THE OPEN UNIVERSITY OF SRI LANKA
Faculty of Engineering Technology
Department of Mathematics & Philosophy of Engineering

Bachelor of Industrial Studies

255

Final Examination (2021/2022)
MHZ3576/TAZ3536: Statistics for Industrial Studies

Date: 9th January 2023 (Thursday) **Time: 0930 hrs. – 1230 hrs.**

Instructions:

Reg. No:

- ***Part A is Compulsory***
  - *Provide short answers in the given space.*
  - *Do not need to show any workings.*
- *Answer **five (05)** questions only out of seven (07) questions from **Part B**.*
  - *Provide answers in separate sheets (answer booklet) which will be provided in the examination.*
  - *Show all your workings.*
- *The number of pages in the paper is **Six (06)**.*
- *All the symbols are in standard notation unless they are defined.*
- *All the relevant statistical tables and equations are provided.*
- ***Attach Part A to the Answer script of Part B.***

Part A

Provide short answers in the given space. Do not need to show any workings or works. Please attach this part to your answer script.

1. Picking 2 marbles, one at a time, from a bag that contains 3 blue and 2 marbles. Write down the sample space.

Answer.....

[10%]

2. Let A and B be two independent events such that $P(A) = \frac{1}{5}$ while $P(A \cup B) = \frac{1}{2}$. Then what is the value of $P(B)$?

Answer.....

[10%]

3. What is the goal of the descriptive statistics?

Answer.....

[10%]

4. Let the random variable X follow a normal distribution with mean μ and standard deviation σ. Then what will be the standard deviation of the sampling distribution of the sample mean($\bar{X}$) when the sample size is 35?

Answer.....

[10%]

5. What can you say about the shape of the distribution, which is represented by the following stem-and-leaf diagram?

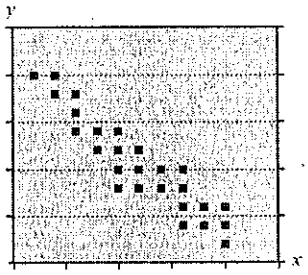
[10%]

0	1 1 2 4 7 8
1	2 2 3 5 6 6 8 9
2	1 5 6 7 7 8 8 9 9 9
3	2 4 4 5 7 7 8
4	1 3 5 8
5	2 3 7
6	2 3 4
7	2 6

Answer.....
.....
.....

6. Identify the relationship between the two variables x and y.

[10%]



Answer.....
.....

7. Arrange the following steps in the process of hypothesis testing in proper sequence.

Answer.....

[10%]

A: Make a Decision
B: Formulate a null hypothesis and an alternate hypothesis.
C: Select the test statistic and calculate.
D: Select the level of significance.
E: State the decision rule.

8. If K is the mean of a random variable (X) which follows the Poisson distribution, what is the standard deviation of the random variable X ?

Answer.....

[10%]

9. What is the area under the standard normal curve?

Answer.....

[10%]

10. The graph of a cumulative frequency distribution is called .....

Answer.....

[10%]

Part B

Q1. The following are the results of a tensile test performed on 25 pieces of fabric.

60	60.8	61.2	61.8	62.4	62.8	63.5	64	64.2	64.2
65	65	65.2	65.5	67.5	68	68.2	68.2	68.4	69.1
70	70.2	71.2	72.1	74					

(a) Construct a group frequency distribution table with five classes. **[30%]**

(b) Draw the histogram for the above frequency distribution. **[30%]**

(c) Draw the frequency polygon for the above distribution on the same diagram of part (b). **[30%]**

(d) Comment about the shape of the distribution of the data. **[10%]**

Q2. The number of laps rejected per two weeks in a blow room were recorded as follows.

20	11	11	18	15	40	8
10	9	11	10	14	20	13

(a) Find the Central Tendency measures (Mean, Median, Mode) of the given data. **[30%]**

(b) Compute the Range, Standard Deviation, and Interquartile range. **[30%]**

(c) Draw the Box-whisker plot for the above data. **[15%]**

(d) Are there any outliers in the given data set? Justify your answer. **[10%]**

(e) What is the best-suited measure for the central tendency? Explain your answer. **[15%]**

Q3.

(a) A box contains 5 red beads, 4 yellow beads and 3 green beads. Two beads are selected at random, one at a time without replacement.

(i) Find the probability that one of the beads selected is the green one. **[25%]**

(ii) Find the probability that both of the beads are red. **[25%]**

(b) A company produces knitting needles and supplies them in packs of 10 needles each. In the quality checking process, it observes that the 5% are defective.

