

# (31) Business Statistics

## Structure of the Question Paper

**I Paper - Time : 02 hours.**

**50** multiple choice questions with 5 options. **All** questions should be answered. Each question carries **02** marks. Total marks **100**

**II Paper - Time : 03 hours.** (In addition, 10 minutes for reading.)

This paper consists of two parts.

**Part I** - Four Structured essay questions

**Part II** - Four Structured essay questions

Selecting at least **two** question from each part, answer **five** questions altogether.

**20** marks for each question. Total marks **100**.

Calculation of the final marks	:	Paper I	=	100
		Paper II	=	100
		Final Marks	=	$200 \div 2 = \underline{100}$

I Paper

### Important :

- All questions should be answered.
- Select the correct and most appropriate option.

1. Which of the following statements is true?
  - (1) Making decisions by collection and analysis of data is known as descriptive statistics.
  - (2) Statistics does not deal with qualitative data.
  - (3) Making conclusions regarding the entirety through sample surveys is a limitation of statistics.
  - (4) Absolutely accurate decisions can be made in Statistics.
  - (5) In Statistics, decisions are always made based on sample surveys.
2. Which of the following statement/s is/are true?

A - Numerical figures are not used in nominal scale data.  
B - Absolute zero is not applicable in interval scale data.  
C - Mathematical operations cannot be implemented in rank scale data.

(1) A only            (2) B only            (3) C only            (4) A and B only            (5) B and C only
3. Which of the following statements is **not true**?
  - (1) Modern electronic devices can be applied in direct observation method.
  - (2) Collection of data using computer software is more appropriate under advanced technological environments.
  - (3) It would be convenient to come to conclusions using focused group method in collection of data.
  - (4) The collection of data in personal interview method may be more reliable compare to self enumeration method.



- (1)  $C \cdot (\bar{x} + A), C \cdot S$  (2)  $C \cdot (\bar{x} + A), C \cdot (S + A)$   
 (3)  $\bar{x} + C, C \cdot S$  (4)  $\bar{x} + A, C \cdot S$   
 (5)  $C \cdot \bar{x}, C(S + A)$
11. The frequency distribution with  $(Q_3 - Q_2) = \frac{1}{2}(Q_2 - Q_1)$  is  
 (1) Symetric (2) Positively skewed (3) Negatively skewed  
 (4) Platy-kurtic (5) Lepto- kurtic
12. Which of the following statement/s is/are true about the regression?  
 A - The direction of relationship of two variabes is represented by the sign of the regression coefficient.  
 B - The strength of a regression model is assessed by the coefficient of determination.  
 C - The coefficient of determination ranges between -1 and +1  
 (1) A only (2) B only (3) C only (4) A and B only (5) A and C only
13. Following values have been calculated by a student who is fitting a regression line of Y on X using eight pair of values.  
 $\sum x = 56,$   $\sum y = 294,$   $\hat{b} = -2.34$   
 The correct equation of the regression line is,  
 (1)  $\hat{Y} = 16.38 - 2.34X$  (2)  $\hat{Y} = 20.37 - 2.34X$   
 (3)  $\hat{Y} = 53.13 - 2.34X$  (4)  $\hat{Y} = 53.13 + 2.34X$   
 (5)  $\hat{Y} = 92.995 - 2.34X$
14. The correlation coefficient between variables X and Y is -0.9. If the regression coefficient of Y on X is -2.5, what should be the regression coefficient of X on Y.  
 (1) 0.324 (2) -0.324 (3) 0.810 (4) 3.240 (5) -3.240
15. Which of the following statement/s is/are true about the probability approaches?  
 A - According to the classical approach, the probability of a male birth is 1/2.  
 B - The accuracy of the probability obtained by the relative frequency approach depends on the number of times that the experiment was repeated.  
 C - In mathematical approach of probability, the outcomes of the experiment should be countable.  
 (1) A only (2) B only  
 (3) C only (4) A and B only  
 (5) All A, B and C
16. For a workshop, two deligates from each of five companies participate. If a commitee of five deligates is to be formed, what is the probability that all five companies are represented.  
 (1)  $\frac{5}{252}$  (2)  $\frac{16}{252}$  (3)  $\frac{32}{252}$  (4)  $\frac{5}{10}$  (5)  $\frac{8}{10}$
17. A and B are collectively exhaustive events and the probability of the event A is two times the probability of two events occur simultaneously. The probability of occurring event B is two times of the probability of occurring event A. The probability of occurring event A is,  
 (1)  $\frac{1}{6}$  (2)  $\frac{2}{7}$  (3)  $\frac{1}{3}$  (4)  $\frac{2}{5}$  (5)  $\frac{3}{7}$

