KAKATIYA UNIVERSITY, WARANGAL
B.Sc. (STATISTICS) PRACTICAL EXAMINATIONS PROCEDURE

(With effect from Academic year 2008-2009) (NEW REGULATION)

1. Duration of Practical Examination: 3 hours.


3. **FIVE** questions are to be set, taking **ONE** question from each section from the given question bank.

4. Student is required to solve any **THREE** questions

5. The scheme of Valuation is as given below:
   
   (i) Formula and explanation of symbols --- (5 Marks)
   
   (ii) Tabular forms with circuit diagram wherever necessary- (5 Marks)
   
   (iii) Observations --- (15 Marks)
   
   (iv) Calculations and graphs --- (8 Marks)
   
   (v) Result --- (2 Marks)
   
   (vi) Viva-voce --- (5 Marks)
   
   (vii) Practical Record --- (10 Marks)

   -------------------------------------

   **TOTAL MARKS: ----- (50 Marks)**
KAKATIYA UNIVERSITY
FACULTY OF SCIENCE
B. Sc. I – YEAR, PRACTICAL EXAMINATION
STATISTICS PAPER - I
(Descriptive Statistics and Probability Distributions)
(Question Bank for Practical Examinations)

Note: 1) **FIVE** questions to be set, taking **ONE** question from each section.
2) Student is asked to answer any **THREE** questions.

**SECTION – A**

1. Draw a Histogram and frequency polygon from the following data:

<table>
<thead>
<tr>
<th>Marks</th>
<th>0 – 10</th>
<th>10 – 20</th>
<th>20 – 40</th>
<th>40 – 50</th>
<th>50 – 60</th>
<th>60 – 70</th>
<th>70 - 90</th>
<th>90 - 100</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of Students</td>
<td>4</td>
<td>6</td>
<td>14</td>
<td>16</td>
<td>14</td>
<td>8</td>
<td>16</td>
<td>5</td>
</tr>
</tbody>
</table>

2. Draw a Histogram and frequency polygon from the following data:

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of Students</td>
<td>6</td>
<td>53</td>
<td>85</td>
<td>56</td>
<td>21</td>
<td>16</td>
<td>8</td>
</tr>
</tbody>
</table>

3. Draw ‘less than’ and ‘more than’ Ogives’ from the data give below:

<table>
<thead>
<tr>
<th>Profits (Rs. Lakhs)</th>
<th>10-20</th>
<th>20-30</th>
<th>30-40</th>
<th>40-50</th>
<th>50-60</th>
<th>60-70</th>
<th>70-80</th>
<th>80–90</th>
<th>90-100</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of Students</td>
<td>6</td>
<td>8</td>
<td>12</td>
<td>18</td>
<td>25</td>
<td>16</td>
<td>8</td>
<td>5</td>
<td>2</td>
</tr>
</tbody>
</table>

4. Following information is obtained on the number of telephone calls made by 246 companies for the months of June and July 1999.

<table>
<thead>
<tr>
<th>Telephone Calls</th>
<th>1000-1050</th>
<th>1050-1100</th>
<th>1100-1150</th>
<th>1150-1200</th>
<th>1200-1250</th>
<th>1250-1300</th>
<th>1300-1350</th>
<th>1350-1400</th>
</tr>
</thead>
<tbody>
<tr>
<td>Companies</td>
<td>7</td>
<td>21</td>
<td>32</td>
<td>49</td>
<td>58</td>
<td>41</td>
<td>27</td>
<td>15</td>
</tr>
</tbody>
</table>

   Construct (a) A more than O give  (b) Less than O give

5. Following data relate to year – wise enrolment in a college classified according to sex. Draw a sub-divided Bar-diagram.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of Girls</td>
<td>810</td>
<td>825</td>
<td>844</td>
<td>780</td>
<td>820</td>
</tr>
<tr>
<td>No. of Boys</td>
<td>1215</td>
<td>1160</td>
<td>1325</td>
<td>1410</td>
<td>1480</td>
</tr>
</tbody>
</table>
6. The regional rainfall indices during the year 1986 to 1988 are given below.

<table>
<thead>
<tr>
<th>Year</th>
<th>West</th>
<th>North</th>
<th>East</th>
<th>South</th>
<th>Centre</th>
</tr>
</thead>
<tbody>
<tr>
<td>1988</td>
<td>78.4</td>
<td>88.9</td>
<td>83.7</td>
<td>89.9</td>
<td>86.5</td>
</tr>
<tr>
<td>1989</td>
<td>75.6</td>
<td>62.5</td>
<td>103.6</td>
<td>75.5</td>
<td>77.4</td>
</tr>
<tr>
<td>1990</td>
<td>121.2</td>
<td>116.5</td>
<td>107.6</td>
<td>123.9</td>
<td>90.3</td>
</tr>
</tbody>
</table>

Represent the data by multiple bar diagrams.

7. a) Draw a suitable bar-diagram to represent the following data related to a school.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of Students</td>
<td>210</td>
<td>242</td>
<td>290</td>
<td>315</td>
<td>340</td>
<td>355</td>
</tr>
</tbody>
</table>

b) Depict the following data by a suitable diagram (Balance of Trade = Export – Import)

<table>
<thead>
<tr>
<th>Year</th>
<th>Export</th>
<th>Import</th>
</tr>
</thead>
<tbody>
<tr>
<td>1993</td>
<td>98</td>
<td>115</td>
</tr>
<tr>
<td>1994</td>
<td>110</td>
<td>140</td>
</tr>
<tr>
<td>1995</td>
<td>115</td>
<td>96</td>
</tr>
<tr>
<td>1996</td>
<td>120</td>
<td>100</td>
</tr>
</tbody>
</table>

8. The growth of production of fish for the period 1950 – 51 to 1986 – 87 is given below.

Represent the data by a suitable diagram.

<table>
<thead>
<tr>
<th>Year</th>
<th>Marine</th>
<th>Inland</th>
</tr>
</thead>
<tbody>
<tr>
<td>1950 – 51</td>
<td>5.34</td>
<td>2.18</td>
</tr>
<tr>
<td>1960 – 61</td>
<td>8.80</td>
<td>2.80</td>
</tr>
<tr>
<td>1970 – 71</td>
<td>10.86</td>
<td>6.70</td>
</tr>
<tr>
<td>1980 – 81</td>
<td>15.55</td>
<td>8.87</td>
</tr>
<tr>
<td>1984 – 85</td>
<td>16.98</td>
<td>11.03</td>
</tr>
<tr>
<td>1985 – 86</td>
<td>17.16</td>
<td>11.60</td>
</tr>
<tr>
<td>1986 – 87</td>
<td>12.47</td>
<td>8.42</td>
</tr>
</tbody>
</table>

9. Draw a pie diagram for the following data of six five-year plan public sector outlays.

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Agricultural and Rural Development</td>
<td>12.9%</td>
</tr>
<tr>
<td>2. Irrigation etc.</td>
<td>12.5%</td>
</tr>
<tr>
<td>3. Energy</td>
<td>27.2%</td>
</tr>
<tr>
<td>4. Industry and Minerals</td>
<td>15.4%</td>
</tr>
<tr>
<td>5. Transport, Communication etc.</td>
<td>15.9%</td>
</tr>
<tr>
<td>6. Social Service and other</td>
<td>16.1%</td>
</tr>
</tbody>
</table>
10. The following data relates to the Expenditure (Rs.) of two families A and B. Draw a Multiple pie-diagram.

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Items of Expenditure</th>
<th>Family – A</th>
<th>Family – B</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Expenditure (Rs.)</td>
<td>Expenditure (Rs.)</td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>Food</td>
<td>1200</td>
<td>1700</td>
</tr>
<tr>
<td>2.</td>
<td>Clothing</td>
<td>500</td>
<td>800</td>
</tr>
<tr>
<td>3.</td>
<td>House Rent</td>
<td>600</td>
<td>900</td>
</tr>
<tr>
<td>4.</td>
<td>Fuel and Electricity</td>
<td>250</td>
<td>300</td>
</tr>
<tr>
<td>5.</td>
<td>Miscellaneous</td>
<td>450</td>
<td>800</td>
</tr>
</tbody>
</table>

**SECTION – B**

11. a) Calculate the first four moments about the mean for the following data. Also calculate $\beta_1$ and $\beta_2$.

<table>
<thead>
<tr>
<th>X</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>f</td>
<td>1</td>
<td>8</td>
<td>28</td>
<td>56</td>
<td>70</td>
<td>56</td>
<td>28</td>
<td>8</td>
<td>1</td>
</tr>
</tbody>
</table>

b). For a distribution the mean is 10, variance is 16, $\gamma_1 = +1$ and $\beta_2 = 4$ find the first four moments about the origin.

12. a) Calculate the first four central moments for the following data. Also calculate $\beta_1$ and $\beta_2$.

<table>
<thead>
<tr>
<th>X</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>f</td>
<td>1</td>
<td>6</td>
<td>13</td>
<td>25</td>
<td>30</td>
<td>22</td>
<td>9</td>
<td>5</td>
<td>2</td>
</tr>
</tbody>
</table>

b) In a certain distribution the first four moments about the point 4 are -1.5, 17, -30, and 108, calculate the four moments about mean.

13. Calculate the values of $\mu_2$, $\mu_3$, $\mu_4$. Hence find
   i) A measure of skewness ($\beta_1$) (ii) a measure of Kurtosis ($\beta_2$) for the following distribution and comment on the nature of distribution.

<table>
<thead>
<tr>
<th>Wages (In Rs.)</th>
<th>20–40</th>
<th>40–60</th>
<th>60–80</th>
<th>80–100</th>
<th>100–120</th>
<th>120–140</th>
<th>140–160</th>
<th>160–180</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of Employees</td>
<td>6</td>
<td>9</td>
<td>11</td>
<td>14</td>
<td>20</td>
<td>15</td>
<td>10</td>
<td>8</td>
</tr>
</tbody>
</table>
14. From the following data calculate moments about
   i) Assumed mean 25   ii) actual mean   iii) moments about zero

<table>
<thead>
<tr>
<th>Class</th>
<th>0 – 10</th>
<th>10 – 20</th>
<th>20 – 30</th>
<th>30 – 40</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>1</td>
<td>3</td>
<td>4</td>
<td>2</td>
</tr>
</tbody>
</table>

15. Calculate the first four central moments for the following data and perform Sheppard’s corrections.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>8</td>
<td>16</td>
<td>30</td>
<td>45</td>
<td>62</td>
<td>32</td>
<td>15</td>
<td>6</td>
</tr>
</tbody>
</table>

16. Given below is the distribution based on a random samples of 110 items from the production line of an industry. Calculate Sheppard’s corrections.

<table>
<thead>
<tr>
<th>Class Interval</th>
<th>100 – 105</th>
<th>105 – 110</th>
<th>110 – 115</th>
<th>115 – 120</th>
<th>120 – 125</th>
<th>125 – 130</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of Employees</td>
<td>12</td>
<td>26</td>
<td>35</td>
<td>20</td>
<td>12</td>
<td>5</td>
</tr>
</tbody>
</table>

17. Calculate the first four moments about the origin zero and $\beta_1$ and $\beta_2$ coefficients for the following distribution of marks in statistics in an university examination. Also give your result about the symmetry of the distribution.

<table>
<thead>
<tr>
<th>Marks</th>
<th>20 – 30</th>
<th>30 – 40</th>
<th>40 – 50</th>
<th>50 – 60</th>
<th>60 – 70</th>
<th>70 – 80</th>
<th>80 – 90</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of Students</td>
<td>14</td>
<td>27</td>
<td>39</td>
<td>48</td>
<td>36</td>
<td>12</td>
<td>4</td>
</tr>
</tbody>
</table>

18. Calculate Karl Pearson’s Co-efficient of skewness and Bowley’s coefficient of skewness for the following data.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>f</td>
<td>8</td>
<td>16</td>
<td>30</td>
<td>45</td>
<td>62</td>
<td>32</td>
<td>15</td>
<td>6</td>
</tr>
</tbody>
</table>

19. Obtain Karl Pearson’s measure of skewness and Bowley’s coefficient of skewness for the following data.

<table>
<thead>
<tr>
<th>Class</th>
<th>5.5-10.5</th>
<th>10.5-15.5</th>
<th>15.5-20.5</th>
<th>20.5-25.5</th>
<th>25.5-30.5</th>
<th>30.5-35.5</th>
<th>35.5-40.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>7</td>
<td>7</td>
<td>16</td>
<td>13</td>
<td>2</td>
<td>5</td>
<td>8</td>
</tr>
</tbody>
</table>

20. The daily expenditure of 100 families is given below:

<table>
<thead>
<tr>
<th>Daily Expenditure</th>
<th>0 – 20</th>
<th>20 – 40</th>
<th>40 - 60</th>
<th>60 – 80</th>
<th>80 – 100</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of families</td>
<td>13</td>
<td>?</td>
<td>27</td>
<td>?</td>
<td>16</td>
</tr>
</tbody>
</table>

If the mode of the distribution is 44, calculate the Karl Pearson coefficient of skewness.
SECTION – C

21. Fit a Binomial distribution for the following data using the direct method.

<table>
<thead>
<tr>
<th>X</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>f</td>
<td>0</td>
<td>4</td>
<td>13</td>
<td>28</td>
<td>42</td>
<td>20</td>
<td>6</td>
<td>2</td>
</tr>
</tbody>
</table>

22. Seven coins are tossed and number of heads noted. The experiment is repeated 205 times and the following data is obtained.

<table>
<thead>
<tr>
<th>No. of heads</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>6</td>
<td>11</td>
<td>29</td>
<td>34</td>
<td>52</td>
<td>41</td>
<td>22</td>
<td>9</td>
<td>1</td>
</tr>
</tbody>
</table>

Using the direct method, fit a Binomial distribution when
1) The coin is unbiased  
2) The nature of the coin is not known.

23. Seven coins are tossed and number of heads noted. The experiment is repeated 128 times and the following distribution is obtained.

<table>
<thead>
<tr>
<th>No. of Heads</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>7</td>
<td>6</td>
<td>19</td>
<td>35</td>
<td>30</td>
<td>23</td>
<td>7</td>
<td>1</td>
</tr>
</tbody>
</table>

Fit a Binomial distribution using recurrence formula, assuming that
(i) The coin is unbiased  
(ii) The nature of the coin is not known.


<table>
<thead>
<tr>
<th>X</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>f</td>
<td>5</td>
<td>3</td>
<td>9</td>
<td>19</td>
<td>11</td>
<td>12</td>
<td>3</td>
<td>5</td>
<td>2</td>
</tr>
</tbody>
</table>

25. Fit a Poisson distribution using the direct method to the following data.

<table>
<thead>
<tr>
<th>X</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>f</td>
<td>142</td>
<td>156</td>
<td>69</td>
<td>27</td>
<td>5</td>
<td>1</td>
</tr>
</tbody>
</table>

26. In 1000 consecutive issues of the ‘utopian seven daily chronicle’ the deaths of centenarians were recorded, the number x having the frequency ‘f’ according to the table. Fit a Poisson distribution by direct method.

<table>
<thead>
<tr>
<th>X</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>f</td>
<td>229</td>
<td>325</td>
<td>257</td>
<td>119</td>
<td>50</td>
<td>17</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>
27. The numbers of the phone calls received at one exchange in 245 successive one minute intervals are given in the following frequency distribution. Fit a Poisson distribution by recurrence method.

<table>
<thead>
<tr>
<th>Number of calls</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>14</td>
<td>21</td>
<td>25</td>
<td>43</td>
<td>51</td>
<td>40</td>
<td>39</td>
<td>12</td>
</tr>
</tbody>
</table>

28. Fit a Poisson distribution by recurrence method to the following data which gives the number of dodders in a sample of clover seeds.

<table>
<thead>
<tr>
<th>No. of dodders (x)</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observed frequency</td>
<td>56</td>
<td>156</td>
<td>132</td>
<td>92</td>
<td>37</td>
<td>22</td>
<td>4</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

29. Fit a negative Binominal distribution and calculate the expected frequencies.

<table>
<thead>
<tr>
<th>X</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>f</td>
<td>213</td>
<td>128</td>
<td>37</td>
<td>18</td>
<td>3</td>
<td>1</td>
</tr>
</tbody>
</table>

30. The number of accidents among 414 machines operators was investigated for three successive months. The following table gives the distribution of the operators according the number of accidents which happened to the same operators.

