

# FOUNDATION COURSE EXAMINATION

(SYLLABUS 2008)

## SUGGESTED ANSWERS TO QUESTIONS

DECEMBER 2012

### Paper- 4 : BUSINESS MATHEMATICS AND STATISTICS FUNDAMENTALS

Time Allowed : 3 Hours

Full Marks : 100

*The figures in the margin on the right side indicate full marks.*

#### SECTION - I (Arithmetic—10 marks)

Q. 1. Answer *any two* of the following :

[3×2]

Choose the correct option showing the proper reasons/calculations.

- (a) The average of 4 numbers is 13. If one number is excluded the average becomes 15. The excluded number is  
(i) 5,                      (ii) 6,                      (iii) 7,                      (iv) none of these
- (b) The compound ratio of  $x : 2$ ,  $2 : 3$ , and  $3 : y$  is  
(i)  $y : x$ ,                      (ii)  $x : y$ ,                      (iii)  $2 : 5$ ,                      (iv) none of these
- (c) A sum ₹ 1,200 amounts to ₹ 1,536 in 2 years at simple interest. The rate of interest per annum is  
(i) 14%,                      (ii) 12%,                      (iii) 11%,                      (iv) none of these

**Answer 1.**

(a) (iii)

$$\text{Excluded number} = (4 \times 13) - (3 \times 15) = 7$$

(b) (ii)

$$\text{The compound ratio } x \times 2 \times 3 : 2 \times 3 \times y = x : y$$

(c) (i)

$$\frac{1200 \times R \times 2}{100} = 1536 - 1200$$

$$24R = 336$$

$$R = 14$$

$$\therefore R = \text{Rate of Interest} = 14\%$$

**Q. 2. Answer any one of the following :** [4×1]

- (a) The True Discount (TD) on Bill due  $2\frac{1}{2}$  years hence at 4% p.a. is ₹ 115. Find the Bill Value (BV).  
 (b) A number is added to each of the numbers 7, 15, 21 and 37 so that the resulting numbers are in proportion. Find the number added.

**Answer 2. (a)**

We know,

$$TD = \frac{BV \times ni}{1 + ni}$$

Where, TD = True Discoun, BV = Bill value  
 n = No. of years & i = % of the Discount Bill value

$$\text{or, } 115 = \frac{BV \times \frac{5}{2} \times 0.04}{1 + \frac{5}{2} \times 0.04}$$

$$\text{or, } BV = ₹ 1,265$$

∴ The, Bill value is ₹ 1,265

**Answer 2. (b)**

Let the number to be added be x.

$$\frac{7+x}{15+x} = \frac{21+x}{37+x}$$

$$\text{or, } (21+x)(15+x) = (37+x)(7+x)$$

$$\text{or, } 315 + 21x + 15x + x^2 = 259 + 37x + 7x + x^2$$

$$\text{or, } 36x + x^2 - 44x - x^2 = 259 - 315$$

$$\text{or, } -8x = -56$$

$$\text{or, } x = 7$$

∴ 7 will be added each of the numbers.

### SECTION - II (Algebra—15 marks)

**Q. 3. Answer any three of the following :** [3×3]

**Choose the correct option showing the proper reasons/calculations.**

- (a) If  ${}^{18}C_r = {}^{18}C_{r+2}$ , then the value of  $rC_5$  is  
 (i) 40, (ii) 56, (iii) 28, (iv) none of these

- (b) If  $8^p = 32^q$ , then the value of  $\frac{p+q}{p-q}$  is  
 (i) 4, (ii) 8, (iii) 2, (iv) none of these

- (c) If  $x\sqrt{2} = 1 + \sqrt{-1}$ , then the value of  $x^6 + x^4 + x^2 + 2$  is  
 (i) 1, (ii) -1, (iii) 2, (iv) none of these
- (d) If  $A$  be a non-empty set and  $\phi$  be the null set, then the number of subsets of the set  $A \cap \phi$  is  
 (i) 0, (ii) 2, (iii) 1, (iv) none of these
- (e) Given  $A = B + C$ , when  $B \propto x^2$  and  $C \propto x^3$ . If  $A = 0$  when  $x = 1$  and  $A = 2$  when  $x = -1$ , then  $A$  in terms of  $x$  is  
 (i)  $2x^2 - x^3$ , (ii)  $x^2 - 2x^3$ , (iii)  $x^2 - x^3$ , (iv) none of these

