New Statistical Scales
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This is a description of my new statistical scales available for your emulator. It is NOT an attempt to explain statistical methods or applications. I verified the scales by using tables from "CRC Standard Math Tables". I will expand documentation for when we do a public release.

I have loaded a 5-sided statistics example with some Gamma, Normal, and Chi Square examples, and all the Log Gamma scales. It takes about 10 seconds to load (the more stat scales included, the slower the startup). It is called "gjm_5_sided_stat.txt".

Basic sets of statistical scales

The sets of scales are divided into two groups:

1) Log Gamma scales
2) Statistical distribution scales

Log Gamma scales

The Log Gamma scales represent the log (or ln) of the Gamma(x). X is located on the Gamma scale, and the log (or ln) of Gamma is found on the D scale (and the actual value, except for higher values of x, are found on the LLD [or LL] scales). Example, we want to determine the logGamma of 10. Set the hairline to 10 on the LogGamma4 scale (the only one of the 6 LogGamma scales with 10 on it), and read 5.56 on the D scale (since this LogGamma scale is designed to read answers from 1 to 10). Also the LLD4 scale shows this to be about 360K (actual value is 362880). There are 6 LogGamma scales, ranging roughly from x=2.00054 thru 71. The last LogGamma scale has no LLD scale for actual value (Gamma(70) > 10^98, the LLD scales only go to 10^10). There are 5 LnGamma scales, ranging roughly from 2.0024 thru 38.3. Again the last LnGamma scale has no LL scale for actual value.

These scales were separated so that they can quickly be graphed and used (similar to LL and LLD scales). They only take one parameter, the height of the scale. Use the following for these scales:

- scale_LogGamma0 [height] … scale_LogGamma5 [height]
- scale_LogGamma0_down [height] … scale_LogGamma5_down [height]
- scale_LnGamma0 [height] … scale_LnGamma4 [height]
- scale_LnGamma0_down [height] … scale_LnGamma4_down [height]

Statistical distribution scales (general)

The statistical scales are all based on common statistical distributions. With the exception of the Chi Square Degrees of Freedom scale, all scale values represent the area (>=0.00001 and <=.99999) under the curve (a.k.a. the cumulative function) for the particular distribution (0 would mean no area exists for

this x value, 1 would mean all the area under the curve). The value on the D scale represents the value of x required to produce the area on the distribution scale.

Normal distribution scales (and use of the decade parameter)

The simplest of the statistical distribution scales is the normal distribution scale. It has two flavors, the 1-tail and 2-tail. The distribution assumes center of 0 and standard deviation of 1. So at D scale = 1 (1 standard deviation, you will get a 1-tail value of .84 (= .5 + .34 for right side of distribution), or a 2-tail value of .68 (.34 on each side of the distribution).

These scales take two parameters, which decade to use (a floating value used to represents the power of 10 to multiply the D scale by for the x-value represented, decade -1.0 covers x = .1 to 1, decade 0.0 covers x = 1 to 10, decade 0.5 could be used to match the distribution to the DF10 scale covering x = sqrt(10) to 10*sqrt(10), etc) and the height of the scale (integer as usual). In this case, the scale parameter isn't of much use above 0.5. Use the following for normal distribution scale definitions:

- scale_NormalDist_1Tail [decade height]
- scale_NormalDist_1Tail_down [decade height]
- scale_NormalDist_2Tail [decade height]
- scale_NormalDist_2Tail_down [decade height]

Student's-T distribution scales

Closely associated with the normal distribution scale is the Student's-T distribution. The Student's-T distribution scale takes an extra parameter (degrees of freedom) in addition to the decade and height parameters. As the degrees of freedom go up, Student's-T more closely approaches the normal distribution (degrees of freedom > 30). Again both 1-tail and 2-tail versions are supplied. Example, for degrees of freedom = 2, hairline to .9 on the Normal Distribution scale as the desired area (confidence level), we find D-scale reads 1.886 if using the 1-tail scale, and 2.92 if using the 2-tail scale.

Interestingly, the degrees of freedom value is a floating value. Usually you will only use an integer value for this, but it must be formatted as a floating value (i.e. put a .0 after the integer) Use the following for Student's-T distribution scale definitions:

- scale_StudentsTDist_1Tail [decade deg_of_freedom height]
- scale_StudentsTDist_1Tail_down [decade deg_of_freedom height]
- scale_StudentsTDist_2Tail [decade deg_of_freedom height]
- scale_StudentsTDist_2Tail_down [decade deg_of_freedom height]

Chi Square distribution scales

Next is the Chi Square distribution. Again the Chi-Square distribution scale takes an extra parameter (degrees of freedom) in addition to the decade and height parameters. Only a 2-tail version is used (it is the only one I have ever seen tables for), and acts as the other distribution scales.

Actually, the Gamma (discussed next), Normal, and Chi Square distributions are all related to each other. Use the following for Chi Square distribution scale definitions:

- scale_ChiSquareDist [scale deg_of_freedom height]
- scale_ChiSquareDist_down [scale deg_of_freedom height]

Degrees of freedom scales

Sometimes it is useful for a particular confidence level (area under the curve) to see what various degrees of freedom will yield that area. So a second Chi Square scale set and a second Student's-T scale set (2-tail only) were produced that takes the area as an extra parameter instead of the degrees of freedom, and yields the degrees of freedom on the scale itself. Use the following for these degrees of freedom scale definitions:

- scale_ChiSquareDegOfFreedom [decade area height]
- scale_ChiSquareDegOfFreedom_down [decade area height]
- scale_StudentsTDegOfFreedom [decade area height]
- scale_StudentsTDegOfFreedom_down [decade area height]

Gamma distribution scales

The Chi Square, Gamma, and Normal distribution scales are really special versions of the incomplete Gamma function. Gamma uses two value to shape the distribution, which I will call here the a_param for the left distribution shaper, and b_param for the right distribution shaper. The Gamma distribution has it's own sliderule scale set. The scale definitions for the Gamma distribution are:

- scale_GammaDist [decade a_param b_param height]
- scale_GammaDist_down [decade a_param b_param height]

F and Beta distribution scales

The F distribution scales require two degree of freedom designations (numerator and denominator). It is related to the Beta distribution (which also is related to Student's-T for that matter). Both of these distributions are implement by using the following scale definitions:

- scale_FDist [decade num_deg_of_freedom den_deg_of_freedom height]
- scale_FDist_down [decade num_deg_of_freedom den_deg_of_freedom height]
- scale_BetaDist [decade a_param b_param height]
- scale_BetaDist_down [decade a_param b_param height]

Conclusion

That about covers the new scales. There are NO degree of freedom scales for the other distributions that have degrees of freedom parameters so far. If you look at an F-distribution table, you can see why it doesn't work very well for F (and believe me I tried!). I haven't tried it for the Beta distribution yet.

Enjoy.