<table>
<thead>
<tr>
<th>X</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>f</td>
<td>296</td>
<td>74</td>
<td>26</td>
<td>8</td>
<td>4</td>
<td>4</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

Fit a negative Binomial distribution.

31. For the following frequency distribution, Fit a Geometric distribution.

<table>
<thead>
<tr>
<th>X</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>f</td>
<td>1</td>
<td>3</td>
<td>9</td>
<td>15</td>
<td>21</td>
<td>26</td>
</tr>
</tbody>
</table>

32. Fit a normal distribution using Areas method for the following data.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>5</td>
<td>12</td>
<td>13</td>
<td>42</td>
<td>76</td>
<td>12</td>
<td>3</td>
<td>15</td>
</tr>
</tbody>
</table>

Also obtain the expected normal frequencies.
33. Fit a normal distribution to the following data by area’s method.

<table>
<thead>
<tr>
<th>Class</th>
<th>60 – 65</th>
<th>65 – 70</th>
<th>70 – 75</th>
<th>75 – 80</th>
<th>80 – 85</th>
<th>85 – 90</th>
<th>90 – 95</th>
<th>95 – 100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>3</td>
<td>21</td>
<td>150</td>
<td>335</td>
<td>326</td>
<td>135</td>
<td>26</td>
<td>4</td>
</tr>
</tbody>
</table>

34. Fit a normal distribution for the following data by ordinates method.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>f</td>
<td>9</td>
<td>24</td>
<td>51</td>
<td>66</td>
<td>72</td>
<td>48</td>
<td>21</td>
<td>6</td>
<td>3</td>
</tr>
</tbody>
</table>

35. Fit a normal distribution for the following data by the method of ordinates.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>F</td>
<td>5</td>
<td>18</td>
<td>42</td>
<td>27</td>
<td>8</td>
</tr>
</tbody>
</table>

36. Fit a normal distribution and obtain the expected frequencies by using any one of the methods for the following data.

<table>
<thead>
<tr>
<th>C.I.</th>
<th>0 – 7</th>
<th>7 – 14</th>
<th>14 – 21</th>
<th>21 – 28</th>
<th>28 – 35</th>
<th>35 – 42</th>
<th>42 – 49</th>
</tr>
</thead>
<tbody>
<tr>
<td>f</td>
<td>3</td>
<td>12</td>
<td>15</td>
<td>28</td>
<td>49</td>
<td>17</td>
<td>4</td>
</tr>
</tbody>
</table>

37. 200 electrical bulbs tested for the following data obtained. Fit an exponential distribution and draw graph for the observed and expected frequency.

<table>
<thead>
<tr>
<th>C.I.</th>
<th>0 – 20</th>
<th>20 – 40</th>
<th>40 – 60</th>
<th>60 – 80</th>
<th>80 – 100</th>
</tr>
</thead>
<tbody>
<tr>
<td>f</td>
<td>104</td>
<td>56</td>
<td>24</td>
<td>12</td>
<td>4</td>
</tr>
</tbody>
</table>

38. The life time (in hours) of an I.C. of television set of a certain type is tested for 200 T.V. sets and recorded in the following frequency distribution.

<table>
<thead>
<tr>
<th>Life time (in hrs)</th>
<th>0 – 30</th>
<th>30 – 60</th>
<th>60 – 90</th>
<th>90 – 120</th>
<th>120 – 150</th>
<th>150 – 180</th>
<th>180 – 210</th>
<th>210 – 240</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>108</td>
<td>45</td>
<td>21</td>
<td>9</td>
<td>8</td>
<td>5</td>
<td>4</td>
<td>0</td>
</tr>
</tbody>
</table>

Fit an exponential distribution.

39. The waiting time X (in minutes) at a railway booking counter is exponentially distributed. The following distribution is obtained for 200 passengers.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of passengers</td>
<td>79</td>
<td>48</td>
<td>29</td>
<td>18</td>
<td>11</td>
<td>7</td>
<td>4</td>
<td>4</td>
</tr>
</tbody>
</table>

Fit an exponential distribution.
40. In air force operation, suppose a pilot-less helicopter is flying at 1 K.M. height from the origin. It has a sophisticated machine gun which identifies the enemy crossing the border and fires at him. It can uniformly turn in between $\left(\frac{-\pi}{2}, \frac{\pi}{2}\right)$. It was reported that 200 terrorists were killed at different places along the border as given below. Fit a Cauchy distribution.

<table>
<thead>
<tr>
<th>Distance</th>
<th>$-\infty$ to $-25$</th>
<th>$-25$ to $-19$</th>
<th>$-19$ to $-13$</th>
<th>$-13$ to $-7$</th>
<th>$-7$ to $-1$</th>
<th>$-1$ to $-5$</th>
<th>$5$ to $11$</th>
<th>$11$ to $17$</th>
<th>$17$ to $23$</th>
<th>$23$ to $+\infty$</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of terrorists killed</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>4</td>
<td>41</td>
<td>137</td>
<td>7</td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
</tbody>
</table>

41. Fit a Cauchy distribution with location parameter 1.5 and scale parameter 1.

<table>
<thead>
<tr>
<th>Distance</th>
<th>$-\infty$ to $-15$</th>
<th>$-15$ to $-12$</th>
<th>$-12$ to $-9$</th>
<th>$-9$ to $-6$</th>
<th>$-6$ to $-3$</th>
<th>$-3$ to $0$</th>
<th>$0$ to $3$</th>
<th>$3$ to $6$</th>
<th>$6$ to $9$</th>
<th>$9$ to $12$</th>
<th>$12$ to $15$</th>
<th>$15$ to $\infty$</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of terrorists killed</td>
<td>17</td>
<td>1</td>
<td>3</td>
<td>5</td>
<td>15</td>
<td>60</td>
<td>311</td>
<td>59</td>
<td>14</td>
<td>3</td>
<td>2</td>
<td>16</td>
</tr>
</tbody>
</table>

**SECTION – E**

42. Draw the histogram for ungrouped data using MS EXCEL.

<table>
<thead>
<tr>
<th>Data</th>
<th>2.4</th>
<th>3.9</th>
<th>4.7</th>
<th>4.9</th>
<th>5.9</th>
<th>7.9</th>
<th>10.3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data</td>
<td>3.4</td>
<td>3.9</td>
<td>4.8</td>
<td>4.9</td>
<td>6.0</td>
<td>8.0</td>
<td>10.4</td>
</tr>
<tr>
<td>Data</td>
<td>3.5</td>
<td>3.9</td>
<td>4.8</td>
<td>4.9</td>
<td>6.4</td>
<td>8.0</td>
<td>10.7</td>
</tr>
<tr>
<td>Data</td>
<td>3.5</td>
<td>3.9</td>
<td>4.8</td>
<td>4.9</td>
<td>6.4</td>
<td>8.0</td>
<td>11.0</td>
</tr>
<tr>
<td>Data</td>
<td>3.6</td>
<td>4.1</td>
<td>4.8</td>
<td>4.9</td>
<td>6.6</td>
<td>8.3</td>
<td>11.6</td>
</tr>
<tr>
<td>Data</td>
<td>3.6</td>
<td>4.4</td>
<td>4.9</td>
<td>5.0</td>
<td>7.0</td>
<td>8.3</td>
<td>12.0</td>
</tr>
<tr>
<td>Data</td>
<td>3.6</td>
<td>4.5</td>
<td>4.9</td>
<td>5.4</td>
<td>7.2</td>
<td>8.5</td>
<td></td>
</tr>
<tr>
<td>Data</td>
<td>3.8</td>
<td>4.6</td>
<td>4.9</td>
<td>5.8</td>
<td>7.4</td>
<td>8.6</td>
<td></td>
</tr>
<tr>
<td>Data</td>
<td>3.9</td>
<td>4.7</td>
<td>4.9</td>
<td>5.8</td>
<td>7.7</td>
<td>8.8</td>
<td></td>
</tr>
</tbody>
</table>
43. Draw the Histogram for the grouped data using MS EXCEL.

<table>
<thead>
<tr>
<th>C.I.</th>
<th>20-30</th>
<th>30-40</th>
<th>40-50</th>
<th>50-60</th>
<th>60-70</th>
<th>70-80</th>
<th>80–90</th>
</tr>
</thead>
<tbody>
<tr>
<td>f</td>
<td>4</td>
<td>6</td>
<td>8</td>
<td>12</td>
<td>9</td>
<td>7</td>
<td>4</td>
</tr>
</tbody>
</table>

44. Draw the frequency polygon for the following data using MS-EXCEL.

<table>
<thead>
<tr>
<th>Class</th>
<th>0-10</th>
<th>10-20</th>
<th>20-30</th>
<th>30-40</th>
<th>40-50</th>
<th>50-60</th>
<th>60-70</th>
<th>70-80</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>2</td>
<td>8</td>
<td>2</td>
<td>15</td>
<td>19</td>
<td>13</td>
<td>6</td>
<td>1</td>
</tr>
</tbody>
</table>

45. Draw the OGIVE curves for the following data using MS-EXCEL.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>2</td>
<td>4</td>
<td>7</td>
<td>11</td>
<td>15</td>
<td>10</td>
<td>6</td>
<td>2</td>
</tr>
</tbody>
</table>

46. Following data relate to the year-wise enrolment of students in a college. Draw a simple Bar diagrams using MS-EXCEL.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Students Enrolments</td>
<td>100</td>
<td>175</td>
<td>250</td>
<td>225</td>
<td>300</td>
<td>350</td>
<td>400</td>
</tr>
</tbody>
</table>

47. Draw a sub-divided and multiple Bar-diagram using MS-EXCEL for the following data.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Boys</td>
<td>100</td>
<td>150</td>
<td>240</td>
<td>290</td>
<td>300</td>
<td>350</td>
</tr>
<tr>
<td>Girls</td>
<td>50</td>
<td>75</td>
<td>170</td>
<td>250</td>
<td>290</td>
<td>320</td>
</tr>
</tbody>
</table>

48. Draw a pie diagram using MS-EXCEL represent the following data showing the unit of electricity sold to different classes of consumers during a month by an electricity supplying company.

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Consumers Class</th>
<th>Percentage of Units Sold</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Motive Power</td>
<td>40</td>
</tr>
<tr>
<td>2</td>
<td>Light &amp; Fans</td>
<td>30</td>
</tr>
<tr>
<td>3</td>
<td>Domestic Supply</td>
<td>25</td>
</tr>
<tr>
<td>4</td>
<td>Street Light</td>
<td>5</td>
</tr>
</tbody>
</table>

49. Calculate measures of central tendency, dispersion and coefficients of skewness, kurtosis using MS-EXCEL for the following data.

<table>
<thead>
<tr>
<th>Size (x)</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>6</td>
<td>12</td>
<td>15</td>
<td>28</td>
<td>20</td>
<td>14</td>
<td>5</td>
</tr>
</tbody>
</table>
50. Calculate measures of central tendency, dispersion and coefficient of skewness, kurtosis using MS-EXCEL for the following data.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>8</td>
<td>10</td>
<td>12</td>
<td>20</td>
<td>11</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

51. Fit a binomial distribution direct method using MS-EXCEL.

<table>
<thead>
<tr>
<th>X</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>f</td>
<td>0</td>
<td>4</td>
<td>13</td>
<td>28</td>
<td>42</td>
<td>20</td>
<td>6</td>
<td>2</td>
</tr>
</tbody>
</table>

52. The distribution of typing mistakes committed by a typist is given below. Assuming a Poisson model find out the expected frequencies using MS-EXCEL.

<table>
<thead>
<tr>
<th>Mistakes per page</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of Pages</td>
<td>142</td>
<td>156</td>
<td>69</td>
<td>27</td>
<td>5</td>
<td>1</td>
</tr>
</tbody>
</table>

53. The study of divorced cases in the western countries, the following distribution is obtained for the time interval (in yeas) between the day of their marriages and the day of the their divorce. Fit an exponential distribution using MS-EXCEL.

<table>
<thead>
<tr>
<th>No. of year</th>
<th>0 – 2</th>
<th>2 – 4</th>
<th>4 – 6</th>
<th>6 – 8</th>
<th>8 – 10</th>
<th>10 and Above</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of Persons</td>
<td>126</td>
<td>48</td>
<td>17</td>
<td>6</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

54. Fit a Cauchy distribution for the following data using MS-EXCEL.

<table>
<thead>
<tr>
<th>Distance</th>
<th>Observed frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>-∞ to -29</td>
<td>12</td>
</tr>
<tr>
<td>-29 to -21</td>
<td>10</td>
</tr>
<tr>
<td>-21 to -13</td>
<td>20</td>
</tr>
<tr>
<td>-13 to -5</td>
<td>38</td>
</tr>
<tr>
<td>-5 to 3</td>
<td>400</td>
</tr>
<tr>
<td>3 to 11</td>
<td>32</td>
</tr>
<tr>
<td>11 to 19</td>
<td>20</td>
</tr>
<tr>
<td>19 to 27</td>
<td>10</td>
</tr>
<tr>
<td>27 to 35</td>
<td>8</td>
</tr>
<tr>
<td>35 to +∞</td>
<td>0</td>
</tr>
</tbody>
</table>
KAKATIYA UNIVERSITY
FACULTY OF SCIENCE
B. Sc. II - YEAR, PRACTICAL EXAMINATION
STATISTICS PAPER - II
(Statistical Methods and Inference)
(Question Bank for Practical Examinations)

Note: 1) **FIVE** questions to be set, taking **ONE** question from each section.
2) Student is asked to answer any **THREE** questions.

**SECTION – A**

1. Fit a straight line to the following data using the method of least squares and calculate expected values.

<table>
<thead>
<tr>
<th>X</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>6</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of Students</td>
<td>2.4</td>
<td>3.6</td>
<td>4.0</td>
<td>5.0</td>
<td>6.0</td>
<td></td>
</tr>
</tbody>
</table>

2. Fit a straight line by the method of least squares to the following data.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Production (1000 Qts)</td>
<td>80</td>
<td>90</td>
<td>92</td>
<td>83</td>
<td>94</td>
<td>99</td>
<td>92</td>
</tr>
</tbody>
</table>

3. Fit a parabola of second degree by the method of least squares to the following data.

<table>
<thead>
<tr>
<th>X</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y</td>
<td>1.0</td>
<td>1.8</td>
<td>1.3</td>
<td>2.5</td>
<td>6.3</td>
</tr>
</tbody>
</table>

4. Fit a second degree parabola by the method of least squares method.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales</td>
<td>18</td>
<td>16</td>
<td>17</td>
<td>18</td>
<td>15</td>
</tr>
</tbody>
</table>

5. Fit an exponential curve of the form $y = ab^x$ to the following data by the method of least squares.

<table>
<thead>
<tr>
<th>X</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y</td>
<td>1.0</td>
<td>1.2</td>
<td>1.8</td>
<td>2.5</td>
<td>3.6</td>
<td>4.7</td>
<td>6.6</td>
<td>9.1</td>
</tr>
</tbody>
</table>

6. Fit an Exponential curve of the form $Y = ab^x$ to the following data. By the method of least squares.

<table>
<thead>
<tr>
<th>Year (X)</th>
<th>1951</th>
<th>1952</th>
<th>1953</th>
<th>1954</th>
<th>1955</th>
<th>1956</th>
<th>1957</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population (Y)</td>
<td>201</td>
<td>263</td>
<td>314</td>
<td>395</td>
<td>427</td>
<td>504</td>
<td>612</td>
</tr>
</tbody>
</table>
7. Fit an exponential curve of the form \( Y = ae^{bx} \) to the following data. By the method of least squares.

<table>
<thead>
<tr>
<th>X</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y</td>
<td>8.3</td>
<td>15.4</td>
<td>33.1</td>
<td>65.2</td>
<td>127.4</td>
</tr>
</tbody>
</table>

8. Fit an Exponential curve of the form \( y = ae^{bx} \) to the following data. By the method of least squares.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Profit (y)</td>
<td>52</td>
<td>45</td>
<td>98</td>
<td>92</td>
<td>110</td>
<td>185</td>
<td>175</td>
<td>220</td>
</tr>
</tbody>
</table>

9. Fit a power curve \( Y = ax^b \) for the following data and find the expected values.

<table>
<thead>
<tr>
<th>X</th>
<th>1</th>
<th>3</th>
<th>4</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y</td>
<td>7</td>
<td>10</td>
<td>15</td>
<td>21</td>
<td>27</td>
<td>28</td>
</tr>
</tbody>
</table>

10. Investigate the association between darkness of eye-color in father and son from the following data:

| Fathers with dark eyes and sons with dark eyes | 50   |
| Fathers with dark eyes and sons with not dark eyes | 79   |
| Fathers with not dark eyes and sons with dark eyes | 89   |
| Fathers with not dark eyes and sons with not dark eyes | 782  |

Also tabulate for comparison the frequencies that would have been observed had there been no heredity.

