Total No. of Questions: 6 *Total No. of Printed Pages:3*

Enrollment No.....

Faculty of Management Studies

End Sem (Odd) Examination Dec-2019

MS5CO05 Business Mathematics and Statistics for Managers

Programme: MBA Branch/Specialisation: Management

Duration: 3 Hrs. **Maximum Marks: 60**

Note: All questions are compulsory. Internal choices, if any, are indicated. Answers of Q.1 (MCQs) should be written in full instead of only a, b, c or d.

Q.1 i. The value of the $\lim_{x\to 0} \frac{e^x-1}{x}$ =? **1**

(a) 1 (b) 0 (c) ∞ (d) None of these

ii. A constant function is always continuous. **1**

(a) False (b) True (c) Can't say (d) None of these

iii. The derivative of $y = e^x + 5$ with respect to x is **1**

(a) $e^x + 2x$ (b) $2e^x + x$ (c) e^x (d) None of these

iv. If $R(x)$ is the revenue function, then Average revenue is given by: **1**

(a) $\frac{d}{dx}R(x)$ (b) $\int R(x)dx$ (c) $x.R(x)$ (d) $\frac{R(x)}{x}$

v. What is the last stage in statistics? **1**

(a) Organization of data (b) Interpretation of data

(c) Analysis of data (d) Collection of data

vi. Any numerical value calculated from sample data is called _____. **1**

(a) Mean (b) Error (c) Statistic (d) Parameter

vii. For Poisson distribution, which of the following is true: **1**

(a) Mean = variance (b) Mean < variance

(c) Mean > variance (d) None of these

viii. Which of the following is *not* a correct statement about a probability? **1**

(a) It must have a value between 0 and 1

(b) It can be reported as a decimal

(c) A value near 0 means that the event is not likely to occur/happens

(d) It is the collection of several experiments.

P.T.O.

ix. Time-series is used in? **1**
(a) Sampling (b) Forecasting
(c) Probability (d) None of these

x. Seasonal variations are **1**
(a) Sudden variation (b) Short term variation
(c) Long term variation (d) None of these

Q.2 Attempt any two:

i. Define Algebraic functions, Total Cost function, Revenue function, Profit function, Break-even Point. **5**

ii. Evaluate $\lim_{x\to 0}\frac{(\sqrt{1+x}-\sqrt{1-x})}{x}$ **5**

iii. A function is defined by $f(x)=\frac{x+1}{x^2+1}$. Check whether the function is continuous at $x=1$? **5**

Q.3 Attempt any two:

i. The total cost of a firm is given by $C(x)=20+2x+0.5x^2$. **5**
Determine
(a) Marginal cost (b) Average cost
(c) Slope of Marginal Cost (d) Slope of Average cost

ii. Differentiate $e^x/(1+x)$ with respect to x **5**

iii. $\int \log x\, dx$. **5**

Q.4 Attempt any two:

i. Define statistics by Horace Secrist and explain its all characteristics. **5**

ii. Discuss in brief, the scope of Statistics in different fields. **5**

iii. Discuss any five limitations of Statistics in brief. **5**

Q.5 Attempt any two:

i. A problem in Statistics is given to three students A, B and C whose chances of solving it are 1/3,1/4 and 1/5 respectively. What is the probability that the problem will be solved? **5**

ii. Eight unbiased coins are tossed simultaneously. Find the probability that there will be **5**
(a) Exactly 4 heads (b) At most 2 heads.

iii. Write any five characteristics of Normal distribution, draw a standard normal curve and explain area under the curve. **5**

Q.6 Attempt any two:

i. Define Time Series. Explain the four components of Time Series. **5**

ii. Fit a straight line to the following data regarding x as the independent variable **5**

x	1	2	3	4	5	6
y	1200	900	600	200	110	50

iii. Construct a 4-yearly centred moving average from the following data: **5**

Years	1970	1975	1980	1985	1990	1995	2000
Imported cotton (in '000)	129	131	106	91	95	84	93

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MSE005 Business Mathematics and Statistics for managers.

