Independent Samples t tests and repeated samples t tests in SPSS

1. **What are the assumptions that must be met in order to conduct an independent samples t test?**

1 There is equal variances between groups

2 The variables are normally distributed

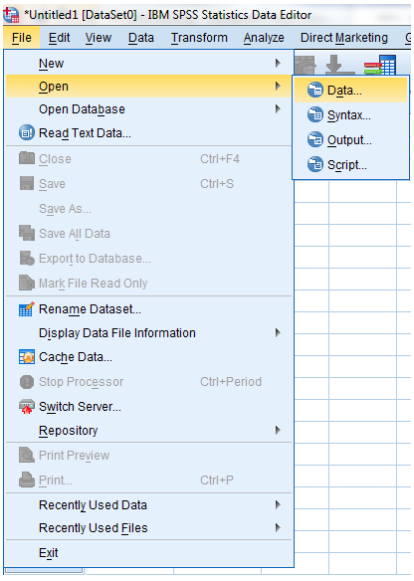
3 The observations are independent of each other

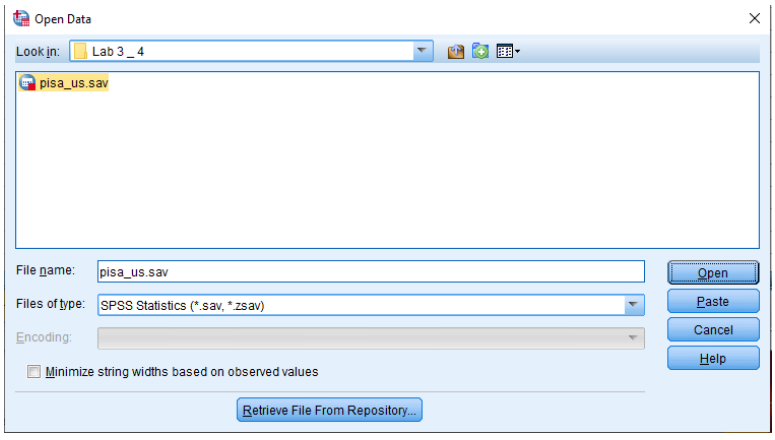
4 The data is numeric

2. **Levene's Test – What assumption does Levene's test confirm? What conditions indicate that the assumption has been met?**
   Assumption 1 of equal variances between groups is confirmed by the Levene's test. When we fail to reject the null hypothesis after carrying out the Levene's test then the condition has been met.

Dataset: pisa_us

3. Open/Import/Read Dataset: File -> Open -> Data. Select **All Files** from Files of type to show the file you're looking for. Select the correct file and click **Open**.





4. Independent samples t-test. Test whether reading score (wleread2) differs by gender (ST03Q01; 1=Female, 2=Male).

What is the independent variable?

Gender

What is the dependent variable?