11. The following table shows the association among 1,000 criminals between their weight and mentality. Calculate the coefficient of contingency between the two.

<table>
<thead>
<tr>
<th>Weight in Pounds</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mentality</td>
<td></td>
</tr>
<tr>
<td>110-120</td>
<td>800</td>
</tr>
<tr>
<td>120-130</td>
<td>200</td>
</tr>
<tr>
<td>130-140</td>
<td>270</td>
</tr>
<tr>
<td>140-150</td>
<td>240</td>
</tr>
<tr>
<td>Above 150</td>
<td>270</td>
</tr>
<tr>
<td>Total</td>
<td>1000</td>
</tr>
</tbody>
</table>
SECTION – B

12. Calculate the correlation co-efficient for the following height (in inches) of fathers (X) and their sons (Y)

<table>
<thead>
<tr>
<th></th>
<th>65</th>
<th>66</th>
<th>67</th>
<th>68</th>
<th>69</th>
<th>70</th>
<th>72</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Y</td>
<td>67</td>
<td>68</td>
<td>65</td>
<td>68</td>
<td>72</td>
<td>69</td>
<td>71</td>
</tr>
</tbody>
</table>

13. The following table give the frequency, according to grades and marks obtained by 67 students in an intelligence test. Measure the degree of relation ship between age and intelligence test.

<table>
<thead>
<tr>
<th>Marks</th>
<th>Age in years</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>18</td>
<td>19</td>
</tr>
<tr>
<td>200 – 250</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>250 – 300</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>300 – 350</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>350 – 400</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>10</td>
<td>19</td>
</tr>
</tbody>
</table>

14. Ten competitions in a beauty contest are ranked by three judges in the following order.

<table>
<thead>
<tr>
<th>1st Judge</th>
<th>1</th>
<th>6</th>
<th>5</th>
<th>10</th>
<th>3</th>
<th>2</th>
<th>4</th>
<th>9</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>2nd Judge</td>
<td>3</td>
<td>5</td>
<td>8</td>
<td>4</td>
<td>7</td>
<td>10</td>
<td>2</td>
<td>1</td>
<td>6</td>
<td>9</td>
</tr>
<tr>
<td>3rd Judge</td>
<td>6</td>
<td>4</td>
<td>9</td>
<td>8</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>10</td>
<td>5</td>
<td>7</td>
</tr>
</tbody>
</table>

Use the rank correlation coefficient to determine which pair of judges has the nearest approach to common tastes in beauty.

15. Suppose the observations on X and Y are give as:

<table>
<thead>
<tr>
<th>X Statistics</th>
<th>59</th>
<th>65</th>
<th>45</th>
<th>52</th>
<th>60</th>
<th>62</th>
<th>70</th>
<th>55</th>
<th>45</th>
<th>49</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y Maths</td>
<td>75</td>
<td>70</td>
<td>55</td>
<td>65</td>
<td>60</td>
<td>69</td>
<td>80</td>
<td>65</td>
<td>57</td>
<td>61</td>
</tr>
</tbody>
</table>

Compute the least square regression lines of Y on X and X on Y. If a student gets 61 marks in statistics what would you estimate his marks in mathematics.
16. Following are the data pertaining to the production and export of sugar in lakh tones in India from 1971 to 1982.

<table>
<thead>
<tr>
<th>Production (X)</th>
<th>37.4</th>
<th>31.1</th>
<th>38.7</th>
<th>39.5</th>
<th>47.9</th>
<th>42.6</th>
<th>48.4</th>
<th>64.6</th>
<th>58.4</th>
<th>38.6</th>
<th>51.4</th>
<th>84.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Export (Y)</td>
<td>3.90</td>
<td>1.33</td>
<td>1.10</td>
<td>4.39</td>
<td>9.41</td>
<td>9.67</td>
<td>3.41</td>
<td>2.51</td>
<td>8.62</td>
<td>9.90</td>
<td>6.64</td>
<td>6.50</td>
</tr>
</tbody>
</table>

Find the regression lines of X on Y and Y on X. Also estimate export when production is 47.5 lakh tones.

17. Obtain the regression equation of Y on X and X on Y the value of ‘r’ from the following table giving the marks in accountancy and statistics.

<table>
<thead>
<tr>
<th>Marks in Statistics</th>
<th>Marks in accountancy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Y</td>
</tr>
<tr>
<td>0 – 10</td>
<td>1</td>
</tr>
<tr>
<td>10 – 20</td>
<td>3</td>
</tr>
<tr>
<td>20 – 30</td>
<td>1</td>
</tr>
<tr>
<td>30 – 40</td>
<td>-</td>
</tr>
<tr>
<td>40 – 50</td>
<td>-</td>
</tr>
<tr>
<td>Total</td>
<td>5</td>
</tr>
</tbody>
</table>

18. Compute partial correlation co-efficient for the following data.

<table>
<thead>
<tr>
<th>X₁</th>
<th>4</th>
<th>5</th>
<th>7</th>
<th>9</th>
<th>13</th>
<th>15</th>
</tr>
</thead>
<tbody>
<tr>
<td>X₂</td>
<td>15</td>
<td>12</td>
<td>8</td>
<td>6</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>X₃</td>
<td>30</td>
<td>24</td>
<td>20</td>
<td>14</td>
<td>10</td>
<td>4</td>
</tr>
</tbody>
</table>

19. The following data gives the weights (X₁) to the nearest pound, heights (X₂) to the nearest inches, and ages (X₃) to the nearest years of 12 boys data given below.

<table>
<thead>
<tr>
<th>Weights (X₁)</th>
<th>64</th>
<th>53</th>
<th>71</th>
<th>67</th>
<th>55</th>
<th>58</th>
<th>77</th>
<th>57</th>
<th>56</th>
<th>51</th>
<th>76</th>
<th>68</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heights (X₂)</td>
<td>57</td>
<td>49</td>
<td>59</td>
<td>62</td>
<td>51</td>
<td>50</td>
<td>55</td>
<td>48</td>
<td>52</td>
<td>42</td>
<td>61</td>
<td>57</td>
</tr>
<tr>
<td>Age (X₃)</td>
<td>8</td>
<td>6</td>
<td>10</td>
<td>11</td>
<td>8</td>
<td>7</td>
<td>10</td>
<td>9</td>
<td>10</td>
<td>6</td>
<td>12</td>
<td>9</td>
</tr>
</tbody>
</table>

Compute multiple correlation coefficients.
20. Compute correlation ratio $\eta_{xy}$ from the following table.

<table>
<thead>
<tr>
<th>Y</th>
<th>X</th>
<th>10</th>
<th>15</th>
<th>20</th>
<th>25</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>3</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>-</td>
<td>1</td>
<td>4</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>-</td>
<td>3</td>
<td>4</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>2</td>
<td>1</td>
<td>5</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>-</td>
<td>6</td>
<td>-</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

21. Calculate rank correlation coefficient for the following data.

<table>
<thead>
<tr>
<th>X</th>
<th>68</th>
<th>64</th>
<th>75</th>
<th>50</th>
<th>64</th>
<th>80</th>
<th>75</th>
<th>40</th>
<th>55</th>
<th>64</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y</td>
<td>62</td>
<td>58</td>
<td>68</td>
<td>45</td>
<td>81</td>
<td>60</td>
<td>68</td>
<td>48</td>
<td>50</td>
<td>70</td>
</tr>
</tbody>
</table>

**SECTION – C**

22. a). A dice is thrown 9000 times and throw 3 or 4 observed 3240 times. Test whether the dice can be regarded as an unbiased one.

b). The means of two single large samples of 1000 and 2000 members are 67.5 inches and 68.0 inches respectively. Can the samples be regarded as drawn from the same population of standard deviation 2.5 inches? (Test at 5% l.o.s.)

23. a). A sample of 900 members as a mean 3.5 cms and standard deviation is 2.61 cms. Is the sample from a large population of mean 3.25cms and S.D. 2.61 cms.  

   $(\alpha =5\%)$

b). Before an increase in excise duty on tea, 800 persons out of sample of 1000 persons were found to be tea drinkers. After an increase in duty, 800 people were tea drinkers in a sample of 1200 people. Test at $\alpha = 0.05$ whether there is a significant decrease in the consumption of tea after the increase in excise duty.

24. a). A coin is tossed 10,000 times and it turns up head 5,195 times. Test at 5% level of significance whether the coin can be treated as unbiased one.
b). The mean height of a random sample of size 100 individuals from a population 64.3 inches. The standard deviation of the sample is 2.7 inches. Would it be reasonable that the mean height of the population is 60 inches (Test at $\alpha = 0.01$.)

25. An insurance agent has claimed that the average age of policy holders who insure through him is less than the average for all agents, which is 30.5 years.

A random sample of 100 policy holders who had insured through him gave the following age distribution.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of persons</td>
<td>12</td>
<td>22</td>
<td>20</td>
<td>30</td>
<td>16</td>
</tr>
</tbody>
</table>

Calculate the arithmetic mean and S.D. of this distribution and use these values to test his claim at the 5% level of significance.

26. Random samples drawn from two countries gave the following data relating to the heights of adult males.

<table>
<thead>
<tr>
<th></th>
<th>Country A</th>
<th>Country B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean height in inches</td>
<td>67.42</td>
<td>67.25</td>
</tr>
<tr>
<td>S.D.</td>
<td>2.58</td>
<td>2.50</td>
</tr>
<tr>
<td>Number in Samples</td>
<td>1000</td>
<td>1200</td>
</tr>
</tbody>
</table>

a) Is the difference in means significant.

b) Is the difference in S.D. significant (use $\alpha = 0.05$)

27. The correlation between the price indices of animal feeding stuffs and home-grown cats in a sample of 60 members is 0.68 could the observed value have arisen.

a) From an uncorrelated population?

b) From a population in which true correlation was 0.8?

28. Prices of shares of a company of 10 days were found to be 66, 65, 69, 70, 69, 71, 70, 63, 64, 68 can be concluded that the prices of shares on an average is 65?
29. Below are given the gain in weights (in lbs) of pigs fed on two diets ‘A’ and ‘B’.

<table>
<thead>
<tr>
<th>Gain in Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diet A</td>
</tr>
<tr>
<td>25 32 30 34 24</td>
</tr>
<tr>
<td>14 32 24 30 31</td>
</tr>
<tr>
<td>35 25</td>
</tr>
<tr>
<td>Diet B</td>
</tr>
<tr>
<td>44 34 22 10 47</td>
</tr>
<tr>
<td>31 40 30 32 35</td>
</tr>
<tr>
<td>18 21 35 29 22</td>
</tr>
</tbody>
</table>

Test, if the two diets differ significantly as regards their effect on increase in weight.

30. 12 school boys were given a test in mathematics they were given a month of coaching and second test was held at the end of it. The marks recorded are as follows.

<table>
<thead>
<tr>
<th>Boys</th>
<th>Marks in Test – I</th>
<th>Marks in Test – II</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>44 40 61 52 32 44</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>50 70 67 72 53 72</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>38 69 57 46 39 73</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>53 38 69 57 46 39</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>52 51 57 46 39 73</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>72 67 74 73 72 53</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>72 53 74 60 78 53</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>72 53 74 60 78 53</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>72 53 74 60 78 53</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>72 53 74 60 78 53</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>72 53 74 60 78 53</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>72 53 74 60 78 53</td>
<td></td>
</tr>
</tbody>
</table>

Do the marks give the evidence that the students have been benefited by the extra coaching?

31. It is believed that the precision (as measured by the variance) of an instrument is no more than 0.16. Write down the null and alternative hypothesis for testing this belief. Carry out the test at 1% level given 11 measurement of the same subject on the instrument.

2.5, 2.3, 2.4, 2.3, 2.5, 2.7, 2.5, 2.6, 2.6, 2.7, 2.5.

**SECTION – D**

32. Two samples are drawn from two normal population from the data information given below. Test whether the two samples have the same variance at 5% and 1% l.o.s.

| Sample – I | 60 65 71 74 76 82 85 87 - - |
| Sample – II| 61 66 67 85 78 63 85 86 91 88 |

33. a). In an experiment on pea breeding, Mendal obtained the following frequencies of seeds. 315 round and yellow, 101 wrinkled and yellow, 108 round and green and 32 wrinkled and green. Theory predicts that the frequencies would be in the proportion 9:3:3:1 does the experiment results support the theory?
b). A survey of 320 families with 5 children each revealed the following distribution.

<table>
<thead>
<tr>
<th>No. of Boys</th>
<th>5</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of Girls</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>No. of Families</td>
<td>14</td>
<td>56</td>
<td>110</td>
<td>88</td>
<td>40</td>
<td>12</td>
</tr>
</tbody>
</table>

Is this result consistent with the hypothesis that male and female births are equally probable?

34. The following table reveals the conditions of the house and the condition of the children.

<table>
<thead>
<tr>
<th>Conditions of children</th>
<th>Condition of house</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Clean</td>
<td>Not Clean</td>
</tr>
<tr>
<td>Very Clean</td>
<td>76</td>
<td>43</td>
</tr>
<tr>
<td>Clean</td>
<td>38</td>
<td>17</td>
</tr>
<tr>
<td>Dirty</td>
<td>25</td>
<td>47</td>
</tr>
<tr>
<td>Total</td>
<td>139</td>
<td>107</td>
</tr>
</tbody>
</table>

At 5% l.o.s. find out whether the condition of house effects the condition of children.

35. The following table shows.

<table>
<thead>
<tr>
<th>Eye colour in father</th>
<th>Eye Colour in sons</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Not Light</td>
</tr>
<tr>
<td>Not light</td>
<td>230</td>
</tr>
<tr>
<td>Light</td>
<td>151</td>
</tr>
</tbody>
</table>

Test whether the colour of sons’s eye is associated with that of the father.

36. a) Test the randomness of the samples 8, 4, 6, 3, 9, 12, 15, 6, 9, 13, 7 by using single sample run test.

b) Test the median equal to 20 of the population at 1% l.o.s. 15, 18, 22, 20, 16, 25, 28, 18, 19, 41, 21.

37. The following are the scores of certain randomly selected students at mid term and final examinations.

<table>
<thead>
<tr>
<th>Mid term Score X</th>
<th>55</th>
<th>57</th>
<th>72</th>
<th>90</th>
<th>57</th>
<th>74</th>
</tr>
</thead>
<tbody>
<tr>
<td>Final Score Y</td>
<td>80</td>
<td>76</td>
<td>63</td>
<td>58</td>
<td>56</td>
<td>37</td>
</tr>
</tbody>
</table>

Apply ‘run test’ to test whether the distribution of scores at two occasions is same (use $\alpha = 0.05$)
38. Test the equality of two populations at 1% l.o.s. by using paired sign test.

<table>
<thead>
<tr>
<th>Sample – I</th>
<th>2</th>
<th>8</th>
<th>6</th>
<th>7</th>
<th>9</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample – II</td>
<td>3</td>
<td>5</td>
<td>9</td>
<td>6</td>
<td>10</td>
<td>4</td>
</tr>
</tbody>
</table>

39. Test the equality of population by using Median Test.

<table>
<thead>
<tr>
<th>Sample – I</th>
<th>2</th>
<th>8</th>
<th>6</th>
<th>4</th>
<th>3</th>
<th>-</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample – II</td>
<td>8</td>
<td>2</td>
<td>9</td>
<td>7</td>
<td>5</td>
<td>7</td>
</tr>
</tbody>
</table>

40. Test the equality of two populations at 1% l.o.s. by using mann-whitney wilcoxon signed rank test.

<table>
<thead>
<tr>
<th>Sample – I</th>
<th>8</th>
<th>7</th>
<th>6</th>
<th>3</th>
<th>5</th>
<th>10</th>
<th>4</th>
<th>8</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample – II</td>
<td>3</td>
<td>8</td>
<td>7</td>
<td>2</td>
<td>6</td>
<td>4</td>
<td>3</td>
<td>7</td>
<td>6</td>
</tr>
</tbody>
</table>

41. The data 10 plots each, under two treatments are as given below:

<table>
<thead>
<tr>
<th>Treatment I</th>
<th>46</th>
<th>45</th>
<th>32</th>
<th>42</th>
<th>39</th>
<th>48</th>
<th>49</th>
<th>30</th>
<th>51</th>
<th>34</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment II</td>
<td>44</td>
<td>40</td>
<td>59</td>
<td>47</td>
<td>55</td>
<td>50</td>
<td>47</td>
<td>70</td>
<td>43</td>
<td>55</td>
</tr>
</tbody>
</table>

Apply an appropriate Non-parametric test to test whether the medians of two populations from which the above two sample have been chosen are same (use $\alpha = 0.05$).

