Working with MS-Excel and SPSS

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Learning Objectives

1. Define Statistics
2. Descriptive & Inferential Statistics
3. Scales of Measurement
4. Uni-bi-multi-variate analysis
5. ‘t’ test
6. ANOVA
7. ANCOVA
8. MANOVA
9. Regression
10. SPSS Help Desk

Statistics

Statistics techniques used to

collect,

organize,

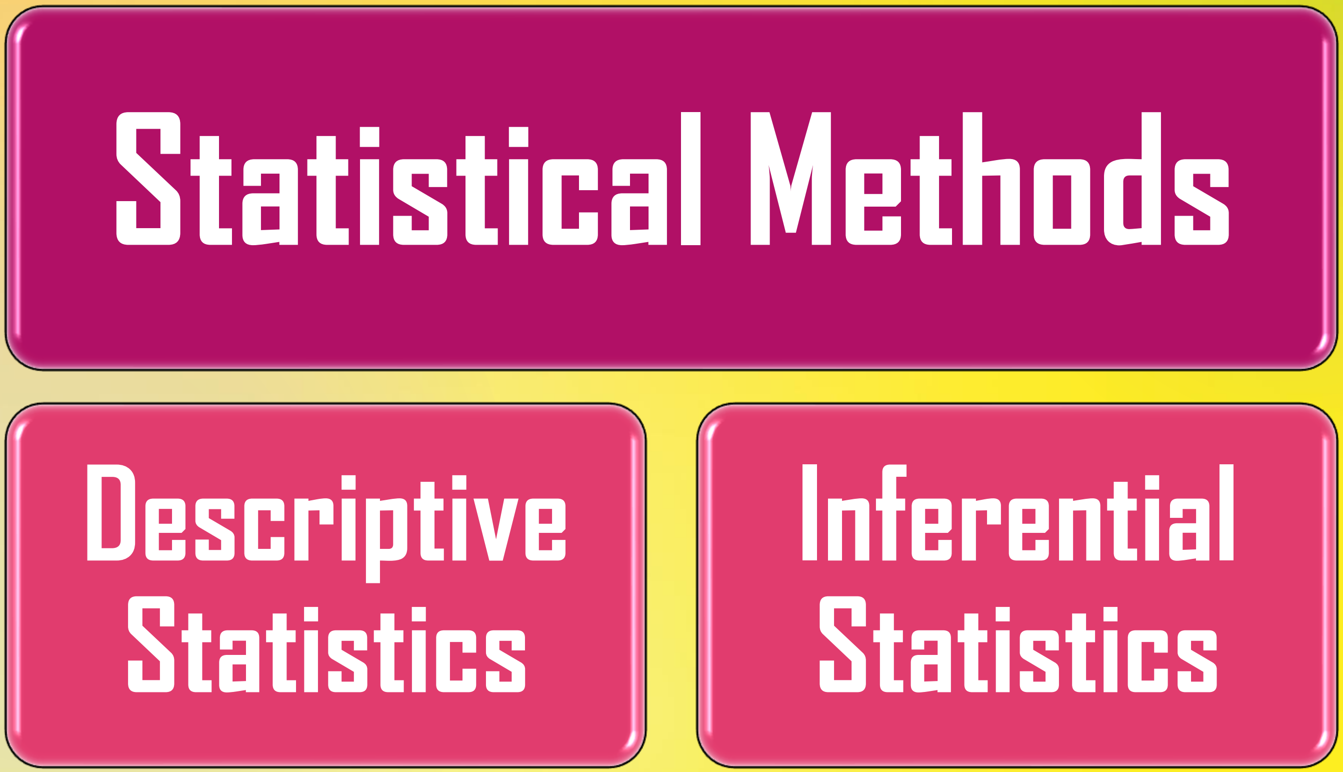
present,

analyse, and

interpret

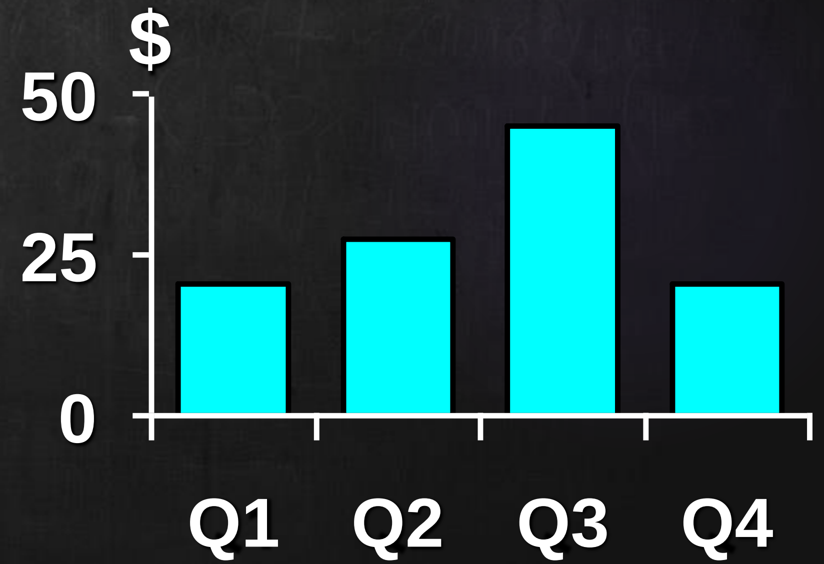
data to make better decisions.

Statistical Methods



Descriptive Statistics

1. Involves
   - Collecting Data
   - Presenting Data
   - Characterizing Data



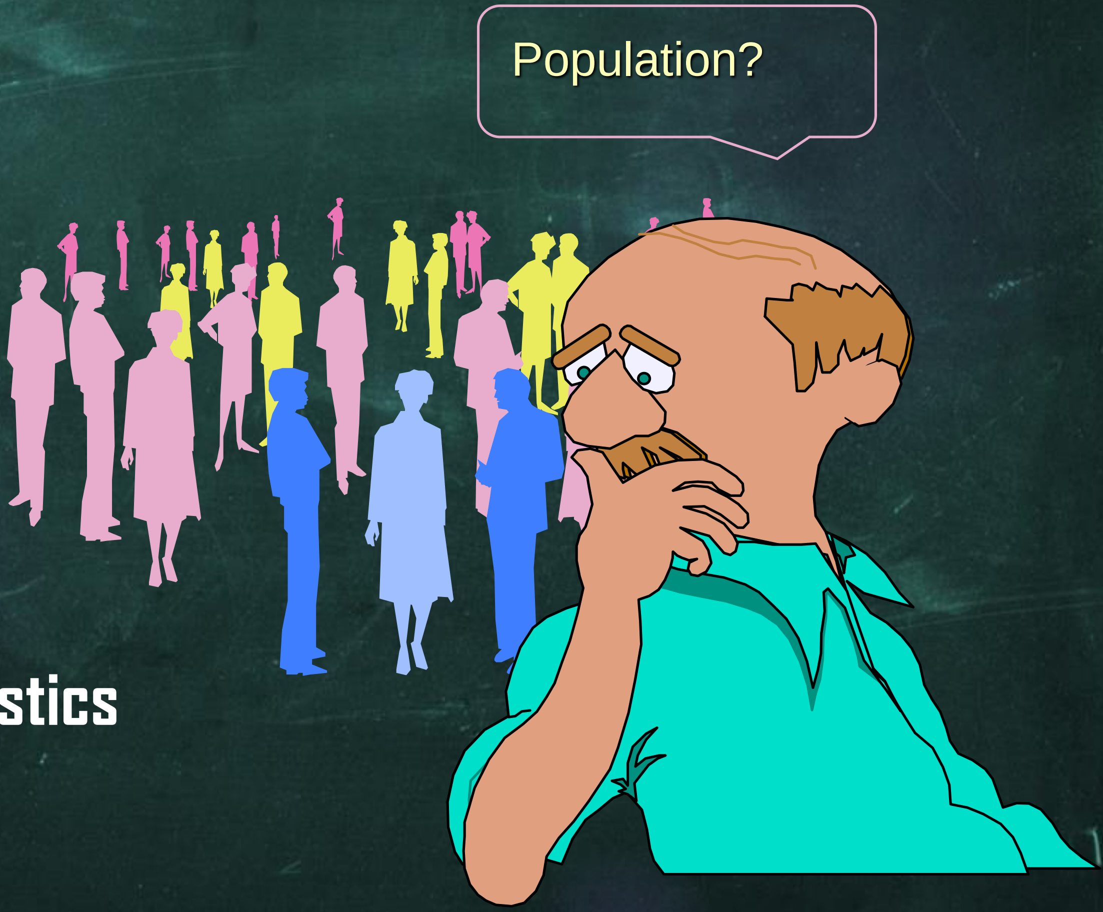
$\bar{X} = 30.5 \quad S^2 = 113$

2. Purpose
   - Describe Data

E-Spss demo S_Spss demo Excel Descriptive

Inferential Statistics

1. Involves
   - Estimation
   - Hypothesis Testing
2. Purpose
   - Make Decisions About Population Characteristics



MEASUREMENT SCALES

Stevents (1946) has recognized some types of scales

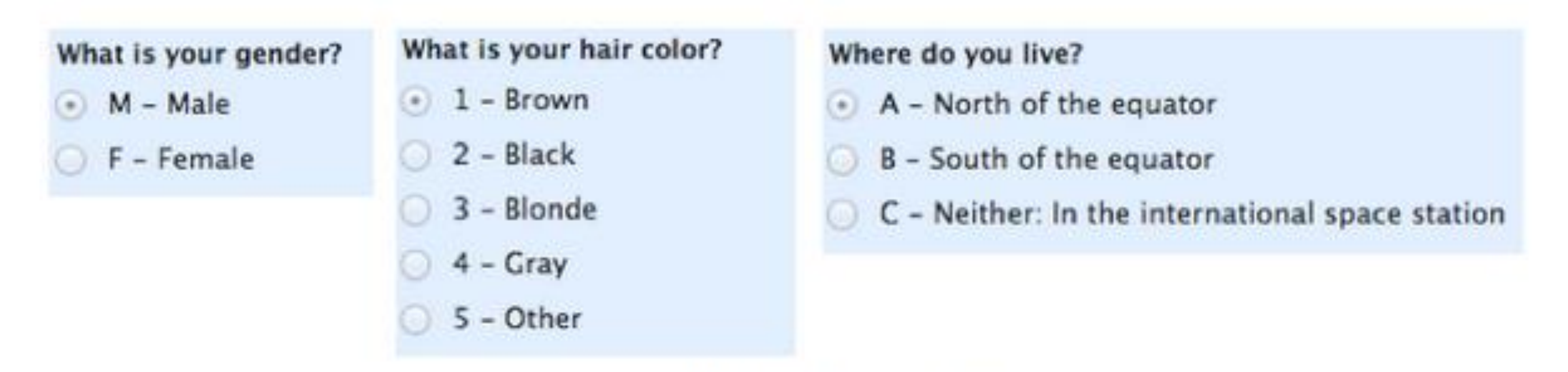
- Nominal scale
- Ordinal scale
- Interval scale
- Ratio scale

Measurement Scale

SCALE	MAGNITUDE	EQUAL INTERVALS	ABSOLUTE ZERO
NOMINAL	X	X	X
ORDINAL	√	X	X
INTERVAL	√	√	X
RATIO	√	√	√

Nominal Scale

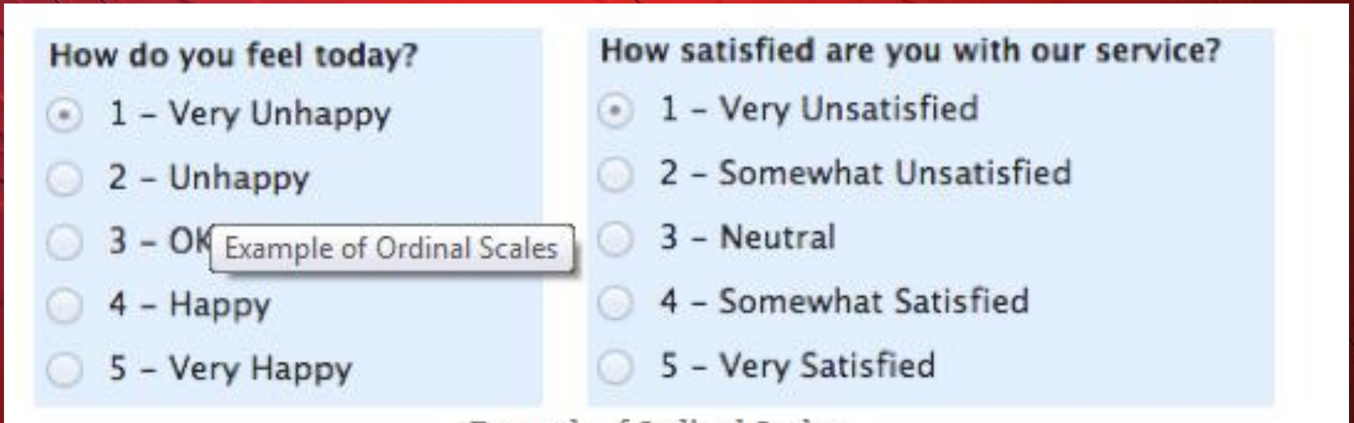
- Simple classification of objects or items into discrete groups.
- Eg. Naming of streets, naming of persons and cars



Examples of Nominal Scales

Ordinal Scale

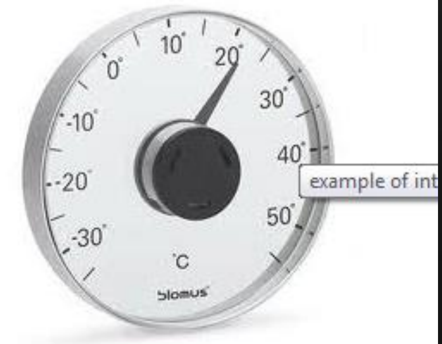
- Scale involving ranking of objects, persons, traits, or abilities without regard to equality of difference.
- Eg. Line up the students of a class according to height or merits.



