


D-OPTIMAL DESIGNS

Introduction

In situations where it is too costly to use a fractional design which is orthogonal, the D-optimal may be used. DOE Wisdom accommodates 12 factors and up to 5 levels of each factor for D-optimal designs. The software also allows you to choose any arrangement of interactions. D-optimal designs generally require fewer runs than the appropriate orthogonal design. D-optimal designs are especially useful when there is a mixture of quantitative and qualitative factors. It should be noted that D-optimal designs are not typically orthogonal.

Design Definition

Double-click on the **Design** folder in the **Project** window or click the **Design**  button.

The Design Definition Dialog Box will appear. (See Figure 2-1 in Chapter 2) DOE Wisdom supports five types of experimental objectives:

- **Screening**
- **Robust™ Design**
- **Modeling**
- **D-optimal**
- **User Defined**

The D-optimal objective can be selected either before or after factors and responses have been entered. Click on the arrow at the right of the drop-down **Objective** list box to display more objective types. Select D-optimal. When D-optimal is selected, the D-optimal Design Definition screen will appear as shown in Figure 7-1.

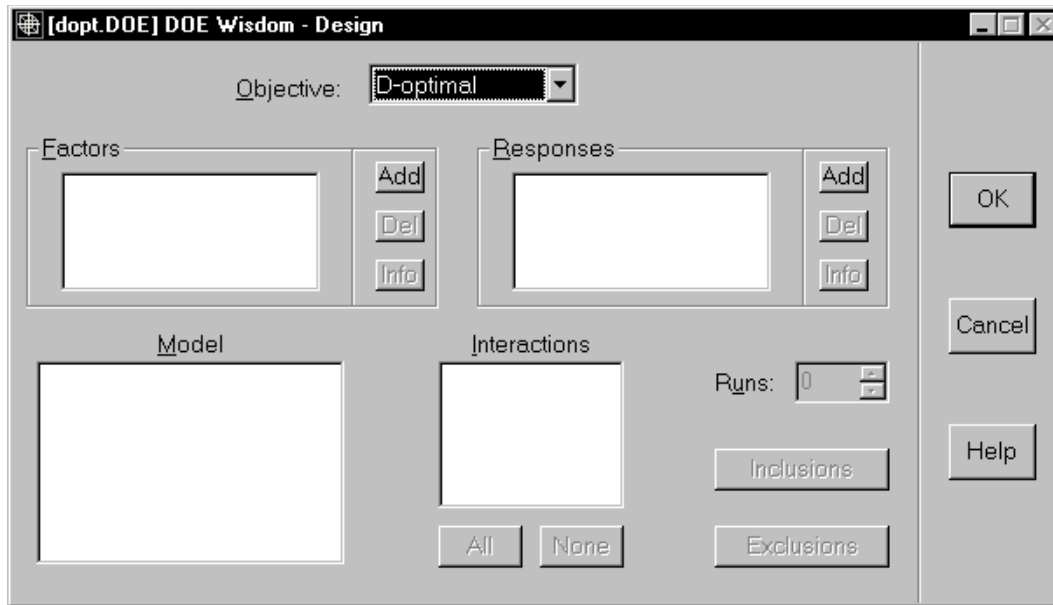


Figure 7-1

Adding Factors and Responses

The procedure used to add factors and responses is the same as that described in Chapter 2. For our example, we added three factors. Factor A and B are quantitative and Factor “resin” is qualitative. The Design Definition screen now appears as shown in Figure 7-2.

