NAMIBIA UNIVERSITY
OF SCIENCE AND TECHNOLOGY

FACULTY OF HEALTH, NATURAL RESOURCES AND APPLIED SCIENCES
SCHOOL OF NATURAL AND APPLIED SCIENCES
DEPARTMENT OF MATHEMATICS, STATISTICS AND ACTUARIAL SCIENCE

| | |
|---|---|
| **QUALIFICATION: BACHELOR OF COMPUTER SCIENCE** | |
| **QUALIFICATION CODE: 07BACS, 07BCMS, 07BCCS, 07BCCY** | **LEVEL:** 6 |
| **COURSE CODE:** ASP610/ASP611S | **COURSE NAME:** APPLIED STATISTICS & PROBABILITY FOR IT |
| **SESSION:** JUNE 2023 | **PAPER:** THEORY |
| **DURATION:** 3 HOURS | **MARKS:** 90 |

| **FIRST OPPORTUNITY EXAMINATION QUESTION PAPER** | |
|---|---|
| **EXAMINER(S)** | MR. ROUX, AJ |
| **MODERATOR:** | MR. E MWAHI |

**INSTRUCTIONS**

1. Answer ALL the questions.
2. Write clearly and neatly.
3. Number the answers clearly.

**PERMISSIBLE MATERIALS**

1. NON-PROGRAMABLE SCIENTIFIC CALCULATOR

**ATTACHMENTS**

1. Statistical Tables ( Z-table )
2. 1 x A4 Graph Paper (to be supplied by Examinations Department)
3. Formulae Sheets

**THIS QUESTION PAPER CONSISTS OF 5 PAGES** (Including this front page)

QUESTION 1 [ 20]

1.1 Indicate whether each of the following variables is quantitative or qualitative, and identify the appropriate scale of measurement:

1.1.1) age of a child during an immunization (2)

1.1.2) gender of an applicant attending an interview (2)

1.1.3) the rank in which athletes obtained prices (2)

1.1.4) the make of the cellphone which the child lost (2)

1.1.5) percentage of students who passed the test (2)

1.2) For each of the following random variables, indicate whether the data type is discrete or continuous

1.2.1) The weight of a bag of potatoes (1)

1.2.2) The number of cars damaged in the accident (1)

1.2.3) The distance a cyclist completed (1)

1.2.4) The number of children with disabilities (1)

1.2.5) The height of a ten-year old girl (1)

1.3) **[For each of these questions ( 1.3.1 – 1.3.5), Only provide the letter indicating your correct answer]**

1.3.1 Which of the following measures of central tendency can reliably be used when dataset has outliers?

a) Mean b) Median c) Mode d) All the above (1)

1.3.2) A sample is

a) An experiment in the population b) A subset of the population

c) A variable in the population d) An outcome of the population (1)

1.3.3) A parameter refers to

a) Calculation made from the population b) A measurement that is made from the population c) A value observed in the experiment d) All of the above (1)

1.3.4) Weight is a _________ variable

a) Continuous b) Discrete c) Ordinal d) Interval (1)

1.3.5) Researchers do sampling because of all of the following reasons except

a) Reduce cost b) Can be done in a shorter time frame c) Sampling is interesting

d) Easy to manage due to manageable logistics requirements (1)

QUESTION 2 [30]

2.1) The Ministry of Education summarized the mathematics grades of ten thousand Grade 12 learners. The result was to categorize into the following categories *A, B, C, D* and *E* respectively. The following table shows data on mathematics results for a sample of 50 Grade 12 learners.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| A | C | E | B | D | C | D | B | D | C |
| *D* | *B* | *D* | *E* | *C* | *A* | *D* | *C* | *D* | *E* |
| D | C | A | B | D | C | B | E | C | D |
| *B* | *C* | *D* | *C* | *D* | *C* | *E* | *A* | *D* | *C* |
| *C* | *B* | *D* | *D* | *B* | *D* | *C* | *E* | *B* | *A* |

