Lecture 10: T-tests

Tasks:
1. **How to perform and Interpret t-tests?**

   a. **One sample t-test**
   b. **Independent Sample t-test**
   c. **Paired Sample t-tests**

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1 a) One Sample t-test : This is used to compare the mean score of a sample to a known value. **Usually, the known value is a population mean. (Use Dataset 7)**

Hypothesis:

Hypotheses:

Null: H_0 : **There is no significant difference between the sample mean and the population mean.** (Mean Value is equal to test value)

Alternate: H_1: **There is a significant difference between the sample mean and the population mean.** (Mean Value is not equal to test value)

The one sample t-test procedure tests whether the mean of a single variable differs from a specified constant. For e.g. you may want to test whether the IQs of 30 students in your class differs from 105.

The superintendent of the NC school district claims that the students in his district are more intelligent, on the average, than the general population of the students. The mean IQ of the general population of school children is 105. A study was conducted to determine the IQs of a sample of school children in the NC district. Use data set 1 to test the null hypothesis that the mean IQ of all school children in the NC school district equals 105. This will be assessed by examining a random sample of NC students. This value was selected because it was already known that 105 is the overall mean IQ of all students in all districts. Actually, we want to know whether the NC population is any different. or Is the mean of this sample significantly different from 105?

1 b) Independent-Sample t-Test: This is used to compare the means of one variable for two groups of cases. (Use Dataset 8)

Hypothesis:

Null: H_0 : The means of two groups are not significantly different (There is no difference between integrated and traditional courses)

Alternate: H_1: The means of two groups are significantly different (There is difference between integrated and traditional courses)

The psychology department at NC University conducted a study to determine the effectiveness of an integrated statistics/experimental methods course as opposed to the traditional method of taking the two courses separately. It was hypothesized that the students taking the integrated would conduct better quality (more controlled and statistically sound) research projects than students in the traditional courses as a result of their integrated training. To determine whether there actually was a difference in student performance as a result of integrated versus traditional training, the final research projects of 20 student from an integrated course and 20 students from a traditional course were evaluated.

Use data set 2 to test the null hypothesis **that there is no difference in student performance as a result of the integrated versus traditional courses;** that is the mean difference between the conditions in the population from which the sample was drawn is zero. The alternative hypothesis reflects the psychology department's belief that the population means for the two groups of students are not equal (that is, the belief that course format had some kind of effect on quality of research projects).

1 c) Paired Sample t-Test (Dependent t test)   (Use Dataset 9)

The Paired Samples T Test compares the means of two variables. It computes the difference between the two variables for each case, and tests to see if the average difference is significantly different from zero.

Hypothesis:
Null: H_0 : There is no significant difference between the means of the two variables.

Alternate: H₁ **:** There is a significant difference between the means of the two variables.

This is used to compare the means of two variables for a single group. The procedure computes the differences between values of the two variables for each case and test whether the average differs from zero.

An investigator believes (based on past research) that parents who use positive verbal statements (polite requests and suggestions) have children who are more socially accepted and more positive in interactions with peers. Although children acquire behavioral information from sources other than parents (TV, peers, and so on), more induction (coaching children by introducing consequences for behaviors and supplying rationales that support them) on the part of parents, as opposed to more power-assertive and permissive types of discipline, facilitates a prosocial behavioral orientation in children that leads to greater social competence and greater acceptance by peers. Twenty first-grade children (who were rated by teachers and peers as aggressive) and their parents were selected for a study to determine whether a seminar instructing on inductive parenting techniques improves social competence in children. The parents attended the seminar for one month. The children were tested for social competency before course began and were retested six months after the completion of the course. The results of the social competency test are shown here (with higher scores indicating greater social competency):

Use data set 3 to test the null hypothesis that **there is no difference between the means of pre-and post-seminar social competency scores**. The alternative hypothesis reflects the investigator's belief that there is a difference between pairs of pre-and post-seminar scores; the population mean of difference scores does not equal zero (that is, the seminar has some effect on social competency scores).

