ПATIBIA UMIVERSITY

Faculty of Health, Natural

School of Natural and Applied
Sciences
Department of Mathematics,
Statistics and Actuarial Science

|  <br> BACHELOR of SCIENCE |  |
| :--- | :--- |
| QUALIFICATION CODE: O7BSAM \& O7BSOC | LEVEL: 5 |
| COURSE: INTRODUCTION TO APPLIED STATISTICS | COURSE CODE: IAS501S |
| DATE: NOVEMBER 2023 | SESSION: 1 |
| DURATION: $\mathbf{3}$ HOURS | MARKS: 100 |

## FIRST OPPORTUNITY: EXAMINATION QUESTION PAPER

EXAMINER:
MODERATOR:

MR. ANDREW ROUX
DR. DISMAS NTIRAMPEBA

## INSTRUCTIONS

1. Answer all questions on the separate answer sheet.
2. Please write neatly and legibly.
3. Do not use the left side margin of the exam paper. This must be allowed for the examiner.
4. No books, notes and other additional aids are allowed.
5. Mark all answers clearly with their respective question numbers.

## PERMISSIBLE MATERIALS :

1. Non-Programmable Calculator

## ATTACHEMENTS

1. Statistical Formulae Sheet
2. Standard Normal Probability Distribution Table
3. $1 \times$ A4 Graph Sheet

This paper consists of 4 pages including this front page

## QUESTION ONE [15]

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.

| $A$ | $C$ | $E$ | $B$ | $D$ | $C$ | $D$ | $B$ | $D$ | $C$ |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| $D$ | $B$ | $D$ | $E$ | $C$ | $A$ | $D$ | $C$ | $D$ | $E$ |
| $D$ | $C$ | $A$ | $B$ | $D$ | $C$ | $B$ | $E$ | $C$ | $D$ |
| $B$ | $C$ | $D$ | $C$ | $D$ | $C$ | $E$ | $A$ | $D$ | $C$ |
| $C$ | $B$ | $D$ | $D$ | $B$ | $D$ | $C$ | $E$ | $B$ | $A$ |

1.1) Construct the frequency distribution for the set of qualitative data in the table. (8)
1.2) Construct the relative frequency distribution for the data set.
1.3) Construct the bar chart for the absolute frequency distribution for the data set. (5)

## QUESTION TWO [25]

The data below shows scores in BBS611C for a random sample of 7 students in a class test.

$$
86, \quad 72, \quad 23, \quad 56, \quad 62, \quad 94, \quad 48
$$

Use the data provided to find the following:
2.1 The average score
a) 64
b) 62
c) 100
d) none of the provided
2.2 The modal scores
a) 86
b) no mode
c) 23
d) none of the provided
2.3 The median scores
a) 72
b) 62
c) no median
d) none of the provided
2.4 The range of the scores
a) 72
b) 73
c) 38
d) none of the provided
(2)
2.5 The first quartile of the scores
a) 62
b) 48
c) 71
d) none of the provided
(3)
2.6 The third quartile of the scores
a) 88
b) 94
c) 62
d) none of the provided
(3)
2.7 The inter-quartile range for the scores
a) 0
b) 38
c) 17
d) none of the provided
2.8) The variance for the scores
a) 23.9
b) 15.25
c) 574.3
d) none of the provided
2.9) The Standard Deviation in scores
a) 25.75
b) 22.25
c) 125.50
d) none of the provided
2.10) The Coefficient of Variation
a) 40.5
b) 38.0
c) 35.5
d) none of the provided

## QUESTION THREE

 [15]A popular retail store receives, on average 6 calls per day.
What is the probability that on any given day:
3.1) No calls will be received
3.2) At most two calls will be received
3.3) At least four calls will be received

