

**QUESTION BANK**  
**Academic Year 2019-2020**

Class : M. Sc. I (Semester- I)  
 Paper Code : **MICRO4102**  
 Paper : II  
 Title of Paper : **Quantitative Biology**  
 Credit : 4  
 No. of lectures : 60

**Questions for 2marks**

1. Write the definition of Biostatistics.
2. Write the definition of sample.
3. Write the definition of population.
4. Write the definition of data.
5. Write the definition of variable.
6. Enlist different types of data.
7. Enlist different types of variables.
8. Write the definition of tabulation.
9. Calculate the arithmetic mean of the following set of observations: 7, 6, 8, 10, 13, and 14.
10. Calculate the arithmetic mean of the following set of observations: 10, 11, 10, 11, 9, 11, 12 and 10.
11. Calculate the arithmetic mean of the following set of observations of number of spikelet per spike in wheat: 18, 20, 21, 19, 28, 22, 29, 30, 31 and 35.
12. Data recorded on the production of fat during 10 consecutive days in cow's milk is presented below. Calculate the median: 4.0, 5.7, 3.9, 4.2, 6.6, 7.0, 7.9, 8.0, 9.0 and 10.0.
13. Calculate the median of the following set of observations: 10, 11, 9, 11, 8, 10, 11, 9, 11, 12 and 10.
14. Calculate the modal value of the following set of observations: 10, 11, 10, 11, 9, 8, 10, 11, 11, 9, 11, 12, 13, 10, 11, 12 and 10.
15. Calculate the geometric mean from the data on the number of branches per plant in lentil. Number of branches = 4, 5, 5, 6, 7, 8.
16. Calculate the geometric mean from the data on the number of pods per plant. Number of pods = 80, 82, 84, 90, 85, 100, 105, 110, 90, 115.
17. Calculate the harmonic mean of following series:  $X = 2, 4, 6, 8$ .
18. Data on number of secondary branches in pulse are given below. Find out the range and its coefficient. Number of secondary branches = 8, 10, 15, 18, 17, 26, 22, 20.
19. Data recorded on the production of fat during 10 consecutive days in cow's milk is presented below. Find out the range: 4.0, 5.7, 3.9, 4.2, 6.6, 7.0, 7.9, 8.0, 9.0 and 10.0.
20. Calculate the range and its coefficient from following data.

No. of clusters	10-20	20-30	30-40	40-50	50-60	60-70	70-80
No. of plants	6	10	12	15	11	7	4

21. If a surgeon transplants kidneys in 400 cases and succeeds in 160 cases calculate the probability of survival after operation.
22. From a pack of 52 cards, one card is drawn at random. What is the probability that it is either a king or a queen?

23. From a pack of 52 cards, one card is drawn at random. What is the probability that it is either a Ace or a queen?
24. From a pack of 52 cards, one card is drawn at random. What is the probability that it is either a spade or a queen?
25. What is the probability of the heads on two successive tosses?
26. What is the probability of the heads on three successive tosses?
27. A bag contains 7 red and 3black balls. Two balls are drawn at random one after the other without replacement. What will be the probability that both the balls drawn are black?
28. From a pack of 52 cards, one card is drawn at random. What is the probability that it will be a heart?
29. From a pack of 52 cards, one card is drawn at random. What is the probability that it will be a ace?
30. From a pack of 52 cards, one card is drawn at random. What is the probability that it will be a king?

### Questions for 4 marks

1. What is pie diagram? Draw a pie diagram of the following data relating to the areas under cultivation of different crops in one of the Indian state in the year 1987-88.

Crops	Rice	Jowar	Bajra	Maize	Wheat
Area in thousand hectares	3123	1572	324	296	11

2. In one microbiological, dairy fermented food samples were collected from six different dairy products. The number of *Lactobacillus* spp. were enumerated and count was expressed as  $1 \times 10^4$  cfu/ml. Test the hypothesis that number of organism present in each sample does not depend on the particular sample using appropriate test.

