calculus of binary relations in terms of the two operations $|$ and $<$. In his paper McKinsey shows that $<$ is definable in terms of $|$ but not conversely. In this paper the author develops a set of independent postulates for the calculus of binary relations in terms of the single operation $|$. (Received January 25, 1941.)

Statistics and Probability

169. Archie Blake: *The exploratory determination of statistical distributions.*

The most powerful statistics are not always the most "efficient" or those whose distributions have already been tabled, but their distributions can be computed in small samples without inordinate labor. To find the distribution of $g(X=x_1, \cdots, x_n)$ subject to the condition $P(X)$, compute requisite values of g^{-1} (multiple-valued) and require $\int^{P,g^{-1}} f(X)dX$, f being the given distribution function. The chief task is the computation of many values of the functions involved; this is alleviated by modern machine methods (especially punched cards). Tables of f, g, and so on, with their derivatives or the required fractions of the latter are prepared once for all on cards; thereafter the work consists only of interpolation. (Taylor's series recommends itself in this problem, as it converges more rapidly than ordinary interpolation formulae, and in the case of multivariate interpolation is much less complicated.) For a statistic whose asymptotic distribution is known, we can interpolate approximately between this and the results of the computation for small n to obtain an estimated distribution for any n. (Received January 23, 1941.)

170. W. G. Madow: *The distribution of the general quadratic form in normally distributed random variables.*

The distribution of the general quadratic form in normally distributed random variables is obtained. This distribution is used to obtain the distribution of Neyman's estimate in the theory of the representative method of sampling, and it is also used to obtain a generalization of P. L. Hsu's distribution of Student's ratio when the true means and variances are unequal. The distribution is also used in tests occurring in the analysis of variance with non-orthogonal data, and the study of differences of various orders. In the latter use, a test for periodicity is obtained. (Received January 25, 1941.)

171. Henry Scheffé: *An inverse problem in correlation theory.*

An $m \times n$ matrix Y may be used to represent m sets of measurements on n variables. The $n \times n$ matrix R of correlation coefficients r_{ij} is a function of the matrix Y, $R=F(Y)$. Necessary conditions (C) that $R=F(Y)$ are that R be real symmetric with diagonal elements unity, and positive (rank=index). Given any matrix R satisfying the conditions (C), does a "statistics problem Y" exist such that $R=F(Y)$? It is proved by matrix methods that there are no solutions Y with $m \leqq \text{rank } R$, but ∞ solutions for each $m > \text{rank } R$. Particular solutions are constructed and the most general solution is characterized. Some corollaries are drawn. (Received January 8, 1941.)

172. Jacob Wolfowitz: *Tests of statistical hypotheses where the distribution forms are unknown.*

The likelihood ratio criterion for testing composite statistical hypotheses, discovered by Neyman and Pearson and recently proved by Wald to be asymptotically