16.4-4.

(a)

	State of Nature	
Alternative	W	L
Hold Campaign	3	-2
Not Hold Campaign	0	0
Prior Probability	0.6	0.4

(b) Choose to hold the campaign with expected payoff \$1 million.

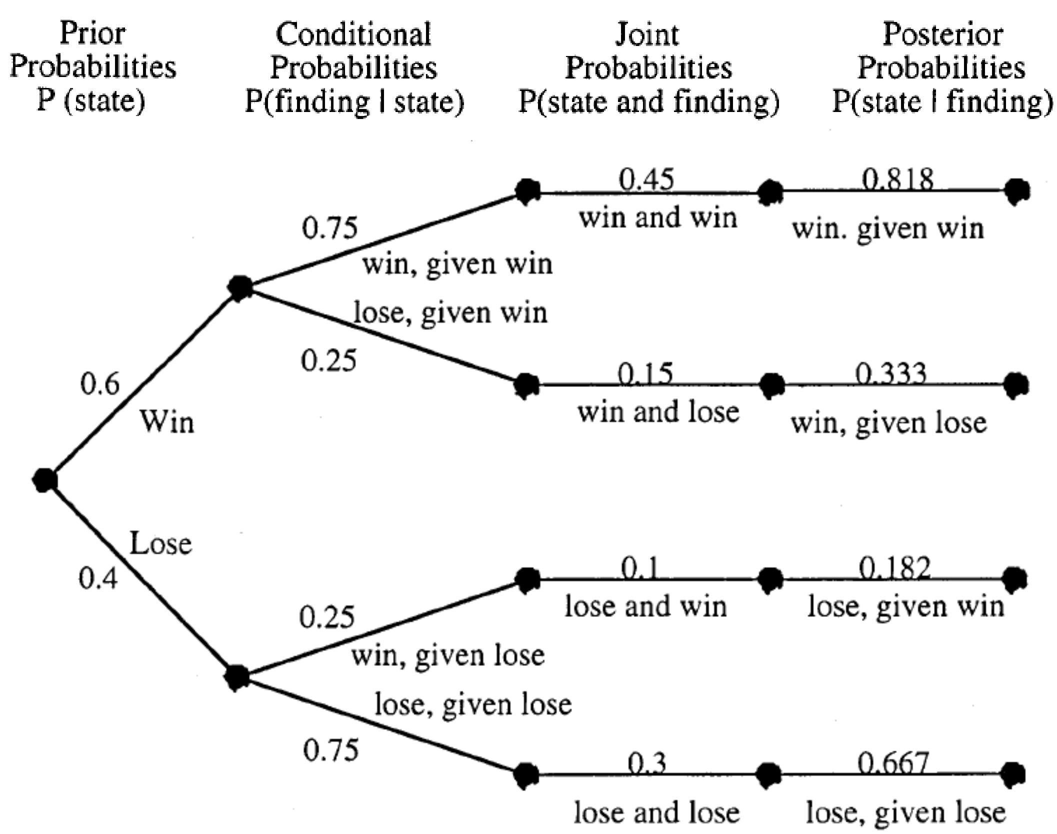
	State of Nature		Exp.
Alternative	W	L	Payoff
Hold Campaign	3	-2	1
Not Hold Campaign	0	0	0
Prior Probability	0.6	0.4	

(c)

	State of Nature	
Alternative	W	L
Hold Campaign	3	-2
Not Hold Campaign	0	0
Prior Probability	0.6	0.4
Maximum Payoff	3	0

Expected Payoff with Perfect Information: $0.6(3) + 0.4(0) = 1.8$
Expected Payoff without Information: 1
EVPI $= 1.8 - 1 = \$0.8$ million

(d)

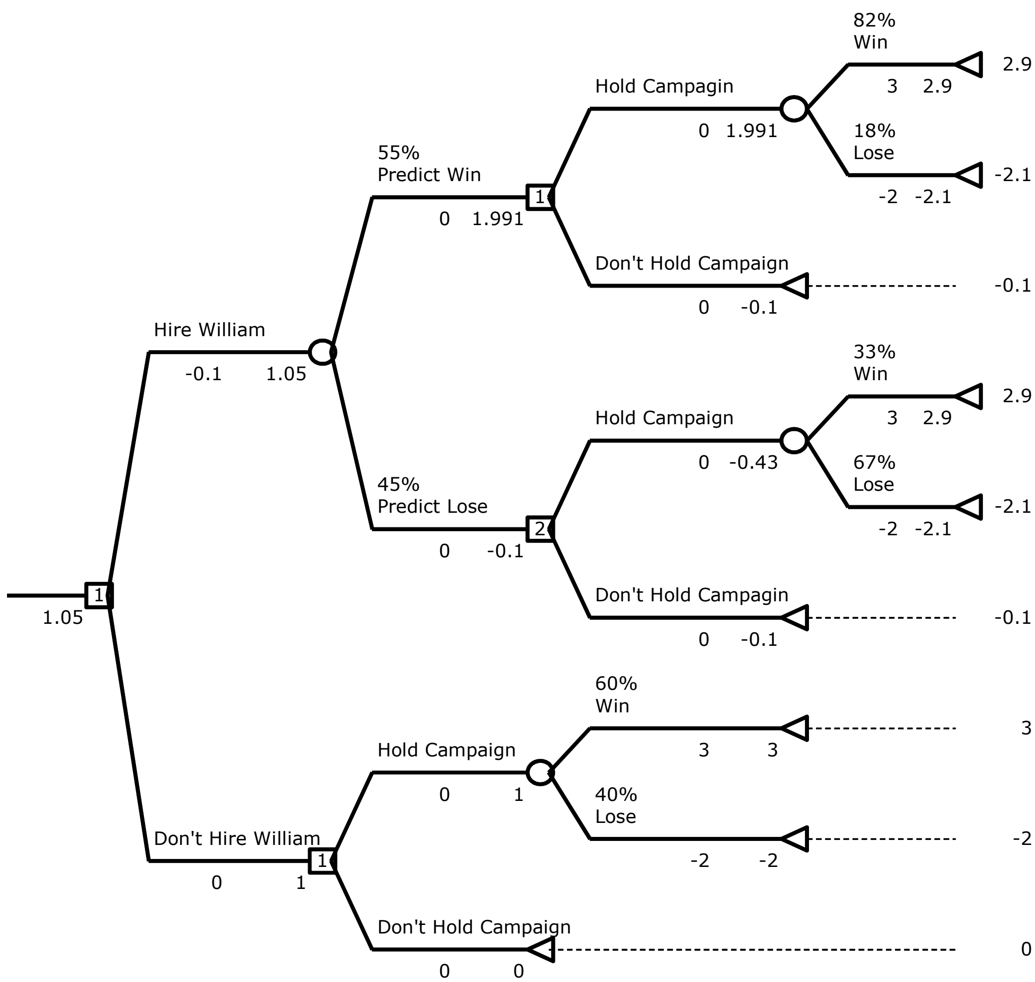


(e)