2.1.1) Construct the frequency distribution for the set of qualitative data in the table. (8)
2.1.2) Construct the relative frequency distribution for the data set. (2)
2.1.3) Construct the bar chart for the absolute frequency distribution for the data set. (5)

2.2) The Namibian Cycling Federation (NCF) analyzed the exercise time (in hours) spent by a sample of 530 cyclists in preparation for the popular Desert Dash.

| Exercise Time (hours) | Number of cyclists |
|---|---|
| 3 - < 7 | 104 |
| 7 - < 11 | 138 |
| 11 - < 15 | 121 |
| 15 - < 19 | 95 |
| 19 - < 23 | 72 |

Use the data provided to calculate the:

2.2.1) mean, (5)
2.2.2) median, (5)
2.2.3) and modal exercise time . (5)

QUESTION 3 [15]

The data below shows the price (in millions) for a standard size plot in an upmarket residential suburb of Windhoek.

| 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 |
|---|---|---|---|---|---|---|---|---|---|
| 3.0 | 4.2 | 4.8 | 3.7 | 3.4 | 4.3 | 5.6 | 4.4 | 3.8 | 4.1 |

3.1) Determine the least squares trend line equation, using the sequential coding method with the first period coded as 1. (9)

3.2) Use the trend line equation obtained in Question 3.1 to estimate the price for the same plot in 2010 and 2023. (6)

QUESTION 4 [12]

A small scale manufacturing company operates a project that yields a cash flow having a normal distribution with a daily average of N$500 and a standard deviation of N$60.

4.1) Calculate and interpret the probability that the cash flow on a given day will be N$560 and more. (4)

4.2) Calculate and interpret the probability that the cash flow on a given day will be N$420 and less. (4)

4.3) Calculate the probability that the cash flow on a given day will lie between N$460 and 540 (inclusive). (4)

QUESTION 5 [ 13 ]

In a random sample of two hundred students, we found that one hundred and thirty eight of them have their own personal computers .

5.1) What part of this sample have their own personal computers
a) 0.96 b) 0.69 c) 1.38 d) none of the provided (1)

5.2) When constructing a confidence interval estimate for the single unknown population proportion { $\pi$} of the student population who have their own personal computers:-

5.2.1) What critical value will be used?

a) t  b) z  c) $\chi$  d) none of the provided (1)

5.2.2) Compute the Standard Error of estimate

a) 0.2139  b) 1.0695  c) 0.0327  d) none of the provided (3)

5.3) If you construct a 90 % degree of confidence interval estimate for the population proportion of successes.

5.3.1) What critical value will be used?

a) 1.645  b) 1.96  c) 2.575  d) none of the provided (2)

5.3.2) What will be the lower limit (LL) for this confidence interval estimate?

a) 0.05379  b) 0.63620  c) 0.69  d) none of the provided (3)

5.3.3) What will be the upper limit (UL) for this confidence interval estimate?

a) 0.69  b) 0.05379  c) 0.7438  d) none of the provided (3)

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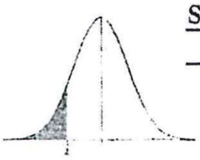
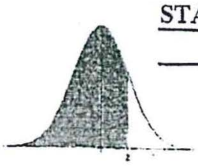
# Standard Normal Distribution Tables



STANDARD NORMAL DISTRIBUTION: Table Values Represent AREA to the LEFT of the Z score.

