

Making data models better explainable and actionable using JMP Profilers

ENBIS Spring Meeting 2024

Volker Kraft, JMP Global Academic Program



Abstract





JMP software converts data into insights with no coding required, and is a leading solution for real-world problem-solving in many industries. Some users call the JMP Profiler, the key tool for any data modeler, “the coolest thing in JMP”. This presentation will demonstrate several Profilers and various use cases and discuss its value in both industrial settings as well as in teaching and learning.

Profilers are [interactive visualizations](#) of any model built in JMP, being tree-based, regression models, neural networks or other predictive models. The profiles are [cross-section views of the response surface](#) for any number of factors (Xs) and responses (Ys). All factors can be changed interactively to see the effects on the response(s) and on other profiles. Additional Profiler features help with the [model understanding and interpretation](#), like confidence intervals, overlaid data points or interaction traces, sensitivity indicators and extrapolation warnings.

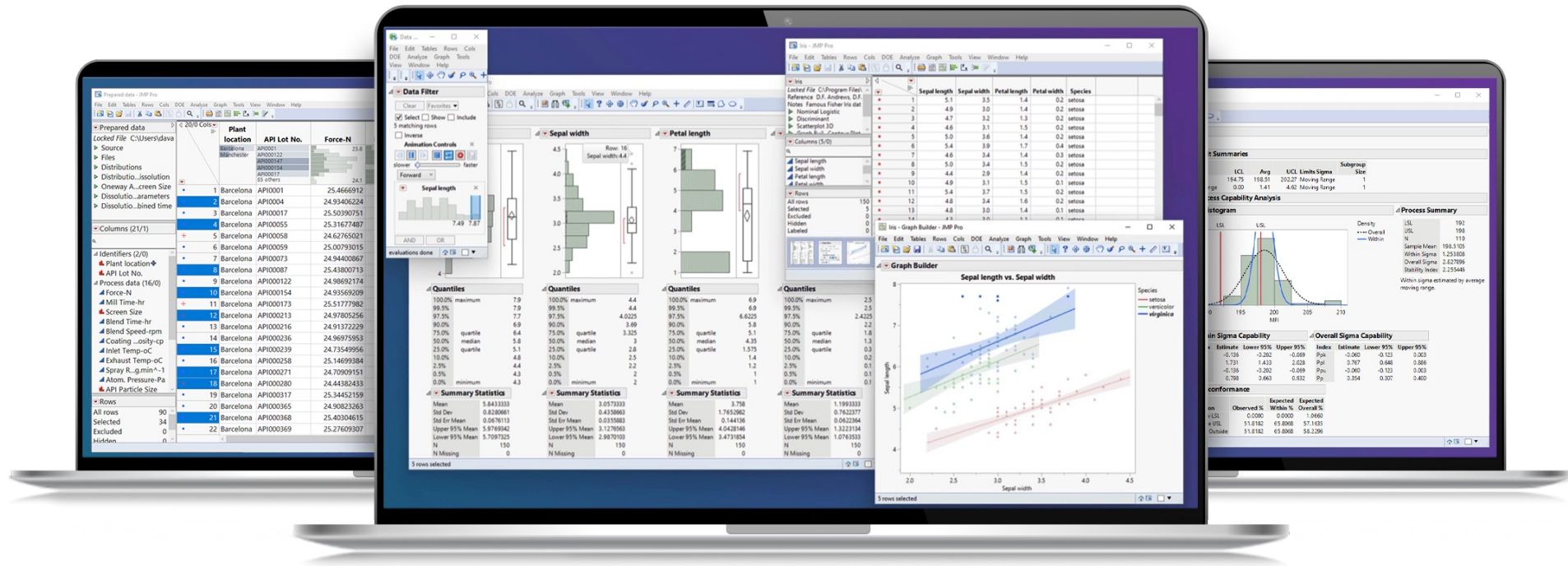
Based on the desirability representing the goals for each response, like maximize, minimize or match target, the Profiler can also find the best factor settings to [optimize](#) the response(s) for the system or process at hand. A built-in Monte-Carlo Simulation and Gaussian Process model helps to find more [robust settings](#) in the light of any stochastic variation of the factors.

Beside the [Prediction Profiler](#), we will also demonstrate the [Contour Profiler](#), [Interaction Profiler](#) and the [Design Space Profiler](#) – all interactive and visual tools to get the most out of your models.

Agenda

1. Introduction to JMP
2. Profilers in JMP
 - Prediction-, Contour-, Surface- and Mixture Profiler
 - Optimizing response curves 
3. Profiler Demos
 - Single-response Prediction Profiler
 - Multiple-response optimization
 - Simulation Experiment for robust optimization
 - More (old and new) Profiler features 
 - Design Space Profiler 
4. Deep Learning using Torch Add-in 
5. Resources

