D A T A


    DATA DESCRIPTION: Reader 11 Analog Calc resp for 84 cases available

    DATA COLLECTED IN  5 CATEGORIES
    WITH CATEGORY  5 REPRESENTING STRONGEST EVIDENCE OF POSITIVITY
    (E.G., THAT ABNORMALITY IS PRESENT).

    NO. OF ACTUALLY NEGATIVE CASES =   69.
    NO. OF ACTUALLY POSITIVE CASES =   15.

    RESPONSE DATA:
     CATEGORY                    1      2      3      4      5
     ACTUALLY NEGATIVE CASES    65.     1.     0.     2.     1.
     ACTUALLY POSITIVE CASES     8.     1.     0.     0.     6.

    OBSERVED OPERATING POINTS:
     FPF:  .000  .014  .043  .058 1.000
     TPF:  .000  .400  .400  .467 1.000

           INITIAL VALUES OF PARAMETERS:
    A=   .3117    B=   .2605
    Z(K)=  1.572  1.712  2.184
    LOGL=   -34.1360
    CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
     BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.

    PROCEDURE CONVERGES AFTER   4 ITERATIONS.

           FINAL VALUES OF PARAMETERS:
    A=   .3984    B=   .3099
    Z(K)=  1.570  1.792  2.122
    LOGL=   -33.8073
    CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
     BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.


           VARIANCE-COVARIANCE MATRIX:
    A        .4849   .2138   .0283  -.0003  -.0627
    B        .2138   .1205   .0065  -.0109  -.0492
    Z( 1)    .0283   .0065   .0587   .0536   .0472
    Z( 2)   -.0003  -.0109   .0536   .0758   .0729
    Z( 3)   -.0627  -.0492   .0472   .0729   .1349

           CORRELATION MATRIX:
    A       1.0000   .8844   .1679  -.0015  -.2451
    B        .8844  1.0000   .0768  -.1141  -.3856
    Z( 1)    .1679   .0768  1.0000   .8044   .5303
    Z( 2)   -.0015  -.1141   .8044  1.0000   .7207
    Z( 3)   -.2451  -.3856   .5303   .7207  1.0000
```

AREA = .6482 STD. DEV.(AREA) = .2347

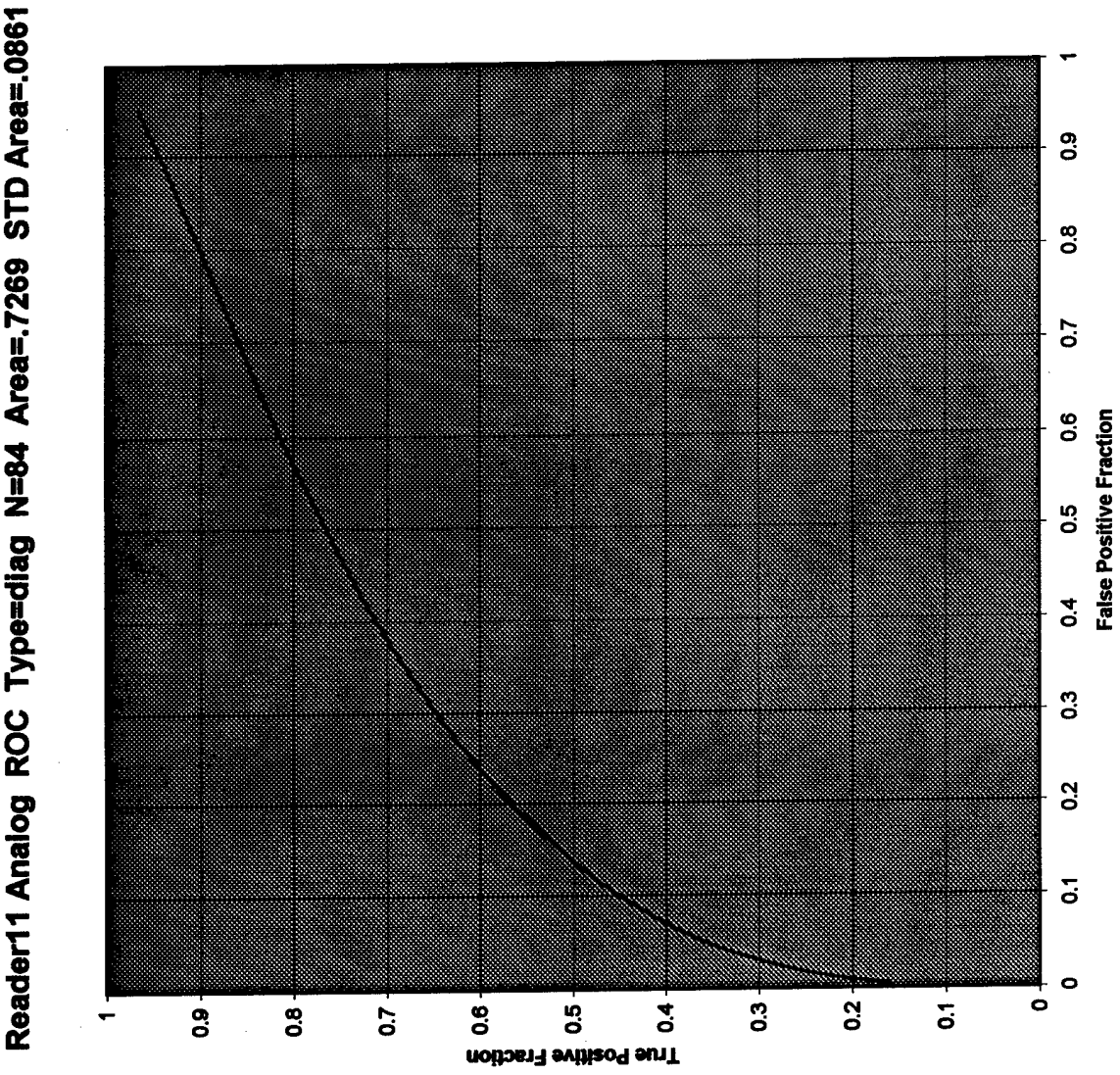
ESTIMATED BINORMAL ROC CURVE, WITH LOWER AND UPPER BOUNDS ON ASYMMETRIC 95% CONFIDENCE INTERVAL FOR TRUE-POSITIVE FRACTION AT EACH SPECIFIED FALSE-POSITIVE FRACTION:

FPF	TPF	(LOWER BOUND,	UPPER BOUND)
.005	.3446	(.1077 ,	.6696)
.010	.3735	(.1440 ,	.6616)
.020	.4058	(.1833 ,	.6652)
.030	.4268	(.2045 ,	.6760)
.040	.4426	(.2173 ,	.6889)
.050	.4556	(.2253 ,	.7024)
.060	.4667	(.2304 ,	.7158)
.070	.4764	(.2335 ,	.7289)
.080	.4852	(.2352 ,	.7413)
.090	.4931	(.2361 ,	.7532)
.100	.5005	(.2362 ,	.7645)
.110	.5073	(.2359 ,	.7752)
.120	.5136	(.2352 ,	.7853)
.130	.5197	(.2342 ,	.7950)
.140	.5253	(.2329 ,	.8041)
.150	.5308	(.2316 ,	.8128)
.200	.5547	(.2232 ,	.8501)
.250	.5751	(.2138 ,	.8794)
.300	.5933	(.2042 ,	.9030)
.400	.6255	(.1853 ,	.9376)
.500	.6548	(.1669 ,	.9611)
.600	.6832	(.1486 ,	.9770)
.700	.7125	(.1297 ,	.9877)
.800	.7451	(.1092 ,	.9946)
.900	.7869	(.0839 ,	.9985)
.950	.8181	(.0663 ,	.9996)

ESTIMATES OF EXPECTED OPERATING POINTS ON FITTED ROC CURVE, WITH LOWER AND UPPER BOUNDS OF ASYMMETRIC 95% CONFIDENCE INTERVAL ALONG THE CURVE FOR THOSE POINTS:

EXPECTED OPERATING POINT (FPF , TPF)	LOWER BOUND (FPF , TPF)	UPPER BOUND (FPF , TPF)
(.0169, .3978)	(.0022, .3148)	(.0805, .4856)
(.0366, .4376)	(.0099, .3729)	(.1052, .5041)
(.0583, .4649)	(.0205, .4070)	(.1368, .5236)

Do you want to use data from a previously created input file for the next run?
(Y/N, or Q to quit)
Stop - Program terminated.


Reader11 Analog ROC Type=diag N=84 Area=.7269 STD Area=.0861
True Positive Fraction
False Positive Fraction
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1

```
Do you want to use data from a previously created input file for the next run?
(Y/N, or Q to quit)
enter INPUT file name:
Do you want to save an output file for plotting the ROC curve?
(Y/N, or R to restart)
                                                        DATE - 11/12/1998
                                                      TIME - 10:10:18
            R O C F I T  (IBM VERSION 1.2) :

    M A X I M U M   L I K E L I H O O D   E S T I M A T I O N
         O F   A   B I N O R M A L   R O C   C U R V E
               F R O M   R A T I N G   D A T A


     DATA DESCRIPTION: Reader 11 Analog Diag resp for 84 cases available

     DATA COLLECTED IN  5 CATEGORIES
     WITH CATEGORY  5 REPRESENTING STRONGEST EVIDENCE OF POSITIVITY
     (E.G., THAT ABNORMALITY IS PRESENT).

     NO. OF ACTUALLY NEGATIVE CASES =   61.
     NO. OF ACTUALLY POSITIVE CASES =   23.

     RESPONSE DATA:
      CATEGORY                    1      2      3      4      5
      ACTUALLY NEGATIVE CASES    43.    11.     6.     1.     0.
      ACTUALLY POSITIVE CASES     8.     5.     4.     4.     2.

     OBSERVED OPERATING POINTS:
      FPF:  .000  .000  .016  .115  .295 1.000
      TPF:  .000  .087  .261  .435  .652 1.000

            INITIAL VALUES OF PARAMETERS:
     A=    .8605     B=    .8311
     Z(K)=    .538  1.202  2.135  2.400
     LOGL=   -90.1587
     CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
      BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.

     PROCEDURE CONVERGES AFTER   7 ITERATIONS.

            FINAL VALUES OF PARAMETERS:
     A=    .7241     B=    .6632
     Z(K)=    .533  1.243  2.072  3.183
     LOGL=   -87.0819
     CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
      BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.


            VARIANCE-COVARIANCE MATRIX:
     A        .1289    .0573    .0220    .0112   -.0156   -.0911
     B        .0573    .0525    .0064   -.0077   -.0419   -.1284
     Z( 1)    .0220    .0064    .0285    .0199    .0131    .0032
     Z( 2)    .0112   -.0077    .0199    .0416    .0392    .0499
     Z( 3)   -.0156   -.0419    .0131    .0392    .1202    .1744
     Z( 4)   -.0911   -.1284    .0032    .0499    .1744    .5951

