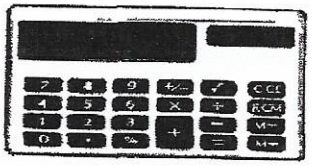
UNIVERSITY EXAMINATIONS



UNIVERSITEITSEKSAMENS

UNISA university of south africa

May / June 2014

PYC3704 (472703) May/June 2014

PSYCHOLOGICAL RESEARCH

Duration . 2 Hours + the answers. 70 Marks

EXAMINATION PANEL AS APPOINTED BY THE DEPARTMENT.

Use of a non-programmable pocket calculator is permissible.

Closed book examination.

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EXAMINERS:

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This paper consists of 19 pages plus 2 blank pages for rough work (pp 20 & 21) plus 1 page (i) of formulae and 4 pages of tables(ii-v) as well as instructions for the completion of a mark reading sheet

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After completing your answers, you must hand in the following

(i) The mark reading sheet
(ii) The question paper (All the pages must be handed in)

This exam paper consists of seventy items Your mark will be converted to a mark out of 90 and 10% of your assignment mark will be added, to produce a mark out of 100 [Note that if your mark is less than 40% the assignment mark will not be added.]

ENSURE THAT YOU HAVE WRITTEN YOUR **STUDENT NUMBER AND COURSE CODE** ON THE MARK READING SHEET.

Please complete the attendance register on the back page, tear off and hand to the invigilator

[TURN OVER]

ANSWER THE FOLLOWING SEVENTY MULTIPLE CHOICE QUESTIONS ON THE MARK READING SHEET. READ THE ATTACHED INSTRUCTIONS AND FOLLOW THEM CAREFULLY.

Question 1 = 4

Empirical research in psychology refers to research based on - - - - -

1 valid theories
2 quantitative measurements
3 suitable experiments
4 careful observations

Question 2 = 3

A "latent" variable refers to a variable which is - - - - -

1 observable
2 quantifiable
3 hidden
4 operationalized

Question 3 = 3

In science, including social science, the word 'theory is used to refer to - - - - -

1 a description of a possible relationship among variables based on intelligent guesswork
2 a description of abstract constructs in terms of observable measurements
3 an explanation or a set of explanations that account for the observed relationships among phenomena
4 a procedure which makes abstract constructs visible by finding suitable ways of measuring them

Question 4 = 2

In quantitative research, 'operationalisation' refers to a process of - - - - -

1 doing empirical research to test a theory
2 finding a suitable way to measure a theoretical construct
3 setting up suitable hypotheses to test
4 choosing the correct test statistic to calculate

Question 5 = 2

Which best describes "research hypothesis"?

1 A proven relation between two constructs
2 A proposed relation between two or more variables
3 A network of all the possible relations between constructs
4 Specifying the procedures for testing whether a relationship exists among variables

Question 6 = 4

A researcher is investigating the way in which people's attention span is affected by the hours of sleep they completed the previous night In this case, 'hours of sleep' is the - - - - - variable and 'attention span' is the - - - - - variable (cause) "effect"

1 dependent, independent
2 manifest, empirical
3 latent, manifest
4 independent, dependent

Question 7 = 3

In psychological research, the term 'construct' can be used to refer to a - - - - -

1 hypothetical relation between two or more variables
2 measurement of a variable
3 hypothetical aspect of a person that we wish to investigate
4 testable prediction derived from a theory of human behaviour

Question 8 = 3

"Arithmetic ability is the number of simple sums a person can do correctly in two minutes" In this scenario "the number of sums done correctly in two minutes" can be regarded as - - - - - "arithmetic ability"

1 an inference about
2 a hypothesis regarding
3 a construct which represents
4 the operationalisation of

Question 9 = 1

In a study, the relationship between level of physiological arousal (high and low) and mood (measured on three levels) is considered A suitable hypothesis for the study can be viewed as a - - - - -

1 rule associating the values of 'physiological arousal' with the values of 'mood'
2 correlation between the constants 'physiological arousal' and 'mood'
3 determining the appropriate test statistic for measuring the effect of 'physiological arousal' on 'mood'
4 specification of the procedures for measuring 'physiological arousal' and 'mood'

Question 10 = 3

Operational definitions enable us to - - - - -.

(a) make observations of constructs, (b) link constructs to observable phenomena

1 (a) but not (b)
2 (b) but not (a)
3 both (a) and (b)
4 neither (a) nor (b)

Question 11 =2

A psychologist conducts a study in which she measures the reaction times of a team of soccer players using a psychometric test She proceeds from the assumption that reaction time correlates with athletic ability In this study 'athletic ability' is the - - - - -

1 empirical measurement
2 latent construct or variable
3 manifest variable
4 observable or empirical construct

Base your answers to Questions 12 and 13 on the following scenario

A class of 10 boys and 15 girls, which includes Susan and John, chooses a class representative by writing all their classmates' names on slips of paper, putting these into a box and asking their teacher to draw one name blindly

Question 12 =4

What is the probability that Susan will be selected?

1 1/15
2 15/25
3 15/25
4 1/25

Question 13 =2

What is the probability that *either* Susan *or* John will be selected?

1 1/25 + 1/25
2 1/15 + 1/10
3 1/25
4 1/25 X 1/25

Question 14 =3

Which of the following does **not** represent a probability?

1 99%
2 0
3 -- 0 05
4 1

Question 15 = (1)

A sample of 100 research participants are tested on a test of 'interpersonal skills', which ranges from 1 (for 'low interpersonal skills') to 10 ('high interpersonal skills') The distribution of scores is as follows

Score (interpersonal skill)	1	2	3	4	5	6	7	8	9	10
Relative frequency (%)	3	11	12	21	18	16	9	6	3	1

What is a reasonable estimate of the probability that any specific individual will get a score of 8 or more on this particular test?

