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JMPer Cable™

BIANNUAL NEWSLETTER FOR JMP® USERS

JMP® to the Future

JOHN SALL, SENIOR VICE PRESIDENT
SAS Institute Inc.

CITIZENSHIP IMPROVEMENT

Why is the Macintosh® productive and yet easy to use? It is because Mac applications share a well thought out and standardized user interface supported by a system toolbox. Support and standards for things like pictures, the clipboard, and dialog widgets helped make the Mac an environment that was so good it was copied into all the other environments popular today.

But progress has not stopped. For developers, there is an explosion of new facilities to learn and hook up to their applications. The burden has grown most rapidly in the last two years with System 7. Consider this list of system support features:

- PostScript® customizations
- System 7 odds and ends such as Balloon Help and color icons
- Data Access Manager
- QuickTime Movies
- Publish and Subscribe
- AppleEvents™ and scripting
- future QuickDraw™ GX
- OCE

In Version 2 of JMP® and JMP *Design*® we were able to support some of these new features. We use Postscript extensions to draw dashed lines and rotate text on a printer. We offer Balloon Help for many items and we have a complete color icon family. We support the required AppleEvents and also a custom AppleEvent for transferring data tables from JMP *Design* to JMP.

In the next version of JMP you will see support for additional systems features such as:

- the DAL/DAM database interface—so you can bring data into JMP from remote database servers supporting DAL, Fairfield Software's ClearAccess™, and in the future, SAS/CONNECT®
- QuickTime movies—so you can record a spinning plot as a movie and paste it into a word processor document
- AppleEvents and scripting—you will be able to program analyses, record sessions, and play them back. We were tempted to provide a programming facility earlier but resisted the impulse since our charter was to support the interactive casual user, not the power user-developer. In the meantime Apple has developed a powerful and easy-to-read scripting language that allows you to program across many applications.

SURVEY RESULTS

A few months ago we sent out a survey to ask about your progress in converting to System 7 and to ask for your suggestions and comments. The response rate was nearly 30%, which is very high. Many users included wonderful compliments and success stories. One user sent in a paragraph of praise followed by four pages of improvements he wanted.

We wanted to know if we could depend on Version 3 users being on System 7 so that we could simplify some of our implementation details. Although most of you have upgraded to System 7, there are enough of you still on System 6 so that we will **not** make JMP require System 7 in the next release.

In the statistics area the popular suggestions included:

- stepwise regression
- time series analysis
- survival analysis
- clustering
- better response surface contours
- more nonparametrics
- more kinds of correlations
- better integration of JMP *Design* with JMP
- more nonlinear features
- Durbin-Watson statistics
- mixed models
- Fisher's Exact test
- more likelihood ratio tests.

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In the presentation area the most popular items were:

- more editable graphics
- 3D graphics
- presentation quality graphics
- print preview
- log scale graphs
- histogram rescaling
- hot linked results
- better title and footnote facility.

In the data table area you JMPing beings wanted:

- better insert and move of rows and columns
- better data entry
- better Excel interchange
- improved calculator ease-of-use
- an alternative way to specify formulas
- no limit on number of rows
- a find command.

In the "Other" category popular choices were:

- a scripting or macro or template facility (see discussion above on AppleEvents)
- a Microsoft® Windows™ version
- more documentation
- better journal
- publish and subscribe support.

It will be a while before we are ready to make public commitments on Version 3 features. However, many of your suggestions are under serious consideration and some have already been implemented.

Thank you very much for your responses. We are always happy to hear from you and it is still not too late to give us your ideas for JMP Version 3.

"By using JMP software I found evidence for a co-orbital meteoroid stream in the labile trace element composition of H chondrite meteorites, and presented these results at the 55th Annual meeting of the Meteoritical Society at Copenhagen, Denmark in August 1992."

Mr. Stephen F. Wolf
Purdue University

*JMP*ing to Conclusions

Power Check with a Synthetic ANOVA

AL BEST, Ph.D.
Medical College of Virginia
Richmond, Virginia

I'd like to share a discovery I made while using JMP on real-world problems. The question I am addressing is:

"How can I do an analysis of variance if all I have is a table of means and standard deviations?"

Sometimes I read a study report that compares groups and I think, "Something is fishy here." I wonder what I would have found if I had done the analysis myself. In any event, if the paper shows a table of means and standard deviations for the groups, I can construct data and check the study conclusions for myself.

For example, suppose I have a product and a competitor has two formulations of the same product touted to be just as good as mine. The competitor does a study to compare the three products and publishes a report using the following table of summary statistics to support this claim:

Table of Summary Statistics

Group	Sample Size	Mean	Std. Dev.
Ours	10	4.7	1.25
Theirs 1	9	3.9	1.20
Theirs 2	9	3.7	1.13

The report goes on to say that the groups are "not significantly different ($p < .20$)." What makes me doubtful is that I know one sure way to do a study and show that groups are not different, thus "proving" the null hypothesis, is to have an insufficient sample size.

David Larson (1992) figured out how to manufacture a set of data from the kind of summary information shown above that enables me to redo the analysis as though all the data were available. Larson's method creates one observation below the mean of each group and N–1 observations above the mean in such a way that the mean and standard deviation for each group come out as calculated in the original table of summary statistics.

To do this using JMP, I begin by creating a new JMP data table as shown in ***Figure A***. I key in the values for Group, Sample (sample size), Mean, and Std. Dev. from the summary statistics table shown previously.

Figure A
JMP Table of Summary Values

Summary Stats

3 Rows	Group	Sample	Mean	Std. Dev.
1	Ours	10	4.7	1.25
2	Theirs1	9	3.9	1.20
3	Theirs2	9	3.7	1.13

Next I use the Concatenate command from the Tables menu and append this table with itself. The result is shown in ***Figure B***.

