Solution to Homework Set #6
ENCE 627 – Decision Analysis for Engineering - Fall 2003
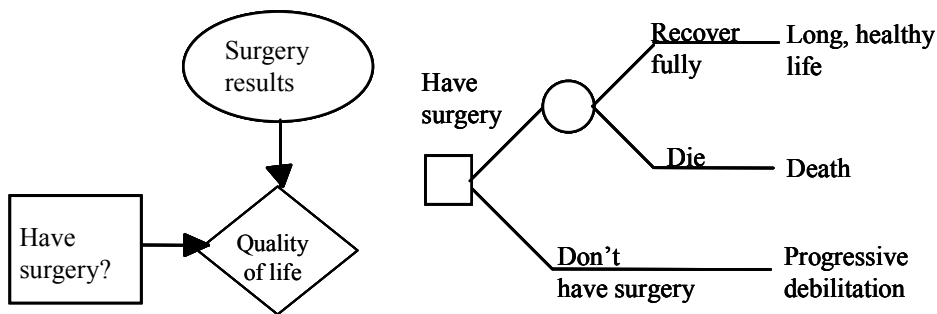
Assigned T, 10/28   Due T, 11/4

Problem 1
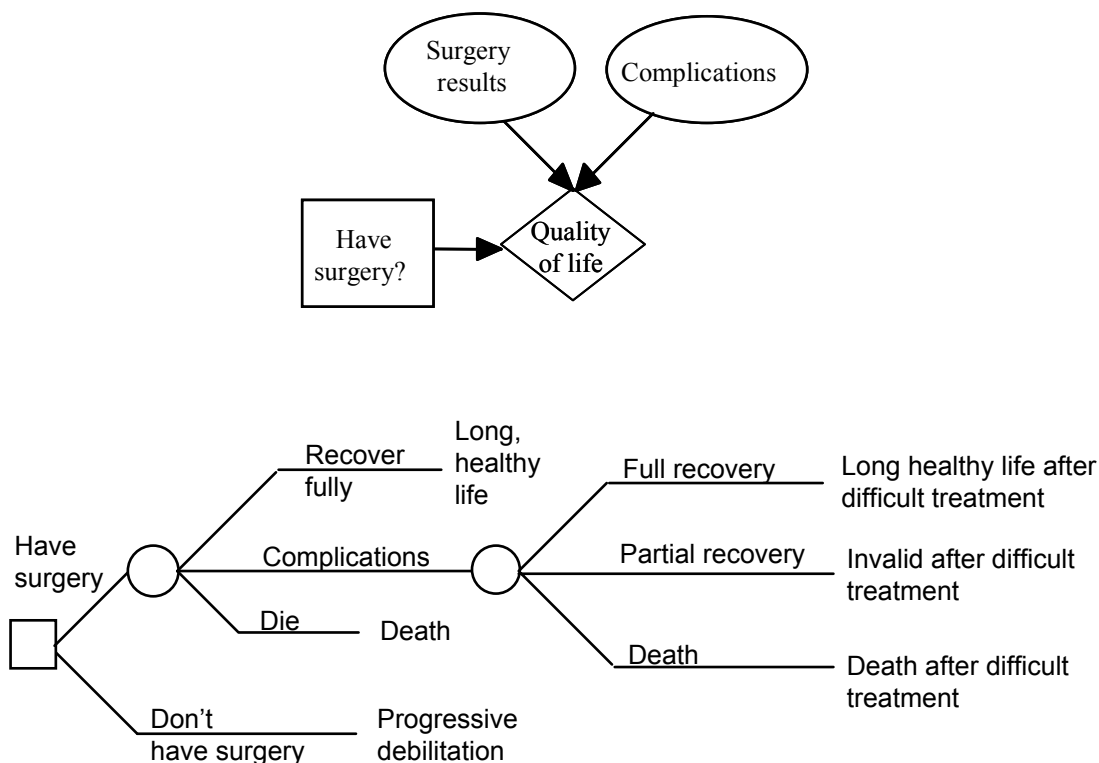
Textbook (CR): 3.20

*** SOLUTION ***

a.

b.

Given the possibility of complications and eventual consequences, the surgery looks considerably less appealing.