10/100 = 0,1

1 0 1
2 0 01
3 0 18
4 This probability cannot be estimated if the mean and standard deviations of the scores in the general population is unknown

Question 16 = (1)

Which statement best represents an application of the law of large numbers? If I flip a coin 1000 times it will fall heads up - - - - - 500 times

1 approximately
2 exactly
3 at most
4 significantly more than

Question 17 = (4)

The expression "0 05 < p ≤ 0 10" denotes a probability value - - - - -

1 half way between 0 05 and 0 10
2 larger than or equal to 0 10, or smaller than 0 05
3 larger than or equal to 0 05 and smaller than 0 10
4 larger than 0 05 and smaller than or equal to 0.10

Question 18 = (1)

Consider the following table, which shows the mark (percentage) of a specific student (Student X) and those of his classmates in four different courses

Subject	Student X	Mean for class	Standard deviation of class
Psychology	50%	40% 10	5%
Sociology	55%	50% 5	5%
Criminology	60%	50% 10	10%
Communication Science	65%	65% 0	5%

In which subject did Student X do best, relative to his class?

1 Psychology
2 Sociology
3 Criminology
4 Communication Science

50 - 40 / 5 = 2

Question 19 = (4)

Which of the following expressions of the rule for combining two probabilities which are *not mutually exclusive* is the correct formula to complete the equation below?

P (A or B) = - - - - -

1 P(A) + P(B) + P(A and B)
2 P(A) + P(B)
3 P(A) x P(B|A)
4 P(A) + P(B) – P(A and B)

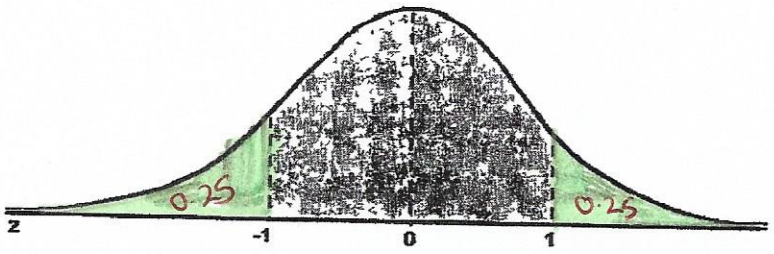
Question 20 = (3)

Which of the following represents the best estimate of the population mean?

1 The sample mean divided by the square root of the sample size
2 The sample mean divided by the sample standard deviation
3 The mean of several sample means
4 The standard error of the mean

Question 21 = (2)

What is the probability that a randomly selected test score from data which is known to be normally distributed will fall between z-values of z = – 1 and z = 1 after it is standardised (indicated by the grey area in the graph below)?



1 0 84
2 0 5
3 0 34
4 0 68

0.25 + 0.25 = 0.5

Question 22 = (1)

The standard error of the estimated population mean will be smaller in cases where the - - - -

1 sample is larger and the standard deviation of the population smaller
2 population is larger and the variability of the scores in the sample is smaller
3 sample mean is smaller
4 sample size is smaller

Question 23 = (3)

The mean and standard deviation of a set of scores on a questionnaire which measure people's attitudes to immigrants are 20 and 8 respectively If these scores are standardised, what is the z-score corresponding to a test score of 14?

1 6
2 0 75
3 – 0.75
4 – 2 12

$z = 14 - 20 / 8 = -0,75$

$\mu = 20$

$\sigma = 8$

Question 24 = (4)

Given that the mean and standard deviation of scores on a questionnaire measuring 'attitudes towards immigrants' are 20 and 8 respectively, what is the probability that a person chosen at random will get a score of less than 14 on this test? Select the interval in which this probability would fall from the options below

1 Smaller than 0 009
2 Between 0 010 and 0 099
3 Between 0 100 and 0.499
4 Larger than 0 500

Question 25 = 4

A psychologist is uses a test which measures level of motivation on a random sample of 36 research participants It is known that the scale was standardized to a population mean of 10 and a population standard deviation of 4 The psychologist analyses the data and finds that the mean motivation level for her sample is 11.6 with a sample standard deviation of 2 5 What is the standard error?

1 0 11 2,5/36
2 0 67
3 0 33
4 0 42

Base your answers to Questions 26 and 27 on the following scenario.

Suppose that the memory span of adults is normally distributed with a mean of 7 items and a standard deviation of 2 items A researcher predicts that "dyslexic adults have a shorter memory span than adults in general"

Question 26 = 2

Which of the following is an appropriate null hypothesis for testing the above prediction?

1 The mean memory span of the population of dyslexic adults is smaller than 7
2 The mean memory span of the population of dyslexic adults equals 7
3 The mean memory span of the population of adults equals 7
4 The mean memory span of the population of dyslexic adults is smaller than that of adults in general

Question 27 = 3

Testing the above prediction will require a - - - - - statistical test

1 non-directional
2 two-tailed
3 directional
4 two group

Question 28 = 1

The central limit theorem implies that, for large samples from non-normal populations, - - - - -

1 the sampling distribution of the mean will deviate significantly from a normal distribution
2 the distribution of sample values will be approximately normal
3 the sample standard deviation will be a good estimate of the population standard deviation
4 the sampling distribution of the mean will be approximately normal

Question 29 = 1

Statistical hypotheses are statements about - - - - -

1. population parameters
2 sample statistics
3 inferential statistics
4 the significance of statistical tests

Question 30 = 4

The sampling distribution of a statistic (e g of the sample mean) can be calculated if we assume that the - - - - - hypothesis is true, but not if we assume that the - - - - - hypothesis is true

1	research;	statistical
2	alternative;	null
3	statistical,	research
4	null,	alternative

Question 31 = 3

When a statistical test yields a large p-value, which of the following statements is most correct?

