Tutorial Letter 201/2/2017

Organisational Research Methodology

IOP2601

Department of Industrial and Organisational Psychology

IMPORTANT INFORMATION:

This tutorial letter contains important information about your module.

BAR CODE

CONTENTS

Dear Student

In this tutorial letter you will receive feedback on Assignments 01 and 02. Model answers are given for the calculations. Please pay special attention to the mark allocation. For the multiple-choice questions, the correct alternative as well as a discussion on it, is given. Your task is to compare your completed assignments with the memoranda to see where you made mistakes. Remember that the feedback on Assignment 03 is given in the MO001.

We have also included more information on the examination in this tutorial letter. A copy of an examination paper is included in the appendix as an example. By working through it, you will get a good idea of what could be expected of you in the examination.

1 FEEDBACK ON ASSIGNMENT 01

This is the first compulsory assignment that you had to submit. It contributes 10% towards your final mark. See page 12 in Tutorial Letter IOP2601/101/3/2017 for details on how to calculate your final mark.

A full memorandum is provided here. Compare your answers with the following memorandum and make sure that you understand this first part of Descriptive Statistics before you continue with the next assignment on the rest of Descriptive Statistics and Inferential Statistics.

QUESTIONS 1–30 [30]

The correct alternatives are given in **the second column** next to the question number.

Item	**Answer**	Comments
1	**3**	The module focuses predominantly on the fourth step of the research process, namely data analysis. See figure 2 and the explanation provided below it on page 41 of the MO001.
2	**2**	The typical order of the basic steps followed in a research process is listed on page 40 of the MO001.
3	**3**	All students registered for the IOP2601 module represent the population of the study and the sample is the 35 students selected from each gender list. See the definition of a population on page 14 of the prescribed book and page 52 of the MO001.

Item	Answer	Comments
4	**4**	Gender is an independent variable while students' attitudes would be the dependent variable. The study is intended to measure students' attitudes. See page 13 of Tredoux & Durrheim (2013) for further explanation and pages 49 and 53 of the MO001 for activities on variables.
5	**2**	The study will investigate whether there is a difference between males and females with regard to their attitudes towards IOP2601. Although only 35 of each gender group will be selected, the intention is to make inferences about the rest of the students registered for IOP2601, thus implying the use of inferential statistics. See page 45 of the MO001.
6	**1**	Interval width (interval size) is the distance between the upper class and the lower class. The distance between 40 and 44 is 5. **Note:** We start counting from 40 and not from 41. See page 66 of the MO001, and pages 22 and 32 of Tredoux and Durrheim (2013).
7	**3**	The formula for the percentile rank is provided on page 32 of Tredoux and Durrheim (2013) as: $percentile\ rank = \%\ below + \frac{score - RLL}{class\ interval\ width}\ (interval\ \%)$ The substitution of the formula is explained on page 32 of Tredoux and Durrheim (2013). Also, see the exercises in activity 4.7 on pages 75 to 77 of the MO001. Based on this, the percentage (%) below of a score of 63 is **40**: **40** + $\frac{63 - 59,5}{5}$ (8,75)
8	**1**	Using the substitution from the formula above, the real lower limit (RLL) is **59,5**. 40 + $\frac{63 - \mathbf{59,5}}{5}$ (8,75)
9	**4**	Using the substitution from the formula above (question 7), the interval percentage (%) is **8,75**: 40 + $\frac{63 - 59,5}{5}$ (**8,75**)
10	**3**	Determining percentiles is discussed on page 34 of Tredoux and Durrheim (2013). Also, see the exercises in activity 4.7 on pages 75 to 76 of the MO001. The score found at the 82nd percentile: score of p = RLL + $\frac{PR - \%\ below}{interval\ \%}$ (interval width) = 79,5 + $\frac{82 - 78,75}{7,5}$ (5) = 79,5 + $\frac{3,25}{7,5}$ (5) = 79,5 + 0,43333 (5) = 79,5 + 2,16667 **= 81,67**

