

**B. PHARMACY FOURTH YEAR SECOND SEMESTER EXAM 2025**  
**Course Name: BIOSTATISTICS AND RESEARCH METHODOLOGY**  
**Course Code: BP801T**

Time: 3hours

Full Marks: 75

*Answer any five questions taking at least one from each group*

**Group-A**

1. (a) What is called a decision tree? Give its importance. Give  $H_a/H_0$  hypothesis.  
 (b) Selling of tablet strip of four brands of antihypertensive drugs of a pharmaceutical company, of six days of a week in an area of a city, is given below. Analyze following three groups of data by one-way ANOVA for your statistical interpretation, assuming  $\alpha = 0.05$ .

| Day       | Tablet strip Brand 1 | Tablet strip Brand 2 | Tablet strip Brand 3 | Tablet strip Brand 4 |
|-----------|----------------------|----------------------|----------------------|----------------------|
| Monday    | 123                  | 145                  | 152                  | 112                  |
| Tuesday   | 134                  | 156                  | 167                  | 143                  |
| Wednesday | 120                  | 163                  | 110                  | 148                  |
| Thursday  | 143                  | 165                  | 127                  | 197                  |
| Friday    | 168                  | 155                  | 139                  | 142                  |
| Saturday  | 124                  | 142                  | 160                  | 115                  |

[1+2+2+10=15]

2. (a) A manufacturer of medicine wants to know on which day of five days of a week workers are most likely to be absent. The company expects that all the day's workers will be absent in the numbers given below. The actual absentees are also given. Based on this, find out the statistical level of variation at 5% level of significance.

| Days      | Observed values | Expected values |
|-----------|-----------------|-----------------|
| Monday    | 38              | 15              |
| Tuesday   | 12              | 10              |
| Wednesday | 18              | 12              |
| Thursday  | 16              | 14              |
| Friday    | 34              | 20              |

- (b) A retailer claims the sale of two different brands of a drug as given below. Determine the statistical level of significance at 5% level, using two sample (paired) Student's t-test.

Group 1

Group 2

| Days      | Brand A | Brand B |
|-----------|---------|---------|
| Monday    | 56      | 75      |
| Tuesday   | 43      | 67      |
| Wednesday | 78      | 28      |
| Thursday  | 36      | 63      |
| Friday    | 63      | 44      |
| Saturday  | 35      | 19      |

- (c) Blood pressure data (mm Hg) of two groups of patients are given below. Determine the statistical level of significance at 5% level, using two sample independent Student's t-test. [5+ 5+5 = 15]

|         |    |    |    |    |    |    |    |    |    |
|---------|----|----|----|----|----|----|----|----|----|
| Group A | 55 | 76 | 87 | 58 | 89 | 91 |    |    |    |
| Group B | 67 | 88 | 92 | 60 | 64 | 90 | 98 | 87 | 64 |

[ Turn over

**Group-B**

3. i) Explain the following terms:

a) Median b) Arithmetic mean c) Dispersion d) Frequency distribution e) Range

ii) Find the sample standard deviation of the given observations: 8,10,9,11,12,10,7,6,13,14

iii) Draw the pie chart for the following data on the expenditure pattern in a family

| Items           | Food | Clothing | Rent | Education | Unforeseen events | Medicine |
|-----------------|------|----------|------|-----------|-------------------|----------|
| Expenditure (%) | 40   | 20       | 10   | 10        | 15                | 5        |

[5 + 5 + 5 = 15]

4. i) Define the terms “factor” and “level” with examples. ii) Explain the central composite design.

[5+10=15]

**Group-C**

5. Among 1000000 tablets in a batch, 50000 are containing specks of grease. What is the probability of chosen tablet with specks? 30000 have chipped edges and 40000 are discoloured. What is the probability of chosen defect tablet? If 20000 tablets are chipped and specked, what is the probability of specked or chipped tablet? [15]

6. a. The overall failure percentage in dissolution test is 40%. What is the probability that out of 6 tablets at least 4 pass the test?

b. Define and classify hypothesis. What are four possible conditions may arise during test of hypothesis? Why type-II error is more dangerous than type-I error in the test of hypothesis? Define confidence limits.

