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

Enrollment No.....

Faculty of Management

End Sem (Odd) Examination Dec-2017

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 function $f(x) = 5x^2$ *is called* **1**

(a) Odd (b) Exponential (c) Quadratic (d) None of these

ii. $\lim_{x\to\infty} \frac{2x^2 + 3x}{3x^2 + 3x}$ is equal to **1**

(a) $\frac{2}{3}$ (b) 0 (c) 1 (d) ∞

iii. $\int 2x\, dx$ is equal to **1**

(a) x^{-2}+ c (b) x^2 + c (c) 2 (d) 1

iv. The derivative of $\sin x$ is **1**

(a) $\cos x$ (b) $\cot x$ (c) $\sec x$ (d) None of these

v. Number of trucks produced by a manufacturer is a case of **1**

(a) Continuous variable (b) Discrete variable

(c) Random variable (d) None of these

vi. Statistics results are **1**

(a) Absolutely correct (b) Not true

(c) True on average (d) None of these

vii The probability of the intersection of two mutually exclusive events is always **1**

(a) Infinity (b) Zero (c) One (d) None of these

vii Probability of rainfall in July is **1**

(a) More than 1 (b) Between 0 and 1

(c) More than 2 (d) All of these

P.T.O.

ix. Trend in a time series means **1**
(a) Long-term regular variation (b) Short-term regular variation
(c) Both (a) and (b) (d) Neither a nor b

x. Irregular variation in a time series are caused by **1**
(a) Lockouts and strikes (b) Floods
(c) Epidemics (d) All of these

Q.2 i. Define limit of a function and hence evaluate $\lim_{x\to a}\frac{x^2-a^2}{x-a}$. **3**

ii. A shoe manufacturer is planning production of new varieties of shoes for the first year the fixed costs for setting up the new production line are Rs. 1.25 lakhs. Variable cost for producing each pair of shoes is Rs. 35. The sales department project that 1500 pairs can be sold in the first year at the rate of Rs 160 a pair. **7**
(a) Determine the profit function for the profit from the sales of a pairs of shoes.
(b) If 1500 pairs are actually sold, what profit or loss the company would incur.
(c) Determine the Break Even Point.

OR iii. Test the continuity of the function **7**

$$f(x)=\begin{cases} x^2, & 0<x<1 \\ x, & 1<x<2 \\ -6+x^3, & 2\le x<3 \end{cases} \quad \text{at} \quad x=2$$

Q.3 i. $If\ y=e^x\ logx, find\ \frac{dy}{dx}$. **3**

ii. The price p per unit at which a company can sell all that it produces is given by function p(x) = 300 - 4x. The cost function is C(x) = 500 + 28x, where x is the number of unit produced. Find x so that the profit is maximum and find maximum profit. **7**

OR iii. Evaluate (a) $\int x^2e^x dx$ (b) $\int 4x+x^3\ dx$ **7**

Q.4 i. Differentiate between population and sample? **3**

ii. Discuss any three functions and four limitations of statistics? **7**

OR iii. Define statistics. Discuss scope of statistics in managerial decision making? **7**

Q.5 i. Define following terms with example in Probability: Trial and Event, Mutually exclusive events, Independent events. **3**

ii. Define Poisson distribution and indicate its main characteristics. The average number of customers, who appear at a counter of a certain bank per minute, is two. Find the probability that during a given minute **7**
(a) No customer appears
(b) Three or more customers appear. [Given $e^{-2}=0.1353$]

OR iii. A husband and wife appear in an interview for two vacancies in the same post. The probability of husband's selection is 1/7 and that of wife's selection is 1/5. What is the probability that **7**
(a) Both of them will be selected
(b) Only one of them will be selected
(c) None of them will be selected.

Q.6 i. What is time series? What do you understand by Secular trend and Seasonal variation? **3**

ii. Find the trend values from the following data using 3-yearly and 4-yearly moving averages: **7**

Years	96	97	98	99	2000	01	02	03	04
Sales	50	53	57	54	51	60	65	73	70

OR iii. Fit a trend line to the following data by the least square method : **7**

Years :	2002	2004	2006	2008	2010
Production :	18	21	23	27	16

Specify the year of origin. Estimate trend for year 2009 and 2011.

