(A)

IMPROVEMENT OF THE U.S. NAVY MOBILE BLOOD BANK THROUGH SIMULATION ANALYSIS AND FORECASTING

OR 680
MAY 1996

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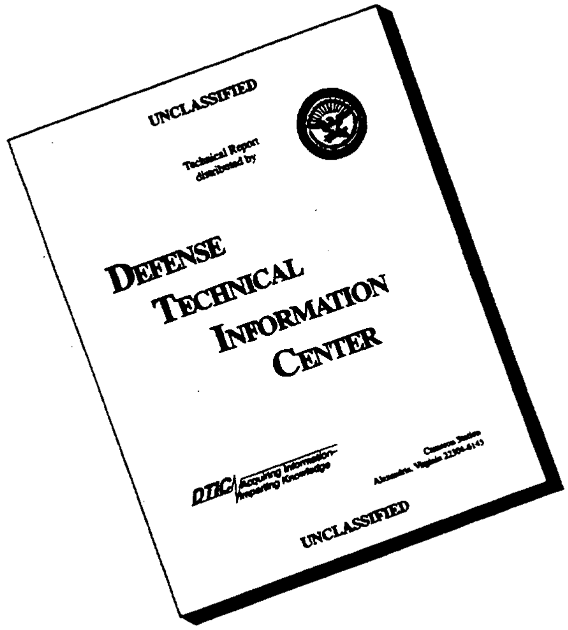

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I. DESCRIPTION OF SYSTEM BEING SIMULATED.

The U.S. Navy mobile blood bank is responsible for providing blood to the National Naval Medical Center located in Bethesda, MD as well as to other military and civilian hospitals in the surrounding area (e.g. VA hospital). The mobile blood bank travels to various locations throughout the year with all equipment and personnel support required to draw blood from donors. The Navy wanted our team to study their system to determine if it could be improved. We then determined that our project for the Navy mobile blood bank was to provide three products: Recommendations to improve the actual blood donating process as determined through computer simulation modeling of their system (e.g. reduce time in system): Information through forecasting where to go to get blood products and forecasting likely quantities at each location; lastly, from the computer simulation, a chart to determine more accurately the number of servers required for a mission based on anticipated donors.

The Navy mobile blood bank visits, annually over 44 different organizations throughout Washington, DC, Maryland, Virginia and Pennsylvania. The Navy averages 191 blood drawings each year, or 16 drawing per month, to meet the hospital's needs.

TIME PERIOD	TOTAL # VISITS	TOTAL BAGS OF BLOOD
Jan 1994 - Dec 1994	199	6340
Jan 1995 - Dec 1995	182	6111
Jan 1996 - Feb 1996	27	892
Jan 1994 - Feb 1996	408	13343

Figure 1. Yearly sums for all data

The mobile blood bank has an assigned team of approximately eight to twelve civilian and military personnel; the team can be augmented by hospital personnel temporarily beyond twelve for large drawings. The blood drawings at the various locations are scheduled one year in advance by a member of the Navy's blood bank. The blood bank does not require the organizations they visit to schedule donors. The locations visited by the mobile blood bank have personnel that are not always in fixed locations due to their jobs and schedules. As noted in the study by Jennifer Michaels et al. In "A Simulation Study of Donor Scheduling Systems for the American Red Cross", 1992, the Navy's clients are not conducive to a scheduling system. They stated in their study ..."any company that does not have most of its employees on site during the course of the day, will benefit from a more flexible scheduling system."[1] Therefore, our study team did not examine the impact of scheduling donors to improve the system's effectiveness.

[1] Michaels, Jennifer, John Brennan, Bruce Golden and Michael Fu, "A Simulation Study of Donor Scheduling Systems for the American Red Cross", Computer Ops Res, Vol. 20, No 2, 1992, pg 212.

The Navy, as does the American Red Cross, relies heavily on repeat donors. Just as with the Red Cross, the Navy's blood program is voluntary. Additionally, the Navy has a smaller population to draw from for donors, but they represent a healthy segment of the population. The donors are from the military community (active duty, retired, DoD civilians and family members) account for less than six percent of the population. To keep this small donor population happy and returning the Navy was interested in ways to improve the overall blood donating system. They wanted to improve the time required to go through the system, which includes the total time as well as time in queues.

To simulate the process we first had to have an understanding of the operation at the different locations the mobile blood bank visited. Depending on the location, space allocated by the organization, and projected number of donors, these factors effected the size of the blood team and the set-up of the process. Our team went with the blood bank to four locations to observe the various factors and collect data on the following dates:

1. U.S. Naval Academy, Annapolis, MD	Nov 27, 1995
2. U.S. Naval Academy, Annapolis, MD	Feb 27, 1996
3. National Naval Medical Center, Bethesda, MD	Mar 5, 1996
4. U.S. Naval Academy, Annapolis, MD	Mar 26, 1996

The set-ups were very similar at each of the locations. The system has approximately eight stations with the number of servers varying depending on the anticipated number of donors. Additionally, the first four stations were sometimes combined:

1. Registration/personal history.
2. Vital signs.
3. Hemoglobin check.
4. Deferral check (computer based or hard copy).
5. Interview.
6. Bag issue.
7. Phlebotomy (blood donating).
8. Recovery (food and drinks).

Station 1: Personal History.

The first station had infinite capacity because it did not require any servers. The amount of time spent at this first station was dependent upon how fast the individual could fill out the personnel history and answer the questions. When the potential donor has completed the paperwork he or she moves to the next station.

Station 2 and 3: Vital signs and hemoglobin.

The vital signs check includes: temperature, blood pressure and pulse check. The hemoglobin check is a simple prick of the individuals finger followed by a simple test. At both of these stations a potential donor could be deferred or sent to station four. The second and third stations were difficult to measure since the donors could go to station three before station two or visa versa depending upon if there was a line at one of these two stations. Also, there were times when a server would combine the tasks of station two and three at one location.

Station 4: Deferment check.

Station four consisted of one server with a laptop. The server would check the data base to determine if the donor had been deferred from donating blood. Reasons for deferral included overseas assignments, immunization, etc. If the donor is not deferred he or she move on to the next station. This station has on occasion been combined with stations two, three or five.

Station 5: Interview.

Station five is the interview station. The sever or severs at this station trained and tested on the military and federal regulations for blood donating. The interviewers re-ask the questions potential donors answered on the personal history form to include emphasis on sexual preference, use of drugs, tattoos, travel outside the United States, etc. The questions are asked in a screened off area to preserve the individuals privacy. Once the donor has successfully completed the interview he or she goes to the bag issue table, station six. If donors fails this station they depart the system.

Station 6: Bag issue.

At station six the individual selects one of two bar-coded stickers which tells the lab to use or not use their blood. From this station the donor goes to station seven to donate blood.

Station 7: Phlebotomy.

The beds are set up in groups of threes with one phlebotomist assigned to each group. The number of beds set up is dependent upon the anticipated number of donors. The donor is sent to the first available bed to actually donate blood. The process of filling the bag takes four to seven minutes on average. If the donor takes longer than 10 minutes to fill the bag, the blood cannot be used and that fact is noted on the donor's bag.

Station 8: Canteen.

Upon completion, the donor then goes to the canteen for snacks and beverages. We did not measure station eight because donors can control their departure time once they are feeling "OK" to leave.

For the blood donating process our team assumed the donor's system time started when he or she walked up to the registration table to fill out the personal history form. The process ended when the donor left the system because of deferment at one of the stations which we noted in our time logs, or left the bed after donating blood. For this study our team measured donor's times at each station in minutes. We did not record the seconds due to limited personnel to monitor the system. Our study was similar to other studies done on the American Red Cross' mobile blood banks in terms of the constraints on the system.[2] Our problem had the following constraints: The arrival rate of our donors was random because the Navy does not use scheduling, with arrivals constrained to a four hour window on average; the system has a limited number of servers at each station, due to personnel constraints and resource constraints, such as equipment to take blood pressure; and because tests and/or questions completed at each station can result in moving on to another station or deferment.

For our base case model we used the following system configuration:

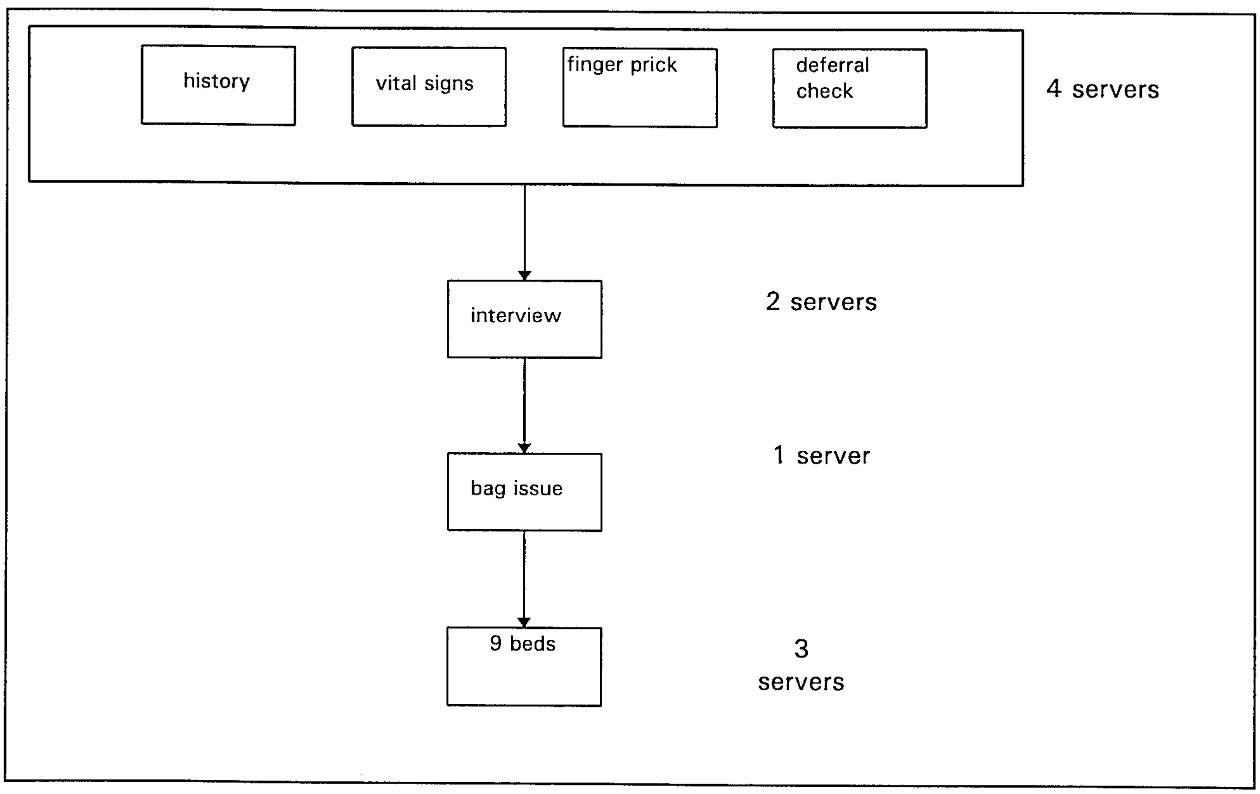

Figure 2. Base Case System

[2] Brennan, Hohn, Bruce Golden, and Harold Rapport, "Go with the Flow: Improving Read Cross Bloodmobiles Using Simulation Analysis.", Interfaces Vol 22, Sep-Oct 1992, pp 1-13.

II. MODEL VALIDATION AND VERIFICATION.

A. Verification.

We modeled the Navy's system using the computer simulation package GPSS/H (version 3) to simulate the process as well as Proof Animation to simulate the process independently. To verify our programs we changed all the service time distributions in our model to exponential distributions with the same mean as our sample data. We computed our theoretical results using Queuing Analyses with TK solver for windows to verify the results generated by the computer simulation model (see Appendix A, QTK output). Queuing Analyses with TK solver gave the following results (where E(IAT) is the Expected inter-arrival time, E(ST) is the Expected service time, W is Expected waiting time in the system, Wq is the Expected waiting time in the queue, L is the Expected system size, Lq it the Expected queue size, Pi is the probability of a server idle).:

Stations	Sample u	E[IAT]	E[ST]	W	Wq	L	Lq	Pi
Station 1	14.5	3.4843	14.1443	14.1462	0.0019	4.06	0.0006	0.3383
Station 2	4.48	4.0992	4.4769	6.3791	1.9022	1.5562	0.464	0.5461
Station 3	2.67	4.183	3	10.6078	7.6078	2.5359	1.8187	0.7172
Station 4	21.1698	4.183	21.1698	21.6302	0.4604	5.171	0.1101	0.5627

Figure 3. QTK Results.

To compare our results with our theoretical results required steady state of the system. To approximate steady state we ran the exponential computer simulation for forty-eight hours and 500 replications. The long run length successfully overwhelmed the system and reduce the standard deviation to achieve steady state in order get closer to theoretical solution. The absolute error between our program's results (GPSS/H) and QTK's was minimal, with $\pm$ .06 minutes for all point estimates; thus verifying our open Jackson network computer simulation, (see figure 4, GPSS/H and QTK absolute error comparison). The difference from GPSS/H results and the theoretical is due to the rounding error in our data.

Stations	W	Wq	L	Lq	Pi
Station 1	0.02	0.0001	0.03	0.0004	0.002
Station 2	0.06	0.05	0.03	0.02	0.006
Station 3	0.4	0.4	0.1	0.1	0.01
Station 4	0.2	0.04	0.1	0.01	0.01

Figure 4. Absolute Error Comparison

B. Validation.

We were able to validate the base case model by comparing the simulated model with the actual system on which we had previously collected data. We compared the base case simulation with the actual data from our visit to the USNA on March 26, 1996. In the base case, running the model for 500 replications for the four hour drawing, the model had 71 donors go through the system. For the actual collection of data, there were 71 donors go through the system, three which were discarded for lost data. Validating our system allowed us to use the base case to study changes to the number of servers and inter-arrival rates.

In addition, we had the previous 26 months of historical information on the mobile blood bank. From this historical data we knew the date of the drawing, the number of donors at each location, and the actual number deferred. This information was then compared to the hospital's flat logs that are maintained by the blood lab. The flat logs register donors by bag ID number. The flat logs record the actual number of bags processed from the blood drawings. They also dènote which bags of blood were usable and which ones were not. For privacy reasons we did not record the details of why the blood was not useable. We took a random sample from the flat logs, 109 sample dates all together. The overall difference between the flat log data and the data collected by the mobile blood bank personnel was less than a five percent error which we considered acceptable (se Appendix B, Flatlog Comparison).

III. GENERATION OF INPUT.

We collected donor inter-arrival times, service times, and deferments at the different blood drawings manually using synchronized watches, (see Appendix C for the times). We visited the Naval Academy a total of three times. At each, the drawings were similar in size and configuration. The blood drawing at the National Naval Medical Center was smaller in size, but of similar system configuration. All four drawings were four hours in duration. From the data we were able to determine the distributions of the arrival rates and service times. We used Unifit II to fit the data to the best distribution by matching the first four moments as closely as possible, (see appendix D for detailed Unifit II printouts). Similar to the study by John E. Brennan at al., "Go with the Flow: Improving Red Cross Bloodmobiles Using Simulation Analysis", 1992 we also examined the arrival pattern of the donors. The drawings at the USNA were scheduled from 1400 hours until 1800 hours. We determined that the donors were following a bimodal function as suspected, (see Figure 5 for Donor Pattern charts). This is due to the student's schedules, who predominately get out of class at 1530 hours and leave activities an hour or so later. The figure below shows the donor patterns for all three visits to the USNA with the times in minutes.

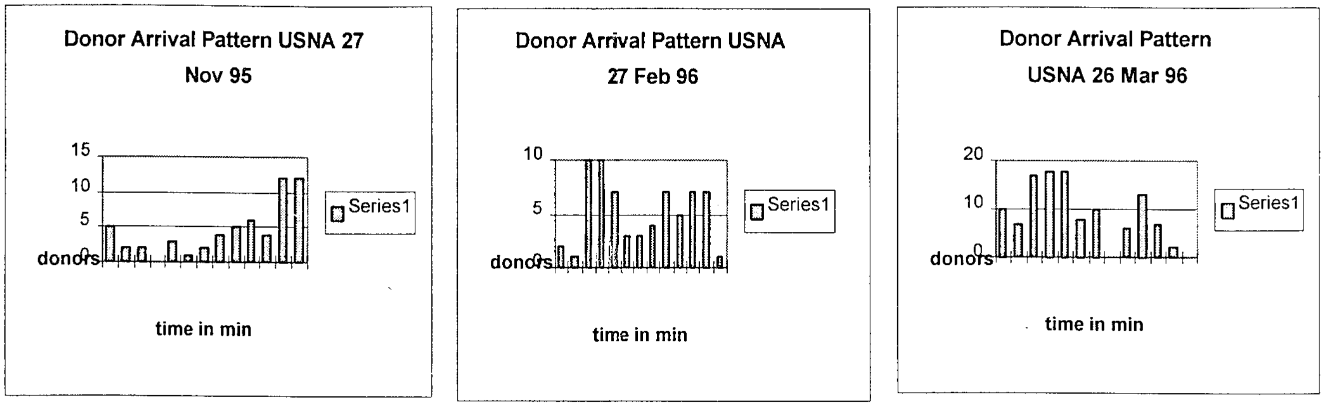

Figure 5. Donor Arrival Patterns.

In collecting the service times we attempted to time all the different stations. At station one we were able to collect the service time for potential donors to complete the personnel history form in minutes. However, we were unable to collect the times separately of the vitals, hemoglobin and deferral checks. At these three station donors were able to go to stations out of order as they became available. If we had had an automated system for tracking service times then this data would have been available. Therefore, we dealt with only the total service time to complete stations one through four and combined them into one station for our model. At the remaining stations, (interview, bag issue and phlebotomy) we were able to collect data and determine their distributions for the computer simulation model, (see Figure 6, Station statistics for Base Case Model).

STATIONS	MEAN	VARIANCE	SKEWNESS	KURTOSIS	DISTRIBUTION
Interarrival time	3.5333	16.4247	2.294	10.8937	gamma
Station 1	14.0934	22.4297	0.08521	2.71145	Weibull
Station 2	4.4687	3.4491	1.31857	1.3857	lognormal
Station 3	N/A	N/A	N/A	N/A	discrete(0.4,2/0.9,3/1.0,4)
Station 4	21.1698	45.6677	0.63844	3.6114	gamma

Figure 6. Station Statistics for Base Case Model.

For the interviewers, station two in our model, we collected the service times for each of the interviewers to include break times. When an interviewer went on break this caused the queue to build up in front of one server. We were able to model a server on break in GPSS/H to note the overall impact on the system. For this station, the service times of the two interviewers was very similar, the differences were negligible. Therefore, for simplicity within our model we assumed the same service time for each interviewer. However, for station three in the model, bag issue, the service times were short. The service times were one of three times: two, three or four minutes because we had truncated the times to minutes, not seconds. For this station we modeled it as a discrete distribution.

At the phlebotomy, station four in the model, we did not look at the service times of the individual blood bank employees. Our data at this station combines into one service time the various stages the donor goes through: Preparation of the arm, actual filling of the bag, and removal of the needle. Because we calculated the service time as the minutes between time the donor went to a bed to the time he or she left the bed, we assumed each bed was a server, not the attendant/phlebotomist of three beds.

IV. THE EXPERIMENTAL DESIGN:

A. Computer Simulation and Model of the Navy's system.

The Navy's mobile blood bank donor process is an FCFS open Jackson network with donors arriving randomly into station one. In our base case computer simulation model donors arrived into station one (personal history paperwork, vital signs, hemoglobin and deferral check) with 98 percent move on to station two (interview). At station two 17 percent are deferred with 83 percent moving to station three (bag issue). All donors in our system moved from three to station four (phlebotomy) and then out of the system.

We were interested in the effects on the system if the number of servers were varied. By varying the system to improve one area, such as the interview station, we did not want to create queue build ups at other stations, like the beds. We ran four variations on our simulation model of the Navy's process. They included:

1. Exponential Case. Used to determine steady state to verify our model.
2. Base Case. Modeled the real system we observed. Interviewers at Station two were on a clock to put one interviewer on break twenty minutes every other hour, (90 to 110 minutes and 210 to 240 minutes). Changes were made to this model to note improvements to the overall system.
3. Two Interviewers. Used base case but with two interviews in place at all times.
4. Decreased the number of beds. Changed the number of beds from nine to six.

For each case the number of servers at each station was as follows:

CASE	STATION 1	STATION 2	STATION 3	STATION 4
Expon Case	4	2	1	9
Base Case (interviewers on breaks)	4	1-2	1	9
Two interviewers always	4	2	1	9
Decrease beds: 6	4	2	1	6

Figure 7. Number of Servers at Each Station.

To show the difference from the actual observed system and our simulation model we used animation. We first animated our visit to the Navy Academy on the 27^{th} of February. This system has the same number of servers at each of the stations as the Base case. However, the animation, unlike the Base case model shows the true arrivals of the donors to include batch arrivals and the exact times the interviewers went on break, reducing that station to one server. The second animation shows the base case with two servers dedicated to station two and the distributions for the inter-arrival times and service times as determined by Unifit II. The third animation is the same as the second but with the number of beds reduced to six. All three animation models visually show how the changes impact the system. Most notable was the development of queues at various stations. The animation also show deferments being rejected at the various decision points in the system. The deferments collected at the bottom of the model to show the cumulative sum of deferrals in a four hour drawing.

B. Trend Analysis.

The Navy mobile blood bank has maintained logs for the last 2 years of its operation (we have the data from January 1994 - February 1996). These logs include information regarding: (1) Visit location, (2) day, date, year of visit, (3) anticipated donor turnout, (4) actual donor turnout, (5) amount of bags obtained for the given day, and (6) number of people deferred. (See Appendix E) We used this data to look for possible trends in donor turnout. We quickly realized that two years of data is definitely a minimum amount necessary for any trend analysis. However, we were able to use the results from different statistical tests as indicators of potential trends. These indicators provide insight to areas of potential interest and those which should be tracked in coming years. We analyzed the available data using the following:

1. Runs tests
    - Runs Up/Down test
    - Run length
2. Linear trends test.
3. Additive time series model.
4. Auto regressive/moving averages.

C. Runs Tests.

We implemented two types of Runs test as a diagnostic procedure in part to check the reasonableness of the assumption that our data is a sequence of binary outcomes from independent and identically distributed (iid) Bernoulli random variables. The first test is a Runs Up / Down test, and the second is a test taking into account the length of each run. The question we were interested in answering was: 'is our sequence of time series data occurring by random chance, or is there evidence indicating a lack of randomness in the ordering of the data?'

1. Runs Up / Down Test.

Initially we considered the entire sequence of bi-monthly sums using a Runs Up / Down test to identify patterns in our time series data which are unlikely to occur if the iid Bernoulli random variable assumption is valid. To assess whether or not our observed sequence of outcomes is incompatible with an assumption of randomness we compared the observed number of up / down runs with the number which is expected if all possible orderings of n_0 ups and n_1 downs are equally likely.

A test of this nature will give us some indication of whether changes in our sequence is a departure from randomness and indicative of a persistence in its direction of movement or where our sequence contains a trend (e.g. a cyclical pattern). Our hypothesis and test statistics were:

Hypothesis:

H_0: Sequence generated by a random process

H_1: Sequence generated by a process containing either persistence or frequent changes in direction.

Test Statistics:

$\mathbf{E(R)} = (2n - 1)/3$ $\sigma^2\mathbf{(R)} = (16n - 29) / 90$ $\mathbf{z^*} = (R - E(R)) / s(R)$

Bi-monthly Sums:

Sum(+/-)*	Run #	Sum(+/-)	Run #	Sum(+/-)	Run #	Sum(+/-)	Run #
252		228-		273+	18	256-	27
173-	1	216-	11	241-	19	277+	
311+	2	259+		338+		321+	28
302-	3	278+	12	528+	20	234-	29
378+	4	265-	13	212-		293+	30
163-	5	286+		209-	21	127-	31
251+	6	288+	14	243+	22	461+	32
248-	7	276-		199-	23	145-	
277+	8	239-	15	286+	24	104-	
181-	9	300+	16	243-		34-	33
227+		216-		156-	25	395+	34
373+	10	178-	17	235+		232-	
353-		261+		291+	26	231-	35

*+/- indicates up / down run

Our Results:
E(R) = 34.33 σ^2(R) = 8.922 $z_{\alpha/2}^* = 0.2243$
At an $\alpha = 0.05$; $-1.96 >= |0.2243| <= 1.96$, p-value = .956

We also ran a Runs Up / Down test on the correlation coefficient obtained when comparing the same point in time for the year 1994 and 1994 (e.g. week 2 of February 1994 vs. week 2 of February 1995). We used the same hypothesis to test our results.

Correlation Coefficients:

Sum(+/-)	Run #	Sum(+/-)	Run #	Sum(+/-)	Run #	Sum(+/-)	Run #
-0.065728		-0.066126		-0.027471	7	-0.264036	11
-0.124466		0.035185		0.021972	8	-0.008851	12
-0.188667	1	0.036203	4	-0.061436	9	-0.026086	
0.197515	2	-0.007813	5	0.150433	10	-0.042193	13
-0.166030	3	0.095876	6	0.075086		0.096705	14
-0.068282		0.075071		-0.050343		-0.024776	15

Our Results:
E(R) = 15.667 $\sigma(R) = 1.986$ $z_{\alpha/2}* = -0.3359$
At an $\alpha = 0.05$; -1.96 >= |0.3359| <= 1.96

These test results indicate the sequence is random; it is appropriate to treat the observations as a random sample from an infinite population. However, according to resident GMU statistics expert, Dr. Sutton, Runs can be quite ineffective for detecting inconsistency in variation if the variation is, for example, cyclical and the period is not very long. For our time series data, we only have two years worth of information; enough to make some initial observations, but not enough information to rule out possible trends. With this in mind, we continued with other methods of time series analysis.

2. Run Length.

Performing a test to see if the longest run warrants anything other than iid also yielded insignificant results. The longest run is three and the p-value associated with that amount is 0.9466. This indicates there is no reason to reject the assumption that the data comes from anything other than iid.

D. Linear Trends.

Analyzing the linear trends yielded very interesting results. We first looked at the linear trend of the data across the 26 months (See Figure 8). The linear trend for the 26 month span is: $\boldsymbol{Y_t = 274.923 - 2.85162*t}$, indicating a decrease of approximately 74 bags over the last two years (-2.85162*26). Initially, this decrease did not appear to be extremely significant. Yet, there are additional studies[3] that claim an overall decline in donor participation is occurring. We felt that our declining trend together with the studies indicating decline warranted a deeper look into the data.

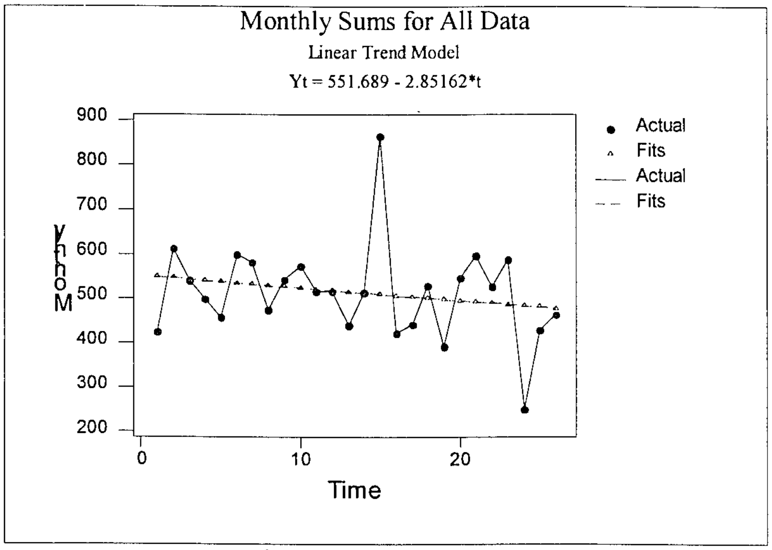

Figure 8. Monthly Sums.

Looking at 1994 and 1995 separately revealed greater insight to the source of declining participation. The linear equation describing 1994 is: $\boldsymbol{Y_t = 514.651 + 2.10490*t}$ (See Figure 9). This equation indicates an *increase* of approximately 25 bags over the year. Still not very significant since we are only dealing with twelve data points.

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[3] Roberts, Russell and Michael Wolkoff, "Improving the Quality and Quantity of Whole Blood Supply: Limits to Voluntary Arrangements", Journal of Health Politics, Policy and Law, 1988, Vol. 13, No. 1, pp167-177.

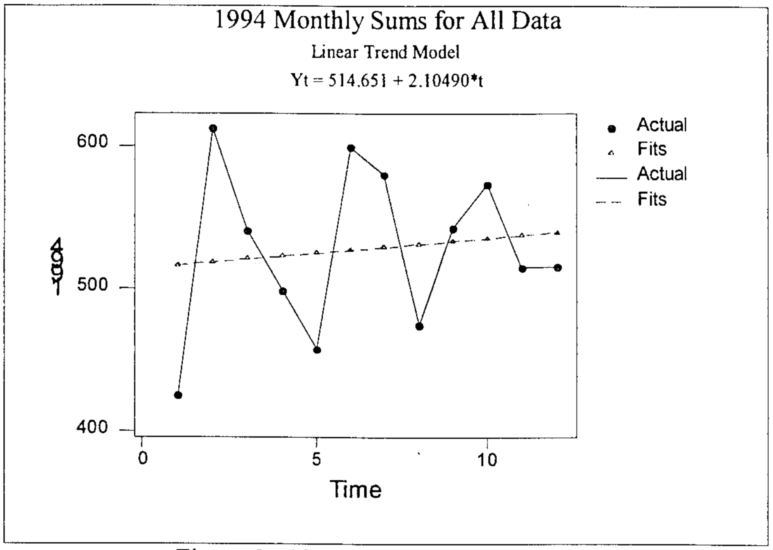

Figure 9. 1994 Monthly Sums

The linear equation for 1995 is: $Y_t = 571.409 - 9.56294*t$ (See Figure 10). This equation suggests a *loss* of approximately 115 bags over the year.