1 The alternative hypothesis is probably true
2 The null hypothesis is probably false
3 The null hypothesis is probably true
4 The error of Type I which will be made if the null hypothesis is rejected is relatively small

Question 32 = 1

When applying a t-test to compare a sample mean to a known population mean, what do we call the calculated t-value?

1 A test statistic
2 A sample statistic
3 A population parameter
4 The effect size

Question 33 = 2

When applying a z-test to compare a sample mean to a known population mean, the p-value represents the probability of - - - - -

1 correctly rejecting the null hypothesis
2 obtaining the sample mean under the alternative hypothesis
3 obtaining the sample mean under the null hypothesis
4 making a mistake if the null hypothesis is not rejected

Question 34 = 2

The standard error of the mean is - - - - -

1 the standard deviation of the population mean
2 the standard deviation of the sampling distribution of the mean for samples of a specific size
3 the mean of the standard deviations of repeated samples of a specific size
4 an estimate of the population mean

Question 35 = 4

Which of the options below is true of a null hypothesis?

(a) It specifies the condition where no relationship exists among relevant variables in a population
(b) It specifies the condition where no relationship exists among relevant variables in a sample
(c) It specifies the condition where no difference exists between the parameters of two (or more) groups

1 Both (a) and (b) but not (c)
2 Only (b) but not (a) nor (c)
3 The statements (a), (b) and (c) are all true
4 Both (a) and (c) but not (b)

Question 36 = 1

A type I error occurs when - - - - -

1 the null hypothesis is rejected when it should not be rejected
2 the null hypothesis is not rejected when it should be rejected
3 the alternative hypothesis is rejected when it should not be rejected
4 the alternative hypothesis is not accepted when it should be accepted

Base your answers to Questions 37 to 40 on the following scenario:

A researcher hypothesizes that babies born prematurely will be somewhat less intelligent as young adults than their peers. She uses the records of various maternity hospitals to identify a random sample of 25 persons who are now young adults, but who were born more than four weeks prematurely She measures the IQ of each, using the SAWAIS She knows from the manual that IQ scores on this test are distributed normally in the general population, with a mean of 100 and a standard deviation of 15 Suppose she finds that the mean IQ score of her sample is 97 9 and the standard deviation of the scores is 17

Question 37 = 1

How would you describe the population investigated in this research?

1 Adults that were born more than four weeks prematurely
2 All adults
3 Adults that completed the SAWAIS
4 Adults with lower than average IQ

Question 38 = (2)

Which research design did the researcher use?

1 A correlational design
2 A single-sample groups design
3 A two-sample groups design
4 A repeated measures design

Question 39 = (1)

Which of the following are an appropriate null hypothesis (H_0) and alternative hypothesis (H_1)?

1 H_0 $\mu = 100$, H_1: $\mu < 100$
2 H_0 $\mu = 100$, H_1 $\mu \neq 100$
3 H_0. $\mu \neq 100$, H_1 $\mu < 100$
4 H_0: $\mu = 100$, H_1 $\mu > 100$

Question 40 = (2)

Which is the correct value of the standard deviation of the sampling distribution of the mean of the 25 IQ scores?

1 30
2 34
3 15
4 17

17/25 = 3,4

Question 41 = (2)

The size of the level of significance depends on - - - - -

1 the effect size of the test results
2 a decision made by the researcher
3 the size of the calculated test statistic
4. the p-value under H_0

Question 42 = (3)

During the process of using statistical procedures to establish whether a relationship exists between the variables x and y, a researcher considers the *effect size* of the findings. What does this refer to?

1 It is another way of saying that the statistical test was significant
2 It refers to the probability of making an error of Type I if the null hypothesis is rejected
3 It gives a general indication of the size of the relationship among variables which indicates its importance from a practical point of view
4 It refers to the extent to which the p-value which was found differs from the chosen level of significance

Question 43 = (4)

A failure to reject H_0 implies that any observed difference between the calculated sample mean and its expected value under H_0 is due to - - - - -

1 the dependent variable
2 the independent variable
3 one or more hidden variables
4 chance or measurement error

Question 44 = (3)

Which one of the following alternative hypotheses requires a non-directional test of significance?

1 The mean anxiety score for boys is greater than that of girls
2 The mean verbal ability score for boys is lower than that of girls
3 There is a lack of correlation between test marks and examination of Unisa students
4 There is a negative correlation between assignment marks and examination marks of psychology students

Base your answers to Questions 45 to 48 on the following scenario.

A researcher hypothesizes that chess-playing students are better at non-verbal reasoning than students in general. He draws a random sample of 25 students from the members of the chess clubs of South African universities and measures their non-verbal reasoning ability by means of a test developed for this purpose (where a high score implies a high reasoning ability) The scores of a large group of students on this test were found in earlier research to be distributed normally with a mean of 20 Suppose the researcher finds that the mean score of his sample is 22.3 and the standard deviation of the scores 6 0 The researcher decides to test his hypothesis at a significance level of 0 05

Question 45 = (2)

Which of the following is an appropriate way to specify the null hypothesis for this project?

1 $H_0\ \mu \neq 20$
2 $H_0\ \mu = 20$
3 $H_0\ \bar{x} = 20$
4 $H_0\ \bar{x} \neq 20$

Question 46 = (1)

Which is an appropriate way to specify the alternative hypothesis?

1 $H_1\ \mu > 20$
2 $H_1\ \bar{x} > 20$
3 $H_1\ \mu \neq 20$
4 $H_1.\ \mu > \bar{x}$

Question 47 = (1)

Which is the appropriate test statistic to calculate?