(i) Which probability distribution would you suggest as the best model for predicting the number of defective needles in a pack? **[10%]**

(ii) Write down the three reasons why the distribution stated above be a suitable model. **[15%]**

(iii) Determine the probability that a pack will contain at least one defective needle. **[15%]**

(iii) Find the expected number of defective needles in a pack. **[15%]**

Q4. Fabric laser cutter cuts a roll of fabric into pieces of length $L(cm)$, where L is normally distributed with a mean of $305.2cm$ and a standard deviation of $0.25cm$.

(a) If the pieces are less than the minimum length of $304.55cm$ they are scrapped. If they are larger than the maximum length of 305.7cm they are reworked.

(i) Find the probability that a randomly selected piece is scrapped. **[30%]**

(ii) What percentage is rework? **[30%]**

(b) The quality assurance department has tested a sample of 36 of fabric pieces for their quality assurance purposes.

(i) Compute the upper control limit and the lower control limit for this sample. **[30%]**

(ii) If a tested fabric piece which cuts using the given laser cutter having the length of 305.8cm , then what will be the quality inspectors decision on this tested fabric piece. **[10%]**

Q5.

(a) Define the following terms.

(i) Point estimation. **[10%]**

(ii) Interval Estimation. **[10%]**

(b) In a snap-reading survey of weavers, a researcher is interested about the mean time spent in mending wrap-breaks and past records indicate that standard deviation is 0.06minutes. The following are the records of the time spent in minutes by 12 weavers in mending wrap-breaks.

6.24 6.33 6.37 6.36 6.32 6.37 6.25 6.31 6.29 6.21 6.30 6.40

(i) Find the point estimate for the population mean of the time spent in mending wrap-breaks. **[20%]**

(ii) Find the standard error of the population mean of the time spent in mending wrap-breaks. **[20%]**

(iii) Find the interval estimate for the population mean of the time spent in mending wrap-breaks at 5% significant level. **[30%]**

(iv) Interpret your results. **[10%]**

Q6.

(a) State the properties of the Null hypothesis and Alternative hypothesis. **[20%]**

(b) Suppose that a tester measures the linear density of yarn spun at a factory during a shift to check whether the production of the shift is of the required average linear density of 14Tex., It has shown an average linear density of 14.8Tex and a standard deviation of 2.5Tex for a sample of 45 spun of yarn tested.

(i) State the null hypotheses and alternative hypothesis to be tested. **[20%]**

(ii) Find the test statistics associated with this hypothesis testing. **[20%]**

(iii) Test the hypothesis at 5% significant level. **[30%]**

(iv) State your conclusion regarding the hypothesis. **[10%]**

Q7.

(a) Define the following terms.

(i) Correlation coefficient. **[10%]**

(ii) Coefficient of Determination. **[10%]**

(b) A study was conducted to determine whether the number of years of experience has an impact on the annual compensation of a Juki machine operator. The table below provides the years of experience and annual income of 10 Juki operators.

EXPERIENCE IN YEARS	13	16	22	2	8	26	19	20	1	4
ANNUAL COMPENSATION IN THOUSAND RUPEES	260	330	360	160	260	370	330	360	160	190

(i) Identify the independent variable and the dependent variable. **[10%]**

(ii) Calculate the correlation coefficient for above data. **[30%]**

(iii) Interpret your answer of correlation coefficient. **[10%]**

(iv) Draw the scatter plot for dependent variable against the independent variable. **[20%]**

(v) What conclusion can you draw from the plot? **[10%]**

End.

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Important Formulars:

- Binomial distribution

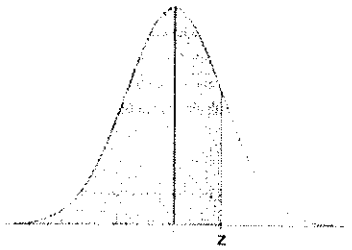
  $$Pr(X = r) = \frac{n!}{r!(n-r)!} p^r q^{n-r}$$

- Poison Distribution

  $$Pr(X = r) = e^{-\pi} \frac{\mu^r}{r!}$$

- If random variable X, follows normal distribution ($X \sim N(\mu, \sigma^2)$)Then $Z = \frac{X-\mu}{\sigma}$ follows standard normal distribution where $Z \sim N(1,0)$.
- $UCL = \bar{x} + 3\frac{\bar{\sigma}}{\sqrt{n}}$
- $LCL = \bar{x} - 3\frac{\bar{\sigma}}{\sqrt{n}}$