Tips For Task 1 a)

Under the Analyze menu, choose Compare Means, then One-Sample T Test. Move the dependent variable into the "Test Variables" box. Type in the value you wish to compare your sample to in the box called "Test Value." *(see fig1,2,3,4a and b).*
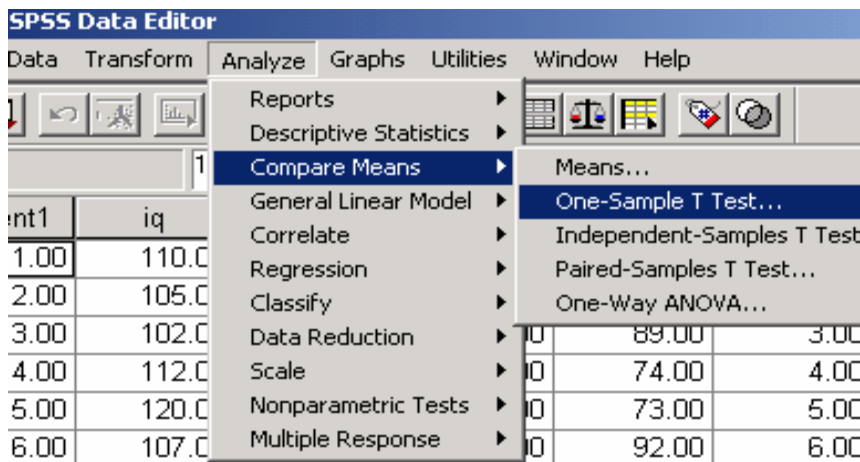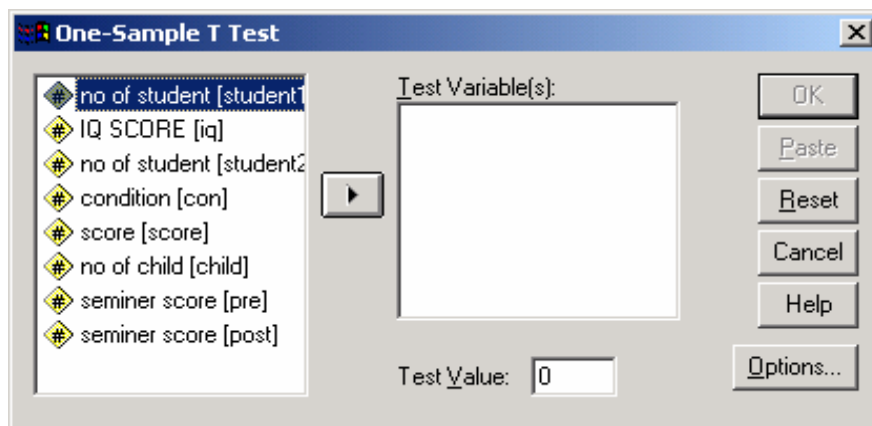
SPSS Data Editor

Data Transform Analyze Graphs Utilities Window Help

Reports	▶
Descriptive Statistics	▶
Compare Means	▶	Means…
General Linear Model	▶	One-Sample T Test…
Correlate	▶	Independent-Samples T Test
Regression	▶	Paired-Samples T Test…
Classify	▶	One-Way ANOVA…
Data Reduction	▶
Scale	▶
Nonparametric Tests	▶
Multiple Response	▶

nt1	iq
1.00	110.0
2.00	105.0
3.00	102.0	0	89.00	3.00
4.00	112.0	0	74.00	4.00
5.00	120.0	0	73.00	5.00
6.00	107.0	0	92.00	6.00

FIG 1

One-Sample T Test

no of student [student1
IQ SCORE [iq]
no of student [student2
condition [con]
score [score]
no of child [child]
seminer score [pre]
seminer score [post]

Test Variable(s):

OK
Paste
Reset
Cancel
Help
Options…

Test Value: 0

FIG 2

One-Sample T Test

no of student [student1
no of student [student2
condition [con]
score [score]
no of child [child]
seminer score [pre]
seminer score [post]

Test Variable(s):
IQ SCORE [iq]

