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VARIANCE TEST FOR NORMALITY.(U)
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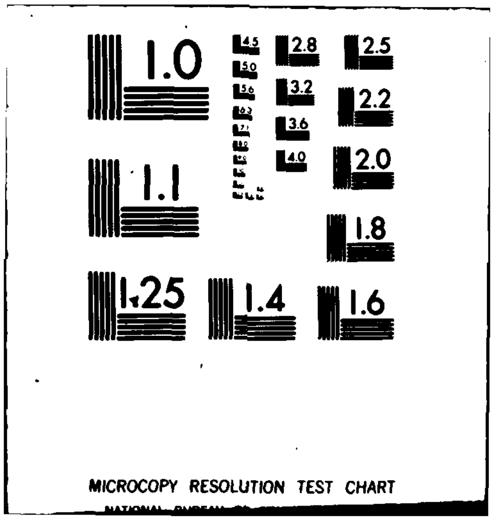
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NAVY UNDERWATER SOUND LABORATORY
NEW LONDON, CONNECTICUT 06320

(6) VARIANCE TEST FOR NORMALITY

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by

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INTRODUCTION

For sample sizes up to n = 50 an ordered sample $(X_1 \ldots X_n)$ may be tested for normality by a calculation involving a vector $(V_1 \ldots V_n)$ that is tabulated in (1). If V and X are column vectors the test statistic, also tabulated in (1), is

(9) Technical memo

(12) 3

$$W = \frac{(V_i^T X_i)^2}{(X_i - \bar{X})^2} \qquad i = 1 \ldots n$$

The distribution of W ranges from 0 to 1 where as W approaches 1.0 the distribution of $(X_1 \ldots X_n)$ comes closer and closer to being Gaussian.

When dealing with a very large sample, N measurements, how does one proceed to test for normality since V for samples greater than 50 is not available? A common procedure is the chi squared test for deviations from an expected distribution. A more attractive but approximate method, outlined below, is the taking of a sample of n = 50 from the cross section of the large sample of N values. These 50 values may

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then be tested by $(V_1 \ldots V_{50})$ from the table in (1).

METHOD

The procedure for obtaining n = 50 values from N values is:

The i^{th} ordered value of the sample $(X_1 \ldots X_{50})$ equals the $(NP_i + \frac{50-i}{49})$th ordered value of sample $(X_1 \ldots X_N)$ rounding to the nearest integral value.

The vector $P = (P_1 \ldots P_{50})$ is obtained from (2) using 50 percent ranks with the tails of the distribution adjusted outward to give a standard deviation for $(X_1 \ldots X_{50})$ close to that of the large sample $(X_1 \ldots X_N)$ and with W close to 1. The vector P is:

P = .0048,.0322,.0531,.0729,.0928,.1126,.1325,.1524,.1722,.1921,.2119,
.2318,.2517,.2715,.2914,.3113,.3311,.3510,.3709,.3907,.4106,.4305,
.4503,.4702,.4901,.5099,.5298,.5497,.5695,.5894,.6093,.6291,.6490,
.6689,.6887,.7086,.7285,.7483,.7682,.7880,.8079,.8278,.8476,.8675,
.8873,.9072,.9270,.9469,.9678,.9952

If N = 10,000 the required set $(X_1 \ldots X_{50})$ equals the (49th, 323rd, 532nd ...9952nd) ordered values of the sample $(X_1 \ldots X_{10,000})$.

The vector $(V_1 \ldots V_{50})$ = (-.3751,...-.0035,.0035,...,.3751) and W would be calculated as usual. From tables of the unit normal distribution a cross-section sample of 50 yielded a sigma of 1.004 (for 50 degrees of freedom) and a W of .9996, both sufficiently close to unity for general application.

SUMMARY

An alternate method has been outlined to test if a large sample is Gaussian in distribution. Instead of a chi squared test of fit a new statistic W is evaluated using a cross-section sample of 50 from a much larger sample of data. If the large sample is at least 100, the technique yields reliable results which may be assessed for significance against tabulated percentiles of W.

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REFERENCES

1. Shapiro, S.S., and Wilk, M.B., "An Analysis of Variance Test for Normality," Biometrika, 52, 3 and 4, p 591, (1965).

2. Failure Distribution Analyses Study, Volume 3, Tables of Plotting Positions, Dept of the Navy, CAI-NY 6052, Contract NObsr-89126, AD631527, (1964).