

Paper 255-26

THE ABCs OF ADX: A SOLUTION FOR DESIGN AND ANALYSIS OF EXPERIMENTS

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ABSTRACT

The ADX Interface® is intended for engineers, scientists, and other researchers who require a point-and-click solution for designing and analyzing experiments to improve processes and products. You will find this tutorial helpful if you use designed experiments in your own work, or if you provide SAS® support for experimental work in your organization.

In this paper, we will show how ADX guides you through the steps of designing a statistical experiment, analyzing the data, and then creating Web-based results that you can share with your co-workers. We will give an overview of how to accelerate process knowledge discovery with ADX through automated design construction algorithms and model-fitting techniques; interactive graphics for exploration and optimization; and HTML report generation. We will illustrate some of these tools by analyzing data from a fractional factorial with multiple responses.

Key words: DoE, ADX, Optimization, and HTML.
SAS Products: ADX Interface.
SAS Skill level: Beginners to advanced.

INTRODUCTION

Design of Experiments (DoE) has been proven to be a useful approach for studying the impact of process parameters on responses of interest, such as functional product parameters. SAS® has developed an interface to help engineers, scientists, and other researchers who require a point-and-click solution for designing and analyzing experiments to improve processes and products. The ADX Interface guides you through the steps of designing a statistical experiment, analyzing the data, and then creating Web-based results that you can place on your intranet site for company access.

In this paper we will walk you through all of the steps needed to design, analyze, and generate a report for a fictitious experiment performed by a chemical company to study one of their manufacturing processes. We will illustrate many features of the ADX Interface in this paper and will refer you to *Getting Started with the SAS ADX Interface for Design of Experiments*, published by SAS Institute, which we will refer to as the ADX manual, for additional information on features not covered here.

EXPERIMENT BACKGROUND

A company in the chemical industry is manufacturing a product and wants to identify important process parameters and their impact on a few key responses. The engineers brainstormed a list of possible process parameters that may be included in the experiment. After several discussions, the team chose 6 process parameters to include in the experiment, each at 2 levels. These parameters, or factors, are listed next.

<u>Factors</u>	<u>Levels</u>
TH_CURE	low, high
QUANTITY	small, big
Z_DIST	A, B

UV_CURE	low, high
SH_LIFE	old, new
PLASMA	no, yes

We are not at liberty to discuss the meaning of these factors and levels in any further detail.

The team also selected two responses to investigate, AV_MW and SD_MW. Each experimental unit contains a number of sub-units, therefore, the team will study both the average power output from all sub-units on a unit, as well, as the standard deviation of the power across the sub-units. The two responses, along with their desired values, are shown below.

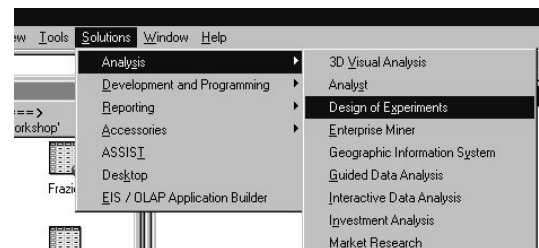
<u>Responses</u>	<u>Objective</u>
AV_MW	maximize
SD_MW	minimize.

ADX INTERFACE

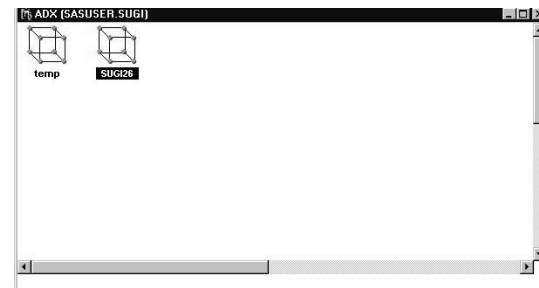
In the remainder of this paper we will take you through the steps needed to design, analyze, and write an HTML report for this experiment using the ADX Interface.

1. Defining the Design . . .

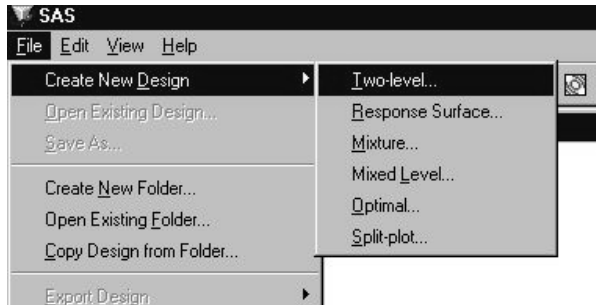
You can launch the ADX Interface by selecting Solutions, Analysis, Design of Experiments from the main menu in your SAS session.



This will open the ADX Interface window. If this is your first time launching the ADX Interface then your window will appear blank. We have saved two previous experiments in our window, as is shown by the two cube icons.



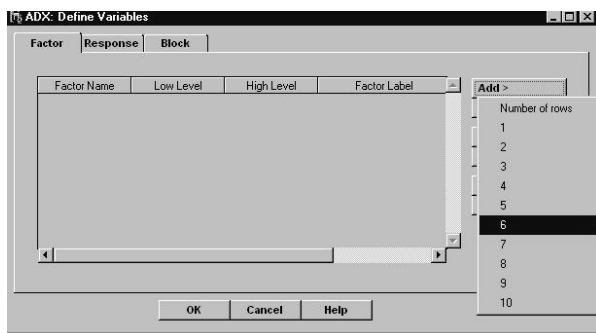
We need to create a new design for this experiment by selecting **File, Create New Design** from the tool bar along the top of the window. There are a number of design structures to choose from, such as two-level, response surface, and mixture designs. For this experiment, we will select **Two-level** from this menu.



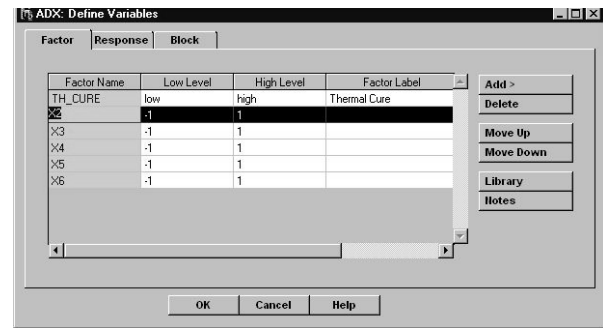
The window that appears next is the main interface that we will interact with to design, analyze, and develop a report for the experiment. The window is currently empty except for the buttons along the right-hand side of the window. Notice that most of the buttons are “grayed out” and not accessible at this stage of the design.



The first step in designing our experiment is to define our process parameters and responses. We can do this by selecting the **Define Variables...** button on the right-hand side of the window. The window that is displayed next is also empty. Notice that there are three tabs in this window, **Factor**, **Response**, and **Block**.

