VPM's
Dr. V. N. BRIMS, Thane
Programme: PGDM (2014-16) Fourth Batch
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Subject : Quantitative Techniques

Roll No.	**:**	**Marks**	**: 60 Marks**
Total No. of Questions	**: 7**	**Duration**	**: 3 Hours**
Total No. of printed pages	**:**	**Date**	**: 22/9/2014**

Note: Q1 is compulsory and solve any FOUR from the remaining SIX questions. Q.1) comprises of 2 sub questions Q.1.a] and Q.1.b] 10 marks each.

Q1) 20 Marks (Compulsory).

Q.1.a] Multiple choice questions. Write the correct option in the answer sheets.(10 Marks)

1. In a study of discrimination at work against pregnant women, women were asked to rate their experiences on a scale of 1 to 10. A rating of 1 signifies nearly no discrimination where as a rating of 10 signifies very high level of discrimination. This is best described as an example of _______________ data.

   a. Ordinal b. Ratio c. Interval d. Nominal

2. A sample of 25 women has been asked to give their opinion on the smoothness of their skin before and after using a moisturizing body lotion in the market. The women were given a "ten point rating scale" to judge the difference. The proper statistical test for examining the data is

   a. Regression analysis
   b. t-test for 2 Dependent Samples
   c. ANOVA
   d. Z-test

3. HUL wants to see if there is any relationship between color of detergent powder and income groups of the consumers. To do this they have classified the target market in to low, mid and high income segments. The colors of detergents selected are yellow, blue and white. In effect they have one ordinal (income group) and one nominal variable(color of detergent). The type of the test for analysis is:

   a. ANOVA I b. Z test c. Multiple Regression d.Chi Square

4. A consultant performed regression analysis for purchase factors for a laptop, where he found r = 0.8. The model is
   a. Weak b. Moderate c. Strong
5. The measure of central tendency that can be used on a ratio data is
   a. Mean b. Median c. Mode d. All of the above
6. For a normally distributed data set ***"About 68.27% of the values lie within 1 standard deviation of the mean. Similarly, about 95.45% of the values lie within 2 standard deviations of the mean. Nearly all (99.73%) of the values lie within 3 standard deviations of the mean."***

   The above result is an outcome of which of the followings principles in statistics

a. Chebeyshev's Lemma b. Central Limit Theorem
c. Empirical Rule d. Baye's Theorem

7. The Special Rule of Multiplication is used when the two events are
   a. Independent Events b. Mutually Exclusive events
   b. Events based on subjective probabilities d. None of the above

8, 9 & 10) ***Note:*** *This question is for 3 marks and No marks will be given if calculations are not shown*

Suppose that a researcher wishes to estimate the average height (denoted by μ) in a population. He wants the error of estimation to be less than 1.5 cm with a level of significance of 0.05. Suppose that a previous study reveals the population standard deviation as 10 cm. *The required sample size* would be approximately equal to

a. 171 b. 100 c. 151 d.271

Q.1.b.]**For the following two cases** (1) State the null and alternative hypothesis, (2) State the test to be used for a particular case. (3) State the decision as to accept or reject Ho (4)State your decision and (5) State the business Implication

(i) Two cities, Bradford and Kane are separated only by the Conewango River. There is competition between the two cities. The local paper recently reported that the mean household income in Bradford is $38,000 with a standard deviation of $6,000 for a sample of 40 households. The same article reported the mean income in Kane is $35,000 with a standard deviation of $7,000 for a sample of 35 households.

Calculated value of test statistic = 1.98 p-value = 0.0639

At the 0.01 significance level can we conclude the mean income in Bradford is more? (5 Marks)

(ii) According to a study conducted for Gateway Computers, 59% of men and 70% of women say that weight is an extremely/very important factor in purchasing a laptop computer. Suppose this survey was conducted using 374 men and 481 women.

An appropriate hypothesis testing was done and following results were obtained.