            CORRELATION MATRIX:
     A       1.0000    .6960    .3631    .1532   -.1251   -.3288
     B        .6960   1.0000    .1657   -.1654   -.5270   -.7262
     Z( 1)    .3631    .1657   1.0000    .5779    .2244    .0245
     Z( 2)    .1532   -.1654    .5779   1.0000    .5549    .3169
     Z( 3)   -.1251   -.5270    .2244    .5549   1.0000    .6523
     Z( 4)   -.3288   -.7262    .0245    .3169    .6523   1.0000
```

AREA = .7269 STD. DEV.(AREA) = .0861

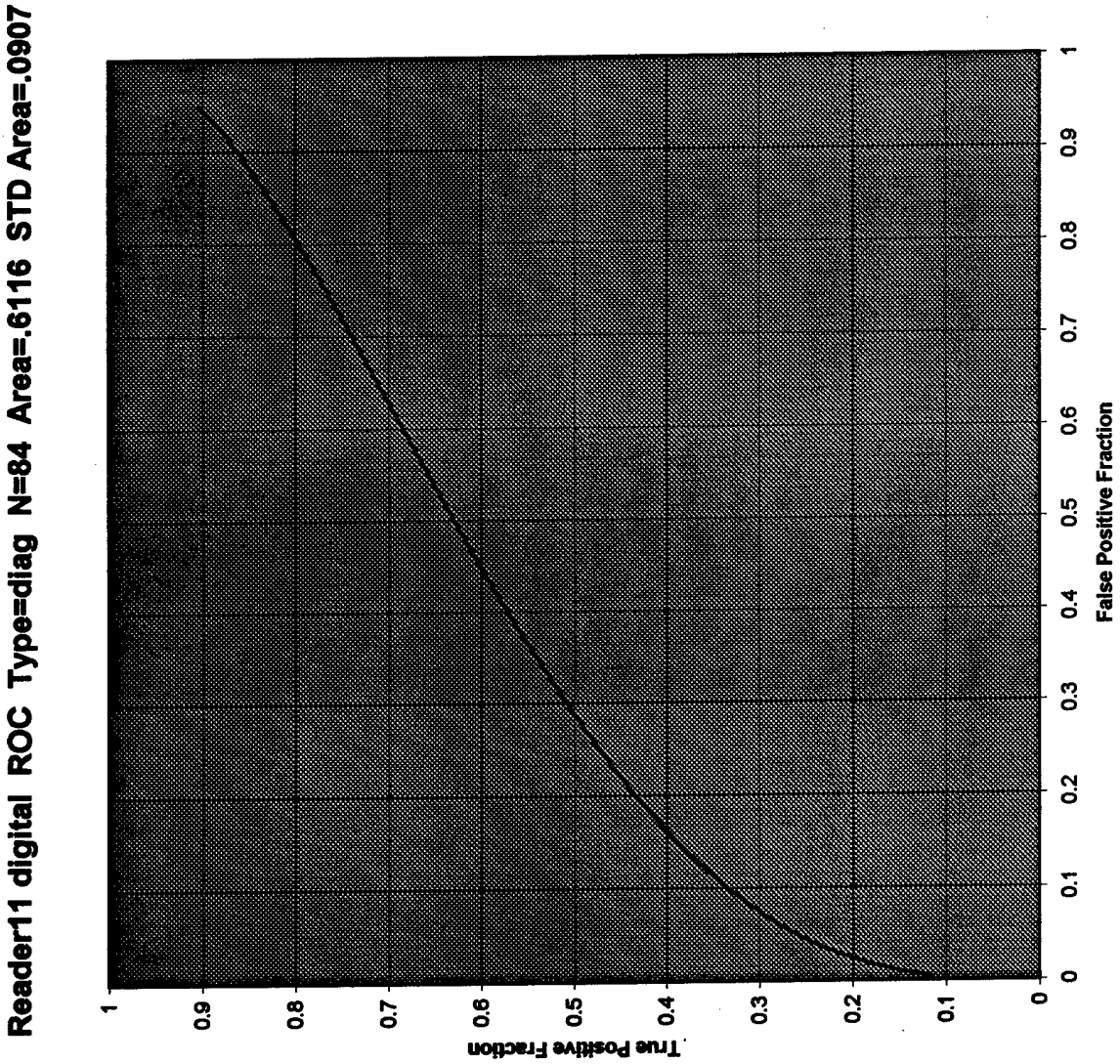
ESTIMATED BINORMAL ROC CURVE, WITH LOWER AND UPPER BOUNDS ON ASYMMETRIC 95% CONFIDENCE INTERVAL FOR TRUE-POSITIVE FRACTION AT EACH SPECIFIED FALSE-POSITIVE FRACTION:

FPF	TPF	(LOWER BOUND,	UPPER BOUND)
.005	.1624	(.0342 ,	.4414)
.010	.2064	(.0582 ,	.4728)
.020	.2616	(.0962 ,	.5108)
.030	.3003	(.1269 ,	.5375)
.040	.3309	(.1531 ,	.5591)
.050	.3568	(.1760 ,	.5778)
.060	.3793	(.1965 ,	.5946)
.070	.3994	(.2150 ,	.6100)
.080	.4176	(.2319 ,	.6243)
.090	.4344	(.2473 ,	.6377)
.100	.4499	(.2615 ,	.6505)
.110	.4643	(.2747 ,	.6626)
.120	.4780	(.2870 ,	.6742)
.130	.4908	(.2985 ,	.6853)
.140	.5030	(.3093 ,	.6960)
.150	.5146	(.3195 ,	.7063)
.200	.5659	(.3626 ,	.7529)
.250	.6091	(.3967 ,	.7927)
.300	.6467	(.4250 ,	.8270)
.400	.7110	(.4706 ,	.8822)
.500	.7655	(.5081 ,	.9233)
.600	.8138	(.5417 ,	.9534)
.700	.8580	(.5744 ,	.9747)
.800	.9001	(.6095 ,	.9889)
.900	.9423	(.6535 ,	.9971)
.950	.9653	(.6867 ,	.9992)

ESTIMATES OF EXPECTED OPERATING POINTS ON FITTED ROC CURVE, WITH LOWER AND UPPER BOUNDS OF ASYMMETRIC 95% CONFIDENCE INTERVAL ALONG THE CURVE FOR THOSE POINTS:

EXPECTED OPERATING POINT (FPF , TPF)	LOWER BOUND (FPF , TPF)	UPPER BOUND (FPF , TPF)
(.0007, .0827)	(.0000, .0084)	(.0473, .3503)
(.0191, .2578)	(.0030, .1355)	(.0819, .4210)
(.1069, .4600)	(.0502, .3574)	(.1996, .5655)
(.2970, .6445)	(.1938, .5600)	(.4199, .7224)

Do you want to use data from a previously created input file for the next run?
(Y/N, or Q to quit)
Stop - Program terminated.


Reader11 digital ROC Type=diag N=84 Area=.6116 STD Area=.0907
True Positive Fraction
False Positive Fraction
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1

```
Do you want to use data from a previously created input file for the next run?
(Y/N, or Q to quit)
enter INPUT file name:
Do you want to save an output file for plotting the ROC curve?
(Y/N, or R to restart)
                                                        DATE - 11/13/1998
                                                      TIME -  7:40:10
            R O C F I T  (IBM VERSION 1.2) :

    M A X I M U M   L I K E L I H O O D   E S T I M A T I O N
         O F   A   B I N O R M A L   R O C   C U R V E
               F R O M   R A T I N G   D A T A


     DATA DESCRIPTION: Reader 11 Digital Diag resp for 84 cases available

     DATA COLLECTED IN  5 CATEGORIES
     WITH CATEGORY  5 REPRESENTING STRONGEST EVIDENCE OF POSITIVITY
     (E.G., THAT ABNORMALITY IS PRESENT).

     NO. OF ACTUALLY NEGATIVE CASES =   61.
     NO. OF ACTUALLY POSITIVE CASES =   23.

     RESPONSE DATA:
      CATEGORY                    1      2      3      4      5
      ACTUALLY NEGATIVE CASES    33.    14.     8.     5.     1.
      ACTUALLY POSITIVE CASES     9.     4.     2.     4.     4.

     OBSERVED OPERATING POINTS:
      FPF:  .000  .016  .098  .230  .459 1.000
      TPF:  .000  .174  .348  .435  .609 1.000

            INITIAL VALUES OF PARAMETERS:
     A=   .3193    B=   .5844
     Z(K)=   .103   .740  1.291  2.135
     LOGL=  -108.2841
     CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
      BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.

     PROCEDURE CONVERGES AFTER   3 ITERATIONS.

            FINAL VALUES OF PARAMETERS:
     A=   .3294    B=   .5907
     Z(K)=   .101   .759  1.266  2.147
     LOGL=  -108.2288
     CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
      BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.


            VARIANCE-COVARIANCE MATRIX:
     A        .0828   .0280   .0154   .0113   .0078  -.0039
     B        .0280   .0357   .0054  -.0014  -.0089  -.0348
     Z( 1)    .0154   .0054   .0257   .0172   .0131   .0074
     Z( 2)    .0113  -.0014   .0172   .0297   .0245   .0212
     Z( 3)    .0078  -.0089   .0131   .0245   .0432   .0410
     Z( 4)   -.0039  -.0348   .0074   .0212   .0410   .1362

            CORRELATION MATRIX:
     A       1.0000   .5148   .3329   .2288   .1304  -.0368
     B        .5148  1.0000   .1791  -.0445  -.2276  -.4991
     Z( 1)    .3329   .1791  1.0000   .6210   .3928   .1243
     Z( 2)    .2288  -.0445   .6210  1.0000   .6829   .3337
     Z( 3)    .1304  -.2276   .3928   .6829  1.0000   .5350
     Z( 4)   -.0368  -.4991   .1243   .3337   .5350  1.0000
```

AREA = .6116 STD. DEV.(AREA) = .0907

ESTIMATED BINORMAL ROC CURVE, WITH LOWER AND UPPER BOUNDS ON ASYMMETRIC 95% CONFIDENCE INTERVAL FOR TRUE-POSITIVE FRACTION AT EACH SPECIFIED FALSE-POSITIVE FRACTION:

FPF	TPF	(LOWER BOUND,	UPPER BOUND)
.005	.1166	(.0220 ,	.3553)
.010	.1480	(.0364 ,	.3835)
.020	.1884	(.0595 ,	.4171)
.030	.2172	(.0788 ,	.4403)
.040	.2404	(.0957 ,	.4589)
.050	.2603	(.1109 ,	.4748)
.060	.2779	(.1249 ,	.4890)
.070	.2937	(.1379 ,	.5019)
.080	.3083	(.1500 ,	.5139)
.090	.3218	(.1615 ,	.5251)
.100	.3344	(.1723 ,	.5358)
.110	.3464	(.1825 ,	.5460)
.120	.3577	(.1923 ,	.5557)
.130	.3684	(.2016 ,	.5651)
.140	.3788	(.2105 ,	.5742)
.150	.3887	(.2191 ,	.5831)
.200	.4334	(.2573 ,	.6242)
.250	.4726	(.2897 ,	.6615)
.300	.5079	(.3180 ,	.6960)
.400	.5714	(.3661 ,	.7587)
.500	.6291	(.4072 ,	.8142)
.600	.6840	(.4448 ,	.8635)
.700	.7386	(.4818 ,	.9072)
.800	.7957	(.5216 ,	.9451)
.900	.8614	(.5719 ,	.9768)
.950	.9034	(.6101 ,	.9899)

ESTIMATES OF EXPECTED OPERATING POINTS ON FITTED ROC CURVE, WITH LOWER AND UPPER BOUNDS OF ASYMMETRIC 95% CONFIDENCE INTERVAL ALONG THE CURVE FOR THOSE POINTS:

EXPECTED OPERATING POINT (FPF , TPF)	LOWER BOUND (FPF , TPF)	UPPER BOUND (FPF , TPF)
(.0159, .1739)	(.0020, .0859)	(.0772, .3044)
(.1027, .3378)	(.0471, .2549)	(.1952, .4294)
(.2239, .4526)	(.1363, .3750)	(.3367, .5321)
(.4599, .6064)	(.3391, .5336)	(.5846, .6757)

Do you want to use data from a previously created input file for the next run?
(Y/N, or Q to quit)
Stop - Program terminated.

Totals

Reader 14 Analog

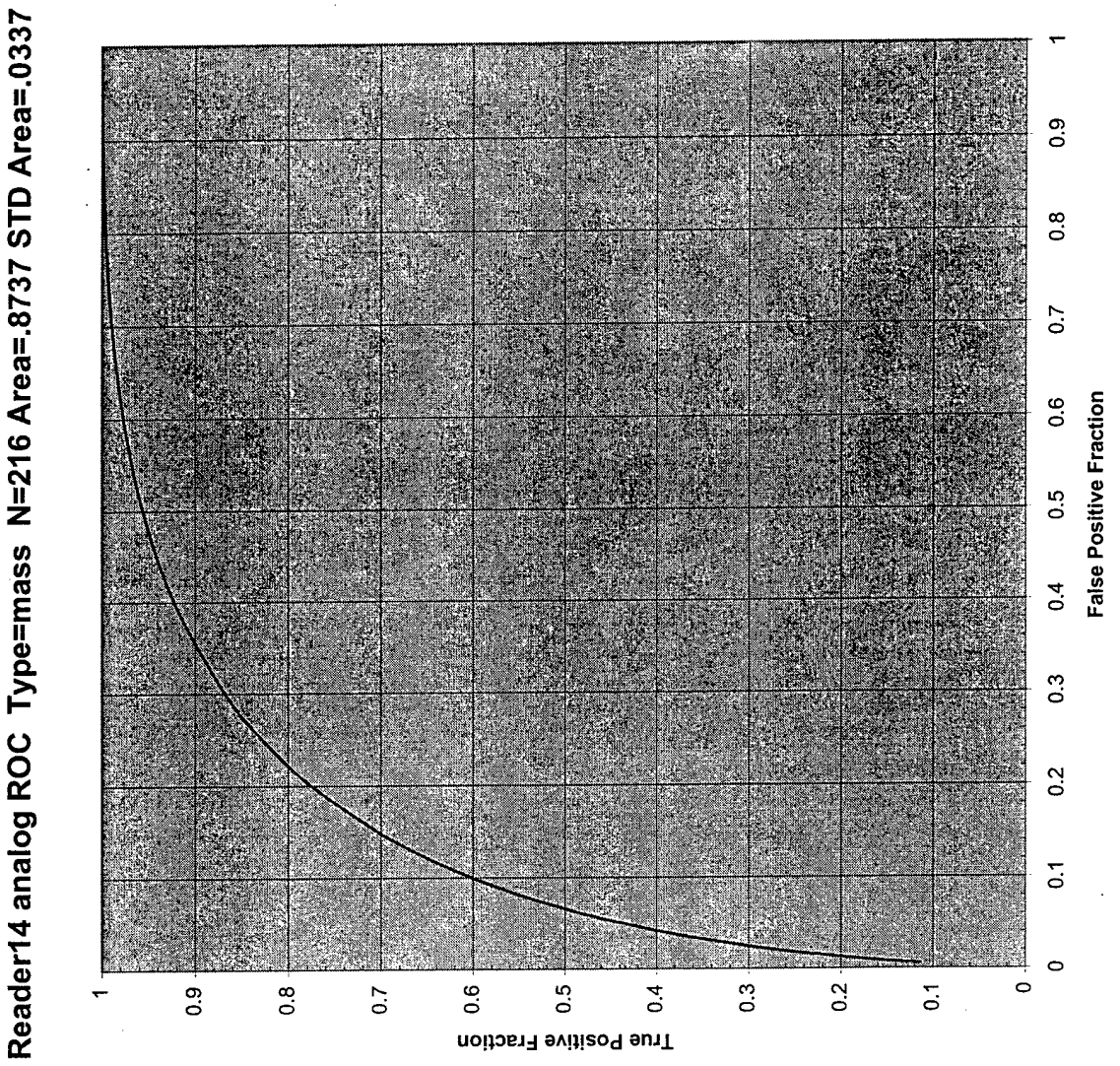
	Type	Ground Truth, Mass	Ground Truth, uCa	Ground Truth, FAD	Ground Truth, Diag
Total Normal	122	184	173	200	172
Total Abnormal	94	32	43	16	44

	Resp = 1	Resp = 2	Resp = 3	Resp = 4	Resp = 5
Resp, Mass, N	123	21	5	12	23
Resp, Mass, A	4	1	1	5	21
Resp, Ca, N	154	2	1	1	15
Resp, Ca, A	10	2	0	1	30
Resp, FAD, N	150	9	2	10	29
Resp, FAD, A	5	1	1	0	9
Resp, Diag, B	102	32	27	8	3
Resp, Diag, M	2	4	13	14	11

Reader14, Digital

Totals	Type	Mass	uCa	FAD	Diag
Total Normal	122	184	173	200	172
Total Abnormal	94	32	43	16	44

	Resp = 1	Resp = 2	Resp = 3	Resp = 4	Resp = 5
Resp, Mass, N	107	21	14	10	32
Resp, Mass, A	2	0	5	1	24
Resp, Ca, N	133	15	0	3	22
Resp, Ca, A	15	4	0	1	23
Resp, FAD, N	136	13	20	7	24
Resp, FAD, A	6	1	2	3	4
Resp, Diag, B	85	32	41	10	4
Resp, Diag, M	4	5	18	5	12


Reader14 analog ROC Type=mass N=216 Area=.8737 STD Area=.0337
True Positive Fraction
False Positive Fraction
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1