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c. Defining this scale is a personal matter, but it must capture important aspects of what life would be like in case complications arise. Here is one possible scale:

(Best)   No complications. Normal, healthy life.
   --   Slight complications lead to minor health annoyances, need for medication, frequent visits. Little or no pain experienced. Able to engage in most age-appropriate activities.
   --   Recovery from surgery requires more than two weeks of convalescence. Pain is intense but intermittent. Need for medication is constant after recovery. Unable to engage in all age-appropriate activities.
   --   Recovery requires over a month. Chronic pain and constant need for medication. Confined to wheelchair 50% of the time.

(Worst) Complete invalid for remainder of life. Restricted to bed and wheelchair. Constant pain, sometimes intense. Medication schedule complicated and occasionally overwhelming.
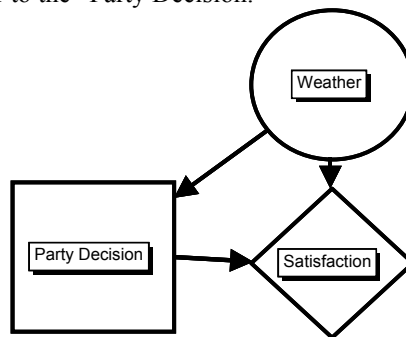
Problem 2
Textbook (CR): 3.26

*** SOLUTION ***

a. The influence diagram from Exercise 3.11(a) is shown here drawn in PrecisionTree.

In order for the "Convert To Tree" button to automatically adjust for the asymmetries, a structure arc is needed from "Party Decision" to "Weather" (represented by the dotted arrow). This influence diagram and the corresponding converted decision tree are shown in the first two worksheets in the Excel file "Problem 3.26.xls". Some assumed values for outcomes and probabilities are shown in the converted decision tree.
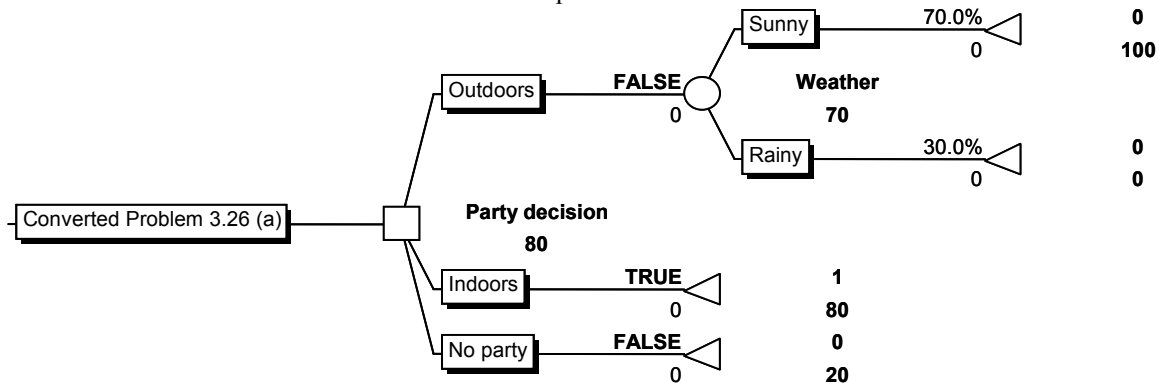
b. Adding the arrow from "Weather" to "Party Decision" means that the information regarding the weather is known before the time of the decision. Therefore, in the Converted Decision Tree, the "Weather" chance events will appear in the tree prior to the "Party Decision."

Outdoors   **TRUE**   **0.7**
100   **100**

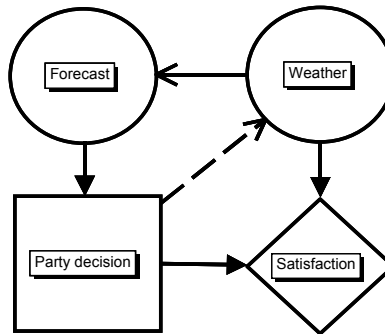**Sunny**   70.0%   **Party Decision**
0   **100**

