INFERENTIAL STATISTICS II - TESTING HYPOTHESIS ON TWO SAMPLES MEANS: HINTS

Testing Hypothesis about the Difference between Two Means

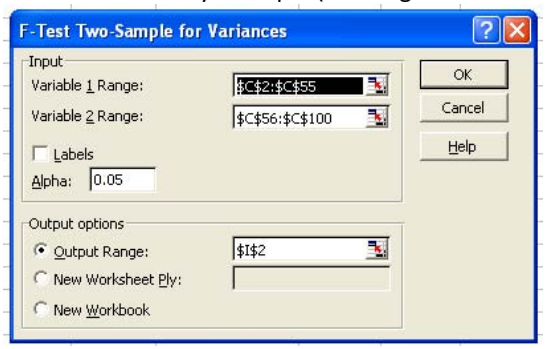
Assumptions underlying the ***paired samples t-Test***

- Observations are randomly sampled from the population(s) of interest.
- The observations are correlated.
- Observations are normally distributed in the population.
- The variance of the difference scores is unknown

A. TESTING HYPOTHESIS ON VARIANCES

To apply the F-test:

- **[Tool – Data Analysis – F-test Two-Sample for Variances].**
- F-test Two-Samples for Variances window by example (haemoglobin at 12 months)



  - *Variable 1 Range*: select the data of the haemoglobin (6 months respectively 12 months) for rural group.
  - *Variable 2 Range*: select the data of the haemoglobin (6 months respectively 12 months) for urban group.
  - *Labels*: checked it if the first row of the input contains labels that should not be included in the data analysis.
  - *Alpha*: refers to the type I error probability for the statistical test. Let's use the default value of 5%.
  - *Output options*: put the results in the same sheet starting with E2 cell (for haemoglobin at 6 months) – I2 cell (for haemoglobin at 12 months).
  - *The results*: will look like in the image bellow:

E	F	G	H	I	J	K
F-Test Two-Sample for Variances				F-Test Two-Sample for Variances		
Haemoglobin at 6 months				Haemoglobin at 12 months		
	Bi-weekly	Daily			Bi-weekly	Daily
Mean	11.21	10.82		Mean	11.57	12.03
Variance	0.72	1.56		Variance	1.63	0.99
Observations	50	49		Observations	50	49
df	49	48		df	49	48
F	0.46			F	1.65	
P(F<=f) one-tail	0.0038			P(F<=f) one-tail	0.0428	
F Critical one-tail	0.62			F Critical one-tail	1.61	
The variances are not equal				The variances are not equal		

To read the output of F-test (e.g. Haemoglobin at 6 months):

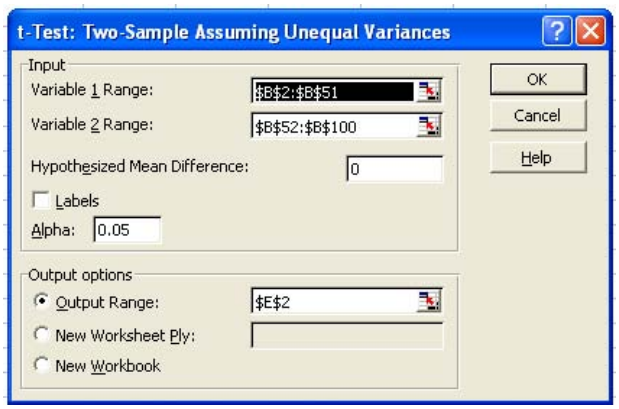
- *Mean*: the mean of haemoglobin at 6 months is 11.21 mg/dl for patients with bi-weekly treatment compared to 10.82 mg/dl for patients with daily schema.
- *Variance*: the variance of haemoglobin for patients with bi-weekly treatment was 0.72, and for patients with daily treatment was of 1.56 mg/dl.

- *Observations*: 50 patients received bi-weekly treatment and 49 patients received daily treatment.
- *df*: the degree of freedom is equal with 50-1 = 49 for patients who received bi-weekly treatment and 49 – 1 = 48 for patients who received daily treatment.
- *F*: the obtained F was 0.46.
- *P-value one-tail*: the one-tailed probability of obtained F was 0.0038. Since the probability of obtained F is less than 0.05, the result is statistically significant (the alternative hypothesis is accepted: the variances of two groups are not equal). This result tells us that in comparing the means the t-test assuming unequal variance must be applied.

