**How to Create an Interaction Plot?**

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The following shows how one can examine the existence of interactions in variables in massive databases. We demonstrate the procedure through a model that examines outcome Y as a function of 4 variables A, B, C, and D. In these steps we show how to create the plot to examine the possible interactions between A and any other subset of the 3 variables B, C, and D. We assume that data are transformed so that variables are each related to Y with a monotone function. In the following, when a variable is absent it is not mentioned, thus the case BC is the case in which B, and C are present and A and D are absent.

1. **Create strata.** Group the data by A, B, C and D, and calculate the average value for Y for each combination. If there are combinations of variables that are likely to be interaction terms, then also group data by this combination of features. For example, if BC is a likely interaction term, then group by A, B, C, D, and BC. At start of the procedure, we do not have any likely interaction terms in mind, but as the procedure proceeds these likely interaction terms can be discovered. The following refers to the grouped data as “strata.”

SELECT Sum(IIf([Y]="Yes",1,0))/Count(Y) AS Prob

, Count(Interdata.Y) AS CountOfY

, Interdata.A

, Interdata.B

, Interdata.C

, Interdata.D

FROM Interdata

GROUP BY Interdata.A, Interdata.B, Interdata.C, Interdata.D;

1. **Identify shared features**. Split the strata into two sets, depending on whether A is present or absent. We refer to the set with A present as cases and the other set as controls. In these two sets, match on the remaining variables (B, C, D or any likely interaction term). For example, the case ABC is matched to the case BC and the case ABCD is matched to the case BCD. Refer to these matched variables as the “shared features.” Sort the result in order of increasing average outcome Y.

SELECT Round([Prob],2) AS YCases

, Strata.A

, Strata.B

, Strata.C

, Strata.D

INTO Cases

FROM Strata

WHERE Strata.A="Yes"

SELECT Round([Prob],2) AS YControls

, Strata.A

, Strata.B

, Strata.C

, Strata.D

INTO Controls

FROM Strata

WHERE Strata.A="No"

SELECT Cases.YCases, Controls.YControl, Controls.B, Controls.C, Controls.D

FROM Controls INNER JOIN Cases ON

(Controls.D = Cases.D) AND (Controls.C = Cases.C) AND (Controls.B = Cases.B)

ORDER BY Cases.YCases;

1. **Create the interaction plot**. In this plot, the X-axis is the shared features, arranged in order of increasing values of Y.  The Y axis is the average value of Y within the strata.  One line is plotted for cases with the variable A and the combination of shared features in the X-axis.  Another line is plotted for cases constructed without the variable A and the shared features in the X-axis. For example, if ABCD is matched to BCD and ABC is matched to BC, then X-axis is BC and BCD. The line with A present is composed of average Y value for two strata ABC and ABCD. The second line is made for the cases that do not have A. These are the average Y values for the two points BC and BCD.

SELECT Cases.YCases  
, Controls.YControl, IIf([cases.B]="Yes","B","")+IIf([cases.C]="Yes","C","")+IIf([cases.D]="Yes","D","") AS Shared

FROM Controls INNER JOIN Cases ON (Controls.D = Cases.D) AND (Controls.C = Cases.C) AND (Controls.B = Cases.B)

ORDER BY Cases.YCases;

1. **Interpret the plot**. If there is no interaction term between the variable A and the shared features, then the two lines must be parallel or nearly parallel throughout the range of shared features. Changing the shared features should not change the impact of the variable A. If there is an interaction between A and any subset of B, C, and D variables, then the two lines could be diverging or converging. If the two lines cross each other then it indicates a violation of independence and no model will fit the data. The interaction plot shows at what shared features there is an interaction with the variable A. The points in the plot that diverge from parallel lines indicate “diverging shared features.” Each diverging shared feature can indicate a new possible interaction.  
     
   In the plot, the median effect size is around 0.13. B, D, BC and BCD seem to diverge from this median. These are referred to diverging shared features. They imply interactions AB, AD, ABC, and ABCD.