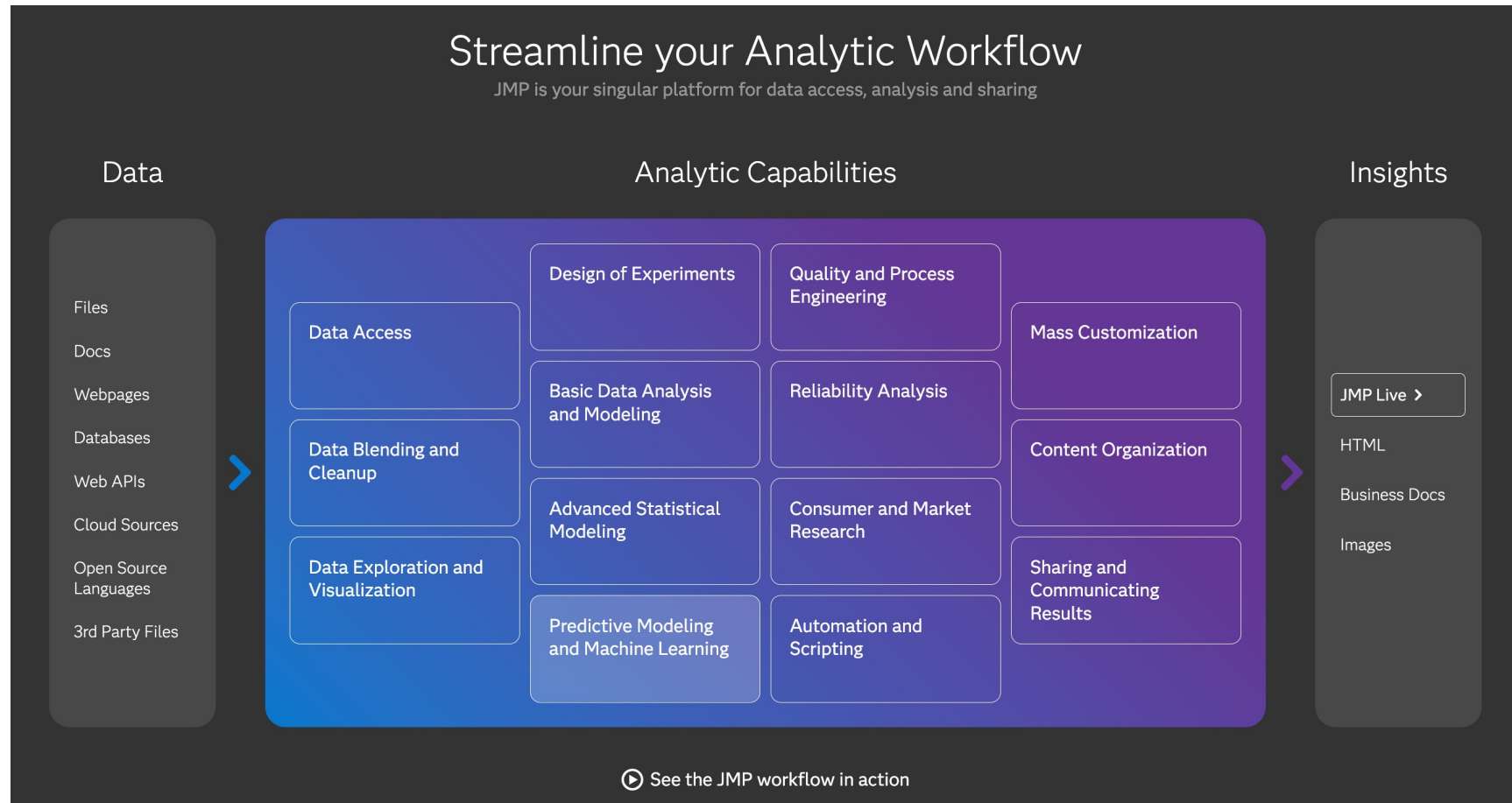
1. Introduction to JMP



JMP[®] software combines interactive visualization with powerful statistics.

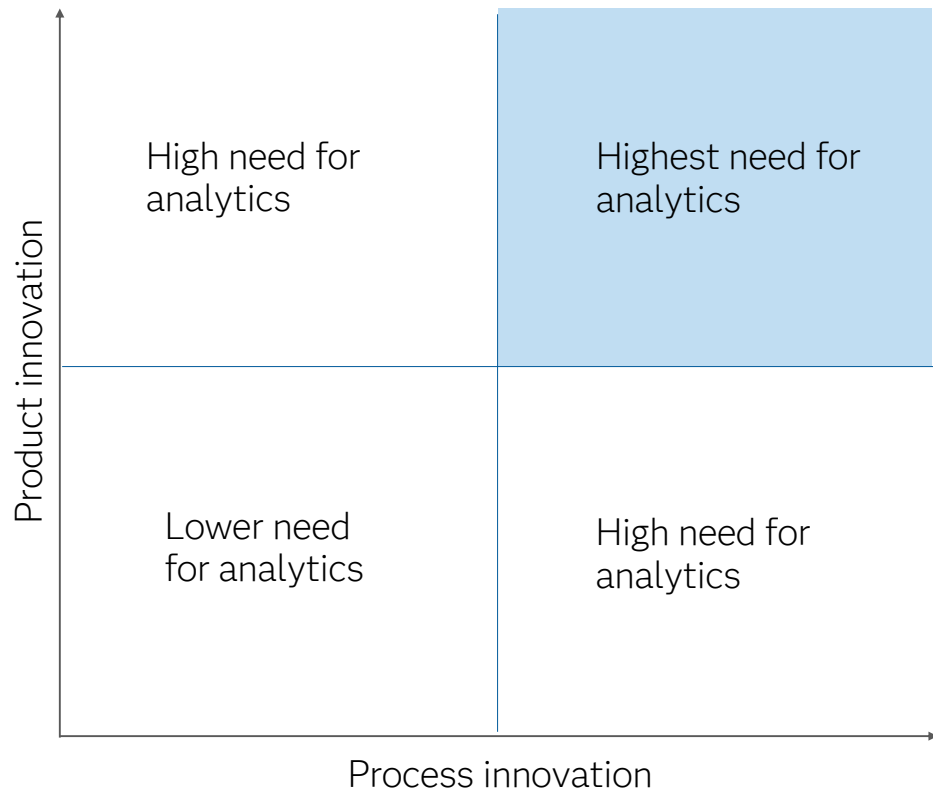
Analytic Capabilities

jmp.com/workflow



Where we play

jmp.com/success



- A **strong R&D investment** with teams of scientists and engineers **focused on innovation** to drive profitability.
- **Complex problems** that need timely solutions that can be implemented collaboratively across the organization.
- **Rapid development cycles** so that new products and processes remain competitive.
- A need to **define new processes** and stabilize them once in production.

Success in the chemical industry

All 10 of the world's largest chemical companies use JMP



BASF

Design time reduced by more than **75%**, ensuring cleaner dishes and a healthier environment.



