Solution to Homework Set #5

ENCE 627 – Decision Analysis for Engineering - Fall 2003

Assigned T, 10/14   Due T, 10/21

<u>Problem 1</u>

Textbook (CR): 2.10

***** SOLUTION *****

$$.NPV = \frac{-12000}{1.12} + \frac{5000}{1.12^2} + \frac{5000}{1.12^3} + \frac{-2000}{1.12^4} + \frac{6000}{1.12^5} + \frac{6000}{1.12^6}$$

$$= -10{,}714.29 + 3985.97 + 3558.90 - 1271.04 + 3404.56 + 3039.79$$

$$= \$2003.90$$

Using Excel's NPV function:
=NPV(0.12,-12000,5000, 5000,-2000,6000,6000)
= $2,003.90

The internal rate of return (IRR) for this cash flow is approximately 19.2%.

<u>Problem 2</u>

A contractor is considering the following three alternatives:

A. Purchase a new microcomputer system for $5,017. The system is expected to last for 6 years with salvage value of $1,000.
B. Lease a new microcomputer system for $1,400 per year, payable in advance. It should last 6 years.
C. Purchase a used microcomputer system for $2,720. It is expected to last 3 years with essentially no salvage value.
   (a) For a MARR of 12%, which alternative should be selected?
   (b) For a MARR of 15%, which alternative should be selected?
   (c) What is the rate of return (ROR) between alternative A and B?

Note: Assume equal replacement conditions for this problem

***** SOLUTION *****

(a) i =12%:

$NPW_A = -5{,}017 + 1{,}000\ (1/\ [1.12]^6) = -4{,}510.37$ = **-$4,510**
$NPW_B = -1{,}400 + 1{,}400\ (P/A,12,5) = -6{,}446.687$ = **-$6,450**
$NPW_C = -2{,}720 + 2{,}720\ (1/\ [1.12]^3) = -4{,}656.042$ = -**$4,660**

<u>Choose A</u>

(b) i =15%:

$NPW_A = -5{,}017 + 1{,}000\ (1/\ [1.15]^6) = -4{,}584.672$ = **-$4,580**
$NPW_B = -1{,}400 + 1{,}400\ (P/A,15,5) = -6{,}093.017$ = **-$6,090**
$NPW_C = -2{,}720 + 2{,}720\ (1/\ [1.15]^3) = -4{,}508.44$ = -**$4,510**

<u>Choose C</u>

(c) $NPW_{A\text{-}B} = -5{,}017 + 1{,}000\,(1/(1+i)^6) + 1400 + 1400\,(P/A,i,5) = 0$

By tial and error, i = 30.0%

Problem 3

Textbook (CR): 3.1

***** SOLUTION *****

Fundamental objectives are the essential reasons we care about a decision, whereas means objectives are things we care about because they help us achieve the fundamental objectives. In the automotive safety example, maximizing seat-belt use is a means objective because it helps to achieve the fundamental objectives of minimizing lives lost and injuries. We try to measure achievement of fundamental objectives because we want to know how a consequence "stacks up" in terms of the things we care about.

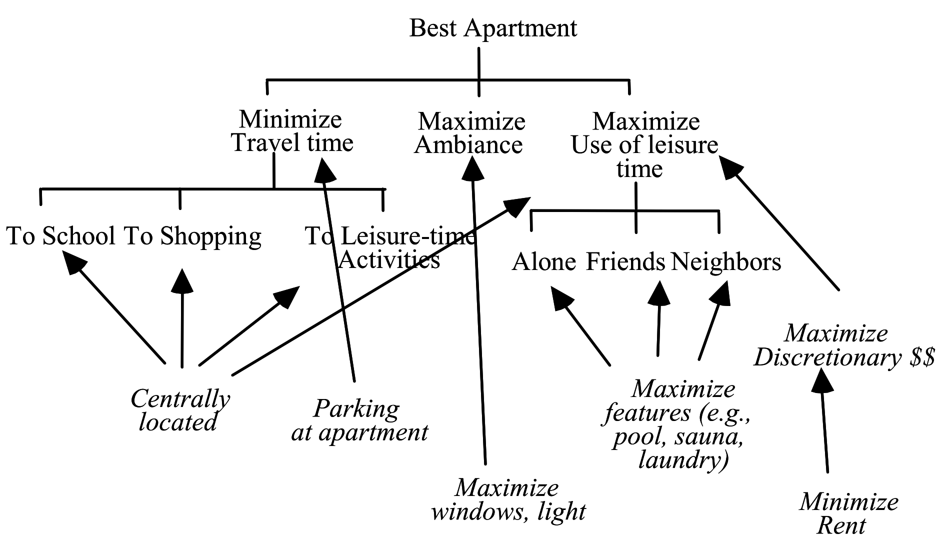
Separating means objectives from fundamental objectives is important in Chapter 3 if only to be sure that we are clear on the fundamental objectives, so that we know what to measure. In Chapter 6 we will see that the means-objectives network is fertile ground for creating new alternatives