```
Do you want to use data from a previously created input file for the next run?
(Y/N, or Q to quit)
enter INPUT file name:
Do you want to save an output file for plotting the ROC curve?
(Y/N, or R to restart)
                                                        DATE - 11/ 9/1998
                                                      TIME - 11:49:58
            R O C F I T  (IBM VERSION 1.2) :

    M A X I M U M   L I K E L I H O O D   E S T I M A T I O N
         O F   A   B I N O R M A L   R O C   C U R V E
               F R O M   R A T I N G   D A T A


    DATA DESCRIPTION: Reader 14 Analog Mass resp for 216 cases available

    DATA COLLECTED IN  5 CATEGORIES
    WITH CATEGORY  5 REPRESENTING STRONGEST EVIDENCE OF POSITIVITY
    (E.G., THAT ABNORMALITY IS PRESENT).

    NO. OF ACTUALLY NEGATIVE CASES =  184.
    NO. OF ACTUALLY POSITIVE CASES =   32.

    RESPONSE DATA:
     CATEGORY                    1      2      3      4      5
     ACTUALLY NEGATIVE CASES   123.    21.     5.    12.    23.
     ACTUALLY POSITIVE CASES     4.     1.     1.     5.    21.

    OBSERVED OPERATING POINTS:
     FPF:  .000  .125  .190  .217  .332 1.000
     TPF:  .000  .656  .813  .844  .875 1.000

           INITIAL VALUES OF PARAMETERS:
    A=  1.6910    B=  1.0220
    Z(K)=   .435   .781   .877  1.150
    LOGL=  -228.4589
    CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
     BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.

    PROCEDURE CONVERGES AFTER   4 ITERATIONS.

           FINAL VALUES OF PARAMETERS:
    A=  1.7118    B=  1.1132
    Z(K)=   .438   .758   .855  1.162
    LOGL=  -228.1727
    CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
     BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.


           VARIANCE-COVARIANCE MATRIX:
    A       .1918   .1468   .0121   .0091   .0076   .0006
    B       .1468   .1620   .0047  -.0006  -.0030  -.0129
    Z( 1)   .0121   .0047   .0092   .0076   .0071   .0060
    Z( 2)   .0091  -.0006   .0076   .0102   .0098   .0086
    Z( 3)   .0076  -.0030   .0071   .0098   .0108   .0097
    Z( 4)   .0006  -.0129   .0060   .0086   .0097   .0141

           CORRELATION MATRIX:
    A      1.0000   .8327   .2894   .2050   .1659   .0113
    B       .8327  1.0000   .1211  -.0152  -.0706  -.2701
    Z( 1)   .2894   .1211  1.0000   .7803   .7181   .5321
    Z( 2)   .2050  -.0152   .7803  1.0000   .9279   .7189
    Z( 3)   .1659  -.0706   .7181   .9279  1.0000   .7842
    Z( 4)   .0113  -.2701   .5321   .7189   .7842  1.0000
```

AREA = .8737 STD. DEV.(AREA) = .0337

ESTIMATED BINORMAL ROC CURVE, WITH LOWER AND UPPER BOUNDS ON ASYMMETRIC 95% CONFIDENCE INTERVAL FOR TRUE-POSITIVE FRACTION AT EACH SPECIFIED FALSE-POSITIVE FRACTION:

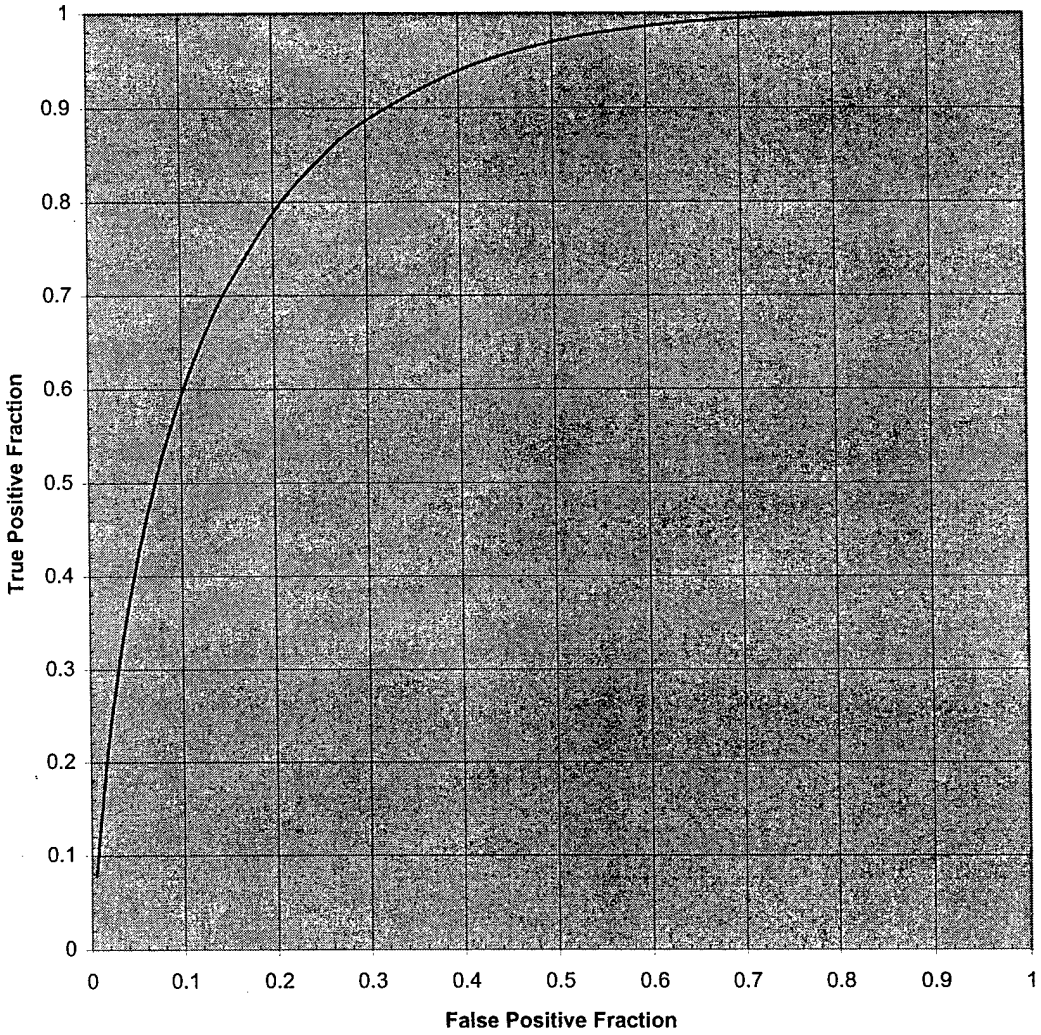
FPF	TPF	(LOWER BOUND,	UPPER BOUND)
.005	.1238	(.0053 ,	.5966)
.010	.1898	(.0180 ,	.6327)
.020	.2826	(.0550 ,	.6729)
.030	.3511	(.0991 ,	.6991)
.040	.4061	(.1454 ,	.7194)
.050	.4524	(.1916 ,	.7365)
.060	.4923	(.2364 ,	.7515)
.070	.5273	(.2790 ,	.7651)
.080	.5586	(.3192 ,	.7778)
.090	.5867	(.3567 ,	.7896)
.100	.6121	(.3916 ,	.8010)
.110	.6354	(.4238 ,	.8118)
.120	.6568	(.4535 ,	.8223)
.130	.6764	(.4807 ,	.8325)
.140	.6947	(.5057 ,	.8423)
.150	.7116	(.5286 ,	.8518)
.200	.7808	(.6168 ,	.8949)
.250	.8318	(.6743 ,	.9293)
.300	.8704	(.7142 ,	.9546)
.400	.9237	(.7671 ,	.9835)
.500	.9565	(.8033 ,	.9949)
.600	.9769	(.8322 ,	.9988)
.700	.9891	(.8579 ,	.9998)
.800	.9960	(.8830 ,	1.0000)
.900	.9992	(.9112 ,	1.0000)
.950	.9998	(.9299 ,	1.0000)

ESTIMATES OF EXPECTED OPERATING POINTS ON FITTED ROC CURVE, WITH LOWER AND UPPER BOUNDS OF ASYMMETRIC 95% CONFIDENCE INTERVAL ALONG THE CURVE FOR THOSE POINTS:

EXPECTED OPERATING POINT (FPF , TPF)	LOWER BOUND (FPF , TPF)	UPPER BOUND (FPF , TPF)
(.1226, .6621)	(.0816, .5633)	(.1764, .7509)
(.1961, .7762)	(.1447, .7028)	(.2573, .8380)
(.2243, .8074)	(.1695, .7413)	(.2880, .8619)
(.3306, .8895)	(.2657, .8450)	(.4010, .9240)

Do you want to use data from a previously created input file for the next run?
(Y/N, or Q to quit)
Stop - Program terminated.

Reader14 digital ROC Type=mass N=216 Area=.8761 STD Area=.0344



```
Do you want to use data from a previously created input file for the next run?
(Y/N, or Q to quit)
enter INPUT file name:
Do you want to save an output file for plotting the ROC curve?
(Y/N, or R to restart)
                                                        DATE - 11/ 9/1998
                                                      TIME - 11:49:58
            R O C F I T  (IBM VERSION 1.2) :

    M A X I M U M   L I K E L I H O O D   E S T I M A T I O N
         O F   A   B I N O R M A L   R O C   C U R V E
               F R O M   R A T I N G   D A T A


    DATA DESCRIPTION: Reader 14 Digital Mass resp for 217 cases available

    DATA COLLECTED IN  5 CATEGORIES
    WITH CATEGORY  5 REPRESENTING STRONGEST EVIDENCE OF POSITIVITY
    (E.G., THAT ABNORMALITY IS PRESENT).

