Introduction to Data Science

Data Analysis Assignment

Group K

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Notebook DS_Assignment_Group_K.ipynb

Conduct a descriptive analysis and provide three main insights from it. You should elaborate on how you derive those insights.

The given dataset shows the results of a survey conducted to understand the public perception of Explainable AI (XAI). The data has been collected from 327 individuals (the number of rows in the dataset) and under 31 topics (number of columns in the dataset).

When analyzing the dataset, it can be observed that the survey has been answered most by individuals of the age range 25-40 and most of them are occupied in the computer and mathematical field, out of the given set of fields of occupations. A scatter plot of age against the field of occupation was made and it can be observed there that most data points concentrate in the age range 25-40 and most of them lie in the above-mentioned field of occupation. It also can be observed that most participants of this survey are from Sri Lanka. So, it can be argued that this survey results represents the local public opinion on Explainable AI.

When observing the distributions of the answers given to the questions 7-10 under Section 2 of the survey, it can be seen that the option chosen by the most number of individuals for each question tallies with the actual answer for the particular question. So it can be argued that the individuals who participated in the survey have a reasonable knowledge of AI and its uses. But it was also observed that the most number of individuals who participated in the survey are in the computer and mathematical fields which are closely engaged with AI, so it raises a slight question on the knowledge of the common public on AI.

When analyzing the answers provided to the questions under Section 3 of the survey, it can be suggested that the individuals who answered the survey prefer explanations with minimum technical details over complex explanations. When observing the answers given for questions 13 and 14, it is evident that most prefer the simple verbal explanation over the graphical explanation. In case of question 15, both options have an almost equal preference as both graphical and verbal explanations provide an equally clear explanation. In question 16, the pictorial explanation is preferred over the verbal explanation. Pictures are more comprehensible to the human brain than a verbal explanation in this type of context. The suggestion

made above is also reflected in the answers given for question 21. Among the given answers, most prefer easy-to-understand answers that require minimal to no technical background.

Test the following hypotheses. You should elaborate on the tools and techniques you used to evaluate the hypotheses.

For the following hypotheses 0.05 (5%) will be considered as the significance level. Since all of the hypotheses are about the association between two categorical variables (Here Age is considered as a categorical variable even though it is discrete numerical), the chi square test of association is used to test the hypotheses.

Since there are a significant amount of data instances to handle several python classes are used to create the contingency table and the test results. Python **"pandas"** package is used to handle the data and python **"researchpy"** package is used to create the contingency table and the test results. For further details please refer to the workings under Hypothesis Testing in notebook.

a. **H0: Gender significantly impacts the perceived importance of XAI.**
   - **$H0_0$** : Gender significantly impacts the perceived importance of XAI.
   - **$H0_A$** : Gender does not significantly impact the perceived importance of XAI.
   - **Test Results** :
     - Pearson Chi-square (df =8) = 8.5557
     - P-value = 0.3812
     - Cramer's V = 0.1144
   - **Conclusion** : Here p-value is higher than the significance level. Therefore the null hypothesis is not rejected. Cramer's V value shows a moderate association between gender and perceived importance of XAI.

b. **H1: Age significantly impacts the perceived importance of XAI.**
   - **$H1_0$** : Age significantly impacts the perceived importance of XAI.
   - **$H1_A$** : Age does not significantly impact the perceived importance of XAI.
   - **Test Results** :
     - Pearson Chi-square (df = 128) = 149.6854
     - P-value = 0.0923
     - Cramer's V = 0.3383
   - **Conclusion** : Here the p value is higher than the significance level. Therefore the null hypothesis is not rejected. Given the degree of freedom is quite high, the Cramer's V value indicates a very strong association.

c. **H2: Education significantly impacts the perceived importance of XAI.**
   - **$H2_0$** : Education significantly impacts the perceived importance of XAI.
   - **$H2_A$** : Education does not significantly impact the perceived importance of XAI.
   - **Test Results** :
     - Pearson Chi-square (df = 20) = 16.5583
     - P-value = 0.6814
     - Cramer's V = 0.1125

- **Conclusion** : Here the p value is higher than the significance level. Therefore the null hypothesis is not rejected. And the Cramer's V value indicates a moderate association.

d. H3: Occupation significantly impacts the perceived importance of XAI.