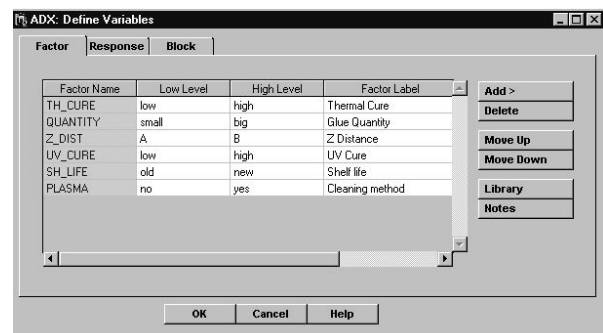


The **Factor** tab is where we will describe our process parameters, or factors, for the experiment. We can add factors by selecting the **Add >** button along the right-hand side of the window and highlighting the number 6 for our 6 process parameters.

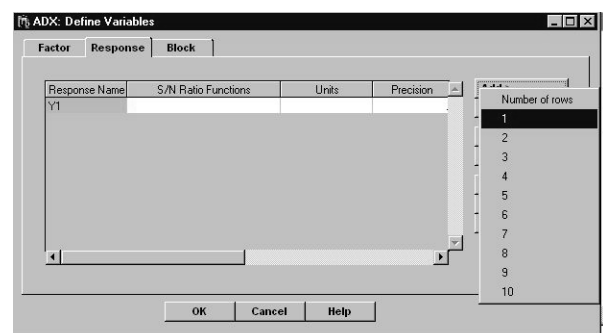


We can edit the default factor names, X1 to X6, and low (-1) and high (1) levels by placing the mouse-button in the field and typing over the existing values. Factor labels can also be added in this window. The completed factor names and levels are shown in the next screen capture.

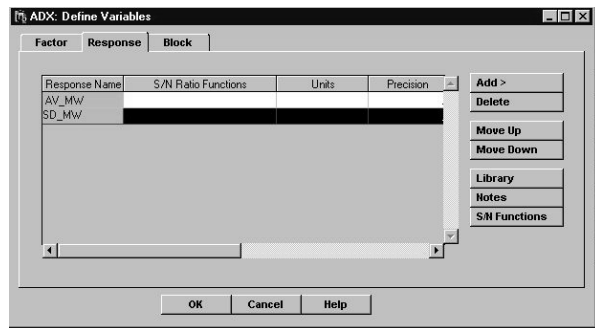
The additional buttons on the right-hand side are fairly self-explanatory and can be used to delete a factor or to move a factor up or down in the order that is shown. The **Library** button is handy because it can be used to access factors, levels, and factor labels that were used in previous experiments and saves some typing.



The next step is to define the responses in our experiment by clicking on the **Response** tab. The window will appear with one generic response Y1. You can add additional responses by, once again, selecting the **Add >** button on the right-hand side and selecting the number of additional responses to include in the experiment. For our example, we will add one additional response.



After typing in the response names and labels we have the information in the screen capture shown next.



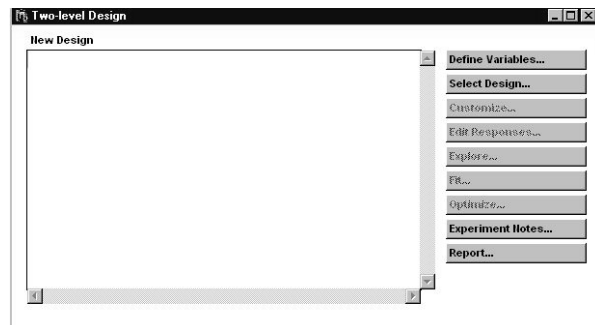
You can also add the units, precision, target values and S/N functions in this window and should refer to the ADX manual for more details.

The Block tab is used to define block levels, if the experiment needs to be blocked. Since our experiment is not blocked, we will not discuss this further.

To exit this window, we click on the OK button at the bottom of the window. When you exit any window in ADX you will be prompted to save your changes. You should say 'Yes' to this otherwise all of your work will be lost and you will have to start over.

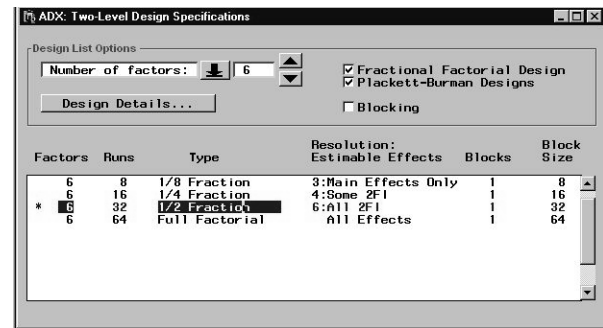
II. Selecting the Design . . .

When you exit the Define Variables dialogue window you will return to the main window. We are now ready to select a design for our experiment. The Select Design... button is used to look for an appropriate design for our factor space.



There are a number of design choices for our experiment with 6 factors that are shown, ranging from fractional factorials with as few as 8 runs to the full factorial experiment with 64 runs. You should note that you can view additional designs with blocking factors by clicking in the box labeled as Blocking on the right-hand side of the window. Since our experiment is not blocked we will omit this step.

This window also provides information about the resolution of the design and the estimable effects. At a glance, we can evaluate the different designs to see which ones will meet our requirements for estimating main effects and interactions.



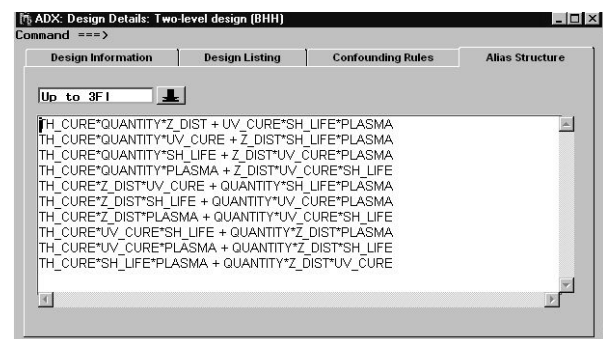
The engineering team has already told us that they do not have the resources to run a full factorial experiment. Therefore, we will have to investigate the fractional factorial designs. We can get an idea for the limitation of the fractional factorial designs by looking at the resolution and estimable effects.

You can get a closer look at any design by highlighting it and then clicking on the Design Details... button in the top of the window.



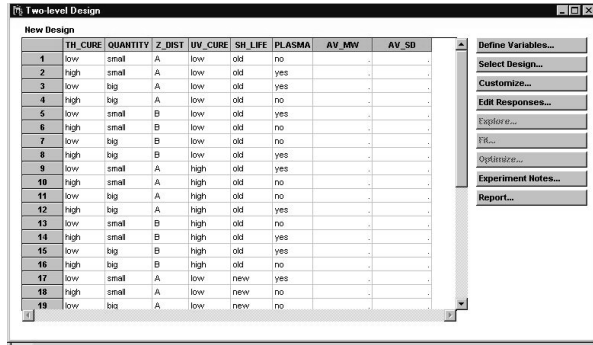
The Design Details includes general information about the selected design in the Design Information tab, shows the treatment combinations in the Design Listing tab, provides the confounding rules that were used to generate the design in the Confounding Rules tab and the alias structure in the Alias Structure tab.

