

7.6 FREQUENCY GRAPHS

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The frequency analysis for the Mississippi River at St. Louis is presented graphically in Figs. 7.1 and 7.2. These graphs were printed from the Hydrologic Engineering Center-Flood Frequency Analysis (HEC-FFA) (Hydrologic Engineering Center, 1992) computer program discussed in Section 7.7.1. The confidence limits on the frequency curves are discussed in Section 7.7.2. The Weibull plotting positions from Section 7.4 and analytical flow frequency curves from Section 7.5 are discussed in the following paragraphs.

In Fig. 7.1, flows are on an arithmetic scale versus exceedance frequency on a normal probability scale. In the log-normal graph of Fig. 7.2, the flows are on a logarithmic scale. The Weibull plotting positions from Table 7.2 are plotted on both graphs as discussed in Section 7.4. A curve could be drawn through the 66 data points manually based on judgment regarding the best fit. Different people might draw the line somewhat differently. However, the frequency curve lines actually included on the two graphs are based on the analytical probability functions discussed in Section 7.5, not Weibull plotting positions. The frequency curves are fixed precisely by the analytical distributions with parameters computed from the data. The normal distribution and log-Pearson type III distribution are graphed in Figs. 7.1 and 7.2, respectively.

The normal distribution is a straight line on graph paper with an arithmetic scale versus normal probability scale. Thus, the frequency curve in Fig. 7.1 is a straight line through the 10-year and 100-year recurrence interval flows of 21,500 and 27,000 m³/s determined in Example 7.5 or any other two points computed based on the normal probability distribution. The log-normal distribution is linear on log-normal graph paper, which has a logarithmic scale versus normal probability scale as illustrated by Fig. 7.2. Equivalently, a graph of logarithms of flows plotted on an arithmetic scale versus exceedance frequencies determined from the log-normal distribution plotted on a normal scale is linear. Although the log-normal distribution is not plotted in Fig. 7.2, it easily could be. The 10-year and 100-year flows determined in Example 7.5 define a straight line representing the log-normal distribution on log-normal graph paper.

The log-Pearson type III flow frequency curve is shown in Fig. 7.2, along with confidence limits that are discussed later in Section 7.7.2. The graph has logarithmic versus normal probability scales. With a nonzero skew coefficient, the log-Pearson type III distribution is a nonlinear curve. If the skew coefficient is zero, the log-Pearson type III distribution is equivalent to the log-normal distribution and plots as a straight line on log-normal probability paper.

The 1993 flood discussed in Section 2.2.3.2 resulted in a peak discharge of 30,600 m³/s on August 1, 1993 at the gage on the Mississippi River at St. Louis. The log-Pearson type III curve in Fig. 7.2 indicates that 30,600 m³/s has an exceedance frequency of about 0.4 percent ($P = 0.004$ and $T = 250$ years). This analysis addresses only peak discharge at this particular gaging station. As discussed in Section 2.2.3.2, the 1993 flood in the Midwest encompassed the Missouri and Mississippi Rivers and their tributaries in several states. Different recurrence intervals are assigned at different locations for the same flood.

SOURCE: Wurbs & James,
2002

EXAMPLES OF FREQUENCY GRAPHS
 (HEC-FFA computer program)
 [Hydrologic Eng. Center - Flood Frequency Analysis]

