Statistical Testing

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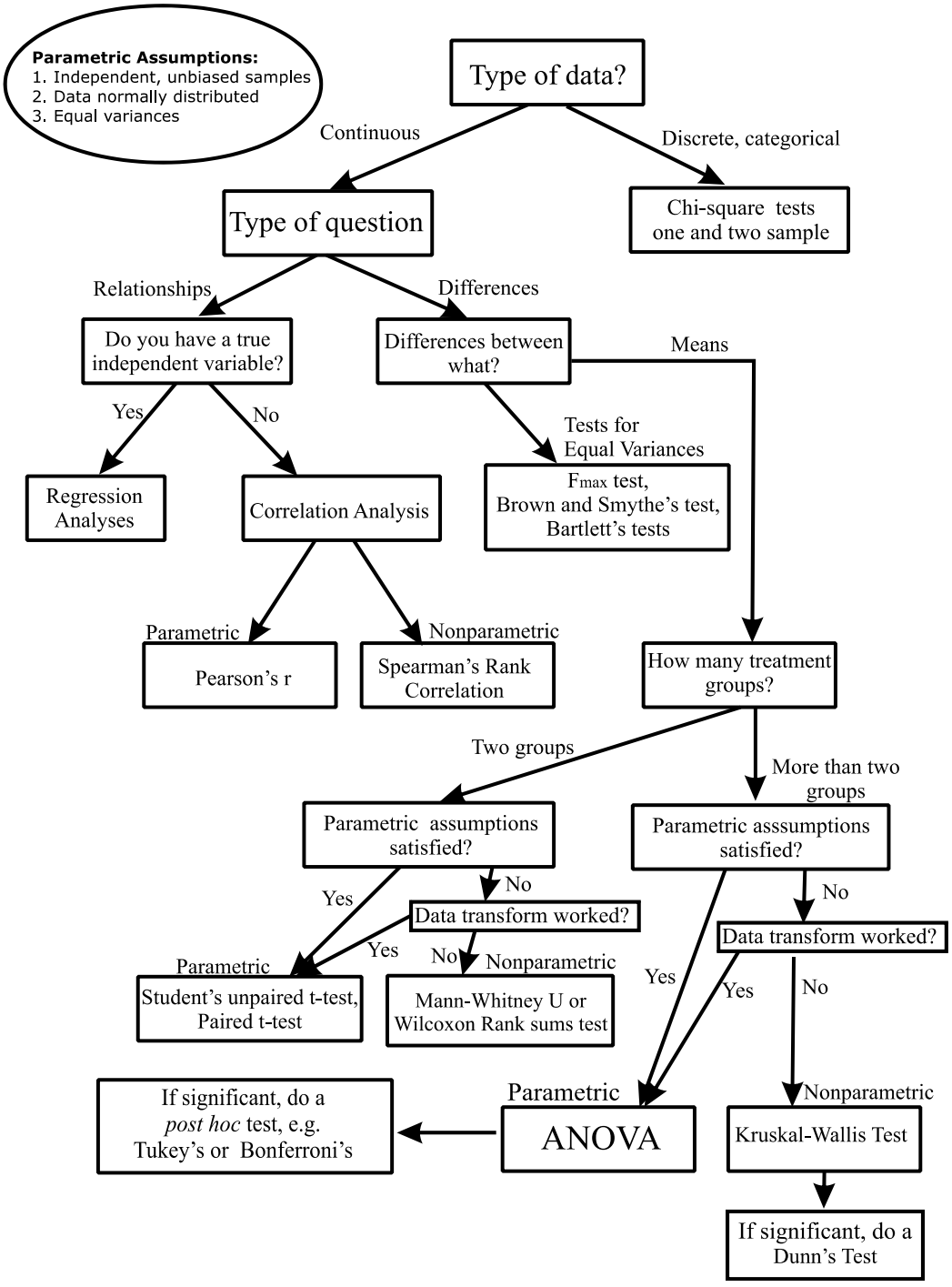
This statistical testing lab introduces how to do statistical testing in Prism 8. All analyses are based on the sample data provided by Prism 8. This lab will also mention the selection of statistical methods and the explanation of the statistical results. For more details, please check another BCBB workshop – Statistical Testing.

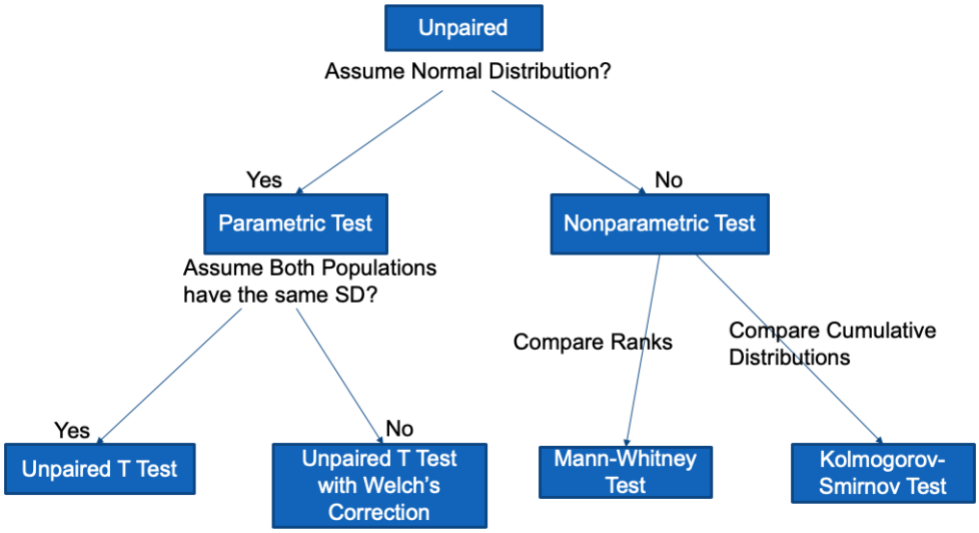
1. **Selection of Statistical Methods**
   1) Useful References for choosing appropriate tests
      - *Statistics with Prism 8 (link)*
      - *Choosing the Correct Statistical Test in SAS, Stata, SPSS and R (link)*
      - *Summary and Analysis of Extension Program Evaluation in R (link)*
      - *Analysis Data Model (ADaM) Examples in Commonly Used Statistical Analysis Methods (link)*
   2) Flow chart for selecting commonly used statistical tests

