ZIMBABWE

MINISTRY OF HIGHER AND TERTIARY EDUCATION, INNOVATION, SCIENCE AND TECHNOLOGY DEVELOPMENT

HIGHER EDUCATION EXAMINATIONS COUNCIL (HEXCO)

NATIONAL DIPLOMA

IN

QUANTITY SURVEYING/IRRIGATION ENGINEERING

SUBJECT: Statistics **PAPER NO: 575/15/S06**
575/22/S06

DURATION: 3 Hours

MARCH/APRIL 2025 EXAMINATION

REQUIREMENTS

1) Graph papers.
2) Scientific calculator.
3) Area under normal distribution table.

INSTRUCTIONS TO CANDIDATE

1) Answer any five (5) questions.
2) Show your working.

This paper consists of 7 printed pages.

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QUESTION 1

a) Differentiate a population from a sample. (2 marks)

b) Give three (3) examples of sampling techniques. (3 marks)

c) State any two (2) advantages and any two (2) disadvantages of the median as a measure of location. (4 marks)

d) The following data gives the salary earned by a sample of 40 employees at a certain company:

Salary (US$)	No of employees
200-400	3
400-600	10
600-800	17
800-1000	6
1000-1200	4

i) Calculate the mean of the data set. (3 marks)

ii) Calculate the standard deviation of the data. (4 marks)

iii) Construct a cumulative frequency curve of the data. (4 marks)

QUESTION 2

a) The probabilities of germination of three types of seed X,Y and Z are 4/9, 1/3 and 7/9 respectively. Determine the probability that:

i) All types of seeds germinate. (2 marks)

ii) Type X germinates but types Y and Z do not germinate. (3 marks)

iii) At least one type will germinate. (4 marks)

b) A medical treatment gives damaging side effects for one in 1000 of the patients treated by it. If 3000 people are given the treatment, find the probability that fewer than three will show the side effects. (4 marks)

c) Cartons of orange juice are advertised as containing $1000cm^3$. In fact their contents have mean $1005m^3$ and standard deviation $6cm^3$. Assuming that the distribution of the volume is normal, what proportion of the cartons contain less than $1000cm^3$. (3 marks)

d) What volume is exceeded by 99 percent of the cartons. (4 marks)

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QUESTION 3

a) A call centre manager would like to know if aptitude test scores can be used to predict job performance. The aptitude scores and job performance scores of 12 randomly selected employees is recorded as follows:

Aptitude score x	7	6	5	4	5	8	7	8	9	6	4	6
Performance score y	82	74	82	68	75	92	86	69	85	76	72	64

i) Plot a scatter graph for the data. (4 marks)

ii) Determine the regression line of performance score on aptitude score. (6 marks)

iii) Calculate the correlation coefficient between performance score and aptitude score and comment on its significance. (4 marks)

b) A property analyst wished to examine the relationship between town councils valuation of residential property and the market value of properties. A random sample of 10 recent property transactions was examined and recorded below:

Council valuations ($000)	54	144	96	150	84	132	62	120	114	98
Market values ($000)	156	189	110	198	144	226	106	182	147	198

Calculate Spearman's rank correlation coefficient to assess whether there is any correlation between council valuations and market values. (6 marks)

QUESTION 4

A tyre manufacturing company recorded the following sales, in thousands, for the years 2018, 2019 and 2020

Year	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
2018	20	22	21	23
2019	19	21	24	25
2020	22	23	26	28

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a) Using a period of four quarters, calculate the trend values using the method of moving averages. (6 marks)

b) Calculate the seasonal variations using the additive model. (5 marks)

c) Obtain the deseasonalised figures. (4 marks)

d) Forecast the total sales for 2025 using the least- squares method. (5 marks)

QUESTION 5

A random sample of 100 households was selected to participate in a study to establish a composite price index for household utilities usage. The following average annual figures have been obtained.

