

Module 1. JMP Basics

Presented by: QE NPI Andres Ruelas



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Instructor: Andres Ruelas



- Quality and New Product Introduction Engineer
- Medical sector (Cardinal Health, Medtronic, Stryker)
- Specialized in molding, extrusion, sealing with Urania and Multivac equipment, and automatic inspection systems
- 7 published textbooks, available at Amazon
 - Quality Engineering for Recent College Graduates (Engineering / Quality)
 - Guía Para la inversión utilizando Cetes Directo (Finance / Costs)
 - Minitab Masters Fundamentals / Validations (Engineering / DOE)
- Cetys University: Diploma in Medical Manufacturing Engineering
- Cetys University: Diploma in Cost Engineering
- Cetys University: Diploma in Project Management
- Eje Institute: Seminar in Scientific Molding
- Minitab YouTube channel with more than 250,000 views and 4,200 training hours given



Training and Courses Given

- YouTube Channel: CUSUM Training For Professionals
- Views: +250,000 People
- Videos: 6 Videos focused on Minitab
- Hours given: 4,200 hours



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Instructor at Lean Six Sigma Academy – Bit Center

Courses given

- Root Cause Analysis in Minitab (RCA)
- Statistical Analysis for Validations with Minitab

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- To this date, there are multiple JMP versions available
- Most of the studies should be applicable for all versions however we can't guarantee full compatibility.
- JMP 16 has just been launched in 2021, and is not currently being used by most companies. However, the interface and analysis should be similar to other versions.

JMP Interface







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Worksheet Creation



Press Ctrl + N To create a new worksheet

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Select File > New > Data Table

📭 JMP Home Window - JMP Trial

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	Print Print Preview Page Setup	Ctrl+P			
	Recent Files				
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Project Creation



Select File > New > Project



	New		•	Data Table	Ctrl+N
2	Open Quick Open Import Multiple Files Close	Ctrl+O Alt+Shift+O Ctrl+W		 Script Journal Database Query Project 	Ctrl+T Ctrl+Shift+J Ctrl+Shift+D Ctrl+Shift+P
	Save Save As Revert	Ctrl+S	2	Application Dashboard Add-In	Ctrl+Shift+A
	Export Publish				
	Database Internet Open		•		
	Preferences	Ctrl+K			
2	Print Print Preview Page Setup	Ctrl+P			
	Recent Files				
	Save Session Script				

Worksheets / Data Tables: Mostly used to make quick analysis

Projects: Can contain multiple data tables and allow for sharing JMP files among users easier.

We recommend using projects, when possible, for organizational purposes.

Types of Data



JMP manages all of its data though the use of columns. The columns are arranged as Column 1, 2, 3.... etc.

The left side column will notify you of the type of data contained within.

- Nominal: Text based information
- Ordinal: Names or Numbers with order (Satisfaction 1 to 10)
- Continuous: Numbers where distance is important. (Height 1.65 to 2.20 Meters)

۹	Inspector	Dimensional	
	Name	Results	Inspection Date
1	Andres R	0.25	06/11/2021
2	Roberto G	0.251	06/12/2021
3	Eduardo S	0.25	06/13/2021
	Ú Ó		
	Graphs ×	Graphs X Exercises* X C Constraints C Constraints	Graphs X Exercises* X Inspector Name Dimensional Results Andres R 0.25 2 Roberto G 0.251 3 Eduardo S 0.25 Eduardo S 0.25 Control Control

Data Input JMP



Exercise: Input the following data in JMP.

Nombre Inspector	Resultado Dimensional	Fecha de Inspección		Inspector Name	Dimensional Results	Inspection Date
Andres R	0.250	06/11/19	1	Andres R	0.25	06/11/2021
	0.200		2	Roberto G	0.251	06/12/2021
Roberto G	0.251	06/12/19	3	Eduardo S	0.25	06/13/2021
Gabriela R	0.250	06/13/19				

Make sure you create a Data Table within your Project!

Organizing Data in JMP



Notice that the Data Table has a name. In this case, it's called "Samples". You can assign a unique name to this data table by double clicking on it.