Example of Ordinal Scales

Interval Scale

- Interval scales are also called equal unit scales.
- Scale having equal difference between successive categories
- Eg. Intelligence scores, personality scores



Example of Interval Scale

Ratio Scale

- Scale having an absolute zero, magnitude and equal intervals
- Eg. Height , weight, number of students in various class

SCALE	Typical statistics	
	Descriptive	Inferential
Nominal	Percentage, mode	Chi-square, Binomial test
Ordinal	Median	Rank order correlation
Interval	Mean, range, standard déviation	Product moment correlation, t-test, factor analysis
Ratio	Geometric mean	Coefficient of variation

VARIABLES

DEMOGRAPHIC VARIABLES

SEX,CLASS,

RESIDENCE

OPTIONALS,

TYPE OF SCHOOLS,

NATURE OF SCHOOLS,

MEDIUM OF INSTRUCTION,

TYPE OF FAMILIES,

FATHER'S EDUCATION,

MOTHER'S EDUCATION,

FATHER'S OCCUPATION,

MOTHER'S EDUCATION,

FAMILY INCOME

STUDY VARIABLES

ACADEMIC ACHIEVEMENT / INTELLIGENCE,

CREATIVITY

SELF-CONCEPT,

TEMPERAMENT,

ADJUSTMENT,

ANXIETY,

EMOTIONAL INTELLIGENCE,

MULTIPLE INTELLIGENCE,

ICT AWARENESS,

ATTITUDE TOWARDS ICT,

STUDY HABITS,

SOFT SKILLS

Terms uses for testing

Test	Terms
‘t’ test	Between
F- test / one way ANOVA	Among
Correlation	Relationship
Chi-square	Association
regression	Influence / impact
Two way ANOVA	Interaction effect

Test	Terms
't' test	There is no significant difference between the male and female B.Ed., trainees in their emotional intelligence
F- test	There is no significant difference among rural, urban, semi rural, semi urban B.Ed., trainees in their emotional intelligence

Test	Terms
Correlation	There is no significant relationship between the emotional intelligence and achievement of B.Ed., trainees
Chi-square	There is no significant association between the level of emotional intelligence and Parental Income of B.Ed., trainees

Interpretation Based on Table Value

If Calculated Value < Table Value,

Then H_0 accepted.

It means Not Significant

If Calculated Value > Table Value,

Then H_0 rejected.

It means Significant

Interpretation Based on ‘p’ Value

If “p” Value $<$ 0.05, Then H_0 rejected.

It means Significant

If “p” Value $>$ 0.05, Then H_0 accepted.

It means Not Significant

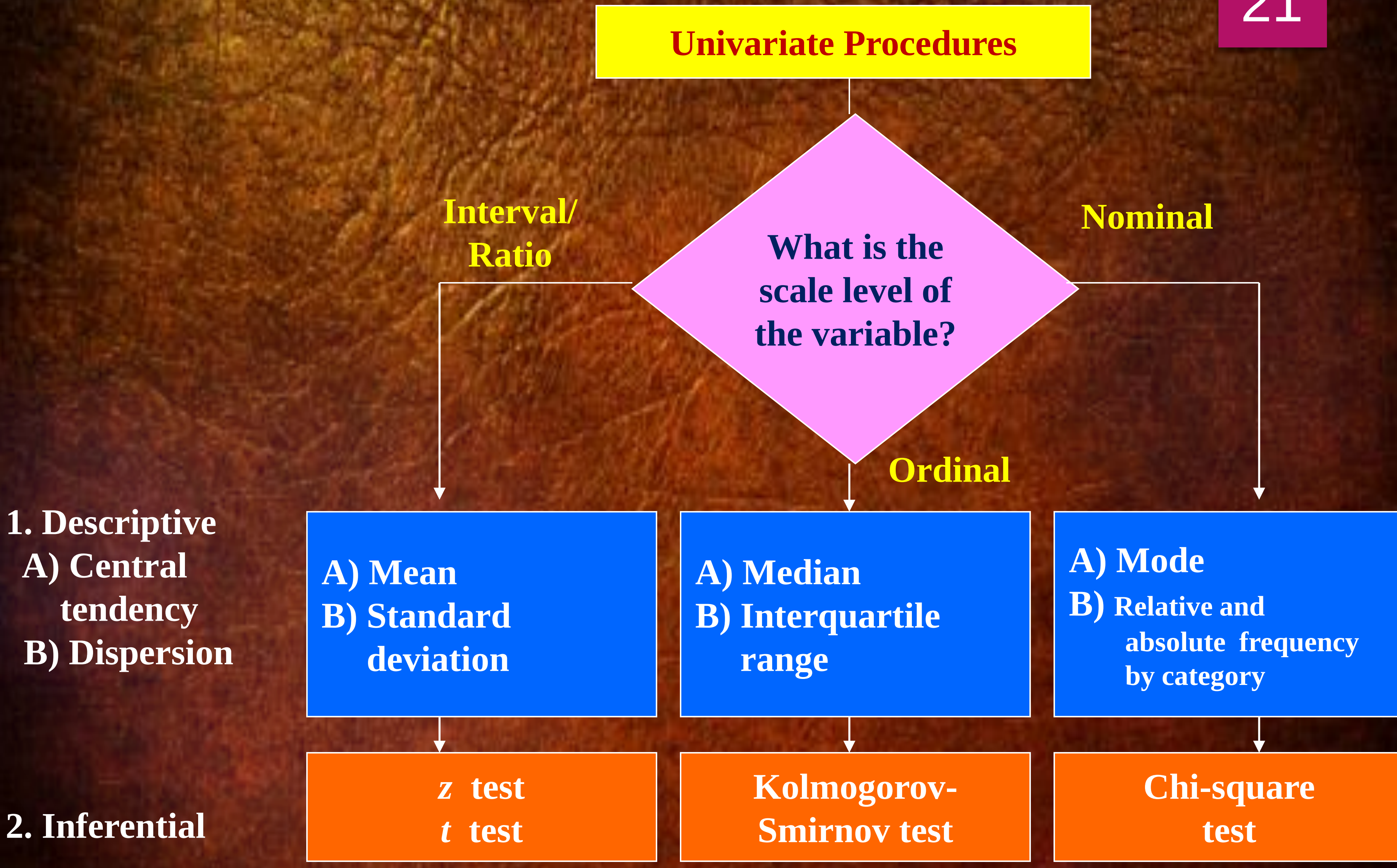
Degrees of Freedom

The number of degrees of freedom generally refers to the number of independent observations in a sample minus the number of population parameters that must be estimated from sample data.

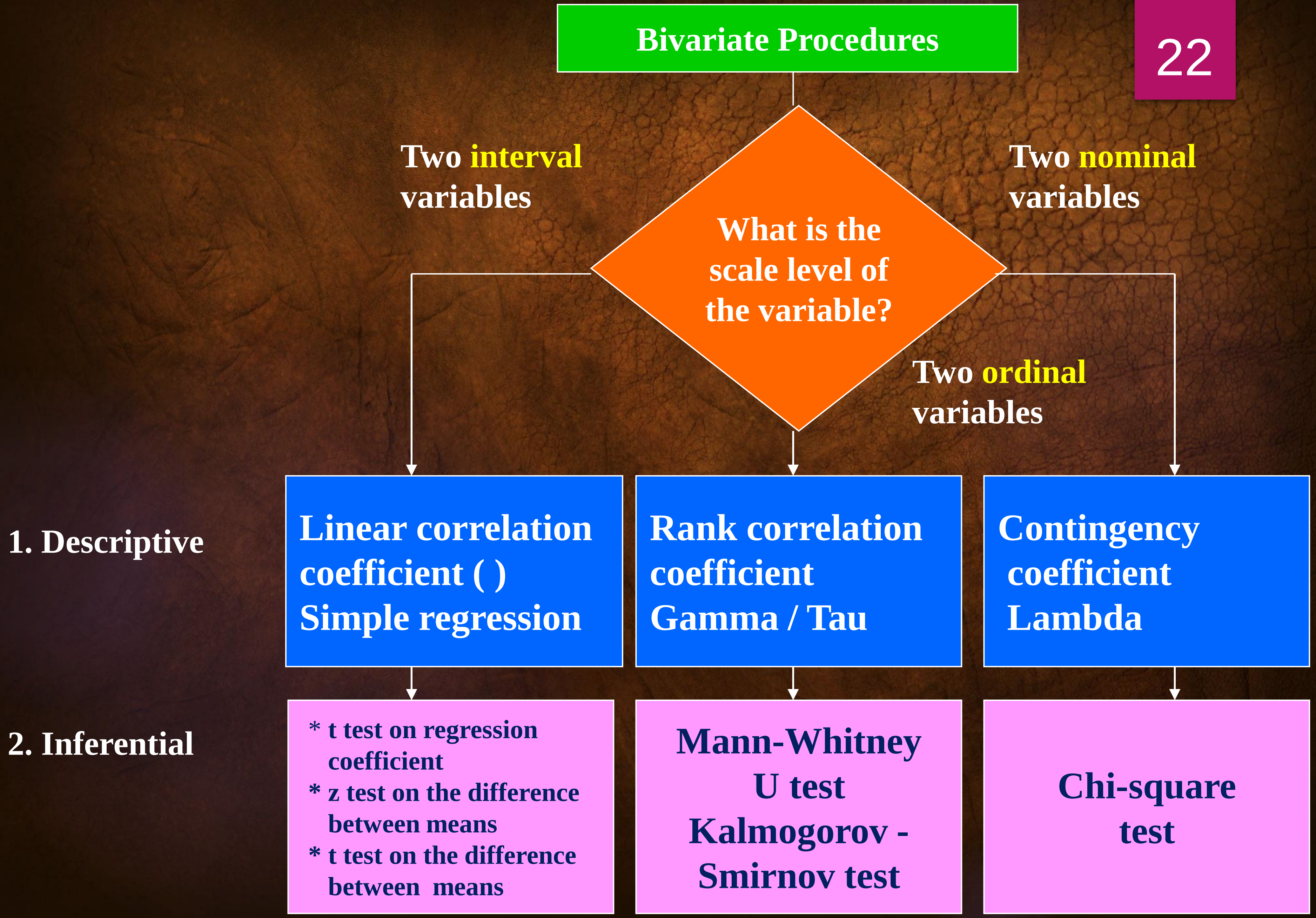
$$Df = N-1$$

Test	DF
't' test	$Df = N_1+N_2-2$
F- test	$Df_B = K-1$; $Df_W = N-K$; $Df_T = Df_B + Df_W = N-1$;
Correlation	$Df = N - 2$
Chi-square	$Df = (C-1)(R-1)$

OVERVIEW OF UNIVARIATE DATA ANALYSIS PROCEDURES



BIVARIATE DATA ANALYSIS PROCEDURES



MULTI VARIATE METHODS

INTERDEPENDENCE METHODS

1. Factor Analysis
2. Cluster Analysis
3. Multi- dimensional scaling

DEPENDENCE METHODS

Depends on:

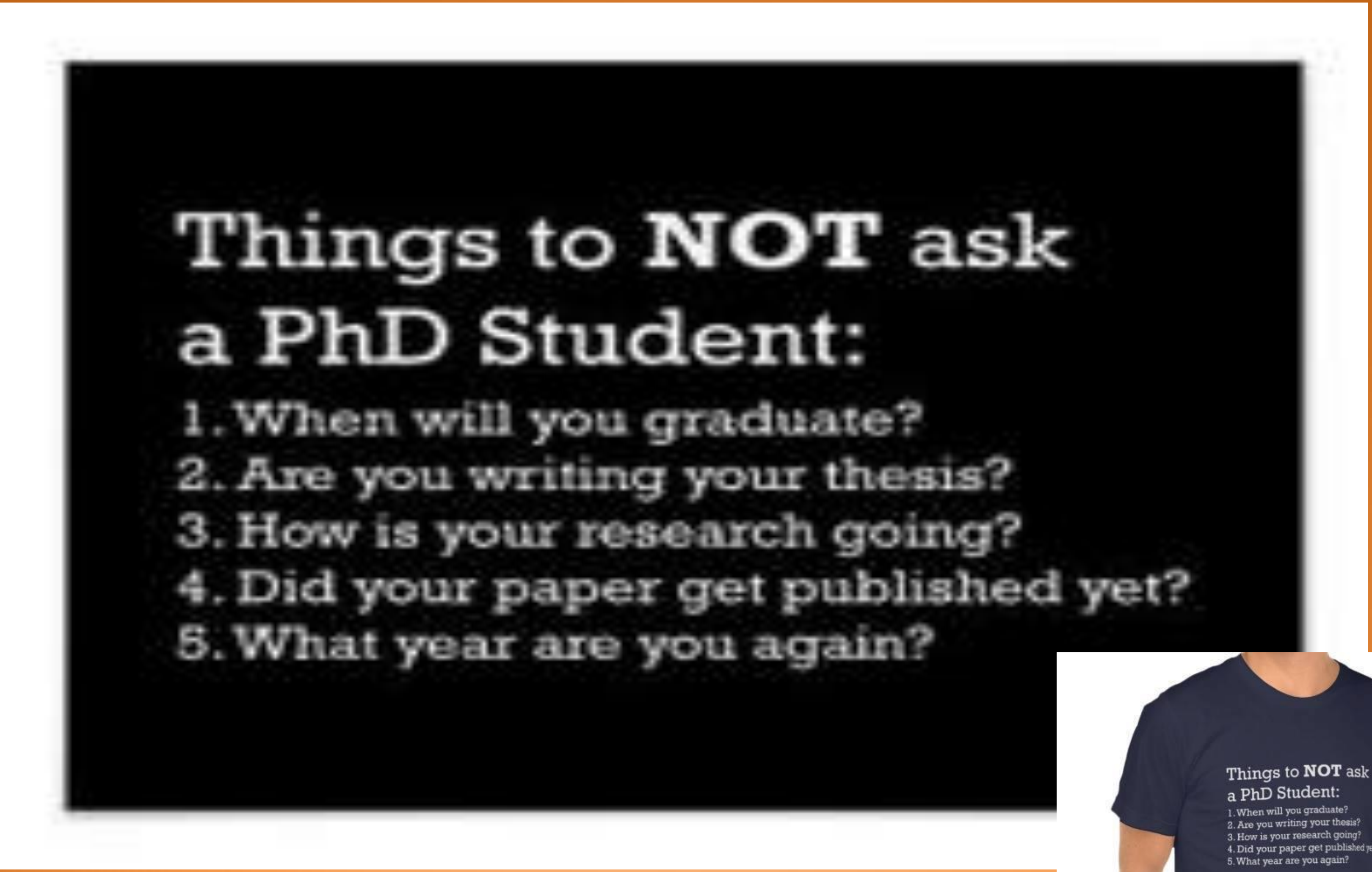
* Number of dependent variables
* Nature of the scale of data