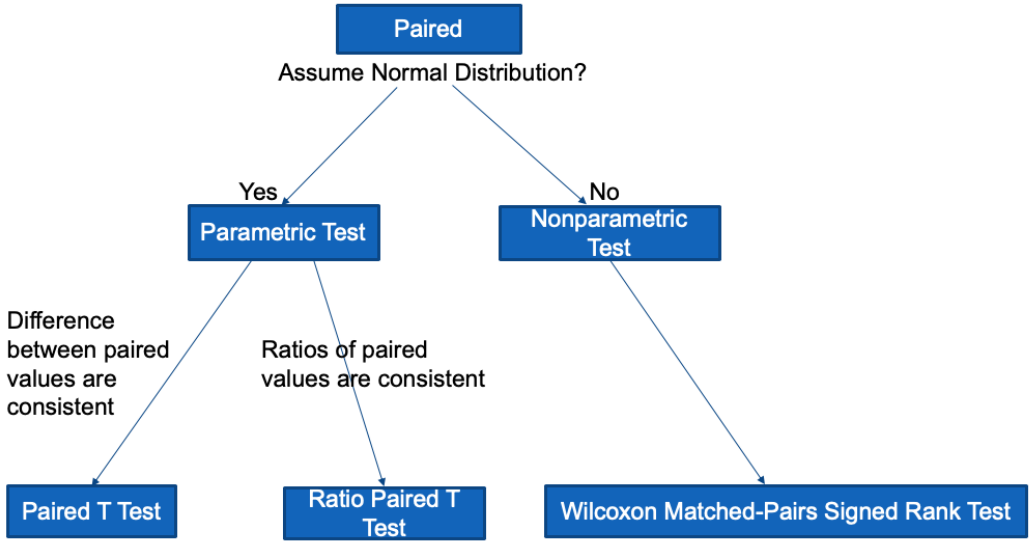
Flow Chart for Selecting Commonly Used Statistical Tests



2. Two-sample t-test

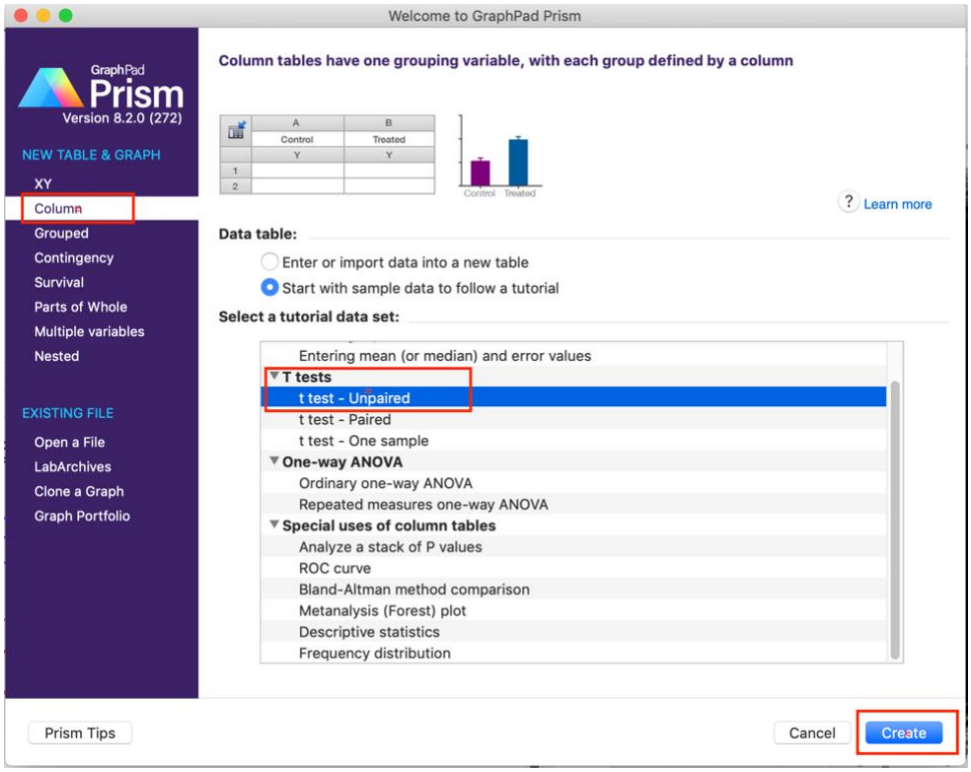
1) The decision tree of two-sample comparisons