**SECTION – E**

42. Generate the uniform random numbers between (0, 1) using MS-Excel.

43. Generate the uniform random numbers between (2, 5) using MS-EXCEL.

44. Generate the Poisson random numbers with parameters ($\lambda = 2$) using MS-Excel.

45. Generate the Exponential random numbers with parameter ($\theta = 2$) using MS-Excel.

46. Generate the standard normal random Numbers using MS-Excel.

47. Fit a straight line by least squares method using MS-Excel.

<table>
<thead>
<tr>
<th>X</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y</td>
<td>2</td>
<td>5</td>
<td>8</td>
<td>11</td>
<td>14</td>
<td>17</td>
</tr>
</tbody>
</table>
48. Fit a second degree parabola to the following data using MS-Excel.

<table>
<thead>
<tr>
<th>X</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y</td>
<td>2</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>10</td>
<td>11</td>
<td>11</td>
<td>10</td>
<td>0</td>
</tr>
</tbody>
</table>

49. Calculate Karl Pearson’s coefficient of correlation for the following data using MS-Excel.

<table>
<thead>
<tr>
<th>X</th>
<th>55</th>
<th>56</th>
<th>57</th>
<th>57</th>
<th>58</th>
<th>59</th>
<th>60</th>
<th>62</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y</td>
<td>57</td>
<td>58</td>
<td>55</td>
<td>58</td>
<td>62</td>
<td>62</td>
<td>59</td>
<td>61</td>
</tr>
</tbody>
</table>

50. Compute Regression line ‘Y’ on ‘X’ for the following data using MS-Excel.

<table>
<thead>
<tr>
<th>X</th>
<th>55</th>
<th>56</th>
<th>57</th>
<th>57</th>
<th>58</th>
<th>59</th>
<th>60</th>
<th>62</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y</td>
<td>57</td>
<td>58</td>
<td>55</td>
<td>58</td>
<td>62</td>
<td>62</td>
<td>59</td>
<td>61</td>
</tr>
</tbody>
</table>

51. Compute partial correlation co-efficient for the following data using MS-Excel.

<table>
<thead>
<tr>
<th>X1</th>
<th>3</th>
<th>4</th>
<th>6</th>
<th>8</th>
<th>12</th>
<th>14</th>
</tr>
</thead>
<tbody>
<tr>
<td>X2</td>
<td>14</td>
<td>11</td>
<td>7</td>
<td>5</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>X3</td>
<td>29</td>
<td>23</td>
<td>19</td>
<td>13</td>
<td>9</td>
<td>3</td>
</tr>
</tbody>
</table>

52. Compute multiple correlation co-efficient for the following data using MS-Excel.

<table>
<thead>
<tr>
<th>X1</th>
<th>62</th>
<th>51</th>
<th>69</th>
<th>65</th>
<th>53</th>
<th>56</th>
<th>75</th>
<th>55</th>
<th>54</th>
<th>49</th>
<th>74</th>
<th>66</th>
</tr>
</thead>
<tbody>
<tr>
<td>X2</td>
<td>55</td>
<td>47</td>
<td>57</td>
<td>60</td>
<td>49</td>
<td>48</td>
<td>53</td>
<td>46</td>
<td>50</td>
<td>40</td>
<td>59</td>
<td>55</td>
</tr>
<tr>
<td>X3</td>
<td>6</td>
<td>4</td>
<td>8</td>
<td>9</td>
<td>6</td>
<td>5</td>
<td>8</td>
<td>7</td>
<td>8</td>
<td>4</td>
<td>10</td>
<td>7</td>
</tr>
</tbody>
</table>

53. An automatic machine was designed to pack exactly two kilograms of oil. A sample of 100 tins was examined to test the machine. The average weight was found to be 1.94 kilogram with a standard deviation of 0.10 kilograms. Is machine working properly. Test using MS-Excel.

54. Two samples of 49 items each respectively gave the following data.

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>S.D.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample I</td>
<td>49.77</td>
<td>4</td>
</tr>
<tr>
<td>Sample II</td>
<td>49.00</td>
<td>5</td>
</tr>
</tbody>
</table>

Is the difference of the means significant, at 5% l.o.s. ? Test using MS-Excel.
55. The height of 10 males of a given locality are found to be 70, 67, 62, 68, 61, 68, 70, 64, 64, 66 inches. It is reasonable to believe that the average height is greater than 64 inches? Test at 5% l.o.s. using MS-Excel.

56. The result of a survey to know the educational attainment among 100 persons, randomly selected is a locality, are given below.

<table>
<thead>
<tr>
<th>EDUCATION</th>
<th>Sex</th>
<th>Middle school</th>
<th>High School</th>
<th>College</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>10</td>
<td>15</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>25</td>
<td>10</td>
<td>15</td>
<td></td>
</tr>
</tbody>
</table>

Can you say that education depend on Sex? Test using MS-Excel.
KAKATIYA UNIVERSITY  
FACULTY OF SCIENCE  
B.Sc. III-YEAR, PRACTICAL EXAMINATION  
STATISTICS, PAPER- III  
APPLIED STATISTICS  
(Question Bank for Practical Examination)  

Note:  
1. FIVE questions to be set, taking **ONE** question from each section.  
2. Student is asked to answer any **THREE** questions  
3. Solutions to these problems are to be obtained using calculator/graph sheets/statistical tables and computer for MS-excel.  

**SECTION – A**  

1. Consider a population of 4 units with values 1, 2, 3, 4 write down all possible samples of size 2 (without replacement) from this population and verify that sample mean is an unbiased estimate of the population mean. Also calculate its sampling variance.  

2. Consider a population of 6 units with values 1, 2, 3, 4, 5, 6 write down all the possible samples of 2 (without replacement) from this population and verify that:  
   
   (i) Sample mean is an unbiased estimate of population mean.  
   (ii) Sample mean square is an unbiased estimate of population Mean Square.  
   (iii) Find its sampling variance and verify that this variance is less than the variance obtained from sampling with replacement.  

3. In a pop with N=6, the values of $Y_i$ are 8, 3, 11, 1, 4 and 7. Calculate the Sample Mean $\bar{y}$ for all possible Simple Random Samples without replacement of size 3 and show that:  
   
   (i) $E(\bar{y}) = \bar{Y}$  
   (ii) $E(s^2) = S^2$  

4. The number of diseased plants (out of 9) in 25 areas are in the following table:  

<table>
<thead>
<tr>
<th>S.No.of areas</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
</tr>
</thead>
<tbody>
<tr>
<td>No.of Diseased Plants</td>
<td>1</td>
<td>4</td>
<td>1</td>
<td>2</td>
<td>5</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>7</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>12</td>
<td>13</td>
<td>14</td>
<td>15</td>
<td>16</td>
<td>17</td>
<td>18</td>
<td>19</td>
<td>20</td>
<td>21</td>
<td>22</td>
<td>23</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>7</td>
<td>2</td>
<td>6</td>
<td>3</td>
<td>5</td>
<td>3</td>
</tr>
</tbody>
</table>

Draw a simple random sample (without replacement) of 10 areas.
5. A sample of 30 students is to be drawn from a population consisting of 300 students belonging to two colleges A and B. The means and standard deviations of their marks are given below:

<table>
<thead>
<tr>
<th></th>
<th>Total Number of Students</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>College A</td>
<td>200</td>
<td>30</td>
<td>10</td>
</tr>
<tr>
<td>College B</td>
<td>100</td>
<td>60</td>
<td>40</td>
</tr>
</tbody>
</table>

How would you draw the sample using proportional allocation technique? Hence obtain the variance of estimate of the population mean and compare its efficiency with simple random sampling without replacement.

6. A population of size 800 is divided into 3 strata. Their sizes and standard deviations are given below:

<table>
<thead>
<tr>
<th>Strata</th>
<th>I</th>
<th>II</th>
<th>III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size</td>
<td>200</td>
<td>300</td>
<td>300</td>
</tr>
<tr>
<td>S.D</td>
<td>6</td>
<td>8</td>
<td>12</td>
</tr>
</tbody>
</table>

A stratified random sample of size 120 is to be drawn from the population. Determine the sizes of samples from the three strata in case of
(i) Proportional allocation
(ii) Neyman’s optimum allocation.

7. There are 200 small industrial establishments in a city. The number of employees in each establishment in a simple random sample of 20 establishments is given below:

<table>
<thead>
<tr>
<th>12</th>
<th>28</th>
<th>39</th>
<th>52</th>
<th>76</th>
<th>81</th>
<th>75</th>
<th>84</th>
<th>28</th>
<th>68</th>
</tr>
</thead>
<tbody>
<tr>
<td>98</td>
<td>35</td>
<td>82</td>
<td>13</td>
<td>20</td>
<td>52</td>
<td>15</td>
<td>21</td>
<td>43</td>
<td>59</td>
</tr>
</tbody>
</table>

Estimate the average number of employees per establishment in the city and find the standard error of the estimate.

8. A sample survey is to be undertaken to ascertain the mean annual income of farms in certain area. The farms are stratified according to their principal products. A census conducted several years earlier gave the following information.

<table>
<thead>
<tr>
<th>Types of Farm</th>
<th>Number of Farms</th>
<th>Mean Annual Income</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sheep</td>
<td>161</td>
<td>10946</td>
<td>2236</td>
</tr>
<tr>
<td>Wheat</td>
<td>195</td>
<td>6402</td>
<td>2614</td>
</tr>
<tr>
<td>Dairying</td>
<td>274</td>
<td>2228</td>
<td>606</td>
</tr>
<tr>
<td>Others</td>
<td>382</td>
<td>1458</td>
<td>230</td>
</tr>
</tbody>
</table>

For a sample of 12 farms compute the sample sizes in each stratum under:
(i) Proportion allocation and
(ii) Optimum allocation. Compare the precision’s of these methods with that of simple random sampling.
9. The data below are for a small artificial population which exhibits a fairly steady rising trend. Each column represents a systematic sample and the rows are the strata. Compare the precision of systematic sampling, random sampling and stratified sampling.

<table>
<thead>
<tr>
<th>Strata</th>
<th>Systematic Sample Number</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>I</td>
<td>0</td>
</tr>
<tr>
<td>II</td>
<td>6</td>
</tr>
<tr>
<td>III</td>
<td>18</td>
</tr>
<tr>
<td>IV</td>
<td>26</td>
</tr>
</tbody>
</table>

10. The data given below are for a small artificial population which exhibits a fairly steady rising trend. Each column represents a systematic sample and the rows are the strata. Compare the precision of systematic sampling, random sampling and stratified sampling. Data for 10 systematic samples with $n=4$, $k=10$, $N=mk=40$.

<table>
<thead>
<tr>
<th>Strata</th>
<th>Systematic Sample Number</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>I</td>
<td>1</td>
</tr>
<tr>
<td>II</td>
<td>10</td>
</tr>
<tr>
<td>III</td>
<td>22</td>
</tr>
<tr>
<td>IV</td>
<td>31</td>
</tr>
</tbody>
</table>

**SECTION-B**

11. A test was given to five students taken at random from the fifth class of three schools of a town. The individual scores are

<table>
<thead>
<tr>
<th>Schools</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>9</td>
<td>7</td>
<td>6</td>
<td>5</td>
<td>8</td>
</tr>
<tr>
<td>II</td>
<td>7</td>
<td>4</td>
<td>5</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>III</td>
<td>6</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>6</td>
</tr>
</tbody>
</table>

Carry out the analysis of variance and state your conclusions.
12. The following table gives quality rating of service stations by five professional raters:

<table>
<thead>
<tr>
<th>RATER</th>
<th>SERVICE STATION</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td></td>
<td>99</td>
<td>70</td>
<td>90</td>
<td>99</td>
<td>65</td>
<td>85</td>
<td>75</td>
<td>70</td>
<td>85</td>
<td>92</td>
</tr>
<tr>
<td>B</td>
<td></td>
<td>96</td>
<td>65</td>
<td>80</td>
<td>95</td>
<td>70</td>
<td>88</td>
<td>70</td>
<td>51</td>
<td>84</td>
<td>91</td>
</tr>
<tr>
<td>C</td>
<td></td>
<td>95</td>
<td>60</td>
<td>48</td>
<td>87</td>
<td>48</td>
<td>75</td>
<td>71</td>
<td>93</td>
<td>80</td>
<td>93</td>
</tr>
<tr>
<td>D</td>
<td></td>
<td>98</td>
<td>65</td>
<td>70</td>
<td>95</td>
<td>67</td>
<td>82</td>
<td>73</td>
<td>94</td>
<td>86</td>
<td>80</td>
</tr>
<tr>
<td>E</td>
<td></td>
<td>97</td>
<td>65</td>
<td>62</td>
<td>99</td>
<td>60</td>
<td>80</td>
<td>76</td>
<td>92</td>
<td>90</td>
<td>89</td>
</tr>
</tbody>
</table>

Analyse the data and discuss whether there is any significant difference between ratings or between service stations.

13. A set of data involving four tropical feedstuffs A, B, C, D tried on 20 chicks is given below. All the 20 chicks are treated alike in all respects except the feeding treatments and each feeding treatment is given to 5 chicks. Analyse the data.

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>55</td>
<td>49</td>
<td>42</td>
<td>21</td>
<td>52</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>61</td>
<td>112</td>
<td>30</td>
<td>89</td>
<td>63</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>42</td>
<td>97</td>
<td>81</td>
<td>95</td>
<td>92</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>169</td>
<td>137</td>
<td>169</td>
<td>85</td>
<td>154</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

14. An experiment was carried out on wheat with three treatments in four randomized blocks. The plan and yield per plot in kgs are given below. Analyze the data and state the conclusions.

<table>
<thead>
<tr>
<th>BLOCKS</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B (18)</td>
<td>A (80)</td>
<td>B (18)</td>
<td>B (18)</td>
</tr>
<tr>
<td></td>
<td>A (17)</td>
<td>B (72)</td>
<td>C (13)</td>
<td>C (27)</td>
</tr>
<tr>
<td></td>
<td>C (18)</td>
<td>C (18)</td>
<td>A (22)</td>
<td>A (45)</td>
</tr>
</tbody>
</table>
15. The following data gives yields (in qtls) of 5 varieties in a 4 block Randomized Block Design experiment. Carry out the ANOVA for
(i) Homogeneity of blocks
(ii) Homogeneity of varieties. Write your conclusion.

<table>
<thead>
<tr>
<th>Varieties</th>
<th>V₁</th>
<th>V₂</th>
<th>V₃</th>
<th>V₄</th>
<th>V₅</th>
</tr>
</thead>
<tbody>
<tr>
<td>B₁</td>
<td>21</td>
<td>32</td>
<td>67</td>
<td>45</td>
<td>43</td>
</tr>
<tr>
<td>B₂</td>
<td>29</td>
<td>32</td>
<td>15</td>
<td>67</td>
<td>33</td>
</tr>
<tr>
<td>B₃</td>
<td>41</td>
<td>22</td>
<td>25</td>
<td>25</td>
<td>35</td>
</tr>
<tr>
<td>B₄</td>
<td>35</td>
<td>16</td>
<td>18</td>
<td>19</td>
<td>22</td>
</tr>
</tbody>
</table>

16. In the table below are the yields of 6 varieties in a 4 replicate experiment for which one value is missing. Estimate the missing value and analyze the data.

