# *Mean comparison*

- One sample test

  *compare a mean with a standard value*

- Independent samples test

  *compare means between two independent groups*

- Paired sample test

  *compare two means of a sample group*

- ANOVA (Analysis of variance)

  *compare means between three or more independent groups*

# *Mean comparison*

- One sample test

  *compare a mean with a standard value*

  $H: \mu = 165$

  $H_n: \mu \neq 165$

- Independent samples test

  *compare means between two independent groups*

  $H: \mu_1 = \mu_2$

  $H_n: \mu_1 \neq \mu_2$

- Paired sample test

  *compare two means of a sample group*

  $H: \mu_1 = \mu_2$

  $H_n: \mu_1 \neq \mu_2$

- ANOVA (Analysis of variance)

  *compare means between three or more independent groups*

  $H: \mu_1 = \mu_2 = \mu_3 \ldots\ldots$

  $H_n: \mu_1 \neq \mu_2 \neq \mu_4 \ldots\ldots$

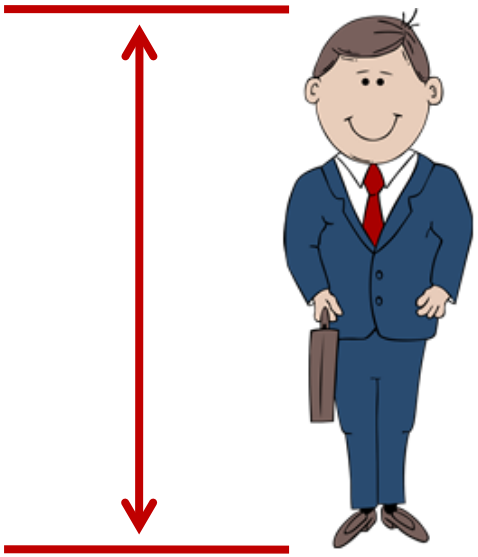
# One sample test

*compare a mean with a standard value*

*Question: Are Thai men's average-height equal to 165 cm?*

*H:* $\mu = 165$

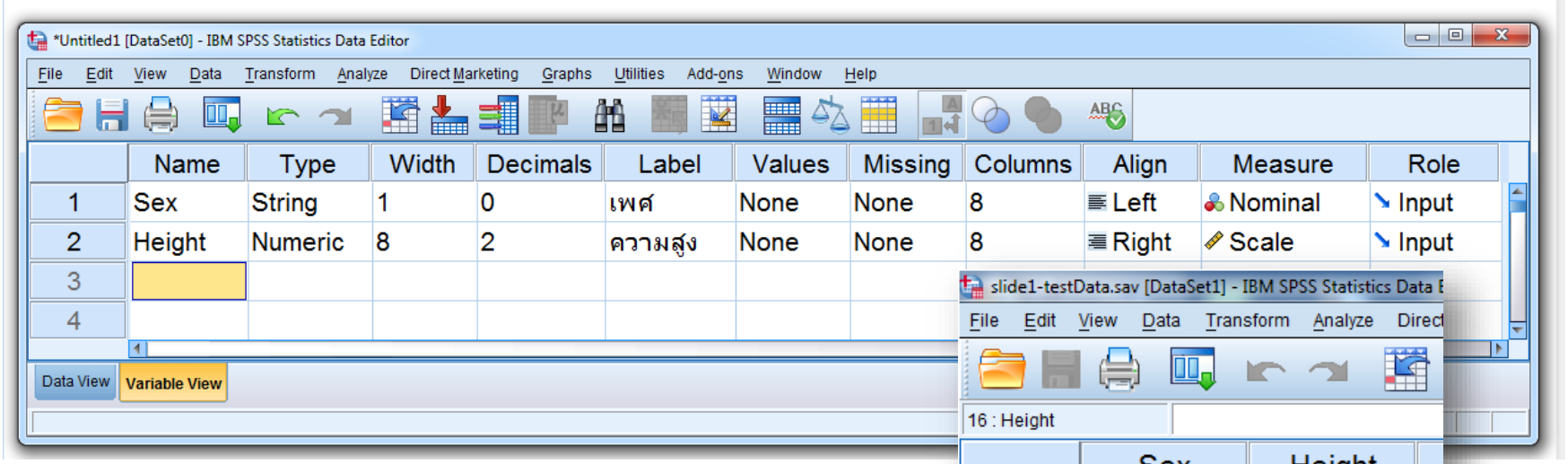
*Hn:* $\mu \neq 165$



| คนที่ | เพศ | ความสูง |
|---|---|---|
| 1 | m | 167 |
| 2 | m | 162 |
| 3 | m | 168 |
| 4 | m | 162 |
| 5 | m | 162 |
| 6 | m | 165 |
| 7 | m | 166 |
| 8 | m | 166 |
| 9 | m | 160 |
| 10 | m | 165 |

