

# Chapter 1

## Overview of ADX

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# Chapter 1

## Overview of ADX

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### The ADX Interface

Welcome to the SAS® ADX Interface for Design of Experiments. The ADX Interface provides features for designing and analyzing experiments in a friendly point-and-click environment.

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### Using This Book

*Getting Started with the SAS® ADX Interface for Design of Experiments* is intended to help you quickly learn the primary features of the ADX Interface. This tutorial takes you through the steps of creating and analyzing one or more examples of each type of experimental design offered by ADX.

This book is not intended as comprehensive documentation, nor should it be considered as an experimental design text. However, the Appendices provide a glossary of terms and a list of references you may find useful.

You should have some understanding of design of experiments and be familiar with such terms as factorial screening design and normal plots. Of course, ADX provides some new and exciting ways to analyze your experimental designs.

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### Chapter Topics

In this chapter, you get acquainted with the ADX environment by working through a simple example.

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## Covered in This Chapter

- Creating a new two-level design
- Selecting a design
- Editing responses
- Exploring data
- Using a main effects plot
- Using a cube plot
- Using ADX Help

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## Your First ADX Session

The organization of the ADX Interface provides a step-by-step strategy for experimentation.

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## Task List

- Get acquainted with the ADX desktop.
- Learn how ADX organizes designs.
- Learn how designs achieve particular experimental objectives.
- Create a simple two-level factorial design.

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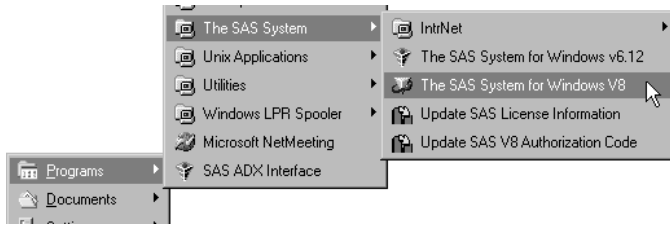
## The ADX Desktop

ADX provides menus and tool buttons for performing tasks ranging from constructing designs to creating reports. Menu options available depend on the ADX window that is open on the desktop.

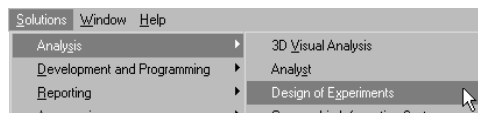
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## Starting ADX

To access ADX, first access the SAS application from your desktop.

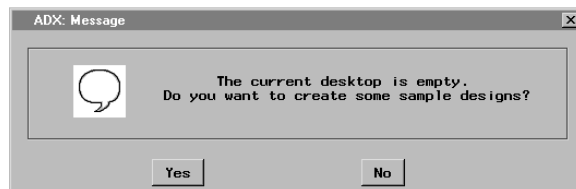


Call ADX using the Design of Experiments pull-down menu or by typing **adx** in the SAS command window.

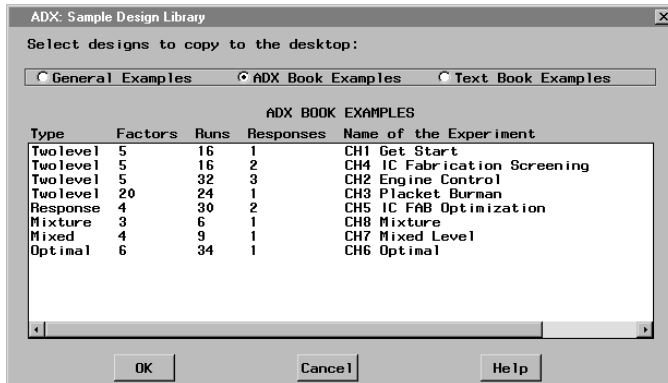


### Initial ADX Call

If this is the first time ADX is called, you will see this ADX Message window.



Click **Yes** and ADX will open the ADX desktop with a list of sample designs.



To create the designs used in this book, select the **ADX Book Designs** radio button and Shift-click to select the designs that begin with CH:

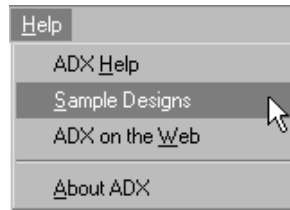
- CH1 Getting Started
- CH2 Engine Control
- CH3 Placket Burman
- CH4 IC Fab Screening
- CH5 IC Fab Optimization
- CH6 Optimal Design
- CH7 Mixed Level
- CH8 Mixture

### ***Adding Sample Designs to the Desktop Folder***

Once ADX creates the sample designs, it puts them in the ADX desktop, a SAS library called `SASUSER.ADXPARM`. If you are accessing ADX subsequent to an initial call, you want to add the sample designs listed above to the `ADXPARM` folder. (Your folder of sample designs may have different designs, depending on which sample designs were selected during the initial ADX call.)

