Solution to Homework Set #9

ENCE 627 – Decision Analysis for Engineering - Fall 2003

Assigned T, 12/2 Due T, 12/9

Problem 1

Textbook (CR): 12.1

***** SOLUTION *****

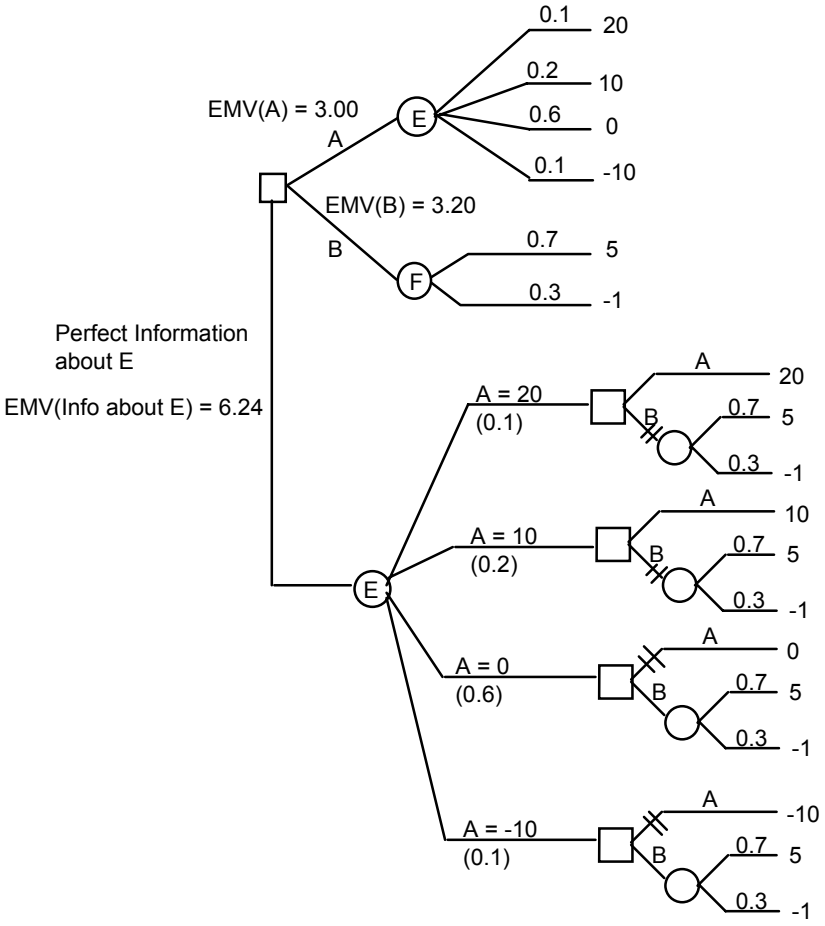
The issue typically is whether to obtain information about some uncertain factor, and this decision must be made up front: Should we hire the expert? Should we conduct a survey? The decision must be made in anticipation of what the information will be and its possible impact and value with regard to the decision itself. As a result, the focus is on what the value of the information is expected to be.