QUESTION FOUR [20]
The travelling speed for cars within townland areas normally distributed with a mean speed of $70 \mathrm{~km} / \mathrm{h}$ and a standard deviation of $8 \mathrm{~km} / \mathrm{h}$. What is the probability that a car travelling within townland areas will drive at a speed of:-
4.1) $74.9 \mathrm{~km} / \mathrm{h}$ (inclusive) and faster.
4.2) $64.1 \mathrm{~km} / \mathrm{h}$ (inclusive) and slower
4.3) Between $59.7 \mathrm{~km} / \mathrm{h}$ and $82.3 \mathrm{~km} / \mathrm{h}$ (both inclusive)
(5)
4.4) What is the probability that nine cars travelling within townland areas will drive at an average of $66.4 \mathrm{~km} / \mathrm{h}$ (inclusive) and slower

## QUESTION FIVE [15]

Consider a random variable with the following distribution and find the following probabilities.

| $x$ | 2 | 4 | 6 | 8 |
| :--- | :--- | :--- | :--- | :--- |
| $P(x)$ | 0.2 | 0.3 | 0.4 | 0.1 |

5.1) $\quad P(x>6)$
5.2). $P(X=8)$
5.3) $P(2 \leq X \leq 6)$
5.4) Find Mean or Mathematical Expectation
5.5 ) Variance, $\operatorname{Var}(x)$
5.6) and the standard deviation for the random variable.

## QUESTION SIX [10]

Given the following prices and quantities, use the data provided to compute and interpret:

| Price (per kg) |  |  |  | Quantities produced |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 2012 |  |  |  |  |  |  |  | 2017 | 2022 | 2012 | 2017 | 2022 |
| Sugar | 3.95 | 3.89 | 4.13 | 675 | 717 | 436 |  |  |  |  |  |  |
| Coffee | 61.50 | 62.20 | 59.70 | 117 | 115 | 115 |  |  |  |  |  |  |
| Tee | 34.80 | 35.40 | 38.90 | 77 | 74 | 82 |  |  |  |  |  |  |

6.1) Compute and interpret the Laspeyres price index number for the year 2022 with as 2012 base.
6.2) Compute and interpret the Paasche's price index number for the year 2022 with 2017 as base.

## Statistical Formulae Sheet

$$
\begin{gathered}
\bar{x}=\frac{\sum x}{\sum f} \cdot \quad ; \text { Median }=L+\frac{h(M e d V a l-F)}{f_{m}} \quad ; \text { Mode }=\mathrm{L}+\left(\frac{\Delta_{1}}{\Delta_{1}+\Delta_{2}}\right) \mathrm{c} \\
S^{2}=\frac{\sum x^{2}-\frac{\left(\sum x\right)^{2}}{n}}{n-1}
\end{gathered}
$$

$$
P(X)={ }^{n} C_{x} p^{x}(1-p)^{n-x}, \text { where } X=0,1,2, \ldots \ldots, n
$$

$$
P(x / u)=\frac{u^{x}}{x!} e^{-u}
$$

$$
Y^{\prime}=b x+a
$$

$$
b=\frac{n \sum x y-\sum x \sum y}{n \sum x^{2}-\left(\sum x\right)^{2}} \quad \& \quad a=\frac{\sum y-b \sum x}{n}
$$

$$
E(X)=\sum p\left(x_{i}\right) \bullet x_{i} \quad \& \operatorname{Var}(x)=\sum p(x) x^{2}-u^{2}
$$

$$
\begin{aligned}
& I p(L)=\frac{\sum P_{i} \times Q_{b}}{\sum P_{b} \times Q_{b}} \times 100 \quad \& I q(L)=\frac{\sum Q_{i} \times P_{b}}{\sum Q_{b} \times P_{b}} \times 100 \\
& I p(P)=\frac{\sum P_{i} \times Q_{i}}{\sum P_{b} \times Q_{i}} \times 100 \quad \& \quad I q(P)=\frac{\sum Q_{i} \times P_{i}}{\sum Q_{b} \times P_{i}} \times 100
\end{aligned}
$$

