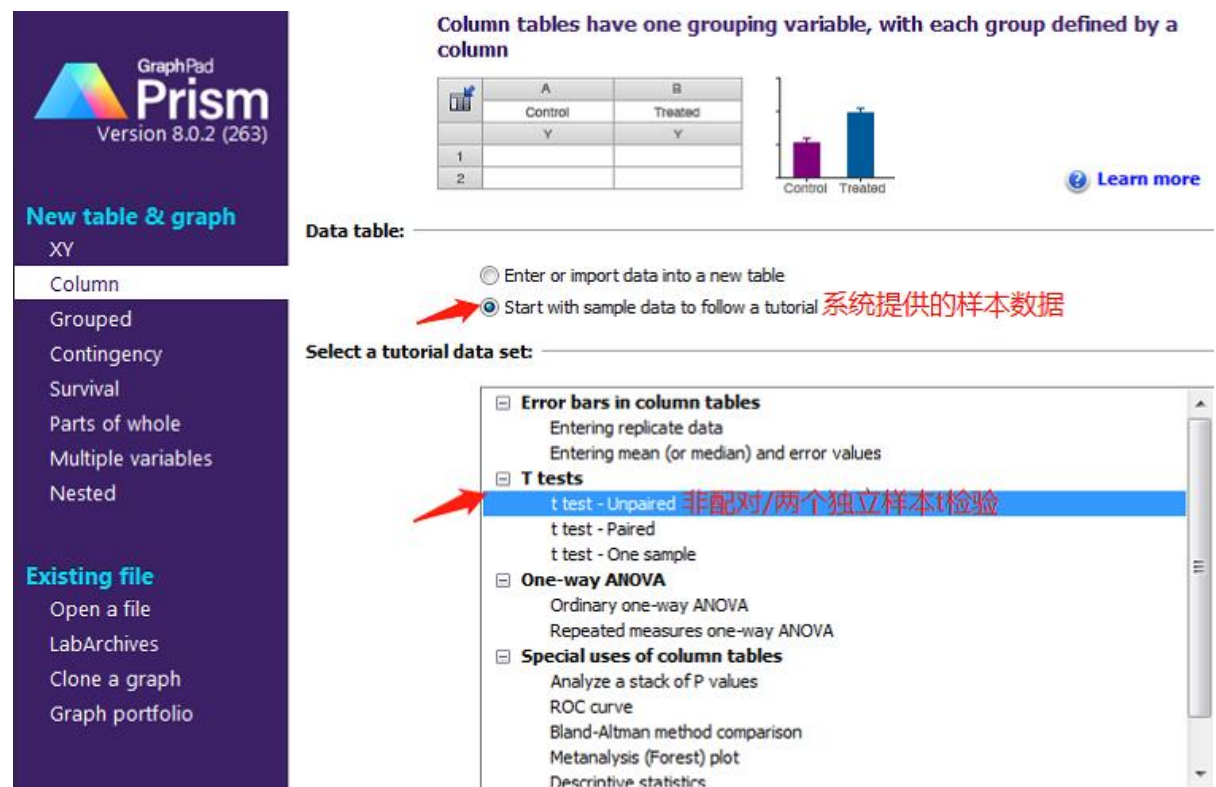


如何用 Graphpad prism 8.0 进行非配对 / 独立样本 (unpaired) t 检验 (或秩和检验)

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。

今天继续给大家介绍一下 Graphpad 的统计分析功能之非配对 / 独立样本 (unpaired) t 检验。



Column tables have one grouping variable, with each group defined by a column

	A	B
	Control	Treated
	Y	Y
1		
2		

Data table:

☐ Enter or import data into a new table

☒ Start with sample data to follow a tutorial 系统提供的样本数据

Select a tutorial data set:

- ☒ Error bars in column tables
 - Entering replicate data
 - Entering mean (or median) and error values
- ☒ T tests
 - t test - Unpaired 非配对/两个独立样本t检验
 - t test - Paired
 - t test - One sample
- ☐ One-way ANOVA
 - Ordinary one-way ANOVA
 - Repeated measures one-way ANOVA
- ☐ Special uses of column tables
 - Analyze a stack of P values
 - ROC curve
 - Bland-Altman method comparison
 - Metanalysis (Forest) plot
 - Descriptive statistics

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	Title	Title	Title	Title	Title	Title	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