Problem 2

Textbook (CR): 12.4

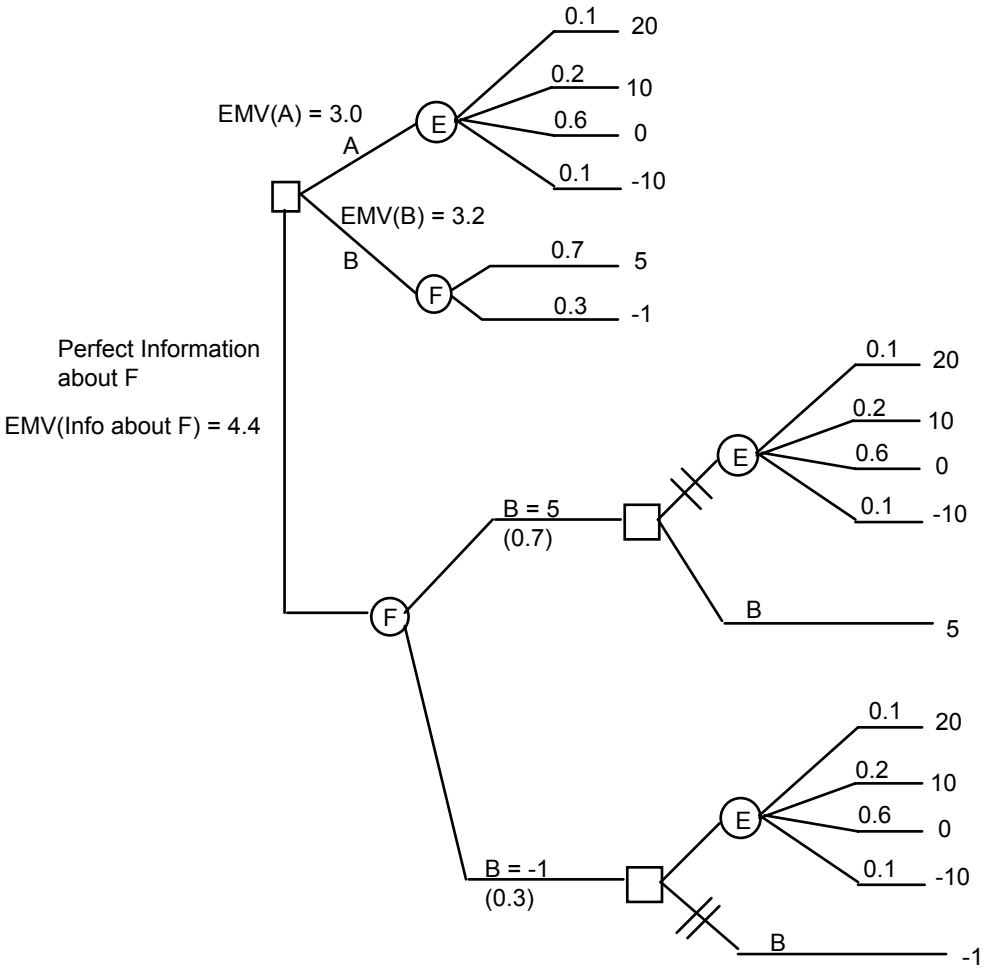
***** SOLUTION *****

a. The following decision trees are generated. Each part is shown in a separate worksheet.



