1 (70%) The following are 2D and 3D pie charts for a categorical variable with three levels.

a) (10%) From the 2D pie chart, can we draw the conclusion that the three levels have exactly the same frequency? Explain.

b) (10%) Do you think the 3D pie chart is easier to read than the 2D pie chart? Explain.

c) (10%) Does the 3D pie chart bring extra dimensional information compared to the 2D pie chart? Explain.
d) (20%) Suppose we are given a two-way contingency table shown below:

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>T</td>
<td>51</td>
<td>46</td>
<td>53</td>
</tr>
<tr>
<td>F</td>
<td>15</td>
<td>20</td>
<td>15</td>
</tr>
</tbody>
</table>

Can you use either 2D or 3D pie chart to visualize such data? If yes, explain how. If no, explain why and suggest a better alternative chart.

e) (20%) Based on the above results, what advices would you give when using 2D and 3D pie charts? List at least three advices.
The Pearson correlation coefficient for two random variables \( X, Y \) is defined by

\[
\rho = \frac{E[(X - \mu_X)(Y - \mu_Y)]}{\sigma_X \sigma_Y}
\]

where \((\mu_X, \sigma_X), (\mu_Y, \sigma_Y)\) are the means and standard deviations for \( X \) and \( Y \), respectively. For the following scatter plots of six bivariate data sets, it is found that they all have the same Pearson correlation coefficient \( \rho^* \).

![Scatter plots of six bivariate data sets]

a) (10%) What is \( \rho^* \)? Explain.

b) (10%) Obviously each of the six data sets has some relationship between \( X \) and \( Y \). Explain why Pearson correlation cannot discriminate these data sets.

c) (10%) Among the six data sets, which ones (group A) have stronger dependence in \((X, Y)\) than which others (group B)? For each group, find at least one representative.