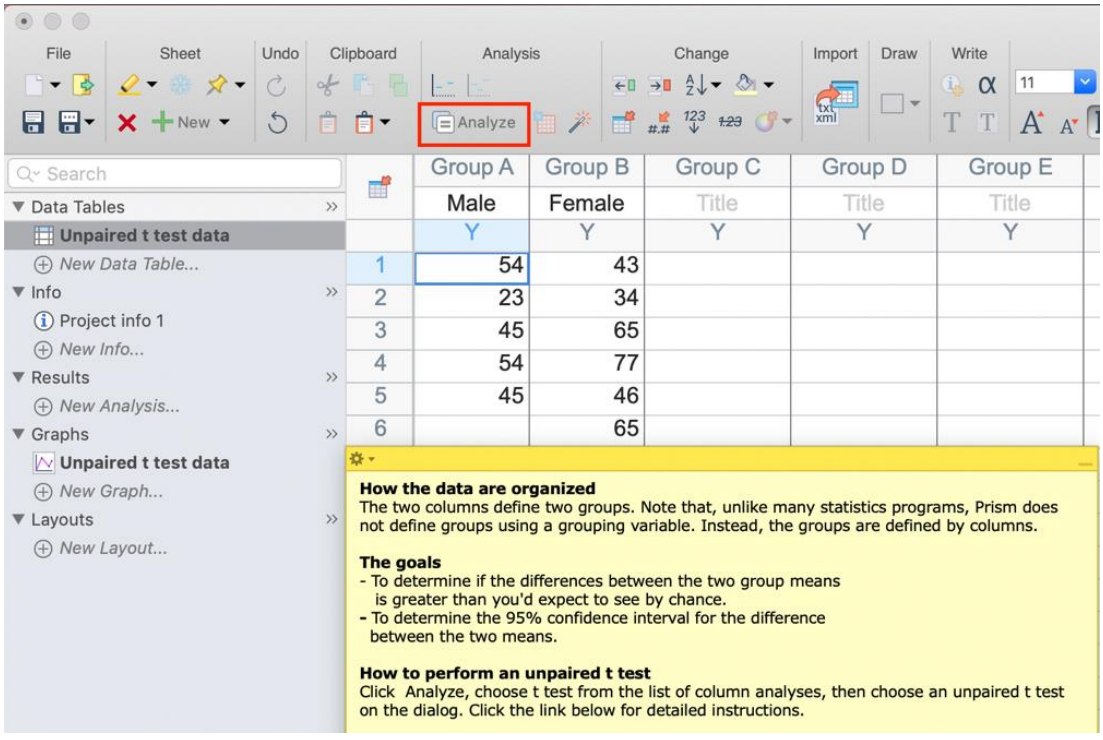


2) Unpaired t test

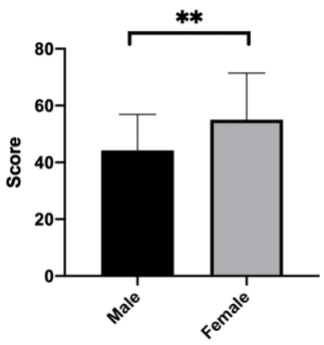
From the Welcome dialog, **choose the Column tab** on the left and **choose the sample data with "t test - Unpaired"** on the right. Then **click "Create"**.



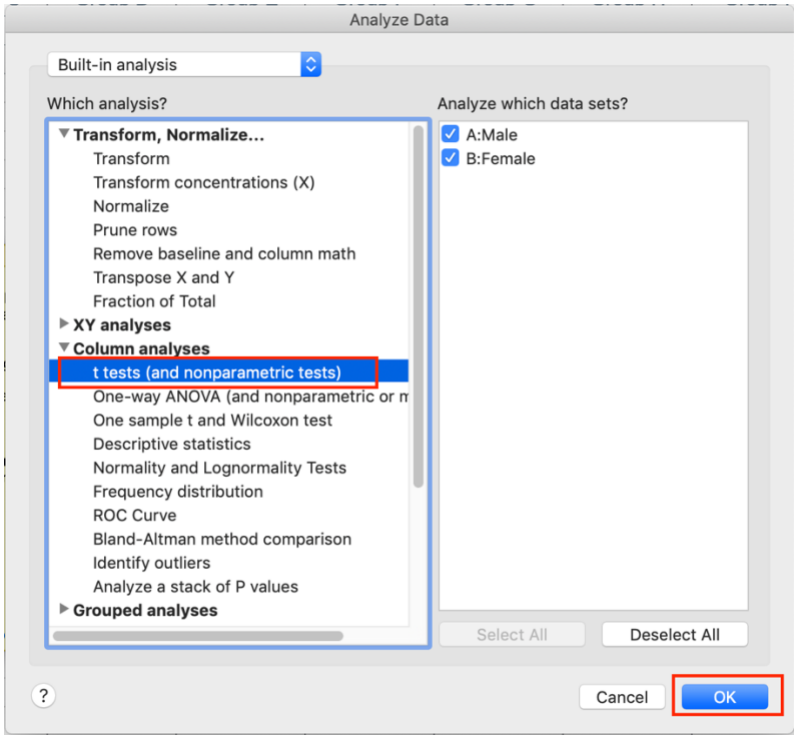
In the sample data, there are two groups, the male group which includes 5 subjects while the female group includes 6 subjects. **Click "Analyze"** on the toolbar.



At the same time, Prism 8 generates a graph for the dataset. Try to customize the graph like this:

