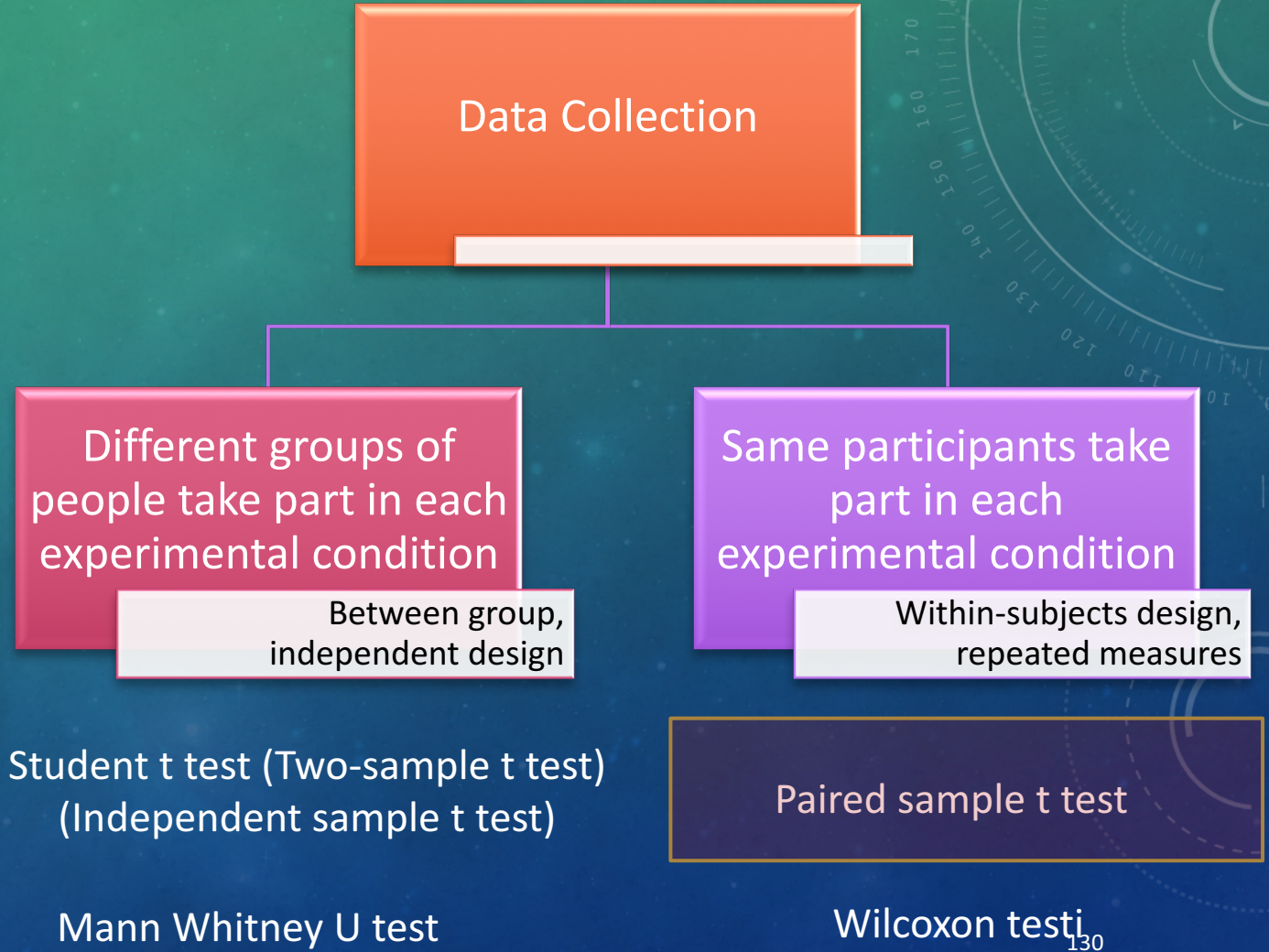


WEEK 10

COMPARING TWO MEANS: PAIRED SAMPLE T TEST

COMPARING TWO MEANS

- Simplest scenario..
- test statistics follow the t -distribution



Parametric test assumptions met:



Student t test (Two-sample t test)
(Independent sample t test)

Parametric test assumptions violated:



Mann Whitney U test

Paired sample t test

Wilcoxon test₁₃₀

ASSUMPTIONS OF PAIRED SAMPLE T TEST

- The two samples must be *dependent*.
- (*Ideally*) Observations should be chosen by random selection
- The set of differences for all pairs should be approximately *Normally* distributed in each population from which the samples are taken.

CALCULATING THE TEST STATISTIC

Suppose we are investigating effect of an ferritin supplement on Hemoglobin levels of dogs.

Animal no	Before Treatment	After Treatment	Difference (D)	(D ²)
1	11.5	11.8	-0.3	0.9
2	9.7	10.5	-0.8	0.64
3	10.3	11.0	-0.7	0.49
.
.
30	11.1	11.0	+0.1	0.01
Total			-20	12.5

Step 1. Calculate D and D²

Step 2. Calculate $\sum D$ and $\sum D^2$

Step 3. Calculate mean D: $\bar{D} = \frac{\sum D}{n} = \frac{-20}{30} = -0.67$

Step 4. Calculate standard deviation of (mean D):

$$S = \sqrt{\frac{\sum D^2 - \frac{(\sum D)^2}{n}}{n-1}} = \sqrt{\frac{12.5 - \frac{(-20)^2}{30}}{30-1}} = 0.169$$

Step 5. *Test statistic* = $\frac{\bar{D}}{SE(\bar{D})} = \frac{\bar{D}}{s/\sqrt{n}} = \frac{-0.67}{0.169/\sqrt{30}} = -21.75$

Step 6. with $\alpha=0.05$ and $df=29$; P value is <0.001

EXAMPLE: Paired sample t test

	Before_surgery	After_surgery
1	40	30
2	35	35
3	50	45
4	55	40
5	65	50
6	55	35
7	50	55
8	35	25
9	30	30
10	50	45
11	60	40
12	39	50

- Suppose we want to investigate the effect of patient-centered care to anxiety levels in an animal hospital after surgery.

Hypothesis?

H_0 : There is no effect of patient centered care to anxiety levels

H_1 : There is no effect of patient centered care to anxiety levels

Dependent variable?