**Answer 3. (a)** (ii)

$${}^{18}C_5 = {}^{18}C_r \Rightarrow r + (r + 2) = 18 \Rightarrow r = 8$$

$$\therefore {}^r C_5 = {}^8 C_5 = 56.$$

**Answer 3. (b)** (i)

$$2^{3p} = 2^{5q} \Rightarrow \frac{p}{q} = \frac{5}{3} \Rightarrow \frac{p+q}{p-q} = \frac{\frac{p}{q} + \frac{q}{q}}{\frac{p}{q} - \frac{q}{q}} = \frac{\frac{5}{3} + 1}{\frac{5}{3} - 1} = 4$$

**Answer 3. (c)** (i)

$$x\sqrt{2} = 1 + i \Rightarrow x^2 = (1+i)^2 / 2 = i \quad [\because \sqrt{-1} = i]$$

$$\therefore x^6 + x^4 + x^2 + 2 = -i - 1 + i + 2 = 1$$

**Answer 3. (d)** (iii)

$A \cap \phi = \phi$ . So  $\phi$  is the subset of itself as set itself is a subset of the set.

Hence the number of subsets is 1.

**Answer 3. (e)** (iii)

$$A = B + C = K_1 x^2 + K_2 x^3 \quad [\text{assuming } B = K_1 x^2 \text{ \& } C = K_2 x^3]$$

$$A = 0, x = 1 \Rightarrow K_1 + K_2 = 0 \text{ and } A = 2, x = -1 \Rightarrow K_1 - K_2 = 2$$

Hence, solving the above two  $K_1 = 1$  and  $K_2 = -1$ ,

$$\text{So } A = B + C = A = x^2 - x^3.$$

**Q. 4. Answer any two of the following :**

[3×2]

- (a) If  $\log_2 x + \log_4 x + \log_{16} x = \frac{21}{4}$ , find the value of  $x$ .

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- (b) When two statements  $s$  and  $t$  are said to be biconditional? Construct a truth-table for biconditional statements.
- (c) In how many ways can 6 boys and 4 girls be arranged in a row so that no two girls sit together?

**Answer 4. (a)**

$$\log_2 x + \log_4 x + \log_{16} x = \frac{21}{4}$$

$$\Rightarrow \log_2 x \left( 1 + \frac{1}{2} + \frac{1}{4} \right) = \frac{21}{4}$$

$$\Rightarrow \log_2 x = 3 \Rightarrow x = 8$$

**Answer 4. (b)**

If  $s \Rightarrow t$  and  $t \Rightarrow s$ , then the statements are bi-conditional statements, is denoted by  $s \Leftrightarrow t$ .

s	t	$s \Leftrightarrow t$
T	T	T
T	F	F
F	T	F
F	F	T

**Answer 4. (c)**

$$\begin{aligned} \text{Total no. of arrangements} &= 6! \times {}^7P_4 \\ &= 6,04,800 \end{aligned}$$

**SECTION - III (Mensuration—15 marks)**

**Q. 5. Answer any three of the following :**

[3×3]

**Choose the correct option showing necessary reasons/calculations.**

- (a) The sides of a triangle are in the proportion of 3 : 4 : 5. The perimeter is 36 cm. The area of the triangle is  
 (i) 42 sq cm, (ii) 54 sq cm, (iii) 48 sq cm, (iv) none of these.
- (b) A road which is 7 meters wide surrounds a circular park whose circumference is 352 meters. The area of the road is  $\left( \pi = \frac{22}{7} \right)$   
 (i) 2618 sq cm, (ii) 2628 sq cm, (iii) 2648 sq cm, (iv) none of these.
- (c) The side of the base and height of a right square pyramid are 4 cm and 6 cm respectively. The ratio of base area to volume is  
 (i) 2 : 1, (ii) 1 : 2, (iii) 1 : 3, (iv) none of these.