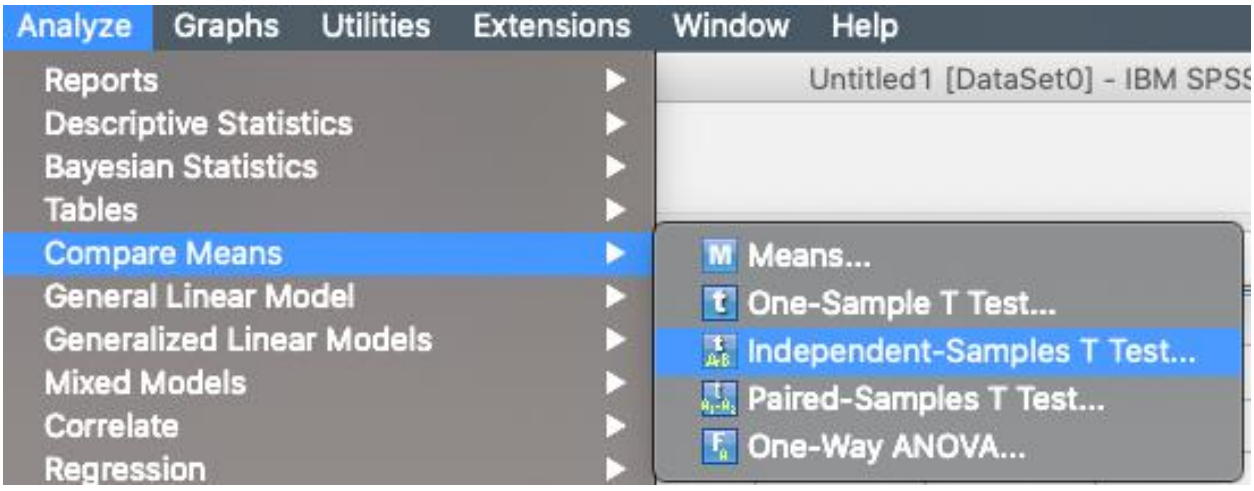
Reading Scores

State the null and alternative hypotheses

H_0: The reading score does not differ by gender

H_1: The reading score differs by gender

Analyze -> Compare Means -> Independent Samples T Test -> Find and move **wleread2** into Test Variable(s) -> Move **ST03Q01** into Grouping Variable -> Define Groups -> Enter 1 into Group 1 and 2 into Group 2 -> Continue -> Paste.



Take a screenshot of your syntax and paste it here:

```
T-TEST GROUPS=ST03Q01(1 2)
  /MISSING=ANALYSIS
  /VARIABLES=wleread2
  /CRITERIA=CI(.95).
```

Run the test (highlight the syntax and click the green triangle button). Take a screenshot of the output and paste it below:

Group Statistics

	Sex - Q3	N	Mean	Std. Deviation	Std. Error Mean
Warm estimate in reading - interpreting	Female	865	516.6773	104.51919	3.55362
	Male	836	488.7485	118.94389	4.11367

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Warm estimate in reading - interpreting	Equal variances assumed	12.882	.000	5.149	1699	.000	27.92889	5.42412	17.29023	38.56754
	Equal variances not assumed			5.138	1655.430	.000	27.92889	5.43604	17.26665	38.59113

5. Interpreting your results.

1	2 Sex – Q3	3 N	4 Mean	5 Std. Deviation	6 Std. Error Mean
Warm estimate in reading – interpreting	Female	865	516.6773	104.51919	3.55362
	Male	836	488.7485	118.94389	4.11367

1. Dependent Variable
2. Independent Variable (groups)
3. Sample Size (n) for each group
4. Sample Mean (M) for each group
5. Sample standard deviation (s) for each group
6. Sample standard error (s_M) for each group

A	B	Levene's Test for Equality of Variances: C (F)	Levene's Test for Equality of Variances: D (Sig.)	E (t)	F (df)	G (Sig. (2-tailed))	H (Mean Difference)	I (Std. Error Difference)	J (95% Confidence Interval of the Difference: Lower)	J (95% Confidence Interval of the Difference: Upper)
Warm estimate in reading – interpreting	Equal variances assumed	12.882	.000	5.149	1699	.000	27.92889	5.42412	17.29023	38.56754
	Equal variances not assumed			5.138	1655.430	.000	27.92889	5.43604	17.26665	38.59113

A. Dependent Variable
B. Independent Variable (groups)
C. Levene's test statistic (*F*)
D. Significance level for Levene's test
E. The *t* statistic (*t*)
F. Degrees of freedom (*df*)
G. Significance value (*p*)
H. Mean difference ($M_1 - M_2$)
I. Standard error of the mean difference (s_{M1-M2})
J. 95% C.I. of the mean difference

To Calculate effect Size:

- How do I calculate effect size (Cohen's *d*)? It's not in the SPSS tables!
  - Solve for pooled standard deviation (s_p), given standard error!
  - $s_{M1-M2} = \sqrt{\frac{s_p^2}{n_1} + \frac{s_p^2}{n_2}}$
  - $5.44 = \sqrt{\frac{s_p^2}{865} + \frac{s_p^2}{836}}$
  - $(5.44)^2 = s_p^2 * \left(\frac{1}{865} + \frac{1}{836}\right)$
  - $s_p^2 = \frac{1.33^2}{(1/865 + 1/836)}$
  - $\sqrt{s_p^2} = \sqrt{\frac{5.44^2}{(1/865 + 1/836)}}$
  - $s_p \cong$ *BRING A CALCULATOR TO THE EXAM, or* 112.17
  - $d = \frac{mean\ difference}{standard\ deviation} = \frac{27.93}{112.17} = 0.25, small\ effect$

To formally write up your results, use the following format:

Results from an independent samples t-test indicate that females (M= 516.68, SD = 104.52, n = 865) score higher than males (M = 488.75 SD= 118.94, n = 836) on reading level, t(1655.43) = 5.14, p < .001.