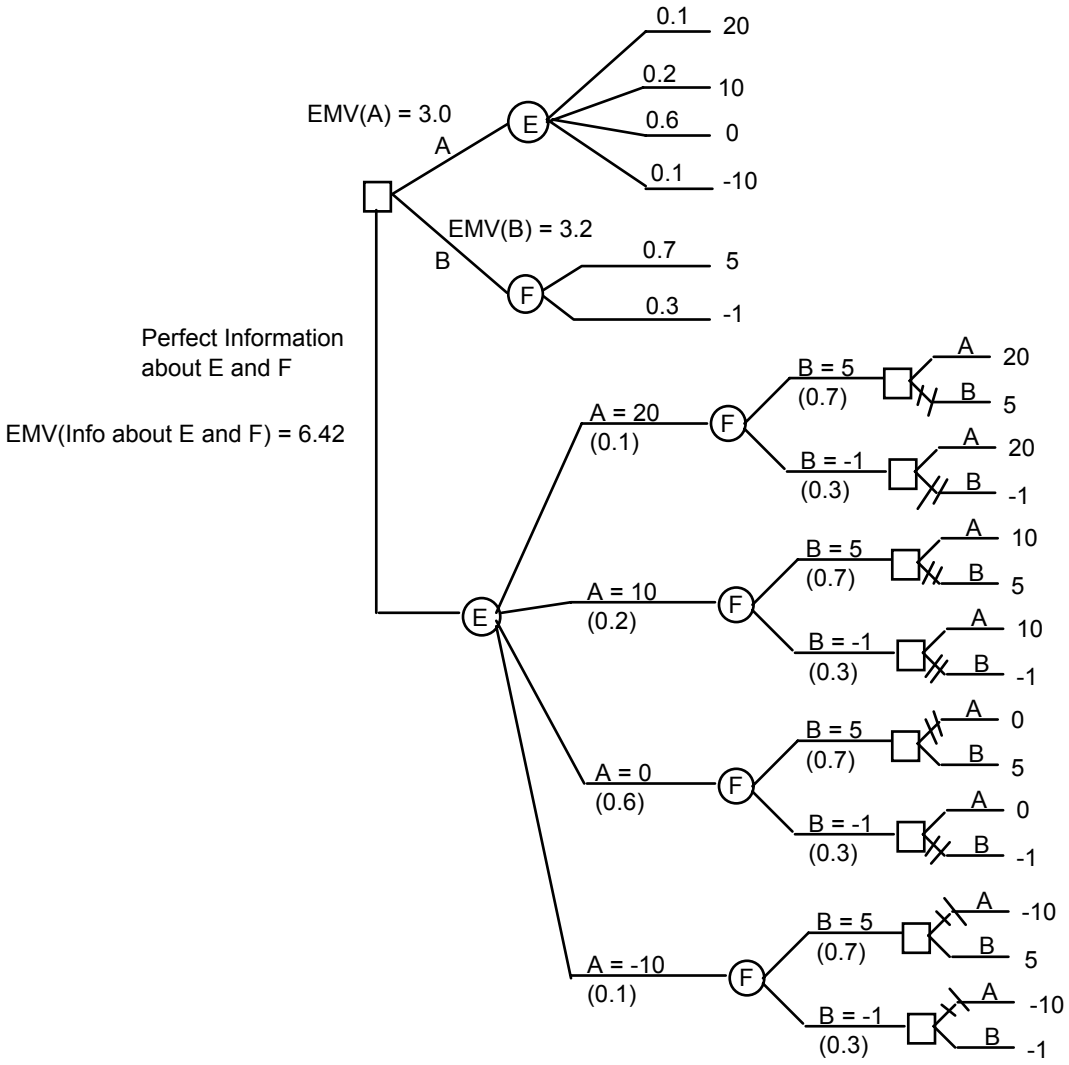
EVPI(Information about E) = EMV(Info) - EMV(B) = 6.24 - 3.20 = 3.04

b.



EVPI(Information about F) = EMV(Info) - EMV(B) = 4.4 - 3.2 = 1.2

c.



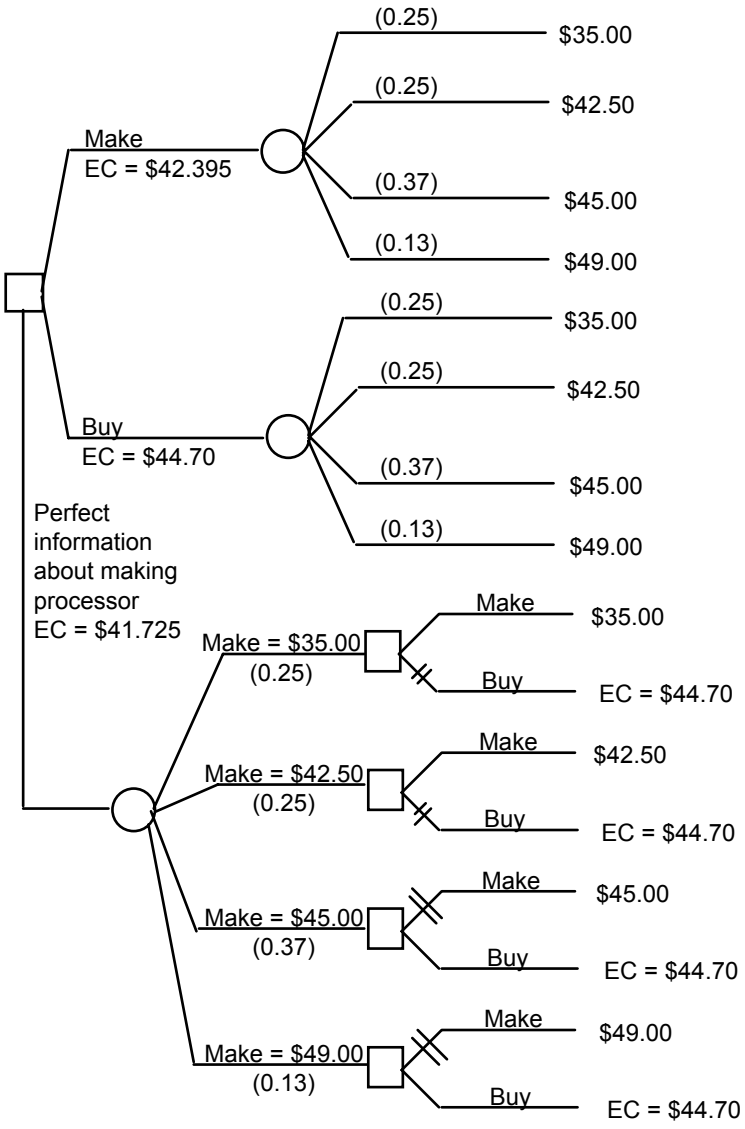
EVPI(Information about both E and F) = EMV(Info) - EMV(B) = 6.42 - 3.2 = 3.22.