Item	Answer	Comments
11	**3**	When the majority of the scores are low, the distribution is positively skewed. See the illustration provided in figure 2.6 on page 30 of Tredoux and Durrheim (2013). Therefore, a distribution of the ages of people with a majority of young people would be indicated by a positively skewed distribution. Also, see the explanation on pages 28 to 29 of Tredoux and Durrheim (2013).
12	**1**	The discussion on description of frequency distributions is on pages 72 to 74 of the MO001 and pages 28 to 31 of Tredoux and Durrheim (2013).
13	**1**	The kurtosis of a distribution refers to the relative flatness or peakedness in the middle. See the discussion of kurtosis on pages 72 to 74 of the MO001 and page 28 of Tredoux and Durrheim (2013).
14	**2**	Grouped frequency distributions are discussed on page 66 of the MO001.
15	**2**	The 50th percentile is called the median. See pages 74 to 75 of the MO001 for the explanation of the percentile divisions.
16	**4**	The variance and standard deviation are discussed on pages 92 to 95 of the MO001. The standard deviation is the square root of the variance $$s_x = \sqrt{s_x^2}$$ You start with the calculation of the variance: $$s_x^2 = \frac{\Sigma x^2 - \frac{(\Sigma x)^2}{N}}{N - 1}$$ $$\frac{94 - \frac{(28)^2}{10}}{10 - 1}$$ 1,73 Therefore, the standard deviation = 1,31. **Note:** The correct principles of roundingoff would have gotten you to: s_x =1,32.
17	**3**	The range is the difference between the highest and the lowest scores in a data set. The formula for calculating the range is as follows: Range = highest score – lowest score (5 – 1 = 4).
18	**2**	If you look at the formula for variance, it is clear that you do not need to calculate the mean: $$s_x^2 = \frac{\Sigma x^2 - \frac{(\Sigma x)^2}{N}}{N - 1}$$ The mean is: $$\bar{X} = \frac{\Sigma X}{N}$$ See the formulas for calculating variance and the standard deviation of scores on page 63 of your MO001.
19	**2**	All variances and standard deviations are positive numbers. If you have obtained a negative answer, you have definitely made a mistake. Refer to the hint on page 96 of the MO001.
20	**4**	The regression is used to make predictions. See the discussion on page 113 of the MO001.
21	**1**	Similar to question 19 – refer to the hint on page 96 of the MO001.
22	**1**	The smaller the variance, the closer the individual scores are to the mean – refer to the hint on page 92 of the MO001.

Item	Answer	Comments
23	**1**	Refer to the interpretation scale on page 106 of the MO001.
24	**4**	Common variance for r = 0,49 $r^2 = (0,49)^2 \times 100\%$ **r^2 = 24,01%**
25	**3**	For a variance of 12,5 the standard deviation is = 3,54. The standard deviation is discussed on pages 92 to 95 of the MO001.
26	**2**	Refer to section 5.1 on page 7 of the Tutorial Letter 101/3/2017.
27	**2**	Refer to section 6.2 on page 12 of the Tutorial Letter 101/3/2017.
28	**2**	Refer to page 11 of the Tutorial Letter 101/3/2017.
29	**2**	Refer to section 6.2 on page 12 of the Tutorial Letter 101/3/2017.
30	**2**	Refer to section 5.1 on page 7 of the Tutorial Letter 101/3/2017.

TOTAL: [30]

2 FEEDBACK ON ASSIGNMENT 02

This is the second compulsory assignment that you had to submit. It contributes 10% towards your final mark. See page 12 in Tutorial Letter IOP2601/101/3/2017 for details on how to calculate your final mark.

A full memorandum is provided here. Compare your answers with the following memorandum and make sure that you understand the rest of descriptive statistics and inferential statistics that are covered in this assignment.

REMEMBER:
- Always give the formula (computational formula) for the computation asked – in most cases you will receive a mark for it.
- Read the questions carefully.
- Do computations with the variable asked. You will not receive any marks if you do the computations correctly, but with the wrong variable.

QUESTION 1 **[7]**

Refer to learning unit 9 – specifically activity 9.3 on pages 131 and 132 of the MO001.

1.1 p(You) = 20/300
= 0,0667
= **0,07** (2)

1.2 p(Friend) = 30/299
= 0,1003
= **0,10** (2)

.3 p(You) x p(Friend) = 20/300 x 30/299
= 0,0667 x 0,1003
= 0,00667 **(**1)

p(Friend) x p(You) = 30/300 x 20/299
= 0,1 x 0,0669
= 0,00669 (1)

p(You & Friend) = 0,00667 + 0,00669
= **0,01** (1)

QUESTION 2 **[6]**

Refer to learning unit 10 – specifically last paragraph of page 137 and activity 10.5 on pages 141 to 143 of the MO001.

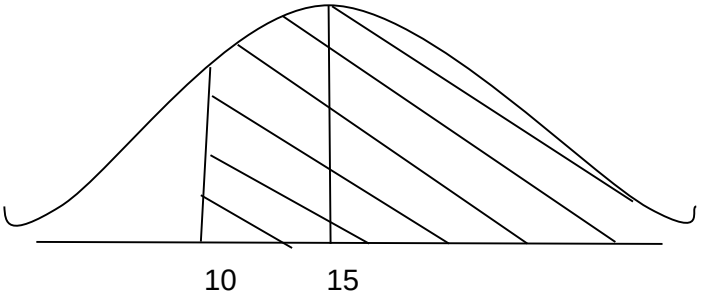
2.1 What is the **proportion** of students with a raw score greater than 10? (2)