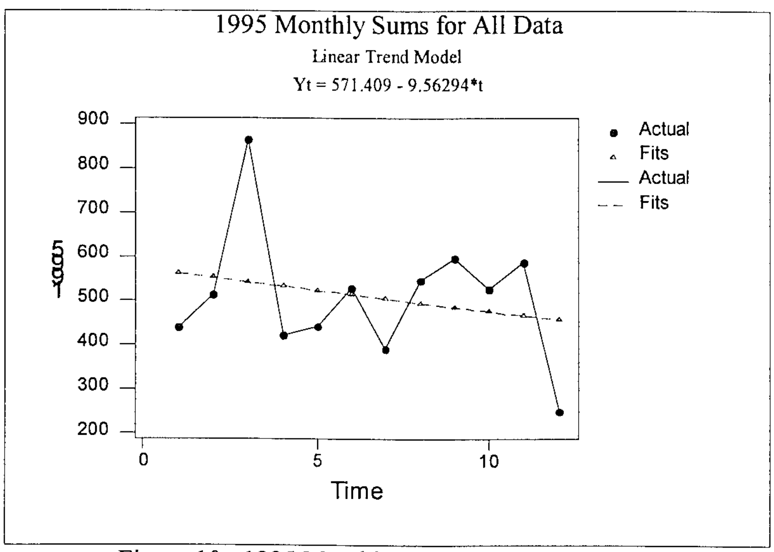

Figure 10. 1995 Monthly Sums.

The linear model representing 1995 lends more support to the notion of declining donor participation. It is interesting to note the average blood drawn for 1995 is only slightly less than the average for 1994 (509 vs. 528), yet there is a much more drastic negative trend in 1995. Again, our data is limited to only two years, but we can conclude areas which may be potential indicators of actual trends.

To determine if the Navy Mobile Blood Bank should be concerned with the 1995 trend and focus on methods to minimize the affects of a declining donor population we subjected the data to a number of additional statistical tests, (see Appendix F for all additional test results). Parametric and nonparametric tests for rejecting iid based on differences in the years yielded extremely insignificant p-values (t-test, sign test, Wilcoxon test, Mann-Whitney). These results imply that the data is not really following any type of trend even though visually there appears to be something occurring.

E. Additive Time Series Model.

Running an Additive Time Series Model in Minitab enabled us to look at our data sequence with the Seasonal Component isolated (See Figure 11). This type of model is looking at seasonal trends together with some type of trend component (linear or exponential obtained using a least squares calculation) and cyclical component (deviations from the trend).

The trend obtained from this model exactly matched the linear trend model discussed in the previous section. For seasonal indicators, we see evidence of extreme variation over the seasonal periods (approximately 10 to 90 bags of variation). The high variation and seasonal indices for March can be explained by the outlier data point that is due to a rare day at the Naval Academy when 253 bags of blood were drawn. Furthermore, there does not appear to be any cyclical trend.

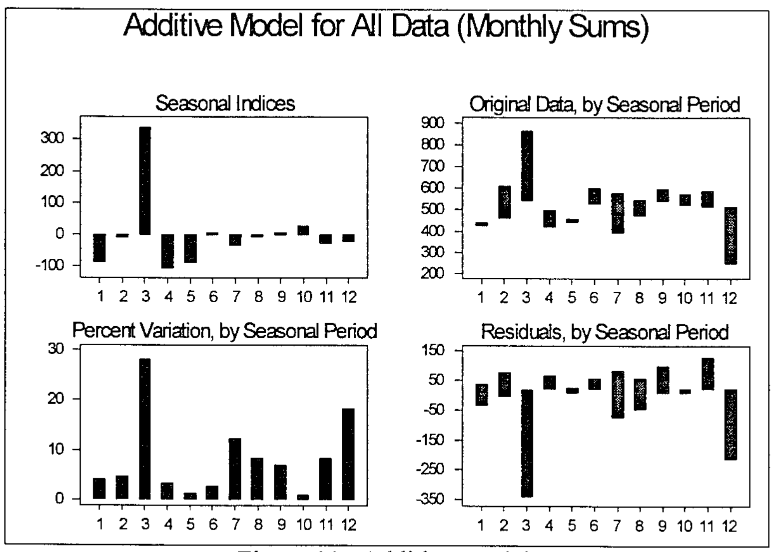

Figure 11. Additive Model.

There is not a lot to obtain from an additive model with only two years of data. With two years of data, the model really only has two data points to compare (one from 1994, and the other from the same period in 1995). It would be interesting to see how data over the next two to three years supports the indicators represented in the figure above.

Simply eyeing the raw data seems to support the idea that there are seasonal factors affecting the amount drawn. January's average is consistently below the norm (431 vs. 513), as well as the months of April and May (460 and 450 respectively). September through November tend to be above average months (570, 550, and 551 respectively). These observations are supported by the Seasonal Indices chart, but until more data can be obtained, not a lot of confidence can be offered from the additive model. In fact, a Durbin-Watson test statistic of 2.15 indicates there is no support of positive/negative correlation of error terms. This suggests there is no need to even look at time series analysis.

F. Autoregressive / Moving Averages.

Autoregressive / Moving Averages (ARMA) is a form of analysis which generates a model using white noise as the forcing terms in a set of linear differences equations. This is an iterative process; we had to try different combinations of AR and MA types (e.g. AR(2) and MA(2)) to obtain a model best fitting our data. Using Minitab to calculate the ARMA statistic, we found that an AR(1) MA(1) best describes our data. The Minitab results are as follows:

Minitab Output	
Final Estimates of Parameters	
Type	Estimate
AR 1	0.8449
MA 1	1.0052
Constant	40.0585
Mean	258.225

To measure how well the model fits the data, we used the Minitab output for the modified Box-Pierce chi-square statistic. We computed the p-value to check the significance of the value for each of the lags (12, 24, 36).

H_0: The specified ARMA model fits our data.

H_1: The specified ARMA model does not fit our data.

Modified Box-Pierce (Ljung-Box) chi-square statistic

Lag	12	24	36
Chi-square	6.8(DF=10)	17.5(DF = 22)	25.7(DF=34)
p-value:	***0.744159***	***0..735185***	***0.846087***

We accept the null hypothesis based on the observed p-value and are unable to conclude that the model obtained from Minitab does not fits our data. The model is:

Drawn at time t = 40.0585 + 0.8449($\mathbf{Drawn_{t-1}}$) + $\mathbf{Z_t}$ + 1.0052($\mathbf{Z_{t-1}}$)
(where Z_t is the "white noise error" $\sim N(0,\sigma^2)$).

Obtaining a model with such an insignificant p-value for rejecting the Minitab model, suggests the ARMA process is potentially a good method of forecasting coming months. However, we must keep in mind we have only two years of data and the previous Durbin-Watson test (together with several additional tests) indicates an iid process. Obtaining two to three more years of data would yield much more significant results. Hence, we interpreted the information obtained from the ARMA process as offering an interesting suggestion of the potential for using the above model for forecasting the data.

V. RUN SUMMARIES.

The summary of our runs output is in Appendix G. We ran the various cases for 20 runs for four hours, 500 runs for four hours.

VI. ANALYSIS OF OUTPUT.

The following adjustments to the system were tested at 500 replications for four hours:

SYSTEM	AVG TIME IN SYSTEM	TOTAL DONORS
a. Exponential case	52.09	68.30
b. Base case (2 inter-viewer- take breaks)	38.76	70.60
c. Two interviewers (always)	36.99	70.60
d. Decrease beds 6	37.04	69.80

Figure 12. Model Output Run Summary.

By changing the number of servers at station two (interviewer) and at station four (blood drawing) we noted slight improvement in the total time through the system. Decreasing the number of beds did not change the overall time in the system. A similar decrease in total system time was noted, as compared to the base case, when there were two dedicated interviewers. In both changes the queues actually decreased (see Figure 13 , Summary of Model Variations). The reduction in queue build up at the interview station was most noticeable in the animation simulation in comparing the 27 February actual system to the modeled system. The February 27 model has queues form when one interviewer goes on break which is visually demonstrated in the animation. The minimal difference between the simulated models is due to the lack of any large queue forming as noted in our output. The Lq never builds up in the Base case as was actually observed at the various blood drawing because we were not able to program for batch arrivals into our model.

CASE	L (system size)	W (waiting time in system)	Lq (queue size)	Wq (waiting time in queue)
a. Expon Case	13.03	52.09	2.27	9.51
b. Base Case	8.59	37.02	0.44	1.92
c. 2 interviewers	8.55	36.99	0.44	1.95
d. Decrease beds	8.55	37.04	0.44	1.95

Figure 13. Summary of Model Variations.

VII. CONCLUSIONS.

From the beginning of our project we attempted to produce three products to assist the Navy in improving their number of donors and overall donor satisfaction. We examined the Navy's larger blood drawings of 70 to 100 donors. From our study we noted that the system could be improved by reducing the time donors spend the system as a whole. The total system time in our model was reduced by having two dedicated interviewers at station two.

There is not a significant reduction in system time between the two models because our model did not demonstrate the queue build up we observed at the USNA blood drawings. We were unable to program batched arrivals into the system as we observed at the drawings. Batched arrivals would have reflected the true system in terms of queue build up at the various stations. In the animation model of February 27th all of the arrivals times were entered as discrete times which is a more accurate reflection of the system we observed because it allows manual batching of the donors. However, from our survey of donors we noted that station two was a point of dissatisfaction.

In the survey we randomly surveyed donors at the blood drawing at the Naval Academy on March 26th. We wanted to determine the satisfaction or dissatisfaction, of the donors and their time in system. The survey included the start and end time in the system (not including the canteen), and the following questions:

- Was the process too long?
- Is there anything in the process you would change?
- Would you donate again?

The survey confirmed our initial thoughts. Out of the 33 randomly selected, two were deferred and 31 completed the system. Of the thirty-one, seventy-four percent of those surveyed concluded the system time was not too long, forty-eight percent recommended changes, and one-hundred percent said that they would donate again in the future. On average, it took those surveyed fifty-eight minutes to complete the system. Those surveyed who did offer comments focused on the interview station and recommended more servers.

The students surveyed support our conclusions on the need to maintain two interviewers at station two at all times. We recommend the supervisor act as a relief person when assigned interviewers need a break. If the supervisor serves also as an interviewer then the system's queues at that station develop as noted in our base case model. At previous drawings we had observed there were two interviewers, however, one of the interviewers fulfilled two jobs: interviewer and overall supervisor.

In addition to the number of servers at station two, we also concluded that the number of beds could be decreased from nine to six for drives with donor populations less than or equal to 70. Previously the Navy had listed the following table in its operations manual as a guideline:

Number of Donors	Number of Beds	Donors per Hour
< 30	4 to 5	16 to 20
30 to 45	6 to 8	24 to 32
46 to 60	9 to 10	36 to 40
61 to 80	11 to 12	44 to 48
> 80	> 12	> 48

Figure 14. Donors to beds.

To draw any more detailed conclusions on the number of servers we would have to implement our proposed changes and observe their impact on the system. However, the Navy, to conserve its resources would benefit by further studying the ratio of servers to donors.

An additional area of study should be reducing the number of decision points. Within the current system there is redundancy in the questions the donors are asked from station one to station two. Station two re-asks the donor the questions on the form. A reexamination of what questions really need to be asked at each station of the donors could also reduce time within the system.

Finally, we noted in our trend analysis that donor participation is decreasing. But with only 26 months of data we cannot draw any strong conclusions. All the tests performed show the data to be iid. Some of the tests offered possibilities of indicating potential trends but we cannot extracted anything significant from the trend analysis without more data. The data will provide insights and should be further collected and monitored in the coming years.

Overall the Navy's system is adequate in its current state. But we know from our observations, donor surveys and prior studies, that the Navy should do what it can to continuously improve donor satisfaction and examine other ways to obtain new donors.

St	Input	Name	Output	Unit	Comment
					M/M/c:Multiple Servers/Unlimited Queue
		iat	3.4843	min	Mean interarrival time
		st	14.1443	min	Mean time to complete service
	.287	lambda		1/min	Arrival rate (arrivals/unit of time)
	.0707	mu		1/min	Service rate per channel (#/time)
		r	4.0594		Avg # arrivals during avg service time
	12	c			# of servers in the system (c > 1)
		rho	.3383		Fraction of time each server is busy
		p0	.0173		Probability of 0 in the system
	6	n			Target # of customers in the system
		pn	.1073		Probability of n in the system
		Lq	.0006		Expected queue size
		L	4.06		Expected system size
		Wq	.0019	min	Expected waiting time in the queue
		W	14.1462	min	Expected waiting time in the system
	10	t		min	Specific time in the queue
		Ptq	0		Prob. of waiting >= t in the queue
		Pq0	.9989		Probability of no wait in the queue
	10	K			Max variable value whose prob wanted
		pK	.0058		Probability of K in system (K>=c)
		PK	.9989		Probability of <= K in system
	1	d		min	Size of time interval for plot
	60	T		min	Total time horizon for prob plotting
		TWq	1		Probability that queue delay <= T (should be 1 if full plot is needed)

See Tables and Plots

St	Input	Name	Output	Unit	Comment
					M/M/c:Multiple Servers/Unlimited Queue
	4.0992	iat		min	Mean interarrival time
	4.4769	st		min	Mean time to complete service
		lambda	.244	1/min	Arrival rate (arrivals/unit of time)
		mu	.2234	1/min	Service rate per channel (#/time)
		r	1.0921		Avg # arrivals during avg service time
	2	c			# of servers in the system (c > 1)
		rho	.5461		Fraction of time each server is busy
		p0	.2936		Probability of 0 in the system
	6	n			Target # of customers in the system
		pn	.0156		Probability of n in the system
		Lq	.464		Expected queue size
		L	1.5562		Expected system size
		Wq	1.9022	min	Expected waiting time in the queue
		W	6.3791	min	Expected waiting time in the system
	10	t		min	Specific time in the queue
		Ptq	.0508		Prob. of waiting >= t in the queue
		Pq0	.6143		Probability of no wait in the queue
	10	K			Max variable value whose prob wanted
		pK	.0014		Probability of K in system (K>=c)
		PK	.9983		Probability of <= K in system
	1	d		min	Size of time interval for plot
	60	T		min	Total time horizon for prob plotting
		TWq	1		Probability that queue delay <= T (should be 1 if full plot is needed)

See Tables and Plots

St	Input	Name	Output	Unit	Comment
					M/M/c:Multiple Servers/Unlimited Queue
	4.183	iat		min	Mean interarrival time
	3	st		min	Mean time to complete service
		lambda	.2391	1/min	Arrival rate (arrivals/unit of time)
		mu	.3333	1/min	Service rate per channel (#/time)
		r	.7172		Avg # arrivals during avg service time
	1	c			# of servers in the system (c > 1)
		rho	.7172		Fraction of time each server is busy
		p0	.2828		Probability of 0 in the system
	6	n			Target # of customers in the system
		pn	.0385		Probability of n in the system
		Lq	1.8187		Expected queue size
		L	2.5359		Expected system size
		Wq	7.6078	min	Expected waiting time in the queue
		W	10.6078	min	Expected waiting time in the system
	10	t		min	Specific time in the queue
		Ptq	.2794		Prob. of waiting >= t in the queue
		Pq0	.2828		Probability of no wait in the queue
	10	K			Max variable value whose prob wanted
		pK	.0102		Probability of K in system (K>=c)
		PK	.9742		Probability of <= K in system
	1	d		min	Size of time interval for plot
	60	T		min	Total time horizon for prob plotting
		TWq	.9975		Probability that queue delay <= T (should be 1 if full plot is needed)

See Tables and Plots

St	Input	Name	Output	Unit	Comment
					M/M/c:Multiple Servers/Unlimited Queue
	4.183	iat		min	Mean interarrival time
	21.1698	st		min	Mean time to complete service
		lambda	.2391	1/min	Arrival rate (arrivals/unit of time)
		mu	.0472	1/min	Service rate per channel (#/time)
		r	5.0609		Avg # arrivals during avg service time
	9	c			# of servers in the system (c > 1)
		rho	.5623		Fraction of time each server is busy
		p0	.0062		Probability of 0 in the system
	6	n			Target # of customers in the system
		pn	.1458		Probability of n in the system
		Lq	.1101		Expected queue size
		L	5.171		Expected system size
		Wq	.4604	min	Expected waiting time in the queue
		W	21.6302	min	Expected waiting time in the system
	10	t		min	Specific time in the queue
		Ptq	.0133		Prob. of waiting >= t in the queue
		Pq0	.9143		Probability of no wait in the queue
	10	K			Max variable value whose prob wanted
		pK	.0211		Probability of K in system (K>=c)
		PK	.9729		Probability of <= K in system
	1	d		min	Size of time interval for plot
	60	T		min	Total time horizon for prob plotting
		TWq	1		Probability that queue delay <= T (should be 1 if full plot is needed)

See Tables and Plots

#	Year	Month	Day	Place	Drawn	Defered	Total Arrivals	flat log data:	received	not used
1	1994	8	1	NSHS	20	1	21	0	20	5
2	1994	8	2	NASP	23	2	25	0	23	5
3	1994	8	4	NIS	25	7	32	1	26	6
4	1994	8	5	NS Station	41	4	45	3	44	17
5	1994	8	9	Bupers	32	2	34	1	33	7
6	1994	8	11	NSWC	56	2	58	3	59	13
7	1994	8	12	NAF	2	2	4	0	2	0
8	1994	8	15	D. Taylor	17	1	18	0	17	3
9	1994	8	16	Quantico	29	1	30	2	31	6
10	1994	8	18	Pent	21	2	23	2	23	4
11	1994	8	19	NRL	44	7	51	3	47	10
12	1994	8	22	NRL (mil)	19	1	20	2	21	3
13	1994	8	23	NSGA	36	3	39	5	41	12
14	1994	8	25	Bupers	23	1	24	3	26	12
15	1994	8	26	Pax Run	28	4	32	3	31	9
16	1994	8	29	NC	20	5	25	1	21	8
17	1994	8	30	NSNA	39	6	45	5	34	5
18	1994	9	1	PNSY	110	11	121	2	112	22
19	1994	9	2	NMRC	6	0	26	0	6	0
20	1994	9	6	USNA	32	6	38	2	34	7
21	1994	9	8	Navy Band	21	3	24	0	21	5
22	1994	9	9	WNY	20	2	22	2	22	4
23	1994	9	12	USNA	9	2	11	0	9	1
24	1994	9	13	DIA	28	3	31	2	30	4
25	1994	9	14	Bupers	31	4	35	2	33	8
26	1994	9	15	Pent	21	0	21	0	21	3
27	1994	9	19	NNMC	44	6	50	1	45	8
28	1994	9	20	ONI	33	2	35	1	34	11
29	1994	9	22	NRC	13	3	16	0	13	5
30	1994	9	23	Quantico	25	5	30	0	25	5
31	1994	9	26	NSA	17	4	21	0	17	3
32	1994	9	27	USNA	68	9	77	0	68	14
33	1994	9	29	ONI	42	4	46	3	45	14
34	1994	9	30	NS Station	23	1	24	1	24	9
35	1994	10	3	MSC	27	4	31	1	26	7
36	1994	10	4	USNA	44	7	51	1	45	6

#	Year	Month	Day	Place	Drawn	Defered	Total Arrivals	flat log data:	received	not used
37	1994	10	6	NNMC	30	11	41	0	30	5
38	1994	10	5	USCG	36	1	37	2	38	7
39	1994	10	11	Bupers	9	3	12	0	9	4
40	1994	10	12	Quantico	71	10	81	1	72	10
41	1994	10	13	Dahlgrin	24	5	29	5	29	11
42	1994	10	14	USCG	45	6	51	1	46	10
43	1994	10	17	USNA	20	4	24	0	20	2
44	1994	10	19	NRL (mil)	17	4	21	2	19	4
45	1994	10	20	GW NROTC	44	7	51	0	44	12
46	1994	10	21	NRL	45	5	50	3	48	11
47	1994	10	24	NCG	32	7	39	3	35	8
48	1994	10	25	USNA	28	3	31	2	30	6
49	1994	10	27	OSIA	36	6	42	1	37	11
50	1994	10	28	AIMD	31	3	34	2	33	8
51	1994	10	31	VA Med	35	6	41	3	38	14
52	1994	11	1	NEOD	40	12	52	1	41	10
53	1994	11	3	NIS	33	5	38	4	37	12
54	1994	11	4	WNY	30	4	34	5	35	6
55	1994	11	7	USNA	22	2	24	3	25	6
56	1994	11	8	DIA	39	6	45	1	40	7
57	1994	11	9	Camp Dav	56	7	63	1	57	12
58	1994	11	14	Marine Bks	25	6	31	1	26	8
59	1994	11	15	USNA	31	2	33	1	32	3
60	1994	11	16	Bupers	33	9	42	2	35	8
61	1994	11	17	Pent	23	2	25	2	25	8
62	1994	11	18	Pax Run	39	5	44	4	43	11
63	1994	11	21	USNA	32	1	33	1	33	4
64	1994	11	22	NSA Ann	15	3	18	1	16	5
65	1994	11	23	NNMC	24	8	32	0	24	6
66	1994	11	29	USNA	45	4	49	0	45	11
67	1994	11	30	USNA	28	4	32	0	28	10
68	1994	12	1	SS Kenned	85	10	95	7	92	23
69	1994	12	2	NSA	24	9	33	1	25	5
70	1994	12	6	ONI	24	7	31	7	31	7
71	1994	12	7	NRC	29	4	33	2	31	14
72	1994	12	8	NSWC	34	5	39	4	38	12

#	Year	Month	Day	Place	Drawn	Defered	Total Arrivals	flat log data:	received	not used
73	1994	12	12	NMRI	15	6	21	2	17	6
74	1994	12	13	Bupers	41	4	45	3	44	6
75	1994	12	14	ONI	28	9	37	5	33	11
76	1994	12	15	Pent	20	1	21	0	20	1
77	1994	12	16	NRL	43	5	48	3	46	9
78	1994	12	19	BUMED	36	3	39	2	38	12
79	1994	12	20	NRL (mil)	18	2	20	2	20	6
80	1994	12	21	NSS	15	3	18	1	16	5
81	1994	12	22	NNMC	34	6	40	2	36	8
82	1994	12	23	NNMC	24	4	28	4	28	8
83	1994	12	27	NNMC	13	2	15	2	15	7
84	1994	12	28	NNMC	14	1	15	1	15	4
85	1994	12	29	NNMC	12	8	20	0	12	2
86	1994	12	30	NNMC	7	1	8	1	8	2
87	1995	9	5	USNA	76	6	82	1	77	8
88	1995	9	19	NNMC	32	5	37	4	36	10
89	1995	9	28	ONI	31	6	37	2	33	5
90	1995	9	29	Pax Run	87	16	103	4	91	27
91	1995	10	13	NRL	49	7	56	9	40	9
92	1995	10	17	USNA	40	8	48	8	48	7
93	1995	10	31	OSIA	45	12	57	1	46	5
94	1995	11	3	GW NROTC	30	12	42	2	28	4
95	1995	11	6	Bupers	26	3	29	0	26	2
96	1995	11	20	USNA	54	12	66	3	57	9
97	1995	11	22	NSHS	28	3	31	3	31	8
98	1995	11	28	USNA	113	3	116	10	123	5
99	1995	12	7	Pent	14			1	13	3
100	1995	12	15	NRL	30			7	23	3
101	1995	12	21	Pent	19			1	20	4
102	1995	12	28	NNMC	25			0	25	6
103	1996	1	4	NNMC	18	3	21	7	25	3
104	1996	1	17	USCG	38	7	45	7	31	8
105	1996	1	23	USNA	79	16	95	5	84	21
106	1996	2	8	Dahlgrin	24	2	26	0	24	6
107	1996	2	9	Quantico	52	4	56	1	53	7
108	1996	2	23	ONI	46	7	53	2	48	8

#	Year	Month	Day		Drawn	Defered	Total Arrivals	difference	received	not used
109	1996	2	27	USNA	55	12	67	0	55	6
				SUM	3634	522	4088	231	3801	833
				AVE	8.906863	1.279412	10.0196078			
				STD	19.22297	3.361139	21.2915958			
				% not used						22%

Arrivals Rate to Station 1						
ID	In					
1	14:05					
2	14:05	0:00	0		0	16
3	14:20	0:15	15		1	13
4	14:30	0:10	10		2	10
5	14:41	0:11	11		3	4
6	14:43	0:02	2		4	3
7	14:44	0:01	1		5	5
8	14:46	0:02	2		6	2
9	14:46	0:00	0		7	2
10	14:46	0:00	0		8	2
11	14:47	0:01	1		9	1
12	14:48	0:01	1		10	3
13	14:53	0:05	5		11	2
14	14:53	0:00	0		12	0
15	15:06	0:13	13		13	1
16	15:09	0:03	3		14	0
17	15:11	0:02	2		15	1
18	15:11	0:00	0		16	0
19	15:13	0:02	2		17	1
20	15:15	0:02	2			
21	15:15	0:00	0			
22	15:15	0:00	0			
23	15:16	0:01	1			
24	15:20	0:04	4			
25	15:30	0:10	10			
26	15:32	0:02	2			
29	15:33	0:01	1			
30	15:33	0:00	0			
32	15:38	0:05	5			
33	15:39	0:01	1			
34	15:40	0:01	1			
35	15:51	0:11	11			
36	15:54	0:03	3			
37	15:55	0:01	1			
38	16:02	0:07	7			
39	16:03	0:01	1			
40	16:07	0:04	4			
41	16:24	0:17	17			
42	16:24	0:00	0			
43	16:32	0:08	8			
45	16:35	0:03	3			
44	16:44	0:09	9			
46	16:45	0:01	1			
47	16:45	0:00	0			
48	16:47	0:02	2			
49	16:47	0:00	0			
50	16:53	0:06	6			
51	16:59	0:06	6			
52	17:04	0:05	5			
53	17:06	0:02	2			
54	17:07	0:01	1			

Arrivals Rate to Interview						
ID	Out of Sta 1					
1	14:19					
3	14:30	0:11	11		0	3
4	14:42	0:12	12		1	11
5	14:53	0:11	11		2	13
7	14:55	0:02	2		3	15
6	14:56	0:01	1		4	6
8	14:58	0:02	2		5	2
9	15:03	0:05	5		6	4
10	15:03	0:00	0		7	3
12	15:07	0:04	4		8	0
11	15:09	0:02	2		9	3
14	15:10	0:01	1		10	0
13	15:12	0:02	2		11	3
15	15:16	0:04	4		12	1
17	15:19	0:03	3		13	0
18	15:26	0:07	7		14	0
19	15:29	0:03	3		15	0
16	15:30	0:01	1		16	0
21	15:31	0:01	1		17	0
23	15:37	0:06	6			
22	15:41	0:04	4			
24	15:41	0:00	0			
26	15:41	0:00	0			
29	15:50	0:09	9			
25	15:52	0:02	2			
32	15:55	0:03	3			
30	15:56	0:01	1			
33	15:57	0:01	1			
34	15:59	0:02	2			
36	16:04	0:05	5			
35	16:06	0:02	2			
37	16:07	0:01	1			
38	16:18	0:11	11			
40	16:20	0:02	2			
39	16:23	0:03	3			
41	16:32	0:09	9			
42	16:33	0:01	1			
43	16:42	0:09	9			
45	16:48	0:06	6			
44	16:49	0:01	1			
46	16:56	0:07	7			
48	16:57	0:01	1			
49	16:58	0:01	1			
47	17:01	0:03	3			
50	17:04	0:03	3			
51	17:10	0:06	6			
52	17:13	0:03	3			
53	17:15	0:02	2			
54	17:21	0:06	6			
56	17:28	0:07	7			
55	17:32	0:04	4			

Arrivals Rate to Bag						
ID	Out of Interview					
1	14:22					
3	14:36	0:14	14		0	4
4	14:47	0:11	11		1	7
5	14:55	0:08	8		2	9
7	15:00	0:05	5		3	8
6	15:03	0:03	3		4	3
8	15:05	0:02	2		5	6
9	15:07	0:02	2		6	3
12	15:11	0:04	4		7	1
14	15:17	0:06	6		8	3
13	15:19	0:02	2		9	2
15	15:24	0:05	5		10	2
17	15:24	0:00	0		11	3
18	15:30	0:06	6		12	1
19	15:36	0:06	6		13	0
16	15:38	0:02	2		14	1
21	15:41	0:03	3		15	0
22	15:53	0:12	12		16	0
23	15:53	0:00	0		17	0
24	15:53	0:00	0			
29	16:00	0:07	7			
25	16:03	0:03	3			
32	16:04	0:01	1			
30	16:06	0:02	2			
33	16:07	0:01	1			
36	16:09	0:02	2			
35	16:13	0:04	4			
37	16:14	0:01	1			
38	16:23	0:09	9			
40	16:26	0:03	3			
41	16:36	0:10	10			
42	16:40	0:04	4			
43	16:48	0:08	8			
44	16:56	0:08	8			
46	17:06	0:10	10			
48	17:07	0:01	1			
49	17:09	0:02	2			
50	17:14	0:05	5			
47	17:16	0:02	2			
51	17:18	0:02	2			
52	17:18	0:00	0			
54	17:21	0:03	3			
53	17:22	0:01	1			
56	17:33	0:11	11			
57	17:38	0:05	5			
60	17:43	0:05	5			
59	17:46	0:03	3			
62	17:55	0:09	9			
63	18:00	0:05	5			
64	18:11	0:11	11			
66	18:12	0:01	1			

