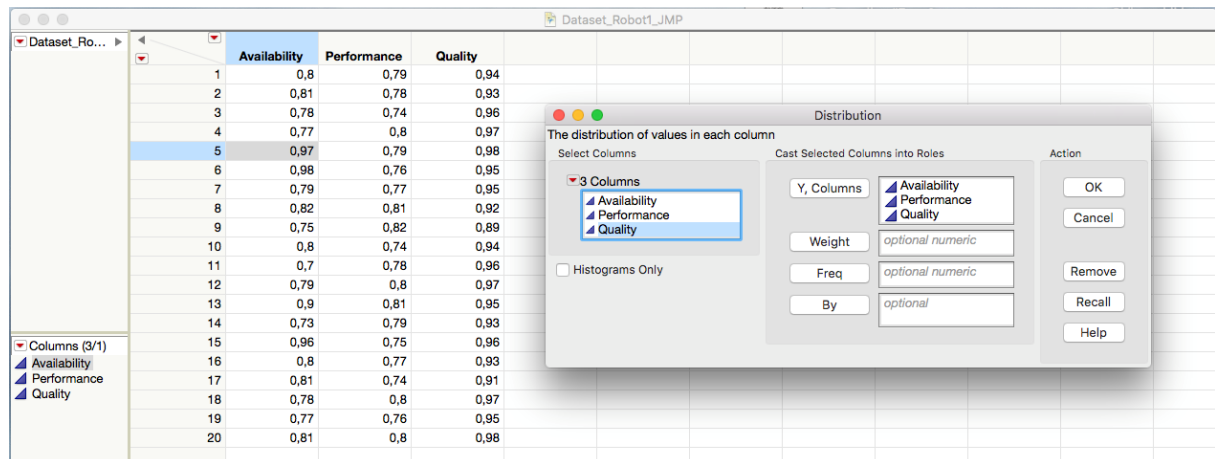


Instructions to JMP

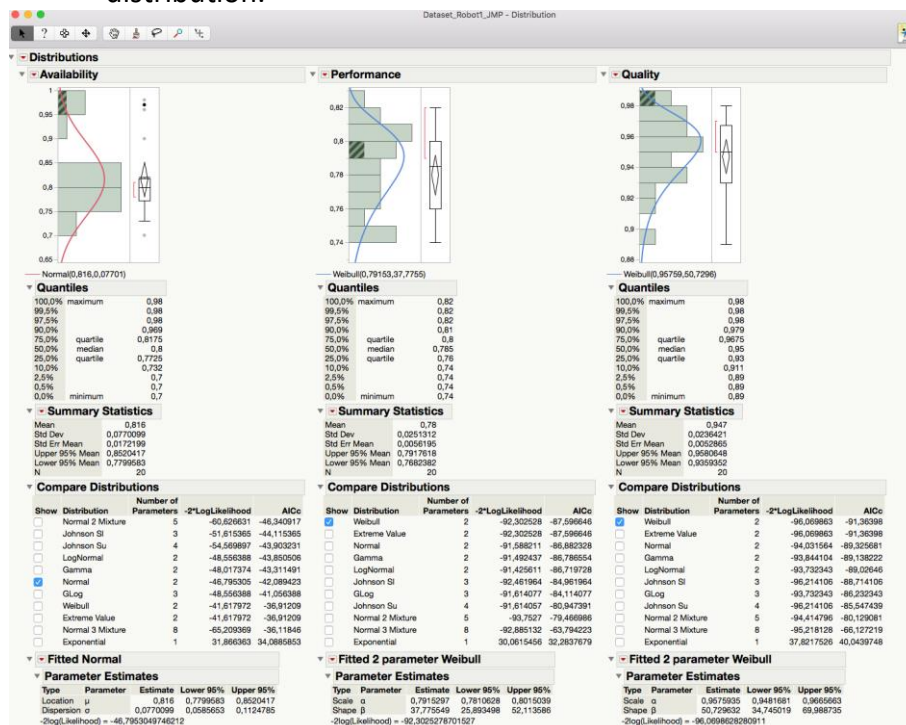
This document exemplifies the work process in JMP to complete WS2: Servitization. Specifically, it shows how to how to **(1) fit distributions to a data set** and **(2) generate new data points from fitted distributions** (monte carlo simulation).

Fit distributions to a data set

- Click “Analyze - Distributions”
- Choose variables to analyze by adding them to the Y, Columns (in this case availability, performance, quality), then click “OK”.



