## Program Details

## Experimental Practices Description

The Experimental Practices program provides the participant with the fundamental tools and procedures required to function in the world of statistical experimental design. This program includes all prerequisite courses that are needed to fully comprehend and capitalize on the training of experimental design, commonly referred to as Design of Experiments or simply DOE. This program will arm the participant with the insights necessary to plan, execute, analyze, interpret and report the results of statistically designed experiments as well as how the application of a statistically designed experiment can be used to establish the optimum operating conditions for one or more input variables, also called adjustment factors.

Participants will learn how to translate a practical problem into a statistical problem and then isolate simple and complex cause-and-effect relationships which often remain undetected with traditional problem-solving methods. Students will learn how to depict and communicate the results of a statistics-based experiment in down-to-earth language. Of special interest, the instructional content even provides the participant with the helpful insights, short-cuts and tips on how to establish a post-experiment action plan. A heavy emphasis is placed on the application of fractional factorial experiments. Of course, such experiments are intended to discover the “vital few” variables as contrasted to the “trivial many.” In short, fractional factorial experiments can provide a “screen” for filtering potentially causal variables, thereby allowing the practitioner to discover improvement leverage.

From this frame of reference, the participant will also learn how to use fractional factorial experiments as an economy measure when the availability of samples or the cost of sampling restricts the use of a full factorial experiment. In addition, a primary focus is placed on the key design principles, primary methods of data analysis, and powerful graphical procedures that drives success. From here, the participant is fully prepared to move on to more advanced experimental methods and statistical procedures.

Reinforcement of major concepts, techniques, and applications is realized through exercises, scenarios, case studies, and field studies. Through this training, the participant will gain tremendous insight into the field of statistically designed experiments as well as the logic and reasoning which underlies Six Sigma and business process improvement. Total instructional time for this program is approximately 60 hours.

# Experimental Practices Outline

**Run Time** (h:mm:ss)

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|---|---|---|
| **Global Concepts** | | **11:07:36** |
| **Training Orientation** | | **1:29:43** |
| Excel Orientation | *Explore the Excel software package* | 0:29:01 |
| Minitab Orientation | *Explore the Minitab software package* | 0:31:42 |
| Simulator Orientation | *Explore the Process Simulator* | 0:29:00 |
| **Breakthrough Vision** | | **1:31:26** |
| Deterministic Reasoning | *Describe a basic cause-and-effect relationship in terms of Y=f(X)* | 0:52:57 |
| Leverage Principle | *Relate the principle of leverage to an improvement project* | 0:38:29 |
| **Process Management** | | **8:06:27** |
| Performance Yield | *Explain why final yield is often higher than first-time yield* | 1:14:06 |
| Hidden Processes | *Describe the non-value added component of a process* | 0:40:57 |
| Measurement Power | *Describe the role of measurement in an improvement initiative* | 0:33:38 |
| Establishing Baselines | *Explain why performance baselines are essential to realizing improvement* | 0:45:52 |
| Defect Opportunity | *Understand the nature of a defect opportunity and its role in metrics reporting* | 1:01:18 |
| Process Models | *Define the key features of a Six Sigma performance model* | 1:11:11 |
| Process Capability | *Identify the primary indices of process capability* | 1:21:53 |
| Design Complexity | *Describe the impact of complexity on product and service quality* | 1:17:32 |
| **General Practices** | | **17:36:29** |
| **Quality Tools** | | **8:30:56** |
| Variable Classifications | *Define the various types of variables commonly encountered during quality improvement* | 0:08:32 |
| Measurement Scales | *Describe each of the four primary scales of measure and their relative power* | 0:50:01 |
| Problem Definition | *Characterize the nature of a sound problem statement* | 0:35:25 |
| Focused Brainstorming | *Explain how focused brainstorming is used to facilitate improvement efforts* | 0:11:57 |
| Matrix Analysis | *Understand how matrices are created and used to facilitate problem solving* | 0:16:56 |
| C&E Analysis | *Explain how C&E matrices can be used to solve quality problems* | 0:06:02 |
| Performance Sampling | *Explain how to design and implement a sampling plan* | 0:20:17 |
| Check Sheets | *Understand how check sheets can be used for purposes of data collection* | 0:12:59 |
| Analytical Charts | *Identify the general range of analytical charts that can be used to assess performance* | 0:20:02 |
| Pareto Charts | *Explain how Pareto charts can be used to isolate improvement leverage* | 0:24:25 |
| Run Charts | *Utilize run charts to assess and characterize time-based process data* | 0:10:59 |
| Correlation Charts | *Utilize a correlation chart to illustrate the association between two variables* | 1:01:24 |
| Frequency Tables | *Explain how to construct and interpret a frequency table* | 0:14:42 |
| Performance Histograms | *Construct and interpret a histogram and describe several purposes* | 1:14:40 |
| Basic Probability | *Understand basic probability theory and how it relates to process improvement* | 0:29:16 |
| Search Patterns | *Explain how the use of designed experiments can facilitate problem solving* | 0:32:13 |
| Concept Integration | *Understand how to sequence a given selection of quality tools to better solve problems* | 1:02:54 |
| Quality Simulation | *Employ the related quality tools to analyze data generated by the process simulator* | 0:18:12 |
| **Basic Statistics** | | **9:05:33** |
| Performance Variables | *Identify and describe the types of variables typically encountered in field work* | 0:10:26 |
| Statistical Notation | *Recognize and interpret the conventional forms of statistical notation* | 0:44:53 |
| Performance Variation | *Explain the basic nature of variation and how it can adversely impact quality* | 0:22:24 |