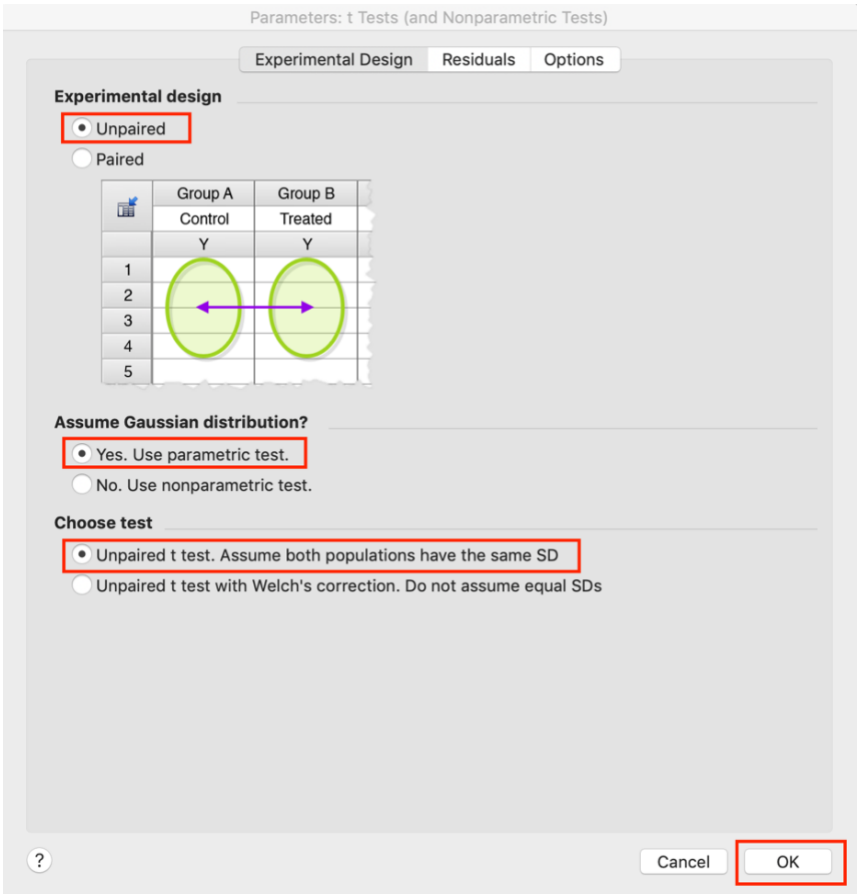


Choose "t tests (and nonparametric tests)" from the list of column analyses then **click "OK"** on the bottom right.

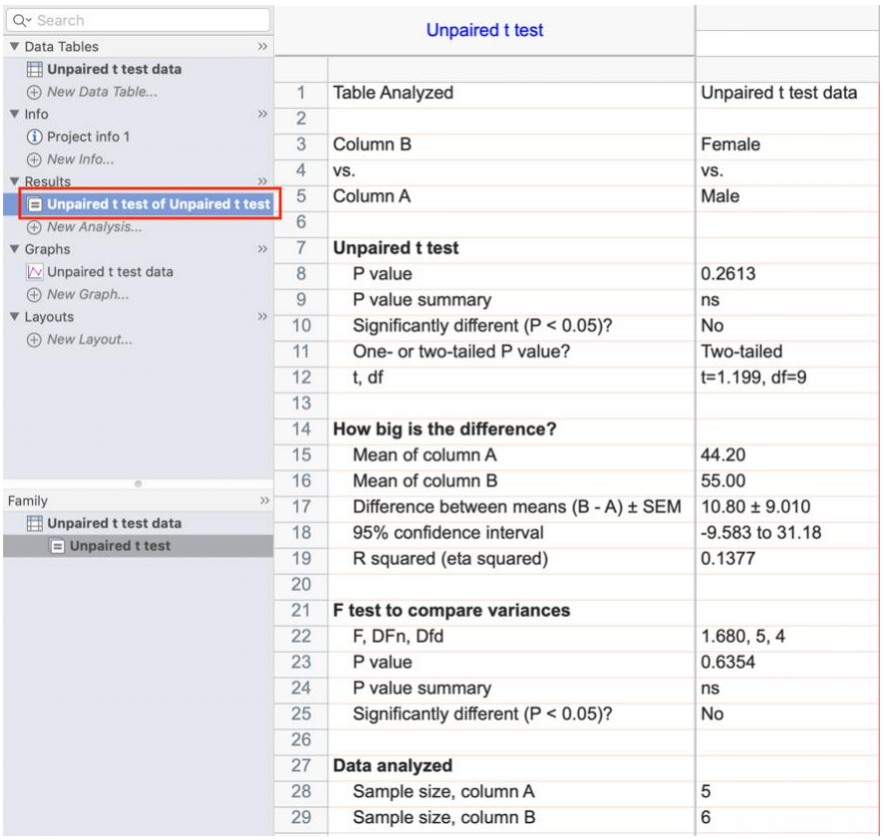


On the first (Experimental Design) tab of t test dialog, **make these choices**:

- Experimental design: **Unpaired**
- Assume Gaussian distribution: **Yes**.
- Choose test: **Unpaired t test**. Choose the Welch's correction if you don't want to assume the two sets of data are sampled from populations with equal variances, and you are willing to accept the loss of power that comes with that choice. That choice is used rarely, so don't check it unless you are quite sure.



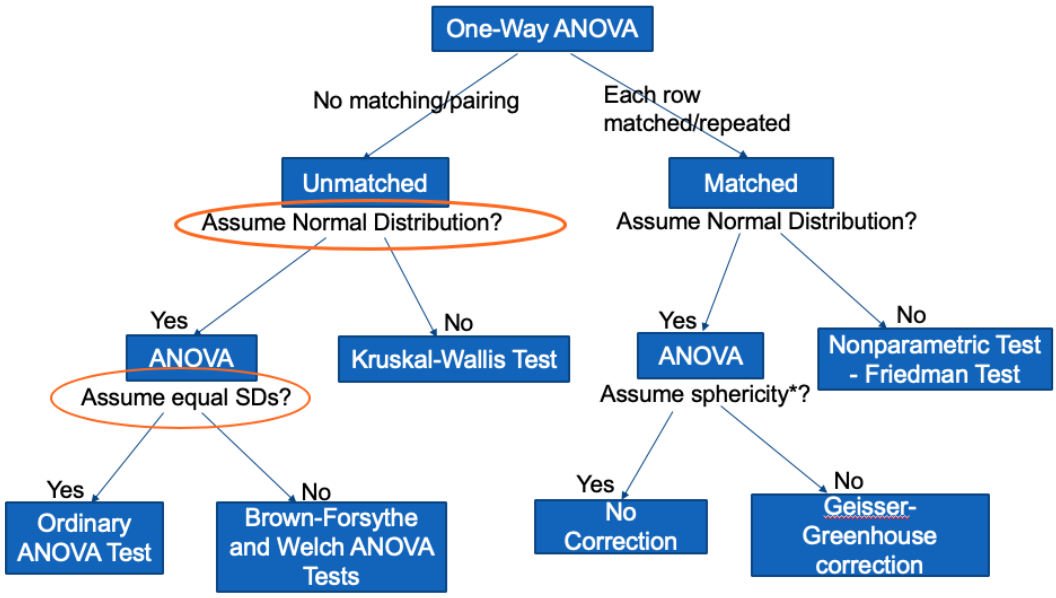
Then the analysis results will be stored and shown in the results “Unpaired t test of Unpaired t test”. More information about how to interpret the results could be found at [Interpreting results: Unpaired t](#).