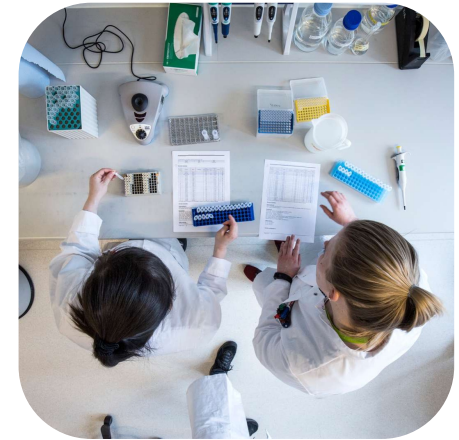
Dupont

Fabrication steered toward **zero-defect** status for semiconductor processes.



Kodak

Reduced defects to **only one defect in 300 million linear feet** of motion picture film.



Symrise

Drastically **reduced the experimentation workload** and improved response up to 30-fold.

Success in the pharmaceutical industry

20 of the world's largest pharmaceutical companies use JMP



Thermo Fisher

JMP was **the only software** that offered us a range of tools **allowing access to data analysis for non-statisticians.**



Lonza

Increased the overall yield by almost a **factor of two**, while also achieving **significant time savings** milestones.



Novozymes

Method with 752 tubes across **4 experiments** down to just 300 tubes in **1 experiment.**

Success in the semiconductor industry

25 of the world's top semiconductor companies use JMP



ST Microelectronics

Reduction of manufacturing defect rate **by 40%** – helping build momentum for analytics transformation.



NXP

Fabrication steered toward **zero-defect** status supporting better products and higher customer satisfaction.



Jeju Semiconductor

Dramatically **reduced analysis time**, limiting the cost of experiments and improving yield.



Vishay

Significantly decreased costs as a result of an **83% reduction** in data processing time.

Success in the consumer goods industry

22 of the world's top 25 consumer goods companies use JMP



Kirin

Advanced sensory analysis led to a **top-rated** drink.



Kraft

Saw a **50% reduction** in analysis time.



P&G

Sophisticated experimentation **yielded more insight** in less time.

JMP Academic Program

jmp.com/academic

- More than [1600 universities](#) worldwide use JMP in teaching and research
- [Professors](#) can spend more time on teaching concepts and real-world applications without programming
- The highly visual, point-and-click interface of JMP helps [students](#) grasp statistical and analytical concepts to real data and apply those concepts in their careers
- Free [academic resources](#) for teaching and learning
- [Academic licensing](#)
 - Free Student Subscription for class use
 - Single user licenses for academic research
 - Low-cost site licenses for JMP Pro (campuswide)

2. Profilers in JMP

Prediction Profiler: Purpose

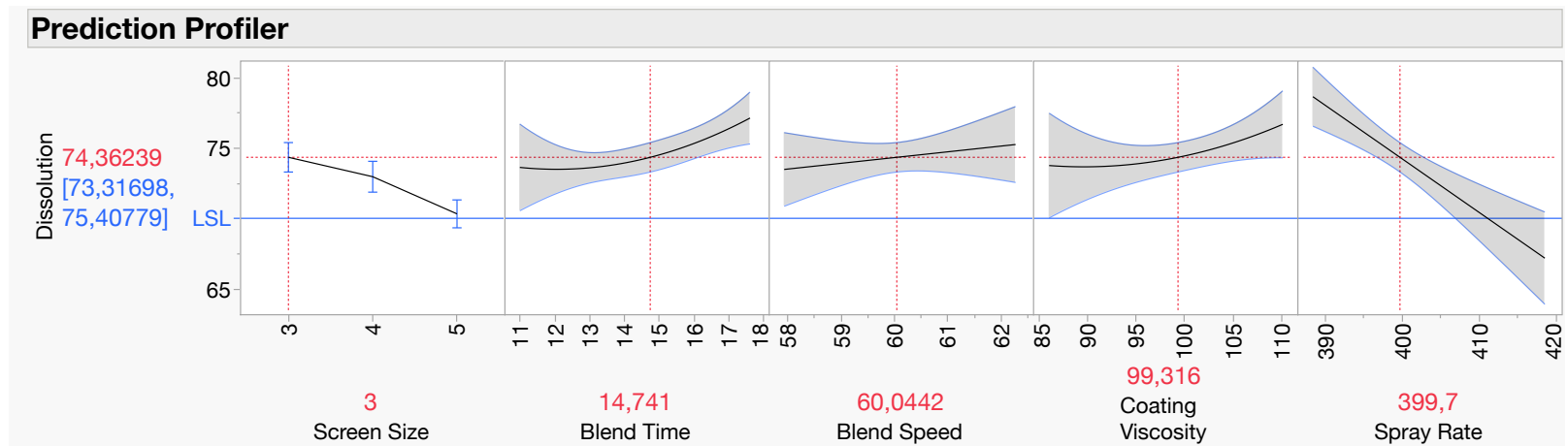
- Visualize, explore and understand models
 - Uncover modeled relationships and model limitations
 - All model types*, any number of factors, any number of responses, any data types
- Support **data-driven decision-making**
 - What-if scenarios
 - Optimization tasks, tolerance analysis, defect profiling, sensitivity analysis
 - Quality-by-design
 - etc.

*) Exceptions will be mentioned later

Prediction Profiler: Layout

Profile traces (in black) with error bars (categorical X) or CIs (continuous X), holding all other X's constant