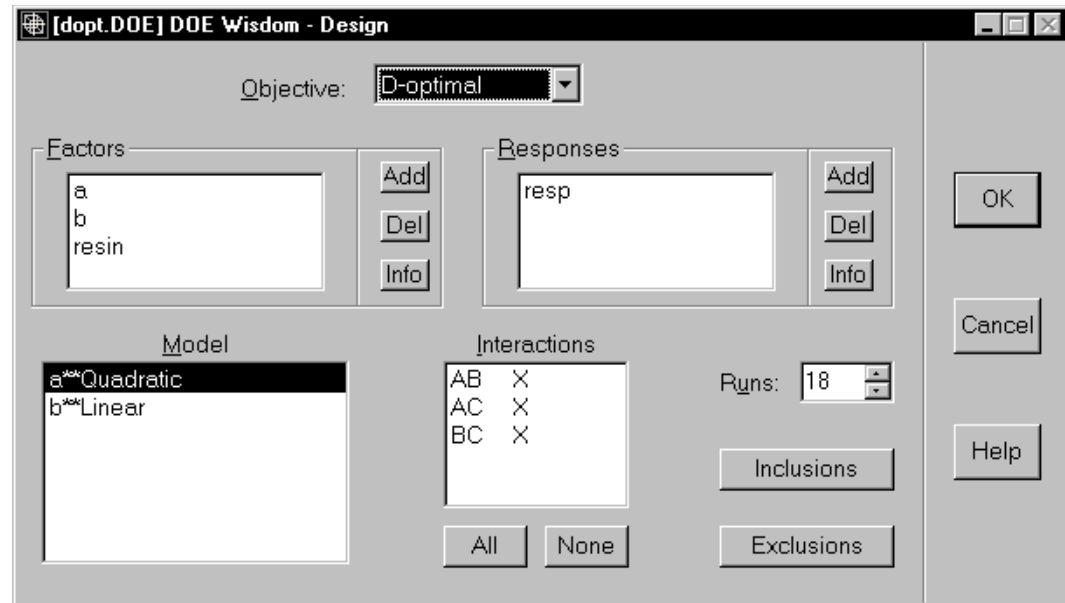


Figure 7-2

Choosing the Model

DOE Wisdom supports both linear and quadratic models for D-optimal designs. You may select a linear model for one factor and a quadratic model for another factor.

Position the mouse pointer over the desired model type and click. The selected model type will be highlighted. In Figure 7-2, the model for factor A is quadratic and the model for factor B is linear. Since factor “resin” is qualitative, no model can be selected.

Selecting the Desired Interactions

DOE Wisdom allows you to select some, all, or none of the interactions for a D-optimal design.

If you want none of the interactions included, simply click the **None** button at the bottom of the interaction box.

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If you want all of the interactions included, click the All button at the bottom of the interaction box. If you want some of the interactions included, position the mouse pointer over the interaction and click. An **X** next to the interaction means it is included. No **X** next to the interaction means it is not included.

Number of Runs

The number of runs is shown in the **Runs** list box. Use the scroll bar to the right of the **Runs** list box to select the desired number of runs for your design.

Inclusions

Use this option to indicate specific runs that must be included in your experiment. Position the mouse pointer over the **Inclusions** button and click. The screen shown in Figure 7-3 will appear.

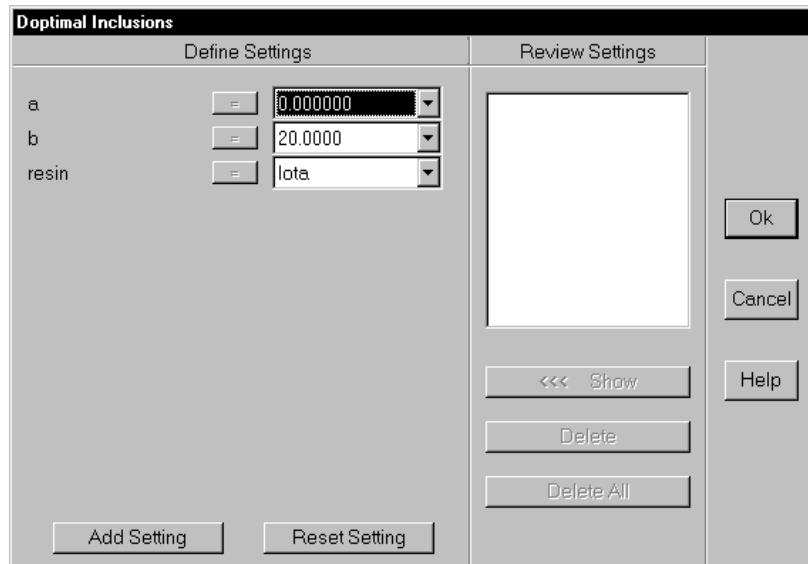


Figure 7-3

Suppose you wanted your design to include a run where the factors were set as follows:

Factor A = 10
Factor B = 20
Resin = Lot C

Position the mouse pointer on the arrow to the right of factor A and click. The possible levels for factor A will appear. Position the mouse pointer over the desired level, (in this case, 10) and click. 10 will now be highlighted and will appear as the setting for factor A. Use the same procedure to change Factor B to 20 and the resin to Lot C.