Arrivals Rate to Take Blood						
ID	Out of Bag					
1	14:26					
3	14:39	0:13	13		0	1
4	14:50	0:11	11		1	0
5	15:00	0:10	10		2	13
7	15:03	0:03	3		3	17
6	15:05	0:02	2		4	4
8	15:08	0:03	3		5	4
9	15:11	0:03	3		6	2
12	15:14	0:03	3		7	1
13	15:22	0:08	8		8	4
15	15:26	0:04	4		9	2
17	15:28	0:02	2		10	2
18	15:33	0:05	5		11	2
19	15:39	0:06	6		12	0
16	15:42	0:03	3		13	1
21	15:45	0:03	3		14	0
23	15:56	0:11	11		15	0
22	15:59	0:03	3		16	0
29	16:02	0:03	3		17	0
25	16:06	0:04	4			
32	16:08	0:02	2			
30	16:13	0:05	5			
33	16:16	0:03	3			
36	16:18	0:02	2			
35	16:20	0:02	2			
24	16:23	0:03	3			
37	16:25	0:02	2			
38	16:28	0:03	3			
40	16:32	0:04	4			
41	16:39	0:07	7			
42	16:43	0:04	4			
43	16:51	0:08	8			
44	16:59	0:08	8			
46	17:08	0:09	9			
48	17:10	0:02	2			
49	17:13	0:03	3			
50	17:16	0:03	3			
14	17:19	0:03	3			
47	17:19	0:00	0			
51	17:21	0:02	2			
52	17:23	0:02	2			
54	17:25	0:02	2			
53	17:27	0:02	2			
56	17:36	0:09	9			
57	17:41	0:05	5			
60	17:46	0:05	5			
59	17:49	0:03	3			
62	17:57	0:08	8			
63	18:03	0:06	6			
64	18:13	0:10	10			
66	18:15	0:02	2			

55	17:15	0:08	8
56	17:19	0:04	4
57	17:21	0:02	2
58	17:26	0:05	5
59	17:26	0:00	0
61	17:28	0:02	2
62	17:28	0:00	0
60	17:29	0:01	1
63	17:39	0:10	10
64	17:42	0:03	3
65	17:42	0:00	0
66	17:47	0:05	5
67	17:48	0:01	1
68	17:55	0:07	7
69	17:55	0:00	0
70	17:55	0:00	0
	Average		3.5
	Variance		16.4
	Skew		1.5
	Kurtosis		1.6
	Std Dev		4.0
	CV		1.2
	Min		0.0
	Max		17.0

57	17:34	0:02	2
58	17:37	0:03	3
60	17:39	0:02	2
59	17:43	0:04	4
62	17:47	0:04	4
61	17:49	0:02	2
63	17:52	0:03	3
65	17:55	0:03	3
64	17:58	0:03	3
66	18:01	0:03	3
67	18:04	0:03	3
68	18:06	0:02	2
70	18:09	0:03	3
69	18:12	0:03	3
2			
20			
	Average		3.6
	Variance		8.5
	Skew		1.3
	Kurtosis		1.1
	Std Dev		2.9
	CV		0.8
	Min		0.0
	Max		12.0

67	18:15	0:03	3
70	18:18	0:03	3
69	18:19	0:01	1
2			
10			
11			
20			
26			
34			
39			
45			
55			
58			
61			
65			
68			
	Average		4.5
	Variance		12.8
	Skew		0.9
	Kurtosis		-0.1
	Std Dev		3.6
	CV		0.8
	Min		0.0
	Max		14.0

67	18:18	0:03	3
70	18:20	0:02	2
69	18:23	0:03	3
2			
10			
11			
20			
26			
34			
39			
45			
55			
58			
61			
65			
68			
	Average		4.5
	Variance		8.8
	Skew		1.2
	Kurtosis		0.5
	Std Dev		3.0
	CV		0.7
	Min		0.0
	Max		13.0

	Station 1					Interview						Bag				Take Blood					Totals	
ID	In	Out	Time	Min	Def.	Int#	In	Out	Time	Min	Def.	In	Out	Time	Min	Bed#	In	Out	Time	Min	Served	In System
1	14:05	14:19	0:14	14		1	14:19	14:22	0:03	3		14:22	14:26	0:04	4	2	14:26	14:40	0:14	14	35	0:35
2	14:05	14:14	0:09	9	1																	
3	14:20	14:30	0:10	10		2	14:30	14:36	0:06	6		14:36	14:39	0:03	3	6	14:39	15:14	0:35	35	54	0:54
4	14:30	14:42	0:12	12		1	14:42	14:47	0:05	5		14:47	14:50	0:03	3	2	14:50	15:03	0:13	13	33	0:33
5	14:41	14:53	0:12	12		1	14:53	14:55	0:02	2		14:58	15:00	0:02	2	4	15:00	15:23	0:23	23	39	0:42
6	14:43	14:56	0:13	13		2	14:58	15:03	0:05	5		15:03	15:05	0:02	2	7	15:05	15:20	0:15	15	35	0:37
7	14:44	14:55	0:11	11		2	14:55	15:00	0:05	5		15:00	15:03	0:03	3	1	15:03	15:17	0:14	14	33	0:33
8	14:46	14:58	0:12	12		1	15:00	15:05	0:05	5		15:06	15:08	0:02	2	3	15:08	15:25	0:17	17	36	0:39
9	14:46	15:03	0:17	17		2	15:03	15:07	0:04	4		15:08	15:11	0:03	3	9	15:11	15:23	0:12	12	36	0:37
10	14:46	15:03	0:17	17		2	15:05	15:09	0:04	4	1											
11	14:47	15:09	0:22	22		2	15:10	15:14	0:04	4	1											
12	14:48	15:07	0:19	19		1	15:07	15:11	0:04	4		15:11	15:14	0:03	3	6	15:15	15:36	0:21	21	47	0:48
13	14:53	15:12	0:19	19		2	15:14	15:19	0:05	5		15:19	15:22	0:03	3	9	15:23	15:57	0:34	34	61	1:04
14	14:53	15:10	0:17	17		1	15:11	15:17	0:06	6		14:17	17:19	3:02	2	1	15:19	15:37	0:18	18	43	0:44
15	15:06	15:16	0:10	10		2	15:19	15:24	0:05	5		15:24	15:26	0:02	2	3	15:26	15:40	0:14	14	31	0:34
16	15:09	15:30	0:21	21		1	15:36	15:38	0:02	2		15:39	15:42	0:03	3	6	15:42	16:13	0:31	31	57	1:04
17	15:11	15:19	0:08	8		1	15:20	15:24	0:04	4		15:26	15:28	0:02	2	4	15:28	15:47	0:19	19	33	0:36
18	15:11	15:26	0:15	15		1	15:27	15:30	0:03	3		15:30	15:33	0:03	3	7	15:33	15:48	0:15	15	36	0:37
19	15:13	15:29	0:16	16		1	15:30	15:36	0:06	6		15:36	15:39	0:03	3	8	17:54	18:16	0:22	22	47	3:03
20	15:15	15:16	0:01	1	1																	
21	15:15	15:31	0:16	16		1	15:38	15:41	0:03	3		15:42	15:45	0:03	3	3	15:45	15:58	0:13	13	35	0:43
22	15:15	15:41	0:26	26		1	15:41	15:53	0:12	12		15:56	15:59	0:03	3	3	15:59	16:17	0:18	18	59	1:02
23	15:16	15:37	0:21	21		2	15:43	15:53	0:10	10		15:53	15:56	0:03	3	4	15:56	16:28	0:32	32	66	1:12
24	15:20	15:41	0:21	21		1	15:49	15:53	0:04	4		16:20	16:23	0:03	3	5	16:24	16:32	0:08	8	36	1:12
25	15:30	15:52	0:22	22		1	15:55	16:03	0:08	8		16:03	16:06	0:03	3	8	16:07	16:36	0:19	19	52	0:56
26	16:32	15:41	0:09	9		1	15:43	15:46	0:05	5	1											
29	15:33	15:50	0:17	17		2	15:54	16:00	0:06	6		16:00	16:02	0:02	2	5	16:02	16:19	0:17	17	42	0:46
30	15:33	15:56	0:23	23		1	16:03	16:06	0:03	3		16:09	16:13	0:04	4	6	16:14	16:35	0:21	21	51	1:02
32	15:38	15:55	0:17	17		2	16:00	16:04	0:04	4		16:06	16:08	0:02	2	1	16:08	16:40	0:32	32	55	1:02
33	15:39	15:57	0:18	18		2	16:04	16:07	0:03	3		16:13	16:16	0:03	3	7	16:16	16:32	0:16	16	40	0:53
34	15:40	15:59	0:19	19		1	16:06	16:11	0:05	5	1											
35	15:51	16:06	0:15	15		2	16:09	16:13	0:04	4		16:18	16:20	0:02	2	2	16:22	16:52	0:30	30	51	1:01
36	15:54	16:04	0:10	10		2	16:07	16:09	0:02	2		16:16	16:18	0:02	2	3	16:19	16:35	0:16	16	30	0:41
37	15:55	16:07	0:12	12		1	16:11	16:14	0:03	3		16:23	16:25	0:02	2	9	16:30	16:51	0:21	21	38	0:56
38	16:02	16:18	0:16	16		2	16:19	16:23	0:04	4		16:25	16:28	0:03	3	4	16:30	17:06	0:36	36	59	1:04
39	16:03	16:23	0:20	20		2	16:24	16:29	0:05	5	1											
40	16:07	16:20	0:13	13		1	16:20	16:26	0:06	6		16:28	16:32	0:04	4	4	16:34	16:59	0:25	25	48	0:52
41	16:24	16:32	0:08	8		2	16:32	16:36	0:04	4		16:36	16:39	0:03	3	7	16:41	16:56	0:15	15	30	0:32
42	16:24	16:33	0:09	9		1	16:34	16:40	0:06	6		16:40	16:43	0:03	3	6	16:43	17:01	0:18	18	36	0:37
43	16:32	16:42	0:10	10		2	16:42	16:48	0:06	6		16:48	16:51	0:03	3	1	16:51	17:12	0:21	21	40	0:40
44	16:44	16:49	0:05	5		2	16:52	16:56	0:04	4		16:56	16:59	0:03	3	3	16:59	17:26	0:27	27	39	0:42
45	16:35	16:48	0:13	13		1	16:49	16:55	0:06	6	1											
46	16:45	16:56	0:11	11		2	16:57	17:06	0:09	9		17:06	17:08	0:02	2	2	17:08	17:28	0:20	20	42	0:43
47	16:45	17:01	0:16	16		1	17:07	17:16	0:09	9		17:16	17:19	0:03	3	1	17:19	17:37	0:18	18	46	0:52
48	16:47	16:57	0:10	10		1	17:02	17:07	0:05	5		17:08	17:10	0:02	2	4	17:11	17:37	0:26	26	43	0:50
49	16:47	16:58	0:11	11		2	17:06	17:09	0:03	3		17:10	17:13	0:03	3	6	17:14	17:38	0:24	24	41	0:51
50	16:53	17:04	0:11	11		2	17:10	17:14	0:04	4		17:14	17:16	0:02	2	5	17:19	17:58	0:39	39	56	1:05
51	16:59	17:10	0:11	11		2	17:14	17:18	0:04	4		17:19	17:21	0:02	2	7	17:22	17:43	0:21	21	38	0:44
52	17:04	17:13	0:09	9		1	17:16	17:18	0:02	2		17:21	17:23	0:02	2	8	17:24	17:48	0:24	24	37	0:44
53	17:06	17:15	0:09	9		2	17:18	17:22	0:04	4		17:25	17:27	0:02	2	9	17:28	17:49	0:21	21	36	0:43
54	17:07	17:21	0:14	14		1	17:19	17:21	0:02	2		17:23	17:25	0:02	2	2	17:28	17:55	0:27	27	45	0:48
55	17:15	17:32	0:17	17		2	17:32	17:36	0:04	4	1											

	Station 1					Interview						Bag				Take Blood					Totals	
ID	In	Out	Time	Min	Def.	Int#	In	Out	Time	Min	Def.	In	Out	Time	Min	Bed#	In	Out	Time	Min	Served	In System
56	17:19	17:28	0:09	9		1	17:29	17:33	0:04	4		17:33	17:36	0:03	3	6	17:39	18:05	0:26	26	42	0:46
57	17:21	17:34	0:13	13		1	17:34	17:38	0:04	4		17:38	17:41	0:03	3	1	17:41	17:59	0:18	18	38	0:38
58	17:26	17:37	0:11	11		2	17:37	17:40	0:03	3	1											
59	17:26	17:43	0:17	17		2	17:43	17:46	0:03	3		17:46	17:49	0:03	3	7	17:53	18:11	0:18	18	41	0:45
60	17:29	17:39	0:10	10		2	17:40	17:43	0:03	3		17:43	17:46	0:03	3	4	17:47	18:17	0:30	30	46	0:48
61	17:28	17:49	0:21	21		2	17:54	17:58	0:04	4	1											
62	17:28	17:47	0:19	19		2	17:51	17:55	0:04	4		17:54	17:57	0:03	3	2	17:57	18:11	0:14	14	40	0:43
63	17:39	17:52	0:13	13		2	17:58	18:00	0:02	2		18:00	18:03	0:03	3	1	18:03	18:18	0:15	15	33	0:39
64	17:42	17:58	0:16	16		2	18:03	18:11	0:08	8		18:11	18:13	0:02	2	7	18:15	18:31	0:16	16	42	0:49
65	17:42	17:55	0:13	13		2	18:00	18:03	0:03	3	1											
66	17:47	18:01	0:14	14		1	18:09	18:12	0:03	3		18:13	18:15	0:02	2	6	18:16	18:37	0:21	21	40	0:50
67	17:48	18:04	0:16	16		2	18:11	18:15	0:04	4		18:15	18:18	0:03	3	9	18:20	18:39	0:19	19	42	0:51
68	17:55	18:06	0:11	11		1	18:12	18:15	0:03	3	1											
69	17:55	18:12	0:17	17		2	18:16	18:19	0:03	3		18:20	18:23	0:03	3	1	18:23	18:40	0:17	17	40	0:45
70	17:55	18:09	0:14	14		1	18:15	18:18	0:03	3		18:18	18:20	0:02	2	4	18:20	18:47	0:27	27	46	0:52
		Average		14.15				Average		4.48			Average		2.67			Average		21.17		
		Variance		21.98				Variance		3.88			Variance		0.34			Variance		47.58		
		Skew		0.08				Skew		1.59			Skew		0.20			Skew		0.72		
		Kurtosis		0.05				Kurtosis		3.27			Kurtosis		-0.61			Kurtosis		-0.07		
		Std Dev		4.69				Std Dev		1.97			Std Dev		0.58			Std Dev		6.90		
		CV		0.33				CV		0.44			CV		0.22			CV		0.33		
		Min		1.00				Min		2.00			Min		2.00			Min		8.00		
		Max		26.00				Max		12.00			Max		4.00			Max		39.00		
								1s	0	0			1s	0	0.00							
								2s	6	0.09			2s	21	0.39							
								3s	15	0.23			3s	30	0.56							
								4s	20	0.3			4s	3	0.06							
								5s	10	0.15			>4s	0	0.00							
								6s	8	0.12			54	54	1.00							
								7s	0	0												
								8s	2	0.03												
								9s	2	0.03												
								10s	1	0.02												
								11s	1	0.02												
								12s	1	0.02												
									66	1.000												
									66													
Data points not used																						
27	15:32	15:32	0:00																			
28	15:33	15:33	0:00																			
31	15:34	B	#VALUE!			2	15:53				1											

```
Specified Models and Their Parameters          Sample: Data From A_ARRST1.TXT
ëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëë
Model 1: Gamma Distribution
   Location Parameter              .15789       Quantile Estimate
   Scale Parameter                6.31422       M.L. Estimate
   Shape Parameter                 .53458       M.L. Estimate

Model 2: Weibull Distribution
   Location Parameter             0.            Default
   Scale Parameter                3.19219       M.L. Estimate
   Shape Parameter                 .82883       M.L. Estimate

Model 3: Weibull Distribution
   Location Parameter              .15789       Quantile Estimate
   Scale Parameter                2.61592       M.L. Estimate
   Shape Parameter                 .66020       M.L. Estimate

Model 4: Gamma Distribution
   Location Parameter             0.            Default
   Scale Parameter                4.64850       M.L. Estimate
   Shape Parameter                 .76010       M.L. Estimate


ëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëë
Screen 1/3 - Press F1-4 for help or another allowed key:     Logfile: Open, On

UniFit Manual Model Selection                  Sample: Data From A_ARRST1.TXT
ëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëë
Õáááááááááááááááááááááááááááááááááááá¢
°         Functional Groups (Phase) °
ûááááááááááááááááááááááááááááááááááááÇ
° Sample maintenance                °
° Descriptive sample summaries  (I) °
° Model specification          (II) °
° Goodness-of-fit assessment  (III) °
° Inferences about model and sample °
° Change to guided selection mode   °
° eXit manual selection mode        °
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F1-4 = Help, F8-10 = Logfile, ESC = Exit                     Logfile: Open, On
```

Model Moment Comparison — Sample: Data From A_ARRST1.TXT

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Model	Mean	Variance	Skewness	Kurtosis
Sample Values	3.53333	16.0410	1.43210	4.37573
1-Gamma (E)	3.53333	21.3133	2.73543	14.2238
2-Weibull	3.52972	18.3476	2.66245	14.2769
3-Weibull (E)	3.67161	30.2599	3.86722	28.6174
4-Gamma	3.53333	16.4247	2.29400	10.8937
5-Rand. Walk(E)	3.53333	21.1666	2.77606	14.5954
6-Random Walk	3.53333	18.5726	2.61623	13.3952
7-Lognormal	4.43168	129.208	24.5693	4339.30
8-Lognormal (E)	7.99936	3425.23	438.151	1.07136E+07
9-Inv. Gaussian	3.53333	56.1879	6.36441	70.5095
A-Exponential	3.53333	12.4844	2.00000	9.00000
B-Expo. (E)	3.53333	11.3936	2.00000	9.00000
C-In. Gaus. (E)	3.53333	225.057	13.3333	299.295

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Press F1-4 for help or ENTER to continue: Logfile: Not Open

Model Moment Comparison — Sample: Data From A_ARRST1.TXT

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Model	Mean	Variance	Skewness	Kurtosis
Sample Values	3.53333	16.0410	1.43210	4.37573
1-Gamma (E)	3.53333	21.3133	2.73543	14.2238
2-Weibull	3.52972	18.3476	2.66245	14.2769
3-Weibull (E)	3.67161	30.2599	3.86722	28.6174
4-Gamma	3.53333	16.4247	2.29400	10.8937
5-Rand. Walk(E)	3.53333	21.1666	2.77606	14.5954
6-Random Walk	3.53333	18.5726	2.61623	13.3952
7-Lognormal	4.43168	129.208	24.5693	4339.30
8-Lognormal (E)	7.99936	3425.23	438.151	1.07136E+07
9-Inv. Gaussian	3.53333	56.1879	6.36441	70.5095
A-Exponential	3.53333	12.4844	2.00000	9.00000
B-Expo. (E)	3.53333	11.3936	2.00000	9.00000
C-In. Gaus. (E)	3.53333	225.057	13.3333	299.295

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Press F1-4 for help or ENTER to continue: Logfile: Not Open