OK
Paste
Reset
Cancel
Help
Options…

Test Value: 105

FIG 3

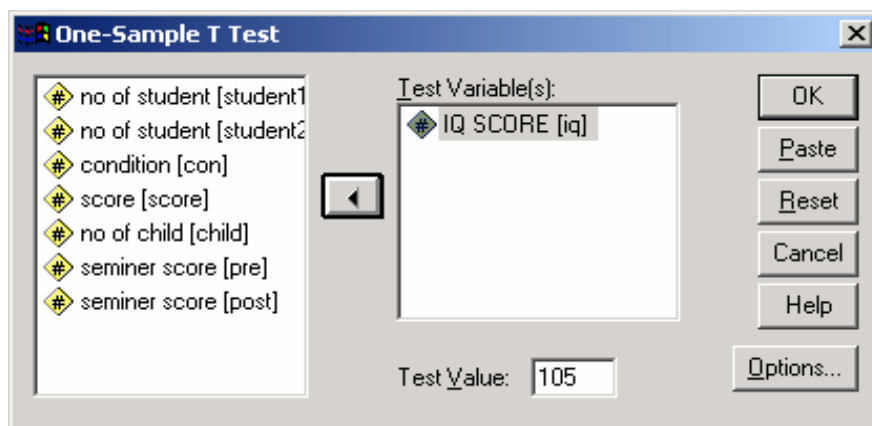|				

FIG 4a

4

The mean of our sample is 110.7333, which is slightly higher than our population mean of 105.

Next, we see the results of our one-sample T test:

FIG 4b

Our T value is 3.9

We have 29 degrees of freedom.

Our significance value is .001.

There is a significant difference between the two groups (the significance is less than .05).

Therefore, we can say that our sample mean of 110,7333 is significantly greater than the population mean of 105.

Note: If you look at the output in fig 4b, you can realize that mean difference is 5. 73. Is a mean difference of 5.73 large enough to be significantly different from 105? The results of t-test show that t=3.9 is statistical significant at the conventional level 0.01 and so the null hypothesis is rejected

Tips For Task 1 b)