<table>
<thead>
<tr>
<th>Blocks</th>
<th>Varieties</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>18.5</td>
</tr>
<tr>
<td>2</td>
<td>11.7</td>
</tr>
<tr>
<td>3</td>
<td>15.4</td>
</tr>
<tr>
<td>4</td>
<td>16.5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Blocks</th>
<th>Varieties</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>15.7</td>
</tr>
<tr>
<td>2</td>
<td>------</td>
</tr>
<tr>
<td>3</td>
<td>16.6</td>
</tr>
<tr>
<td>4</td>
<td>18.6</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Blocks</th>
<th>Varieties</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>16.2</td>
</tr>
<tr>
<td>2</td>
<td>12.9</td>
</tr>
<tr>
<td>3</td>
<td>15.5</td>
</tr>
<tr>
<td>4</td>
<td>12.7</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Blocks</th>
<th>Varieties</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>14.1</td>
</tr>
<tr>
<td>2</td>
<td>14.4</td>
</tr>
<tr>
<td>3</td>
<td>20.3</td>
</tr>
<tr>
<td>4</td>
<td>15.7</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Blocks</th>
<th>Varieties</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>13.0</td>
</tr>
<tr>
<td>2</td>
<td>16.9</td>
</tr>
<tr>
<td>3</td>
<td>18.4</td>
</tr>
<tr>
<td>4</td>
<td>16.5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Blocks</th>
<th>Varieties</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>13.6</td>
</tr>
<tr>
<td>2</td>
<td>12.5</td>
</tr>
<tr>
<td>3</td>
<td>21.5</td>
</tr>
<tr>
<td>4</td>
<td>18.0</td>
</tr>
</tbody>
</table>

17. Consider the results given in the following table for an experiment involving six treatments in four randomized blocks. The treatments are indicated by numbers within parenthesis.

<table>
<thead>
<tr>
<th>Blocks</th>
<th>Treatment and yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>(1) 24.7</td>
</tr>
<tr>
<td>2</td>
<td>(3) 27.7 (2) 20.6</td>
</tr>
<tr>
<td>3</td>
<td>(6) 22.7 (2) 27.3</td>
</tr>
<tr>
<td>4</td>
<td>(5) 26.3 (4) 38.5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Blocks</th>
<th>Treatment and yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>(1) (2) 22.7 (2) 27.3</td>
</tr>
<tr>
<td>2</td>
<td>(3) 27.3 (2) 15.0</td>
</tr>
<tr>
<td>3</td>
<td>(6) 28.8 (4) 36.8</td>
</tr>
<tr>
<td>4</td>
<td>(5) 19.6 (1) 14.1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Blocks</th>
<th>Treatment and yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>(5) 38.5 (2) 36.8</td>
</tr>
<tr>
<td>2</td>
<td>(6) 19.6 (1) 14.1</td>
</tr>
<tr>
<td>3</td>
<td>(5) 31.0 (1) 28.5</td>
</tr>
<tr>
<td>4</td>
<td>(6) 17.7 (2) 22.6</td>
</tr>
</tbody>
</table>

Test whether the treatments differ significantly. Also (i) Determine the critical difference between the means of any two treatments, and (ii) Obtain the efficiency of this design relative to its layout as C.R.D.
18. Setup the analysis of variance for the following results of Latin square design.

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>15.2</td>
<td>12.6</td>
<td>13.8</td>
<td>17.1</td>
</tr>
<tr>
<td>B</td>
<td>22.7</td>
<td>32.9</td>
<td>14.2</td>
<td>31.7</td>
</tr>
<tr>
<td>C</td>
<td>32.0</td>
<td>41.0</td>
<td>58.8</td>
<td>42.6</td>
</tr>
<tr>
<td>D</td>
<td>16.2</td>
<td>62.3</td>
<td>62.0</td>
<td>38.8</td>
</tr>
</tbody>
</table>

19. Estimate the missing value in the following Latin Square Design.

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>5.7</td>
<td>10.2</td>
<td>9.5</td>
<td>28.9</td>
</tr>
<tr>
<td>B</td>
<td>18.9</td>
<td>10.2</td>
<td>24.0</td>
<td>37.0</td>
</tr>
<tr>
<td>C</td>
<td>29.4</td>
<td>21.2</td>
<td>24.0</td>
<td>37.0</td>
</tr>
<tr>
<td>D</td>
<td>5.7</td>
<td>19.1</td>
<td>37.0</td>
<td>28.9</td>
</tr>
</tbody>
</table>

20. An experiment was carried out to determine the effect of claying the ground on the field of barley grains; amount of clay used were as follows:
   A: No clay  B: Clay at 100 per acre
   C: Clay at 200 per acre  D: Clay at 300 per acre

   (i) Perform the ANOVA and calculate the critical difference for the treatment mean yields.
   (ii) Calculate the efficiency of the above Latin Square Design over
        (a) R.B.D  and  (b) C.R.D.
21. Below are given the figures of production (in thousand quintals) of a Sugar factory.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Production</td>
<td>77</td>
<td>88</td>
<td>94</td>
<td>85</td>
<td>91</td>
<td>98</td>
<td>90</td>
</tr>
</tbody>
</table>

Fit a straight line by the least squares method and tabulate the trend values.

22. Fit a second degree parabola to a given time series data. From the following production data.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Production</td>
<td>1</td>
<td>2.8</td>
<td>6.3</td>
<td>12.5</td>
<td>26.5</td>
</tr>
</tbody>
</table>

23. Fit a power curve to the given data below. By using method of least squares.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales in ('000Rs.)</td>
<td>10</td>
<td>12</td>
<td>13</td>
<td>10</td>
<td>8</td>
</tr>
</tbody>
</table>

24. You are given the population figures of India as follows.

<table>
<thead>
<tr>
<th>Census year</th>
<th>1911</th>
<th>1921</th>
<th>1931</th>
<th>1941</th>
<th>1951</th>
<th>1961</th>
<th>1971</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population (In crores)</td>
<td>25.0</td>
<td>25.1</td>
<td>27.9</td>
<td>31.9</td>
<td>43.9</td>
<td>47.8</td>
<td>54.7</td>
</tr>
</tbody>
</table>

Fit an exponential trend $y = ab^x$ to the above data.

25. Calculate 4 years and 5 years moving average for the following data of number of commercial industrial failure in a country during 1985-2000.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>No. Of failure</td>
<td>23</td>
<td>26</td>
<td>28</td>
<td>32</td>
<td>20</td>
<td>12</td>
<td>12</td>
<td>10</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>No. Of failure</td>
<td>9</td>
<td>13</td>
<td>11</td>
<td>14</td>
<td>12</td>
<td>9</td>
<td>3</td>
<td>1</td>
</tr>
</tbody>
</table>
26. Calculate seasonal variations for the following data of sales in thousand rupees of a firm by ratio to trend method.

<table>
<thead>
<tr>
<th>Years</th>
<th>Quarters</th>
<th>Q₁</th>
<th>Q₂</th>
<th>Q₃</th>
<th>Q₄</th>
</tr>
</thead>
<tbody>
<tr>
<td>1979</td>
<td>30</td>
<td>40</td>
<td>36</td>
<td>34</td>
<td></td>
</tr>
<tr>
<td>1980</td>
<td>34</td>
<td>52</td>
<td>50</td>
<td>44</td>
<td></td>
</tr>
<tr>
<td>1981</td>
<td>40</td>
<td>58</td>
<td>54</td>
<td>48</td>
<td></td>
</tr>
<tr>
<td>1982</td>
<td>54</td>
<td>76</td>
<td>68</td>
<td>62</td>
<td></td>
</tr>
<tr>
<td>1983</td>
<td>80</td>
<td>92</td>
<td>86</td>
<td>82</td>
<td></td>
</tr>
</tbody>
</table>

27. Calculate seasonal indices by ratio to moving average method for the following data.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Q₁</td>
<td>75</td>
<td>86</td>
<td>90</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>Q₂</td>
<td>60</td>
<td>65</td>
<td>72</td>
<td>78</td>
<td></td>
</tr>
<tr>
<td>Q₃</td>
<td>54</td>
<td>63</td>
<td>66</td>
<td>72</td>
<td></td>
</tr>
<tr>
<td>Q₄</td>
<td>59</td>
<td>80</td>
<td>85</td>
<td>93</td>
<td></td>
</tr>
</tbody>
</table>

28. From the following data calculate seasonal indices by Link Relative method.

<table>
<thead>
<tr>
<th>Years</th>
<th>Quarters</th>
<th>Q₁</th>
<th>Q₂</th>
<th>Q₃</th>
<th>Q₄</th>
</tr>
</thead>
<tbody>
<tr>
<td>1979</td>
<td>30</td>
<td>26</td>
<td>22</td>
<td>31</td>
<td></td>
</tr>
<tr>
<td>1980</td>
<td>35</td>
<td>28</td>
<td>22</td>
<td>36</td>
<td></td>
</tr>
<tr>
<td>1981</td>
<td>31</td>
<td>29</td>
<td>28</td>
<td>32</td>
<td></td>
</tr>
<tr>
<td>1982</td>
<td>31</td>
<td>31</td>
<td>25</td>
<td>35</td>
<td></td>
</tr>
<tr>
<td>1983</td>
<td>34</td>
<td>36</td>
<td>26</td>
<td>33</td>
<td></td>
</tr>
</tbody>
</table>

29. From the data given below construct the
(i) Simple Index numbers and
(ii) Laspeyer’s, Paasche’s and Fisher’s price and Quantity Index numbers. (Using 1978 as the base year)

<table>
<thead>
<tr>
<th>Commodity</th>
<th>1978</th>
<th>1982</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Price</td>
<td>Quantity</td>
</tr>
<tr>
<td>A</td>
<td>2.00</td>
<td>4000</td>
</tr>
<tr>
<td>B</td>
<td>5.00</td>
<td>500</td>
</tr>
<tr>
<td>C</td>
<td>1.50</td>
<td>1500</td>
</tr>
<tr>
<td>D</td>
<td>10.00</td>
<td>250</td>
</tr>
<tr>
<td>E</td>
<td>8.00</td>
<td>2500</td>
</tr>
</tbody>
</table>
30. Prepare price and quantity index numbers for 1993 with 1992 as base year from the following data by using.
   (i) Laspeyer’s, (ii) Paasche’s and (iii) Fisher’s

<table>
<thead>
<tr>
<th>Year</th>
<th>Article I</th>
<th>Article II</th>
<th>Article III</th>
<th>Article IV</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Price</td>
<td>Quantity</td>
<td>Price</td>
<td>Quantity</td>
</tr>
<tr>
<td>1992</td>
<td>5.00</td>
<td>5</td>
<td>7.75</td>
<td>6</td>
</tr>
<tr>
<td>1993</td>
<td>6.50</td>
<td>4</td>
<td>8.80</td>
<td>10</td>
</tr>
</tbody>
</table>

With reference to the above, prove how the factor Reversal Test and Time Reversal Test are satisfied by Fisher’s Formula.

31. a). From the following data construct the cost of living index.

<table>
<thead>
<tr>
<th>Group</th>
<th>Index number</th>
<th>Weights</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food</td>
<td>352</td>
<td>48</td>
</tr>
<tr>
<td>Fuel and lighting</td>
<td>200</td>
<td>10</td>
</tr>
<tr>
<td>Clothing</td>
<td>230</td>
<td>8</td>
</tr>
<tr>
<td>House rent</td>
<td>160</td>
<td>12</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>190</td>
<td>15</td>
</tr>
</tbody>
</table>

b). Construct the wholesale price index number for 1982 and 1983 from the data given below, using 1981 as the base year.

<table>
<thead>
<tr>
<th>Commodity</th>
<th>Wholesale price (in rupees) per quintal</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1981</td>
</tr>
<tr>
<td>A</td>
<td>140</td>
</tr>
<tr>
<td>B</td>
<td>120</td>
</tr>
<tr>
<td>C</td>
<td>100</td>
</tr>
<tr>
<td>D</td>
<td>75</td>
</tr>
<tr>
<td>E</td>
<td>250</td>
</tr>
<tr>
<td>F</td>
<td>400</td>
</tr>
</tbody>
</table>

32. Show that for the following series of fixed base index numbers, the chain indices are same as fixed base index numbers.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Index Number</td>
<td>100</td>
<td>120</td>
<td>122</td>
<td>116</td>
<td>120</td>
<td>120</td>
<td>137</td>
<td>136</td>
<td>149</td>
<td>156</td>
<td>137</td>
</tr>
</tbody>
</table>
33. From the index numbers given below, find out index numbers by shifting base from 1980 to 1983.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Index Number</td>
<td>100</td>
<td>76</td>
<td>68</td>
<td>50</td>
<td>60</td>
<td>70</td>
<td>75</td>
</tr>
</tbody>
</table>

34. Given below are two price Index series. Splice them on the base 1974=100.

<table>
<thead>
<tr>
<th>Year</th>
<th>Old price index for Steel base (1965=100)</th>
<th>New price index For steel base (1974=100)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1970</td>
<td>141.5</td>
<td></td>
</tr>
<tr>
<td>1971</td>
<td>163.7</td>
<td></td>
</tr>
<tr>
<td>1972</td>
<td>158.2</td>
<td>99.8</td>
</tr>
<tr>
<td>1973</td>
<td>156.8</td>
<td>100.0</td>
</tr>
<tr>
<td>1974</td>
<td>157.1</td>
<td>102.3</td>
</tr>
<tr>
<td>1975</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

35. The following table gives the annual income of a worker and the general index numbers of price during 1999 to 2007. Prepare index number to show the changes in the real income of the teacher and comment on price increase:

<table>
<thead>
<tr>
<th>Year</th>
<th>1999</th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
</tr>
</thead>
<tbody>
<tr>
<td>Income (Rs.)</td>
<td>36000</td>
<td>42000</td>
<td>50000</td>
<td>55000</td>
<td>60000</td>
<td>64000</td>
<td>68000</td>
<td>72000</td>
<td>75000</td>
</tr>
<tr>
<td>Price Index No.</td>
<td>100</td>
<td>120</td>
<td>145</td>
<td>160</td>
<td>250</td>
<td>320</td>
<td>450</td>
<td>530</td>
<td>600</td>
</tr>
</tbody>
</table>

36. Compute the crude and standardized death rates of the two populations A and B regarding A as standard population, from the following data:

<table>
<thead>
<tr>
<th>Age-Group (Years)</th>
<th>A Population</th>
<th>A Deaths</th>
<th>B Population</th>
<th>B Deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>Under 10</td>
<td>20000</td>
<td>600</td>
<td>12000</td>
<td>372</td>
</tr>
<tr>
<td>10-20</td>
<td>12000</td>
<td>240</td>
<td>30000</td>
<td>660</td>
</tr>
<tr>
<td>20-40</td>
<td>50000</td>
<td>1250</td>
<td>62000</td>
<td>1612</td>
</tr>
<tr>
<td>40-60</td>
<td>30000</td>
<td>1050</td>
<td>15000</td>
<td>325</td>
</tr>
<tr>
<td>Above 60</td>
<td>10000</td>
<td>500</td>
<td>3000</td>
<td>180</td>
</tr>
</tbody>
</table>
37. Estimate the standardized death rates for the following countries:

<table>
<thead>
<tr>
<th>Age-Group (In years)</th>
<th>Death rate per 1000</th>
<th>Standardized Population (In lakhs)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Country A</td>
<td>Country B</td>
</tr>
<tr>
<td>0-4</td>
<td>20.00</td>
<td>5.00</td>
</tr>
<tr>
<td>5-14</td>
<td>1.00</td>
<td>0.50</td>
</tr>
<tr>
<td>15-24</td>
<td>1.40</td>
<td>1.00</td>
</tr>
<tr>
<td>25-34</td>
<td>2.00</td>
<td>1.00</td>
</tr>
<tr>
<td>35-44</td>
<td>3.30</td>
<td>2.00</td>
</tr>
<tr>
<td>45-54</td>
<td>7.00</td>
<td>5.00</td>
</tr>
<tr>
<td>55-64</td>
<td>15.00</td>
<td>12.00</td>
</tr>
<tr>
<td>65-74</td>
<td>40.00</td>
<td>35.00</td>
</tr>
<tr>
<td>75 and above</td>
<td>120.00</td>
<td>110.00</td>
</tr>
</tbody>
</table>

38. Find the standardized death rate by direct and indirect methods for data given below.

<table>
<thead>
<tr>
<th>Age</th>
<th>Standard population</th>
<th>Population A</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Population</td>
<td>Specific Death rate</td>
</tr>
<tr>
<td>0-5</td>
<td>8000</td>
<td>50</td>
</tr>
<tr>
<td>5-15</td>
<td>10000</td>
<td>15</td>
</tr>
<tr>
<td>15-50</td>
<td>27000</td>
<td>10</td>
</tr>
<tr>
<td>50 and above</td>
<td>5000</td>
<td>60</td>
</tr>
</tbody>
</table>

39. Compute (i) G.F.R (ii) A.S.F.R (iii) T.F.R. from the data given below.

<table>
<thead>
<tr>
<th>Age group of child Bearing females</th>
<th>15-19</th>
<th>20-24</th>
<th>25-29</th>
<th>30-34</th>
<th>35-39</th>
<th>40-44</th>
<th>45-49</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of women ('000)</td>
<td>16.0</td>
<td>16.4</td>
<td>15.8</td>
<td>15.2</td>
<td>14.8</td>
<td>15.0</td>
<td>14.5</td>
</tr>
<tr>
<td>Total Births</td>
<td>260</td>
<td>2244</td>
<td>1894</td>
<td>1320</td>
<td>916</td>
<td>280</td>
<td>145</td>
</tr>
</tbody>
</table>

Assume the proportion of female births is 46.2%.
40. Calculate (i). G.F.R (ii). T.F.R (iii). G.R.R. from the following data, assuming that for every 100 girls, 106 boys are born.