The alias structure for the design that we highlighted indicates that all 2-factor interactions are free of main effects and other 2-factor interactions. The alias structure for 3-factor interaction is shown below. You can close this window by clicking on the 'X' in the upper right-hand corner of this window.



The team decided to go with the 1/2 fraction, resolution 6 design with 32 runs. In order to select this design, we

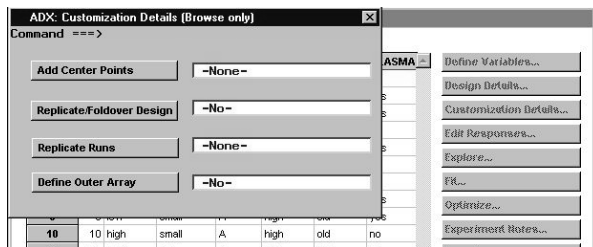
highlight it and close the window by clicking on the 'X' in the upper right-hand corner of the window. The treatment combinations will now appear in the main window.



III. Augmenting the Design . . .

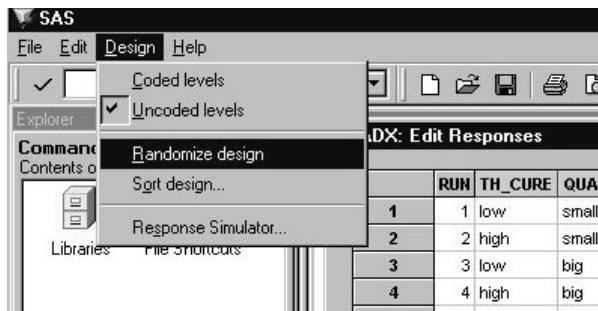
When you select a two-level design using the Select Design... button, the design does not contain any replicates or center points. If you want to replicate the design, or add center points, then you must select the Customize... button on the right-hand side of the window. This will launch a dialogue window that will allow you to perform several different types of augmentation to your design.

We have decided to leave our design as it is and not augment it. You should refer to the ADX manual for a more detailed discussion about these choices.

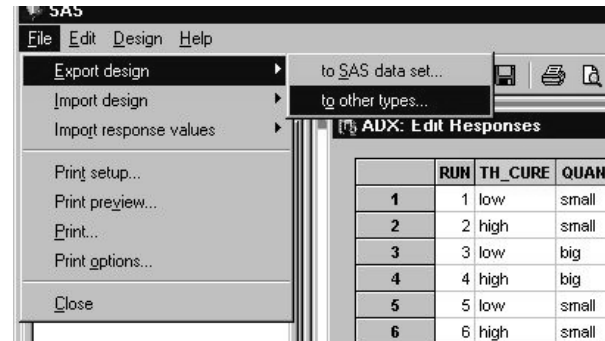


IV. Running the Design . . .

We would like to randomize the design and export it to EXCEL before giving it to the engineering team to run. We can do this by selecting the Edit Responses... button in the right-hand side of the main window. In order to randomize the design we select Design, Randomize design from the main menu at the top of the window. This will randomize the order of the design. You can also sort the design, if you wish, by using the Sort design... option in this menu.



The last thing that we need to do is to export this design to EXCEL and email it to the engineering team so they can run the experiment and record the results. This is accomplished by selecting File, Export design, to other types... in the main menu. This will launch a dialogue box that is similar to the Import Wizard, which allow you to export this design to an EXCEL spreadsheet. The details are left for the reader.



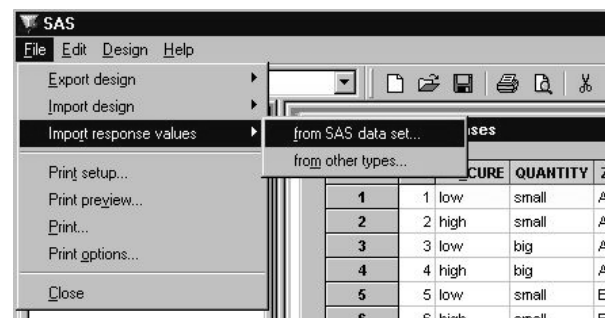
Upon exiting the ADX Interface, make sure that you save your work and provide a name for the design that you created. Otherwise, the design will not be available the next time that you log into SAS and the ADX Interface.

V. Preparing the Results . . .

We can open up our design and continue our experimental process by double clicking on the appropriate icon when we enter the ADX Interface. This will open up the design and place us into the main window.

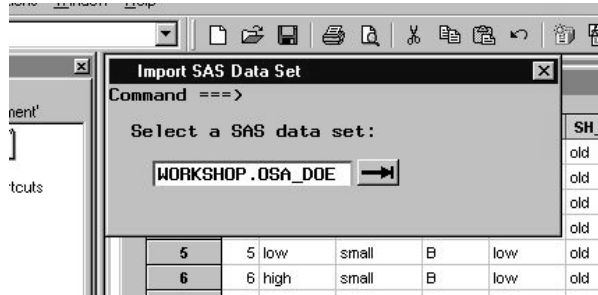
The first thing we need to do is to enter the results from the experiment into the experimental worksheet. In order to do this we click on the Edit Responses... button on the right-hand side of the window. There are several ways that you can get your response values into the ADX Interface. We will illustrate one method and refer you to the ADX manual for a description of the other methods.

We want to enter the response values into ADX from an existing SAS data set. First we must read in the completed EXCEL spreadsheet using the Import Wizard and generate a SAS data set. Note that the spreadsheet contains the original design along with the completed response values. These details are not going to be discussed here. From the ADX Interface, Select File, Import response values, from SAS data set... from the main menu at the top of the window.

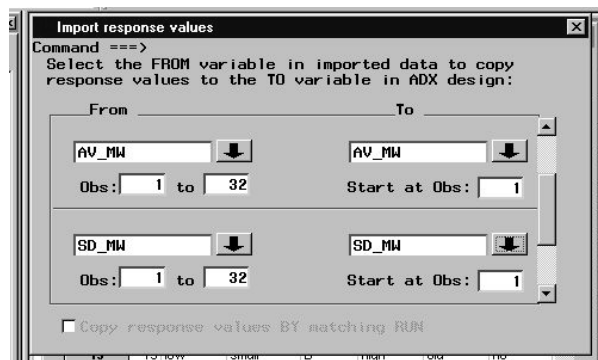


You will be prompted to enter the library and data set name that the response values are contained within. You can either enter LIBRARY.DATA or use the arrow to search for the

library and data set. Our data is located in the Workshop library and is called Osa_doe. To exit this window click on the 'X' in the upper right-hand side of this window.



The next window that appears requires us to map the response names in the SAS data set (From) to the response names in the ADX Interface (To).



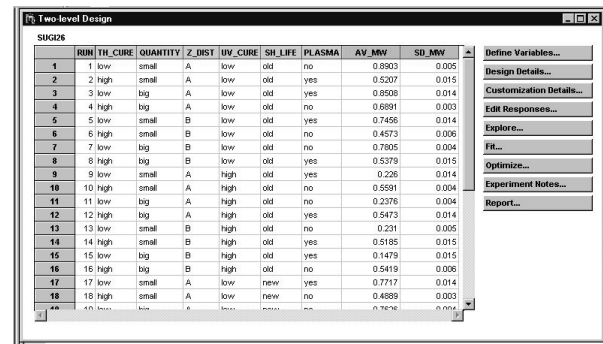
We can accomplish this by pressing the arrows next to each field and selecting the appropriate responses. Recall that we have 2 responses in our experiment, AV_MW and SD_MW so we are required to map both responses to the ADX design. It should be noted that the order of the runs in the SAS data set must be identical to the order of the runs in the ADX Interface. Otherwise, the response values will not be properly matched up with the treatment combinations.