1 The z-statistic for the mean of a single sample
2 The t-statistic for the difference between the means of two independent samples
3 The t-statistic for the difference between the means of two dependent samples
4 The t-statistic for the mean of a single sample

Question 48 = (3)

After calculating the appropriate test statistic, the researcher uses this to determine the probability that the null hypothesis is true given the population mean of $\mu = 20$ and the observed mean of $\bar{x} = 22\,3$ He finds that the p-value = 0 25

What can the researcher conclude from this?

1 H_0 should be rejected because the chess players are in fact better at non-verbal reasoning than students in general
2 H_0 should not be rejected because chess players differ significantly in non-verbal reasoning from students in general
3 H_0 should not be rejected because chess players are not significantly better in non-verbal reasoning than students in general
4 H_0 should be rejected because chess players are not significantly better in non-verbal reasoning than students in general

Question 49 = (1)

A politician asks his audience of 100 whether they will vote for him, and 60 say yes. He then delivers his speech and repeats the question Now 70 persons say yes When analysing these results the two sets of answers should be regarded as - - - - -

1 dependent
2 independent
3 correlated
4 drawn from different populations

Question 50 = (3)

A researcher stated the following hypothesis

H_0 $\mu = 100$
H_1 $\mu > 100$

She drew a random sample of 50 persons Given that the null hypothesis is false, what can she expect the mean of the sample to be?

1 Less than 100
2 Some value different from 100 in either direction
3 More than 100
4. No conclusion can be made without first calculating the sample mean

Question 51 = (2)

An error of Type II occurs when - - - - -

1 the null hypothesis is rejected when it should not be rejected
2 the null hypothesis is not rejected when it is in fact false
3 the alternative hypothesis is accepted when it is actually false
4 the alternative hypothesis is not accepted when it is in fact true

Base your answers Questions 52 to 54 on the following scenario

To test the efficacy of psychotherapy aimed at relieving depression, a researcher applies a depression scale to 50 depressed patients before and again after the treatment (i e the psychotherapy), predicting that the latter scores will be lower (reflecting less depression) It is known that scores on his depression scale among the general population have a mean of 30

(Note: In the questions below, assume that μ_{Before} refers to the population mean on the depression scale *before* the treatment while μ_{After} is the population mean *after* the treatment and that a higher score on the depression scale implies a greater level of depression).

Question 52 = (4)

The depression scores of which population(s) are studied in this research?

1 The general population of potential research participants
2 The 50 participants in the research
3 Depressed patients that can potentially undergo the psychotherapy
4 The depressed patients who underwent this specific form of psychotherapy

Question 53 = (4)

Which is an appropriate alternative hypothesis for the analysis of the results?

1 $\mu_{After} < 30$
2 $\mu_{Before} < \mu_{After}$
3 $\mu_{Before} \neq \mu_{After}$
4 $\mu_{After} < \mu_{Before}$

Question 54 = (2)

Which is the appropriate test statistic to calculate?

1 The z-statistic for comparing the means of two samples
2 The t-statistic for comparing the difference between the means of two dependent samples
3 The t-statistic for comparing the mean of a sample to the population mean
4 The t-statistic for comparing the difference between the means of two independent samples

Question 55 = 3

A Pearson correlation of r = –0 72 is found What kind of relationship between two variables X and Y does this represent?

1 As one variable grows larger, so does the other get larger
2 As one variable grows smaller, so does the other get smaller
3 As one variable grows larger, the other grows smaller
4 The negative sign indicates that there is no relationship at all

Question 56 = 1

Cohen's d refers to a - - - - -

1 way of determining effect size or relative importance of the result when means are compared
2 test statistic for comparing two means
3 way of determining the power or sensitivity of a particular test statistic
4 way of determining the probability of making an error of Type II

Question 57 = 3

Two samples can always be considered *dependent* when - - - - -

1 the correlation between variables in the two samples is found to be high
2 care was not taken to ensure that the samples were drawn under different experimental conditions
3 the samples are drawn from a single population of research participants
4 the composition of one sample is systematically related to the composition of the other one

Question 58 = 1

A researcher wants to test the hypothesis that boys are generally more aggressive than girls He draws a sample of 100 boys and a sample of 100 girls, and gives each child a test that measures their general level of aggression Which would be the most appropriate statistical test to use, out of the following?

1 The t-test for independent samples
2 The chi-square (χ^2) test
3 The t-test for dependent samples
4 The test statistic for determining the significance of a correlation (*r*)

Question 59 = 4

Pearson's r represents - - - - -

1 a comparison between the observed frequencies of certain events and the expected frequencies of the events if the null hypothesis were true
2 a way of estimating the standard error of sets of observations
3 a way of estimating the effect size of a relationship between two variables
4 the extent to which changes in one variable affects the changes in another variable

Question 60 = (2)

The difference score ($d = x_2 - x_1$) is used in the calculation of the t-test statistic for - - - - - samples.

1 independent
2 dependent
3 random
4 correlated

Question 61 = (1)

Why would a statistician choose to do a t-test rather than a z-test to compare a sample mean with a given population mean?

1 The population standard deviation is unknown
2 The sample size (n) is relatively small
3 The standard error is unknown
4 The sample standard deviation is unknown

Question 62 = (1)

A researcher wants to compare two group means by testing the following hypotheses at a significance level of $\alpha = 0\ 05$

H_0: $\mu_1 = \mu_2$
H_1: $\mu_1 > \mu_2$

On the basis of data provided, the output from a computer program indicates that a t-value of $t = -1\ 9$ was found The computer program also indicates that a p-value for a ***two-tailed*** or nondirectional test would be $p=0\ 07$ What conclusion can the researcher make, and why?