We recommend organizing data tables based on data origin. For example: "Study ETR2021-015"

- 1			mpics = +		a con a franca	
×	Samples	🔛 Graj hs 🛛 🛛	Exercises* ×			
	Samples		Inspector Name	Dimensional Results	Inspection Date	
		1	Andres R	0.25	06/11/2021	
		2	Roberto G	0.251	06/12/2021	
		3	Eduardo S	0.25	06/13/2021	

Organizing Data in Minitab



Using Different Data Tables is important because JMP Won't allow two columns to share the same name in the same data table. This can be an issue if you try and place all the information in one data table.

 Samples 		Inspector Name	Dimensional Results	Inspection Date	Inspection Date 2
	1	Andres R	0.25	06/11/2021	
	2	Roberto G	0.251	06/12/2021	
	3	Eduardo S	0.25	06/13/2021	

Understanding Basic Data Analysis



JMP is a program designed to perform statistical analysis. The top menu includes all analysis available in JMP, grouped in categories.

/				
🛂 Module 1 - JMP Basics - JMP Tria	al	n og entre ren or ord		Module 1 - JMP Basics - JMP Trial
File Edit Tables Rows Cols	DOE Analyze Grag	oh Tools Project View Win	dow Help	File Edit Tables Rows Cols DOE Analyze Graph Tools Project View Window Help Get Started
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× Tables, reports, and scripts that are currently open in this project	Samples	Inspector	Dimensiona	
Samples* Graphs Exercises*		Name Name Andres R Roberto G S Eduardo S	Results 0.	 The main menus to run analysis in JMP are Analyze, Graph and DOE. In summary, the menus contain the following options: File and Edit: Tools to open and configure files Tables, Rows and Columns: Tools to configure columns DOE: Tools to run Design of Experiments Analyze: Tools to run statistical analysis Graph: Tools to create visual graphs
× Folders and files saved inside of this self- contained project file	Columns (4/1)			 Iools, Project, View and Window: Iools to manipulate
Graphs.jmp Samples.jmp	q			your workspace.

Understanding Basic Data Analysis



Each tool will be explained as soon as it is required. As of now, you can observe that the "Analyze" menu contains many submenus, and these can contain other submenus.

File Edit Tables Rows Cols	DOE	Analy	yze Gr Distrib	aph Tools Proje ution	ect V	iew	Window Help Get S	tarted	ną.		
Workspace ×	S.	۱ <u>۶</u>	Fit Y by	X		rcises	5* ×				
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			Predict	ive Modeling		o S	0.25	06/13/2021			
			Screen	ing							
			Multiva	riate Methods							
			Cluster	ing	•						
			Quality and Process		•	**	Control Chart Builder		-		
			Reliability and Survival		•		Measurement Systems Analysis				
	Consumer Research				•	$II I_{1}$	Variability / Attribute	Gauge Chart			
Contents ×						M	Process Capability				
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	Ins	pectio	on Date	2		≫	Diagram				
							Manage Spec Limits				
						**	OC Curves				



The "Graph" menu contains the most common graphs (e.g. histograms, boxplots, interval plots, bar charts and pie charts).





A histogram is a visual representation of your data, where your data is grouped based on value ranges (Bins / Columns). Open the worksheet "Graphs" and observe it contains data in C1 to C5.

