**UNIVERSITY OF GUELPH**

# Department of Food, Agricultural and Resource Economics

## Decision Science

**FARE\*4500**

**Assignment #2 - Answers**

**Decision Analysis**

**Instructor: Alfons Weersink Due: Tuesday October 3, 2023**

1. 4.9 (**25**)

a. The decision to be made is to choose the type of service to provide. The chance event is the level of demand for the Myrtle Air service. The consequence is the amount of quarterly profit. There are two decision alternatives (full price and discount service). There are two outcomes for the chance event (strong demand and weak demand).

b.

|  |  |  |
| --- | --- | --- |
| **Type of Service** | **Maximum Profit** | **Minimum Profit** |
| Full Price | $960 | -$490 |
| Discount | $670 | $320 |

Optimistic Approach: Full price service

Conservative Approach: Discount service

Opportunity Loss or Regret Table

|  |  |  |  |
| --- | --- | --- | --- |
|  | **High Demand** | **Low Demand** | **Maximum Regret** |
| Full Service | 0 | 810 | 810 |
| Discount Service | 290 | 0 | 290 |

Minimax Regret Approach: Discount service

c. EV(Full) = 0.7(960) + 0.3(-490) = 525

EV (Discount) = 0.7(670) + 0.3(320) = 565

Optimal Decision: Discount service

d. EV(Full) = 0.8(960) + 0.2(-490) = 670

EV (Discount) = 0.8(670) + 0.2(320) = 600

Optimal Decision: Full price service

e. Let *p* = probability of strong demand

EV(Full) = *p*(960) + (1- *p*)(-490) = 1450*p* - 490

EV (Discount) = *p*(670) + (1- *p*)(320) = 350*p* + 320

EV (Full) = EV(Discount)

1450*p* - 490 = 350*p* + 320

1100*p* = 810

*p* = 810/1100 = 0.7364

If *p* = 0.7364, the two decision alternatives provide the same expected value.

For values of *p* below 0.7364, the discount service is the best choice.

For values of *p* greater than 0.7364, the full price service is the best choice.

3. 4.15 (**30**)

1. EV (Small) = 0.1(400) + 0.6(500) + 0.3(660) = 538

EV (Medium) = 0.1(-250) + 0.6(650) + 0.3(800) = 605

EV (Large) = 0.1(-400) + 0.6(580) + 0.3(990) = 605

Best decision: Build a medium or large-size community center.

Note that using the expected value approach, the Town Council would be indifferent between building a medium-size community center and a large-size center.

 b. Risk profile for medium-size community center:

Risk profile for large-size community center:



Given the mayor's concern about the large loss that would be incurred if demand is not large enough to support a large-size center, we would recommend the medium-size center. The large-size center has a probability of 0.1 of losing $400,000. With the medium-size center, the most the town can lose is $250,000.

c. The Town's optimal decision strategy based on perfect information is as follows:

If the worst-case scenario, build a small-size center

If the base-case scenario, build a medium-size center

If the best-case scenario, build a large-size center

Using the consultant's original probability assessments for each scenario, 0.10, 0.60 and 0.30, the expected value of a decision strategy that uses perfect information is:

EVwPI = 0.1(400) + 0.6(650) + 0.3(990) = 727

In part (a), the expected value approach showed that EV(Medium) = EV(Large) = 605.

Therefore, EVwoPI = 605 and EVPI = 727 - 605 = 122

The town should seriously consider additional information about the likelihood of the three scenarios. Since perfect information would be worth $122,000, a good market research study could possibly make a significant contribution.

d. EV (Small) = 0.2(400) + 0.5(500) + 0.3(660) = 528

EV (Medium) = 0.2(-250) + 0.5(650) + 0.3(800) = 515

EV (Small) = 0.2(-400) + 0.5(580) + 0.3(990) = 507

Best decision: Build a small-size community center.

e. If the promotional campaign is conducted, the probabilities will change to 0.0, 0.6 and 0.4 for the worst case, base case and best case scenarios respectively.

EV (Small) = 0.0(400) + 0.6(500) + 0.4(660) = 564

EV (Medium) = 0.0(-250) + 0.6(650) + 0.4(800) = 710

EV (Small) = 0.0(-400) + 0.6(580) + 0.4(990) = 744

In this case, the recommended decision is to build a large-size community center. Compared to the analysis in Part (a), the promotional campaign has increased the best expected value by $744,000 - 605,000 = $139,000. Compared to the analysis in part (d), the promotional campaign has increased the best expected value by $744,000 - 528,000 = $216,000.

Even though the promotional campaign does not increase the expected value by more than its cost ($150,000) when compared to the analysis in part (a), it appears to be a good investment. That is, it eliminates the risk of a loss, which appears to be a significant factor in the mayor's decision-making process.

