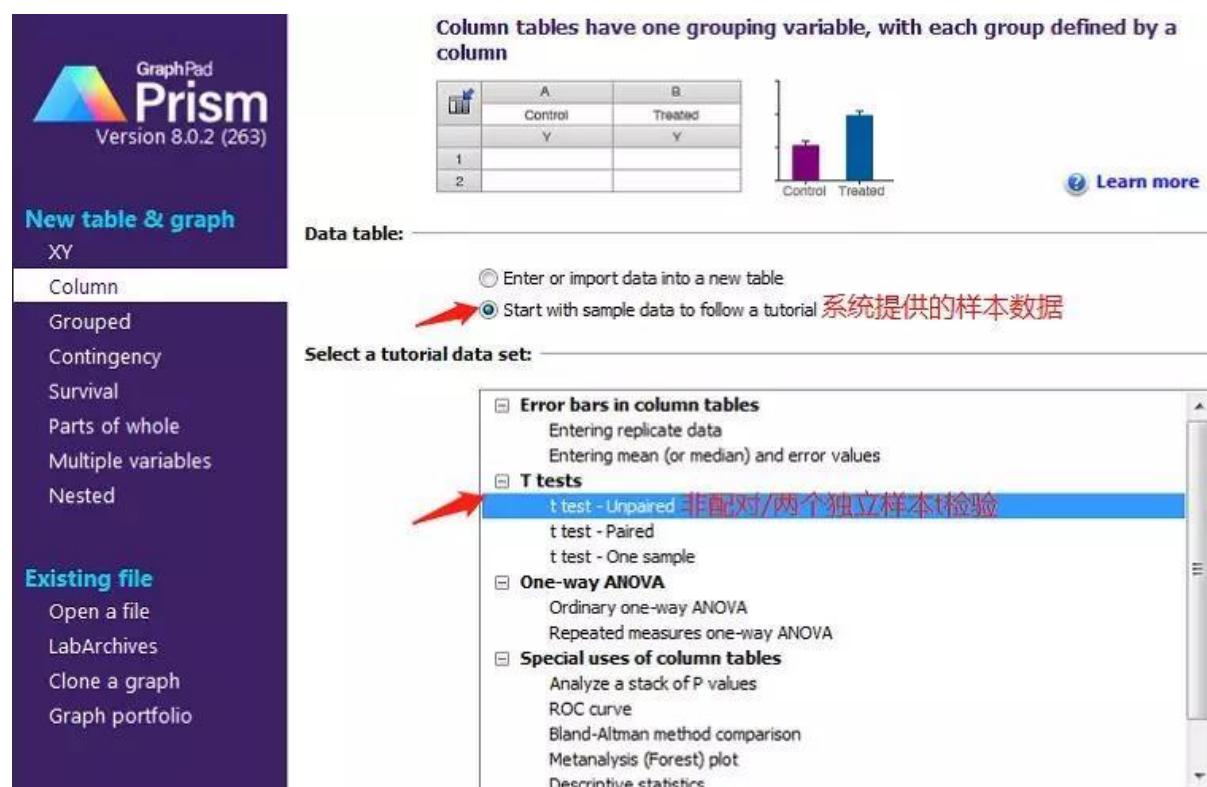


Graphpad 分析教程 | 手把手教你玩转独立样本 t 检验

在统计学分析里，最重要的元素是数据，因为数据的属性决定了用什么样的方式来比较数据，不同的数据比较方式就决定了统计分析方法以及对应的统计图。

今天给大家介绍一下 Graphpad 的统计分析功能之**非配对 / 独立样本**

(unpaired) t 检验。



今天的演示直接以 sample data 来进行。

1. 点击 creat，生成一组系统示例数据。如下图

	Group A	Group B	Group C	Group D	Group E	Group F	Group G	Group H	Group I	Group J
	Male	Female	Title							
1	54	43								
2	23	34								
3	45	65								
4	54	77								
5	45	46								
6		65								
7										
8										
9										
10										
11										
12										
13										
14										
15										