Position the mouse pointer over the **Add Setting** button and click. The specific run now appears in the **Review Settings** box. The screen appears as shown in Figure 7-4.

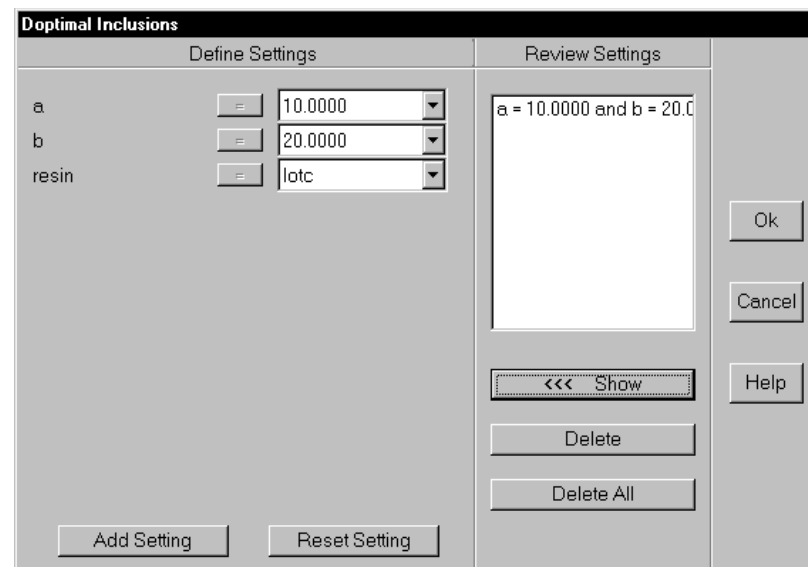


Figure 7-4

As you will note, the entire set-up for the run does not appear in the **Review Setting** box. To show the entire list of settings for a specific run, position the mouse pointer over that run and click. The run is now highlighted. Click on the **Show** button and the set-up for that run appears in the **Define Settings** section.

To delete a specific inclusion run, position the mouse pointer over that run and click. The run is now highlighted. Click on the **Delete** button and that specific run will be deleted. If you have defined several runs but decide you do not want to include any of them, click on the **Delete All** button and all the runs will be deleted.

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After all inclusions have been entered, click on the **OK** button. This will return you to the D-optimal Design Definition Screen.

Exclusions

Use this option to indicate specific runs that must be excluded in your experiment. Position the mouse pointer over the **Exclusions** button and click. The screen shown in Figure 7-5 will appear.

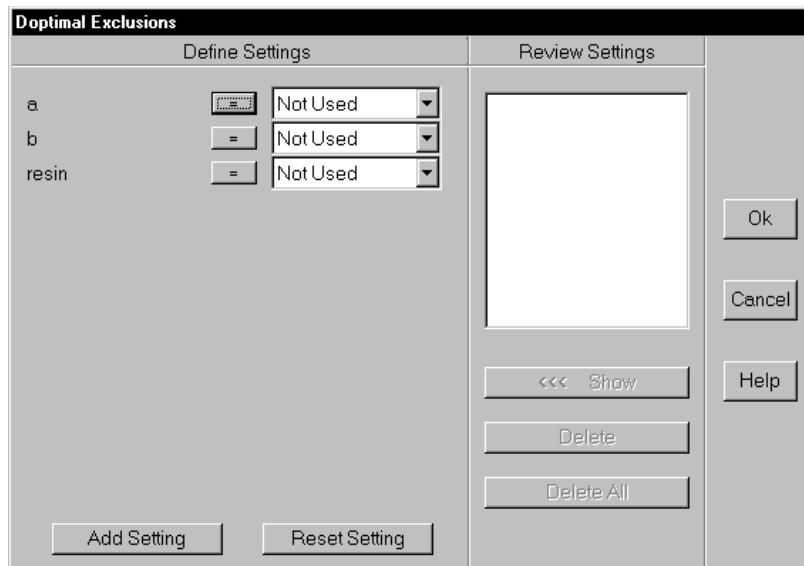


Figure 7-5

Suppose you wanted your design to exclude a run where the factors were set as follows:

