



*Sound ethical decisions based on data!*SM

Statistical Design and Analysis of Experiments and Reliability Studies with STATGRAPHICS

*Sound Decisions for Scientific Research and
Product and Process Development*

(Second course of two-course sequence)

Course Code: *DOE&RS* Course, 5 Days (M-F), 4.0 CEUs [for 1st course see *Fnd* outline]

Prerequisites: *DOE&RS* is continuation of Alpine Analytics *Fnd* Course (required)

Reference Text: Montgomery, Douglas C. *Design and Analysis of Experiments*. Wiley.

Tobias, Paul A. and David C. Trindade. *Applied Reliability*. Chapman & Hall.

Manual and Course Materials: Copy of all PowerPoint presentation slides plus additional notes, exercises and data files.

STATGRAPHICS Centurion XV Software: Get training and experience using the software

I. Statistical Thinking in Experimental Design

A. Framework for Statistical Thinking and the Scientific Method

B. Strategy of Experimentation

C. Simple Comparative Experiments

D. Fundamental Design Concepts

E. Decision Context Overview: Product and Process Development

II. Fundamentals of Analysis: Single Factor Designs

A. STATGRAPHICS Software & Basic Statistics: Review of Fundamentals

B. Measurement Issues

C. Design Models

D. Two Sample Comparative Experiments

E. Completely Randomized Single Factor Designs

F. Dealing with the Effects of Nuisance Factors

III. Basic Classical Designs: Concepts, Designs and Analysis

A. Single Factor Designs

B. Crossed Factors (Full Factorial): Main effects and factor interactions

C. Randomized Complete Block (RCB): Blocks = Nuisance factors

D. Balance Incomplete Block

E. Latin Square

F. Expected Mean Squares and Special Purpose Designs

Ex: Repeated measures on each experimental unit over time (Split-Plot with GLM)

IV. Process & Product Validation Designs and Methodology

- A. Process & Product Characterization Designs:** Screening Designs
- B. Process & Product Optimization Designs:** Response Surface Designs
- C. Robust Parameter Designs:** Design Parameters and Noise Factors
- D. Mixed Models and Randomization Restrictions:** General Linear Model
- E. Maintaining Validation Over Time**

Integrating process control, capability studies and qualification problem investigations

V. Measurement Validation Designs and Methodology

- A. Measurement Uncertainty:** Concepts & Measures (International consensus)
- B. Component of Variance Designs:** Nested Design Structure
- C. Characterization and Calibration of Measurement Systems**
- D. Maintaining Validation Over Time:** Measurement Process Control

VI. Product Reliability Testing

- A. Reliability Concepts, Measures and Data**
- B. Fundamentals of Reliability Analysis**
 - 1. Component Reliability Models**
Failure Distributions; Weibull Analysis; Life as a function of explanatory variables; Accelerated Test Models
 - 2. System Reliability Models**
Series System Models; Parallel (Redundant) System Models; Standby Models; Complex Systems
 - 3. Repairable and Non-Repairable Systems: System Maintainability**
- C. Reliability Experimental Design Parameters**
Sample Size; Test Duration; Stress Test Environment
- D. Reliability Response Variables**
Product Failure; Product Parameter Degradation
- E. Reliability Product Testing Strategies**
 - 1. Strategies for Product Design and Development**
 - 2. Strategies for Pre-production Builds**
 - 3. Strategies for Accelerating Failure Times**
 - 4. Strategies for Production Burn-in**
 - 5. Field Failures and Warrantee Data**
 - 6. Non-Destructive Testing**
- F. Reliability Design Models and Analysis: Case Exercises**
- G. Managing Product Development Using DOE's**
 - 1. DOE and QFD**
 - 2. Unified Test Strategy**
 - 3. Structured Test Strategy**