Problem 4

Textbook (CR): 3.2

***** SOLUTION *****

Answers will vary because different individuals have different objectives. Here is one possibility. (Means objectives are indicated by *italics*.)

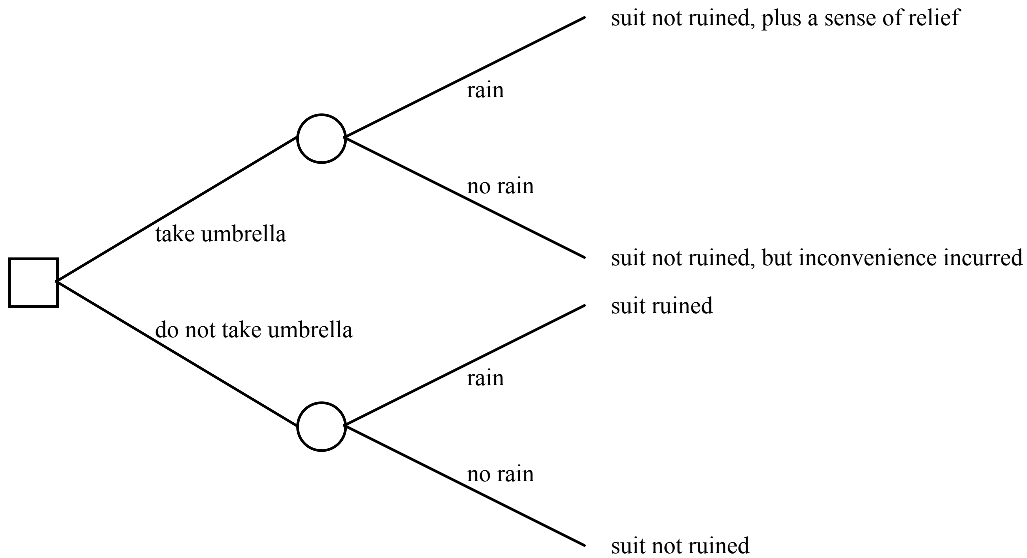


Problem 5

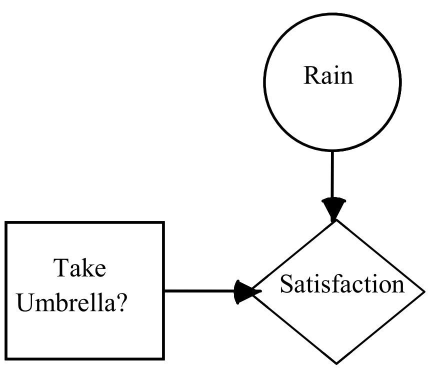
Textbook (CR): 3.9

***** SOLUTION *****

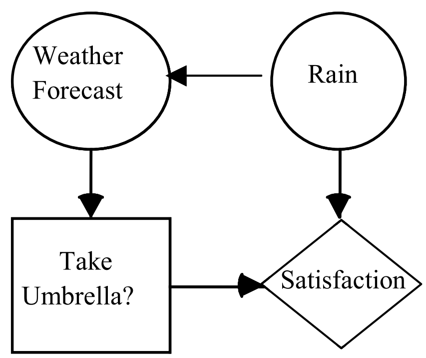
The following answers are based on the interpretation that the suit *will* be ruined if it rains. They are a good first pass at the problem structure (but see below).