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| Normal Distribution | *Describe the features and properties that are characteristic of a normal distribution* | 0:49:36 |
| Distribution Analysis | *Explain how to test the assumption that a set of data is normally distributed* | 1:21:06 |
| Location Indices | *Identify, compute, and interpret the mean, median, and mode* | 0:42:05 |
| Dispersion Indices | *Identify, compute, and interpret the range, variance, and standard deviation* | 1:16:37 |
| Quadratic Deviations | *Understand the nature of a quadratic deviation and its basic purpose* | 0:24:47 |
| Variation Coefficient | *Compute and interpret the coefficient of variation* | 0:07:17 |
| Deviation Freedom | *Explain the concept of degrees-of-freedom and how it is used in statistical work* | 0:29:47 |
| Standard Transform | *Describe how to transform a set of raw data into standard normal deviates* | 0:47:51 |
| Standard Z-Probability | *Describe how to convert a standard normal deviate into its corresponding probability* | 0:40:58 |
| Central Limit | *Understand that the distribution of sampling averages follows a normal distribution* | 0:17:29 |
| Standard Error | *Recognize that the dispersion of sampling averages is described by the standard error* | 0:13:32 |
| Student's Distribution | *Understand that the T distribution applies when sampling is less than infinite* | 0:06:07 |
| Standard T-Probability | *Describe how to convert a T value into its corresponding probability* | 0:15:26 |
| Statistics Simulation | *Employ basic statistics to analyze data generated by the process simulator* | 0:15:12 |

## Technical Practices — 28:58:34

### Hypothesis Testing — 6:05:49

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| Statistical Inferences | *Explain the concept of a statistical inference and its primary benefits* | 0:23:00 |
| Statistical Questions | *Explain the nature and purpose of a statistical question* | 0:20:35 |
| Statistical Problems | *Understand why practical problems must be translated into statistical problems* | 0:10:43 |
| Null Hypotheses | *Define the nature and role of null hypotheses when making process improvements* | 0:31:29 |
| Alternate Hypotheses | *Define the nature and role of alternate hypotheses when making process improvements* | 0:18:03 |
| Statistical Significance | *Explain the concept of statistical significance versus practical significance* | 0:56:05 |
| Alpha Risk | *Explain the concept of alpha risk in terms of the alternate hypothesis* | 0:24:18 |
| Beta Risk | *Define the meaning of beta risk and how it relates to test sensitivity* | 0:38:41 |
| Criterion Differences | *Explain the role of a criterion difference when testing hypotheses* | 0:15:49 |
| Decision Scenarios | *Develop a scenario that exemplifies the use of hypothesis testing* | 0:17:09 |
| Sample Size | *Define the statistical elements that must be considered when computing sample size* | 1:49:57 |

