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Taguchi Method

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ABSTRACT

The Taguchi method (Tm) is a powerful problem solving technique for improving process performance, yield and productivity. It reduces scrap rates, rework costs and manufacturing costs due to excessive variability in processes. It is based on '**ORTHOGONAL ARRAY'** which gives much reduced 'variance' for the experiment with 'optimum setting' of control parameters. By using Minitab17 software we can implement a Taguchi Design. Paper gives a information about how to use a Taguchi by Minitab17.

Keywords: Taguchi Method, Orthogonal Array, Signal to noise ratio, Minitab17.

I. INTRODUCTION

Design of Experiments (DOE) is a powerful statistical technique introduced by R. A. Fisher in England in the 1920's to study the effect of multiple variables simultaneously. He made effort to make this experimental technique more user-friendly and applied it to improve the quality of manufactured products.

A Taguchi design is a designed experiment that chooses a product or process so that functions more consistently in the operating environment. Taguchi designs recognize that not all factors that cause variability can be controlled. These uncontrollable factors are called noise factors. Taguchi designs try to identify controllable factors (control factors) that minimize the effect of the noise factors. During experimentation, it can manipulate noise factors to force variability to occur and then determine optimal control factor settings that make the process or product robust, or resistant to variation from the noise factors. A process designed with this goal will produce more consistent output. A product designed with this goal will deliver more consistent performance regardless of the environment in which it is used. The purpose of the current study was to determine, Taguchi Design by Minitab17 for reducing variance.

II. METHODS AND MATERIAL

Orthogonal Array

Taguchi designs use orthogonal arrays, which estimate the effects of factors on the response mean and variation. An orthogonal array means the design is balanced so that factor levels are weighted equally. Because of this, each factor can be assessed independently of all the other factors, so the effect of one factor does not affect the estimation of a different factor. This can reduce the time and cost associated with the experiment when fractionated designs are used.

III. RESULTS AND DISCUSSION

3. Experimental Procedure

Before start using Minitab, need to choose control factors for the inner array and noise factors for the outer array. Control factors are factors that can control to optimize the process. Noise factors are factors that can affect the performance of a system but are not in control during the intended use of the product.

A. Step-1

Go to Minitab17 then **Stat > DOE > Taguchi > Create Taguchi Design** to generate a Taguchi design (orthogonal array). Each column in the orthogonal array represents a specific factor with two or more levels. Each row represents a run; the cell values identify the factor settings for the run. By default, Minitab's orthogonal array designs use the integers 1, 2, 3, to represent factor levels. If you enter factor levels, the integers 1, 2, 3, will be the coded levels for the design.

B. Step-2

After you create the design, you can use **Stat > DOE > Modify Design** to rename the factors, change the factor levels, add a signal factor to a static design, ignore an existing signal factor (treat the design as static), and add new levels to an existing signal factor.

C. Step-3

After creating the design, we can use **Stat > DOE > Display Design** to change the units (coded or uncoded) in which Minitab expresses the factors in the worksheet.

D. Step-4

Conduct the experiment and collect the response data. The experiment is done by running the complete set of noise factor settings at each combination of control factor settings (at each run). The response data from each run of the noise factors in the outer array are usually aligned in a row, beside the factor settings for that run of the control factors in the inner array.

E. Step-5

Use **Stat > DOE > Taguchi > Analyze Taguchi Design** to analyse the experimental data. It must analyse each response variable separately with Taguchi designs. Although Taguchi analysis accepts multiple response columns, these responses should be the same variable measured under different noise factor conditions.

F. Step-6

Use **Stat > DOE > Taguchi > Predict Taguchi** Results to predict signal to noise ratios and response characteristics for selected new factor settings.

3.1. Two-step Optimization for Taguchi Designs

The goal of a robust parameter design is usually to determine factor settings that will minimize the variability of the response about some ideal target value.

- First, set all factors that have a substantial effect on the signal-to-noise ratio at the level where the signal-to-noise is maximized.
- Then, adjust the level of one or more factors that substantially affect the mean (or slope) but not the signal-to-noise to put the response on target.

3.2. Display the alias structure for a Taguchi design

Create an L8 Taguchi design with three 2-level factors. You enter the factors in C1, C2, and C3, and the responses in C4 and C5. To display the alias structure:

1. Choose Stat > DOE > Factorial > Define Custom Factorial Design.
2. In Factors, enter C1 C2 C3.
3. Click Low/High. Click OK in each dialog box.
4. Choose Stat > DOE > Factorial > Analyze Factorial Design.
5. In Responses, enter C4. Click OK.