Anxiety

Independet variable

Time

Dataset > Anxiety.sav

Checking the assumptions

Step 1: Take the difference of each pair

- Transform > Compute variable

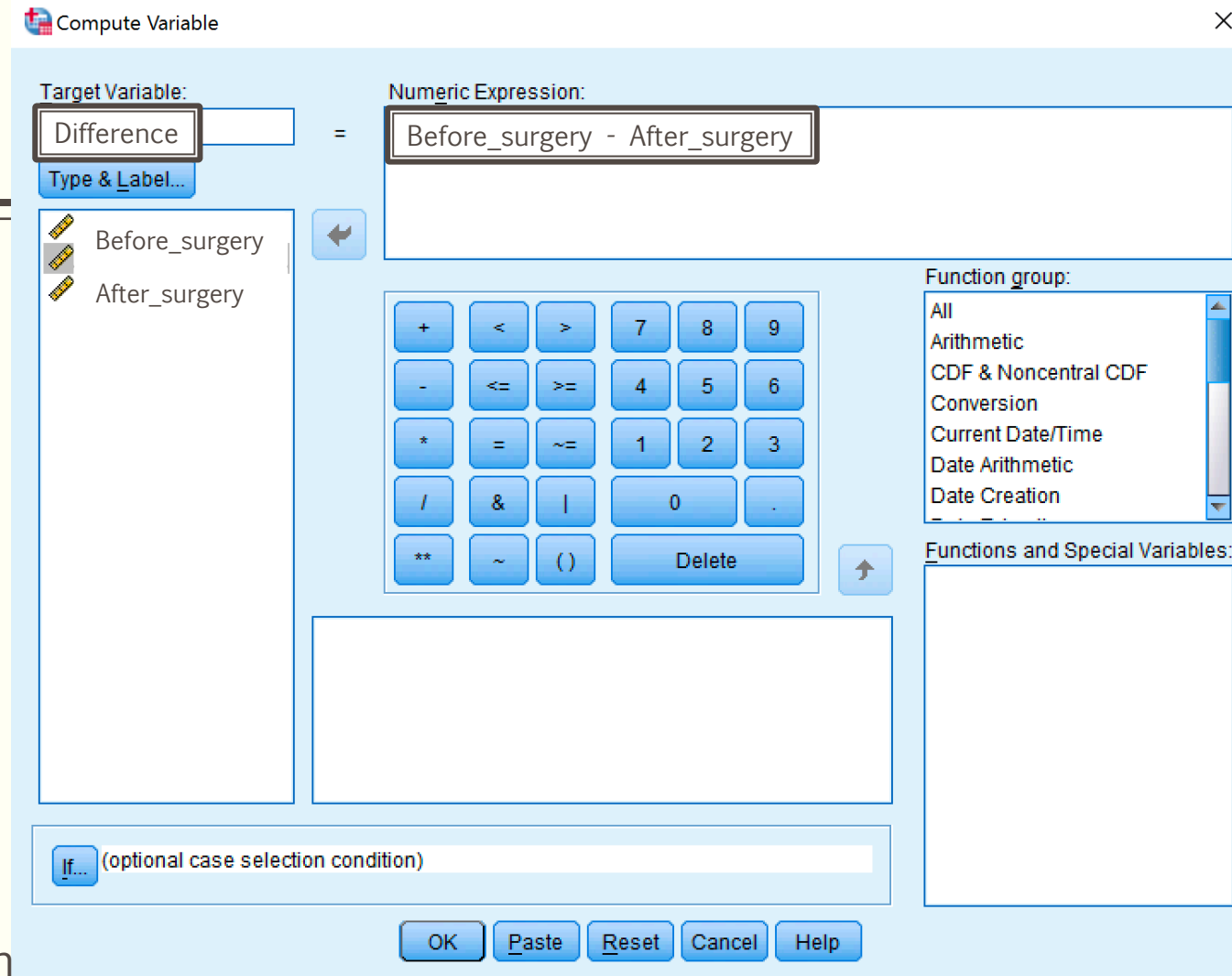
Step 2: Testing the normality of the difference

- Analyze > Descriptive Statistics > Explore

a) Normality assumption:

H_0 = The data follow a normal distribution

H_1 = The data do not follow a normal distribution



Tests of Normality						
	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Difference	0,126	12	,200*	0,956	12	0,722