3. 4.20 (**30**)

a.



b. EV (node 7) = 0.75(750) + 0.25(-250) = 500

EV (node 8) = 0.417(750) + 0.583(-250) = 167

Decision (node 4)  Accept EV = 500

Decision (node 5)  Accept EV = 167

EV(node 2) = 0.7(500) + 0.3(167) = $400

Note: Regardless of the review outcome *F* or *U*, the recommended decision alternative is to accept the manuscript.

EV(node 3) = .65(750) + .35(-250) = $400

The expected value is $400,000 regardless of review process. The company should accept the manuscript.

c. The manuscript review cannot alter the decision to accept the manuscript. Do not do the manuscript review.

d. Perfect Information.

If *s*1, accept manuscript $750

If *s*2, reject manuscript -$250

EVwPI = 0.65(750) + 0.35(0) = 487.5

EVwoPI = 400

EVPI = 487.5 - 400 = 87.5 or $87,500.

A better procedure for assessing the market potential for the textbook may be worthwhile.

4. Draw a decision tree for this decision problem facing the dairy farmer.

**(5)**

1. Decision Tree **Milk Quality Payoff**

A quality (p = .55) $2,800

Intensive B quality (p = .35) -$700

C quality (p = .10) -$2,200

A quality (p = .20) $4,250

Advisory

Program General B quality (p = .60) $750

Decision

C quality (p = .20) -$7.50

A quality (p = 0) $5,000

None B quality (p = .70) $1,500

C quality (p = .30) 0

1. What is the optimal decision based on the expected value of the alternatives? **(5)**

When a farmer receives a B or a C certification, she has the opportunity to apply for a re-examination after 6 months. The dairy cooperative, however, will only grant such a re-examination when the farmer is already participating the intensive management program. In case of an improved quality level, the farmer could obtain a certificate of a higher quality level for the remaining 6 months of the year. The upgrade from a B to an A certificate results in a total annual premium of $3,250 (=$1,500/2 + $5,000/2), and from C to B in a premium of $750. The cost of the re-examination is $200, which is paid by the farmer.

|  |  |  |  |
| --- | --- | --- | --- |
| Quality Level before | Quality Level after Re- | | |
| Re- Examination | A | B | C |
| B | 0.40 | 0.60 | 0.00 |
| C | 0.00 | 0.70 | 0.30 |

EV (Intensive) = .55 (2800) + .35 (-700) + .10 (-2200)

= $1.075

EV (General) = .20 (4.250) + .60 (750) + .2 (-750)

= $1.150

EV (None) = 0 (5.00) + .70 (1500) + .3 (0)

= $1,050

Optimal decision that maximizes expected returns is to undertake the general herd health program.

1. Does the opportunity to apply for a re-examination alter the optimal decision? **(7)**

A quality (p = .55) $2,800

A quality (p = .4) $850

Re-Exam

B quality (p = .350) B quality (p = .6) -$900

No Re-Exam -$700

A quality (p = .7) $1,650

Intensive

Re-Exam

C quality (p = .10) B quality (p = .3) $2,400

No Re-Exam -$2,200

A quality (p = .2) $4,250

General B quality (p = .6) $750

C quality (p = .20) -$750

A quality (p = 0) $5,000

None B quality (p = .70) $1,500

C quality (p = .30) 0

In order to evaluate the expected returns of the intensive herd health program, you must first assess whether to re-exam or not under B and C quality.

If B quality

EV (Re-exam) = 0.4 [(1500/2)-220+ (5000/2)-200] + .6(-900)

= 0.4 (850) + .6 (-900)

= -200

EV (None) = 1 \*(1500 – 2200) = -700

.. . Re-exam

If C quality

EV (Re-exam) = .7 (+1650) + .3 (-2400)

= -1875

EV (None) = (0 – 2200) = -2200

.. . Re-exam

.. . EV (Intensive) = .55 (2800) + .35 (-200) + .1 (-1875)

= $1,283

EV (General) = $1,150

EV (None) = $1,050

.. . Choose the Intensive program with the re-exam option.

1. Should a farmer opt for a re-examination when, despite her participation in the intensive management program, the certification level is less than A? **(3)**

Yes – the certification level will be A with a probability of 0.55 (not 1.00). The analysis accounts for the effects of B or C quality milk.

1. The costs of the re-examination were $200. What is the maximum amount the farmer should pay for the re-examination? **(5)**

EV (Intensive) = $1,283

EV (General) = $1,150

Difference $ 133

The costs of re-examination has an impact of 0.45 with respect to the EV of the intensive program (= .35 (B quality) + .10 (C quality)).

.. . The maximum additional amount to pay for re-examination is $295.56 (=$133/0.45)

.. . The total cost the farmer would be willing to pay for a re-examination is $495.56 ($200 + $295.56).