*One sample test*

# SPSS




## 1. Set variables

- Sex
- Height

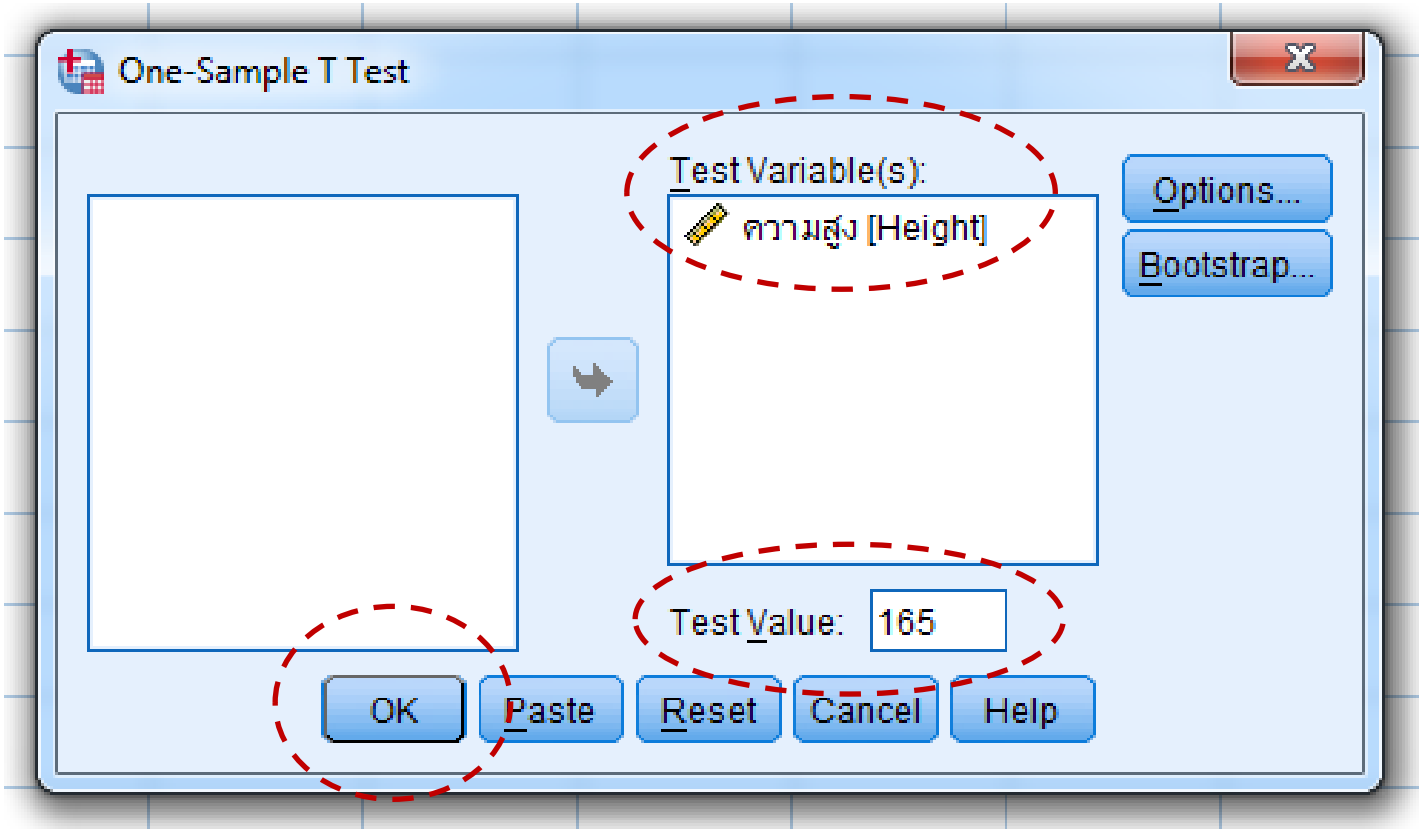
## 2. Input data

*One sample test*

# SPSS

5. Define Test Value 165

click OK



# Results

```
T-TEST
  /TESTVAL=165
  /MISSING=ANALYSIS
  /VARIABLES=Height
  /CRITERIA=CI(.95).
```

## T-Test

```
[DataSet1] C:\Users\Administrator\Documents\slide1-testData.sav
```

**One-Sample Statistics**

| | N | Mean | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|
| ความสูง | 10 | 164.3000 | 2.62679 | .83066 |