To add new sample designs, follow these steps:

1. Select **Help** → **Sample Designs**.



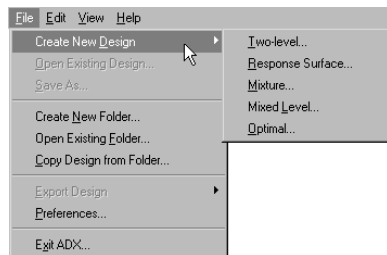
2. ADX instructs you to select the designs you want to copy.
3. Select the **ADX Book Designs** radio button.
4. Select all the designs (Shift-click can be used to select multiple designs at the same time).

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## Managing Your Designs

Any new designs that you create are added to the default ADXPARM folder.

Use the **File** menu or the folder icons   on the toolbar to create new folders or to change folders.



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## Design of Experiments Process

Design of experiments is a process in which designing the experiment is only one step. For any experiment, follow these steps:

1. Determine the experimental objective.
2. Determine the factors and responses.
3. Design the experiment to meet the objective.
4. Collect the data.
5. Analyze the data with graphs, plots, and statistics.
6. Report the experimental results.
7. Design a new experiment.

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## Design Objectives

Designs offered by ADX can be used to achieve specific experimental objectives.

**Table 1.1.** Design Types and Their Objectives

Design Type	Design Objective
Two-level Screening	Identify factors of greatest impact on response
Response Surface	Modeling with curvature effects
Mixture	Modeling effects that are components of a blend
Mixed Level	Two- and three-level, mixed quantitative and qualitative factors
Optimal	D- and A-optimal designs for irregular design regions
Split-Plot	Modeling effects where some levels are hard to change



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## Getting Started with a Simple Example

You do not need to know SAS programming to get started with ADX. The ADX Interface guides you through the steps of the experimental design process.

The best way to learn the ADX Interface is to step through a simple example. This example creates a fractional factorial design and illustrates a few of the plots you can use to explore the data.

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### Experimental Objective

As a dairy researcher you want to run a quick pilot study to examine 20 strains of bacteria (X1–X20) and determine which, if any, might be worth further study for use in dairy products. The eventual goal is to minimize the pH of milk in which these bacteria are placed, but a screening experiment will be used to identify a small number of factors that influence the pH.

The factors in this experiment are the 20 strains (X1–X20). In each run of the experiment, a factor can have a coded value of  $-1$  (strain absent) or  $+1$  (strain present). The response variable is pH.

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### Task List

- Create a two-level factorial design.
- Type the response values into the design.
- Examine main effects plots and cube plots to see which bacterial strains are worth further investigation.

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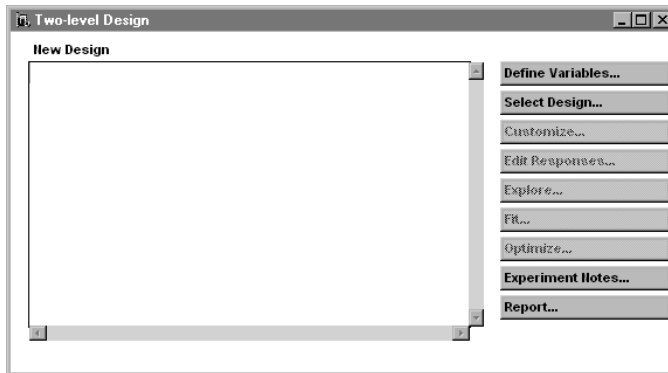
### Creating the Design

Select **File** → **Create New Design** → **Two-level**.



Alternatively, you can click the **Two-Level** design icon  on the toolbar.

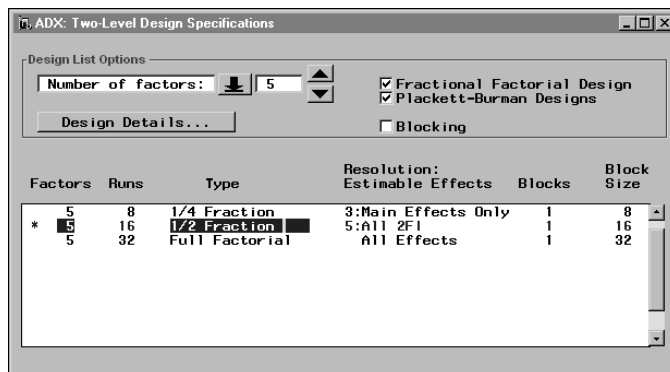
ADX brings up the main design window titled Two-level Design.



