# Assignment 2

Chen Siyi A0194556R     Gao Haochun A0194525Y     He Yuan A0211297H

Wang Pei A0194486M     Wang Zi A0194504E

10/18/2020

## Question 1

**1.a**

**1.b**

**1.c**

**1.d**

## Question 2

**2.a**

**2.b**

**2.c**

**2.d**

## Question 3

**3.a**

No market survey: (Unit in $1\mathrm{x}10^4$)

|                  | FM(1/3) | UM(2/3) | Expectation |
|------------------|---------|---------|-------------|
| Major renovation | 250     | -80     | 30          |
| Minor renovation | 100     | -20     | 20          |
| Do nothing       | 0       | 0       | 0           |

Regret table:

|            | FM(1/3) | UM(2/3) | Oppo.loss |
|------------|---------|---------|-----------|
| Major      | 0       | 80      | 160/3     |
| Minor      | 150     | 20      | 190/3     |
| Do nothing | 250     | 0       | 250/3     |

Hence, **Major renovation** can minimize the expected opportunity loss to $\frac{160}{3} \times 10^4$

**3.b**

$$EVWOI = 250 \times \frac{1}{3} - 80 \times \frac{2}{3} = 30$$

**3.c**

$$EVWPI = 250 \times \frac{1}{3} + 0 \times \frac{2}{3} = \frac{250}{3}$$

$$EVOPI = EVWPI - EVWOI = \frac{160}{3} \times 10^4$$

**3.d**

Let
$$P(FM) = \alpha \quad and \quad P(UM) = 2P(FM) = 2\alpha$$

Given:
$$P(P|FM) = 0.8, P(P|UM) = 0.4, P(N|FM) = 0.2, P(N|UM) = 0.6$$

Total probability:
$$P(P) = P(FM)P(P|FM) + P(UM)P(P|UM) = 1.6\alpha$$
$$P(N) = P(FM)P(N|FM) + P(UM)P(N|UM) = 1.4\alpha$$

Combined with $P(P) + P(N) = 1$
$$P(P) = \frac{8}{15} \quad and \quad P(N) = \frac{7}{15}$$

Probability conditioned on Positive result:

$$P(FM|P) = \frac{P(FM)P(P|FM)}{P(P)} = \frac{3}{2}\alpha$$

$$P(UM|P) = \frac{P(UM)P(P|UM)}{P(P)} = \frac{3}{2}\alpha$$

Combined with $P(FM|P) + P(UM|P) = 1$

$$P(UM|P) = P(FM|P) = 0.5$$

Probability conditioned on Negative result:

$$P(FM|N) = \frac{P(FM)P(N|FM)}{P(N)} = \frac{3}{7}\alpha$$

$$P(UM|N) = \frac{P(UM)P(N|UM)}{P(N)} = \frac{18}{7}\alpha$$

Combined with $P(FM|N) + P(UM|N) = 1$

$$P(UM|N) = \frac{6}{7} \quad and \quad P(FM|N) = \frac{1}{7}$$

Free market survey with Positive result(8/15):

|                  | FM(1/2) | UM(1/2) | Expectation |
|------------------|---------|---------|-------------|
| Major renovation | 250     | -80     | 85          |
| Minor renovation | 100     | -20     | 40          |
| Do nothing       | 0       | 0       | 0           |

Free market survey with Negative result(7/15):

|                  | FM(1/7) | UM(6/7) | Expectation |
|------------------|---------|---------|-------------|
| Major renovation | 250     | -80     | -230/7      |
| Minor renovation | 100     | -20     | -20/7       |
| Do nothing       | 0       | 0       | 0           |

$$EVWSI = 85 \times \frac{8}{15} + 0 \times \frac{7}{15} = \frac{136}{3}$$

$$EVOSI = EVWSI - EVWOI = \frac{46}{3} \times 10^4$$

**Conclusion**

As EVOSI ($\frac{46}{3} \times 10^4$) > Cost of survey ($5 \times 10^4$), the company should do market survey.

To maximize return, after doing market research, if the survey result is positive, it should do Major renovation, if the result is negative, it should do nothing.

Charged market survey with Positive result(8/15):

|                  | FM(1/2) | UM(1/2) | Expectation |
|------------------|---------|---------|-------------|
| Major renovation | 245     | -85     | 80          |
| Minor renovation | 95      | -25     | 35          |
| Do nothing       | -5      | -5      | -5          |

Charged market survey with Negative result(7/15):

|                  | FM(1/7) | UM(6/7) | Expectation |
|------------------|---------|---------|-------------|
| Major renovation | 245     | -85     | -265/7      |
| Minor renovation | 95      | -25     | -55/7       |
| Do nothing       | -5      | -5      | -5          |

$$Expected\ \ return = 80 \times \frac{8}{15} - 5 \times \frac{7}{15} = \frac{121}{3} \times 10^4$$