Data:		P(Finding | State)	
		Finding	
State of Nature	Prior Probability	Predict W	Predict L
Winning Season	0.6	0.75	0.25
Losing Season	0.4	0.25	0.75

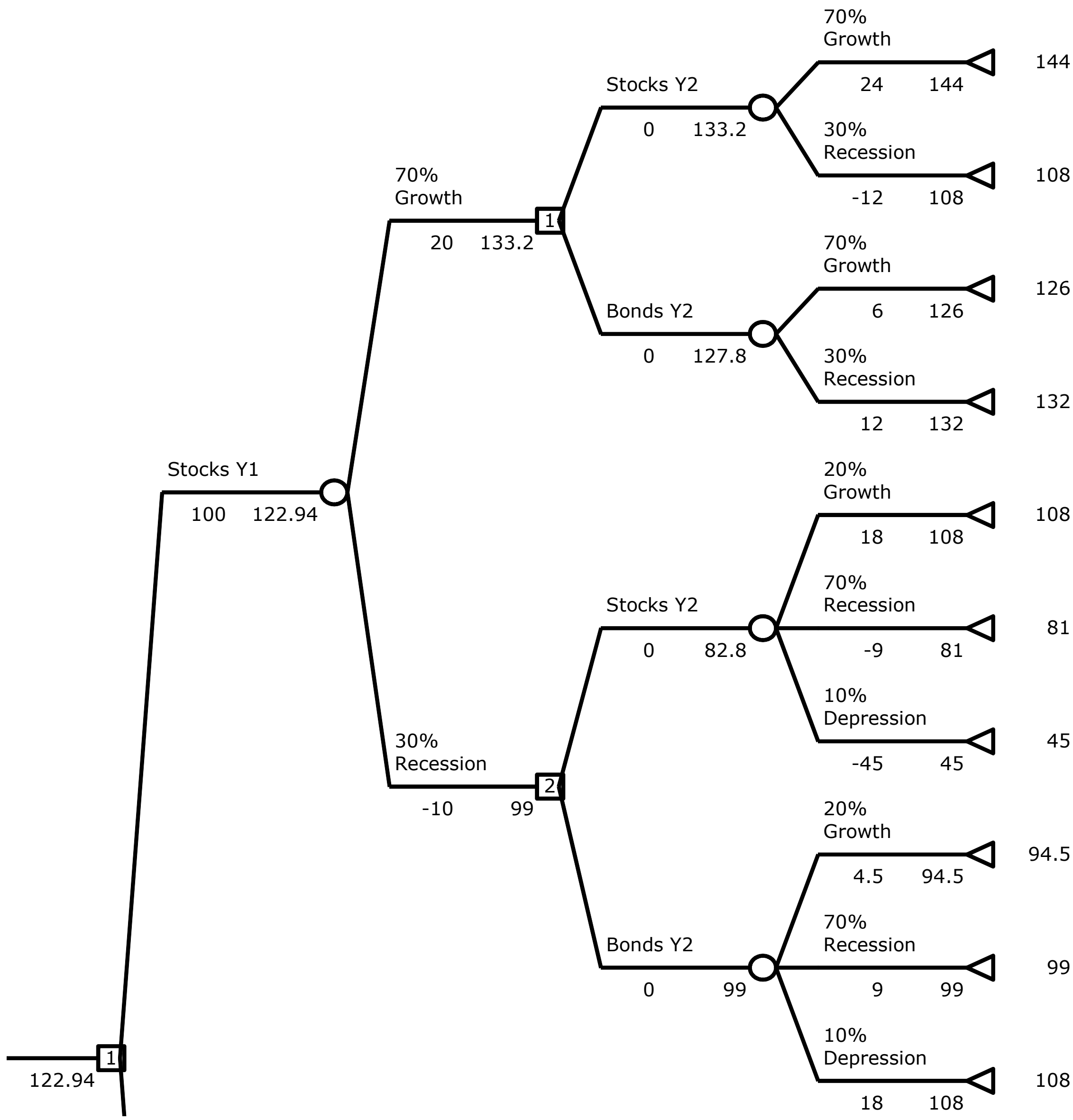
Posterior Probabilities:		P(State | Finding)	
		State of Nature	
Finding	P(Finding)	Winning Season	Losing Season
Predict W	0.55	0.818	0.182
Predict L	0.45	0.333	0.667

(f) Leland University should hire William. If he predicts a winning season, then they should hold the campaign and if he predicts a losing season, then they should not hold the campaign.