Difference Between Parametric & Non parametric Tests

	Parametric Statistics	Non-Parametric Statistics
Scale	Interval (or) Ratio	Nominal (or) Ordinal
Distribution	Normal Distribution	Any Distribution
Sample	Large	Small
Power	More Power	Less Power
Example	‘t’ Test, ANOVA, ANCOVA, PM Correlation, Regression	Chi-Square Sign Test Median Mode Rank Difference

	Parametric	Non-parametric
Assumed distribution	Normal	Any
Assumed variance	Homogeneous	Any
Typical data	Ratio or Interval	Ordinal or Nominal
Usual central measure	Mean	Median

Tests	Parametric	Non-parametric
Correlation test	Pearson	Spearman
Independent measures, 2 groups	t-test	Mann-Whitney test
Independent measures, >2 groups	One-way, independent-measures ANOVA	Kruskal-Wallis test
Repeated measures, 2 conditions	Matched-pair t-test	Wilcoxon test
Repeated measures, >2 conditions	One-way, repeated measures ANOVA	Friedman's test


Things to **NOT** ask
a PhD Student:
1. When will you graduate?
2. Are you writing your thesis?
3. How is your research going?
4. Did your paper get published yet?
5. What year are you again?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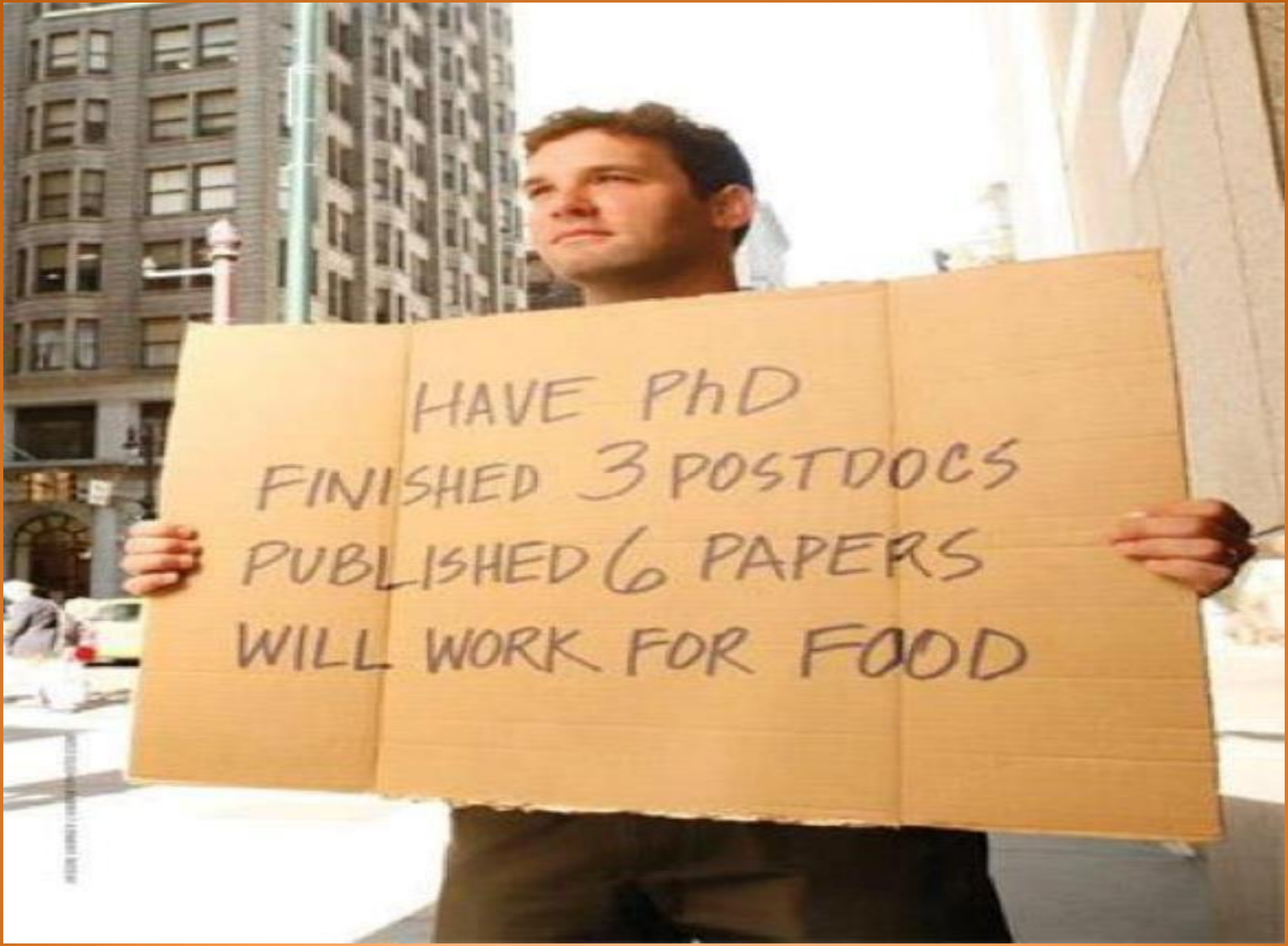

HAVE PhD
FINISHED 3 POSTDOCS
PUBLISHED 6 PAPERS
WILL WORK FOR FOOD

‘t’- Test

It was introduced by William Sealy Cosset

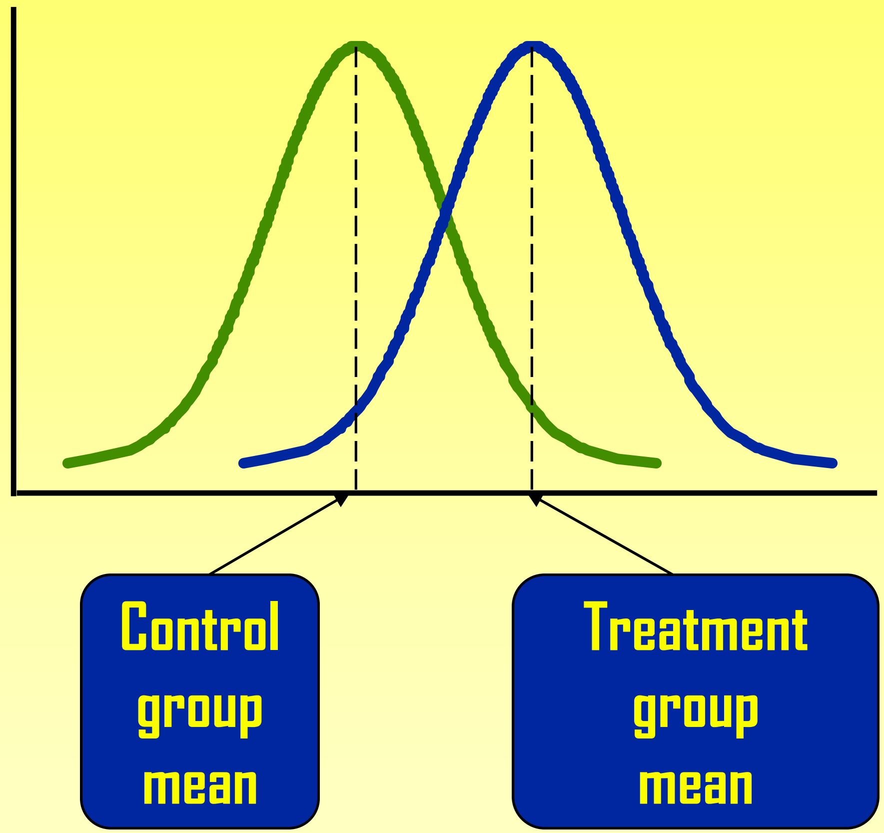
Compare the mean between 2 samples/ conditions

FORMULAS FOR CALCULATING OF SE_D OF MEANS

Independent / uncorrelated means	Correlated means
Large sample $SE_D = \sqrt{\sigma^2_{M_1} + \sigma^2_{M_2}}$ $SE_D = \sqrt{\frac{\sigma_1^2}{N_1} + \frac{\sigma_2^2}{N_2}} = \sigma_D$ $\sigma_{M_1} and \sigma_{M_2} = SE's$ of the means of the two groups; $\sigma_1 and \sigma_2$ = SD's of the two groups. N1 and N2 = number of cases in the two groups	**Large sample** $SE_D = \sqrt{\sigma^2_{M_1} + \sigma^2_{M_2} - 2r_{12}\sigma_{M_1}\sigma_{M_2}}$ r12=correlation coefficient between scores of Groups 1 and II
Small sample $SE_D = SD\sqrt{\frac{N_1 + N_2}{N_1 N_2}}$ Where $SD = \sqrt{\frac{\Sigma(X_1 - M_1)^2 + \Sigma(X_2 - M_2)^2}{(N_1 - 1) + (N_2 - 1)}}$ SD= Pooled standard deviation of the two groups. X1 and X2 = individual raw scores in the two groups.	**Small sample** $SE_D = \frac{SD}{\sqrt{N}}$ N = Number of difference of number of persons in the group. SD=the standard deviation of the difference scores.

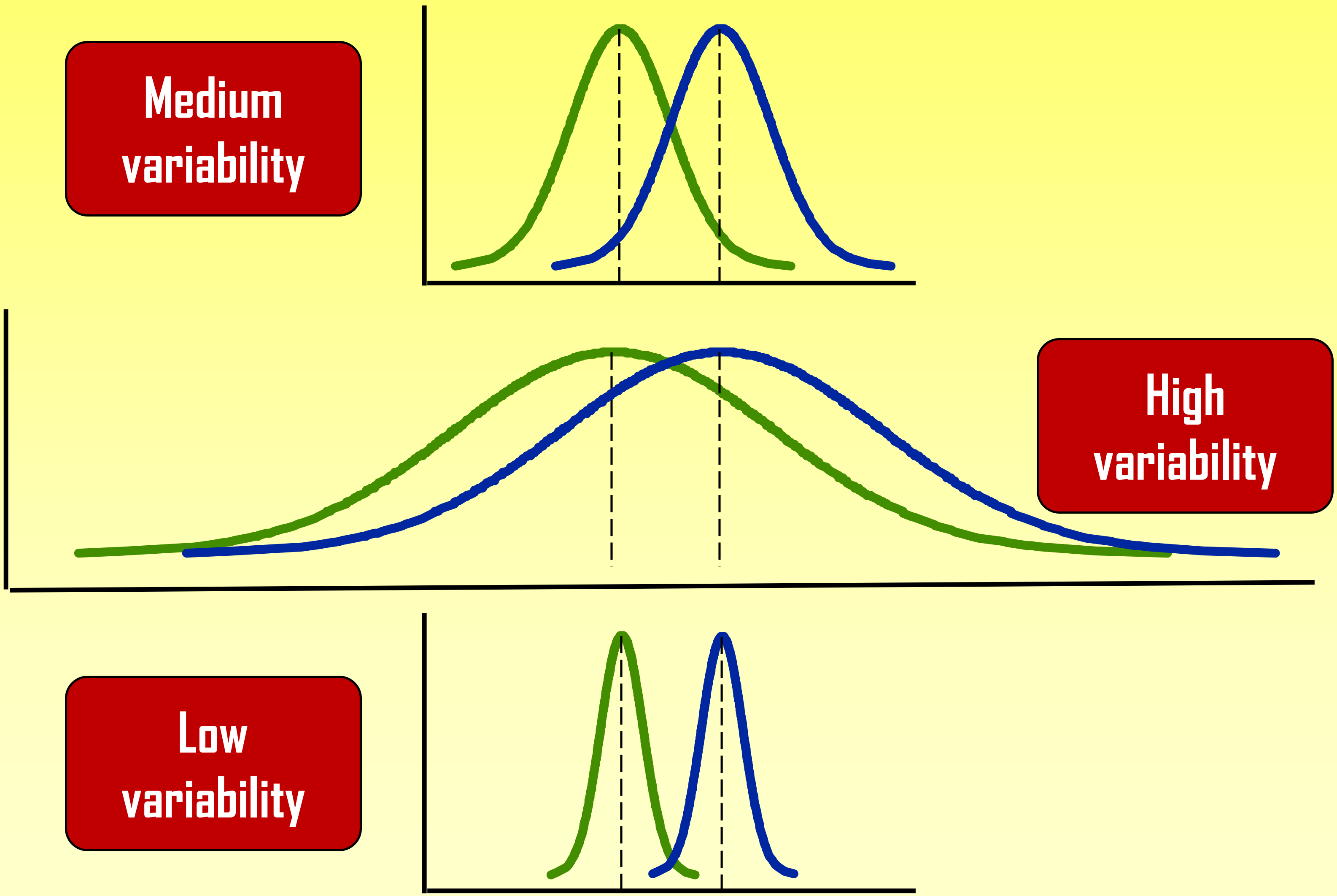
$$t = \frac{M_1 - M_2}{SE_D}$$

Statistical Analysis

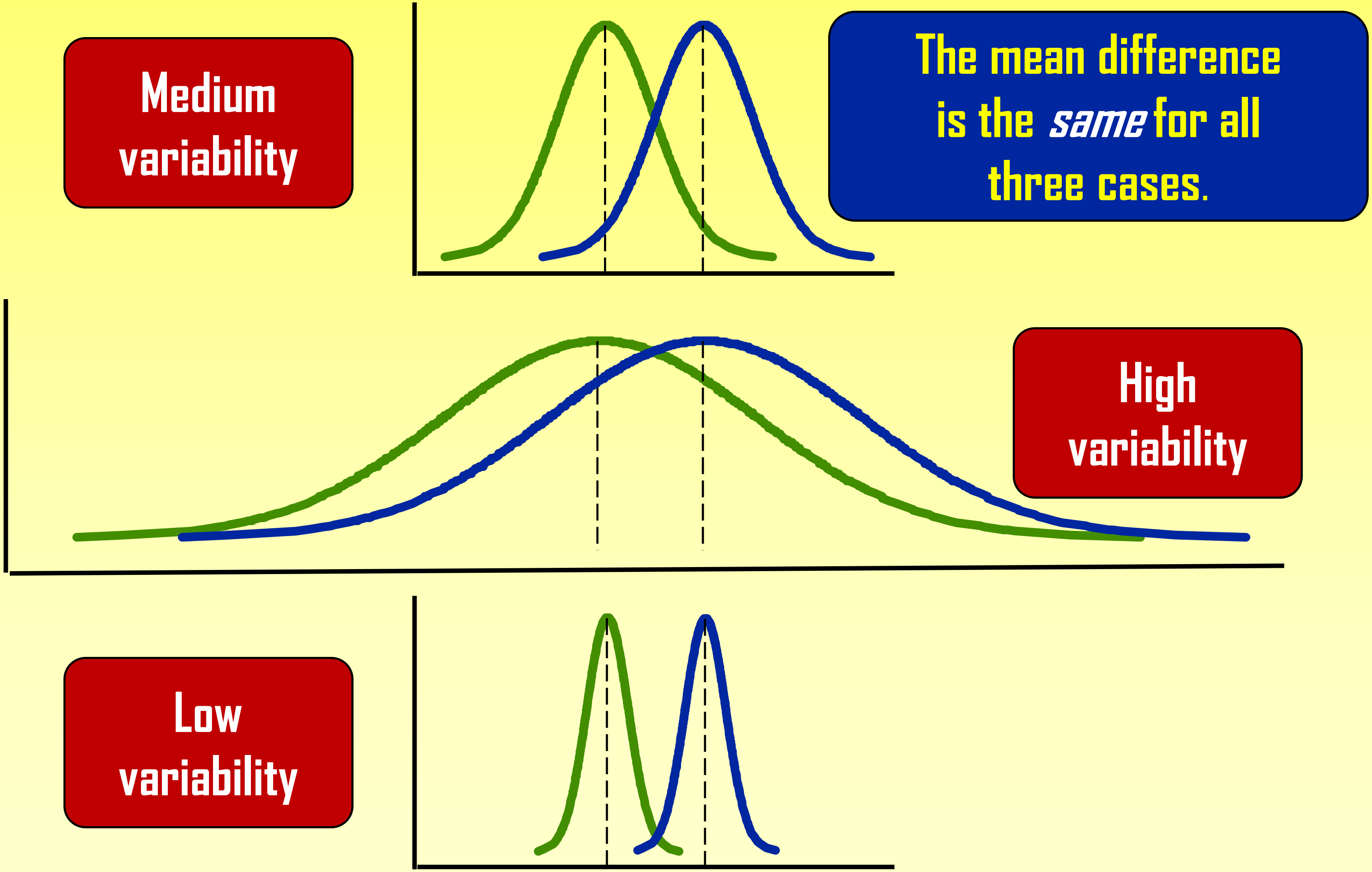


Is there a difference?