1 H_0 cannot be rejected because p-value > α
2 H_0 can be rejected because $\alpha <$ p-value
3 H_0 can be rejected because $\alpha <$ p-value / 2
4 H_0 cannot be rejected because p-value X 2 > α

Question 63 = (4)

In correlational research one investigates the relation between - - - - -

1 the mean of a single sample of subjects and a population mean
2 two groups of subjects, with respect to a single variable
3 a sample and the population from which is was drawn
4 two variables measured on the same group of subjects

Question 64 = (1)

A researcher hypothesizes that the drug treatment of hospitalised schizophrenic patients improves their mental alertness. He studies a random sample of 27 such patients and finds a Pearson product-moment correlation coefficient of r = 0 6 between the number of days of drug treatment and patients' scores on the Mental Alertness Test

Which is an appropriate *null* hypothesis for this research?

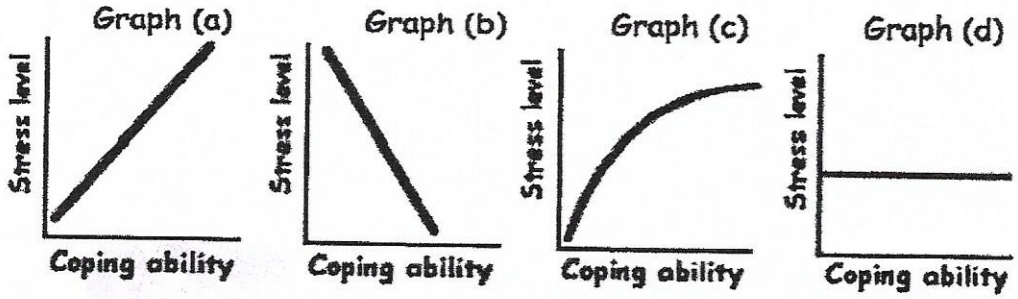
1 $\rho = 0$
2 $\mu = 0$
3 $r = 0$
4 $\rho \neq 0$

Base your answers to Questions 65 and 66 on the following

Miriam has formulated the research hypothesis that as people's stress levels increase, their ability to cope with everyday interpersonal interactions becomes less effective To investigate this, she presents a test which determines people's level of stress and a questionnaire which measures the effectiveness of their interpersonal coping strategies to a sample of 100 research participants

Question 65 = (2)

If the research hypothesis is valid, which of the graphs below is the most likely representation of the relationship between *stress level* and *interpersonal coping ability*?



1 Graph (a)
2 Graph (b)
3 Graph (c)
4 Graph (d)

Question 66 = (4)

What descriptive statistic or set of statistics can Miriam calculate to represent the size of the relationship between stress level and interpersonal coping?

1 The Cohen effect size d
2 The means and standard deviations
3 The variance
4 The Pearson product-moment correlation coefficient

Question 67 = (2)

Which of the following can never be exactly zero?

1. A probability
2. A level of significance
3. A correlation coefficient
4. A standard deviation

Base your answers to Questions 68 to 70 on the following scenario:

A sample of clients are drawn from three community mental health centres (indicated as A, B and C) Counts are made of those clients who are diagnosed as having social adjustment problems and those who are diagnosed as having problems related to anxiety The remaining clients are classified under 'other problems ' Counts of the number of clients from the different centres in each of the categories are supplied below

Mental Health Centre (columns) by Type of Problem (rows)	A	B	C	Row totals
Social adjustment problems	50	40	40	130
Anxiety related	26	34	20	80
Other	24	26	40	90
Column totals	100	100	100	300

Question 68 = (1)

Which of the following is an appropriate null hypothesis to test *relationships*, *given* the data above?

1. The particular community mental health centres that the clients visit have no relationship to the type of problem that clients present with
2. There is no significant correlation between the type of problems that clients have and the particular community mental health centres that they visit
3. There are no significant difference among clients having social adjustment problems, those with problems related to anxiety, and those with other problems
4. Variances in mental health problems are equal across the mental health centres

Question 69 = (2)

Given the data above, which of the options below would be the most appropriate test statistic to use to test the null hypothesis above against an appropriate alternative hypothesis?

1. The test statistic for the Pearson product-moment correlation coefficient (r)
2. The chi-square (χ^2) test statistic
3. The t-test statistic for two dependent samples (t_d)
4. The t-test statistic for two in dependent samples (t_c)

Question 70 = (4)

What would be the *expected* proportion of the clients diagnosed as suffering from 'anxiety related problems' in hospital C be if the null hypothesis is true?

1 20
3 0 067
2 80
4 26 67

100 x 80 / 300 = 26,666

[TOTAL: 70]

END OF EXAM PAPER

List of formulae:

$$Z_{\overline{X}} = \frac{\left(\overline{X} - \mu_{\overline{X}}\right)}{\frac{\sigma}{\sqrt{n}}}$$

$$t_C = \frac{\left(\overline{X}_1 - \overline{X}_2\right)}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$$

$$t_{\overline{d}} = \frac{\overline{X}_1 - \overline{X}_2}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2} - 2r\,s_1\,s_2}}$$

$$z_C = \frac{\left(p_1 - p_2\right)}{\sqrt{\frac{p_1\left(1-p_1\right)}{n_1} + \frac{p_2\left(1-p_2\right)}{n_2}}}$$

$$r = \frac{\operatorname{cov}(X,Y)}{\sqrt{\operatorname{var}(X)\operatorname{var}(Y)}}$$

$$r = \frac{N\sum XY - \left(\sum X\right)\left(\sum Y\right)}{\sqrt{\left[N\sum X^2 - \left(\sum X\right)^2\right]\left[N\sum Y^2 - \left(\sum Y\right)^2\right]}}$$

