



JMP Instructional data set 025

Online Advertising Experiment

JMP platforms and statistical methods

Graph Builder:	Comparative dot plots; confidence interval for the mean; F-Test for one-way analysis of variance (ANOVA)
Fit Y by X:	Multiple comparisons
Formula Editor:	Creating new variables

Problem statement

An online clothing retailer is interested in studying the effect that different advertising styles and promotional offers have on consumers' engagement.



An experiment was designed to test the performance of 4 different styles of an advertisement for a casual wear line. These 4 advertisement styles varied design elements such as imagery, messaging, and ad copy. These will be referred to simply as Ad 1, Ad 2, Ad 3, and Ad 4. In addition, 3 different promotional offers were varied in the experiment.

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|----------|--|
| Promo 1: | Receive a one-time credit of \$40 to use in a separate future purchase within the next 60 days when the total amount for the current purchase exceeds \$150. |
| Promo 2: | Receive a one-time credit of \$50 to use in a separate future purchase within the next 30 days when the total amount for the current purchase exceeds \$150. |
| Promo 3: | Receive 30% off on current purchase of \$150 or more. |

Each possible combination of the four advertisement styles and three promotional offers was studied, resulting in $4 \times 3 = 12$ treatment combinations. The experiment was conducted by displaying one of the 12 different ad/promo combinations each day across June and July (61 days) on 20 different lifestyle and leisure website properties. The click-through rate (CTR) per thousand ad impressions for each day was observed.

The table below displays the days each of the $4 \times 3 = 12$ ad/promo combinations were shown.

		Day of Week							
Ad Style	Promotion	Sun	Mon	Tues	Wed	Thurs	Fri	Sat	TOTAL
Ad 1	Promo 1	1	1	1	0	0	2	0	5
	Promo 2	0	2	1	0	2	0	0	5
	Promo 3	1	0	0	2	1	0	2	6
Ad 2	Promo 1	3	0	0	0	0	2	0	5
	Promo 2	0	0	0	0	1	0	3	4
	Promo 3	1	1	0	2	0	0	0	4
Ad 3	Promo 1	1	2	0	1	0	0	2	6
	Promo 2	0	0	1	0	0	3	2	6
	Promo 3	0	2	2	0	0	0	0	4
Ad 4	Promo 1	0	0	1	1	2	1	0	5
	Promo 2	0	0	0	3	1	1	0	5
	Promo 3	1	0	3	0	2	0	0	6
TOTAL	All	8	8	9	9	9	9	9	61

Data

IDS_025.jmp

Date	Date Ad/Promo combination was shown (June 1, ... , July 31)
Day of Week	Day of week Ad/Promo combination was shown (Sun, ... , Sat)
Ad Style	Four different advertisement styles
Promotion	Three different promotional offers
Ad/Promo	Twelve different advertisement styles and promotional offer groups
CTR_WS1	The “click-through-rate” (per thousand impressions) on Website 1
▪	
▪	
▪	
CTR_WS20	The “click-through-rate” (per thousand impressions) on Website 20

Exercises

1. Create comparative dot plots for each website showing the CTR for each of the four advertisement styles. Going through each website, does it appear that there is a certain Ad Style that consistently performs best or worst across most of the websites?

Instructions:

Graph > Graph Builder. Place ‘CTR_WS 1’ on the Y axis. Place ‘Ad Style’ on the X axis.

Instead of creating 20 different comparative dot plots, it would be best to utilize the Column Switcher tool so all the variables can be viewed from the one graph by selecting the variable to display on the Y Axis. To do so, select Redo > Column Switcher under the red triangle. Select the current variable used for the Y as the Column to Switch (‘CTR WS 1’), and choose that along with all the others to use as the Replacement Columns. Now any of the variables can be selected to display on the graph.

2. Create comparative dot plots for each website showing the CTR for each of the three promotional offers. Going through each website, does it appear that there is a certain promotional offer that consistently performs best or worst across most of the websites?