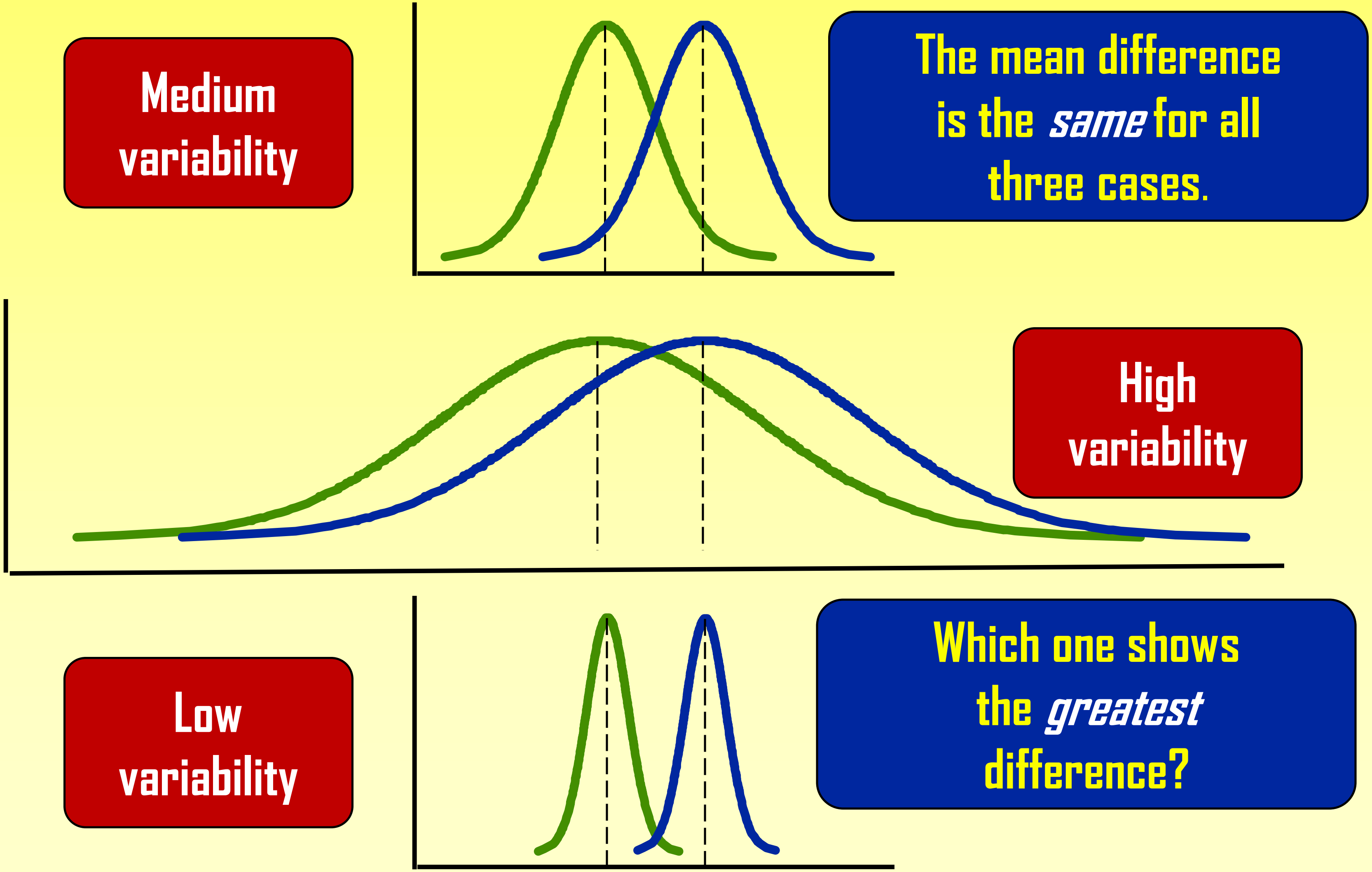
What Does Difference Mean?



What Does Difference Mean?



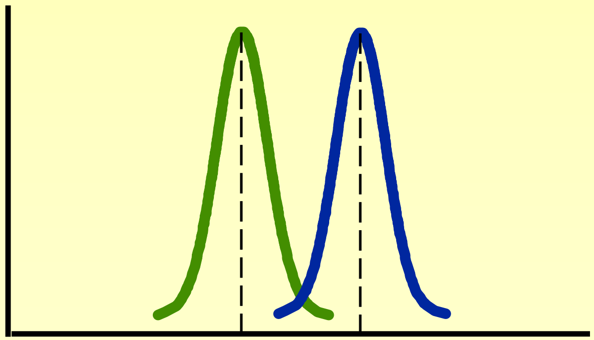
What Does Difference Mean?



What Do We Estimate?

$$\frac{\text{Signal}}{\text{Noise}}$$

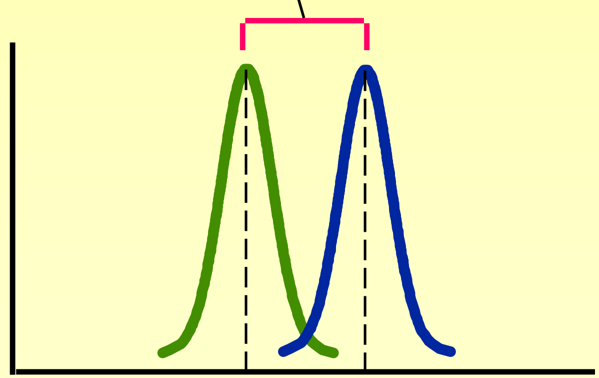
Low variability



What Do We Estimate?

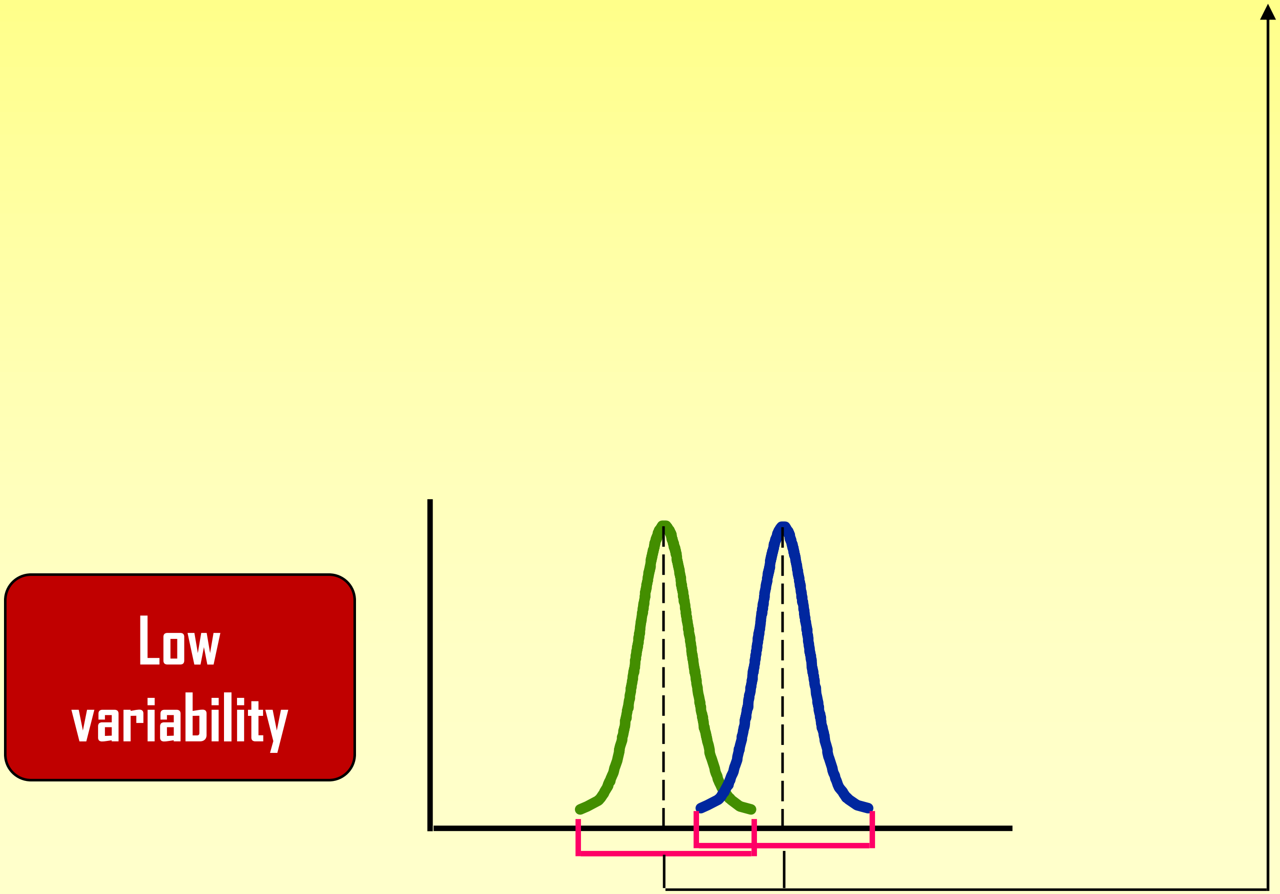
$$\frac{\text{Signal}}{\text{Noise}} = t = \text{Difference between group means}$$

Low variability



What Do We Estimate?

$$\frac{\text{Signal}}{\text{Noise}} = t = \frac{\text{Difference between group means}}{\text{Variability of groups}}$$

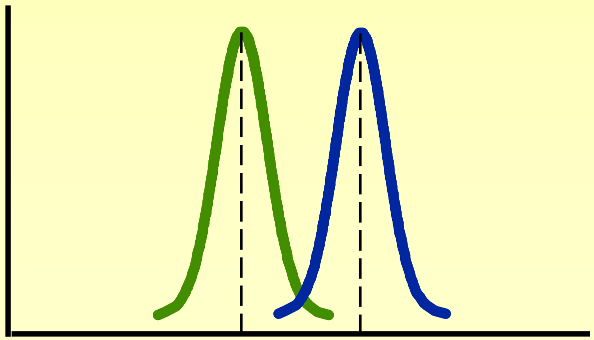


What Do We Estimate?

$$\frac{\text{Signal}}{\text{Noise}} = \frac{\text{Difference between group means}}{\text{Variability of groups}}$$

$$= \frac{\bar{X}_T - \bar{X}_C}{SE(\bar{X}_T - \bar{X}_C)}$$

Low variability



Types of t-tests

	Independent Samples	**Related Samples** also called dependent means test
Interval measures/ parametric	Independent samples t-test*  	Paired samples t-test**  
Ordinal/ non-parametric	Mann-Whitney U-Test	Wilcoxon test

*** 2 experimental conditions and different participants were assigned to each condition**

**** 2 experimental conditions and the same participants took part in both conditions of the experiments**

Independent Sample 't' test

Independent test

- IV : No. of groups (categorical-two groups)
- DV : Scores in Problem Solving (interval)

Analyze

↓

Compare Means

↓

Independent sample 't' test

E-Spss demo

S_Spss demo

Ho: There is no significant difference between control and experiment group students in their post test score.

Tool Excel Interpretation

Paired Sample 't' test

Paired test

- Two test (same sample – different interval test) : Interval Scales

Analyze

↓

Compare Means

↓

Paired sample 't' test

Ho: There is no significant difference between pre test and post test means scores of experiment group students

E-Spss demo   Interpretation

Item analysis

ANOVA
ANCOVA
MANOVA
MANCOVA

ANOVA

- No Covariate
- One dependent variable

ANCOVA

- Covariate/s
- One dependent variable

MANOVA

- No Covariate
- Two or More dependent variables

MANCOVA

- Covariate/s
- Two or More dependent variables

What is ANOVA?

- ✓ Statistical technique specially designed to test whether the **<u>means</u>** of more than 2 quantitative populations are equal.
- ✓ **Developed by Sir Ronald A. Fisher in 1920's.**

Analysis of Variance (ANOVA)

One-Way (One Independent variable)

- IV : No. of groups (categorical)
- DV : Scores in Problem Solving (interval)

- To test for significant differences between means (2 or more means) (for groups or variables) for statistical significance.
- The variables that are measured (e.g., a test score) are called <u>dependent variables.</u>
- The variables that are manipulated or controlled (e.g., a teaching method or some other criterion used to divide observations into groups that are compared) are called factors or <u>independent variables</u>.