$$z = \frac{X - \mu}{\sigma}$$

$$= \frac{10 - 15}{3}$$

$$= \mathbf{-1,67}$$

Proportion = **0,95254**



2.2 What is the **percentage** of students with a raw score less than 21? (2)

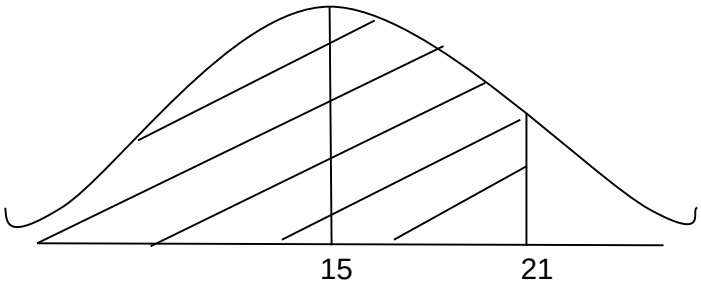
$$z = \frac{X - \mu}{\sigma}$$

$$= \frac{21 - 15}{3}$$

$$= 2$$

Proportion = **0,97725**

Percentage = 0,97725 x 100 **= 97,73%**



2.3 What is the **number** of students with a raw score between 10 and 21? (2)

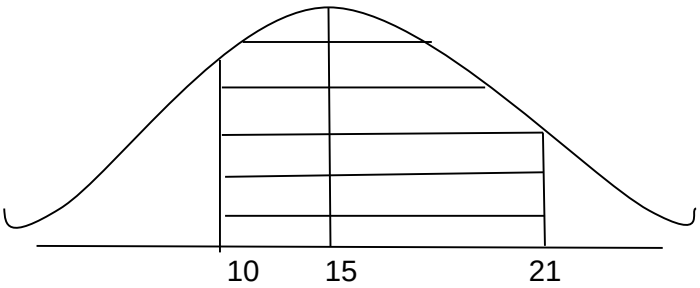
X = 10: Mean to z (1,67) score = 0,45254

X = 21: Mean to z (2) score = 0,47725

Total = **0,92979**

0,92979 x 70 students = 65,0853

= **65 students**



QUESTION 3 **[7]**

Refer to learning unit 12 – specifically exercise 2 of activity 12.4 on pages 167 and 168 of the MO001.

3.1 Independent: attitudes of students (negative or positive)
Dependent: examination performance (2)

3.2

Null hypothesis: There is no difference in performance in the examination for IOP2601 between students who have a positive attitude towards research and those students who have a negative attitude towards research.

OR

Students who have a positive attitude towards research do not perform better in their examination for IOP2601 than students who have a negative attitude towards research. (1)

Alternative hypothesis: Students who have a positive attitude towards research perform better in their examination for IOP2601 than students who have a negative attitude towards research. (1)

3.3 **Do not reject** the null hypothesis. (1)

Explanation:
In the Levene's test, the p-value (Sig) is less than 0,05 [0,000 < 0,05] – which means we read the second row of the Sig (2-tailed) column. In this column 0,072 > 0,05, which means the t-test is not significant, thus showing no statistical difference between the groups.

3.4 There **is no difference** in performance in the examination for IOP2601 between students who have a positive attitude towards research and students who have a negative attitude towards research. This can be said with **95% certainty**. (2)

QUESTION 4 **[10]**

Refer to learning unit 12 – specifically activity 12.8 on pages 172 to 176 of the MO001.

$\overline{D}$ = 2,7	s_D = 1,83

4.1 H_0 : $\mu_{GroupA} = \mu_{GroupB}$ (1)

4.2 H_1 : $\mu_{GroupA} \neq \mu_{GroupB}$ (1)

4.3

$$t = \frac{\overline{D} - 0}{\frac{s_D}{\sqrt{N}}}$$

$$t = \frac{2,7 - 0}{\frac{1,83}{\sqrt{10}}}$$

$$t = \frac{2,7}{\frac{1,83}{3,16228}}$$
$$t = \frac{2,7}{0,5787}$$
$$t = 4,66563$$
$$\boldsymbol{t = 4,67}$$ (3)

4.4 $df = N - 1$
$= 10 - 1$
$= \mathbf{9}$ (1)

4.5 $t_{0.05}(9) = \mathbf{2,2622}$ (1)

4.6 $4,67 > 2,2622$
$\therefore$ **Reject H_0** (1)

4.7 There **is a significant difference** between the effectiveness of the two educational tools for the module. This can be said **with 95% certainty**. (2)

QUESTION *5* **[12]**

Refer to learning unit 13 – specifically question 1 in activity 13.4 on pages 191 to 194 of the MO001.