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END SEM (ODD) EXAMINATION DEC-2017

COURSE CODE:- MS5C005

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ANSWER-1

(i)	c) quadratic	+1
(ii)	a) $\frac{2}{3}$	+1
(iii)	b) x^2+C	+1
(iv)	a) $\cos x$	+1
(v)	b) discrete variable	+1
(vi)	c) True on average	+1
(vii)	b) Zero	+1
(viii)	b) between 0 and 1	+1
(ix)	a) long-term regular variation	+1
(x)	d) All of these	+1

ANSWER-2

2(i) <u>limit</u>:- If $f(x)$ be the function of x which is undefined at $x=a$ built approaches to a definite value, say, P if x approaches to a from left or right then P is called limit of function $f(x)$ at $x=a$. +1

$$\lim_{x \to a} f(x) = P$$

$$\lim_{x \to a} \frac{x^2 - a^2}{x - a} = \lim_{x \to a} \frac{x^2 - a^2}{x - a}$$

apply $\lim_{x \to a} \frac{x^n - a^n}{x - a} = n a^{n-1}$ +2

$$= 2a^{2-1}$$

$$\lim_{x \to a} \frac{x^2 - a^2}{x - a} = 2a \quad \text{Ans}$$

Q.2(ii) Let company sells x pair of shoes

Fixed cost, $F = 125000$

Variable cost, $V(x) = .35x$

first, Total cost, $C(x) = V(x) + F$

$$\boxed{C(x) = 35x + 1,25,000}$$ +1

Revenue cost :-

$$R(x) = 160x$$

(a) Profit function :-

$$\text{Profit} = R(x) - C(x)$$

$$\text{profit} = 125x - 125000 \quad (1)$$ Ans +2

(b) Put $x = 1500$ in eqn (1)

$$\text{Profit}(1500) = 125(1500) - 125000$$

$$\text{Profit}(1500) = 62,500/-$$ Ans +2

(c) Break-Even point

At B.E.P.

Revenue = cost

$$160x = 35x + 1,25,000$$

$$125x = 125000$$

$x = 1000$ pair of shoes Ans +2

Q.2(iii)

$$f(x) = \begin{cases} x^2 & 0 < x < 1 \\ x & 1 < x < 2 \\ -6 + x^3, & 2 \le x < 3 \end{cases} \quad \text{at } x = 2$$

Value of function at $x = 2$

$$f(x) = -6 + x^3$$

$$\boxed{f(2) = -6 + 2^3 = 2} \quad -(1)$$ +2

LHL at $x = 2$

Here $x \to 2$ from LHS so $x < 2$

$\therefore f(x) = x$

$$\lim_{x \to 2} f(x) = \lim_{x \to 2} x$$

Put $x = 2 - h$ and take limit $h \to 0$

$$\lim_{h \to 0} f(2-h) = \lim_{h \to 0} 2 - h$$

$$\boxed{\lim_{h \to 0} f(2-h) = 2} \quad -(2)$$ +2.5

R.HL at $x = 2$

Here $x \to 2$ from RHS so $x > 2$

$\therefore f(x) = -6 + x^3$

$$\lim_{x \to 2} f(x) = \lim_{x \to 2} (-6 + x^3)$$

Put $x = 2 + h$ and take limit $h \to 0$

$$\lim_{h \to 0} f(2+h) = \lim_{h \to 0} -6 + (2+h)^3$$

$$= \lim_{h \to 0} -6 + (2+h)^3$$

$$= -6 + 2^3$$

$$\boxed{\lim_{h \to 0} f(2+h) = 2} \quad -(3)$$

from (1), (2) and (3), we get

Value of function = LHL = RHL = 2. +2.5

So function is continuous at $x = 2$.