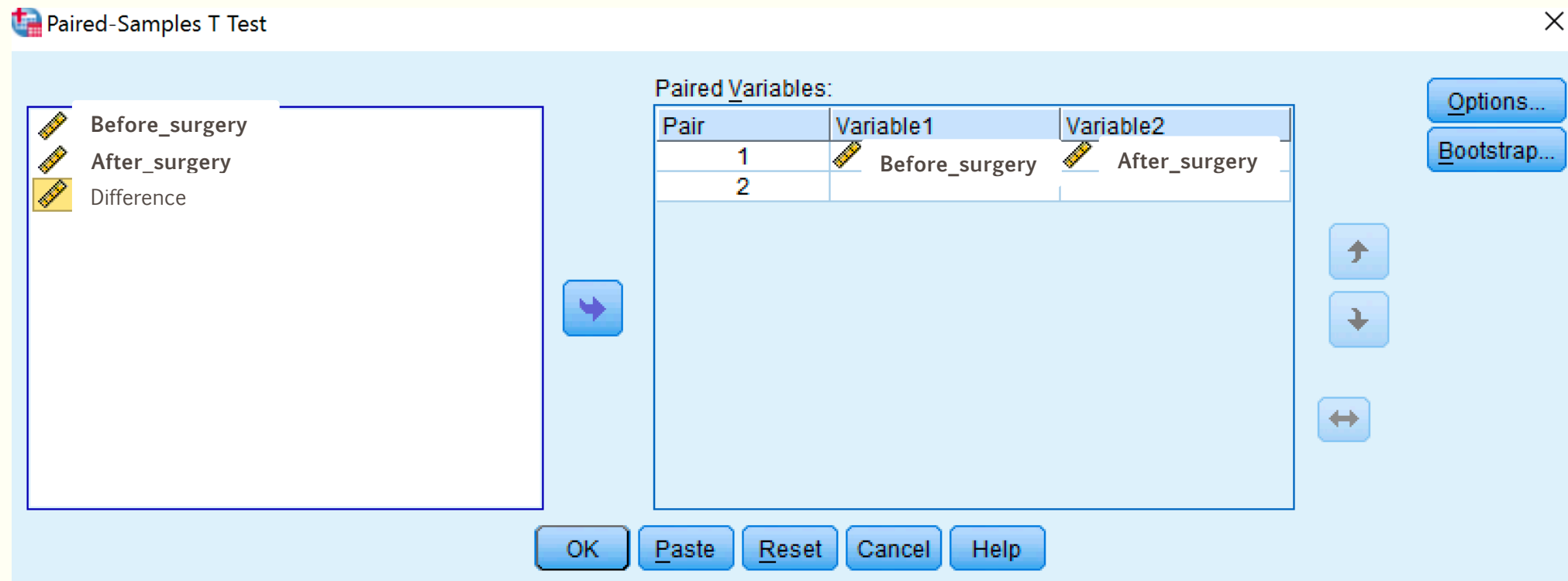
Sig.
0,722

$P > 0.05$

H_0 is accepted

Data Analysis: Paired sample t test

Analyze > Compare Means > Paired sample t test



Results

Pair 1	N	Mean	Std. Error Mean	Std. Deviation
After_surgery	12	40	2,683	9,293
Before_surgery	12	47	3,184	11,029

Paired Differences				95% Confidence Interval of the Difference		t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1								
Before - After	7	9,807	2,831	0,769	13,231	2,473	11	0,031