18. If A and B are any two events,  $P(A|B)$  is same as  
 (1)  $P(B|A)$  (2)  $1 - P(A)$  (3)  $1 - P(B|A)$  (4)  $1 - P(A|B)$  (5)  $1 - P(B|A)$
19. If the random variable X can take only the values 1, 2, 3 and 4. Which of the following function represent the Probability distribution.  
 (1)  $f(x) = \frac{x-2}{2}$  (2)  $f(x) = \frac{x-1}{4}$  (3)  $f(x) = \frac{x+1}{4}$   
 (4)  $f(x) = \frac{x^2}{15}$  (5)  $f(x) = \frac{x+2}{18}$
20. If the number of binomial trials is 6 and  $4P(X=4) = P(X=2)$ , then the probability of success is  
 (1)  $1/4$  (2)  $1/3$  (3)  $1/2$  (4)  $2/3$  (5)  $3/4$
21. For in a poisson distribution if  $P(X = 0) = P(X = 1)$  then what is the mean of the distribution  
 (1)  $1/e$  (2)  $\sqrt{e}$  (3) 1 (4) e (5)  $e^2$
22. The life time of a certain kind of a electric bulb has a normal distribution with mean 4000 hours and standard deviation 400 hours. Find  $x'$  such that  $P(x \geq x') = 0.90$   
 (1) 3344 (2) 3488 (3) 4512 (4) 4656 (5) 4784
23. Which of the following statements is true?  
 (1) The simple random sampling is more appropriate when the population variation is large.  
 (2) In probability sampling, every population unit is given an equal probability for being included in the sample.  
 (3) When the variation among strata is high, the stratified sampling method is more appropriate.  
 (4) When the sampling frame is in random order systematic sampling can be expected to yield better results than simple random sampling.  
 (5) If the intra-class correlation coefficient is small, cluster sampling is more appropriate.
24. Which of the following statement/s is/are true?  
 A - Sampling from the experts persons about a certain field is called judgment sampling.  
 B - When compared to the methods of non-random sampling, the personal bias in random sampling is low.  
 C - Quota sampling can be regarded as a non-probability stratified sampling.  
 (1) A only (2) B only  
 (3) C only (4) B and C only  
 (5) All A, B and C
25. Which of the following statements is true ?  
 (1) The standard error of the sample mean is greater than the standard error of sample median estimator in probability sampling  
 (2) Non-sampling error can be reduced by increasing the sample size.  
 (3) When sampling fraction is small, the finite population correction factor is closed to one.  
 (4) The unit selected for a sample from a population is known as a sampling unit  
 (5) Absence of a clear sampling frame is an example for sampling error.
26. Mean income of people in a certain area is Rs.40,000 and the variance is Rs 6,250,000. If a random sample of 100 persons is selected, the probability that the sample mean lies within Rs. 400 from the true population

mean is

- (1) 0.4332                      (2) 0.4452                      (3) 0.4641                      (4) 0.8904                      (5) 0.9282

27. The variance of a population of size 500 is 64. If a random sample of size 50 is selected from this population the standard error of sample mean is

- (1)  $\frac{8}{\sqrt{50}}$                       (2)  $\frac{64}{\sqrt{50}}$                       (3)  $\frac{24}{\sqrt{499}}$                       (4)  $\frac{72}{\sqrt{499}}$                       (5)  $\frac{192}{\sqrt{499}}$

28. 40% of the people in area A and 50% of the people in area B have internet facility. If a random sample of size 100 is selected from each of these areas, the sampling distribution of the difference of the sample proportion of the people with internet facilities is.