## Z - Table

The table shows cumulative probabilities for the standard normal curve.
Cumulative probabilities for NEGATIVE z-values are shown first. SCROLL DOWN to the $2^{\text {nd }}$ page for POSITIVE $z$

| $z$ | . 00 | . 01 | . 02 | . 03 | . 04 | . 05 | . 06 | . 07 | . 08 | . 09 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 3.4 | . 0003 | . 0003 | . 0003 | . 0003 | . 0003 | . 0003 | . 0003 | . 0003 | . 0003 | . 0002 |
| 3.3 | . 0005 | . 0005 | . 0005 | . 0004 | . 0004 | . 0004 | . 0004 | . 0004 | . 0004 | . 0003 |
| -3.2 | . 0007 | . 0007 | . 0006 | . 0006 | . 0006 | . 0006 | . 0006 | . 0005 | . 0005 | . 0005 |
| 3.1 | . 0010 | . 0009 | . 0009 | . 0009 | . 0008 | . 0008 | . 0008 | . 0008 | . 0007 | . 0007 |
| 3.0 | . 0013 | . 0013 | . 0013 | . 0012 | . 0012 | . 0011 | . 0011 | . 0011 | . 0010 | . 0010 |
| -2.9 | . 0019 | . 0018 | . 0018 | . 0017 | . 0016 | . 0016 | . 0015 | . 0015 | . 0014 | . 0014 |
| -2.8 | . 0026 | . 0025 | . 0024 | . 0023 | . 0023 | . 0022 | . 0021 | . 0021 | . 0020 | . 0019 |
| -2.7 | . 0035 | . 0034 | . 0033 | . 0032 | . 0031 | . 0030 | . 0029 | . 0028 | . 0027 | . 0026 |
| -2.6 | . 0047 | . 0045 | . 0044 | . 0043 | . 0041 | . 0040 | . 0039 | . 0038 | . 0037 | . 0036 |
| -2.5 | . 0062 | . 0060 | . 0059 | . 0057 | . 0055 | . 0054 | . 0052 | . 0051 | . 0049 | . 0048 |
| -2.4 | . 0082 | . 0080 | . 0078 | . 0075 | . 0073 | . 0071 | . 0069 | . 0068 | . 0066 | . 0064 |
| -2.3 | . 0107 | . 0104 | . 0102 | . 0099 | . 0096 | . 0094 | . 0091 | . 0089 | . 0087 | . 0084 |
| -2.2 | . 0139 | . 0136 | . 0132 | . 0129 | . 0125 | . 0122 | . 0119 | . 0116 | . 0113 | . 0110 |
| -2.1 | . 0179 | . 0174 | . 0170 | . 0166 | . 0162 | . 0158 | . 0154 | . 0150 | . 0146 | . 0143 |
| -2.0 | . 0228 | . 0222 | . 0217 | . 0212 | . 0207 | . 0202 | . 0197 | . 0192 | . 0188 | . 0183 |
| -1.9 | . 0287 | . 0281 | . 0274 | . 2258 | . 0262 | . 0256 | . 0250 | . 0244 | . 0239 | . 0233 |
