SQT

TRAINING THAT DEVELOPS
REAL CAPABILITY

Advanced Design of Experiments

CPI002

Advanced Design of Experiments

Many R&D experimenters, design and development engineers and scientists are using an OFAT (one-factor-at-a-time) approach to their experimental designs. In addition to the issue of inefficiency (unnecessarily large number of experiments), this approach fails to identify often crucially important interaction effects among factors. There are available to experimenters advanced analytical tools based on advanced mathematical techniques and utilising special computer software, which will enable them to gain a deep understanding of their processes, including the impact of interactions among factors, and to do so in the most efficient manner with minimum numbers of experimental runs. These modern DOE tools will be presented on this training course.

Duration & Price

Duration: 5 days
Delivery mode: This programme is available In-Company

Dates & Locations

In-Company training programmes are customised for your organisations specific needs. Most In-Company training is now delivered virtually.

In-Company Training

Please contact us for more information on our In-Company training options

What's covered?

The course is presented in two modules:

Module 1 – Three-day programme in which the participants will be trained in the use of DOE factorial techniques, including the statistics that underlie DOE. The objective of factorial DOE is to identify the few factors, among many possible factors, which have an effect on the response. On day three of module 1, delegates will partake in a practical workshop designing experiments, applicable to their own area of work.

Module 2- Two-day programme devoted to the optimization techniques of Response Surface Methodology (RSM) and Mixture Design. On day two of module 2, delegates will partake in a practical workshop designing experiments, applicable to their own area of work.

The training course is built around more than 30 real-life case studies, mainly from the chemical, electronics, and engineering manufacturing industries. The cases studies have been carefully selected to demonstrate all of the key principles of DOE. Delegates will work their way through these practical case studies learning the techniques of DOE and the advanced software that is used to design and analyze experiments.

Module 1

Days 1 – 3: Factorial and Fractional Factorial Designs

Day 1: Statistics that Underlie Design of Experiments

- Introduction to basic statistics-understanding variation in processes
- Mean, standard deviation, degrees of freedom
- The normal and standard normal distributions – their importance in DOE
- The normal probability plot and the Anderson Darling statistic – understanding the importance of normality and how to test for normality
- Explanation of tail values, alpha values and p-values
- Hypothesis testing – 2-sample t-test and F-test
- Analysis of variance (ANOVA) and introduction to experimental design with one factor

Note: Regression analysis will be left over to Day 1 of module 2.

Days 2 – 3: Design and Analysis of Experiments

- Planning the experiment and determining the experimental objective.
- Explanation of the terminology – responses, factors, levels, replication, repetition, randomization, design points, design runs
- Understanding the statistical importance of avoiding excess variation in experiments – the role of measurement and careful control of the experiments
- Establishing the basic principles with a two factor and three factor design – explanation of main effects and interactions
- Analysis of experimental results using the two-sample t-test, ANOVA, and the probability plot
- Screening out the non-significant factors

- Understanding how to interpret interaction plots
- The role of blocking in DOE
- The need to reduce the number of runs when there are a large number of factors involved – the concept of using fractional factorial designs
- “Folding over” to improve resolution of factorial designs
- Practical exercise designing an experiment applicable to the delegates own area of work.

Module 2

Days 4 and 5: Optimization with Response Surface Methodology (RSM) and Mixture Designs

- Overview of the factorial designs linking the work covered in Module 1 to the RSM techniques in Module 2
- Regression analysis – modelling with regression - lack-of-fit analysis, correlation analysis, R-squared, R-squared adjusted, R squared predicted
- The objectives of RSM - Optimizing the settings of the input factors which affect the response
- Understanding the quadratic model – selecting the appropriate model – adjusting the model for best results
- Finding the best compromise between multiple responses using advanced mathematical techniques and computer software
- Optimal designs – using advanced mathematical techniques and computer software to select the most appropriate runs in a reduced set of candidate points
- Mixture designs – experimenting with component proportions to achieve optimum formulation
- Designs with constraints – Optimal mixture designs
- Combined Designs using combination of mixture components and process factors
- Practical exercise designing an experiment applicable to the delegates own area of work.

The time span between the presentations of the two modules can be arranged to suit the requirements of the delegates.

Note: Course can be presented in four days if Mixture Design is not required.

Who should participate?

- All R&D personnel
- Design and development engineers and scientists
- Process Engineers

A prior knowledge of statistics is not required. However, the participants should have knowledge of mathematical principles, for example, Leaving Certificate or A-level mathematics.

What will I learn?

Participants achieve the following learning outcomes from the programme;

- Plan and execute screening experiments to select factors that affect the process
- Analyse factor effects and interaction effects using specialist computer software
- Use advanced mathematical techniques to construct and model response surfaces
- Select factor and component levels to simultaneously optimise multiple responses

How do we train and support you?

In-House Courses

For In-House courses the tutor will contact you in advance to discuss the course programme in more detail in order to tailor it specifically for your organisation. Where appropriate and facilitated by the company, the course can be run using Minitab or Design Expert software.

Course Manual

Delegates will receive a very comprehensive course manual, which explains the underlying statistics, describes the principles of experimental design, explains in detail how experiments are designed and analysed, includes examples of several practical case studies, includes instructions for operating the software, and incorporates completed versions of all the course exercises and graphs, including the output from Design Expert or Minitab computer software. The course manual will provide a very useful reference for participants undertaking the design and analysis of experiments when they return to their workplace.

What software do we use?

Minitab is a leading brand of general-purpose statistical software with powerful DOE capability. Design Expert is special-purpose DOE software incorporating the most advanced mathematical techniques available for DOE, and utilizing state of the art graphics.

Delegates will need to have either Minitab (versions 20. 21 or 22) or Design Expert loaded on laptop computers. Trial versions of the software, suitable for training, are available - Design Expert (free 45 day trial available on www.statease.com) or Minitab 20 or 21 (free 14 day trial available on www.minitab.com).

Mixture Design is presented only with Design Expert software.

Tutors

Albert Plant
View Profile

Grainne Heneghan
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What Our Learners Say

We believe in excellence through transparency and continuous improvement. That's why we invite all our delegates to share their experiences on CourseCheck.com, an independent platform dedicated to genuine, unfiltered feedback. Learner insights help us not only to enhance our training programmes but also empower potential learners to make informed decisions. Click on the link below to read firsthand experiences and testimonials from past learners.

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