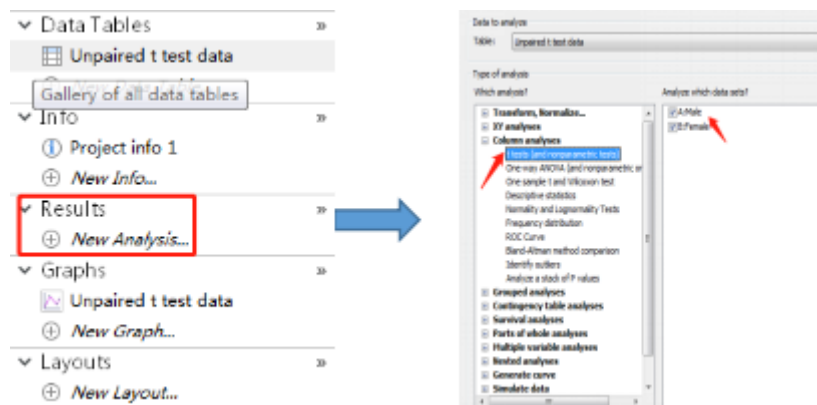
- To determine if the differences between the two group means is greater than you'd expect to see by chance.
- To determine the 95% confidence interval for the difference between the two means.

How to perform an unpaired t test 如何t检验的步骤，是不是很人性化啊

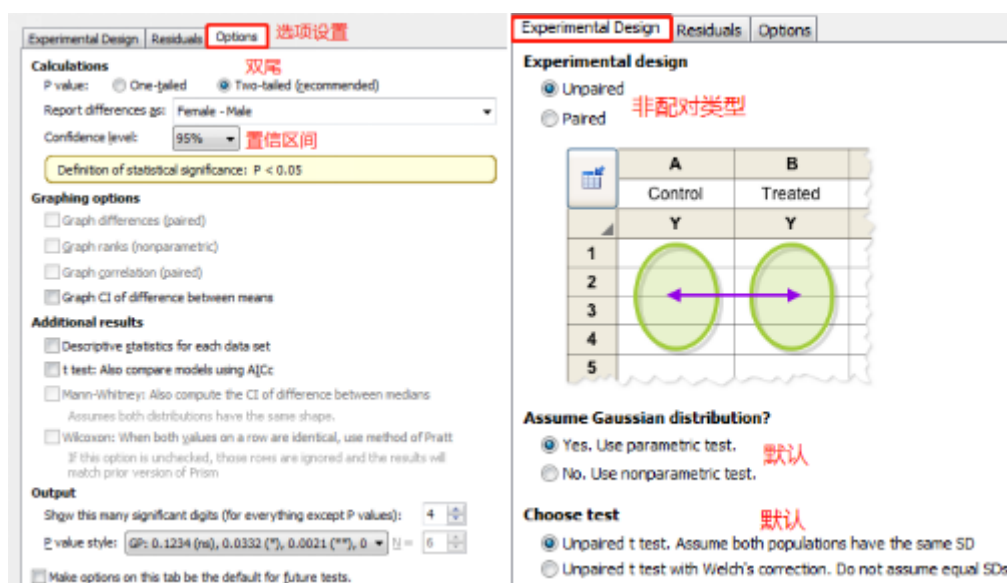
Click **Analyze**, choose **t test** from the list of **column analyses**, then choose an **unpaired t test** on the dialog. Click the link below for detailed instructions.

[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



4. 得到本次 t 检验和 F 检验结果

21	F test to compare variances		Unpaired t test	
22	F, DFn, Dfd	1.680, 5, 4	P value	0.2613
23	P value	0.6354	P value summary	ns
24	P value summary	ns	Significantly different (P < 0.05)?	No
25	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。

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

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

Experimental Design

Experimental design

☒ Unpaired
☐ Paired

	A	B
	Control	Treated
1	Y	Y
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

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）。

Experimental Design
Residuals
Options

What graphs to create?

☐ Residual plot

Correct model?

☐ Homoscedasticity plot

Equal variance?

☒ QQ plot

Normality?

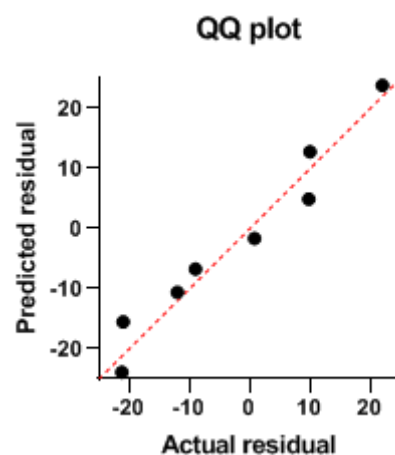
☐ Heatmap plot

Diagnostics for residuals

☒ Are the residuals Gaussian?

Normality tests of Anderson-Darling, D'Agostino, Shapiro-Wilk and Kolmogorov-Smirnov.

☐ Make options on this tab be the default for future tests.



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 Residuals Options

Experimental design

☒ Unpaired
☐ Paired

	A	B
	Control	Treated
	Y	Y
1		
2		
3		
4		
5		

Assume Gaussian distribution? 是否服从正态分布

☐ 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。

