**EASTERN MEDITERRANEAN UNIVERSITY**



**Department of Industrial Engineering**

**IENG314/MANE314 Operations Research II**

**HOMEWORK 2 Spring 2021-22**

1. A decision maker has a utility function for monetary gains *x* given by *u*(*x*) = (*x+* 10,000)1/2.

**a)** Show that the person is indifferent between the status quo (current status) and

*L*: With probability 0. 3, he or she gains $80,000

*L*: With probability 0.7, he or she loses $10,000

**b)** If there is a 15% chance that a painting valued at $10,000 will be stolen during the next year, what is the most (per year) that the decision maker would be willing to pay for insurance covering the loss of the painting?

1. Julia is trying to determine which of two courses to take. If she takes the Operations Research I course, she believes that she has a 8% chance of receiving an A, a 5% chance for an A-, a 25% chance for a B+ , a 10% chance for a B, a 15% chance for a B-, a 16% chance for a C+, a 11% chance for a C, a 5% chance for a C- and 5% chance for a D+. If Julia takes the Statistical Application in Engineering course, she has a 28% chance for a B+, a 29% chance for a B, a 24% chance for a B-, a 11% chance for a C+ and 8% chance for a C.

|  |  |
| --- | --- |
| Regarding to the drawn utility function, Julia wants to take the course that maximizes the expected utility of her final grade, which course should she take? What is her attitude toward risk in this decision?  F D- D D+ C- C C+ B- B B+ A- A | 1  0.9  0.8  0.7  0.6  0.5  0.4  0.3  0.2  0.1 |

1. Three decision makers have the utility functions as follows:

|  |  |  |  |
| --- | --- | --- | --- |
| Outcome | Ahmed | Meltem | Cemal |
| -20000TL | 0.00 | 0.00 | 0.00 |
| 40000TL | 0.35 | 0.25 | 0.20 |
| 100000TL | 0.65 | 0.65 | 0.35 |
| 160000TL | 0.85 | 0.85 | 0.65 |
| 220000TL | 1.00 | 1.00 | 1.00 |

Classify the decision makers according their attitude to risk.

1. The Nitro Fertilizer Company is developing a new fertilizer. If Nitro markets the product and it is successful, the company will earn a $50,000 profit; if it is unsuccessful, the company will lose $35,000. In the past, similar products have been successful 60% of the time. At a cost of $5,000, the effectiveness of the new fertilizer can be tested. If the test result is favourable, there is an 80% chance that the fertilizer will be successful. If the test result is unfavourable, there is only a 30% chance that the fertilizer will be successful. There is a 65% chance of a favourable test result and a 35% chance of an unfavourable test result. Determine Nitro’s optimal strategy. Also find EVSI and EVPI.
2. Oilco must determine whether or not to drill for oil in the South China Sea. It costs $100,000, and if oil is found, the value is estimated to be $600,000. At present, Oilco believes there is a 45% chance that the field contains oil. Before drilling, Oilco can hire (for $10,000) a geologist to obtain more information about the likelihood that the field will contain oil. There is a 55% chance that the geologist will issue a favourable report and a 45% chance of an unfavourable report. Given a favourable report, there is an 80% chance that the field contains oil. Given an unfavourable report, there is a 10% chance that the field contains oil. Determine Oilco’s optimal course of action. Also determine EVSI and EVPI.
3. A nuclear power company is deciding whether or not to build a nuclear power plant at Diablo Canyon or at Roy Rogers City. The cost of building the power plant is $10 million at Diablo and $20 million at Roy Rogers City. If the company builds at Diablo, however, and an earthquake occurs at Diablo during the next five years, construction will be terminated and the company will lose $10 million (and will still have to build a power plant at Roy Rogers City). A priori, the company believes there is a 20% chance that an earthquake will occur at Diablo during the next five years. For $1 million, a geologist can be hired to analyse the fault structure at Diablo Canyon. He will either predict that an earthquake will occur or that an earthquake will not occur. The geologist’s past record indicates that he will predict an earthquake on 95% of the occasions for which an earthquake will occur and no earthquake on 90% of the occasions for which an earthquake will not occur. Should the power company hire the geologist? Also find EVSI and EVPI.
4. A business is about to purchase a new personal computer. Three objectives are important in determining which computer should be purchased: cost, user-friendliness, and software availability. The pairwise comparison matrix for these objectives is as follows:

|  |  |  |  |
| --- | --- | --- | --- |
|  | Cost | User-friendliness | Software-availability |
| Cost |  | | |
| User-friendliness |
| Software-availability |

Verify the consistency of the above pair wise comparison matrix.Three computers are being considered for purchase. The performance of each computer with regard to each objective is indicated by the following pairwise comparison matrices. For cost (low cost is good, high cost is bad!):

|  |  |  |  |
| --- | --- | --- | --- |
|  | Computer1 | Computer2 | Computer3 |
| Computer1 |  | | |
| Computer2 |
| Computer3 |

For user-friendliness

|  |  |  |  |
| --- | --- | --- | --- |
|  | Computer1 | Computer2 | Computer3 |
| Computer1 |  | | |
| Computer2 |
| Computer3 |

For software-availability

|  |  |  |  |
| --- | --- | --- | --- |
|  | Computer1 | Computer2 | Computer3 |
| Computer1 |  | | |
| Computer2 |
| Computer3 |

Which computer should be purchased? Check the consistency of pairwise comparison matrix for objectives.

1. A consumer is trying to determine which type of frozen dinner to eat. He considers three attributes to be important: taste, nutritional value, and price. Nutritional value is considered to be determined by cholesterol and sodium levels. Three types of dinners are under consideration. The pairwise comparison matrix for the three attributes is as follows:

Taste Nutrition Price

|  |  |  |  |
| --- | --- | --- | --- |
|  | Taste | Nutrition | Price |
| Taste |  | | |
| Nutrition |
| Price |

Between the three frozen dinners the pairwise comparison matrix for each attribute is as follows. For taste:

|  |  |  |  |
| --- | --- | --- | --- |
|  | Dinner1 | Dinner2 | Dinner3 |
| Taste1 |  | | |
| Taste2 |
| Taste3 |

For sodium:

|  |  |  |  |
| --- | --- | --- | --- |
|  | Dinner1 | Dinner2 | Dinner3 |
| Sodium1 |  | | |
| Sodium 2 |
| Sodium 3 |

For cholesterol:

|  |  |  |  |
| --- | --- | --- | --- |
|  | Dinner1 | Dinner2 | Dinner3 |
| Cholesterol 1 |  | | |
| Cholesterol 2 |
| Cholesterol 3 |

For price:

|  |  |  |  |
| --- | --- | --- | --- |
|  | Dinner1 | Dinner2 | Dinner3 |
| Price 1 |  | | |
| Price 2 |
| Price 3 |

To determine how each dinner rates on nutrition you will need the following pairwise comparison matrix for cholesterol and sodium:

|  |  |  |  |
| --- | --- | --- | --- |
|  |  | Cholesterol | Sodium |
| Cholesterol |  | | |
| Sodium |

Which frozen dinner would he prefer? (*Hint:* Nutrition score for a dinner =(score of dinner on sodium) \* (weight for sodium) + (score for dinner on cholesterol) \* (weight for cholesterol).)