Household utility	2018		2020	
	Price/unit	Consumption	Price/ unit	Consumption
Electricity	1.97	745	2.09	977
Sewage	0.62	68	0.72	64
Water	0.29	296	0.35	378
Telephone	1.24	1028	1.06	1284

Taking 2018 as base year, calculate the price index numbers for 2020 using.

a) The simple aggregate method (5 marks)

b) Laspeyre's index metod (5 marks)

c) Paasche's index method (5 marks)

d) Fishers indeal method (5 marks)

QUESTION 6

a) The heights of 100 male students at a college are given in the following table. These heights represent a random sample of the heights of all the 1540 students at the college

Height (cm)	Number of students
150-155	5
156-161	18
162-167	42
168-173	27
174-179	8

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i) Calculate the mean height (4 marks)

ii) Calculate the unbiased sample variance (5 marks)

iii) Find a 99% confidence interval for estimating the mean height of the students. (4 marks)

iv) Without any further calculation comment on a claim that the true mean height of the students is 169cm. (2 marks)

b) The breaking strength of cables produced by a manufacturer has a mean of 816kg and a standard deviation of 45kg. By a new technique in the manufacturing process, it is claimed that the breaking strength can be increased. To test this claim a sample of 50 cables is tested and it is found that the mean breaking strength is 839kg. Can we support the claim at the 0.01 significance level? (5 marks)

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List of Formulae

$$y = a + bx$$

$$b = \frac{n\varepsilon xy - (\varepsilon x)(\varepsilon y)}{n\varepsilon x^2 - (\varepsilon x)^2}$$

$$a = \frac{\Sigma y - b\Sigma x}{n}$$

$$r = \frac{n\Sigma xy - (\Sigma x)(\Sigma y)}{\sqrt{[n\Sigma x^2 - (\Sigma x)^2][n\Sigma y^2 - (\Sigma y)^2]}}$$

$$r^1 = 1 - \frac{6\Sigma d^2}{n(n^2 - 1)}$$

Critical values for the standard normal distribution

[Significance for 1 – tail test (2-trail in brackets]

	10% (20%)	5% (10%)	2.5%(5%)	2% (4%)	1% (2%)	0.5% (1%)
Z	1.282	1.645	1.960	2.054	2.326	2.576

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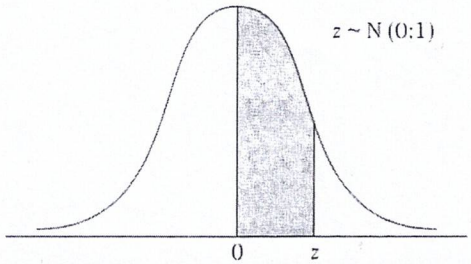
APPENDIX 1: LIST OF STATISTICAL TABLES

TABLE 1

The standard normal distribution (z)

This table gives the area under the standard normal curve between 0 and z i.e. $P[0 < Z < z]$



