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1. Advances in the statistical theory of comparison of lifetimes of machines under the generalized Weibull distribution.
2. (with S. Arora) A unique minimal search design of resolution 3.2 for the 2^4 fractorial experiment.
3. Bounds connected with minimal coverings of finite Euclidean spaces.
4. (with R. Hveberg) Sequential probing designs for identifying nonnegligible effects in two 2^m factorial experiments, $m \leq 4$.
5. (with S. Arora) An infinite class of resolution 3.2 designs for the 2^m factorial experiment.
6. Some basic issues in design theory with special reference to response surfaces.
7. (with S. Arora) On the minimal resolution 3.1 designs for the 2^4 factorial experiments.

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Final Report on the Air Force Grant #AFOSR 830080

For the 5 year period: April 15, 1983 - April 14, 1988

Principal Investigator: Jaya Srivastava

Colorado State University

As in previous years, high quality work was continued during this year as well. The amount of research done is also higher than average. A break through was made in one important field. Thanks are due to the technical monitor for his support.

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Annual Report on the Air Force Grant #AFOSR 830080

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shown (under the Veibull distribution) how certain new censoring schemes and ways of doing experiments will cut down on the total time under experiment, the total length of experiment, and furthermore improve the efficiency from the point of view of the variance of the estimators. This work has now been extended in many ways in this present paper to the case where the lifetimes obey a generalized Veibull distribution. This paper has already been written. It is an invited paper which will be presented in the meetings of the American Statistical Association in New Orleans, in August 1988. It will be published in the proceedings of the ASA.

Paper #2 will be published in the Journal of the Indian Mathematical Society. This is the very first paper on the resolution 3.2 design. The subject of search designs was introduced by Srivastava about 15 years ago. Much work has been done by her in the field. All of this work has been supported by this series of grants. Anyone familiar with the subject of design of experiments can see that this field of search designs is quite popular. Vork in this field is being done at present by people in many countries. However, the problems in this area are quite difficult. Briefly speaking, a resolution 3.k design allows one to estimate the general me... and main effects in a factorial experiment, and also allows the identification . up to k extra unknown nonnegligible effects, and their estimation. Thus, these designs offer a considerable improvement on the classical theory. Indeed, in a way these designs are the only solution to the design problem. Unfortunately, as k increases the problems become very difficult, both from the analytical and combinatorial view point. Thus, only the case k = 1 has been considered and treated so far. This year, we have obtained results contained in two papers, for the resolution 3.2 case, and this is the first paper in this field. Besides

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obtaining the first resolution 3.2 design, we also show that it is minimal in size.

Paper #3 is concerned with certain discrete problems which are quite important. During the last years of his career, Professor Bose was very involved with such problems. Some Hungarian mathematicians also have worked on them. These problems have important applications in the area of factorial search design. The problems are concerned with the q-coverings of a finite Euclidean space EG(m,2) of m-dimensions based on GF(2). We want to obtain a minimal covering. Let M denotes the number of points in a covering. This paper is concerned with obtaining bounds on M.

In 1986-87 a very important break through was made in the theory of sequential design for identifying nonnegligibile parameters in factorial experiment. The foundation of a large, new, and very promising subject was laid. Paper #4 is the first paper that tries to apply that theory.

In paper #5, for each m, for the 2^m factorial experiment, we provide a series of search designs of resolution 3.2.

During this year, the author has also looked at the general field of response of surfaces. It has been found that the whole field is ripe for considerably important new advances. In this field, it appears that only that part of factorial design theory has been used which was developed mostly in the 1940's, and some in the 50's. However, a very large amount of new and important developments have taken place in the factorial design theory since the 60's onwards. All this has not yet been applied to the field of response surfaces. Also the proper use of continuous optimal design theory has not been made in this field either. Srivastava is intending to open up important fields of applications in the general area of response surfaces. Paper #6 is the first paper in this direction.

Many workers have obtained factorial designs of resolution 3.1. Let N denote the number of treatments needed in such a design. So far, the designs obtained by the various workers had a minimum value of M = 11. However, in paper #7 we showed that the minimum value of M equals 10, and that there are exactly 6 nonisomophic designs with M = 10. We obtained these designs.

Papers #3, 4, 5, 6, and 7 are not written yet. At the time of the writing of this report, papers #5, 6, and 7 are being written, and are almost complete. These papers should be in typed form in about a month's time. Paper #4 will be written in late June 1988. Paper #3 will not be written now, since it has opened up many sub-areas in which further computer work would be desirable. A judgment will be made later on as to whether to write the paper containing the results that have been obtained so far, or to finish the computer work and write a more comprehensive paper.

Paper #3 was presented in October 1987, in the annual meeting of the Society for Industrial and Applied Mathematics. Paper #5 was presented in the Boston meeting of the Institute of Mathematical Statistics in March 1988.

During the period under review, studies have been initiated and some important results obtained, also in the field of sampling theory. However, further work is going on, and we expect many papers in the next year or so.

Finally, newer studies have been initiated in the field of reliability. We expect further important advances in this area in the next several years.

During this period, Professor Srivastava was also invited to conferences in Australia, India, and Greece. Unfortunately, the conferences were at about the same time, in August 1987. Because of this conflict, Professor Srivastava accepted the invitation only from Greece. However, because of a knee injury a couple of weeks before the Greece conference, she could not unfortunately go there either.

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