LAWLEY, D. N. AND MAXWELL, A. E. *Factor Analysis as a Statistical Method*. Butterworths Mathematical Texts, England, 1963. viii + 117 pp. $4.25.

Reviewed by HERMAN RUBIN

Michigan State University

This little book is an excellent treatment of what factor analysis is and, apart from the shortcomings below, a good treatment of the computational methods available and of the sampling errors and tests of significance involved. Although there is an appendix on matrices and determinants, the reviewer would not recommend either the book or the appendix to someone who does not already have a reasonable knowledge of matrix algebra. Each chapter is followed by a selected list of references which is more than adequate. The authors clearly state what the problem of factor analysis is; give three computational methods—the centroid method, principal components, and maximum likelihood; discuss the problem of rotation and the estimation of factor loadings under restrictions; the estimation of factor scores; and the problem of different populations.

For the centroid method and the method of principal components the computational methods given are the classical ones. For maximum likelihood, the procedures given do not always converge very rapidly, as has been noted in too many of the references to list. However, the authors do not seem as concerned from a practical standpoint about this as other workers in the field. The examples given in the book are not those in which this problem would arise. Unfortunately, the only place in the literature known to the reviewer where any computational method adequate for treating the problems involved here is even indicated is an abstract of the reviewer's, reference (2) below. Similar methods are needed to handle the problem of deciding whether or not a specific variance should be estimated to be 0, which the authors pass over. Another point inadequately discussed by the authors is the problem of robustness. Good results in this direction are available, especially if the normalization is based entirely on factor loadings. A treatment of the asymptotic distribution under non-normal alternatives is given as the last theorem of reference (1) below.

REFERENCES

[1] ANDERSON, T. W. and RUBIN, HERMAN (1954–55). Statistical inference in factor analysis. *Proc. Third Berkeley Symp. Math. Statist. Prob.* **5** 111–150. Univ. of California Press.
[2] RUBIN, HERMAN (1955). Asymptotic distribution of maximum likelihood estimates in factor analysis in the loading-normalized case. *Ann. Math. Statist.* **26** 770.