**Assignment #6: Decision Tree**

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| **Submission Instructions**  **Deadline:** **Tuesday, April 9th, 2019, before class.**   * Submit the following three files through Canvas\Assignments\Assignments:  1. The completed, working R script that produced the analysis with the complexity factor set to 0.05 in Part 1. 2. The output file “DecisionTreeOutput.txt” and “TreeOutput.pdf” for the analysis with the complexity factor set to 0.05 in Part 1. 3. The completed answer sheet provided on the last two pages and also as a separate file (for Q1-Q10 in Part 1 and Q11-Q13 in Part 2).  * If you do not follow the instructions, your assignment will be counted late.   + Late Assignment policy: Same as before.   **Evaluation**  Your submission will be graded based on the correctness of the completed answer sheet, with other files as supporting documents. |

**Part 1. Decision Tree Analysis in R**

**Before you start**

For this assignment, you’ll be working with the **BankLoan.csv** file and the **dTree.r** script (which we used in ICA #12). The BankLoan.csv file has data about 600 customers that received personal loans from a bank. The president of the bank wants to predict how likely a future customer is to pay back their loan so she can make better loan approval decisions.

The data file contains the following variables:

|  |  |
| --- | --- |
| **Variable Name** | **Variable Description** |
| **ID** | Customer identification number |
| **age** | The age of the customer, in years |
| **sex** | The gender of the customer |
| **region** | The type of area where the customer lives (INNER\_CITY, TOWN, SUBURBAN, RURAL) |
| **income** | Customer’s yearly income in dollars |
| **married** | Whether the customer is married |
| **children** | How many children the customer has |
| **car** | Whether the customer has a car |
| **save\_act** | Whether the customer has ever had a savings account with SchuffBank! |
| **current\_act** | Whether the customer has an active account with SchuffBank! |
| **mortgage** | Whether the customer has a mortgage |
| **payback** | Whether the customer paid back their loan (0 = no, 1 = yes)  **NOTE: payback** is the outcome variable we are interested in here. It describes a categorical event (0 = no, 1 = yes). |

**Guidelines:**

1. You’ll need to modify the script with the following information to perform the analysis:

* Set the input filename to the bank’s dataset (i.e., BankLoan.csv).
* Set the training partition (using TRAINING\_PART) to 50% of the data set.
* Set the minimum split (using MINIMUMSPLIT) to 25.
* Set the complexity factor (using COMPLEXITYFACTOR) to 0.005.
* Make sure the outcome column setting is correct for your data set (using OUTCOME\_COL).
* You will need to modify the model to reflect the data set. This requires editing lines 82- 84 of the dTree.r script. Make sure you choose the correct outcome variable and exclude the variables that are inappropriate for the analysis. (HINT: ID is irrelevant to the analysis.)

1. Once you finish modifying the script, you can set the working directory and run the script.
2. **Based on your script output, answer Questions 1-6 in the answer sheet at the end of this document:**  
   *(NOTE: When asked “how likely…” cite the percentage!)*
3. **Now change the complexity factor from 0.005 to 0.05 and re-run the script. Using the new tree, answer Questions 7-10 in the answer sheet at the end of this document.**

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| **NOTE: Scientific Notations in R**  In the output, you may see numbers like-1.8e-04 or 31e+5.  The "e" is a symbol for base-10 scientific notation. The "e" stands for ×10exponent.  So -1.8e-04 means −1.8×10−4. In fixed-point notation that would be -0.00018.  Similarly, 31e+5 means 31×105. In fixed-point notation that would be 3,100,000. |

**Part 2. Compute and Evaluate Decision Trees**

Consider the following based on a different data set than what you have done so far in this assignment.

**Question 11.** (write your answer in the answer sheet)

Suppose we run the decision tree algorithm and get a decision tree (called it Tree #1): compute the correct classification rate based on the following confusion matrix (*Compute it by hand. No need to use R/RStudio*):

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  | **Predicted outcome:** | |  |
|  |  | 1 | 0 |  |
| **Observed outcome:** | 1 | 600 | 170 |  |
| 0 | 230 | 1000 | Total: 2000 |

Table 1. Confusion Matrix (Tree #1)

**Question 12.** (write your answer in the answer sheet)

Suppose we re-run the decision tree algorithm and get another decision tree (called it Tree #2): compute the correct classification rate based on the following confusion matrix (Compute it *by hand. No need to use R/RStudio*):

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  | **Predicted outcome:** | |  |
|  |  | 1 | 0 |  |
| **Observed outcome:** | 1 | 900 | 50 |  |
| 0 | 250 | 800 | Total: 2000 |

Table 2. Confusion Matrix (Tree #2)

**Question 13.** (write your answer in the answer sheet)

Which decision tree (Tree #1 versus Tree #2) has higher classification accuracy?

**Answer Sheet on the Next Two Pages……**

Answer Sheet for Assignment: Decision Trees in R

Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

*Fill in the answer sheet below.*

|  |  |  |
| --- | --- | --- |
|  | **Question** | **Answer** |
| **Part 1. Decision Tree in R**  **(Complexity factor = 0.005)** | | |
| 1 | How often will this tree make a correct prediction (include decimals)? Provide your answer for both the training set and the validation set. |  |
| 2 | How likely is a customer to pay back their loan if they have one child and make $35,000 per year?  *(NOTE: When asked “how likely…” cite the percentage!)* |  |
| 3 | How likely is a customer to pay back their loan if they are married, make $45,000 per year, have no children, and no mortgage? |  |
| 4 | How likely is a customer to pay back their loan if they make $83,000 per year and have no children? |  |
| 5 | Describe the profile of the least likely customer to successfully repay their loan. |  |
| 6 | Describe the profile of the most likely customer to successfully repay their loan. |  |
| **(Complexity factor = 0.05)** | | |
| 7 | How often will this new tree make a correct prediction (include decimals)? Provide your answer for both the training set and the validation set. |  |
| 8 | Is this model better or worse than the first model at predicting who will repay their loan? Explain how changing the complexity factor affected the tree using **no more than two sentences.** |  |
| 9 | How likely is a customer to pay back their loan if they have one child and make $35,000 per year? |  |
| 10 | Does marriage increase or decrease the likelihood that a customer will pay back their loan? |  |
| **Part 2 Compute and Evaluate Decision Trees** | | |
| 11 | What is the correct classification rate for Tree #1? |  |
| 12 | What is the correct classification rate for Tree #2? |  |
| 13 | Which decision tree (Tree #1 versus Tree #2) has higher classification accuracy? |  |