■Graphs	 П П	Diameter 0.250 +- 0.05	Supplier 1	Supplier 2	Supplier 3	Diameter 0.125 +- 0.025
	1	0.259184	9.977	12.4492	10.0092	0.145795
	2	0.25443	9.0734	10.1889	14.4875	0.137859
	3	0.250743	10.0538	12.8172	8.7663	0.163654
	4	0.245933	10.2908	10.5667	8.9401	0.129301
	5	0.252907	10.8929	12.4933	10.1973	0.146013
	6	0.246211	10.0706	9.834	9.8526	0.167788
	7	0.268676	10.5752	10.1902	9.2851	0.086794
	8	0.238426	9.0089	11.3299	15.4965	0.122819
	9	0.234241	9.7957	11.9687	9.0952	0.131131
	10	0.251524	10.9781	12.2113	10.0808	0.117255
	11	0.247376	10.5804	10.394	10.5844	0.155107
	12	0.268773	8.8766	11.6638	4.278	0.164808
	13	0.247419	10.2051	9.4387	9.899	0.066643
	14	0.252849	10.6153	11.3659	12.042	0.17714
	15	0.264889	8.5165	10.0101	11.0946	0.094368
Columns (5/1)	16	0.278753	7.7768	10.2777	12.1498	0.025054
વ	17	0.24954	10.268	9.0836	11.9049	0.250184
Diamet +- 0.05	18	0.236947	8.9891	10.0688	6.5965	0.078581
Supplier 1	19	0.254127	10.9405	11.8896	12.2982	0.167557
Supplier 2	20	0.234677	10.6372	10.0994	10.9142	0.091406
Supplier 3	21	0.236449	9.5495	9.8096	12.6469	0.083669
Diamet+- 0.025	22	0.272994	9.2748	9.3864	11.0258	0.077018
	23	0.255844	8.7197	14.5607	8.3553	0.138801
	24	0.229435	9.8765	11.9398	11.1098	0.115557



The first step consists in creating a histogram using column C1 data. To do this, just click "Graph > Histogram". A window will open select the histogram graph option, the Diameter 0.250+- 0.05 column

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s 単 第 第	Scatterplot Matrix Parallel Plot Cell Plot Scatterplot 3D Contour Plot	C 0.1 0.1 0.1 0.1 0.1 0.1	Graph Build Undo Dial 5 Columns Diameter 0.250 Supplier 1 Supplier 2 Supplier 3 Diameter 0.125	ler log Done 0 +- 0.05 5 +- 0.025			M × <mark>P ≥ I</mark> •	Title Group X
	 Ternary Plot Surface Plot Profiler Contour Profiler Mixture Profiler Custom Profiler Excel Profiler 		Points Summary Statistic Error Interval Interval Style Jitter Jitter Limit Variables	None Auto Error Bar Auto	> > > >			



Now Click and Drag the Diameter column into the middle blank portion of the canvas (Middle of the screen). A Histogram should now appear. Note how the bars go left to right instead of up and down. You can modify this behavior by clicking and dragging the column toward the X axis instead of the Y Axis.



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You can personalize the Histogram by making a right click and selecting the Histogram Option. Within you can add the bar count and bar percent.



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Creating Graphs - Histogram

Select "OK". The graph will be created automatically. The usefulness of an histogram is in that it can show you where your data is grouped. The taller the bar, the more data there is in the corresponding range. Observe that the histogram shows that there's data from 0.22 to 0.28.





Now, this data was pulled using a specification of 0.250 +- 0.05. This means that the data is acceptable as long its values are between 0.200 and 0.300. To add this information to the data, right click the graph and select "Axis Settings"



Scale		Axis Label Row -			
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Minimum: Maximum:	0.2185 0.2815	Tick Marks Inside Label Orientation:	Graph Frame Automatic Y	_	
Tick/Bin Increment Increment: # Minor Ticks: Tick Offset:	tt 0.01	Allow Ranges Value: Label: Line Color: Line Style: Label Color Font Label Position C Label Axis Side	(1009 C utside ame	Update 2000 Add Remove 6 - 1 - ·	
Preview					
0.22	0.23	0.24	0.25	0.26	0.27

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In the next window, Record the 0.200 and 0.300 reference line marks and click Add. You can also change the line size with the Style option and color.

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0.2 0	21 0.23	0.23	0.24	0.25	0.26	0.27	0.28	0.29
< 0	0.22	0.20	0.24	5.2.5	0.20	0.21	0.20	0.25

Note: We have also modified the minimum and maximum axis values to 0.19 and 0.31 to provide visibility for the lines.





Observe how two reference lines have been added. Compare this histogram with the original. As a general rule, adding reference lines allows you to see if the process analyzed complies or not with your specification.