Levene's test found the assumption of homogeneity of variances was violated (p < .05) [plausible (p > .05)] , therefore degrees of freedom were adjusted [the test was carried out based on equal variances]. The mean difference of 27.93 points (95% CI [17,29, 38.57]) is a small effect size, d = 0.25.

6. Repeat the process – do an Independent Samples T-Test using the variable wlemath and sex as your grouping variable. State your null and alternative hypotheses and then provide a formal write up for your results.

H_0: The mathematics score does not differ by gender

H_1: The mathematics score differs by gender.

Results: Results from an independent samples t-test indicate that females (M= 491.07, SD = 91.22, n = 860) score similar to males (M = 497.70 SD = 101.66, n = 832) on mathematics level, t(1657.52) = -1.409, p > .05.

Levene's test found the assumption of homogeneity of variances was violated ($p < .05$) [plausible ($p > .05$)] , therefore degrees of freedom were adjusted [the test was carried out based on equal variances]. The mean difference of -6.62 points (95% CI [-15.84, 2.6]) is a small effect size, d = -0.07.

Repeated Samples t tests in SPSS

1. **What are the assumptions that must be met in order to conduct a repeated samples t test?**

1 Existence of two dependent samples

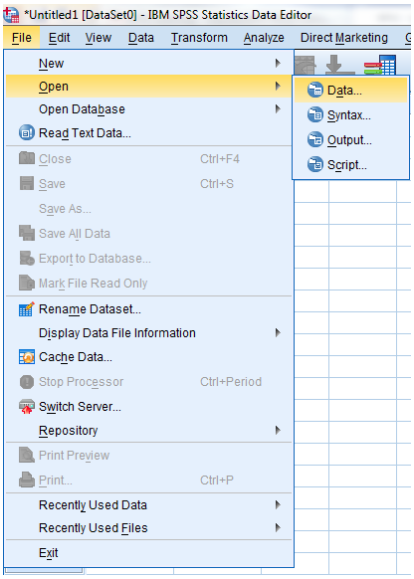
2 The differences of the paired values are normally distributed

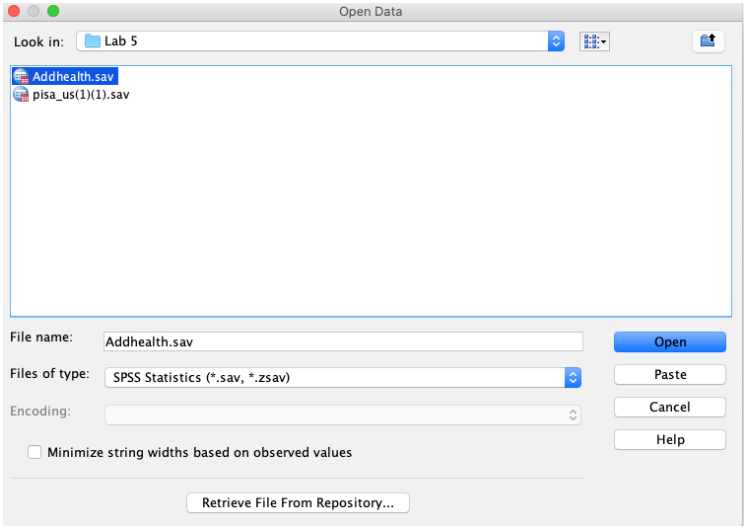
3 The dependent variable is continuous

4 Observations are independent from one another

Dataset: Addhealth.sav

2. Open/Import/Read Dataset: File -> Open -> Data. Select **All Files** from Files of type to show the file you're looking for. Select the correct file and click **Open**.





