



Second Semester Examination
2020/2021 Academic Session

July/August 2021

EMT 302 – Mathematical Modeling

Duration: 2 hours (2+2)

Please check that this examination paper consists of **FOUR (4)** pages before you begin the examination.

Instructions : Answer **ALL FOUR (4)** questions.

Answer to each question must begin from a new page.

1. [a] Discuss the roles of features in the machine learning modeling.
- [b] Explain how the Principal Component Analysis can be used to construct these features.

(50 marks)

2. Suppose there is a petrol station A on your normal route that sells petrol shown in Figure 2. Another station B off your route also sells petrol but at a lower price.

- Let P^* represent the price per liter at the station A along the normal route and P the price per liter at the station B you are considering.
- Let D represent the distance in kilometer from the normal route that must be driven to get to and from the other station B.
- Let M represent the average fuel efficiency of the car you drive.
- Let T represent the number of liter of petrol purchased.

- [a] Develop an algebraic equation to describe the
 - (i) cost per useable liter
 - (ii) distance (kilometers) of driving
- [b] Draw level curves for $I = 1.85, 2.00$ and 2.50 to represent the cost per useable liter for $M = 10$ and $T = 20$.
- [c] Suppose you are considering a station B which is 10 kilometers away, based on the level curves in part [b], what is lowest price per liter, P of the station B if the price per liter, P^* for the station A is RM 1.85?

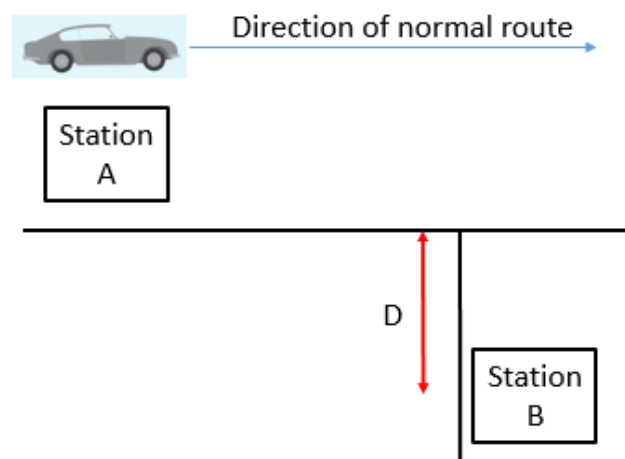


Figure 2

(50 marks)

3. Figure 3 shows different set of weather conditions and whether a player can play tennis or not.

Day	Outlook	Temperature	Humidity	Wind	Play Tennis
1	Sunny	Hot	High	Weak	No
2	Sunny	Hot	High	Strong	No
3	Overcast	Hot	High	Weak	Yes
4	Rain	Mild	High	Weak	Yes
5	Rain	Cool	Normal	Weak	Yes
6	Rain	Cool	Normal	Strong	No
7	Overcast	Cool	Normal	Strong	Yes
8	Sunny	Mild	High	Weak	No
9	Sunny	Cool	Normal	Weak	Yes
10	Rain	Mild	Normal	Weak	Yes
11	Sunny	Mild	Normal	Strong	Yes
12	Overcast	Mild	High	Strong	Yes
13	Overcast	Hot	Normal	Weak	Yes
14	Rain	Mild	High	Strong	No

- a) Calculate the probability of the following conditions using Naïve Bayes
- playing tennis
 - not playing when the weather is sunny

(20 marks)

- b) Suppose the day is described by:
 a = (Outlook = sunny, Temperature = cool, Humidity = high, Wind = strong)

Compare probability of playing or not playing tennis what would our based on the Naïve Bayes classifier prediction on a day like this.

(30marks)

4. [a] Discuss the differences in terms of grid between Lagrangian and Eulerian. Please use a sketch to demonstrate the differences between these methods.

(30 marks)

- [b] Discuss the formulation of Bounce Back scheme on the following collision “look up” table as shown in Table 3.

Table 3

	Out-State Bit Value							
	128 R	64 S	32 F	16 E	8 D	4 C	2 B	1 A
64	0	1	0	0	0	0	0	0
72	0	1	0	0	1	0	0	0
80	0	1	0	1	0	0	0	0
...								
127	0	1	1	1	1	1	1	1

(20 marks)

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