$$t_r = \frac{r\sqrt{N-2}}{\sqrt{1-r^2}}$$

$$\chi_p^2 = \sum_{ij} \frac{\left(O_{ij} - E_{ij}\right)^2}{E_{ij}}$$

$$t_{\overline{X}} = \frac{\left(\overline{X} - \mu_{\overline{X}}\right)}{S_{\overline{X}}}$$

$$Z_p = \frac{\left(p - P_O\right)}{\sqrt{P\left(1-P_O\right)/n}}$$

Appendix: Probabilities associated with the standard normal distribution (z) continued

z	Mean to z	Larger portion	Smaller portion	z	Mean to z	Larger portion	Smaller portion
1.02	0.3461	0.8461	0.1539	1.53	0.4370	0.9370	0.0630
1.03	0.3485	0.8485	0.1515	1.54	0.4382	0.9382	0.0618
1.04	0.3508	0.8508	0.1492	1.55	0.4394	0.9394	0.0606
1.05	0.3531	0.8531	0.1469	1.56	0.4406	0.9406	0.0594
1.06	0.3554	0.8554	0.1446	1.57	0.4418	0.9418	0.0582
1.07	0.3577	0.8577	0.1423	1.58	0.4429	0.9429	0.0571
1.08	0.3599	0.8599	0.1401	1.59	0.4441	0.9441	0.0559
1.09	0.3621	0.8621	0.1379	1.60	0.4452	0.9452	0.0548
1.10	0.3643	0.8643	0.1357	1.61	0.4463	0.9463	0.0537
1.11	0.3665	0.8665	0.1335	1.62	0.4474	0.9474	0.0526
1.12	0.3686	0.8686	0.1314	1.63	0.4484	0.9484	0.0516
1.13	0.3708	0.8708	0.1292	1.64	0.4495	0.9495	0.0505
1.14	0.3729	0.8729	0.1271	1.65	0.4505	0.9505	0.0495
1.15	0.3749	0.8749	0.1251	1.66	0.4515	0.9515	0.0485
1.16	0.3770	0.8770	0.1230	1.67	0.4525	0.9525	0.0475
1.17	0.3790	0.8790	0.1210	1.68	0.4535	0.9535	0.0465
1.18	0.3810	0.8810	0.1190	1.69	0.4545	0.9545	0.0455
1.19	0.3830	0.8830	0.1170	1.70	0.4554	0.9554	0.0446
1.20	0.3849	0.8849	0.1151	1.71	0.4564	0.9564	0.0436
1.21	0.3869	0.8869	0.1131	1.72	0.4573	0.9573	0.0427
1.22	0.3888	0.8888	0.1112	1.73	0.4582	0.9582	0.0418
1.23	0.3907	0.8907	0.1093	1.74	0.4591	0.9591	0.0409
1.24	0.3925	0.8925	0.1075	1.75	0.4599	0.9599	0.0401
1.25	0.3944	0.8944	0.1056	1.76	0.4608	0.9608	0.0392
1.26	0.3962	0.8962	0.1038	1.77	0.4616	0.9616	0.0384
1.27	0.3980	0.8980	0.1020	1.78	0.4625	0.9625	0.0375
1.28	0.3997	0.8997	0.1003	1.79	0.4633	0.9633	0.0367
1.29	0.4015	0.9015	0.0985	1.80	0.4641	0.9641	0.0359
1.30	0.4032	0.9032	0.0968	1.81	0.4649	0.9649	0.0351
1.31	0.4049	0.9049	0.0951	1.82	0.4656	0.9656	0.0344
1.32	0.4066	0.9066	0.0934	1.83	0.4664	0.9664	0.0336
1.33	0.4082	0.9082	0.0918	1.84	0.4671	0.9671	0.0329
1.34	0.4099	0.9099	0.0901	1.85	0.4678	0.9678	0.0322
1.35	0.4115	0.9115	0.0885	1.86	0.4686	0.9686	0.0314
1.36	0.4131	0.9131	0.0869	1.87	0.4693	0.9693	0.0307
1.37	0.4147	0.9147	0.0853	1.88	0.4699	0.9699	0.0301
1.38	0.4162	0.9162	0.0838	1.89	0.4706	0.9706	0.0294
1.39	0.4177	0.9177	0.0823	1.90	0.4713	0.9713	0.0287
1.40	0.4192	0.9192	0.0808	1.91	0.4719	0.9719	0.0281
1.41	0.4207	0.9207	0.0793	1.92	0.4726	0.9726	0.0274
1.42	0.4222	0.9222	0.0778	1.93	0.4732	0.9732	0.0268
1.43	0.4236	0.9236	0.0764	1.94	0.4738	0.9738	0.0262
1.44	0.4251	0.9251	0.0749	1.95	0.4744	0.9744	0.0256
1.45	0.4265	0.9265	0.0735	1.96	0.4750	0.9750	0.0250
1.46	0.4279	0.9279	0.0721	1.97	0.4756	0.9756	0.0244
1.47	0.4292	0.9292	0.0708	1.98	0.4761	0.9761	0.0239
1.48	0.4306	0.9306	0.0694	1.99	0.4767	0.9767	0.0233
1.49	0.4319	0.9319	0.0681	2.00	0.4772	0.9772	0.0228
1.50	0.4332	0.9332	0.0668	2.01	0.4778	0.9778	0.0222
1.51	0.4345	0.9345	0.0655	2.02	0.4783	0.9783	0.0217
1.52	0.4357	0.9357	0.0643	2.03	0.4788	0.9788	0.0212