Data

Shift 1 (X_1)	***Shift 2 (X_2)***	***Shift 3 (X_3)***	X^2_1	X^2_2	X^2_3
7	4	2	49	16	4
10	6	2	100	36	4
10	7	3	100	49	9
11	9	7	121	81	49
12	9	6	144	81	36
$\Sigma X_1 = 50$	$\Sigma X_2 = 35$	$\Sigma X_3 = 20$	$\Sigma X^2_1 = 514$	$\Sigma X^2_2 = 263$	$\Sigma X^2_3 = 102$
$\bar{X}_1 = 10$	$\bar{X}_2 = 7$	$\bar{X}_3 = 4$			
Total $\Sigma X = 50 + 35 + 20 = 105$ $\Sigma X^2 = 514 + 263 + 102 = 879$ $\bar{X} = 7$					

$SS_{total} = \Sigma X^2 - \frac{(\Sigma X)^2}{N}$
$= 879 - \frac{(105)^2}{15}$
$= 879 - \frac{11025}{15}$
$= 879 - 735$
$= \mathbf{144}$

$df_{total} = N - 1$
$= 15 - 1$
$= 14$

$SS_{group} = n\Sigma(\bar{X}_j - \bar{X}..)^2$
$= 5[(10 - 7)^2 + (7 - 7)^2 + (4 - 7)^2]$
$= 5[(3)^2 + (0)^2 + (-3)^2]$
$= 5[(9) + (0) + (9)]$
$= 5[18]$
$= \mathbf{90}$

$df_{group} = k - 1$
$= 3 - 1$
$= 2$

$SS_{error} = SS_{total} - SS_{group}$
$= 144 - 90$
$= \mathbf{54}$

$df_{error} = k(n - 1)$
$= 3(5 - 1)$
$= 12$

$MS_{group} = SS_{group} / df_{group}$
$= 90/2$
$= \mathbf{45}$

$MS_{error} = SS_{error}/df_{error}$
$= 54/12$
$= \mathbf{4,5}$

$$F = \frac{MS_{group}}{MS_{error}}$$
$$= \frac{45}{4,5}$$
$$= \mathbf{10}$$

5.1

Source	*Df*	*SS*	*MS*	*F*
Groups	2	90	45	10
Error	12	54	4,5	
Total	14	144		

(8)

5.2 $F_{0,05}(2,12) = 3,89$ (1)

5.3 $10 > 3,89$

∴ **Yes**, reject the null hypothesis. (1)

5.4 There **is a significant difference** in the productivity of the three shift groups. This can be said **with 95% certainty**. (2)

QUESTION 6 [3]

Refer to pages 279 and 280 of the prescribed book.

6.1 **Yes**, reject the null hypothesis. (1)

Explanation: If p-value (Sig) is less than 0,05, we reject the null hypothesis.

In the computer output, 0,010 < 0,05, which means we reject the null hypothesis.

6.2 There **is significant differences** between the three age groups of students and their attitudes towards a research methodology course. This can be said with **95% certainty**. (2)

QUESTION 7 [5]

Refer to learning unit 14 – specifically activity 14.5 on pages 207 to 209 of the MO001.

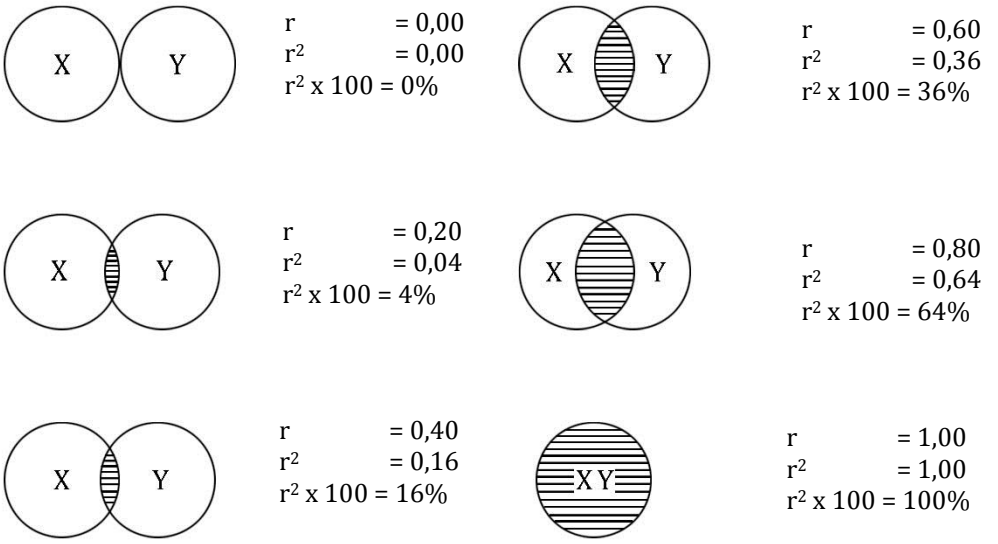
7.1 $df = (R - 1)(C - 1)$
$= (2 - 1)(2 - 1)$
$= \mathbf{1}$ (1)