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Summary of Sample: Data From A_SVRST1.TXT
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Sample Characteristic        Value
áááááááááááááááááááááááá     ááááááááááááááá
Observation Type             Real Valued
Number of Observations          67
Minimum Observation              1.00000
Maximum Observation             26.0000
Mean                            14.1493
Median                          14.0000
Variance                        21.9774
Skewness                          .07682
```

Guided Selection Model Rankings For Sample: Data From A_SVRST1.TXT

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R ge of Random Variable

During the fitting process UniFit considers distributions having any reasonable range (not just the specified range), provided they produce values in the specified range at least 99.99% of the time.

Specified random variable range   At least 0.

Relative Evaluation of Candidate Models

Models	Relative Score (0-100)	Random Variable Range (if different from that specified)
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1-Weibull	95.0	
2-Weibull (E)	92.5	At least .05882
3-Extreme Value Type B	85.0	Unrestricted
4-Gamma	82.5	
5-Log-logistic	81.3	

In addition, 16 other models were considered having scores from .0 to 81.3.

Current Primary Model

1-Weibull

solute Evaluation of the Primary Model

Based on a heuristic evaluation, there is no current evidence for not using the primary model. If you are doing simulation, then the primary model wil probably provide a good representation for your data. However, we recommend further confirmation of the primary model. Press F3 for more information.

Additional Information About the Primary Model

Result of an Anderson-Darling goodness-of-fit test at level 0.1   Do not reject

"Error" in the model mean relative to the sample mean   .05582 = .39%

Model Moment Comparisons With Sample: Data From A_SVRST1.TXT

Model	Mean	Variance	Skewness	Kurtosis
Sample Values	14.1493	21.9774	.07682	2.87434
1-Weibull	14.0934	22.4297	.08521	2.71145
2-Weibull (E)	14.0909	22.4513	.09018	2.71189
3-Ext. Value B	14.5305	35.5956	1.13955	5.40000
4-Gamma	14.1493	28.9137	.76006	3.86654
5-Log-logistic	14.6845	15.4080	2.76657	40.6371
6-Log-logis.(E)	14.6925	15.6614	2.80616	42.5799
7-Gamma (E)	14.1493	29.1362	.76616	3.88051
8-Log-Laplace	15.3953	70.4480	13.5037	Does Not Exist
9-Log-Lap. (E)	15.4101	71.5865	14.4007	Does Not Exist
A-Lognormal	14.5498	47.8327	1.53343	7.45283
B-Lognormal (E)	14.5696	48.9761	1.55903	7.61150
C-Random Walk	14.1493	54.5156	1.43581	6.32929
D-Rand. Walk(E)	14.1493	56.3534	1.46102	6.44350
E-Inv. Gaussian	14.1493	57.3606	1.60581	7.29772
F-Pearson 6	15.5893	132.546	5.87716	Does Not Exist
G-In. Gaus. (E)	14.1493	59.5196	1.64258	7.49679
H-Pearson 6 (E)	15.6816	142.769	6.59030	Does Not Exist
I-Pearson 5	16.5942	285.262	Does Not Exist	Does Not Exist
J-Pearson 5 (E)	16.8266	339.170	Does Not Exist	Does Not Exist
K-Expo. (E)	14.1493	198.540	2.00000	9.00000
L-Exponential	14.1493	200.201	2.00000	9.00000

Models Available For Sample: Data From A_SVRST1.TXT
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Model 1: Weibull Distribution

Location Parameter	0.	Default
Scale Parameter	15.7177	M.L. Estimate
Shape Parameter	3.27388	M.L. Estimate

Model 2: Weibull Distribution

Location Parameter	.05882	Quantile Estimate
Scale Parameter	15.6535	M.L. Estimate
Shape Parameter	3.25628	M.L. Estimate

Model 3: Extreme Value Type B Distribution

Location Parameter	11.8454	M.L. Estimate
Scale Parameter	4.65183	M.L. Estimate

Model 4: Gamma Distribution

Location Parameter	0.	Default
Scale Parameter	2.04348	M.L. Estimate
Shape Parameter	6.92411	M.L. Estimate

Model 5: Log-logistic Distribution

Location Parameter	0.	Default
Scale Parameter	13.6332	M.L. Estimate
Shape Parameter	4.74092	M.L. Estimate

Model 6: Log-logistic Distribution

Location Parameter	.05882	Quantile Estimate
Scale Parameter	13.5722	M.L. Estimate
Shape Parameter	4.70930	M.L. Estimate

Model 7: Gamma Distribution

Location Parameter	.05882	Quantile Estimate
Scale Parameter	2.06780	M.L. Estimate
Shape Parameter	6.81422	M.L. Estimate

Model 8: Log-Laplace Distribution

Location Parameter	0.	Default
Scale Parameter	14.0000	M.L. Estimate
Shape Parameter	3.32170	M.L. Estimate

Model 9: Log-Laplace Distribution

Location Parameter	.05882	Quantile Estimate
Scale Parameter	13.9412	M.L. Estimate
Shape Parameter	3.29945	M.L. Estimate

Model A: Lognormal Distribution

Location Parameter	0.	Default
Scale Parameter	2.57572	M.L. Estimate
Shape Parameter	.45135	M.L. Estimate

Model B: Lognormal Distribution

Location Parameter	.05882	Quantile Estimate
Scale Parameter	2.57033	M.L. Estimate
Shape Parameter	.45730	M.L. Estimate

Model C: Random Walk Distribution

Location Parameter	0.	Default

Scale Parameter	.09092	M.L. Estimate
Shape Parameter	.31735	M.L. Estimate
Model D: Random Walk Distribution		
Location Parameter	.05882	Quantile Estimate
Scale Parameter	.09225	M.L. Estimate
Shape Parameter	.30771	M.L. Estimate
Model E: Inverse Gaussian Distribution		
Location Parameter	0.	Default
Scale Parameter	14.1493	M.L. Estimate
Shape Parameter	49.3841	M.L. Estimate
Model F: Pearson Type 6 Distribution		
Location Parameter	0.	Default
Scale Parameter	1.00000	Default
Shape 1 Parameter	46.0063	M.L. Estimate
Shape 2 Parameter	3.95115	M.L. Estimate
Model G: Inverse Gaussian Distribution		
Location Parameter	.05882	Quantile Estimate
Scale Parameter	14.0904	M.L. Estimate
Shape Parameter	47.0016	M.L. Estimate
Model H: Pearson Type 6 Distribution		
Location Parameter	.05882	Quantile Estimate
Scale Parameter	1.00000	Default
Shape 1 Parameter	44.0406	M.L. Estimate
Shape 2 Parameter	3.81899	M.L. Estimate
[Mo]del I: Pearson Type 5 Distribution		
Location Parameter	0.	Default
Scale Parameter	32.6130	M.L. Estimate
Shape Parameter	2.96532	M.L. Estimate
Model J: Pearson Type 5 Distribution		
Location Parameter	.05882	Quantile Estimate
Scale Parameter	30.6675	M.L. Estimate
Shape Parameter	2.82896	M.L. Estimate
Model K: Exponential Distribution		
Location Parameter	.05882	Quantile Estimate
Scale Parameter	14.0904	M.L. Estimate
Model L: Exponential Distribution		
Location Parameter	0.	Default
Scale Parameter	14.1493	M.L. Estimate

Summary of Sample: Data From A_SVRINT.TXT
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Sample Characteristic	Value
Observation Type	Real Valued
Number of Observations	65
Minimum Observation	2.00000
Maximum Observation	12.0000
Mean	4.47692
Median	4.00000
Variance	3.87837
Skewness	1.52038

Guided Selection Model Rankings For Sample: Data From A_SVRINT.TXT
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P ıge of Random Variable

During the fitting process UniFit considers distributions having any reasonable range (not just the specified range), provided they produce values in the specified range at least 99.99% of the time.

Specified random variable range At least 0.

Relative Evaluation of Candidate Models

Models	Relative Score (0-100)	Random Variable Range (if different from that specified)
1-Pearson Type 6	80.6	
2-Log-logistic	77.8	
3-Pearson Type 5	69.4	
4-Lognormal	68.1	
5-Log-Laplace	68.1	

In addition, 14 other models were considered having scores from .0 to 66.7.

Current Primary Model

1-Pearson Type 6

ɔsolute Evaluation of the Primary Model

Based on a heuristic evaluation, we recommend being cautious about using the primary model. If you are doing simulation, then this model may or may not provide an adequate representation for your data. We strongly recommend further confirmation of the primary model. Press F3 for more information.

Additional Information About the Primary Model

Result of an Anderson-Darling goodness-of-fit test at level 0.1	Not applicable
"Error" in the model mean relative to the sample mean	.00313 = .07%

Model Moment Comparisons With Sample: Data From A_SVRINT.TXT
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Model	Mean	Variance	Skewness	Kurtosis
Sample Values	4.47692	3.87837	1.52038	5.74908
1-Pearson 6	4.47380	3.80285	1.87556	10.8166
2-Log-logistic	4.43541	1.67977	3.09177	60.8163
3-Weibull (E)	4.47017	3.83547	1.28600	5.18220
4-Pearson 5	4.48849	4.21873	2.31523	16.0992
5-Inv. Gaussian	4.47692	3.40973	1.23738	5.55183
*6-Lognormal	4.46870	3.44911	1.31857	6.24283
7-Log-Laplace	4.37252	5.15222	10.5353	Does Not Exist
8-Gamma (E)	4.47692	4.36009	1.60503	6.86418
9-Random Walk	4.47692	3.33766	1.15928	5.19403
A-Ext. Value B	4.43230	3.03947	1.13955	5.40000
B-Johnson SB	4.45366	Can Not Compute	Can Not Compute	Can Not Compute
C-Inv. Weibull	4.82686	16.1781	Does Not Exist	Does Not Exist
D-Expo. (E)	4.47692	6.77000	2.00000	9.00000
E-Gamma	4.47692	3.18301	.79702	3.95286
F-Rand. Walk(E)	4.47692	7.64405	2.41509	11.9611
G-Lognormal (E)	4.95612	17.6025	6.60992	134.307
H-In. Gaus. (E)	4.47692	14.0194	4.31710	34.0622
I-Weibull	4.48357	3.99428	.41049	2.91202
J-Exponential	4.47692	20.0428	2.00000	9.00000

Models Available For Sample: Data From A_SVRINT.TXT
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M del 1: Pearson Type 6 Distribution

Location Parameter	0.	Default
Scale Parameter	1.00000	Default
Shape 1 Parameter	33.2831	M.L. Estimate
Shape 2 Parameter	8.43956	M.L. Estimate

Model 2: Log-logistic Distribution

Location Parameter	0.	Default
Scale Parameter	4.08519	M.L. Estimate
Shape Parameter	4.50918	M.L. Estimate

Model 3: Weibull Distribution

Location Parameter	1.87500	Quantile Estimate
Scale Parameter	2.82580	M.L. Estimate
Shape Parameter	1.33869	M.L. Estimate

Model 4: Pearson Type 5 Distribution

Location Parameter	0.	Default
Scale Parameter	25.9233	M.L. Estimate
Shape Parameter	6.77550	M.L. Estimate

Model 5: Inverse Gaussian Distribution

Location Parameter	0.	Default
Scale Parameter	4.47692	M.L. Estimate
Shape Parameter	26.3159	M.L. Estimate

del 6: Lognormal Distribution

Location Parameter	0.	Default
Scale Parameter	1.41743	M.L. Estimate
Shape Parameter	.39916	M.L. Estimate

Model 7: Log-Laplace Distribution

Location Parameter	0.	Default
Scale Parameter	4.00000	M.L. Estimate
Shape Parameter	3.42604	M.L. Estimate

Model 8: Gamma Distribution

Location Parameter	1.87500	Quantile Estimate
Scale Parameter	1.67572	M.L. Estimate
Shape Parameter	1.55272	M.L. Estimate

Model 9: Random Walk Distribution

Location Parameter	0.	Default
Scale Parameter	.26137	M.L. Estimate
Shape Parameter	1.53635	M.L. Estimate

Model A: Extreme Value Type B Distribution

Location Parameter	3.64767	M.L. Estimate
Scale Parameter	1.35933	M.L. Estimate

Model B: Johnson SB Distribution

Lower Endpoint Parameter	1.08579	Quantile Estimate
Upper Endpoint Parameter	47.6248	Quantile Estimate
Shape 1 Parameter	3.81165	Quantile Estimate
Shape 2 Parameter	1.37684	Quantile Estimate

Model C: Inverted Weibull Distribution

Location Parameter	0.	Default
Scale Parameter	3.40047	M.L. Estimate
Shape Parameter	2.71978	M.L. Estimate

Model D: Exponential Distribution

Location Parameter	1.87500	Quantile Estimate
Scale Parameter	2.60192	M.L. Estimate

Model E: Gamma Distribution

Location Parameter	0.	Default
Scale Parameter	.71098	M.L. Estimate
Shape Parameter	6.29682	M.L. Estimate

Model F: Random Walk Distribution

Location Parameter	1.87500	Quantile Estimate
Scale Parameter	1.18021	M.L. Estimate
Shape Parameter	.56993	M.L. Estimate

Model G: Lognormal Distribution

Location Parameter	1.87500	Quantile Estimate
Scale Parameter	.60090	M.L. Estimate
Shape Parameter	1.02411	M.L. Estimate

Model H: Inverse Gaussian Distribution

Location Parameter	1.87500	Quantile Estimate
Scale Parameter	2.60192	M.L. Estimate
Shape Parameter	1.25647	M.L. Estimate

Model I: Weibull Distribution

Location Parameter	0.	Default
Scale Parameter	5.05816	M.L. Estimate
Shape Parameter	2.38848	M.L. Estimate

Model J: Exponential Distribution

Location Parameter	0.	Default
Scale Parameter	4.47692	M.L. Estimate

Summary of Sample: Data From A_SVRBAG.TXT
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Sample Characteristic	Value
Observation Type	Real Valued
Number of Observations	54
Minimum Observation	2.00000
Maximum Observation	4.00000
Mean	2.66667
Median	3.00000
Variance	.33962
Skewness	.18713

Guided Selection Model Rankings For Sample: Data From A_SVRBAG.TXT
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R-nge of Random Variable

During the fitting process UniFit considers distributions having any reasonable range (not just the specified range), provided they produce values in the specified range at least 99.99% of the time.

Specified random variable range   At least 0.

Relative Evaluation of Candidate Models

Models	Relative Score (0-100)	Random Variable Range (if different from that specified)
1-Gamma	69.2	
2-Random Walk	67.3	
3-Lognormal	63.5	
4-Normal	63.5	Unrestricted
5-Inverse Gaussian	61.5	

In addition, 9 other models were considered having scores from 9.6 to 59.6.

Current Primary Model

1-Gamma

A olute Evaluation of the Primary Model

Based on a heuristic evaluation, we do not recommend using the primary mode... If you are doing simulation, then you should use an empirical distribution rather than the primary model (unless you can show that it is good). Press F3 for more information.

Additional Information About the Primary Model

Result of an Anderson-Darling goodness-of-fit test at level 0.1   Reject

"Error" in the model mean relative to the sample mean   0.

Model Moment Comparisons With Sample: Data From A_SVRBAG.TXT

Model	Mean	Variance	Skewness	Kurtosis
Sample Values	2.66667	.33962	.18713	2.24771
1-Gamma	2.66667	.33746	.43569	3.28473
2-Random Walk	2.66667	.35039	.65505	3.71052
3-Lognormal	2.66872	.36042	.68626	3.84890
4-Normal	2.66667	.33962	0.	3.00000
5-Inv. Gaussian	2.66667	.35117	.66667	3.74074
6-Weibull	2.66394	.36672	-.25986	2.88660
7-Pearson 6	2.66849	.36475	.81217	4.27083
8-Pearson 5	2.66983	.38010	.97572	4.87144
9-Log-logistic	2.71521	.14508	1.36014	9.45007
A-Ext. Value B	2.67177	.41190	1.13955	5.40000
B-Inv. Weibull	2.70853	.70778	3.48848	46.0233
C-Pareto (E)	2.72139	1.15584	79.2119	Does Not Exist
D-Exponential	2.66667	7.11111	2.00000	9.00000
E-Log-Laplace	3.09329	.66622	2.35109	24.5857

Models Available For Sample: Data From A_SVRBAG.TXT
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Model 1: Gamma Distribution

Location Parameter	0.	Default
Scale Parameter	.12655	M.L. Estimate
Shape Parameter	21.0723	M.L. Estimate

Model 2: Random Walk Distribution

Location Parameter	0.	Default
Scale Parameter	.39352	M.L. Estimate
Shape Parameter	7.96875	M.L. Estimate

Model 3: Lognormal Distribution

Location Parameter	0.	Default
Scale Parameter	.95691	M.L. Estimate
Shape Parameter	.22219	M.L. Estimate

Model 4: Normal Distribution

Location Parameter	2.66667	M.L. Estimate
Scale Parameter	.58277	M.L. Estimate

Model 5: Inverse Gaussian Distribution

Location Parameter	0.	Default
Scale Parameter	2.66667	M.L. Estimate
Shape Parameter	54.0000	M.L. Estimate

Model 6: Weibull Distribution

Location Parameter	0.	Default
Scale Parameter	2.89997	M.L. Estimate
Shape Parameter	5.04168	M.L. Estimate

Model 7: Pearson Type 6 Distribution

Location Parameter	0.	Default
Scale Parameter	1.00000	Default
Shape 1 Parameter	74.2866	M.L. Estimate
Shape 2 Parameter	28.8384	M.L. Estimate

Model 8: Pearson Type 5 Distribution

Location Parameter	0.	Default
Scale Parameter	52.7365	M.L. Estimate
Shape Parameter	20.7528	M.L. Estimate

Model 9: Log-logistic Distribution

Location Parameter	0.	Default
Scale Parameter	2.63378	M.L. Estimate
Shape Parameter	7.37275	M.L. Estimate

Model A: Extreme Value Type B Distribution

Location Parameter	2.38293	M.L. Estimate
Scale Parameter	.50040	M.L. Estimate

Model B: Inverted Weibull Distribution

Location Parameter	0.	Default
Scale Parameter	2.33041	M.L. Estimate
Shape Parameter	5.04440	M.L. Estimate

Model C: Pareto Distribution

Location Parameter	1.99016	Quantile Estimate

Scale Parameter	3.72167	M.L. Estimate

Model D: Exponential Distribution

Location Parameter	0.	Default
Scale Parameter	2.66667	M.L. Estimate

Model E: Log-Laplace Distribution

Location Parameter	0.	Default
Scale Parameter	3.00000	M.L. Estimate
Shape Parameter	5.75827	M.L. Estimate

Summary of Sample: Data From A_SVRBLD.TXT
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S~mple Characteristic	Value
Observation Type	Real Valued
Number of Observations	53
Minimum Observation	8.00000
Maximum Observation	39.0000
Mean	21.1698
Median	19.0000
Variance	48.4898
Skewness	.67436

Guided Selection Model Rankings For Sample: Data From A_SVRBLD.TXT
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Range of Random Variable

During the fitting process UniFit considers distributions having any reasonable range (not just the specified range), provided they produce values in the specified range at least 99.99% of the time.

Specified random variable range   At least 0.

Relative Evaluation of Candidate Models

Models	Relative Score (0-100)	Random Variable Range (if different from that specified)
1-Pearson Type 5	90.8	
2-Extreme Value Type B	85.5	Unrestricted
3-Log-logistic (E)	81.6	At least 7.30435
4-Inverse Gaussian	78.9	
5-Gamma (E)	78.9	At least 7.30435

In addition, 15 other models were considered having scores from .0 to 72.4.

Current Primary Model

1-Pearson Type 5

Absolute Evaluation of the Primary Model

Based on a heuristic evaluation, there is no current evidence for not using the primary model. If you are doing simulation, then the primary model will probably provide a good representation for your data. However, we recommend further confirmation of the primary model. Press F3 for more information.

Additional Information About the Primary Model

Result of an Anderson-Darling goodness-of-fit test at level 0.1   Do not reject

"Error" in the model mean relative to the sample mean   -.09635 = .46%

Model Moment Comparisons With Sample: Data From A_SVRBLD.TXT

Model	Mean	Variance	Skewness	Kurtosis
Sample Values	21.1698	48.4898	.67436	2.67380
1-Pearson 5	21.2662	58.7141	1.65629	8.88870
2-Ext. Value B	21.1766	50.5320	1.13955	5.40000
3-Log-logis.(E)	21.9312	93.3360	18.5554	Does Not Exist
4-Inv. Gaussian	21.1698	49.2338	.99434	4.64786
5-Gamma (E)	21.1698	54.0641	1.06060	4.68730
6-Lognormal	21.1984	50.4161	1.04243	4.99251
7-Random Walk	21.1698	48.7515	.95440	4.49704
8-Log-logistic	21.1600	21.4014	2.18730	21.4920
9-Inv. Weibull	23.1135	242.262	300.015	Does Not Exist
A-Gamma	21.1698	45.6677	.63844	3.61140
B-Weibull (E)	21.1669	47.7828	.56253	3.12454
C-Lognormal (E)	21.7908	97.6036	2.36312	14.3367
D-Log-Lap. (E)	21.8184	402.009	Does Not Exist	Does Not Exist
E-Log-Laplace	20.3890	80.5110	5.99271	Does Not Exist
F-Weibull	21.1752	51.2203	.09111	2.71198
G-Rand. Walk(E)	21.1698	96.0148	1.82952	8.30719
H-Pearson 6 (E)	24.0084	701.517	Does Not Exist	Does Not Exist
I-In. Gaus. (E)	21.1698	110.837	2.27787	11.6478
J-Expo. (E)	21.1698	192.251	2.00000	9.00000
K-Exponential	21.1698	448.161	2.00000	9.00000

Models Available For Sample: Data From A_SVRBLD.TXT
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Model 1: Pearson Type 5 Distribution

Location Parameter	0.	Default
Scale Parameter	185.070	M.L. Estimate
Shape Parameter	9.70256	M.L. Estimate

Model 2: Extreme Value Type B Distribution

Location Parameter	17.9774	M.L. Estimate
Scale Parameter	5.54254	M.L. Estimate

Model 3: Log-logistic Distribution

Location Parameter	7.30435	Quantile Estimate
Scale Parameter	12.3696	M.L. Estimate
Shape Parameter	3.18633	M.L. Estimate

Model 4: Inverse Gaussian Distribution

Location Parameter	0.	Default
Scale Parameter	21.1698	M.L. Estimate
Shape Parameter	192.702	M.L. Estimate

Model 5: Gamma Distribution

Location Parameter	7.30435	Quantile Estimate
Scale Parameter	3.89919	M.L. Estimate
Shape Parameter	3.55599	M.L. Estimate

Model 6: Lognormal Distribution

Location Parameter	0.	Default
Scale Parameter	3.00076	M.L. Estimate
Shape Parameter	.32609	M.L. Estimate

Model 7: Random Walk Distribution

Location Parameter	0.	Default
Scale Parameter	.05243	M.L. Estimate
Shape Parameter	.47722	M.L. Estimate

Model 8: Log-logistic Distribution

Location Parameter	0.	Default
Scale Parameter	19.9696	M.L. Estimate
Shape Parameter	5.36120	M.L. Estimate

Model 9: Inverted Weibull Distribution

Location Parameter	0.	Default
Scale Parameter	17.1013	M.L. Estimate
Shape Parameter	3.01295	M.L. Estimate

Model A: Gamma Distribution

Location Parameter	0.	Default
Scale Parameter	2.15721	M.L. Estimate
Shape Parameter	9.81351	M.L. Estimate

Model B: Weibull Distribution

Location Parameter	7.30435	Quantile Estimate
Scale Parameter	15.6520	M.L. Estimate
Shape Parameter	2.10771	M.L. Estimate

Model C: Lognormal Distribution

Location Parameter	7.30435	Quantile Estimate

Scale Parameter	2.48225	M.L. Estimate
Shape Parameter	.61800	M.L. Estimate
Model D: Log-Laplace Distribution		
Location Parameter	7.30435	Quantile Estimate
Scale Parameter	11.6957	M.L. Estimate
Shape Parameter	2.26931	M.L. Estimate
Model E: Log-Laplace Distribution		
Location Parameter	0.	Default
Scale Parameter	19.0000	M.L. Estimate
Shape Parameter	3.83127	M.L. Estimate
Model F: Weibull Distribution		
Location Parameter	0.	Default
Scale Parameter	23.6232	M.L. Estimate
Shape Parameter	3.25299	M.L. Estimate
Model G: Random Walk Distribution		
Location Parameter	7.30435	Quantile Estimate
Scale Parameter	.11370	M.L. Estimate
Shape Parameter	.19722	M.L. Estimate
Model H: Pearson Type 6 Distribution		
Location Parameter	7.30435	Quantile Estimate
Scale Parameter	1.00000	Default
Shape 1 Parameter	23.7458	M.L. Estimate
Shape 2 Parameter	2.42156	M.L. Estimate
Model I: Inverse Gaussian Distribution		
Location Parameter	7.30435	Quantile Estimate
Scale Parameter	13.8655	M.L. Estimate
Shape Parameter	24.0501	M.L. Estimate
Model J: Exponential Distribution		
Location Parameter	7.30435	Quantile Estimate
Scale Parameter	13.8655	M.L. Estimate
Model K: Exponential Distribution		
Location Parameter	0.	Default
Scale Parameter	21.1698	M.L. Estimate

#	Year	Month	Day	Place	Forcast	Drawn	Defered	Total Arrivals
1	1994	1	3	NNMC	20	14	2	16
2	1994	1	4	NNMC	20	13	3	16
3	1994	1	5	NNMC	20	18	2	20
4	1994	1	6	VA Med.	35	35	10	45
5	1994	1	7	USCG	40	49	5	54
6	1994	1	11	Bupers	35	39	1	40
7	1994	1	12	NFEC	40	33	5	38
8	1994	1	13	USUHS	30	19	3	22
9	1994	1	14	USCG HQ	30	32	6	38
10	1994	1	19	NMRI	20	8	0	8
11	1994	1	21	WNY	35	15	1	16
12	1994	1	24	USNA	25	35	3	38
13	1994	1	25	ONI	40	36	6	42
14	1994	1	26	OSIA	45	47	8	55
15	1994	1	27	NRC	35	32	3	35
16	1994	2	1	USNA	40	55	18	73
17	1994	2	2	ONI	50	48	4	52
18	1994	2	4	NSS	40	41	5	46
19	1994	2	7	USNA	40	57	5	62
20	1994	2	8	Bupers	35	27	5	32
21	1994	2	10	Dahlgrin	45	53	2	55
22	1994	2	15	USNA	40	30	6	36
23	1994	2	16	Camp Dav	50	57	3	60
24	1994	2	17	Pent	30	25	4	29
25	1994	2	18	NRL (civ)	65	63	9	72
26	1994	2	22	NRL (mil)	35	31	3	34
27	1994	2	23	NIS	35	18	11	29
28	1994	2	24	NSHS	30	20	4	24
29	1994	2	25	Pax Run	65	71	9	80
30	1994	2	28	BUMED	20	17	1	18
31	1994	3	1	USNA	30	26	6	32
32	1994	3	3	Pent	20	29	4	33
33	1994	3	4	PWBETH	20	11	1	12
34	1994	3	7	Nav Obs	30	20	2	22
35	1994	3	8	G Military	20	16	3	19
36	1994	3	9	Bupers	30	40	5	45
37	1994	3	10	Philly	100	125	16	141
38	1994	3	11	NEOS	4	36	0	36
39	1994	3	14	Dior	4	56	5	61
40	1994	3	15	USNA	35	19	2	21
41	1994	3	17	Pent	30	20	0	20
42	1994	3	18	WNY	35	23	5	28
43	1994	3	21	USNA	35	27	5	32
44	1994	3	22	NNMC	30	35	10	45
45	1994	3	24	NRC	30	28	6	34
46	1994	3	29	USNA	35	30	0	30
47	1994	4	1	USCG	25	21	0	21
48	1994	4	4	USNA	25	13	1	14
49	1994	4	5	ONI	35	26	5	31
50	1994	4	7	VA Med	35	50	4	54

#	Year	Month	Day	Place	Forcast	Drawn	Defered	Total Arrivals
51	1994	4	8	USCG	30	27	2	29
52	1994	4	12	Bupers	30	23	5	28
53	1994	4	13	ONI	35	20	5	25
54	1994	4	14	Dahlgrin	35	44	3	47
55	1994	4	15	NS Station	30	27	4	31
56	1994	4	17	USNA	25	19	1	20
57	1994	4	18	NRL (mil)	20	12	2	14
58	1994	4	21	Pent	20	14	0	14
59	1994	4	22	Pax Run	35	51	4	55
60	1994	4	25	OSIA	40	32	4	36
61	1994	4	26	USNA	20	42	2	44
62	1994	4	28	MSC	20	18	0	18
63	1994	4	29	NRL	50	60	0	60
64	1994	5	2	USNA	25	19	1	20
65	1994	5	3	NNMC	30	21	4	25
66	1994	5	5	NIS	35	36	4	40
67	1994	5	9	Navy Band	25	31	1	32
68	1994	5	10	Bupers	30	35	7	42
69	1994	5	11	NSHS	30	33	4	37
70	1994	5	12	Quantico	30	36	6	42
71	1994	5	14	Rescue U	50	31	4	35
72	1994	5	15	Rescue U	50	35	4	39
73	1994	5	18	Ft. Meade	35	23	0	23
74	1994	5	19	Pent	20	21	2	23
75	1994	5	20	WNY	25	36	0	36
76	1994	5	23	NS Ann	20	20	5	25
77	1994	5	24	Camp Dav	40	27	3	30
78	1994	5	25	Quantico	35	25	9	34
79	1994	5	26	NRC	30	22	2	24
80	1994	5	31	NS Ficility	20	7	1	8
81	1994	6	1	AF	30	20	1	21
82	1994	6	2	Pent	30	21	3	24
83	1994	6	3	NS Station	40	30	10	40
84	1994	6	6	Quantico	40	43	4	47
85	1994	6	9	Dahlgrin	40	38	4	42
86	1994	6	10	NS Station	40	60	7	67
87	1994	6	14	Bupers	25	15	4	19
88	1994	6	16	Pent	20	14	1	15
89	1994	6	17	Pax Run	40	38	7	45
90	1994	6	20	Nav Obs	20	26	4	30
91	1994	6	21	NRL (mil)	21	17	5	22
92	1994	6	22	NNMC	30	61	20	81
93	1994	6	23	Office	35	43	8	51
94	1994	6	24	NRL	50	56	3	59
95	1994	6	27	NCG	20	13	1	14
96	1994	6	28	NNMC	20	27	5	32
97	1994	6	30	AIMD	40	78	14	92
98	1994	7	1	Quantico	30	4	0	4
99	1994	7	5	Quantico	30	36	4	40
100	1994	7	7	Philly	100	115	10	125

#	Year	Month	Day	Place	Forcast	Drawn	Defered	Total Arrivals
101	1994	7	8	USCG	30	30	4	34
102	1994	7	11	SIA	40	54	10	64
103	1994	7	12	Bupers	35	50	7	57
104	1994	7	14	VA Med	40	38	4	42
105	1994	7	15	WNY	30	26	3	29
106	1994	7	18	USUHS	30	30	1	31
107	1994	7	19	USCG	30	25	2	27
108	1994	7	21	Pent	30	20	3	23
109	1994	7	22	OSIA	40	56	5	61
110	1994	7	25	NSA	30	17	3	20
111	1994	7	26	NNMC	30	20	7	27
112	1994	7	28	NRC	30	25	1	26
113	1994	7	29	NEOS	35	35	0	35
114	1994	8	1	NSHS	30	20	1	21
115	1994	8	2	NASP	30	23	2	25
116	1994	8	4	NIS	30	25	7	32
117	1994	8	5	NS Station	40	41	4	45
118	1994	8	9	Bupers	35	32	2	34
119	1994	8	11	NSWC	40	56	2	58
120	1994	8	12	NAF	20	2	2	4
121	1994	8	15	D. Taylor	20	17	1	18
122	1994	8	16	Quantico	30	29	1	30
123	1994	8	18	Pent	20	21	2	23
124	1994	8	19	NRL	50	44	7	51
125	1994	8	22	NRL (mil)	25	19	1	20
126	1994	8	23	NSGA	35	36	3	39
127	1994	8	25	Bupers	20	23	1	24
128	1994	8	26	Pax Run	45	28	4	32
129	1994	8	29	NC	30	20	5	25
130	1994	8	30	NSNA	40	39	6	45
131	1994	9	1	PNSY	100	110	11	121
134	1994	9	2	NMRC	20	6	0	26
135	1994	9	6	USNA	40	32	6	38
136	1994	9	8	Navy Band	30	21	3	24
137	1994	9	9	WNY	30	20	2	22
138	1994	9	12	USNA	40	9	2	11
139	1994	9	13	DIA	30	28	3	31
140	1994	9	14	Bupers	30	31	4	35
141	1994	9	15	Pent	20	21	0	21
142	1994	9	19	NNMC	40	44	6	50
143	1994	9	20	ONI	30	33	2	35
144	1994	9	22	NRC	25	13	3	16
145	1994	9	23	Quantico	35	25	5	30
146	1994	9	26	NSA	20	17	4	21
147	1994	9	27	USNA	40	68	9	77
148	1994	9	29	ONI	35	42	4	46
149	1994	9	30	NS Station	35	23	1	24
150	1994	10	3	MSC	25	27	4	31
151	1994	10	4	USNA	40	44	7	51
152	1994	10	6	NNMC	25	30	11	41

#	Year	Month	Day	Place	Forcast	Drawn	Defered	Total Arrivals
153	1994	10	5	USCG	30	36	1	37
154	1994	10	11	Bupers	25	9	3	12
155	1994	10	12	Quantico	45	71	10	81
156	1994	10	13	Dahlgrin	40	24	5	29
157	1994	10	14	USCG	30	45	6	51
158	1994	10	17	USNA	40	20	4	24
159	1994	10	19	NRL (mil)	20	17	4	21
160	1994	10	20	GW NROTC	40	44	7	51
161	1994	10	21	NRL	50	45	5	50
162	1994	10	24	NCG	25	32	7	39
163	1994	10	25	USNA	40	28	3	31
164	1994	10	27	OSIA	30	36	6	42
165	1994	10	28	AMID	50	31	3	34
166	1994	10	31	VA Med	40	35	6	41
167	1994	11	1	NEOD	40	40	12	52
168	1994	11	3	NIS	30	33	5	38
169	1994	11	4	WNY	25	30	4	34
170	1994	11	7	USNA	40	22	2	24
171	1994	11	8	DIA	40	39	6	45
172	1994	11	9	Camp Dav	50	56	7	63
173	1994	11	14	Marine Bks	40	25	6	31
174	1994	11	15	USNA	40	31	2	33
175	1994	11	16	Bupers	35	33	9	42
176	1994	11	17	Pent	20	23	2	25
177	1994	11	18	Pax Run	40	39	5	44
178	1994	11	21	USNA	40	32	1	33
179	1994	11	22	NSA Ann	25	15	3	18
180	1994	11	23	NNMC	30	24	8	32
181	1994	11	29	USNA	40	45	4	49
182	1994	11	30	USNA	40	28	4	32
183	1994	12	1	SS Kenned	100	85	10	95
184	1994	12	2	NSA	25	24	9	33
185	1994	12	6	ONI	40	24	7	31
186	1994	12	7	NRC	30	29	4	33
187	1994	12	8	NSWC	50	34	5	39
188	1994	12	12	NMRI	25	15	6	21
189	1994	12	13	Bupers	35	41	4	45
190	1994	12	14	ONI	40	28	9	37
191	1994	12	15	Pent	20	20	1	21
192	1994	12	16	NRL	50	43	5	48
193	1994	12	19	BUMED	25	36	3	39
194	1994	12	20	NRL (mil)	25	18	2	20
195	1994	12	21	NSS	40	15	3	18
196	1994	12	22	NNMC	20	34	6	40
197	1994	12	23	NNMC	20	24	4	28
198	1994	12	27	NNMC	20	13	2	15
199	1994	12	28	NNMC	20	14	1	15
200	1994	12	29	NNMC	20	12	8	20
201	1994	12	30	NNMC	20	7	1	8
202	1995	1	3	NNMC	20	5	0	5

#	Year	Month	Day	Place	Forcast	Drawn	Defered	Total Arrivals
203	1995	1	4	NNMC	20	15	4	19
204	1995	1	5	USCG	30	26	6	32
205	1995	1	6	NNMC	20	10	0	10
206	1995	1	9	Dla	40	32	7	39
207	1995	1	10	Bupers	40	33	6	39
208	1995	1	12	NIS	35	27	3	30
209	1995	1	13	WNY	35	30	7	37
210	1995	1	17	USNG	40	37	5	42
211	1995	1	18	USCG	30	20	1	21
212	1995	1	19	Pent	20	29	1	30
213	1995	1	20	Pax Run	40	21	2	23
214	1995	1	23	USNA	40	38	4	42
215	1995	1	24	USUHS	30	21	4	25
216	1995	1	26	Bupers	20	10	0	10
217	1995	1	27	AIMD	40	22	1	23
218	1995	1	30	NCG	27	8	4	12
219	1995	1	31	USNA	40	55	4	59
220	1995	2	2	PNSY	100	39	7	46
221	1995	2	3	GW NROTC	40	37	6	43
222	1995	2	6	USNA	60	56	9	65
223	1995	2	7	Bupers	30	20	3	23
224	1995	2	9	Dahlgrin	45	44	4	48
225	1995	2	10	Ft. Meade	20	19	2	21
226	1995	2	14	Camp Dav	45	33	4	37
227	1995	2	15	ONI	40	25	4	29
228	1995	2	16	Pent	20	12	0	12
229	1995	2	17	NRL	50	50	3	53
230	1995	2	21	USNA	40	85	8	93
231	1995	2	22	NRC	25	5	1	6
232	1995	2	24	NSS	35	31	2	33
233	1995	2	27	USNA	60	58	6	64
234	1995	3	2	USNA	40	45	3	48
235	1995	3	2	NNMC	40	40	7	47
236	1995	3	3	NEOD	45	66	6	72
237	1995	3	6	Dla	45	30	6	36
238	1995	3	7	Marine Bks	40	41	12	53
239	1995	3	9	Pent	50	45	8	53
240	1995	3	10	WNY	100	35	2	37
241	1995	3	13	USNa	70	18	1	19
242	1995	3	14	Bupers	35	18	2	20
243	1995	3	16	Pent	25	18	2	20
244	1995	3	17	W Grove	125	105	10	115
245	1995	3	20	OSIA	50	46	7	53
246	1995	3	21	NSS	30	9	1	10
247	1995	3	23	G Military	20	12	2	14
248	1995	3	27	BUMED	30	24	3	27
249	1995	3	28	USNA	70	253	22	275
250	1995	3	30	VA Med	40	36	9	45
251	1995	3	31	AIMD	35	25	1	26
252	1995	4	4	USNA	70	67	13	80

#	Year	Month	Day	Place	Forcast	Drawn	Defered	Total Arrivals
253	1995	4	6	USCG	50	13	4	17
254	1995	4	7	NSA	35	13	1	14
255	1995	4	10	USUHS	30	13	0	13
256	1995	4	11	Bupers	30	20	1	21
257	1995	4	13	Dahlgrin	50	42	5	47
258	1995	4	14	NRL	75	44	8	52
259	1995	4	17	USNA	70	19	4	23
260	1995	4	18	ONI	50	30	3	33
261	1995	4	19	USCG	30	30	2	32
262	1995	4	20	Pent	30	19	1	20
263	1995	4	24	Pax Run	50	16	0	16
264	1995	4	25	USNA	70	45	11	56
265	1995	4	27	ONI	50	29	1	30
266	1995	4	28	NSS	30	21	1	22
267	1995	5	1	DIA	40	24	2	26
268	1995	5	5	NNMC	50	49	14	63
269	1995	5	8	Bupers	35	31	3	34
270	1995	5	9	Camp Dav	50	38	0	38
271	1995	5	10	WNY	50	51	9	60
272	1995	5	12	Sugar Grove	130	17	12	29
273	1995	5	15	NSHS	30	33	3	36
274	1995	5	16	Nav Rescue	30	20	4	24
275	1995	5	17	Ft. Meade	40	18	0	18
276	1995	5	18	Pent	20	10	1	11
277	1995	5	22	Nav Obs	25	15	4	19
278	1995	5	23	NRL (mil)	30	17	3	20
279	1995	5	25	VA Med	40	27	4	31
280	1995	5	26	Pax Run	50	39	4	43
281	1995	5	30	Quantico	40	38	13	51
282	1995	5	31	NNMC	20	15	2	17
283	1995	6	1	NNMC	35	29	2	31
284	1995	6	2	AIMD	40	30	5	35
285	1995	6	5	Quantico	40	8	3	11
286	1995	6	6	Quantico	40	26	4	30
287	1995	6	8	Dahlgrin	40	37	5	42
288	1995	6	9	W Grove	85	62	10	72
289	1995	6	12	Pax Run	40	39	5	44
290	1995	6	13	Bupers	35	31	5	36
291	1995	6	15	Pent	20	24	3	27
292	1995	6	16	NRL	50	55	6	61
293	1995	6	19	NCG	20	16	1	17
294	1995	6	20	ONI	40	23	6	29
295	1995	6	22	NEOD	50	51	8	59
296	1995	6	23	WRAMC	50	24	5	29
297	1995	6	26	DIA	40	24	5	29
298	1995	6	27	NSS	30	18	2	20
299	1995	6	29	ONI	40	18	5	23
300	1995	6	30	Pax Run	40	14	1	15
301	1995	7	3	NNMC	35	20	2	22
302	1995	7	5	NFEC	30	12	3	15

#	Year	Month	Day	Place	Forcast	Drawn	Defered	Total Arrivals
303	1995	7	6	NFC	30	14	4	18
304	1995	7	7	USCG	30	17	0	17
305	1995	7	10	WNY	45	29	4	33
306	1995	7	11	Bupers	40	28	4	32
307	1995	7	14	OSIA	45	36	1	37
308	1995	7	17	BUMED	30	6	3	9
309	1995	7	19	USCG	40	18	1	19
310	1995	7	20	Pent	20	23	3	26
311	1995	7	21	Quantico	50	19	5	24
312	1995	7	24	SS Kenned	75	72	9	81
313	1995	7	25	USUHS	30	39	3	42
314	1995	7	27	VA Med	40	20	9	29
315	1995	7	28	Pax Run	45	26	1	27
316	1995	7	31	Dental	30	12	1	13
317	1995	8	1	USNA	35	38	9	47
318	1995	8	2	AIMD	40	34	3	37
319	1995	8	4	NSA	50	29	3	32
320	1995	8	7	Bupers	30	30	6	36
321	1995	8	8	Camp Dav	50	30	1	31
322	1995	8	10	Dahlgrin	40	24	2	26
323	1995	8	11	Ft. Meade	35	50	8	58
324	1995	8	14	Pax Run	40	22	12	34
325	1995	8	15	NSHA	30	34	5	39
326	1995	8	17	Pent	20	23	4	27
327	1995	8	18	NRL	50	34	1	35
328	1995	8	21	Navy Yard	20	13	2	15
329	1995	8	22	NRL (mil)	20	23	3	26
330	1995	8	24	AFRRI	30	6	1	7
331	1995	8	25	W Grove	100	40	0	40
332	1995	8	28	Quantico	35	19	3	22
333	1995	8	29	USNA	40	57	12	69
334	1995	8	31	NRC	25	41	6	47
335	1995	9	1	Pax Run	40	44	10	54
336	1995	9	5	USNA	40	76	6	82
337	1995	9	6	NNMC	40	39	9	48
338	1995	9	7	Pent	30	21	3	24
339	1995	9	8	NMRI	20	21	1	22
340	1995	9	1	Bupers	35	22	1	23
341	1995	9	12	USNA	40	12	6	18
342	1995	9	13	WNY	40	37	2	39
343	1995	9	15	NSS	35	5	1	6
344	1995	9	18	BUMED	30	17	4	21
345	1995	9	19	NNMC	30	32	5	37
346	1995	9	21	Pent	20	14	3	17
347	1995	9	22	NECD	45	51	3	54
348	1995	9	25	Quantico	40	40	0	40
349	1995	9	26	USNA	40	49	10	59
350	1995	9	28	ONI	50	31	6	37
351	1995	9	29	Pax Run	40	87	16	103
352	1995	10	2	Quantico	35	33	8	41

#	Year	Month	Day	Place	Forcast	Drawn	Defered	Total Arrivals
353	1995	10	3	USNA	40	28	6	34
354	1995	10	5	USCG	30	18	0	18
355	1995	10	6	VA Med	30	22	8	30
356	1995	10	10	AIMD	35	42	4	46
357	1995	10	11	Bupers	35	26	0	26
358	1995	10	12	Dahlgrin	40	16	4	20
359	1995	10	13	NRL	55	49	7	56
360	1995	10	16	DIA	40	22	7	29
361	1995	10	17	USNA	40	40	8	48
362	1995	10	18	Pent	20	8	1	9
363	1995	10	20	W Groves	85	38	5	43
364	1995	10	24	USNA	40	35	3	38
365	1995	10	25	USCG	30	38	4	42
366	1995	10	26	NR Comm	35	22	3	25
367	1995	10	27	NNMC	40	31	4	35
368	1995	10	30	NCG	30	14	2	16
369	1995	10	31	OSIA	40	45	12	57
370	1995	11	2	NMRI	20	9	4	13
371	1995	11	3	GW NROTC	40	30	12	42
372	1995	11	6	Bupers	35	26	3	29
373	1995	11	7	USNA	50	32	11	43
374	1995	11	9	WNY	40	18	1	19
375	1995	11	13	Quantico	45	12	0	12
376	1995	11	16	Pent	20	14	3	17
377	1995	11	17	Pax Run	40	33	12	45
378	1995	11	20	USNA	50	54	12	66
379	1995	11	21	NRL (mil)	35	23	1	24
380	1995	11	22	NSHS	30	28	3	31
381	1995	11	27	USNA	50	46	9	55
382	1995	11	28	USNA	50	113	3	116
383	1995	11	29	USNA	50	150	24	174
384	1995	12	4	Quantico		17		
385	1995	12	5	ONI		31		
386	1995	12	6	VA Med		18		
387	1995	12	7	Pent		14		
388	1995	12	11	DIA		14		
389	1995	12	14	Dahlgrin		21		
390	1995	12	15	NRL		30		
391	1995	12	18	Nav Obs		18		
392	1995	12	19	BUMED		1		
393	1995	12	21	Pent		19		
394	1995	12	22	NNMC		13		
395	1995	12	26	NNMC		12		
396	1995	12	27	NNMC		6		
397	1995	12	28	NNMC		25		
398	1995	12	29	NNMC		10		
399	1996	1	2	NNMC	20	11	2	13
400	1996	1	3	NNMC	20	5	2	7
401	1996	1	4	NNMC	20	18	3	21
402	1996	1	17	USCG	25	38	7	45

#	Year	Month	Day	Place	Forcast	Drawn	Defered	Total Arrivals
403	1996	1	18	Pax Run	40	24	0	24
404	1996	1	19	USUHS	25	26	14	40
405	1996	1	22	Quantico	40	25	2	27
406	1996	1	23	USNA	40	79	16	95
407	1996	1	25	Pent	20	25	7	32
408	1996	1	26	NSA	30	30	13	43
409	1996	1	29	DIA	30	28	7	35
410	1996	1	30	USNA	40	76	6	82
411	1996	1	31	Marine Bks	40	44	15	59
412	1996	2	5	VA Med	35	13	4	17
413	1996	2	6	USNA	40	86	0	86
414	1996	2	8	Dahlgrin	40	24	2	26
415	1996	2	9	Quantico	45	52	4	56
416	1996	2	12	Bupers	40	43	11	54
417	1996	2	15	Pax Run	50	14	4	18
418	1996	2	16	GW NROTC	40	26	9	35
419	1996	2	20	NEOD	45	25	4	29
420	1996	2	21	NRL	40	21	1	22
421	1996	2	22	Pent	20	17	1	18
422	1996	2	23	ONI	50	46	7	53
423	1996	2	27	USNA	40	55	12	67
424	1996	2	28	NRC	30	27	3	30
425	1996	2	29	NRL (mil)	35	14	4	18
#	Year	Month	Day		Forcast	Drawn	Defered	Total Arrivals
					15001	13343	1859	14973
				AVE	36.76716	32.70343	4.556373	36.6985294
				STD	15.41266	21.60519	3.724117	24.138112

BASIC & NON PARAMETRIC TESTS FOR DIFFERENCE IN 1994 & 1995
(test about the mean & median)

