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The Role of Interactions in Designed Expeiments

In designed experiments we measure the effects of several factors simultaneously. However, we are usually interested in the interactions between two or more factors, also.

Two factor interactions are of special interest because they are a model for synergistic effects between the two factors. When a two-factor interaction exists, one can say that one of the factors is 'accelerating' (or 'decelerating ') the effect of the other factor on the Response.

This is demonstrated in the graphs below. Figure 1 shows the results of a two-factor experiment (A and B) where no interaction between A and B exists. The levels of factor A are shown on the x-axis while the two lines represent the two levels of factor B. Note that the lines are roughly parallel which means that the level of factor B only increases or decreases the Response value proportionately as we go from the low level of factor A to the high level. The basic, positive sloped relationship between factor A and the response is not affected by the level of factor B.

Figure 1

A Factorial Experiment Without Interaction

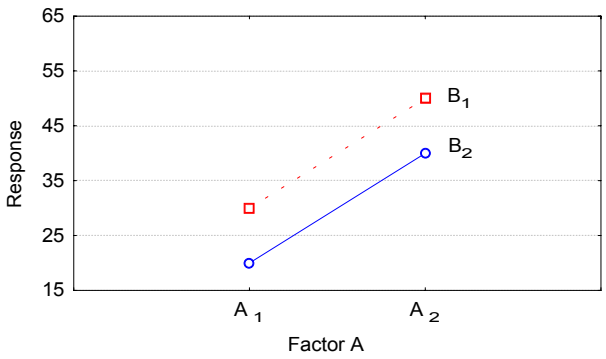

Figure 2 shows the results of the two factor experiment where an interaction between A and B exists. Note that the lines are no longer parallel and that one may say that, in going from level B_2 to B_1 of factor B, the effect of factor A on the Response has been accelerated. That is, the slope of the line is steeper at level B_1 than B_2. If higher Response is the desirable outcome, than this may be considered a synergistic effect.

This pattern in experiments with an interaction is called a non-linear effect. Other non-linear patterns may occur also. One that is commonly seen is for the two lines to cross, as in Figure 3. Sometimes they cross in such a way that one line has a positive slope while the other line has a negative slope. This means that the basic relationship between factor A and the Response changes depending on the level of factor B. In chemical technology, this sometimes suggests a mechanistic change or perhaps a threshold level of one factor that causes the onset of a particular mechanism.

Figure 2

A Factorial Experiment With An Interaction

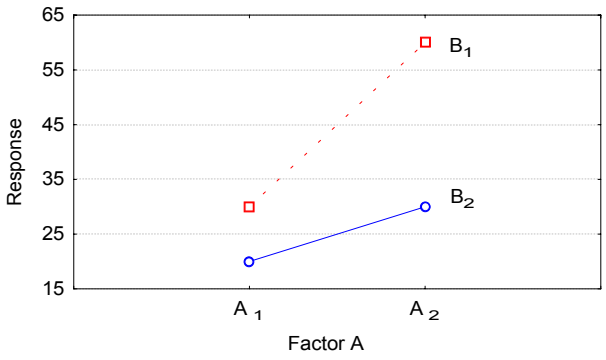

Figure 3

A Factorial Experiment With A Crossing Interaction