Problem 3

Textbook (CR): 12.8

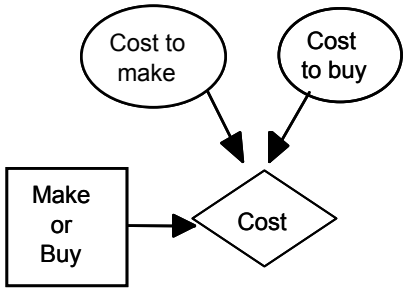
***** SOLUTION *****

a.

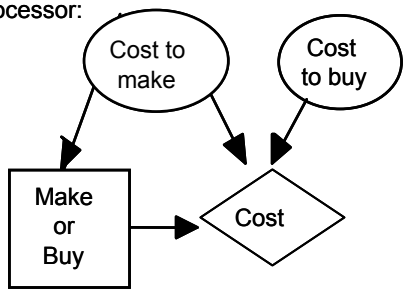


Influence diagrams:

Basic Influence Diagram:



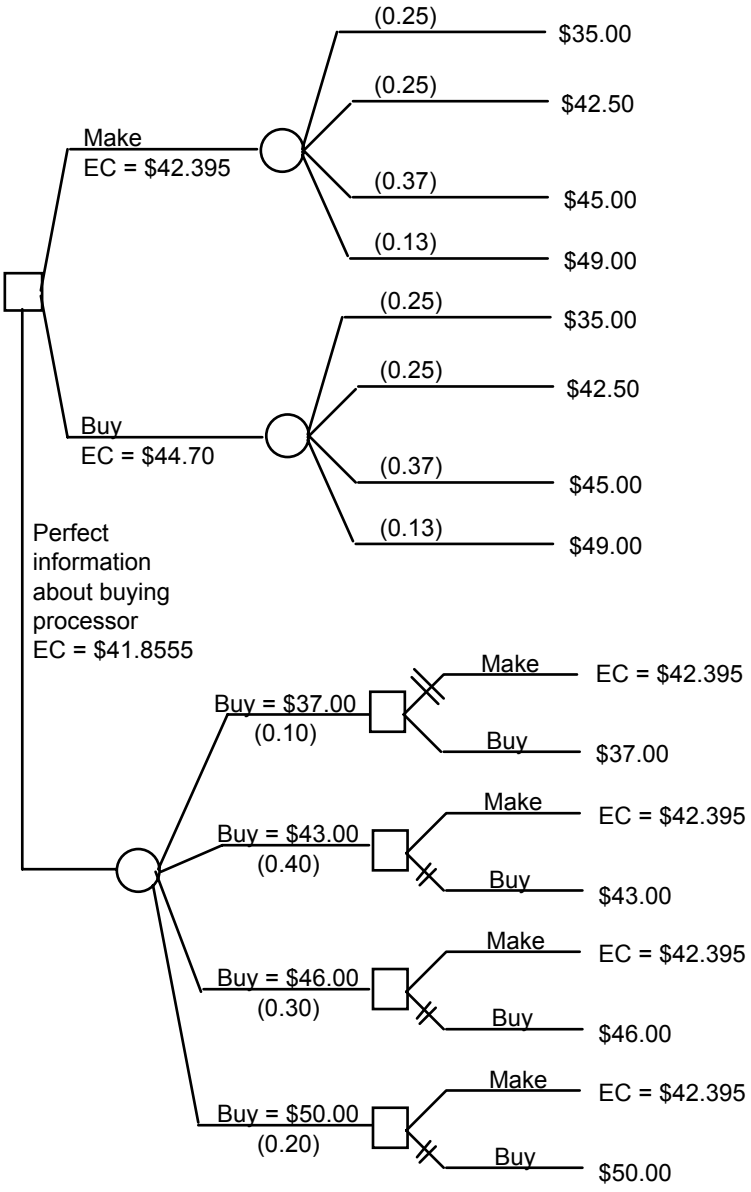
Information about making processor:

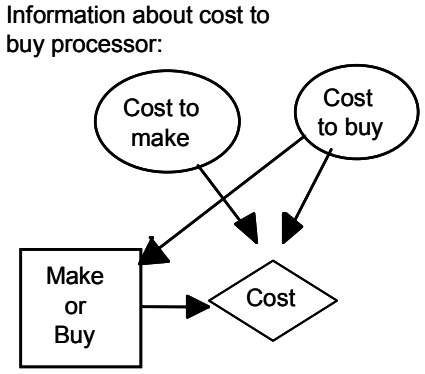


Note that because we are minimizing cost in this problem, we need to find the expected cost savings due to the information. For that reason, EVPI = EC(Make processor) - EC(Information) = $42.395 - $41.725 = $0.670 per unit.

Reference nodes are used to simplify the representation of the tree by referring to the cost uncertainty node associated with the "Buy" decision.

b.



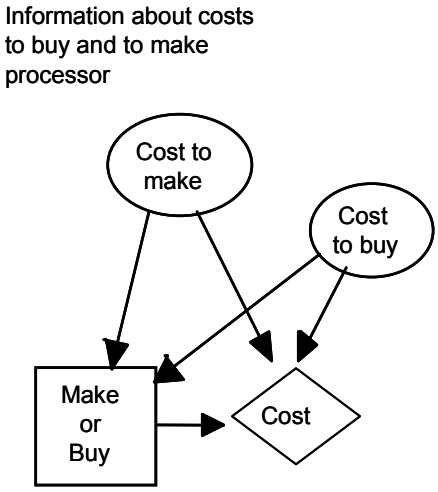


EVPI = EC(Make processor) - EC(Information) = \$42.395 - \$41.8555 = \$0.5355 per unit.

Reference nodes are used to simplify the representation by referring to the Cost uncertainty associated with the "Make" decision.

