

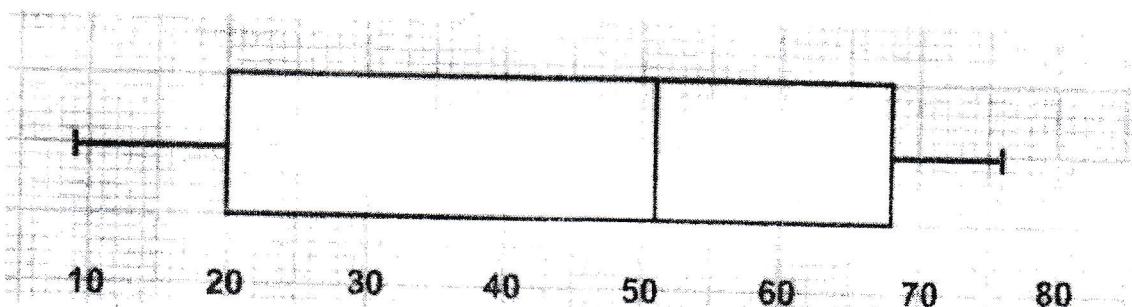
Exam.	Back		
Level	BE	Full Marks	80
Programme	BEI	Pass Marks	32
Year / Part	II / I	Time	3 hrs.

Subject: - Probability and Statistics (SH 505)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
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- ✓ Necessary figures are attached herewith.
- ✓ Assume suitable data if necessary.



1. The distribution of daily average wind speed in km/hr on an island over a period of 152 days is displayed on this box-whisker diagram.



- a) Write down the median wind speed. [6]
 - b) Write down the minimum wind speed.
 - c) Find the interquartile range.
 - d) Write normality (symmetry) about the distribution comparing its median with quartiles.
 - e) Write down the number of days the wind speed was between 20km/h and 51 km/h.
 - f) Write down the number of days the wind speed was between 9 km/h and 68 km/h. [6]
2. Define mutually exclusive and independent events. An insurance company insured 2000 Civil engineers, 4000 Electrical engineers and 6000 Mechanical engineers. The probability of an accident involving Civil engineer, Electrical engineer and Mechanical engineer during their jobs is 0.01, 0.03 and 0.15 respectively. One of the insured engineers meets with an accident. What is the probability that he is civil Engineer? [6]
3. Under which condition we use hyper geometric distribution. Define this distribution and write basic properties. [5]
4. Define negative binomial probability distribution. From past experience it is known that a popular footballer Messi has probability to score a goal in each matches is 80. He continue to play the matches until he score 5 goals. What is the probability that he gets them at most 7 matches? [5]
5. Show that the following is a cumulative distribution function. Also find its mean and variance. [5]

$$F(x) = \begin{cases} 0 & \text{for } x < -a \\ \frac{1}{2a} (x+1) & \text{for } -a \leq x \leq a \\ 0 & \text{for } x > a \end{cases}$$

6. Time taken by an automatic packaging machine to complete a certain task follows Normal Distribution. From the past record 17% of time machine complete task in less than 35 minutes. Similarly 89% of the time machine takes more than 28 minutes. Find the mean and the standard deviation of diameter of rods. [5]
7. A population consists of five numbers 4,5,6,7 and 8. If a random sample of size 3 is drawn without replacement.
- Find the population proportion of even number.
 - List the all possible sample and find their sample proportion of even number.
 - Show the sample proportion is unbiased estimator of population proportion.
 - Find the standard error of sample proportion of even number.
8. Define Central Limit theorem. It is found that the entrance score of large number of students follows Normal distribution with mean of 72 and standard deviation of 12. If a researcher choose 35 random sample, find the probability that the average of this sample.
- More than 77
 - Between 69 to 75
 - Less than 70
9. Write the systematic steps of testing a hypothesis concerning difference of two means when population standard deviations of two population are known.
10. Two sets of ten students are selected at random from a college. One set was given memory test without training and other set was given the same test after two weeks of training. The scores obtained are given below:

Students	1	2	3	4	5	6	7	8	9	10
Set A	10	8	7	9	8	10	9	6	7	8
Set B	12	8	8	10	8	11	9	8	9	9

Use 5% level of significance whether the training is significantly differ from Set A and Set B.