When you are finished mapping the responses in this window click on the 'X' in the upper right-hand corner of the window. The response values will be added to the design sheet. To exit this window, click on the 'X' in the upper right-hand corner of this window and don't forget to save the results when prompted.

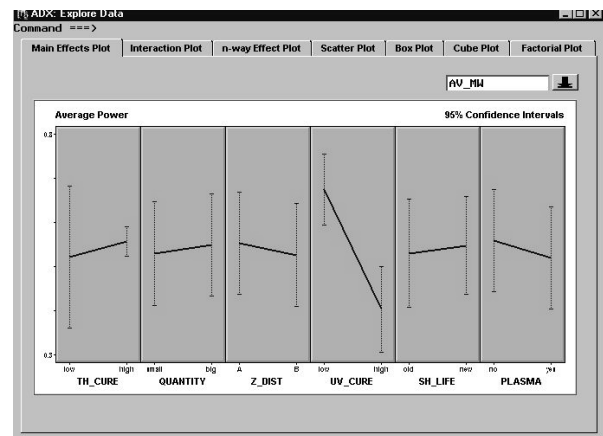
RUN	TH_CURE	QUANTITY	Z_DIST	UV_CURE	SH_LIFE	PLASMA	AV_MW	SD_MW
1	low	small	A	low	old	no	0.8903	0.005
2	high	small	A	low	old	yes	0.5207	0.015
3	low	big	A	low	old	yes	0.8508	0.014
4	high	big	A	low	old	no	0.6891	0.003
5	low	small	B	low	old	yes	0.7456	0.014
6	high	small	B	low	old	no	0.4573	0.006
7	low	big	B	low	old	no	0.7805	0.004
8	high	big	B	low	old	yes	0.5379	0.015
9	low	small	A	high	old	yes	0.226	0.014
10	high	small	A	high	old	no	0.5591	0.004
11	low	big	A	high	old	no	0.2376	0.004
12	high	big	A	high	old	yes	0.5473	0.014
13	low	small	B	high	old	no	0.231	0.005
14	high	small	B	high	old	yes	0.5185	0.015
15	low	big	B	high	old	yes	0.1479	0.015
16	high	big	B	high	old	no	0.5419	0.006
17	low	small	A	low	new	yes	0.7717	0.014
18	high	small	A	low	new	no	0.4889	0.003
19	low	big	A	low	new	no	0.7626	0.004
20	high	big	A	low	new	yes	0.5251	0.013
21	low	small	B	low	new	no	0.6644	0.006
22	high	small	B	low	new	yes	0.5017	0.016
23	low	big	B	low	new	yes	0.8068	0.016

VI. Graphical Analysis of the Results . . .

We are now ready to analyze the results from our experiment. You will notice that all of the buttons in the right-hand side of the window are now accessible to us and some of the labels have slightly changed. We would like to Explore, Fit, and Optimize, in that order, the outcomes from our experiment.



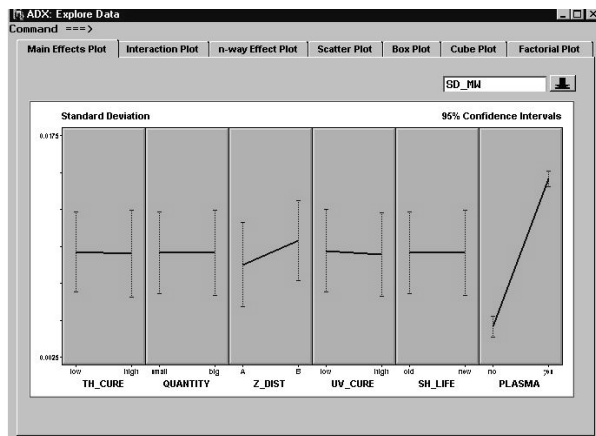
The first step in our analysis is to perform a graphical exploration of our data. The ADX Interface has several graphical tools that are located in the Explore... button on the right-hand side of the window.



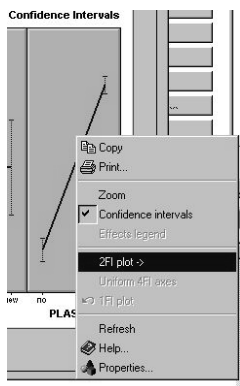
From this window we can look at main effects, interactions, scatter plots, cube plots, boxplots and factorial plots, as is indicated by the different tabs.

The first graph that appears is a main effects plot showing the effects for the process parameters in our experiment for the average power, or AV_MW. From this plot, it appears that UV_CURE may have an impact on AV_MW, that is, the average power decreases as we go from a low to a high value for this process parameter.

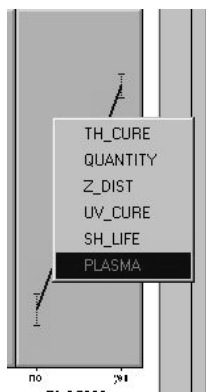
We can change the response value in the main effects plot by pressing on the down arrow next to the label showing AV_MW and select the other response, SD_MW. The main effects plot will be adjusted on the fly with the new response data. The next screen capture shows the main effects plot for SD_MW. PLASMA may have an impact on the standard deviation of power because it increases as we go from no to yes levels for this parameter.



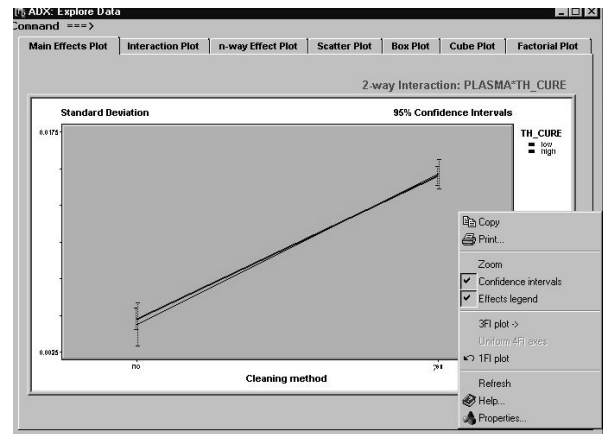
These graphs are interactive. If we perform a right-mouse click over any of the main effects plots we will get a menu with additional choices. We can zoom in on a graph, toggle confidence intervals on and off, change the colors of the plots with the Properties... selection or look at 2-factor interaction plots.