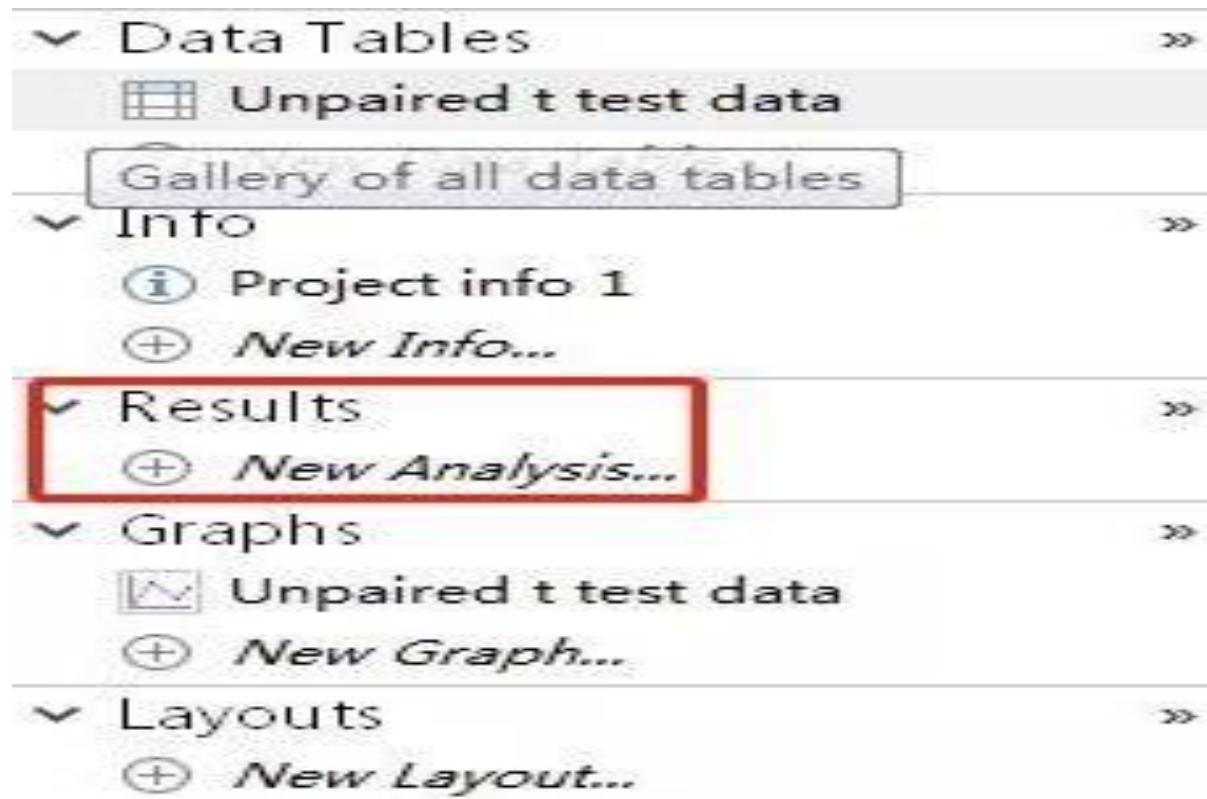
How the data are organized 数据的组织形式
The two columns define two groups. Note that, unlike many statistics programs, Prism does not define groups using a grouping variable. Instead, the groups are defined by columns.

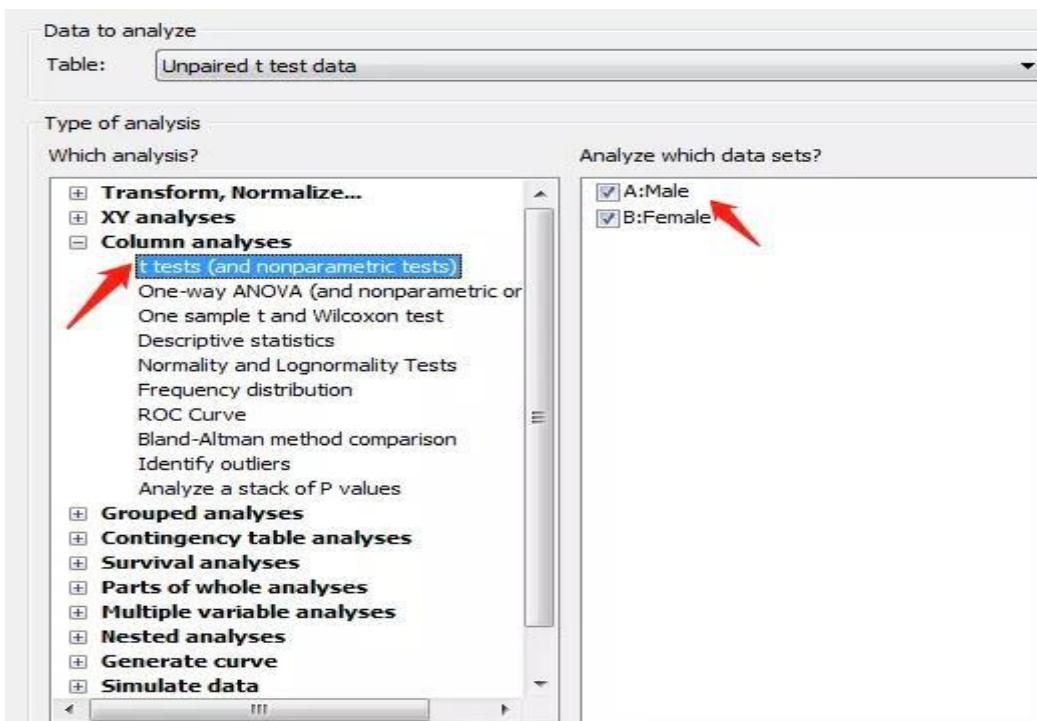
The goals t检验分析的目的
- To determine if the differences between the two group means is greater than you'd expect to see by chance.
- To determine the 95% confidence interval for the difference between the two means.

