

Chapter 887

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 procedure 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 can be stored in the current spreadsheet--replacing any data that is already there.

An introduction to experimental design is presented in Chapter 881 on Two-Level Factorial Designs and will not be repeated here.

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.

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- **L32 2³¹**
This design consists of up to 31 factors at 2 levels each. There are 32 rows.
- **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 columns 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 enter more than the maximum allowed, the maximum will be used.

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Data Storage to Spreadsheet

Store Data on Spreadsheet

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

First Factor Column

This is where the group of columns of the spreadsheet 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 factors 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 data, you should always begin with an empty output spreadsheet.**

In this example, we will show you how to generate an L18 design.

Setup

This section presents the values of each of the parameters needed to run this example. First, from the PASS Home window, load the **Taguchi Designs** procedure window by expanding **Design of Experiments**, then clicking on **Experimental Design**, and then clicking on **Taguchi Designs**. You may then make the appropriate entries as listed below, or open **Example 1** by going to the **File** menu and choosing **Open Example Template**.

1 Specify the design parameters.

- 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 **Store Data on Spreadsheet** box.
- Enter **1** in the **First Factor Column** box.

2 Run the procedure.

- From the Run menu, select **Start Calculation**. Alternatively, just click the Calculate button.

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Taguchi L18 Design

Experimental Design

Row	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Factor 8
1	1	1	1	1	1	1	1	1
2	1	1	2	2	2	2	2	2
3	1	1	3	3	3	3	3	3
4	1	2	1	1	2	2	3	3
5	1	2	2	2	3	3	1	1
6	1	2	3	3	1	1	2	2
7	1	3	1	2	1	3	2	3
8	1	3	2	3	2	1	3	1
9	1	3	3	1	3	2	1	2
10	2	1	1	3	3	2	2	1
11	2	1	2	1	1	3	3	2
12	2	1	3	2	2	1	1	3
13	2	2	1	2	3	1	3	2
14	2	2	2	3	1	2	1	3
15	2	2	3	1	2	3	2	1
16	2	3	1	3	2	3	1	2
17	2	3	2	1	3	1	2	3
18	2	3	3	2	1	2	3	1

The values were also produced on the spreadsheet.

These values are also generated on the spreadsheet. You can use the Find/Replace facility of the spreadsheet if you want to change the values from 1, 2, 3 to something more meaningful.