```
Worksheet size: 3500 cells

MTB > Retrieve  'C:\JENNIFER\DIFFER.MTW'.
Retrieving worksheet from file: C:\JENNIFER\DIFFER.MTW
Worksheet was saved on  5/12/1996
    > nsco c3 c4
MTB > erase c4
MTB > let c4 = c2-c3
MTB > nsco c4 c14
MTB > plot c14 c4

* ERROR * Graph type is not allowed for this command.

MTB > STest 0.0 '94-95';
SUBC>   Alternative 0.
```

DIFFERENCE TESTS

```
SIGN TEST OF MEDIAN = 0.00000 VERSUS  N.E.  0.00000

              N  BELOW  EQUAL  ABOVE   P-VALUE     MEDIAN
94-95        12      5      0      7    0.7744      31.50
MTB > WTest 0.0 '94-95';
SUBC>   Alternative 0.

TEST OF MEDIAN = 0.000000 VERSUS MEDIAN N.E. 0.000000

                N FOR   WILCOXON              ESTIMATED
            N    TEST  STATISTIC  P-VALUE        MEDIAN
94-95      12      12       48.0    0.505         19.25
MTB > TTest 0.0 '94-95';
SUBC>   Alternative 0.

TEST OF MU =  0.0 VS MU N.E.  0.0

            N       MEAN     STDEV   SE MEAN        T     P VALUE
94-95      12       19.1     149.5      43.1     0.44        0.67

MTB > dotplot c1 c2;
SUBC> same.

                                      .
          .           . :.:...  .:::. :.:.                  .
     -+---------+---------+---------+---------+---------+-----Sums

                        .  . . .: :  : ..
     -+---------+---------+---------+---------+---------+-----1994
    240       360       480       600       720       840

MTB > Mann-Whitney 95.0 '1994' '1995';
SUBC>   Alternative 0.
```

2-SAMPLE TESTS

```
Mann-Whitney Confidence Interval and Test

1994        N =  12     Median =        528.5
1995        N =  12     Median =        520.5
Point estimate for ETA1-ETA2 is          27.0
95.4 Percent C.I. for ETA1-ETA2 is (-48.0,101.0)
  = 164.0
Test of ETA1 = ETA2  vs.  ETA1 ~= ETA2 is significant at 0.4357

Cannot reject at alpha = 0.05
```

```
MTB > Mann-Whitney 95.0 '1994' '1995';
SUBC>   Alternative 1.

Mann-Whitney Confidence Interval and Test

1994        N =  12     Median =        528.5
1995        N =  12     Median =        520.5
Point estimate for ETA1-ETA2 is          27.0
95.4 Percent C.I. for ETA1-ETA2 is (-48.0,101.0)
W = 164.0
Test of ETA1 = ETA2  vs.  ETA1 > ETA2 is significant at 0.2179

Cannot reject at alpha = 0.05

MTB > TwoSample 95.0 '1994' '1995';
SUBC>   Alternative 0.

TWOSAMPLE T FOR 1994 VS 1995
       N       MEAN      STDEV   SE MEAN
1994  12      528.3       58.2        17
1995  12        509        148        43

95 PCT CI FOR MU 1994 - MU 1995: ( -80,  118)

TTEST MU 1994 = MU 1995 (VS NE): T= 0.41  P=0.68  DF=  14

MTB >
```

```
MTB > read 'jen94.dat' c101 c102
Entering data from file: jen94.dat
     12 rows read.
MTB > read 'jen95.dat' c103 c104
Entering data from file: jen95.dat
     12 rows read.
MTB > print c101-c104


 ROW   C101   C102   C103   C104

   1      1    425     13    439
   2      2    613     14    514
   3      3    541     15    866
   4      4    499     16    421
   5      5    458     17    442
   6      6    600     18    529
   7      7    581     19    391
   8      8    475     20    547
   9      9    543     21    598
  10     10    574     22    527
  11     11    515     23    588
  12     12    516     24    249

MTB > let c1 = c102
MTB > let c2 = c104
MTB > let c3 = c2 - c1
MTB > name c1 '1994' c2 '1995' c3 '95 - 94'
MTB > dotplot c3


   .     .       . : .  . .   .:                    .
-----+---------+---------+---------+---------+---------+-95 - 94
   -240      -120         0       120       240       360

MTB > name c4 'n score'
MTB > nsco c3 c4

MTB > plot c4 c3

  n score -
          -                                                      *
          -
       1.2+                                 *
          -
          -                                 *
          -                                *
          -                            *
       0.0+                       *  *
          -                     *
          -                     *
          -                   *
          -
      -1.2+           *
          -
          -     *
          -
            ------+---------+---------+---------+---------+---------+95 - 94
               -240      -120         0       120       240       360

MTB > let k90 = 3
MTB > execute 'symplote'
Executing from file: symplote.MTB

          -                                                    *
          -
```

```
MTB > read 'jen94.dat' c101 c102
Entering data from file: jen94.dat
     12 rows read.
MTB > read 'jen95.dat' c103 c104
Entering data from file: jen95.dat
     12 rows read.
MTB > print c101-c104


 ROW   C101   C102   C103   C104

   1      1    425     13    439
   2      2    613     14    514
   3      3    541     15    866
   4      4    499     16    421
   5      5    458     17    442
   6      6    600     18    529
   7      7    581     19    391
   8      8    475     20    547
   9      9    543     21    598
  10     10    574     22    527
  11     11    515     23    588
  12     12    516     24    249

MTB > let c1 = c102
MTB > let c2 = c104
MTB > let c3 = c2 - c1
MTB > name c1 '1994' c2 '1995' c3 '95 - 94'
MTB > dotplot c3


          .     .      . : .  . .   .:             .
      -----+---------+---------+---------+---------+---------+-95 - 94
         -240      -120        0       120       240       360

MTB > name c4 'n score'
MTB > nsco c3 c4

MTB > plot c4 c3

  n score -                                                  *
          -
          -
      1.2+                             *
          -
          -                            *
          -                           *
          -                       *
      0.0+                   *  *
          -                 *
          -                 *
          -               *
          -
     -1.2+        *
          -
          -   *
          -
            ------+---------+---------+---------+---------+---------+95 - 94
               -240      -120         0       120       240       360

MTB > let k90 = 3
MTB > execute 'symplote'
Executing from file: symplote.MTB

          -                                                *
          -
```

```
     210+
        -
C94     -
        -
        -                *
     140+
        -
        -
        -
        -
      70+                *
        -
        -           *    *
        -
        -  *
          +---------+---------+---------+---------+---------+------C95
          0        70       140       210       280       350

MTB > end
MTB >
MTB > execute 'skku'
Executing from file: skku.MTB
MTB > print k95 k96

skewness 0.705876
kurtosis 1.92659
MTB > end
MTB > ttest 0.0 c3

TEST OF MU =   0.0 VS MU N.E.   0.0

               N      MEAN     STDEV   SE MEAN        T     P VALUE
95 - 94       12     -19.1     149.5      43.1    -0.44        0.67

MTB > stest 0.0 c3

SIGN TEST OF MEDIAN = 0.00000 VERSUS  N.E.  0.00000

                 N  BELOW  EQUAL  ABOVE   P-VALUE      MEDIAN
95 - 94         12      7      0      5    0.7744      -31.50
MTB > wtest 0.0 c3

TEST OF MEDIAN = 0.000000 VERSUS MEDIAN N.E. 0.000000

                   N FOR  WILCOXON              ESTIMATED
              N    TEST  STATISTIC   P-VALUE      MEDIAN
95 - 94      12      12       30.0     0.505      -19.25
MTB > let k91 = 0.0
MTB > execute 'johnson'
Executing from file: johnson.MTB
MTB > print k105

K105      -0.395013
MTB > cdf k105 k1;
SUBC> t 11.

MTB > let k1 = 2*k1
MTB > name k1 'p-value'
MTB > print k1

p-value   0.700390
MTB > dotplot c1 c2;
SUBC> same.
```

```
                         .   .  . .: :   : ..
        -+---------+---------+---------+---------+---------+------1994

          .            . . :      .: .   ..                      .
        -+---------+---------+---------+---------+---------+------1995
       240       360       480       600       720       840

MTB > nsco c1 c4
MTB > plot c4 c1

 n score -
         -                                                            *
         -
     1.2+                                                        *
         -
         -                                                    *
         -                                                  *
         -                                       *
     0.0+                          *             *
         -                         *
         -                     *
         -              *
         -
    -1.2+          *
         -
         -  *
         -
          +---------+---------+---------+---------+---------+------1994
         420       455       490       525       560       595

MTB > let k90 = 1
MTB > execute 'symplote'
Executing from file: symplote.MTB

 C94     -
         -                                                       *
         -
     90+
         -
         -
         -                                                *
         -
     60+
         -
         -                                   *
         -
         -
     30+                              *
         -
         -
         -     * *
          ------+---------+---------+---------+---------+---------+C95
               15        30        45        60        75        90

MTB > end
MTB >
MTB > execute 'skku'
Executing from file: skku.MTB
MTB > print k95 k96

skewness -0.227973
kurtosis -0.764211
MTB > end
MTB > nsco c2 c4
MTB > plot c4 c2
```

```
  n score -                                                            *
          -
          -
      1.2+                              *
          -
          -                            *
          -                         *
          -                       *
      0.0+                       **
          -                *
          -                *
          -              *
          -
     -1.2+             *
          -
          -    *
          -
           --+---------+---------+---------+---------+---------+----1995
            240       360       480       600       720       840

MTB > let k90 = 2
MTB > execute 'symplote'
Executing from file: symplote.MTB

          -
      300+
          -                                                   *
  C94     -
          -
          -
      200+
          -
          -
          -
          -             *
      100+             *
          -  *  *
          -
          -
          -
        0+   *
          +---------+---------+---------+---------+---------+------C95
          0        70       140       210       280       350

MTB > end
MTB >
MTB > execute 'skku'
Executing from file: skku.MTB
MTB > print k95 k96

skewness 0.868077
kurtosis 2.83897
MTB > end
MTB > twos c1 c2

TWOSAMPLE T FOR 1994 VS 1995
       N      MEAN     STDEV   SE MEAN
1994  12     528.3      58.2      16.8
1995  12       509       148      42.9

95 PCT CI FOR MU 1994 - MU 1995: ( -79.66,  117.8)

TTEST MU 1994 = MU 1995 (VS NE): T= 0.41  P=0.68  DF=  14
```

```
MTB > twos c1 c2;
SUBC> same.
* ERROR * Subcommand not found in dictionary.
        * Subcommand ignored.
SUBC> pooled.

TWOSAMPLE T FOR 1994 VS 1995
       N      MEAN      STDEV   SE MEAN
1994  12     528.3       58.2      16.8
1995  12       509        148      42.9

95 PCT CI FOR MU 1994 - MU 1995: ( -76.40,  114.6)

TTEST MU 1994 = MU 1995 (VS NE): T= 0.41  P=0.68  DF=  22

POOLED STDEV =        113

MTB > mann c1 c2

Mann-Whitney Confidence Interval and Test

1994        N =  12     Median =        528.5
1995        N =  12     Median =        520.5
Point estimate for ETA1-ETA2 is          27.0
95.4 pct c.i. for ETA1-ETA2 is (-48.0,101.0)
W = 164.0
Test of ETA1 = ETA2  vs.  ETA1 n.e. ETA2 is significant at 0.4357

Cannot reject at alpha = 0.05

MTB > describe c1 c2

                  N     MEAN   MEDIAN   TRMEAN    STDEV   SEMEAN
1994             12    528.3    528.5    530.2     58.2     16.8
1995             12    509.3    520.5    499.6    148.5     42.9

                MIN      MAX       Q1       Q3
1994          425.0    613.0    481.0    579.2
1995          249.0    866.0    425.5    577.7


MTB > sort c1 c11
MTB > sort c2 c12
MTB > name c11 'sort 94' c12 'sort 95'
MTB > print c11 c12


 ROW  sort 94  sort 95

   1      425      249
   2      458      391
   3      475      421
   4      499      439
   5      515      442
   6      516      514
   7      541      527
   8      543      529
   9      574      547
  10      581      588
  11      600      598
  12      613      866

MTB > rank c1 c21
MTB > rank c2 c22.
MTB > name c21 'rank 94' c22 'rank 95'
```

```
MTB > print c21 c22


 ROW  rank 94  rank 95

   1        1        4
   2       12        6
   3        7       12
   4        4        3
   5        2        5
   6       11        8
   7       10        2
   8        3        9
   9        8       11
  10        9        7
  11        5       10
  12        6        1

MTB > save 'jenny'
Saving worksheet in file: jenny.MTW
MTB > stop
*** Minitab Release 9.1 *** Minitab Inc. ***
Worksheet size: 5310509 cells
```

Runs Test on Correlation of 12-Monthly Data

Autocorrelation (Lag =24)

... reject H_0 ∴ our sequence generated ...

		C1	C2		
		Sum(All)	ACF1		
1		252	-0.065728		
2	1 −	173	-0.124466	−	r_1
3	2 +	311	-0.188667	−	
4	3 −	302	0.197515	+	r_2
5	4 +	378	-0.166030	−	r_3
6	5 −	163	-0.068282	+	r_4
7	6 +	251	-0.066126	+	
8	7 −	248	0.035185	+	
9	8 +	277	0.036203	+	
10	9 −	181	-0.007813	−	r_5
11	10 +	227	0.095876	+	r_6
12	+	373	0.075071	−	r_7
13	−	353	-0.027471	−	
14	11 −	228	0.021972	+	r_8
15	−	216	-0.061436	−	r_9
16	12 +	259	0.150433	+	r_{10}
17	+	278	0.075086	−	r_{11}
18	13 −	265	-0.050343	−	
19	14 +	286	-0.264036	−	
20	+	288	-0.008851	+	r_{12}
21	15 −	276	-0.026086	−	r_{13}
22	−	239	-0.042193	−	
23	16 +	300	0.096705	+	r_{14}
24	17 −	216	-0.024776	−	r_{15}
25	−	178			
26	18 +	261			
27	+	273			
28	19 −	241			
29	20 +	338			
30	+	528			
31	21 −	212			
32	−	209			
33	22 +	243			
34	23 −	199			
35	24 +	286			
36	25 −	243			
37	−	156			
38	26 +	235			
39	+	291			
40	27 −	256			
41	28 +	277			
42	+	321			
43	29 −	234			
44	30 +	293			
45	31 −	127			
46	32 +	461			
47	−	145			
48	33 −	104			
49	−	34			
50	34 +	395			
51	35 −	232			
52	−	231			

H_0: Sequence is generated by random process
H_1: " " by process containing either persistence or frequent changes in direction

2 RUNS TESTS –
① on correlation
② on actual data

RUNS based on 'up/down' trends

CORRELATION — 2 sided test

$R = 15$

H_0: expected R (sequence comes from iid)
H_1: small values of R or large values of R

$$E(R) = \frac{2(24)-1}{3} = 15.667$$

$$\sigma^2(R) = \frac{16(24)-29}{90} = 3.944$$

$$\sigma = 1.986$$

$$z^* = \frac{15 - 15.667}{1.986} = -.3359$$

$n = 24$

$|Z| \geq z_{\alpha/2}$

at $\alpha = .05$ $\quad z_{.025} = -1.96$

$-1.96 \leq .3359 \leq 1.96$

runs based on just on pos./neg. correlation

$R = 13. \quad E(R) = \frac{2(15)(9)}{24} + 1 = 12.25$

min ...

$$\sigma_V^2 = \frac{2(15)(9)[2(15)(9) - 15 - 9]}{(24)^2(23)} = 5.011$$

p-value $= 2\left(1 - \Phi\left(\frac{12.5 - 12.25}{\ldots}\right)\right)$
$= 2(1 - \Phi(.11)) = .9124$

$$\frac{2\binom{14}{6}\binom{8}{5} + \binom{14}{5}\binom{8}{6}}{\binom{24}{9}} = \frac{2(3003)(56) + 2002(28)}{1307504} = .171$$

```
The observed no. of runs =  27
The expected no. of runs =  26.8462
24 Observations above K   28 below
        The test is significant at  0.9654
        Cannot reject at alpha = 0.05
```

$E(R) = \frac{2n-1}{3} = 34.3$ $\sigma^2(R) = 2.987$

```
Jorksheet size: 3500 cells

ITB > Name c2 = 'ACF1'
ITB > ACF 24 'Sum(All)' 'ACF1'.

ACF of Sum(All)

             -1.0 -0.8 -0.6 -0.4 -0.2  0.0  0.2  0.4  0.6  0.8  1.0
               +----+----+----+----+----+----+----+----+----+----+
  1  -0.066                           XXX
  2  -0.124                          XXXX
  3  -0.189                        XXXXXX
  4   0.198                             XXXXXX
  5  -0.166                         XXXXX
  6  -0.068                           XXX
  7  -0.066                           XXX
  8   0.035                             XX
  9   0.036                             XX
 10  -0.008                            X
 11   0.096                             XXX
 12   0.075                             XXX
 13  -0.027                            XX
 14   0.022                             XX
 15  -0.061                           XXX
 16   0.150                             XXXXX
 17   0.075                             XXX
 18  -0.050                            XX
 19  -0.264                      XXXXXXXX
 20  -0.009                            X
 21  -0.026                            XX
 22  -0.042                            XX
 23   0.097                             XXX
 24  -0.025                            XX

ITB >
```

ARMA MODEL / TREND ANALYSIS

Final Estimates of Parameters

Type		Estimate	St. Dev.	t-ratio
AR	1	0.8449	0.1026	8.23
MA	1	1.0052	0.0572	17.58
' nstant		40.0585	0.3521	113.78
..an		258.225	2.270	

No. of obs.: 52
Residuals: SS = 319593 (backforecasts excluded)
MS = 6522 DF = 49

Modified Box-Pierce (Ljung-Box) chisquare statistic

Lag	12	24	36	48
Chisquare	6.8(DF=10)	17.5(DF=22)	25.7(DF=34)	52.0(DF=46)

Forecasts from period 52

Period	Forecast	95 Percent Limits Lower	Upper	Actual
53	283.250	124.927	441.573	
54	279.368	119.023	439.712	
55	276.088	114.316	437.860	
56	273.317	110.533	436.100	
57	270.976	107.474	434.477	

MARCH - 562.618 ⇒ Actually 460 (Canceled trip - 100+ anticipated)
APRIL - 549.325 ⇒ N/A
MAY - 537.976 N/A

AUTOCORRELATION

```
         -1.0 -0.8 -0.6 -0.4 -0.2  0.0  0.2  0.4  0.6  0.8  1.0
            +----+----+----+----+----+----+----+----+----+----+
 1  -0.066                         XXX
 2  -0.124                        XXXX
 3  -0.189                      XXXXXX
 4   0.198                           XXXXXX
 5  -0.166                       XXXXX
 6  -0.068                         XXX
 7  -0.066                         XXX
 8   0.035                           XX
 9   0.036                           XX
10  -0.008                           X
11   0.096                           XXX
12   0.075                           XXX
13  -0.027                          XX
14   0.022                           XX
15  -0.061                         XXX
16   0.150                           XXXXX
17   0.075                           XXX
18  -0.050                          XX
19  -0.264                    XXXXXXXX
20  -0.009                           X
21  -0.026                          XX
22  -0.042                          XX
23   0.097                           XXX
24  -0.025                          XX
```

PACF of Bi-Mont.

PARTIAL AUTOCORRELATION

```
          -1.0 -0.8 -0.6 -0.4 -0.2  0.0  0.2  0.4  0.6  0.8  1.0
            +----+----+----+----+----+----+----+----+----+----+
   1 -0.066                        XXX
   2 -0.129                       XXXX
   3 -0.211                     XXXXXX
   4  0.157                          XXXXX
   5 -0.208                     XXXXXX
   6 -0.091                        XXX
   7 -0.064                        XXX
   8 -0.114                       XXXX
   9  0.049                          XX
  10 -0.060                        XXX
  11  0.094                          XXX
  12  0.091                          XXX
  13 -0.044                         XX
  14  0.129                          XXXX
  15 -0.084                        XXX
  16  0.213                          XXXXXX
  17  0.193                          XXXXXX
  18 -0.039                         XX
  19 -0.097                        XXX
  20 -0.114                       XXXX
  21 -0.115                       XXXX
  22 -0.116                       XXXX
  23  0.110                          XXXX
  24 -0.135                       XXXX
```

```
MTB > retrieve 'jen.mtw'
* ERROR * File not found: jen.mtw

MTB > retrieve 'jenreg.mtw'
Retrieving worksheet from file: jenreg.mtw
Worksheet was saved on  5/12/1996
MTB > rreg c2 1 c1

The regression equation is
sum = 531 - 1.19 month
```

from least squares

```
                  Coefficient            St. dev. of coef.
Predictor        Rank     Least-sq        Rank     Least-sq
Constant        530.66     545.32        39.88       47.25
month           -1.190     -2.122         2.791       3.307
```

from nonparametric rank regression

```
Hodges-Lehmann estimate of tau = 94.65      Least-squares S = 112.1
```

(Given the heaviness of the tails of the standardized residuals (from least squares output), I'd trust the nonparametric reg. more. But neither method gives a coefficient that is significantly different from 0.)

```
MTB > describe c2

                 N      MEAN    MEDIAN    TRMEAN     STDEV    SEMEAN
sum             24     518.8     521.5     515.3     110.7      22.6

               MIN       MAX        Q1        Q3
sum          249.0     866.0     446.0     579.2

MTB > nsco c2 c6
MTB > plot c6 c2

n score -
        -                                                       *
        -
     1.5+                                  *
        -                                 *
        -                                **
        -                             * 2
        -                           *2
     0.0+                          **
        -                         *2
        -                    ** *
        -                  * *
        -                  *
    -1.5+                *
        -
        -    *
        -
          --+---------+---------+---------+---------+---------+----sum
           240       360       480       600       720       840

MTB > corr c1 c2

Correlation of month and sum = -0.136

MTB > stop
*** Minitab Release 9.1 *** Minitab Inc. ***
Worksheet size: 5310509 cells
```

?

ALL DATA - W/O JAN-FEB 16)

```
MTB > ARIMA 1 0 2 'Bi-Mont.';
SUBC>   Constant;
SUBC>   Forecast 6 .
```

Estimates at each iteration

Iteration	SSE	Parameters			
0	274153	0.100	0.100	0.100	233.546
1	270133	0.228	0.250	0.121	200.604
2	265353	0.356	0.400	0.137	167.568
3	258902	0.480	0.550	0.148	135.619
4	249802	0.589	0.700	0.159	107.506
5	239225	0.538	0.756	0.200	121.469
6	235085	0.442	0.747	0.199	146.993
7	234581	0.389	0.698	0.248	160.853
8	234482	0.345	0.647	0.297	172.461
9	234469	0.341	0.643	0.298	173.643
10	234461	0.344	0.646	0.296	172.852

Unable to reduce sum of squares any further

Final Estimates of Parameters

Type	Estimate	St. Dev.	t-ratio
AR 1	0.3435	0.2983	1.15
MA 1	0.6461	0.3013	2.14
MA 2	0.2956	0.2450	1.21
Constant	172.852	0.805	214.84
Mean	263.313	1.226	

No. of obs.: 48
Residuals: SS = 234306 (backforecasts excluded)
MS = 5325 DF = 44

Modified Box-Pierce (Ljung-Box) chisquare statistic

Lag	12	24	36	48
Chisquare	2.3(DF= 9)	11.0(DF=21)	14.5(DF=33)	* (DF= *)
	.01 < p-value < .025	.025 < p-val < .05	≈ .025 < p < .05	

Forecasts from period 48

Period	Forecast	95 Percent Limits Lower	95 Percent Limits Upper	Actual
49	340.688	197.632	483.745	
50	333.900	184.438	483.362	
51	287.563	127.545	447.580	
52	271.644	110.426	432.862	
53	266.175	104.816	427.534	
54	264.296	102.920	425.672	

MTB >

$\varepsilon_t \sim N(0,)$

$$\left[X_t = 0.3435\, X_{t-1} + Z_t + 0.6461\, Z_{t-1} + 0.3435 \ldots \right.$$

error

```
MTB > ARIMA 2 0 2 'Bi-Mont.';
SUBC>   Constant;
SUBC>   Forecast 6 .