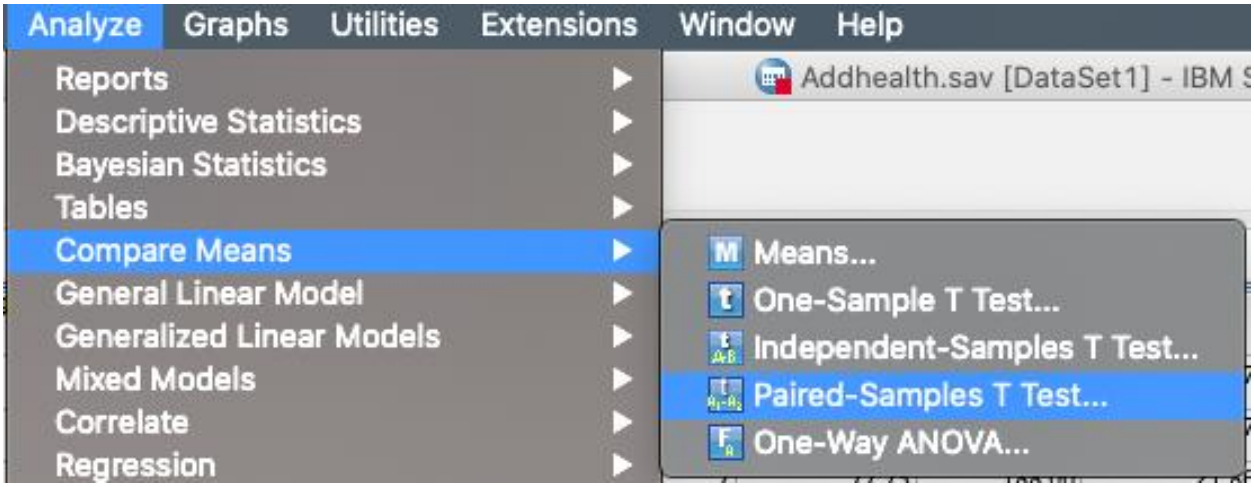
3. Independent samples t-test. Test the means of the standardized Peabody test scores for wave1 (PVTSTD1) and wave3 (PVTSTD3C) are equal.

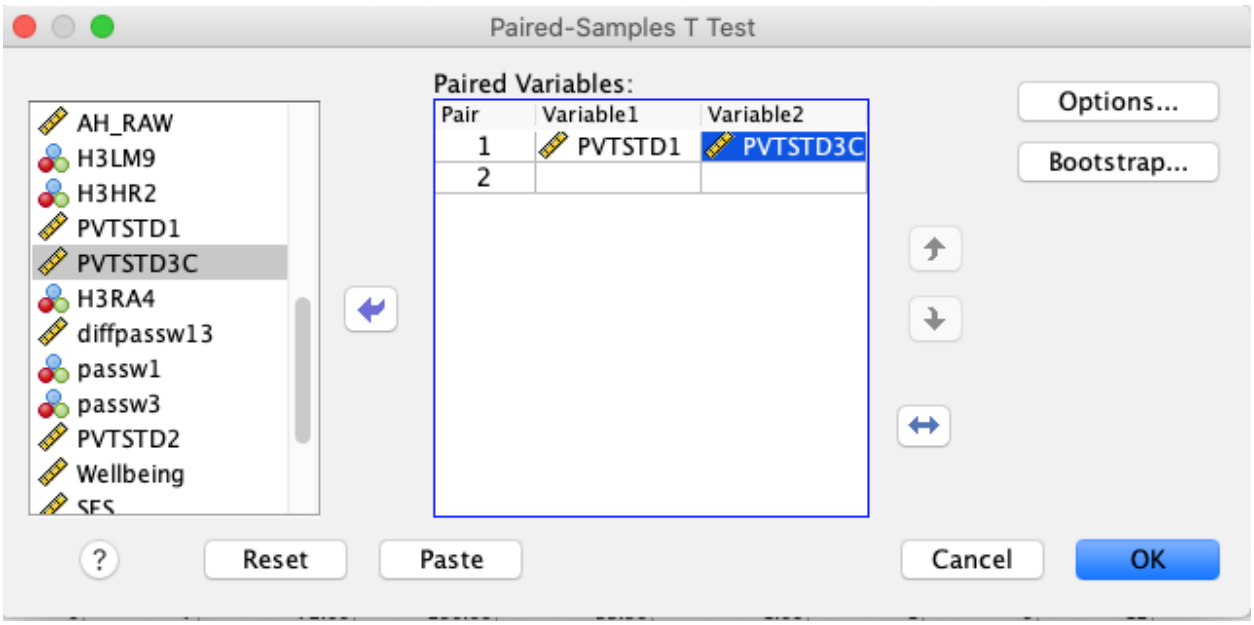
State the null and alternative hypotheses

H_0: The average Peabody test scores for wave1 and wave3 are equal.