	Unpaired t test	
1	Table Analyzed	Unpaired t test data
2		
3	Column B	Female
4	vs.	vs.
5	Column A	Male
6		
7	**Unpaired t test**	
8	P value	0.2613
9	P value summary	ns
10	Significantly different (P < 0.05)?	No
11	One- or two-tailed P value?	Two-tailed
12	t, df	t=1.199, df=9
13		
14	**How big is the difference?**	
15	Mean of column A	44.20
16	Mean of column B	55.00
17	Difference between means (B - A) ± SEM	10.80 ± 9.010
18	95% confidence interval	-9.583 to 31.18
19	R squared (eta squared)	0.1377
20		
21	**F test to compare variances**	
22	F, DFn, Dfd	1.680, 5, 4
23	P value	0.6354
24	P value summary	ns
25	Significantly different (P < 0.05)?	No
26		
27	**Data analyzed**	
28	Sample size, column A	5
29	Sample size, column B	6

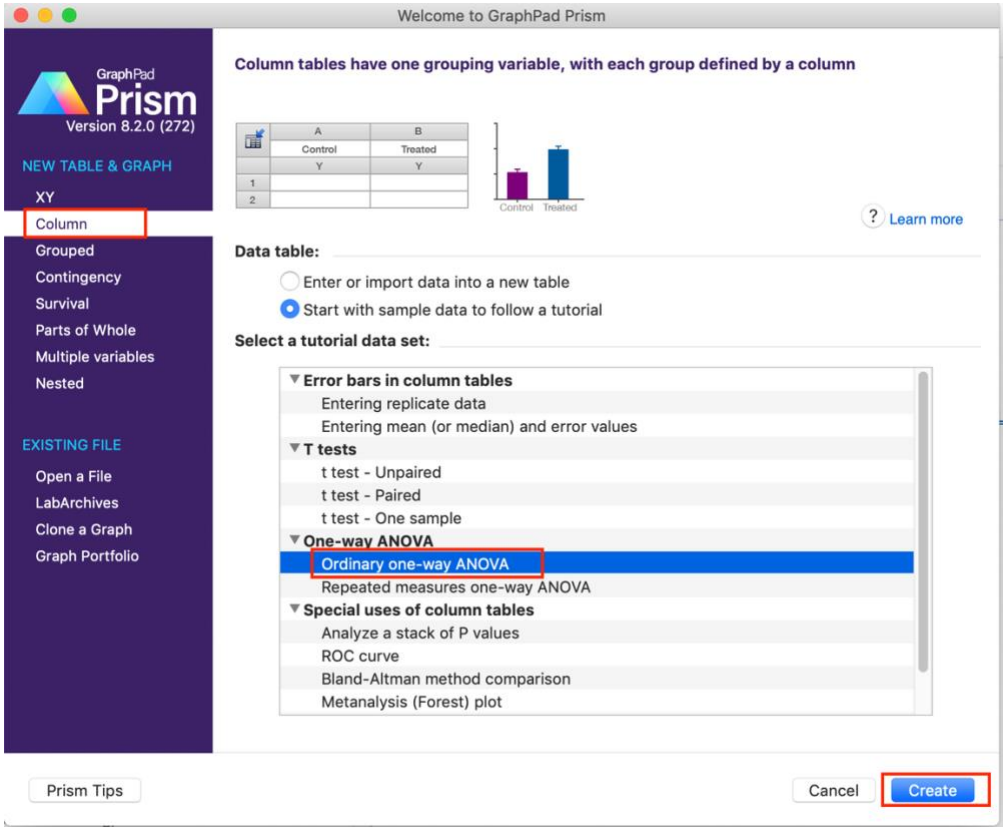
3. ANOVA

1) The decision tree of One-Way ANOVA

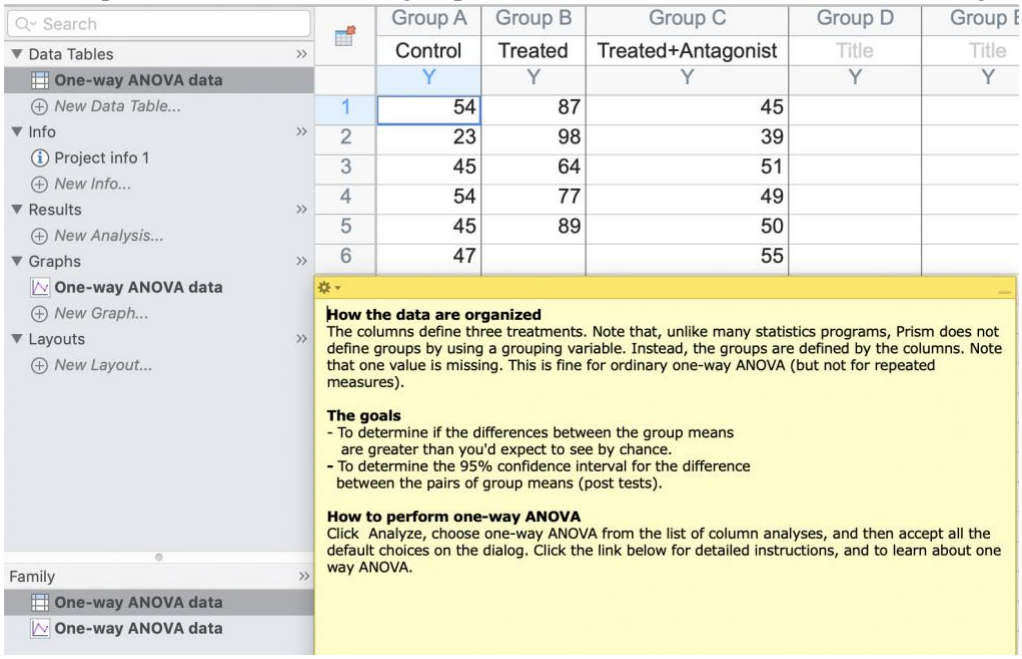


2) One-way ANOVA

From the Welcome dialog, **choose the Column tab** on the left then **choose the sample data provided by "Ordinary one-way ANOVA"** on the right. **Click "create"**.



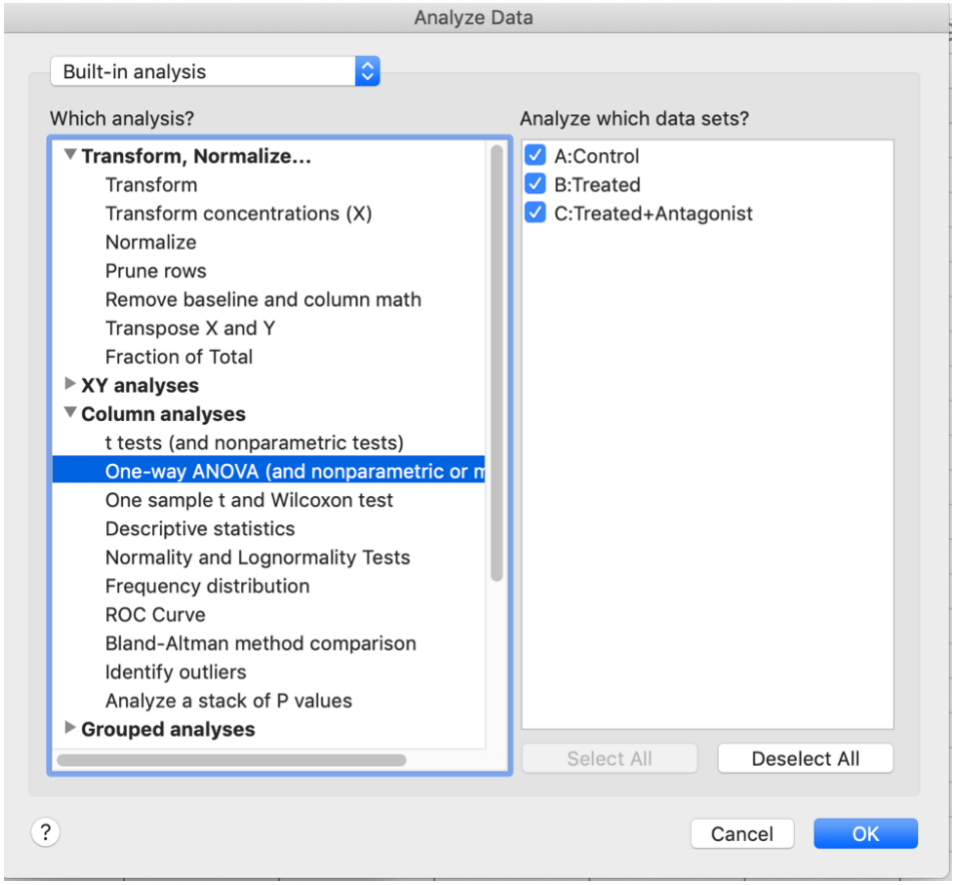
Prism 8 provides a dataset with 3 groups, "Control", "Treated" and "Treated+Antagonist".