Q.3 (i) $y = e^x \log x$

$$\frac{dy}{dx} = e^x \frac{d}{dx}(\log x) + \log x \frac{d}{dx} e^x \quad +1$$

$$= e^x \cdot \frac{1}{x} + (\log x)\, e^x \quad +1$$

$$\frac{dy}{dx} = e^x \left(\frac{1}{x} + \log x\right) \quad \text{Ans} \quad +1$$

Q.3 (ii) Given, cost function, $C(x) = 500 + 28x$

$\because$ Revenue = (price) × (quantity)

$= (300 - 4x) \times x$

$$\boxed{\text{Revenue, } R(x) = 300x - 4x^2} \quad +1$$

Now, profit = Revenue − cost

$= (300x - 4x^2) - (500 + 28x)$

$= 300x - 4x^2 - 500 - 28x$

$$\boxed{\text{profit} = 272x - 4x^2 - 500} \quad -(1) \quad +2$$

Differentiate eqn (1) w.r.t. x twice

$$\frac{d}{dx}(\text{Profit}) = \frac{d}{dx}(272x - 4x^2 - 500)$$

$$\frac{d}{dx}(\text{Profit}) = 272 - 8x \quad -(2) \quad +1$$

Again.

$$\frac{d^2}{dx^2}(\text{Profit}) = -8 \quad -(3) \quad +1$$

from (2), $\frac{d}{dx}(\text{Profit}) = 0$

$\therefore \quad 272 - 8x = 0$

$8x = 272$

$\boxed{x = 34}$ $+1$

Put $x = 34$ in eqn (3)

$\therefore \frac{d^2}{dx^2}(\text{Profit}) = -8 = -\text{ve}$. So profit is

For maximum profit, put $x = 34$ in (1)

$$\text{Profit} = 272x - 4x^2 - 500$$
$$= 272(34) - 4(34)^2 - 500$$
$$= 9248 - 4624 - 500$$

max. profit = 4124 Ans +1

Q3(iii) (a) $\int x^2 e^x \, dx$

$$I = \int \underset{I}{x^2} \underset{II}{e^x} \, dx$$

$$I = x^2 \int e^x \, dx - \int \left(\frac{d}{dx} x^2 \int e^x \, dx \right) + C \quad +1$$

$$I = x^2 e^x - \int \underset{I}{2x} \underset{II}{e^x} \, dx + C$$

$$I = x^2 e^x - \left[2x \int e^x dx - \int \left(\frac{d}{dx}(2x) \int e^x dx \right) dx \right] + C \quad +1.5$$

$$I = x^2 e^x - [2x e^x - \int 2 e^x \, dx] + C$$

$$I = x^2 e^x - 2x e^x + 2e^x + C \quad +1.5$$

Ans

(b) $\int 4x + x^3 \, dx = \frac{4x^2}{2} + \frac{x^4}{4} + C = 2x^2 + \frac{x^4}{4} + C$ +3

Q4 (i) Population and sample → write minimum Three difference [Each difference is of 1 mark] 1+1 +1

(ii) Three function of statistics → Each of 1 mark
Four limitations of statistics → Each of 1 mark

or (iii) Definition of Statistics → 2 marks
Scope of statistics → Atleast five scope – Each of 1 mark

Q5 (i) Trial and Event → 1 mark
Mutually Exclusive Event → 1 mark
Independent Event → 1 mark

Q.5(ii) **Poisson Distribution:-**

A random variable X is said to follow a poisson Distribution if it assumes only non-negative values and its probability mass function is given by

$$P(X=x) = \begin{cases} \frac{e^{-m} m^x}{x!} & ; x = 0,1,2,\ldots ; m>0 \\ 0 & ; \text{otherwise.} \end{cases}$$ +2

Characteristic:-

1. The no. of trial i.e. n should be very large.
2. The probability of success i.e. P is very large.
3. The trials are independent of eachother. +2
4. The variable is discrete.
5. If $\bar{x}$ mean $= m$, variance $= m$, S.D. $= \sqrt{m}$.

