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SEMI-ANNUAL PROGRESS REPORT NO. 6

AND

FINAL REPORT

"Estimation and Testing of Parameters of Distributions by Order Statistics"

University of North Carolina

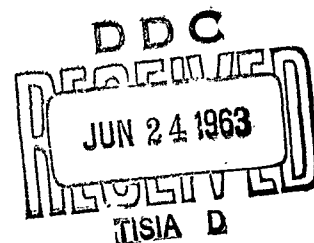
Chapel Hill, North Carolina

Period Covered: October 1, 1962 through March 31, 1963

Final Report: April 1, 1960 through March 31, 1963

Chief Investigator: Bernard G. Greenberg, Department of Biostatistics

GRANT NUMBER: DA-ORD-7  
2776-M



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## I. Fulfillment of Objectives

### A. Reports and Publications

1. Technical Report #12 (June 1, 1960) - Not published.  
"A Non-Parametric Comparison of Two Samples One of Which is Censored" by John G. Saw.
2. Technical Report #13 (July 15, 1960) - Biometrika, Vol. 47, Nos. 1 and 2, 1960, pp. 79-86.  
"A Note on the Error after a Number of Terms of the David and Johnson Series for the Expected Value of the  $r$ -th Smallest of  $n$  Ordered Normal Variates" by John G. Saw.
3. Interim Technical Report No. 1 (August 15, 1960) - Annals Mathematical Statistics, Vol. 34, No. 1, March 1963, pp. 102-116.  
"Simplified Estimates for the Exponential Distribution" by A. E. Sarhan, B. G. Greenberg and Junjiro Ogawa.
4. Interim Technical Report #2 (August 25, 1960) - Biometrika, Vol. 48, Nos. 3 and 4, 1961, pp. 448-451.  
"The Bias of the Maximum Likelihood Estimates of the Location and Scale Parameters Given a Type II Censored Normal Sample" by John G. Saw.
5. Interim Technical Report #3 (August 31, 1960) - Biometrika, Vol. 48, Nos. 3 and 4, 1961, pp. 367-377.  
"Estimation of the Normal Population Parameters Given a Type I Censored Sample" by John G. Saw.
6. Interim Technical Report #4 (February 25, 1961) - Abstract published.  
"Nearly Best Linear Estimates" by Carl-Erik Sarndal.
7. Interim Technical Report #5 (April 3, 1961) - Arkiv för Matematik, Band 4, Nr 29, 1961, pp. 385-392.  
"On a Maximizing Problem with Several Applications in Statistical Theory" by Carl-Erik Sarndal. Abstracted in Mathematical Reviews, Vol. 25, No. 4, April 1963, p. 699.
8. Interim Technical Report #6 (November 15, 1961) - Published as monograph in "Information From Censored Samples", Almquist and Wiksell, Stockholm, 1962, 120 pages.  
"Loss of Information in Estimation from Incomplete Samples" by Carl-Erik Sarndal.

9. Contributions to Order Statistics, by A. E. Sarhan and B. G. Greenberg, John Wiley and Sons, New York, N. Y., Sept. 1962, 482 pages.
10. Interim Technical Report #7 (December 1, 1962) - Being submitted to Technometrics.

"Nearly Optimum Spacings for Estimating the Parameters of the Gamma Distribution" by Carl-Erik Sarndal.

B. Current Period (September 1, 1962 through March 31, 1963)

1. Dr. Sarhan was on leave in Egypt during this entire period. Dr. Greenberg had heavy teaching and administrative duties and did no new research during this period. He followed through in getting Interim Technical Report #1 published in March 1963 issue of Annals of Mathematical Statistics, and supervised the work of Dr. Sarndal. In addition, he continued to negotiate for the services of Dr. M. N. Ghosh, India, to work on this project. He also supervised the doctoral dissertation of Mr. Khatab Hassanein whose work is described below.
2. Dr. Carl-Erik Sarndal resumed full-time employment on this project in the summer of 1962. His research involved an investigation into the efficiency and loss of information in censoring and with grouped data. He also worked on the development of nearly optimum estimates for the Gamma distribution.

This research has produced excellent results and is being finished under the new, continuing grant DA-31-124-ARO(D)-G432. A manuscript is being prepared for submission to Annals of Mathematical Statistics under the title, "Some New Aspects of Estimation from Grouped Samples and Type I Censored Samples." A technical report will not be issued on this research unless publication is delayed.

Another paper being readied for submission to the Journal American Statistical Association is "A Unified Derivation of Some Parameter-Free Distributions." This will also be distributed as a reprint, if accepted, rather than as a technical report.

3. Mr. Khatab Hassanein has finished his doctoral dissertation on nearly best linear estimates in specified distributions under various conditions of censoring. This will be issued as a technical report under the new grant and a smaller, condensed version will be used for submission to either Annals of Mathematical Statistics or Journal American Statistical Association.

C. Future Work

1. Plans are to continue the research outlined in grant proposal DA-31-124-ARO(D)-G432.

2. A postdoctoral fellow has been employed as of April 1, 1963 (Charles Roberts) to work on the problem of estimating minimum life and average life in the rectangular distribution when the sample is based upon  $n$  series of first failures among  $k$  simultaneously observed objects.

## II. Personnel

- A. The personnel who have served on this project for varying periods of time are:

Bernard G. Greenberg  
Ahmed E. Sarhan  
Junjiro Ogawa  
Bernard Pasternack  
John G. Saw  
Carl-Erik Sarndal  
Khatab Hassanein

## III. Fiscal (See attached table)

### III. Fiscal .

| Item                                | Total<br>budgeted* | Expenditures        |                     |                  | Remainder |
|-------------------------------------|--------------------|---------------------|---------------------|------------------|-----------|
|                                     |                    | Previous<br>Periods | Current<br>Period** | Total<br>to Date |           |
| 1. Salaries and wages               |                    | \$17,067.52         | \$4,200.00          | \$21,267.52      |           |
| 2. Supplies and printing            |                    | 1,053.97            | 35.37               | 1,089.34         |           |
| 3. Travel                           |                    | 772.61              | None                | 772.61           |           |
| 4. Communications and<br>shipping   |                    | 111.33              | 1.20                | 112.53           |           |
| Subtotal                            | \$23,750.00        | \$19,005.43         | \$4,236.57          | \$23,242.00      | \$508.00  |
| 5. Overhead<br>(at 20% of subtotal) | 4,750.00           | 3,801.08            | 847.32              | 4,648.40         | 101.60    |
| 6. Grand total                      | \$28,500.00        | \$22,806.51         | \$5,083.89          | \$27,890.40      | \$609.60  |

\* April 1, 1960 through March 31, 1963.

\*\* October 1, 1962 through March 31, 1963.