Minitab displays the alias structure at the bottom of the Session window. You can disregard the other output

TABLE I
STANDARD ORTHOGONAL ARRAY

Run	A	B	C	D
1	1	1	1	1
2	1	2	2	2
3	1	3	3	3
4	2	1	2	3
5	2	2	3	1
6	2	3	1	2
7	3	1	3	2
8	3	2	1	3
9	3	3	2	1

4. Measurement System

- To trust your experimental results, you need to verify that your measurement system is accurate. It necessary to verify the measurement systems that are used both to measure the response and to set the factor levels.
- If the experiments are part of a larger improvement project, such as a six sigma project, the measurement system for the response should have been validated previously. Make sure that you verify the measurement system for the factors as well. For example, if you set an oven at 350 degrees F, you need to be certain that the temperature is actually 350 degrees F.

- Design combination: After you create your design, review the actual combinations of factor settings for each experimental run to make sure they are feasible and safe to run
- Trial and Runs: Performing trial runs before you run an experiment is useful, if time and budget permits. Trial runs allow you to:

i. Assess the consistency of materials in the experiment.
ii. Check the measurement systems for the experiment.
iii. Test the experimental procedures and ensure that operators perform them correctly.
iv. Check that the different combinations of factor levels can be run safely.
v. Obtain preliminary estimates of variation.

Control Chart example

The control chart is a graph used to study how a process changes over time. Data are plotted in time order. A control chart always has a central line for the average, an upper line for the uppercontrol limit and a lower line for the lower control limit. These lines are determined from historical data.

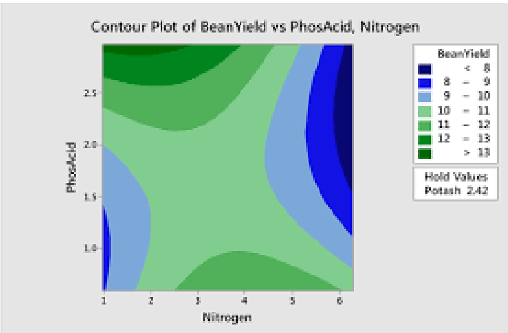

Figure 1. Signal to Noise Ratio

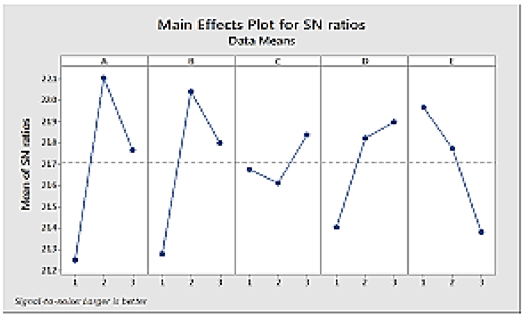

Figure 2: Example of SN ratio graph

- Taguchi's emphasis on minimizing deviation from target led him to develop measures of the process output that incorporate both the location of the output as well as the variation. These measures are called signal to noise ratios.
- The signal to noise ratio provides a measure of the impact of noise factors on performance. The larger the S/N, the more robust the product is against noise.

IV. CONCLUSION

The Taguchi approach to quality engineering places a great deal of emphasis on minimizing variation as the main means of improving quality. The idea is to design products and processes whose performance is not affected by outside conditions and to build this in during the development and design stage through the use of experimental design. The method includes a set of tables that enable main variables and interactions to be investigated in a minimum number of trials. Taguchi Method uses the idea of Fundamental Functionality, which will facilitate people to identify the common goal because it will not change from case to case and can provide a robust standard for widely and frequently changing situations. It is also pointed out that the Taguchi Method is also very compatible with the human focused quality evaluation approaches that are coming up.

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VI. REFERENCES

[1] Taguchi, G., Wu, Y.Introduction to off-line Quality Control Nagaya, Japan: Central Japan Quality Control Organization, 1979'

[2] Taguchi, G. Introduction to Quality Engineering Tokyo, Japan: Asian Productivity Organization, 1986

[3] Khan, R. M. (2013). Problem solving and data analysis using minitab: A clear and easy guide to six sigma methodology (1st ed.). West Sussex, United Kingdom: Wiley.

[4] Phadke M.S., 1989. Quality engineering using robust design. Englewood Cliffs, NJ: Prentice-Hall.

[5] Montgomery D.C., 1991. Design and analysis of experiments. John Wiley and Sons, NewYork.

[6] Singh H & Kumar P, Quality Optimization of Turned Parts (EN24) by Taguchi Method, Productivity, Vol. 44 (1),(2003) pp. 43-49.

[7] Singh H & Kumar P,Effect on Power Consumption forTurned parts using Taguchi Technique, Productivity, Vol.45 (2), July-Sept,(2004).

[8] Singh H & Kumar P, Optimizing cutting force for turnedparts by taguchi parameter design approach, Indian Journalof Engineering and Material Science,Vol-12, April (2005) Minitab's Help Section.