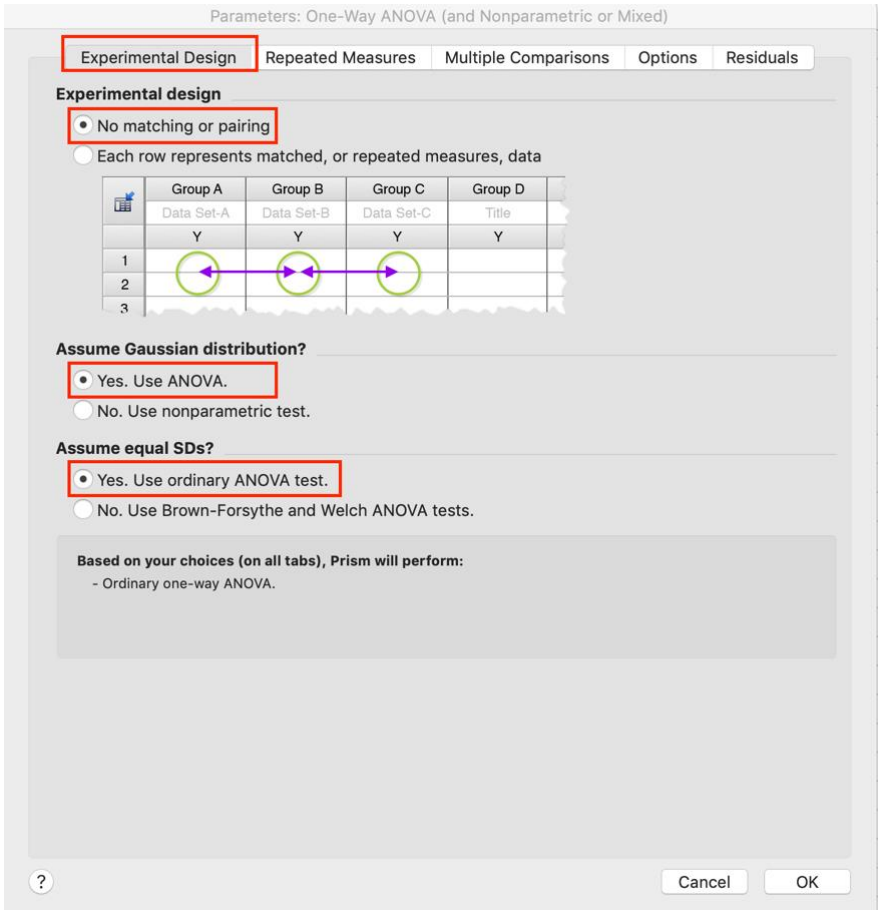
	Group A	Group B	Group C	Group D	Group E
	Control	Treated	Treated+Antagonist	Title	Title
	Y	Y	Y	Y	Y
1	54	87	45		
2	23	98	39		
3	45	64	51		
4	54	77	49		
5	45	89	50		
6	47		55		

Like what we did for the unpaired t-test example, from the data table, **click** 

on the tool bar. Then **choose "one-way ANOVA (and nonparametric or mixed)"** from the list of column analyses. **Click "OK"** on the bottom right.

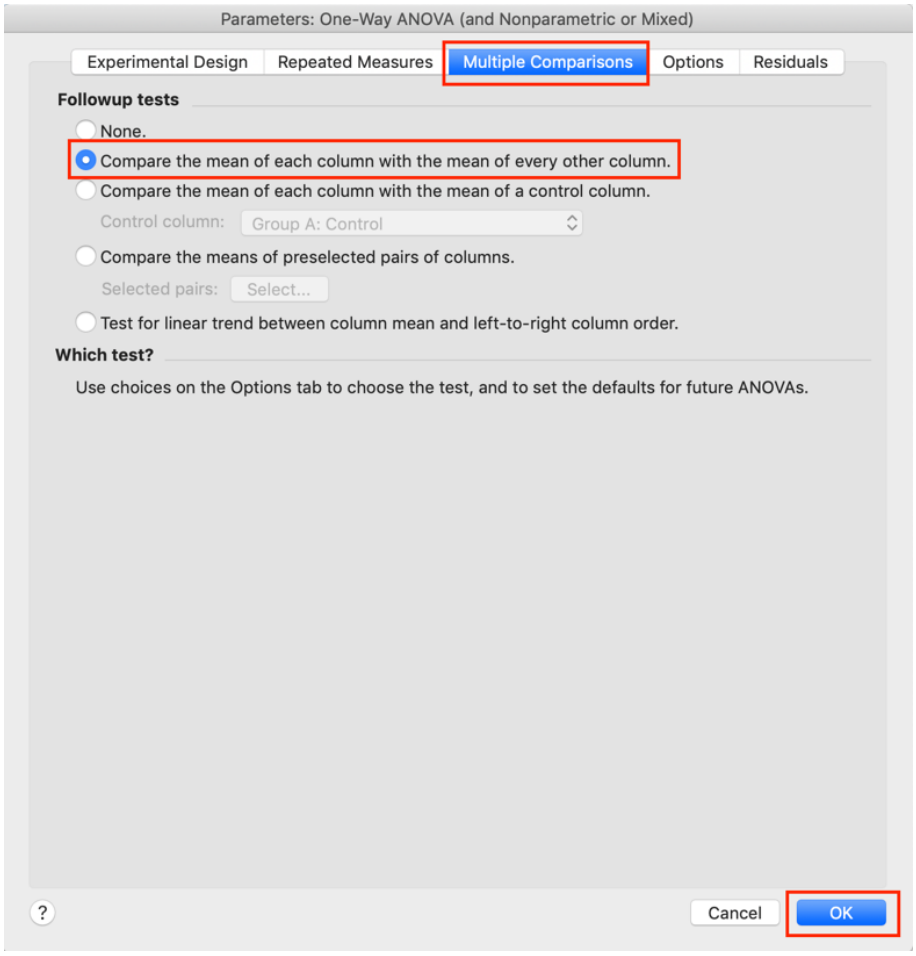


In the pops-up window, on the first tab – "Experimental Design", choose what test you want to perform. In this case, we use the default settings: **"No Matching or pairing"**, **"Yes. Use ANOVA"** and **"Yes. Use ordinary ANOVA test"**.