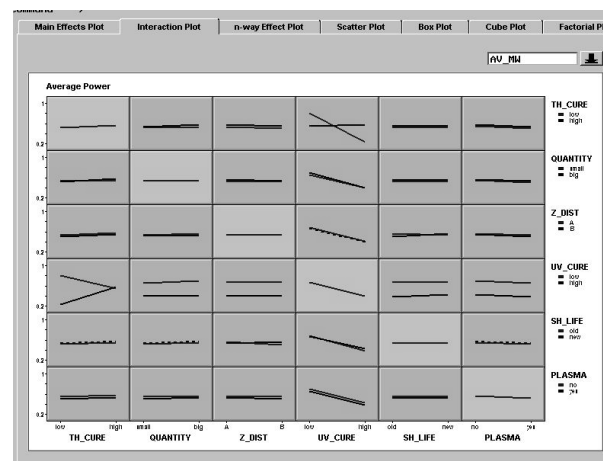
If we select 2FI plot -> for plasma then a menu will appear with the other factors in the experiment. We should highlight the name of the factor that we would like to see interacting with the factor originally selected.



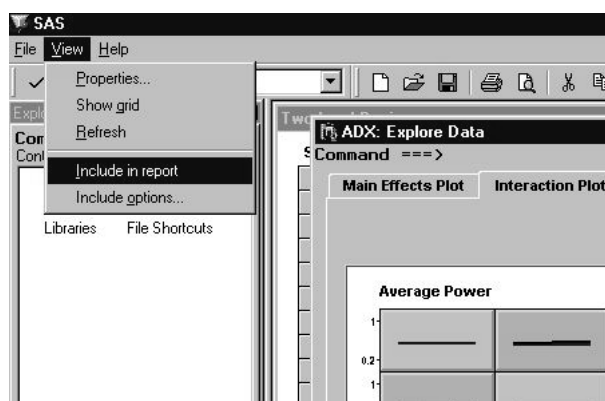
The 2-factor interaction plot will be displayed once you let go of the mouse button. Once again, this graph is interactive and you can perform additional actions by performing a right-mouse click on top of the graph. To get back to the main effects plots select the 1FI plot option.



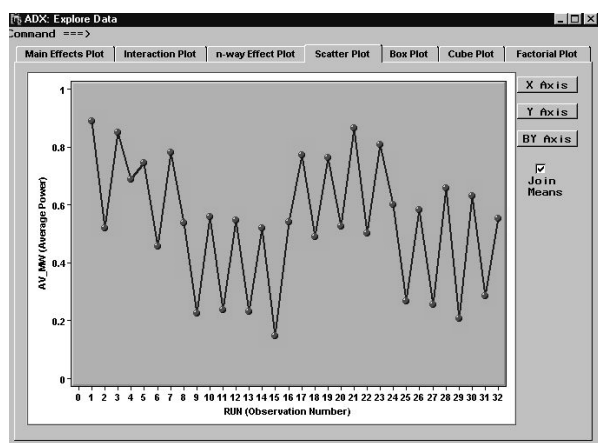
It will be cumbersome for us to look at all of the 2-factor interactions in this manner. We can view a matrix of all of the 2-factor interactions by selecting the Interaction Plot tab. The main effects for the factors are shown along the diagonal of the matrix. To find the 2 factors involved in any interaction, read off the factor name to the right of the plot and below the plot. For example, the 2 factors involved in the interaction plot shown in the upper most right-hand corner of the plot are TH_CURE and PLASMA.



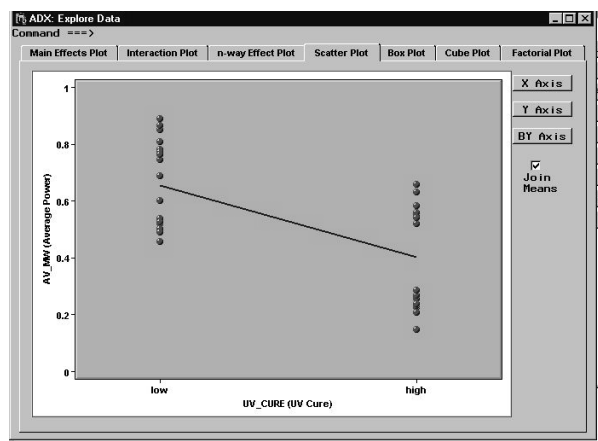
Up to this point we haven't talked much about how to generate the final report. However, as you go through the analysis, you should keep in mind which plots you want to include in the report. If we want to include this interaction plot in our final report then all we have to do is select View, Include in report from the main menu. This will generate a GIF file of this graph that can be accessed by the HTML report when we are ready to generate the report.



If we want to look for trends in the run order of the experiment we can click on the Scatter Plot tab. To connect the points you can check off the box next to Join Means. This will generate the plot shown in the next display.



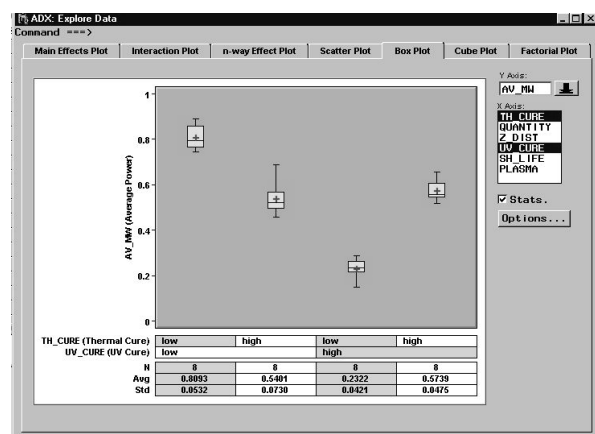
We can change the variables on either axis by clicking on the X Axis or Y Axis buttons on the right-hand side of the window. For example, to look at the main effects plot for UV_CURE on AV_MW we can click on X Axis and select UV_CURE. The plot will be updated on the fly.



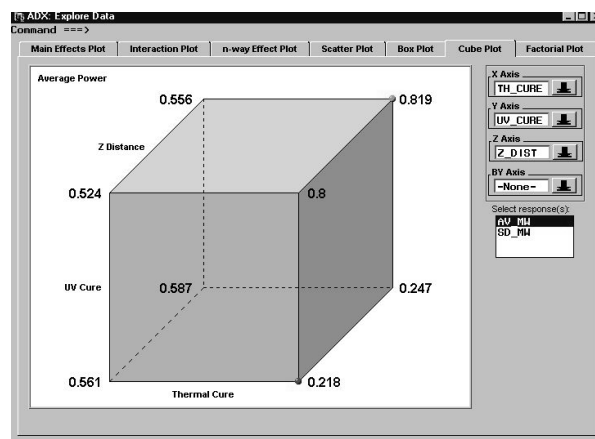
Boxplots are useful tools for viewing data and the ADX Interface has added the Box Plot tab to the tool. When you enter this window the graphs will show two boxplots for each level of one factor in your experiment. You can further segment your data by highlighting another factor of interest for the list of factors displayed in the right-hand side of the

window. Statistics can be viewed at the bottom of the plot by checking the box next to the Stats... label.