How to perform an unpaired t test 如何t检验的步骤，是不是很人性化啊
Click Analyze, choose t test from the list of column analyses, then choose an unpaired t test on the dialog. Click the link below for detailed instructions.
怕用户还不会，提供了傻瓜式教学step by step

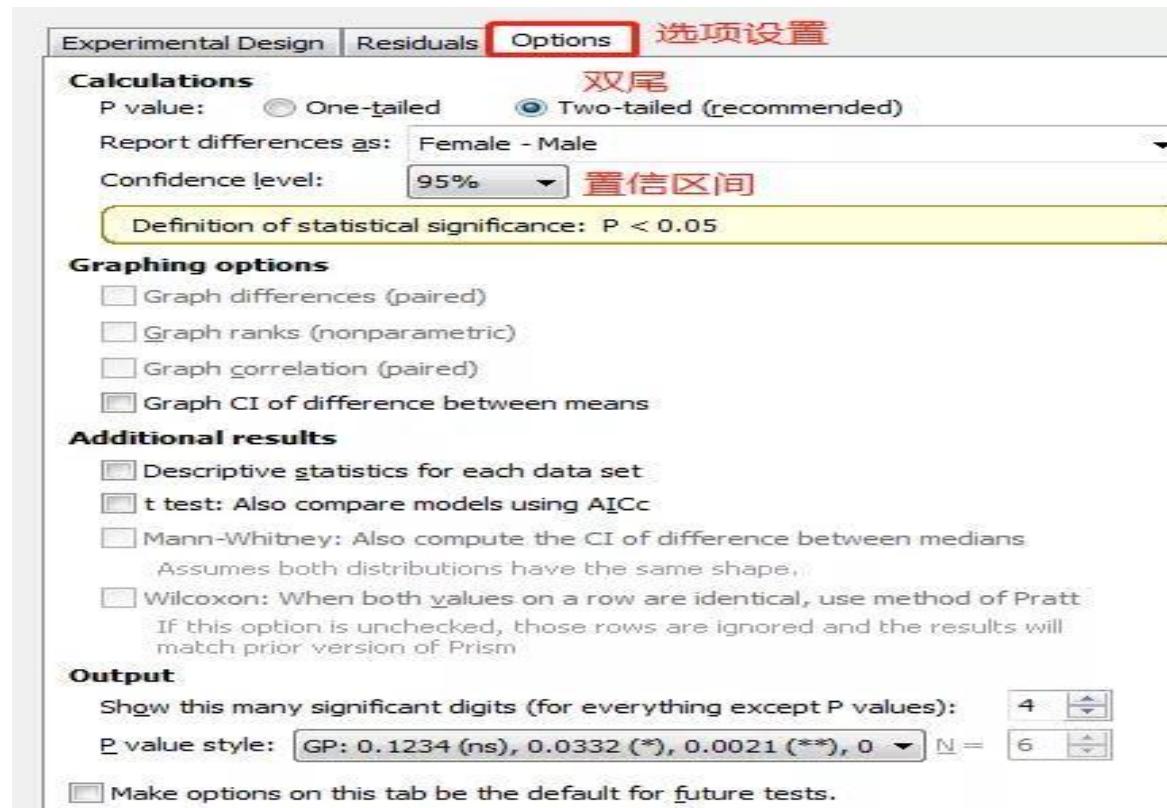
Step-by-step instructions for performing an unpaired t test 式教学step by step