One-way ANOVA

Example:

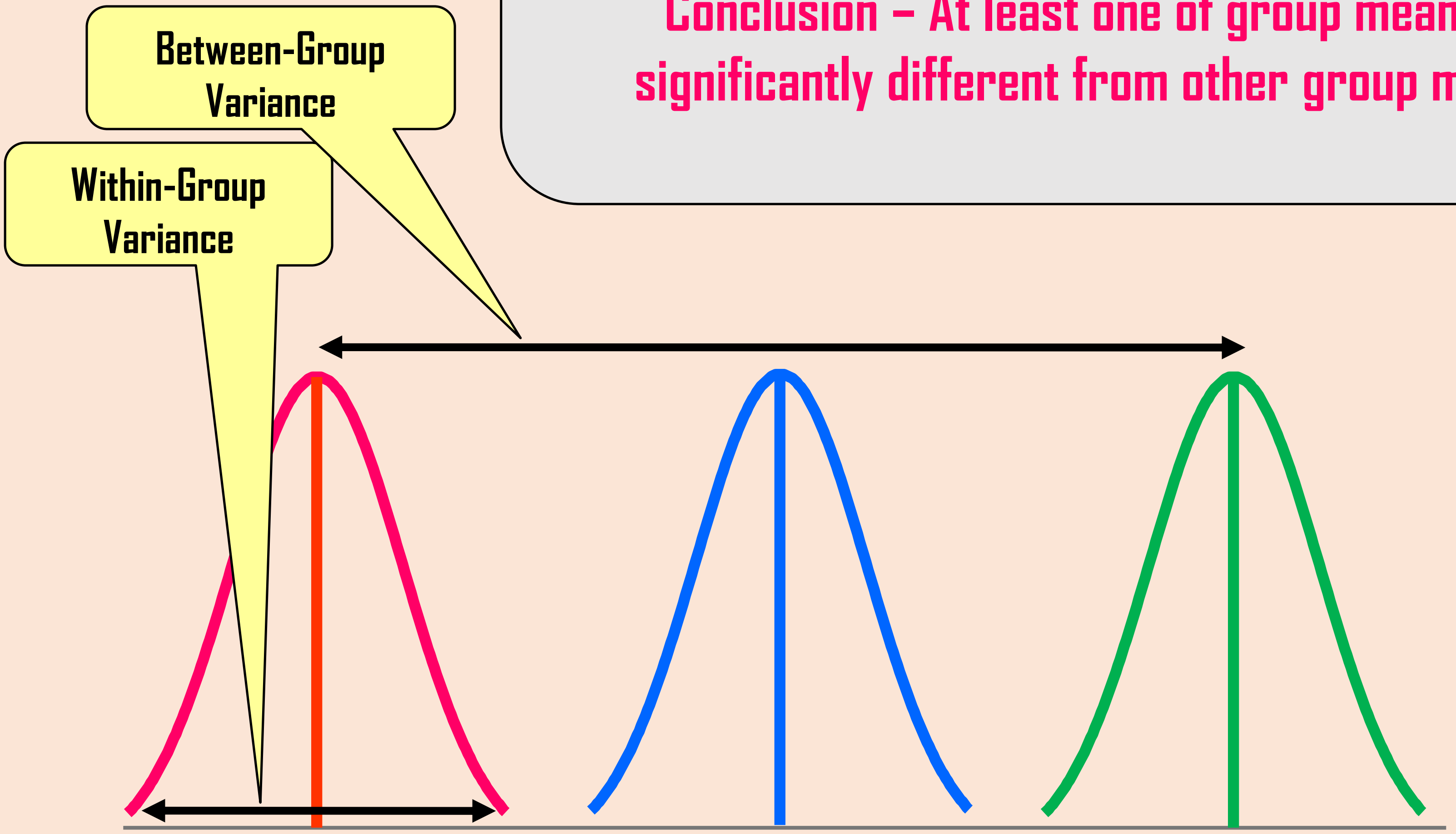
- Independent Variable (e.g., Types of School) has more than two levels / Sub Groups (e.g., Government, Aided, Self-finance
- Dependent Variable (e.g., Attitude about a Environmental Education)

Hypothesis Sample:

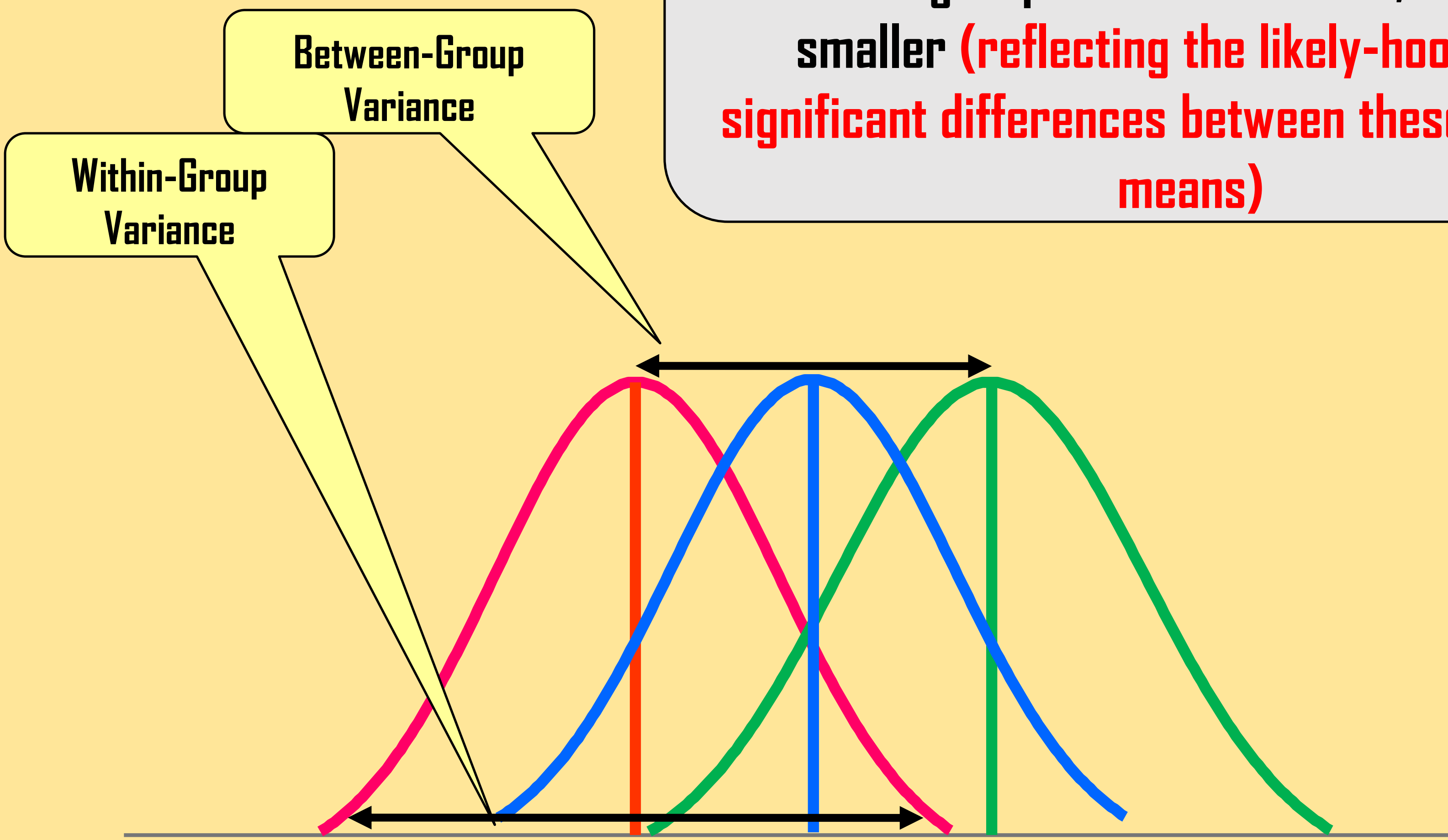
- There is no significant difference in the means scores of attitude towards environmental education among government, aided and self finance school students.

Between-group variance is large relative to the within-group variance, so F statistic will be larger & > critical value, therefore statistically significant .

Conclusion – At least one of group means is significantly different from other group means

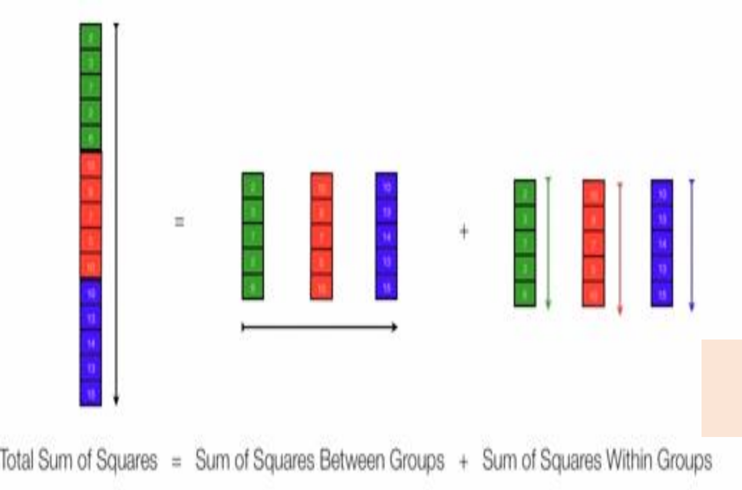


Within-group variance is larger, and the between-group variance smaller, so F will be smaller (reflecting the likely-hood of no significant differences between these 3 sample means)



One way ANOVA: Table

Source of Variation	SS (Sum of Squares)	Degrees of Freedom	MS (Mean Square)	Variance Ratio of F
Between Group	SS_B	k-1	$MS_B = SS_B /(k-1)$	$F = MS_B/MS_W$
Within Group	SS_W	n-k	$MS_W = SS_W/(n-k)$	
Total	SS(Total)	n-1		



Tools Excel Spss demo Interpretation

Post-hoc Tests

- Used to determine which mean or group of means is/are significantly different from the others (significant *F*)
- Depending upon research design & research question:
  - ✓ Bonferroni (more powerful)
    - Only some pairs of sample means are to be tested
    - Desired alpha level is divided by no. of comparisons
  - ✓ Tukey's HSD Procedure
    - when all pairs of sample means are to be tested
  - ✓ Scheffe's Procedure
    - when sample sizes are unequal

Tools | Excel | Spss demo | Interpretation

Example of One-Way ANOVA

One-Way (One Independent variable)

- IV : No. of groups (categorical)
- DV : Scores in problem solving (interval)

ANOVA

Problem solving

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	216.600	2	108.300	93.124	.000
Within Groups	31.400	27	1.163		
Total	248.000	29			

Groups: Individuals=2.4, Pair=8.7, Group=3.9

Significant differences occur among the three groups on their problem solving scores, $F(2, 27) = 93.24$, $MSE = 1.16$, $p<.001$. The paired group significantly had the highest problem solving scores ($M=8.7$)

Post ANOVA Measure

Multiple Comparisons

Dependent Variable: Problem solving

	(I) Groups	(J) Groups	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Tukey HSD	Individual	Pair	-6.30000*	.48228	.000	-7.4958	-5.1042
		Group (3 members)	-1.50000*	.48228	.012	-2.6958	-.3042
	Pair	Individual	6.30000*	.48228	.000	5.1042	7.4958
		Group (3 members)	4.80000*	.48228	.000	3.6042	5.9958
	Group (3 members)	Individual	1.50000*	.48228	.012	.3042	2.6958
		Pair	-4.80000*	.48228	.000	-5.9958	-3.6042
Scheffe	Individual	Pair	-6.30000*	.48228	.000	-7.5491	-5.0509
		Group (3 members)	-1.50000*	.48228	.016	-2.7491	-.2509
	Pair	Individual	6.30000*	.48228	.000	5.0509	7.5491
		Group (3 members)	4.80000*	.48228	.000	3.5509	6.0491
	Group (3 members)	Individual	1.50000*	.48228	.016	.2509	2.7491
		Pair	-4.80000*	.48228	.000	-6.0491	-3.5509

*. The mean difference is significant at the .05 level.

One way Analysis of Variance

SPSS Path

Analyze

↓

Compare Means

↓

One-way ANOVA

Tools Excel Spss demo Interpretation

Two Way ANOVA

E-Spss demo

Two-Way Analysis of Variance

Two Independent Variables (categorical),
One DV (interval)

- IV : Gender (males & females) and
  type of management (Govt, aided & self finance)
- DV : Value perception

Tools Excel S-Spss demo Interpretation

Two way ANOVA

Condition:

- Two independent variables (Nominal / Categorical) and one dependent variable (Interval / Ratio)

Example:

- Independent Variables - 2

(e.g., Types of School: Govt/aided/self-finance & Gender: Male/female)

- Dependent Variable (e.g., value perception)

Two way ANOVA

E-Spss demo

Example

- Two independent factors- Management, Gender
- Dependent factor – value perception

Hypotheses Examples:

- **Ho -Gender will have no significant effect on value perception**
- **Ho - Management will have no significant effect on value perception**
- **Ho – Gender & Management interaction will have no significant effect on value perception**

Tools Excel S-Spss demo Interpretation

E-Spss demo

Two-way ANOVA Table

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F-ratio	P-value
Factor A	r - 1	SS_A	MS_A	$F_A = MS_A / MS_E$	Tail area
Factor B	c- 1	SS_B	MS_B	$F_B = MS_B / MS_E$	Tail area
Interaction	(r – 1) (c – 1)	SS_{AB}	MS_{AB}	$F_{AB} = MS_{AB} / MS_E$	Tail area
Error (within)	rc(n – 1)	SS_E	MS_E		
Total	rcn - 1	SS_T			

Tools Excel S-Spss demo Interpretation

Two-Way Analysis of Variance

Two Independent Variable (categorical), One DV (interval)

- IV : Gender (males & females) and
  Physical condition (sedentary & exercise)-factorial design 2 X 2
- DV : Stress

Tests of Between-Subjects Effects

Dependent Variable: Stress

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	48.916[a]	3	16.305	92.825	.000
Intercept	197.539	1	197.539	1124.570	.000
Gender	7.021	1	7.021	39.969	.000
Phys_cond	38.225	1	38.225	217.609	.000
Gender * Phys_cond	1.705	1	1.705	9.705	.005
Error	4.391	25	.176		
Total	261.490	29			
Corrected Total	53.308	28			

a. R Squared = .918 (Adjusted R Squared = .908)

