

## Assignment 3

Maximum points: 20

Due date: 4<sup>th</sup> Dec. 2025 at 23:00

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### Guidelines

- Individual Assignment: This is an individual assignment. Please do not seek help from others or collaborate with classmates.
- Problem Understanding: Carefully read the problem description and each question before starting your analysis.
- Choice of Software: You can use either R or Python to perform your analysis.
- Code Requirements: Your code should be well-structured and free of errors. Please use clear and descriptive variable names. Support your answers with appropriate code, wherever possible.
- Deliverables: Submit the following two files on Canvas:
  1. Code file (.R/.Rmd/.py/.ipynb): This file should contain the complete executable code for the analysis.
  2. Report file (.pdf): This document should contain your answers to all the questions asked below. Please use the solution template provided on Canvas (Assignment\_3\_Template.docx) to answer the questions. On the cover page, please write your name, student number, and date. After writing your answers, submit the document as a PDF file.
- Plagiarism Warning: Ensure all the code and analysis are your original work. Plagiarism will lead to disqualification and academic consequences.
- Late Submissions: Late submissions will be progressively penalized.
- Points Distribution: The distribution of points and the grading rubric for the questions is provided at the end of this document.

Use the attached “insurance\_new.csv” dataset to answer questions 1 and 2:

1. Create a column `binary_charges` (as you did in Question 9 of Assignment 2). Build a logistic regression model (as you did in Question 10 of Assignment 2) using `age`, `gender`, `bmi`, `children`, `smoker`, and `region` as predictor variables and `binary_charges` as the target variable. For this logistic regression model:
  - a. Set a threshold (cut-off probability) of **0.2** and use the model to classify all the observations. Report the confusion matrix.
  - b. Set a threshold of **0.8** and use the model to classify all the observations. Report the confusion matrix.
  - c. Create an ROC plot for the logistic regression model and report the area under the curve (AUC). Explain the meaning of AUC in 1-2 lines.
2. Suppose we decide to use a threshold of **0.5** for the logistic regression model. Do the following:
  - a. Report the confusion matrix.
  - b. Report the accuracy of the model and explain it (1-2 lines).
  - c. Report the precision of the model and explain it (1-2 lines).
  - d. Report the sensitivity of the model and explain it (1-2 lines).
  - e. Report the specificity of the model and explain it (1-2 lines).
  - f. Report the true positive rate of the model and explain it (1-2 lines).
  - g. Report the false positive rate of the model and explain it (1-2 lines).

To answer the questions below, access the “books.csv” file from Canvas. The dataset contains 500 transactions of customers across 5 categories of books. An entry of 1 indicates purchase and an entry of 0 indicates no purchase.

3. Compute the following (based on the 5 categories):
  - a. Euclidean distance between customers 241 and 431
  - b. Manhattan distance between customers 82 and 199
  - c. Centroid of the first 150 customers (a five-dimensional vector)
4. Which two genres of books have:
  - a. the highest co-occurrence? How many occurrences?
  - b. the lowest co-occurrence? How many occurrences?
5. Suppose we cluster the customers based on the total number of books purchased. What is the size of each cluster?
6. Compute the **support** of the following itemsets:
  - a. `{fiction}`
  - b. `{non_fiction}`
  - c. `{fiction, self_help}`
7. Compute the **confidence** of the following association rules:
  - a. `{fiction} → {mystery}`

- b.  $\{\text{non\_fiction}\} \rightarrow \{\text{self\_help}\}$
  - c.  $\{\text{fiction, self\_help}\} \rightarrow \{\text{childrens\_books}\}$
8. Compute the **lift** of the following association rules:
- a.  $\{\text{fiction, self\_help}\} \rightarrow \{\text{childrens\_books}\}$
  - b.  $\{\text{fiction}\} \rightarrow \{\text{non\_fiction}\}$
  - c.  $\{\text{non\_fiction}\} \rightarrow \{\text{self\_help}\}$
9. Explain the meaning of the following:
- a. Support of  $\{\text{fiction, self\_help}\}$
  - b. Confidence of  $\{\text{fiction, self\_help}\} \rightarrow \{\text{childrens\_books}\}$
  - c. Lift of  $\{\text{fiction, self\_help}\} \rightarrow \{\text{childrens\_books}\}$
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## Points distribution and grading rubric

Question	Point(s)	Grading criteria		
		Correct answer	Incorrect answer, but coding logic partially correct	Incorrect answer and coding logic
1a	1	1	0.5	0
1b	1	1	0.5	0
1c	1	1	0.5	0
2a	1	1	0.5	0
2b	0.5	0.5	0.25	0
2c	0.5	0.5	0.25	0
2d	0.5	0.5	0.25	0
2e	0.5	0.5	0.25	0
2f	0.5	0.5	0.25	0
2g	0.5	0.5	0.25	0
3a	0.5	0.5	0.25	0
3b	0.5	0.5	0.25	0
3c	1	1	0.5	0
4a	1	1	0.5	0
4b	1	1	0.5	0
5	1	1	0.5	0
6a	0.5	0.5	0.25	0
6b	0.5	0.5	0.25	0
6c	0.5	0.5	0.25	0
7a	0.5	0.5	0.25	0
7b	0.5	0.5	0.25	0
7c	1	1	0.5	0
8a	1	1	0.5	0
8b	1	1	0.5	0
8c	1	1	0.5	0
9a	0.5	0.5	0.25	0
9b	0.5	0.5	0.25	0
9c	0.5	0.5	0.25	0