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".

					Dataset_Robot1_JMP			
■ Dataset_Ro ▶		Availability	Performance	Quality				
	1	0,8	0,79	0,94				
	2	0,81	0,78	0,93				
	3	0,78	0,74	0,96		Distribution		
	4	0,77	0,8	0,97	The distribution of values in each column			
	5	0,97	0,79	0,98	Select Columns	Cast Selected Columns into Roles	Action	
	6	0,98	0,76	0,95	Fact			
	7	0,79	0,77	0,95	Columns	Y, Columns Availability	ОК	
	8	0,82	0,81	0,92	Availability Performance Quality Histograms Only	Quality	Canaal	
	9	0,75	0,82	0,89			Cancer	
	10	0,8	0,74	0,94		Weight optional numeric		
	11	0,7	0,78	0,96		Free Optional numeric	Remove	
	12	0,79	0,8	0,97				
	13	0,9	0,81	0,95		By optional	Recall	
	14	0,73	0,79	0,93			Liele	
Columns (3/1) Availability Performance Quality	15	0,96	0,75	0,96			Help	
	16	0,8	0,77	0,93				
	17	0,81	0,74	0,91				
	18	0,78	0,8	0,97				
	19	0,77	0,76	0,95				
	20	0,81	0,8	0,98				

- 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

			untitled 3				
Close data grid	Colu	umn 1					
	'C(olumn 1' in table '	ОК				
		Column Name	Availability_SIM	Cancel			
		Data Type	V Lock	Apply			
		Modeling Type	Continuous 🗘	Help			
Columns (1/1)		Format	Best Width 12				
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		Initialize Data	Missing/Empty Number of rows 1000				
		Column Properties -					
		Formula	Formula				
		optional item	Suppress Eval				
			Edit Formula Ignore Errors				
		Remove					

- 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.



- 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.

		OEE_SIM			
'OEE_SIM' in table '	untitled 3'				ОК
Column Name	OEE_SIN	4			Cancel
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Format	Best	Width 12			
	Use t	housands separator ()		
Column Prop	perties *				
Formula		Spec Limits			
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		the Distribution pl	atform. Clic	ck below	
		to key in values. Lower Spec Limit	0	.7	
Remove		Target		·	
		Show as graph	reference l	ines	
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100,0% ma	aximum	0,817445099			
99,5%		0,7589424409			
90,0%		0,6775269559			
75,0%	quartile	0,6423123383			
25,0%	quartile	0,5645392913			
10,0%		0,5304390247			
0,5%		0,4512517625			
0,0% m	inimum	0,4087858131			
• • Sumr	nary	Statistics			
Mean Std Dev		0,6030717 0,0573164			
Std Err Mea	an	0,0018125			
Lower 95%	Mean	0,599515			
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🔻 💌 Capa	bility	Analysis			
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Spec Targe	t	0,7 Below	USL	95,4000	
Upper Spec	c Limit	. Total (Outside	95,4000	