H_0 : There is no effect of patient centered care to anxiety levels

H_1 : There is an effect of patient centered care to anxiety levels

$P < 0.05$



H_0 is rejected

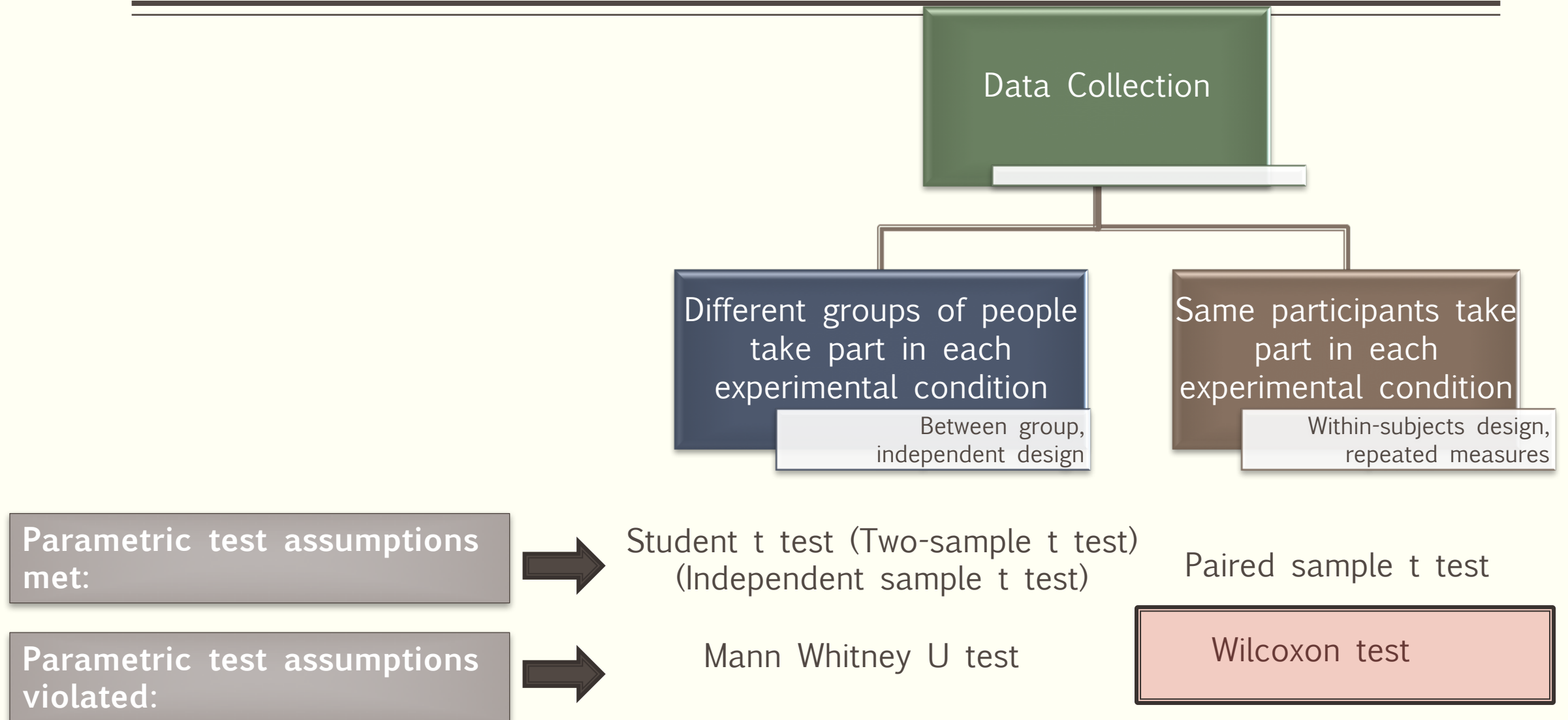
Reporting the results

Table 1. ...HEADLINE...

Anxiety Level	n	Mean	Std. Error	Std. Dev.	P
After_Surgery	12	40	2,683	9,293	0,031
Before_Surgery	12	47	3,184	11,029	

- The new patient-centered care significantly reduces the post-operative anxiety level ($p < 0.05$).