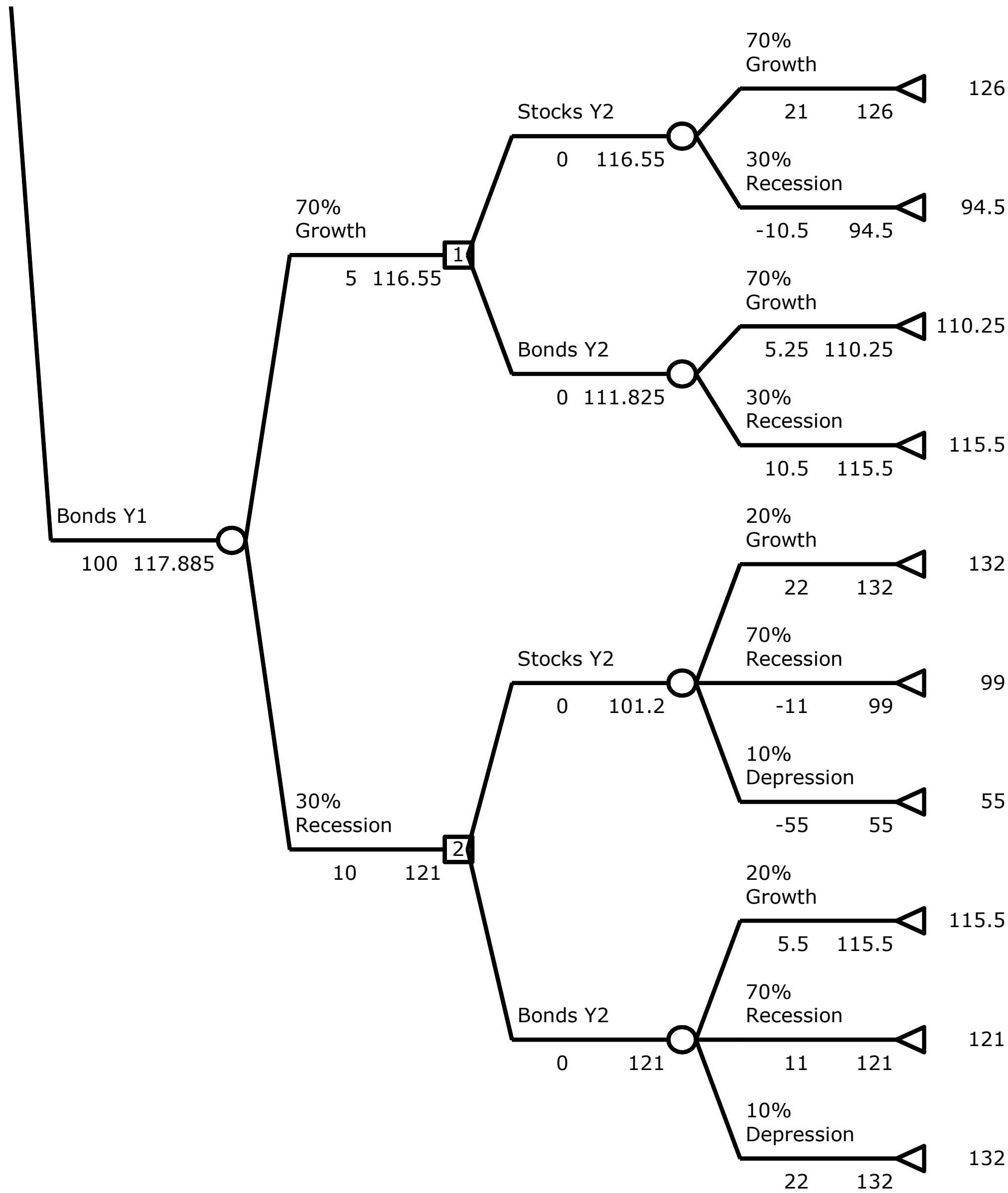


16.4-5.

(a)



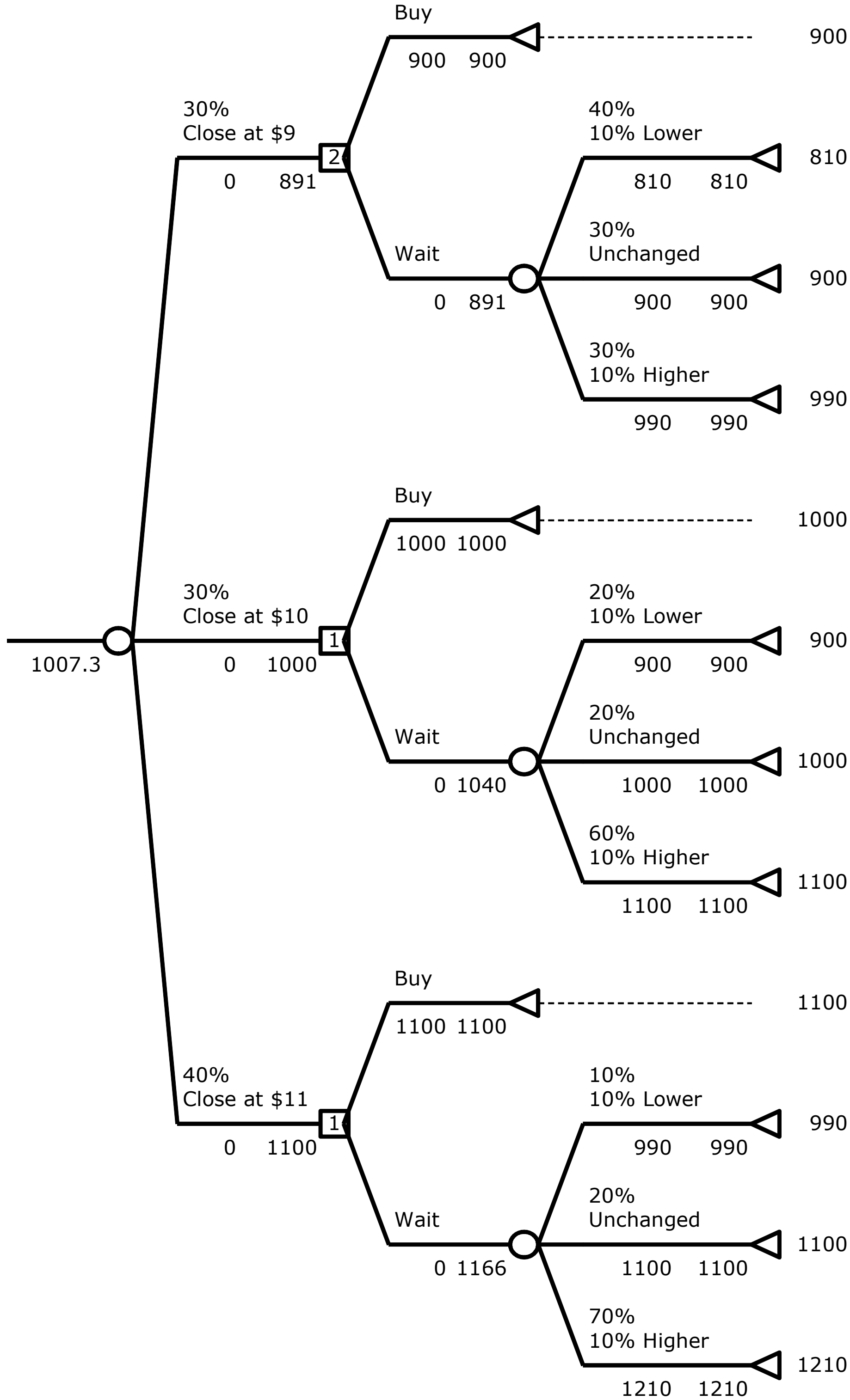
70%
Growth
24 144
144
Stocks Y2
0 133.2
30%
Recession
-12 108
108
70%
Growth
20 133.2
1
70%
Growth
6 126
126
Bonds Y2
0 127.8
30%
Recession
12 132
132
Stocks Y1
100 122.94
20%
Growth
18 108
108
70%
Recession
-9 81
81
Stocks Y2
0 82.8
10%
Depression
-45 45
45
30%
Recession
-10 99
2
20%
Growth
4.5 94.5
94.5
70%
Recession
9 99
99
Bonds Y2
0 99
10%
Depression
18 108
108
1
122.94



(b) The comptroller should invest in stocks the first year. If growth occurs in the first year, then she should invest in stocks again the second year. If recession occurs in the first year, then she should invest in bonds the second year.

