Design and Analysis of Experiments Using JMP 15

During the testing of these objectives; you will be expected to perform common tasks, such as:

Create a DOE Plan (40%)

Identify and define the critical responses to be measured for the experiment

- Determine an appropriate goal
- Determine the relative importance of the responses
- Choose the appropriate responses to solve a business problem
- Continuous versus categorical
- Determine the appropriate use of the low and high limit
- Determine minimum acceptable power
- Determine the minimal detectable effect size

Identify and define the factors to be varied for the experiment

- Create a list of possible factors for an experiment
- Determine which factors should be included in the experiment, which should be held constant, which should be blocking factors
- Determine the need for blocking
    - Determine the block size
    - Determine the nature of the blocks, random versus fixed blocks
- Identify various types of factors including: categorical, blocking, continuous and mixture , discrete numeric
- Identify hard to change factors
- Identify reasonable ranges for the factors
- Determine number of levels for factors
- Explain what a mixture factor is and how it is different from other factors

Identify and implement factor constraints if necessary

- Convert a constraint into the proper linear constraint form
    - Define the inclusion region
- Recognize linear constraints versus disallowed combinations
    - Define the exclusions

Identify terms to be included in the model

- Specify the appropriate linear model to solve a business problem
  - Main Effects, Interactions, RSM, Powers, (JMP buttons)
  - Discrete numeric factors produce higher order terms
  - Do not cross the blocking factor with any others
- Match the classical design with the appropriate linear model
  - full factorial, fractional factorial, CCD, Box Behnken, Placket-Burman and Folded Plackett-Burman
- Determine the relationship between the model and the minimum number of runs.

- Stack/Split
- Subset

Create a design with the appropriate design features

- Select Optimality criterion
  - Choose d-optimal design for parameter estimation and testing
  - Choose i-optimal design for response estimation
- Include blocking in the design when necessary
  - Specify the block size
  - Determine the nature of the blocks, random versus fixed blocks
- Determine the number of runs
- Distinguish between replicates and replicate runs
- Specify the number of whole plots for hard to change factors
- Determine the appropriate number of center points
- Use the JMP feature Simulate Responses
- Use the JMP feature Number of starts and design search time to find a better design

Evaluate the performance of the design for estimation, testing, and prediction

- Analyze power and evaluate estimation efficiency
  - Explain the relationship between number of runs, error variance, effect size, significance level and power
  - Determine the value to enter for the error variance, effect size and significance level
  - Determine the anticipated coefficient from the minimum detectable effect size
  - Explain the relationship between the anticipated coefficient and the anticipated response
  - Explain the fractional increase in CI length
  - Explain the relative standard error of estimate

- Evaluate correlations with color map and alias matrix
    - Identify estimates that are correlated
    - Determine the strength of the correlations between estimates
    - Relate the correlation of the estimates to the estimation efficiency
    - Decide if the correlations are tolerable
    - Compare and contrast the color map on correlations and the Alias matrix
- Evaluate the prediction variance profile, surface plot, and Fraction of Design Space (FDS)
    - Choose a design with better prediction variance
    - Be able to relate the set of runs to the shape of the prediction variance function and the FDS function
- Compare designs platform
    - Use the Compare designs platform to choose a design
    - Consider impact of changing the model on design performance
    - Consider impact of using different optimality criteria
    - Consider the impact of changing the number of runs on the prediction variance, parameter estimate variance and the power

Data Collection (15%)

- Enumerate the benefits of randomization, and identify the impact of a restriction on randomization
- Explain how replication can be used and overused and distinguish between replication and multiple measurements on the same experimental unit
- Determine blocking requirements (how the blocking variable influences the collection of your data)
- Evaluate measurement system signal to noise ratio

Analysis (30%)

Select the best model

- Use the fit model platform to analyze data (assume from ANOVA/Regression)
- Be able to identify and remove the non-important terms from the model (assume from ANOVA/Regression)
- Explain the effect of column properties especially coding and design role (blocking versus random block, discrete numeric variable)
- Explain the function of each of the scripts saved to the table from the DOE platform

- Perform residual analysis to validate model assumptions
- Identify impact that a lost run might have on your analysis

Exploit the best model

- Use the prediction profiler with desirability functions and contour profiler to:
  - determine the need to augment the experiment
  - optimize the process for one or more responses
  - lock a factor for a constrained optimization problem
  - define optimal regions
- Relate parameter estimates to main effects

Fit separate or combine models for multiple responses

Be able to use the profiler under the graph menu (prediction formulas)

Create the next Experiment (15%)

Conduct verification to determine the need to augment an existing experiment

Be able to augment a design (add runs) to address specific needs

- Change the range of a continuous factor
- Add a level to a categorical factor
- Add a new model term
- Increase power
- Be able to put new runs into a separate block (check blocking option)

Under Augment Design, be able to define:

- Replicate
- Add center points
- Add Axial
- Fold Over
- Augment