Sample No.	1	2	3	4	5	6
Lactobacillus spp. ( $1 \times 10^4$ cfu/ml)	80	83	101	60	93	87

3. Define mode. Calculate the mode of the following data:

Wt. of seeds (mg)	0-5	5-10	10-15	15-20	20-25	25-30
Number of spikes	2	4	8	5	4	1

4. A pharmaceutical company claim to develop a drug, which increases hemoglobin content (g/100ml) of 10 subjects, is measured before and after administration of the drug as given below. Test whether the company's claim is valid.

Subject	1	2	3	4	5	6	7	8	9	10
Hb before	10	9	11	12	8	7	12	18	10	9
Hb after	12	11	13	14	9	10	12	14	11	12

5. The 69 sterile Nutrient agar plates were exposed to air and data was recorded on red pigmented colonies per plate. Calculate standard deviation.

Pigmented colonies/plate	2	4	6	8	5	3	1
Frequency	8	10	12	15	11	9	4

6. Find the regression of X on Y from the following data:  $\sum X=24$ ,  $\sum Y=44$ ,  $\sum XY=306$ ,  $\sum X^2=164$ ,  $\sum Y^2=574$ .  $N = 4$ . Find the value of X when  $Y = 6$

7. Find the geometric mean for the data related to the internode length(cms) for rice variety.

Internode length(cms)	0-10	10-20	20-30	30-40	40-50	50-60
Frequency	10	16	22	32	26	20

8. Data obtained on two sets of results with regard to number of flowers per plant. Analyse the data using t test and give your inference on the mean difference on number of flowers.

	Set 1	Set 2
N	30	32
Mean	15.65	10.15
Variance	6.2	7.8

9. Test whether the prevalence of carriers of filarial is associated with sex.

Sex	No. of carriers	No. of non carriers	Total
Male	78	412	490
Female	57	553	610

10. Following data relate to the heights of two varieties of plant H1 and H2. Determine whether the two means are significantly different (table z value at % LS is 1.96)

	H1	H2
N	32	35
Mean	34	38
Variance	9.62	14.23

11. Nephropathy was observed in 100 cases of each class of diabetes divided into 5 classes as per severity of the disease.

Diabetes Class	I	II	III	IV	V
Frequency	8	15	14	7	6

12. Test whether severity of diabetes and the incidence of nephropathy are independent

13. Represent the following data by a pie diagram:

Country	Birth Rate
China	40
India	33
New Zealand	30
United kingdom	20
Germany	16
Sweden	15

14. A person is known to hit target in 4 out of 5 shots. Whereas another person is known to hit the target in 3 out of 4 shots. Find the probability of the target being hit at all when they both try.

15. Alpha particles are emitted by radioactive source at the rate of 5 per every minute on the average. The number of particles is distributed according to the Poisson distribution. Calculate the probability of getting exactly 7 emissions in one minute.

16. Compute mean of the following distribution.

Score	60-64	55-59	50-54	45-49	40-44	35-39	30-34	25-29	20-24
Frequency	2	2	4	6	9	12	7	5	3

17. When 10 sterile nutrient agar plates were exposed for 10 min. in a fruit juice manufacturing unit, following number of colonies were obtained after incubation. Number of colonies (CFU) on each agar plate : 12, 13, 12, 16, 15, 09, 18, 10, 12, 13 Determine standard deviation and coefficient of variation.

18. Two horticulture plots were each divided into six equal sub-plots. Organic fertilizer is added to Plot 1 and chemical fertilizer is added to Plot 2. The yields of fruits from Plot 1 and Plot 2, in kg/sub-plot, is given below. Can we say the yield due to organic fertilizer is higher than due to chemical fertilizer?

Plot 1	6.2	5.7	6.5	6.0	6.3	5.8
Plot 2	5.6	5.9	5.6	5.7	5.8	5.7

19. In an experiment on immunization of goats from anthrax, the following results were obtained. Derive your inferences on the efficacy of the vaccine.

	Affected	Not Affected	Total
Inoculated	2	10	12
Not Inoculated	6	6	12
Total	8	16	24

20. Draw the cumulative frequency polygon or ogives (both 'less than' and 'more than' types) for the following frequency distribution.

No. of colonies	50-59	60-69	70-79	80-89	90-99	100-109	110-119
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No. of plates	8	10	16	14	10	5	2
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21. Describe scales used in statistics.

22. A book contains 100 misprints distributed randomly throughout its 100 pages. What is the probability that a pages observed at random contains at least two misprints. Assuming Poisson distribution.

