

Chapter 268

Design Generator

Introduction

This program generates factorial, repeated measures, and split-plots designs with up to ten factors. The design is placed in the current database.

Crossed Factors

Two factors are *crossed* if all levels of one factor occur with each level of the second factor. No distinction needs to be made as to whether a factor is random or fixed. Factorial and randomized block designs are examples of designs that contain crossed factors.

Nested Factors

In the repeated measures and split-plot designs, at least one of the factors is nested in another factor. A factor is *nested* when all levels of this factor do not occur with each level of another factor. For example, suppose a study is being made to compare the heart rate of males and females. Five males and five females are selected. One factor in the study would be gender with two levels: male and female. Another factor would be individual with ten levels: P1, P2, ..., and P10. Since five of the ten individuals are in the males group and the other five individuals are in the females group, individuals are nested within gender.

The basic structure of *repeated measures* and *split-plot* designs is identical. The difference between the two is in the way the factor levels are assigned within the individual factor. Consider an exercise study in which heart rate readings are to be made on an individual at five different points in time. If the amounts of exercise is assigned at random before each reading, the design is a split plot. If the amounts of exercise follow the same pattern for each individual, the design is a repeated measures.

Example 1 – Three-by-Four Factorial Design with Three Replicates

This section presents an example of how to degenerate a three-by-four factorial design with three replicates per treatment combination. To run this example, take the following steps. **CAUTION: since the purpose of this routine is to generate (not analyze) data, you should always begin with an empty dataset.**

Setup

To run this example, complete the following steps:

1 Open a new (empty) dataset

- From the **File** menu of the NCSS Data window, select **New**.

2 Specify the Design Generator procedure options

- Find and open the **Design Generator** procedure using the menus or the Procedure Navigator.
- The settings for this example are listed below and are stored in the **Example 1** settings template. To load this template, click **Open Example Template** in the Help Center or File menu.

<u>Option</u>	<u>Value</u>
Design Tab	
Factor 1 Values (A).....	1 2 3
Factor 2 Values (B).....	1 2 3 4
Factor 3 Values (C)	Nested 3
Store the Design Data in the Data Table.....	Checked

3 Run the procedure

- Click the **Run** button to perform the calculations and generate the output.

Three-by-Four Design with Three Replicates

Factor_1	Factor_2	Factor_3
1	1	1
1	1	2
1	1	3
1	2	4
1	2	5
1	2	6
1	3	7
1	3	8
1	3	9
1	4	10
1	4	11
1	4	12
2	1	13
2	1	14
2	1	15
2	2	16
2	2	17
2	2	18
2	3	19
2	3	20
2	3	21
2	4	22
2	4	23
2	4	24
3	1	25
3	1	26
3	1	27
3	2	28
3	2	29
3	2	30
3	3	31
3	3	32
3	3	33
3	4	34
3	4	35
3	4	36

Notice that column 1 contains the three values for factor 1, column 2 contains the four values of factor 2, and column 3 contains the value of the nested factor. When these data are analyzed, column 3 will be ignored.

You would now proceed with your experiment, obtain the real response values, and analyze the data using either the Analysis of Variance, GLM, or Mixed Models procedure. The output will appear as follows.

ANOVA for 3-by-4 Factorial

Expected Mean Squares Section

Source Term	DF	Term Fixed?	Denominator Term	Expected Mean Square
A: Factor_1	2	Yes	S(AB)	S+bsA
B: Factor_2	3	Yes	S(AB)	S+asB
AB	6	Yes	S(AB)	S+sAB
S(AB)	24	No		S

Note: Expected Mean Squares are for the balanced cell-frequency case.

Analysis of Variance Table

Source Term	DF	Sum of Squares	Mean Square	F-Ratio	Prob Level	Power (Alpha=0.05)
A: Factor_1	2	355.1667	177.5833	0.21	0.809379	0.079515
B: Factor_2	3	534.3055	178.1019	0.21	0.885717	0.084357
AB	6	1711.944	285.3241	0.34	0.907111	0.125169
S	24	19975.33	832.3055			
Total (Adjusted)	35	22576.75				
Total	36					

* Term significant at alpha = 0.05

Of course, your F-Ratios will be different because you would be using a different set of response data. However, you will be able to see the number of degrees of freedom that are associated with each factor.

Example 2 – Randomized Block Design

This section presents an example of how to degenerate a randomized block design with three blocks and four treatments. To run this example, take the following steps. **CAUTION: since the purpose of this routine is to generate (not analyze) data, you should always begin with an empty dataset.**

Setup

To run this example, complete the following steps:

1 Open a new (empty) dataset

- From the **File** menu of the NCSS Data window, select **New**.

2 Specify the Design Generator procedure options

- Find and open the **Design Generator** procedure using the menus or the Procedure Navigator.
- The settings for this example are listed below and are stored in the **Example 2** settings template. To load this template, click **Open Example Template** in the Help Center or File menu.