Calculated value of test statistic = -3.35 p-value = 0.00004

Do these data show enough evidence to declare that a significantly higher proportion of women than men believe that weight is an extremely/very important factor in purchasing a laptop computer using a 5% level of significance.(5 Marks)

Attempt Any FOUR from the Remaining SIX Questions

Q2) *Any two from (a) or (b) or (c) ———— (5x2) = 10 Marks*

Q.2. a) You are working for the transport manager of a call center which hires cars for the staff. You are interested in the weekly distances covered by theses cars. The data for the same is as follows:

Kilometers covered	100-110	110-120	120-130	130-140	140-150	150-160	160-170	170-180	180-190
No.of Cars	4	0	3	7	11	8	5	0	2

(i) Calculate the three quartiles (3 M)
(ii) Draw a box plot and comment on spread of data (2 M)

Q.2.b) The automatic filling machine A and B are used to fill tea in 500 gm cartons. A random sample of 100 cartons on each of the machine showed following results:

Tea Contents	Samples from	
	Machine A (F1)	Machine B (F2)
485-490	12	10
490-495	18	15
495-500	20	24
500-505	22	20
505-510	24	18
510-515	4	13

(i) Calculate the mean and standard deviation of the two machines (4 M)
(ii) Based on the above results, which would you choose, A or B and Why? (1 M)

Q.2.c) Write a note on different measures of central tendency and measures of dispersion. Explain in brief its application in business management.

Q3) ***Any two from (a) or (b) or (c) ———— (5x2) = 10 Marks***

a)The Alabama Department of Labor reports that 20% of the workforce in Mobile Industry is unemployed. If 14 workers were interviewed. Using binomial distribution, find the probability that no. of workers who are unemployed are:
a) Exactly 3 b) At least 3

b) In a manufacturing plant, machine A produces 10% of a certain product, machine B produces 40% of this product, and machine C produces 50% of this product. Five percent of machine A products are defective, 12% of machine B products are defective, and 8% of machine C products are defective. The company inspector has just sampled a product from this plant and has found it to be defective. Using <u>baye's theorem</u>, determine the revised probabilities that the sampled product was produced by machine A, machine B, or machine C.

c) According to the Air Transport Association of America, the average operating cost of an MD-80 jet airliner is $2,087 per hour. Suppose the operating costs of an MD-80 jet airliner are <u>normally distributed</u> with a standard deviation of 175 per hour. Find the probability that the operating cost of an MD-80 jet airliner is

i) Between $ 2000 to $ 2200
ii) Less than $ 2300

Q4) ***Any two from (a) or (b) or (c) ———— (5x2) = 10 Marks***

a)Jamestown Steel Company manufactures and assembles desks and other office equipment. The weekly production of the Model A325 desk at the Fredonia Plant follows the <u>normal probability distribution</u> with a mean of 200 and a standard deviation of 16. Recently, new production methods have been introduced and new employees hired. A sample of 50 desks is studied. The VP of manufacturing would like to investigate whether there has been a change in the weekly production of the Model A325 desk. Test the hypothesis at the level of significance of 0.01.

b)A survey was taken of U.S. companies that do business with firms in India. One of the questions on the survey was: Approximately how many years has your company been trading with firms in India? A random sample of 44 responses to this question yielded a mean of 10.455 years. Suppose the population standard deviation for this question is 7.7 years. Using this information, construct a 90% and 95 % confidence interval for the mean number of years that a company has been trading in India for the population of U.S. companies trading with firms in India.

c)An economist wanted to find out if there was any relationship between the unemployment rate in the country and its inflation rate. The data gathered from 7 countries for the year is as follows:

Unemployment rate (%)	4	8.5	5.5	0.8	7.3	5.8	2.1
Inflation rate (%)	3.2	8.2	9.4	5.1	10.1	7.8	4.7

Find the Spearman's Rank correlation coefficient(denoted as ρ) and give your comments?

Q5) ***Any two from (a) or (b) or (c) ——————— (5x2) = 10 Marks***

a)A packaging device is set to fill detergent powder packets with a mean weight of 5 Kg and S.D. of 0.21 kg. A random sample of 100 packets is chosen at random and the average weight was noted as 5.03 kg. Can we conclude that the mean weight of the produced packets has increased? Test the hypothesis at 5% level of significance.

b) Write a short note on any two of the following:
(i) Normal Distribution and its application in business
(ii) Binomial Distribution & its application in service industry like Insurance, Restaurants etc
(iii) Poisson Distribution and its application in various business processes.

c)The claims department at Wise Insurance Company believes that younger drivers have more accidents and, therefore, should be charged higher insurance rates. Investigating a sample of 1,200 Wise policyholders revealed the following breakdown on whether a claim had been filed in the last three years and the age of the policyholder.Is it reasonable to conclude that there is a relationship between the age of the policyholder and whether or not the person files a claim? Use L.O.S as 0.05
(If value for$\chi 2_{tab}$= 7.81)

