Statistical Bulletin
Reliability & Variation Research

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FLASH! DRI WILL PROVIDE ITS OWN MONTHLY STATISTICAL BULLETIN!

This constitutes the beginning of a new service by DETROIT RESEARCH INSTITUTE to those who are interested in the latest statistical developments in the field of practical applications of statistics to Reliability, Quality Control and Industrial Management. The Statistical Bulletin will appear eight times a year at the annual subscription of $32. (A charter subscription rate is $25, which will be in effect until July 1, 1971). In this way it will be possible for all our former clients and students to keep up to date with the latest developments in applied reliability methods and Weibull statistics, as well as with order statistics and skewed distribution mathematics. Mr. Leonard G. Johnson, who is so well known in this field, will be providing the technical portions of these Bulletins. You may be assured that each Bulletin will be chock full of interesting and informative tidbits of a practical nature for use in everyday problems which involve statistical analysis. Take, for example, the following questions and answers we now include:

QUESTION #1: What is a simple approximate formula for the cumulative area under a normal curve?

Answer #1: Let t = Number of standard deviations from the mean

(A positive t denotes values above the mean.)

(A negative t denotes values below the mean.)

Let N (t) = Cumulative area under a normal curve from $-\infty$ to t.

Then,
$$N(t) = \frac{1}{1 + e^{-1.8138\,t}}$$

This is the LOGISTIC FORMULA for N (t).

For those who are curious, $1.8138 = \dfrac{\pi}{\sqrt{3}}$

Note: At values of $t > 1$ it has been found that 1.664 is a better constant than 1.8138

Question #2: Since it is claimed that a Weibull function with slope parameter 3.5 approximates a normal distribution, how could we write an approximate formula for the area under a normal curve by using such a Weibull approximation?

Answer #2: Just a Weibull slope of 3.5 will not be sufficient to fully define every normal distribution situation. The Weibull approximation must also have a minimum value of 3.162 standard deviations below the mean. The Weibull approximation for N (t) then is

$$N(t) = 1 - e^{-(.8998 + .2846\,t)^{3.5}}$$

$$(-3.162 \leq t < +\infty)$$

Question #3: How can the c - level in an F distribution be calculated by using rank tables?

Answer #3:

$$F_c(\nu_1, \nu_2) = \left(\frac{\nu_2}{\nu_1}\right) \frac{Z\left(\frac{\nu_1}{2}, \frac{\nu_1}{2} + \frac{\nu_2}{2} - 1\right)}{1 - Z_c\left(\frac{\nu_1}{2}, \frac{\nu_1}{2} + \frac{\nu_2}{2} - 1\right)}$$

ν_1 = Numerator degrees of freedom (in the F Ratio)

ν_2 = Denominator degrees of freedom (in the F Ratio)

$Z_c\left(\frac{\nu_1}{2}, \frac{\nu_1}{2} + \frac{\nu_2}{2} - 1\right)$ = c - rank of the $\left(\frac{\nu_1}{2}\right)$ th order statistic in $\left(\frac{\nu_1}{2} + \frac{\nu_2}{2} - 1\right)$

For example, the 95% level in an F Distribution for $\nu_1 = 20$ and $\nu_2 = 10$ degrees of freedom is

$$F_{.95}(20, 10) = \left(\frac{10}{20}\right) \frac{Z_{.95}(10, 14)}{1 - Z_{.95}(10, 14)} = (.5)\left(\frac{.84728}{.15272}\right) = 2.77 \quad \text{(Ans.)}$$

Question #4: If in a distribution of STRESS a band of width W can be placed around the mean, without overlapping another band of width W around the mean in a distribution of STRENGTH, what is the probability that the strength will exceed the stress?

Answer #4: Probability that STRENGTH > STRESS = P = $\dfrac{\text{Log}\left(\frac{1 - W}{2}\right)}{\text{Log}\left(\frac{1 - W^2}{4}\right)}$