Estimates at each iteration
Iteration        SSE      Parameters
    0          282466    0.100     0.100     0.100     0.100   207.597
    1          260533    0.028    -0.012     0.173     0.213   257.339
    2          253810    0.066     0.129     0.230     0.363   210.799
    3          244027    0.124     0.263     0.320     0.513   160.738
    4          236524    0.102     0.245     0.369     0.556   171.506
    5          235227    0.062     0.197     0.375     0.551   195.055
    6          234962    0.105     0.158     0.423     0.508   194.203
    7          234554    0.255     0.063     0.565     0.372   179.643
    8          234491    0.300     0.033     0.606     0.332   175.700
    9          234491    0.296     0.036     0.602     0.338   175.904
   10          234491    0.296     0.036     0.602     0.337   176.087
Unable to reduce sum of squares any further

Final Estimates of Parameters
Type        Estimate      St. Dev.   t-ratio
AR    1      0.2956        1.0501      0.28
AR    2      0.0356        0.6691      0.05
MA    1      0.6020        1.0043      0.60
MA    2      0.3375        0.9862      0.34
Constant   176.087          0.865    203.67
Mean       263.303          1.293

No. of obs.:   48
Residuals:     SS =   234322   (backforecasts excluded)
               MS =     5449   DF = 43

Modified Box-Pierce (Ljung-Box) chisquare statistic
Lag             2.2    12            24              36              48
Chisquare        2.3(DF= 8)   10.9(DF=20)    14.5(DF=32)       * (DF= *)

Forecasts from period 48
                               95 Percent Limits
Period        Forecast        Lower        Upper          Actual
  49          342.153        197.437      486.869
  50          331.137        179.780      482.493
  51          286.165        124.505      447.825
  52          272.479        109.779      435.179
  53          266.830        103.959      429.701
  54          264.673        101.777      427.569
```

$$X_t = 0.296\,Y_{t-1} + Z_t + \underbrace{0.602\,Z_{t-1} + .3375\,Z_{t-2}}$$

$\boxed{ARMA(1,2)}$

ALL DATA W/O JAN-FEB 96 [illegible] — BI-MONTHLY

```
MTB > ARIMA 0 0 2 0 0 0 24 'Bi-Mont.';
SUBC>   Constant;
SUBC>   Forecast 6 .
```

Estimates at each iteration

Iteration	SSE	Parameters		
0	269781	0.100	0.100	259.496
1	258997	0.166	0.250	261.581
2	253418	0.235	0.328	262.040
3	249676	0.285	0.388	262.488
4	247391	0.323	0.430	262.834
5	246098	0.348	0.459	263.112
6	245113	0.367	0.483	263.333
7	243901	0.385	0.505	263.544
8	242378	0.402	0.526	263.719
9	242133	0.411	0.529	263.656
10	242131	0.412	0.527	263.633
11	242131	0.411	0.528	263.632

Relative change in each estimate less than 0.0010

3.944

4.

Final Estimates of Parameters

Type	Estimate	St. Dev.	t-ratio
MA 1	0.4113	0.1323	3.11
MA 2	0.5276	0.1354	3.90
Constant	263.632	0.993	265.47
Mean	263.632	0.993	

No. of obs.: 48
Residuals: SS = 241928 (backforecasts excluded)
MS = 5376 DF = 45

Modified Box-Pierce (Ljung-Box) chisquare statistic

Lag	12	24	36	48
Chisquare	4.5(DF=10)	12.6(DF=22)	14.7(DF=34)	* (DF= *)

Forecasts from period 48

Period	Forecast	95 Percent Limits Lower	95 Percent Limits Upper	Actual
49	388.839	245.098	532.580	
50	334.487	179.061	489.912	
51	263.632	90.689	436.576	
52	263.632	90.689	436.576	
53	263.632	90.689	436.576	
54	263.632	90.689	436.576	

MA(2) $X_t = Z_t + 0.4113\, Z_{t-1} + 0.5276\, Z_{t-2}$

AR(2) $X_t = \phi_1 X_{t-1} + \phi_2 X_{t-2}$

TEST TO DETERMINE IF THERE EXISTS A TREND

```
MTB > read 'jen9495.dat' c1 c2
Entering data from file: jen9495.dat
     24 rows read.
MTB > name c1 'month' c2 'sum'
MTB > plot c2 c1

           -                               *
           -
        800+
           -
 sum       -
           -
           -
        600+     *       * *                           *   *
           -       *           * *                   *
           -                       * *   *       *       *
           -         *       *
           -   *       *               *     * *
        400+                                       *
           -
           -
           -
           -                                                 *
             +---------+---------+---------+---------+---------+------month
            0.0       5.0      10.0      15.0      20.0      25.0
```

indicates iid from some dist. w/ 2 outliers

```
MTB > regress c2 1 c1 c3 c4;
SUBC> tres c5;
SUBC> dw.

The regression equation is
sum = 545 - 2.12 month

Predictor        Coef        Stdev    t-ratio        p
Constant       545.32        47.25      11.54    0.000
month          -2.122        3.307      -0.64    0.528

s = 112.1        R-sq = 1.8%        R-sq(adj) = 0.0%

Analysis of Variance

SOURCE        DF          SS          MS         F        p
Regression     1        5179        5179      0.41    0.528
Error         22      276665       12576
Total         23      281844

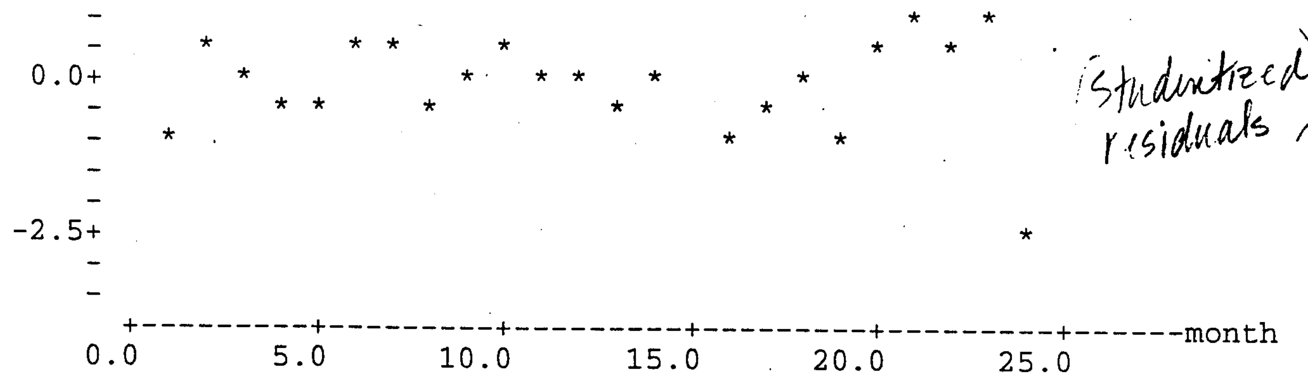
Unusual Observations
Obs.    month        sum        Fit  Stdev.Fit   Residual    St.Resid
 15      15.0      866.0      513.5       24.3      352.5       3.22R
 24      24.0      249.0      494.4       44.4     -245.4      -2.38R

R denotes an obs. with a large st. resid.

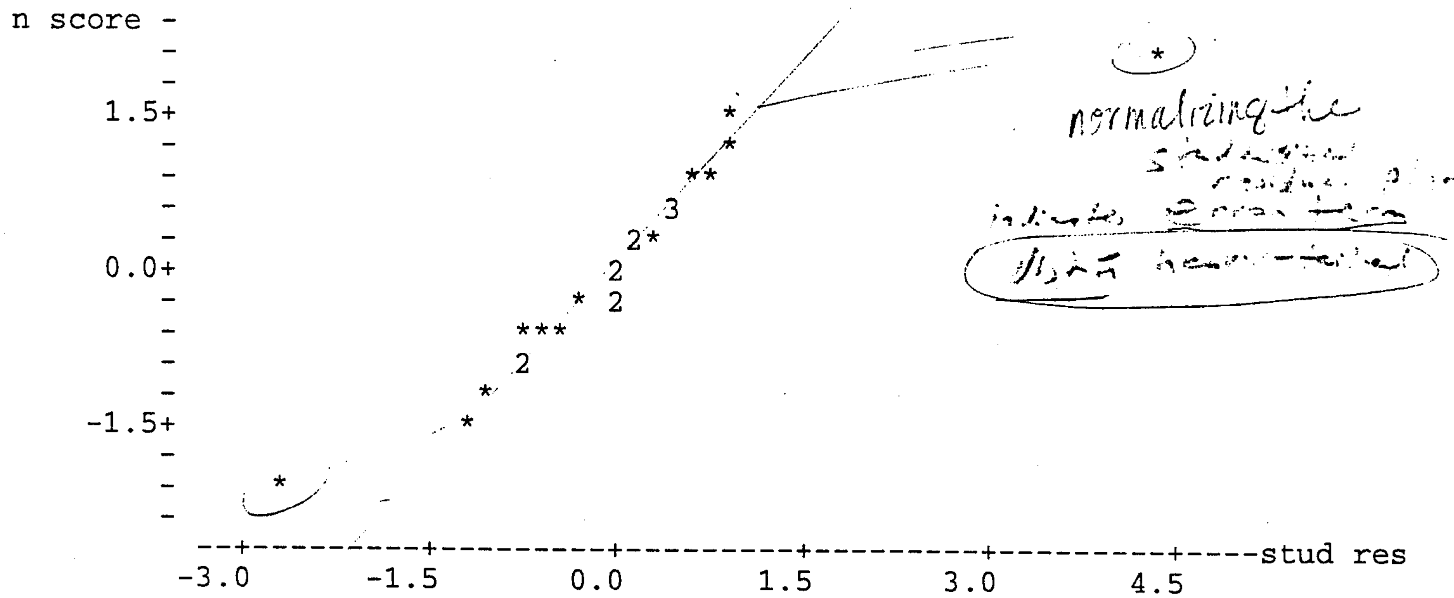
Durbin-Watson statistic = 2.15

MTB > name c4 'pred sum' c5 'stud res'
MTB > plot c5 c1

           -                               *
   stud res-
           -
           -
        2.5+
           -
           -
```




```
MTB > nsco c5 c6
MTB > name c6 'n score'
MTB > plot c6 c5
```

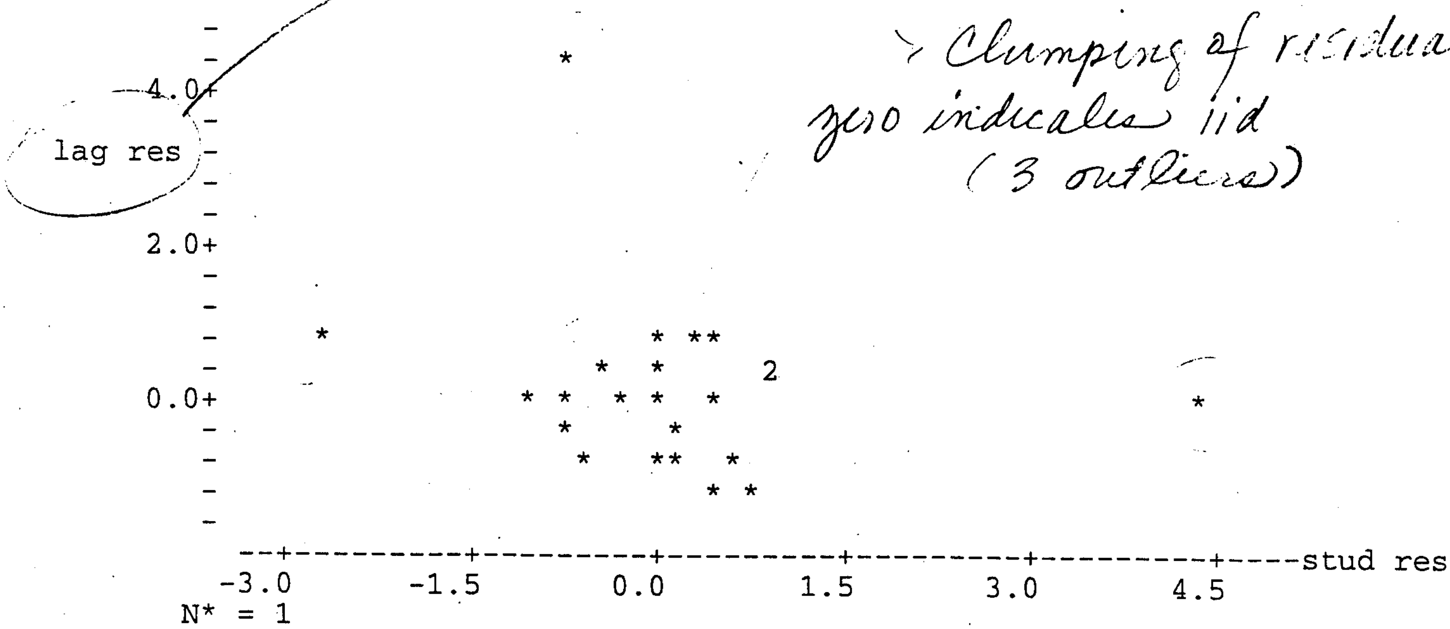


normalizing the studentized residuals plot indicates error term heavy-tailed

```
MTB > lag c5 c7
MTB > name c7 'lag res'
MTB > plot c7 c5
```

? What does laging buy you? a smoother of the residuals?

> Clumping of residuals a zero indicates iid
(3 outliers)



N* = 1

```
MTB > plot c5 c7
```

```
 stud res-
         -
         -
      2.5+
         -
         -
         -                **
         - **   *        *   *  *
      0.0+      ***   *    *  *
         -     *    *  2    *
         -               *                                        *
         -
         -
     -2.5+                      *
         -
         -
           --+---------+---------+---------+---------+---------+----lag res
          -1.0       0.0       1.0       2.0       3.0       4.0
        N* = 1

MTB > save 'jenreg'
Saving worksheet in file: jenreg.MTW
MTB > ls jen*
* ERROR * Name not found in dictionary.

MTB > stop
*** Minitab Release 9.1 *** Minitab Inc. ***
Worksheet size: 5310509 cells
```

still sense of clumping

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```
Release: 7.1      (AXP/OpenVMS)          DATE:    12-MAY-96        AT 17:28:57
 Manual: BMDP Manual Volumes 1, 2, and 3.
 Digest: BMDP User's Digest.
Updates: State NEWS. in the PRINT paragraph for summary of new features.

PROGRAM INSTRUCTIONS

/input        variables are 2.
              format is free.
              file is 'jen9495.dat'.
/variables    names are month, sum.
/test         kendall.
              spearman.
/end

PROBLEM TITLE IS
   12-MAY-96           17:28:57

NUMBER OF VARIABLES TO READ . . . . . . . . . . .          2
NUMBER OF VARIABLES ADDED BY TRANSFORMATIONS. .            0
TOTAL NUMBER OF VARIABLES . . . . . . . . . . .            2
CASE LABELING VARIABLES . . . . . . . . . . . .
NUMBER OF CASES TO READ . . . . . . . . . . . . . TO END
MISSING VALUES CHECKED BEFORE OR AFTER TRANS. . NEITHER
BLANKS IN THE DATA ARE TREATED AS      . . . . . . MISSING
INPUT FILE. . .jen9495.dat
REWIND INPUT UNIT PRIOR TO READING. . DATA. . .      YES
NUMBER OF INTEGER WORDS OF MEMORY FOR STORAGE .    19998

VARIABLES TO BE USED
     1 month       2 sum

DATA FORMAT:  FREE

THE LONGEST RECORD MAY HAVE UP TO   80 CHARACTERS.
  USE ONLY COMPLETE CASES
  COMPUTE KENDALL RANK CORRELATION COEFFICIENT(S)
  COMPUTE SPEARMAN RANK CORRELATION COEFFICIENT(S)

NUMBER OF CASES READ. . . . . . . . . . . . . . .        24
```

VARIABLE NO. NAME	MEAN	STANDARD DEVIATION	MINIMUM	MEDIAN	MAXIMUM	COUNT
1 month	12.5000	7.0711	1.0000	12.5000	24.0000	24
2 sum	518.7917	110.6982	249.0000	521.5000	866.0000	24

KENDALL RANK CORRELATION COEFFICIENTS

```
            month      sum
                1        2
```

		month	sum
		1	2
month	1	1.0000	
sum	2	-0.0797	1.0000

p-value > 0.2

(would need the absolute value to be at least 0.290 to have a p-value ≤ 0.05)
would need ≥ 0.196 to have p-value ≤ 0.2
The Mann test for trend (based on Kendall's tau stat

SPEARMAN RANK CORRELATION COEFFICIENTS

		month	sum
		1	2
month	1	1.0000	
sum	2	-0.0957	1.0000

NUMBER OF INTEGER WORDS USED IN PRECEDING PROBLEM 652
CPU TIME USED 0.130 SECONDS
1PAGE 3 3S

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Release: 7.1 (AXP/OpenVMS) DATE: 12-MAY-96 AT 17:28:58

PROGRAM INSTRUCTIONS

END OF INSTRUCTIONS

PROGRAM TERMINATED

```
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```
Release: 7.1      (AXP/OpenVMS)          DATE:     12-MAY-96        AT 17:32:23
 Manual: BMDP Manual Volumes 1, 2, and 3.
 Digest: BMDP User's Digest.
Updates: State NEWS. in the PRINT paragraph for summary of new features.

PROGRAM INSTRUCTIONS

/input        variables are 2.
              format is free.
              file is 'jen94.dat'.
/variables    names are month, sum.
/test         kendall.
              spearman.
/end

PROBLEM TITLE IS
   12-MAY-96           17:32:23

NUMBER OF VARIABLES TO READ . . . . . . . . . . .          2
NUMBER OF VARIABLES ADDED BY TRANSFORMATIONS. .            0
TOTAL NUMBER OF VARIABLES . . . . . . . . . . .            2
CASE LABELING VARIABLES . . . . . . . . . . . .
NUMBER OF CASES TO READ . . . . . . . . . . . . . TO END
MISSING VALUES CHECKED BEFORE OR AFTER TRANS. . NEITHER
BLANKS IN THE DATA ARE TREATED AS      . . . . . . MISSING
INPUT FILE. . .jen94.dat
REWIND INPUT UNIT PRIOR TO READING. . DATA. . .      YES
NUMBER OF INTEGER WORDS OF MEMORY FOR STORAGE .    19998

VARIABLES TO BE USED
     1 month          2 sum

DATA FORMAT:   FREE

THE LONGEST RECORD MAY HAVE UP TO    80 CHARACTERS.
  USE ONLY COMPLETE CASES
  COMPUTE KENDALL RANK CORRELATION COEFFICIENT(S)
  COMPUTE SPEARMAN RANK CORRELATION COEFFICIENT(S)

NUMBER OF CASES READ. . . . . . . . . . . . . . .         12
```

VARIABLE NO. NAME	MEAN	STANDARD DEVIATION	MINIMUM	MEDIAN	MAXIMUM	COUNT
1 month	6.5000	3.6056	1.0000	6.5000	12.0000	12
2 sum	528.3333	58.1524	425.0000	528.5000	613.0000	12


```
KENDALL RANK CORRELATION COEFFICIENTS


               month       sum
                   1          2
```

p-value > 0.2

month	1	1.0000	
sum	2	0.0303	1.0000

SPEARMAN RANK CORRELATION COEFFICIENTS

2-tailed
p-value > 0.2

		month 1	sum 2
month	1	1.0000	
sum	2	0.0979	1.0000

NUMBER OF INTEGER WORDS USED IN PRECEDING PROBLEM 568
CPU TIME USED 0.170 SECONDS
1PAGE 3 3S

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Release: 7.1 (AXP/OpenVMS) DATE: 12-MAY-96 AT 17:32:23

PROGRAM INSTRUCTIONS

END OF INSTRUCTIONS

PROGRAM TERMINATED

```
1PAGE   1   3S
```

[illegible]

```
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Release: 7.1     (AXP/OpenVMS)        DATE:    12-MAY-96       AT 17:34:19
 Manual: BMDP Manual Volumes 1, 2, and 3.
 Digest: BMDP User's Digest.
Updates: State NEWS. in the PRINT paragraph for summary of new features.

PROGRAM INSTRUCTIONS

/input        variables are 2.
              format is free.
              file is 'jen95.dat'.
/variables    names are month, sum.
/test         kendall.
              spearman.
/end

PROBLEM TITLE IS
   12-MAY-96           17:34:19

NUMBER OF VARIABLES TO READ . . . . . . . . . .         2
NUMBER OF VARIABLES ADDED BY TRANSFORMATIONS. .         0
TOTAL NUMBER OF VARIABLES . . . . . . . . . . .         2
CASE LABELING VARIABLES . . . . . . . . . . . .
NUMBER OF CASES TO READ . . . . . . . . . . . . . TO END
MISSING VALUES CHECKED BEFORE OR AFTER TRANS. . NEITHER
BLANKS IN THE DATA ARE TREATED AS      . . . . . . MISSING
INPUT FILE. . .jen95.dat
REWIND INPUT UNIT PRIOR TO READING. . DATA. . .     YES
NUMBER OF INTEGER WORDS OF MEMORY FOR STORAGE .   19998

VARIABLES TO BE USED
     1 month        2 sum

DATA FORMAT:  FREE

THE LONGEST RECORD MAY HAVE UP TO    80 CHARACTERS.
  USE ONLY COMPLETE CASES
  COMPUTE KENDALL RANK CORRELATION COEFFICIENT(S)
  COMPUTE SPEARMAN RANK CORRELATION COEFFICIENT(S)

NUMBER OF CASES READ. . . . . . . . . . . . . . .        12

VARIABLE            MEAN     STANDARD     MINIMUM        MEDIAN      MAXIMUM  COUNT
NO. NAME                     DEVIATION
  1 month         18.5000      3.6056     13.0000       18.5000      24.0000     12
  2 sum          509.2501    148.4650    249.0000      520.5000     866.0000     12
1PAGE   2   3S    12-MAY-96               17:34:19


KENDALL RANK CORRELATION COEFFICIENTS


               month      sum
                    1          2
```

```
month       1      1.0000
sum         2      0.0606      1.0000

SPEARMAN RANK CORRELATION COEFFICIENTS

                   month       sum
                       1           2

month       1      1.0000
sum         2      0.0490      1.0000

NUMBER OF INTEGER WORDS USED IN PRECEDING     PROBLEM      568
CPU TIME USED        0.140 SECONDS
1PAGE    3   3S

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```


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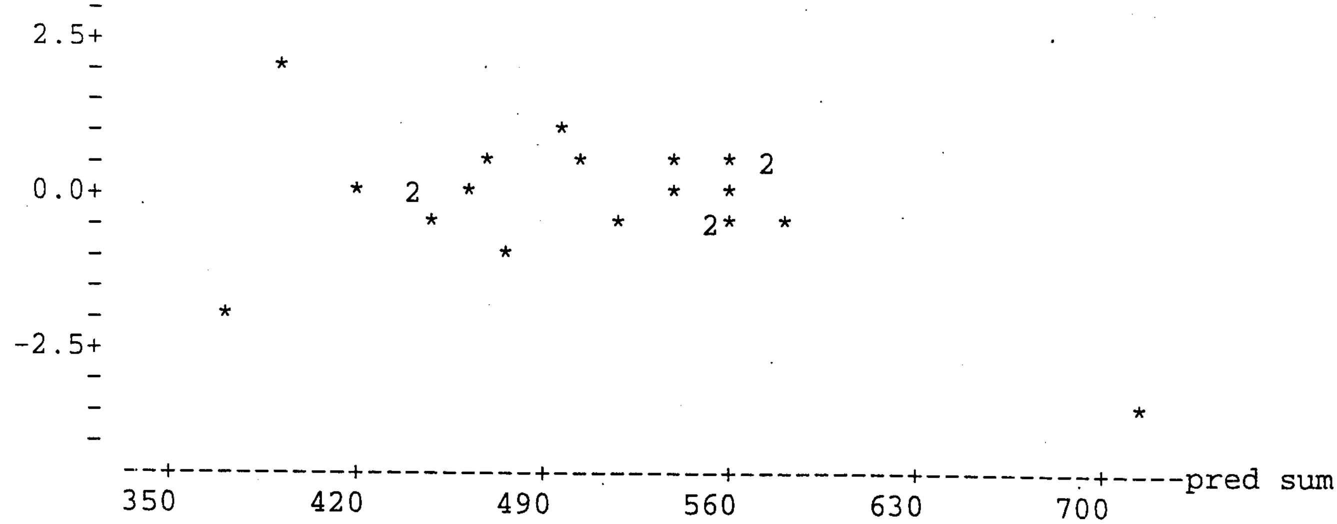
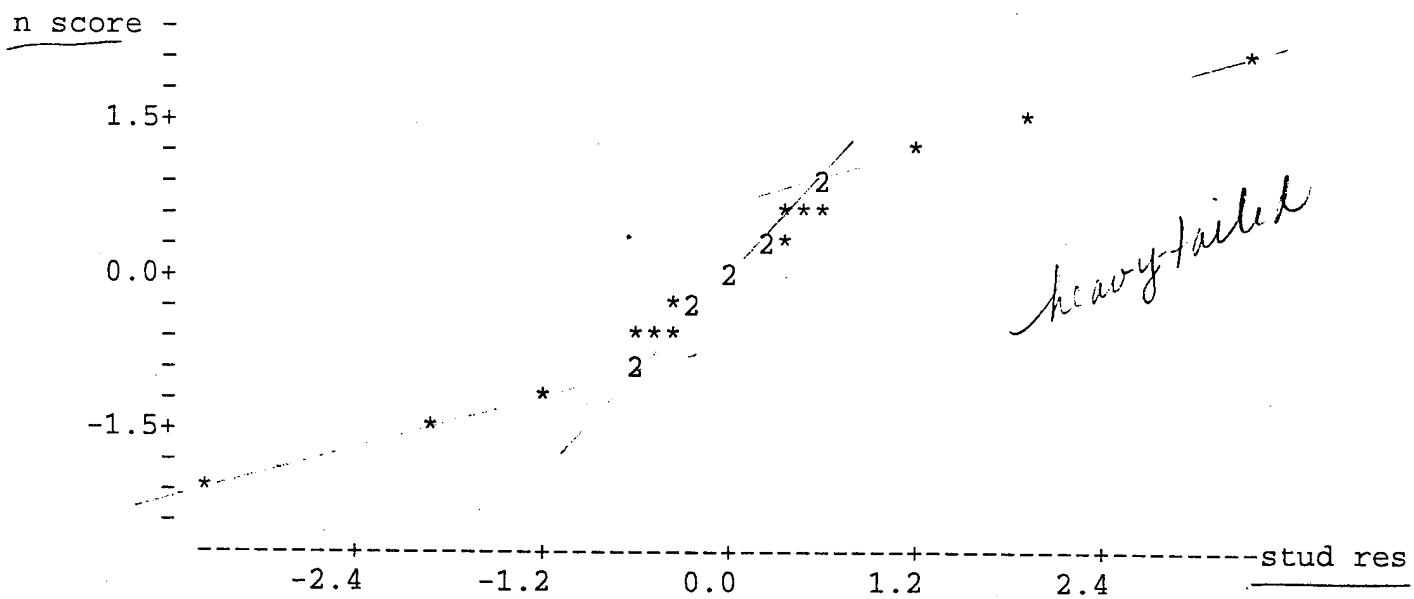
```
Release: 7.1      (AXP/OpenVMS)          DATE:     12-MAY-96         AT 17:34:19

PROGRAM INSTRUCTIONS


END OF INSTRUCTIONS

PROGRAM TERMINATED
```

```
MTB > read 'jenifer.dat' c1-c13
Entering data from file: jenifer.dat
     24 rows read.
MTB > name c1 'month' c2 'Jan' c3 'Feb' c4 'Mar' c5 'Apr' c6 'May' c7 'June'
MTB > name c8 'July' c9 'Aug' c10 'Sep' c11 'Oct' c12 'Nov' c13 'sum'
MTB > regress c13 12 c1-c12 c21 c22;
SUBC> tres c23;
SUBC> dw.

The regression equation is
sum = 411 - 1.59 month + 32 Jan + 165 Feb + 307 Mar + 65 Apr + 56 May
           + 172 June + 96 July + 122 Aug + 183 Sep + 165 Oct + 167 Nov

Predictor       Coef        Stdev     t-ratio       p
Constant      411.13        98.87        4.16   0.002
month         -1.590        3.596       -0.44   0.667
Jan             32.0        112.9        0.28   0.782
Feb            165.1        111.6        1.48   0.167
Mar            306.7        110.5        2.77   0.018
Apr             64.8        109.5        0.59   0.566
May             56.4        108.7        0.52   0.614
June           172.5        107.9        1.60   0.138
July            95.5        107.2        0.89   0.392
Aug            122.1        106.7        1.15   0.276
Sep            183.2        106.2        1.72   0.113
Oct            164.8        105.9        1.56   0.148
Nov            167.4        105.8        1.58   0.142
 took out Dec.
s = 105.7       R-sq = 56.4%     R-sq(adj) = 8.8%

Analysis of Variance

SOURCE       DF          SS          MS         F        p
Regression   12      158960       13247      1.19    0.392
Error        11      122884       11171
Total        23      281844

SOURCE       DF      SEQ SS
month         1        5179
Jan           1       22441
Feb           1         999
Mar           1       64844
Apr           1        5407
May           1        9779
June          1        4000
July          1        1865
Aug           1         109
Sep           1        7664
Oct           1        8680
Nov           1       27994

Unusual Observations
Obs.   month        sum        Fit   Stdev.Fit    Residual    St.Resid
  3      3.0      541.0      713.0        77.8      -172.0      -2.40R
 15     15.0      866.0      694.0        77.8       172.0       2.40R

R denotes an obs. with a large st. resid.