Q1 MCQ

(i) (a) 1 — 1

(ii) (b) True (iii) (c) e^x — 1, 1

(iv) (a) $R(x)/x$ — 1

(v) (b) Interpretation of data — 1

(vi) (c) Statistic — 1

(vii) (a) mean = Variance — 1

(viii) (a) It is a collection of several experiments — 1

(ix) (b) Forecasting — 1

(x) (b) Short term variation — 1

Q2. (i) Algebraic function: These are the functions which are made upon power of the variable and constants connected together by the mathetical operation $(+, -, \times, \div)$ Eg if $f(x) = x^3+3x^2+4$. — 1

$g(x) = \frac{3x^2+5}{2x}$ etc

(ii) Total cost function $T(x) = F(x) + V(x)$

$F(x)$ = fixed cost $V(x)$ = Variable cost — 1

(iii) fixed cost remains constant at all levels of production it generally include rent, building insurance etc.

Variable cost varies at each level of production. It includes cost of raw material, Labour etc.

(iii) Revenue function: If R is the total Revenue collected by a company when it sells x units of a product at price p per unit; Then R is given by — 1

$R = p(x).x$

(iv) Profit function: $P(x) = R(x) - C(x)$

$R(x)$ = total Revenue received

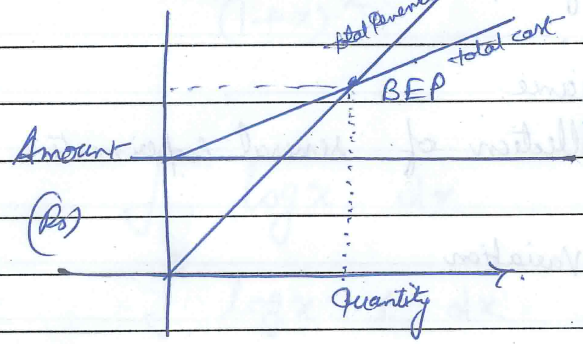
$C(x)$ = total cost in production of x units

1

(v) Break-even point: The break even point is the level of production where the revenue from the sales is equal to the cost of production and marketing. ie no loss, no gain

$C(x) = R(x)$ or $P(x) = 0$

1



(ii) Evaluate $\lim_{x \to 0} \frac{\sqrt{1+x} - \sqrt{1-x}}{x}$

Soln: $\lim_{x \to 0} \frac{\sqrt{1+x} - \sqrt{1-x}}{x} \times \frac{\sqrt{1+x} + \sqrt{1-x}}{\sqrt{1+x} + \sqrt{1-x}}$ 2

$= \lim_{x \to 0} \frac{(1+x) - (1-x)}{x(\sqrt{1+x} + \sqrt{1-x})}$ 2

$= \lim_{x \to 0} \frac{2x}{x(\sqrt{1+x} + \sqrt{1-x})} = 1$ 1

(iii) $f(x) = \frac{x+1}{x^2+1}$ at $a = 1$

$\lim_{h \to 0} f(a-h) = \lim_{h \to 0} f(a+h) = f(a)$

(Condition of Continuity)

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$$\lim_{h \to 0} f(1-h) = \lim_{h \to 0} \frac{1-h+1}{(1-h)^2+1} = \frac{2}{2} = 1$$ 2

$$\lim_{h \to 0} f(1+h) = \lim_{h \to 0} \frac{1+h+1}{(1+h)^2+1} = \frac{2}{2} = 1$$ 2

$$f(1) = \frac{1+1}{1^2+1} = \frac{2}{2} = 1$$ 1

$\therefore$ $f(x)$ is continuous at $x = 1$

Q. 3. (i) Total cost of firm $C(x) = 20 + 2x + 0.5x^2$

(a) Marginal cost $C'(x)$ $\frac{dC}{dx} = 2 + x$ $1\frac{1}{4}$

(b). Average cost $AC(x) = \frac{C(x)}{x} = \frac{20 + 2x + 0.5x^2}{x}$ $1\frac{1}{4}$

$$= \frac{20}{x} + 2 + 0.5x$$

(c) Slope of $MC(x) = \frac{d}{dx} MC(x) = 0 + 1 = 1$ $1\frac{1}{4}$

(d) Slope of Avgcost $= \frac{d}{dx} AC(x) = \frac{-20}{x^2} + 0 + 0.5$ $1\frac{1}{4}$

$$= \frac{-20}{x^2} + 0.5$$

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(ii) $\frac{d}{dx}\left[\frac{e^x}{1+x}\right] = \frac{[(1+x)e^x - e^x(1)]}{(1+x)^2}$ 2