2. 点击 Analyze , 也可以点击左侧的 Results 的 New Analysis , 则会 creat a new analysis , 选定 Column analyses 里的 t test (and nonparametric test) , 再勾选右侧的 A:male 和 B:female





3. 点击 OK , 得到下图 , 按照图示选择双尾 (two-tailed) 的 P value 和 95% CI 后 , 点击 OK



Experimental design Unpaired Paired

非配对类型

	A	B
	Control	Treated
	Y	Y
1		
2		
3		
4		
5		

Assume Gaussian distribution?

- Yes. Use parametric test. 默认
- No. Use nonparametric test.

Choose test

默认

- Unpaired t test. Assume both populations have the same SD
- Unpaired t test with Welch's correction. Do not assume equal SDs

4. 得到本次 t 检验和 F 检验结果

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

Unpaired t test

P value	0.2613
P value summary	ns
Significantly different ($P < 0.05$)?	No
One- or two-tailed P value?	Two-tailed
t, df	t=1.199, df=9

①一般来说在双样本非配对 t 检验之前应先进行 F 检验，如上图 F 检验的 P 值为 0.6354 > 0.05，说明无明显差异，说明 male 和 female 两组样本是方差齐。

②再来看 t 检验的 p 值为 0.2613 > 0.05，同样无明显差异。

这里我们用 sample data 得到的两组数据的 F 检验 $p > 0.05$ （方差齐），若实际操作过程中遇到 F 检验 $p < 0.05$ 怎么办呢？

别急，听我说。若两组数据方差不齐，则需要校正。How ?

点击 unpaired t test，选择 Experimental design 里的 choose test，按图示选择 welch 校正，得到校正后的新 P 值。



1	Table Analyzed	Unpaired t test data
2		
3	Column B	Female
4	vs.	vs.
5	Column A	Male
6		

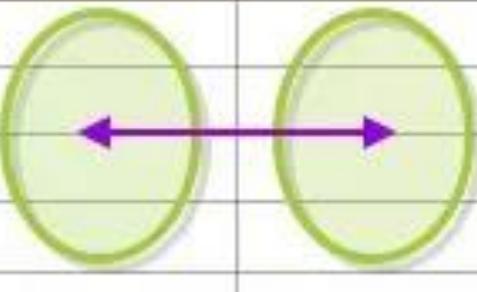
Experimental Design Residuals Options

Experimental design

Unpaired

Paired

	A	B
	Control	Treated
Y	Y	
1		
2		
3		
4		
5		



Assume Gaussian distribution?

Yes. Use parametric test.

No. Use nonparametric test.