| Z | .00 | .01 | .02 | .03 | .04 | .05 | .06 | .07 | .08 | .09 |
|---|---|---|---|---|---|---|---|---|---|---|
| -3.9 | .00005 | .00005 | .00004 | .00004 | .00004 | .00004 | .00004 | .00004 | .00003 | .00003 |
| -3.8 | .00007 | .00007 | .00007 | .00006 | .00006 | .00006 | .00006 | .00005 | .00005 | .00005 |
| -3.7 | .00011 | .00010 | .00010 | .00010 | .00009 | .00009 | .00008 | .00008 | .00008 | .00008 |
| -3.6 | .00016 | .00015 | .00015 | .00014 | .00014 | .00013 | .00013 | .00012 | .00012 | .00011 |
| -3.5 | .00023 | .00022 | .00022 | .00021 | .00020 | .00019 | .00019 | .00018 | .00017 | .00017 |
| -3.4 | .00034 | .00032 | .00031 | .00030 | .00029 | .00028 | .00027 | .00026 | .00025 | .00024 |
| -3.3 | .00048 | .00047 | .00045 | .00043 | .00042 | .00040 | .00039 | .00038 | .00036 | .00035 |
| -3.2 | .00069 | .00066 | .00064 | .00062 | .00060 | .00058 | .00056 | .00054 | .00052 | .00050 |
| -3.1 | .00097 | .00094 | .00090 | .00087 | .00084 | .00082 | .00079 | .00076 | .00074 | .00071 |
| -3.0 | .00135 | .00131 | .00126 | .00122 | .00118 | .00114 | .00111 | .00107 | .00104 | .00100 |
| -2.9 | .00187 | .00181 | .00175 | .00169 | .00164 | .00159 | .00154 | .00149 | .00144 | .00139 |
| -2.8 | .00256 | .00248 | .00240 | .00233 | .00226 | .00219 | .00212 | .00205 | .00199 | .00193 |
| -2.7 | .00347 | .00336 | .00326 | .00317 | .00307 | .00298 | .00289 | .00280 | .00272 | .00264 |
| -2.6 | .00466 | .00453 | .00440 | .00427 | .00415 | .00402 | .00391 | .00379 | .00368 | .00357 |
| -2.5 | .00621 | .00604 | .00587 | .00570 | .00554 | .00539 | .00523 | .00508 | .00494 | .00480 |
| -2.4 | .00820 | .00798 | .00776 | .00755 | .00734 | .00714 | .00695 | .00676 | .00657 | .00639 |
| -2.3 | .01072 | .01044 | .01017 | .00990 | .00964 | .00939 | .00914 | .00889 | .00866 | .00842 |
| -2.2 | .01390 | .01355 | .01321 | .01287 | .01255 | .01222 | .01191 | .01160 | .01130 | .01101 |
| -2.1 | .01786 | .01743 | .01700 | .01659 | .01618 | .01578 | .01539 | .01500 | .01463 | .01426 |
| -2.0 | .02275 | .02222 | .02169 | .02118 | .02068 | .02018 | .01970 | .01923 | .01876 | .01831 |
| -1.9 | .02872 | .02807 | .02743 | .02680 | .02619 | .02559 | .02500 | .02442 | .02385 | .02330 |
| -1.8 | .03593 | .03515 | .03438 | .03362 | .03288 | .03216 | .03144 | .03074 | .03005 | .02938 |
| -1.7 | .04457 | .04363 | .04272 | .04182 | .04093 | .04006 | .03920 | .03836 | .03754 | .03673 |
| -1.6 | .05480 | .05370 | .05262 | .05155 | .05050 | .04947 | .04846 | .04746 | .04648 | .04551 |
| -1.5 | .06681 | .06552 | .06426 | .06301 | .06178 | .06057 | .05938 | .05821 | .05705 | .05592 |
| -1.4 | .08076 | .07927 | .07780 | .07636 | .07493 | .07353 | .07215 | .07078 | .06944 | .06811 |
| -1.3 | .09680 | .09510 | .09342 | .09176 | .09012 | .08851 | .08691 | .08534 | .08379 | .08226 |
| -1.2 | .11507 | .11314 | .11123 | .10935 | .10749 | .10565 | .10383 | .10204 | .10027 | .09853 |
| -1.1 | .13567 | .13350 | .13136 | .12924 | .12714 | .12507 | .12302 | .12100 | .11900 | .11702 |
| -1.0 | .15866 | .15625 | .15386 | .15151 | .14917 | .14686 | .14457 | .14231 | .14007 | .13786 |
| -0.9 | .18406 | .18141 | .17879 | .17619 | .17361 | .17106 | .16853 | .16602 | .16354 | .16109 |
| -0.8 | .21186 | .20897 | .20611 | .20327 | .20045 | .19766 | .19489 | .19215 | .18943 | .18673 |
| -0.7 | .24196 | .23885 | .23576 | .23270 | .22965 | .22663 | .22363 | .22065 | .21770 | .21476 |
| -0.6 | .27425 | .27093 | .26763 | .26435 | .26109 | .25785 | .25463 | .25143 | .24825 | .24510 |
| -0.5 | .30854 | .30503 | .30153 | .29806 | .29460 | .29116 | .28774 | .28434 | .28096 | .27760 |
| -0.4 | .34458 | .34090 | .33724 | .33360 | .32997 | .32636 | .32276 | .31918 | .31561 | .31207 |
| -0.3 | .38209 | .37828 | .37448 | .37070 | .36693 | .36317 | .35942 | .35569 | .35197 | .34827 |
| -0.2 | .42074 | .41683 | .41294 | .40905 | .40517 | .40129 | .39743 | .39358 | .38974 | .38591 |
| -0.1 | .46017 | .45620 | .45224 | .44828 | .44433 | .44038 | .43644 | .43251 | .42858 | .42465 |
| -0.0 | .50000 | .49601 | .49202 | .48803 | .48405 | .48006 | .47608 | .47210 | .46812 | .46414 |