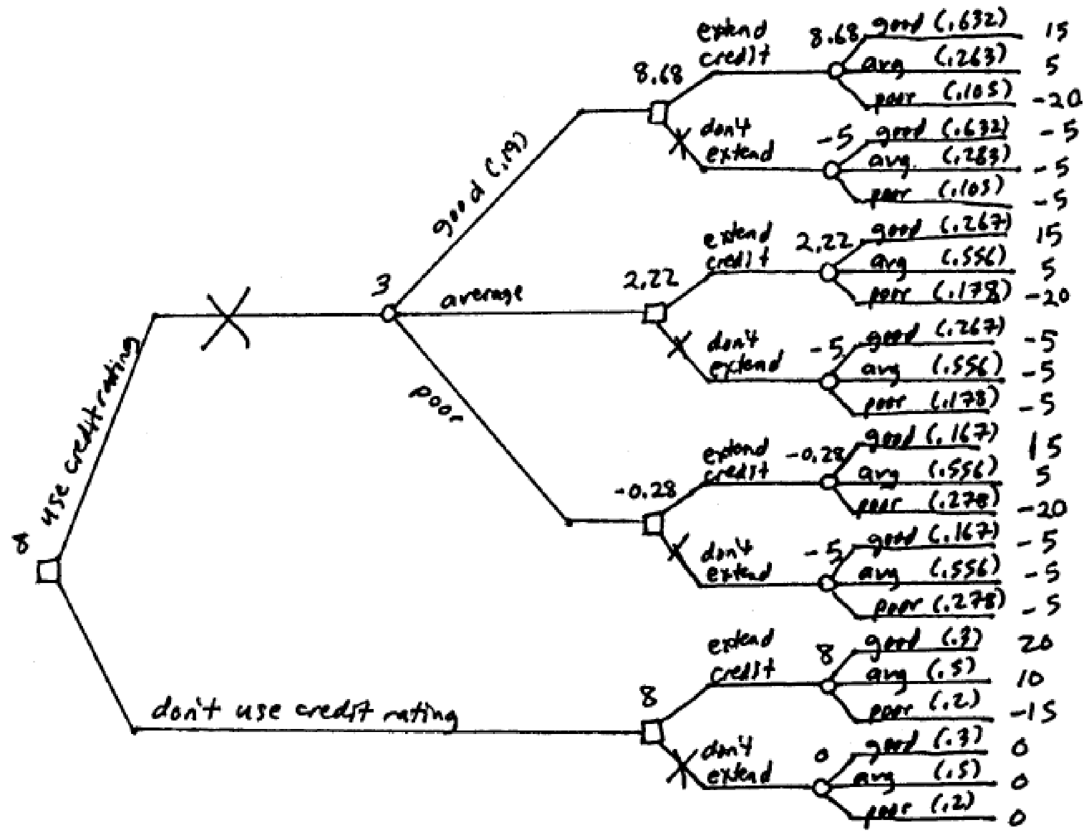
16.4-6.

The optimal policy is to wait until Wednesday to buy if the price is \$9 on Tuesday. If the price is \$10 or \$11 on Tuesday, then buying on Tuesday is optimal.



16.4-7.

(a)



(b) Prior Distribution:

	θ_1	θ_2	θ_3
$P_\theta(k)$	0.2	0.5	0.3

	$Q_{X\|\theta=k}(x)$		
x	θ_1	θ_2	θ_3
X_1	0.5	0.4	0.2
X_2	0.4	0.5	0.4
X_3	0.1	0.1	0.4

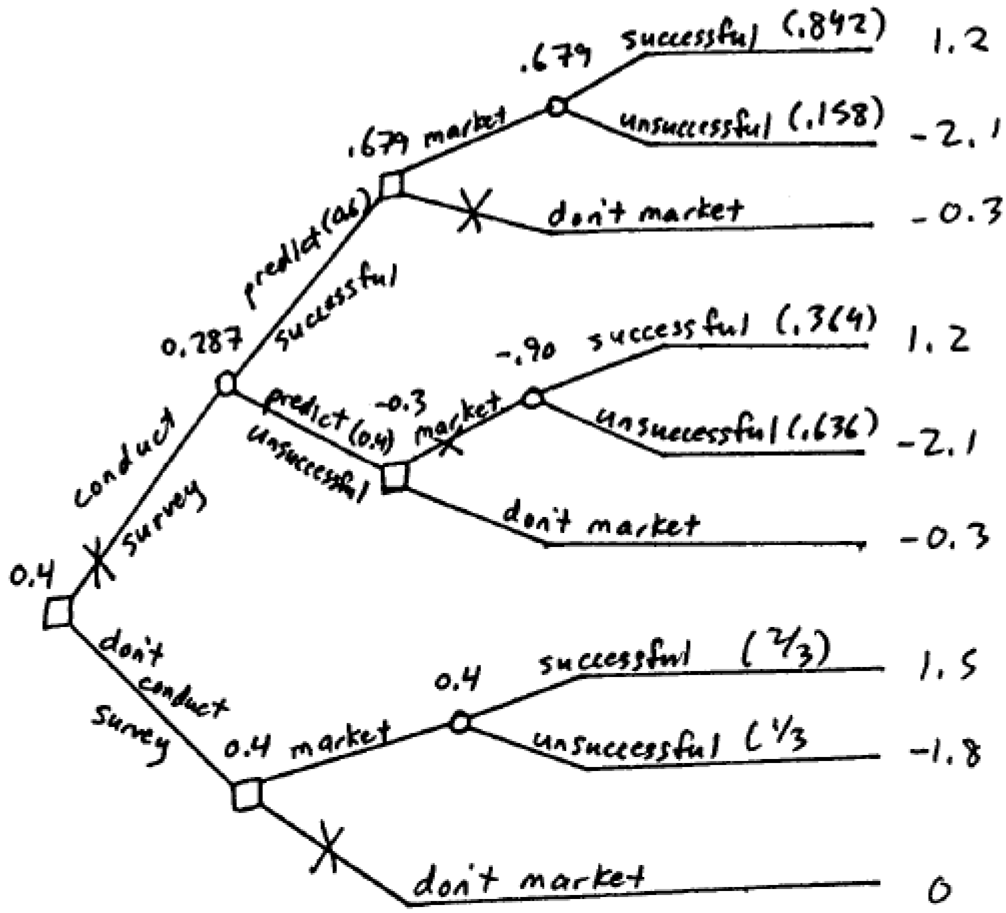
Posterior Distribution:

	$h_{\theta\|X=x}(k)$		
x	θ_1	θ_2	θ_3
X_1	0.278	0.556	0.167
X_2	0.178	0.556	0.267
X_3	0.105	0.263	0.632

(c) It is optimal to not use credit rating, but to extend credit, see part (a).