Factor A = 10
Factor B = 20
Resin = Lot D

Position the mouse pointer on the arrow to the right of factor A and click. The possible levels for factor A will appear. Position the mouse pointer over the desired level, (in this case, 10) and click. 10 will now be highlighted and will appear as the setting for factor A. Use the same procedure to change factor B to 20 and the resin to Lot D.

Position the mouse pointer over the **Add Setting** button and click. The specific run now appears in the **Review Settings** box. The screen now appears as shown in Figure 7-6.

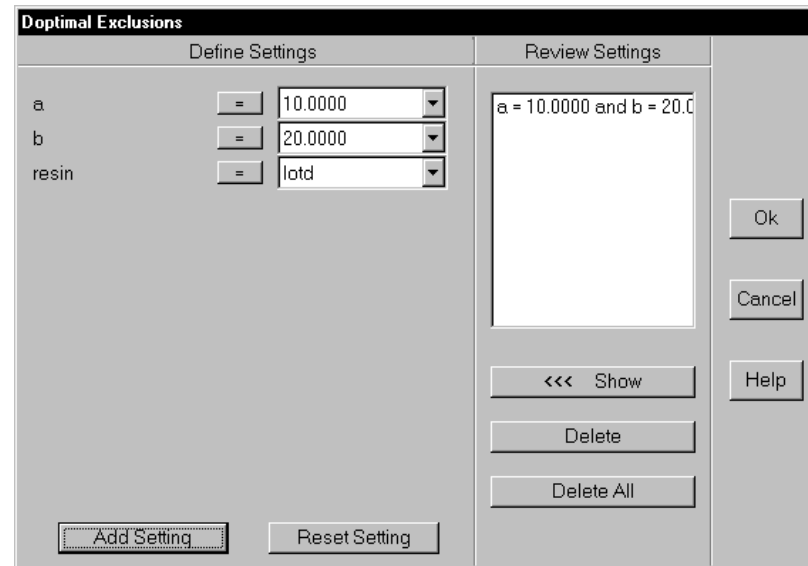


Figure 7-6

DOE Wisdom also allows you to define a “formula” that will exclude many runs at once. Suppose you never wanted your design to include runs where factor B was 400 and the resin was Lot A. In the define settings portion of the screen, set factor A to **Not Used**, factor B to 400, and resin to Lot A. Click on the **Add Setting** button. No runs with the combination of Factor B = 400 and resin = Lot A will be included in the design.

DOE Wisdom also allows you to define “formulas” using a \neq sign. In the define settings portion of the screen, click on the = button. The button will now appear as \neq and means “not equal” when defining that factor setting.

To show the entire list of settings for a specific run, position the mouse pointer over that run and click.

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The run is now highlighted. Click on the **Show** button and the set-up for that run appears in the **Define Settings** section.

To delete a specific exclusion run, position the mouse pointer over that run and click. The run is now highlighted. Click on the **Delete** button and that specific run will be deleted. If you have defined several runs but decide you do not want to exclude any of them, click on the **Delete All** button and all the runs will be deleted.

After all exclusions have been entered, click on the **OK** button. This will return you to the D-optimal Design Definition Screen.

Design Check

When a D-optimal design is generated, a Design Check folder will appear in Project Window. The Design Check window allows the user to check how close the D-optimal design is to orthogonal. A tolerance value of 1.0 means the design is orthogonal.

Worksheet

The procedure used to generate the D-optimal worksheet is the same as that discussed in Chapter 3.

Data Definition

The procedure used to enter the D-optimal data is the same as that discussed in Chapter 4.

Statistics

The procedure used to review the D-optimal statistics is the same as that discussed in Chapter 5.

Graphics

The procedure used to view the D-optimal graphics is the same as that discussed in Chapter 6. Scatter Plots, Contour Plots and Response Surface Graphs are supported for D-optimal designs.