Figure B
JMP Table of Summary Values Appended with Itself

Untitled

6 Rows	Group	Sample	Mean	Std. Dev.
1	Ours	10	4.7	1.25
2	Theirs1	9	3.9	1.20
3	Theirs2	9	3.7	1.13
4	Ours	10	4.7	1.25
5	Theirs1	9	3.9	1.20
6	Theirs2	9	3.7	1.13

Then I add columns Freq and Y, and use the JMP calculator to compute their values. The formula for Freq (***Figure C***) assigns a 1 to the last three rows and computes Sample–1 for the first three rows.

Figure C
Formula for Calculating Frequency

$$\begin{cases} 1, & \text{if } i > \dfrac{n}{2} \\ Sample - 1, & \text{otherwise} \end{cases}$$

Thanks to David Larson there is the formula shown in ***Figure D*** that calculates the derived Y for the analysis. If the sample size is 1 for any group, the computed value is simply the study mean. This condition doesn't occur here. The first three rows are assigned values above the mean. The last three rows, with frequency values of 1, have values below the mean.

These computations give the table shown in ***Figure E***, which now has all the information needed to complete the synthesized ANOVA. I can verify that the computed Y column has the same means and standard deviations as those of the original groups using the Group/Summary command in the Tables menu (not shown here).

The next step is to set the Y, Freq, and X roles as shown in ***Figure E***, and choose Fit Y by X from the Analyze menu. When I select Fit Means from the Fitting pop-up menu, the p–value in the Analysis of Variance table shows that the groups are not significantly different (see Prob>F .1734 in ***Figure F***), which supports the competitor's conclusions.

Ah!—but was there enough power in this study to have found a difference with just 28 subjects? I can look at power and the LSN (least significant number) with the Power Details Dialog from the Fitting pop-up menu.

The Power Details Dialog shown in ***Figure G*** requests solutions for Power and LSN at Alpha=.05. The *s* and |Delta| from the study are used in these calculations where *s* is the Root Mean Square Error in the Summary of Fit table and |Delta| is the effect size. Delta² is estimated by dividing the hypothesis sum of squares by *n*, the total sample size.

The same dialog can be used to request power solutions for other model parameters. The example in ***Figure G*** requests additional solutions for sample sizes of 50 and 100.

When I click Done, the table of solutions in ***Figure H*** appears. The solution for LSN tells me that the study needed at least 48 observations to have much hope of finding a difference. The researchers were doomed to insignificance from the start. Further, it looks like a study with about 100 observations would produce a probability that indicates *my* product to be superior to *theirs*.

All of the fitting options in the Fit Y by X platform work with this synthesized set of data except the nonparametric tests, fitting quantiles and checking for equal variances. Note that you can customize this technique to do an *n*-way ANOVA. You can then use the Fit Y by X's or Specify Model platforms for more complicated models. The Noah Decay prospective power analysis example in the JMP manual (page 417) is similar to the one shown here, but it does not use all of the information available.

Figure D
Formula for Calculating a Derived Response

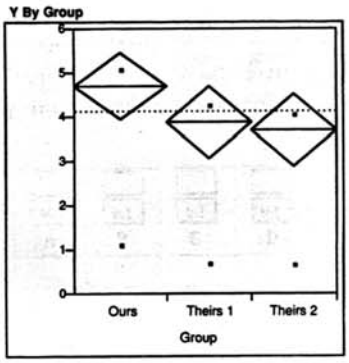
$$\begin{cases} Mean, & \text{if } Sample = 1 \\ Mean + \sqrt{\dfrac{Std.Dev.^2}{Sample}}, & \text{if } i \le \dfrac{n}{2} \\ Sample \bullet Mean - (Sample - 1) \bullet Y_{i-\frac{n}{2}}, & \text{otherwise} \end{cases}$$

Figure E
JMP Table of Summary Statistics and Computed Columns

One Way ANOVA

6 Rows	Group	Sample	Mean	Std. Dev.	Freq	Y
1	Ours	10	4.7	1.25	9	5.10
2	Theirs1	9	3.9	1.20	8	4.30
3	Theirs2	9	3.7	1.13	8	4.08
4	Ours	10	4.7	1.25	1	1.14
5	Theirs1	9	3.9	1.20	1	0.70
6	Theirs2	9	3.7	1.13	1	0.69

Figure F
Analysis of Variance Platform



Means

Summary of Fit

Rsquare	0.130804
Root Mean Square Error	1.196624
Mean of Response	4.121429
Observations (or Sum Wgts)	28

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	2	5.387143	2.69357	1.8811
Error	25	35.797700	1.43191	Prob>F
C Total	27	41.184843		0.1734

Mean Estimates

Level	number	Mean	Std Error
Ours	10	4.70	0.37841
Theirs 1	9	3.90	0.39887
Theirs 2	9	3.70	0.39887

Figure G
Power Details Dialog

Power Details Dialog

1-way Anova
Click and Enter Values:

Alpha	N [Sample Size]	s [std dev error]	|Delta|
0.050	28	1.196624	0.438632
.	50	.	.
.	100	.	.

☒ Solve for Power
☒ Solve for Least Significant Number
☐ Solve for Least Significant Value
☐ Adjusted Power and Confidence Interval

Done Cancel Help

Calculations will be done on all combinations

Figure H
Power Details Report Showing LSN

Power Details
Test 1-way Anova

Power

Alpha	Number	Sigma	Delta	Power
0.05	28	1.20	0.44	0.35
0.05	50	1.20	0.44	0.61
0.05	100	1.20	0.44	0.91

Least Significant Number

Alpha	Sigma	Delta	Number(LSN)
0.05	1.20	0.44	47.7

Unstack a Data Table by Transposing Groups

ANN LEHMAN
SAS Institute Inc.

The Transpose command rearranges a table so that the rows become columns and the columns become the rows. Transpose handles only columns that have the same data type (numeric or character), and can transpose by groups defined with a summary table. You can assign the label role to one column, whose values then become the new column names in the transposed table. Here is a typical example of using the Transpose command.