**One-Sample Test**

| | Test Value = 165 | | | | | |
|---|---|---|---|---|---|---|
| | t | df | Sig. (2-tailed) | Mean Difference | 95% Confidence Interval of the Difference | |
| | | | | | Lower | Upper |
| ความสูง | -.843 | 9 | .421 | -.70000 | -2.5791 | 1.1791 |

# *One sample test*

## SPSS

```
T-TEST
  /TESTVAL=165
  /MISSING=ANALYSIS
  /VARIABLES=Height
  /CRITERIA=CI(.95).
```

Test value = 165

**T-Test**

[DataSet1] C:\Users\Administrator\Documents\slide1-testData.sav

**One-Sample Statistics**

| | N | Mean | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|
| ความสูง | 10 | 164.3000 | 2.62679 | .83066 |

significance level = 0.05

Sig (2-tailed) = 0.421
== Greater than 0.05
>>>> Accept H (not significant)

**One-Sample Test**

| | Test Value = 165 | | | | | |
|---|---|---|---|---|---|---|
| | t | df | Sig. (2-tailed) | Mean Difference | 95% Confidence Interval of the Difference | |
| | | | | | Lower | Upper |
| ความสูง | -.843 | 9 | .421 | -.70000 | -2.5791 | 1.1791 |

# conclusion

*Hypotheses:*

*H:* $\mu = 165$

*Hn:* $\mu \neq 165$

**Sig (2-tailed) = 0.421 that is greater than 0.05** ***(not significant)***

**Therefore, accept** ***H:*** $\mu = 165$

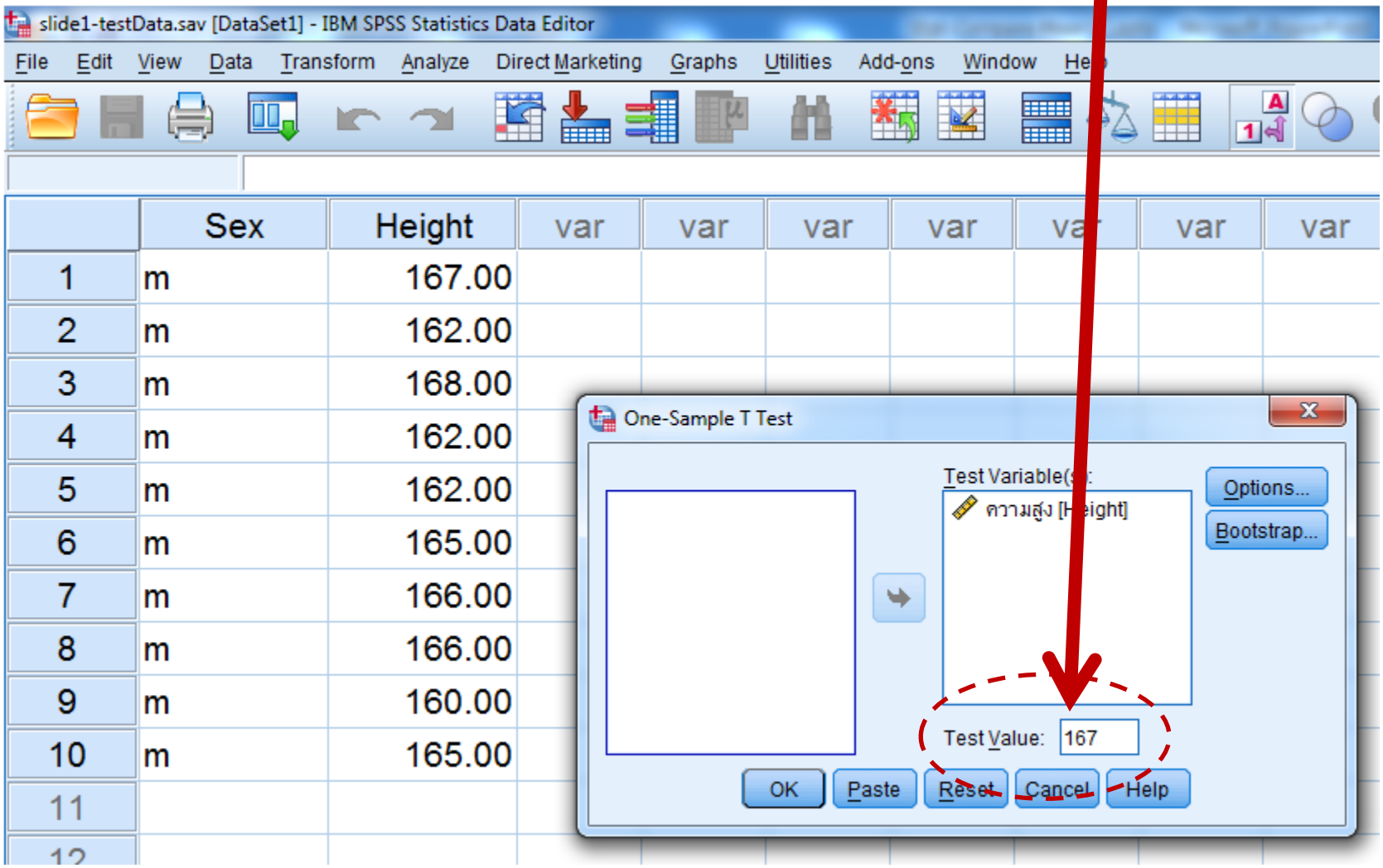
*Thai men's average-height is* ***equal to*** *165 cm*