Two-Way Analysis of Variance

SPSS Path

Analyze

↓

General Linear Models

↓

Univariate

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Tools | Excel | S_Spss demo | Interpretation

Three way ANOVA

E-Spss demo

Three way ANOVA

Condition:

- Three independent variables and one dependent variable

Example:

- Independent Variables - 3

(e.g., Types of School: Govt/aided/self finance; Gender: Male/female & Locality: Rural / Urban)

- Dependent Variable (e.g., Attitude about a Environmental Education)

Tools Excel S_Spss demo Interpretation

Three-Way Analysis of Variance

SPSS Path

Analyze

↓

General Linear Models

↓

Univariate

E-Spss demo

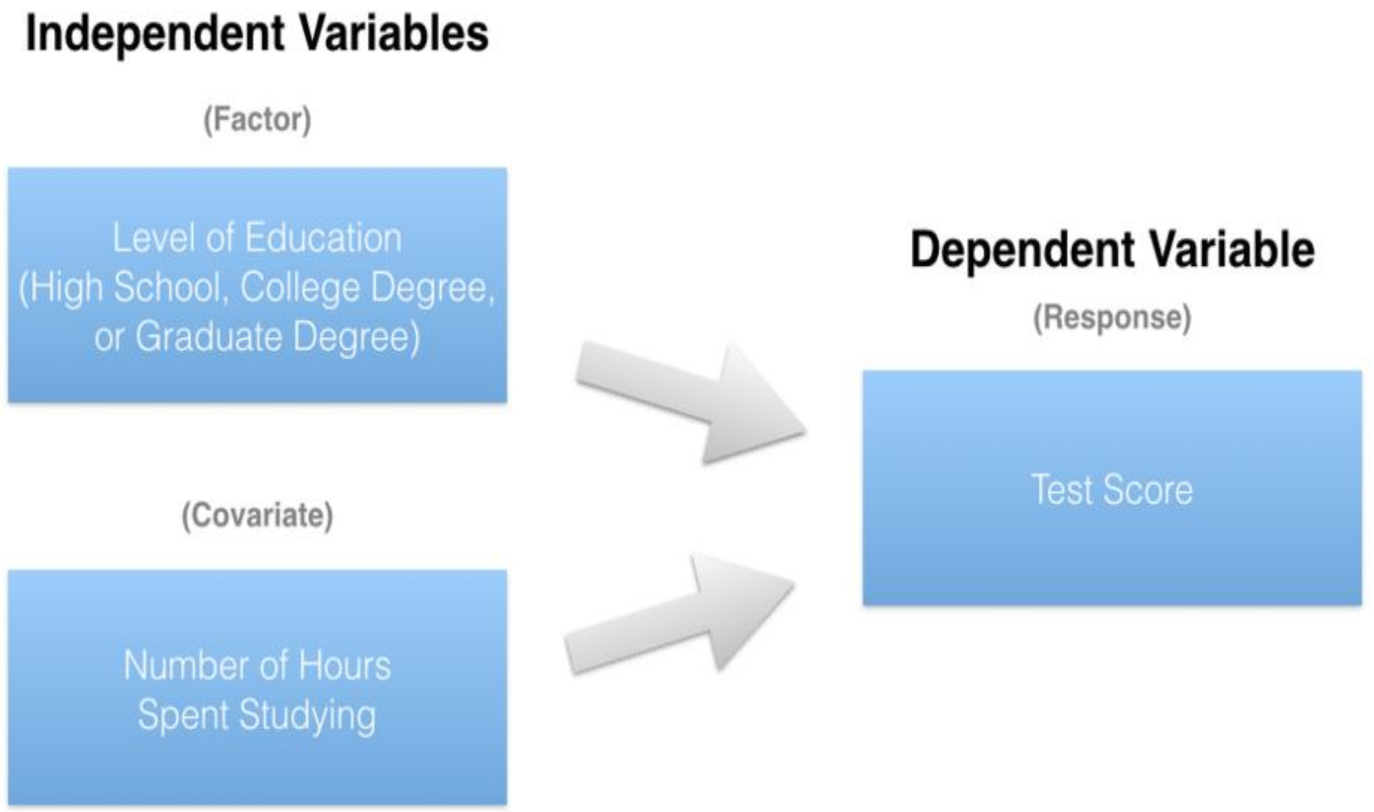
Tools Excel S_Spss demo Interpretation

ANOVA

- One way ANOVA
  - Type of Management on EA
- Two way ANOVA
  - Type of Management, Gender on EA
- Three way ANOVA
  - Type of Management, Gender & Locality on EA

ANCOVA

ANCOVA EXAMPLE



Analysis of Covariance (ANCOVA)

- "Controlling" for factors and how the inclusion of additional factors can reduce the error SS and increase the statistical power (sensitivity) of our design.
- This idea can be extended to continuous variables, and when such continuous variables are included as factors in the design they are called *covariates.*
- Fixed covariates – In addition to the dependent variable we add other measures of dependent variables.
- Changing covariates

ANCOVA with fixed covariates

- IV: Type of textbook,
- DV: Intelligence
- Covariate: Math ability
- By controlling the effect of textbook type on intelligence, we also control its effect on math ability.

Tests of Between-Subjects Effects

Dependent Variable: Intelligence

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	5525.275[a]	2	2762.638	275.414	.000
Intercept	281.123	1	281.123	28.026	.000
math_ability	14.075	1	14.075	1.403	.252
txtbook_type	260.426	1	260.426	25.962	.000
Error	170.525	17	10.031		
Total	23576.000	20			
Corrected Total	5695.800	19			

a. R Squared = .970 (Adjusted R Squared = .967)

- Type of textbook significantly affects intelligence, p <.001. Students exposed to textbook 1 had higher intelligence scores (M = 46.15) that those exposed to textbook 1 (M = 13.3).
- When the effects of textbook type on intelligence was controlled, textbook type do not significantly vary on math ability (p =.252, n.s.).
- Math ability is not a covariate of intelligence on the effect of textbook type.

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	t2	Type III Sum of Squares	df	Mean Square	F	Sig.
t2	Linear	137.269	1	137.269	50.069	.000
t2 * math_ability	Linear	104.843	1	104.843	38.241	.000
t2 * txtbook_type	Linear	90.976	1	90.976	33.184	.000
Error(t2)	Linear	46.607	17	2.742		

Tests of Between-Subjects Effects

Measure: MEASURE_1

Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	217.757	1	217.757	45.090	.000
math_ability	17.151	1	17.151	3.551	.077
txtbook_type	118.502	1	118.502	24.538	.000
Error	82.099	17	4.829		

ANCOVA (Experimental Method)

When using a **pre-post test research design**, the Analysis of Covariance allows a **comparison of post-test scores with pre-test scores** factored out.

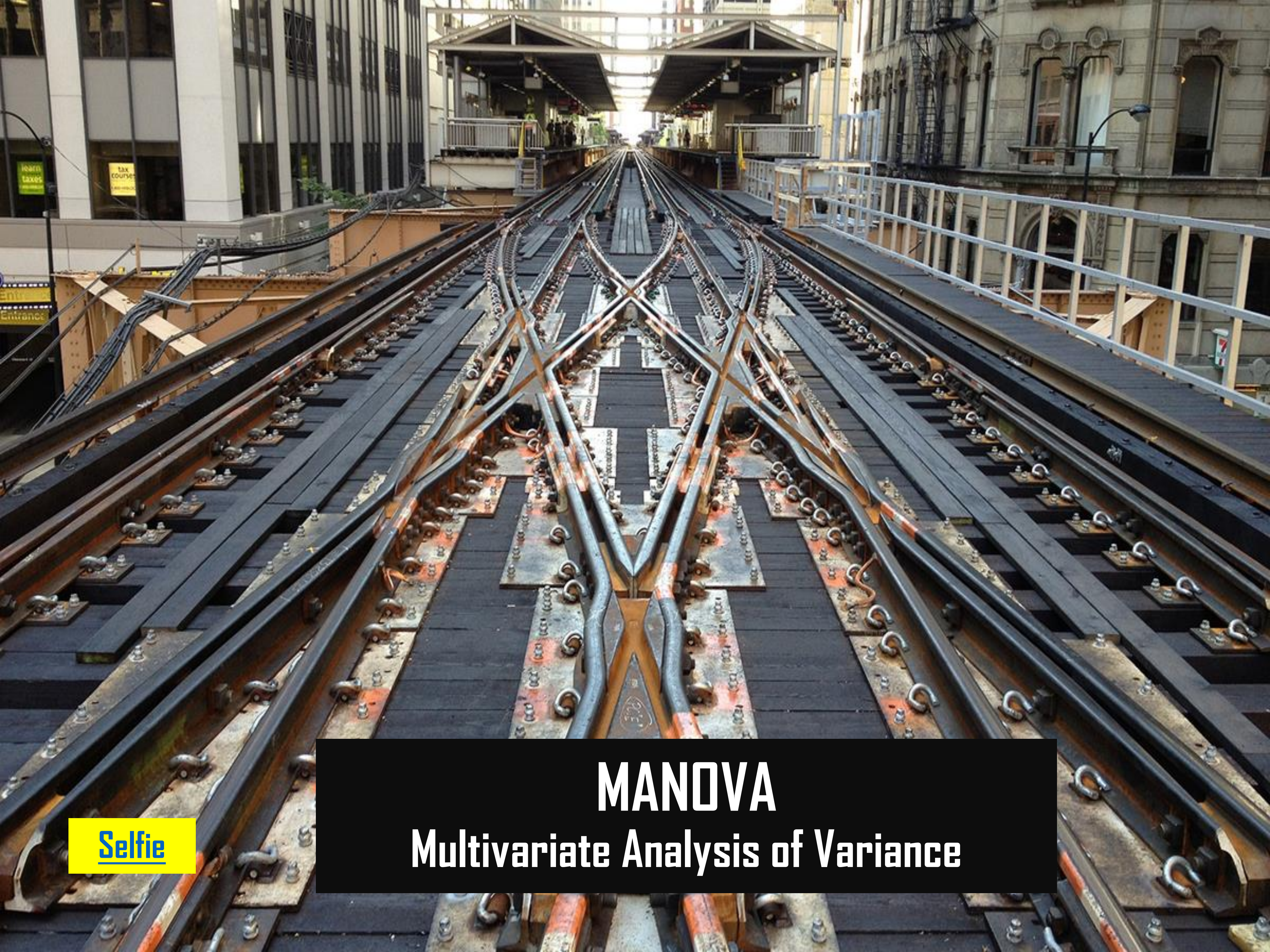
For example,

If comparing a experimental (treatment) and control group on achievement motivation with a pre-post test design, the ANCOVA will compare the treatment and control groups' post-test scores by statistically setting the pre-test scores as being equal.

E-Spss demo Interpretation

ANCOVA with changing covariates

- Applied for repeated measures
- When we have repeated measures, we are interested in testing the differences in repeated measurements on the same subjects.
- We are actually interested in evaluating the significance of *changes.*
- If we have a covariate that is also measured at each point when the dependent variable is measured, then we can compute the correlation between the changes in the covariate and the changes in the dependent variable.
- For example, we could study math anxiety and math skills at the beginning and at the end of the semester.
- It would be interesting to see whether any changes in math anxiety over the semester correlate with changes in math skills.


MANOVA
Multivariate Analysis of Variance
Selfie
Entrance

MANOVA

- MANOVA is used to test the significance of the effects of one or more IVs on **two or more DVs**.

- It can be viewed as an extension of ANOVA with the key difference that we are dealing with **many dependent variables** (not a single DV as in the case of ANOVA)

Combination of dependent variables is called "joint distribution"

MANOVA gives answer to question

" Is joint distribution of 2 or more DVs significantly related to one or more factors?"

Tools Excel S_Spss demo E-Spss demo

- Dependent Variables (at least 2)
    - Interval /or ratio measurement scale
    - May be correlated
    - Multivariate normality
    - Homogeneity of variance

- Independent Variables (at least 1)
    - Nominal measurement scale
    - Each independent variable should be independent of each other

- The result of a MANOVA simply tells us that a difference exists (or not) across groups.
- It does not tell us which treatment(s) differ or what is contributing to the differences.
- For such information, we need to run ANOVAs with post hoc tests.

Various tests used-

✓ **Wilk's Lambda**

➢ Widely used; good balance between power and assumptions

✓ **Pillai's Trace**

➢ Useful when sample sizes are small, cell sizes are unequal, or covariances are not homogeneous