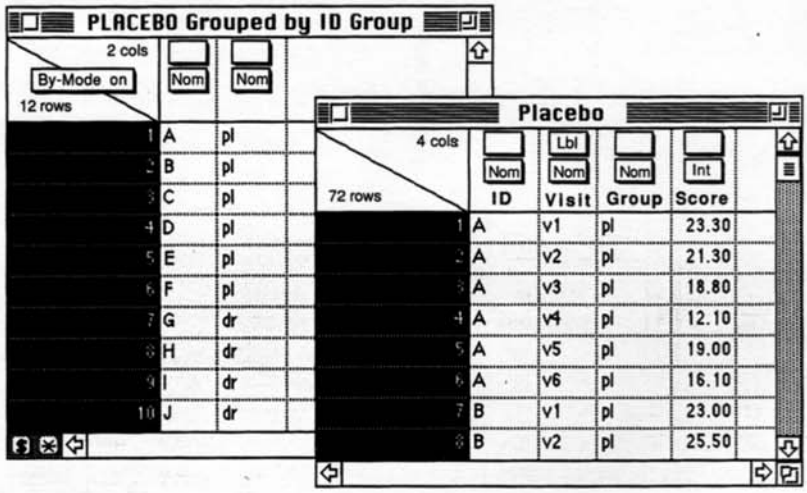
The data table shown in ***Figure A*** (Placebo) contains results of a clinical trial that compares the effect of a drug with a placebo. A base test followed by five weekly tests were given to a patient in a treatment group denoted "dr" and a placebo group denoted "pl." The data table is arranged with test scores in a single column. Each row is identified by columns showing patient ID, visit number, and treatment group. In JMP terms this table is referred to as having stacked scores, which means the scores for each visit are stacked in a single column giving six rows (6 visits) for each patient.

Figure A
JMP Table with Stacked Scores

Placebo

72 rows	ID (Nom)	Visit (Nom)	Group (Nom)	Score (Int)
1	A	v1	pl	23.30
2	A	v2	pl	21.30
3	A	v3	pl	18.80
4	A	v4	pl	12.10
5	A	v5	pl	19.00
6	A	v6	pl	16.10
7	B	v1	pl	23.00
8	B	v2	pl	25.50

Figure B
Source and Summary Tables with All Groups Selected



To analyze this repeated measures design using a multivariate model you first have to unstack the table so that the data are arranged with one row for each patient and columns for each visit (***Figure C***). In cases like this one you can unstack the table using the Group/Summary and Transpose commands.

You can unstack the PLACEBO table as follows:

First, use Group/Summary and select both ID and Group as grouping variables. This creates the summary table shown in ***Figure B***.

Note that because the character columns ID and Group are in the summary table they are grouping variables instead of columns to be transposed. You assign the label role to the remaining character column (Visit) in the source table the label role. This leaves only the numeric Score column to be transposed.

Next, turn the By-Mode on in the summary table and select all rows. The corresponding rows highlight in the source table (***Figure B***). This tells JMP to separately process each group of rows in the source table group identified by a single row in the summary table.

There is an N column (not shown) in the summary table frequency of each group that can be deleted. Also, the columns in a summary table have default roles assigned. You can remove them with the Clear Roles command in the Cols menu.

With the summary table active select the Transpose command from the Tables menu. The result is the unstacked placebo table shown in ***Figure C***. The Transpose command adds the column called Labels (with the Lbl role) to this table. Each value of the Labels column is the name of the column that was transposed to form the current row.

The only column transposed was the Score column, so the new Labels column has "Score" as its constant value. It can be deleted from the transposed table.

Figure C
Unstacked JMP Tables

Untitled

12 Rows	ID (Nom)	Group (Nom)	Labels (Lbl Nom)	v1 (Int)	v2 (Int)	v3 (Int)	v4 (Int)	v5 (Int)	v6 (Int)
1	A	pl	Score	23.30	21.30	18.80	12.10	19.00	16.10
2	B	pl	Score	23.00	25.50	16.10	17.20	10.30	14.30
3	C	pl	Score	20.00	18.50	21.00	23.10	23.10	23.10

Using the JMP Help System

JEFF PERKINSON
SAS Institute Inc.

Answering questions from users every day presents many challenges. I never know what inquiry will come from the other end of the phone. As a result I have to think quickly to respond. People frequently ask me how I remember all the answers. I'll let you in on a secret—I don't remember all the answers. I just remember where to find them.

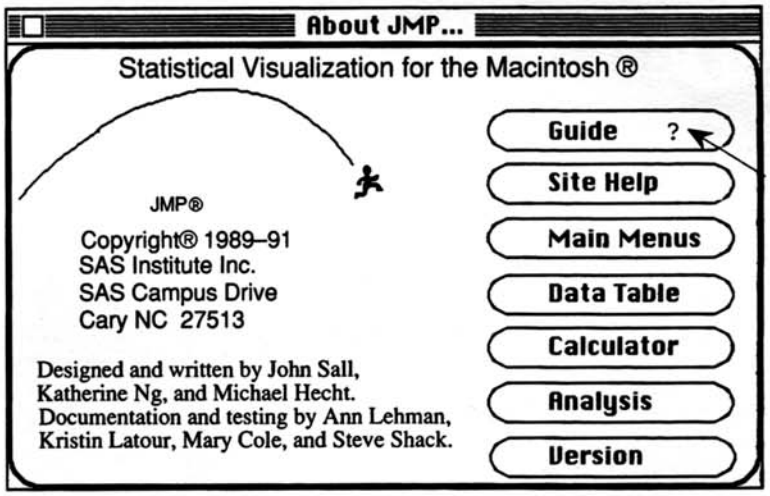
The most useful advice I got when I started working in technical support was: "Never memorize anything that you can look up." In this column I'll try and give you some hints on ways you can answer many of your own questions without having to memorize anything.

Can JMP Do *and* How To *Questions*

There are two main types of questions JMP users usually ask me: *Can JMP do* questions and *How to* questions. Can JMP do questions are about the capabilities of the product. You have a task in mind and want to know if the product can perform that task. The answer to a Can JMP do question is usually a clear-cut yes or no. If the answer is yes then you can proceed to the *How to* question. *How to* questions are task-oriented. You have a goal in mind and need to know how to achieve that goal. I find that the best way to approach this type of problem is to state the goal clearly and then take inventory to see how far short of the goal I am. I now have a starting point, an ending point, and a clear idea of what assets I have to get from start to finish.