# One sample test

## Example: *Significant*

$H: \mu = 167$

$Hn: \mu \neq 167$



*One sample test*

# SPSS

```
T-TEST
  /TESTVAL=167
  /MISSING=ANALYSIS
  /VARIABLES=Height
  /CRITERIA=CI(.95).
```

Test value = 167

## T-Test

[DataSet1] C:\Users\Administrator\Documents\slide1-testData.sav

**One-Sample Statistics**

| | N | Mean | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|
| ความสูง | 10 | 164.3000 | 2.62679 | .83066 |

Sig (2-tailed) = 0.01
== Less than 0.05 (significance level)
>>>> Significant = Accept Hn

**One-Sample Test**

| | Test Value = 167 | | | | | |
|---|---|---|---|---|---|---|
| | t | df | Sig. (2-tailed) | Mean Difference | 95% Confidence Interval of the Difference | |
| | | | | | Lower | Upper |
| ความสูง | -3.250 | 9 | .010 | -2.70000 | -4.5791 | -.8209 |

# Independent samples test

*compare means between two independent groups*

Question:

*Are Thai men's average-height equal to Thai women's average-height ?*

*H:* $\mu 1 = \mu 2$

*Hn:* $\mu 1 \neq \mu 2$

# Independent sample T-test

*compare two means of two sample groups*

**Question:**

*Is the average of male test-score equal to female test-score?*

*H:* $\mu 1 = \mu 2$

*Hn:* $\mu 1 \neq \mu 2$

# Paired sample T-test

*compare two means of a sample group*

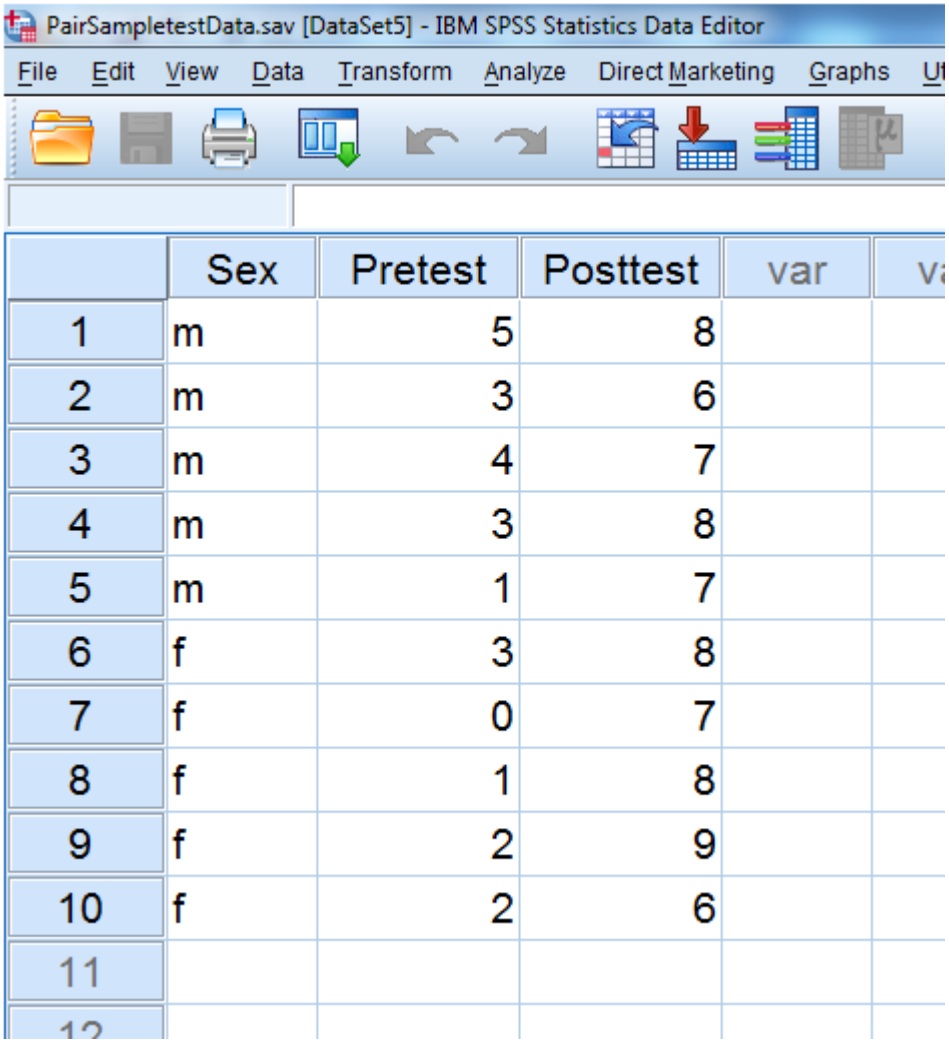