The main design window is conveniently arranged to facilitate designing and analyzing an experiment. The task buttons are listed to the right of the design display area. (Some of the task buttons are grayed out until preliminary steps are completed.)

To create the design for the strains, follow these steps:

1. Click on **Select Design...** to access the Two-Level Design Specifications window.
2. Type **5**, the number of strains, for **Number of factors**.
3. Select the **1/2 Fraction** design, a **16** run Resolution 5 design.



4. Close the window (select **File** → **Close** or click the upper right  ) to use the design.

The ADX Message window gives you a chance to change your mind.



Click **Yes** to use the selected design.

ADX returns you to the main design window and displays a table of the runs in the design.

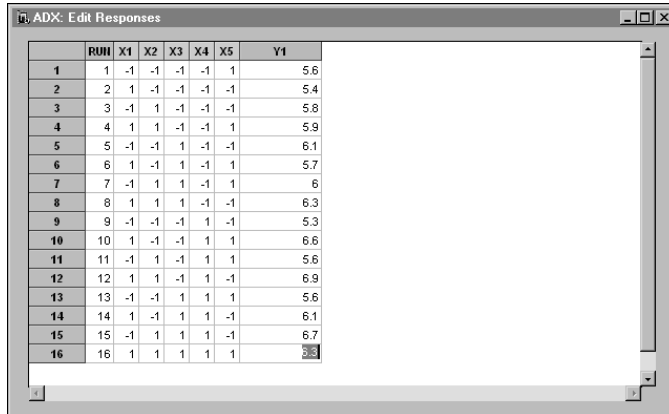
	X1	X2	X3	X4	X5
1	-1	-1	-1	-1	1
2	1	-1	-1	-1	-1
3	-1	1	-1	-1	-1
4	1	1	-1	-1	1
5	-1	-1	1	-1	-1
6	1	-1	1	-1	1
7	-1	1	1	-1	1
8	1	1	1	-1	-1
9	-1	-1	-1	1	-1
10	1	-1	-1	1	1
11	-1	1	-1	1	1
12	1	1	-1	1	-1
13	-1	-1	1	1	1

You can now perform the **Edit Responses** and **Customize** tasks.

Default factor names are given at the top of the columns, and the levels of each factor are the rows. For the purposes of this experiment, X1 corresponds to the presence or absence of bacterial strain 1, X2 to strain 2, and so on.

To enter the response data into the design, follow these steps:

1. Click **Edit Responses...** ADX takes you to the Edit Responses window and provides a column, called **Y1**, for you to enter the pH response values.
2. Type the pH values listed below in the default response column **Y1** (in order from row 1 to 16): 5.6, 5.4, 5.8, 5.9, 6.1, 5.7, 6, 6.3, 5.3, 6.6, 5.6, 6.9, 5.6, 6.1, 6.7, 6.3



Run	X1	X2	X3	X4	X5	Y1
1	1	-1	-1	-1	1	5.6
2	2	1	-1	-1	-1	5.4
3	3	-1	1	-1	-1	5.8
4	4	1	1	-1	1	5.9
5	5	-1	-1	1	-1	6.1
6	6	1	-1	1	1	5.7
7	7	-1	1	1	-1	6
8	8	1	1	1	-1	6.3
9	9	-1	-1	-1	1	5.3
10	10	1	-1	-1	1	6.6
11	11	-1	1	-1	1	5.6
12	12	1	1	-1	1	6.9
13	13	-1	-1	1	1	5.6
14	14	1	-1	1	-1	6.1
15	15	-1	1	1	1	6.7
16	16	1	1	1	1	6.3

3. Close the window.
4. Click **Yes** to apply the changes (accept the entered responses) to the design data set.

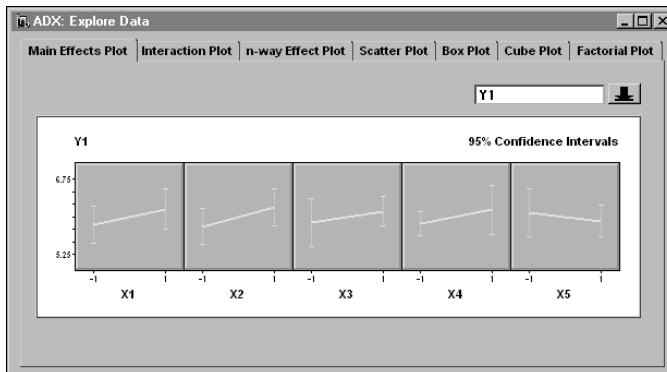


Once a design has response values, you can use the **Explore**, **Fit**, and **Optimize** features for exploring and analyzing the data.