- **$H3_0$** : Occupation significantly impacts the perceived importance of XAI.
- **$H3_A$** : Occupation does not significantly impact the perceived importance of XAI.
- **Test Results** :
  - Pearson Chi-square (df = 72) = 47.0225
  - P-value = 0.9901
  - Cramer's V = 0.1896
- **Conclusion** : Here the p value is higher than the significance level. Therefore the null hypothesis is not rejected. Cramer's V indicates strong association between two attributes.

e. H4: Carer level significantly impacts the perceived importance of XAI.

- **$H4_0$** : Carer level significantly impacts the perceived importance of XAI.
- **$H4_A$** : Carer level does not significantly impact the perceived importance of XAI.
- **Test Results** :
  - Pearson Chi-square (df = 44) = 47.0357
  - P-value = 0.3493
  - Cramer's V = 0.1914
- **Conclusion** : Here the p value is higher than the significance level. Therefore the null hypothesis is not rejected. Given the degree of freedom is quite high, the Cramer's V value indicates a strong association.

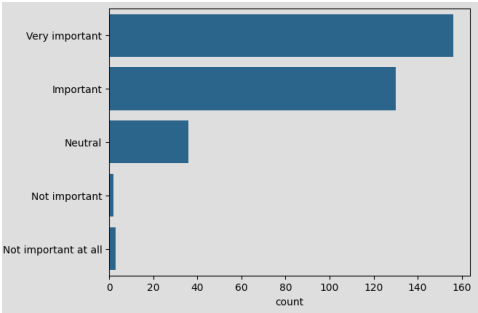
f. H5: AI awareness significantly impacts the perceived importance of XAI.

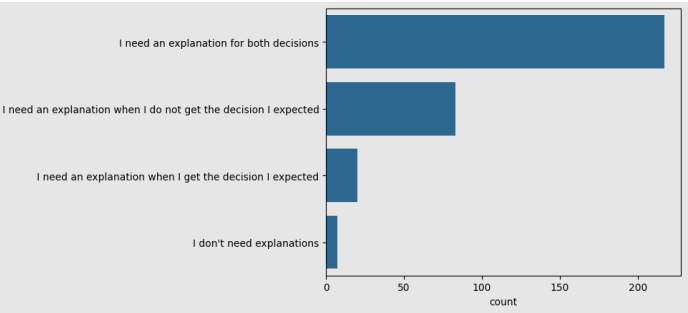
- **$H4_0$** : Carer level significantly impacts the perceived importance of XAI.
- **$H4_A$** : Carer level does not significantly impact the perceived importance of XAI.
- **Test Results** :
  - Pearson Chi-square (df = 16) = 26.1232
  - P-value = 0.0523
  - Cramer's V = 0.1413
- **Conclusion** : Here the p value is slightly higher than the significance level. Therefore the null hypothesis is not rejected. However this hypothesis might be rejected in other data samples. Cramer's V value shows a moderate asscociation.

Answer the following questions. Ensure you use the appropriate measurements and visualizations to derive and explain the answers.

a. Is it important for users to know the reasons behind the decisions of AI systems?

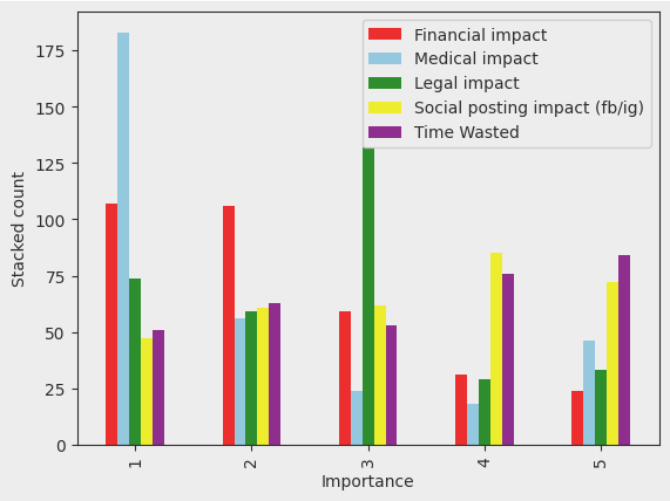
From Q11 and 12 in the survey we can get the following insights