There are two sources (excluding JMP technical support) for answers to these questions—the manuals and the software itself. If you are loath to open a manual except as a last resort, then you can begin by launching the JMP software application. In typical Macintosh fashion, there is an About JMP selection under the Apple menu. Selecting About JMP gives you access to the entire JMP Help system. It also offers a statistical guide that lists all the statistics available in the JMP and JMP *Design* applications.

Figure A About JMP Help Screen



For example, the phone rings and a new JMP user asks, "Can JMP do a multiple regression and give me predicted values and a prediction equation?" Even if I know the answer, I ask the caller to follow along to see how to use the JMP Help system, pointing out information and features along the way.

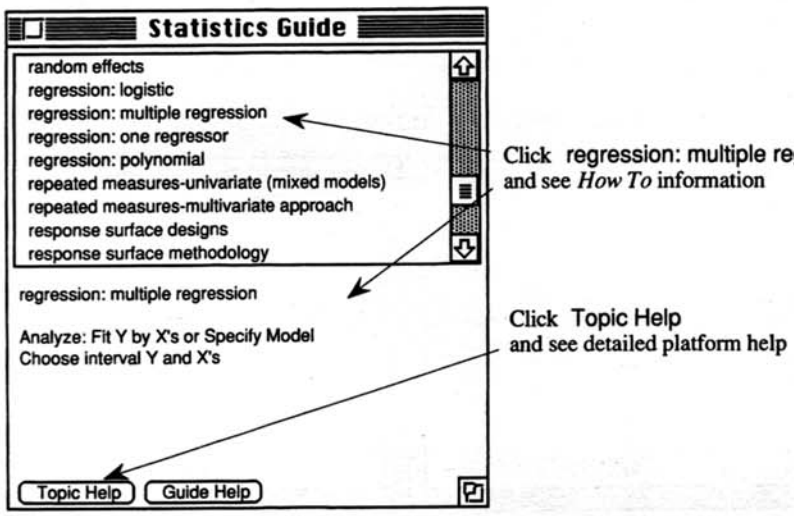
I begin by asking the caller to select About JMP under the Apple menu and look at the Help system (***Figure A***). Notice that the cursor becomes a question mark when it is on buttons that access Help.

Click Guide to see an alphabetical list of statistical methods available in JMP and JMP *Design*. Then scroll to find the entry called regression: multiple regression (the same item is also listed as multiple regression). When you click this item more information shows in the area below the list (***Figure B***). The instructions tell you which command from the Analyze menu to use, and how to specify variables. Now you know that JMP can do a multiple regression. The how to area tells you to use the Fit Y by X's command in the Analyze menu.

Next, click Topic Help and see if there is further information about predicted values and the prediction equation. The JMP Help system is hierarchical, providing more help as needed. The Topic Help button brings up the Model Fitting Platform help screen (***Figure C***). As usual, the cursor shows as a question mark wherever more help is available.

(continued on page 6)

Figure B List of JMP Statistical Methods with How To Information



Current News

Upcoming Conferences and Training

Come visit the JMP booth at SUGI 18, SAS Institute's annual international users group conference held May 9-12 at the New York Hilton and Towers at Rockefeller Center and the Sheraton New York Hotel and Towers. Experts will be there to answer questions, demonstrate JMP, JMP *Design*, and JMP Serve, and preview JMP Version 3. Demo disks will be available, and attendees can purchase JMP at a 29% discount off the regular price.

If you can't make SUGI, try MacWorld Boston August 3-6, or the American Statistical Association conference August 8-11 in San Francisco. Pick up a demo disk, see Version 2.0.5, and preview Version 3. A 29% purchase discount on JMP will also be available at these shows.

While you're in California, take in a JMP training class at SAS Institute's regional training center in Irvine, August 12-13.

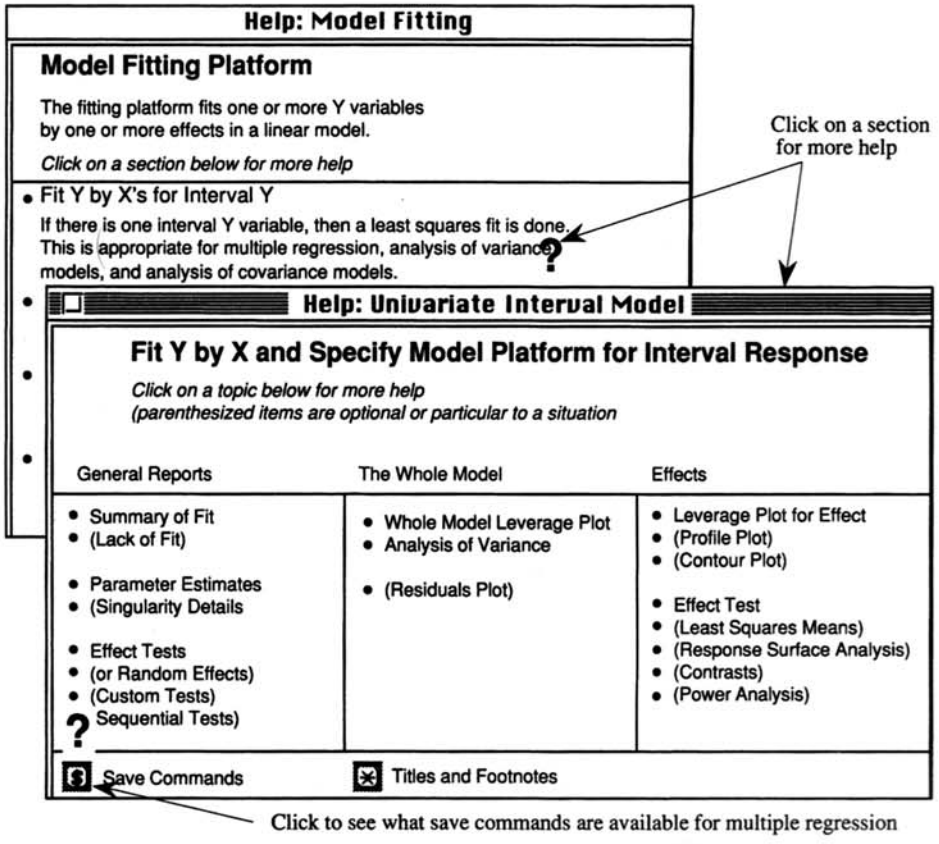
Duxbury Press Agreement

Beginning January 1, 1993, Duxbury Press acquired exclusive distribution rights for JMP IN, the student version of JMP. For more information, contact Duxbury Press at 800-354-9706.