Instructions:

Graph > Graph Builder. Place ‘CTR_WS 1’ on the Y axis. Place ‘Promo’ on the X axis.

Follow the same steps in Exercise 1 to set up the Column Switcher.

3. Explain why the graphs created in Exercise 1 and 2 is not the best way to evaluate the performance of each Ad Style and Promotional offer.
4. Create comparative dot plots including both 'Ad Style' and 'Promo'. Add confidence intervals for the means and conduct statistical tests comparing the three Promotional offers within each Advertisement style. Go through the websites and identify all the statistically significant results. Note: Because there are a large number of comparisons, use the stricter significant level of 0.01.

Instructions:

Graph > Graph Builder. Place 'CTR_WS 1' on the Y axis. Place 'Promo' on the X axis. Place 'Ad Style' in the Group X role.

Follow the same steps in Exercise 1 and 2 to set up the Column Switcher.

Add Confidence Intervals by selecting the Line of Fit icon in the graph palette. 

Select to display the F-Test in the Line of Fit controls on the left.

For each Ad Style, the test statistics and p-values for a one-factor ANOVA test for Promotional offer is displayed.

5. Recreate a similar graph as in Exercise 4, except switch the roles of 'Ad Style' and 'Promotion'. Add confidence intervals for the mean sand conduct statistical tests comparing the four Ad Styles within each Promotional offer. Go through the websites and identify all the statistically significant results. Note: Use a significant level of 0.01.

Instructions:

Graph > Graph Builder. Place 'CTR_WS 1' on the Y axis. Place 'Ad Style' on the X axis. Place 'Promo' in the Group X role.

Follow the same steps in Exercise 1 and 2 to set up the Column Switcher.

Add Confidence Intervals and F-Tests following the same steps in Exercise 4.

6. Choose one website where you found a significant results of a difference in average CTR – either across Promotional offer within Ad Style, or across Ad Style within Promotional offer. Perform Student t's multiple comparisons. Summarize the results of the multiple comparisons?

Instructions:

Analyze > Fit Y by X. Place chosen Website in the Y, Response role. Place the factor for the comparison in the X, Factor and the other in the By role. Click OK.

Under the red triangle for the group(s) of the By variable where there was a significant result, select Compare Means > Each Pair, Student t's.

7. What are potential reasons why certain websites would have higher/lower CTRs than others independent of the advertisement styles and/or promotional offers? What are potential reasons why certain advertisement styles and/or promotional offers would perform better/worse than others for certain websites but not for all?

8. Create 20 new variables (one for each website) that is the difference in the CTR for each day from the Avg CTR for the specific Ad/Promo shown.

Instructions:

Choose *Cols > New Columns*. Name the column 'WS 1_Diff from Avg of each Ad/Promo'. Select *Column Properties > Formula*. In the formula editor, write the following formula:

`CTR_WS 1 - Col Mean ( CTR_WS 1 , Ad/Promo )`

*Note: The 'Col Mean' function is under the Statistical Functions.
Repeat this for the other 19 websites.*

9. Are there days of the week that tend to have higher or lower CTRs across the websites independent of the specific Ad/Promo combinations? What are some potential reasons for this?

Instructions:

Graph > Graph Builder. Place 'WS 1_Diff from Avg of each Ad/Promo' on the Y axis. Place 'Day of Week' on the X axis. Choose to display the data points and the confidence interval for the mean by selecting both from the graph palette. 

Follow the same steps in Exercise 1 and 2 to set up the Column Switcher for all the new difference variables.

You may find it helpful to add a reference line at 0. Do so by right-clicking on the Y axis to open the axis settings. Select Retain Axis Settings under the red triangle for the Column Switcher to have that reference line display for each website.

Go through each of the website to see if certain days consistent stand out as having higher/lower CTRs than what occurred on average for a given Ad/Promo group.

10. Provide a critique of the experimental design. Do you have any recommendations for additional follow-up experiments?