16.4-8.

(a)



(b) Prior Distribution:

	θ_1	θ_2
$P_\theta(k)$	0.667	0.333

	$Q_{X\|\theta=k}(x)$	
x	θ_1	θ_2
X_1	0.8	0.3
X_2	0.2	0.7

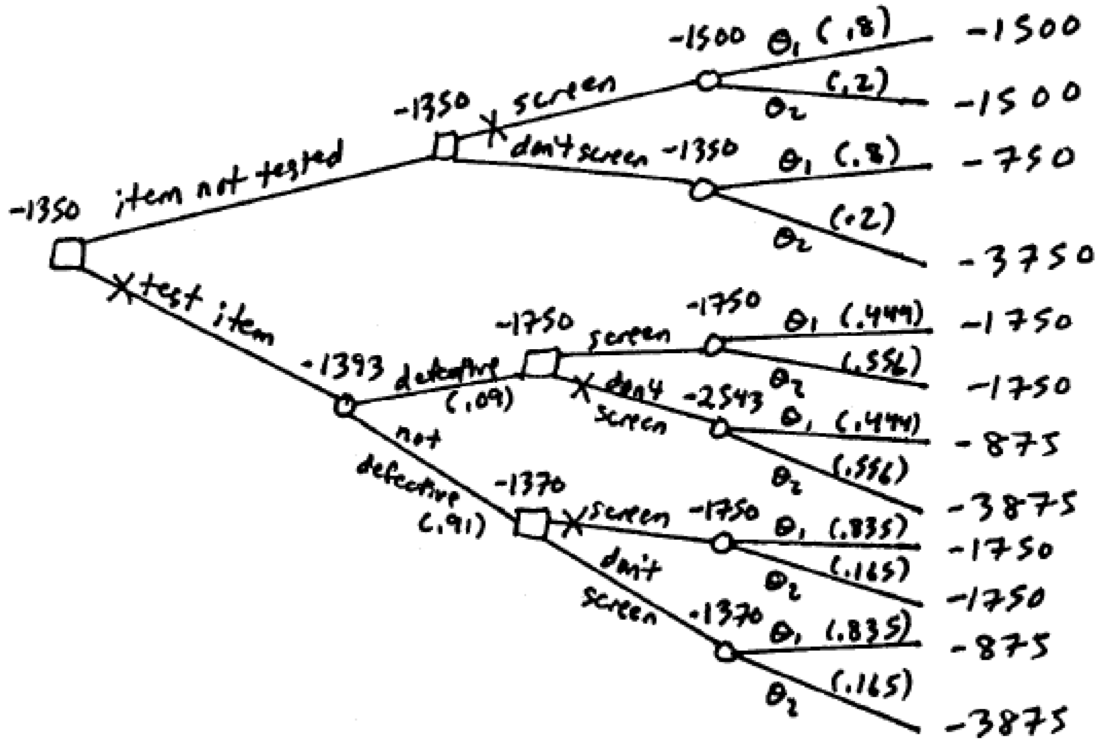
Posterior Distribution:

	$h_{\theta\|X=x}(k)$	
x	θ_1	θ_2
X_1	0.842	0.158
X_2	0.364	0.636

(c) It is optimal to not conduct a survey, but to market the new product, see part (a).

16.4-9.

(a)



(b) Prior Distribution:

	θ_1	θ_2
$P_\theta(k)$	0.8	0.2

	$Q_{X\mid\theta=k}(x)$	
x	θ_1	θ_2
X_1	0.95	0.75
X_2	0.05	0.25

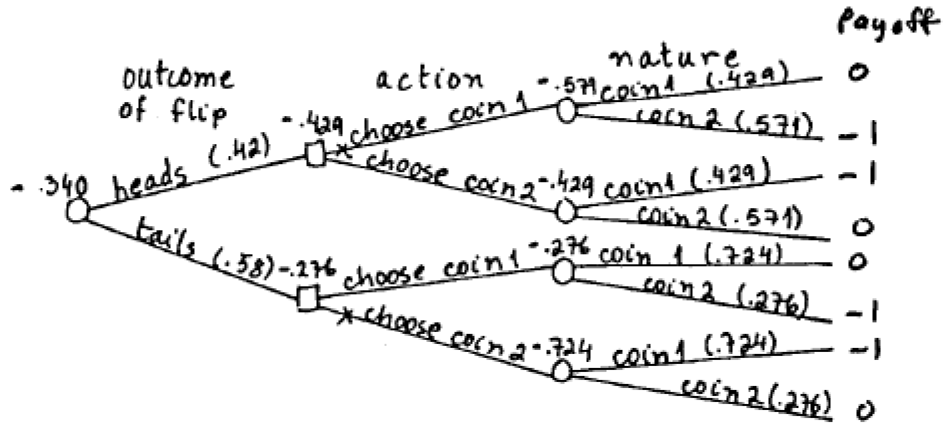
Posterior Distribution:

	$h_{\theta\mid X=x}(k)$	
x	θ_1	θ_2
X_1	0.835	0.165
X_2	0.444	0.556

(c) It is optimal to not test and to not screen, see part (a).

16.4-10.

(a)



(b) Prior Distribution:

	θ_1	θ_2
$\mathrm{P}_\theta(k)$	0.6	0.4

	$Q_{X\mid\theta=k}(x)$	
x	θ_1	θ_2
X_1	0.3	0.6
X_2	0.7	0.4

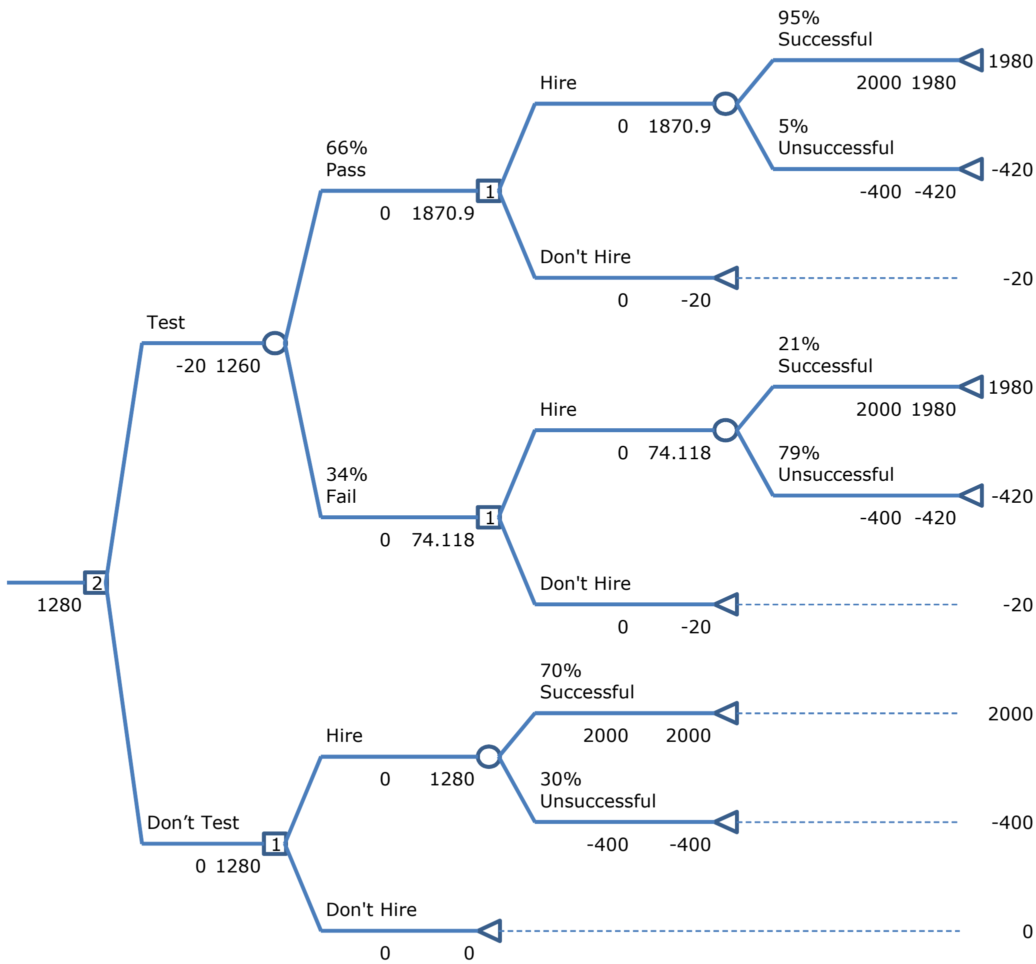
Posterior Distribution:

	$h_{\theta\mid X=x}(k)$	
x	θ_1	θ_2
X_1	0.429	0.571
X_2	0.724	0.276

(c) It is optimal to choose coin 1 if the outcome is tails and coin 2 if the outcome is heads, see part (a).

16.4-11.

(a)



(b)

Data:		P(Finding | State)	
		Finding	
State of Nature	Prior Probability	Pass Test	Fail Test
Successful	0.7	0.9	0.1
Not Successful	0.3	0.1	0.9

Posterior Probabilities:		P(State | Finding)	
		State of Nature	
Finding	P(Finding)	Successful	Not Successful
Pass Test	0.6600	0.9545	0.0455
Fail Test	0.3400	0.2059	0.7941

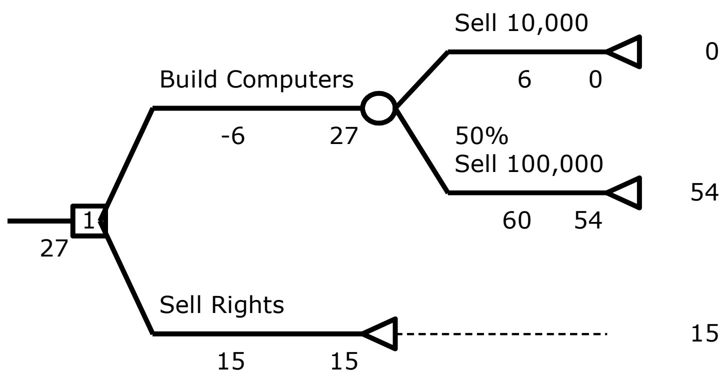
(c) The optimal policy is to not pay for testing and to hire Matthew.

(d) Even if the fee is zero, hiring Matthew without any further investigation is optimal, so Western Bank should not pay anything for the detailed report.

16.5-1.

(a)

	State of Nature	
Alternative	Sell 10,000	Sell 100,000
Build Computers	0	54
Sell Rights	15	15



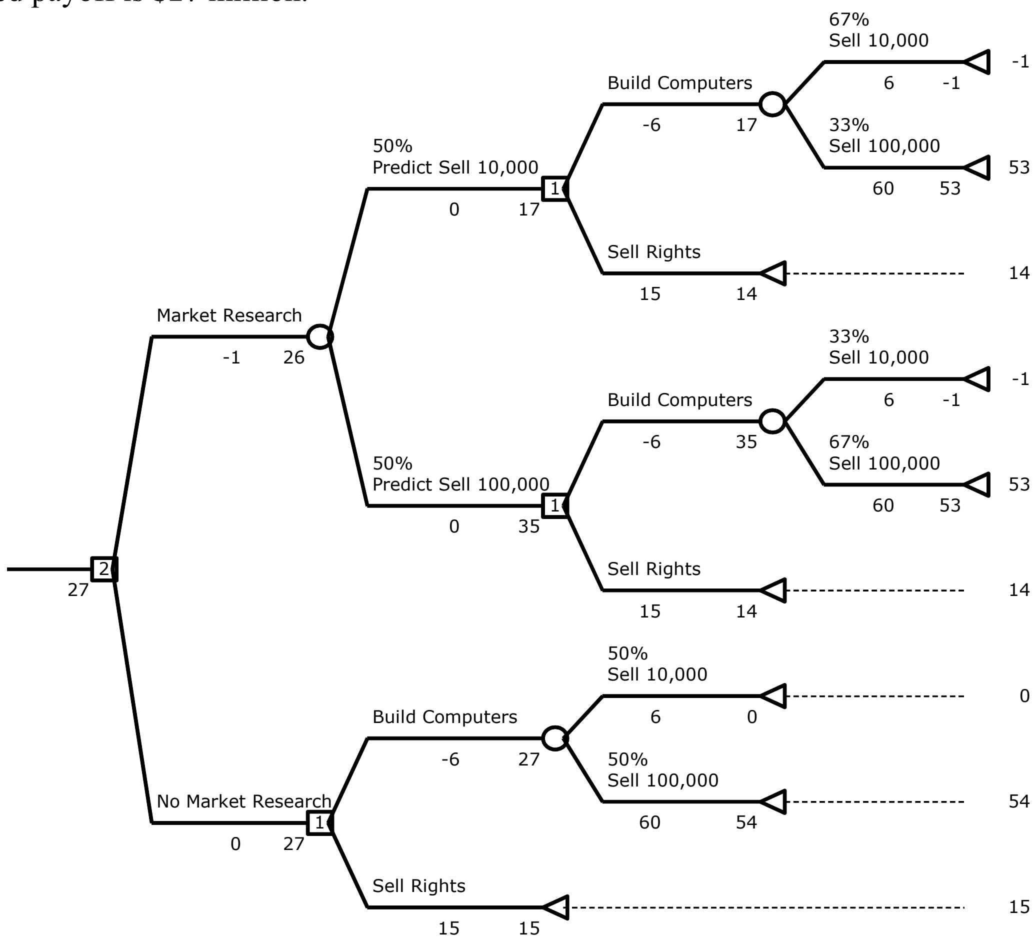
They should build computers with an expected payoff of $27 million.