23. Calculate the median from following data:

Number of branches	0-3	3-6	6-9	9-12	12-15
Number of plants	4	8	22	10	2

24. Calculate the mean deviation from the following data recorded on the length of carrots. Length (cms.) = 9.2, 9.6, 9.7, 9.8, 10, 10.2, 10.6, 11.6, 12.6, 12.7

25. Determine the correlation coefficient from following data:

x	11	12	13	14	15	16
y	1	2	3	4	5	6

26. A random sample of 10 and 12 persons were fed on diet A and B respectively. The increase to the weight in pounds in a certain period is given in the following table.

Type of Diet	Increase to weight in pounds											
Diet A	10	6	16	17	13	12	8	14	15	9		
Diet B	7	13	22	15	12	14	18	8	21	23	10	17

Test whether the diet A and B differ significantly as regards their effect on increase in weight (table value of t for 20 d.f. at 5% l.o.s. is 2.086).

27. Data on two sets of results with regard to number of flowers per plant is given. Analyze the data using appropriate test and give your inference on difference in mean number of flowers (table value of z at 5% l.o.s. is 1.96).

	Set 1	Set 2
n	52	55
Mean	15.55	10.05
Variance	6.3	7.8

28. In a radio listeners survey 120 persons were interviewed and their opinion about preference to Hindi or English music were asked. The results are as follows.

Type of Music	Hindi	English
I	13	45
II	3	23

Test whether the preference for music type is dependent on language (tabulated chi square at 5% l.o.s. for 1 d.f. is 3.84).

29. Data recorded on dwarf plants are given below. Calculate the Geometric mean.

Dwarf plants	8	12	15	21	35
No. of plants	201	206	310	390	400

30. The ratio of male and the female births is expected to be 1:1. It was found in one village that male children born were 52 and the female were 48. Test that whether these figures fits in the given ratio (tabulated chi square at 5% l.o.s. for 1 d.f. is 3.84).

31. A firm manufactured articles of which 1% are defective. These articles are packed in boxes each containing 5. Find out the probability of boxes which are free from defective articles.

32. A traffic police records an average of three road accidents per week. The number of accidents is distributed according to a poisson distribution. Calculate the probability of exactly one accident in any week.

33. IQ of children forms a normal distribution with arithmetic mean of 100 and a variance of 100. Among 500 children, randomly chosen, how many are expected to have IQ in the range of 100 to 110.

34. The following results were obtained from the measurement of body length (y) in cm & body weight (x) in gram of 25 fishes

$$\Sigma(x) = 1165, \Sigma x^2 = 56947, \Sigma xy = 9024.40,$$

$$\Sigma y = 185.20, \Sigma y^2 = 1434.24$$

Find the appropriate regression equation and estimate the body length of fish having weight 50 gms?

35. Calculate the mean median and the mode for the following data series : 19, 20, 17, 11, 19, 19, 15, 8, 15, 20, 17 and 18. Identify data distribution (skewness)?

36. In a cross between black and white coat coloured mice, the  $F_2$  individual segregated into 787 black and 277 white coat coloured individuals. Test that these results agree with the expected ratio 3:1.

37. Calculate the correlation coefficient between two measurements of water quality of a lake.

Salinity (%)	2	4	6	8	10	12	14
Dissolved Oxygen (mg/l)	4	2	5	10	4	11	12

38. Random testing of ABO blood group in the offspring of only AB couples in an European population obtained the following distribution of blood groups. A - 312, AB - 575 & B - 313 Test whether the data is consistent with the normal segregation

of alleles in the population (i.e. 1:2:1 ratio)

39. In a town, 10 accidents take place in a span of 50 days. Assuming that the number of accident follows the poisson distribution, find the probability that there will be 3 or more accidents in a day.

40. A biostatistical problem is given to three students ; A, B and C whose chances of solving it are  $\frac{1}{3}$ ,  $\frac{1}{4}$  and  $\frac{1}{5}$  respectively. Find out the probability that the problem would be solved.