Standard Normal Cumulative Probability Table



Cumulative probabilities for POSITIVE z-values are shown in the following table:

z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.5000	0.5040	0.5080	0.5120	0.5160	0.5199	0.5239	0.5279	0.5319	0.5359
0.1	0.5398	0.5438	0.5478	0.5517	0.5557	0.5596	0.5636	0.5675	0.5714	0.5753
0.2	0.5793	0.5832	0.5871	0.5910	0.5948	0.5987	0.6026	0.6064	0.6103	0.6141
0.3	0.6179	0.6217	0.6255	0.6293	0.6331	0.6368	0.6406	0.6443	0.6480	0.6517
0.4	0.6554	0.6591	0.6628	0.6664	0.6700	0.6736	0.6772	0.6808	0.6844	0.6879
0.5	0.6915	0.6950	0.6985	0.7019	0.7054	0.7088	0.7123	0.7157	0.7190	0.7224
0.6	0.7257	0.7291	0.7324	0.7357	0.7389	0.7422	0.7454	0.7486	0.7517	0.7549
0.7	0.7580	0.7611	0.7642	0.7673	0.7704	0.7734	0.7764	0.7794	0.7823	0.7852
0.8	0.7881	0.7910	0.7939	0.7967	0.7995	0.8023	0.8051	0.8078	0.8106	0.8133
0.9	0.8159	0.8186	0.8212	0.8238	0.8264	0.8289	0.8315	0.8340	0.8365	0.8389
1.0	0.8413	0.8438	0.8461	0.8485	0.8508	0.8531	0.8554	0.8577	0.8599	0.8621
1.1	0.8643	0.8665	0.8686	0.8708	0.8729	0.8749	0.8770	0.8790	0.8810	0.8830
1.2	0.8849	0.8869	0.8888	0.8907	0.8925	0.8944	0.8962	0.8980	0.8997	0.9015
1.3	0.9032	0.9049	0.9066	0.9082	0.9099	0.9115	0.9131	0.9147	0.9162	0.9177
1.4	0.9192	0.9207	0.9222	0.9236	0.9251	0.9265	0.9279	0.9292	0.9306	0.9319
1.5	0.9332	0.9345	0.9357	0.9370	0.9382	0.9394	0.9406	0.9418	0.9429	0.9441
1.6	0.9452	0.9463	0.9474	0.9484	0.9495	0.9505	0.9515	0.9525	0.9535	0.9545
1.7	0.9554	0.9564	0.9573	0.9582	0.9591	0.9599	0.9608	0.9616	0.9625	0.9633
1.8	0.9641	0.9649	0.9656	0.9664	0.9671	0.9678	0.9686	0.9693	0.9699	0.9706
1.9	0.9713	0.9719	0.9726	0.9732	0.9738	0.9744	0.9750	0.9756	0.9761	0.9767
2.0	0.9772	0.9778	0.9783	0.9788	0.9793	0.9798	0.9803	0.9808	0.9812	0.9817
2.1	0.9821	0.9826	0.9830	0.9834	0.9838	0.9842	0.9846	0.9850	0.9854	0.9857
2.2	0.9861	0.9864	0.9868	0.9871	0.9875	0.9878	0.9881	0.9884	0.9887	0.9890
2.3	0.9893	0.9896	0.9898	0.9901	0.9904	0.9906	0.9909	0.9911	0.9913	0.9916
2.4	0.9918	0.9920	0.9922	0.9925	0.9927	0.9929	0.9931	0.9932	0.9934	0.9936
2.5	0.9938	0.9940	0.9941	0.9943	0.9945	0.9946	0.9948	0.9949	0.9951	0.9952
2.6	0.9953	0.9955	0.9956	0.9957	0.9959	0.9960	0.9961	0.9962	0.9963	0.9964
2.7	0.9965	0.9966	0.9967	0.9968	0.9969	0.9970	0.9971	0.9972	0.9973	0.9974
2.8	0.9974	0.9975	0.9976	0.9977	0.9977	0.9978	0.9979	0.9979	0.9980	0.9981
2.9	0.9981	0.9982	0.9982	0.9983	0.9984	0.9984	0.9985	0.9985	0.9986	0.9986
3.0	0.9987	0.9987	0.9987	0.9988	0.9988	0.9989	0.9989	0.9989	0.9990	0.9990
3.1	0.9990	0.9991	0.9991	0.9991	0.9992	0.9992	0.9992	0.9992	0.9993	0.9993
3.2	0.9993	0.9993	0.9994	0.9994	0.9994	0.9994	0.9994	0.9995	0.9995	0.9995
3.3	0.9995	0.9995	0.9995	0.9996	0.9996	0.9996	0.9996	0.9996	0.9996	0.9997
3.4	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9998