    NO. OF ACTUALLY NEGATIVE CASES =  184.
    NO. OF ACTUALLY POSITIVE CASES =   32.

    RESPONSE DATA:
     CATEGORY                    1      2      3      4      5
     ACTUALLY NEGATIVE CASES   107.    21.    14.    10.    32.
     ACTUALLY POSITIVE CASES     2.     0.     5.     1.    24.

    OBSERVED OPERATING POINTS:
     FPF:  .000  .174  .228  .304  .418 1.000
     TPF:  .000  .750  .781  .938  .938 1.000

           INITIAL VALUES OF PARAMETERS:
    A=  2.0380    B=  1.4720
    Z(K)=   .205   .512   .744   .939
    LOGL=  -253.7449
    CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
     BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.

    PROCEDURE CONVERGES AFTER   5 ITERATIONS.

           FINAL VALUES OF PARAMETERS:
    A=  1.8781    B=  1.2808
    Z(K)=   .207   .491   .767   .939
    LOGL=  -253.2547
    CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
     BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.


           VARIANCE-COVARIANCE MATRIX:
    A       .1988   .1759   .0120   .0108   .0075   .0039
    B       .1759   .2367   .0053   .0015  -.0054  -.0118
    Z( 1)   .0120   .0053   .0087   .0072   .0061   .0055
    Z( 2)   .0108   .0015   .0072   .0091   .0079   .0072
    Z( 3)   .0075  -.0054   .0061   .0079   .0104   .0097
    Z( 4)   .0039  -.0118   .0055   .0072   .0097   .0118

           CORRELATION MATRIX:
    A      1.0000   .8111   .2888   .2534   .1650   .0810
    B       .8111  1.0000   .1176   .0325  -.1097  -.2240
    Z( 1)   .2888   .1176  1.0000   .8043   .6389   .5411
    Z( 2)   .2534   .0325   .8043  1.0000   .8064   .6959
    Z( 3)   .1650  -.1097   .6389   .8064  1.0000   .8787
    Z( 4)   .0810  -.2240   .5411   .6959   .8787  1.0000
```

AREA = .8761 STD. DEV.(AREA) = .0344

ESTIMATED BINORMAL ROC CURVE, WITH LOWER AND UPPER BOUNDS ON ASYMMETRIC 95% CONFIDENCE INTERVAL FOR TRUE-POSITIVE FRACTION AT EACH SPECIFIED FALSE-POSITIVE FRACTION:

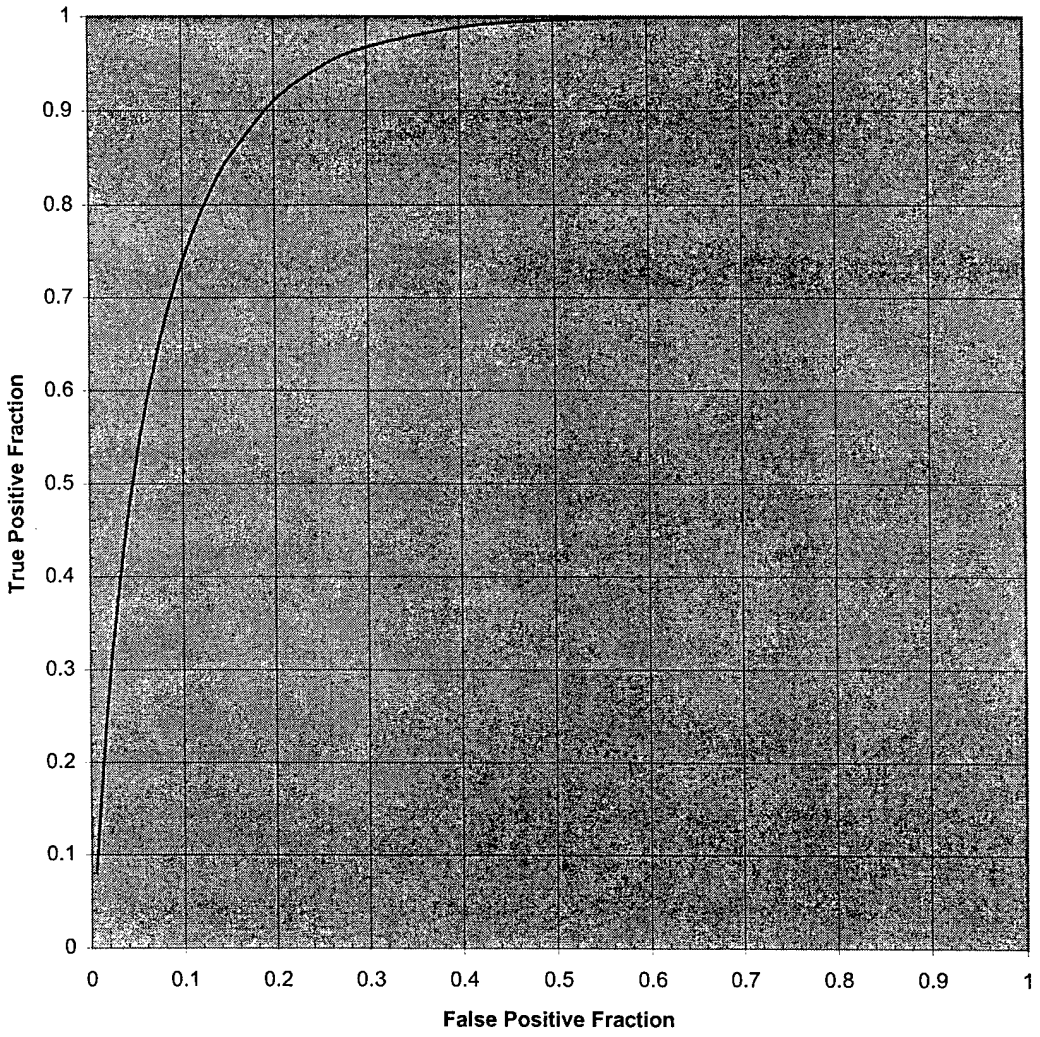
FPF	TPF	(LOWER BOUND,	UPPER BOUND)
.005	.0776	(.0006 ,	.6553)
.010	.1352	(.0035 ,	.6887)
.020	.2257	(.0177 ,	.7250)
.030	.2976	(.0417 ,	.7480)
.040	.3577	(.0731 ,	.7654)
.050	.4094	(.1094 ,	.7798)
.060	.4547	(.1488 ,	.7922)
.070	.4950	(.1899 ,	.8033)
.080	.5311	(.2314 ,	.8134)
.090	.5638	(.2726 ,	.8228)
.100	.5934	(.3127 ,	.8317)
.110	.6206	(.3515 ,	.8402)
.120	.6454	(.3884 ,	.8484)
.130	.6683	(.4235 ,	.8562)
.140	.6895	(.4564 ,	.8639)
.150	.7090	(.4872 ,	.8714)
.200	.7882	(.6105 ,	.9066)
.250	.8448	(.6912 ,	.9370)
.300	.8863	(.7437 ,	.9607)
.400	.9399	(.8055 ,	.9877)
.500	.9698	(.8424 ,	.9970)
.600	.9862	(.8693 ,	.9995)
.700	.9946	(.8920 ,	.9999)
.800	.9984	(.9132 ,	1.0000)
.900	.9998	(.9360 ,	1.0000)
.950	1.0000	(.9506 ,	1.0000)

ESTIMATES OF EXPECTED OPERATING POINTS ON FITTED ROC CURVE, WITH LOWER AND UPPER BOUNDS OF ASYMMETRIC 95% CONFIDENCE INTERVAL ALONG THE CURVE FOR THOSE POINTS:

EXPECTED OPERATING POINT (FPF , TPF)	LOWER BOUND (FPF , TPF)	UPPER BOUND (FPF , TPF)
(.1739, .7503)	(.1247, .6564)	(.2339, .8285)
(.2215, .8147)	(.1668, .7389)	(.2851, .8751)
(.3115, .8941)	(.2486, .8434)	(.3806, .9317)
(.4180, .9466)	(.3485, .9161)	(.4902, .9676)

Do you want to use data from a previously created input file for the next run?
(Y/N, or Q to quit)
Stop - Program terminated.

Reader14analog ROC Type=calc N=216 Area=.9232 STD Area=.0229



```
Do you want to use data from a previously created input file for the next run?
(Y/N, or Q to quit)
enter INPUT file name:
Do you want to save an output file for plotting the ROC curve?
(Y/N, or R to restart)
                                                        DATE - 11/ 9/1998
                                                      TIME - 11:49:58
            R O C F I T  (IBM VERSION 1.2) :

    M A X I M U M   L I K E L I H O O D   E S T I M A T I O N
         O F   A   B I N O R M A L   R O C   C U R V E
               F R O M   R A T I N G   D A T A


     DATA DESCRIPTION: Reader 14 Analog Calc resp for 216 cases available

     DATA COLLECTED IN  5 CATEGORIES
     WITH CATEGORY  5 REPRESENTING STRONGEST EVIDENCE OF POSITIVITY
     (E.G., THAT ABNORMALITY IS PRESENT).

     NO. OF ACTUALLY NEGATIVE CASES =  173.
     NO. OF ACTUALLY POSITIVE CASES =   43.

     RESPONSE DATA:
      CATEGORY                    1      2      3      4      5
      ACTUALLY NEGATIVE CASES   154.     2.     1.     1.    15.
      ACTUALLY POSITIVE CASES    10.     2.     0.     1.    30.

     OBSERVED OPERATING POINTS:
      FPF:  .000  .087  .092  .098  .110 1.000
      TPF:  .000  .698  .721  .721  .767 1.000

            INITIAL VALUES OF PARAMETERS:
     A=  2.7379    B=  1.6198
     Z(K)=  1.228  1.292  1.326  1.362
     LOGL=  -110.0205
     CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
      BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.

     PROCEDURE CONVERGES AFTER   4 ITERATIONS.

            FINAL VALUES OF PARAMETERS:
     A=  2.6777    B=  1.5878
     Z(K)=  1.227  1.303  1.322  1.361
     LOGL=  -109.7538
     CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
      BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.