Age Group in years	No Claim	Claim
16 up to 25	170	74
25 up to 40	240	58
40 up to 55	400	44
55 or older	190	24
Total	1,000	200

Q6) *Any two from (a) or (b) or (c) ———— (5x2) = 10 Marks*

a)The Construction Labor Research Council lists a number of construction labor jobs that seem to pay approximatelythe same wages per hour. Some of these are bricklaying, iron working, and crane operation. Suppose a labor researcher takes a random sample of workers from each of these types of construction jobs and from across the country and asks what are their hourly wages. The survey yields the following data

Bricklaying	Iron working	Crane Operation
19	26	16
17	21	23
20	16	23
24	22	20
19	23	27
22	19	23
21	18	26

Using ANOVA, at 0.05 level of significance can we conclude there is a significant difference in mean hourly wages for these three jobs? (Critical Value for *f* = 3.55)

b)Some people drink coffee to relieve stress on the job. Is there a correlation between the number of cupsof coffee consumed on the job and perceived jobstress?

Suppose the data shown represent the numberof cups of coffee consumed per week and a stressrating for the job on a scale of 0 to 100 for nine managersin the same industry.

Cups of Coffee per week	25	41	16	0	11	28	34	18	5
Job Stress	80	85	35	45	30	50	65	40	20

(i) Find the regression equation of above given data

(ii) If a person perceived stress at work is 70, then find the expected number of cups of coffee he would consume in week.

c) Write short note on "Application of ANOVA and Regression in Business Management".

Q7) *Any two from (a) or (b) or (c) ———— (5x2) = 10 Marks*

a) IMRB, ace name in Market Research Company has been approached by Bose Speakers to conduct a research to analyze the effectiveness of the sales staff in their outlets. Kindly suggest how IMRB as a researcher should should sample their target respondents for the study. Which of the probabilistic or non-probabilistic sampling should they use or not use? Justify with in each of the cases.

b) A company wants to forecast its sales for the coming financial year. Kindly recommend which of the tools of time series data analysis they should use. Reason your recommendations in each of the methods in brief.

c) Write short note on "Application of Quantitative Techniques in Management".

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List of Concepts and their formulas in Quantitative techniques / Business Statistics

Sr. No	Concept	Formula
1	**Summation** a. Summation of n numbers	$\sum_{i=1}^{n} x_i = x_1 + x_2 + x_3 + \ldots \ldots .+x_n$ Simply as, $\sum x = x_1 + x_2 + x_3 + \ldots \ldots .+x_n$
2	Arithmetic Mean a. **Ungrouped Data** i) **Population Mean** ii) **Sample Mean** b. **Grouped Data**	$\mu = \frac{\sum x}{N}$ $\bar{x} = \frac{\sum x}{n}$ $\bar{x} = \frac{\sum f * x}{\sum f}$
3	Weighted Mean	$\bar{x}_w = \frac{\sum x * w}{\sum w}$
4	Geometric Mean	G.M = $\sqrt[n]{Product\ of\ the\ n\ values} - 1$
5	Median a. **Ungrouped Data** b. **Grouped Data**	$\left(\frac{n+1}{2}\right)^{th}$ *observation in the data set* $Median = L + \left(\frac{\frac{N}{2} - C.F.}{F}\right)(i)$ L: Lower Limit of the Median class N: Total of all frequencies C.F: Cum. Freq of the class preceding to the median class F: Frequency of the median class *i* : Class Interval
6	Mode a. **Ungrouped Data** b. **Grouped Data**	Most Frequently Occurring observation in the data set $Mode = L + \left(\frac{(f_1 - f_0)}{(f_1 - f_0) + (f_1 - f_2)}\right) * (i)$ L: Lower Limit of the Modal class *i* : Class Interval

