APPENDIX III

ANALYSIS OF CORRELATION BETWEEN TWO VARIABLES

"Quadrant Sum" Correlation Test

Although statistical analysis of correlation between two variables is not discussed in this Guide, the following test is very useful in determining whether or not a correlation between two variables probably exists. This simple, quickly applied test is described by Wilcoxon (**28**) and credited by him to Olmstead and Tukey, referring to their paper, "A Corner Test for Association," (**30**). After the scatter diagram has been plotted, the following procedure is to be followed:[1]

"Two median lines are drawn so as to divide the points into two groups of equal numbers, horizontally and vertically. The plotted points now lie in four quadrants, the lower left and upper right being taken as plus (or minus) quadrants while the upper left and lower right are taken as minus (or plus) quadrants. Commencing at the right side of the diagram, lay a ruler or pencil parallel to the vertical axis and move it to the left, counting the plotted points passed over until the next point lies on the other side of the y-median. Next lay the ruler at the bottom of the diagram parallel to the horizontal axis and move it upwards, counting the plotted points passed over before a point is reached on the other side of the x-median. In a similar manner, move in from the left, and down from the top. Four values are thus obtained to which are attached the signs of the quadrants in which they lie. The algebraic sum of these four values is called the quadrant sum and its expected value is zero if there is no association of the two plotted quantities."

Table 34 gives critical values of the quadrant sum, indicating significant association at various probability levels. These critical values are almost independent of the number of points.

TABLE 34.—WORKING SIGNIFICANCE LEVELS FOR QUADRANT SUM.

Significance Levels, per cent	Quadrant Sums	Significant Levels, per cent	Quandrant Sums
10	± 9	2	±13
5	±11	1	±14 to 15[a]

[a] Use 14 for 14 or more points, 15 for fewer points.

When it is necessary to deal with an odd number of points, one of the coordinates of a point will lie on the x-median and one of the coordinates of another point will lie on the y-median. In this case, substitute for these points a new point, with those coordinates taken from the original points which do not involve the medians. Then proceed in the usual manner.

Another difficulty arises when tied values are encountered. Some of the tied points may be on the side of the median favorable to being included in the quadrant sum, and one or more of the other members of the tied group may be on the

[1] Quoted with permission of Frank Wilcoxon (**28**).

other side of the median. In this case treat the tied group as if the number of its points before crossing the median were:

$$\frac{\text{number favorable for inclusion in quadrant sum}}{1 + \text{number unfavorable}}$$

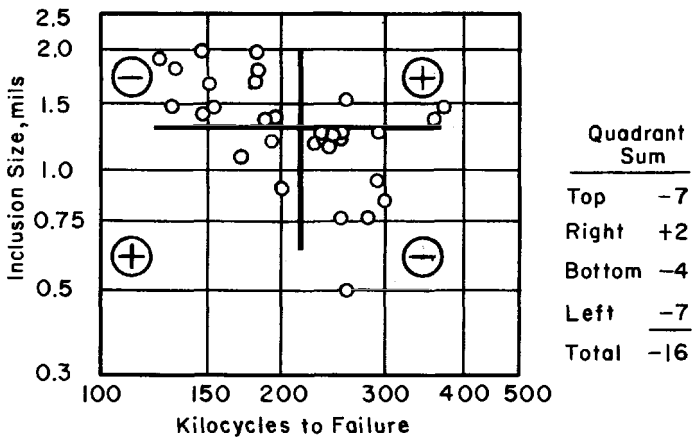

FIG. 11.—Scatter Diagram.

EXAMPLE.—The scatter diagram of Fig. 11 shows inclusion size plotted against specimen life to failure and suggests a possible correlation. The above test was applied and shows a quadrant sum of −16, as indicated at the right of the figure. The conclusion is that a definite correlation probably exists between the two variables.