Here $m = 2$, so that the Poisson distribution is

$$P(X=x) = \frac{e^{-2} 2^x}{x!} ; x = 0,1,2,\ldots$$ +1

(i) $P(X=0)$ = no. customer $= \frac{e^{-2} 2^0}{0!} = e^{-2} = 0.1353$ Ans +1

(ii) $P(X = 3 \text{ or more}) = 1 - [P(X=0) + P(X=1) + P(X=2)]$

$= 1 - [e^{-2} + 2e^{-2} + 2e^{-2}]$

$= 1 - 5e^{-2}$

$= 1 - 5(0.1353)$

$= 1 - 0.6765$

$P(X = 3 \text{ or more}) = 0.3235$ Ans +1

Q.5 (iii) Given

$P(A)$ = probability of Husband selection $= \frac{1}{7}$

$P(B)$ = probability of wife selection $= \frac{1}{5}$ +1

(a) prob. that both of them will be selected

$P(A \cap B) = P(A) \cdot P(B)$

$P(A \cap B) = \frac{1}{7} \times \frac{1}{5} = \frac{1}{35}$ Ans +2

(b) prob. that only one of them will be selected.

$P(\bar{A} \cap B) \cup P(A \cap \bar{B}) = P(\bar{A}) \times P(B) + P(A) \cdot P(\bar{B})$

$= \frac{6}{7} \times \frac{1}{5} + \frac{1}{7} \times \frac{4}{5}$ +1

$P(\bar{A} \cap B) \cup P(A \cap \bar{B}) = \frac{6}{35} + \frac{4}{35} = \frac{10}{35}$ Ans

(c) prob. that none of them will be selected.

$P(\bar{A} \cap \bar{B}) = P(\bar{A}) \times P(\bar{B})$

$= [1 - P(A)] \times [1 - P(B)]$

$= \left(1 - \frac{1}{7}\right) \times \left(1 - \frac{1}{5}\right)$ +3

$= \frac{6}{7} \times \frac{4}{5} = \frac{24}{35}$ Ans

6(i) Define Time-series → 1 mark

Secular Trend → 1 mark

Seasonal Trend → 1 mark

2.6 (ii)

3 Yearly moving Average

Year	Sales	Three year moving total (T)	Three-Yearly moving Average
96	50	–	
97	53	160	53.33
98	57	164	54.66
99	54	162	54
2000	51	165	55
01	60	176	58.66
02	65	198	66
03	73	208	69.33
04	70	–	

+3.5

4-Yearly moving Average

Year	Sales	4-Yearly moving Total (T)	4-Yearly moving Average (A)	4-Yearly moving Average centered (C)
96	50			
97	53	214	53.5	$\frac{53.5+53.75}{2}$ = 53.625
98	57	215	53.75	54.625
99	54	222	55.5	56.5
2000	51	230	57.5	59.875
01	60	249	62.25	64.625
02	65	268	67	
03	73	–		
04	70	–		

+3.5

Q.6

(iii) Let equation of Trend line is

$$Y = a + bX \quad \text{—(1)}$$

Normal Equation

$$\Sigma Y = na + b\Sigma X \quad \text{—(2)}$$

$$\Sigma XY = a\Sigma X + b\Sigma X^2 \quad \text{—(3)}$$

Year	Production (Y)	X = Year − middle Year X = Year − 2006	XY	X^2
2002	18	−4	−72	16
2004	21	−2	−42	4
2006	23	0	0	0
2008	27	2	54	4
2010	16	4	64	16
	$\Sigma Y = 105$	$\Sigma X = 0$	$\Sigma XY = 4$	$\Sigma X^2 = 40$

+2

Here we shift origin to middle Year i.e. 2006 because n = no. of years = 5 (odd)

Put value of table in eqn (2) and (3)

$$\therefore 105 = 5a + 0$$

$$5a = 105$$

$$\boxed{a = 21}$$ +1

and $$4 = 0 + 40b$$

$$\boxed{b = \frac{4}{40} = 0.1}$$ +1

Put a and b in eqn (1)

$$\boxed{Y = 21 + 0.1X} \quad \text{—(4)}$$ which is trend line eqn. +1

for estimation

X = Year − 2006

Year = 2009

X = 2009 − 2006 = 3

Put X = 3 in (4)

$Y_{2009} = 21 + 0.1(3)$

$Y_{2009} = 21.3$ Ans

X = Year − 2006

Year = 2011

X = 2011 − 2006 = 5

put X = 5 in (4)

$Y_{2011} = 21 + 0.1(5)$

$Y_{2011} = 21.5$ Ans

+2

Graph