

Chapter 266

Taguchi Designs

Introduction

Taguchi experimental designs, often called orthogonal arrays (OA's), consist of a set of fractional factorial designs which ignore interaction and concentrate on main effect estimation. This program module generates the most popular set of Taguchi designs.

Taguchi uses the following convention for naming the orthogonal arrays: $L_a(b^c)$ where a is the number of experimental runs, b is the number of levels of each factor, and c is the number of variables. Designs can have factors with several levels, although two and three level designs are the most common. The L_{18} design is perhaps the most popular.

When a design is generated, the levels of each factor are stored in the current dataset—replacing any data that is already there. No output reports are generated by this procedure.

Procedure Options

This section describes the options available in this procedure.

Design Tab

This panel specifies the parameters that will be used to create the design values.

Experimental Setup

Design Type

This option designates the particular design that is to be generated. The available choices are:

- **L4 2³**
This design consists of up to 3 factors at 2 levels each. There are 4 rows.
- **L8 2⁷**
This design consists of up to 7 factors at 2 levels each. There are 8 rows.
- **L12 2¹¹**
This design consists of up to 11 factors at 2 levels each. There are 12 rows.
- **L16 2¹⁵**
This design consists of up to 15 factors at 2 levels each. There are 16 rows.
- **L32 2³¹**
This design consists of up to 31 factors at 2 levels each. There are 32 rows.

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- **L64 2⁶³**
This design consists of up to 63 factors at 2 levels each. There are 64 rows.
- **L9 3⁴**
This design consists of up to 4 factors at 3 levels each. There are 9 rows.
- **L27 3¹³**
This design consists of up to 13 factors at 3 levels each. There are 27 rows.
- **L27' 3²²**
This design consists of up to 22 factors at 3 levels each. There are 27 rows.
- **L16' 4⁵**
This design consists of up to 5 factors at 4 levels each. There are 16 rows.
- **L25 5⁶**
This design consists of up to 6 factors at 5 levels each. There are 25 rows.
- **L18 2¹ x 3⁷**
This design consists of one factor at 2 levels and up to 7 factors at 3 levels each. There are 18 rows.
- **L36 2³ x 3¹³**
This design consists of up to 3 factors at 2 levels and up to 13 factors at 3 levels each. There are 36 rows.
- **L36' 2¹¹ x 3¹²**
This design consists of up to 11 factors at 2 levels and up to 12 factors at 3 levels each. There are 36 rows.
- **L54 2¹ x 3²⁵**
This design consists of one factor at 2 levels and up to 25 factors at 3 levels each. There are 54 rows.
- **L32' 2¹ x 4⁹**
This design consists of one factor at 2 levels and up to 9 factors at 4 levels each. There are 32 rows.
- **L50 2¹ x 5¹¹**
This design consists of one factor at 2 levels and up to 11 factors at 5 levels each. There are 50 rows.

Experimental Setup – Factor Specification

2 Level Factors...5 Level Factors

The number of variables of this type (number of levels) that are generated. For example, if you selected L36 2³ x 3¹³ as the Design Type, you could specify up to three two-level factors and up to thirteen three-level factors. You would enter the number of two-level factors in the 2-Level Factors box and the number of three-level factors in the 3-Level Factors box. Entries in the unused boxes (such as 4-Level and 5-Level in this example) are ignored. If you ask for more than the maximum allowed, the maximum will be used.

Warning: The program fills these variables with data, so previous data may be lost.

Data Storage

Store Data with the Dataset

Check this box to generate the design data on the dataset. The data will be identical to the design data generated on the output window.

First Factor Column

This is where the group of columns that is to contain your design begins. The K-1 columns after this column are also filled with data, where K is the number of columns specified.

Warning: The program fills these columns with data, so any previous data will be lost.

Example 1 – Taguchi Design

This section presents an example of how to generate an experimental design using this program. **CAUTION: since the purpose of this routine is to generate (not analyze) data, you should always begin with an empty dataset.**

In this example, we will show you how to generate an L18 design. You may follow along here by making the appropriate entries or load the completed template **Example 1** by clicking on Open Example Template from the File menu of the Taguchi Designs window.

1 Open a new (empty) dataset.

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

2 Open the Taguchi Designs window.

- Using the Analysis menu or the Procedure Navigator, find and select the **Taguchi Designs** procedure.
- On the menus, select **File**, then **New Template**. This will fill the procedure with the default template.

3 Specify the design parameters.

- On the Taguchi Designs window, select the **Design** tab.
- Select **L18 2¹ x 3⁷** in the **Design Type** list box.
- Enter **1** in the **2-Level Factors** box.
- Enter **7** in the **3-Level Factors** box.
- Check the box **Store Data with the Dataset**.
- Enter **1** in the **First Factor Column** box.

4 Run the procedure.

- From the Run menu, select **Run Procedure**. Alternatively, just click the Run button (the left-most button on the button bar at the top).

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Taguchi L18 Design

C1	C2	C3	C4	C5	C6	C7	C8
1	1	1	1	1	1	1	1
1	1	2	2	2	2	2	2
1	1	3	3	3	3	3	3
1	2	1	1	2	2	3	3
1	2	2	2	3	3	1	1
1	2	3	3	1	1	2	2
1	3	1	2	1	3	2	3
1	3	2	3	2	1	3	1
1	3	3	1	3	2	1	2
2	1	1	3	3	2	2	1
2	1	2	1	1	3	3	2
2	1	3	2	2	1	1	3
2	2	1	2	3	1	3	2
2	2	2	3	1	2	1	3
2	2	3	1	2	3	2	1
2	3	1	3	2	3	1	2
2	3	2	1	3	1	2	3
2	3	3	2	1	2	3	1

This shows the data that were generated in the dataset. You can use the Find/Replace facility of the spreadsheet if you want to change the values from 1, 2, 3, to values that are meaningful to your study.