[8+7=15]

7. A Pharmaceutical company has purchased three new tablet machines of different makes and wishes to determine the efficiency of tablet production. Five, hourly production in thousand figures are given below. Test the analysis of variance and determine whether the machines are significantly differing in producing tablets at 5% level of significance (At d.f. 2&12,  $F_{0.05}=3.89$ ).

| Machine |    |    |
|---------|----|----|
| A       | B  | C  |
| 25      | 31 | 24 |
| 30      | 39 | 30 |
| 36      | 38 | 28 |
| 38      | 42 | 25 |
| 31      | 35 | 28 |

[15]

## ANOVA TABLE

| $v_1 \backslash v_2$ | 1     | 2     | 3     | 4     | 5     | 6     | 7     | 8     | 9     | 10    |
|----------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1                    | 161.4 | 199.5 | 215.7 | 224.6 | 230.2 | 234.0 | 236.8 | 238.9 | 240.5 | 241.9 |
| 2                    | 18.51 | 19.00 | 19.16 | 19.25 | 19.30 | 19.33 | 19.35 | 19.37 | 19.38 | 19.40 |
| 3                    | 10.13 | 9.55  | 9.28  | 9.12  | 9.01  | 8.94  | 8.89  | 8.85  | 8.81  | 8.79  |
| 4                    | 7.71  | 6.94  | 6.59  | 6.39  | 6.26  | 6.16  | 6.09  | 6.04  | 6.00  | 5.96  |
| 5                    | 6.61  | 5.79  | 5.41  | 5.19  | 5.05  | 4.95  | 4.88  | 4.82  | 4.77  | 4.74  |
| 6                    | 5.99  | 5.14  | 4.76  | 4.53  | 4.39  | 4.28  | 4.21  | 4.15  | 4.10  | 4.06  |
| 7                    | 5.59  | 4.74  | 4.35  | 4.12  | 3.97  | 3.87  | 3.79  | 3.73  | 3.68  | 3.64  |
| 8                    | 5.32  | 4.46  | 4.07  | 3.84  | 3.69  | 3.58  | 3.50  | 3.44  | 3.39  | 3.35  |
| 9                    | 5.12  | 4.26  | 3.86  | 3.63  | 3.48  | 3.37  | 3.29  | 3.23  | 3.18  | 3.14  |
| 10                   | 4.96  | 4.10  | 3.71  | 3.48  | 3.33  | 3.22  | 3.14  | 3.07  | 3.02  | 2.98  |

F Critical Values ( $\alpha=0.05$ )

## Critical values of chi-square (right tail)

Significance level ( $\alpha$ )

