

IE5203 Decision Analysis**Assignment #1****Due: 15 September 2026, 9 pm****Instructions**

You may use computing tools or software to compute your final answers, but you must explain or show your workings by breaking down the steps in your computations.

Decision trees and any diagrams may be hand-drawn.

Submit your answers as one PDF file via Canvas.

Problem Description

The marine industry is undergoing a transition towards lower-emission propulsion technologies. Conventional diesel engines, widely used in river sightseeing vessels, will no longer comply with new environmental regulations. A marine engine manufacturer has identified the development of a next-generation low-emission propulsion system as a strategic R&D priority.

The company is considering two alternative systems, A and B:

- A. Methanol dual-fuel internal combustion engine system.** The R&D cost is expected to be \$3 million with a 75% chance of success. If successfully developed, the future profit (excluding R&D cost) from the production and sale of this system is expected to be \$13 million. Otherwise, nothing.
- B. Battery-electric propulsion engine system.** The R&D cost is expected to be \$7 million with a 60% chance of success. If successfully developed, the future profit (excluding R&D cost) from the production and sale of this system is expected to be \$22 million. Otherwise, nothing.

The company must initially decide whether to choose to develop systems A, B, or do nothing. If the company chooses to develop one of the systems, and succeeded, it will proceed to manufacture and market that system.

However, if R&D fails, the company has the option to either develop the other system, or do nothing. If the second development effort is successful, the company will proceed to manufacture and market the system.

You may assume that the success or failure of developing the two systems are independent. The company is risk-neutral, and you do not need to consider the time value of money in this analysis.

Question 1.

Draw a decision tree describing the company's problem. What is the company's optimal decision policy and certainty equivalent? **(20 marks)**

Question 2.

Plot the risk profiles for three initial alternatives (i.e., Develop System A, Develop System B and "do-nothing") on the same graph in excess probability distribution format. **(5 marks)**

Question 3.

Is there any first- or second-order stochastic dominance among the three initial alternatives? Explain your answer. **(5 marks)**

Question 4.

What is the expected value of perfect information on the R&D result of System A? **(10 marks)**

Question 5.

For $\$X$, the company can engage a consultant to predict the R&D result of System B. The company believes that if System B is going to be **successfully** developed, the consultant will predict it correctly with probability **0.8**. On the other hand, if System B is going to be **unsuccessfully** developed, the consultant will predict it correctly with probability **0.9**.

- (a) Determine the optimal decision policy for the company on whether to engage the consultant to predict the R&D result of System B or not. The optimal policy should state the initial decision which depends on the value of X , and also subsequently, what the company should do when it receives the consultant's prediction on System B. **(15 marks)**
- (b) What is the **certainty equivalent** of the optimal decision policy? **(5 marks)**

***** End of Assignment *****