Under the Analyze menu, choose Compare Means, the Independent Samples T Test. Move your dependent variable into the box marked "Test Variable." Move your independent variable into the box marked "Grouping Variable." Click on the box marked "Define Groups" and specify the value labels of the two groups you wish to compare. *(see figs 5,6,7,8,9a and 9b).*
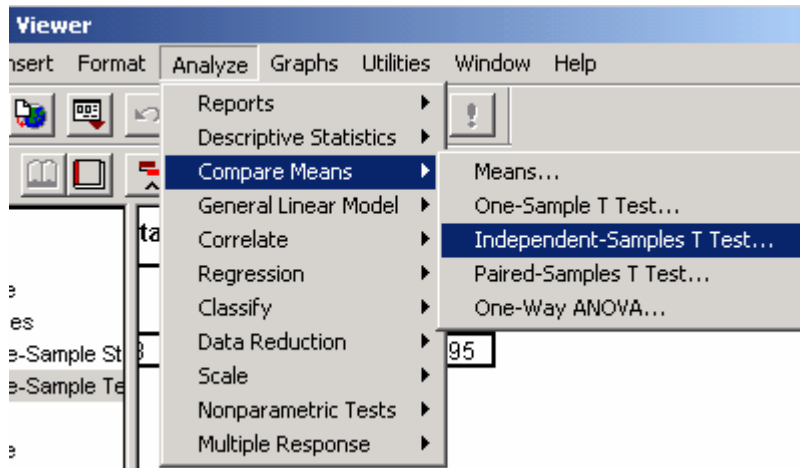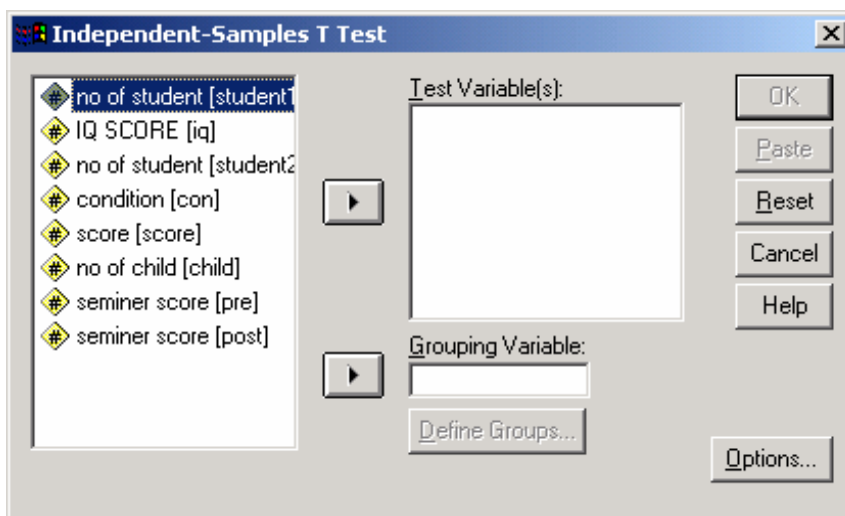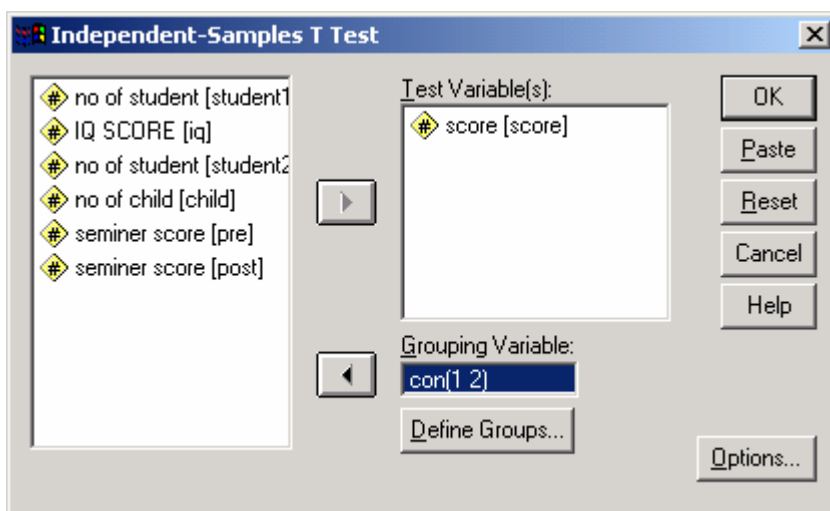
FIG 5

FIG 6

FIG 7

Define Groups

- ⦿ Use specified values   Continue
  - Group 1: 1
  - Group 2: 2   Cancel
- ○ Cut point: _____   Help

FIG 8

FIG 9a

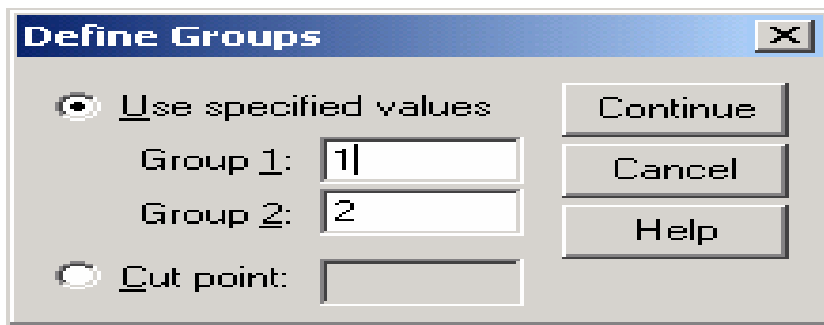|									

FIG 9b

Next, we see the Levene's Test for Equality of Variances. This tells us if we have met our second assumption (the two groups have approximately equal variance on the dependent variable). If the Levene's Test is significant (the value under "Sig." is less than .05), the two variances are significantly different. If it is not significant (Sig. is greater than .05), the two variances are not significantly different; that is, the two variances are approximately equal.

Our T value is 2.043.

We have 38 degrees of freedom.