- (1) distributed normally with mean 0.1 and standard deviation 0.7  
(2) distributed normally with mean 0.1 and standard deviation 0.07  
(3) distributed normally with mean -0.1 and standard deviation 0.7  
(4) distributed approximately normally with mean 0.1 and standard deviation 0.07  
(5) distributed approximately normally with mean -0.1 and standard deviation 0.07

29. If a random sample of size 48 is selected from a poisson distribution with mean 12, the probability that the sample mean is greater than 13 is

- (1) 0.0228                      (2) 0.1587                      (3) 0.6587                      (4) 0.04772                      (5) 0.9772

30. Which of the following statement/s is/are true?

- A - Among all possible unbiased estimators for a population parameter, the estimator with minimum variance is the most efficient estimator.  
B - If the variance of unbiased estimator approaches zero when the sample size increases, it is called consistent estimator.  
C - The estimator which represent all the information about the parameter in a sample is called a sufficient estimator.

- (1) A only    (2) B only  
(3) C only    (4) B and C only  
(5) All A, B and C

31. Which of the following statement/s is/are true about statistical estimation?

- A - The width of the 99% confidence interval is greater than the width of the 95% confidence interval.  
B - t-distribution is used for making statistical inference about the mean of a normal population with known variance.  
C - If the sample size is large, the width of a confidence interval is small.

- (1) A only    (2) B only  
(3) C only    (4) A and C only  
(5) All A, B and C

32. If the mean of a normal population with variance 100 is to be estimated with margin of error within  $\pm 2$  and with 5% probability of error, the size of the sample that should be selected is,

- (1) 10    (2) 20    (3) 49    (4) 68    (5) 97

33. A random sample of 100 items were selected from a product and 10 of the items were defective. The upper confidence limit of the 90% confidence interval constructed for true defective proportion is,

- (1) 0.0508                      (2) 0.1014                      (3) 0.1490                      (4) 0.1588                      (5) 0.1774

34. Which of the following statement/s is/are true about hypothesis testing?  
 A - Probability of rejecting false null hypothesis is type I error.  
 B - The level under which the type I error is kept controlled is called confidence level  
 C - Probability of rejecting true alternative hypothesis is size of type II error.  
 (1) A only            (2) B only            (3) C only            (4) A and B only            (5) B and C only
35. Which of the following statements is true?  
 (1) If the P-value of a test is larger than 0.05,  $H_0$  : should be rejected at 5% significance level.  
 (2) When type I error increases type II error will also increase.  
 (3) A test of hypothesis with 10% level of significance is better than a test of hypothesis with 5% level of significance.  
 (4) Both type I error and type II error can be reduced simultaneously only by increasing the sample size.  
 (5) The probability of rejecting  $H_0$  when it is false is called the power of the test.
36. The value of test statistic computed by a researcher for testing the mean of a normal distribution  $H_0 : \mu_1 = \mu_2$  vs  $H_1 : \mu_1 \neq \mu_2$  at 5% level of significance is 1.35. What should be the 'P' value of the test and the decision of the test.  
 (1)  $P = 0.0885$  and  $H_0$  will be rejected  
 (2)  $P = 0.0885$  and  $H_0$  will not be rejected  
 (3)  $P = 0.177$  and  $H_0$  will be rejected  
 (4)  $P = 0.177$  and  $H_0$  will not be rejected  
 (5)  $P = 0.5885$  and  $H_0$  will not be rejected
37. A population is normally distributed with mean  $\mu$  and variance 25. The mean of a sample of size 9 is 36.8. The value of the test statistic used to test  $H_0 : \mu = 37.5$  is  
 (1) -0.084            (2) - 0.420            (3) - 0.420            (4) - 1.260            (5) -1.170
38. Which of the following statements is true regarding the chi-square distribution?  
 (1) It is symmetrical and takes any value in the range 0 to 1.  
 (2) It is right skewed and takes zero or a value greater than zero.  
 (3) It is left skewed and can take even minus values.  
 (4) It is right skewed and can take a value in the range  $-3$  to  $+3$   
 (5) It is symmetrical about the mean and dispersed in the range  $-3\sigma$  to  $+3\sigma$  to either side.
39. An analysis of variance table to compare the means of four normal populations is given below.