7.2 $\chi^2_{0.05}$ (1) = **3,8415** (1)

7.3 0,55 **<** 3,8415
∴ **No,** do not reject H_0 (1)

7.4 There is **no significant difference** between the opinion of students and the opinion of human resources officers of different organisations in terms of preparedness of students for the world of work after obtaining their qualifications. This can be said with **95% certainty**. (2)

3 ERRATA IN THE MO001

Page	Comment
66	The heading should read as follows: **Plotting data: grouped data**.
108	The complete figure should appear as follows: *Correlation as common variance* 
165	The *t*-test formula for independent groups: $$t = \frac{\overline{X_1} - \overline{X_2}}{\sqrt{\frac{s_1^2}{N_1} + \frac{s_2^2}{N_2}}}$$
174	The *t*-test formula for dependent groups: $$t = \frac{\overline{D} - 0}{\frac{s_D}{\sqrt{N}}}$$
175	The second step of the calculation should read as follows: $$= \frac{-1,6}{\frac{1,78}{3,16}}$$

Page	Comment
181	The *t*-test formula for independent groups using pooled variance: $$t = \frac{\overline{X_1} - \overline{X_2}}{\sqrt{\frac{s_p^2}{N_1} + \frac{s_p^2}{N_2}}}$$

4 EXAMINATION INFORMATION

Refer to page 11 in Tutorial Letter 101/3/2017 for information on the examination. For examination preparation, we suggest that you work through the MO001 thoroughly. Where reference is made to sections and pages in the textbook, you can summarise those sections and integrate them with the MO001. In this way, when you start your revision for the examination, you should be able to focus on the MO001 and your own summaries.

We have also included a past examination paper to give you an indication of the format of the examination and the types of question that you could expect in the examination.

Remember that formulas and tables will be provided in the examination paper.

The pass mark for the examination is 50%. If you are admitted to the supplementary examination, you will be able to rewrite the examination next semester. If you fail the supplementary examination, you will have to reregister for the module.

All the questions (both sections A and B) must be answered in your examination book.

The examination will cover the entire curriculum, that is, the whole MO001, as well as the assignments. Like the assignments, the examination paper will include questions that test knowledge, insight and application.

5 APPENDIX: EXAMINATION PAPER

October/November 2016

SECTION 2

QUESTION 1 **[18]**

After calculating the correlation between the performance of students in Assignment 01 and their performance in Assignment 02, you found the following:

- The relationship between the performance of students in Assignment 01 and their performance in Assignment 02 was **0,91**.
- The mean of *X* (Assignment 01) was **6** and the mean of *Y* (Assignment 02) was **7,44**.
- The slope was **0,67**.

Use the results above to respond to the following questions or instructions:

(a) Interpret the correlation coefficient. (2)

(b) What deduction can be made about the nature of the relationship? (1)

(c) Calculate the percentage of common variance between the two sets of scores and then illustrate this percentage diagrammatically. (2)

From the above calculations, use the regression equation formula to predict the performance of a student in Assignment 02 based on his/her performance in Assignment 01.

(d) What is the value of the intercept? (2)

(e) Calculate the examination score of a student who obtained a score of 2 in Assignment 01. (1)

(f) Provide a graphic representation of the regression line by indicating the intercept and predicted value for a student who obtained a score of 2 in Assignment 01. (5)

The distribution table below is for the scores of 150 students for the IOP2601 examinations. The minimum score obtained was 37 and the maximum score was 94. Use the frequency table below to do the following calculations:

Class interval	Frequency	Cumulative frequency	% Frequency	Cumulative % frequency
93–98	9	150	6,00	100,00
87–92	11	141	7,33	94,01
71–86	10	130	6,67	86,68
65–70	28	120	18,67	80,01
59–64	34	92	22,67	61,34
53–58	18	58	12,00	38,67
47–52	19	40	12,67	26,67
41–46	12	21	8,00	14,00
35–40	9	9	6,00	6,00

(g) What is the percentile rank for a score of 55%? (3)

(h) What is the score of 75% of the students? In other words, what score is found at the 75th percentile? (2)

QUESTION 2 **[6]**

Given a normally distributed population with a mean (μ) of 9, a standard deviation (σ) of 3, and 400 as the number of cases (N), answer the following questions:

(a) What is the **proportion** of students with a raw score greater than 5? (2)

(b) What is the **percentage** of students with a raw score lower than 15? (2)

(c) What is the **number** of students with raw scores between 5 and 15? (2)

QUESTION 3 **[10]**

The IOP2601 lecturers want to know if students' attitude towards statistics is different at the end of the course in comparison to their attitude towards statistics before the course. They randomly select a group of 15 students from the class and present them with a questionnaire to assess their attitude towards statistics before they start with the course. They ask the same group of students to complete the same questionnaire at the end of the course.