(d) The radius and height of a cylindrical pipe are 7 cm and 77 cm respectively. The total surface

area is  $\left(\pi = \frac{22}{7}\right)$

(i) 3542 sq cm, (ii) 3545 sq cm, (iii) 3554 sq cm, (iv) none of these.

(e) The diameter of the base of a conical tank is 28 m and its height is 18 m. The amount of water the

tank can hold is  $\left(\pi = \frac{22}{7}\right)$

(i) 3696 cu m, (ii) 3968 cu m, (iii) 3869 cu m, (iv) none of these.

**Answer 5. (a) — (ii)**

Let us the sides are 3x cm, 4x cm and 5x cm = per meter = 3x + 4x + 5x = 36 cm

$$\Rightarrow x = 3$$

∴ Three sides are a = 9 cm, b = 12 cm and c = 15 cm

$$s = \frac{1}{2} \times 36 = 18 \text{ cm}$$

$$\text{Area} = \sqrt{s(s-a)(s-b)(s-c)} = 54 \text{ sq. cm.}$$

**Answer 5. (b) — (i)**

Circumference =  $2\pi r = 352 \Rightarrow r = 56 \text{ m}$  ∴ Radius of inner circle = 56 m.

Radius of outer circle  $R = r + 7 = 63 \text{ m}$

Area of the road =  $\pi(R^2 - r^2) = 2618 \text{ sq. m}$

**Answer 5. (c) — (ii)**

Base area = 16 sq. cm. Volume =  $\frac{1}{3} \times 16 \times 6 = 32 \text{ C.C}$

Required ratio =  $\frac{16}{32} = \frac{1}{2} = 1 : 2$

**Answer 5. (d) — (iv)**

Total surface area =  $2\pi r(h+r) = 2 \times \frac{22}{7} \times 7(77+7) = 3696 \text{ sq. cm}$

**Answer 5. (e) — (i)**

Reqd. amount of water =  $\frac{1}{3} \pi r^2 h = \frac{1}{3} \times \frac{22}{7} \times (14)^2 \times 18$   
= 3696 cu m.

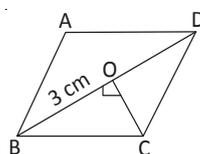
**Q. 6. Answer any two of the following :**

[3×2]

- (a) The perimeter of a rhombus is 36 cm and one of its diagonals is 6 cm. Find its area.  
 (b) The radius of a circle is 3 m. What is the circumference of another circle, whose area is 49 times that of the first?  $\left(\pi = \frac{22}{7}\right)$   
 (c) The volume of two spheres are in the ratio 64 : 27 and sum of their radii is 21 cm. Find the radius of each sphere.

**Answer 6. (a)**

For a Rhombus diagonals bisect each other at right angles.



$$OC = \sqrt{9^2 - 3^2} = 6\sqrt{2} \text{ cm}$$

$$AC = 2 \times 6\sqrt{2} = 12\sqrt{2} \text{ cm}$$

$$\begin{aligned} \text{Area} &= \frac{1}{2} \times \text{Product of two diagonals} = \frac{1}{2} \times 6 \times 12\sqrt{2} \\ &= 36\sqrt{2} \text{ sq. cm} \end{aligned}$$

**Answer 6. (b)**

The radius of the second circle = r

$$\therefore \pi r^2 = 49 \cdot \pi (3)^2 \Rightarrow r = 21 \text{ m}$$

$$\text{Circumference of second circle} = 2\pi r = 132 \text{ m}$$

**Answer 6. (c)**

Let the two radii be  $r_1$  and  $r_2$

$$\therefore \frac{\frac{4}{3}\pi r_1^3}{\frac{4}{3}\pi r_2^3} = \frac{64}{27} \Rightarrow r_2 = \frac{3}{4}r_1 \dots (1)$$

$$\text{Again } r_1 + r_2 = 21 \dots (2)$$

Solving (1) and (2) we get  $r_1 = 12 \text{ cm}$  and  $r_2 = 9 \text{ cm}$ .