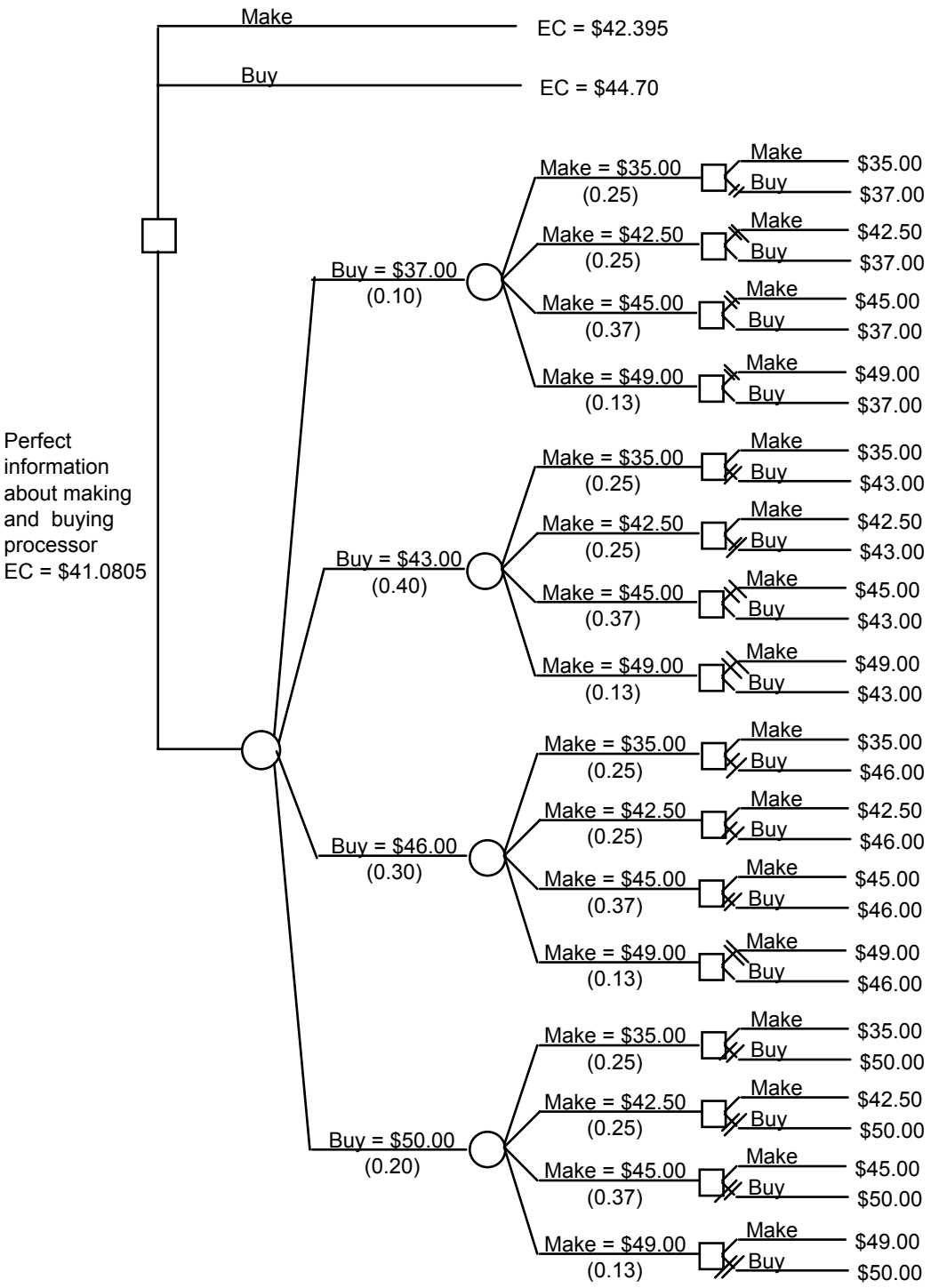
c.

Influence diagram:



EVPI = EC(Make processor) - EC(Information) = \$42.395 - \$41.0805 = \$1.3145 per unit

The decision tree, however, in its complete form has too many nodes for the student version (limit 50). The tree was manually trimmed near the bottom to satisfy this constraint.



Problem 4

Textbook (CR): 13.7

***** SOLUTION *****

a.

$U(1000) = 1 - e^{-1000/1210} = 0.56.$

Likewise,

U(800) = 0.48
U(0) = 0.00
U(-1250) = -1.81

b. EU = 0.33(0.56) + 0.21 (0.48) + 0.33(0) + 0.13 (-1.81) = 0.052.

This decision tree is shown in the Excel file "Problem 13.7.xls". The decision tree currently shows the expected utility 0.052. To find the Certainty Equivalent (part c), click on the tree's name and choose Certainty Equivalent for the Display. The CE is \$64.52. The risk premium is the EMV - CE. To find the EMV, click on the tree's name and choose Expected Value for the Display. The EMV = \$335.50. Therefore, the risk premium is \$270.98.

c. To find CE, set up equation

$1 - e^{-CE/1210} = 0.052$

and solve for CE:

$1 - 0.052 = e^{-CE/1210}$
$\ln(1 - 0.052) = -CE/1210$
$-1210 [\ln(1 - 0.052)] = CE$
$\$64.52 = CE.$

d. μ = EMV = \$335.50, and $\sigma^2 = 554{,}964.75$

$$CE \approx 335.5 - \frac{0.5(554{,}964.75)}{1210} = \$106.18.$$

The approximation is poor because the distribution is skewed.

