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Principal Author's Signature X Thomas A. Donnelly	Date 3 June 2021
MORS Event 89th MORSS	Event Date(s) 21-24 June 2021

Presentation Type ☐ Plenary ☐ Course ☒ Tutorial ☐ Special Session ☐ Poster ☐ Demonstration

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Title of Presentation Exploratory Data Analysis & Root Cause Analysis – "What can you do when you don't have a designed experiment?"	Presentation ID (if assigned) 56939

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EXPLORATORY DATA ANALYSIS AND ROOT CAUSE ANALYSIS

"What can you do when you don't have a designed experiment?"

89th MORSS
Webcast Tutorial 56939
June 21, 2021

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JMP Defense & Aerospace Team
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TOPICS

Exploratory Data Analysis and Root Cause Analysis

- Dynamic linking – look for correlation between behavior and possible causes – make lots of graphs
  - Just don't think that **correlation** necessarily means **causation**!
- Use data filters to isolate factors and levels
- Preparing the data – outliers, missing, recoding
- Example data sets
  - Pharmaceutical – continuous & binary – root cause
  - Breast cancer – binary – PCA – Penalized Regression
  - Cyber Attack – Multinomial - binary
  - Diamonds – lots of categorical classifications
  - FAA Data – daily records
  - Hundreds of factors
  - Positional – latitude & longitude (GPS, satellite, image)
    - GPS, SST, Drone
  - What Type of Data Do You Have?

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TOPICS

Exploratory Data Analysis and Root Cause Analysis

- Just how much are my factors correlated?
  - Matrix – VSS cont/cat response
  - PCA – breast cancer
- Create a design of experiments from candidate set –
  - Phamaceutical Tablet Data
  - Diamonds Data
  - FAA Data
- Use Data Mining Tools
  - Use a Robust “Honest Assessment Method” – Train, Validate & Test
  - Other Cross-Validation approaches – K-fold, Leave-One-Out
  - Penalization criteria – BIC, AICc, ERIC, Adjusted R-Square

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TOPICS

Exploratory Data Analysis and Root Cause Analysis

- Decision tree methods (Useful when too many columns for regression)
- Regression – Linear, Generalized Linear (logistic), Stepwise (not always), Penalized (GenReg)
- Neural

- CKPS Today? Tomorrow?
  - Physics (timeless) vs People (shifty/adaptive)
- Case Study - FAA Data/Models
  - Cross-Validation approaches – K-fold, Leave-One-Out
  - Penalization criteria – BIC, AICc, ERIC, Adjusted R-Square

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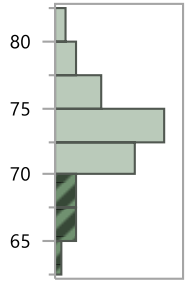
INTERACTIVE SELECTION

LOOK FOR CORRELATIONS BETWEEN MEASURED RESPONSES AND POTENTIAL FACTORS

Distributions

Dissolution



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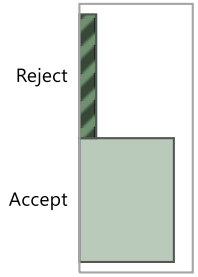

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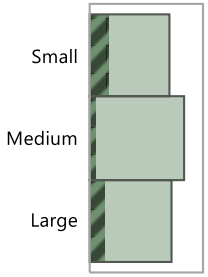

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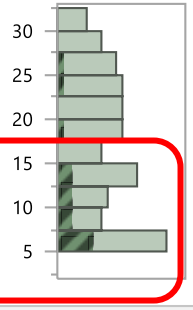

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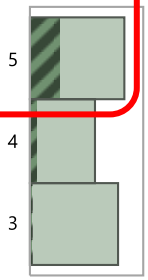

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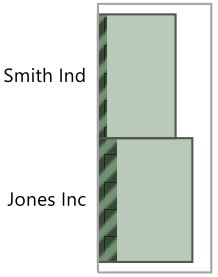
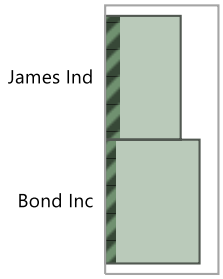


Lactose Supplier



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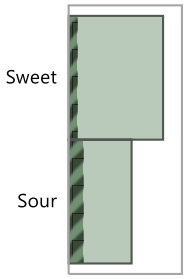

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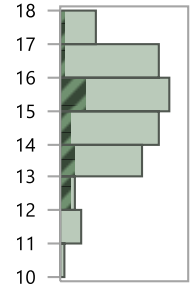
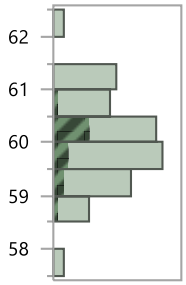
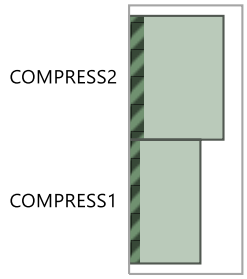