**STANDARD NORMAL DISTRIBUTION: Table Values Represent AREA to the LEFT of the Z score.**

| Z | .00 | .01 | .02 | .03 | .04 | .05 | .06 | .07 | .08 | .09 |
|---|---|---|---|---|---|---|---|---|---|---|
| 0.0 | .50000 | .50399 | .50798 | .51197 | .51595 | .51994 | .52392 | .52790 | .53188 | .53586 |
| 0.1 | .53983 | .54380 | .54776 | .55172 | .55567 | .55962 | .56356 | .56749 | .57142 | .57535 |
| 0.2 | .57926 | .58317 | .58706 | .59095 | .59483 | .59871 | .60257 | .60642 | .61026 | .61409 |
| 0.3 | .61791 | .62172 | .62552 | .62930 | .63307 | .63683 | .64058 | .64431 | .64803 | .65173 |
| 0.4 | .65542 | .65910 | .66276 | .66640 | .67003 | .67364 | .67724 | .68082 | .68439 | .68793 |
| 0.5 | .69146 | .69497 | .69847 | .70194 | .70540 | .70884 | .71226 | .71566 | .71904 | .72240 |
| 0.6 | .72575 | .72907 | .73237 | .73565 | .73891 | .74215 | .74537 | .74857 | .75175 | .75490 |
| 0.7 | .75804 | .76115 | .76424 | .76730 | .77035 | .77337 | .77637 | .77935 | .78230 | .78524 |
| 0.8 | .78814 | .79103 | .79389 | .79673 | .79955 | .80234 | .80511 | .80785 | .81057 | .81327 |
| 0.9 | .81594 | .81859 | .82121 | .82381 | .82639 | .82894 | .83147 | .83398 | .83646 | .83891 |
| 1.0 | .84134 | .84375 | .84614 | .84849 | .85083 | .85314 | .85543 | .85769 | .85993 | .86214 |
| 1.1 | .86433 | .86650 | .86864 | .87076 | .87286 | .87493 | .87698 | .87900 | .88100 | .88298 |
| 1.2 | .88493 | .88686 | .88877 | .89065 | .89251 | .89435 | .89617 | .89796 | .89973 | .90147 |
| 1.3 | .90320 | .90490 | .90658 | .90824 | .90988 | .91149 | .91309 | .91466 | .91621 | .91774 |
| 1.4 | .91924 | .92073 | .92220 | .92364 | .92507 | .92647 | .92785 | .92922 | .93056 | .93189 |
| 1.5 | .93319 | .93448 | .93574 | .93699 | .93822 | .93943 | .94062 | .94179 | .94295 | .94408 |
| 1.6 | .94520 | .94630 | .94738 | .94845 | .94950 | .95053 | .95154 | .95254 | .95352 | .95449 |
| 1.7 | .95543 | .95637 | .95728 | .95818 | .95907 | .95994 | .96080 | .96164 | .96246 | .96327 |
| 1.8 | .96407 | .96485 | .96562 | .96638 | .96712 | .96784 | .96856 | .96926 | .96995 | .97062 |
| 1.9 | .97128 | .97193 | .97257 | .97320 | .97381 | .97441 | .97500 | .97558 | .97615 | .97670 |
| 2.0 | .97725 | .97778 | .97831 | .97882 | .97932 | .97982 | .98030 | .98077 | .98124 | .98169 |