Z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.0000	0.0040	0.0080	0.0120	0.0160	0.0199	0.0239	0.0279	0.0319	0.0359
0.1	0.0398	0.0438	0.0478	0.0517	0.0557	0.0596	0.0636	0.0675	0.0714	0.0753
0.2	0.0793	0.0832	0.0871	0.0910	0.0948	0.0987	0.1026	0.1064	0.1103	0.1141
0.3	0.1179	0.1217	0.1255	0.1293	0.1331	0.1368	0.1406	0.1443	0.1480	0.1517
0.4	0.1554	0.1591	0.1628	0.1664	0.1700	0.1736	0.1772	0.1808	0.1844	0.1879
0.5	0.1915	0.1950	0.1985	0.2019	0.2054	0.2088	0.2123	0.2157	0.2190	0.2224
0.6	0.2257	0.2291	0.2324	0.2357	0.2389	0.2422	0.2454	0.2486	0.2517	0.2549
0.7	0.2580	0.2611	0.2642	0.2673	0.2703	0.2734	0.2764	0.2793	0.2823	0.2852
0.8	0.2881	0.2910	0.2939	0.2967	0.2995	0.3023	0.3051	0.3078	0.3106	0.3133
0.9	0.3159	0.3186	0.3212	0.3238	0.3264	0.3289	0.3315	0.3340	0.3365	0.3389
1.0	0.3413	0.3438	0.3461	0.3485	0.3508	0.3531	0.3554	0.3557	0.3599	0.3621
1.1	0.3643	0.3665	0.3686	0.3708	0.3729	0.3749	0.3770	0.3790	0.3810	0.3830
1.2	0.3849	0.3869	0.3888	0.3907	0.3925	0.3944	0.3962	0.3980	0.3997	0.4015
1.3	0.4032	0.4049	0.4066	0.4082	0.4099	0.4115	0.4131	0.4147	0.4162	0.4177
1.4	0.4192	0.4207	0.4222	0.4236	0.4251	0.4265	0.4279	0.4292	0.4306	0.4319
1.5	0.4332	0.4345	0.4357	0.4370	0.4382	0.4394	0.4406	0.4418	0.4429	0.4441
1.6	0.4452	0.4463	0.4474	0.4484	0.4495	0.4505	0.4515	0.4525	0.4535	0.4545
1.7	0.4554	0.4564	0.4573	0.4582	0.4591	0.4599	0.4608	0.4616	0.4625	0.4633
1.8	0.4641	0.4649	0.4656	0.4664	0.4671	0.4678	0.4686	0.4693	0.4699	0.4706
1.9	0.4713	0.4719	0.4726	0.4732	0.4738	0.4744	0.4750	0.4756	0.4761	0.4767
2.0	0.4772	0.4778	0.4783	0.4788	0.4793	0.4798	0.4803	0.4808	0.4812	0.4817
2.1	0.4821	0.4826	0.4830	0.4834	0.4838	0.4842	0.4846	0.4850	0.4854	0.4857
2.2	0.4861	0.4864	0.4868	0.4871	0.4875	0.4878	0.4881	0.4884	0.4887	0.4890
2.3	0.48928	0.48956	0.48983	0.49010	0.49036	0.49061	0.49086	0.49111	0.49134	0.49158
2.4	0.49180	0.49202	0.49224	0.49245	0.49266	0.49286	0.49305	0.49324	0.49343	0.49361
2.5	0.49379	0.49396	0.49413	0.49430	0.49446	0.49461	0.49477	0.49492	0.49506	0.49520
2.6	0.49534	0.49547	0.49560	0.49573	0.49585	0.49598	0.49609	0.49621	0.49632	0.49643
2.7	0.49653	0.49664	0.49674	0.49683	0.49693	0.49702	0.49711	0.49720	0.49728	0.49736
2.8	0.49744	0.49752	0.49760	0.49767	0.49774	0.49781	0.49788	0.49795	0.49801	0.49807
2.9	0.49813	0.49819	0.49825	0.49831	0.49836	0.49841	0.49846	0.49851	0.49856	0.49861
3.0	0.49865	0.49869	0.49874	0.49878	0.49882	0.49886	0.49889	0.49893	0.49897	0.49900
3.1	0.49903	0.49906	0.49910	0.49913	0.49916	0.49918	0.49921	0.49924	0.49926	0.49929
3.2	0.49931	0.49934	0.49936	0.49938	0.49940	0.49942	0.49944	0.49946	0.49948	0.49950
3.3	0.49952	0.49953	0.49955	0.49957	0.49958	0.49960	0.49961	0.49962	0.49964	0.49965
3.4	0.49966	0.49968	0.49969	0.49970	0.49971	0.49972	0.49973	0.49974	0.49975	0.49976
3.5	0.49977	0.49978	0.49978	0.49979	0.49980	0.49981	0.49981	0.49982	0.49983	0.49983
3.6	0.49984	0.49985	0.49985	0.49986	0.49986	0.49987	0.49987	0.49988	0.49988	0.49989
3.7	0.49989	0.49990	0.49990	0.49990	0.49991	0.49991	0.49991	0.49992	0.49992	0.49992
3.8	0.49993	0.49993	0.49993	0.49994	0.49994	0.49994	0.49994	0.49995	0.49995	0.49995
3.9	0.49995	0.49995	0.49996	0.49996	0.49996	0.49996	0.49996	0.49996	0.49997	0.49997
4.0	0.49997	0.49997	0.49997	0.49997	0.49997	0.49997	0.49998	0.49998	0.49998	0.49998

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