According to the above bar charts it is clear that users are considering it is important to know the reasons behind the decisions of AI system

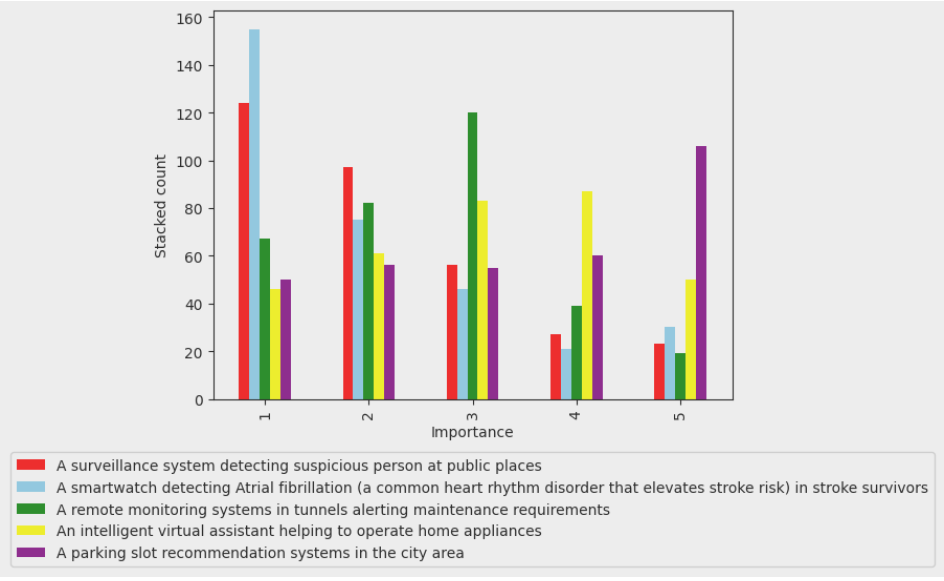
b. Which impact (financial, medical, legal, etc.) caused by AI decisions gives rise to XAI being of higher importance?



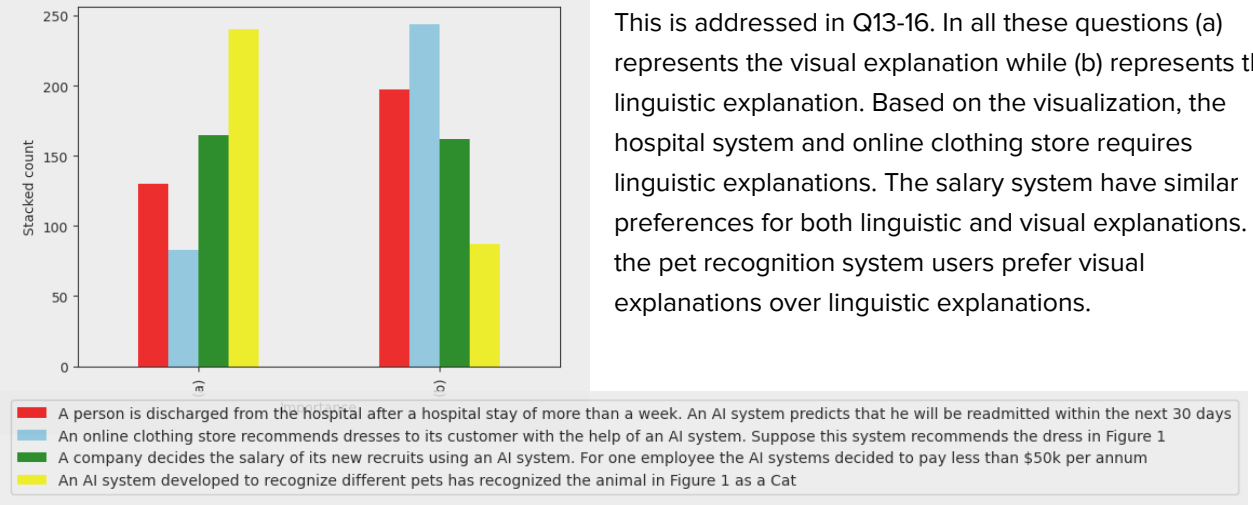
This is addressed in Q17 of the survey. 1 has the highest importance and 5 is least. As you can see both Financial and Medical impact is given a high importance. This is understandable because these areas can lead to greater repercussions. Further we can compare each impact by taking the mean for each impact. It is worth noticing that smaller values for mean have higher importance. Medical impact has the highest overall importance having 2.05 as the mean. While Financial, Legal, Social posting and Time Wasted have average values 2.26, 2.66, 3.23, 3.24 respectively.