11. 300 employees of a company were selected at random and asked whether they were in favor of a scheme to introduce flexible working hours. The following table shows the opinion and the departments of the employees.

Department	Opinion		
	In favor	Uncertain	Against
Production	89	42	9
Sales	53	36	11
Administration	38	12	10

Test whether there is evidence of a significant association between opinion and department at 5% significance level.

12. Write the systematic procedure of testing a hypothesis concerning single proportion for large population. [5]
13. Ten still wires of diameter 0.5 mm and length 2.5 m were extended in a laboratory by applying vertical forces of varying magnitudes. Results are as follows: [5]

Force in kg	15	19	25	35	42	48	53	56	62	65
Increase in length (mm)	1.7	2.1	2.5	3.4	3.9	4.9	5.4	5.7	6.6	7.2

a) Estimate the parameters of a simple line regression model with forces as explanatory variable.

b) Find 95% confidence limit for the slope of the line.

14. Write the properties of regression coefficient and describe under what condition there exist only one regression line. [5]

15. The final marks in mathematics of 48 students in a class of IOE are given in the following table; [5]

68	84	75	82	68	90	62	88	76	93
73	79	88	73	60	93	71	59	85	75
61	65	75	87	74	62	95	78	63	72
66	78	82	75	94	77	69	74	68	60
80	69	92	85	71	95	90	88		

Use scientific calculator and show key operations to find;

Mean, Median, quartiles, mode, sample standard deviation, population standard deviation and coefficient of variations.

[8]

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1. Meat products are regularly monitored for freshness. A trained inspector in Kathmandu Metropolitan selects a sample of the product and assigns an offensive smell score between 1 and 7 where 1 is very fresh. The resulting offensive smell scores for each of 16 samples are
3.2, 3.9, 1.7, 5.0, 1.9, 2.6, 2.4, 5.3, 1.0, 2.7, 3.8, 5.2, 1.0, 6.3, 3.3, 4.3
Construct a box-plot, interpret the result and comment on the shape of the distribution. [6]
2. Define Baye's Theorem for conditional Probability. A box containing 5000 IC chips, of which 1000 are manufactured by company A and the rest by company B. Ten percentage of chips made by company A and five percentage of chips by company B are defective. If we select a chip at a random
 - a) What is the probability that the chip chosen is defective?
 - b) If a randomly chosen chip is found to be defective, what is the probability that it comes from company A.
[6]
3. Define random variable. Differentiate between discrete random variables and continuous random variables with suitable example. [5]
4. Compare Binomial and Negative Binomial distribution including similarity and difference with suitable examples. [5]
5. If X is a continuous random variable with probability density function $f(x) = x/8$ or $3 < x < 5$.
 - a) Find the probability for $P(1 < x < 2.5)$
 - b) Determine the mean and standard deviation for x .
[5]
6. If height of the doors in traditional house in a cultural city follow normal distribution, 73% of the doors has height above 58 inches and 18% of the doors has height over 63 inches. Find the mean and the standard deviation of the height of the doors. [5]
7. Discuss the following terms in statistics population, sample, parameter and statistic with suitable example. [5]
8. From the population of size 5 as: 22, 23, 24, 25 and 26.
 - a) List out all the samples of size three without replacement.
 - b) Find the sample mean of each samples.
 - c) Prove that, sample mean is unbiased mean of population mean.
 - d) Also find the standard error of sample mean.
[5]
9. Explain clearly the major steps to be adopted by researchers in testing of hypothesis of single mean for small sample. [5]
10. A social worker believes that fewer than 25% of the married couples in a certain area of Nepal ever used any form of birth control. A random sample of 120 couples was contacted 25 of them said they had used same method of birth control. Test and comment the social worker's belief at $\alpha = 5\%$. [5]

11. A company manufacturing company has three types of computers. The cost (in thousand rupees) for each type of computer is given in the following table. Using ANOVA, test whether the average cost per computer is considerably different across three types of computer at 5% level of significance?

[5]

Type C ₁	Type C ₁	Type C ₁
83	56	79
83	76	95
76	72	87

12. To determine whether there is really relationship between an employee's performance in the training program and his ultimate success in the job, it takes a sample of 400 cases from its very extensive files and obtains the result shown in the following table: [χ^2 -value is 9.488]

Success in job	Performance in training program		
	Below average	Average	Above average
Poor	23	60	29
Average	28	79	60
Very good	9	49	63

Use the 0.05 level of significance to test whether performance in training program and success in the job are independent.