The boxplot shown below partitions the data for the factors TH_CURE and UV_CURE for the average power. This plot suggests a significant interaction between these 2 factors since the behavior of the response changes across the levels of TH_CURE as we go from low to high UV_CURE. You can also change the order of the variables in the plot by passing the mouse button over the variable label in the lower left-hand side of the plot and dragging the variable up or down. Once again, the response can be changed on the fly by selecting SD_MW from the drop down arrow next to the field for Y Axis in the upper right-hand corner of the window.



The final graphical analysis that we will look at in this window is a cube plot. The cube plots can be accessed with the Cube Plot tab.



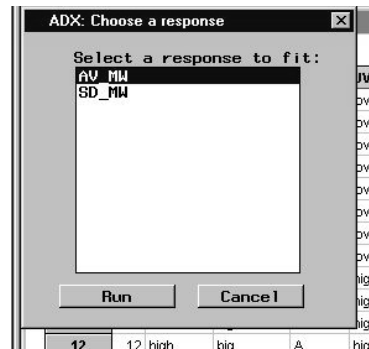
This plot allows us to look at the outcome from our experiment using 3 of the factors in the experiment. The values that appear on the vertices of the cube are the actual response values averaged across all of the levels of the factors not shown in the plot. The high and low response values are indicated using green and red dots, respectively.

Once again, if you would like to include any of these plots in your final report, when you are viewing them make sure that you select View, Include in report from the main menu.

Select the 'X' in the upper right-hand corner of the window to get back to the main menu when you are finished with the exploration or your data.

VII. Statistical Analysis of the Results . . .

We have just completed the preliminary graphical analysis of the data. Now we are ready to look at the tests of hypothesis for our factors. Select the Fit... button on the right-hand side of the main menu to look at the statistical findings. If you have more than one response to look at, then you must select the response that you want to analyze first by highlighting the name of the response and clicking on the Run button.



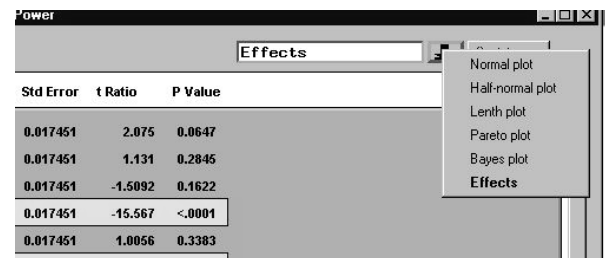
The results from an ANOVA will be displayed with the statistically significant ($p\text{-value} \leq 0.05$) factors highlighted in yellow. The analysis for AV_MW is shown in the next screen capture. You may have to scroll down the window to look at the results for all of the factors in the model.

Recall that our fractional factorial design allows us to estimate 6 main effects and 15 2-factor interactions. Although we didn't include any replicates in our design, we ran 32 treatment combinations from the full factorial. Since there aren't any 3-factor interactions in our model, this leaves 10 degrees of freedom that we can use to estimate the error term (assuming 3-factor interactions are negligible).

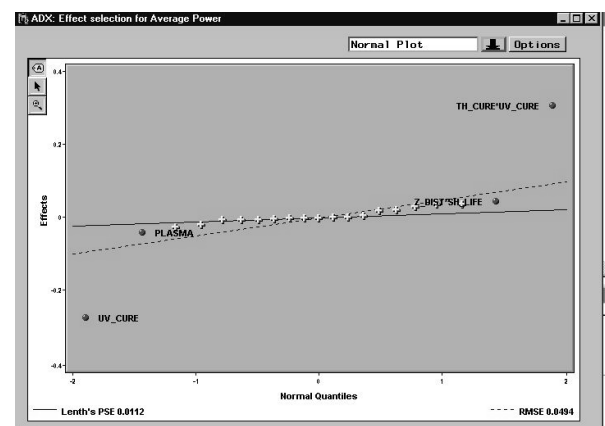
Effect	Estimate	Std Error	t Ratio	P Value
TH_CURE	0.036212	0.017451	2.075	0.0647
QUANTITY	0.019738	0.017451	1.131	0.2845
Z_DIST	-0.026337	0.017451	-1.5092	0.1622
UV_CURE	-0.27166	0.017451	-15.567	<.0001
SH_LIFE	0.01755	0.017451	1.0056	0.3383
PLASMA	-0.04015	0.017451	-2.3007	0.0442
TH_CURE*QUANTITY	0.028837	0.017451	1.6524	0.1295
TH_CURE*Z_DIST	-0.0024375	0.017451	-0.13967	0.8917
TH_CURE*UV_CURE	0.30549	0.017451	17.505	<.0001
TH_CURE*SH_LIFE	0.00345	0.017451	0.19769	0.8472
TH_CURE*PLASMA	-0.001975	0.017451	-0.11317	0.9121
QUANTITY*Z_DIST	-0.0074875	0.017451	-0.42995	0.6770
QUANTITY*UV_CURE	-0.019513	0.017451	-1.1181	0.2897
QUANTITY*SH_LIFE	-0.003325	0.017451	-0.19053	0.8527
QUANTITY*PLASMA	-0.00085	0.017451	-0.048707	0.9621
Z_DIST*UV_CURE	-0.0009375	0.017451	-0.5372	0.5982
Z_DIST*SH_LIFE	0.0437	0.017451	2.5041	0.0312
Z_DIST*PLASMA	-0.006425	0.017451	-0.36816	0.7204
UV_CURE*SH_LIFE	0.0362	0.017451	2.0743	0.0648
UV_CURE*PLASMA	-0.006325	0.017451	-0.36243	0.7246

There are four terms in the model that are highlighted yellow, indicating that their p-values are below the cutoff value of 0.05.

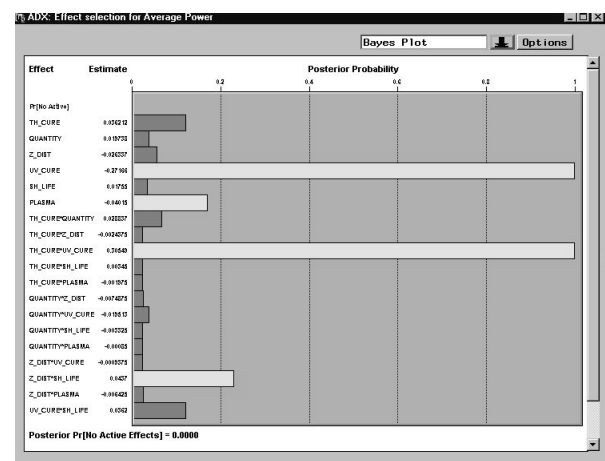
The ADX Interface provides additional graphical techniques to further examine the significant effects in our experiment. These graphs can be accessed by selecting the black down arrow in the upper right-hand corner of the window next to the label Effects and highlighting the graph of interest. There are a number of graphs to choose from. We will describe two of them, Normal plot and Bayes plot, in this paper. You should refer to the ADX manual for additional details.