<table>
<thead>
<tr>
<th>Age of women</th>
<th>No. of women</th>
<th>Age-specific fertility rate Per (1,000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>15-19</td>
<td>212619</td>
<td>98.0</td>
</tr>
<tr>
<td>20-24</td>
<td>198732</td>
<td>169.6</td>
</tr>
<tr>
<td>25-29</td>
<td>162800</td>
<td>158.2</td>
</tr>
<tr>
<td>30-34</td>
<td>145362</td>
<td>39.7</td>
</tr>
<tr>
<td>35-39</td>
<td>128109</td>
<td>98.6</td>
</tr>
<tr>
<td>40-44</td>
<td>106211</td>
<td>42.8</td>
</tr>
<tr>
<td>45-49</td>
<td>86753</td>
<td>16.9</td>
</tr>
</tbody>
</table>

41. From the data given below, calculate the G.R.R and N.R.R.

<table>
<thead>
<tr>
<th>Age-group</th>
<th>Number of children born to 1,000 women passing through the age-group</th>
<th>Mortality rate (Per 1000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>16-20</td>
<td>150</td>
<td>120</td>
</tr>
<tr>
<td>21-25</td>
<td>1500</td>
<td>180</td>
</tr>
<tr>
<td>26-30</td>
<td>2000</td>
<td>150</td>
</tr>
<tr>
<td>31-35</td>
<td>800</td>
<td>200</td>
</tr>
<tr>
<td>36-40</td>
<td>500</td>
<td>220</td>
</tr>
<tr>
<td>41-45</td>
<td>200</td>
<td>230</td>
</tr>
<tr>
<td>46-50</td>
<td>100</td>
<td>250</td>
</tr>
</tbody>
</table>

Sex ratio being males: female’s 52:48.

42. If X is the age of a living being and \( l_x \) is the no. of living beings at age X, the following data is obtained for a creature in a forest construct life table of the living being:

<table>
<thead>
<tr>
<th>X</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>( l_x )</td>
<td>100</td>
<td>92</td>
<td>87</td>
<td>56</td>
<td>49</td>
<td>32</td>
<td>25</td>
<td>18</td>
<td>8</td>
<td>7</td>
<td>0</td>
</tr>
</tbody>
</table>

43. Fill in the blanks in a portion of life table given below:

<table>
<thead>
<tr>
<th>Age in Years</th>
<th>( l_x )</th>
<th>( d_x )</th>
<th>( p_x )</th>
<th>( q_x )</th>
<th>( L_x )</th>
<th>( T_x )</th>
<th>( e_x )</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>95000</td>
<td>500</td>
<td>?</td>
<td>?</td>
<td>?</td>
<td>4850300</td>
<td>?</td>
</tr>
</tbody>
</table>
44. a). Given the following table for \( l_x \), the number of rabbits living at age \( x \), complete the life table for rabbits.

<table>
<thead>
<tr>
<th>( X )</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>( l_x )</td>
<td>100</td>
<td>90</td>
<td>80</td>
<td>75</td>
<td>60</td>
<td>30</td>
<td>0</td>
</tr>
</tbody>
</table>

b). If \( X, Y, Z \) are three rabbits of age 1, 2 and 3 years respectively. Find the probability that at least one of them will be alive for one year more.

45. Below are given the year \( t \), the yearly per capita consumption of butter in kgs \( (d_t) \) and the real price \( (p_t) \) i.e. the nominal price divided by the consumer price index during the years 1 to 19.

<table>
<thead>
<tr>
<th>( T )</th>
<th>( d_t )</th>
<th>( p_t )</th>
<th>( t )</th>
<th>( d_t )</th>
<th>( P_t )</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>12.16</td>
<td>1.92</td>
<td>11</td>
<td>18.44</td>
<td>1.25</td>
</tr>
<tr>
<td>2</td>
<td>12.63</td>
<td>1.62</td>
<td>12</td>
<td>18.85</td>
<td>1.21</td>
</tr>
<tr>
<td>3</td>
<td>13.46</td>
<td>1.76</td>
<td>13</td>
<td>18.77</td>
<td>1.27</td>
</tr>
<tr>
<td>4</td>
<td>14.12</td>
<td>1.74</td>
<td>14</td>
<td>19.11</td>
<td>1.40</td>
</tr>
<tr>
<td>5</td>
<td>14.94</td>
<td>1.67</td>
<td>15</td>
<td>19.91</td>
<td>1.34</td>
</tr>
<tr>
<td>6</td>
<td>15.34</td>
<td>1.51</td>
<td>16</td>
<td>20.38</td>
<td>1.30</td>
</tr>
<tr>
<td>7</td>
<td>15.65</td>
<td>1.47</td>
<td>17</td>
<td>20.44</td>
<td>1.42</td>
</tr>
<tr>
<td>8</td>
<td>17.04</td>
<td>1.44</td>
<td>18</td>
<td>20.20</td>
<td>1.46</td>
</tr>
<tr>
<td>9</td>
<td>17.62</td>
<td>1.37</td>
<td>19</td>
<td>20.44</td>
<td>1.48</td>
</tr>
<tr>
<td>10</td>
<td>18.04</td>
<td>1.30</td>
<td>----</td>
<td>----</td>
<td>----</td>
</tr>
</tbody>
</table>

Fit a demand curve of the form \( d_t = \alpha p_t \)

**SECTION – E**

46. (i) A test was given to five students take at random from the fifth class of four schools of a town. The individual scores are:

<table>
<thead>
<tr>
<th>Schools</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>19</td>
<td>17</td>
<td>16</td>
<td>15</td>
<td>18</td>
</tr>
<tr>
<td>II</td>
<td>17</td>
<td>14</td>
<td>15</td>
<td>14</td>
<td>15</td>
</tr>
<tr>
<td>III</td>
<td>16</td>
<td>15</td>
<td>16</td>
<td>17</td>
<td>16</td>
</tr>
<tr>
<td>IV</td>
<td>18</td>
<td>17</td>
<td>16</td>
<td>19</td>
<td>17</td>
</tr>
</tbody>
</table>

Carry out the analysis of variance of one way classification by using MS-EXCEL.
(ii) A company has appointed four salesman, A, B, C, and D, and observed their sales in three seasons—summer, winter and monsoon. The figures (in lakh) are given in the following table:

<table>
<thead>
<tr>
<th>Seasons</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Summer</td>
<td>36</td>
<td>36</td>
<td>21</td>
<td>35</td>
</tr>
<tr>
<td>Winter</td>
<td>28</td>
<td>29</td>
<td>31</td>
<td>32</td>
</tr>
<tr>
<td>Monsoon</td>
<td>26</td>
<td>28</td>
<td>29</td>
<td>29</td>
</tr>
</tbody>
</table>

Perform an analysis of variance on the above data by using MS-EXCEL.

47. A set of data involving four tropical feedstuffs A, B, C, D tried on 20 chicks is given below. All the 20 chicks are treated alike in all respects expect the feeding treatments and each feeding treatment is given to 5 chicks. Analyse the data by using MS-EXCEL

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>55</td>
<td>49</td>
<td>42</td>
<td>21</td>
</tr>
<tr>
<td>B</td>
<td>61</td>
<td>112</td>
<td>30</td>
<td>89</td>
</tr>
<tr>
<td>C</td>
<td>42</td>
<td>97</td>
<td>81</td>
<td>95</td>
</tr>
<tr>
<td>D</td>
<td>169</td>
<td>137</td>
<td>169</td>
<td>85</td>
</tr>
</tbody>
</table>

48. A varieties trial was conducted at a research station. The design adopted for the same was five randomized blocks of 6 plots each. The yields in lb. per plot obtained from the experiment are as under:

<table>
<thead>
<tr>
<th>Blocks</th>
<th>V_1</th>
<th>V_2</th>
<th>V_3</th>
<th>V_4</th>
<th>V_5</th>
<th>V_6</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>30</td>
<td>23</td>
<td>34</td>
<td>25</td>
<td>20</td>
<td>13</td>
</tr>
<tr>
<td>2</td>
<td>39</td>
<td>22</td>
<td>28</td>
<td>25</td>
<td>28</td>
<td>32</td>
</tr>
<tr>
<td>3</td>
<td>26</td>
<td>43</td>
<td>43</td>
<td>31</td>
<td>49</td>
<td>17</td>
</tr>
<tr>
<td>4</td>
<td>38</td>
<td>45</td>
<td>36</td>
<td>35</td>
<td>32</td>
<td>20</td>
</tr>
<tr>
<td>5</td>
<td>44</td>
<td>51</td>
<td>23</td>
<td>58</td>
<td>40</td>
<td>30</td>
</tr>
</tbody>
</table>

Analyze the design by using MS-EXCEL

49. Analyze the following Latin square design by using MS-EXCEL

<table>
<thead>
<tr>
<th>Rows</th>
<th>Columns</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>C_1</td>
</tr>
<tr>
<td>R_1</td>
<td>A (22)</td>
</tr>
<tr>
<td>R_2</td>
<td>B (26)</td>
</tr>
<tr>
<td>R_3</td>
<td>C (18)</td>
</tr>
<tr>
<td>R_4</td>
<td>D (12)</td>
</tr>
</tbody>
</table>
50. a). Use the method of least squares to find the straight line trend for the following data by using MS-EXCEL.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales</td>
<td>10</td>
<td>12</td>
<td>15</td>
<td>16</td>
<td>18</td>
<td>19</td>
</tr>
</tbody>
</table>

b). Fit a second degree parabola to the following data by using MS-EXCEL.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Price</td>
<td>100</td>
<td>107</td>
<td>128</td>
<td>140</td>
<td>181</td>
<td>192</td>
</tr>
</tbody>
</table>

51. Using three year moving averages determine the trend for the following data using MS-EXCEL.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Production</td>
<td>21</td>
<td>22</td>
<td>23</td>
<td>25</td>
<td>24</td>
<td>22</td>
<td>25</td>
<td>26</td>
<td>27</td>
<td>26</td>
</tr>
</tbody>
</table>

52. Find seasonal variation by the ratio to trend method for the following data by using MS-EXCEL.

<table>
<thead>
<tr>
<th>Year</th>
<th>Q1</th>
<th>Q2</th>
<th>Q3</th>
<th>Q4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1982</td>
<td>15</td>
<td>20</td>
<td>18</td>
<td>17</td>
</tr>
<tr>
<td>1983</td>
<td>17</td>
<td>26</td>
<td>25</td>
<td>22</td>
</tr>
<tr>
<td>1984</td>
<td>20</td>
<td>29</td>
<td>27</td>
<td>24</td>
</tr>
<tr>
<td>1985</td>
<td>27</td>
<td>38</td>
<td>34</td>
<td>31</td>
</tr>
<tr>
<td>1986</td>
<td>40</td>
<td>46</td>
<td>43</td>
<td>41</td>
</tr>
</tbody>
</table>

53. Obtain seasonal indices by the ratio to moving average method for the following data by using MS-EXCEL.

<table>
<thead>
<tr>
<th>Year</th>
<th>Q1</th>
<th>Q2</th>
<th>Q3</th>
<th>Q4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1982</td>
<td>68</td>
<td>62</td>
<td>61</td>
<td>63</td>
</tr>
<tr>
<td>1983</td>
<td>65</td>
<td>58</td>
<td>66</td>
<td>61</td>
</tr>
<tr>
<td>1984</td>
<td>68</td>
<td>63</td>
<td>63</td>
<td>67</td>
</tr>
</tbody>
</table>

54. From the following data calculate seasonal indices by Link Relative method by using MS-EXCEL.

<table>
<thead>
<tr>
<th>Year</th>
<th>Q1</th>
<th>Q2</th>
<th>Q3</th>
<th>Q4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1979</td>
<td>30</td>
<td>26</td>
<td>22</td>
<td>31</td>
</tr>
<tr>
<td>1980</td>
<td>35</td>
<td>28</td>
<td>22</td>
<td>36</td>
</tr>
<tr>
<td>1981</td>
<td>31</td>
<td>29</td>
<td>28</td>
<td>32</td>
</tr>
<tr>
<td>1982</td>
<td>31</td>
<td>31</td>
<td>25</td>
<td>35</td>
</tr>
<tr>
<td>1983</td>
<td>34</td>
<td>36</td>
<td>26</td>
<td>33</td>
</tr>
</tbody>
</table>
55. Compute (i) Laspeyre’s (ii) Paasche’s and (iii) Fisher’s price and quantity index numbers for the following data by using MS-EXCEL.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Price</td>
<td>Quantity</td>
</tr>
<tr>
<td>A</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>B</td>
<td>8</td>
<td>6</td>
</tr>
<tr>
<td>C</td>
<td>6</td>
<td>3</td>
</tr>
</tbody>
</table>

56. Construct a cost of living index from the following data by using MS-EXCEL, the weights being food 55, Rent 20, Clothing 15, fuel and lighting 15 and miscellaneous 5

<table>
<thead>
<tr>
<th>Year</th>
<th>Food</th>
<th>Rent</th>
<th>Clothing</th>
<th>Fuel and Lighting</th>
<th>Miscellaneous</th>
</tr>
</thead>
<tbody>
<tr>
<td>1985</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>1986</td>
<td>105</td>
<td>104</td>
<td>98</td>
<td>100</td>
<td>110</td>
</tr>
<tr>
<td>1987</td>
<td>110</td>
<td>112</td>
<td>102</td>
<td>101</td>
<td>115</td>
</tr>
<tr>
<td>1988</td>
<td>112</td>
<td>115</td>
<td>105</td>
<td>103</td>
<td>120</td>
</tr>
</tbody>
</table>

57. a). From the index numbers given below, find out index numbers by shifting base from 1970 to 1973 by using MS-EXCEL.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Index Number</td>
<td>200</td>
<td>86</td>
<td>78</td>
<td>60</td>
<td>70</td>
<td>80</td>
<td>95</td>
</tr>
</tbody>
</table>

b). Given below are two price Index series. Splice them on the base 1974=100 by using MS-EXCEL.

<table>
<thead>
<tr>
<th>Year</th>
<th>Old price index for Steel base (1965=100)</th>
<th>New price index For steel base (1974=100)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1970</td>
<td>141.5</td>
<td></td>
</tr>
<tr>
<td>1971</td>
<td>163.7</td>
<td></td>
</tr>
<tr>
<td>1972</td>
<td>158.2</td>
<td></td>
</tr>
<tr>
<td>1973</td>
<td>156.8</td>
<td></td>
</tr>
<tr>
<td>1974</td>
<td>157.1</td>
<td></td>
</tr>
<tr>
<td>1975</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
58. The following table gives the annual income of a worker and the general index numbers of price during 1999 to 2007. Prepare index number to show the changes in the real income of the teacher and comment on price increase by using MS-EXCEL.

<table>
<thead>
<tr>
<th>Year</th>
<th>1999</th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
</tr>
</thead>
<tbody>
<tr>
<td>Income (Rs.)</td>
<td>36000</td>
<td>42000</td>
<td>50000</td>
<td>55000</td>
<td>60000</td>
<td>64000</td>
<td>68000</td>
<td>72000</td>
<td>75000</td>
</tr>
<tr>
<td>Price Index No.</td>
<td>100</td>
<td>120</td>
<td>145</td>
<td>160</td>
<td>250</td>
<td>320</td>
<td>450</td>
<td>530</td>
<td>600</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>Age group of child Bearing females</th>
<th>15-19</th>
<th>20-24</th>
<th>25-29</th>
<th>30-34</th>
<th>35-39</th>
<th>40-44</th>
<th>45-49</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of women (‘000)</td>
<td>16.0</td>
<td>16.4</td>
<td>15.8</td>
<td>15.2</td>
<td>14.8</td>
<td>15.0</td>
<td>14.5</td>
</tr>
<tr>
<td>Total Births</td>
<td>260</td>
<td>2244</td>
<td>1894</td>
<td>1320</td>
<td>916</td>
<td>280</td>
<td>145</td>
</tr>
</tbody>
</table>

Assume the proportion of female births is 46.2%.