JMP & DeltaGraph® Pro Bundle

Through June 22, or while supplies last, customers purchasing JMP will receive free DeltaGraph Pro presentation software from DeltaPoint®. DeltaGraph Pro offers comprehensive, easy-to-use presentation tools that can enhance graphical display of statistical output from JMP. A $990 value, the JMP & DeltaGraph Pro bundle costs only $695.

Figure C Hierarchical Help Screens



When you click anywhere in the section Fit Y by X's for Interval Y, which includes the information about multiple regression, you see a second screen that lists the platform plots and reports (***Figure C***). This screen gives you descriptions of general reports, whole model reports, and effects reports for each model.

At this point, you've probably caught on to the art of mousing around and proceed to click about the Help screen just to see what's there. Exploring leads you to the Save Commands button with the dollar ($) icon . Your cursor becomes a question mark there so you click—and find a list of save commands that contains the predicted values and prediction formula you want (***Figure D***).

This phone call is completed in a few minutes with answers to a *Can JMP do* question and a *How to* question. And better yet, a new user now knows how to go about finding answers to other questions using the JMP software help system.

Figure D Save Commands for Univariate Interval Response Models

Save commands

The Save border menu allows you to save certain statistics in new columns on the data table. In the case of Save Prediction Formula, a formula is also installed, which will calculate predicted values for changed or added rows.

Save Predicted Values	The model evaluated at the estimates.
Save Residuals	Observed Y minus predicted value.
Save Prediction Confidence	95% confidence limits for the fitted model.
Save Indiv Confidence	95% confidence limits for an individual predicted case.
Save Studentized Residual	Residual divided by its standard error.
Save h(i)	The hats, the coefficient of a pred. value on its own observed.
Save Std Error of Predicted	Standard Error of the predicted value.
Save Std Error of Residual	Standard Error of the residual.
Save Std Error of Individual	Standard Error of an individual predicted point.
Save Effect Leverage Pairs	Values for leverage plots.
Save Cook's D Influence	A measure of the influence of an observation.
Save Prediction Formula	The predicted value with formula also stored in the column.

Labeling Points with Multiple Values

ANN LEHMAN
SAS Institute Inc.

The JMP table shown in ***Figure A*** is a collection of measurements taken on five types of crop. For some crops there are multiple measures with the same value. Suppose you use JMP's Fit Y by X platform to take a look at the relationship between Crop and BioMass and to examine the distribution of BioMass values in each crop group (***Figure B***).

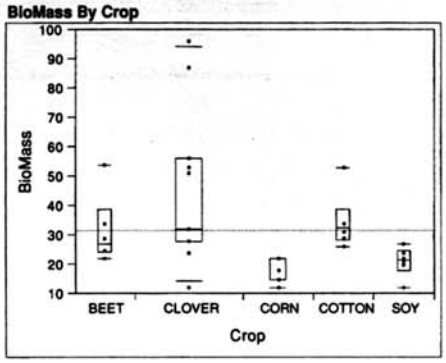
Figure A
Crop Mass Data Table

Crop Mass

36 rows	Crop (Nom)	BioMass (Int)
1	CLOVER	32
2	SOY	27
3	CORN	15
4	BEET	25
5	CLOVER	51
6	CLOVER	32
7	CLOVER	87
8	CORN	18
9	SOY	21
10	COTTON	26

The quantile box plots for some groups don't appear to represent the distributions very well because there are multiple values at some points. For example, the mean line for the clover group in ***Figure B*** seems quite low considering the very high values showing. That is because four of the BioMass values for clover are 32. These values affect the group mean and show skewness that seems unreasonable for the set of clover points. A better way to visualize the data structure is to label the points that represent multiple values. You can do this with a little creative use of several commands in JMP.

Figure B
Scatterplot with Quantile Box Plots for Crop Groups



Labeling points with the same value requires several steps:

- First, summarize the data by its X and Y variables (Crop and BioMass) using the Group/Summary command from the Tables menu. The N column in this table tells how many duplicates there are for any combination of Crop and BioMass. For example, row 2 in the summary table to the left in ***Figure C*** shows two BioMass values of 25 for the beet crop.
- Before doing anything else use the Subset command in the Tables menu to create a duplicate of the summary table. This creates a table that is not linked to the source table. You can use the Set Window Name command in the Windows menu to give the untitled subset table a suitable name, as shown to the right in ***Figure C***, and discard the summary table.
- Change the variable role of the N column from Y to Freq and change the Crop and BioMass roles so that they correspond to the source table.
- Next, make a copy of the N column and give it the Lbl (label) role. One way to duplicate N is to create a new column, give it a name, and use the calculator to specify N as its values. Or create the new column and use the Copy and Paste commands to copy the N values to the new column.
- The last step is to create row states that label all rows that have N values greater than 1.* To do this, create another new column and give it the row state data type. Then use the calculator to assign row state constants. The formula in ***Figure D*** creates a row state constant in the new column called Dups that labels, marks, and selects each row whose N value is greater than 1.