(b)

Prob(Sell 10,000)	Decision	Expected Payoff ($million)
	Build	27
0	Build	54
0.1	Build	48.6
0.2	Build	43.2
0.3	Build	37.8
0.4	Build	32.4
0.5	Build	27
0.6	Build	21.6
0.7	Build	16.2
0.8	Sell	15
0.9	Sell	15
1	Sell	15

16.5-2.

(a) The optimal policy is to not do market research and build the computers. The expected payoff is $27 million.



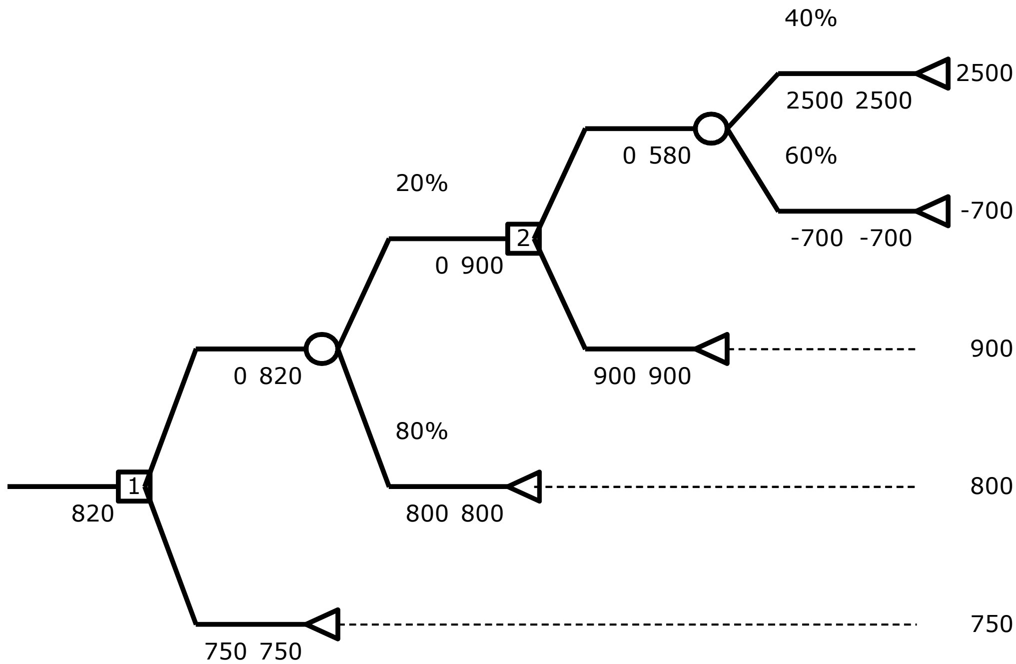
(b)

Prior(Sell 10,000)	Action 1	Action 2	Expected Payoff
	No Market Research	Build	27
0	No Market Research	Build	54
0.1	No Market Research	Build	48.6
0.2	No Market Research	Build	43.2
0.3	No Market Research	Build	37.8
0.4	No Market Research	Build	32.4
0.5	No Market Research	Build	27
0.6	No Market Research	Build	21.6
0.7	Market Research	Build if Predict Sell 100,000	18.3
0.8	Market Research	Build if Predict Sell 100,000	15.2
0.9	No Market Research	Sell	15
1	No Market Research	Sell	15

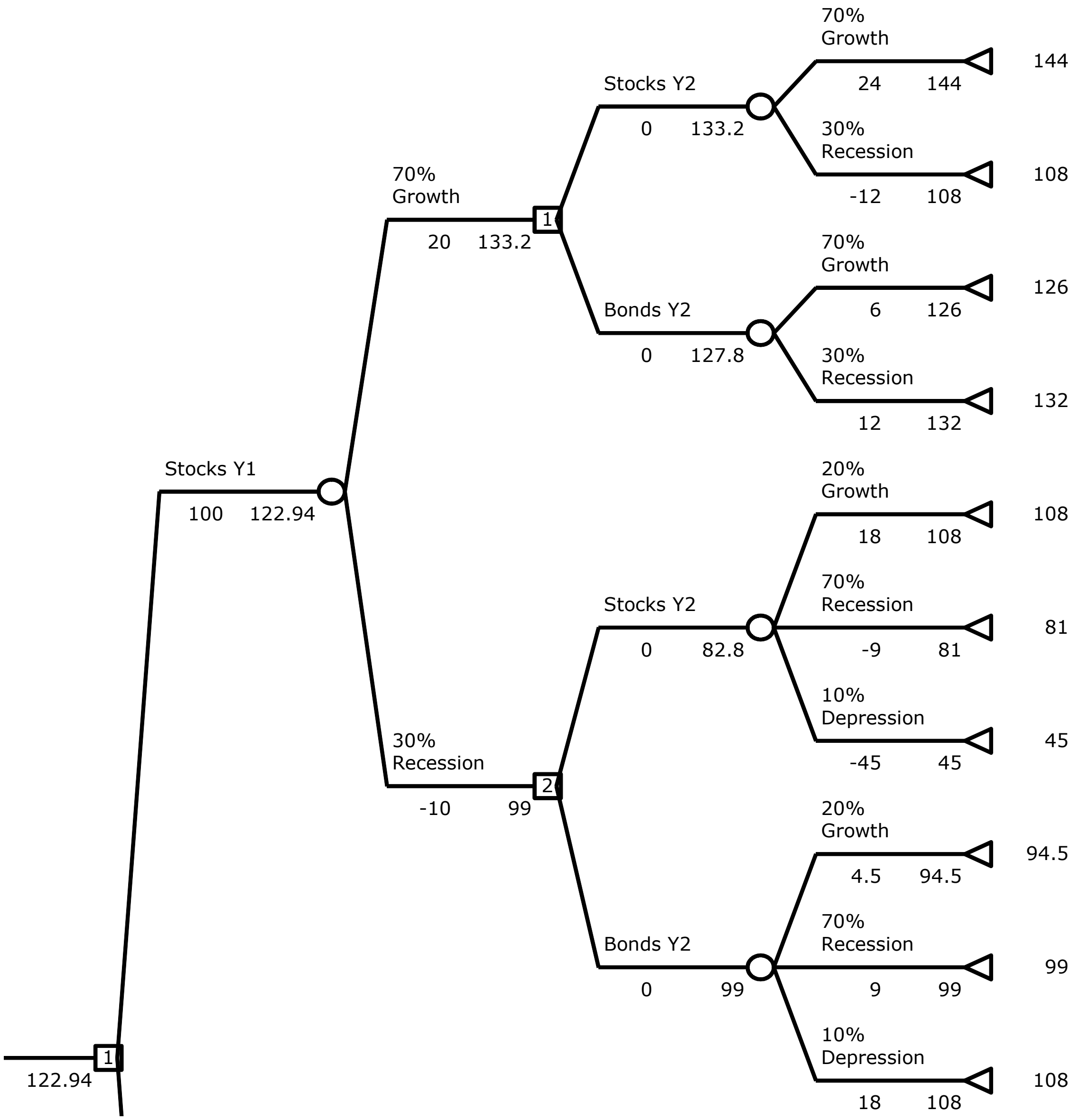
(c) If the rights can be sold for $16.5 or $13.5 million, the optimal policy is still to build the computers with an expected payoff of $27 million. If the cost of setting up the assembly line is $5.4 million or $6.6 million, the optimal policy is still to build the computers with an expected payoff of $27.6 or $26.4 million respectively. If the difference between the selling price and the variable cost of each computer is $540 or $660, the optimal policy is still to build the computers with an expected payoff of $23.7 or $33.3 million respectively. For each combination of financial data, the expected payoff is as shown in the following table. In all cases, the optimal policy is to build the computers without doing market research.