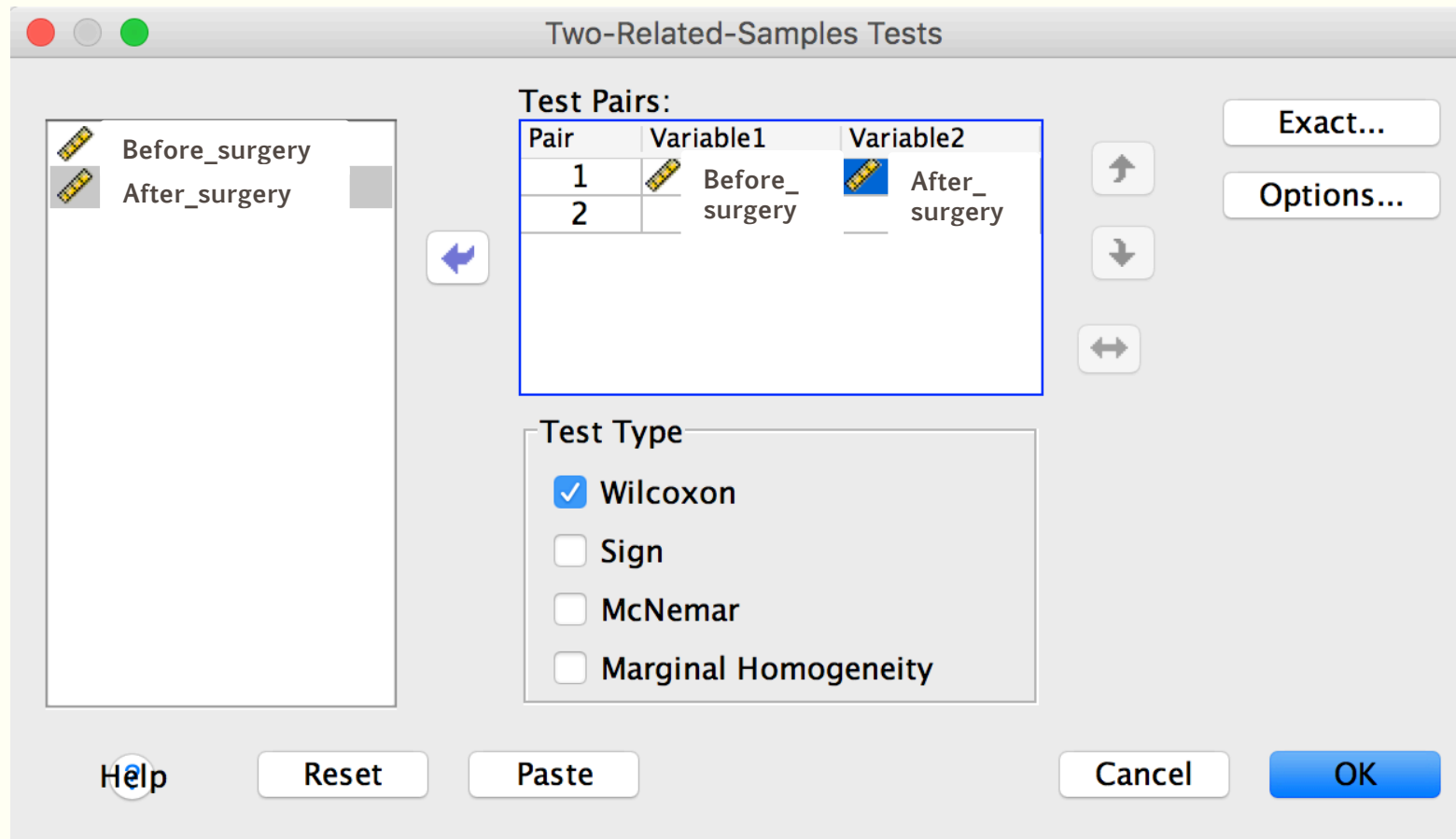
What if the parametric test assumptions violated?



Let's use the same dataset and assume that the assumptions are violated

Wilcoxon Signed Rank test

- Analyze > Non-Parametric Tests > Legacy Dialogs > 2 Related Samples



Output:

Ranks

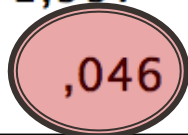
		N	Mean Rank	Sum of Ranks
Before_surgery - After_surgery	Negative Ranks	8 ^a	5,88	47,00
	Positive Ranks	2 ^b	4,00	8,00
	Ties	2 ^c		
	Total	12		

a. Op_sonrası < Op_öncesi

b. Op_sonrası > Op_öncesi

c. Op_sonrası = Op_öncesi

Test Statistics^a

	Before_surgery - After_surgery
Z	-1,997 ^b
Asymp. Sig. (2-tailed)	 0,046

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

9.04.2018

Interpretation ?

The new patient-centered care significantly reduces the post-operative anxiety level ($p < 0.05$)