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**Exercise 2- Data Pre-processing in R**

**Exercise Overview**

In this exercise, you will use the RStudio interface to load data from a CSV file, to explore the statistics that this software provides for different attribute types, and to apply data pre-processing filters.  The data pre-processing filters include selection of a subset of variables, discretization methods, handling missing values, and more.

**Exercise Instructions**

This exercise consists of two parts. The first part will help you master and apply the key concepts from course readings to the data analysis. **The first part is not graded and you do not need to submit a report for part 1 before starting part 2. However, you should do it** to get maximum benefit from the exercise. **Part 2 must be submitted**.

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| **Part 1**  Complete the exercise in the Word document on data provided in the cars.csv file.  You do not need to submit anything for this part.  Keep in mind that your output might be slightly different depending on your operating system and RStudio version. | Car Risk Level Bar Chart |

**Part 2**

Use the provided CreditApproval.csv dataset for this part. Follow the instructions below to write an R script with comments and to write a report on your findings and results interpretation.

**The report should be in your own words and should cover the following key points in the same order as below.**

1. **Introduction**
2. Read the dataset description at <http://archive.ics.uci.edu/ml/datasets/Credit+Approval>   Explain what data is in the dataset, and what each row represents.
3. Use the read.csv command to load the CreditApproval.csv data into RStudio.  Then, run the command to preview the first 10 data rows.  Include the command, the output screenshot, and an explanation of what the output shows.
4. A screenshot of a computer

   Description automatically generated with medium confidence
   1. Head is showing the first 10 rows of data. Since the window isn’t large enough to show all at once, the data looks like it is stacked.
5. Run the str command.  Add a screenshot of the output to the report, and explain what the output tells you about the Credit Approval data structure.
6. Graphical user interface, text

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   1. This is printing out the dataframe as a string so that you can see all of the data structure
7. **Descriptive statistics -**Run the summary command to display the descriptive statistics for all variables. Include the command, output, and answers to the following questions in the report:
8. Graphical user interface, text

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9. What descriptive statistics does the output show for numeric variables in the credit approval data?  Provide some examples.
   1. The descriptive statistics from the summary command shows the basic shape and some data that can be helpful in getting a high level understanding of the data, For example, getting the min and max of each column for key, male, age, debt, etc gives us an idea of the range of data to look for. Looking at the mean and median gives the reader an idea of where the data might be if it is a normal distribution.
10. What descriptive statistics does the output show for factor variables in the credit approval data?  Provide some examples.
    1. An example of a factor variable shown in summary statistics would be education level. It shows c,w,q,I,aa,ff, and then a broad category labeled other. Another example would be ethnicity which is coded as v,h,bb,ff, j. and other.
11. What are the differences between the str command and summary command?
    1. The summary command focuses more on numerical values and focuses on displaying the information found in the columns so that a user gets an idea as to the shape of the data in the dataframe’s columns. On the other hand, the str command shows more of the data structure of the dataframe by listing the columns, the data type, identifying factor variables and giving a sneak peek as to what the first few rows of data. Combined together, this can really help a data analyst get a better idea what queries to use and how to clean the data as well.
12. **Variable filters**
13. Discretization
14. In your own words, explain what discretization is.
    1. Discretization is where a user may take noisy data that is spread out and categorize them into easily digestible categories or levels. In the reading, we use age and label the data as youth, adult, and senior.
15. Run 3 different discretization methods discussed in the tutorial.  For each method, include the command you ran, and output screenshot.  Discuss the input parameters you used, including the number of bins, and interpret the command output.
16. Text

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    1. The first discretization method I used was interval on the numerical value column, Age. I wanted to see if we broke it down into 5 equal intervals, what the data would look like. It is displaying the interval beginning and end and age in each of the intervals. So we can see that 27 years to 40 years makes up majority of the data in the column Age.
17. Text

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18. 2. The second discretization method I used was the cluster to see if the data is grouped around certain values. A better way to go about this would have been to plot the data first to understand if there are any clusters first then run the cluster discretization method.
19. Text

    Description automatically generated
    1. The last discretization method I rant was frequency to see if there was an even distribution with debt in the dataset. In this case there is not as you can see majority are below 9.43 so the width of the category is largest between 9.43 and 28.
20. Compare the discretization methods you ran, and discuss when you would use each method.
21. Run the command to remove one of the dataset variables, and run a second command to validate that the variable no longer exists.  Include both commands and the output in the report.  Explain when and why we remove variable(s).
    1. Graphical user interface, text

       Description automatically generated
    2. I chose to delete the 2nd variable which was income so that is why instead the variable Age is missing from the second data frame whereas the first data frame contains Age. Also you can see that creditshort has 16 variables where as creditapproval and creditapproval2 both have 17 variables. A reason why a user may want to delete a variable is if the dataset is too large so they want to speed up the processing time, to clean the data so it only contains relevant data so any future users aren’t having to look at irrelevant data, or if there are simply too many nulls, a user may choose to delete a variable instead of keep a variable since it is not used.
22. **Row filters**
23. Missing values
    1. Run the command(s) to check if the data has missing values. Include the command(s) and the output in the report.
    2. What variables have missing values, and how many values is each variable missing?  Support the answer with an output screenshot.
    3. Choose one of the numeric variables with missing values, and run the command to replace the missing values with the variable mean.  Verify that the variable no longer has missing values.  Include and discuss the commands you ran and the commands’ output.
    4. Why do we need to handle the missing values?
    5. Besides replacing the value with the mean, what alternative approaches for handling missing values could we use?
24. Run the command to sort the data by one of the variables.  Then run the command to validate the sorting.  (See example in the tutorial) Include the commands and the screenshot in the report.  What are some reasons for sorting data?
25. **Data visualization -**Run the plot function for one of the variables.  Include the command, the output, and an explanation of what the output shows.
26. **Summary**
27. Why is data pre-processing important?
28. What are the differences between row and variable filters?
29. Which part of this exercise did you find the most challenging? What approach did you take to resolve the challenge?

**Exercise Deliverables (Part 2 only)**

Submit the following files into your Exercise 2 Assignment Folder:

* Word document with answers to all questions in order.
* An R script with all commands for part 2. The order of commands must follow the order of corresponding questions.

**Exercise Grading**

* ***This exercise is worth 2% of the course grade.***
* *This exercise* ***will not*** *be graded if an R script is not submitted.*
* *To get full credit, the R code must have comments that explain what the code does*
* Cite references on a references list and in text as needed.
* *The report must be your original work and should address all key points above in order.*
* *Keep in mind that no points will be returned for any misplaced answers that did not get credit.*
* *Grammatical and spelling errors may affect the exercise grade.*

***Start working on the exercise early, and post any questions in class. This exercise may take 3-5 hours to complete.***

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