There is a significant difference between the two groups (the significance is less than .05).

Therefore, we can say that there is a significant difference between the Integrated and Traditional groups. People who took the integrated courses had significantly higher student performance than those who took traditional course.

Note: In this question, we need to evaluate the test labeled "Equal variance assumed" because we are assuming that the two population variances are equal a pooled variance estimate is used to combine the two sample variances to obtain the most accurate estimate of the variance common to both populations. The observed t-value for this problem is 2.034 with the probability of 0.048 that is less than 0.05 and therefore, the test is considered significant at the 0.05 level. So we can conclude that the null hypothesis is rejected at the 0.05 level of significance. In other word, we reject that there is no difference in student performance as a result of the integrated versus traditional courses.

Tips For Task 1 c)

Under the Analyze menu, choose Compare Means, then choose Paired Samples T Test. Click on both variables you wish to compare, then move the pair of selected variables into the Paired Variables box. *(see fig 10,11,12,13,14a, b and c).*
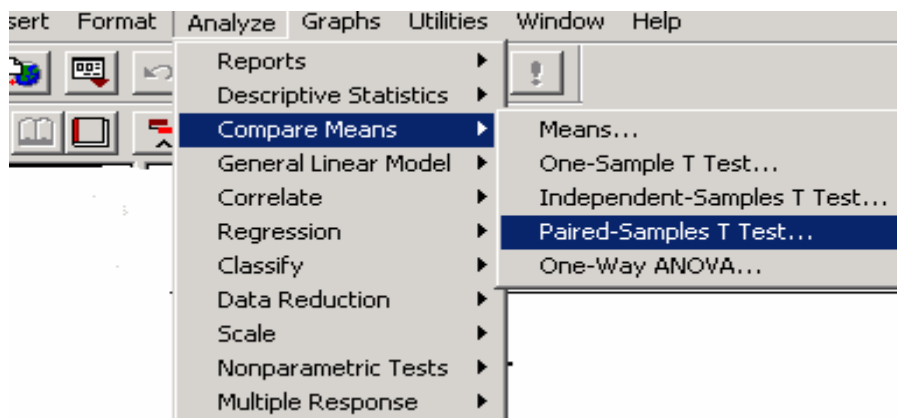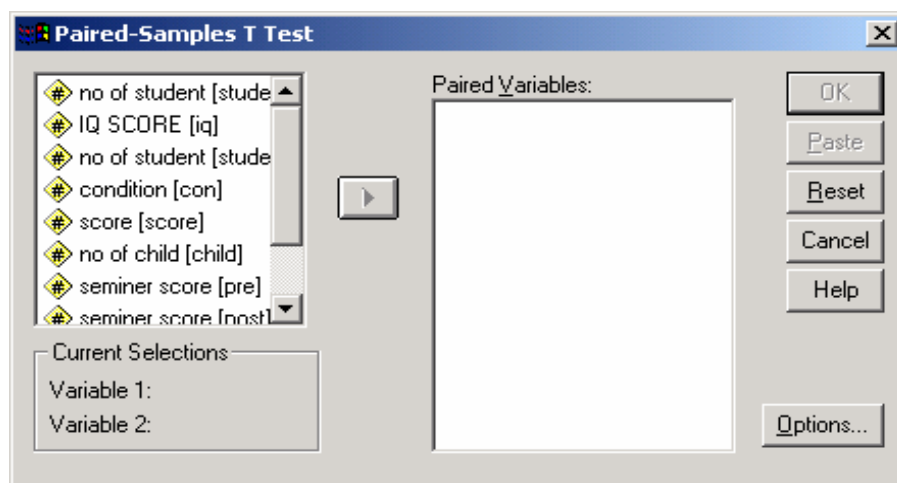