They ask your help with the data analysis and request you to determine if there is a difference in students' attitude towards statistics after the course in comparison to their attitude before the course.

You set the level of significance at $\alpha = 0,01$.

(a) Formulate an appropriate null hypothesis (H_0) in symbols. (1)

(b) Formulate an appropriate alternative hypothesis (H_1) in words. (1)

(c) Assuming that your data are normally distributed, select an appropriate statistical test and calculate the test statistic. Show ALL the calculations. (3)

$\bar{D}$	s_D
-2,27	3,49

(d) Determine the degrees of freedom. (1)

(e) Determine the critical value for a two-tailed test for a significance level of 1% (0,01). (1)

(f) Interpret the results in terms of the rejection or non-rejection of the null hypothesis. (1)

(g) Interpret your rejection or non-rejection of the null hypothesis in plain language in terms of the original problem statement. With how much certainty can you conclude this? (2)

QUESTION 4 **[12]**

The IOP2601 lecturers are interested to know if there are differences between students' attitude towards statistics for students at first-, second- and third-year level. The following table represents the scores for attitudes towards statistics for each group:

ATTITUDES TOWARDS STATISTICS		
1st-year students (X_1)	2nd-year students (X_2)	3rd-year students (X_3)
6	7	9
6	7	9
3	5	8
5	6	7
2	8	9
4	5	6
3	6	8
$\Sigma X_1 = 29$	$\Sigma X_2 = 44$	$\Sigma X_3 = 56$
$\bar{X}_1 = 4,14$	$\bar{X}_2 = 6,29$	$\bar{X}_3 = 8$
Total $\bar{X} = 6,14$ $\Sigma X = 129$ $\Sigma X^2 = 875$		

You would like to answer the following question: Is there a significant difference in the attitudes towards statistics of students at first-, second- and third-year levels? Or, stated differently, you test the following null hypothesis:

$$H_0: \mu_{1st\ year} = \mu_{2nd\ year} = \mu_{3rd\ year} \text{ with } \alpha = 0,05$$

(a) Choose an appropriate test statistic to test this hypothesis and calculate the test statistic. Present your answers in a summary table. (8)

(b) Determine the critical value that will help you to decide whether or not you should reject the null hypothesis at a **significance level of 0,05.** (1)
(c) Do you reject the null hypothesis? (1)

(d) Interpret your findings in terms of the original problem statement. With how much certainty can you conclude this? (2)

QUESTION 5 **[4]**

You want to find out if there is a difference between historical first-year, second-year and third-year students' level of satisfaction relating to the teaching method used for this module.

In the table below, the responses of the various groups to the following question are captured:

Are you satisfied with the way in which IOP2601 (Organisational Research Methodology) was presented?

A) Yes
B) No

	A	**B**
First-year level	6	8
Second-year level	19	12
Third-year level	7	11

The chi-square value is 2,74.

(a) Determine the critical value **for a significance level of 0,01**. (1)

(b) Do you reject the null hypothesis? (1)

(c) Interpret your findings in terms of the original problem statement. With how much certainty can you come to this conclusion? (2)

TOTAL SECTION 2: [50]
GRAND TOTAL: [70]

MEMORANDUM: SECTION 2

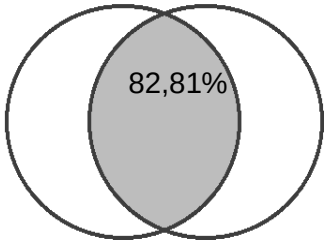
QUESTION 1

(a) 0.91 **= strong positive relationship** (2)

b) The better the performance for Assignment 01, the better the performance for Assignment 02 as well. (1)

(c) Common variance: r = 0,91

r^2 = 0,8281 x 100%
r^2 = 82,81% (2)



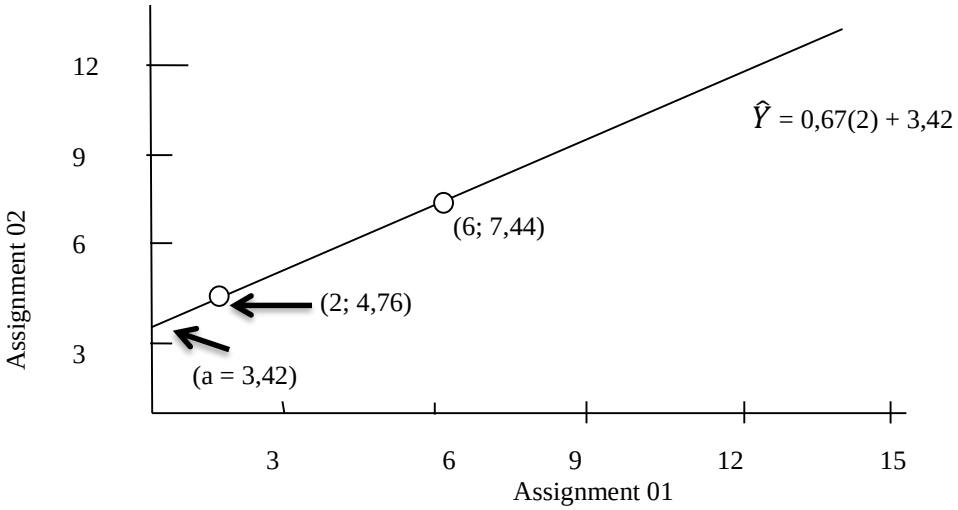
From the above calculations, use the regression equation formula to predict the performance of a student in Assignment 02 based on his/her performance of 6 marks in Assignment 01.