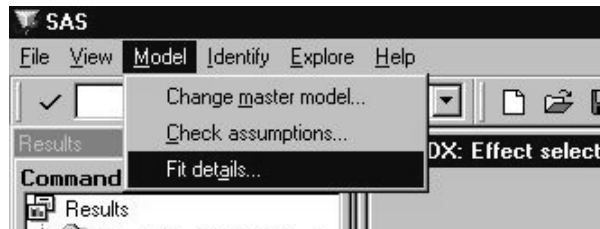
The Normal plot is a normal probability plot of the estimates of the effect size for all of the terms in the model. We look for effects that fall away from the line. The ADX Interface labels the effects that are seen as falling away from the population. Once again, for our data, we see four significant effects.



Another plot that we can use is Bayes Plot. This plot is based upon Bayesian statistics and plots the probability that an effect is important. Once again, the same four effects are large.



Along with the graphical output, we can also look at some detailed information regarding the fit of the model, which can be accessed by selecting **Model** from the main menu in the Fit window. The choices in this window include: changing the master model, for example, if we want to add some 3-factor interactions to the model, checking the model assumptions and performing residual analysis, and looking at the output from a least squared fit of the data to the model, for example, the sums of squares for each factor and the R^2 value.



Shown below, is the window that appears when we select **Fit details...** from the menu discussed above. We are looking at the predictive model information. We can see that there are probably some statistically significant terms in the model because the p-value for the model is less than 0.05, the model error is 0.05 and the model is explaining 95% of the variation in our data as is shown by the R^2 value.

Source	DF	SS	MS	F	Pr > F
Model	4	1.3652	0.3413	136.2193	.0001000
Error	27	0.0676	0.0025		

Response Mean	R-square	Adjusted R-square	Root MSE	CV
0.538869	0.952787	0.945793	0.050054	9.288792

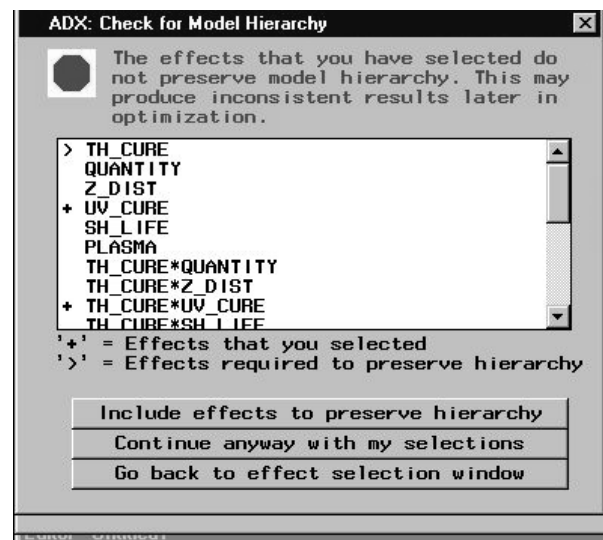
If you want to see the model fit information for the full model then click on the **Master Model** button at the top of the window and all of the information will be updated on the fly.

The other two tabs in the Fit Details window provide information about each term in the model and can be selected by clicking on the tab of interest. For example, to view the parameters in the model, we click on the **Parameters** tab. The parameters are displayed in both the coded (-1, 1) and uncoded units of our data. We can compare the magnitude and signs for the effects for each parameter in the model by looking at the coded values for the parameters. We can see that changing from the low level of UV_CURE to the high level of UV_CURE will change the prediction from the model by -0.6 units, with everything else held constant.

Model term	Coded data	Uncoded data
Intercept	0.7670375	1.0777375
TH_CURE	-0.3053750	0.0362125
QUANTITY	0.0054000	0.0197375
Z_DIST	0.0656000	-0.0263375
UV_CURE	-0.6011000	-0.2716625
SH_LIFE	0.0212875	0.0175500
PLASMA	0.0387875	-0.0401500
TH_CURE*QUANTITY	0.0576750	0.0288375
TH_CURE*Z_DIST	0.0048750	-0.0024375
TH_CURE*UV_CURE	0.6109750	0.3054875
TH_CURE*SH_LIFE	0.0063000	0.0034500
TH_CURE*PLASMA	0.0039500	-0.0019750
QUANTITY*Z_DIST	0.0149750	-0.0074875
QUANTITY*UV_CURE	-0.0390250	-0.0195125
QUANTITY*SH_LIFE	-0.0066500	-0.0033250
QUANTITY*PLASMA	0.0017000	-0.0008500
Z_DIST*UV_CURE	0.0018750	-0.0009375
Z_DIST*SH_LIFE	-0.0074000	0.0437000
Z_DIST*PLASMA	-0.0128500	-0.0064250
UV_CURE*SH_LIFE	0.0724000	0.9362900

To exit this window click on the 'X' in the upper right-hand corner of the window.

The last step in fitting the model to AV_MW is to select the final terms that we want in the model. Although, four terms are statistically significant, UV_CURE, PLASMA, TH_CURE*UV_CURE, Z_DIST*SH_LIFE, after evaluating all of the plots and statistics, we have decided to only keep two of these terms, UV_CURE and TH_CURE*UV_CURE. When we exit the Fit window the following message appears:

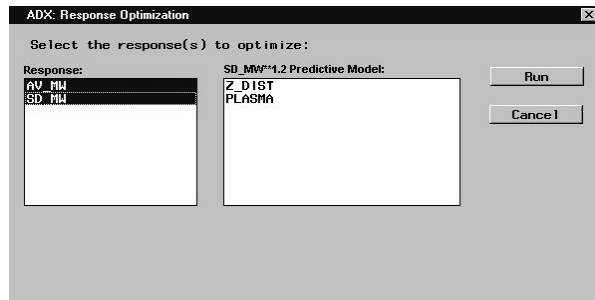


which tells us that we have included an interaction in the model without including the main effects associated with it. We click on the button that says 'Include effects to preserve hierarchy' and the main effect for TH_CURE is also added to our model, for reasons not explained here.

A similar exercise was conducted for the standard deviation of power. The details are omitted here except to specify the final model that we arrived at that includes the 2 main effects of PLASMA and Z_DIST.

VIII. Optimization of the Models . . .

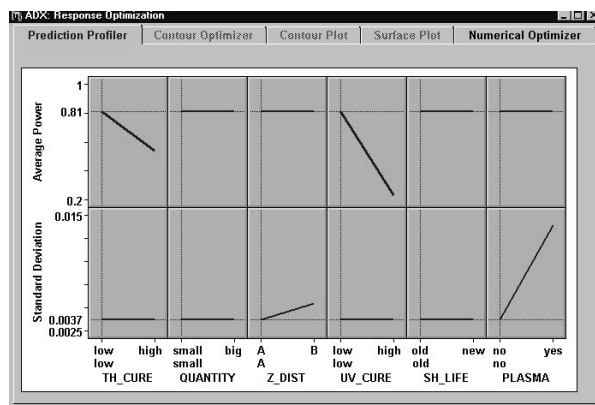
Now that we have identified our models, we want to select the settings of our factors that maximize the power while minimizing the standard deviation. This can be accomplished in the ADX Interface by selecting the **Optimize...** button in the main menu.



If we want to simultaneously optimize both responses then we need to highlight both AV_MW and SD_MW and then select the Run button in the right-hand side of the window.