[5]

13. Define partial correlation with examples. A sample of 10 values of three variables X_1 , X_2 and X_3 were obtained as

$\sum X_1 = 10$	$\sum X_2 = 10$	$\sum X_3 = 10$
$\sum X_1^2 = 20$	$\sum X_2^2 = 68$	$\sum X_3^2 = 170$
$\sum X_1 X_2 = 10$	$\sum X_2 X_3 = 64$	$\sum X_1 X_3 = 15$

Find Partial correlation coefficient between X_2 and X_3 eliminating the effect of X_1 .

[5]

14. The grams of solids removed from a material (y) is thought to be related to the drying time (x). Ten observations obtained from an experimental study follow:

y	4.3	1.5	1.8	4.9	4.2	4.8	5.8	6.2	7.0	7.9
x	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0

- a) Construct the scatter plot.
- b) Calculate correlation coefficient.
- c) Draw your construction on relation of solid removal and drying time.

[5]

15. Temporary or permanent hearing loss from occupational noise exposure is one of the most common of all industrial diseases. Generally, 85-90 dB over an eight-hour workday is the allowable level of noise, although it is better to reduce noise even further, whenever possible. A sample of 50 individuals working at a particular industry was selected and the noise level (dB) experienced by each individual was determined, yielding the following data:

55.3, 55.3, 55.3, 55.9, 55.9, 55.9, 56.1, 56.1, 56.1, 56.1, 56.1, 56.1, 56.1, 56.8, 56.8, 57.0, 57.0, 57.0, 57.8, 57.8, 57.8, 57.9, 57.9, 57.9, 58.8, 58.8, 58.8, 59.8, 59.8, 59.8, 62.2, 62.2, 63.8, 63.8, 63.8, 63.9, 63.9, 63.9, 64.7, 64.7, 64.7, 65.1, 65.1, 65.1, 65.3, 65.3, 65.3, 67.4, 67.4

- a) Find mean, standard deviation of the noise level at the industry and interpret the results.
- b) Construct 95% confidence interval on true mean noise level at the industry.
- c) Interpret your findings.

[8]

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1. Describe the various measures of central tendency. The following table represents the marks of 100 students.

[6]

Marks	0-20	20-40	40-60	60-80	80-100
No. of Students	14	18	27	26	15

Find the mean, median and standard deviation of all 100 students.

2. State the law of addition of probability. If there are three candidates for the position of principal X, Y, Z whose chances of getting the appointments are in ratio 4/9, 2/9, 3/9. The probability that X if selected would introduce co-education in the college is 0.3. The probability of Y and Z doing the same are respectively 0.5 and 0.8. What is the probability that there was co-education in the college?

[2+4]

3. Define Binomial distribution. Under what condition Binomial distribution can be approximated by Poisson distribution?

[5]

4. A hospital administrator, who has been studying daily emergency admissions over a period of several years, has concluded that they are distributed according to the Poisson Law. Hospital records reveal that emergency admissions have averaged three per day during this period. If the administrator is correct in assuming a Poisson distribution, find the probability that

[5]

- a) Exactly two emergency admissions will occur in a given day.
- b) No emergency admissions will occur in a given day.
- c) Either three or four emergency cases will be admitted on a particular day.

5. Describe the conditions for the probability density function. The length of time (in minutes) that a certain lady speaks on the telephone is found to be random phenomenon, with a probability function specified by the probability density function $f(x)$ as

$$f(x) = \begin{cases} Ae^{-x/5} & \text{for } x \geq 0 \\ 0 & \text{elsewhere} \end{cases}$$

Find the value of A. what is the probability that the number of minutes that she will take over the phone is

[5]

- a) more than 10 minutes;
- b) less than 5 minutes and
- c) between 5 and 10 minutes.