Source of Variation	Sum of Squars	d.f.-Value	Mean Sum of Squars	F Value
Between the Samples	168	?	MSC ?	F = ?
Within the Samples	?	?	MSE = 22	
Total	608			

Choose the correct statement containing the sample size (n) value of test statistic (F) and the decision of the test respectively

- (1) 6, 2.54,  $H_0$  is not rejected.            (2) 6, 2.54,  $H_0$  is rejected.



47. If the total cost for a consumer basket of the current year is expressed as a percentage of the total cost of that basket in the base year the resulting index is called,
- (1) Laspeyres' price index
  - (2) Laspeyres' quantity index
  - (3) Paasche's price index
  - (4) Paasche's quantity index
  - (5) Value index
48. Which of the following statement/s is/are true?
- A - The simple value relative satisfies both time reversal test and a factor reversal test.  
B - The price index that obtained using the average of current year quantity and the base year quantity as weight is called Marshall-Edworth index.  
C - Fishers-index has upward Edworth bias and downward bias.
- (1) A only
  - (2) B only
  - (3) C only
  - (4) A and B only
  - (5) All A, B and C
49. Compare to the year 2010 the income of a certain firm increases by 50% in 2015 and the quantity produced increase by 20%. The percentage increase of the price of this production is.
- (1) 12%
  - (2) 20%
  - (3) 25%
  - (4) 30%
  - (5) 33.3%
50. The group index for food is 150 and the group index for other items is 180. If the overall index is 152 what percentage of the total weight has been allocated for food,
- (1) 30%
  - (2) 40%
  - (3) 50%
  - (4) 60%
  - (5) 70%

agaram.lk  
\*\*\*

# (31) Business Statistics

## Paper II

### Part 1

#### Important :

- Answer **five** questions all together selecting at least **two** questions from **each part**.

1. (a) State three instances for importance of Statistics and missuses of Statistics seperately. **(03 marks)**
- (b) (i) Describe the advantages and disadvantages of personal interview method relative to the self enumeration method which is used in collecting primary data.
- (ii) What are the facts that should be considered in preparing a good questionnaire? **(07 marks)**
- (c) (i) Give examples for two practical situations where the pie chart can be used in representing business data.
- (ii) When two Lorenz curves are intersect on the same co-ordinate plane, how would you explain the deviation between them comparatively? **(04 marks)**
- (d) When the employees of two firms in the same industry were categorized equally into five groups based on their earnings, the distribution of the earnings is given in the following table.

Earnings (Rs. Millions)	
Firm A	Firm B
40	80
60	120
80	160
120	200
200	240

Represent these data using lorenz curves constructed on the same co-ordinate plane. and compare the deviations between two distributions. **(06 marks)**

2. (a) (i) Briefly explain the role of each type of measures given below which are used in analysing a data set.  
Measures of central tendency  
Measures of dispersion
- (ii) “Though the arithmetic mean is a frequently used measure of central tendency, sometimes it becomes weak measure” How would you verify this statement? **(06 marks)**
- (b) A frequency distribution for the data related to the quantity of units produced by 200 employees during a period of one month is given below.