41. Calculate the mode from the following data:

Variable	0-5	5-10	10-15	15-20	20-25	25-30
Frequency	2	4	8	5	4	1

42. When 10 sterile nutrient agar plates were exposed (10 min.) in a fruit juice manufacturing unit. Following number of colonies were obtained after incubation. Number of colonies (CFU) on each agar plate: 18, 11, 15, 20, 25, 23, 26, 13, 17. Calculate coefficient of variation.

43. In the  $F_2$  generation, Mendel obtained 510 tall plants and 190 dwarf plants out of total 700. Test whether these two types of plants are in accordance with the Mendelian ratio of 3:1.

44. From the data given on the weight (in Kgs) of boys, test that whether the group 1 is identical to group 2.

Group 1	19	18	21	17	20	21	19	
Group 2	25	22	24	20	23	24	23	22

(for a two tailed test with  $\alpha = 0.05$ , the critical value of 'U' = 10)

45. A traffic police records an average of three road accidents per week. The number of accidents is distributed according to a poisson distribution. Calculate the probability of exactly two accidents in any week.

46. Alpha particles are emitted by radioactive source at the rate of three per every minute on the average. the number of particles is distributed according to the Poisson distribution. Calculate the probability of getting exactly 4 emissions in one minute.

47. A certain disease has a mortality rate of 65%. Two patient suffering from the disease are selected at random. What is the probability that at least one of them will recover.

48. Find the value of mode of this distribution.

No. of seeds per plants	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100
No. of plants	10	18	37	45	27	15	8	4

49. The incubation period of smallpox recorded on 10 patients is given below. Calculate the variance and coefficient of variation.  
Incubation period = 10, 14, 13, 11, 15, 10, 9, 12, 10, 16.

50. Determine the regression coefficient from following data.

X	1	2	3	4	5	6
Y	9	10	11	12	1	14

### Questions for 6 marks

1. Data recorded on soluble nitrogen N (mg/leaf) and total chlorophyll (mg/leaf) is given below:

Soluble nitrogen (mg/leaf)	1.04	1.34	2.00	2.44	1.36	0.92	1.40	0.29	1.21	2.27
Total Chlorophyll (mg/leaf)	0.75	1.32	1.76	2.67	1.42	0.73	1.71	0.40	1.12	2.61

Calculate the regression coefficient (b).

2. Maturity data recorded on an early maturing mutant variety of Castor used for production biodiesel. Calculate variance, standard deviation and coefficient of variation.

Days of maturity = 140, 140, 141, 141, 142, 145, 146, 150, 150, 155.

3. The data on heights of male and female students is given to you. Test with the help of "Mann-Whitney" test whether heights of male and female students is same (Critical  $U_{0.05(2),7.5} = 30$ )

Height of Males (cm)	193	188	186	183	179	177	171
Height of females (cm)	176	174	168	165	163		

4. Calculate the mean median and the mode for the following data series: 19, 20, 17, 11, 19, 19, 15, 8, 15, 20, 17, 18 and 11

5. To examine the relationship between obesity and age represent following data with appropriate tool.

	Age group			
Obesity level	Under 50	50-59	60-69	70 & over
Normal	11	22	26	19
Overweight	11	23	30	21
Obese	8	7	10	12

6. Calculate correlation coefficient between X & Y for the following data:

X	1	2	3	4	5	6	7	8	9
Y	10	11	12	14	13	15	16	17	18

7. A researcher designed an experiment to assess the effects of prolonged inhalation of cadmium oxide. Fifteen laboratory animals served as experimental subjects, while 10 similar animals served as controls. The variable of interest was haemoglobin level following the experiment. From the data can we conclude that prolonged inhalation of cadmium oxide reduces haemoglobin level. Use Mann whitely test. (Critical U = 45) :

Exposed	14.4	14.2	13.8	16.5	14.1	16.6	15.9	15.6	14.1	15.3	15.7	16.7	13.7	15.3	14
Unexposed	17.	16.2	17.1	17.5	15	16	16.9	15	16.3	16.8					

8. Calculate Karl Pearson's coefficient of skewness from the data recorded on the number of fruits per plant.

No. of fruits	8	11	14	17	20	23
No. of plants	2	4	6	10	6	3

9. Blood samples were taken from 16 hepatitis patients and 9 healthy controls. The following data were obtained on the percentage of yeast cells killed by monocytes in culture.