            VARIANCE-COVARIANCE MATRIX:
     A       2.3862  1.7890   .0397   .0050  -.0044  -.0243
     B       1.7890  1.3875   .0116  -.0160  -.0235  -.0392
     Z( 1)    .0397   .0116   .0160   .0155   .0153   .0150
     Z( 2)    .0050  -.0160   .0155   .0168   .0168   .0168
     Z( 3)   -.0044  -.0235   .0153   .0168   .0172   .0173
     Z( 4)   -.0243  -.0392   .0150   .0168   .0173   .0183

            CORRELATION MATRIX:
     A       1.0000   .9832   .2030   .0250  -.0217  -.1161
     B        .9832  1.0000   .0779  -.1046  -.1518  -.2460
     Z( 1)    .2030   .0779  1.0000   .9416   .9222   .8778
     Z( 2)    .0250  -.1046   .9416  1.0000   .9882   .9587
     Z( 3)   -.0217  -.1518   .9222   .9882  1.0000   .9746
     Z( 4)   -.1161  -.2460   .8778   .9587   .9746  1.0000
```

AREA = .9232 STD. DEV.(AREA) = .0229

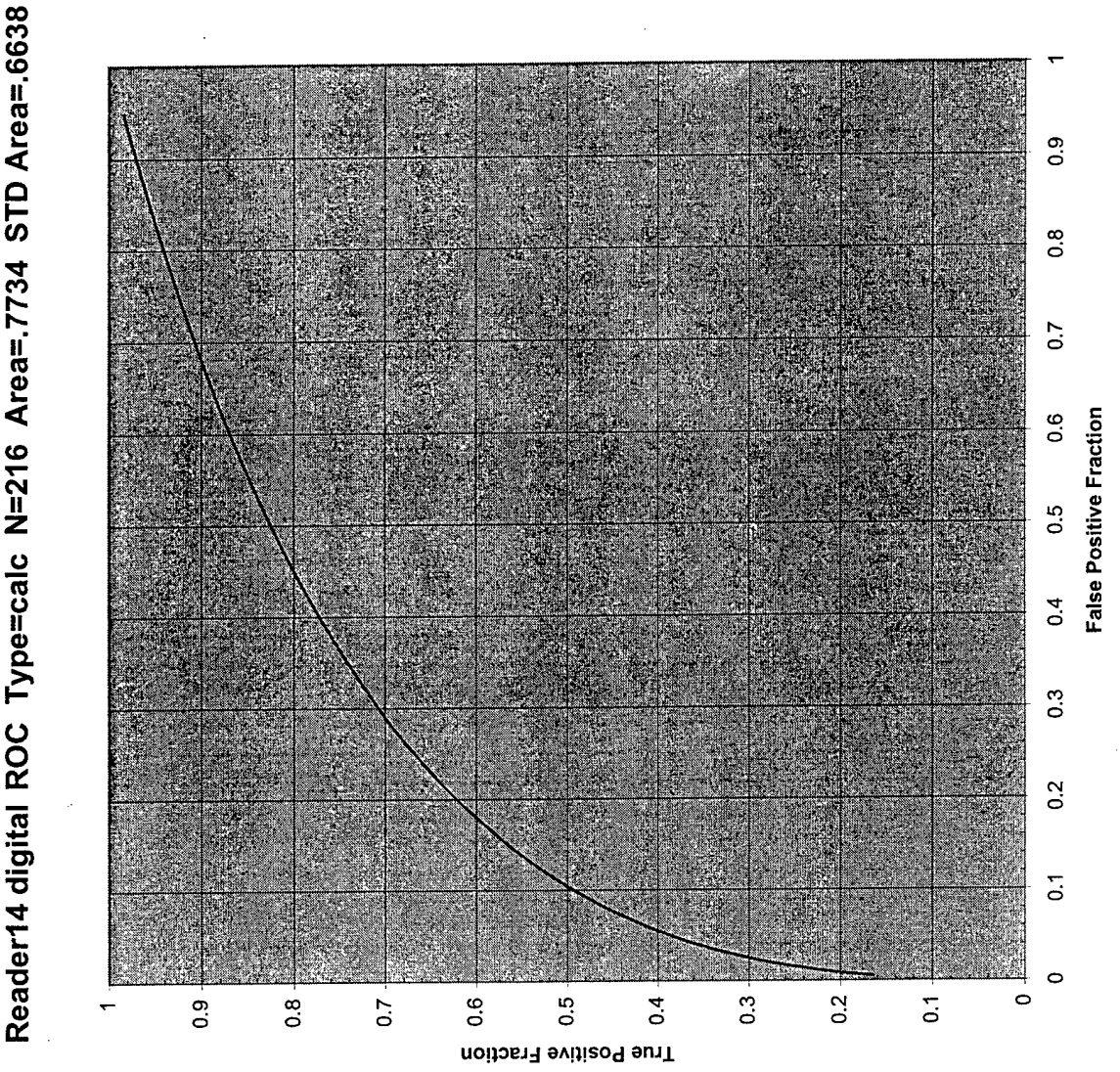
ESTIMATED BINORMAL ROC CURVE, WITH LOWER AND UPPER BOUNDS ON ASYMMETRIC 95% CONFIDENCE INTERVAL FOR TRUE-POSITIVE FRACTION AT EACH SPECIFIED FALSE-POSITIVE FRACTION:

FPF	TPF	(LOWER BOUND,	UPPER BOUND)
.005	.0789	(.0000 ,	.9462)
.010	.1546	(.0003 ,	.9252)
.020	.2796	(.0075 ,	.8973)
.030	.3786	(.0373 ,	.8779)
.040	.4591	(.0963 ,	.8639)
.050	.5261	(.1776 ,	.8544)
.060	.5826	(.2686 ,	.8494)
.070	.6308	(.3569 ,	.8496)
.080	.6723	(.4335 ,	.8555)
.090	.7083	(.4934 ,	.8673)
.100	.7398	(.5358 ,	.8840)
.110	.7673	(.5631 ,	.9034)
.120	.7916	(.5791 ,	.9228)
.130	.8130	(.5874 ,	.9403)
.140	.8321	(.5905 ,	.9550)
.150	.8490	(.5902 ,	.9668)
.200	.9101	(.5672 ,	.9940)
.250	.9460	(.5332 ,	.9991)
.300	.9675	(.4977 ,	.9999)
.400	.9886	(.4287 ,	1.0000)
.500	.9963	(.3632 ,	1.0000)
.600	.9990	(.3001 ,	1.0000)
.700	.9998	(.2379 ,	1.0000)
.800	1.0000	(.1745 ,	1.0000)
.900	1.0000	(.1059 ,	1.0000)
.950	1.0000	(.0658 ,	1.0000)

ESTIMATES OF EXPECTED OPERATING POINTS ON FITTED ROC CURVE, WITH LOWER AND UPPER BOUNDS OF ASYMMETRIC 95% CONFIDENCE INTERVAL ALONG THE CURVE FOR THOSE POINTS:

EXPECTED OPERATING POINT (FPF , TPF)	LOWER BOUND (FPF , TPF)	UPPER BOUND (FPF , TPF)
(.0868, .6975)	(.0520, .5382)	(.1367, .8260)
(.0931, .7187)	(.0572, .5677)	(.1436, .8383)
(.0964, .7289)	(.0597, .5815)	(.1472, .8445)
(.1098, .7670)	(.0700, .6312)	(.1637, .8692)

Do you want to use data from a previously created input file for the next run?
(Y/N, or Q to quit)
Stop - Program terminated.


Reader14 digital ROC Type=calc N=216 Area=.7734 STD Area=.6638
True Positive Fraction
False Positive Fraction
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1

```
Do you want to use data from a previously created input file for the next run?
(Y/N, or Q to quit)
enter INPUT file name:
Do you want to save an output file for plotting the ROC curve?
(Y/N, or R to restart)
                                                        DATE - 11/ 9/1998
                                                      TIME - 11:49:58
              R O C F I T  (IBM VERSION 1.2) :

    M A X I M U M   L I K E L I H O O D   E S T I M A T I O N
         O F   A   B I N O R M A L   R O C   C U R V E
               F R O M   R A T I N G   D A T A


     DATA DESCRIPTION: Reader 14 Calc resp for 217 cases available

     DATA COLLECTED IN  5 CATEGORIES
     WITH CATEGORY  5 REPRESENTING STRONGEST EVIDENCE OF POSITIVITY
     (E.G., THAT ABNORMALITY IS PRESENT).

     NO. OF ACTUALLY NEGATIVE CASES =  173.
     NO. OF ACTUALLY POSITIVE CASES =   43.

     RESPONSE DATA:
      CATEGORY                    1      2      3      4      5
      ACTUALLY NEGATIVE CASES   133.    15.     0.     3.    22.
      ACTUALLY POSITIVE CASES    15.     4.     0.     1.    23.

     OBSERVED OPERATING POINTS:
      FPF:  .000  .127  .145  .231 1.000
      TPF:  .000  .535  .558  .651 1.000

            INITIAL VALUES OF PARAMETERS:
     A=    .9332     B=    .7422
     Z(K)=    .735  1.060  1.140
     LOGL=  -172.6328
     CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
      BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.

     PROCEDURE CONVERGES AFTER   3 ITERATIONS.

            FINAL VALUES OF PARAMETERS:
     A=    .9344     B=    .7430
     Z(K)=    .735  1.060  1.140
     LOGL=  -172.6328
     CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
      BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.


            VARIANCE-COVARIANCE MATRIX:
     A        .1500   .1179   .0112   .0015  -.0013
     B        .1179   .1258   .0040  -.0074  -.0108
     Z( 1)    .0112   .0040   .0111   .0093   .0089
     Z( 2)    .0015  -.0074   .0093   .0136   .0133
     Z( 3)   -.0013  -.0108   .0089   .0133   .0148