No. of Units	135 - 140	140 - 145	145 - 150	150 - 155	155 - 160	160 - 165	165 - 170
No. of Employees	08	12	40	50	60	25	05

- (i) Find the mean, median, mode and standard deviation of this distribution.
- (ii) Compute the pearson’s co-efficient of skewness and comment on the shape of the ditribution. **(08 marks)**

- (c) Following measures have been computed using two samples of bulbs which are manufactured in two factories with the same capacity.

Details	Factory A	Factory B
No. of Bulbs.	100	120
Average Life Time (Hours)	1100	900
Standard Deviation (Hours)	240	220

- (i) Which factory produces bulbs with more stable life time.  
 (ii) Compute the combined average life time of bulbs produced by two factories.  
 (iii) If the average life time of a bulb produced in factory B is improved up to 1100 hours compute the combined variance of life time.

**(06 marks)**

**(Total marks 20)**

3. (a) What is an index number? Explain the importance of index numbers in evaluating the economic condition of a country? **(04 marks)**

- (b) The price and quantity of four goods A B C and D in the years 2010 and 2016 are given in the following table.

Good	2010		2016	
	Price (Rs.)	Quantity	Price (Rs.)	Quantity
A	40	10	60	15
B	50	12	65	10
C	45	10	75	12
D	60	20	100	25

Compute the following price indices for the year 2016 taking the base year as 2010.

- (i) Laspyre's price index  
 (ii) Paasche's price index  
 (iii) Marshall-Edgeworth price index  
 (iv) Fisher's ideal price index

**(06 marks)**

- (c) Explain what do you understand by deseasonalizing of a time series and state the importance of it.

**(04 marks)**

- (d) The following table contains the annual production of a firm from the year 2011 to 2016.

Year	2011	2012	2013	2014	2015	2016
Quantity of Production (Units '000)	65	80	95	85	110	105

- (i) Estimate the trend line by using least square method.  
 (ii) Estimate the quarterly trend line considering the first quarter of 2014 as the base period and estimate the production for third quarter in 2015.

**(06 marks)**

**(Total marks 20)**

4. (a) Explain the meaning of the following coefficients and describe the relationships among them.
- (i) Correlation coefficient
  - (ii) Regression coefficient
  - (iii) Coefficient of determination (04 marks)

- (b) The advertising and the net profit in each month of first six months of a certain year of a company are given below.

Month	Jan	Feb	March	April	May	June
Advertising Expensess (Rs. Millians)	4	6	10	8	20	12
Net Profit (Rs. Millions)	40	50	70	60	80	60

$$\Sigma x = 60 \quad \Sigma y = 360 \quad \Sigma xy = 3960 \quad \Sigma x^2 = 760 \quad \Sigma y^2 = 22600$$

- (i) Estimate the regression line of net profit on advertising expenses using the least square method.
  - (ii) If the company is in need of promoting the net profit in July up to Rs. 95 millians, find the amount of expenses that should be spent for advertsing.
  - (iii) compute the coefficient of determination and obtain the correlation coefficient. Interpret these two coefficients. (06 marks)
- (c) Distinguish between the terms in each pair given below.
- (i) Random variation and assignable variation
  - (ii) Porcess control and product control.
  - (iii) Control charts for variables and control charts for attributes.
  - (iv) Producer's risk and consumer's risk (04 marks)
- (d) Number of defectives found in ten samples of size 50 each are given in the following table.

Sample No.	1	2	3	4	5	6	7	8	9	10
No. of Defectives	3	2	4	0	1	5	6	4	2	3

Construct an appropriate control chart and state whether the process is under control.

(06 marks)  
(Total marks 20)

## Part II

5. (a) Explain how the concept of probability is important in business field. (03 marks)
- (b) The director board of a company with 11 members, 7 are men and 4 are women. If three directors are selected at random for a committee, find the probability that it consists of at least two men. (04 marks)
- (c) The employees of a business firm have been classified on their gender, wage and educational qualifications.