| 2.1 | .98214 | .98257 | .98300 | .98341 | .98382 | .98422 | .98461 | .98500 | .98537 | .98574 |
| 2.2 | .98610 | .98645 | .98679 | .98713 | .98745 | .98778 | .98809 | .98840 | .98870 | .98899 |
| 2.3 | .98928 | .98956 | .98983 | .99010 | .99036 | .99061 | .99086 | .99111 | .99134 | .99158 |
| 2.4 | .99180 | .99202 | .99224 | .99245 | .99266 | .99286 | .99305 | .99324 | .99343 | .99361 |
| 2.5 | .99379 | .99396 | .99413 | .99430 | .99446 | .99461 | .99477 | .99492 | .99506 | .99520 |
| 2.6 | .99534 | .99547 | .99560 | .99573 | .99585 | .99598 | .99609 | .99621 | .99632 | .99643 |
| 2.7 | .99653 | .99664 | .99674 | .99683 | .99693 | .99702 | .99711 | .99720 | .99728 | .99736 |
| 2.8 | .99744 | .99752 | .99760 | .99767 | .99774 | .99781 | .99788 | .99795 | .99801 | .99807 |
| 2.9 | .99813 | .99819 | .99825 | .99831 | .99836 | .99841 | .99846 | .99851 | .99856 | .99861 |
| 3.0 | .99865 | .99869 | .99874 | .99878 | .99882 | .99886 | .99889 | .99893 | .99896 | .99900 |
| 3.1 | .99903 | .99906 | .99910 | .99913 | .99916 | .99918 | .99921 | .99924 | .99926 | .99929 |
| 3.2 | .99931 | .99934 | .99936 | .99938 | .99940 | .99942 | .99944 | .99946 | .99948 | .99950 |
| 3.3 | .99952 | .99953 | .99955 | .99957 | .99958 | .99960 | .99961 | .99962 | .99964 | .99965 |
| 3.4 | .99966 | .99968 | .99969 | .99970 | .99971 | .99972 | .99973 | .99974 | .99975 | .99976 |
| 3.5 | .99977 | .99978 | .99978 | .99979 | .99980 | .99981 | .99981 | .99982 | .99983 | .99983 |
| 3.6 | .99984 | .99985 | .99985 | .99986 | .99986 | .99987 | .99987 | .99988 | .99988 | .99989 |
| 3.7 | .99989 | .99990 | .99990 | .99990 | .99991 | .99991 | .99992 | .99992 | .99992 | .99992 |
| 3.8 | .99993 | .99993 | .99993 | .99994 | .99994 | .99994 | .99994 | .99995 | .99995 | .99995 |
| 3.9 | .99995 | .99995 | .99996 | .99996 | .99996 | .99996 | .99996 | .99996 | .99997 | .99997 |

# APPENDIX A

Population mean, raw data

$$\mu = \frac{\sum x}{N}$$

Sample mean, raw data

$$\bar{X} = \frac{\sum x}{n}$$

Weighted mean

$$\overline{X_w} = \frac{w_1 X_1 + w_2 X_2 + \ldots + w_n X_n}{w_1 + w_2 + \ldots + w_n}$$

Geometric mean

$$GM = \sqrt[n]{(X_1)\ (X_2)\ (X_3)\ \ldots .\ (X_n)}$$

Geometric mean rate of increase

$$GM = \sqrt[n]{\frac{\text{Value at end of period}}{\text{Value at start of period}}} - 1.0$$