Durbin-Watson statistic = 2.48

MTB > name c22 'pred sum' c23 'stud res' c24 'n score'
MTB > plot c23 c22

  stud res-
          -                                                          *
```

Subtracts out possible seasonal monthly adjustment

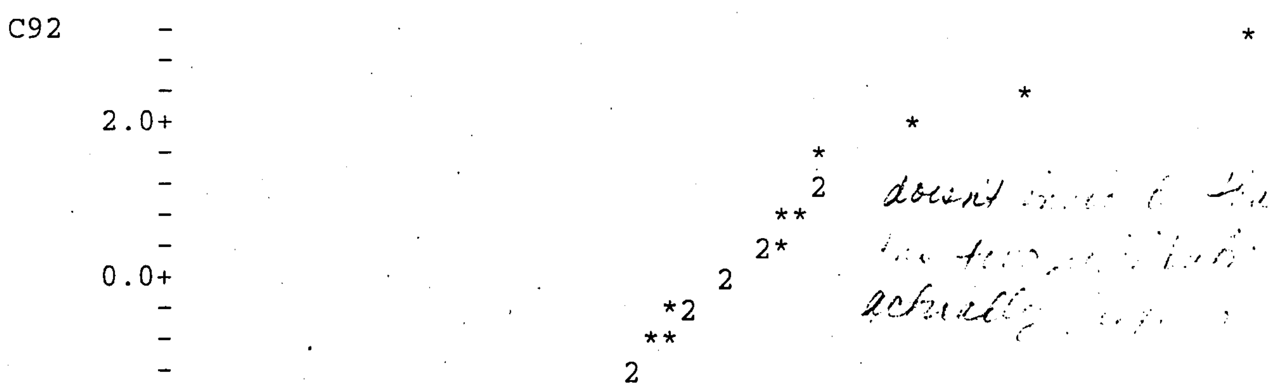



```
MTB > nsco c23 c24
MTB > plot c24 c23
```



heavy tailed

```
MTB > let k90 = 23
MTB > execute 'skku'
Executing from file: skku.MTB
MTB > print k95 k96

skewness 0.000000035
kurtosis 2.99777
MTB > end
MTB > execute 'qqlog'
Executing from file: qqlog.MTB
MTB > plot c92 c90
```



doesn't [illegible]
[illegible]
actually [illegible]

```
        -                            *
 -2.0+                   *
        -          *
        -
        -  *
          --------+---------+---------+---------+---------+--------C90
               -2.4      -1.2       0.0       1.2       2.4
MTB > end
MTB > execute 'qqlap'
Executing from file: qqlap.MTB
MTB > plot c92 c90

  C92    -                                                          *
         -
         -                                                    *
  1.6+
         -                                  *    *
         -                                  *
         -                                 **
         -                                *2
  0.0+                              *  2  *
         -                           2*
         -                         **
         -                          *
         -                     *    *
 -1.6+
         -               *
         -
         -  *
          --------+---------+---------+---------+---------+--------C90
               -2.4      -1.2       0.0       1.2       2.4

MTB > end
MTB > rreg c13 12 c1-c12

The regression equation is
sum = 411 - 1.59 month + 32.0 Jan + 165 Feb + 307 Mar + 64.8 Apr + 56.4 May
           + 172 June + 95.5 July + 122 Aug + 183 Sep + 165 Oct + 167 Nov

                   Coefficient           St. dev. of coef.
Predictor        Rank     Least-sq        Rank     Least-sq
Constant       411.13      411.13        93.61       98.87
month          -1.590      -1.590        3.405       3.596
Jan              32.0        32.0        106.9       112.9
Feb             165.1       165.1        105.7       111.6
Mar             306.7       306.7        104.7       110.5
Apr              64.8        64.8        103.7       109.5
May              56.4        56.4        102.9       108.7
June            172.5       172.5        102.1       107.9
July             95.5        95.5        101.5       107.2
Aug             122.1       122.1        101.0       106.7
Sep             183.2       183.2        100.6       106.2
Oct             164.8       164.8        100.3       105.9
Nov             167.4       167.4        100.1       105.8

Hodges-Lehmann estimate of tau = 100.1     Least-squares S = 105.7
MTB > save 'jenifer.mtw'
Saving worksheet in file: jenifer.mtw
MTB > ls jen*
* ERROR * Name not found in dictionary.

