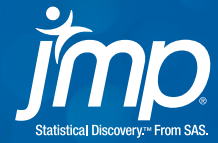


# Statistical Thinking for Industrial Problem Solving



## Course outline

Statistical Thinking for Industrial Problem Solving is a free, online course available to anyone interested in building practical skills in using data to solve problems better. The course is comprised of seven modules, totaling about 30 hours of self-paced learning. Each module includes short instructional videos, JMP demonstrations, questions and exercises. Learn more and enroll at [jmp.com/statisticalthinking](http://jmp.com/statisticalthinking).

The topics covered in each module are outlined below.



### Module 1: Statistical Thinking and Problem Solving

Learn how to map a process, define and scope your project, and determine the data you need to solve your problem.

#### Statistical Thinking

- What Is Statistical Thinking

#### Problem Solving

- Overview of Problem Solving
- Statistical Problem Solving
- Types of Problems

#### Defining the Problem

- Defining the Problem
- Goals and Key Performance Indicators
- The White Polymer Case Study

#### Defining the Process

- What Is a Process?
- Developing a SIPOC Map
- Developing an Input/Output Process Map
- Top-Down and Deployment Flowcharts

#### Identifying Potential Root Causes

- Tools for Identifying Potential Causes
- Brainstorming
- Multi-Voting
- Using Affinity Diagrams
- Cause-and-Effect Diagrams
- The 5 Whys
- Cause-and-Effect Matrices

#### Compiling and Collecting Data

- Data Collection for Problem Solving
- Types of Data
- Operational Definitions
- Data Collection Strategies
- Importing Data for Analysis



### Module 2: Exploratory Data Analysis

Learn how to describe data with graphics and use interactive visualizations to find and communicate the story in your data.

#### Describing Data

- Introduction to Descriptive Statistics
- Types of Data
- Histograms
- Measures of Central Tendency and Location
- Measures of Spread – Range and Interquartile Range
- Measures of Spread – Variance and Standard Deviation
- Visualizing Continuous Data
- Describing Categorical Data

#### Probability Concepts

- Introduction to Probability Concepts
- Samples and Populations

- Understanding the Normal Distribution
- Checking for Normality
- The Central Limit Theorem

#### Exploratory Data Analysis for Problem Solving

- Introduction to Exploratory Data Analysis
- Exploring Continuous Data: Enhanced Tools
- Pareto Plots
- Packed Bar Charts and Data Filtering
- Tree Maps and Mosaic Plots
- Using Trellis Plots and Overlay Variables
- Bubble Plots and Heat Maps
- Summary of Exploratory Data Analysis Tools

## Module 2: Exploratory Data Analysis (continued)

### Communicating With Data

- Introduction to Communicating With Data
- Creating Effective Visualizations
- Evaluating the Effectiveness of a Visualization
- Designing an Effective Visualization
- Communicating Visually With Animation
- Designing for Your Audience
- Understanding Your Target Audience
- Designing Visualizations for Communication
- Designing Visualizations: The Do's and Don'ts

### Saving and Sharing Results

- Introduction to Saving and Sharing Results
- Saving and Sharing Results in JMP
- Saving and Sharing Results Outside of JMP
- Deciding Which Format to Use

### Data Preparation for Analysis

- Data Tables Essentials
- Common Data Quality Issues
- Identifying Issues in the Data Table
- Identifying Issues One Variable at a Time
- Restructuring Data for Analysis
- Combining Data
- Deriving New Variables
- Working With Dates



## Module 3: Quality Methods

Learn about tools to quantify, control and reduce variation in your product, service or process.

### Statistical Process Control

- Introduction to Control Charts
- Individual and Moving Range Charts
- Common Cause Versus Special Cause Variation
- Testing for Special Causes
- X-bar and R, and X-bar and S Charts
- Rational Subgrouping
- 3-Way Control Charts
- Control Charts With Phases

### Process Capability

- The Voice of the Customer
- Process Capability Indices
- Short- and Long-Term Estimates of Capability
- Understanding Capability for Process Improvement

- Estimating Process Capability: An Example
- Calculating Capability for Nonnormal Data
- Estimating Process Capability for Many Variables
- Identifying Poorly Performing Processes
- A View From Industry

### Measurement System Studies

- What Is a Measurement Systems Analysis (MSA)?
- Language and Terminology
- Designing a Measurement System Study
- Designing and Conducting an MSA
- Analyzing an MSA
- Studying Measurement System Accuracy
- Improving the Measurement Process



## Module 4: Decision Making With Data

Learn to draw inferences from data, construct statistical intervals, perform hypothesis tests, and understand the relationship between sample size and power.