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These reference lines can be added to all sorts of graphs, not just histograms. Now, the text in the graph can be edited, too. For example, the title "Dimension 0.250 +- 0.05" can be changed by selecting it with a double click. In the new window you can change the font, size and content of the title.

er	ter 0.250 +- 0.050 Inches		Results for Diameter 0.250 +- 0.050 Inches	
	14	15 -	14	
	13			



You can also edit the bar color by making a right click on the legend column. Within Fill Color select the color for the bars.





The next basic graph is the boxplot. The boxplot graph is used when you want to know how disperse is your data. You can also use it to compare two or more providers, clients, processes, etc.

Observe the data contained in C2 to C4.

	Diameter 0.250 +- 0.05	Supplier 1	Supplier 2	Supplier 3	l iameter 0.125 +- 0.025
1	0.25918	9.977	12.4492	10.0092	0.145795
2	0.2544	9.0734	10.1889	14.4875	0.137859
3	0.25074	10.0538	12.8172	8.7663	0.163654
4	0.24593	10.2908	10.5667	8.9401	0.129301
5	0.25290	10.8929	12.4933	10.1973	0.146013
6	0.24621	10.0706	9.834	9.8526	0.167788
7	0.26867	10.5752	10.1902	9.2851	0.086794
8	0.23842	9.0089	11.3299	15.4965	0.122819
9	0.23424	9.7957	11.9687	9.0952	0.131131
10	0.25152	10.9781	12.2113	10.0808	0.117255
11	0.24737	10.5804	10.394	10.5844	0.155107
12	0.26877	8.8766	11.6638	4.278	0.164808
13	0.24741	10.2051	9.4387	9.899	0.066643
14	0.25284	10.6153	11.3659	12.042	0.17714
15	0.36400	0 5465	10.0101	11 0046	0.004360



Imagine these three providers are interested in being selected to supply you a new component. Suppose this component is a wooden stick that must measure between 8 and 12 meters long (i.e. 10 meters +- 2 meters). To create a boxplot graph, select "Graph > Graph Builder > BoxPlot





Now, select the three providers and add them to the graph's Y Axis with a click and drag.





Once the process is completed, a boxplot graph like in the following image will be generated. This graph is a visual representation of your data, grouped in quartiles (more on this later).





Now, the purpose of this graph is to compare which of the providers gives the better results. We know the specification is between 8 meters and 12 meters. You can add this specification by using reference lines.

Remember: Right click Y Axis > Axis Settings > Reference Lines > Y Axis > 8 12 >

			Allow Ranges	Update
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& 2 mor	Revert Axis	dialog or set configurable axis options for a given axis.	Label Color 🔀	
L 10	Add Avis Label			
ilddu	Show Properties		Reference Lines	
S	Edit •		Allow Ranges	Update
		-	Value:	12 Add
		,	Value:	12 Add Remove
8-			Value: Label: Line Color:	12 Add Remove



Observe how the reference lines quickly show how the provider "Supplier 2" and "Supplier 3" exceed the specification limits whereas the provider "Supplier 1" supplies most of its product within this specification, with a small portion touching the lower limit.





Now, what does the BoxPlot graph represent? Simply the data dispersion. Create a simple boxplot using the data from the provider "Supplier 1". Select "Graph > Graph Builder > Drag Supplier Y to Y Column with Boxplot selected"







Observe the graph created. The first part represents the first 25% of the data (the 1st quartile). The second part represents the next 25% (the 2nd quartile). The third part, the next 25% (the 3rd quartile). The last part represents the last 25% of the data (the 4th quartile).

In total, these four quartiles represent 100% of the data.

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Now, the boxplot graph can show you where is your data, and how far it spreads.

You can also make conclusions like the following:

- 25% of the data has a value of 9 or less.
- 50% of the data has a value of 10 or less.

Creating Graphs – Individual Value Plot



Cumplies Desults us Manual Cumplies ID

A graph similar to boxplots is the Individual Value Plot. To create it, select "Graph > Graph Builder > Individual Value Plots > Drag the Results to the Y Column" and add the data from C7 to the Y Axis and C6 to the X Axis.