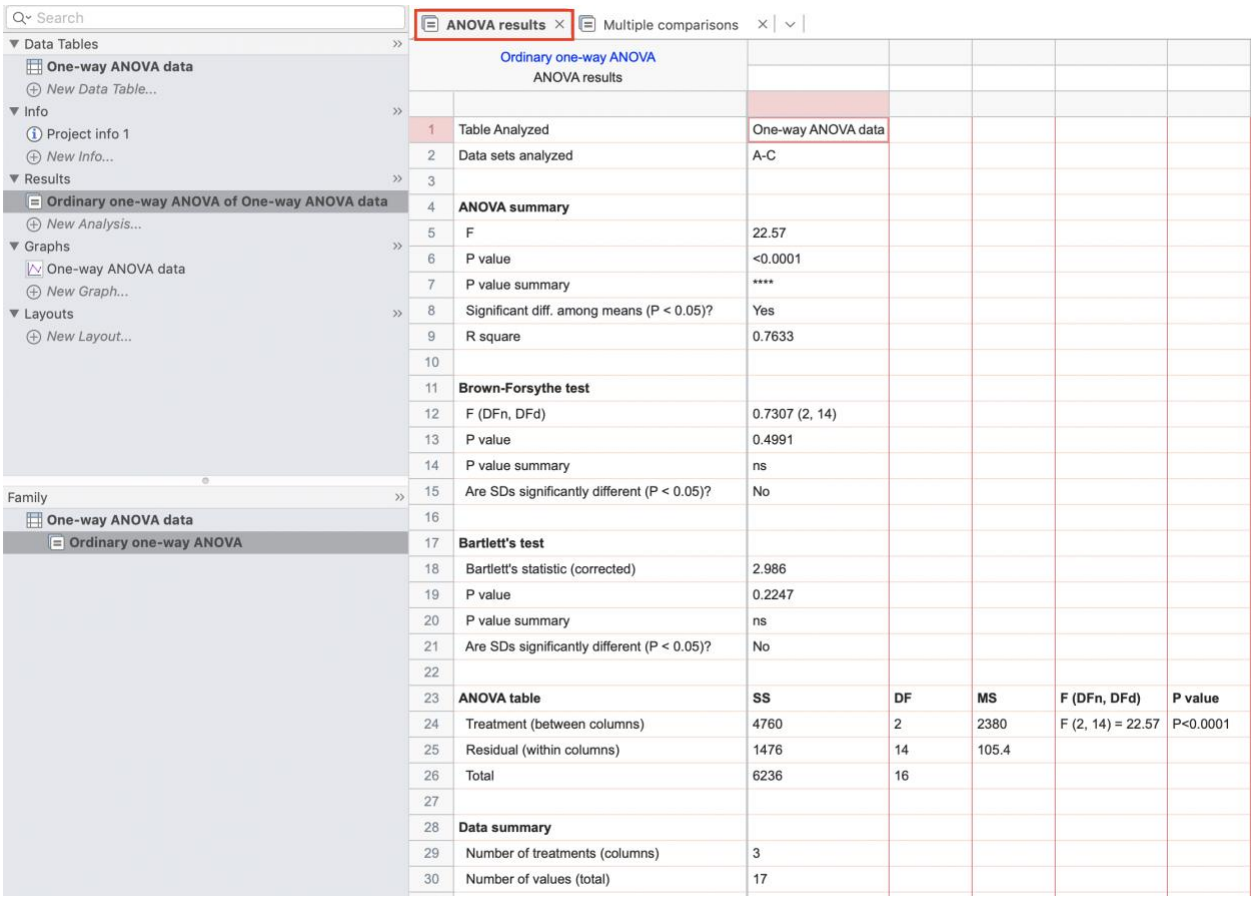
*** More details about choosing ANOVA test could be found at: Choose the test.

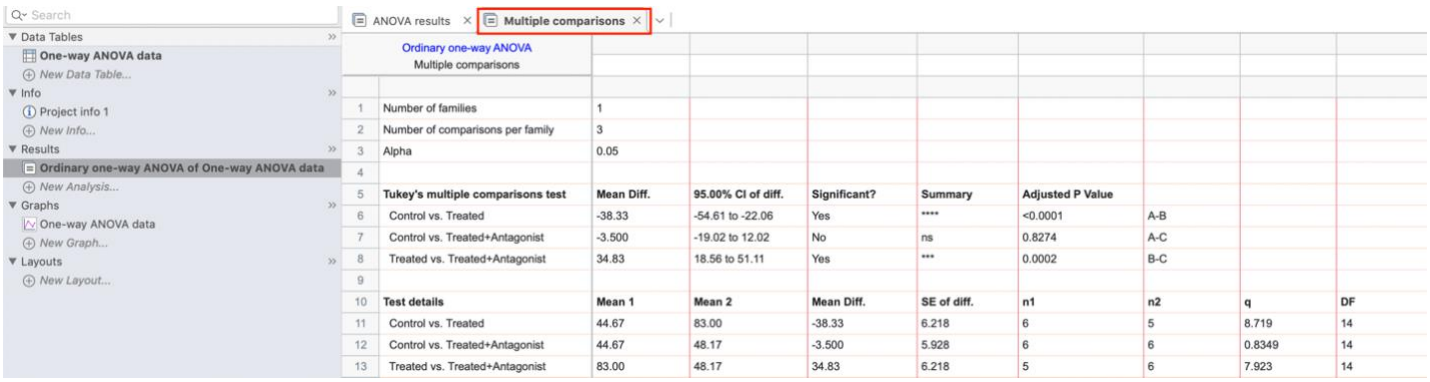
Multiple comparisons could also be performed by Prism 8. In this case, on the **"Multiple Comparisons" tab**, **choose "Compare the mean of each column with the mean of every other column"**. You could also choose which test you would like to choose on the "Options" tab, in this case we just keep the default settings. **Click "OK"**.



*** More details about the options on the Multiple Comparison tab and Options tab.

Prism 8 generates the ANOVA results “Ordinary one-way ANOVA of One-way ANOVA data” which includes two sheets “ANOVA” and “Multiple Comparisons”.





Interpreting results: One-way ANOVA
Interpreting results from multiple comparisons after ANOVA

Conclusion

There are a lot of statistical testing could be performed on Prism 8. Usually Prism 8 has already provided the detailed descriptions about them. If you have any question about which statistical testing should be chosen or how to do the testing in Prism 8, please feel free to contact me (qinlu.wang@nih.gov) or our BCBB (bioinfomatics@niaid.nih.gov)

Reference

Statistics with Prism 8