6. The breakdown voltage X of a randomly chosen diode of a particular type is known to be normally distributed with mean 40 volts and variance 2.25 volts. What is the probability that the breakdown voltage will be

- a) between 39 and 42 volts
- b) less than 44 volts
- c) more than 43 volts

OR

The daily consumption of electric power in a certain city follow a gamma distribution with $\alpha = 2$ and $\beta = 3$. If the power plant of this city has daily capacity of 12 million kilowatt hours, what is the probability that this power supply will be inadequate on any given day?

7. Define parameter, statistic and sampling with suitable examples. Define standard error of mean. [5]

8. Define Central Limit Theorem. If the mean and standard deviation of serum iron values for healthy men are 120 and 15 micrograms per 100 ml, respectively, what is the probability that a random sample of 50 normal men will yield a mean between 115 and 125 micrograms per 100 ml? [5]

9. The following data gives the experience of machine operators in years and their performance as given by the number of good parts turned out per 100 pieces. [5]

Experience (X)	16	12	18	4	3	10	5	12
Performance (Y)	87	88	89	68	78	80	75	83

- a) Fit the regression equation of performance rating on experience and estimate the probable performance of an operator had 8 years experience.
b) Determine coefficient of determination and interpret it. [5]

10. What are two regression coefficients and what do they represent? Write the properties of regression coefficients. [5]

11. Explain clearly the major steps to be adopted by researchers in testing hypothesis. [5]

12. Four brands of flashlights batteries are to be compared by testing each brand in five flashlights. Twenty flashlights are randomly selected and divided randomly into four groups of five flashlights each. Then each group of flashlights uses a different brand of battery. The lifetimes of the batteries, to the nearest hour, are as follows. [5]

Brand A	42	30	39	28	29
Brand B	28	36	31	32	27
Brand C	24	36	28	28	33
Brand D	20	32	38	28	25

At the 5% significance level, does there appear to be a difference in mean lifetime among the four brands of batteries? [5]

13. From the following data can you conclude that there is association between the purchase of brand and geographical region? [5]

	Region		
	Central	Eastern	Western
Purchase brand	40	55	45
Do not purchase brand	60	45	55

Use 5% level of significance.

14. Transceivers provide wireless communication among electronic components of consumer products. Responding to a need for a fast, low-cost test of Bluetooth-capable transceivers, engineer developed a product test at the wafer level. In one set of trials with 60 devices selected from different wafer lots, 48 devices passed. Test the null hypothesis $p = 0.70$ against the alternative hypothesis $p > 0.70$ at 5% level of significance. [5]

15. The following table shows the number of hours 45 hospital patients slept following the administration of a certain anesthetic.

[8]

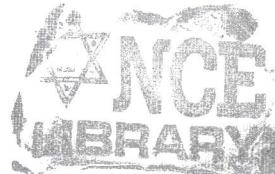
7	10	12	4	8	7	3	8	5
12	11	3	8	1	1	13	10	4
4	5	5	8	7	7	3	2	3
8	13	1	7	17	3	4	5	5
3	1	17	10	4	7	7	11	8

- Find sample mean, sample variance and sample standard deviation.
- Compute a value that measures the amount of variability relative to the value of mean.

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1. Following is the age distribution of 1000 persons working in a factory. [6]

Age Group	15-20	20-25	25-30	30-35	35-40	40-45	45-50	50-55	55-60
No. of person	60	122	135	242	148	107	85	63	38

Due to heavy loss, the management decides to bring down the strength to 50 percent of the present number according to following scheme:

- (i) to retrench the first 8% from the lower group
- (ii) to absorb the next 32% in other branches.
- (iii) to make 10% from highest age group retire premature.

What will be the age limits of the persons retained in the mill and of those transferred to other branches?

2. a) Define the terms: (i) Mutually exclusive events (ii) Independent events. [2]

- b) Customers are used to evaluate preliminary product designs. In the past, 95% of highly successful products received good reviews, 60% of moderately successful products received good reviews, and 10% of poor products received good reviews. In addition, 40% of products have been highly successful, 35% have been moderately successful, and 25% have been poor products.

- (i) What is the probability that a product attains a good review?
- (ii) If a new design attains a good review, what is the probability that it will be a highly successful product?