B. MEANS COMPARISON: T-TEST FOR TWO INDEPENDENT SAMPLES

To apply the t-test for independent samples:

- **[Tools – Data Analysis – t-Test: Two-Sample Assuming Unequal Variances]**.
- **T**-test Unequal Variances window:



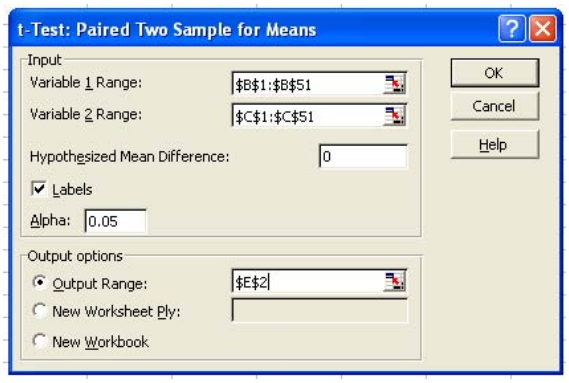
- Your results suppose to look like in the image bellow:

E	F	G	H	I	J	K
t-Test: Two-Sample Assuming Unequal Variances				t-Test: Two-Sample Assuming Unequal Variances		
Haemoglobin at 6 months				Haemoglobin at 12 months		
	Bi-weekly	*Daily*			*Bi-weekly*	*Daily*
Mean	**11.21**	**10.82**		Mean	11.57	12.03
Variance	0.72	1.56		Variance	1.63	0.99
Observations	50	49		Observations	50	49
Hypothesized Mean Difference	0			Hypothesized Mean Difference	0	
df	84			df	92	
t Stat	1.81			t Stat	-1.97	
P(T<=t) one-tail	3.68E-02			P(T<=t) one-tail	2.58E-02	
t Critical one-tail	1.66			t Critical one-tail	1.66	
P(T<=t) two-tail	**7.36E-02**			P(T<=t) two-tail	5.16E-02	
t Critical two-tail	1.99			t Critical two-tail	1.99	
Conclusion				Conclusion		
Statistical: null hypothesis is accepted				Statistical: null hypothesis is accepted		
Clinical: there is no statistically significant difference between the mean of haemoglobin of patients who received bi-weekly treatment compared to those who received daily treatment.				Clinical: there is no statistically significant difference between the mean of haemoglobin of patients who received bi-weekly treatment compared to those who received daily treatment.		

C. MEANS COMPARISON: T-TEST FOR TWO INDEPENDENT SAMPLES

To apply the Paired Samples t-test:

- **[Tools – Data Analysis – t-Test: Paired Two Sample for Means]**
- Test window:



- *Variable 1 Range*: select the value that correspond to haemoglobin at 6 months for children who received bi-weekly treatment schema
- *Variable 2 Range*: select the value that correspond to haemoglobin at 12 months for children who received bi-weekly treatment schema
- *Hypothesized Mean Difference*: enter 0 to test the hypothesis that the mean difference is equal with zero.

- Your results will look like:

E	F	G	H	I	J	K
t-Test: Paired Two Sample for Means				t-Test: Paired Two Sample for Means		
bi-weekely treatment				daily treatment		
	Haemoglobin (mg/dl) 6 month	*Haemoglobin (mg/dl) 12 month*			*Haemoglobin (mg/dl) 6 month*	*Haemoglobin (mg/dl) 12 month*
Mean	**11.21**	**11.57**		**Mean**	**10.82**	**12.03**
Variance	0.72	1.63		Variance	1.56	0.99
Observations	50	50		Observations	49	49
Pearson Correlation	0.16			Pearson Correlation	0.66	
Hypothesized Mean Difference	0			Hypothesized Mean Difference	0	
df	49			df	48	
t Stat	-1.83			t Stat	-8.85	
P(T<=t) one-tail	0.0369			P(T<=t) one-tail	5.95E-12	
t Critical one-tail	1.68			t Critical one-tail	1.68	
P(T<=t) two-tail	**0.0739**			**P(T<=t) two-tail**	**1.19E-11**	
t Critical two-tail	2.01			t Critical two-tail	2.01	
Conclusion				Conclusion		
Statistical: Null hypothesis is accepted.				Statistical: Alternative hypothesis is accepted.		
Clinical: The bi-weekly treatment is not efficient.				Clinical: The daily treatment schema is efficient.		