FIG 10
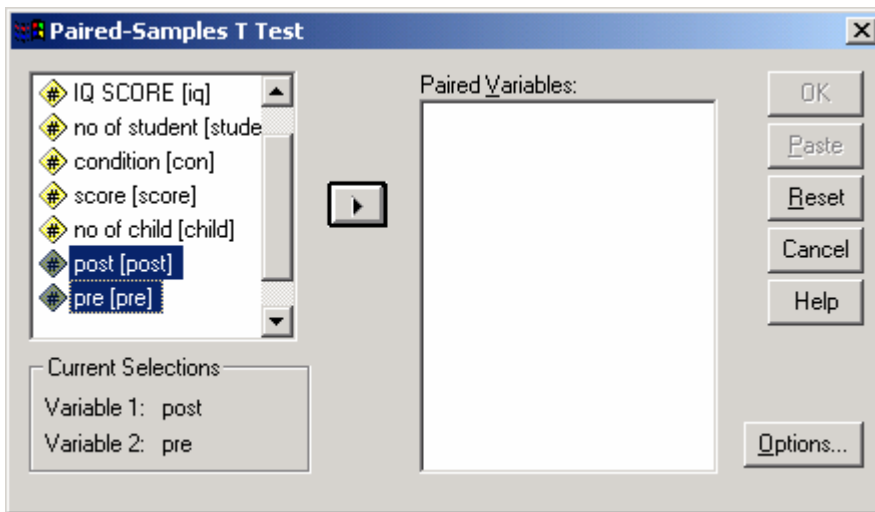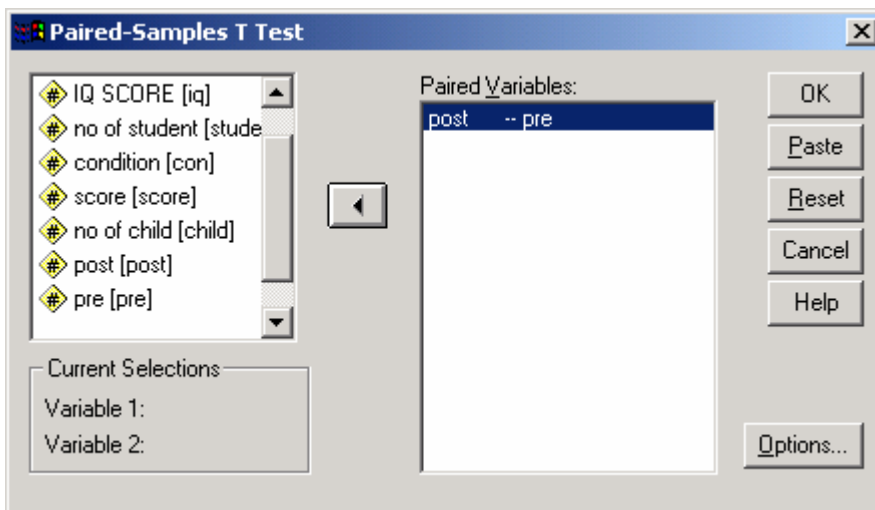

FIG 11

8

FIG 12

FIG 13

FIG 14a

The post-test mean scores are higher.

Next, we see the correlation between the two variables.

FIG 14b

There is a strong positive correlation. People who did well on the pre-test also did well on the post-test.

Finally, we see the results of the Paired Samples T Test. Remember, this test is based on the difference between the two variables. Under "Paired Differences" we see the descriptive statistics for the difference between the two variables.

FIG 14c

To the right of the Paired Differences, we see the T, degrees of freedom, and significance.

The T value = 4.280

We have 19 degrees of freedom

Our significance is .000

If the significance value is less than .05, there is a significant difference.
If the significance value is greater than. 05, there is no significant difference.

Here, we see that the significance value is significant. There is difference between pre- and post-test scores. Our test preparation course did help!

Note: A paired t-test is calculated by first computing a set of difference scores in which one variable is subtracted from the other (i.e. post minus pre). The mean of these differences scores is given under "paired differences" and is equivalent to the difference between the mean of pre and the mean of post. The results of t-test indicate that the estimated t-value (4.28) is greater than the critical t-value (3.88) (it can be determined from any statistic textbook); therefore, the null hypothesis (There is no difference between the means of the two variables) is rejected at the 0.01 level of significance. i.e. Our test preparation course did help!