**Question:**

*Is the average of Pretest-score equal to Posttest-score?*

*H:* $\mu 1 = \mu 2$

*Hn:* $\mu 1 \neq \mu 2$

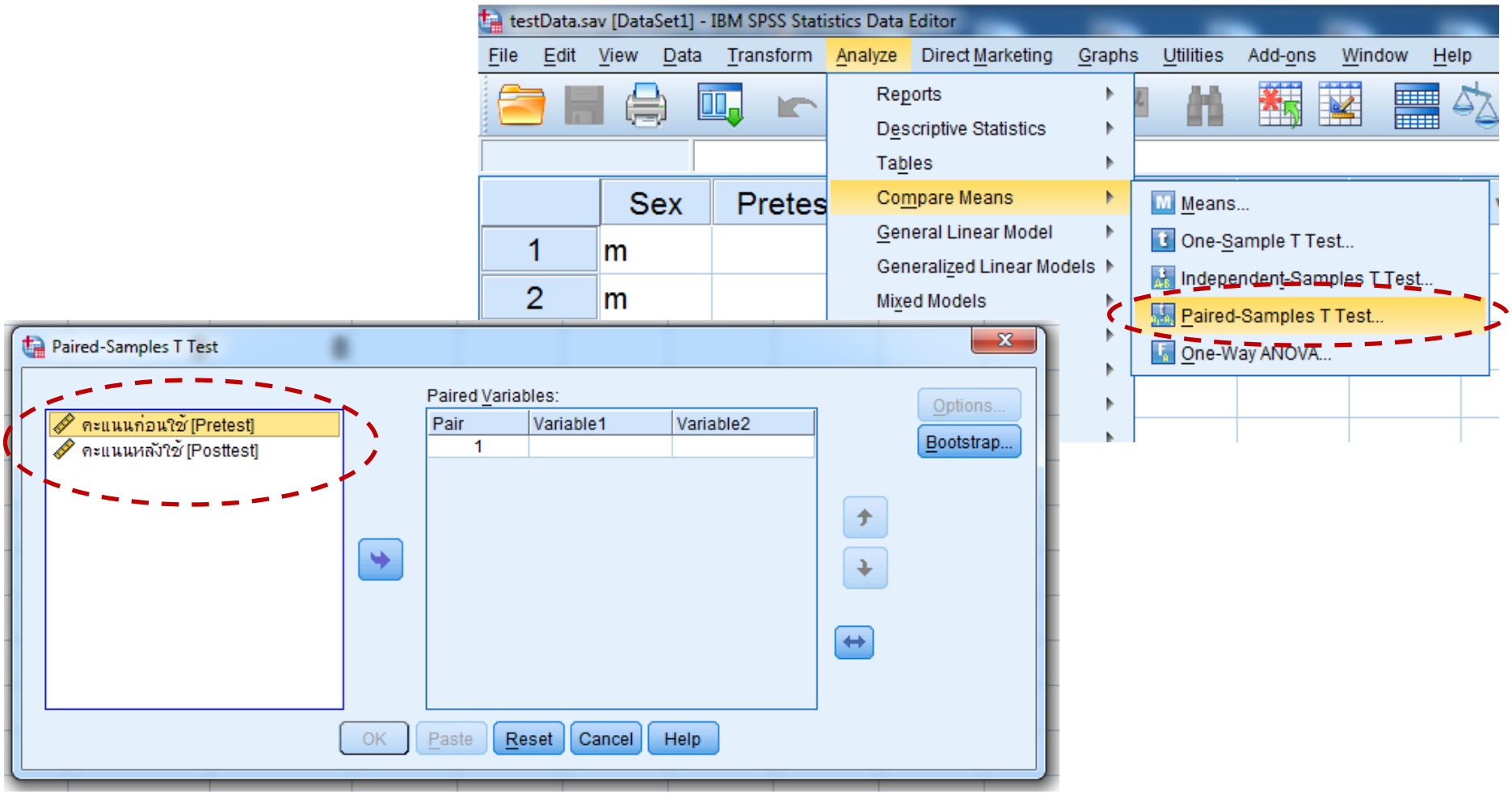
# Paired sample T-test




| | Sex | Pretest | Posttest | var | va |
|---|---|---|---|---|---|
| 1 | m | 5 | 8 | | |
| 2 | m | 3 | 6 | | |
| 3 | m | 4 | 7 | | |
| 4 | m | 3 | 8 | | |
| 5 | m | 1 | 7 | | |
| 6 | f | 3 | 8 | | |
| 7 | f | 0 | 7 | | |
| 8 | f | 1 | 8 | | |
| 9 | f | 2 | 9 | | |
| 10 | f | 2 | 6 | | |
| 11 | | | | | |
| 12 | | | | | |

# **SPSS:** *Paired-samples T-test*

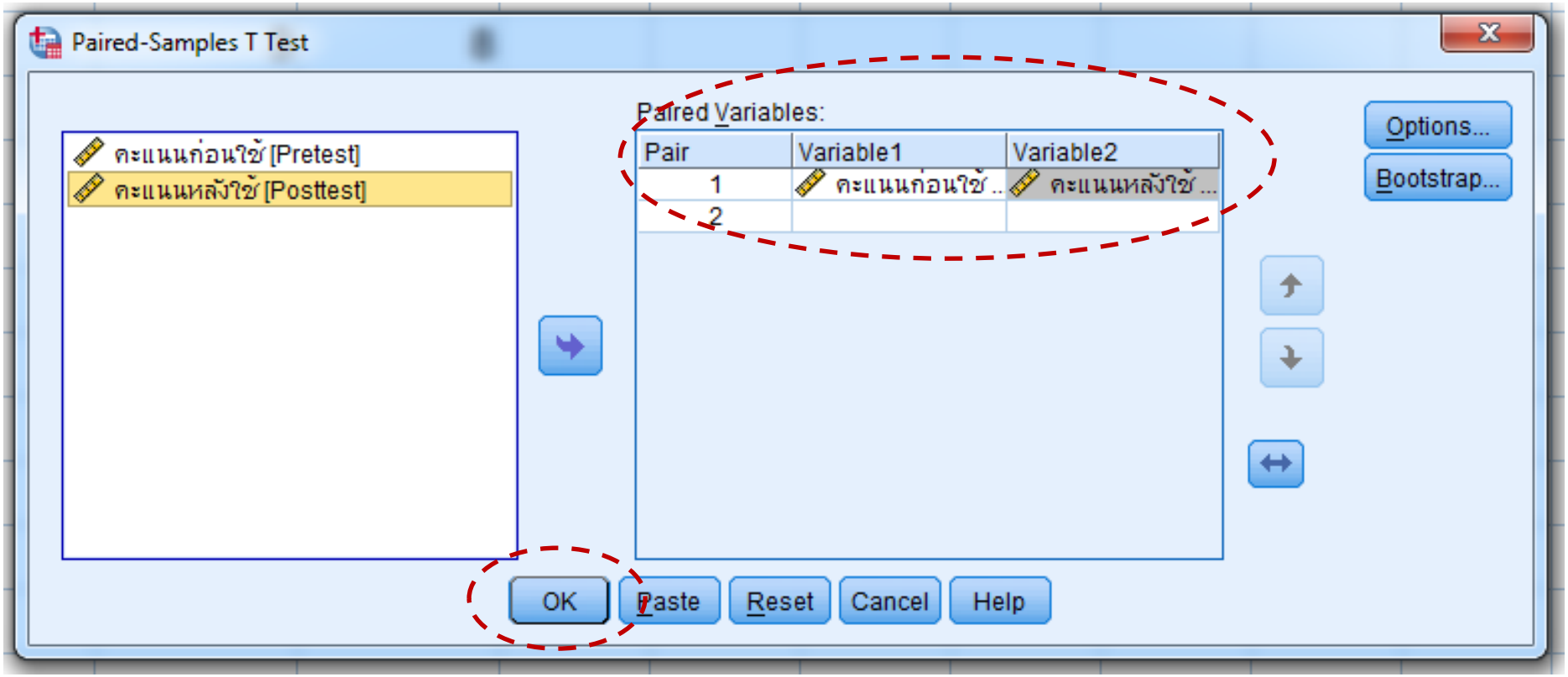
Click Analyze > Compare Means > Paired-Samples T Test



