

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.

Designs

The available design types 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.
- **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.

Taguchi Designs

- **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.

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 procedure 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.

Setup

To run this example, complete the following steps:

1 Specify the Taguchi Designs procedure options

- Find and open the **Taguchi Designs** procedure using the menus or the Procedure Navigator.
- The settings for this example are listed below and are stored in the **Example 1** settings file. To load these settings to the procedure window, click **Open Example Settings File** in the Help Center or File menu.

```

Design Tab
-----
Design Type.....L18 2^1 x 3^7
2-Level Factors.....1
3-Level Factors.....7
Store the Design Data in the Data Table .....Checked
    
```

2 Run the procedure

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

Taguchi L18 Design Output

Experimental Design

Section 1

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

Section 2

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

The values were also written to the Data Table.

Taguchi L18 Design Data Storage

| 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 | 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.