The Prediction Profiler is the first window that appears. Our responses are listed across the y-axis and the factors in the models are listed along the x-axis. The response values are based upon the models that we selected in the last step so the flat lines mean that the factor is not in the model. This graph is useful to see the effect that a factor has on our predicted responses if we change its value from low to high. You can accomplish this by placing the mouse button over the vertical line until it turns into a double-headed horizontal arrow and drag it to the desired factor level. When you release the line the response values will automatically be updated.

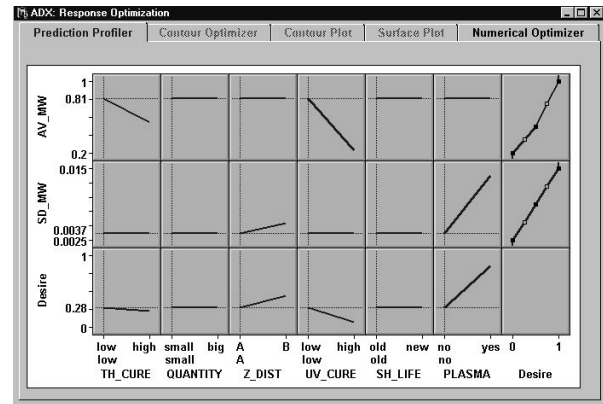
For the graph shown below, the factor settings are predicting a AV_MW of 0.81 and a SD_MW of 0.0037.



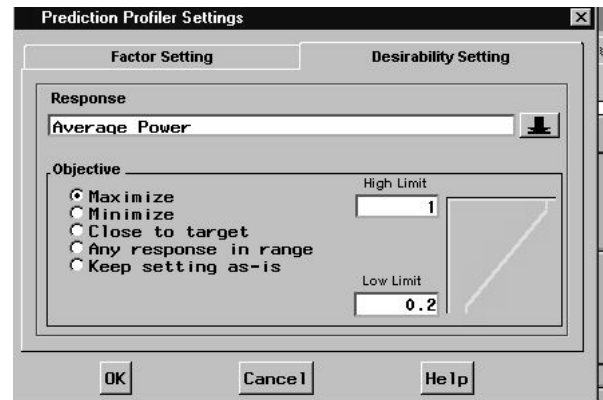
There is a tool called the Desirability function that allows us to simultaneously optimize both response values. We can view this function by selecting **View, Show Desirability** from the main menu at the top of the window. This action will add a third plot to this graph.



In order to optimize our responses we must first define the objectives of the optimization.

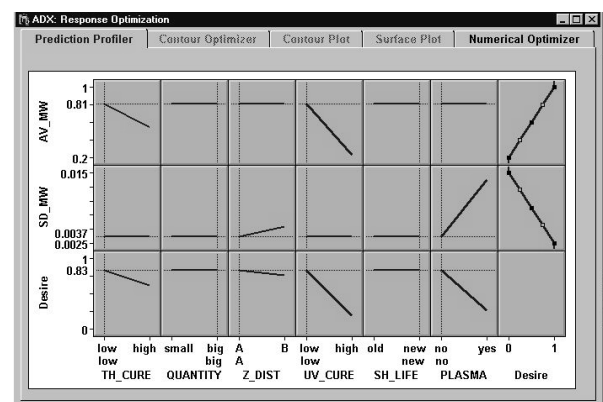


We can do this by selecting **Settings, Desirability settings** from the tool bar above. This will display a menu that allows us to enter the objectives for each response. For average power, we click the circle next to the Maximize label. To set the objective for the standard deviation you must click on the black arrow and select SD_MW from the list and click the Minimize label for this response.



When we are finished with all responses, click on the OK button in the bottom of the window.

The final step in the optimization is to optimize the function by selecting **Settings, Optimize desirability** from the tool bar at the top of this window. You should notice the factor settings changing, along with the value for the desirability function that is shown in the bottom graph.

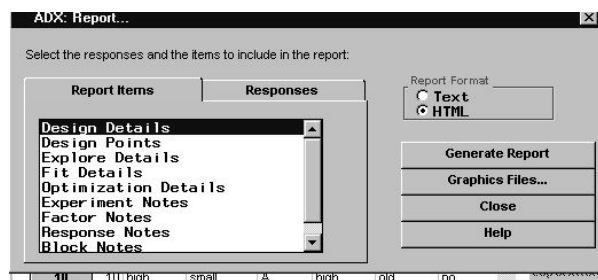


For our experiment, we can maximize AV_MW while minimizing SD_MW by using the following factor settings: low TH_CURE, big QUANTITY, A Z_DIST, low UV_CURE, new SH_LIFE, and no PLASMA. These settings yield a predicted AV_MW of 0.81 and a predicted SD_MW of 0.0037. The Desirability function is 0.83 at these settings. The highest value that the Desirability function can take on is 1.

When we are finished we click on the 'X' in the upper-right hand corner of this window.

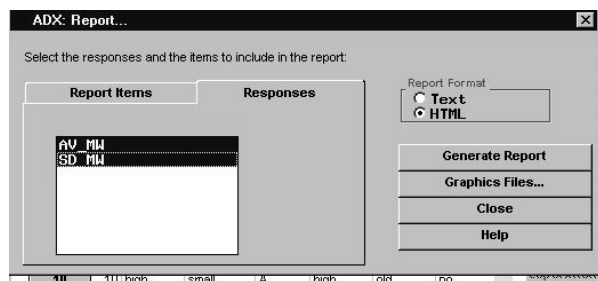
VIV. Generate the Report . . .

The final step in our analysis is to generate a report of the findings. Recall that we were selecting View, Include in report every time we came across a plot or table that we liked. We select the Report... button from the right-hand side of the main menu. The following dialog box is displayed:

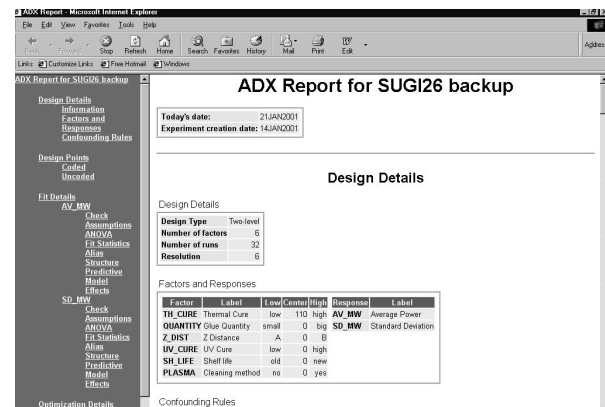


We can generate a text-based report or an HTML based report by clicking next to the appropriate label in the right-hand side of the menu. We recommend using the HTML reports. We want to include all of the possible report items in our report so we highlight all of the items in this window by clicking on them.

It is important to note that the ADX Interface, by default, selects one response value to include in the report. To include additional response values click on the Responses tab and highlight any additional responses.



We select the Generate Report button in the right-hand side of this window to create our HTML report with our experimental findings. An Internet Explorer window will be launched with your results. We can scroll up and down this window or jump to the section that we are interested in using the selections in the left-hand side of this window.



This report can be placed on your company Intranet site or emailed using the files that are generated by the report.

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