H_1: The average Peabody test scores for wave1 and wave3 are not equal.

Analyze -> Compare Means -> Paired Sample T Test -> Find and move both **"PVTSTD1" and "PVTSTD3C"** into Test Variable(s) -> -> Paste.





Take a screenshot of your syntax and paste it here:

```
T-TEST PAIRS=PVTSTD1 WITH PVTSTD3C (PAIRED)
  /CRITERIA=CI(.9500)
  /MISSING=ANALYSIS.
```

Run the test (highlight the syntax and click the green triangle button). Take a screenshot of the output and paste it below:

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	CROSS-SECT/LONG PVT STANDRDIZED SCORE-W1	100.76	4476	14.680	.219
	CROSS-SECTIONAL STANDARDIZED SCORE-W3	100.06	4476	15.192	.227

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	CROSS-SECT/LONG PVT STANDRDIZED SCORE-W1 & CROSS-SECTIONAL STANDARDIZED SCORE-W3	4476	.636	.000

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1	CROSS-SECT/LONG PVT STANDRDIZED SCORE-W1 - CROSS-SECTIONAL STANDARDIZED SCORE-W3	.701	12.756	.191	.327	1.074	3.674	4475	.000

4. Interpreting your results.

Paired Samples Statistics

		2 Mean	3 N	4 Std. Deviation	Std. Error Mean 5
Pair 1 (1)	CROSS-SECT/LONG PVT STANDRDIZED SCORE-W1	100.76	4476	14.680	.219
	CROSS-SECTIONAL STANDARDIZED SCORE-W3	100.06	4476	15.192	.227

1. Independent variable categories
2. Mean score (*M*) for each category of independent variable
3. Sample size (*n*) for each group - should be equal if no missing data
4. Standard deviation (*s*) for each category
5. Sample standard error (s_M) for each category

Paired Samples Test

		A	B Mean	C Std. Deviation	Paired Differences: Std. Error Mean	95% Confidence Interval of the Difference: Lower	Upper	F t	G df	H Sig. (2-tailed)
Pair 1	CROSS-SECT/LONG PVT STANDRDIZED SCORE-W1 - CROSS-SECTIONAL STANDARDIZED SCORE-W3		.701	12.756	.191 (D)	.327	1.074 (E)	3.674	4475	.000

A. Value measured by M_D
B. Mean difference (M_D)
C. Standard Deviation (*s*) for M_D
D. Standard Error (s_{M_D})
E. 95% C.I. for the Mean difference (M_D)
F. The *t* statistic (*t*)
G. Degrees of freedom (*df*)
H. Significance value (*p*)

To formally write up your results, use the following format:

Results from the paired t-test indicate that Peabody math scores statistically differ between wave1 and wave 3 ***(M = 100.76, SD = 14.68, n = 4476 for Wave1; M = 100.06, SD = 15.19, n = 4476 for Wave3), t(4475) = 3.67, p < .001, Mdiff = .70, SD = 12.76, 95% CI: [.33, 1.07].***

Additional Practice

5. Repeat the process – Using a paired t-test to test whether the means of the standardized Peabody test scores for wave 1 (PVTSTD1) and wave 2 (PVTSTD2) are equal. (Data is in Addhealth.sav). Provide a write-up of your interpretation of the SPSS results.

H_0: The average Peabody test scores for wave 1 and wave 2 are equal.

H_1: The average Peabody test scores for wave 1 and wave 2 are not equal.

Results: Results from the paired t-test indicate that Peabody math scores statistically differ between wave 1 and wave 2 ***(M = 100.81, SD = 14.57, n = 4274 for Wave1; M = 97.23, SD = 12.61, n = 4274 for Wave2), t(4273) = 17.75, p < .001, Mdiff = 3.59, SD = 13.21, 95% CI: [3.19, 3.98].***