$= \frac{(1+x)e^x - e^x}{(1+x)^2} = \frac{e^x[1+x-1]}{(1+x)^2}$ 2

$= \frac{x e^x}{(1+x)^2}$ 1

(iii) $\int \log x \, dx$

$= \int \log x \cdot 1 \, dx$

integration by parts

$\log x \int 1 \, dx - \int \frac{1}{x} \cdot x \cdot dx + c.$ 2.

$= x \log x - \int 1 \cdot dx + c$

$= x \log x - x + c.$

$= x(\log x - 1) + c$ 3.

Q4

(i) By Horace Secrist

The definition point out certain characteristics which numerically data i.e statistics must satisfy. These are as follows:-

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1) Statistics are aggregates of facts
Single and isolated figures are not Statistics for the simple reason that such figures are unrelated and can not be compared. 1

2) Statistics are affected to a marked extent by a multiplicity of causes. 1

3) Statistics are numerically expressed. All Statistics are numerical statement facts i.e expressed in numbers.

4) Statistics are enumerated or estimated according to reasonable standards of accuracy. 1

5) Statistics are collected in a systematic manner. Suitable plan should be made for data collection.

6) Statistics are collected for a predetermined purpose. The purpose of data collection must be decided in advance should be specific and well defined. 1

7) Statistics should be placed in relation of each other. If numerical facts are to be called, they should be comparable. they are often compared regionwise or periodwise 1

(ii) Scope of Statistics in various fields.

1) Planning and decision making:
production, Consumption, prices, investment. 1

2) Business and Management:

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orgnisation, production, Scientific management, 1
business forecasting, purchase, Budgeting etc.
3) Sales and Marketing research. 1
economics, price expansion., research etc
4) Medical and Natural Sciences 1
impact of new medicine for a particular disease.
5) physical Science, Social science, Education. 1
6) Accountancy, Astronomy., Psychology

(iii) Limitations (Any five)
1) Statistics are not suitable in study of qualitative phenomenon such as beauty, honesty these deals with only numerical facts. +5 for any five
2) Statistics does not study individual. Statistics is the science of collecting, analysis and interpreting data and gives no importance to individuals.
3) Statistics results are true only on average. does not give unique result. & for each one
4) Statistics laws are not so perfect as laws of physics and chemistry.
5) Statistics is collected with a given purpose and so it can not be indiscriminately applied to any situation.
6) Statistics results are approximate (not accurate)
7) Only Experienced Statisticians Alone can make use of Statistical methods.
These are like clay, out of which you make a god or a Devil mean it is dangerous tool in the hands of inexpert.

Q5 (i) $P(\bar{A}) = \frac{1}{3}$ $P(\bar{B}) = \frac{1}{4}$ $P(\bar{C}) = \frac{1}{5}$ +1

↑ probability of solving problem by A, B, C are given

The problem will be solved if any one of them solve it

ie $P(A \cup B \cup C) = P(\bar{A}) + P(\bar{B}) + P(\bar{C}) - P(A \cap B) - P(A \cap C) - P(B \cap C) + P(A \cap B \cap C)$ +2

OR

$P(A \cup B \cup C) = 1 - P(\overline{A \cup B \cup C})$

$= 1 - P(\bar{A}) \cdot P(\bar{B}) \cdot P(\bar{C})$

$= 1 - \frac{2}{3} \times \frac{3}{4} \times \frac{4}{5}$

$= 1 - \frac{2}{5} = \frac{3}{5}$ +2

$P(\bar{A}) = 1 - \frac{1}{3} = \frac{2}{3}$

$P(\bar{B}) = 1 - \frac{1}{4} = \frac{3}{4}$

$P(\bar{C}) = 1 - \frac{1}{5} = \frac{4}{5}$

(ii) $n = 8$.