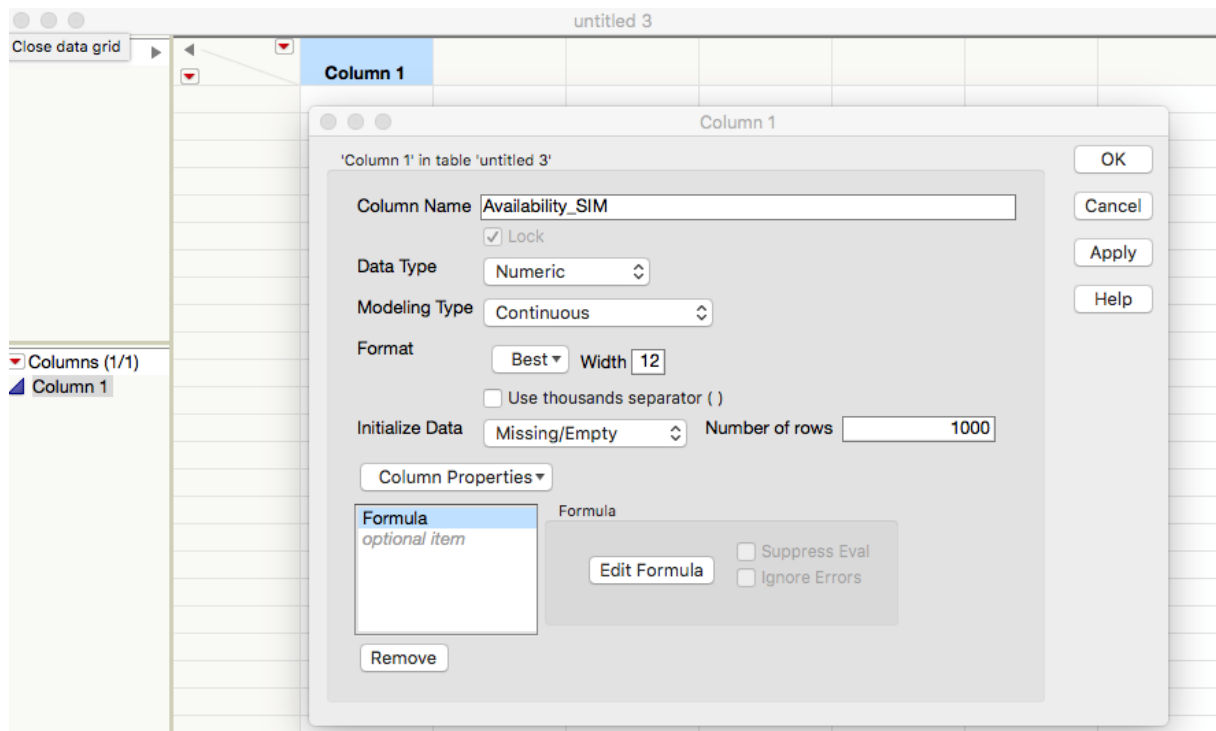
- To fit distributions to each variable, click the red arrow next to the variable name, then choose “Continuous fit - All”.
- Identify the best fitting distributions by analyzing the goodness of fit statistics. Remember to always choose the simplest, best-fitting distributions to avoid overfitting the model. For example, a “Normal” distribution is simpler than a “Jonhson SI” distribution.