            CORRELATION MATRIX:
     A       1.0000   .8580   .2737   .0340  -.0279
     B        .8580  1.0000   .1068  -.1792  -.2497
     Z( 1)    .2737   .1068  1.0000   .7576   .6962
     Z( 2)    .0340  -.1792   .7576  1.0000   .9434
     Z( 3)   -.0279  -.2497   .6962   .9434  1.0000
```

AREA = .7734 STD. DEV.(AREA) = .0638

ESTIMATED BINORMAL ROC CURVE, WITH LOWER AND UPPER BOUNDS ON ASYMMETRIC 95% CONFIDENCE INTERVAL FOR TRUE-POSITIVE FRACTION AT EACH SPECIFIED FALSE-POSITIVE FRACTION:

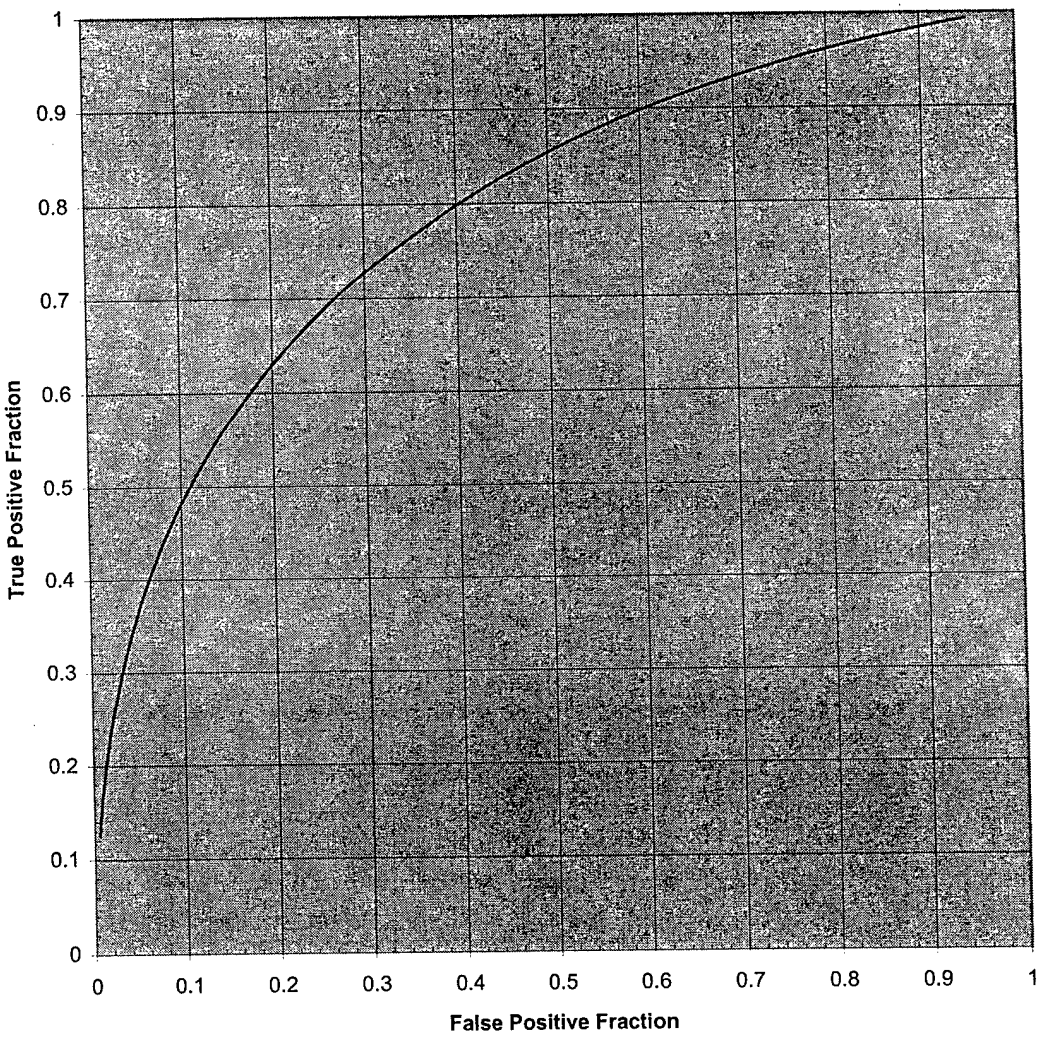
FPF	TPF	(LOWER BOUND,	UPPER BOUND)
.005	.1636	(.0145 ,	.5890)
.010	.2135	(.0331 ,	.5979)
.020	.2770	(.0720 ,	.6093)
.030	.3216	(.1099 ,	.6181)
.040	.3570	(.1459 ,	.6258)
.050	.3867	(.1798 ,	.6332)
.060	.4126	(.2115 ,	.6403)
.070	.4355	(.2410 ,	.6475)
.080	.4563	(.2684 ,	.6548)
.090	.4753	(.2937 ,	.6623)
.100	.4929	(.3172 ,	.6700)
.110	.5092	(.3388 ,	.6779)
.120	.5245	(.3586 ,	.6861)
.130	.5388	(.3767 ,	.6946)
.140	.5524	(.3933 ,	.7034)
.150	.5653	(.4084 ,	.7124)
.200	.6214	(.4657 ,	.7595)
.250	.6677	(.5012 ,	.8062)
.300	.7072	(.5243 ,	.8483)
.400	.7723	(.5524 ,	.9133)
.500	.8249	(.5696 ,	.9548)
.600	.8691	(.5823 ,	.9792)
.700	.9072	(.5932 ,	.9921)
.800	.9406	(.6038 ,	.9979)
.900	.9704	(.6163 ,	.9997)
.950	.9845	(.6254 ,	1.0000)

ESTIMATES OF EXPECTED OPERATING POINTS ON FITTED ROC CURVE, WITH LOWER AND UPPER BOUNDS OF ASYMMETRIC 95% CONFIDENCE INTERVAL ALONG THE CURVE FOR THOSE POINTS:

EXPECTED OPERATING POINT (FPF , TPF)	LOWER BOUND (FPF , TPF)	UPPER BOUND (FPF , TPF)
(.1272, .5349)	(.0841, .4644)	(.1836, .6043)
(.1445, .5583)	(.0988, .4908)	(.2026, .6240)
(.2312, .6512)	(.1733, .5930)	(.2986, .7060)

Do you want to use data from a previously created input file for the next run?
(Y/N, or Q to quit)
Stop - Program terminated.

Reader14 analog ROC Type=fad N=216 Area=.7881 STD Area=.0838



```
Do you want to use data from a previously created input file for the next run?
(Y/N, or Q to quit)
enter INPUT file name:
Do you want to save an output file for plotting the ROC curve?
(Y/N, or R to restart)
                                                        DATE - 11/ 9/1998
                                                      TIME - 11:49:58
            R O C F I T  (IBM VERSION 1.2) :

    M A X I M U M   L I K E L I H O O D   E S T I M A T I O N
         O F   A   B I N O R M A L   R O C   C U R V E
               F R O M   R A T I N G   D A T A


    DATA DESCRIPTION: Reader 14 Analog FAD resp for 216 cases available

    DATA COLLECTED IN  5 CATEGORIES
    WITH CATEGORY  5 REPRESENTING STRONGEST EVIDENCE OF POSITIVITY
    (E.G., THAT ABNORMALITY IS PRESENT).

    NO. OF ACTUALLY NEGATIVE CASES =  200.
    NO. OF ACTUALLY POSITIVE CASES =   16.

    RESPONSE DATA:
     CATEGORY                    1      2      3      4      5
     ACTUALLY NEGATIVE CASES   150.     9.     2.    10.    29.
     ACTUALLY POSITIVE CASES     5.     1.     1.     0.     9.

    OBSERVED OPERATING POINTS:
     FPF:  .000  .145  .195  .205  .250 1.000
     TPF:  .000  .563  .563  .625  .688 1.000

           INITIAL VALUES OF PARAMETERS:
    A=  1.0325    B=   .8519
    Z(K)=   .674   .824   .859  1.058
    LOGL=  -184.7371
    CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
     BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.

    PROCEDURE CONVERGES AFTER   3 ITERATIONS.

           FINAL VALUES OF PARAMETERS:
    A=  1.0531    B=   .8567
    Z(K)=   .674   .827   .876  1.055
    LOGL=  -184.5440
    CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
     BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.


           VARIANCE-COVARIANCE MATRIX:
    A       .3794   .3188   .0106   .0068   .0054  -.0003
    B       .3188   .3602   .0040  -.0009  -.0026  -.0099
    Z( 1)   .0106   .0040   .0093   .0085   .0083   .0075
    Z( 2)   .0068  -.0009   .0085   .0100   .0098   .0090
    Z( 3)   .0054  -.0026   .0083   .0098   .0103   .0095
    Z( 4)  -.0003  -.0099   .0075   .0090   .0095   .0119

           CORRELATION MATRIX:
    A      1.0000   .8625   .1789   .1104   .0869  -.0040
    B       .8625  1.0000   .0686  -.0151  -.0434  -.1511
    Z( 1)   .1789   .0686  1.0000   .8819   .8452   .7148
    Z( 2)   .1104  -.0151   .8819  1.0000   .9608   .8222
    Z( 3)   .0869  -.0434   .8452   .9608  1.0000   .8586
    Z( 4)  -.0040  -.1511   .7148   .8222   .8586  1.0000
```

AREA = .7881 STD. DEV.(AREA) = .0838

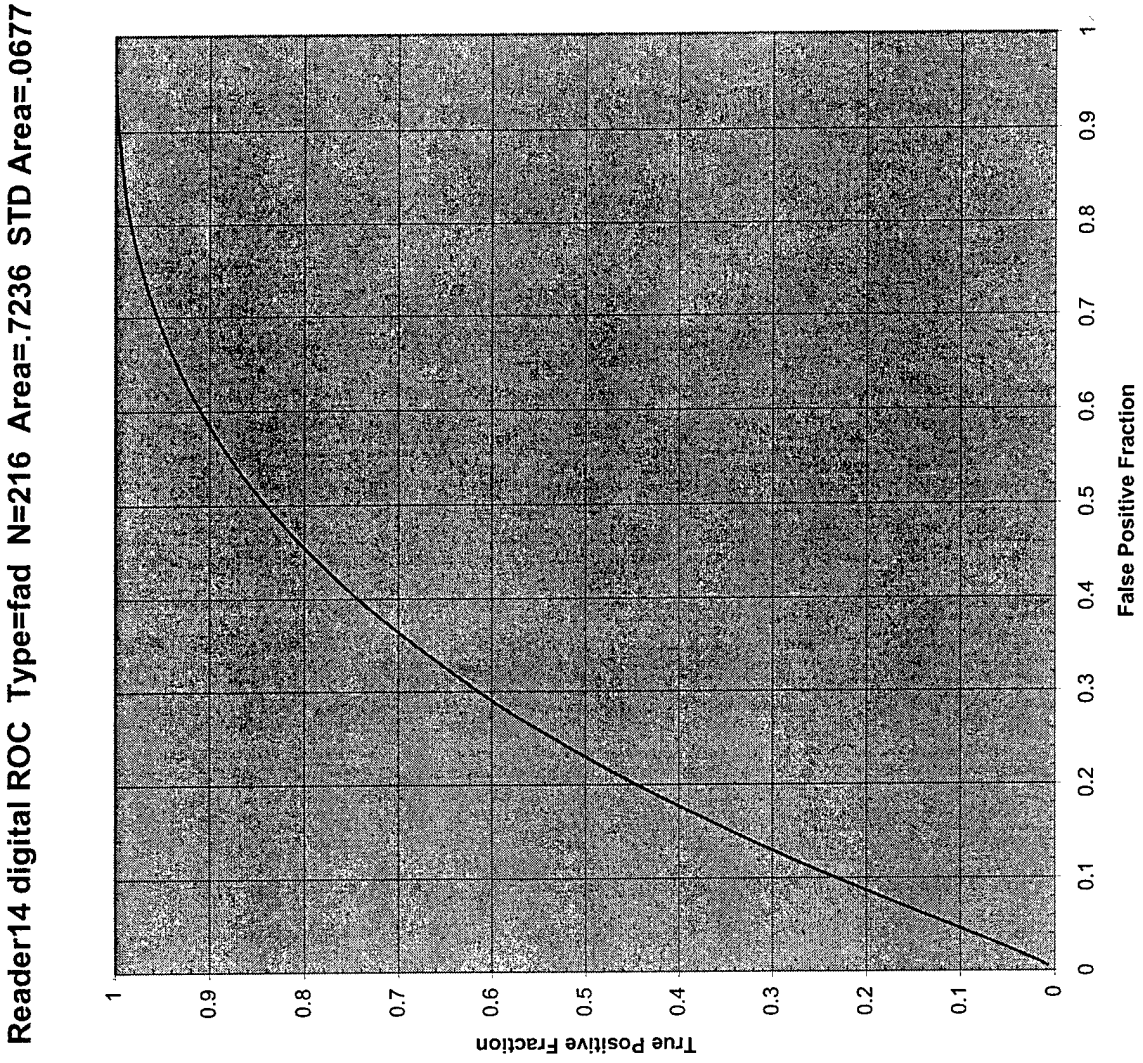
ESTIMATED BINORMAL ROC CURVE, WITH LOWER AND UPPER BOUNDS ON ASYMMETRIC 95% CONFIDENCE INTERVAL FOR TRUE-POSITIVE FRACTION AT EACH SPECIFIED FALSE-POSITIVE FRACTION:

FPF	TPF	(LOWER BOUND,	UPPER BOUND)
.005	.1243	(.0006 ,	.8230)
.010	.1735	(.0030 ,	.8057)
.020	.2399	(.0135 ,	.7876)
.030	.2882	(.0301 ,	.7772)
.040	.3274	(.0510 ,	.7706)
.050	.3608	(.0750 ,	.7662)
.060	.3901	(.1009 ,	.7636)
.070	.4163	(.1278 ,	.7624)
.080	.4400	(.1549 ,	.7623)
.090	.4619	(.1818 ,	.7634)
.100	.4821	(.2079 ,	.7654)
.110	.5009	(.2330 ,	.7683)
.120	.5185	(.2568 ,	.7722)
.130	.5351	(.2790 ,	.7769)
.140	.5507	(.2997 ,	.7824)
.150	.5656	(.3187 ,	.7886)
.200	.6301	(.3894 ,	.8278)
.250	.6828	(.4270 ,	.8718)
.300	.7271	(.4443 ,	.9112)
.400	.7985	(.4498 ,	.9640)
.500	.8538	(.4387 ,	.9881)
.600	.8979	(.4200 ,	.9969)
.700	.9334	(.3956 ,	.9995)
.800	.9620	(.3643 ,	1.0000)
.900	.9843	(.3191 ,	1.0000)
.950	.9931	(.2823 ,	1.0000)

ESTIMATES OF EXPECTED OPERATING POINTS ON FITTED ROC CURVE, WITH LOWER AND UPPER BOUNDS OF ASYMMETRIC 95% CONFIDENCE INTERVAL ALONG THE CURVE FOR THOSE POINTS:

EXPECTED OPERATING POINT (FPF , TPF)	LOWER BOUND (FPF , TPF)	UPPER BOUND (FPF , TPF)
(.1456, .5592)	(.1022, .4864)	(.2000, .6301)
(.1905, .6189)	(.1411, .5525)	(.2492, .6819)
(.2041, .6348)	(.1531, .5700)	(.2640, .6958)
(.2502, .6829)	(.1941, .6232)	(.3138, .7381)

Do you want to use data from a previously created input file for the next run?
(Y/N, or Q to quit)
Stop - Program terminated.


Reader14 digital ROC Type=fad N=216 Area=.7236 STD Area=.0677
True Positive Fraction
False Positive Fraction
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1

```
Do you want to use data from a previously created input file for the next run?
(Y/N, or Q to quit)
enter INPUT file name:
Do you want to save an output file for plotting the ROC curve?
(Y/N, or R to restart)
                                                        DATE - 11/ 9/1998
                                                      TIME - 11:49:58
              R O C F I T  (IBM VERSION 1.2) :

    M A X I M U M   L I K E L I H O O D   E S T I M A T I O N
         O F   A   B I N O R M A L   R O C   C U R V E
               F R O M   R A T I N G   D A T A


     DATA DESCRIPTION: Reader 14 Digital FAD resp for 217 cases available

     DATA COLLECTED IN  5 CATEGORIES
     WITH CATEGORY  5 REPRESENTING STRONGEST EVIDENCE OF POSITIVITY
     (E.G., THAT ABNORMALITY IS PRESENT).