Appendix: Probabilities associated with the standard normal distribution (z) continued

z	Mean to z	Larger portion	Smaller portion	z	Mean to z	Larger portion	Smaller portion
2.04	0.4793	0.9793	0.0207	2.55	0.4946	0.9946	0.0054
2.05	0.4798	0.9798	0.0202	2.56	0.4948	0.9948	0.0052
2.06	0.4803	0.9803	0.0197	2.57	0.4949	0.9949	0.0051
2 07	0.4808	0.9808	0.0192	2.58	0.4951	0.9951	0.0049
2.08	0.4812	0.9812	0.0188	2.59	0.4952	0.9952	0.0048
2.09	0.4817	0.9817	0.0183	2.60	0.4953	0.9953	0.0047
2.10	0.4821	0.9821	0.0179	2.61	0.4955	0.9955	0.0045
2.11	0.4826	0.9826	0.0174	2.62	0.4956	0.9956	0.0044
2.12	0.4830	0.9830	0.0170	2.63	0.4957	0.9957	0.0043
2.13	0.4834	0.9834	0.0166	2.64	0.4959	0.9959	0.0041
2.14	0.4838	0.9838	0.0162	2.65	0.4960	0.9960	0.0040
2.15	0.4842	0.9842	0.0158	2.66	0.4961	0.9961	0.0039
2.16	0.4846	0.9846	0.0154	2.67	0.4962	0.9962	0.0038
2.17	0.4850	0.9850	0.0150	2.68	0.4963	0.9963	0.0037
2.18	0.4854	0.9854	0.0146	2.69	0.4964	0.9964	0.0036
2.19	0.4857	0.9857	0.0143	2.70	0.4965	0.9965	0.0035
2.20	0.4861	0.9861	0.0139	2.71	0.4966	0.9966	0.0034
2.21	0.4864	0.9864	0.0136	2.72	0.4967	0.9967	0.0033
2.22	0.4868	0.9868	0.0132	2.73	0.4968	0.9968	0.0032
2.23	0.4871	0.9871	0.0129	2.74	0.4969	0.9969	0.0031
2.24	0.4875	0.9875	0.0125	2.75	0.4970	0.9970	0.0030
2.25	0.4878	0.9878	0.0122	2.76	0.4971	0.9971	0.0029
2.26	0.4881	0.9881	0.0119	2.77	0.4972	0.9972	0.0028
2.27	0.4884	0.9884	0.0116	2.78	0.4973	0.9973	0.0027
2.28	0.4887	0.9887	0.0113	2.79	0.4974	0.9974	0.0026
2.29	0.4890	0.9890	0.0110	2.80	0.4974	0.9974	0.0026
2.30	0.4893	0.9893	0.0107	2.81	0.4975	0.9975	0.0025
2.31	0.4896	0.9896	0.0104	2.82	0.4976	0.9976	0.0024
2.32	0.4898	0.9898	0.0102	2.83	0.4977	0.9977	0.0023
2.33	0.4901	0.9901	0.0099	2.84	0.4977	0.9977	0.0023
2.34	0.4904	0.9904	0.0096	2.85	0.4978	0.9978	0.0022
2.35	0.4906	0.9906	0.0094	2.86	0.4979	0.9979	0.0021
2.36	0.4909	0.9909	0.0091	2.87	0.4979	0.9979	0.0021
2.37	0.4911	0.9911	0.0089	2.88	0.4980	0.9980	0.0020
2.38	0.4913	0.9913	0.0087	2.89	0.4981	0.9981	0.0019
2.39	0.4916	0.9916	0.0084	2.90	0.4981	0.9981	0.0019
2.40	0.4918	0.9918	0.0082	2.91	0.4982	0.9982	0.0018
2.41	0.4920	0.9920	0.0080	2.92	0.4982	0.9982	0.0018
2.42	0.4922	0.9922	0.0078	2.93	0.4983	0.9983	0.0017
2.43	0.4925	0.9925	0.0075	2.94	0.4984	0.9984	0.0016
2.44	0.4927	0.9927	0.0073	2.95	0.4984	0.9984	0.0016
2.45	0.4929	0.9929	0.0071	2.96	0.4985	0.9985	0.0015
2.46	0.4931	0.9931	0.0069	2.97	0.4985	0.9985	0.0015
2.47	0.4932	0.9932	0.0068	2.98	0.4986	0.9986	0.0014
2.48	0.4934	0.9934	0.0066	2.99	0.4986	0.9986	0.0014
2.49	0.4936	0.9936	0.0064	3.00	0.4987	0.9987	0.0013
2.50	0.4938	0.9938	0.0062	3.01	0.4987	0.9987	0.0013
2.51	0.4940	0.9940	0.0060	3.02	0.4987	0.9987	0.0013
2.52	0.4941	0.9941	0.0059	3.03	0.4988	0.9988	0.0012
2.53	0.4943	0.9943	0.0057	3.04	0.4988	0.9988	0.0012
2.54	0.4945	0.9945	0.0055	3.05	0.4989	0.9989	0.0011