Choose test

Unpaired t test. Assume both populations have the same SD

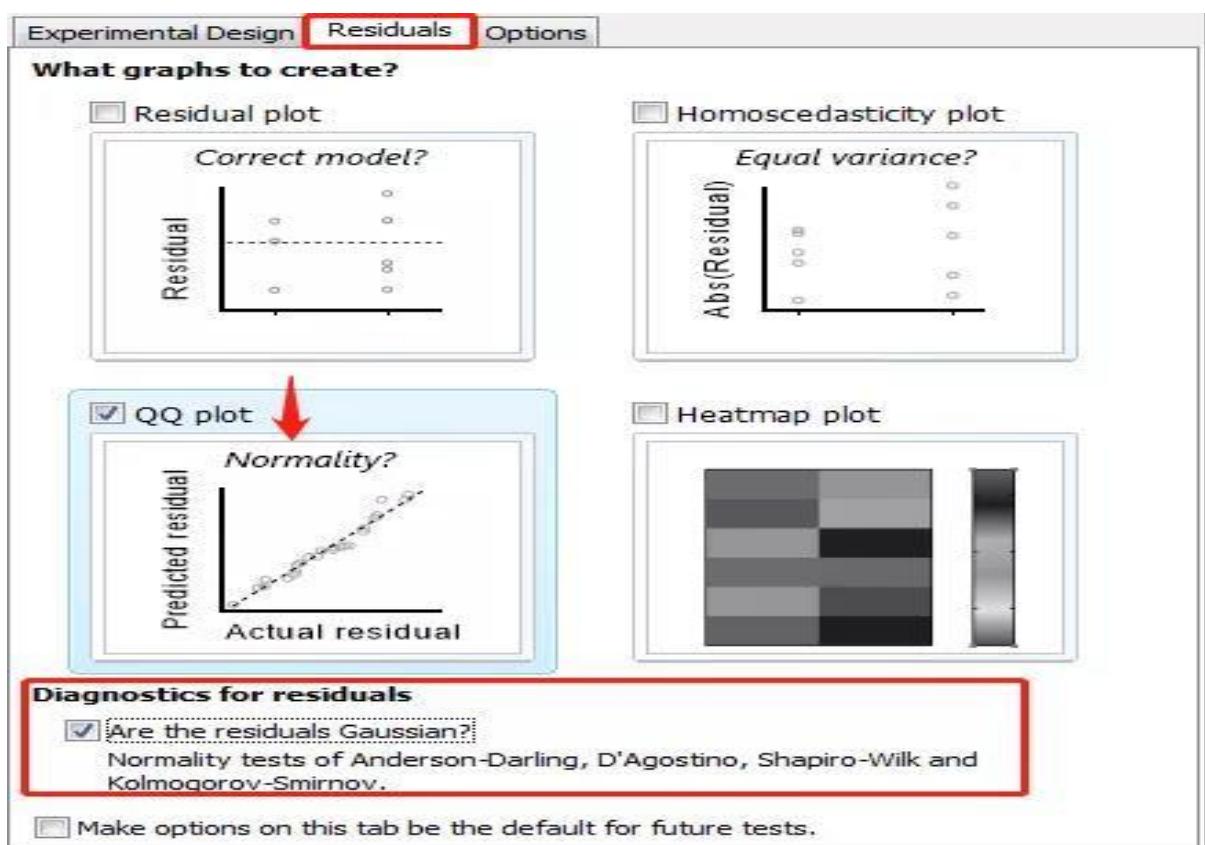
Unpaired t test with Welch's correction. Do not assume equal SDs