(d) intercept: $a = \overline{Y} - b\overline{X}$

= 7,44 – (0,67) (6)
= 7,44 – (4,02)
= 3,42
= 3,42 (2)

(e) regression : $\hat{Y} = bX + a$
= (0,67)2 + 3,42
= **4,76** (1)

(f) Regression line (5)



Class interval	Frequency	Cumulative frequency	% Frequency	Cumulative % frequency
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59–64	34	92	22,67	61,34
53–58	18	58	12,00	38,67
47–52	19	40	12,67	26,67
41–46	12	21	8,00	14,00
35–40	9	9	6,00	6,00

(g) Percentile rank = 55 (3)

$$\text{percentile rank} = \%\text{ below} + \frac{\text{score} - \text{RLL}}{\text{class int width}}(\text{interval }\%)$$

$$= 26{,}67 + \frac{55 - 52{,}5}{6}(12)$$
$$= 26{,}67 + \frac{2{,}5}{6}(12)$$
$$= 26{,}67 + [(0{,}41667)(12)]$$
$$= 26{,}67 + 5{,}00004$$

$$= \mathbf{31{,}67}$$

(h) 75th percentile score of p = RLL + $\frac{\text{PR – \% below}}{\text{interval \%}}$ (interval width) (2)

= 64,5 + $\frac{75 - 61,34}{18,67}$ (6)

= 64,5 + $\frac{13,66}{18,67}$ (6)

= 64,5 + 0,73165 (6)

= 64,5 + 4,3899

= 68,89

QUESTION 2 **[6]**

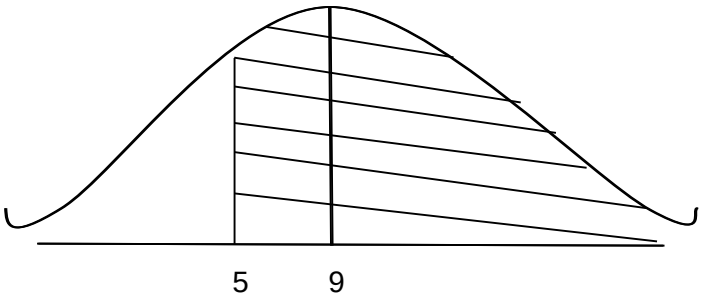
(a) What is the **proportion** of students with a raw score larger than 5? (2)

$$z = \frac{X - \mu}{\sigma}$$

$$= \frac{5 - 9}{3}$$

$$= \frac{-4}{3}$$

$$= \mathbf{-1,33}$$



Proportion/*Proporsie* = **0,90824**

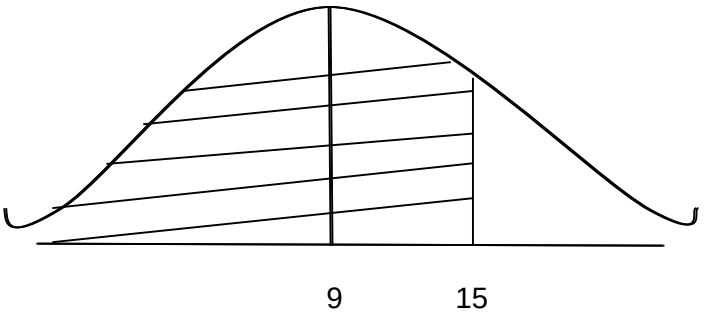
(b) What is the **percentage** of students with a raw score lower than 15? (2)

$$z = \frac{X - \mu}{\sigma}$$

$$= \frac{15 - 9}{3}$$

$$= \frac{6}{3}$$

$$= 2$$



Proportion/*Proporsie* = **0,97725**

Percentage = 97,725 = **97,73%**

(c) What is the **number** of students with raw scores between 5 and 15? (2)