(A) Decision tree



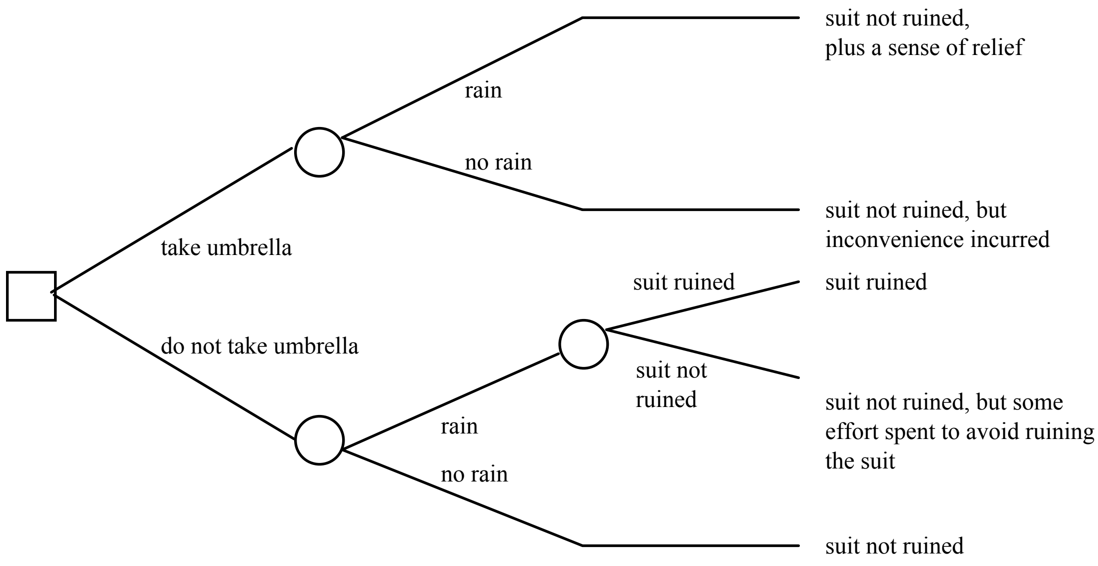
(B) Basic Risky Decision



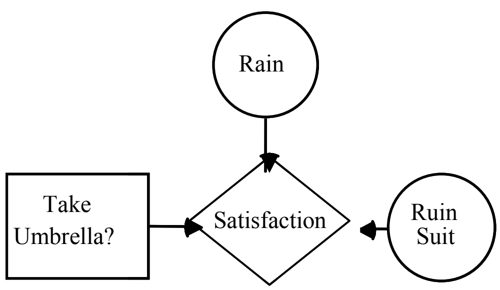
(C) Imperfect Information

The Excel solution "Problem 3.9.xls" shows a realization of this problem assuming the cost of the suit is \$200, the cost of the inconvenience of carrying an umbrella when it is not raining is \$20, the probability of rain is 0.25, and the weather forecaster is 90% accurate.

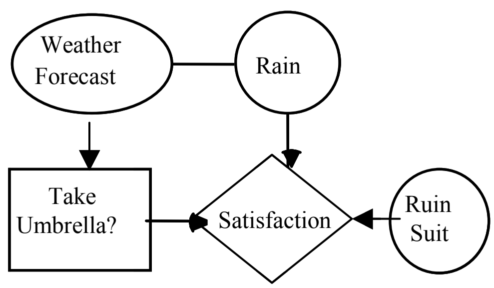
Note that the wording of the problem indicates that the suit *may* be ruined if it rains. For example, the degree of damage probably depends on the *amount* of rain that hits the suit, which is itself uncertain! The following diagrams capture this uncertainty.



(A) Decision tree



(B) Basic Risky Decision



(C) Imperfect Information