| Degrees of freedom<br>(df) | .99    | .975   | .95    | .9     | .1      | .05     | .025    | .01     |
|----------------------------|--------|--------|--------|--------|---------|---------|---------|---------|
| 1                          | -----  | 0.001  | 0.004  | 0.016  | 2.706   | 3.841   | 5.024   | 6.635   |
| 2                          | 0.020  | 0.051  | 0.103  | 0.211  | 4.605   | 5.991   | 7.378   | 9.210   |
| 3                          | 0.115  | 0.216  | 0.352  | 0.584  | 6.251   | 7.815   | 9.348   | 11.345  |
| 4                          | 0.297  | 0.484  | 0.711  | 1.064  | 7.779   | 9.488   | 11.143  | 13.277  |
| 5                          | 0.554  | 0.831  | 1.145  | 1.610  | 9.236   | 11.070  | 12.833  | 15.086  |
| 6                          | 0.872  | 1.237  | 1.635  | 2.204  | 10.645  | 12.592  | 14.449  | 16.812  |
| 7                          | 1.239  | 1.690  | 2.167  | 2.833  | 12.017  | 14.067  | 16.013  | 18.475  |
| 8                          | 1.646  | 2.180  | 2.733  | 3.490  | 13.362  | 15.507  | 17.535  | 20.090  |
| 9                          | 2.088  | 2.700  | 3.325  | 4.168  | 14.684  | 16.919  | 19.023  | 21.666  |
| 10                         | 2.558  | 3.247  | 3.940  | 4.865  | 15.987  | 18.307  | 20.483  | 23.209  |
| 11                         | 3.053  | 3.816  | 4.575  | 5.578  | 17.275  | 19.675  | 21.920  | 24.725  |
| 12                         | 3.571  | 4.404  | 5.226  | 6.304  | 18.549  | 21.026  | 23.337  | 26.217  |
| 13                         | 4.107  | 5.009  | 5.892  | 7.042  | 19.812  | 22.362  | 24.736  | 27.688  |
| 14                         | 4.660  | 5.629  | 6.571  | 7.790  | 21.064  | 23.685  | 26.119  | 29.141  |
| 15                         | 5.229  | 6.262  | 7.261  | 8.547  | 22.307  | 24.996  | 27.488  | 30.578  |
| 16                         | 5.812  | 6.908  | 7.962  | 9.312  | 23.542  | 26.296  | 28.845  | 32.000  |
| 17                         | 6.408  | 7.564  | 8.672  | 10.085 | 24.769  | 27.587  | 30.191  | 33.409  |
| 18                         | 7.015  | 8.231  | 9.390  | 10.865 | 25.989  | 28.869  | 31.526  | 34.805  |
| 19                         | 7.633  | 8.907  | 10.117 | 11.651 | 27.204  | 30.144  | 32.852  | 36.191  |
| 20                         | 8.260  | 9.591  | 10.851 | 12.443 | 28.412  | 31.410  | 34.170  | 37.566  |
| 21                         | 8.897  | 10.283 | 11.591 | 13.240 | 29.615  | 32.671  | 35.479  | 38.932  |
| 22                         | 9.542  | 10.982 | 12.338 | 14.041 | 30.813  | 33.924  | 36.781  | 40.289  |
| 23                         | 10.196 | 11.689 | 13.091 | 14.848 | 32.007  | 35.172  | 38.076  | 41.638  |
| 24                         | 10.856 | 12.401 | 13.848 | 15.659 | 33.196  | 36.415  | 39.364  | 42.980  |
| 25                         | 11.524 | 13.120 | 14.611 | 16.473 | 34.382  | 37.652  | 40.646  | 44.314  |
| 26                         | 12.198 | 13.844 | 15.379 | 17.292 | 35.563  | 38.885  | 41.923  | 45.642  |
| 27                         | 12.879 | 14.573 | 16.151 | 18.114 | 36.741  | 40.113  | 43.195  | 46.963  |
| 28                         | 13.565 | 15.308 | 16.928 | 18.939 | 37.916  | 41.337  | 44.461  | 48.278  |
| 29                         | 14.256 | 16.047 | 17.708 | 19.768 | 39.087  | 42.557  | 45.722  | 49.588  |
| 30                         | 14.953 | 16.791 | 18.493 | 20.599 | 40.256  | 43.773  | 46.979  | 50.892  |
| 40                         | 22.164 | 24.433 | 26.509 | 29.051 | 51.805  | 55.758  | 59.342  | 63.691  |
| 50                         | 29.707 | 32.357 | 34.764 | 37.689 | 63.167  | 67.505  | 71.420  | 76.154  |
| 60                         | 37.485 | 40.482 | 43.188 | 46.459 | 74.397  | 79.082  | 83.298  | 88.379  |
| 70                         | 45.442 | 48.758 | 51.739 | 55.329 | 85.527  | 90.531  | 95.023  | 100.425 |
| 80                         | 53.540 | 57.153 | 60.391 | 64.278 | 96.578  | 101.879 | 106.629 | 112.329 |
| 100                        | 61.754 | 65.647 | 69.126 | 73.291 | 107.565 | 113.145 | 118.136 | 124.116 |
| 1000                       | 70.065 | 74.222 | 77.929 | 82.358 | 118.498 | 124.342 | 129.561 | 135.807 |