(continued on page 8)

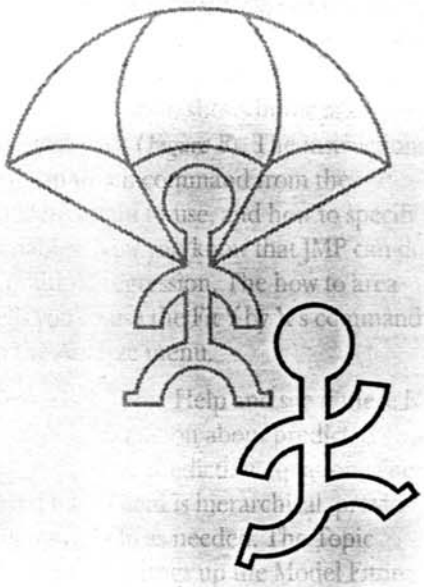


Figure C Summary Table Before and After Subsetting

Crop Mass by Crop BioMass

29 rows	Crop (Nom)	BioMass (Ord)	N (Int)
1	BEET	22	1
2	BEET	25	2
3	BEET	29	1
4	BEET	34	1
5	BEET	54	1
6	CLOVER	12	1
7	CLOVER	24	1
8	CLOVER	32	4

Crop Mass Summary

29 rows	Crop (Nom)	BioMass (Ord)	N (Freq)
1	BEET	22	1
2	BEET	25	2
3	BEET	29	1
4	BEET	34	1
5	BEET	54	1
6	CLOVER	12	1
7	CLOVER	24	1
8	CLOVER	32	4

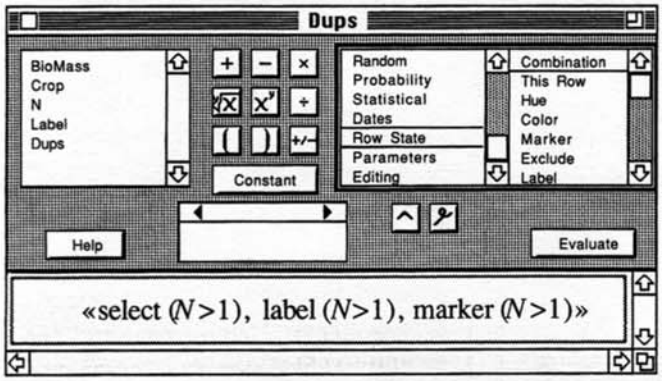


Figure D
Formula Assigns Row States Based on Frequencies

Use the Copy to Row State pop–up command at the top of the Dups column to activate the resulting row state assignments. The final table looks like the one shown in ***Figure E.***

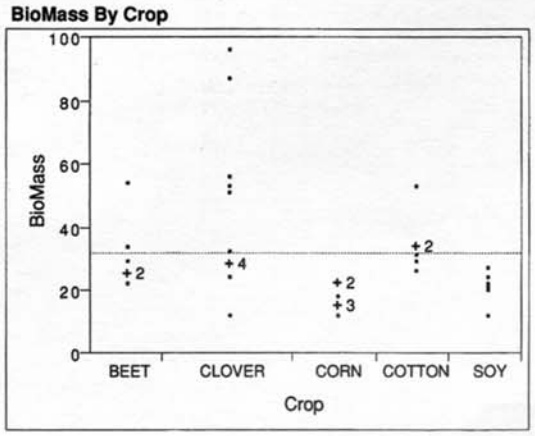
When you use the Fit Y by X command, the scatterplot in ***Figure F*** appears. This one–way analysis of variance uses the frequency variable N in its computations and labels each point that represents multiple values with its number of values.

Figure E
Row States Identify Duplicate BioMass Values

5 cols / 29 rows

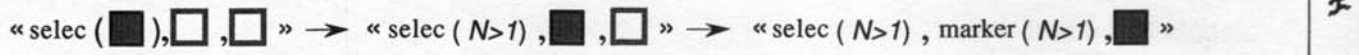
	Crop (Y Nom)	BioMass (X Ord)	N (Frq Int)	Label (Lbl Int)	Dups (« »)
12	CLOVER	87	1	1	▪
13	CLOVER	96	1	1	▪
14	CORN	12	1	1	▪
15	CORN	15	3	3	+
16	CORN	18	1	1	▪
17	CORN	22	2	2	+
18	COTTON	26	1	1	▪
19	COTTON	29	1	1	▪
20	COTTON	31	1	1	▪
21	COTTON	34	2	2	+
22	COTTON	53	1	1	▪

Figure F
Scatterplot with Multiple-Valued Points Labeled



*To create the formula in ***Figure C,*** select Row State from the function browser and select Combination from the list of row state functions. You will see empty boxes for defining two row state constants. If you want to assign more than two row states, use the insert button while one of the row state elements is highlighted, as shown above. Next select the row state characteristic you want from the list of row state functions. Then highlight the left parenthesis on the control panel to enclose the argument box of the select function in parentheses, as shown below. Now enter the function argument (a constant or condition) in the highlighted box.

Repeat this procedure to assign other row states. The Crops example selects, labels, and marks any row that has a frequency greater than 1. Markers other than '+' are available from a palette found on the calculator constant area.



Capture Report Data

When you see a simple frequency table like the one shown in ***Figure A,*** you might wonder what a bar chart of the frequency counts would look like. A quick way to chart these values is to copy them into a JMP table and then use the Bar/Pie command. JMP platform tables can be copied into JMP data tables using the option key with the Copy Report and Paste at End commands.

Figure A
Response Counts Table from the Fit Y by X Platform

Response Counts

Type	Bland	Medium	Scrumptious	Total
Beef	3	16	1	20
Meat	6	8	3	17
Poultry	1	15	1	17
	10	39	5	54

You create the JMP table in ***Figure B*** from the Response Counts report in ***Figure A*** by following these steps:

- Generate a report table with one of the Analyze menu commands.
- Select scissors from the Tools menu. Click and drag with the option key and scissors over the table parts you want to capture.
- Use the option key and Copy Report to copy the report to the clipboard.
- Create a new JMP table with the New command.
- Use the option key and Paste at End to paste the contents of the clipboard to the new JMP table.