Indoors   **FALSE**   **0**
80   **80**

No party   **FALSE**   **0**
20   **20**

Converted Problem 3.26 (b)   **Weather**
94

Outdoors   **FALSE**   **0**
0   **0**

Rainy   30.0%   **Party Decision**
0   **80**

Indoors   **TRUE**   **0.3**
80   **80**

No party   **FALSE**   **0**
20   **20**
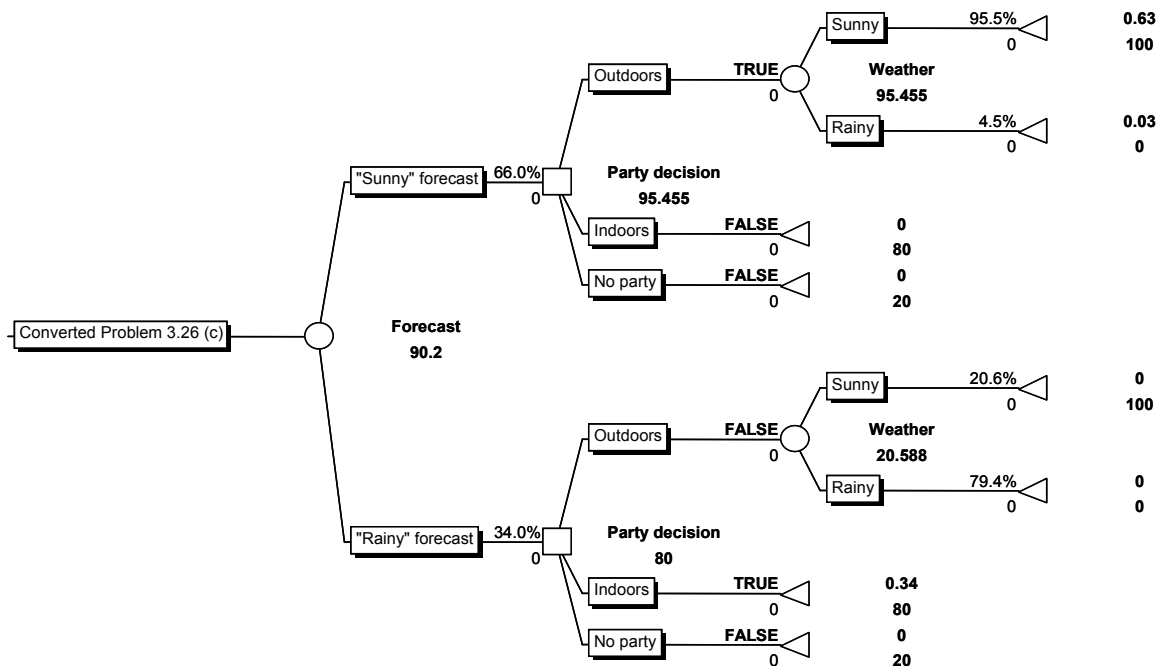
c.

Forecast ← Weather

Party decision → Satisfaction
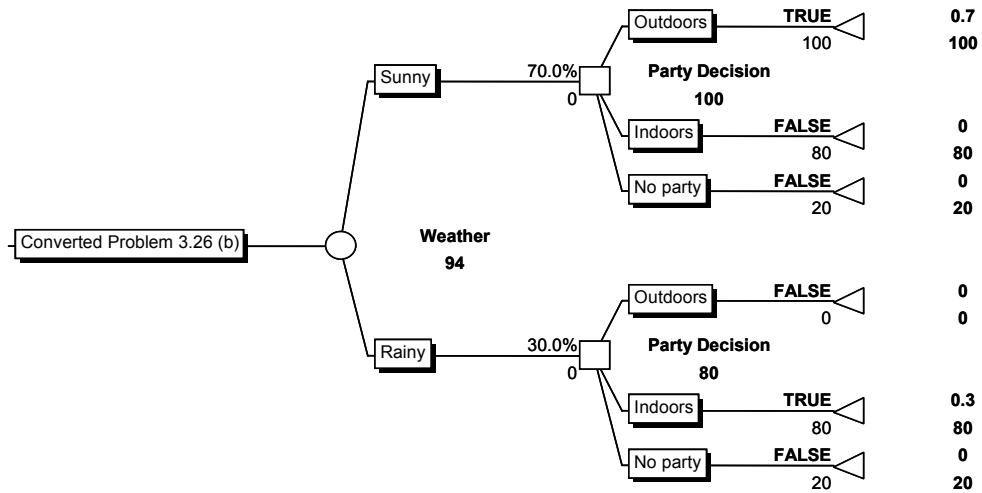
If the arrow went from "Party" to "Forecast", then you would have to make the party decision before you got the forecast. If an arrow started at "Forecast" and went to "Weather", we would be stating that somehow the forecast influences the weather.

