

$$\frac{1}{B\left(\frac{1}{2}, \frac{\nu}{2}\right)} \int_{x_\alpha}^1 p^{-1}(1-p)^{(\nu-2)/2} dp = \alpha.$$

Using the approximation of ordinate over abscissa for the cumulative normal for extreme abscissa we find that z is the abscissa of a cumulative normal which is approximately equal to the power of the t -test for alternative δ . In a similar manner the normal approximation to the binomial yields $z = \delta\sqrt{r+1}$ for the sign test. A fixed value of N and α determines r , α , x_α and we may solve for ν .

REFERENCES

- [1] National Bureau of Standards, *Tables of the Binomial Probability Distribution*, U. S. Government Printing Office, Washington, D. C.
- [2] K. PEARSON, *Tables of the Incomplete Beta Function*, Cambridge University Press, 1934.
- [3] BURTON H. CAMP, "Approximation to the point binomial," *Ann. Math. Stat.*, Vol. 22 (1951), pp. 130-131.
- [4] W. G. COCHRAN, "The efficiencies of the binomial test of significance of a mean and of a correlation coefficient," *J. Roy. Stat. Soc.*, Vol. 100 (1937), pp. 69-73.
- [5] W. J. DIXON AND A. M. MOOD, "The statistical sign test," *J. Amer. Stat. Assn.*, Vol. 41 (1946), pp. 557-566.
- [6] MURRAY F. FREEMAN AND JOHN W. TUKEY, "Transformations related to the angular and the square root," *Ann. Math. Stat.*, Vol. 21 (1950), pp. 607-611.
- [7] T. A. JEEVES AND ROBERT RICHARDS, "A note on the power of the sign test," *Ann. Math. Stat.*, Vol. 21 (1950), p. 618.
- [8] W. L. NICHOLSON, "A computing formula for the power of the analysis of variance test," submitted to *Ann. Math. Stat.*
- [9] JOHN E. WALSH, "On the power function of the sign test for slippage of means," *Ann. Math. Stat.*, Vol. 17 (1946), pp. 358-362.
- [10] JOHN E. WALSH, "On the asymptotic power efficiency of the sign test for slippage of means," Douglas Aircraft Co., Inc. Report.
- [11] JOHN E. WALSH, "Some comments on the efficiency of statistical tests," *Human Biology*, Vol. 21 (1949), pp. 205-217.
- [12] JOHN E. WALSH, "Some significance tests for the median which are valid under very general conditions," *Ann. Math. Stat.*, Vol. 20, (1949), pp. 64-81.
- [13] JOHN E. WALSH, "Some bounded significance level properties of the equal-tail sign test," *Ann. Math. Stat.*, Vol 22 (1951), pp. 408-417.

THE ADMISSIBILITY OF CERTAIN INVARIANT STATISTICAL TESTS INVOLVING A TRANSLATION PARAMETER

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1. Introduction. The notion of invariance (or symmetry) has such strong intuitive appeal that many current statistical procedures have the invariance property and are in fact the best invariant procedures although they were pro-

Received 2/10/53.

¹This work is supported in part by the Office of Naval Research.