60. Given the following table for \( l_x \), the number of rabbits living at age \( x \), complete the life table for rabbit by using MS-EXCEL.

<table>
<thead>
<tr>
<th>( x )</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>( l_x )</td>
<td>100</td>
<td>90</td>
<td>80</td>
<td>75</td>
<td>60</td>
<td>30</td>
<td>0</td>
</tr>
</tbody>
</table>
KAKATIYA UNIVERSITY
FACULTY OF SCIENCE
B.Sc. III – YEAR, PRACTICAL EXAMINATION
STATISTICS, PAPER-IV
(QUALITY, RELIABILITY AND OPERATIONS RESEARCH)
(Question Bank for Practical Examinations)

Note:
1. FIVE questions to be set, taking ONE question from each section.
2. Student is asked to answer any THREE questions.
3. Solutions to these problems are to be obtained using Calculators/Graph sheets/Statistical tables. Examination is conducted accordingly.

SECTION-A

1. Construct a control chart for mean for the following data on the basis of fuses, samples of 5 being taken every hour (each set 5 has been arranged in ascending order of magnitude) comment on whether the production seems to be under control, assuming that these are the first data.

<table>
<thead>
<tr>
<th>42</th>
<th>42</th>
<th>19</th>
<th>36</th>
<th>42</th>
<th>51</th>
<th>60</th>
<th>18</th>
<th>15</th>
<th>69</th>
<th>64</th>
<th>61</th>
</tr>
</thead>
<tbody>
<tr>
<td>65</td>
<td>45</td>
<td>24</td>
<td>54</td>
<td>51</td>
<td>74</td>
<td>60</td>
<td>20</td>
<td>30</td>
<td>109</td>
<td>90</td>
<td>78</td>
</tr>
<tr>
<td>75</td>
<td>68</td>
<td>80</td>
<td>69</td>
<td>57</td>
<td>75</td>
<td>72</td>
<td>27</td>
<td>39</td>
<td>113</td>
<td>93</td>
<td>94</td>
</tr>
<tr>
<td>78</td>
<td>72</td>
<td>81</td>
<td>77</td>
<td>59</td>
<td>78</td>
<td>95</td>
<td>42</td>
<td>62</td>
<td>118</td>
<td>109</td>
<td>109</td>
</tr>
<tr>
<td>87</td>
<td>90</td>
<td>81</td>
<td>84</td>
<td>78</td>
<td>132</td>
<td>138</td>
<td>60</td>
<td>84</td>
<td>153</td>
<td>112</td>
<td>136</td>
</tr>
</tbody>
</table>

2. Construct a control chart for mean for the following data (sample of 5 being taken every hour) comment on whether the production seems to be under control.

<table>
<thead>
<tr>
<th>42</th>
<th>40</th>
<th>42</th>
<th>21</th>
<th>15</th>
<th>19</th>
<th>50</th>
<th>40</th>
<th>31</th>
<th>51</th>
<th>80</th>
<th>52</th>
<th>80</th>
</tr>
</thead>
<tbody>
<tr>
<td>45</td>
<td>47</td>
<td>51</td>
<td>32</td>
<td>29</td>
<td>19</td>
<td>67</td>
<td>42</td>
<td>35</td>
<td>52</td>
<td>81</td>
<td>61</td>
<td>81</td>
</tr>
<tr>
<td>52</td>
<td>51</td>
<td>52</td>
<td>45</td>
<td>37</td>
<td>29</td>
<td>68</td>
<td>47</td>
<td>36</td>
<td>65</td>
<td>92</td>
<td>65</td>
<td>83</td>
</tr>
<tr>
<td>61</td>
<td>56</td>
<td>52</td>
<td>46</td>
<td>46</td>
<td>29</td>
<td>72</td>
<td>52</td>
<td>36</td>
<td>71</td>
<td>92</td>
<td>67</td>
<td>85</td>
</tr>
<tr>
<td>67</td>
<td>62</td>
<td>80</td>
<td>49</td>
<td>58</td>
<td>42</td>
<td>77</td>
<td>55</td>
<td>37</td>
<td>80</td>
<td>93</td>
<td>72</td>
<td>89</td>
</tr>
</tbody>
</table>

3. The following data give the measurements of the axles of bicycle wheels. 12 samples were taken so that each sample contains the measurements of 4 axles construct the control chart for range and comment whether the process is under control or not.

<table>
<thead>
<tr>
<th>139</th>
<th>140</th>
<th>142</th>
<th>136</th>
<th>145</th>
<th>146</th>
<th>148</th>
<th>145</th>
<th>140</th>
<th>140</th>
<th>141</th>
<th>138</th>
</tr>
</thead>
<tbody>
<tr>
<td>140</td>
<td>142</td>
<td>136</td>
<td>137</td>
<td>146</td>
<td>148</td>
<td>145</td>
<td>146</td>
<td>139</td>
<td>140</td>
<td>137</td>
<td>140</td>
</tr>
<tr>
<td>145</td>
<td>142</td>
<td>143</td>
<td>142</td>
<td>146</td>
<td>149</td>
<td>146</td>
<td>147</td>
<td>141</td>
<td>140</td>
<td>142</td>
<td>144</td>
</tr>
<tr>
<td>144</td>
<td>139</td>
<td>141</td>
<td>142</td>
<td>146</td>
<td>144</td>
<td>146</td>
<td>144</td>
<td>138</td>
<td>139</td>
<td>139</td>
<td>138</td>
</tr>
</tbody>
</table>
4. Construct the control chart for standard deviation (σ-chart) for the following data. On the basis of fuses samples of 4 being taken every hour. Comment on whether the production seems to be under control assuming that these are the first data.

\[
\begin{array}{ccccccccccccc}
27 & 30 & 21 & 40 & 51 & 33 & 30 & 35 & 20 & 22 & 34 & 32 & 34 & 28 & 44 \\
23 & 17 & 44 & 21 & 34 & 30 & 22 & 48 & 34 & 50 & 22 & 48 & 32 & 30 & 32 \\
24 & 32 & 28 & 24 & 10 & 22 & 12 & 47 & 42 & 41 & 44 & 33 & 38 & 23 & 41 \\
\end{array}
\]


6. The following are the figure of defectives in 30 lots each containing 1500 items. Draw the control chart for fraction defective (p-chart) and comment on the state of control process. 228, 313, 72, 610, 215, 128, 67, 100, 28, 315, 400, 118, 66, 226, 193, 280, 451, 420, 306, 356, 344, 225, 400, 190, 68, 7, 72, 818, 196, 300.

7. The following data give number of detectives in 10 independent samples of varying sizes from a production process.

<table>
<thead>
<tr>
<th>Sample no.</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample size</td>
<td>2000</td>
<td>1500</td>
<td>1400</td>
<td>1350</td>
<td>1250</td>
<td>1760</td>
<td>1875</td>
<td>1955</td>
<td>3125</td>
<td>1575</td>
</tr>
<tr>
<td>No. of defectives</td>
<td>425</td>
<td>430</td>
<td>216</td>
<td>341</td>
<td>225</td>
<td>322</td>
<td>280</td>
<td>306</td>
<td>337</td>
<td>305</td>
</tr>
</tbody>
</table>

Draw the control chart for fraction defective and comment on it.

8. Construct appropriate control chart.

<table>
<thead>
<tr>
<th>Lot-Number</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number inspected</td>
<td>500</td>
<td>400</td>
<td>300</td>
<td>150</td>
<td>600</td>
<td>450</td>
<td>750</td>
<td>800</td>
<td>900</td>
<td>1000</td>
</tr>
<tr>
<td>No. of defectives</td>
<td>25</td>
<td>42</td>
<td>35</td>
<td>16</td>
<td>15</td>
<td>40</td>
<td>72</td>
<td>81</td>
<td>82</td>
<td>100</td>
</tr>
</tbody>
</table>

Estimate the process average fraction defective.

9. The following table gives inspection data on completed spark plugs and 10 Samples of 100 each being included. Construct the number of defects chart.

<table>
<thead>
<tr>
<th>Sample No.</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of defects</td>
<td>5</td>
<td>4</td>
<td>7</td>
<td>8</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>8</td>
<td>6</td>
</tr>
</tbody>
</table>
10. Assume that 20 liters milk bottles are selected at random from a process. The number of air bubbles (defects) observed from the bottles is given in the table. \([c=\text{No. of air bubbles (defects) in each bottle}]\)

<table>
<thead>
<tr>
<th>Bottle No.</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
<th>15</th>
<th>16</th>
<th>17</th>
<th>18</th>
<th>19</th>
<th>20</th>
</tr>
</thead>
<tbody>
<tr>
<td>No.of defects</td>
<td>4</td>
<td>5</td>
<td>7</td>
<td>3</td>
<td>3</td>
<td>5</td>
<td>6</td>
<td>2</td>
<td>4</td>
<td>8</td>
<td>3</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>3</td>
<td>7</td>
<td>6</td>
<td>13</td>
</tr>
</tbody>
</table>

**SECTION-B**

11. Draw the OC curve for the single sampling plan \(n=89\) and \(c=2\).

12. Suppose that a product is shipped in lots of size \(N=5000\) the receiving inspection procedure used a single sampling with \(n=50\) and \(c=1\). Then draw the OC curve for the plan.

13. For the single sample plan \(N=2000\), \(n=100\), \(c=2\) find the Probability of accepting the lot \((P_a)\) when lot fraction defective \(P=0.005, 0.01, 0.05, 0.10\). Also draw an OC curve.

14. Draw the OC curve for a double sampling plan with \(n_1=50\), \(c_1=1\), \(n_2=100\) and \(c_2=3\).

15. Draw the OC curves for a double sampling plan with \(n_1=30\), \(c_1=1\), \(n_2=70\), \(c_2=4\) and \(N=2000\). If the incoming lots have fraction nonconforming \(P=0.05\), what is the probability of acceptance on the first sample? What is the probability of final acceptance? Calculate the probability of rejection on the first sample.

16. Consider a four component system of which the components are independent and identically distributed with CFR (Constant Failure Rate). If \(R_s(100)=0.95\) is the specified reliability, find the individual component Mean Time To Failure.

17. Consider a system consisting of five components which are independent and identically distributed with Constant Failure Rate. If \(R_s(50)=0.92\) is the specified reliability, find the individual component Mean Time To Failure.

18. Let a parallel system be composed of \(n=2\) identical components, each with failure rate \(\lambda=0.01\) and time \(t=10\) hours, only one of which is needed for system success. Then find total system reliability and Mean Time To Failure.

19. A space vehicle requires three out of its four main engines to operate in order to achieve orbit. If engine has a reliability of 0.97, determine the reliability of achieving orbit.

20. A manufacturing process produces parts which are one percent defective. Fifty of these parts are selected at random. What is the probability that there are two or less defective parts out of the fifty selected parts?
SECTION-C

21. A manufacturer produces two types of models $M_1$ and $M_2$. Each $M_1$ model requires 4 hours of grinding and 2 hours of polishing; whereas each $M_2$ model requires 2 hours of grinding and 5 hours of polishing. The manufacturer has 2 grinders and 3 polishers. Each grinder works for 40 hours a week and each polisher works for 60 hours a week. Profit on an $M_1$ model is Rs.3.00 and on an $M_2$ model is Rs.4.00. Whatever is produced in a week is sold in the market. How should the manufacturer allocate his production capacity to the two types of models so that he may make the maximum profit in a week?

22. Solve graphically the following L.P.P:

Maximize $z = 3x_1 + 2x_2$

Subject to the constraints:

$-2x_1 + x_2 \leq 1$
$x_1 \leq 2$
$x_1 + x_2 \leq 3$
and $x_1, x_2 \geq 0.$

23. Find the minimum value of $z = 600x_1 + 400x_2$

Subject to the constraints:

$1500x_1 + 1500x_2 \geq 20000$
$3000x_1 + 1000x_2 \geq 40000$
$2000x_1 + 5000x_2 \geq 44000$

$x_1, x_2 \geq 0.$

24. Find the maximum value of $z = 3x_1 + 2x_2$

Subject to the constraints:

$x_1 - x_2 \leq 1$
$x_1 + x_2 \geq 3$
and $x_1, x_2 \geq 0.$

25. Use Simplex method to solve the following L.P.P

Maximize $z = x_1 - x_2 + 3x_3$

Subject to the constraints:

$x_1 + x_2 + x_3 \leq 10$
$2x_1 - x_3 \leq 2$
$2x_1 - 2x_2 + 3x_3 \leq 0$

$x_1, x_2, x_3 \geq 0.$
26. Use Simplex method to solve the following L.P.P
Minimize \( z = x_1 - 3x_2 + 2x_3 \)
Subject to the constraints:
\[
\begin{align*}
3x_1 - x_2 + 3x_3 & \leq 7 \\
-2x_1 + 4x_2 & \leq 12 \\
-4x_1 + 3x_2 + 8x_3 & \leq 10 \\
x_1, x_2, x_3 & \geq 0.
\end{align*}
\]

27. Use Big-M method to minimize \( z = 2x_1 + x_2 \)
Subject to the constraints:
\[
\begin{align*}
3x_1 + x_2 &= 3 \\
4x_1 + 3x_2 & \geq 6 \\
x_1 + 2x_2 & \leq 4 \\
x_1, x_2 & \geq 0.
\end{align*}
\]

28. Use Two-Phase Simplex method to maximize \( z = 5x_1 - 4x_2 + 3x_3 \)
Subject to the constraints:
\[
\begin{align*}
2x_1 + x_2 - 6x_3 &= 20 \\
6x_1 + 5x_2 + 10x_3 & \leq 76 \\
8x_1 - 3x_2 + 6x_3 & \leq 50 \\
x_1, x_2, x_3 & \geq 0.
\end{align*}
\]

29. Write down the dual of the following L.P.P and solve it.
Maximize \( z = 2x_1 + x_2 \)
Subject to the constraints:
\[
\begin{align*}
x_1 + 2x_2 & \leq 10 \\
x_1 + x_2 & \leq 6 \\
x_1 - x_2 & \leq 2 \\
x_1 - 2x_2 & \leq 1 \\
\text{and} \quad x_1, x_2 & \geq 0.
\end{align*}
\]

30. Use Dual Simplex Method to solve the following L.P.P
Maximize \( z = -3x_1 - x_2 \)
Subject to the constraints:
\[
\begin{align*}
x_1 + x_2 & \geq 1 \\
2x_1 + 3x_2 & \geq 2 \\
\text{And} \quad x_1, x_2 & \geq 0.
\end{align*}
\]

SECTION-D

31. Determine an initial basic feasible solution to the following Transportation problem using the North-West corner method.

<table>
<thead>
<tr>
<th></th>
<th>( D_1 )</th>
<th>( D_2 )</th>
<th>( D_3 )</th>
<th>( D_4 )</th>
<th>( D_5 )</th>
<th>( D_6 )</th>
<th>Availability</th>
</tr>
</thead>
<tbody>
<tr>
<td>( O_1 )</td>
<td>9</td>
<td>12</td>
<td>9</td>
<td>8</td>
<td>4</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>( O_2 )</td>
<td>7</td>
<td>3</td>
<td>6</td>
<td>8</td>
<td>9</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>( O_3 )</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>8</td>
<td>10</td>
<td>14</td>
<td>6</td>
</tr>
<tr>
<td>( O_4 )</td>
<td>7</td>
<td>3</td>
<td>5</td>
<td>7</td>
<td>10</td>
<td>9</td>
<td>7</td>
</tr>
<tr>
<td>( O_5 )</td>
<td>2</td>
<td>3</td>
<td>8</td>
<td>10</td>
<td>2</td>
<td>4</td>
<td>3</td>
</tr>
</tbody>
</table>

| Requirement | 3 | 4 | 5 | 7 | 6 | 4 |
32. Determine an initial basic feasible solution to the following Transportation problem using Matrix Minima Method.

<table>
<thead>
<tr>
<th>Origin</th>
<th>Destinations</th>
<th>Supply</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>D₁</td>
<td>D₂</td>
</tr>
<tr>
<td>O₁</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>O₂</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>O₃</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>O₄</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td>Demand</td>
<td>21</td>
<td>25</td>
</tr>
</tbody>
</table>

33. Obtain an initial basic feasible solution to the following Transportation Problem using the Vogel’s Approximation Method.