[4]

3. Define Hypergeometric Distribution. How does it differ from Binomial Distribution? Write the approximation condition for approaching Hypergeometric to Binomial Distribution. [5]

4. Three people toss a coin and odd man pays for the coffee. If the coins all turns up the same, they toss again. Find the probability that fewer than 4 tosses are needed. [5]

5. Let the continuous random variable X denote the diameter of a hole drilled in a sheet metal component. The target diameter is 12.5 millimeters. Most random disturbances to the process result in larger diameters. Historical data show that the distribution of X can be modeled by a probability density function $f(x) = 20e^{-20(x-12.5)}$, $x \geq 12.5$. If a part with a diameter larger than 12.60 millimeters is scrapped,

- a) What proportion of parts is scrapped?
- b) What proportion of parts is between 12.5 and 12.6 millimeters?

[5]

6. Under what conditions, the Poisson distribution can be approximated using Normal distribution. Of a large group of men, 5% are under 60 inches in height and 40% are between 60 and 65 inches. Assuming a normal distribution, find the mean height and standard deviation. [5]

[5]

7. Define the terms:

- a) Parameter, statistic
- b) Sample
- c) Sampling distribution of mean
- d) Standard error of mean?

8. An auditor for a large credit card company, knows that on average, the monthly balance of any given customer is 112 and the standard deviation is 56. If the audits 50 randomly selected accounts, what is the probability that the sample average monthly balance is (a) below 100 (b) between 100 and 130?

[5]

9. Define the correlation coefficients and state its important properties.

[5]

*10. An investigation of the relationship between traffic flow x (1000's of cars per 24 hours) and lead content y of bark on trees near the highway ($\mu\text{g/g dry wt.}$) yielded the following data:

[5]

X_i	8.3	8.3	12.1	12.1	17.0	17.0	17.0	24.3	24.3	24.3	33.6
Y_i	227	312	362	521	640	539	728	945	738	759	1263

- a) Find the estimated regression line to estimate lead content from traffic flow.
- b) Compute a 95% confidence interval for the slope of the true regression line.

11. It is claimed that an automobile is driven on the average is 12000 miles per year. To test this claim a random sample of 100 automobile owners are asked to keep a record of the miles they travel. Would you agree that average miles driven is greater than claimed value if the random showed an average of 14,500 miles and a standard deviation of 8,000 miles? Use a 0.01 level of significance.

[5]

Or,

I is claimed that a new diet will reduce a person's weight by 10 pounds on the average in a period of 2 weeks. The weights of seven women who followed this diet were recorded before and after a 2 week period.

Woman	1	2	3	4	5	6	7
Weight Before	129	133	136	152	141	138	125
Weight After	130	121	128	137	129	132	120

Test the manufacturer's claim at 5% level of significance.

12. A study compared the number of hours of relief provided by five different brands of antacid administered to 25 different people, each with stomach acid considered strong. The results are given below.

[5]

Brand				
A	B	C	D	E
4.6	5.2	5.9	2.7	4.3
4.5	4.9	4.9	2.9	3.8
4.1	4.7	4.6	3.9	5.2
3.8	4.6	4.3	4.3	4.4

Calculate the F ratio. At the 0.05 level of significance, do the brands produce significantly different amounts of relief to people with strong stomach acid?

13. A random sample of 200 married men, all retired, were classified according to education and number of children.

[5]

Education	Number of children		
	0-1	2-3	over 3
Elementary	14	37	32
Secondary	19	42	17
College	12	17	10

Test the hypothesis at 0.05 level of significance, that the size of the family is independent of the level of education attained by the father.

14. A random sample of 100 men and 100 women at a college is asked if they have an automobile on campus. If 31 of the mean and 24 of the women have cars, can we conclude that more men than women have cars on the campus? Use a 0.01 level significance. [5]

15. The following are the annual maximum flows in m^3/s in a river for 52-year period: [8]

1980	3120	2120	1700	2550
1700	1570	2830	2120	2410
1420	1980	2690	3260	1840
1980	4960	2120	2550	4250
2690	2270	5660	5950	3400
8500	3260	3960	2270	2410
2550	1980	2120	2410	3170
2410	1840	3120	3290	4550
1980	4670	1700	2410	3310
3120	2070	1470	2410	1130
3230	3090			

- Find descriptive statistics: maximum, minimum, sample mean, range, sample standard deviation, standard error of mean.
- Find approximate a 95% confidence interval for true average of rate of maximum flow.