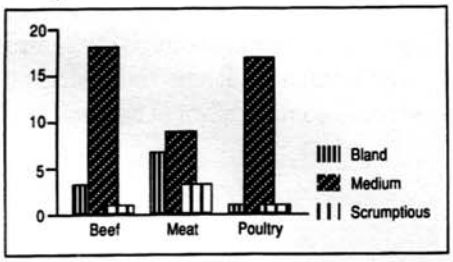
Figure B
JMP Table of Response Counts

Untitled

4 cols / 3 rows	Nom Type	Int Bland	Int Medium	Int Scrumptious
1	Beef	3	16	1
2	Meat	6	8	2
3	Poultry	1	15	2

The report table headers are used as column headers in the new table and the body is written to JMP data table cells. You might need to delete any unwanted rows or columns to clean up the table. To see the bar chart in ***Figure C***, select the Bar/Pie command from the Analyze menu. Assign Type as the X variable and the remaining 3 columns as Y variables. When the bar chart appears, select the Overlay and Pattern options.

Figure C
Overlay Bar Chart of Response Counts



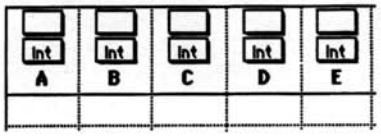
Tips & Techniques

Moving Data Table Columns

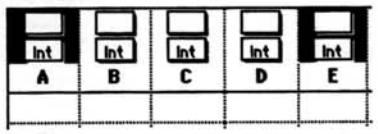
ANN LEHMAN
SAS Institute Inc.

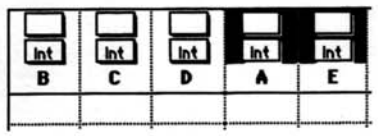
Did you ever want to move a column to a certain location in your data table? If you are using Version 2 of JMP, the Cols menu shows you the Move to First and the Move to Last commands but no Move to... command. This is because you can use the two Move commands to reposition any column to any location in the data table by judicious selection of columns.

Suppose you have a table with columns named A, B, C, D, and E in that order and you want column A to follow column D.

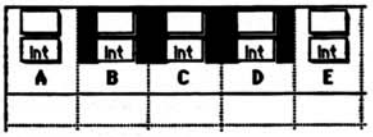


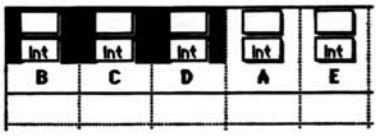
Use command–click to highlight columns A and E and select the Move to Last command from the Cols menu. Move to Last preserves the order of columns A and E and moves them to the end of the table:



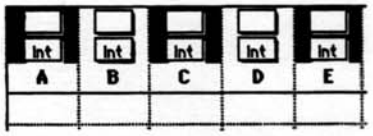


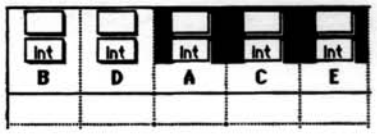
Another way to move column A after column D is to highlight columns B, C, and D (shift–drag across these columns). Select the Move to First command. This moves the selected columns in order to the beginning of the table so that A then follows D:





Suppose you want columns A and C to preceed column E. Use command–click to highlight those three columns. The Move to Last command preserves their order and moves them together to the end of the table:





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Calculator Corner

MICHAEL HECHT
SAS Institute Inc.

Combinations and Permutations

We receive regular inquiries about how to use the JMP Calculator to compute quantities that use combinations and permutations. These numbers are found by computing the combination of *n* things taken *r* at a time (not an easy thing to do by hand but simple with a computer). We can denote this combination as nCr.

The formula is defined as

$$\mathbf{nCr} \Leftarrow \frac{n!}{r! \bullet (n-r)!}$$

A straightforward interpretation of the above formula leads to this calculator formula:

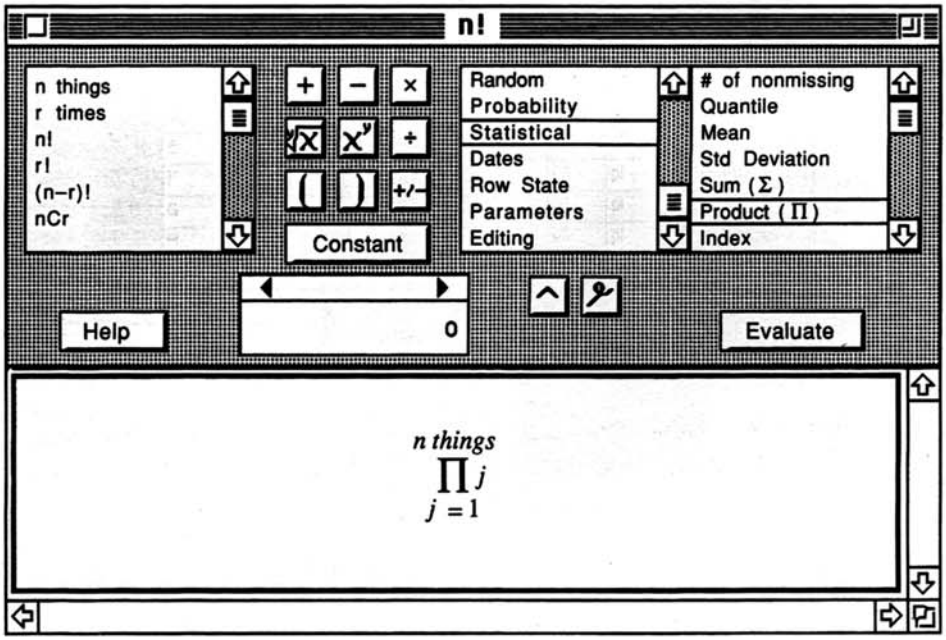
$$\mathbf{nCr} \Leftarrow \frac{\prod_{j=1}^{n} j}{\prod_{j=1}^{r} j \bullet \prod_{j=1}^{n-r} j}$$

The Product (∏) operator from the statistical section of the function browser in JMP's calculator computes the product of its argument. This operator computes factorials when its argument is the statistical index variable (see ***Figures A*** and ***B***).

If you create a JMP data table with a column for *n* things (n things) taken *r* at a time (r times) as shown in the data table to the left in ***Figure B***, then the calculator can use the formulas shown to the right and compute nCr for each row you add.