Binomial distribution.

$P(x) = {}^{n}C_{x}\, p^{x} q^{n-x}$ +1.

getting head is success.

$p = \frac{1}{2}$ $q = 1 - \frac{1}{2} = \frac{1}{2}$

(a)

$P(x=4) = {}^{8}C_{4} \left(\frac{1}{2}\right)^{4} \left(\frac{1}{2}\right)^{8-4}$

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$${}^8C_4 \left(\frac{1}{2}\right)^4 \left(\frac{1}{2}\right)^{8-4}$$

$$= {}^8C_4 \left(\frac{1}{2}\right)^4 \left(\frac{1}{2}\right)^4$$

$$= \frac{8.7.6.5}{4.3.2.1} \cdot \frac{1}{2^3} \cdot \frac{1}{2^5} \qquad +2$$

$$= \frac{35}{2^7} = \frac{35}{128} = 0.27343$$

(b) at most 2 heads. $P(x \leq 2)$

$$P(x=0) + P(x=1) + P(x=2)$$

$$= {}^8C_0 \left(\frac{1}{2}\right)^0 \left(\frac{1}{2}\right)^{8-0} + {}^8C_1 \left(\frac{1}{2}\right)^1 \left(\frac{1}{2}\right)^{8-1} + {}^8C_2 \left(\frac{1}{2}\right)^2 \left(\frac{1}{2}\right)^{8-2}$$

$$= 1 \times \frac{1}{2^8} + 8 \frac{1}{2^8} + \frac{8.7}{2.1} \left(\frac{1}{2^8}\right) \qquad +2$$

$$= \frac{1}{2^8}(1+8+28) = \frac{37}{256} = 0.1445$$

Q5 (iii) Normal distribution

Characteristics of Normal Dist^n.

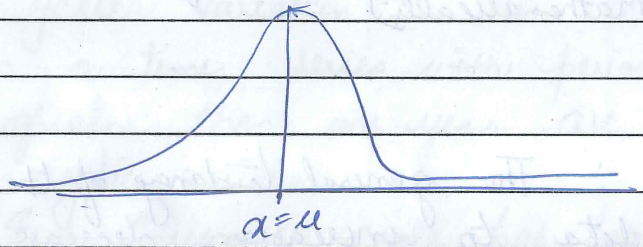
(1) $\int_{-\infty}^{\infty} f(x)\,dx = 1$

(2) $f(x) \geq 0$

(3) The mean, median & mode of the distⁿ coincide.

(4) Since $f(x)$ being the probability can never be negative, no portion of the curve lies below the x-axis +3

(5)



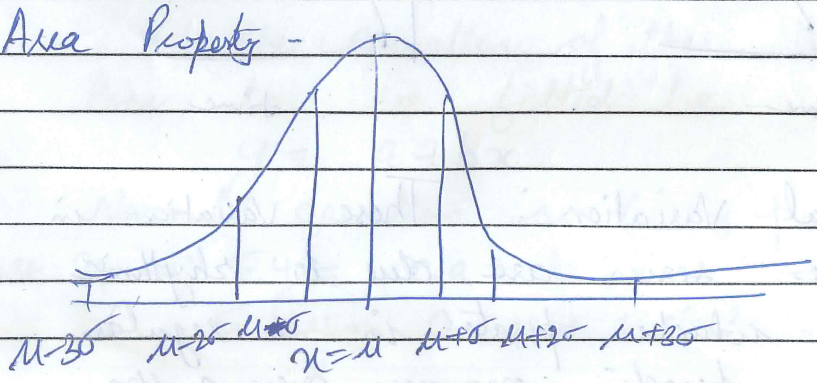
The curve is bell shaped and symmetrical about the line $x = \mu$ +2 1

(6) x-axis is an asymptote to the curve

(7) The points of inflexion are $x = \mu \pm \sigma$

(8) mean (μ) and Variance (σ^2) are the parameters of the distribution.

(9) Area Property - +1



Area under curve

2.