#### SECTION - IV (Co-ordinate Geometry—10 marks)

**Q. 7. Answer any two of the following :**

[3×2]

**Choose the correct option showing proper reasons/calculations.**

- (a) A line passing through the points (x, 2) and (4, 1) is perpendicular to another line with slope  $\frac{1}{2}$ .  
 The value of x is  
 (i) 3.5                      (ii) 3                      (iii) 7                      (iv) none of these.
- (b) A circle with centre (2, 2) touches both the coordinate axes. The length of its diameter is  
 (i) 2                      (ii) 4                      (iii) 6                      (iv) none of these

(c) The eccentricity of the ellipse whose major axis is twice of its minor axis is

- (i)  $\frac{2}{\sqrt{3}}$       (ii)  $\frac{1}{\sqrt{3}}$       (iii)  $\frac{\sqrt{3}}{2}$       (iv) none of these.

(d) The equation of the parabola having vertex (0, 0) and directrix  $y = 2$  is

- (i)  $y^2 = 4x$       (ii)  $y^2 = x$       (iii)  $x^2 = 4y$       (iv) none of these.

**Answer 7. (a) — (i)**

$$\frac{y_1 - y_2}{x_1 - x_2} = -\frac{1}{m}$$

$$\frac{2-1}{x-4} = -2 \Rightarrow x = 3.5$$

**Answer 7. (b) — (ii)**

Radius = 2. Diameter = 4

**Answer 7. (c) — (iii)**

$$b^2 = a^2(1 - e^2) \Rightarrow b^2 = (2b)^2(1 - e^2) \Rightarrow e = \frac{\sqrt{3}}{2}$$

**Answer 7. (d) — (iv)**

$$\text{Equation : } x^2 = -4ay \Rightarrow x^2 = -8y \quad [\text{given } a = 2]$$

**Q. 8. Answer any one of the following :**

[4×1]

(a) A ( $\alpha$ ,  $\beta$ ) lies on the straight line  $y = 6x - 1$  and B ( $\beta$ ,  $\alpha$ ) lies on the straight line  $2x - 5y = 5$ . Find the equation of the straight line AB.

(b) Obtain the equation of the hyperbola whose vertices are ( $\pm 4$ , 0) and foci are ( $\pm 6$ , 0).

**Answer 8. (a)**

$\beta = 6\alpha - 1$  and  $2\beta - 5\alpha = 5 \Rightarrow$  solving the two equations for  $\alpha$  &  $\beta$  we get  $\alpha = 1$ ,  $\beta = 5$

$\therefore$  A  $\equiv$  (1, 5) and B  $\equiv$  (5, 1)

$\therefore$  Equation of AB is  $\frac{y-5}{x-1} = \frac{5-1}{1-5} \Rightarrow x + y = 6$

**Answer 8. (b)**

$a = 4$  and  $ae = 6$

Now  $b^2 = a^2e^2 - a^2 = 36 - 16 = 20$

$\therefore$  Required equation :  $\frac{x^2}{16} - \frac{y^2}{20} = 1$

## SECTION - V (Calculus—15 marks)

Q. 9. Answer any three of the following :

[3×3]

Choose the correct option showing the proper reasons/calculations.

- (a) If  $f(x)$  be an odd function then the value of  $\frac{f(-1)}{f(1)}$  is ( $f(1) \neq 0$ )  
 (i) 2                      (ii) -2                      (iii) -1                      (iv) none of these.
- (b) The value of  $\lim_{x \rightarrow 0} \frac{1 - \sqrt{1-x}}{x}$  is  
 (i) 0                      (ii) 1                      (iii)  $\frac{1}{2}$                       (iv) none of these.
- (c) If  $y = x^3$ , then  $x \frac{dy}{dx}$  is equal to  
 (i)  $3y$                       (ii)  $3x$                       (iii) 3                      (iv) none of these.
- (d) If  $y = x^3 - x^2 + x$ , the value of  $y_2$  at  $x = 1$  is  
 (i) 0                      (ii) 4                      (iii) -4                      (iv) none of these.
- (e) The value of  $\int_0^1 e^{\frac{1}{2} \log x} dx$  is  
 (i)  $\frac{3}{2}$                       (ii)  $\frac{1}{2}$                       (iii)  $\frac{2}{3}$                       (iv) none of these