c. Which ELE application gives rise to XAI being of higher importance?

This is addressed in Q20 of the survey. 1 is of highest importance and 5 is least. From the visualization given below we can see that the Smartwatch has the highest importance with the surveillance system closely nearby. As the function carried out by the smartwatch has a high significance it needs more explainability whereas a parking slot recommendation system won't need much explanation as the function carried there is of less significance. Surveillance system, smartwatch, remote monitoring system, virtual assistance and parking slot recommondation has average values of 2.17, 2.07, 2.58, 3.10, 3.36 respectively. Since the lowest average value corresponds to highest overall importance, Smartwatch detecting Atrial fibrillation has the highest overall importance.

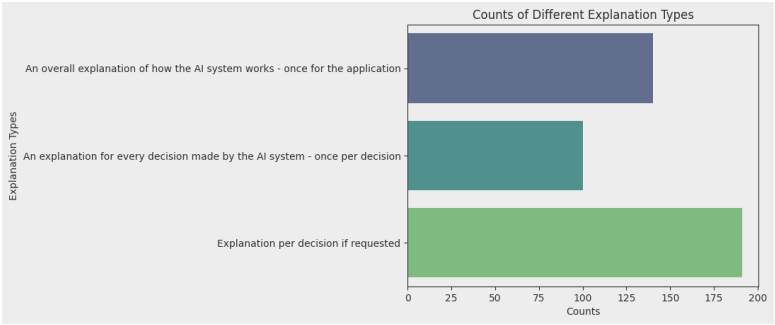


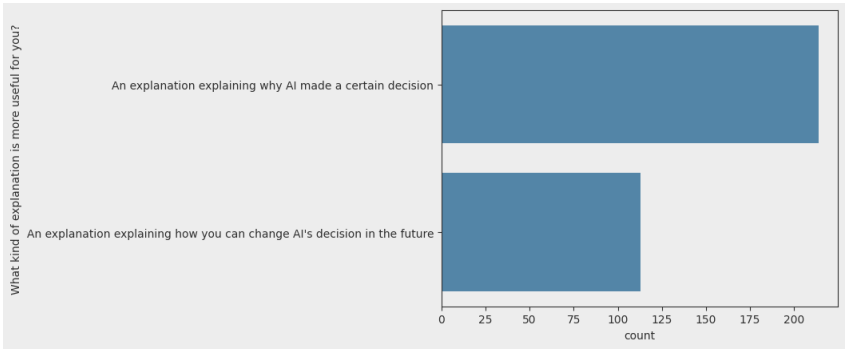
d. Are linguistic explanations preferred over other types of explanations?



This is addressed in Q13-16. In all these questions (a) represents the visual explanation while (b) represents the linguistic explanation. Based on the visualization, the hospital system and online clothing store requires linguistic explanations. The salary system have similar preferences for both linguistic and visual explanations. For the pet recognition system users prefer visual explanations over linguistic explanations.

e. RQ4: What are the expected characteristics of explanations?





This is addressed in Q18,19 & 21 in the survey. From the first visualization we can see that people prefer explanations for AI decision making when requested rather than per decision or per application.
Also the explanations prefered by most people is with regard to the reasoning behind the decision making rather than how to change the decision making in the future.
When looking at the exact characteristics of explanations, we can see most people want them to be understandable, faithful, interactive and descriptive. Whereas less number of people prefered frequency of explanations and transparency.