# *Paired-samples T-test*

Click คะแนนก่อนใช้ [Pretest] then click for Variable1

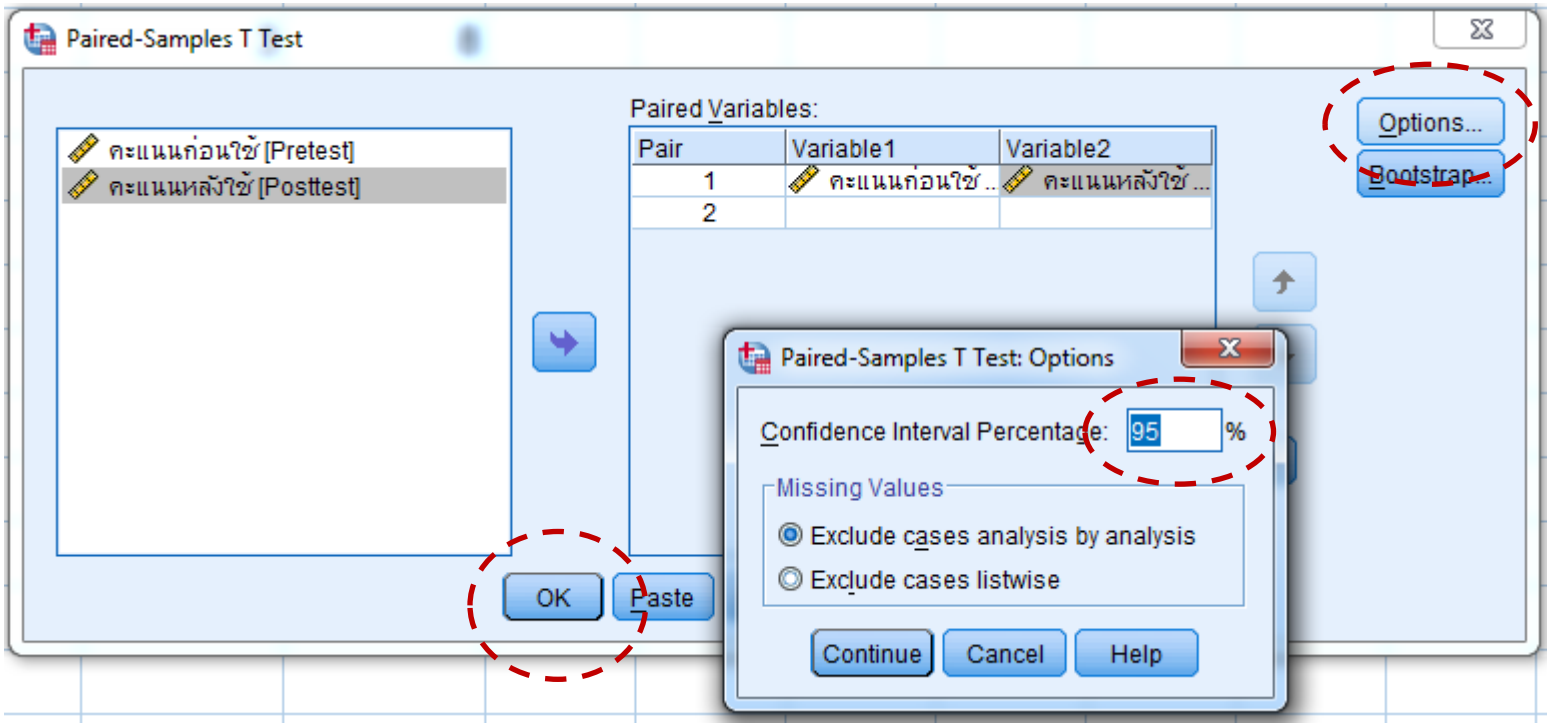
Click คะแนนหลังใช้ [Posttest] then click for Variable2



