*Sound ethical decisions based on data!* ℠

# Fundamentals of Statistical Design and Analysis
## with STATGRAPHICS

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*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
**Reference Text:** Montgomery, Douglas C. and George C. Runger. *Applied Statistics and Probability for Engineers.* John Wiley & Sons. NY.
**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?

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    **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**