<u>Option</u>	<u>Value</u>
Design Tab	
Factor 1 Values (A).....	1 2 3
Factor 2 Values (B).....	A B C D
Store the Design Data in the Data Table.....	Checked

3 Run the procedure

- Click the **Run** button to perform the calculations and generate the output.

Randomized Block Design

Factor_1	Factor_2
1	A
1	B
1	C
1	D
2	A
2	B
2	C
2	D
3	A
3	B
3	C
3	D

Notice that column 1 contains the three values for the blocks, and column 2 contains the value of the treatment.

It is important to remember that when you use this design, you must randomly assign treatments to the four letters and randomly assign the physical blocks to the three block numbers.

You would now proceed with your experiment, obtain the response values, and analyze the data using the GLM procedure. You would specify blocks (Factor_1) as random and treatment (Factor_2) as fixed. You would set the Which Model Terms option of the Model tab to Up to 1-Way. After running the analysis, the format of the output appears as follows.

ANOVA for Randomized Block Design

Expected Mean Squares Section

Source Term	DF	Term Fixed?	Denominator Term	Expected Mean Square
A: Factor_1	2	No	S(AB)	S+bsA
B: Factor_2	3	Yes	S(AB)	S+asB
S(AB)	6	No		S

Note: Expected Mean Squares are for the balanced cell-frequency case.

Analysis of Variance Table

Source Term	DF	Sum of Squares	Mean Square	F-Ratio	Prob Level	Power (Alpha=0.05)
A: Factor_1	2	66.66666	33.33333	0.13	0.882756	
B: Factor_2	3	1748.333	582.7778	2.23	0.185753	0.327037
S	6	1570.667	261.7778			
Total (Adjusted)	11	3385.667				
Total	12					

* Term significant at alpha = 0.05

Example 3 – Repeated Measures Design

This section presents an example of how to degenerate a repeated measures design with three groups, two individuals per group, and two treatments which we will label 'Pre' and 'Post.' To run this example, take the following steps. **CAUTION: since the purpose of this routine is to generate (not analyze) data, you should always begin with an empty dataset.**

Setup

To run this example, complete the following steps:

1 Open a new (empty) dataset

- From the **File** menu of the NCSS Data window, select **New**.

2 Specify the Design Generator procedure options

- Find and open the **Design Generator** procedure using the menus or the Procedure Navigator.
- The settings for this example are listed below and are stored in the **Example 3** settings template. To load this template, click **Open Example Template** in the Help Center or File menu.

<u>Option</u>	<u>Value</u>
Design Tab	
Factor 1 Values (A).....	1 2 3
Factor 2 Values (B).....	Nested 2
Factor 3 Values (C)	Pre Post
Store the Design Data in the Data Table.....	Checked

3 Run the procedure

- Click the **Run** button to perform the calculations and generate the output.

Repeated Measures Design

Factor_1	Factor_2	Factor_3
1	1	Pre
1	1	Post
1	2	Pre
1	2	Post
2	3	Pre
2	3	Post
2	4	Pre
2	4	Post
3	5	Pre
3	5	Post
3	6	Pre
3	6	Post

Column 1 contains the three group values which are sometimes referred to as the *Between* factor. Column 2 contains the identification numbers of the six individuals required for this design. Notice that each individual is placed in only one group (Factor_1). Column 3 contains the pre-post labels. The design is ready for analysis by the GLM procedure.

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You would now proceed with your experiment, obtain the response values, and analyze the data using the GLM procedure. You would specify variable 1 (Factor_1) as fixed, variable 2 (Factor_2) as nested, and variable 3 (Factor_3) as fixed. After running the analysis, the output appears as follows.

ANOVA for Repeated Measures Design

Expected Mean Squares Section

Source Term	DF	Term Fixed?	Denominator Term	Expected Mean Square
A: Factor_1	2	Yes	B(A)	S+csB+bcsA
B(A): Factor_2	3	No	S(ABC)	S+csB
C: Factor_3	1	Yes	BC(A)	S+sBC+absC
AC	2	Yes	BC(A)	S+sBC+bsAC
BC(A)	3	No	S(ABC)	S+sBC
S(ABC)	0	No	S	S

Note: Expected Mean Squares are for the balanced cell-frequency case.

Analysis of Variance Table

Source Term	DF	Sum of Squares	Mean Square	F-Ratio	Prob Level	Power (Alpha=0.05)
A: Factor_1	2	280.6667	140.3333	0.23	0.808024	0.064975
B(A): Factor_2	3	1838	612.6667			
C: Factor_3	1	1.333333	1.333333	0.00	0.969957	0.050102
AC	2	754.6667	377.3333	0.47	0.662874	0.081169
BC(A)	3	2393	797.6667			
S	0	0				
Total (Adjusted)	11	5267.667				
Total	12					

* Term significant at alpha = 0.05