Answer 9. (a) — (iii)

$$f(-1) = -f(1) \Rightarrow f(-1)/f(1) = -f(1)/f(1) = -1$$

Answer 9. (b) — (iii)

$$\lim_{x \rightarrow 0} \frac{1 - \sqrt{1-x}}{x} \text{ multiplying numerator and denominator by } (1 + \sqrt{1-x})$$

$$= \lim_{x \rightarrow 0} \frac{1}{1 + \sqrt{1-x}} = \frac{1}{2}$$

Answer 9. (c) — (i)

$$y = x^3 \quad x \frac{dy}{dx} = x(3x^2) = 3x^3 = 3y$$

Answer 9. (d) — (ii)

$$y_2 \Big|_{x=1} = (6x - 2) \Big|_{x=1} = 4$$

**Answer 9. (e) — (iii)**

$$\int_0^1 e^{\frac{1}{2} \log x} dx = \int_0^1 x^{\frac{1}{2}} dx = \frac{2}{3}$$

**Q. 10. Answer any two of the following :**

[3×2]

(a) If  $f(x, y) = 3x^3 - 5x^2y + 2y^3$ , show that  $f(x, y)$  is a homogeneous function of  $x$  and  $y$  of degree 3 and hence verify Euler's Theorem for the function  $f(x, y)$ .

(b) If  $y = 2x + \frac{3}{x^2}$ , show that  $x^2 \frac{d^2y}{dx^2} + 2x \frac{dy}{dx} = 2y$ .

(c) The marginal cost function (MC) of  $x$  is given by  $MC(x) = 2 + 3x - 6x^2$ . Fixed cost is 30. Find the total cost function  $C(x)$  and hence the total cost for  $x = 1$ .

**Answer 10. (a)**

$$f(x, y) = 3x^3 - 5x^2y + 2y^3$$

$$f(tx, ty) = t^3(3x^3 - 5x^2y + 2y^3) = t^3 f(x, y)$$

Hence  $f(x, y)$  is a homogeneous function of degree 3.

$$\begin{aligned} \text{Now, } x \frac{\partial f}{\partial x} + y \frac{\partial f}{\partial y} &= x(9x^2 - 10xy) + y(-5x^2 + 6y^2) \\ &= 9x^3 - 15x^2y + 6y^3 = 3f(x, y) \end{aligned}$$

Hence, Euler's Theorem is verified.

**Answer 10. (b)**

$$x^2y = 2x^3 + 3$$

$$\therefore 2xy + x^2 \frac{dy}{dx} = 6x^2 \Rightarrow \frac{2y}{x} + \frac{dy}{dx} = 6$$

$$\therefore \frac{2y}{x^2} + \frac{2}{x} \frac{dy}{dx} + \frac{d^2y}{dx^2} = 0 \Rightarrow x^2 \frac{d^2y}{dx^2} + 2x \frac{dy}{dx} = 2y$$

**Answer 10. (c)**

$$\begin{aligned} C(x) &= \int (2 + 3x - 6x^2) dx \\ &= 2x + \frac{3}{2}x^2 - 2x^3 + C \\ &= 2x + \frac{3}{2}x^2 - 2x^3 + 30 \end{aligned}$$

For  $x = 1$ , total cost = 31.5

## SECTION - VI (Statistical Methods—35 marks)

Q. 11. Answer any seven of the following :

[3×7]

Choose the correct option showing proper reasons/calculations.