Controls	Patients
n <sub>1</sub> = 9	n <sub>2</sub> = 16
Mean 1 = 44.22%	Mean 2 = 28.22%
Stand. dev. 1 = 6.17%	Stand. dev. 2 = 4.11%

Is there significant evidence to claim that the mean percentage of yeast cells killed by monocytes among control higher than among patients using t test.

10. If three coins are tossed. Find the probability of  
 0 heads, 1 heads, 2 heads & 3 heads  
 More than one head  
 at least one head

11. An engineer is concerned with the possibility that too many changes are being made in the setting of automatic lathe. The following are mean diameters (in inches) of 15

successive shafts turned on the lathe: 0.271, 0.268, 0.259, 0.261, 0.257, 0.266, 0.26, 0.258, 0.265, 0.262, 0.263, 0.276, 0.274, 0.273, 0.272. Test the null hypothesis of randomness against the alternate hypothesis there is a frequency alternating pattern (At 5% l.o.s. lower critical value is 3 and upper critical value is 13).

12. Draw the frequency polygon from following data:

Number of grains	Number of plants
17-20	6
20-23	10
23-26	17
26-2	22
29-32	14
32-35	8

13. Seasonal averages of nitrate content (mg/l) of water in three ponds are given in the following table. Represent the data by multiple bar diagram.

Ponds	Summer	Monsoon	Winter
Pond 1	0.45	1.10	0.64
Pond 2	0.69	1.24	0.86
Pond 3	1.22	1.46	0.62

14. Sixteen laboratory animals were fed a special diet from the birth through age 12 weeks. Their weight gains (in grams) were as follows.

63      68      79      65      64      63      65      64      76      74      66      66  
67      73      69      76

Can we conclude from these data that the diet results in a mean weight gain of less than 70 grams? Use Wilcoxon Signed Rank test. ( $\alpha = 0.05$ )

15. On the basis of information given below about treatment of 200 patients suffering from disease, state whether the new treatment is comparatively superior to the conventional treatment.

Treatment	No. of patients		Total
	Favourable Response	Not favourable response	
New	60	30	90
Conventional	40	70	110
	100	100	200

16. Construct a histogram and frequency polygon for the following data

Class Interval	Frequency
100 - 150	4
150 - 200	6
200 - 250	13
250 - 300	5
300 - 350	2

17. Explain random sampling methods.

18. Explain non-random sampling methods.

19. Find the regression equation for following data:

x	6	2	10	4	8
y	9	11	5	8	7

20. Calculate the mean, median and the mode for the following data series: 18, 20, 17, 12, 19, 19, 15, 8, 14, 20, 17, 18 and 11. Comment on the skewness of data distribution.

21. Compare the stratified sampling and cluster sampling method.

22. Determine the value of median graphically from following data.

Variable	5-10	10-15	15-20	20-25	25-30	30-35	35-40
Frequency	4	7	11	17	12	8	5

23. What is tabulation? Write down the rules for tabulation.

24. Draw the more than and less than cumulative frequency curve from following data.

Number of Pods	Number of plants
0-10	3
10-20	9
20-30	15
30-40	30
40-50	18
50-60	5

25. The Carbohydrate content of two banana varieties are as follow:  
Variety A: 41, 41, 44, 44, 43, 46, 53

Variety B: 47, 44, 54, 50, 40, 53, 50

Test whether there is any significant difference in carbohydrate content of two varieties.

26. The following data relate to the expenditure of the family per month. Represent data by pie diagram:

Items of Expend.	Food	Rent	Clothing	Education	Transport	Miscellaneous
Amount in Rs.	4000	1500	1000	1000	1200	1300

27. The life expectancy of light bulbs whose life times are normally distributed with a mean life of 700 hours and standard deviation of 40 hours. What is the probability that the bulb will last 790 hours?

28. A scientist is concerned about the possibility that too many changes are occurring in the volume of liquid taken by a 'fixed volume micropipette'. Following are the volumes (in  $\mu\text{l}$ ) of 15 successive pipettings: 0.261, 0.258, 0.249, 0.251, 0.247, 0.256, 0.250, 0.248, 0.255, 0.252, 0.253, 0.266, 0.264, 0.263, 0.262. Use 0.05 level of significance to test the null hypothesis of randomness against the alternate hypothesis that there is a frequently alternating pattern (when  $\alpha = 0.05$ ; lower critical value is 3 and upper critical value is 13).