### Confidence Intervals — 2:47:17

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|---|---|---|
| Mean Distribution | *Comprehend and characterize the distribution of sampling averages* | 0:04:21 |
| Mean Interval | *Compute and interpret the confidence interval of a mean* | 0:54:29 |
| Variance Distribution | *Comprehend and characterize the distribution of sampling variances* | 0:21:10 |
| Variance Interval | *Compute and interpret the confidence interval of a variance* | 0:35:52 |
| Proportion Distribution | *Comprehend and characterize the distribution of sampling proportions* | 0:07:22 |
| Proportion Interval | *Compute and interpret the confidence interval of a proportion* | 0:27:02 |
| Frequency Interval | *Describe how frequency of defects is related to confidence intervals* | 0:17:01 |

### Parametric Methods — 8:19:55

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|---|---|---|
| Mean Differences | *Determine if two means are statistically different from each other* | 1:37:53 |
| Variance Differences | *Determine if two variances are statistically different from each other* | 0:39:34 |
| Variation Total | *Compute and interpret the total sums-of-squares* | 0:16:36 |
| Variation Within | *Compute and interpret the within-group sums-of-squares* | 0:10:53 |
| Variation Between | *Compute and interpret the between-group sums-of-squares* | 0:11:47 |
| Variation Analysis | *Explain how the analysis of variances can reveal mean differences* | 0:32:21 |
| One-Way ANOVA | *Construct and interpret a one-way analysis-of-variance table* | 1:16:36 |
| Two-Way ANOVA | *Construct and interpret a two-way analysis-of-variance table* | 0:20:05 |
| N-Way ANOVA | *Construct and interpret an N-way analysis-of-variance table* | 0:12:49 |
| ANOVA Graphs | *Construct and interpret a main effects plot as well as an interaction plot* | 0:37:24 |

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| Linear Regression | *Conduct a linear regression and construct an appropriate model* | 1:17:34 |
| Multiple Regression | *Conduct a multiple regression and construct an appropriate model* | 0:15:59 |
| Residual Analysis | *Compute and analyze the residuals resulting from a simple regression* | 0:18:46 |
| Parametric Simulation | *Apply general regression methods to the process simulator* | 0:31:38 |
| **Experimental Methods** | | **10:29:49** |
| Design Principles | *Understand the principles of experiment design and analysis* | 0:43:05 |
| Design Models | *Describe the various types of designed experiments and their applications* | 0:13:18 |
| Experimental Strategies | *Outline a strategy for designing and analyzing a statistical experiment* | 0:21:14 |
| Experimental Effects | *Define the various types of experimental effects and how they impact decisions* | 0:24:26 |
| One-Factor Two Level | *Configure and analyze a one-factor two-level statistically based experiment* | 0:38:35 |
| One-Factor Multi Level | *Configure and analyze a one-factor multi-level statistically based experiment* | 0:11:09 |
| Full Factorials | *Understand the nature and underlying logic of full factorial experiments* | 0:19:46 |
| Two-Factor Two Levels | *Configure and analyze a two-factor two-level statistically based experiment* | 2:13:26 |
| Two-Factor Multi Level | *Configure and analyze a two-factor multi-level statistically based experiment* | 0:04:29 |
| Three-Factor Two Level | *Configure and analyze a three-factor two-level statistically based experiment* | 0:51:20 |
| Planning Experiments | *Understand the planning and implementation considerations related to statistical experiments* | 0:29:17 |
| Fractional Factorials | *Understand the nature and underlying logic of fractional factorial experiments* | 1:16:46 |
| Four-Factor Half-Fraction | *Configure and analyze a four-factor half-fraction statistically based experiment* | 0:15:46 |
| Five-Factor Half-Fraction | *Configure and analyze a five-factor half-fraction statistically based experiment* | 0:30:29 |
| Screening Designs | *Understand how to select, implement, and analyze a screening experiment* | 0:16:28 |
| Robust Designs | *Explain the purpose of robust design and define several practical usages* | 1:12:35 |
| Experiment Simulation | *Describe how a DOE can be employed when measurement data is not available* | 0:27:40 |
| **Measurement Analysis** | | **1:15:44** |
| Measurement Uncertainty | *Understand the concept of measurement uncertainty* | 0:15:43 |
| Measurement Components | *Describe the components of measurement error and their consequential impact* | 0:15:42 |
| Measurement Studies | *Explain how a measurement systems analysis is designed and conducted* | 0:44:19 |
| | **Total Video Run Time** | **57:42:39** |