- (a) If the algebraic sum of the deviations of 25 observations measured from 45 be  $-55$ , then the arithmetic mean of the observations is  
 (i) 46.4, (ii) 44.2, (iii) 42.8, (iv) none of these.
- (b) Increase of productions for the first 3 years are respectively 3%, 4% and 5%. The average production of the three years is (Given  $\log 60 = 1.7782$  and  $\text{antilog } 0.5927 = 3.908$ )  
 (i) 3.5%, (ii) 4%, (iii) 3.9%, (iv) none of these.
- (c) The weights (in kg) of some students are given as 65, 69, 75, 72, 71, 73, 74, 76, 75 and 70. The value of the median is  
 (i) 72.5 kg, (ii) 72 kg, (iii) 73 kg, (iv) none of these.
- (d) The mean age of a combined group of men and women is 30 years. If the mean age of the group of men is 32 years and that of the group of women is 27 years, the percentage of women in the group is  
 (i) 30%, (ii) 40%, (iii) 35%, (iv) none of these.
- (e) The weights (in kg) of 6 persons are 64, 60, 60, 64, 60, 64. The standard deviation of weight is  
 (i) 3 kg, (ii) 2 kg, (iii) 5 kg, (iv) none of these.
- (f) If  $y = 10 - 2x$ , arithmetic mean of  $x = 2$  and variance of  $x = 36$ , then the coefficient of variation of  $y$  is  
 (i) 100% (ii) 200% (iii) 50% (iv) none of these.
- (g) For a set of observations mean = 22, median = 24 and standard deviation = 10. The coefficient of skewness is  
 (i)  $-0.5$ , (ii) 0.5, (iii)  $-0.6$ , (iv) none of these.
- (h) If 1, 2, 3, 4 occur with frequency 1, 2, 3, 4 respectively, the arithmetic mean is  
 (i) 2.5, (ii) 3.5, (iii) 3, (iv) none of these.
- (i) If the coefficient of skewness, mean and variance of a variable are  $-6$ , 80 and 4 respectively, then the mode of the variable is  
 (i) 92, (ii) 86, (iii) 75, (iv) none of these.
- (j) If the standard deviation of  $x_1, x_2, \dots, x_{10}$  be 3 and  $\sum_{i=1}^{10} (x_i - 2) = 20$  then the value of  $\sum_{i=1}^{10} (x_i - 4)^2$  is  
 (i) 90, (ii) 80, (iii) 70, (iv) none of these.

**Answer 11. (a) — (iii)**

$$\sum_{i=1}^{25} (x_i - 45) = -55$$

$$\text{or, } \sum_{i=1}^{25} x_i - (45 \times 25) = -55$$

$$\text{or, } \sum_{i=1}^{25} x_i - 1125 = -55$$

$$\text{or, } \sum_{i=1}^{25} x_i = 1070$$

$$\text{or, } \bar{x} = \frac{1070}{25} = 42.8$$

**Answer 11. (b) — (iii)**

$$G = (3 \times 4 \times 5)^{\frac{1}{3}} = (60)^{\frac{1}{3}}$$

$$\log G = \frac{1}{3} \log 60 = \frac{1.7782}{3} = 0.5927$$

$$G = \text{Anti log } (0.5927) = 3.908 \approx 3.9\%$$

**Answer 11. (c) — (i)**

First arrange the numbers in ascending order i.e., 65, 69, 70, 71, 72, 73, 74, 75, 75, 76

$$\therefore \text{Median is} = \frac{\left(\frac{N}{2}\right)^{\text{th}} \text{ term} + \left(\frac{N}{2} + 1\right)^{\text{th}} \text{ term}}{2}, \text{ i.e. } \frac{\left(\frac{10}{2}\right) + \left(\frac{10}{2} + 1\right)}{2} \Rightarrow \frac{5^{\text{th}} \text{ term} + 6^{\text{th}} \text{ term}}{2}$$

$$\text{Median} = \frac{72 + 73}{2} = 72.5 \text{ kg}$$

**Answer 11. (d) — (ii)** $n_1 = \text{no. of men, } n_2 = \text{no. of women}$ 

$$\therefore 30 = \frac{32n_1 + 27n_2}{n_1 + n_2}$$

$$\text{or, } 32n_1 + 27n_2 = 30n_1 + 30n_2$$

$$\text{or, } 32n_1 - 30n_1 = 30n_2 - 27n_2$$

$$\text{or, } 2n_1 = 3n_2$$

$$\text{or, } \frac{n_1}{n_2} = \frac{3}{2}$$

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$$\therefore \text{Percentage of women} = \frac{2}{5} \times 100 = 40\%$$