(continued on page 11)

Figure A
JMP Calculator Equation that Computes the Factorial of *n* Things



When you enter a column name in a ∏ operator's limit expression, the calculator always subscripts it by the index variable. If you don't want this name subscripted, just click on the index variable and press delete twice.

Figure B
Calculator Formulas for Computing Factorials

n things	r times	n!	r!	(n−r)!	nCr
0	0	1	1	1	1
1	0	1	1	1	1
1	1	1	1	1	1
2	0	2	1	2	1
2	1	2	1	1	2
2	2	2	2	1	1
3	0	6	1	6	1
3	1	6	1	2	3
3	2	6	2	1	3
3	3	6	6	1	1
4	0	24	1	24	1
4	1	24	1	6	4
4	2	24	2	2	6
4	3	24	6	1	4
4	4	24	24	1	1

$$\mathbf{n!} \Leftarrow \prod_{j=1}^{n\ things} j$$

$$\mathbf{r!} \Leftarrow \prod_{j=1}^{r\ times} j$$

$$\mathbf{(n-r)!} \Leftarrow \prod_{j=1}^{(n\ things - r\ times)} j$$

$$\mathbf{nCr} \Leftarrow \frac{n!}{(r! \bullet (n-r)!)}$$

However, using all those ∏ operators is incredibly inefficient. We can rearrange the ∏ operators as shown in ***Figure C*** so that only one of them is needed to compute nCr for each row. This equation iterates once from 1 to n things—the maximum number of iterations needed. The numerator of the product (∏) expression computes the n things factorial (!). The denominator of the product expression iterates from 1 to r times giving r times! and from 1 to (n things – r times) giving (n things – r times)!. It then multiplies these results. When the iteration exceeds r times, 1 is substituted in the computation for r times!. Likewise, when the iteration exceeds (n things – r times) then 1 is substituted in the computation for (n things – r times)!.

Let's see what happens when n things is 5 and r times is 3. The formula to compute the number of 5 things taken 3 at a time expands into the following terms multiplied together:

$$\frac{1}{1\cdot1}\cdot\frac{2}{2\cdot2}\cdot\frac{3}{3\cdot1}\cdot\frac{4}{1\cdot1}\cdot\frac{5}{1\cdot1} =$$

$$\frac{1}{1}\cdot\frac{1}{2}\cdot\frac{1}{1}\cdot\frac{4}{1}\cdot\frac{5}{1} = \frac{1}{2}\cdot4\cdot5 = 10$$

Note that although partial results may be fractions the final result is always a whole number.

We can create a JMP table template with only three columns that computes the sequence of nCr numbers by simply keying in the columns for n things and r times. Or, we could use the formulas in ***Figure D*** and calculate n things and r times automatically for any rows we want to add to the table. Using these formulas and adding 28 rows gives the Combinations table showing beneath the formulas.

This sequence is known as Pascal's Triangle, named after Blaise Pascal who first discovered it. We can see these numbers in the triangular arrangement shown in ***Figure E*** by using JMP's Fit Y by X platform with r times as Y and n things as X, and labeling each point with the value of nCr.

Figure C JMP Calculator Formula for Computing Combinations

$$\text{nCr} \Leftarrow \prod_{j=1}^{n\ things} \left(\frac{j}{\begin{cases} j, & \text{if } j \le r\ times \\ 1, & \text{otherwise} \end{cases} \cdot \begin{cases} j, & \text{if } j \le n\ things - r\ times \\ 1, & \text{otherwise} \end{cases}} \right)$$

Figure D JMP Template Showing Computed Combinations

$$\text{n things} \Leftarrow \begin{cases} 0, & \text{if } i=1 \\ n\ things_{\,i-1}, & \text{if } \dfrac{(n\ things_{\,i-1}+1)\cdot(n\ things_{\,i-1}+2)}{2} \ge i \\ n\ things_{\,i-1}+1, & \text{otherwise} \end{cases}$$

$$\text{r times} \Leftarrow \begin{cases} 0, & \text{if } i=1 \\ r\ times_{i-1}+1, & \text{if } n\ things_{\,i} = n\ things_{\,i-1} \\ 0, & \text{otherwise} \end{cases}$$

Combinations

	n things	r times	nCr
1	0	0	1
2	1	0	1
3	1	1	1
4	2	0	1
5	2	1	2
6	2	2	1
7	3	0	1
8	3	1	3
9	3	2	3
10	3	3	1
11	4	0	1
12	4	1	4
13	4	2	6
14	4	3	4
15	4	4	1
16	5	0	1
17	5	1	5
18	5	2	10
19	5	3	10
20	5	4	5
21	5	5	1
22	6	0	1
23	6	1	6
24	6	2	15
25	6	3	20
26	6	4	15
27	6	5	6
28	6	6	1

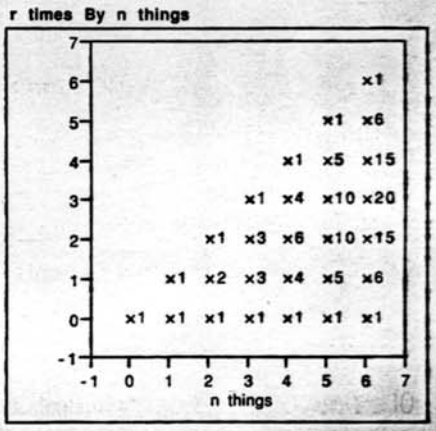
It is easy to see the relationship of the numbers when they are arranged this way. The bottom edge and the diagonal numbers are all 1's, and the interior numbers are the sum of their west and southwest neighbors.

It turns out that each column of numbers lists the coefficients of the terms from the expansion of $(a+b)^n$. It follows that $(a+b)^4$ expands to

$$1a^4 + 4a^3b + 6a^2b^2 + 4ab^3 + 1b^4$$

Note that Pascal's triangle begins with a *0th* column because $(a+b)^0$ is always 1.

Figure E Fit Y by X Platform Showing Pascal's Triangle



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