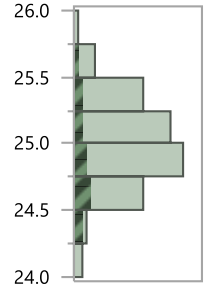
Blend Speed



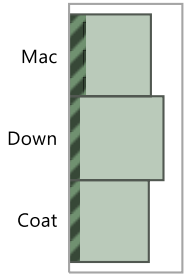
Compressor



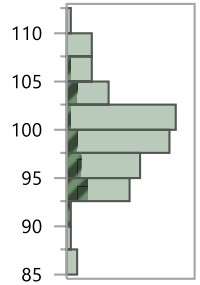
Force



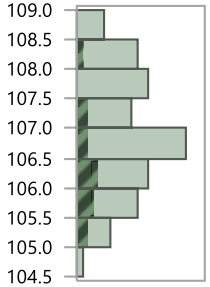
Coating Supplier



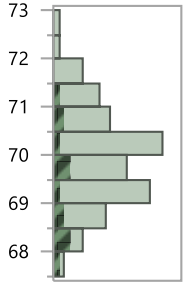
Coating Viscosity



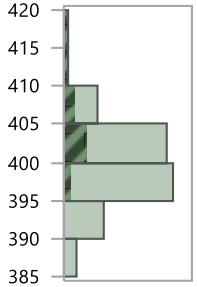
Inlet Temp



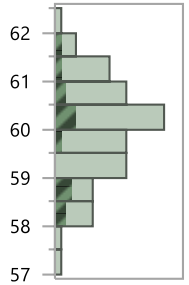
Exhaust Temp



Spray Rate



Atom. Pressure



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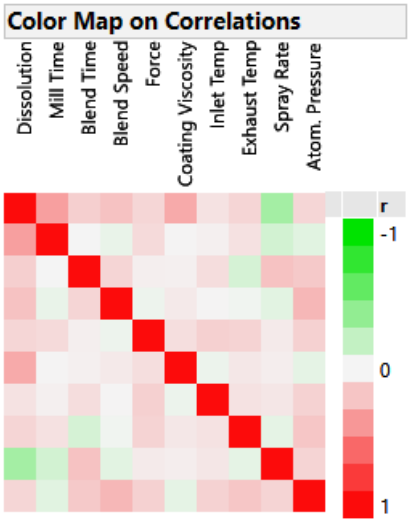
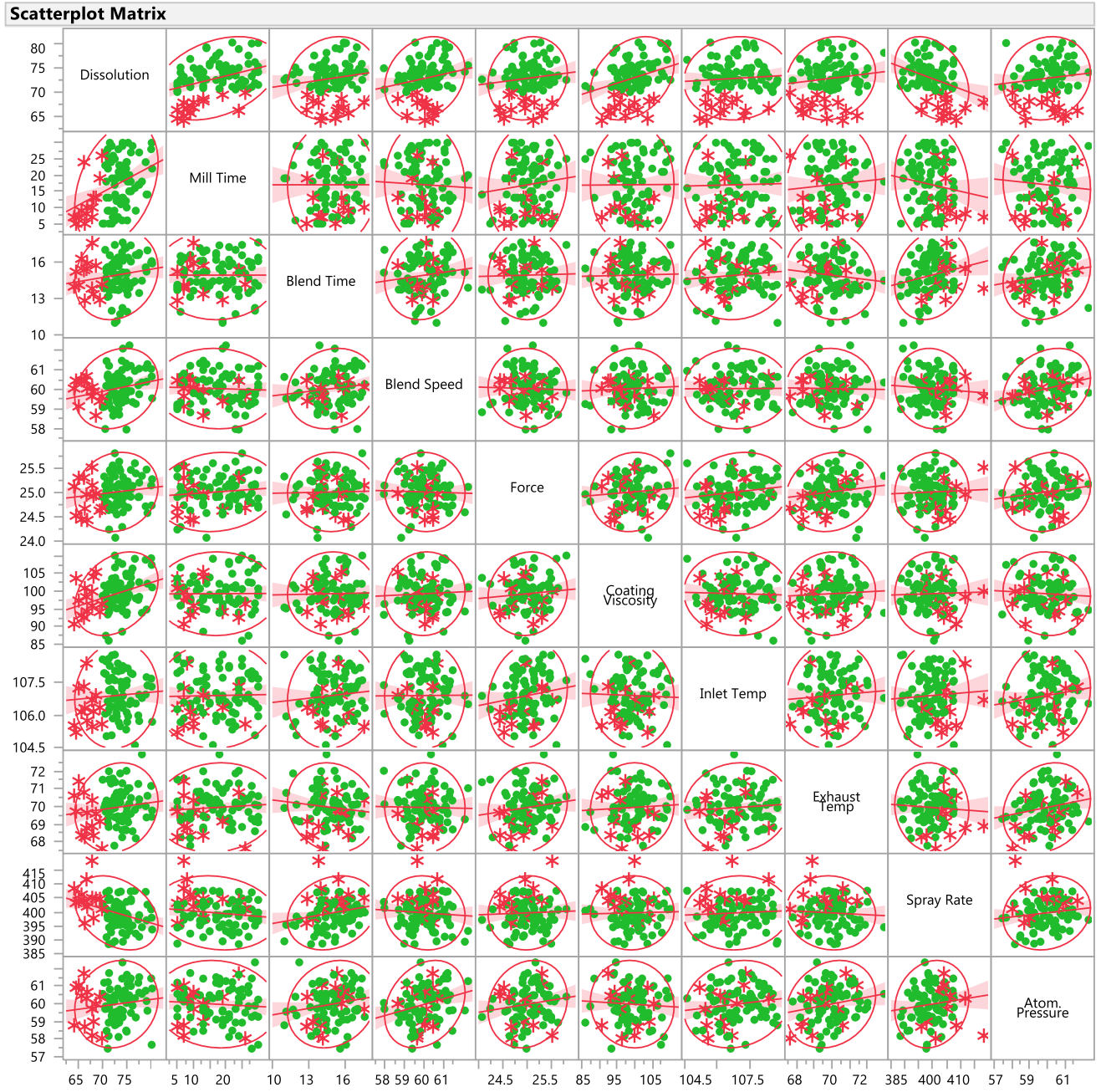
CORRELATION OF CONTINUOUS COLUMNS