**Answer 11. (e) — (ii)**

$$\bar{x} = 62 \text{ kg. S.D } (x) = \sqrt{\frac{1}{6} [3(60-62)^2 + 3(64-62)^2]} = 2 \text{ kg.}$$

**Answer 11. (f) — (ii)**

$$y = 10 - 2x \Rightarrow \Sigma y = 10 - 2\Sigma x \Rightarrow \frac{\Sigma y}{N} = 10 - 2 \cdot \frac{\Sigma x}{N}$$

$$\Rightarrow \bar{y} = 10 - 2\bar{x} \text{ or } \bar{y} = 10 - 2 \times 2$$

$$\text{or, } \bar{y} = 6$$

$$\sigma_y^2 = 4 \times \sigma_x^2 = 4 \times 36 \Rightarrow \sigma_y = 12$$

$$\text{CV of } y = \frac{\sigma_y}{\bar{y}} \times 100 = 200\%$$

**Answer 11. (g) — (iii)**

$$\text{Skewness} = \frac{3(\text{Mean} - \text{Median})}{\text{S.D.}}$$

$$\text{Coefficient of skewness} = \frac{3(22 - 24)}{10} = -0.6$$

**Answer 11. (h) — (iii)**

$$\text{AM} = \frac{1^2 + 2^2 + 3^2 + 4^2}{1 + 2 + 3 + 4} = 3$$

**Answer 11. (i) — (i)**

$$\text{Skewness} = \frac{\text{Mean} - \text{Mode}}{\text{S.D.}}$$

Where, Mean = 80,

$$\text{Skewness} = -6$$

$$\therefore \text{S.D.} = \sqrt{4} = 2$$

$$-6 = \frac{80 - \text{mode}}{2} \Rightarrow \text{mode} = 92$$

**Answer 11. (j) — (i)**

$$\sum_{i=1}^{10} (x_i - 2) = 20 \Rightarrow \bar{x} = 4$$

$$\therefore \frac{1}{10} \sum_{i=1}^{10} (x_i - 4)^2 = (\text{s.d})^2 = 9 \Rightarrow \sum_{i=1}^{10} (x_i - 4)^2 = 90$$

Q. 12. (a) Answer *any two* of the following :

[5×2]

- (i) Draw the histogram on the basis of the following data and use it to estimate the modal value of the frequency distribution :

Age (in years) :	2-9	10-17	18-25	26-33	34-41	Total
No. of persons :	17	27	42	37	27	150

- (ii) The median and mode of the following frequency distribution are known to be 27 and 26 respectively. Find the values of  $a$  and  $b$  :

Values :	0-10	10-20	20-30	30-40	40-50
Frequency :	3	$a$	20	12	$b$

- (iii) The mean of two groups of 30 and 50 observations are equal and their standard deviations are 8 and 4 respectively. Find the variance when both the groups are combined together.

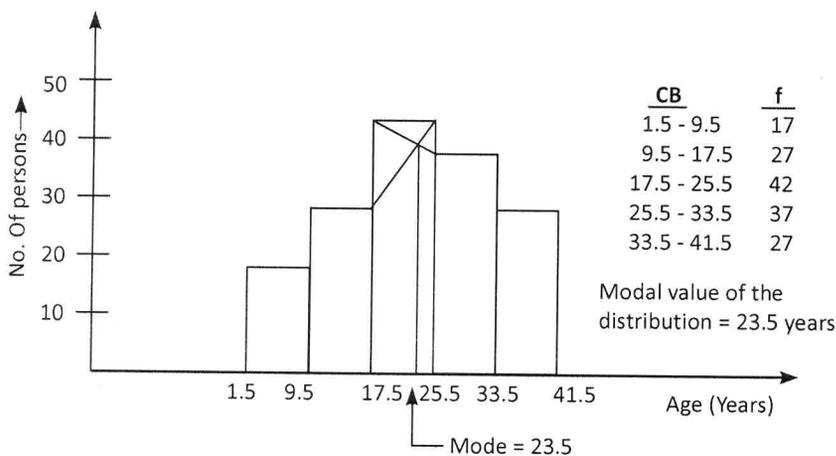
(b) Write short note on *any one* of the following :

[4×1]

- (i) Bar diagram;  
(ii) Skewness and its measures.