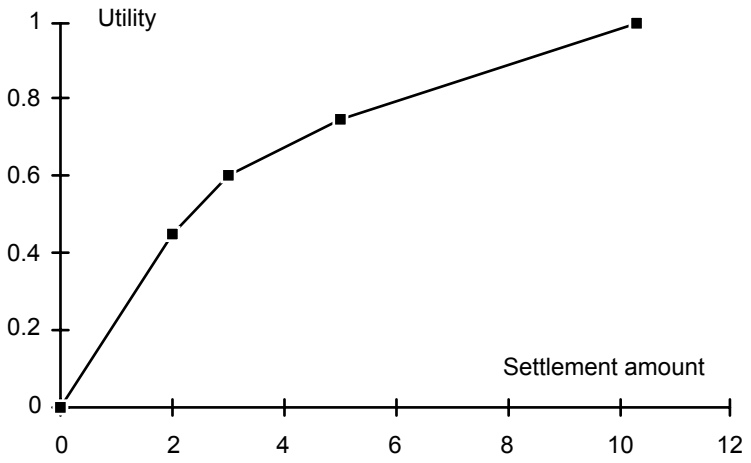
e. $$CE \approx 2400 - \frac{0.5\,(300^2)}{1210} = \$2362.81.$$

Problem 5

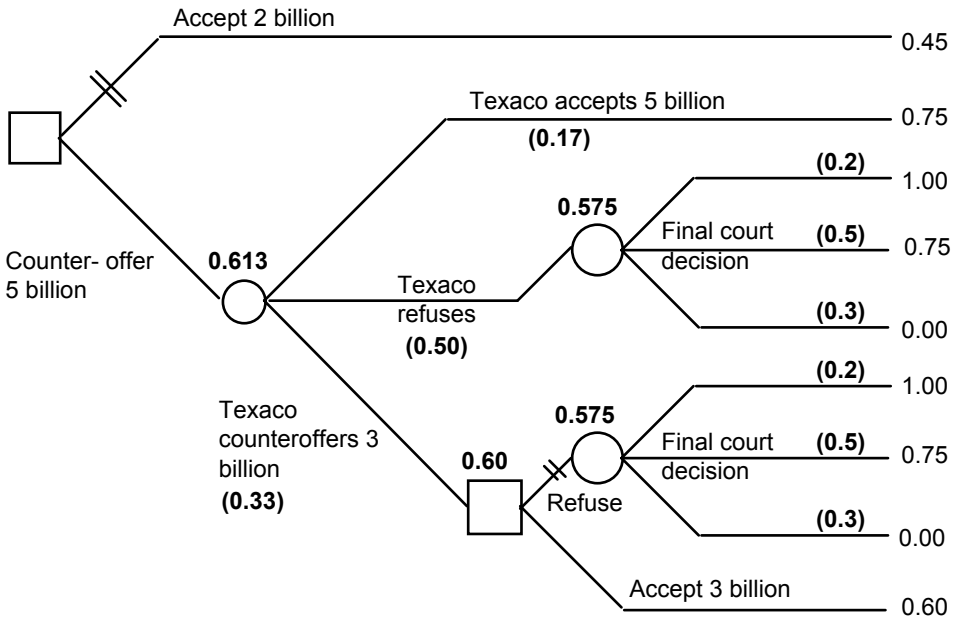
Textbook (CR): 13.14

***** SOLUTION *****

13.14. a.



b.



Liedtke should counteroffer $5 billion, because the expected utility of doing so (0.613) far exceeds the utility of $2 billion (0.45). However, if Texaco counteroffers $3 billion, Liedtke should accept it. Thus, he is being slightly more risk averse than before.

c. From the graph in part a, Liedtke's certainty equivalent appears to be about $2.8 billion. Note that his CE must be less than $3 billion, because U($3 billion) = 0.60. Thus, he should not make a counteroffer for less than this amount. (Nor should he accept a settlement for less than $2.8 billion.)