								16		Supplier Results vs. Merged Supplier ID	
Basics R2 - JMP	Trial				_			10 -			
Rows Cols	DOE Analyze	Graph T	ools Proje	ect View	V						
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1	0 259184	0.077	12 4492	10.0092	0 145795	Supplier 1	9.977	idn .			•
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2	0.25445	10.0520	10.1009	0.7660	0.157655	Supplier 1	10.0530				
3	0.250743	10.0538	12.8172	8./663	0.163654	Supplier 1	10.0538				
4	0.245933	10.2908	10.5667	8.9401	0.129301	Supplier 1	10.2908				
5	0.252907	10.8929	12.4933	10.1973	0.146013	Supplier 1	10.8929	6 -			
6	0.246211	10.0706	9.834	9.8526	0.167788	Supplier 1	10.0706				
7	0.268676	10.5752	10.1902	9.2851	0.086794	Supplier 1	10.5752				
8	0.238426	9.0089	11,3299	15,4965	0.122819	Supplier 1	9.0089				
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10	0.251524	10.9781	12.2113	10.0008	0.11/200	Supplier 1	10.9701				
11	0.24/3/6	10.5804	10.394	10.5844	0.155107	Supplier 1	10.5804				
12	0.268773	8.8766	11.6638	4.278	0.164808	Supplier 1	8.8766	2			
13	0.247419	10.2051	9.4387	9.899	0.066643	Supplier 1	10.2051		Supplier 1	Supplier 2	Supplier 3
14	0.353040	10 6153	11 3650	12042	0 17714	Cumpline 1	10 6153			Merged Supplier ID	

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Creating Graphs – Individual Value Plot



Observe the rendered graph. It is different to a boxplot, with the difference that each value is shown individually as a dot, instead of being grouped in a quartile (box).



Creating Graphs – Individual Value Plot



This graph can be modified the same way as the prior ones. You can change the title, add reference lines or choose a different color. It is not as common as the boxplot graph, though, since the latter is visually more simple and easier to interpret.



Basic Data Analysis



So far, we have went over the JMP interface, and created the most common graphs: histograms, boxplots and individual value plots. These graphs will allow you to analyze your data visually, but to truly understand statistical analysis, some essential knowledge is needed. Observe the next two graphs:



Basic Data Analysis



The basic elements needed to analyze data are the following:

- The Mean: The average of all data.
- The standard deviation: How disperse is the data.

Both graphs (histograms) have the same mean (average), but a different deviation.



The Importance of the Deviation



The standard deviations is key to assess if a process complies or not with a specification. It allows you to know the amplitude of your process. You can calculate the mean and standard deviation as follows: Analyze > Distribution > Select the Results Column (For this example we are using Data Table Exercises column Histogram 50 C1) and click Ok.





The Importance of the Deviation

By clicking OK a summary table will be created showing the Summary Statistics Mean, Standard Deviation and quartiles.





The Importance of the Deviation



The standard deviation is used to know the breadth of data that follows a normal distribution. Commonly, it is said that the Mean +- 3 σ (standard deviations) groups almost all of the data.





It is frequently mentioned that the data must be normal. This means that, when we graph such data, it must follow the shape of the Gauss bell. Observe how there's symmetry in the following graphs.





Normal data follows the shape of a bell, regardless the value of the standard deviation, or the Mean. To demonstrate this, we have created the following graph.





Notice how the blue curve is slimmer than the red curve. This means that the red curve (standard deviation of 2) is more disperse than the blue one (standard deviation of 1). In conclusion, standard deviation is a value that tells us how disperse is the data. Your data will be less disperse when most of the values are similar (e.g. 1.1, 1.2, 1.1) and will be more disperse when your values are very different (e.g. 1, 5, 25).





We have created additional normal distribution graphs, so you can observe how, as the standard deviation is smaller, the data is more grouped together (the mean being 0).







Module 1. JMP Basics

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