Fundamentals of Statistical Design and Analysis

with STATGRAPHICS

Foundation for Sound Decisions with Integrity

Course Code: Fnd Course, 4½ Days (M-F), 4.0 CEUs [see DOE&RS outline for advanced course]

Prerequisites: Experience working with data, some elementary statistical training

College course in statistics helpful, but not required


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. Framework for Statistical Thinking
   A. Context of Statistical Thinking: The Decision Environment
   B. Conceptual Framework Model and the Scientific Method
   C. Decision Context Overview: Product R&D, Process R&D, Manufacturing

II. Basic Sample Statistics and STATGRAPHICS
   A. STATGRAPHICS Software Fundamentals
   B. Basic Sample Statistics: Characterizing data with numbers and graphs

III. Statistical Inference and the Framework
   A. Inference Cycle and Probability Models: Normal and Non-normal Data; Drawing Conclusions from Models
   B. Repeated Sampling and Sampling Distributions: T, $\chi^2$, F, many others
   C. Statistical Uncertainty: Concepts and Measures
   D. Estimation and Testing: Normal and Non-normal Data; Statistical Confidence; Statistical Significance and Practical Significance; Types of Error Uncertainty, Decision Risk and Statistical Power
   E. Power and Sample Size Determination in Statistical Design: Sample size decisions and budget constraints

IV. Data Distribution Models and Decision Uncertainty
   A. Quantifying Natural Variation of Physical Phenomena
      1. Modeling Data Distributions
      2. Estimating Percentiles/Quantiles: Point & Interval Estimation
      3. Decision Application: Does a dataset conform to specified limits? How should we formulate this question? How close to the limits?
B. Design Tolerance and Process Capability
   1. Process Capability Studies and Concurrent Engineering
   2. Statistical Tolerance Analysis
   3. Non-normality and Outlier Detection
   4. Six-Sigma Concepts

V. Analyzing Sources of Variation:
   Building Explanatory Statistical Models
   A. Introduction and Terminology: Statistical Framework
   B. Categorical Factors with Continuous Response Variables: Two-Sample Analysis; Paired Data; ANOVA; Single and Multifactor Analysis; Interaction
   C. Continuous Factors with Continuous Response Variables: Linear & Curvilinear Regression; Single and Multiple Variables; Model Building and Assumption Checking
   D. Associations Among Variables: Correlations and Contingency Tables

VI. Introduction to Managing Processes Over Time with SPC:
   Statistical Process Control Basics with Statgraphics
   A. Statistical Process Control Concepts
   B. Basic Variables Charts
   C. Basic Attributes Charts
   D. Industry Specific and Specialty Charts

VII. Introduction to Experimental Design:
   Design Creation & Analysis with Statgraphics
   A. General Factorial Designs: Concepts and Examples
   B. Screening Designs: \( 2^k \) Designs for Cost-Effective Factor Selection
      1. Screening Design Selection
      2. Screening Design Analysis
   C. Additional Topics as Time Permits