MTB > stop
*** Minitab Release 9.1 *** Minitab Inc. ***
Worksheet size: 5310509 cells
```

try robust mthd.

Decrease Number of Beds to 6

Station 1 Registration - Vitals - Hemoglobin (500 Replications/4 hours)
(Infinite capcity)

Rep No.	L	W	Lq	Wq	Po	Max(sys)	Max(line)
1	3.4359	13.6834	0	0	0.7137	7	1
2	3.5225	14.4145	0	0	0.7065	7	1
3	3.5116	14.3691	0	0	0.7074	7	1
4	3.9133	14.7694	0	0	0.6739	7	1
5	3.6965	13.4775	0	0	0.692	7	1
6	3.4355	14.4729	0	0	0.7137	7	1
7	3.4262	13.0524	0	0	0.7145	7	1
8	3.4563	14.0208	0	0	0.712	6	1
9	3.4616	14.0557	0	0	0.7115	8	1
10	3.5865	13.9964	0	0	0.7011	7	1
11	3.1864	13.1344	0	0	0.7345	7	1
488	3.3624	13.2171	0	0	0.7198	6	1
489	3.9036	14.9705	0	0	0.6747	8	1
490	3.5461	13.6878	0	0	0.7045	7	1
491	3.5362	14.389	0	0	0.7053	8	1
492	4.0483	13.9337	0	0	0.6626	8	1
493	3.6161	13.6527	0	0	0.6987	7	1
494	3.4545	13.1244	0	0	0.7121	7	1
495	3.4497	13.6076	0	0	0.7125	8	1
496	3.6333	13.8754	0	0	0.6972	8	1
497	3.5495	14.6695	0	0	0.7042	6	1
498	3.6303	13.9372	0	0	0.6975	8	1
499	3.8103	15.0071	0	0	0.6825	7	1
500	4.021	14.4745	0	0	0.6649	7	1
Average	3.570	14.100	0.000	0.000	0.702	7.3	1.0
Std Dev	0.237	0.574	0.000	0.000	0.020	0.7	0.0

Max	4.208	15.747	0.000	0.000	0.756	11.0	1.0
Min	2.924	12.178	0.000	0.000	0.649	6.0	1.0

T(.90)	1.730		T(.95)	2.090			
+/- (.90)	0.018	0.044	0.000	0.000	0.002	0.1	0.0
+/- (.95)	0.022	0.054	0.000	0.000	0.002	0.1	0.0

	L	W	Lq	Wq	Po	Max(sys)	Max(line)
LB (.95)	3.548	14.046	0.000	0.000	0.701	7.2	1.0
LB (.90)	3.552	14.055	0.000	0.000	0.701	7.2	1.0
Avg	3.570	14.100	0.000	0.000	0.702	7.3	1.0
UB (.90)	3.589	14.144	0.000	0.000	0.704	7.3	1.0
UB (.95)	3.592	14.153	0.000	0.000	0.704	7.4	1.0

B	0.179	0.705	0.000	0.000	0.035	0.4	0.1
n=	5.273	1.986	0.000	0.000	0.946	12.1	0.0

Decrease Number of Beds to 6

Station 2 - Interview (500 Replications/4 hours)
(2 servers)

Rep No.	L	W	Lq	Wq	Po	Max(sys)	Max(line)
1	1.2262	4.8834	0.1564	0.6227	0.4651	5	3
2	1.0331	4.4197	0.085	0.3638	0.526	4	2
3	1.2423	5.1592	0.1475	0.6128	0.4526	5	3
4	1.4219	5.4409	0.1839	0.7039	0.381	5	3
5	1.3909	5.1396	0.1571	0.5806	0.3831	4	2
6	1.2465	5.4154	0.1729	0.751	0.4632	6	4
7	1.3838	5.4182	0.2055	0.8047	0.4109	5	3
8	1.2257	5.2052	0.1548	0.6575	0.4646	4	2
9	1.3749	5.6648	0.217	0.8942	0.4211	5	3
10	1.4391	5.6163	0.2677	1.0449	0.4143	5	3
11	1.407	6.0632	0.2562	1.1041	0.4246	5	3
488	1.2628	5.036	0.198	0.7898	0.4676	5	3
489	1.3447	5.2945	0.2225	0.876	0.4389	5	3
490	1.4169	5.7105	0.2491	1.0039	0.4161	6	4
491	1.2718	5.2499	0.2007	0.8284	0.4645	5	3
492	1.4645	5.1731	0.2147	0.7586	0.3751	5	3
493	1.3603	5.1359	0.1706	0.644	0.4051	6	4
494	1.6249	6.1733	0.3163	1.2018	0.3457	5	3
495	1.4672	5.9462	0.3609	1.4628	0.4469	6	4
496	1.3499	5.2277	0.2372	0.9184	0.4436	5	3
497	1.1311	5.0579	0.1005	0.4492	0.4847	5	3
498	1.7709	6.7988	0.5193	1.9937	0.3742	8	6
499	1.1957	4.7091	0.1083	0.4266	0.4563	3	1
500	1.5123	5.589	0.2608	0.9639	0.3743	5	3
Average	1.322	5.327	0.211	0.843	0.444	4.9	2.9
Std Dev	0.167	0.516	0.098	0.369	0.044	0.8	0.8

Max	2.138	8.403	0.851	3.346	0.564	8.0	2.9
Min	0.962	4.310	0.033	0.149	0.312	3.0	1.0

T(.90)	1.730		T(.95)	2.090			
+/- (.90)	0.013	0.040	0.008	0.029	0.003	0.1	0.1
+/- (.95)	0.016	0.048	0.009	0.034	0.004	0.1	0.1

	L	W	Lq	Wq	Po	Max(sys)	Max(line)
LB (.95)	1.307	5.279	0.202	0.808	0.440	4.8	2.8
LB (.90)	1.310	5.287	0.203	0.814	0.441	4.9	2.9
Avg	1.322	5.327	0.211	0.843	0.444	4.9	2.9
UB (.90)	1.335	5.367	0.218	0.871	0.448	5.0	3.0
UB (.95)	1.338	5.376	0.220	0.877	0.448	5.0	3.0

B	0.066	0.266	0.011	0.042	0.022	0.2	0.1
n=	18.990	11.253	256.697	229.179	11.739	28.8	81.9

Decrease Number of Beds to 6

Station 3 - Bag Table (500 Replications/4 hours)
(1 server)

Rep No.	L	W	Lq	Wq	Po	Max(sys)	Max(line)
1	0.7849	3.8785	0.2752	1.36	0.4903	4	3
2	0.636	3.2652	0.1225	0.6288	0.4865	3	2
3	0.7932	3.872	0.2325	1.1352	0.4393	4	3
4	0.9099	4.0433	0.2929	1.3014	0.383	3	2
5	0.8227	3.7493	0.2376	1.0827	0.4149	3	2
6	0.5097	3.081	0.0745	0.4505	0.5648	2	1
7	0.8152	3.7067	0.2086	0.9486	0.3934	3	2
8	0.8024	3.8262	0.2248	1.0718	0.4224	4	3
9	0.6675	3.4003	0.1464	0.7457	0.4789	3	2
10	0.9655	4.6425	0.375	1.8032	0.4095	4	3
11	0.6169	3.3108	0.1177	0.6315	0.5007	3	2
488	0.7928	3.6975	0.2222	1.0364	0.4294	3	2
489	0.7626	3.7535	0.2174	1.0701	0.4548	3	2
490	0.7997	3.6529	0.194	0.8862	0.3943	4	3
491	0.7654	3.8929	0.2036	1.0357	0.4383	4	3
492	0.9098	3.7008	0.2617	1.0644	0.3519	3	2
493	0.7664	3.7722	0.2004	0.9864	0.434	3	2
494	0.6845	3.3572	0.1396	0.6845	0.455	3	2
495	0.7945	3.7909	0.2333	1.1134	0.4389	3	2
496	0.7768	3.7471	0.2022	0.9752	0.4254	4	3
497	0.6064	3.3081	0.1188	0.6481	0.5124	3	2
498	0.7817	3.5821	0.1904	0.8724	0.4087	3	2
499	0.6556	3.6361	0.1552	0.8606	0.4996	3	2
500	0.8879	4.1017	0.2962	1.3683	0.4083	4	3
Average	0.768	3.755	0.217	1.051	0.449	3.4	2.4
Std Dev	0.123	0.418	0.088	0.385	0.047	0.7	0.7

Max	1.304	5.902	0.686	3.236	0.597	6.0	2.4
Min	0.481	2.983	0.072	0.425	0.314	2.0	1.0

T(.90)	1.730		**T(.95)**	2.090			
+/- (.90)	0.010	0.032	0.007	0.030	0.004	0.1	0.1
+/- (.95)	0.012	0.039	0.008	0.036	0.004	0.1	0.1

	L	W	Lq	Wq	Po	Max(sys)	Max(line)
LB (.95)	0.757	3.716	0.209	1.015	0.444	3.3	2.3
LB (.90)	0.759	3.722	0.210	1.021	0.445	3.3	2.3
Avg	0.768	3.755	0.217	1.051	0.449	3.4	2.4
UB (.90)	0.778	3.787	0.224	1.081	0.452	3.4	2.4
UB (.95)	0.780	3.794	0.225	1.087	0.453	3.4	2.4

B	0.038	0.188	0.011	0.053	0.022	0.2	0.1
n=	30.706	14.823	197.956	160.866	13.288	44.9	90.8

Decrease Number of Beds to 6

Station 4 - Blood Letting (500 Replications/4 hours)
(6 servers)

Rep No.	L	W	Lq	Wq	Po	Max(sys)	Max(line)
1	3	13.863	0.0095	0.0467	0.534	7	1
2	3	13.0498	0.0021	0.0108	0.5767	7	1
3	3	13.1797	0	0	0.55	6	1
4	3	14.9933	0.0433	0.1923	0.4449	8	2
5	3	13.6247	0	0	0.5017	6	1
6	3	15.3382	0	0	0.5771	6	1
7	3	12.0292	0	0	0.5591	5	1
8	3	15.0517	0.0125	0.0595	0.476	7	1
9	3	13.6665	0	0	0.5529	6	1
10	3	13.3536	0.0038	0.0182	0.5378	7	1
11	2	12.116	0	0	0.6237	6	1
488	3	12.7265	0.0031	0.0146	0.5457	7	1
489	3	14.3097	0.0067	0.0327	0.5165	7	1
490	3	13.5938	0	0	0.504	5	1
491	3	16.2275	0.0386	0.1962	0.4747	8	2
492	4	15.0383	0.0554	0.2253	0.3931	8	2
493	3	14.3897	0.0185	0.0911	0.5158	7	1
494	3	13.1176	0.0105	0.0515	0.556	7	1
495	3	16.2521	0.1256	0.5993	0.4533	9	3
496	3	12.2989	0	0	0.5751	6	1
497	3	13.6707	0	0	0.5823	5	1
498	3	14.2573	0.0039	0.0177	0.4821	7	1
499	2	11.4854	0	0	0.6549	5	1
500	3	12.736	0	0	0.5405	6	1
Average	2.888	13.861	0.011	0.054	0.531	6.7	1.2
Std Dev	0.357	0.972	0.020	0.097	0.049	0.9	0.5

Max	4.000	16.753	0.166	0.958	0.668	9.0	1.2
Min	2.000	11.400	0.000	0.000	0.367	5.0	1.0

T(.90)	1.730		T(.95)	2.090			
+/- (.90)	0.028	0.075	0.002	0.008	0.004	0.1	0.0
+/- (.95)	0.033	0.091	0.002	0.009	0.005	0.1	0.0

	L	W	Lq	Wq	Po	Max(sys)	Max(line)
LB (.95)	2.855	13.770	0.009	0.045	0.526	6.6	1.1
LB (.90)	2.860	13.785	0.010	0.046	0.527	6.7	1.2
Avg	2.888	13.861	0.011	0.054	0.531	6.7	1.2
UB (.90)	2.916	13.936	0.013	0.061	0.534	6.8	1.2
UB (.95)	2.921	13.951	0.013	0.063	0.535	6.8	1.2

B	0.144	0.693	0.001	0.003	0.027	0.3	0.1
n=	18.331	5.893	3756.632	3933.691	10.399	20.1	173.9

Decrease Number of Beds to 6

Total System (from GPSSH)
(6 servers)

Rep No.	L	W	Lmax	#XACTS
1	8	32.8659	14	67
2	8	31.6468	12	69
3	8	33.7457	13	68
4	10	36.3039	16	73
5	9	32.4478	15	75
6	8	32.5618	13	66
7	8	31.5083	13	74
8	9	35.0532	12	67
9	8	33.2424	13	69
10	9	34.2182	15	69
11	7	30.7836	12	69
488	8	32.0242	13	70
489	9	34.2027	15	77
490	9	33.7316	13	71
491	9	35.6601	14	70
492	10	34.8302	16	78
493	9	32.721	13	73
494	8	32.06	14	71
495	9	35.9641	14	75
496	8	31.7336	12	72
497	8	32.207	12	66
498	9	35.6826	15	74
499	8	30.4547	13	69
500	9	33.0386	16	77
Average	8.476	33.514	13.946	70.6
Std Dev	0.712	1.602	1.329	3.6

T(.90)	1.730		T(.95)	2.1
+/- (.90)	0.055	0.620	0.514	1.4
+/- (.95)	0.067	0.748	0.621	1.7

	L	W	Lmax	#XACTS
LB (.95)	8.409	32.765	13.325	68.9
LB (.90)	8.421	32.894	13.432	69.2
Avg	8.476	33.514	13.946	70.6
UB (.90)	8.531	34.133	14.460	71.9
UB (.95)	8.543	34.262	14.567	72.2

B	0.424	1.676	0.697	3.5279
n=	8.439	2.734	10.874	3.0

	L	W	Lq	Wq
Station 1 Registration - Vitals - Hemoglobin (500 Replications/4 hours)	3.57	14.10	0.00	0.00 (Infinite capcity)
Station 2 - Interview (500 Replications/4 hours)	1.32	5.33	0.21	0.84 (2 servers)
Station 3 - Bag Table (500 Replications/4 hours)	0.77	3.75	0.22	1.05 (1 server)
Station 4 - Blood Letting (500 Replications/4 hours)	2.89	13.86	0.01	0.05 (6 servers)
	8.55	**37.04**	**0.44**	**1.95**

Exponential Interarrivals and 9 beds

Station 1 Registration - Vitals - Hemoglobin (500 Replications/4 hours)
(Infinite capcity)

Rep No.	L	W	Lq	Wq	Po	Max(sys)	Max(line)
1	3.4359	13.6834	0	0	0.7137	7	1
2	3.5225	14.4145	0	0	0.7065	7	1
3	3.5116	14.3691	0	0	0.7074	7	1
4	3.9133	14.7694	0	0	0.6739	7	1
5	3.6965	13.4775	0	0	0.692	7	1
6	3.4355	14.4729	0	0	0.7137	7	1
7	3.4262	13.0524	0	0	0.7145	7	1
8	3.4563	14.0208	0	0	0.712	6	1
9	3.4616	14.0557	0	0	0.7115	8	1
10	3.5865	13.9964	0	0	0.7011	7	1
11	3.1864	13.1344	0	0	0.7345	7	1
488	3.3624	13.2171	0	0	0.7198	6	1
489	3.9036	14.9705	0	0	0.6747	8	1
490	3.5461	13.6878	0	0	0.7045	7	1
491	3.5362	14.389	0	0	0.7053	8	1
492	4.0483	13.9337	0	0	0.6626	8	1
493	3.6161	13.6527	0	0	0.6987	7	1
494	3.4545	13.1244	0	0	0.7121	7	1
495	3.4497	13.6076	0	0	0.7125	8	1
496	3.6333	13.8754	0	0	0.6972	8	1
497	3.5495	14.6695	0	0	0.7042	6	1
498	3.6303	13.9372	0	0	0.6975	8	1
499	3.8103	15.0071	0	0	0.6825	7	1
500	4.021	14.4745	0	0	0.6649	7	1
Average	3.570	14.100	0.000	0.000	0.702	7.3	1.0
Std Dev	0.237	0.574	0.000	0.000	0.020	0.7	0.0

Max	4.208	15.747	0.000	0.000	0.756	11.0	1.0
Min	2.924	12.178	0.000	0.000	0.649	6.0	1.0

T(.90)	1.730		T(.95)	2.090			
+/- (.90)	0.018	0.044	0.000	0.000	0.002	0.1	0.0
+/- (.95)	0.022	0.054	0.000	0.000	0.002	0.1	0.0

	L	W	Lq	Wq	Po	Max(sys)	Max(line)
LB (.95)	3.548	14.046	0.000	0.000	0.701	7.2	1.0
LB (.90)	3.552	14.055	0.000	0.000	0.701	7.2	1.0
Avg	3.570	14.100	0.000	0.000	0.702	7.3	1.0
UB (.90)	3.589	14.144	0.000	0.000	0.704	7.3	1.0
UB (.95)	3.592	14.153	0.000	0.000	0.704	7.4	1.0

B	0.179	0.705	0.000	0.000	0.035	0.4	0.1
n=	5.273	1.986	0.000	0.000	0.946	12.1	0.0

Exponential Interarrivals and 9 beds

Station 2 - Interview (500 Replications/4 hours)
(2 servers)

Rep No.	L	W	Lq	Wq	Po	Max(sys)	Max(line)
1	1.2262	4.8834	0.1564	0.6227	0.4651	5	3
2	1.0331	4.4197	0.085	0.3638	0.526	4	2
3	1.2423	5.1592	0.1475	0.6128	0.4526	5	3
4	1.4219	5.4409	0.1839	0.7039	0.381	5	3
5	1.3909	5.1396	0.1571	0.5806	0.3831	4	2
6	1.2465	5.4154	0.1729	0.751	0.4632	6	4
7	1.3838	5.4182	0.2055	0.8047	0.4109	5	3
8	1.2257	5.2052	0.1548	0.6575	0.4646	4	2
9	1.3749	5.6648	0.217	0.8942	0.4211	5	3
10	1.4391	5.6163	0.2677	1.0449	0.4143	5	3
11	1.407	6.0632	0.2562	1.1041	0.4246	5	3
488	1.2628	5.036	0.198	0.7898	0.4676	5	3
489	1.3447	5.2945	0.2225	0.876	0.4389	5	3
490	1.4169	5.7105	0.2491	1.0039	0.4161	6	4
491	1.2718	5.2499	0.2007	0.8284	0.4645	5	3
492	1.4645	5.1731	0.2147	0.7586	0.3751	5	3
493	1.3603	5.1359	0.1706	0.644	0.4051	6	4
494	1.6249	6.1733	0.3163	1.2018	0.3457	5	3
495	1.4672	5.9462	0.3609	1.4628	0.4469	6	4
496	1.3499	5.2277	0.2372	0.9184	0.4436	5	3
497	1.1311	5.0579	0.1005	0.4492	0.4847	5	3
498	1.7709	6.7988	0.5193	1.9937	0.3742	8	6
499	1.1957	4.7091	0.1083	0.4266	0.4563	3	1
500	1.5123	5.589	0.2608	0.9639	0.3743	5	3
Average	1.322	5.327	0.211	0.843	0.444	4.9	2.9
Std Dev	0.167	0.516	0.098	0.369	0.044	0.8	0.8

Max	2.138	8.403	0.851	3.346	0.564	8.0	2.9
Min	0.962	4.310	0.033	0.149	0.312	3.0	1.0

T(.90)	1.730		T(.95)	2.090			
+/- (.90)	0.013	0.040	0.008	0.029	0.003	0.1	0.1
+/- (.95)	0.016	0.048	0.009	0.034	0.004	0.1	0.1

	L	W	Lq	Wq	Po	Max(sys)	Max(line)
LB (.95)	1.307	5.279	0.202	0.808	0.440	4.8	2.8
LB (.90)	1.310	5.287	0.203	0.814	0.441	4.9	2.9
Avg	1.322	5.327	0.211	0.843	0.444	4.9	2.9
UB (.90)	1.335	5.367	0.218	0.871	0.448	5.0	3.0
UB (.95)	1.338	5.376	0.220	0.877	0.448	5.0	3.0

B	0.066	0.266	0.011	0.042	0.022	0.2	0.1
n=	18.990	11.253	256.697	229.179	11.739	28.8	81.9

Exponential Interarrivals and 9 beds

Station 3 - Bag Table (500 Replications/4 hours)
(1 server)

Rep No.	L	W	Lq	Wq	Po	Max(sys)	Max(line)
1	0.7849	3.8785	0.2752	1.36	0.4903	4	3
2	0.636	3.2652	0.1225	0.6288	0.4865	3	2
3	0.7932	3.872	0.2325	1.1352	0.4393	4	3
4	0.9099	4.0433	0.2929	1.3014	0.383	3	2
5	0.8227	3.7493	0.2376	1.0827	0.4149	3	2
6	0.5097	3.081	0.0745	0.4505	0.5648	2	1
7	0.8152	3.7067	0.2086	0.9486	0.3934	3	2
8	0.8024	3.8262	0.2248	1.0718	0.4224	4	3
9	0.6675	3.4003	0.1464	0.7457	0.4789	3	2
10	0.9655	4.6425	0.375	1.8032	0.4095	4	3
11	0.6169	3.3108	0.1177	0.6315	0.5007	3	2
488	0.7928	3.6975	0.2222	1.0364	0.4294	3	2
489	0.7626	3.7535	0.2174	1.0701	0.4548	3	2
490	0.7997	3.6529	0.194	0.8862	0.3943	4	3
491	0.7654	3.8929	0.2036	1.0357	0.4383	4	3
492	0.9098	3.7008	0.2617	1.0644	0.3519	3	2
493	0.7664	3.7722	0.2004	0.9864	0.434	3	2
494	0.6845	3.3572	0.1396	0.6845	0.455	3	2
495	0.7945	3.7909	0.2333	1.1134	0.4389	3	2
496	0.7768	3.7471	0.2022	0.9752	0.4254	4	3
497	0.6064	3.3081	0.1188	0.6481	0.5124	3	2
498	0.7817	3.5821	0.1904	0.8724	0.4087	3	2
499	0.6556	3.6361	0.1552	0.8606	0.4996	3	2
500	0.8879	4.1017	0.2962	1.3683	0.4083	4	3
Average	0.768	3.755	0.217	1.051	0.449	3.4	2.4
Std Dev	0.123	0.418	0.088	0.385	0.047	0.7	0.7

Max	1.304	5.902	0.686	3.236	0.597	6.0	2.4
Min	0.481	2.983	0.072	0.425	0.314	2.0	1.0

T(.90)	1.730		**T(.95)**	2.090			
+/- (.90)	0.010	0.032	0.007	0.030	0.004	0.1	0.1
+/- (.95)	0.012	0.039	0.008	0.036	0.004	0.1	0.1

	L	W	Lq	Wq	Po	Max(sys)	Max(line)
LB (.95)	0.757	3.716	0.209	1.015	0.444	3.3	2.3
LB (.90)	0.759	3.722	0.210	1.021	0.445	3.3	2.3
Avg	0.768	3.755	0.217	1.051	0.449	3.4	2.4
UB (.90)	0.778	3.787	0.224	1.081	0.452	3.4	2.4
UB (.95)	0.780	3.794	0.225	1.087	0.453	3.4	2.4

B	0.038	0.188	0.011	0.053	0.022	0.2	0.1
n=	30.706	14.823	197.956	160.866	13.288	44.9	90.8

Exponential Interarrivals and 9 beds

Station 4 - Blood Letting (500 Replications/4 hours)
(6 servers)

Rep No.	L	W	Lq	Wq	Po	Max(sys)	Max(line)
1	3	13.863	0.0095	0.0467	0.534	7	1
2	3	13.0498	0.0021	0.0108	0.5767	7	1
3	3	13.1797	0	0	0.55	6	1
4	3	14.9933	0.0433	0.1923	0.4449	8	2
5	3	13.6247	0	0	0.5017	6	1
6	3	15.3382	0	0	0.5771	6	1
7	3	12.0292	0	0	0.5591	5	1
8	3	15.0517	0.0125	0.0595	0.476	7	1
9	3	13.6665	0	0	0.5529	6	1
10	3	13.3536	0.0038	0.0182	0.5378	7	1
11	2	12.116	0	0	0.6237	6	1
488	3	12.7265	0.0031	0.0146	0.5457	7	1
489	3	14.3097	0.0067	0.0327	0.5165	7	1
490	3	13.5938	0	0	0.504	5	1
491	3	16.2275	0.0386	0.1962	0.4747	8	2
492	4	15.0383	0.0554	0.2253	0.3931	8	2
493	3	14.3897	0.0185	0.0911	0.5158	7	1
494	3	13.1176	0.0105	0.0515	0.556	7	1
495	3	16.2521	0.1256	0.5993	0.4533	9	3
496	3	12.2989	0	0	0.5751	6	1
497	3	13.6707	0	0	0.5823	5	1
498	3	14.2573	0.0039	0.0177	0.4821	7	1
499	2	11.4854	0	0	0.6549	5	1
500	3	12.736	0	0	0.5405	6	1
Average	2.888	13.861	0.011	0.054	0.531	6.7	1.2
Std Dev	0.357	0.972	0.020	0.097	0.049	0.9	0.5

Max	4.000	16.753	0.166	0.958	0.668	9.0	1.2
Min	2.000	11.400	0.000	0.000	0.367	5.0	1.0

T(.90)	1.730		T(.95)	2.090			
+/- (.90)	0.028	0.075	0.002	0.008	0.004	0.1	0.0
+/- (.95)	0.033	0.091	0.002	0.009	0.005	0.1	0.0

	L	W	Lq	Wq	Po	Max(sys)	Max(line)
LB (.95)	2.855	13.770	0.009	0.045	0.526	6.6	1.1
LB (.90)	2.860	13.785	0.010	0.046	0.527	6.7	1.2
Avg	2.888	13.861	0.011	0.054	0.531	6.7	1.2
UB (.90)	2.916	13.936	0.013	0.061	0.534	6.8	1.2
UB (.95)	2.921	13.951	0.013	0.063	0.535	6.8	1.2

B	0.144	0.693	0.001	0.003	0.027	0.3	0.1
n=	18.331	5.893	3756.632	3933.691	10.399	20.1	173.9

Exponential Interarrivals and 9 beds
Total System (from GPSSH)
(6 servers)

Rep No.	L	W	Lmax	#XACTS
1	8	32.8659	14	67
2	8	31.6468	12	69
3	8	33.7457	13	68
4	10	36.3039	16	73
5	9	32.4478	15	75
6	8	32.5618	13	66
7	8	31.5083	13	74
8	9	35.0532	12	67
9	8	33.2424	13	69
10	9	34.2182	15	69
11	7	30.7836	12	69
488	8	32.0242	13	70
489	9	34.2027	15	77
490	9	33.7316	13	71
491	9	35.6601	14	70
492	10	34.8302	16	78
493	9	32.721	13	73
494	8	32.06	14	71
495	9	35.9641	14	75
496	8	31.7336	12	72
497	8	32.207	12	66
498	9	35.6826	15	74
499	8	30.4547	13	69
500	9	33.0386	16	77
Average	8.476	33.514	13.946	70.6
Std Dev	0.712	1.602	1.329	3.6

T(.90)	1.730		T(.95)	2.1
+/- (.90)	0.055	0.620	0.514	1.4
+/- (.95)	0.067	0.748	0.621	1.7

	L	W	Lmax	#XACTS
LB (.95)	8.409	32.765	13.325	68.9
LB (.90)	8.421	32.894	13.432	69.2
Avg	8.476	33.514	13.946	70.6
UB (.90)	8.531	34.133	14.460	71.9
UB (.95)	8.543	34.262	14.567	72.2

B	0.424	1.676	0.697	3.5279
n=	8.439	2.734	10.874	3.0

	L	W	Lq	Wq
Station 1 Registration - Vitals - Hemoglobin (500 Replications/4 hours)	3.57	14.10	0.00	0.00 (Infinite capcity)
Station 2 - Interview (500 Replications/4 hours)	1.32	5.33	0.21	0.84 (2 servers)
Station 3 - Bag Table (500 Replications/4 hours)	0.77	3.75	0.22	1.05 (1 server)
Station 4 - Blood Letting (500 Replications/4 hours)	2.89	13.86	0.01	0.05 (6 servers)
	8.55	**37.04**	**0.44**	**1.95**

(Infinite capcity)
(2 servers)
(1 server)
(9 servers)

Base Case

Station 1 Registration - Vitals - Hemoglobin (500 Replications/4 hours)
(Infinite capcity)

Rep No.	L	W	Lq	Wq	Po	Max(sys)	Max(line)
1	3.3421	13.7609	0	0	0.7215	7	1
2	3.3344	14.7102	0	0	0.7221	7	1
3	3.5628	14.3258	0	0	0.7031	8	1
4	3.4712	13.96	0	0	0.7107	7	1
5	3.2547	14.0702	0	0	0.7288	6	1
6	3.2259	14.3327	0	0	0.7312	7	1
7	3.0904	12.9921	0	0	0.7425	8	1
8	3.2716	14.1147	0	0	0.7274	7	1
9	3.5991	14.3755	0	0	0.7001	8	1
10	3.3052	13.4354	0	0	0.7246	8	1
11	3.0486	13.1302	0	0	0.746	7	1
488	3.6787	14.9604	0	0	0.6934	7	1
489	3.3049	13.5241	0	0	0.7246	7	1
490	3.6422	14.7991	0	0	0.6965	7	1
491	3.2679	14.034	0	0	0.7277	7	1
492	2.7077	12.6561	0	0	0.7744	6	1
493	3.1866	13.5184	0	0	0.7345	7	1
494	3.0829	13.446	0	0	0.7431	7	1
495	3.2605	13.9349	0	0	0.7283	7	1
496	3.7407	14.8558	0	0	0.6883	8	1
497	2.9255	13.9929	0	0	0.7562	7	1
498	3.6583	14.6385	0	0	0.6951	8	1
499	3.6192	14.8387	0	0	0.6984	7	1
500	3.4097	13.8527	0	0	0.7159	7	1
Average	3.350	14.097	0.000	0.000	0.721	7.3	1.0
Std Dev	0.221	0.563	0.000	0.000	0.018	0.7	0.0

Max	3.994	16.068	0.000	0.000	0.774	11.0	1.0
Min	2.708	12.467	0.000	0.000	0.667	6.0	1.0

T(.90)	1.730		T(.95)	2.090			
+/- (.90)	0.017	0.044	0.000	0.000	0.001	0.1	0.0
+/- (.95)	0.021	0.053	0.000	0.000	0.002	0.1	0.0

	L	W	Lq	Wq	Po	Max(sys)	Max(line)
LB (.95)	3.329	14.045	0.000	0.000	0.719	7.3	1.0
LB (.90)	3.333	14.054	0.000	0.000	0.719	7.3	1.0
Avg	3.350	14.097	0.000	0.000	0.721	7.3	1.0
UB (.90)	3.367	14.141	0.000	0.000	0.722	7.4	1.0
UB (.95)	3.370	14.150	0.000	0.000	0.723	7.4	1.0

B	0.167	0.705	0.000	0.000	0.036	0.4	0.1
n=	5.224	1.910	0.000	0.000	0.783	11.3	0.0

Base Case

Station 2 - Interview (500 Replications/4 hours)
(2 servers)

Rep No.	L	W	Lq	Wq	Po	Max(sys)	Max(line)
1	3.3301	13.7116	2.3013	9.4753	0.2847	13	11
2	2.8494	13.1334	1.9441	8.9607	0.3783	11	10
3	2.863	11.9852	1.7677	7.3998	0.2942	13	12
4	2.8846	11.7598	1.7351	7.0736	0.296	14	12
5	2.1586	9.4733	1.1114	4.8776	0.3435	8	8
6	2.5775	11.6339	1.5817	7.139	0.3366	10	8
7	2.6825	11.2772	1.5657	6.5821	0.2905	8	8
8	3.11	13.612	2.0692	9.0566	0.2755	12	12
9	3.5202	14.2528	2.3148	9.3723	0.2324	12	10
10	3.4434	13.9974	2.3332	9.4845	0.2816	12	10
11	2.8477	12.4429	1.7707	7.7371	0.2999	10	10
488	2.4309	10.1681	1.2772	5.3423	0.2745	10	10
489	3.3154	13.9339	2.2683	9.5332	0.3192	14	12
490	3.1272	12.7068	2.0412	8.2939	0.2969	11	11
491	3.5826	15.8251	2.5801	11.397	0.3196	15	14
492	2.7992	13.4924	1.76	8.4836	0.3112	13	11
493	2.0815	8.9641	1.0356	4.4599	0.329	8	7
494	2.4054	10.6501	1.3916	6.1615	0.3544	10	9
495	2.2964	9.8144	1.233	5.2696	0.3171	9	8
496	2.9728	12.1338	1.834	7.4856	0.275	13	12
497	2.3126	11.0613	1.4488	6.9297	0.4054	13	11
498	2.8818	11.6913	1.747	7.0877	0.2702	10	9
499	3.6293	15.7821	2.5431	11.0586	0.25	11	10
500	2.8222	11.6299	1.6757	6.9054	0.2459	10	9
Average	2.812	12.077	1.768	7.591	0.322	11.0	10.0
Std Dev	0.474	1.905	0.440	1.820	0.042	1.6	1.5

Max	5.148	20.789	3.943	16.089	0.446	16.0	10.0
Min	1.852	7.772	0.833	3.567	0.205	7.0	5.0

T(.90)	1.730		T(.95)	2.090			
+/- (.90)	0.037	0.147	0.034	0.141	0.003	0.1	0.1
+/- (.95)	0.044	0.178	0.041	0.170	0.004	0.2	0.1

	L	W	Lq	Wq	Po	Max(sys)	Max(line)
LB (.95)	2.768	11.899	1.727	7.421	0.318	10.9	9.8
LB (.90)	2.775	11.930	1.734	7.451	0.319	10.9	9.9
Avg	2.812	12.077	1.768	7.591	0.322	11.0	10.0
UB (.90)	2.849	12.224	1.802	7.732	0.325	11.2	10.1
UB (.95)	2.857	12.255	1.809	7.762	0.326	11.2	10.1

B	0.141	0.604	0.088	0.380	0.016	0.6	0.5
n=	34.069	29.777	74.307	68.782	19.919	25.3	27.9

Base Case

Station 3 - Bag Table (500 Replications/4 hours)
(1 server)

Rep No.	L	W	Lq	Wq	Po	Max(sys)	Max(line)
1	0.7679	4.2953	0.3125	1.7481	0.5446	4	3
2	0.681	3.824	0.2018	1.1331	0.5208	4	3
3	1.235	6.6214	0.7049	3.7793	0.4699	7	6
4	0.911	4.6745	0.3465	1.7779	0.4355	4	3
5	0.8248	4.049	0.2724	1.3371	0.4476	4	3
6	0.867	4.5655	0.3465	1.8247	0.4795	5	4
7	1.0201	5.1759	0.439	2.2276	0.4189	4	3
8	0.9182	4.8649	0.395	2.093	0.4768	5	4
9	0.9086	4.4026	0.3741	1.8125	0.4654	4	3
10	1.1295	5.3931	0.5378	2.5677	0.4083	4	3
11	0.7034	4.0781	0.2291	1.3281	0.5257	3	2
488	0.832	4.1291	0.2787	1.3833	0.4467	4	3
489	0.8046	3.9718	0.2869	1.4163	0.4823	4	3
490	0.9488	4.6767	0.4033	1.9882	0.4546	4	3
491	0.7874	4.1977	0.2829	1.508	0.4955	4	3
492	0.7183	4.1809	0.2483	1.445	0.53	4	3
493	0.8781	4.303	0.3292	1.6134	0.4512	5	4
494	0.7008	3.7925	0.2217	1.1999	0.5209	4	3
495	0.8495	4.3315	0.2921	1.4894	0.4426	3	2
496	0.808	3.9574	0.2601	1.2741	0.4522	3	2
497	0.7665	4.6392	0.3147	1.9045	0.5481	5	4
498	0.9937	4.8376	0.4185	2.0376	0.4249	4	3
499	0.8742	4.7338	0.3585	1.9414	0.4843	4	3
500	0.6648	3.4865	0.1898	0.9956	0.5251	3	2
Average	0.864	4.458	0.342	1.754	0.478	4.1	3.1
Std Dev	0.183	0.767	0.155	0.734	0.042	0.9	0.9

Max	1.522	7.730	0.965	5.075	0.604	8.0	3.1
Min	0.530	3.170	0.112	0.580	0.369	3.0	2.0

T(.90)	1.730		**T(.95)**	2.090			
+/- (.90)	0.014	0.059	0.012	0.057	0.003	0.1	0.1
+/- (.95)	0.017	0.072	0.015	0.069	0.004	0.1	0.1

	L	W	Lq	Wq	Po	Max(sys)	Max(line)
LB (.95)	0.847	4.386	0.328	1.686	0.474	4.0	3.0
LB (.90)	0.850	4.398	0.330	1.698	0.475	4.1	3.1
Avg	0.864	4.458	0.342	1.754	0.478	4.1	3.1
UB (.90)	0.878	4.517	0.354	1.811	0.482	4.2	3.2
UB (.95)	0.881	4.529	0.357	1.823	0.482	4.2	3.2

B	0.043	0.223	0.017	0.088	0.024	0.2	0.2
n=	53.666	35.474	245.995	209.662	9.294	59.4	103.5

Base Case

Station 4 - Blood Letting (500 Replications/4 hours)
(9 servers)

Rep No.	L	W	Lq	Wq	Po	Max(sys)	Max(line)
1	2	13.9007	0	0	-0.2761	8	1
2	2	12.9271	0	0	-0.2558	6	1
3	2	13.2711	0	0	-0.275	6	1
4	3	14.3214	0	0	-0.3101	7	1
5	3	14.2888	0	0	-0.3234	7	1
6	3	14.7458	0	0	-0.3111	8	1
7	2	12.1404	0	0	-0.2659	5	1
8	3	15.0505	0	0	-0.3156	8	1
9	3	13.3733	0	0	-0.3067	8	1
10	3	13.2941	0	0	-0.3094	7	1
11	2	12.5645	0	0	-0.2408	6	1
488	3	13.4618	0	0	-0.3014	7	1
489	3	14.4144	0	0	-0.3244	7	1
490	3	14.8326	0	0	-0.3343	9	1
491	2	12.2994	0	0	-0.2563	8	1
492	2	14.3364	0	0	-0.2737	7	1
493	3	14.2133	0	0	-0.3223	7	1
494	2	10.9595	0	0	-0.225	5	1
495	3	13.1014	0	0	-0.2855	6	1
496	3	13.5562	0	0	-0.3075	7	1
497	2	13.4661	0	0	-0.2472	6	1
498	3	13.3013	0	0	-0.3036	6	1
499	2	11.9878	0	0	-0.246	6	1
500	3	14.3283	0	0	-0.3036	8	1
Average	2.742	13.808	0.000	0.001	-0.296	7.2	1.0
Std Dev	0.438	0.929	0.001	0.006	0.028	0.9	0.1

Max	3.000	16.709	0.017	0.090	-0.199	11.0	1.0
Min	2.000	10.892	0.000	0.000	-0.379	5.0	1.0

T(.90)	1.730		T(.95)	2.090			
+/- (.90)	0.034	0.072	0.000	0.000	0.002	0.1	0.0
+/- (.95)	0.041	0.087	0.000	0.001	0.003	0.1	0.0

	L	W	Lq	Wq	Po	Max(sys)	Max(line)
LB (.95)	2.701	13.721	0.000	0.000	-0.299	7.1	1.0
LB (.90)	2.708	13.736	0.000	0.000	-0.298	7.1	1.0
Avg	2.742	13.808	0.000	0.001	-0.296	7.2	1.0
UB (.90)	2.776	13.880	0.000	0.001	-0.294	7.3	1.0
UB (.95)	2.783	13.895	0.000	0.001	-0.293	7.3	1.0

B	0.137	0.690	0.000	0.000	-0.015	0.4	0.1
n=	30.543	5.417	########	########	10.780	20.2	4.7

Base Case
Total System (from GPSSH)
(9 servers)

Rep No.	L	W	Lmax	#XACTS
1	8	32.8283	14	67
2	8	31.6382	12	69
3	8	33.7457	13	68
4	10	36.1406	16	73
5	9	32.4478	15	75
6	8	32.5618	13	66
7	8	31.5083	13	74
8	9	35.0026	12	67
9	8	33.2424	13	69
10	9	34.2035	15	69
11	7	30.7836	12	69
488	8	32.0119	13	70
489	9	34.1772	15	77
490	9	33.7316	13	71
491	9	35.5031	14	70
492	10	34.6396	16	78
493	9	32.6511	13	73
494	8	32.0201	14	71
495	9	35.4686	14	75
496	8	31.7336	12	72
497	8	32.207	12	66
498	9	35.6678	15	74
499	8	30.4547	13	69
500	9	33.0386	16	77
Average	8.464	33.470	13.942	70.6
Std Dev	0.708	1.580	1.329	3.6

T(.90)	1.730		**T(.95)**	2.1
+/- (.90)	0.055	0.611	0.514	1.4
+/- (.95)	0.066	0.739	0.621	1.7

	L	W	Lmax	#XACTS
LB (.95)	8.398	32.731	13.321	68.9
LB (.90)	8.409	32.858	13.428	69.2
Avg	8.464	33.470	13.942	70.6
UB (.90)	8.519	34.081	14.456	71.9
UB (.95)	8.530	34.208	14.563	72.2

B	0.423	1.673	0.697	3.5279
n=	8.384	2.669	10.878	3.0

Sums 500 runs

	L	W	Lq	Wq	Po	Max(sys)	Max(line)
Station 1 Registration - V	3.35	14.10	0.00	0.00			
Station 2 - Interview (50	2.81	12.08	1.77	7.59			
Station 3 - Bag Table (5	0.86	4.46	0.34	1.75			
Station 4 - Blood Letting	2.74	13.81	0.00	0.00			
	9.77	**44.44**	**2.11**	**9.35**			

(Infinite capcity)
(2 servers)
(1 server)
(9 servers)

Two Interviewers at all Times

Station 1 Registration - Vitals - Hemoglobin (500 Replications/48 hours)
(Infinite capcity)

Rep No.	L	W	Lq	Wq	Po	Max(sys)	Max(line)
1	4.0343	14.6855	0.0002	0.0006	0.6638	13	1
2	4.2876	15.0588	0	0	0.6427	12	1
3	3.9541	14.0628	0	0	0.6705	11	1
4	3.8724	13.467	0	0	0.6773	11	1
5	3.6955	13.7784	0	0	0.692	10	1
6	3.8842	13.7764	0	0	0.6763	12	1
7	3.7278	13.7715	0	0	0.6893	11	1
8	4.1851	14.5569	0	0	0.6512	12	1
9	4.0297	14.5527	0	0	0.6642	12	1
10	3.6475	13.4331	0	0	0.696	12	1
11	4.143	14.2216	0	0	0.6547	12	1
488	4.0303	14.4689	0	0	0.6641	12	1
489	4.7263	15.0573	0.0032	0.0103	0.6064	15	3
490	4.1159	14.3162	0.0065	0.0225	0.6575	14	2
491	3.7305	13.6895	0.0008	0.003	0.6892	13	1
492	3.9733	14.6158	0	0	0.6689	11	1
493	4.0941	14.5137	0	0	0.6588	12	1
494	4.0704	14.0225	0.0043	0.0149	0.6612	15	3
495	3.8456	13.8788	0	0	0.6795	12	1
496	4.2672	14.4932	0	0	0.6444	12	1
497	4.1393	13.9222	0.0001	0.0004	0.6551	13	1
498	4.1096	14.2597	0	0	0.6575	11	1
499	3.7109	13.3991	0	0	0.6908	11	1
500	4.4978	14.9695	0	0	0.6252	12	1
Average	4.027	14.127	0.001	0.002	0.664	12.1	1.2
Std Dev	0.198	0.510	0.002	0.007	0.017	1.3	0.6

Max	4.726	16.318	0.025	0.088	0.712	17.0	1.2
Min	3.462	12.666	0.000	0.000	0.606	10.0	1.0

T(.90)	1.730		T(.95)	2.090			
+/- (.90)	0.015	0.039	0.000	0.001	0.001	0.1	0.0
+/- (.95)	0.019	0.048	0.000	0.001	0.002	0.1	0.1

	L	W	Lq	Wq	Po	Max(sys)	Max(line)
LB (.95)	4.008	14.080	0.000	0.002	0.663	12.0	1.2
LB (.90)	4.012	14.088	0.000	0.002	0.663	12.0	1.2
Avg	4.027	14.127	0.001	0.002	0.664	12.1	1.2
UB (.90)	4.042	14.167	0.001	0.003	0.666	12.2	1.3
UB (.95)	4.045	14.175	0.001	0.003	0.666	12.2	1.3

B	0.201	0.706	0.000	0.000	0.033	0.6	0.1
n=	2.908	1.562	########	########	0.740	14.1	289.9

Two Interviewers at all Times

Station 2 - Interview (500 Replications/48 hours)
(2 servers)

Rep No.	L	W	Lq	Wq	Po	Max(sys)	Max(line)
1	1.5042	6.4821	0.4016	1.7307	0.4487	9	7
2	1.4161	5.8936	0.4067	1.6927	0.4953	12	10
3	1.3999	5.8015	0.3752	1.5548	0.4876	10	8
4	1.751	7.1472	0.6228	2.5423	0.4359	10	8
5	1.5383	6.6743	0.494	2.1434	0.4779	14	12
6	1.4546	6.0018	0.3509	1.4476	0.4481	8	6
7	1.4866	6.3517	0.4153	1.7746	0.4644	9	7
8	1.597	6.4418	0.4599	1.855	0.4314	11	9
9	1.4808	6.3003	0.4486	1.9085	0.4839	12	10
10	1.299	5.6512	0.3255	1.4161	0.5133	10	8
11	1.6934	6.9769	0.5848	2.4093	0.4457	13	11
488	1.4441	6.1658	0.3402	1.4524	0.4481	9	7
489	1.6915	6.4098	0.4971	1.8838	0.4028	9	7
490	1.448	6.0792	0.3953	1.6597	0.4736	12	10
491	1.3925	6.1241	0.4038	1.7757	0.5056	10	8
492	1.2844	5.6869	0.279	1.2354	0.4973	7	5
493	1.6235	6.6099	0.5126	2.0868	0.4445	9	7
494	1.5592	6.4893	0.5277	2.196	0.4842	13	11
495	1.4436	6.2519	0.4072	1.7637	0.4818	13	11
496	1.5766	6.2782	0.4833	1.9244	0.4533	11	9
497	1.589	6.2365	0.4848	1.9026	0.4479	11	9
498	1.8011	7.3683	0.6796	2.7801	0.4392	12	10
499	1.42	6.0497	0.3529	1.5036	0.4665	8	6
500	1.4503	5.7498	0.3871	1.5345	0.4684	8	6
Average	1.528	6.318	0.448	1.847	0.460	10.0	8.0
Std Dev	0.180	0.638	0.133	0.516	0.029	2.2	2.2

Max	2.377	9.310	1.096	4.175	0.544	20.0	8.0
Min	1.122	4.770	0.210	0.893	0.350	6.0	4.0

T(.90)	1.730		**T(.95)**	2.090			
+/- (.90)	0.014	0.049	0.010	0.040	0.002	0.2	0.2
+/- (.95)	0.017	0.060	0.012	0.048	0.003	0.2	0.2

	L	W	Lq	Wq	Po	Max(sys)	Max(line)
LB (.95)	1.511	6.258	0.435	1.798	0.457	9.8	7.8
LB (.90)	1.514	6.268	0.437	1.807	0.458	9.9	7.9
Avg	1.528	6.318	0.448	1.847	0.460	10.0	8.0
UB (.90)	1.541	6.367	0.458	1.887	0.462	10.2	8.2
UB (.95)	1.544	6.377	0.460	1.895	0.463	10.2	8.2

B	0.076	0.316	0.022	0.092	0.023	0.5	0.4
n=	16.578	12.197	105.670	93.596	4.695	55.2	86.0

Two Interviewers at all Times

Station 3 - Bag Table (500 Replications/4 hours)
(1 server)

Rep No.	L	W	Lq	Wq	Po	Max(sys)	Max(line)
1	2.362	10.4284	1.6761	7.3998	0.314	14	13
2	2.6168	11.0994	1.9128	8.1131	0.296	15	14
3	2.2927	9.6965	1.5778	6.6731	0.2851	12	11
4	3.9098	16.2812	3.1332	13.0474	0.2234	15	14
5	2.0213	8.9429	1.33	5.8846	0.3088	13	12
6	2.9795	12.5819	2.2454	9.4822	0.266	14	13
7	2.1948	9.6338	1.5172	6.6597	0.3224	12	11
8	2.8905	11.8416	2.1309	8.7297	0.2404	14	13
9	1.7733	7.7252	1.1219	4.8872	0.3485	9	8
10	2.4907	10.9179	1.7913	7.8524	0.3007	16	15
11	2.1636	9.1099	1.4623	6.157	0.2987	11	10
488	1.8567	8.1567	1.1905	5.2302	0.3338	11	10
489	3.686	14.2684	2.8829	11.1594	0.1968	18	17
490	2.4482	10.508	1.7038	7.3131	0.2556	12	11
491	1.9335	8.701	1.2911	5.8103	0.3577	14	13
492	1.792	8.0941	1.1733	5.2995	0.3813	12	11
493	2.2634	9.3458	1.568	6.4746	0.3047	17	16
494	2.0579	8.7286	1.367	5.7982	0.3091	12	11
495	2.1623	9.5659	1.4493	6.4116	0.287	11	10
496	2.0511	8.4958	1.3401	5.5508	0.289	11	10
497	3.623	14.4949	2.8477	11.3931	0.2247	16	15
498	2.3807	9.9083	1.691	7.0377	0.3103	13	12
499	2.167	9.3569	1.4797	6.3889	0.3126	16	15
500	2.731	11.0243	1.9716	7.9587	0.2406	11	10
Average	2.423	10.217	1.719	7.238	0.296	14.2	13.2
Std Dev	0.583	2.245	0.553	2.176	0.038	3.7	3.7

Max	5.127	20.766	4.316	17.481	0.401	32.0	13.2
Min	1.459	6.403	0.829	3.639	0.175	8.0	7.0

T(.90)	1.730		T(.95)	2.090			
+/- (.90)	0.045	0.174	0.043	0.168	0.003	0.3	0.3
+/- (.95)	0.054	0.210	0.052	0.203	0.004	0.3	0.3

	L	W	Lq	Wq	Po	Max(sys)	Max(line)
LB (.95)	2.369	10.008	1.667	7.034	0.292	13.8	12.8
LB (.90)	2.378	10.044	1.676	7.069	0.293	13.9	12.9
Avg	2.423	10.217	1.719	7.238	0.296	14.2	13.2
UB (.90)	2.468	10.391	1.762	7.406	0.299	14.5	13.5
UB (.95)	2.478	10.427	1.771	7.441	0.299	14.5	13.5

B	0.121	0.511	0.086	0.362	0.015	0.7	0.7
n=	69.188	57.776	123.977	108.234	20.104	80.6	93.3

Two Interviewers at all Times

Station 4 - Blood Letting (500 Replications/48 hours)

(9 servers)

Rep No.	L	W	Lq	Wq	Po	Max(sys)	Max(line)
1	4.7751	21.2446	0.0111	0.0493	0.4707	12	3
2	5.005	21.2289	0.1179	0.4999	0.457	16	7
3	5.0877	21.5174	0.1103	0.4664	0.4469	15	6
4	5.5234	23.034	0.126	0.5253	0.4003	14	5
5	4.7615	21.0667	0.0662	0.2927	0.4783	15	6
6	4.8217	20.603	0.082	0.3503	0.4734	15	6
7	4.7656	20.9497	0.0747	0.3283	0.4788	14	5
8	4.6899	19.2957	0.0449	0.1846	0.4839	14	5
9	5.0448	21.9765	0.0936	0.4077	0.4499	14	5
10	4.8437	21.2649	0.039	0.1713	0.4662	12	3
11	5.0458	21.2453	0.0946	0.3982	0.4499	15	6
488	5.0361	22.1585	0.067	0.295	0.4479	14	5
489	5.4469	21.0848	0.2094	0.8104	0.418	16	7
490	5.0064	21.5843	0.086	0.3708	0.4533	14	5
491	4.7835	21.5938	0.0373	0.1682	0.4726	13	4
492	4.5466	20.5678	0.038	0.1718	0.499	14	5
493	5.2003	21.4728	0.1714	0.7075	0.4412	21	12
494	5.3934	22.8762	0.0779	0.3305	0.4094	13	4
495	4.6068	20.3802	0.0524	0.2316	0.494	15	6
496	5.1395	21.4416	0.0819	0.3416	0.438	14	5
497	5.6658	22.7307	0.3657	1.4672	0.4111	21	12
498	5.2464	22.1548	0.1891	0.7984	0.4381	17	8
499	4.8792	21.2259	0.0945	0.4111	0.4684	14	5
500	5.6501	22.9686	0.2155	0.8759	0.3961	16	7
Average	5.048	21.426	0.100	0.420	0.450	14.6	5.6
Std Dev	0.305	0.937	0.068	0.279	0.029	2.1	2.1

Max	5.950	24.715	0.490	1.980	0.532	23.0	5.6
Min	4.247	18.504	0.004	0.017	0.366	10.0	1.0

T(.90)	1.730		T(.95)	2.090			
+/- (.90)	0.024	0.072	0.005	0.022	0.002	0.2	0.2
+/- (.95)	0.028	0.088	0.006	0.026	0.003	0.2	0.2

	L	W	Lq	Wq	Po	Max(sys)	Max(line)
LB (.95)	5.020	21.338	0.093	0.394	0.447	14.4	5.4
LB (.90)	5.025	21.353	0.094	0.398	0.448	14.5	5.5
Avg	5.048	21.426	0.100	0.420	0.450	14.6	5.6
UB (.90)	5.072	21.498	0.105	0.441	0.452	14.8	5.8
UB (.95)	5.077	21.513	0.106	0.446	0.453	14.8	5.8

B	0.252	1.071	0.005	0.021	0.023	0.7	0.3
n=	4.357	2.288	557.372	529.732	5.062	25.6	172.2

Two Interviewers at all Times

Total System (from GPSSH)
(9 servers)

Rep No.	L	W	Lmax	#XACTS
1	8	32.8283	14	67
2	8	31.6382	12	69
3	8	33.7457	13	68
4	10	36.1406	16	73
5	9	32.4478	15	75
6	8	32.5618	13	66
7	8	31.5083	13	74
8	9	35.0026	12	67
9	8	33.2424	13	69
10	9	34.2035	15	69
11	7	30.7836	12	69
488	8	32.0119	13	70
489	9	34.1772	15	77
490	9	33.7316	13	71
491	9	35.5031	14	70
492	10	34.6396	16	78
493	9	32.6511	13	73
494	8	32.0201	14	71
495	9	35.4686	14	75
496	8	31.7336	12	72
497	8	32.207	12	66
498	9	35.6678	15	74
499	8	30.4547	13	69
500	9	33.0386	16	77
Average	8.464	33.470	13.942	70.6
Std Dev	0.708	1.580	1.329	3.6

T(.90)	1.730		T(.95)	2.1
+/- (.90)	0.055	0.611	0.514	1.4
+/- (.95)	0.066	0.739	0.621	1.7

	L	W	Lmax	#XACTS
LB (.95)	8.398	32.731	13.321	68.9
LB (.90)	8.409	32.858	13.428	69.2
Avg	8.464	33.470	13.942	70.6
UB (.90)	8.519	34.081	14.456	71.9
UB (.95)	8.530	34.208	14.563	72.2

B	0.423	1.673	0.697	3.5279
n=	8.384	2.669	10.878	3.0

Sums 500 runs

	L	W	Lq	Wq	Po	Max(sys)	Max(line)
Station 1 Registration - V	4.03	14.13	0.00	0.00			
Station 2 - Interview (50	1.53	6.32	0.45	1.85			
Station 3 - Bag Table (5	2.42	10.22	1.72	7.24			
Station 4 - Blood Letting	5.05	21.43	0.10	0.42			
	13.03	**52.09**	**2.27**	**9.51**			