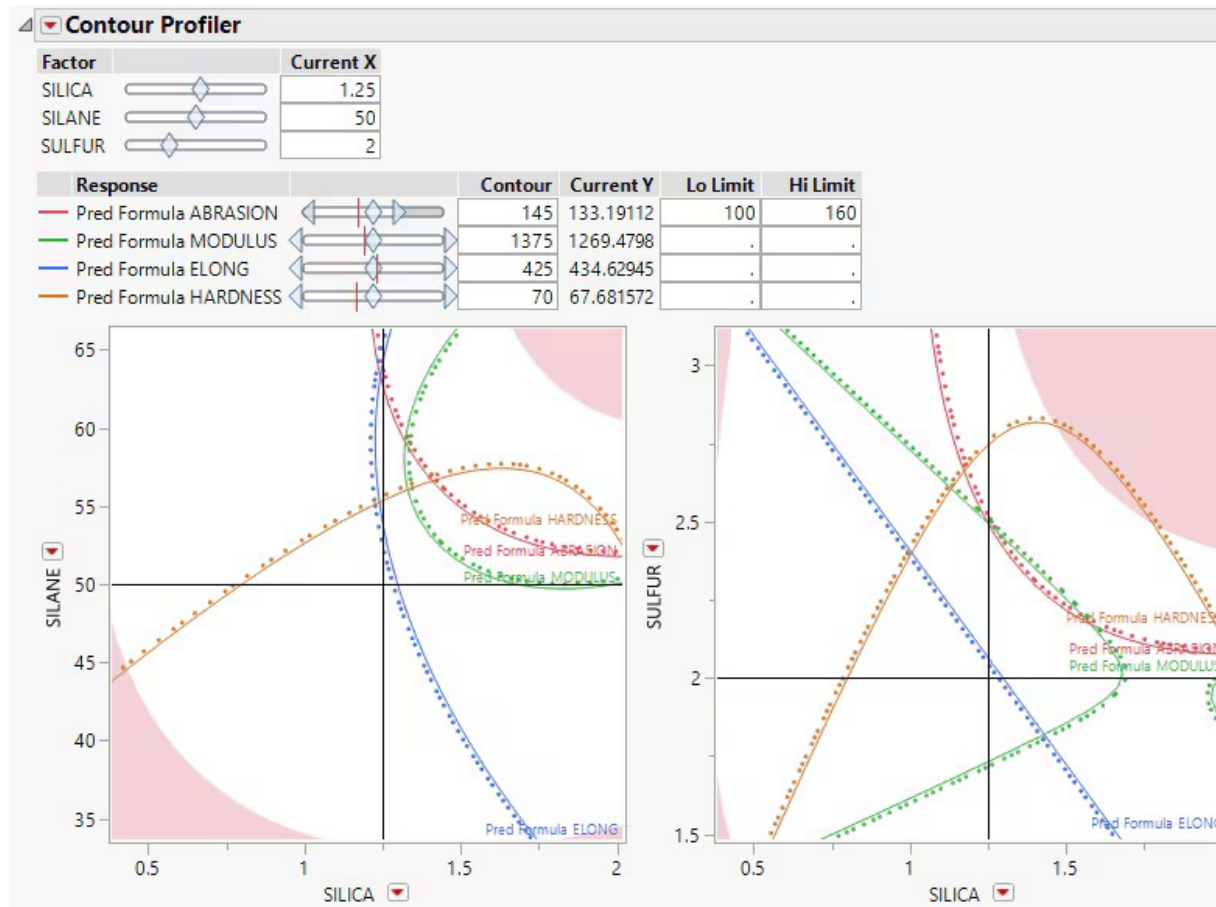
Y variable
(=response)
with predicted
value (in red)
and 95%
confidence
interval (in blue)



X variables (=predictors)
at current settings (in red)

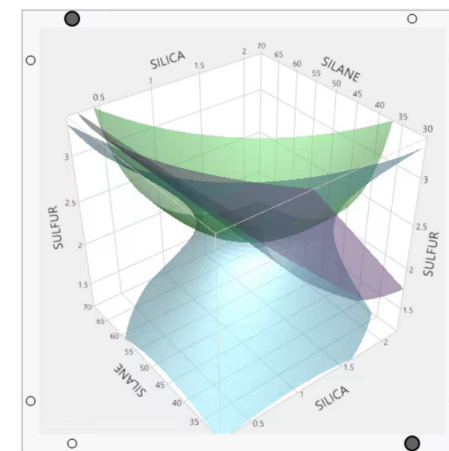
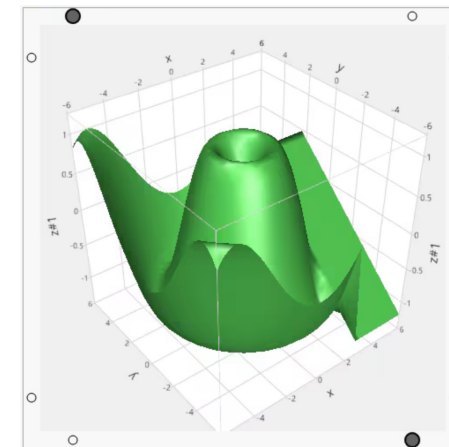
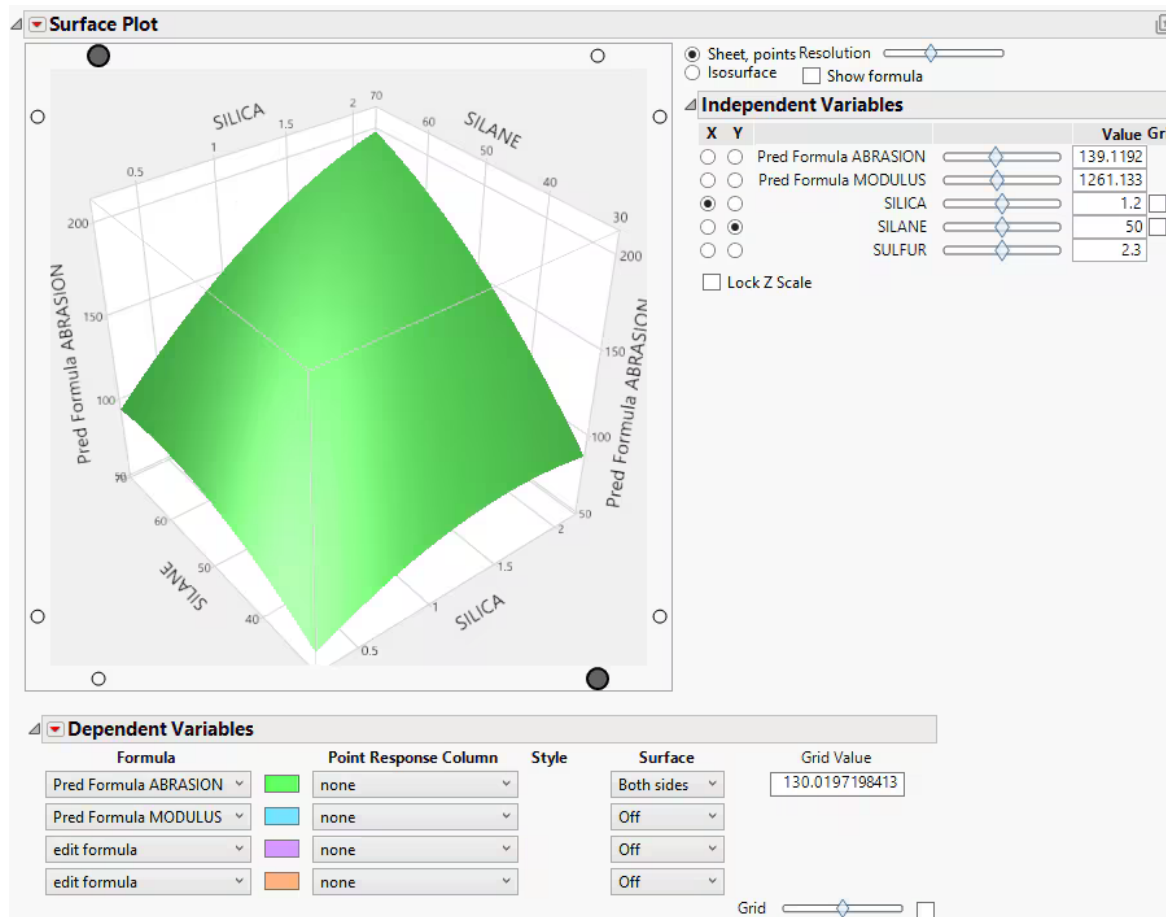
Contour Profiler