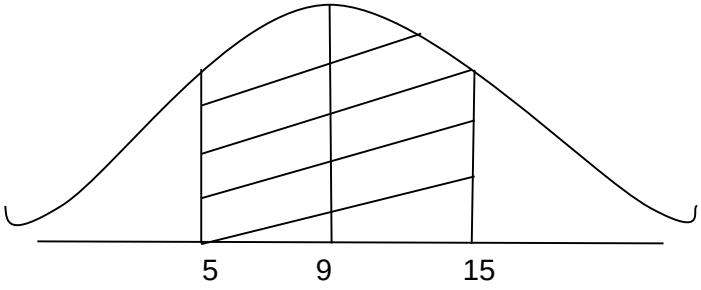
X = 5: mean to z score = 0,40824

X = 15: mean to z score = 0,47725

Total = **0,88549**

0,88549 x 400 students = 354,196

= **354 students**



QUESTION 3 **[10]**

a) H_0 : $\mu_{Before} = \mu_{After}$ (1)

b) H_1 : There is a difference in students' attitude towards statistics after the course in comparison to their attitude before the course. (1)

H_1: $\mu_{Before} \neq \mu_{After}$

c)

$$t = \frac{\bar{D} - 0}{\frac{s_D}{\sqrt{N}}} \quad (1)$$

$$= \frac{-2,27 - 0}{\frac{3,49}{\sqrt{15}}} \quad (1)$$

$$= \frac{-2,27}{\frac{3,49}{3,87298}}$$

$$= \frac{-2,27}{0,901114}$$

$$= -2,51910$$

$$= \mathbf{-2,52} \quad (1)$$

d) $df = N - 1$

$= 15 - 1$

$\mathbf{= 14}$ (1)

e) $t_{0.01}$ (14) = **2,9768** (1)

f) 2,52 < 2,9768

∴ **Do not r*eject* H_0.** (1)

g) It can be concluded with **99% certainty** that **there is no significant difference in students' attitude towards statistics after the course in comparison to their attitude before the course.** (2)

QUESTION 4 **[12]**

Data

ATTITUDES TOWARDS STATISTICS		
1st year students (X_1)	**2nd year students (X_2)**	**3rd year students (X_3)**
$\Sigma X_1 = 29$ $\bar{X}_1 = 4,14$	$\Sigma X_2 = 44$ $\bar{X}_2 = 6,29$	$\Sigma X_3 = 56$ $\bar{X}_3 = 8$
Total $\bar{X} = 6,14$ $\Sigma X = 129$ $\Sigma X^2 = 875$		

$SS_{total} = \Sigma X^2 - \frac{(\Sigma X)^2}{N}$

$= 875 - \frac{(129)^2}{21}$

$= 875 - \frac{16641}{21}$

$= 875 - 792,42857$

$= 82,57143$
$= 82,57$

$df_{total} = N - 1$

$= 21 - 1$
$= 20$

$SS_{group} = n\Sigma(\bar{X}_j - \bar{X}..)^2$

$= 7[(4,14 - 6,14)^2 + (6,29 - 6,14)^2 + (8 - 6,14)^2]$

$= 7\,[(-2)^2 + (0,15)^2 + (1,86)^2]$

$= 7\,[(4) + (0,0225) + (3,4596)]$

$= 7\,[7,4821]$

$= 52,3747$
$= 52,38$

$df_{group} = k - 1$

$= 3 - 1$

$= 2$

$SS_{error} = SS_{total} - SS_{group}$

$= 82,57 - 52,38$

$= 30,19$

$df_{error} = k\,(n - 1)$

$= 3\,(7 - 1)$

$= 18$

$MS_{group} = SS_{group} / df_{group}$

$= 52,38 / 2$

$= 26,19$

$MS_{error} = SS_{error} / df_{error}$

$= 30,19/18$

$= 1,67722$

$= 1,68$

$F = \frac{MS_{group}}{MS_{error}}$

$= \frac{26,19}{1,68}$

$= 15,58928$
$= 15,59$

(a)

Source	*df*	*SS*	*MS*	*F*
Groups	2	52,38	26,19	15,59
Error	18	30,19	1,68	
Total	20	82,57		

(8)

(b) $F_{0,05}$ (2,18) = **3,55**

(1)

15,59 > 3,55

(c) ∴ **Reject H_0.** (1)

(d) There **is a significant difference** in the attitudes towards statistics for students at first-, second- and third-year levels. This can be said **with 95% certainty**. (2)

QUESTION 5 **[4]**

a) *df* = (*R* – 1)(*C* – 1)

= (2 – 1) (3 – 1)

= 2

$\chi^2_{0.01}$ (2) = **9,2104** (1)

b) 2,74 < 9,2104

∴ **Do not reject** the null hypothesis. (1)

c) There is **no significant difference** between historical first-year, second-year and third-year students' level of satisfaction relating to the teaching method used for this module. This can be said **with 99% certainty**. (2)

6 CONCLUSION

Best of luck with your preparation for the examination.

Regards

Your IOP2601 lecturers

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