Arithmetic scale

logarithmic scale

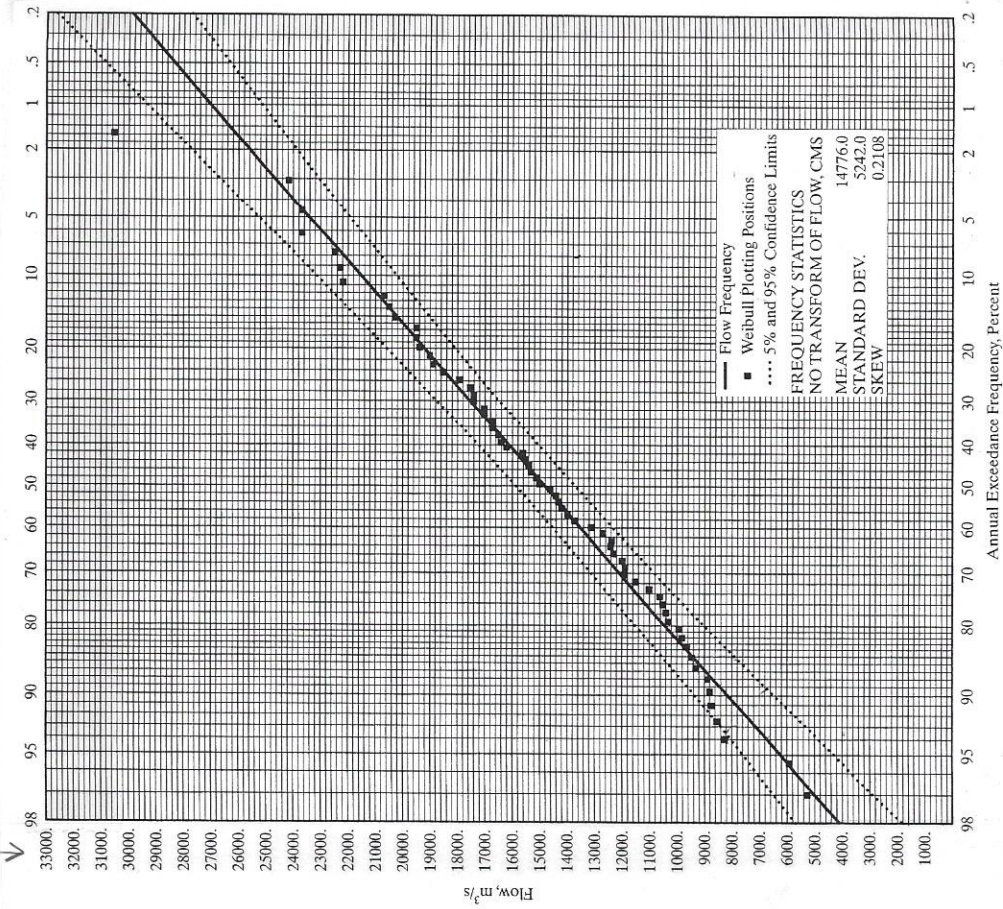


Figure 7.1 The normal frequency curve and Weibull plotting positions for peak annual flows in the Mississippi River at St. Louis are graphed on normal probability paper.

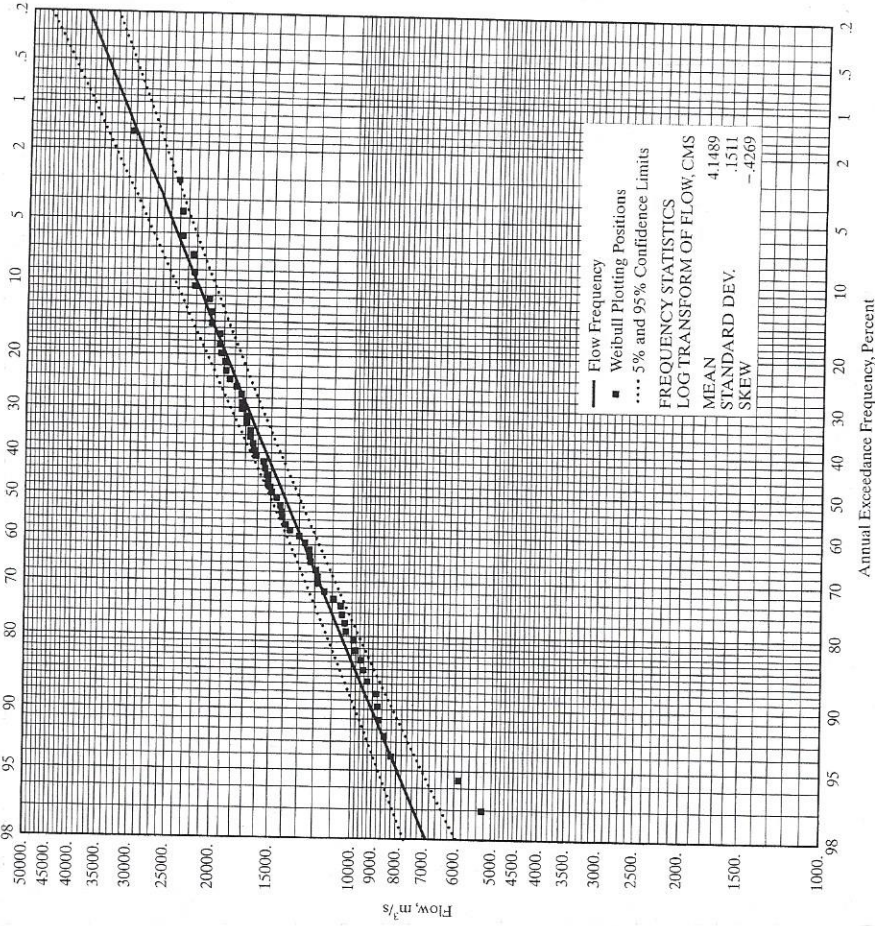


Figure 7.2 The log-Pearson type III frequency curve and Weibull plotting positions for peak annual flows in the Mississippi River at St. Louis are graphed on log-normal probability paper.