### Estimation

- Introduction to Statistical Inference
- What Is a Confidence Interval?
- Estimating a Mean
- Visualizing Sampling Variation
- Constructing Confidence Intervals
- Understanding the Confidence Level and Alpha Risk
- Prediction Intervals
- Tolerance Intervals
- Comparing Interval Estimates

### Foundations in Statistical Testing

- Introduction to Statistical Testing
- Statistical Decision Making
- Understanding the Null and Alternative Hypotheses
- Sampling Distribution Under the Null
- The p-Value and Statistical Significance

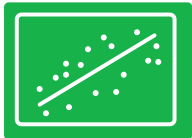
## Module 4: Decision Making with Data (continued)

### Hypothesis Testing for Continuous Data

- Conducting a One-Sample t Test
- Understanding p-Values and t Ratios
- Equivalence Testing
- Comparing Two Means
- Unequal Variances Tests
- Paired Observations
- One-Way ANOVA (Analysis of Variance)
- Multiple Comparisons
- Statistical Versus Practical Significance

### Sample Size and Power

- Introduction to Sample Size and Power
- Sample Size for a Confidence Interval for the Mean
- Outcomes of Statistical Tests
- Statistical Power
- Exploring Sample Size and Power
- Calculating the Sample Size for One-Sample t Tests
- Calculating the Sample Size for Two-Sample t Tests and ANOVA



## Module 5: Correlation and Regression

Learn how to study the linear association between pairs of variables, and how to fit and interpret linear and logistic regression models.

### Correlation

- What Is Correlation?
- Interpreting Correlation

### Simple Linear Regression

- Introduction to Regression Analysis
- The Simple Linear Regression Model
- The Method of Least Squares
- Visualizing the Method of Least Squares
- Regression Model Assumptions
- Interpreting Regression Results
- Fitting a Model With Curvature

### Multiple Linear Regression

- What Is Multiple Linear Regression?
- Fitting the Multiple Linear Regression Model

- Interpreting Results in Explanatory Modeling
- Residual Analysis and Outliers
- Multiple Linear Regression With Categorical Predictors
- Multiple Linear Regression With Interactions
- Variable Selection
- Multicollinearity

### Introduction to Logistic Regression

- What Is Logistic Regression?
- The Simple Logistic Model
- Simple Logistic Regression Example
- Interpreting Logistic Regression Results
- Multiple Logistic Regression
- Logistic Regression With Interactions
- Common Issues



## Module 6: Design of Experiments

Learn the language of design of experiments (DOE) and see how to design, conduct and analyze an experiment in JMP.

### Introduction to DOE

- What Is DOE?
- Conducting Ad Hoc and One-Factor-at-a-Time (OFAT) Experiments
- Why Use DOE?
- Terminology of DOE
- Types of Experimental Designs

### Factorial Experiments

- Designing Factorial Experiments
- Analyzing a Replicated Full Factorial
- Analyzing an Unreplicated Full Factorial

### Screening Experiments

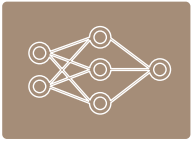
- Screening for Important Effects
- A Look at Fractional Factorial Designs
- Custom Screening Designs

### Response Surface Experiments

- Introduction to Response Surface Designs
- Analyzing Response Surface Experiments
- Creating Custom Response Surface Designs
- Sequential Experimentation

### DOE Guidelines

- Introduction to DOE Guidelines
- Defining the Problem and the Objectives
- Identifying the Responses
- Identifying the Factors and Factor Levels
- Identifying Restrictions and Constraints
- Preparing to Conduct the Experiment
- Case Study



## Module 7: Predictive Modeling and Text Mining

Learn how to identify possible relationships, build predictive models and derive value from free-form text.

### Essentials of Predictive Modeling

- Introduction to Predictive Modeling
- Overfitting and Model Validation
- Assessing Model Performance: Prediction Models
- Assessing Model Performance: Classification Models
- Receiver-Operating Characteristic (ROC) Curves

### Decision Trees

- Introduction to Decision Trees
- Classification Trees
- Regression Trees
- Decision Trees With Validation
- Random (Bootstrap) Forests

### Neural Networks

- What Is a Neural Network?
- Interpreting Neural Networks
- Predictive Modeling With Neural Networks

### Generalized Regression

- Introduction to Generalized Regression
- Fitting Models Using Maximum Likelihood
- Introduction to Penalized Regression

### Model Comparison and Selection

- Comparing Predictive Models

### Introduction to Text Mining

- Introduction to Text Mining
- Processing Text Data
- Curating the Term List
- Visualizing and Exploring Text Data
- Analyzing (Mining) Text Data

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Statistical Discovery.™ From SAS.