Sunny   95.5%   **0.63**
0   **100**

Outdoors   **TRUE**   **Weather**
0   **95.455**

Rainy   4.5%   **0.03**
0   **0**

"Sunny" forecast   66.0%   **Party decision**
0   **95.455**

Indoors   **FALSE**   **0**
0   **80**

No party   **FALSE**   **0**
0   **20**

Converted Problem 3.26 (c)   **Forecast**
90.2

Sunny   20.6%   **0**
0   **100**

Outdoors   **FALSE**   **Weather**
0   **20.588**

Rainy   79.4%   **0**
0   **0**

"Rainy" forecast   34.0%   **Party decision**
0   **80**

Indoors   **TRUE**   **0.34**
0   **80**

No party   **FALSE**   **0**
0   **20**

Problem 3

Textbook (CR): 4.4

*** SOLUTION ***

branch	10.0%		**0**
	20		**20**
branch	20.0%		**0**
	10		**10**

A **FALSE** Chance
0   **3**

branch	60.0%		**0**
	0		**0**
branch	10.0%		**0**
	-10		**-10**

Problem 4.4   **Decision**
                3.2

branch	70.0%		**0.7**
	5		**5**

B **TRUE** Chance
0   **3.2**

branch	30.0%		**0.3**
	-1		**-1**
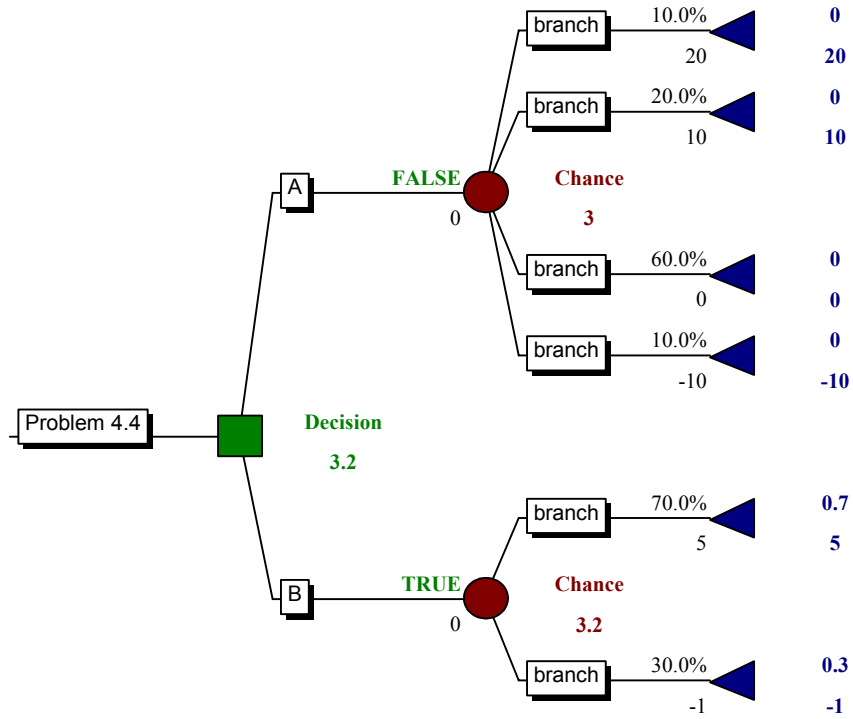
EMV(A) $= 0.1(20) + 0.2(10) + 0.6(0) + 0.1(-10)$
$= 3.0$