Sample mean grouped data

$$\overline{X} = \frac{\sum fx}{n}$$

Median of grouped data

$$\text{Median} = L + \frac{\frac{n}{2} - CF}{f} \text{ (Class width)}$$

Mean deviation

$$MD = \frac{\sum | X - \bar{X} |}{n}$$

Linear regression equation

$$Y = a + bX$$

Sample variance for raw data

$$S^2 = \frac{\sum (X - \bar{X})^2}{n - 1}$$

Sample variance, raw data computational form

$$S^2 = \frac{\sum X^2 - \frac{(\sum X)^2}{n}}{n - 1}$$

Sample standard deviation, raw data

$$S = \sqrt{\frac{\sum X^2 - \frac{(\sum X)^2}{n}}{n - 1}}$$

Sample standard deviation, grouped data

$$S = \sqrt{\frac{\sum fX^2 - \frac{(\sum fX)^2}{n}}{n - 1}}$$

Coefficient of variation

$$CV = \frac{S}{X} (100)$$

Location of percentile

$$L_p = (n + 1) \frac{P}{100}$$

Pearson's Correlation coefficient

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

Correlation test of hypothesis

$$t = \frac{r\sqrt{n - 2}}{\sqrt{1 - r^2}}$$

Population standard deviation for raw data

$$\sigma = \sqrt{\frac{\sum (X - \mu)^2}{N}}$$

Population variance for raw data

$$\sigma^2 = \frac{\sum (X - \mu)^2}{N}$$

Slope of regression line

$$b = \frac{n (\sum XY) - (\sum X) (\sum Y)}{n (\sum X^2) - (\sum X)^2}$$

Intercept of a regression line

$$a = \frac{\sum Y}{n} - b \left(\frac{\sum X}{n}\right)$$

The Range

Range = highest - lowest

# APPENDIX B: ADDITIONAL FORMULAE

$$\text{Mode} = L + \left(\frac{d_1}{d_1 + d_2}\right) \times c$$

position $Q_j = \frac{jn}{4}$ value $Q_j = L + \frac{\left(\frac{jn}{4} - F\right) \times c}{f_{Q_j}}$

position $P_j = \frac{jn}{100}$ value $P_j = L + \frac{\left(\frac{jn}{100} - F\right) \times c}{f_{P_j}}$

$$P(A|B) = \frac{P(A \cap B)}{P(B)} \qquad P(x) = \frac{n!}{x!(n-x)!}\pi^x(1-\pi)^{n-x} \qquad \text{P}(x) = \frac{\lambda^x e^{-\lambda}}{x!}$$

$$z = \frac{x - \mu}{\sigma} \qquad z_{calc} = \frac{\bar{x} - \mu}{\sigma / \sqrt{n}} \qquad t_{calc} = \frac{\bar{x} - \mu}{s / \sqrt{n}}$$

$$z_{calc} = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}} \qquad t_{calc} = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{(n-1)s_1^2 + (n-1)s_2^2}{n_1 + n_2 - 1}\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}}$$

$$z = \frac{p - \pi}{\sqrt{\frac{\pi(1-\pi)}{n}}} \qquad z_{calc} = \frac{p_A - p_B}{\sqrt{(p \times q)\left(\frac{1}{n_A} + \frac{1}{n_B}\right)}} \qquad p = \frac{n_A p_B + n_B p_A}{n_A + n_B} \qquad q = 1 - p$$

$$\chi^2 = \sum \frac{(f_o - f_e)^2}{f_e}$$

$$F_V = P_V(1 + in) \qquad F_V = P_V(1+i)^n \qquad r = (1+i)^m - 1 \qquad D = B(1-i)^n$$

$$P = \frac{A}{(1+i)^n} \qquad PV = \frac{P(1+i)^n}{(1+j)^n} \qquad IRR = \frac{N_1 I_2 - N_2 I_1}{N_1 - N_2}$$