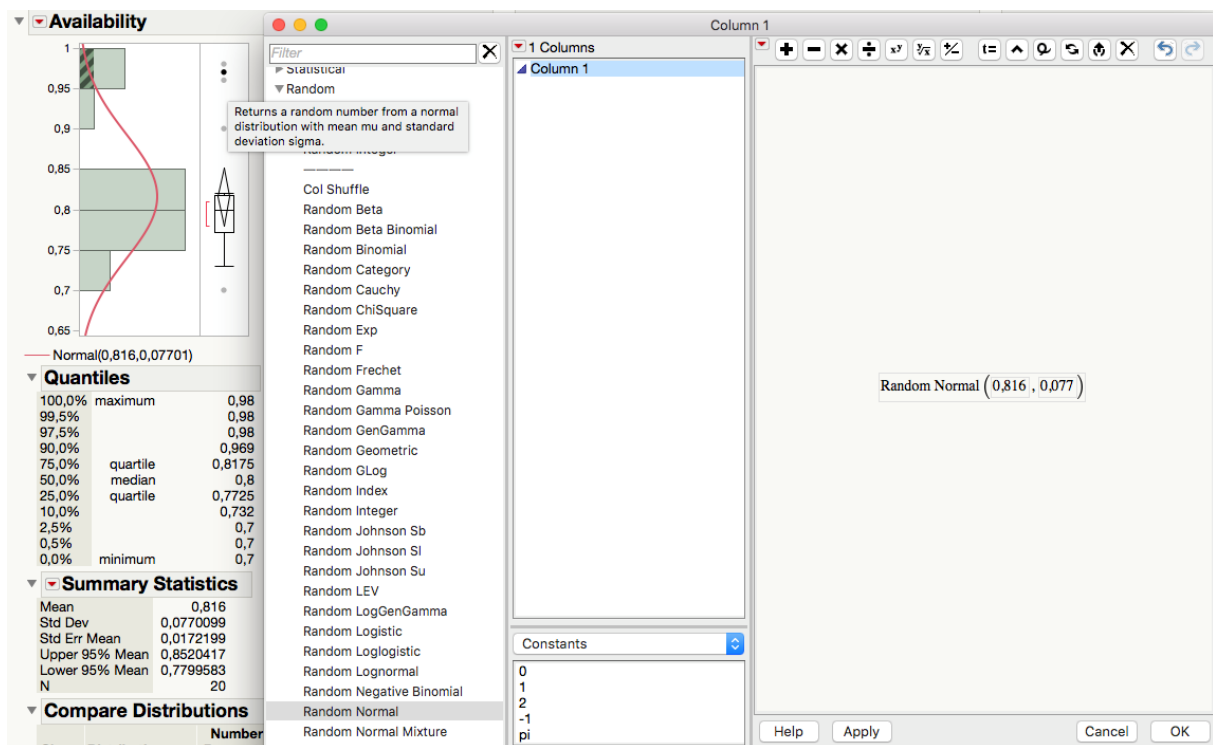
Generate new data sets from fitted distributions

After a suitable distribution has been identified for each variable, a new data set needs to be generated using monte carlo simulation.

- Open a new, blank data table by clicking “File – New – New Data Table”
- Double-click the variable and specify the column properties: specify a new name (e.g. Availability_SIM) and the number of rows = 1000.
- Then click “Column Properties – Formula – Edit formula” to specify the data properties



- To generate new data points, the formula should be specified so that 1000 random data points are drawn based on the fitted distribution.
- Click the tab “Random” and choose the identified best-fitting distribution, and specify the distribution parameters. In the figure below, the historical data for availability had good fit for a normal distribution with mean = 0,816 and standard deviation = 0,077. Specify the parameters and click OK. Then, replicate for the performance and quality parameters.
- Note that different distributions are specified in different ways. For example, a normal distribution is specified as Random Normal (mean, standard deviation), and a Weibull distribution is specified as Random Weibull (beta, alpha). The values are available in the summary statistics and parameter estimates for each variable.



- When new data points have been generated for each variable, create a fourth column that calculates OEE.
- Specify the formula to calculate OEE as Availability * Performance * Quality. JMP will then generate 1000 values for the overall OEE.

The screenshot displays the JMP interface with a data table named 'untitled 3'. The table has four columns: 'Availability_SIM', 'Performance_SIM', 'Quality_SIM', and 'Column 4'. The 'Column 4' column is currently empty. A 'Column Properties' dialog box is open for 'Column 4', showing the following settings:

- Column Name: OEE_SIM
- Lock: ☒
- Data Type: Numeric
- Modeling Type: Continuous
- Format: Best, Width: 12
- Use thousands separator: ☐
- Initialize Data: Missing/Empty
- Column Properties: Formula
- Formula:
- Edit Formula:
- Suppress Eval: ☐
- Ignore Errors: ☐
- Remove:

Below the dialog box, the 'Formula Builder' window is open, showing a list of columns on the left and a formula editor on the right. The formula editor contains the expression: $\text{Availability_SIM} \cdot \text{Performance_SIM} \cdot \text{Quality_SIM}$. The 'Columns' list on the left includes 'Availability_SIM', 'Performance_SIM', 'Quality_SIM', and 'Column 4'. The 'Rows' list on the left shows 'All rows' with a count of 1000.

- To improve interpretation of the OEE results, it is helpful to specify a specification limit to the data. In column properties, add a specification limit with a lower limit of 0.7 (i.e. the threshold for making a profit with 70% OEE for one day).
- To analyze the final results, click “Distribution – Analyze” and add the OEE_SIM column. This will show the distribution of expected OEE values based on the 1000 generated values of availability, performance and quality, which is a more representative image of OEE that accounts for the variability in each of the three variables.