     NO. OF ACTUALLY NEGATIVE CASES =  200.
     NO. OF ACTUALLY POSITIVE CASES =   16.

     RESPONSE DATA:
      CATEGORY                    1      2      3      4      5
      ACTUALLY NEGATIVE CASES   136.    13.    20.     7.    24.
      ACTUALLY POSITIVE CASES     6.     1.     2.     3.     4.

     OBSERVED OPERATING POINTS:
      FPF:  .000  .120  .155  .255  .320 1.000
      TPF:  .000  .250  .438  .563  .625 1.000

            INITIAL VALUES OF PARAMETERS:
     A=    .9775    B=  1.2865
     Z(K)=    .467    .659  1.015  1.175
     LOGL=  -233.0557
     CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
      BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.

     PROCEDURE CONVERGES AFTER   4 ITERATIONS.

            FINAL VALUES OF PARAMETERS:
     A=    .9963    B=  1.3481
     Z(K)=    .470    .653    .992  1.186
     LOGL=  -232.8176
     CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
      BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.


            VARIANCE-COVARIANCE MATRIX:
     A        .2528    .2067    .0139    .0113    .0050    .0007
     B        .2067    .2633    .0054    .0013   -.0081   -.0142
     Z( 1)    .0139    .0054    .0085    .0076    .0063    .0057
     Z( 2)    .0113    .0013    .0076    .0090    .0076    .0069
     Z( 3)    .0050   -.0081    .0063    .0076    .0111    .0104
     Z( 4)    .0007   -.0142    .0057    .0069    .0104    .0133

            CORRELATION MATRIX:
     A       1.0000    .8014    .3002    .2376    .0949    .0121
     B        .8014   1.0000    .1133    .0266   -.1491   -.2397
     Z( 1)    .3002    .1133   1.0000    .8694    .6472    .5338
     Z( 2)    .2376    .0266    .8694   1.0000    .7580    .6354
     Z( 3)    .0949   -.1491    .6472    .7580   1.0000    .8542
     Z( 4)    .0121   -.2397    .5338    .6354    .8542   1.0000
```

AREA = .7236 STD. DEV.(AREA) = .0677

ESTIMATED BINORMAL ROC CURVE, WITH LOWER AND UPPER BOUNDS ON ASYMMETRIC 95% CONFIDENCE INTERVAL FOR TRUE-POSITIVE FRACTION AT EACH SPECIFIED FALSE-POSITIVE FRACTION:

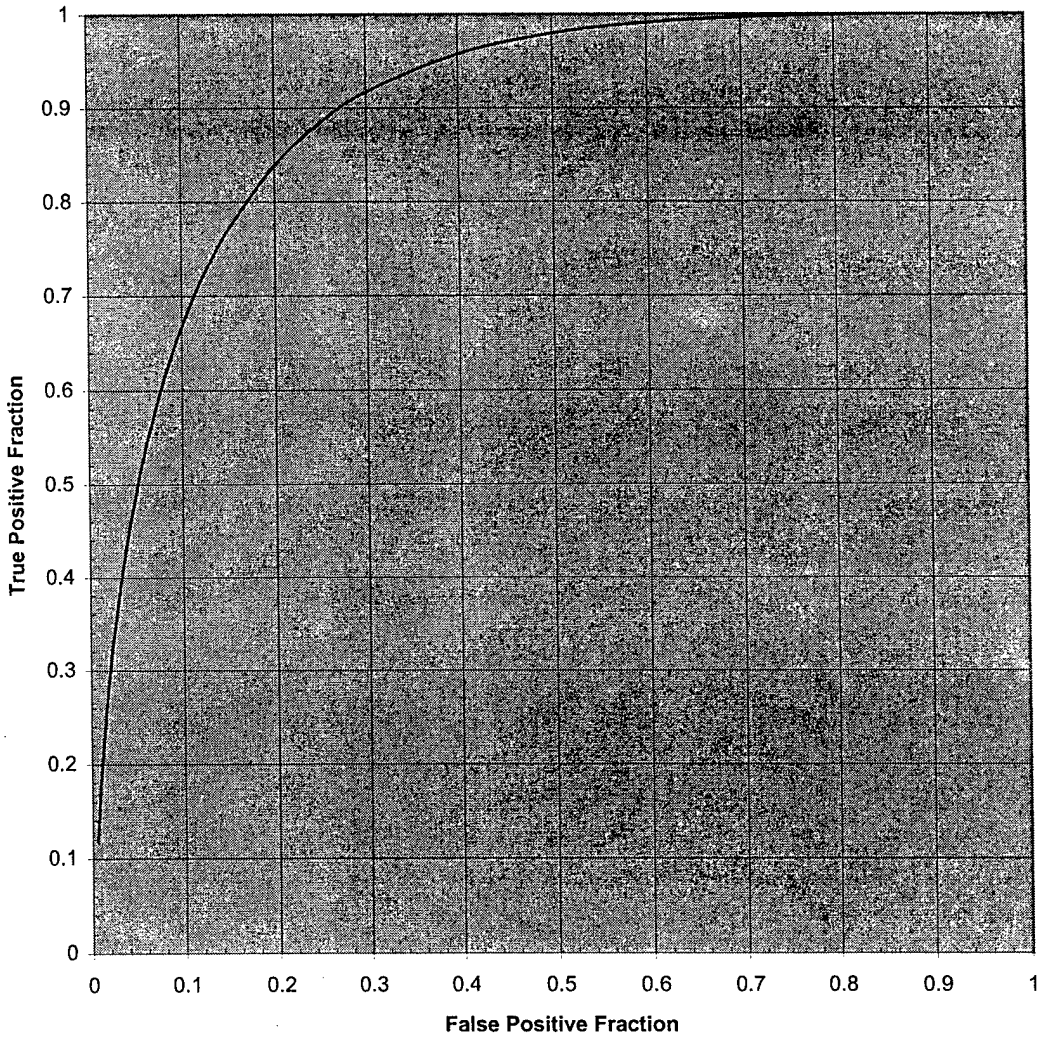
FPF	TPF	(LOWER BOUND,	UPPER BOUND)
.005	.0066	(.0000 ,	.2804)
.010	.0162	(.0001 ,	.3150)
.020	.0381	(.0007 ,	.3567)
.030	.0618	(.0026 ,	.3860)
.040	.0862	(.0062 ,	.4098)
.050	.1109	(.0117 ,	.4306)
.060	.1356	(.0191 ,	.4495)
.070	.1602	(.0284 ,	.4671)
.080	.1845	(.0395 ,	.4840)
.090	.2086	(.0522 ,	.5003)
.100	.2322	(.0663 ,	.5163)
.110	.2555	(.0815 ,	.5321)
.120	.2783	(.0975 ,	.5478)
.130	.3007	(.1142 ,	.5635)
.140	.3227	(.1313 ,	.5792)
.150	.3442	(.1487 ,	.5950)
.200	.4451	(.2326 ,	.6751)
.250	.5348	(.3041 ,	.7541)
.300	.6141	(.3611 ,	.8252)
.400	.7439	(.4439 ,	.9267)
.500	.8405	(.5043 ,	.9762)
.600	.9094	(.5550 ,	.9944)
.700	.9557	(.6026 ,	.9992)
.800	.9834	(.6524 ,	.9999)
.900	.9968	(.7134 ,	1.0000)
.950	.9993	(.7580 ,	1.0000)

ESTIMATES OF EXPECTED OPERATING POINTS ON FITTED ROC CURVE, WITH LOWER AND UPPER BOUNDS OF ASYMMETRIC 95% CONFIDENCE INTERVAL ALONG THE CURVE FOR THOSE POINTS:

EXPECTED OPERATING POINT (FPF , TPF)	LOWER BOUND (FPF , TPF)	UPPER BOUND (FPF , TPF)
(.1179, .2735)	(.0790, .1823)	(.1685, .3829)
(.1606, .3666)	(.1154, .2679)	(.2161, .4750)
(.2570, .5464)	(.2008, .4466)	(.3204, .6433)
(.3193, .6418)	(.2577, .5475)	(.3863, .7280)

Do you want to use data from a previously created input file for the next run?
(Y/N, or Q to quit)
Stop - Program terminated.

Reader14 analog ROC Type=diag N=216 Area=.8986 STD Area=.0244



```
Do you want to use data from a previously created input file for the next run?
(Y/N, or Q to quit)
enter INPUT file name:
Do you want to save an output file for plotting the ROC curve?
(Y/N, or R to restart)
                                                        DATE - 11/ 9/1998
                                                      TIME - 11:49:58
            R O C F I T  (IBM VERSION 1.2) :

    M A X I M U M   L I K E L I H O O D   E S T I M A T I O N
         O F   A   B I N O R M A L   R O C   C U R V E
                 F R O M   R A T I N G   D A T A


    DATA DESCRIPTION: Reader 14 Analog Diag resp for 216 cases available

    DATA COLLECTED IN  5 CATEGORIES
    WITH CATEGORY  5 REPRESENTING STRONGEST EVIDENCE OF POSITIVITY
    (E.G., THAT ABNORMALITY IS PRESENT).

    NO. OF ACTUALLY NEGATIVE CASES =  172.
    NO. OF ACTUALLY POSITIVE CASES =   44.

    RESPONSE DATA:
     CATEGORY                    1      2      3      4      5
     ACTUALLY NEGATIVE CASES   102.    32.    27.     8.     3.
     ACTUALLY POSITIVE CASES     2.     4.    13.    14.    11.

    OBSERVED OPERATING POINTS:
     FPF:  .000  .017  .064  .221  .407 1.000
     TPF:  .000  .250  .568  .864  .955 1.000

           INITIAL VALUES OF PARAMETERS:
    A=  2.0292    B=  1.2578
    Z(K)=   .235   .769  1.523  2.110
    LOGL=  -256.8944
    CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
     BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.

    PROCEDURE CONVERGES AFTER   4 ITERATIONS.

           FINAL VALUES OF PARAMETERS:
    A=  2.0466    B=  1.2580
    Z(K)=   .237   .763  1.509  2.150
    LOGL=  -256.7898
    CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
     BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.


