Chapter 6 The Value of Information

- A decision theory approach to marketing research
- Uncertainty about outcome of a decision can be reduced if more information is obtained.
- To determine how much the additional information is worth

❖ **Expected monetary value criterion (EMV)**

EMV of an alternative j = EMV(A_j) = $\sum_{i=1}^{k} S_i \Pr(S_i)$

where $A_j = j^{th}$ alternative
k = no. of possible outcome in j
S_i = value of i^{th} outcome

➢ **Prior Analysis:** based on present judgement

❖ **Decision Tree:** involve many alternatives and possible outcomes

- Decision nodes
- Event / outcome node
- Chronological ordered event branches
- Monetary values on the rightmost
- Decision criteria: comparing EMV and choose the one with highest EMV
- Double slash marks on rejected alternative

Example 1

	A_1	A_2	Probability
Very favorable	30	0	0.4
Favorable	10	0	0.3
Unfavorable	-20	0	0.3

Solution:

❖ **Expected monetary value of perfect information**

EMVPI = EMV(C) – EMV(UC)
where EMV(C) is the EMV with certainty
EMV(UC) is the EMV with uncertainty

If we are certain about outcomes, we will make the correct decision in each outcome situation.

Example 2: Recall Example 1
If perfect information is given, then we would select the alternative

- if the condition ‘very favorable’ is known
- if the condition ‘favorable’ is known
- if the condition ‘unfavorable’ is known

Then EMV(C) =

No information is provided, EMV(UC) =

$\Rightarrow$ EMVPI = EMV(C) – EMV(UC) =

The manager is willing to spend less than to buy this information

Example 3 (96 final exam)
Kuality Komponents buys on-off switches from two suppliers. The quality of the switches from the supplies is indicated below.

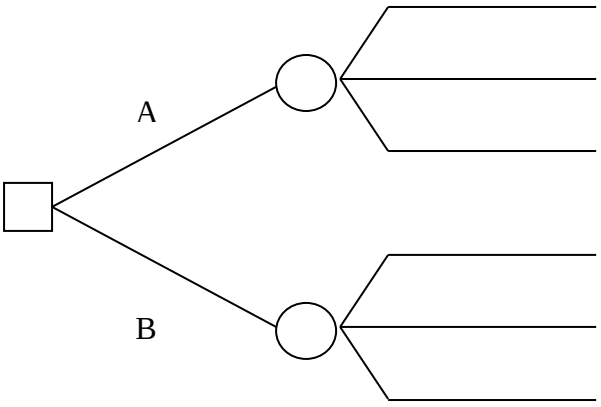
Percent Defective	Prob for supplier A	Prob for supplier B
1	0.7	0.3
3	0.2	0.4
5	0.1	0.3

Kuality Komponents orders 10,000 switches per order. A defective switch can be repaired for 50 cents. Although the quality of supplies B is lower, it will sell an order of 10,000 switches for $37 less than supplier A.

(a) (12%) Which supplier should Kuality Komponents use?
(b) (8%) For how much would supplier B have to sell on order of 10,000 switches than supplier A for Kuality Komponents to be indifferent between the two suppliers?

Solution:

(a) Let **X** be the amount money to order 10000 switches from A
and **(X – 37)** be the amount money to order 10000 switches from B



R_1 = 10000 (1%)(-0.5) = -50
R_2 = 10000 (3%)(-0.5) = -150
R_3 = 10000 (5%)(-0.5) = -250

EMV (A) =

EMV (B) =

(b)

- **Posterior analysis**: based on present and additional information
  - Let B_j be the possible states of nature and A be the data
  - $P(B_j)$ are called prior probabilities and $P(A|B_j)$ can be obtained by experimenter
  - We want to know $P(B_j|A)$ by Bayes' Theorem. These revised probabilities are called posterior probabilities.

  - **Bayes' Theorem**
    - $$\Pr(B_i \mid A) = \frac{\Pr(A \mid B_i)\,\Pr(B_i)}{\sum_{j=1}^{n} \Pr(A \mid B_j)\,\Pr(B_j)}$$

    Proof: For any event A in S

    $$\begin{aligned} P(A) &= P(A \cap S) \\ &= P(A \cap (B_1 \cup B_2 \cdots \cup B_n) \\ &= P(A \cap B_1) + \cdots + P(A \cap B_n) \\ &= P(A \mid B_1)P(B_1) + \cdots + P(A \mid B_n)P(B_n) \\ &= \sum_{j=1}^{n} P(A \mid B_j)P(B_j) \end{aligned}$$

    $$P(B_i \mid A) = \frac{P(B_i \cap A)}{P(A)} = \frac{P(B_i)P(A \mid B_i)}{\sum_{j=1}^{n} P(A \mid B_j)P(B_j)}$$

    All B_i are mutually exclusive.

    $S = B_1 \cup B_2 \cdots \cup B_n$

    $P(B_i) > 0$ for all i

- **Preposterior analysis:** evaluate the worth of research before the research is undertaken.

1. Expected monetary value of imperfect information (EMVII)

   If one is willing to make certain probability assessments, preposterior analysis will allow the value of alternative research studies to be measured prior to the research being undertaken

   EMVII = EMV (with test) – EMV (without test)

2. Expected monetary gain of imperfect information (EMGII)

   EMGII = EMVII – cost of test

   It is worth to conduct the research if **EMGII >0**
   Take the research plan with the **highest** EMGII if more than one exists.

Example 4 (98 final exam)

A publisher is evaluating a book manuscript written by a young, unknown faculty member. The publisher is considering sending the manuscript out to be reviewed by a team of well-known full professors at other universities. Historical experience comparing the reviewer' evaluations against actual success or failure is as follows

Outcome predicted by reviewers	Actual outcome	
	Success	Failure
Success	70	30
Failure	50	50

If a book is successful, the profit to the publisher $50,000; if a failure, the loss to the publisher is $15000. The cost of sending a manuscript out to the team of reviewers is $2000.

What is the optimal strategy for the publisher?

Solution:

Let S_1 = Actual outcome is success T_1 = Outcome predicted is success

S_2 = Actual outcome is failure T_2 = Outcome predicted is failure

Joint prob :

	S_1	S_2	$P(T_i)$
T_1			
T_2			
$P(S_i)$			

$P(S_1 \mid T_1) = P(S_1, T_1) / P(T_1) =$

$P(S_2 \mid T_1) = P(S_2, T_1) / P(T_1) =$

$P(S_1 \mid T_2) = P(S_1, T_2) / P(T_2) =$

$P(S_2 \mid T_2) = P(S_2, T_2) / P(T_2) =$

EMVII =

EMGII =