Horizontal slices show contour lines for two factors at a time



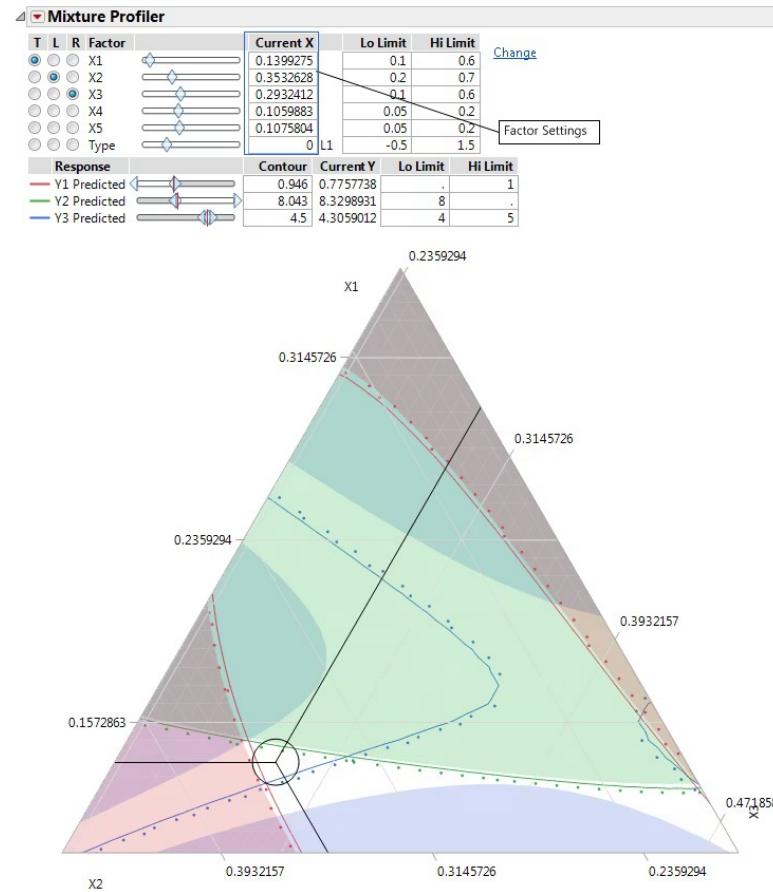
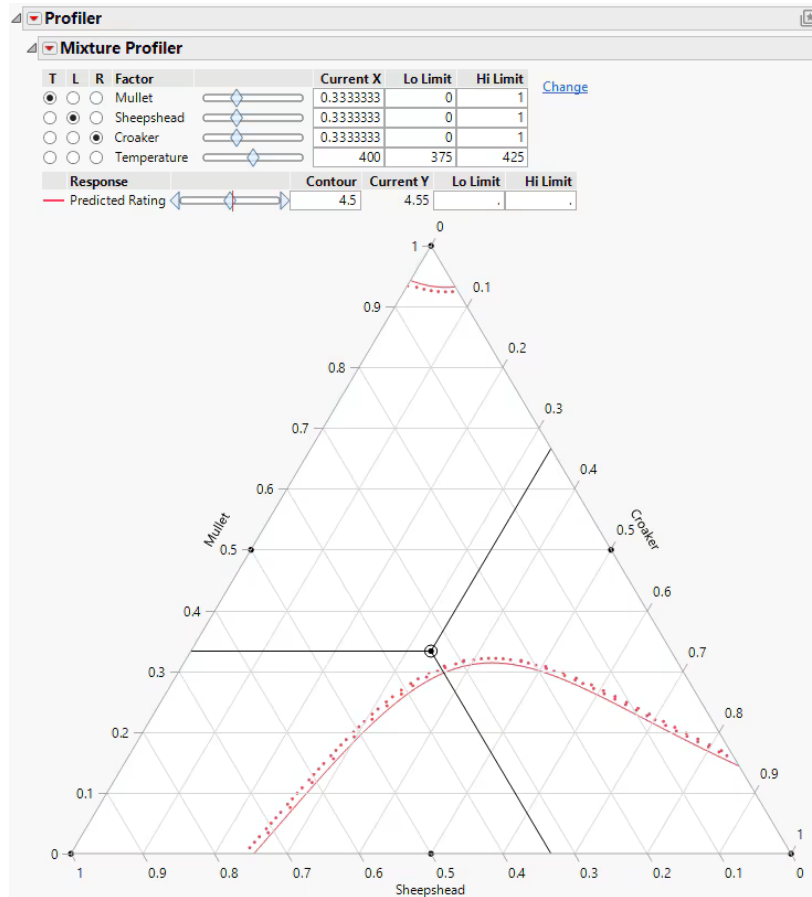
Surface Profiler