Answer 12. (a)

(i)



- (ii) Median = 27 and Mode = 26. So median and modal classes are same which is 20 – 30.

$$\text{Mode} = L + \frac{f_m - f_1}{2f_m - f_1 - f_2} \times C \Rightarrow 26 = 20 + \frac{20 - a}{2 \times 20 - a - 12} \times 10 \Rightarrow a = 8$$

$$\text{Median} = L + \frac{\frac{N}{2} - F}{f_m} \times C \Rightarrow 27 = 20 + \frac{\frac{35+a+b}{2} - (3+a)}{20} \times 10$$

$$\Rightarrow b = a - 1 = 7$$

∴ The value of  $a = 8$  &  $b = 7$

(iii) Let  $\bar{x}$  be the mean of both of the groups and  $\bar{\bar{x}}$  be the mean of the combined group.

$$\bar{\bar{x}} = \frac{30\bar{x} + 50\bar{x}}{30 + 50} = \bar{x}$$

$$d_1 = d_2 = \bar{x} - \bar{x} = 0$$

$$\sigma^2 = \frac{30 \times 8^2 + 50 \times 4^2 + 0 + 0}{30 + 50} = 34$$

#### Answer 12. (b)

(i) **Bar Diagram** : Bar Diagram consists of bars of uniform width separated by equal intervening spaces. The length of the bar is proportional to the values they represent. The bars may be placed vertically or horizontally. Bar diagram generally used to represent a time-series. The base line should be the zero line, when bar diagrams are used for comparison.

There are 4 types of bar diagram :

- (i) Simple Bar Diagram
- (ii) Compound Bar Diagram
- (iii) Subdivided Bar Diagram
- (iv) Subdivided Bar Diagram on percentage basis.

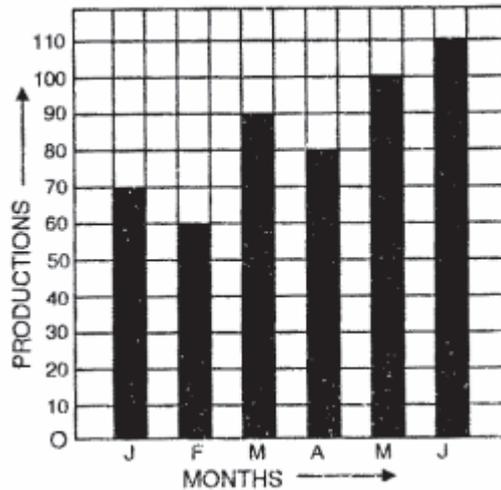
#### Example :

The monthly productions of bicycles of a factory are as follows :

January	70
February	60
March	90
April	80
May	100
June	110.

Represent by simple bar-diagram.

Scale : 1 division along Y axis = 10 units.



(ii) **Skewness** : A frequency distribution is said to be symmetrical when the values of the variables equidistant from their mean have equal frequencies.

If a frequency distribution is not symmetrical, it is said to be asymmetrical or skewed. Skewness is the lack of symmetry.

There are 3 types of skewness :

- (i) Zero Skewness
- (ii) Positive Skewness
- (iii) Negative Skewness

**Measures of Skewness :**

(i) **Pearson's First Measure :**

$$\text{Skewness} = \frac{\text{Mean} - \text{Mode}}{\text{S. D.}}$$

(ii) **Pearson's Second Measure :**

$$\text{Skewness} = \frac{3(\text{Mean} - \text{Median})}{\text{S. D.}}$$