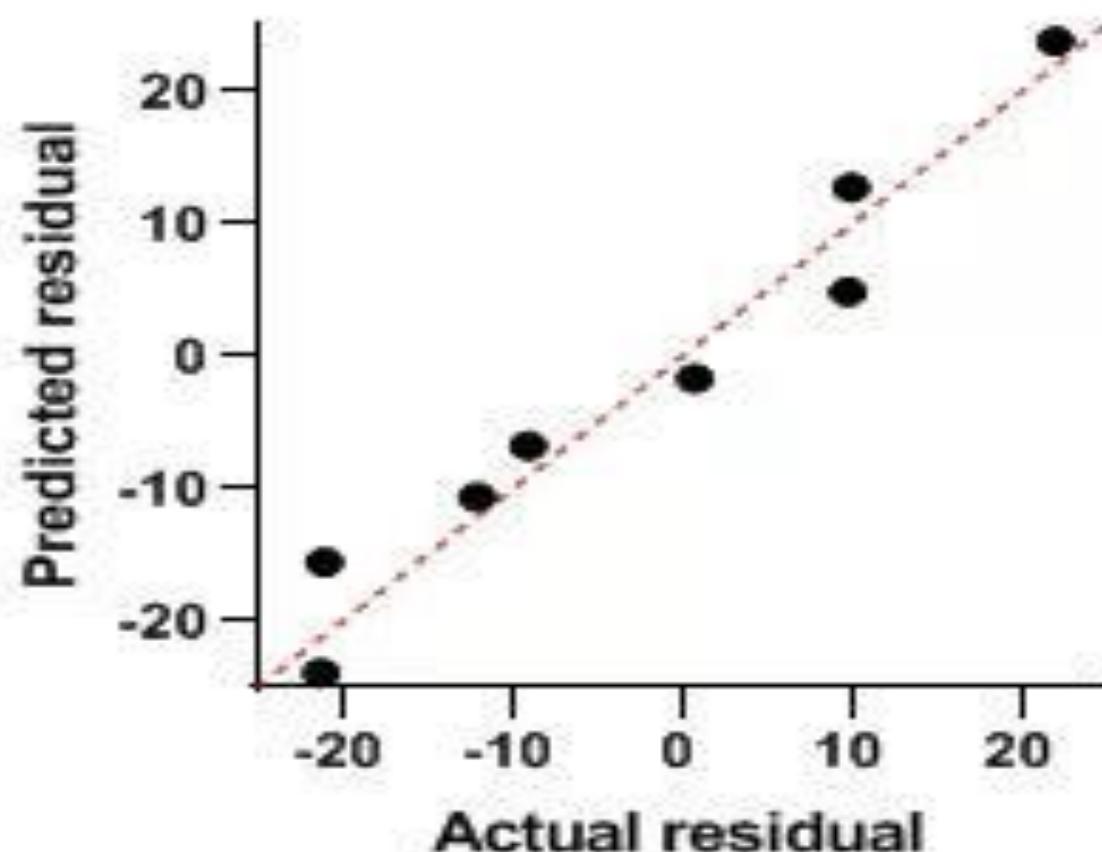
Welch校正，用于方差不齐的情况

Welch's t test	
Table Analyzed	Unpaired t test data
Column B	Female
vs.	vs.
Column A	Male
Unpaired t test with Welch's correction	
P value	0.2501
P value summary	ns
Significantly different ($P < 0.05$)?	No
One- or two-tailed P value?	Two-tailed
Welch-corrected t, df	$t=1.230, df=8.972$

5. 我们先假设数据符合正态分布，按下图勾选，点击 OK 后出现对应 4 个 P 值，均 > 0.05 ，则符合正态分布 (Gaussian distribution)。



QQ plot



Normality of Residuals

Test name	Statistics	P value	Passed norm	P value sum
Anderson-Darling (A2*)	0.4421	0.2330	Yes	ns
D'Agostino-Pearson omnibus (K2)	0.7701	0.6804	Yes	ns
Shapiro-Wilk (W)	0.9177	0.2997	Yes	ns
Kolmogorov-Smirnov (distance)	0.2108	0.1000	Yes	ns

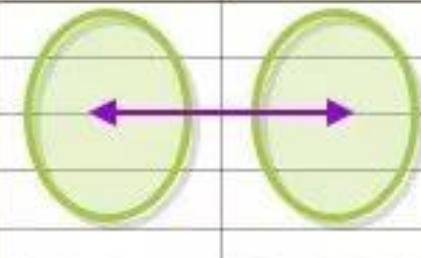
若实际数据不服从正态分布，多采用非参数检验。主要有两种非参数检验方法：

- ① 「曼 - 惠特尼秩和检验」 (Mann-Whitney test) , 它假设两个样本分别来自除了总体均值以外完全相同的两个总体 , 目的是检验两个总体均值是否有显著的差别。
- ② 正态性的 Kolmogorov-Smirnov 检验 , 这是一种基于 ECDF 的检验。

Experimental design

- Unpaired
 Paired

	A	B
	Control	Treated
1	Y	Y
2		
3		
4		
5		



是否服从正态分布

Assume Gaussian distribution?

- Yes. Use parametric test. 是，使用参数检验
 No. Use nonparametric test. 否，使用非参数检验

Choose test

- Mann-Whitney test. Compare ranks M-W检验
 Kolmogorov-Smirnov test. Compare cumulative distributions K-S检验

6. 完成了两组非配对 t 检验，得到了想要的 p 值，其实统计分析过程到这里

就结束了，如果把相对应的统计图一起做出来岂不是更完美。点击下图示

Graphs---Unpaired t test data 按下图示选择，生成想要的图片。

- ▼ Data Tables »
 -  **Unpaired t test data**
 - (+) *New Data Table...*

- ▼ Info »
 - (i) Project info 1
 - (+) *New Info...*

- ▼ Results »
 -  **Unpaired t test of Unpaired t...**
 - (+) *New Analysis...*

- ▼ Graphs »
 -  **Unpaired t test data**
 - (+) *New Graph...*

- ▼ Layouts »
 - (+) *New Layout...*

Data sets to plot

Table: **Unpaired t test data**

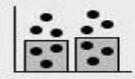
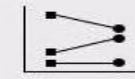
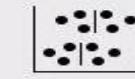
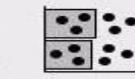
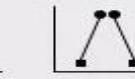
Plot selected data sets only
 Also plot associated curves
 Create a new graph for each data set (don't put them all on one graph)

Y axis title:

Kind of graph

Show: **Column**

Individual values **Box and violin** **Mean/median & error**

Scatter plot

Plot: **Mean with SD**