3-D plots of responses for 2 factors at a time, or a contour surface plot for 3 factors at a time



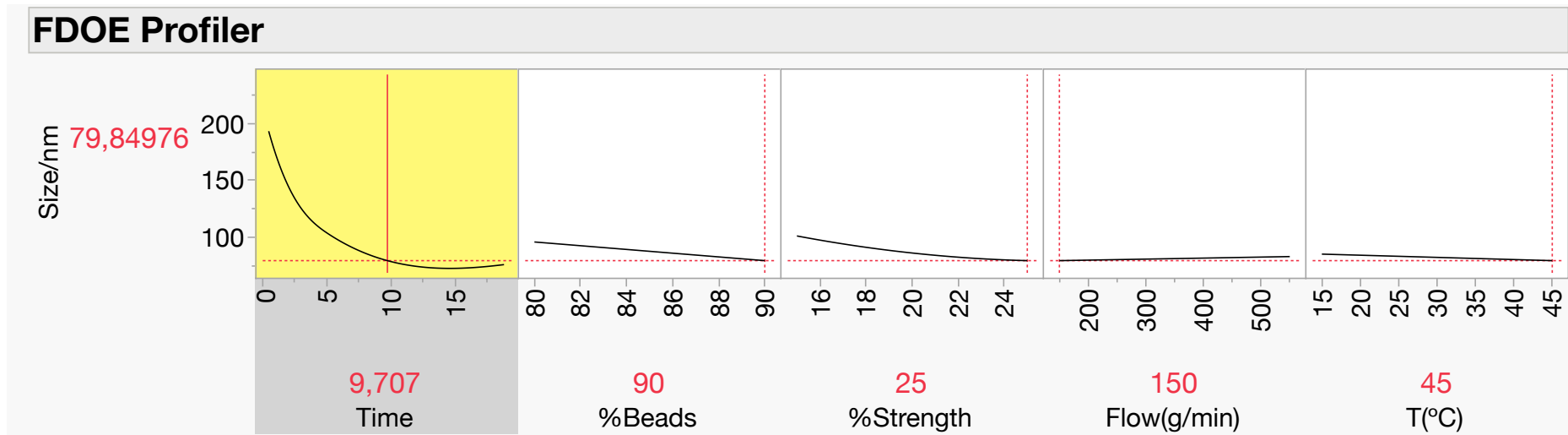
Mixture Profiler

A Contour Profiler for mixture factors (with Ternary Plots)



Optimizing a response curve

Functional Data Explorer > Load Target Function (“golden curve”)



3. Profiler Demos

Live Demo

- Single-response Prediction Profiler
- Multiple-response optimization
- Simulation Experiment for robust optimization
- More Profiler features
 - Assess Variable Importance
 - Confidence & Prediction intervals
 - Interaction profiles, overlaid interactions
 - Data points
 - Extrapolation control
 - Constraints
- Design Space Profiler

4. Deep Learning using Torch Add-in

New in v18: Two features for the data scientist

1) Python integration overhaul brings greater functionality

- Create and run Python scripts from inside JMP
- JMP bundles customizable Python 3.11.5 environment
- Preinstalled "jmp" package provides functions for interfacing with JMP
- Better integration with JMP data tables (shared memory)

Add-ins:

- As an example of how to mass-customize JMP, building out add-ins can solve unique problems or perform analyses that aren't built into JMP directly.
- JMP add-ins can simplify sophisticated data science techniques in a familiar point-and-click JMP workflow.








New in v18: Two features for the data scientist

2) Torch Deep Learning

- Add-in that brings the Torch deep learning library into JMP Pro's visual, no-code interface (as free download from JMP User Community)
- Automatic k-fold crossvalidation
- Pre-trained models for [image, text, and tabular data](#)
- Robust hyperparameter settings
- Many JMP graphical outputs (incl. [Profiler for tabular data](#))
- Save and reload models for further training, scoring

Torch Deep Learning (JMP 18 Pro): Task

potato_leaf_blight JMP

	Picture	Class	Fold A	Fold B	Fold C
		EarlyBlight	1	2	3
		LateBlight	2	3	4
		Healthy	4	5	5
			3	1	1
			5	4	2
1		EarlyBlight	1	3	2
2		EarlyBlight	4	1	3
3		EarlyBlight	4	1	3
4		EarlyBlight	2	2	5
5		EarlyBlight	4	1	3
6		EarlyBlight	4	3	2
7		EarlyBlight	4	1	3

Columns (7/0)

- Picture
- File Name
- Short File Name
- Class
- FoldA *
- FoldB *
- FoldC *

Rows

All rows	4,072
Selected	0
Excluded	0
Hidden	0
Labeled	0

potato_leaf_blight - Torch Deep Learning of Class by Picture

Response: Class Predictor: Picture Validation: FoldA(5)

Launch

Image Model: LeNet5
 Tabular Model: MultiLayerPerceptron
 Nominal Loss: NLL
 Epochs: 10
 Learning Rate: 0,01

Advanced Options

Layer Sizes	16	Batch Size	128	Image Size	28
Activation	ReLU	Mixup Portion	0	X Slide Sigma	0
Dropout Probs	0.0	Frozen Epochs	3	Y Slide Sigma	0
Norm	Batch	Worker Count	4	Aspect Sigma	0
Norm First	Batch	Seed	0	Yaw Sigma	0
FM Layers	0	Margin	1	Pitch Sigma	0
Pooling Layers	Max	Triplet Loss Weight	0	Roll Sigma	0
		Device	auto	Noise Max Sigma	0
		Optimizer	AdamW	Blur Max Sigma	0
		Weight Decay	0	HFlip Prob	0
		L1 Penalty	0	VFlip Prob	0

