Robust Design

Background

- Design and Analysis of Experiments
- Purpose of Designing Experiments
- Efficient Designs
- Taguchi Method
- Reliable Experiment Design

Learning Objective

- Understand Robust Experiment Design.
- List the types of objective functions in Taguchi method.
- Understand critical aspects of Robust Design.
- List the advantages of Robust Design

Robust Design

- It is an engineering methodology used to improve productivity in R & D activities so that high quality products can be developed fast and at low cost.
- A product or a process is robust if its performance is not affected by the noise factors.
- Robust design is a procedure used to design products and processes such that their performance is insensitive to noise factors.
- Robust design was developed by Dr. Genich Taguchi in the 1950s, popularly known as Taguchi methods.
- Orthogonal Array experiments are used in Robust design.

Limitations of ANOVA

- Identifying factors that affect mean performance
- Location effect of the factors
- Basic Assumption in ANOVA analysis is equality of variance
- Variability in the response characteristic remains same for different trails.
- Based on this assumption, mean responses of treatment combinations are compared.
- In some cases, basic assumption may be violated.

Signal to Noise Ratio

- Dispersion effect -
- Mean effect – m
- Signal to Noise Ratio = ——
- m^2 – Power of Signal (taken from communication engineering)
- σ^2 – Power of Noise
- The data is first transformed into S/N ratio and analyzed using ANOVA to determine optimal levels for factors
- Leads to development of Robust process/product.

Factors Affecting Response

- Control Factors
- Noise factors
  - Outer Noise
  - Inner Noise
  - Product Noise
- Signal factors
- Scaling Factors

Objective Functions (S/N Ratios)

- Smaller the better e.g. Pollution
- Nominal the best e.g. 220 ± 10 V supply
- Larger the better e.g. fuel efficiency
- Fraction Defective – 0 to 1.0

Advantages

- Makes product or process robust against noise factors
- Reduce variation and improves quality
- Should we need to remove the cause of variation?
- Or rather Control the variation by finding optimum level of process parameters

Summary

- Robust Design
- Traditional ANOVA
- Taguchi Method
- S/N Ratio
- Factors affecting Responses
- Objective Functions
- Advantages

Questions

- What is the difference between Static and dynamic optimization problems? Explain with examples.
- Why S/N Ratio is always maximized?

REFRENCE

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THANKS