		f_1: Frequency of the Modal Class f_2: Frequency of the class after the modal class f_0: Frequency of the class before the modal class
7	Quartiles	$Q_M = L + \left(\frac{\frac{M*N}{4} - C.F.}{F}\right)(i)$ Q_M: M^{th} Quartile L: Lower Limit of the Quartile Class i : Class Interval N: Total of all frequencies C.F: Cum. Freq of the class preceding to the quartile class F: Frequency of the quartile class
8	Range	Max - Min
9	Inter-quartile Range	$Q_3 - Q_1$
10	Quartile Deviation	$\text{Quartile Deviation} = \frac{Q3 - Q1}{2}$
11	Coeff of QD	$\text{Coeff of QD} = \frac{Q3 - Q1}{Q3 + Q1}$
12	Mean Deviation	$\text{MD} = \frac{\sum\|x - \bar{x}\|}{N}$
13	Standard Deviation (S.D.)	$\sigma = \sqrt{\frac{\sum f * x^2}{\sum f} - \left(\frac{\sum f * x}{\sum f}\right)^2}$ $\sigma = \sqrt{\frac{\sum f * x^2}{\sum f} - \bar{x}^2}$
14	Variance	σ^2
15	Coefficient of Variation	$CV = \frac{\sigma}{\mu} * 100$
16	Coefficient of Skewness a. Pearson's b. Bowley's	$S_k = 3\,(\mu - M) / \sigma$ μ: Arithmetic Mean, σ: Standard Deviation M: Median $S_k = \left(\frac{Q3 + Q1 - 2 * Q2}{Q3 - Q1}\right)$
17	Addition Rule • General • Special (Mutually exclusive)	 P(A or B) = P(A) + P(B) – P(A and B) P(A or B) = P(A) + P(B)
18	Multiplication Rule • General • Special (Independent)	 P (A and B) = P (A / B) * P(B) = P(B/A) * P(A) P (A and B) = P (A) * P(B)

19	Bayes Theorem	$P(A_1 \mid B) = \dfrac{P(A_1)P(B/A_1)}{P(A_1)P(B/A_1)+P(A_2)P(B/A_2)}$
20	Expected value	$\mu = E(x) = \sum x_i * P(x_i)$
21	Variance	$\sigma^2 = V(x) = \sum (x_i - \mu)^2 * P(x_i)$
22	Binomial Distribution	$P(x = r) = {}^{n}_{r}C * p^r * q^{n-r}$ Where n: no. of trials p: probability of success q: 1-p E(X) = n*p V(X) = n*p*q
23	Poisson Distribution	$P(x = r) = \dfrac{m^r * e^{-m}}{x\,!}$ n: no. of observations r: no. of expected successes p: Probability of the success m = $n * p$ E(X) = V(X) = m
24	Sample Mean $\bar{x} \rightarrow Normal\ Distribution$	$Z = \dfrac{\bar{x} - \mu}{\left(\frac{\sigma}{\sqrt{n}}\right)}$
25	Sample proportion $\hat{p} \rightarrow Normal\ Distribution$	$Z = \dfrac{\hat{p} - p}{\left(\sqrt{\frac{p*q}{n}}\right)}$ Where $\hat{p}$: sample proportion P: Population proportion q: 1 – p n: sample size
26	Confidence Interval for Population Mean (μ)	$\left(\bar{x} - \frac{\sigma}{\sqrt{n}} * Z \quad , \quad \bar{x} + \frac{\sigma}{\sqrt{n}} * Z\right)$
27	Confidence Interval for Population Proportion (p)	$\left(p - \sqrt{\frac{p*q}{n}} * Z \quad , \quad p + \sqrt{\frac{p*q}{n}} * Z\right)$
28	Sample Size ❖ Mean ❖ Proportion	$n = \left(\frac{Z * \sigma}{E}\right)^2$ $n = p * q\left(\frac{Z}{E}\right)^2$

29	Sample Mean $\bar{x} \rightarrow Normal\ Distribution$	$Z = \frac{\bar{x} - \mu}{\left(\frac{\sigma}{\sqrt{n}}\right)}$
30	Sample proportion $\hat{p} \rightarrow Normal\ Distribution$	$Z = \frac{\hat{p} - p}{\left(\sqrt{\frac{p*q}{n}}\right)}$ Where $\hat{p}$: sample proportion P: Population proportion q: 1 – p n: sample size
31	Pearson's Correlation Coefficient	$r = \frac{\left(\frac{\sum x*y}{n} - \bar{x}\,\bar{y}\right)}{\sigma_x \sigma_y}$
32	Spearman's Rank Correlation Coefficient	$\rho = 1 - \frac{6 \sum d^2}{n(n^2 - 1)}$
33	Regression equation of • X on Y • Y on X	$(x - \bar{x}) = (r * \frac{\sigma_x}{\sigma_y})(y - \bar{y})$ $(y - \bar{y}) = (r * \frac{\sigma_y}{\sigma_x})(x - \bar{x})$
34	Chi Square	$\chi^2_{cal} = \frac{\sum (O - E)^2}{E}$