Folder: /Users/eurvkr/Library/Application Support/JMP/TorchDeepLearning/
 Restore From: [dropdown]

Go

Torch Deep Learning (JMP 18 Pro): Results

Torch Deep Learning

Response: Class Predictor: Picture Validation: FoldA(5)

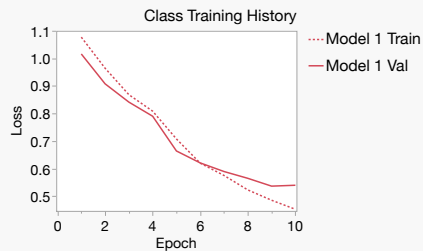
Launch

Image Model
 Tabular Model MultiLayerPerceptron
 Nominal Loss NLL
 Epochs 10
 Learning Rate 0.01

Model Comparison

Show Model	Response	Predictors	Validation	Train RSquare	Val RSquare	Train Accuracy	Val Accuracy	Image Model	Epochs	Learning Rate
<input checked="" type="checkbox"/>	Model 1 Class		1 FoldA	0.6825	0.4793	0.8961	0.7841	LeNet5	10	0.01

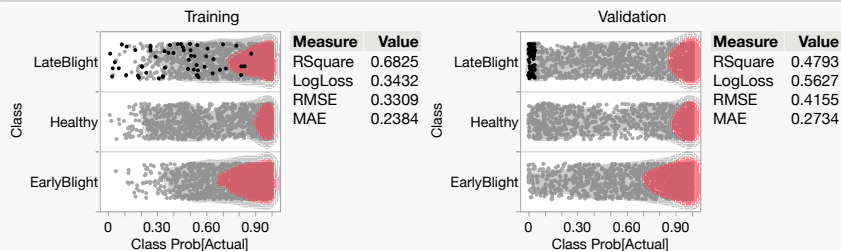
Training History



Model 1

Class

Actual by Predicted Plots



Torch Deep Learning

Response: Class Predictor: Picture Validation: FoldA(5)

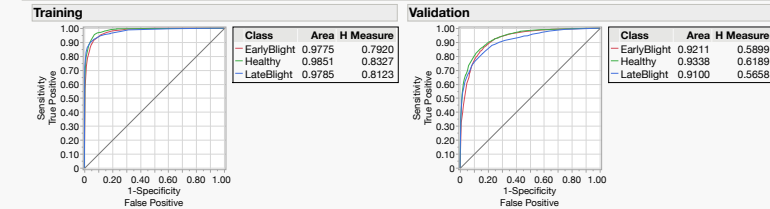
Model 1

Class

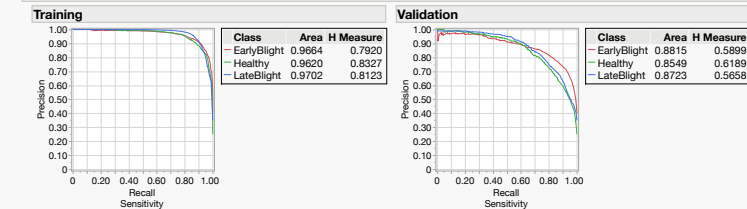
Confusion Matrices

Training				Validation							
Actual Class	Predicted Count	Actual Class	Predicted Rate	Measure	Value	Actual Class	Predicted Count	Actual Class	Predicted Rate	Measure	Value
EarlyBlight	1538	EarlyBlight	0.945	Accuracy	0.8961	EarlyBlight	1378	EarlyBlight	0.846	Accuracy	0.7841
Healthy	121	Healthy	0.119	Misclass	0.1039	Healthy	155	Healthy	0.152	Misclass	0.2159
LateBlight	134	LateBlight	0.094	F1	0.8941	LateBlight	240	LateBlight	0.169	F1	0.7793
				MCC	0.8428					MCC	0.6703

ROC Curves



Precision-Recall Curves



Fit Details

Measure	Training	Validation	Definition
Entropy RSquare	0.6825	0.4793	1-Loglike(model)/Loglike(0)
Generalized RSquare	0.8716	0.7291	(1-L(0)/L(model))^(2/n)/(1-L(0)^(2/n))
Mean -Log p	0.3432	0.5827	∑ Log(p _{ij})/n
RASE	0.3309	0.4155	∑ y _{ij} -p _{ij} /n
Mean Abs Dev	0.2384	0.2734	∑ y _{ij} -p _{ij} /n
Misclassification Rate	0.1039	0.2159	∑ (p _{ij} ≠Max _j)/n
N	4072	4072	n

Model Details

Name	Parameters	Sizes	Layer	Model
Image Model	62,510		All	1
Tabular Model	51		All	1
Total	62,561		All	1
LeNet5	0	0	1	1
Sequential	0	1	1	1
Reshape	0	2	1	1
Conv2d	450 (6,3,5,5)	3	1	1
ReLU	0	4	1	1
AvgPool2d	0	5	1	1
Conv2d	2,416 (16,6,5,5) (16)	6	1	1
ReLU	0	7	1	1
Sequential	0	8	1	1
AvgPool2d	0	9	1	1
Flatten	0	10	1	1
Linear	48,120 (120,400) (120)	11	1	1
ReLU	0	12	1	1
Linear	10,164 (84,120) (84)	13	1	1
ReLU	0	14	1	1
Linear	1,380 (16,84) (16)	15	1	1
Linear	51 (3,16) (3)	16	1	1