| -1.8 | . 0359 | . 0351 | . 0344 | . 0336 | . 0329 | . 0322 | . 0314 | . 0307 | . 0301 | . 0294 |
| -1.7 | . 0446 | . 0436 | . 0427 | . 0418 | . 0409 | . 0401 | . 0392 | . 0384 | . 0375 | . 0367 |
| -1.6 | . 0548 | . 0537 | . 0526 | . 0516 | . 0505 | . 0495 | . 0485 | . 0475 | . 0465 | . 0455 |
| -1.5 | . 0668 | . 0655 | . 0643 | . 0630 | . 0618 | . 0606 | . 0594 | . 0582 | . 0571 | . 0559 |
| -1.4 | . 0808 | . 0793 | . 0778 | . 0764 | . 0749 | . 0735 | . 0721 | . 0708 | . 0694 | . 0681 |
| -1.3 | . 0968 | . 0951 | . 0934 | . 0918 | . 0901 | . 0885 | . 0869 | . 0853 | . 0838 | . 0823 |
| -1.2 | . 1151 | . 1131 | . 1112 | . 1093 | . 1075 | . 1056 | . 1038 | . 1020 | . 1003 | . 0985 |
| -1.1 | . 1357 | . 1335 | . 1314 | . 1292 | . 1271 | . 1251 | . 1230 | . 1210 | . 1190 | . 1170 |
| -1.0 | . 1587 | . 1562 | . 1539 | . 1515 | . 1492 | . 1469 | . 1446 | . 1423 | . 1401 | . 1379 |
| -0.9 | . 1841 | . 1814 | . 1788 | . 1762 | . 1736 | . 1711 | . 1685 | . 1660 | . 1635 | . 1611 |
| -0.8 | . 2119 | . 2090 | . 2061 | 2033 | . 2005 | . 1977 | . 1949 | . 1922 | . 1894 | . 1867 |
| -0.7 | . 2420 | . 2389 | 2358 | 2327 | . 2296 | . 2266 | . 2236 | . 2206 | . 2177 | . 2148 |
| -0.6 | . 2743 | . 2709 | . 2676 | . 2643 | . 2611 | . 2578 | . 2546 | . 2514 | . 2483 | . 2451 |
| -0.5 | . 3085 | . 3050 | . 3015 | . 2981 | . 2946 | . 2912 | . 2877 | . 2843 | . 2810 | . 2776 |
| -0.4 | . 3446 | . 3409 | . 3372 | . 3336 | . 3300 | . 3264 | . 3228 | . 3192 | . 3156 | . 3121 |
| -0.3 | . 3821 | . 3783 | . 3745 | . 3707 | . 3669 | . 3632 | . 3594 | . 3557 | . 3520 | . 3483 |
| -0.2 | . 4207 | . 4168 | . 4129 | . 4090 | . 4052 | . 4013 | . 3974 | . 3936 | . 3897 | . 3859 |
| -0.1 | . 4602 | . 4562 | . 4522 | . 4483 | . 4443 | . 4404 | . 4364 | . 4325 | . 4286 | . 4247 |
| 0.0 | . 5000 | . 4960 | . 4920 | . 4880 | . 4840 | . 4801 | . 4761 | . 4721 | . 4681 | . 4641 |