Look for correlations between responses and potential factors, as well as factors with each other





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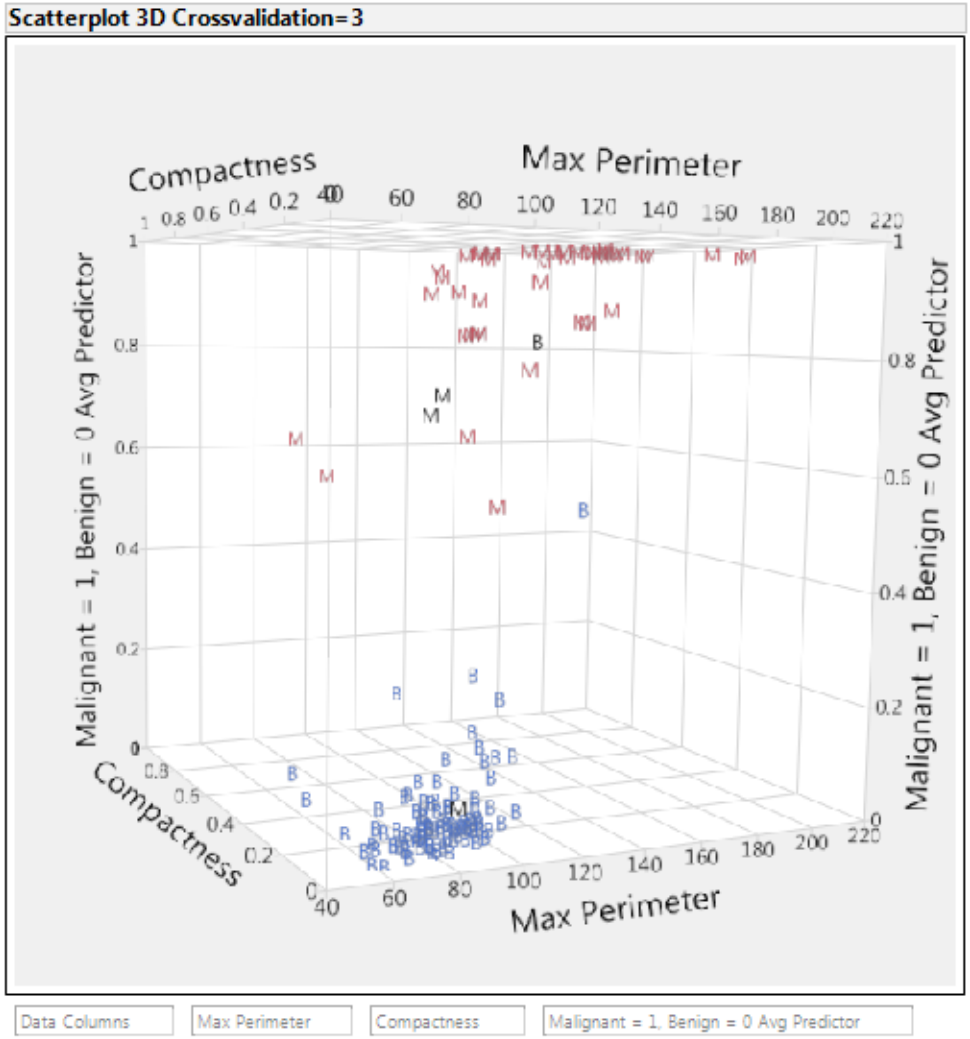
TEST DATA

ACTUAL DIAGNOSIS (M OR B) PROBABILITY OF MALIGNANT AND TWO MAIN FACTORS



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