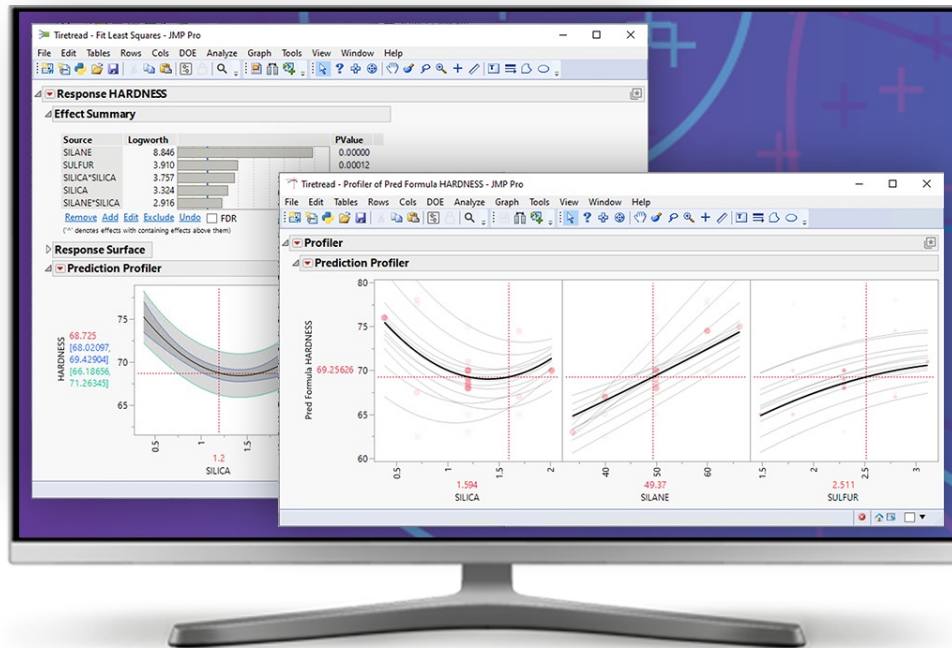
5. Resources

Resources

- [JMP Online Help: Introduction to Profilers](#)
- [Video: Using Prediction Profiling to Maximize Model Proficiency - Part 1](#)
- [Video: Using Prediction Profiling to Maximize Model Proficiency - Part 2](#)
- [RedFame: Monte Carlo Simulation Experiments for Engineering Optimisation](#)
- [Blog: Prediction Profiler enhancements in JMP® 18](#)
- [Video: Maximizing Quality Using Design Space Profiling](#)
- [Download: Torch Deep Learning Add-In for JMP Pro](#)

Wrap-up

Model Profiler Enhancements in JMP 18



- Show prediction intervals for predicted (individual) values as well as confidence intervals for predicted means.
- Show data points and overlaid interaction traces on profilers.
- Save prediction and interval formulas in one step in model fitting platforms. This makes it easier to plot intervals using Graph>Profiler.
- Use the simpler, easier launch dialog in all profiler platforms under the Graph menu.
- View and update constraints in the profiler more easily.
- K Nearest Neighbors based extrapolation control.
- Publish profilers with prediction intervals and interactive profilers for more model-types in JMP Live.


STIPS




Statistical Thinking for Industrial Problem Solving

A free online course


Learn more and enroll today:
jmp.com/statisticalthinking




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.




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




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.




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



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



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.

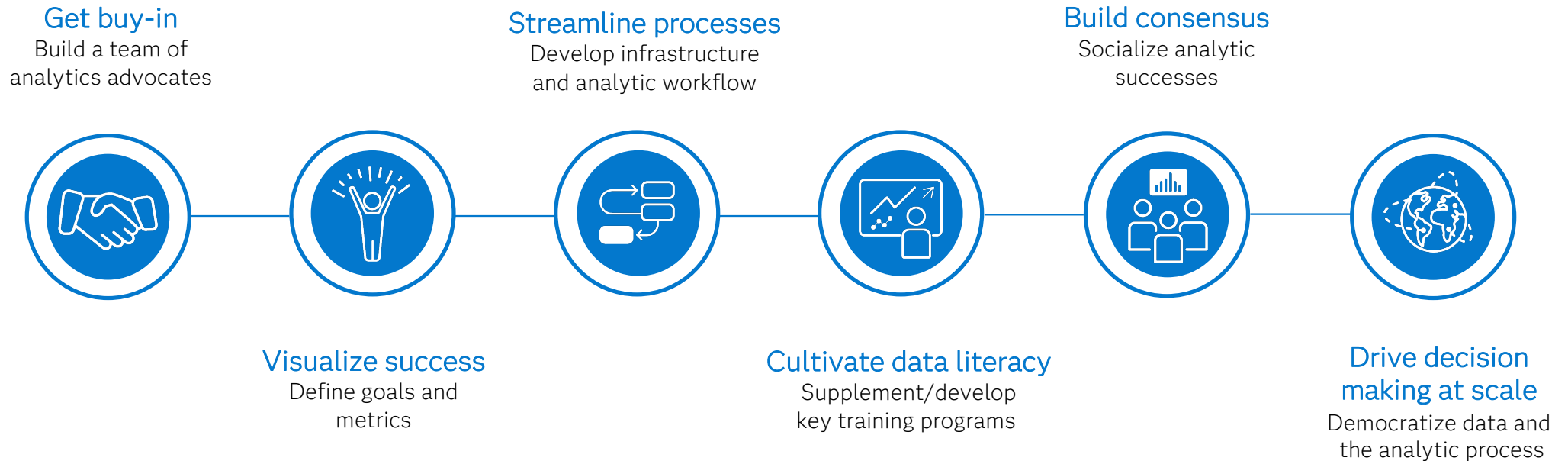


Predictive Modeling and Text Mining
Learn how to identify possible relationships, build predictive models and derive value from free-form text.

- Free, online, self-paced statistics course.
- Ideal for anyone wanting to learn fundamental skills around core statistical applications.
- Shaped by industry experts.
- Helps drive statistical adoption and comprehension.

Building an Analytics Culture

https://www.jmp.com/en_us/software/analytics-advocate-guide.html



Engineering Efficiency

JMP's mission since 1989

Helping scientists and engineers speed innovation
by enabling better decisions with analytics.



Thank you!

volker.kraft@jmp.com

Please contact me for a personal demo or discussion.