Cumulative probabilities for POSITIVE z-values are shown below.

| z | . 00 | . 01 | . 02 | . 03 | . 04 | . 05 | . 06 | . 07 | . 08 | . 09 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 0.0 | . 5000 | . 5040 | . 5080 | . 5120 | . 5160 | . 5199 | . 5239 | . 5279 | . 5319 | . 5359 |
| 0.1 | . 5398 | . 5438 | . 5478 | . 5517 | . 5557 | . 5596 | . 5636 | . 5675 | . 5714 | . 5753 |
| 0.2 | . 5793 | . 5832 | . 5871 | . 5910 | . 5948 | . 5987 | . 6026 | . 6064 | . 6103 | . 6141 |
| 0.3 | . 6179 | . 6217 | . 6255 | . 6293 | . 6331 | . 6368 | . 6406 | . 6443 | . 6480 | . 6517 |
| 0.4 | . 6554 | . 6591 | . 6528 | . 6664 | . 6700 | . 6736 | . 6772 | . 6808 | . 6844 | . 6879 |
| 0.5 | . 6915 | . 6950 | . 6985 | . 7019 | . 7054 | . 7088 | . 7123 | . 7157 | . 7190 | . 7224 |
| 0.6 | . 7257 | . 7291 | . 7324 | . 7357 | . 7389 | . 7422 | . 7454 | . 7486 | . 7517 | . 7549 |
| 0.7 | . 7580 | . 7611 | . 7642 | . 7673 | . 7704 | . 7734 | . 7764 | . 7794 | . 7823 | . 7852 |
| 0.8 | . 7881 | . 7910 | . 7939 | . 7967 | . 7995 | . 8023 | . 8051 | . 8078 | . 8106 | . 8133 |
| 0.9 | . 8159 | . 8186 | . 8212 | . 8238 | . 8264 | . 8289 | . 8315 | . 8340 | . 8365 | . 8389 |
| 1.0 | . 8413 | . 8438 | . 8461 | . 8485 | . 8508 | . 8531 | . 8554 | . 8577 | . 8599 | . 8621 |
| 1.1 | . 8643 | . 8665 | . 8686 | . 8708 | . 8729 | . 8749 | . 8770 | . 8790 | . 8810 | . 8830 |
| 1.2 | . 8849 | . 8869 | . 8888 | . 8907 | . 8925 | . 8944 | . 8962 | . 8980 | . 8997 | . 9015 |
| 1.3 | . 9032 | . 9049 | . 9066 | . 9082 | . 9099 | . 9115 | . 9131 | . 9147 | . 9162 | . 9177 |
| 1.4 | . 9192 | . 9207 | . 9222 | . 9236 | . 9251 | . 9265 | . 9279 | . 9292 | . 9306 | . 9319 |
| 1.5 | . 9332 | . 9345 | . 9357 | . 9370 | . 9382 | . 9394 | . 9406 | . 94118 | . 9429 | . 9441 |
| 1.6 | . 9452 | . 9463 | . 9474 | . 9484 | . 9495 | . 9505 | . 9515 | . 9525 | . 9535 | . 9545 |
| 1.7 | . 9554 | . 9564 | . 9573 | . 9582 | . 9591 | . 9599 | . 9608 | . 9616 | . 9625 | . 9633 |
| 1.8 | . 9641 | . 9649 | . 9656 | . 9664 | . 9671 | . 9678 | . 9686 | . 9693 | . 9699 | . 9706 |
| 1.9 | . 9713 | . 9719 | . 9726 | . 9732 | . 9738 | . 9744 | . 9750 | . 9756 | . 9761 | . 9767 |
| 2.0 | . 9772 | . 9778 | . 9783 | . 9788 | . 9793 | . 9798 | . 9803 | . 9808 | . 9812 | . 9817 |
| 2.1 | . 9821 | . 9826 | . 9830 | . 9834 | . 9838 | . 9842 | . 9846 | . 9850 | . 9854 | . 9857 |
| 2.2 | . 9861 | . 9864 | . 9868 | . 9871 | . 9875 | . 9878 | . 9881 | . 9884 | . 9887 | . 9890 |
| 2.3 | . 9893 | . 9896 | . 9898 | . 9901 | . 9904 | . 9906 | . 9909 | . 9911 | . 9913 | . 9916 |
| 2.4 | . 9918 | . 9920 | . 9922 | . 9925 | . 9927 | . 9929 | . 9931 | . 9932 | . 9934 | . 9936 |
| 2.5 | . 9938 | . 9940 | . 9941 | . 9943 | . 9945 | . 9946 | . 9948 | . 9949 | . 9951 | . 9952 |
| 2.6 | . 9953 | . 9955 | . 9956 | . 9957 | . 9959 | . 9960 | . 9961 | . 9962 | . 9963 | . 9964 |
| 2.7 | . 9965 | . 9966 | . 9967 | . 9968 | . 9969 | . 9970 | . 9971 | . 9972 | . 9973 | . 9974 |
| 2.8 | . 9974 | . 99775 | . 9976 | . 9977 | . 9977 | . 9978 | . 9979 | . 9979 | . 9980 | . 9981 |
| 2.9 | . 9981 | . 9982 | . 9982 | . 9983 | . 9984 | . 9984 | . 9985 | . 9985 | . 9986 | . 9986 |
| 3.0 | . 9987 | . 9987 | . 9987 | . 9988 | . 9988 | . 9989 | . 9989 | . 9989 | . 9990 | . 9990 |
| 3.1 | . 9990 | . 9991 | . 9991 | . 9991 | . 9992 | . 9992 | . 9992 | . 9992 | . 9993 | . 9993 |
| 3.2 | . 9993 | . 9993 | . 9994 | . 9994 | . 9994 | . 9994 | . 9994 | . 9995 | . 9995 | . 9995 |
| 3.3 | . 9995 | . 9995 | . 9995 | . 9996 | . 9995 | . 9996 | . 9996 | . 9996 | . 9996 | . 9997 |
| 3.4 | . 9997 | . 9997 | . 9997 | . 9997 | . 9997 | . 9997 | . 9997 | . 9997 | . 9997 | . 9998 |