✓ **Hotelling's (Lawley-Hotelling) Trace**

➢ Useful when examining differences between two groups

Tools Excel S_Spss demo E-Spss demo

MANOVA
SPSS Path

Analyze

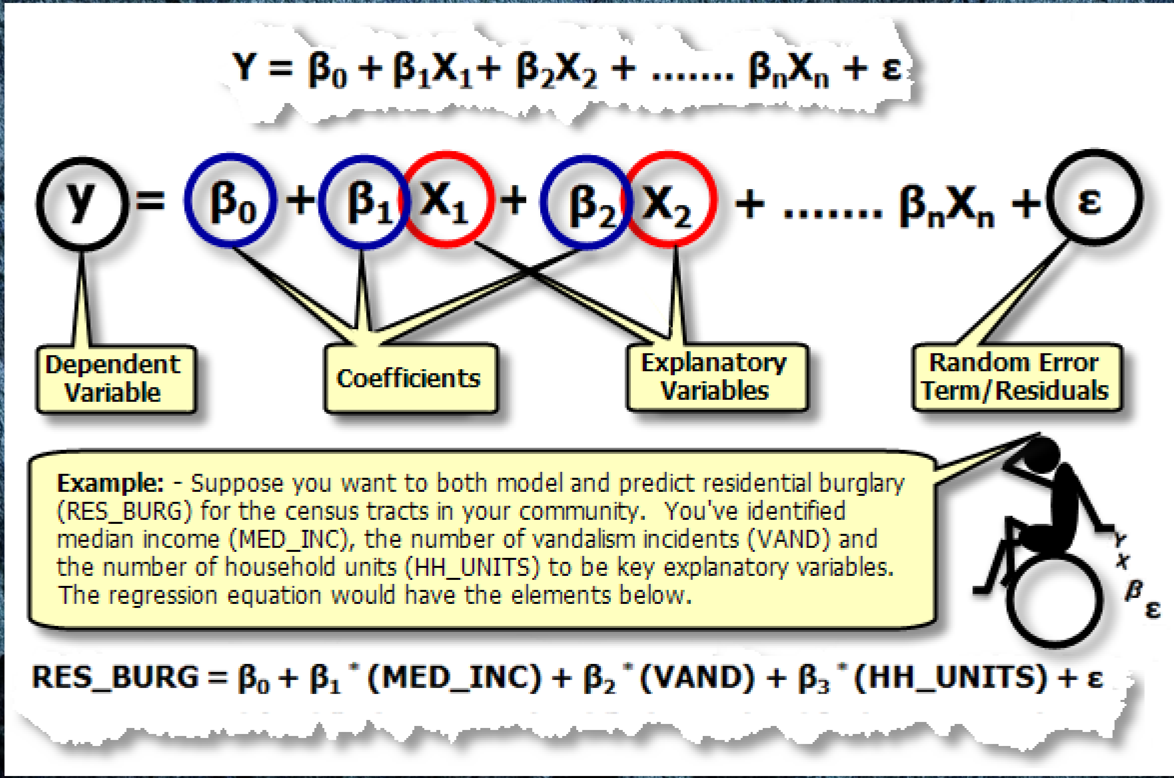
↓

General Linear Model

↓

Multivariate

Regression Analysis



Pain Story

Simple Linear Regression Analysis

SPSS Path

Analyze

↓

Regression

↓

Linear

Multiple Regression Analysis

SPSS Path

Analyze

↓

Regression

↓

Linear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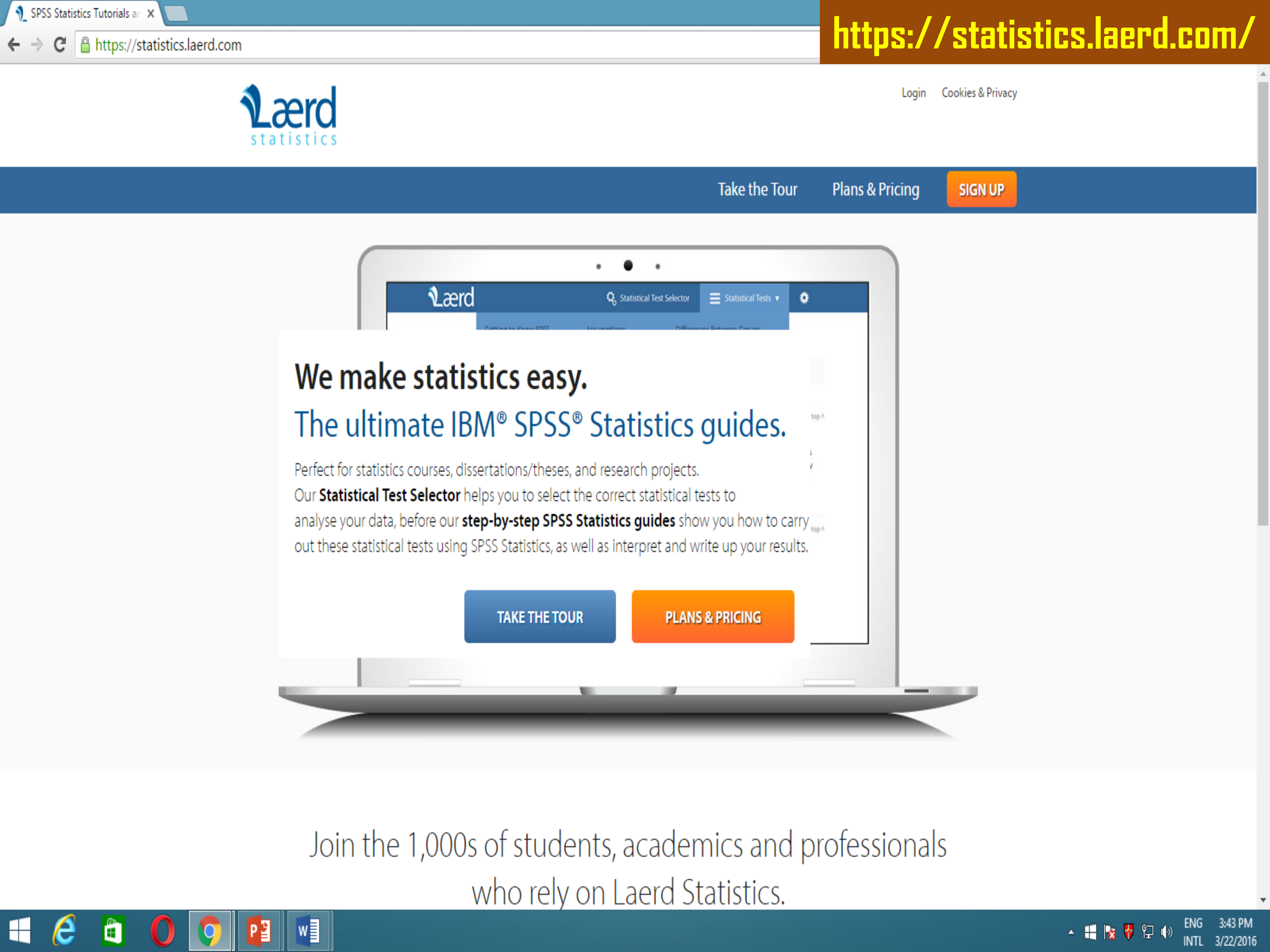

't' Test

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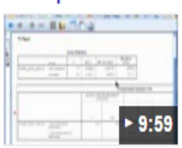
Independent t-test - SPSS (Example 1) - YouTube



https://www.youtube.com/watch?v=8alv3kZt8Ug
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I perform an independent samples **t-test** on data that have been simulated to correspond to an actual study ...

SPSS Tutorials | SPSS Independent Samples T Test
www.**spss**-tutorials.com/**spss**-independent-samples-**t-test**/
Sep 16, 2014 - **SPSS** independent samples **t-test** is a procedure for testing whether the means from two groups of cases on one metric variable are equal.

Using SPSS for t-Tests

ENG INTL 3:47 PM 3/22/2016

Independent T-Test using SPSS Statistics

Introduction

The independent-samples t-test (or independent t-test, for short) compares the means between two unrelated groups on the same continuous, dependent variable. For example, you could use an independent t-test to understand whether first year graduate salaries differed based on gender (i.e., your dependent variable would be "first year graduate salaries" and your independent variable would be "gender", which has two groups: "male" and "female"). Alternately, you could use an independent t-test to understand whether there is a difference in test anxiety based on educational level (i.e., your dependent variable would be "test anxiety" and your independent variable would be "educational level", which has two groups: "undergraduates" and "postgraduates").

This "quick start" guide shows you how to carry out an independent t-test using SPSS Statistics, as well as interpret and report the results from this test. However, before we introduce you to this procedure, you need to understand the different assumptions that your data must meet in order for an independent t-test to give you a valid result. We discuss these assumptions next.

SPSS Statistics top ^

Assumptions

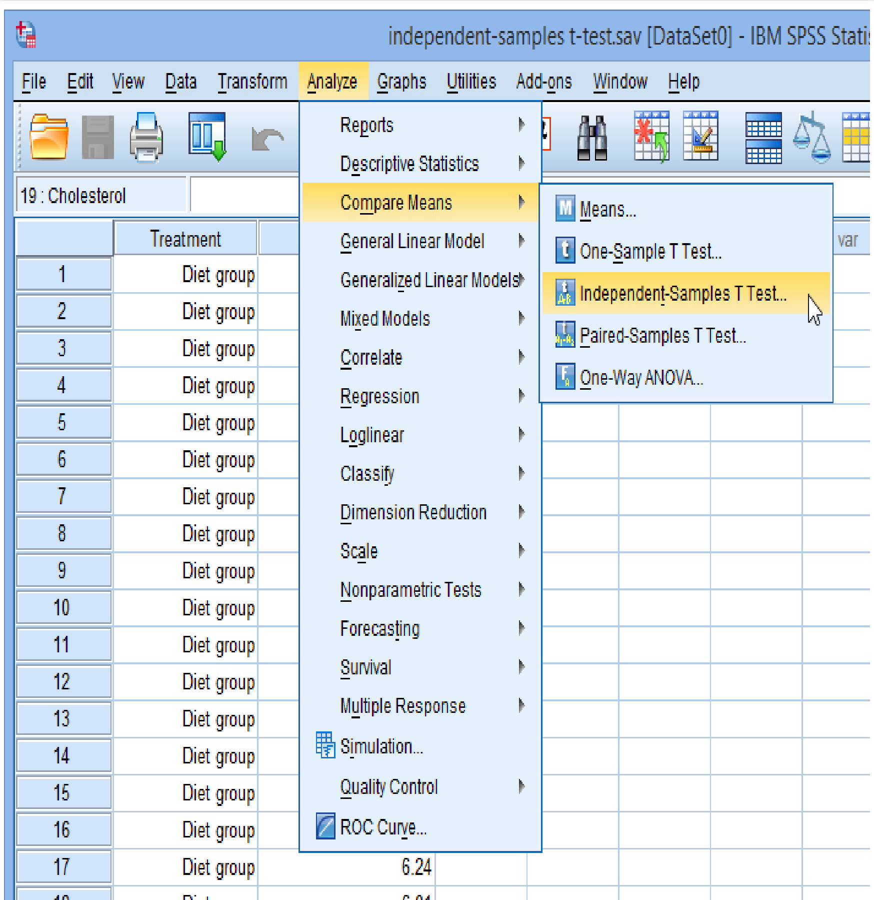
When you choose to analyse your data using an independent t-test, part of the process involves checking to make sure that the data you want to analyse can actually be analysed using an independent t-test. You need to do this because it is only appropriate to use an independent t-test if your data "passes" six assumptions that are required for an independent t-test to give you a valid result. In practice, checking for these six assumptions just adds a little bit more time to your analysis, requiring you to click a few more buttons in SPSS Statistics when performing your analysis, as well as think a little bit more about your data, but it is not a difficult task.

't' Test

Test Procedure in SPSS Statistics

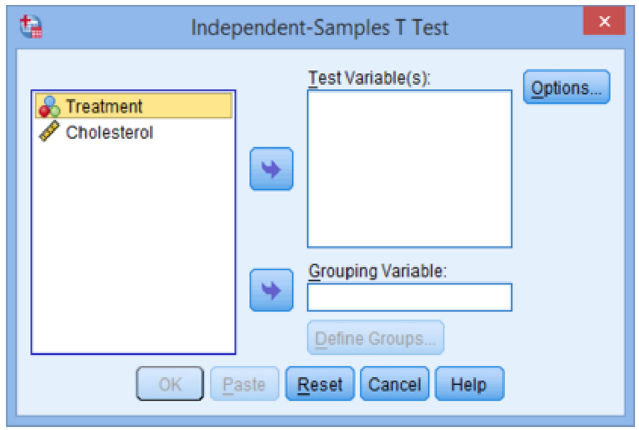
The eight steps below show you how to analyse your data using an independent t-test in SPSS Statistics when the six assumptions in the previous section, Assumptions, have not been violated. At the end of these eight steps, we show you how to interpret the results from this test. If you are looking for help to make sure your data meets assumptions #4, #5 and #6, which are required when using an independent t-test, and can be tested using SPSS Statistics, you can learn more here.

1 Click **Analyze** > **Compare Means** > **Independent-Samples T Test...** on the top menu, as shown below:



't' Test

You will be presented with the **Independent-Samples T Test** dialogue box, as shown below:



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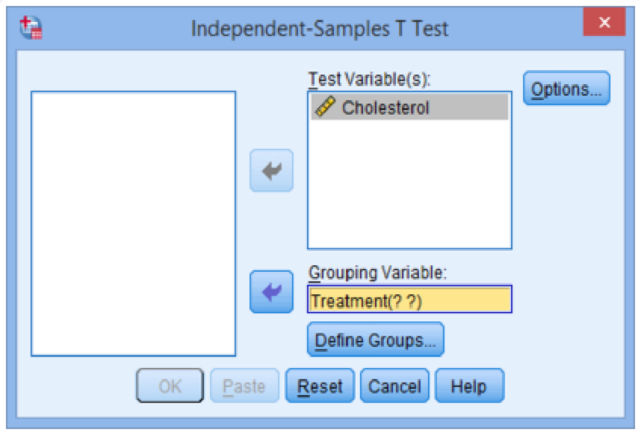
2 Transfer the dependent variable, Cholesterol, into the Test Variable(s): box, and transfer the independent variable, Treatment, into the Grouping Variable: box, by highlighting the relevant variables and pressing the buttons. You will end up with the following screen:



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't' Test

This table provides useful descriptive statistics for the two groups that you compared, including the mean and standard deviation.

Group Statistics

	Group	N	Mean	Std. Deviation	Std. Error Mean
Cholesterol Concentration	Diet	20	6.1450	.51959	.11618
	Exercise	20	5.7950	.38179	.08537

Unless you have other reasons to do so, it would be considered normal to present information on the mean and standard deviation for this data. You might also state the number of participants that you had in each of the two groups. This can be useful when you have missing values and the number of recruited participants is larger than the number of participants that could be analysed.

A diagram can also be used to visually present your results. For example, you could use a bar chart with error bars (e.g., where the error bars could use the standard deviation, standard error or 95% confidence intervals). This can make it easier for others to understand your results. Again, we show you how to do this in our enhanced independent t-test guide.