## Exploring Results

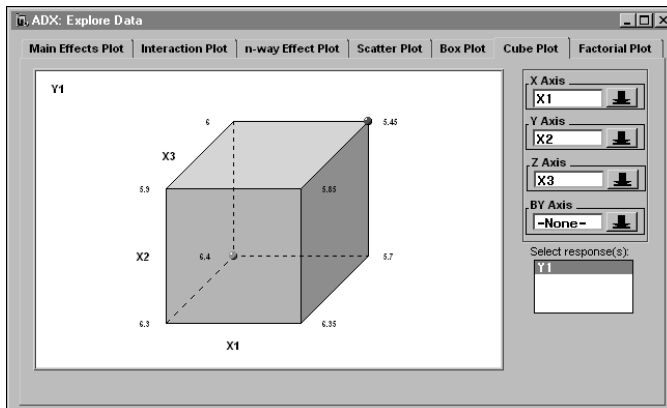
To view the Main Effects and Interaction Plots, click **Explore...** . The Explore Data window will open.

In main effects plots, the slope of the line connecting the low level to the high level indicates the strength of the effect or, in this case, the ability of the strain to change the response, pH.




Switch to the cube plot by clicking the **Cube Plot** tab.

The cube plot is an interactive plot. For example, place the mouse cursor over the X1 label. The cursor changes to a grabbing hand to indicate interactivity. Then you can click and drag the label to another edge of the cube. You will work with other interactive features in later chapters.




The symbols at certain corners indicate which combinations of levels give the highest and the lowest pH (Y1) values. The lowest pH of 5.45 for the X1, X2, X3 strains occurs when all three strains are absent.

Select **File** → **Close** or click  to return to the main design window.

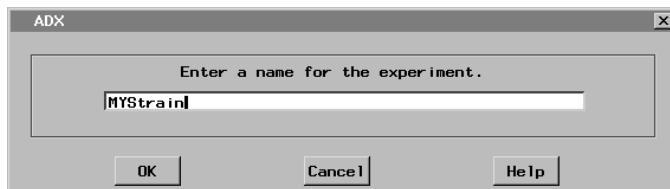
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## Exiting ADX

When you are finished working with a design, select **File** → **Close** or click  from the main design window. An ADX Message window appears to ask if you want to save the changes to the design permanently.

To save your design with the response values entered, follow these steps:

1. Click **Yes**.

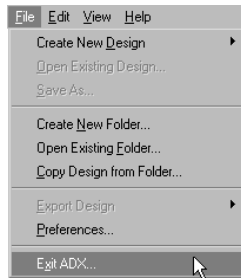


2. Type **MyStrain** as the name for this design.
3. Click **OK**.

ADX adds the new MyStrain design to the open desktop folder so you can use it later.

To exit ADX, follow these steps:

1. Close the desktop window.



2. A confirmation window appears. Click **OK**.



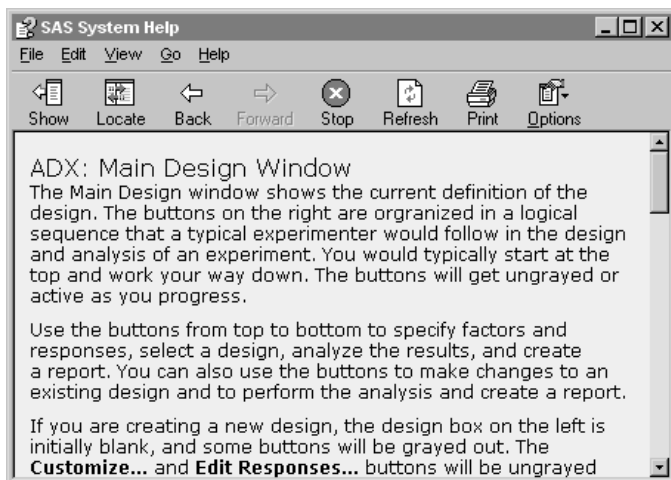
3. To exit the SAS System, select **File** → **Exit**.

Congratulations! You have just performed your first experiment using the ADX Interface.

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## Using ADX Help

ADX Help provides information on how to use ADX and on how to design experiments. Select **Help** → **ADX Help** to open the ADX Help window.



Select **File** → **Close** or click  to close the Help window.

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## Points to Remember

- ADX has features for creating and analyzing experimental designs through a simple point-and-click interface. You can use menus, icons, and right mouse clicks to maneuver through the interface.
- ADX is organized by type of experimental design.
- Different designs accomplish different types of experimental objectives.
- ADX uses folders to group designs so you can organize designs according to projects.
- ADXPARM is the name for the default desktop folder that contains designs.



- Look to the main design window to refine, edit, explore, and analyze your experiment.
- The **Explore...** button calls up a window that provides different plots including main effects and cube plots.
- The online ADX Help system provides useful information on experimental design and analysis methods and how to implement them in the ADX interface.