EMV(B) $= 0.7(5) + 0.3(-1)$
$= 3.2$

Problem 4

Textbook (CR): 4.5

*** SOLUTION ***
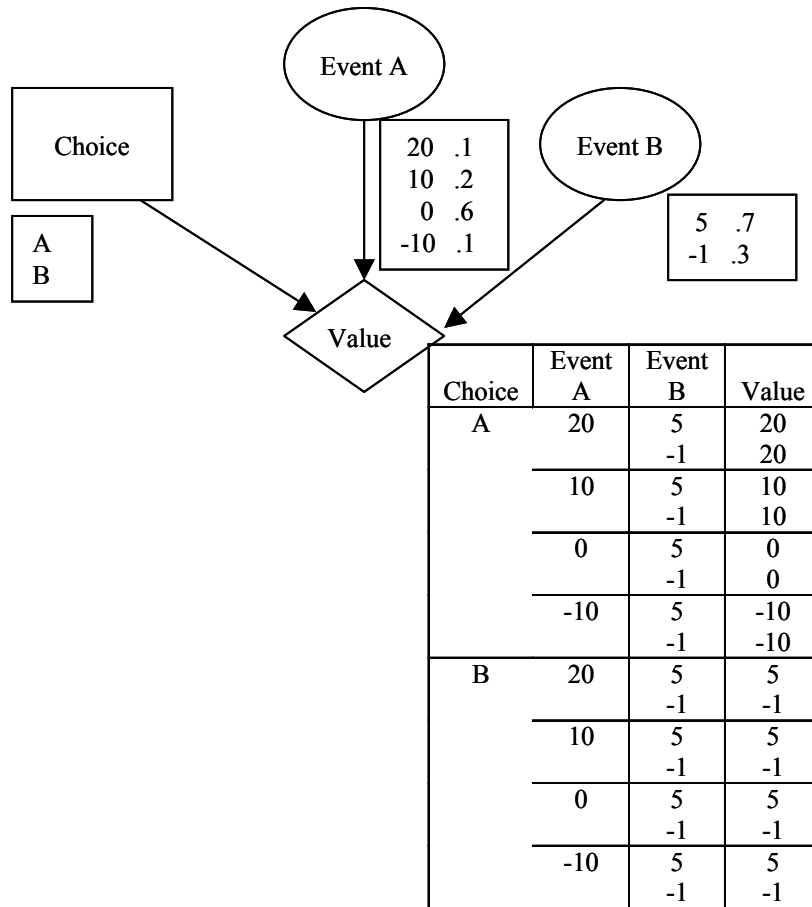
The influence diagram is

Problem 4.5	
EV	**3.2**
STDEV	**2.749545**
MIN	**-1**
MAX	**5**
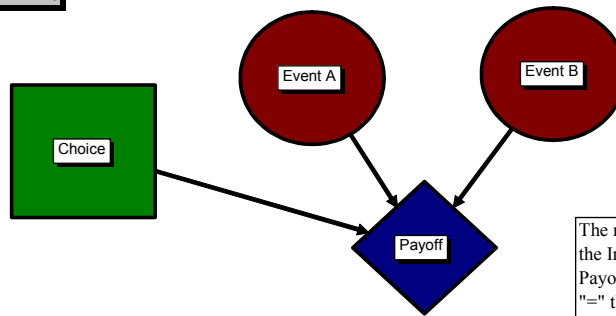
The most difficult part is entering the values in the Influence Value Editor dialog box for the Payoff node. The values are entered by typing "=" then clicking on the appropriate outcome cells in the dialog box.

The most challenging part of implementing the influence diagram is to enter the payoff values. The payoff values reference the outcome values listed in the value table. The value table is a standard Excel spreadsheet with values of influencing nodes. In order for the influence diagram to calculate the expected value of the model, it is necessary to fill in the value tables for all diagram nodes. This value is shown in the upper left of the worksheet. Change a value or probability in the diagram, and you will immediately see the impact on the results of the model. It is possible to use formulas that combine values for influence nodes to calculate the payoff node vales.

The results of the run Decision Analysis button (fourth button from the left on the PrecisionTree toolbar) are shown in the worksheets labeled Statistics, RiskProfile, CumulativeRiskProfile, and ScatterProfile. The results of an influence diagram will only show the Optimal Policy. An analysis based on a decision tree provides the alternative to show only the Optimal Policy or All Alternatives. The following figure shows how to solve the influence diagram by hand.

Event A

Choice

20 .1
10 .2
0 .6
-10 .1

Event B

5 .7
-1 .3

A
B

Value

Choice	Event A	Event B	Value
A	20	5	20
		-1	20
	10	5	10
		-1	10
	0	5	0
		-1	0
	-10	5	-10
		-1	-10
B	20	5	5
		-1	-1
	10	5	5
		-1	-1
	0	5	5
		-1	-1
	-10	5	5
		-1	-1

Solution:

1. Reduce Event B:

Choice	Event A	EMV
A	20	20
	10	10
	0	0
	-10	-10
B	20	3.2
	10	3.2
	0	3.2
	-10	3.2

2. Reduce Event A:

Choice	EMV
A	3.0
B	3.2

3. Reduce Choice:

B   3.2