Gender	Monthly Salary Less Than Rs. 50000		Monthly Salary Rs. 50000 or More	
	Not Degree Holders	Degree Holders	Not Degree Holders	Degree Holders
Female	15	10	20	30
Male	25	20	30	50

If an employee is selected at random, find the probability that the selected employee is

- (i) a male.
- (ii) a female graduate.
- (iii) receiving a monthly salary of Rs. 50000 or more given that a female has been selected.
- (iv) being a male given that the person is receiving a monthly salary of less than Rs. 50000.
- (v) being a male graduate receiving a monthly salary of Rs. 50000 or more.
- (vi) Are the events that the person selected being a male and receiving a monthly salary less than Rs. 50000 statistically independent? (08 marks)
- (d) 60% and 40% of the total production of a manufacturing company are produced by the machine A and machine B respectively. 5% of the items produced by machine A and 8% of the items produced by machine B are found to be defective. If a randomly selected unit from the total production is a non defective, find the probability that it has been produced in machine A. (05 marks)
- (Total marks 20)**
6. (a) Explain the characteristics of a random experiment relevant to a binomial distribution. state the parameters of a binomial distribution and give an example for practical situation where it is applicable. (04 marks)
- (b) A series of competitions is held in five rounds between two teams A and B. The probability that the team A winning the competition at any round is 60%. Find the probability that the team A.
- (i) will win none of the competitions
- (ii) will win all the competitions
- (iii) will win the series of competitions (05 marks)

- (c) (i) State the conditions that should be satisfied for approximating a normal distribution to a binomial distribution.  
(ii) 25% of the vehicles sold by a firm is white coloured. Find the probability that more than 10 white coloured vehicles included in a batch of 48 vehicles. **(05 marks)**
- (d) 12% of the candidates sat for an examination has scored less than 25 marks and 8% has scored more than 75 marks. Assuming that the marks of this examination follows a normaly distribution. Find the mean and variance of the distribution.

If the pass mark is 40, find the percentage of failure. **(06 marks)**  
**(Total marks 20)**

7. (a) (i) Describe advantages and disadvantages of a sample survey relative to a complete enumeration.  
(ii) Briefly explain the steps of planning a sample survey **(04 marks)**
- (b) Describe the stratified sampling method and state the advantages and disadvantages of it. **(04 marks)**
- (c) The values of population characteristic (Y) with  $N = 3$  are  $Y = 1, 3, 5$   
(i) compute the population mean  $\mu$  and population variance  $\sigma^2$   
(ii) Write all possible samples of size 2 that can be drawn without replacement and construct the sampling distribution of sample mean. Hence show that the sample mean is an unbiased estimator for the population mean.  
(iii) Compute the variance of sample mean using the sampling distribution and show that it can be estimated using a formula with a single sample. **(08 marks)**
- (d) State the central limit theorem If a sample of size 54 is drawn from a population whose mean is 4.5 and variance 4. Find the probability that the sample mean exceeds 5. **(04 marks)**  
**(Total marks 20)**

8. (a) What are the factors that determine the width of a confidence interval **(03 marks)**
- (b) Packets of milk are filled in a machine. Once a sample of 25 packets filled in this machine was drawn at random, the total weight of those packets and the sum of the squares of those weights have been computed as 750g and 23 364g respectively.  
Considering that the weight of the packets filled by this machine distribute normally, construct a 95% confidence interval for the mean weight of a packet of milk filled by this machine. **(05 marks)**
- (c) 50 men in a sample of 100 men and 60 women in a sample of 100 women have expressed that they like a particular TV programme. Test whether more women like this programme than men at 5% level of significance. Calculate the P-value of the test. **(06 marks)**

- (d) Number of units of three types of commodities sold in three different areas in a month has been observed as follows.

Type of commodity	Area		
	1	2	3
A	40	30	30
B	25	35	40
C	10	40	50

Test whether the demand for the types of commodity depends on the area at  $\alpha = 0.05$  level of significance

**(06 marks)**

**(Total marks 20)**

\* \* \*



agaram.lk