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http://www.humboldt.edu/~geodept/geology531/531_handouts/rainfall_freq_analysis.pdf

FREQUENCY ANALYSIS OF MEAN ANNUAL PRECIPITATION

Reference: Dunne and Leopold, p. 42-48

There are two possible procedures for computing the frequency distribution of annual rainfalls at a gage. Both are described below.

PROCEDURE 1: RANKING AND PLOTTING ALL THE INDIVIDUAL RAINFALLS

This procedure works well by hand for relatively small data sets (e.g., 30 years or less) but becomes tedious and time-consuming for large sets of data (e.g., 80-100 years) unless done on a computer. Steps a through c below are ideally done by using a spreadsheet with graphics capabilities (such as Excel), a scientific graphing program (such as KaleidaGraph), or a statistics program (such as StatView, Data Desk, JMP, or MINITAB.)

a. *Rank* all the annual precipitation values (P_i) in order from largest to smallest, letting the largest value have rank m = 1 and the smallest value have rank m = n, where n is the total number of years being used.

b. For each value, calculate the *cumulative percent of all rainfall events that were less than or equal to that value.* This can be computed from the following formula:

$$F_i = \left[1 - \frac{m}{n+1}\right] \text{ x } 100\% \qquad \text{where}$$

F_i = percent of years with rainfall less than or equal to the particular annual rainfall having rank m

c. Plot the values of annual precipitation, P_i, versus the corresponding values of cumulative frequency F_i on arithmetic probability paper. Fit the data points with a straight line or a smooth curve. A good fit with a straight line indicates that the rainfalls are normally distributed (i.e., that they follow the normal probability distribution.)

   If the line curves, or does not fit the data well (which commonly happens with strongly skewed data), we can try *transforming* the data by taking either the logarithms or the cube roots of the annual precipitation values. We then plot the transformed values against the cumulative percent and see if we can fit the points with a straight line. (Such straight lines represent, respectively, the log-normal and the cube-root normal distributions.) If this is being done by hand, a short-cut for seeing whether the data is log-normally distributed is to plot it on log-probability paper. This paper's scale automatically takes the logs of the data.

PROCEDURE 2: RANKING AND PLOTTING GROUPED RAINFALLS

This procedure should be used chiefly when large data sets must be reduced by hand. When a computer and appropriate software are available you should use procedure 1.

a. Set up a series of 8 to 12 *class intervals* for rainfall (e.g., 30-40", 40-50", 50-60" etc.) The size (width) of the intervals you actually use depends upon the range of the rainfall data; you want to pick an interval width which will give you from 8 to 10 classes with simple, easy-to-use class boundaries.

b. Inspect the data and *tally* the rainfalls into size classes.

c. Calculate the cumulative percent (cum %) of all the events less than or equal to the *upper limit* (upper boundary) of that size class. This can be calculated by:

$$\text{cum \%} \leq \text{upper bdry} = \frac{\text{n} - \text{total no. of values in all larger classes}}{\text{n} + 1} \times 100\%$$

d. plot the values of the upper class boundaries against the corresponding frequency on arithmetic probability paper. From here on the analysis is identical to that of procedure 1.