Independent Samples Test Table

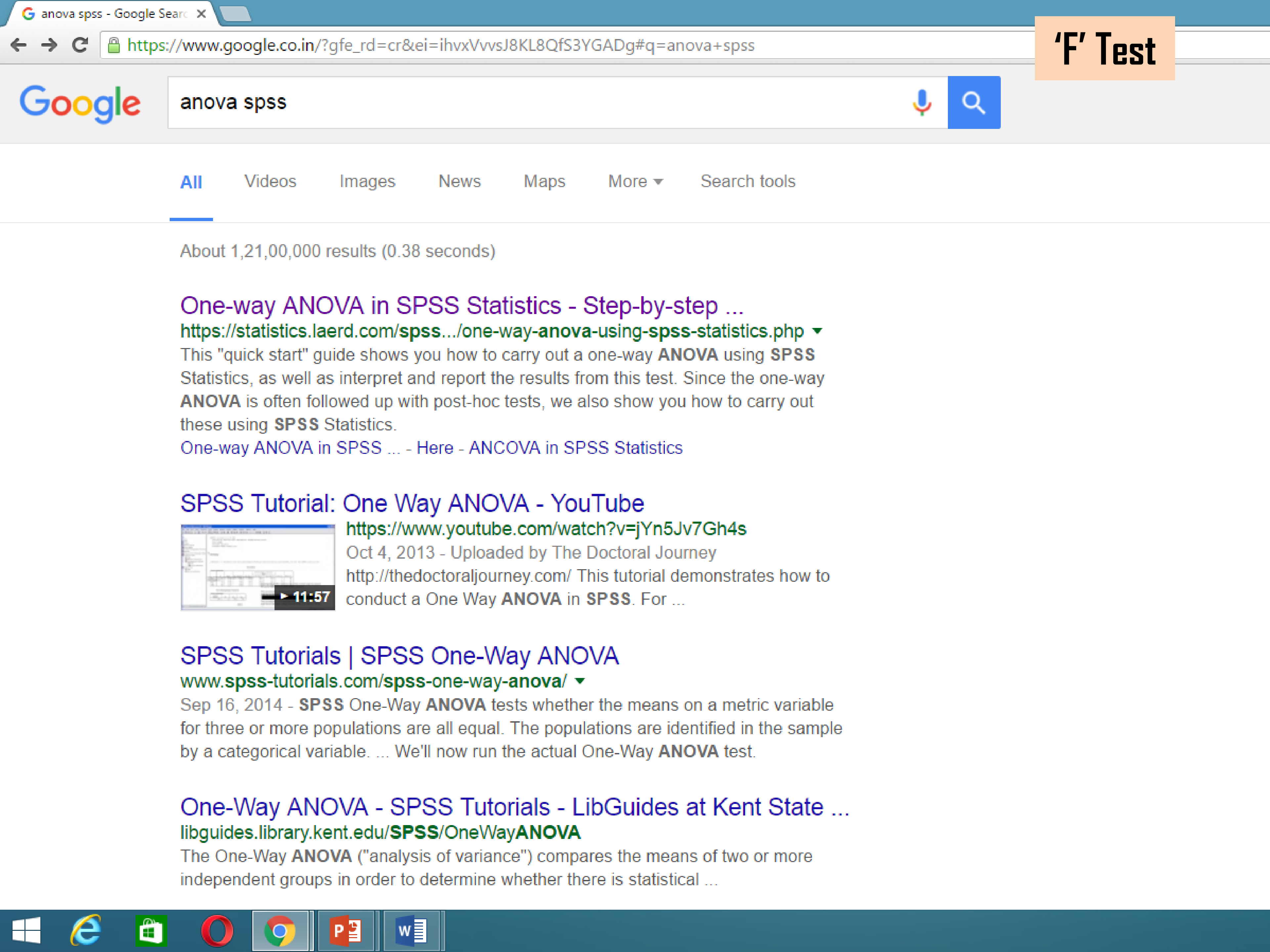
This table provides the actual results from the independent t-test.

Independent Samples Test

			Cholesterol Concentration	
			Equal variances assumed	Equal variances not assumed
Levene's Test for Equality of Variances	F		.314	
	Sig.		.579	
t-test for Equality of Means	t		2.428	2.428
	df		38	34.886
	Sig. (2-tailed)		.020	.021
	Mean Difference		.35000	.35000
	Std. Error Difference		.14418	.14418
	95% Confidence Interval of the Difference	Lower	.05813	.05727
		Upper	.64187	.64273

We can see that the group means are significantly different because the value in the "**Sig. (2-tailed)**" row is less than 0.05. Looking at the **Group Statistics** table, we can see that those people who undertook the exercise trial had lower cholesterol levels at the end of the

'F' Test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This "quick start" guide shows you how to carry out a one-way ANOVA using SPSS Statistics, as well as interpret and report the results from this test. Since the one-way ANOVA is often followed up with post-hoc tests, we also show you how to carry out these using SPSS Statistics.
One-way ANOVA in SPSS ... - Here - ANCOVA in SPSS Statistics
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The One-Way ANOVA ("analysis of variance") compares the means of two or more independent groups in order to determine whether there is statistical ...

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'F' Test

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One-way ANOVA in SPSS Statistics

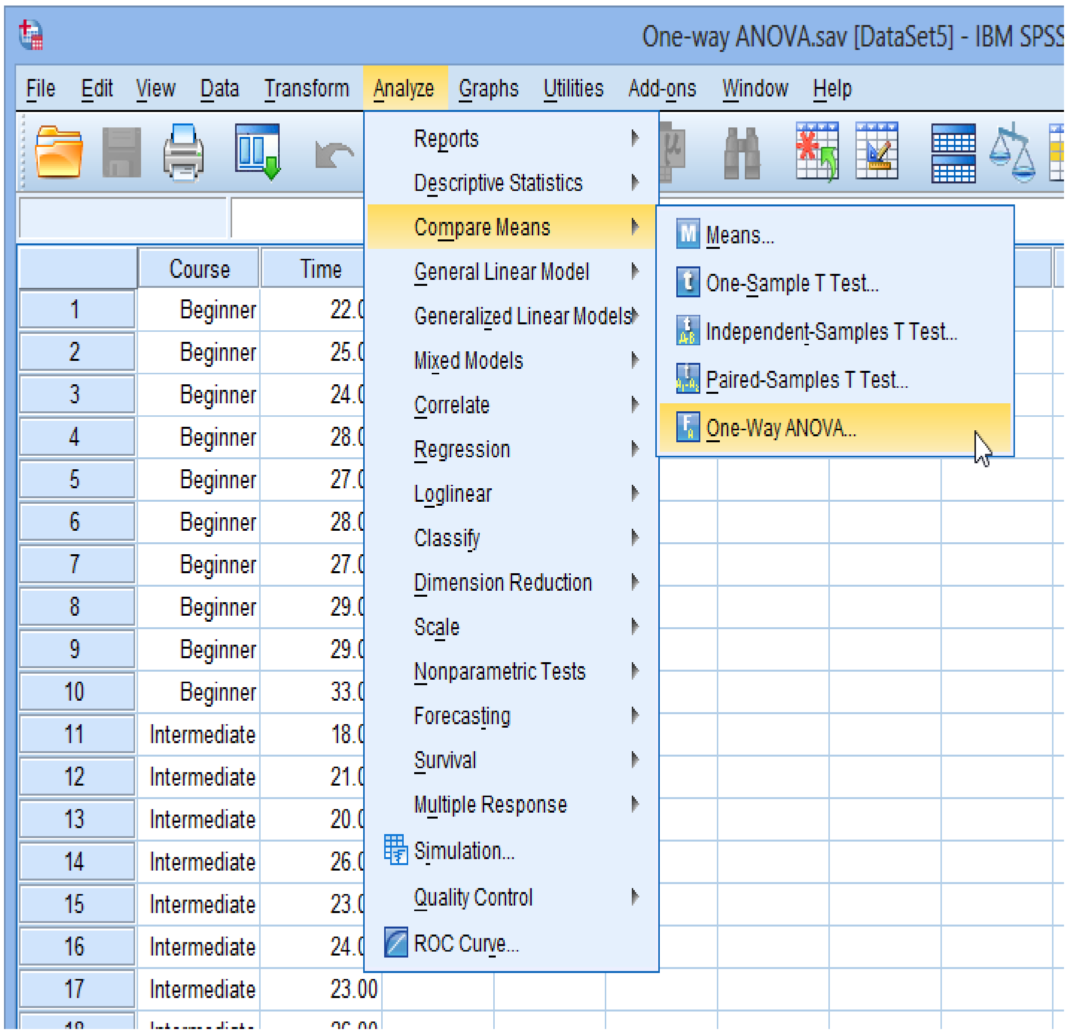
Introduction

The one-way analysis of variance (ANOVA) is used to determine whether there are any significant differences between the means of two or more independent (unrelated) groups (although you tend to only see it used when there are a minimum of three, rather than two groups). For example, you could use a one-way ANOVA to understand whether exam performance differed based on test anxiety levels amongst students, dividing students into three independent groups (e.g., low, medium and high-stressed students). Also, it is important to realize that the one-way ANOVA is an *omnibus* test statistic and cannot tell you which specific groups were significantly different from each other; it only tells you that at least two groups were different. Since you may have three, four, five or more groups in your study design, determining which of these groups differ from each other is important. You can do this using a post-hoc test (N.B., we discuss post-hoc tests later in this guide).

NOTE: If your study design not only involves one dependent variable and one independent variable, but also a third variable (known as a "covariate") that you want to "statistically control", you may need to perform an ANCOVA (analysis of covariance), which can be thought of as an extension of the one-way ANOVA. To learn more, see our SPSS Statistics guide on ANCOVA. Alternatively, if your dependent variable is the time until an event happens, you might need to run a Kaplan-Meier analysis.

This "quick start" guide shows you how to carry out a one-way ANOVA using SPSS Statistics, as well as interpret and report the results from this test. Since the one-way ANOVA is often followed up with post-hoc tests, we also show you how to carry out these using SPSS Statistics. However, before we introduce you to this procedure, you need to understand the different assumptions that your data must meet in order for a one-way ANOVA to give you a valid result. We discuss these assumptions next.

1 Click **Analyze** > **Compare Means** > **One-Way ANOVA...** on the top menu as shown below.



'F' Test

One-way ANOVA in SPSS

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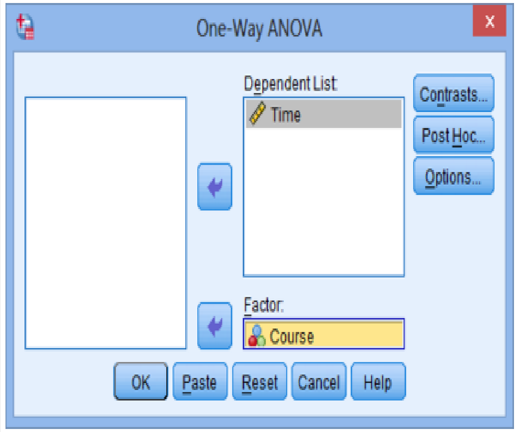
box using the appropriate buttons (or drag-and-drop the variables into the boxes), as indicted in the diagram below:



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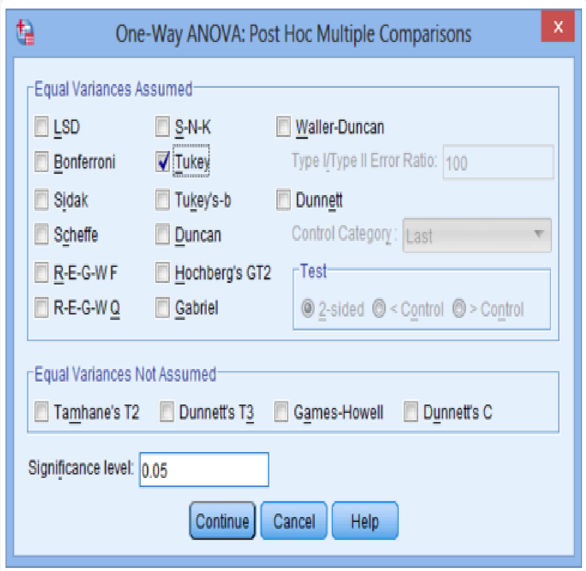
4 Click the Post Hoc... button. Tick the Tukey checkbox as shown below:



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One-way ANOVA in SPSS

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'F' Test

SPSS Statistics

top ^

Descriptives Table

The descriptives table (see below) provides some very useful descriptive statistics, including the mean, standard deviation and 95% confidence intervals for the dependent variable (Time) for each separate group (Beginners, Intermediate and Advanced), as well as when all groups are combined (Total). These figures are useful when you need to describe your data.

Descriptives

Time

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Beginner	10	27.2000	3.04777	.96379	25.0198	29.3802	22.00	33.00
Intermediate	10	23.6000	3.30656	1.04563	21.2346	25.9654	18.00	29.00
Advanced	10	23.4000	3.23866	1.02415	21.0832	25.7168	18.00	29.00
Total	30	24.7333	3.56161	.65026	23.4034	26.0633	18.00	33.00

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SPSS Statistics

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ANOVA Table

This is the table that shows the output of the ANOVA analysis and whether we have a statistically significant difference between our group means. We can see that the significance level is 0.021 (p = .021), which is below 0.05. and, therefore, there is a statistically significant difference in the mean length of time to complete the spreadsheet problem between the different courses taken. This is great to know, but we do not know which of the specific groups differed. Luckily, we can find this out in the **Multiple Comparisons** table which contains the results of post-hoc tests.

ANOVA

Time

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	91.467	2	45.733	4.467	.021
Within Groups	276.400	27	10.237		
Total	367.867	29			

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SPSS Statistics

top ^

Multiple Comparisons Table

From the results so far, we know that there are significant differences between the groups as a whole. The table below, **Multiple Comparisons**, shows which groups differed from each other. The Tukey post-hoc test is generally the preferred test for conducting post-hoc tests on a one-way ANOVA, but there are many others. We can see from the table below that there is a significant difference in time to complete the problem between the group that took the beginner course and the intermediate course ($p = 0.046$), as well as between the beginner course and advanced course ($p = 0.034$). However, there were no differences between the groups that took the intermediate and advanced course ($p = 0.989$).

Multiple Comparisons

Dependent Variable: Time

Tukey HSD

(I) Course	(J) Course	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Beginner	Intermediate	3.60000*	1.43088	.046	.0523	7.1477
	Advanced	3.80000*	1.43088	.034	.2523	7.3477
Intermediate	Beginner	-3.60000*	1.43088	.046	-7.1477	-.0523
	Advanced	.20000	1.43088	.989	-3.3477	3.7477
Advanced	Beginner	-3.80000*	1.43088	.034	-7.3477	-.2523
	Intermediate	-.20000	1.43088	.989	-3.7477	3.3477

*. The mean difference is significant at the 0.05 level.

It is also possible to run comparisons between specific groups that you decided were of interest before you looked at your results. For example, you might have expressed an interest in knowing the difference in the completion time between the beginner and intermediate course groups. This type of comparison is often called a planned contrast or a simple custom contrast. However, you do not have to confine yourself to the comparison between two time points only. You might have had an interest in understanding the difference in completion time between the beginner course group and the average of the intermediate and advanced course groups. This is called a complex contrast. All these types of custom contrast are available in SPSS Statistics. In our enhanced guide we show you how to run custom contrasts in SPSS Statistics using syntax (or sometimes a combination of the graphical user interface and syntax) and how to interpret and report the results. In addition, we also show how to "trick" SPSS Statistics into applying a Bonferroni adjustment for multiple comparisons which it would otherwise not do.

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ThankYou

Acknowledgements

My teachers, My Guide , My Students
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Jai Bharat!