<table>
<thead>
<tr>
<th>Destination</th>
<th>Origin</th>
<th>D₁</th>
<th>D₂</th>
<th>D₃</th>
<th>D₄</th>
<th>Supply</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>O₁</td>
<td>2</td>
<td>4</td>
<td>3</td>
<td>8</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>O₂</td>
<td>6</td>
<td>4</td>
<td>3</td>
<td>7</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>O₃</td>
<td>6</td>
<td>2</td>
<td>4</td>
<td>2</td>
<td>40</td>
</tr>
<tr>
<td>Demand</td>
<td>10</td>
<td>70</td>
<td>10</td>
<td>10</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

34. Obtain an Optimum basic feasible solution to the following transportation problem.

<table>
<thead>
<tr>
<th>Factory</th>
<th>Ware house</th>
<th>Factory capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>W₁</td>
<td>W₂</td>
</tr>
<tr>
<td>F₁</td>
<td>19</td>
<td>30</td>
</tr>
<tr>
<td>F₂</td>
<td>70</td>
<td>30</td>
</tr>
<tr>
<td>F₃</td>
<td>40</td>
<td>80</td>
</tr>
<tr>
<td>Warehouse requirement</td>
<td>5</td>
<td>8</td>
</tr>
</tbody>
</table>

35. Solve the following transportation problem.

<table>
<thead>
<tr>
<th>Source</th>
<th>Destination</th>
<th>Availability</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>D₁</td>
<td>D₂</td>
</tr>
<tr>
<td>O₁</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td>O₂</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>O₃</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>O₄</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>Requirement</td>
<td>7</td>
<td>9</td>
</tr>
</tbody>
</table>
36. A company has three plants at locations A, B and C, which supply to warehouses located at D, E, F, G and H. Monthly plant capacities are 800, 500 and 900 units respectively. Monthly warehouse requirements are 400, 400, 500, 400 and 800 units respectively. Unit transportation costs (in rupees) are given below:

<table>
<thead>
<tr>
<th>From</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>5</td>
<td>8</td>
<td>6</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>B</td>
<td>4</td>
<td>7</td>
<td>7</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>C</td>
<td>8</td>
<td>4</td>
<td>6</td>
<td>6</td>
<td>4</td>
</tr>
</tbody>
</table>

Determine an optimum distribution for the company in order to minimize the total transportation cost by MODI-Method.

37. Find the Optimum solution to the following transportation problem.

<table>
<thead>
<tr>
<th>Source</th>
<th>Destination</th>
<th>D1</th>
<th>D2</th>
<th>D3</th>
<th>Supply</th>
</tr>
</thead>
<tbody>
<tr>
<td>O1</td>
<td></td>
<td>4</td>
<td>8</td>
<td>8</td>
<td>76</td>
</tr>
<tr>
<td>O2</td>
<td>16</td>
<td>24</td>
<td>16</td>
<td></td>
<td>82</td>
</tr>
<tr>
<td>O3</td>
<td>8</td>
<td>16</td>
<td>24</td>
<td></td>
<td>77</td>
</tr>
<tr>
<td>Demand</td>
<td>72</td>
<td>102</td>
<td>41</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

38. A departmental head has four subordinators, and four tasks to be performed. The subordinates differ in efficiency, and the tasks differ in their intrinsic difficulty. His estimate of the time each man would take to perform each task, is given in the matrix below.

<table>
<thead>
<tr>
<th>Tasks</th>
<th>Men</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td></td>
<td>18</td>
<td>26</td>
<td>17</td>
<td>11</td>
</tr>
<tr>
<td>B</td>
<td></td>
<td>13</td>
<td>28</td>
<td>14</td>
<td>26</td>
</tr>
<tr>
<td>C</td>
<td></td>
<td>38</td>
<td>19</td>
<td>18</td>
<td>15</td>
</tr>
<tr>
<td>D</td>
<td></td>
<td>19</td>
<td>26</td>
<td>24</td>
<td>10</td>
</tr>
</tbody>
</table>

How should the tasks be allocated one to a man. So as to minimize the total man–hours?
39. Solve the following Assignment problem

<table>
<thead>
<tr>
<th>Jobs</th>
<th>Machines</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>A: 4</td>
</tr>
<tr>
<td>II</td>
<td>A: 3</td>
</tr>
<tr>
<td>III</td>
<td>A: 4</td>
</tr>
<tr>
<td>IV</td>
<td>A: 3</td>
</tr>
</tbody>
</table>

40. To assign four jobs to four workers. The varying skills of the workers gave rise to varying cost for performing the jobs the below table summarizes the cost data of the assignments. The data indicate that workers ‘A’ can’t work on job 3 and worker ‘c’ cannot work on job 4. Determine the optimum assignment.

<table>
<thead>
<tr>
<th>Workers</th>
<th>Jobs</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1: 50</td>
</tr>
<tr>
<td>B</td>
<td>1: 70</td>
</tr>
<tr>
<td>C</td>
<td>1: 90</td>
</tr>
<tr>
<td>D</td>
<td>1: 70</td>
</tr>
</tbody>
</table>

41. A machine operator processes five types of items on his machine each week, and must choose a sequence for them. The set-up cost per change depends on the item presently on the machine and the set-up to be made according to the following table:

<table>
<thead>
<tr>
<th>From Item</th>
<th>To item</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>A: ∞</td>
</tr>
<tr>
<td>B</td>
<td>A: 4</td>
</tr>
<tr>
<td>C</td>
<td>A: 7</td>
</tr>
<tr>
<td>D</td>
<td>A: 3</td>
</tr>
<tr>
<td>E</td>
<td>A: 4</td>
</tr>
</tbody>
</table>

If he processes each type of item once and only once each week, how should he sequence the items on his machine in order to minimize the total set-up cost?

42. Solve the following sequencing problem and give the optimum sequence of jobs, minimum total elapsed time and individual idle times of M₁, M₂ in the case (the order of machines is M₁, M₂).

<table>
<thead>
<tr>
<th>Jobs</th>
<th>J₁</th>
<th>J₂</th>
<th>J₃</th>
<th>J₄</th>
<th>J₅</th>
<th>J₆</th>
</tr>
</thead>
<tbody>
<tr>
<td>Machine M₁</td>
<td>1</td>
<td>3</td>
<td>8</td>
<td>5</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>Machine M₂</td>
<td>5</td>
<td>6</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>10</td>
</tr>
</tbody>
</table>
43. The following table gives the machines time in (hours) for 5 jobs to be processed on two different machines in the order $M_1, M_2$. Find the sequence of the jobs that minimizes the total elapsed time to complete the jobs also calculate the individuals idle timings of $M_1, M_2$.

<table>
<thead>
<tr>
<th>Job</th>
<th>Machine $M_1$</th>
<th>Machine $M_2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>10</td>
<td>4</td>
</tr>
<tr>
<td>B</td>
<td>2</td>
<td>12</td>
</tr>
<tr>
<td>C</td>
<td>18</td>
<td>14</td>
</tr>
<tr>
<td>D</td>
<td>6</td>
<td>16</td>
</tr>
<tr>
<td>E</td>
<td>20</td>
<td>18</td>
</tr>
</tbody>
</table>

44. Determine an Optimal sequence of jobs that minimizes total elapsed time. Jobs are to be processed on three machines $M_1, M_2$ and $M_3$ in the order $M_1, M_2, M_3$.

<table>
<thead>
<tr>
<th>Jobs</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
</tr>
</thead>
<tbody>
<tr>
<td>Machine $M_1$</td>
<td>3</td>
<td>8</td>
<td>7</td>
<td>4</td>
<td>9</td>
<td>8</td>
<td>7</td>
</tr>
<tr>
<td>Machine $M_2$</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>5</td>
<td>1</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Machine $M_3$</td>
<td>6</td>
<td>7</td>
<td>5</td>
<td>11</td>
<td>5</td>
<td>6</td>
<td>12</td>
</tr>
</tbody>
</table>

45. Find the sequence that minimize the total time required in performing the following jobs on three machines in the order $M_1, M_2$ and $M_3$.

<table>
<thead>
<tr>
<th>Jobs</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Machine $M_1$</td>
<td>8</td>
<td>3</td>
<td>7</td>
<td>2</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>Machine $M_2$</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>2</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>Machine $M_3$</td>
<td>8</td>
<td>7</td>
<td>6</td>
<td>9</td>
<td>10</td>
<td>9</td>
</tr>
</tbody>
</table>
SECTION-E

46. Construct mean, range and standard deviation charts for the following data using MS-EXCEL.

<table>
<thead>
<tr>
<th>Sample No’s</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
</tr>
</thead>
<tbody>
<tr>
<td>X1</td>
<td>15</td>
<td>12</td>
<td>9</td>
<td>10</td>
<td>7</td>
<td>8</td>
<td>16</td>
<td>8</td>
<td>6</td>
<td>16</td>
<td>7</td>
<td>11</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>X2</td>
<td>9</td>
<td>16</td>
<td>11</td>
<td>7</td>
<td>4</td>
<td>8</td>
<td>9</td>
<td>10</td>
<td>12</td>
<td>13</td>
<td>9</td>
<td>13</td>
<td>7</td>
<td>10</td>
</tr>
<tr>
<td>X3</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>8</td>
<td>6</td>
<td>10</td>
<td>8</td>
<td>14</td>
<td>9</td>
<td>13</td>
<td>10</td>
<td>10</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>X4</td>
<td>15</td>
<td>13</td>
<td>10</td>
<td>12</td>
<td>11</td>
<td>5</td>
<td>13</td>
<td>9</td>
<td>16</td>
<td>11</td>
<td>15</td>
<td>12</td>
<td>16</td>
<td>14</td>
</tr>
</tbody>
</table>

47. The following are the figure of defectives in 30 lots each containing 1500 items. Draw the control chart for fraction defective using MS-EXCEL.
128, 213, 72, 510, 115, 128, 67, 100, 28, 215, 300, 118, 66, 126, 193, 180, 351, 320, 206, 256, 244, 125, 300, 190, 68, 75, 72, 718, 196, 200.

48. The following data gives number of defectives in 10 independent samples of varying sizes from a production process.

<table>
<thead>
<tr>
<th>Sample no.</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample size</td>
<td>2000</td>
<td>1400</td>
<td>1300</td>
<td>1250</td>
<td>1150</td>
<td>1660</td>
<td>1775</td>
<td>1855</td>
<td>3025</td>
<td>1475</td>
</tr>
<tr>
<td>No. of defectives</td>
<td>325</td>
<td>330</td>
<td>116</td>
<td>241</td>
<td>125</td>
<td>222</td>
<td>180</td>
<td>206</td>
<td>237</td>
<td>205</td>
</tr>
</tbody>
</table>

Draw the control chart for fraction defective using MS-EXCEL.

49. The number of defects in 20 pieces of cloth each of 100 meters length is given below: 1,3,3,1,6,4,3,7,10,2,2,6,4,3,2,7,1,5,6,4.
Draw the appropriate control chart and say whether the process can be considered to be in control using MS-EXCEL.

50. Draw the OC curve for the single sampling plan n=100 and c=2 using MS-EXCEL.

51. Consider a four component system of which the components are independent and identically distributed with CFR (Constant Failure Rate). If $R_s(200)=0.99$ is the specified reliability, find the individual component Mean Time To Failure using MS-EXCEL.
52. Solve the following L.P.P by simplex method using TORA.
   Maximize \( z = x_1 - x_2 + 3x_3 \)
   Subject to the constraints:
   \[
   \begin{align*}
   x_1 + x_2 + x_3 & \leq 10 \\
   2x_1 - x_3 & \leq 2 \\
   2x_1 - 2x_2 + 3x_3 & \leq 0 \\
   x_1, x_2, x_3 & \geq 0.
   \end{align*}
   \]

53. Solve the following L.P.P by Big-M method using TORA.
   Maximize \( z = 8x_2 \)
   Subject to the constraints:
   \[
   \begin{align*}
   x_1 - x_2 & \geq 0 \\
   2x_1 + 3x_2 & \leq -6 \\
   \text{and } x_1, x_2 & \geq 0.
   \end{align*}
   \]

54. Solve the following L.P.P by Two-Phase Simplex method using TORA.
   Minimize \( z = (15/2) x_1 - 3x_2 \)
   Subject to the constraints:
   \[
   \begin{align*}
   3x_1 - x_2 - x_3 & \geq 3 \\
   x_1 - x_2 + x_3 & \geq 2 \\
   x_1, x_2, x_3 & \geq 0.
   \end{align*}
   \]

55. Write down the dual of the following L.P.P using TORA.
   Maximize \( z = 4x_1 + 2x_2 \)
   Subject to the constraints:
   \[
   \begin{align*}
   x_1 + x_2 & \geq 3 \\
   x_1 - x_2 & \geq 2 \\
   x_1, x_2 & \geq 0.
   \end{align*}
   \]

56. Solve the following L.P.P by Dual Simplex Method using TORA.
   Maximize \( z = -2x_1 - 2x_2 - 4x_3 \)
   Subject to the constraints:
   \[
   \begin{align*}
   2x_1 + 3x_2 + 5x_3 & \geq 2 \\
   3x_1 + x_2 + 7x_3 & \leq 3 \\
   x_1 + 4x_2 + 6x_3 & \leq 5 \\
   x_1, x_2, x_3 & \geq 0.
   \end{align*}
   \]

57. Determine an initial basic feasible solution to the following Transportation Problem by North-West corner method using TORA.

<table>
<thead>
<tr>
<th>Warehouses</th>
<th>W_1</th>
<th>W_2</th>
<th>W_3</th>
<th>Supply</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plant</td>
<td>P_1</td>
<td>7</td>
<td>6</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>P_2</td>
<td>5</td>
<td>7</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>P_3</td>
<td>4</td>
<td>5</td>
<td>8</td>
</tr>
<tr>
<td>Demand</td>
<td>21</td>
<td>25</td>
<td>19</td>
<td></td>
</tr>
</tbody>
</table>
58. Consider the following Transportation problem.

<table>
<thead>
<tr>
<th>Source</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>Availability</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>20</td>
<td>22</td>
<td>17</td>
<td>4</td>
<td>120</td>
</tr>
<tr>
<td>2</td>
<td>24</td>
<td>37</td>
<td>9</td>
<td>7</td>
<td>70</td>
</tr>
<tr>
<td>3</td>
<td>32</td>
<td>37</td>
<td>20</td>
<td>15</td>
<td>50</td>
</tr>
<tr>
<td>Requirement</td>
<td>60</td>
<td>40</td>
<td>30</td>
<td>110</td>
<td>240</td>
</tr>
</tbody>
</table>

Determine an initial basic feasible solution by Matrix Minima Method using TORA.

59. Consider the following Transportation problem.

<table>
<thead>
<tr>
<th>Origin</th>
<th>D1</th>
<th>D2</th>
<th>D3</th>
<th>D4</th>
<th>Availability</th>
</tr>
</thead>
<tbody>
<tr>
<td>O₁</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>4</td>
<td>30</td>
</tr>
<tr>
<td>O₂</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>50</td>
</tr>
<tr>
<td>O₃</td>
<td>4</td>
<td>2</td>
<td>5</td>
<td>9</td>
<td>20</td>
</tr>
<tr>
<td>Requirement</td>
<td>20</td>
<td>40</td>
<td>30</td>
<td>10</td>
<td>100</td>
</tr>
</tbody>
</table>

Determine an initial basic feasible solution by Vogel’s Approximation Method using TORA.

60. Solve the following Assignment problem using TORA.

<table>
<thead>
<tr>
<th>From</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>32</td>
<td>38</td>
<td>40</td>
<td>28</td>
<td>40</td>
</tr>
<tr>
<td>2</td>
<td>40</td>
<td>24</td>
<td>28</td>
<td>21</td>
<td>36</td>
</tr>
<tr>
<td>3</td>
<td>41</td>
<td>27</td>
<td>33</td>
<td>30</td>
<td>37</td>
</tr>
<tr>
<td>4</td>
<td>22</td>
<td>38</td>
<td>41</td>
<td>36</td>
<td>36</td>
</tr>
<tr>
<td>5</td>
<td>29</td>
<td>33</td>
<td>40</td>
<td>35</td>
<td>39</td>
</tr>
</tbody>
</table>