Appendix: Probabilities associated with the standard normal distribution (z)

z	Mean to z	Larger portion	Smaller portion	z	Mean to z	Larger portion	Smaller portion
0.00	0.0000	0.5000	0.5000	0.51	0.1950	0.6950	0.3050
0.01	0.0040	0.5040	0.4960	0.52	0.1985	0.6985	0.3015
0.02	0.0080	0.5080	0.4920	0.53	0.2019	0.7019	0.2981
0.03	0.0120	0.5120	0.4880	0.54	0.2054	0.7054	0.2946
0.04	0.0160	0.5160	0.4840	0.55	0.2088	0.7088	0.2912
0.05	0.0199	0.5199	0.4801	0.56	0.2123	0.7123	0.2877
0.06	0.0239	0.5239	0.4761	0.57	0.2157	0.7157	0.2843
0.07	0.0279	0.5279	0.4721	0.58	0.2190	0.7190	0.2810
0.08	0.0319	0.5319	0.4681	0.59	0.2224	0.7224	0.2776
0.09	0.0359	0.5359	0.4641	0.60	0.2257	0.7257	0.2743
0.10	0.0398	0.5398	0.4602	0.61	0.2291	0.7291	0.2709
0.11	0.0438	0.5438	0.4562	0.62	0.2324	0.7324	0.2676
0.12	0.0478	0.5478	0.4522	0.63	0.2357	0.7357	0.2643
0.13	0.0517	0.5517	0.4483	0.64	0.2389	0.7389	0.2611
0.14	0.0557	0.5557	0.4443	0.65	0.2422	0.7422	0.2578
0.15	0.0596	0.5596	0.4404	0.66	0.2454	0.7454	0.2546
0.16	0.0636	0.5636	0.4364	0.67	0.2486	0.7486	0.2514
0.17	0.0675	0.5675	0.4325	0.68	0.2517	0.7517	0.2483
0.18	0.0714	0.5714	0.4286	0.69	0.2549	0.7549	0.2451
0.19	0.0753	0.5753	0.4247	0.70	0.2580	0.7580	0.2420
0.20	0.0793	0.5793	0.4207	0.71	0 2611	0.7611	0.2389
0.21	0.0832	0.5832	0.4168	0.72	0.2642	0.7642	0.2358
0.22	0.0871	0.5871	0.4129	0.73	0.2673	0.7673	0.2327
0.23	0.0910	0.5910	0.4090	0.74	0.2704	0.7704	0.2296
0.24	0.0948	0.5948	0.4052	0.75	0.2734	0.7734	0.2266
0.25	0.0987	0.5987	0.4013	0.76	0.2764	0.7764	0.2236
0.26	0.1026	0.6026	0.3974	0.77	0.2794	0.7794	0.2206
0.27	0.1064	0.6064	0.3936	0.78	0.2823	0.7823	0.2177
0.28	0.1103	0.6103	0.3897	0.79	0.2852	0.7852	0.2148
0.29	0.1141	0.6141	0.3859	0.80	0.2881	0.7881	0.2119
0.30	0.1179	0.6179	0.3821	0.81	0.2910	0.7910	0.2090
0.31	0.1217	0.6217	0.3783	0.82	0.2939	0.7939	0.2061
0.32	0.1255	0.6255	0.3745	0.83	0.2967	0.7967	0.2033
0.33	0.1293	0.6293	0.3707	0.84	0.2995	0.7995	0.2005
0.34	0.1331	0.6331	0.3669	0.85	0.3023	0.8023	0.1977
0.35	0.1368	0.6368	0.3632	0.86	0.3051	0.8051	0.1949
0.36	0.1406	0.6406	0.3594	0.87	0.3078	0.8078	0.1922
0.37	0.1443	0.6443	0.3557	0.88	0.3106	0.8106	0.1894
0.38	0.1480	0.6480	0.3520	0.89	0.3133	0.8133	0.1867
0.39	0.1517	0.6517	0.3483	0.90	0.3159	0.8159	0.1841
0.40	0.1554	0.6554	0.3446	0.91	0.3186	0.8186	0.1814
0.41	0.1591	0.6591	0.3409	0.92	0.3212	0.8212	0.1788
0.42	0.1628	0.6628	0.3372	0.93	0.3238	0.8238	0.1762
0.43	0.1664	0.6664	0.3336	0.94	0.3264	0.8264	0.1736
0.44	0.1700	0.6700	0.3300	0.95	0.3289	0.8289	0.1711
0.45	0.1736	0.6736	0.3264	0.96	0.3315	0.8315	0.1685
0.46	0.1772	0.6772	0.3228	0.97	0.3340	0.8340	0.1660
0.47	0.1808	0.6808	0.3192	0.98	0.3365	0.8365	0.1635
0.48	0.1844	0.6844	0.3156	0.99	0.3389	0.8389	0.1611
0.49	0.1879	0.6879	0.3121	1 00	0.3413	0.8413	0.1587
0.50	0.1915	0.6915	0.3085	1.01	0.3438	0.8438	0.1562

Appendix: Probabilities associated with the standard normal distribution (z) continued

z	Mean to z	Larger portion	Smaller portion	z	Mean to z	Larger portion	Smaller portion
3.06	0.4989	0.9989	0.0011	3.19	0.4993	0.9993	0.0007
3.07	0.4989	0.9989	0.0011	3.20	0.4993	0.9993	0.0007
3.08	0.4990	0.9990	0.0010	3.21	0.4993	0.9993	0.0007
3.09	0.4990	0.9990	0.0010	3.22	0.4994	0.9994	0.0006
3 10	0.4990	0.9990	0.0010	3.23	0.4994	0.9994	0.0006
3.11	0.4991	0.9991	0.0009	3.24	0.4994	0.9994	0.0006
3.12	0.4991	0.9991	0.0009	3.25	0.4994	0.9994	0.0006
3 13	0.4991	0.9991	0.0009	...	...	...	...
3.14	0.4992	0.9992	0.0008	3.50	0.4998	0.9998	0.0002
3.15	0.4992	0.9992	0.0008	...	...	...	...
3.16	0.4992	0.9992	0.0008	3.75	0.4999	0.9999	0.0001
3.17	0.4992	0.9992	0.0008	...	...	...	...
3.18	0.4993	0.9993	0.0007	4.00	0.5000	1.000	0.0000