29. Give an account of the various methods of random sampling.

30. A certain disease has a morality rate of 75%. Two patients suffering from the disease are selected at random. What is the probability that at least one of them will recover.

31. An average of 5 cars arrives at a tollbooth every minute. Assuming this to be a poisson distribution, what is the probability that exactly 1 car will arrive in a one minute period.

32. Data on days of maturity were recorded in two varieties of pulse crop. Determine whether the two means are significantly different (table value of z at 5% l.o.s is 1.96).

	Variety A	Variety B
n	60	65
Mean	60	65
Variance	8.20	11.13

33. Twenty patients on a certain diet made the following weight gains (in pounds): 7, -6, 3, 1, 6, 4, 9, -5, 9, -7, -3, 7, -9, 8, 6, -4, 4, 9, -6, 1. Test the hypothesis that the median weight gain is zero against it is not. Use 5% l.o.s. (Critical value is 5).

34. The ratio of male and the female is expected to be 1:1. In a Jojoba (*Fimmondsia chinensis*) population, there are 525 female plants and 475 male plants. Test that

whether these figures fits in the given ratio (tabulated chi square at 5% l.o.s. for 1 d.f. is 3.84).

35. Seasonal averages of nitrate content (mg/l) of water in three ponds are given in the following table. Represent the data by divided bar diagram.

Ponds	Summer	Monsoon	Winter
Pond 1	0.45	1.10	0.64
Pond 2	0.69	1.24	0.86
Pond 3	1.22	1.46	0.62

36. What is the probability of getting two tails on three tosses fo a fair coin?

37. It is known from past experience that in a certain industry there are on an average 4 industrial accidents per year. Find the probability that in a given year there will be three accidents. Assume Poisson distribution.

38. If the capacities of the cranial cavities of a certain population are approximately normally distributed with a mean of 1400 cc and a standard deviation of 120, find out the probability that a person randomly peaked from this population will have cranial cavity capacity in between 1400 and 1440cc.

39. Compute karl Pearson's coefficient of correlation for the following data of Goldfish.

Length (cm)	7	5	6	3	4	8
Weight (g)	16	8	10	2	4	18

40. The incubation period of certain disease recorded on 10 patients is given below. Calculate the standard deviation: Incubation period (days) = 12, 16, 15, 13, 17, 12, 11, 14, 12, 18.

41. Pure black rats when test crossed to albinos produce only black  $F_1$  offspring. The  $F_2$  in one experiment was found to consist of 43 blacks, 15 creams and 22 albinos. The genetic control of these coat color is postulated to involve two genetic loci with recessive epistasis (9:3:4 ratio expected). Is the genetic hypothesis consistent with data.

42. The data on heights of male and female students is given to you. Test with the help of "Mann-Whitney test" whether heights of male and female students is same (Critical  $U_{0.05(2),7.5} = 30$ ).

Height of Males(cm)	193	188	186	183	179	177	171
Height of female(cm)	176	174	168	165	163		

43. A new drug candidate was administered to 450 persons out of a total 800 persons in a locality where epidemic was prevalent to test its efficacy against malaria. The results

are given below in the table. Find out effectiveness of drug against disease.

	Infection	No infection
Drug	200	300
No Drug	250	50

44. Calculate the geometric mean of the following data:

X	6	7	8	9	10	11
Y	4	7	10	9	6	2

### Questions for 12 marks

- The data recorded on five self-fertilized  $F_1$  plants segregating for yellow and green seed color are given below. Test the homogeneity of four plants for the 3:1 ratio (tabulated chi square at 5% l.o.s. for 5 d.f. is 11.07).

Plants	Yellow Seeds	Green Seeds
1	46	12
2	25	8
3	23	8
4	25	10
5	35	12

- The data recorded on five self fertilized  $F_1$  plants segregating for yellow and green seed color are given below. Test the homogeneity of four plants for the 3:1 ratio (tabulated chi square at 5% l.o.s. for 5 d.f. is 11.07).

Plants	Yellow Seeds	Green Seeds
1	36	12
2	24	8
3	24	8
4	30	10
5	36	12