           VARIANCE-COVARIANCE MATRIX:
    A       .1291   .0699   .0116   .0126   .0044  -.0163
    B       .0699   .0595   .0037   .0017  -.0111  -.0330
    Z( 1)   .0116   .0037   .0093   .0068   .0047   .0031
    Z( 2)   .0126   .0017   .0068   .0108   .0081   .0069
    Z( 3)   .0044  -.0111   .0047   .0081   .0194   .0212
    Z( 4)  -.0163  -.0330   .0031   .0069   .0212   .0466

           CORRELATION MATRIX:
    A      1.0000   .7972   .3361   .3390   .0887  -.2105
    B       .7972  1.0000   .1569   .0653  -.3254  -.6258
    Z( 1)   .3361   .1569  1.0000   .6747   .3473   .1482
    Z( 2)   .3390   .0653   .6747  1.0000   .5570   .3089
    Z( 3)   .0887  -.3254   .3473   .5570  1.0000   .7056
    Z( 4)  -.2105  -.6258   .1482   .3089   .7056  1.0000
```

AREA = .8986 STD. DEV.(AREA) = .0244

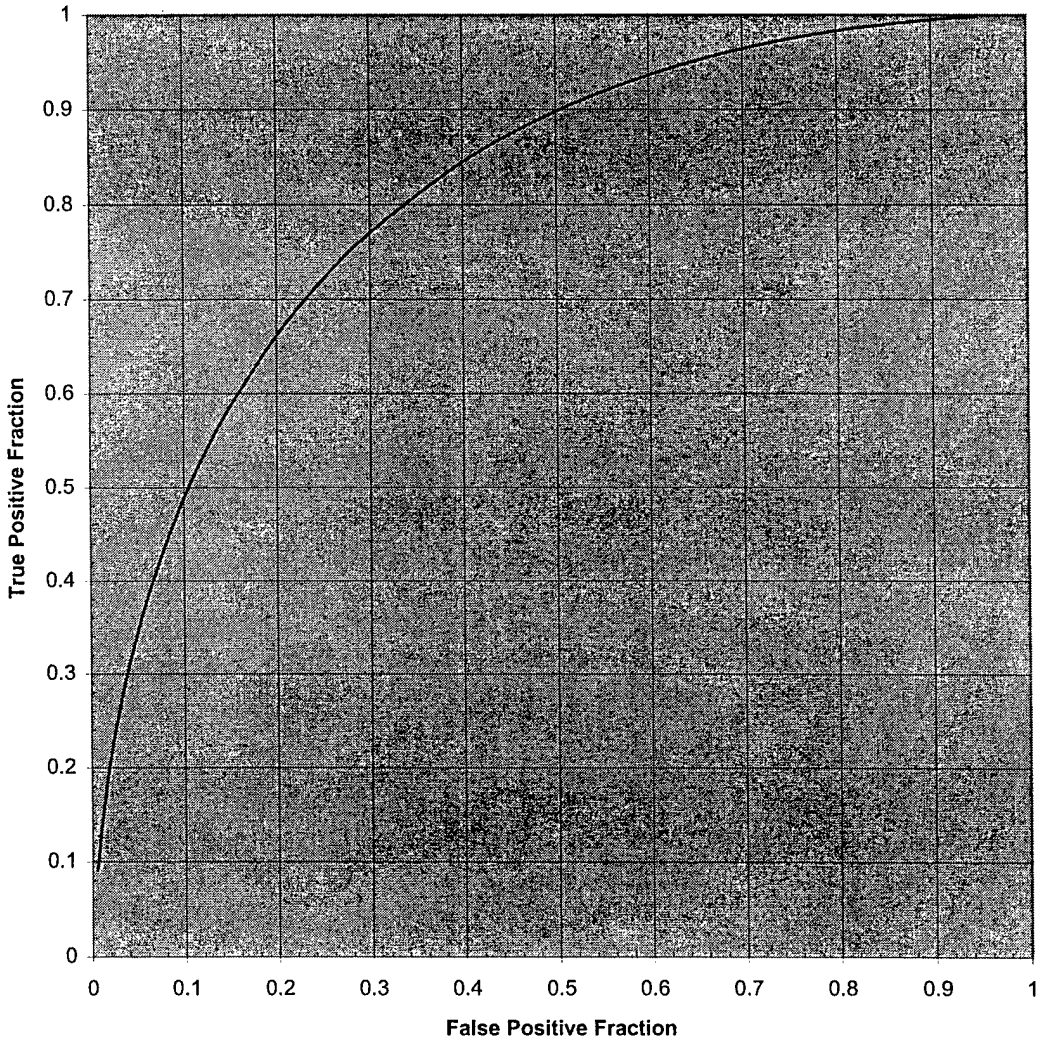
ESTIMATED BINORMAL ROC CURVE, WITH LOWER AND UPPER BOUNDS ON ASYMMETRIC 95% CONFIDENCE INTERVAL FOR TRUE-POSITIVE FRACTION AT EACH SPECIFIED FALSE-POSITIVE FRACTION:

FPF	TPF	(LOWER BOUND,	UPPER BOUND)
.005	.1162	(.0234 ,	.3445)
.010	.1893	(.0574 ,	.4270)
.020	.2954	(.1280 ,	.5243)
.030	.3745	(.1940 ,	.5884)
.040	.4379	(.2536 ,	.6371)
.050	.4908	(.3070 ,	.6766)
.060	.5360	(.3548 ,	.7098)
.070	.5752	(.3977 ,	.7385)
.080	.6098	(.4362 ,	.7636)
.090	.6405	(.4709 ,	.7859)
.100	.6679	(.5024 ,	.8058)
.110	.6927	(.5309 ,	.8236)
.120	.7151	(.5569 ,	.8398)
.130	.7355	(.5807 ,	.8543)
.140	.7541	(.6026 ,	.8676)
.150	.7712	(.6227 ,	.8796)
.200	.8384	(.7034 ,	.9253)
.250	.8846	(.7614 ,	.9541)
.300	.9173	(.8053 ,	.9722)
.400	.9580	(.8679 ,	.9904)
.500	.9797	(.9103 ,	.9970)
.600	.9910	(.9407 ,	.9992)
.700	.9966	(.9632 ,	.9999)
.800	.9990	(.9799 ,	1.0000)
.900	.9999	(.9920 ,	1.0000)
.950	1.0000	(.9966 ,	1.0000)

ESTIMATES OF EXPECTED OPERATING POINTS ON FITTED ROC CURVE, WITH LOWER AND UPPER BOUNDS OF ASYMMETRIC 95% CONFIDENCE INTERVAL ALONG THE CURVE FOR THOSE POINTS:

EXPECTED OPERATING POINT (FPF , TPF)	LOWER BOUND (FPF , TPF)	UPPER BOUND (FPF , TPF)
(.0158, .2551)	(.0050, .1168)	(.0421, .4499)
(.0657, .5591)	(.0374, .4227)	(.1083, .6887)
(.2226, .8613)	(.1668, .7968)	(.2878, .9102)
(.4062, .9598)	(.3349, .9345)	(.4807, .9765)

Do you want to use data from a previously created input file for the next run?
(Y/N, or Q to quit)
Stop - Program terminated.


Reader14 digital ROC Type=diag N=216 Area=.8138 STD Area=.0372
True Positive Fraction
False Positive Fraction
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1

```
Do you want to use data from a previously created input file for the next run?
(Y/N, or Q to quit)
enter INPUT file name:
Do you want to save an output file for plotting the ROC curve?
(Y/N, or R to restart)
                                                        DATE - 11/ 9/1998
                                                      TIME - 11:49:59
              R O C F I T  (IBM VERSION 1.2) :

    M A X I M U M   L I K E L I H O O D   E S T I M A T I O N
         O F   A   B I N O R M A L   R O C   C U R V E
               F R O M   R A T I N G   D A T A


     DATA DESCRIPTION: Reader 14 Digital Diagnosis resp for 217 cases available

     DATA COLLECTED IN  5 CATEGORIES
     WITH CATEGORY  5 REPRESENTING STRONGEST EVIDENCE OF POSITIVITY
     (E.G., THAT ABNORMALITY IS PRESENT).

     NO. OF ACTUALLY NEGATIVE CASES =  172.
     NO. OF ACTUALLY POSITIVE CASES =   44.

     RESPONSE DATA:
      CATEGORY                    1      2      3      4      5
      ACTUALLY NEGATIVE CASES    85.    32.    41.    10.     4.
      ACTUALLY POSITIVE CASES     4.     5.    18.     5.    12.

     OBSERVED OPERATING POINTS:
      FPF:  .000  .023  .081  .320  .506 1.000
      TPF:  .000  .273  .386  .795  .909 1.000

            INITIAL VALUES OF PARAMETERS:
    A=  1.2816    B=  1.0046
    Z(K)=  -.015   .468  1.396  1.991
    LOGL=  -280.7432
    CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
     BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.

     PROCEDURE CONVERGES AFTER   4 ITERATIONS.

            FINAL VALUES OF PARAMETERS:
    A=  1.2701    B=  1.0134
    Z(K)=  -.018   .467  1.446  1.898
    LOGL=  -280.0007
    CHI-SQUARE GOODNESS OF FIT NOT CALCULATED
     BECAUSE SOME EXPECTED CELL FREQUENCIES ARE LESS THAN 5.


            VARIANCE-COVARIANCE MATRIX:
    A        .0651   .0311   .0085   .0084   .0042  -.0013
    B        .0311   .0337   .0031   .0014  -.0084  -.0168
    Z( 1)    .0085   .0031   .0091   .0065   .0038   .0028
    Z( 2)    .0084   .0014   .0065   .0095   .0061   .0054
    Z( 3)    .0042  -.0084   .0038   .0061   .0187   .0188
    Z( 4)   -.0013  -.0168   .0028   .0054   .0188   .0330

            CORRELATION MATRIX:
    A       1.0000   .6646   .3512   .3388   .1191  -.0281
    B        .6646  1.0000   .1785   .0765  -.3355  -.5049
    Z( 1)    .3512   .1785  1.0000   .7065   .2935   .1621
    Z( 2)    .3388   .0765   .7065  1.0000   .4620   .3031
    Z( 3)    .1191  -.3355   .2935   .4620  1.0000   .7566
    Z( 4)   -.0281  -.5049   .1621   .3031   .7566  1.0000
```

AREA = .8138 STD. DEV.(AREA) = .0372

ESTIMATED BINORMAL ROC CURVE, WITH LOWER AND UPPER BOUNDS ON ASYMMETRIC 95% CONFIDENCE INTERVAL FOR TRUE-POSITIVE FRACTION AT EACH SPECIFIED FALSE-POSITIVE FRACTION:

FPF	TPF	(LOWER BOUND,	UPPER BOUND)
.005	.0900	(.0206 ,	.2615)
.010	.1384	(.0431 ,	.3227)
.020	.2085	(.0864 ,	.3976)
.030	.2623	(.1263 ,	.4489)
.040	.3070	(.1631 ,	.4893)
.050	.3457	(.1972 ,	.5230)
.060	.3799	(.2288 ,	.5522)
.070	.4107	(.2583 ,	.5782)
.080	.4388	(.2858 ,	.6017)
.090	.4646	(.3116 ,	.6231)
.100	.4885	(.3358 ,	.6430)
.110	.5108	(.3587 ,	.6614)
.120	.5316	(.3802 ,	.6786)
.130	.5512	(.4005 ,	.6947)
.140	.5696	(.4198 ,	.7099)
.150	.5870	(.4380 ,	.7243)
.200	.6618	(.5170 ,	.7859)
.250	.7214	(.5803 ,	.8343)
.300	.7701	(.6326 ,	.8728)
.400	.8447	(.7153 ,	.9277)
.500	.8980	(.7794 ,	.9616)
.600	.9365	(.8319 ,	.9817)
.700	.9642	(.8770 ,	.9927)
.800	.9831	(.9171 ,	.9979)
.900	.9949	(.9547 ,	.9997)
.950	.9983	(.9739 ,	1.0000)

ESTIMATES OF EXPECTED OPERATING POINTS ON FITTED ROC CURVE, WITH LOWER AND UPPER BOUNDS OF ASYMMETRIC 95% CONFIDENCE INTERVAL ALONG THE CURVE FOR THOSE POINTS:

EXPECTED OPERATING POINT (FPF , TPF)	LOWER BOUND (FPF , TPF)	UPPER BOUND (FPF , TPF)
(.0288, .2568)	(.0121, .1553)	(.0615, .3849)
(.0741, .4227)	(.0433, .3204)	(.1194, .5305)
(.3203, .7873)	(.2555, .7271)	(.3912, .8390)
(.5074, .9013)	(.4331, .8642)	(.5814, .9303)

Do you want to use data from a previously created input file for the next run?
(Y/N, or Q to quit)
Stop - Program terminated.