$P[\mu-\sigma < x < \mu+\sigma] = 0.6826$ 68%

$P[\mu-2\sigma < x < \mu+2\sigma] = 0.9544$ 95%

$P[\mu-3\sigma < x < \mu+3\sigma] = 0.9973$ 99%

Q6. (i) Time series

The time series is an arrangement of statistical data in a chronological order. i.e. in accordance with its time of occurrence 1

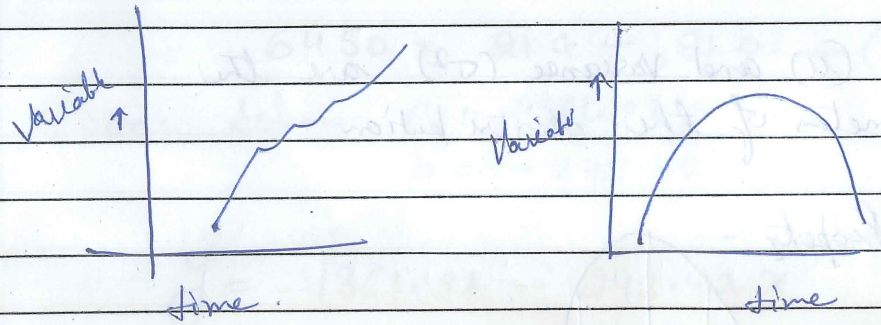
$y = f(t)$ (Mathematically)

Components

1) Secular trend : The general tendancy of the time series data to increase, decrease, or stagnate during long period of time is called secular or simple trend. There are also called long term trend. two type. ½ 1

↙ ↘

Linear Non-linear



2) Seasonal Variation : These variations in a time series are due to rhythmic forces which operate in a regular and periodic manner over a span. ½ 1

less than one year. They may be attributed to the following two causes.

(a) resulting from natural forces.
eg demand of fans goes up in Summer.
demand of rain coat, umberella goes up in the Rainy season.

(b) resulting from man made conventions:
- due to habits, fashion, customs.
Eg. Deepawali, marriage, Christmas etc.

3) Cyclic Variation: The oscillatory movements in a time series with period of oscillation greater than one year are termed as cyclic Variation. 1
Eg. Business cycle has four phases.
boom, recession, depression, recovery.

4) Random or irregular Variation
These fluctuations are purely random are beyond the human Control. 1
Eg. flood, Earthquake, wars.

Q6 (ii) Fitting of straight line:

Let the equation of the straight line to be fitted be

$$y = a + bx$$

Normal equations are (using principle of least square) $\Sigma y = na + b\Sigma x$ — (1)

$$\Sigma xy = a\Sigma x + b\Sigma x^2 \quad \text{— (2)}$$

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x	y	xy	x^2
1	1200	1200	1
2	900	1800	4
3	600	1800	9
4	200	800	16
5	110	550	25
6	50	300	36
$\Sigma x = 21$	$\Sigma y = 3060$	$\Sigma xy = 6450$	$\Sigma x^2 = 91$

+3

normal eqn.

$$\Sigma y = na + b\Sigma x$$

+1

$$3060 = 6a + 21b. \quad \text{—(1)}$$

$$\Sigma xy = a\Sigma x + b\Sigma x^2$$

$$6450 = 21a + 91b. \quad \text{—(2)}$$

on solving $a = 1361.97$

$b = -243.42$

+1

$$y = 1361.97 - 243.42x$$

(iii) Construct 4-yearly centred moving average.

Year	Imported Cotton in ('000)	4-yearly moving average	Centred moving average	
1970	129			
1975	131	$\frac{457}{4} = 114.25$		
				$+3\frac{1}{2}$ upto 3rd colm.
1980	106		110	
		$\frac{423}{4} = 105.75$		
1985	91		99.875	
		$\frac{376}{4} = 94$		
1990	95		92.375	
		$\frac{363}{4} = 90.75$		
1995	84			$+1\frac{1}{2}$ last colm.
2000	93			

[$(129+131+106+91)/4 = \frac{457}{4} = 114.25$

$(131+106+91+95)/4 = \frac{423}{4} = 105.75$

and so on.].

End of the solution.