# *Paired-samples T-test*

5. Click Options

   set confidence interval as 95% then click OK



# Paired-samples T-test

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

## T-Test

```
[DataSet5] C:\Users\Administrator\Documents\PairSampletestData.sav
```

**Paired Samples Statistics**

| | | Mean | N | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|---|
| Pair 1 | คะแนนก่อนใช้ | 2.40 | 10 | 1.506 | .476 |
| | คะแนนหลังใช้ | 7.40 | 10 | .966 | .306 |

**Paired Samples Correlations**

| | | N | Correlation | Sig. |
|---|---|---|---|---|
| Pair 1 | คะแนนก่อนใช้ & คะแนนหลังใช้ | 10 | .107 | .769 |

Sig (2-tailed) = 0.000 less than 0.05

$\Rightarrow$ Significant

$\Rightarrow$ Accept *Hn:* $\mu 1 \neq \mu 2$

*the average of Pretest-score is not equal to Posttest-score*

**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 | คะแนนก่อนใช้ - คะแนนหลังใช้ | -5.000 | 1.700 | .537 | -6.216 | -3.784 | -9.303 | 9 | .000 |

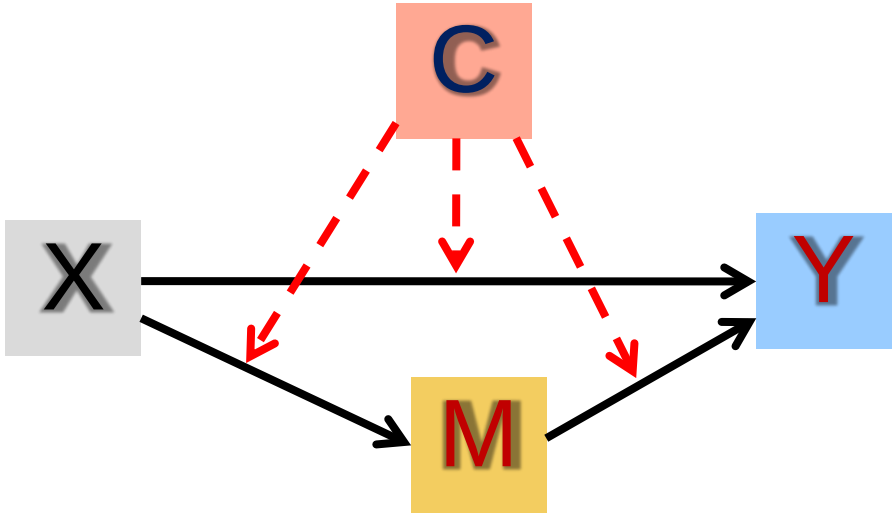
# ANOVA (Analysis of variance)

*compare means between three or more independent groups*

$H: \mu 1 = \mu 2 = \mu 3$

$Hn: \mu 1 \neq \mu 2 \neq \mu 3$

# Variables




| | |
|---|---|
| X | *Independent Variable* |
| Y | *Dependent Variable* |
| M | *Intermediate Variable* |
| C | *Control Variable* |

# Regression

- Simple Linear Regression

*1 independent variable, 1 dependent variable*

$$Y = aX + b$$

- Multiple Regression

*many independent variables, 1 dependent variable*

$$Y = a_1X_1 + a_2X2 + \ldots.. a_kXk + b$$

*Conceptual framework*