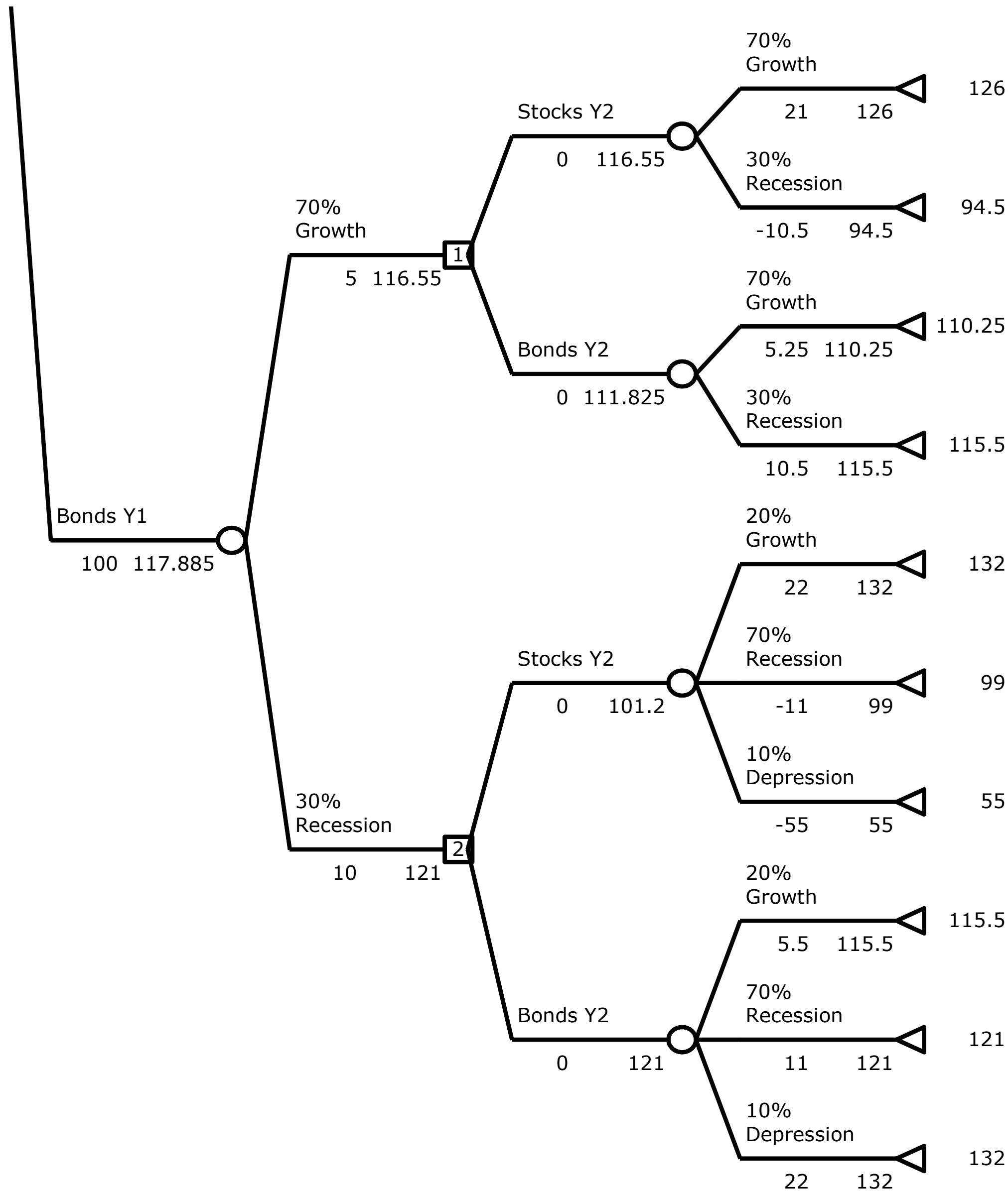
Sell Rights	Cost of Assembly Line	Selling Price – Variable Cost	Expected Payoff
$13.5 million	$5.4 million	$540	$23.4 million
$13.5 million	$5.4 million	$660	$30.9 million
$13.5 million	$6.6 million	$540	$23.1 million
$13.5 million	$6.6 million	$660	$29.7 million
$16.5 million	$5.4 million	$540	$24.3 million
$16.5 million	$5.4 million	$660	$30.9 million
$16.5 million	$6.6 million	$540	$23.1 million
$16.5 million	$6.6 million	$660	$29.7 million

16.5-3.

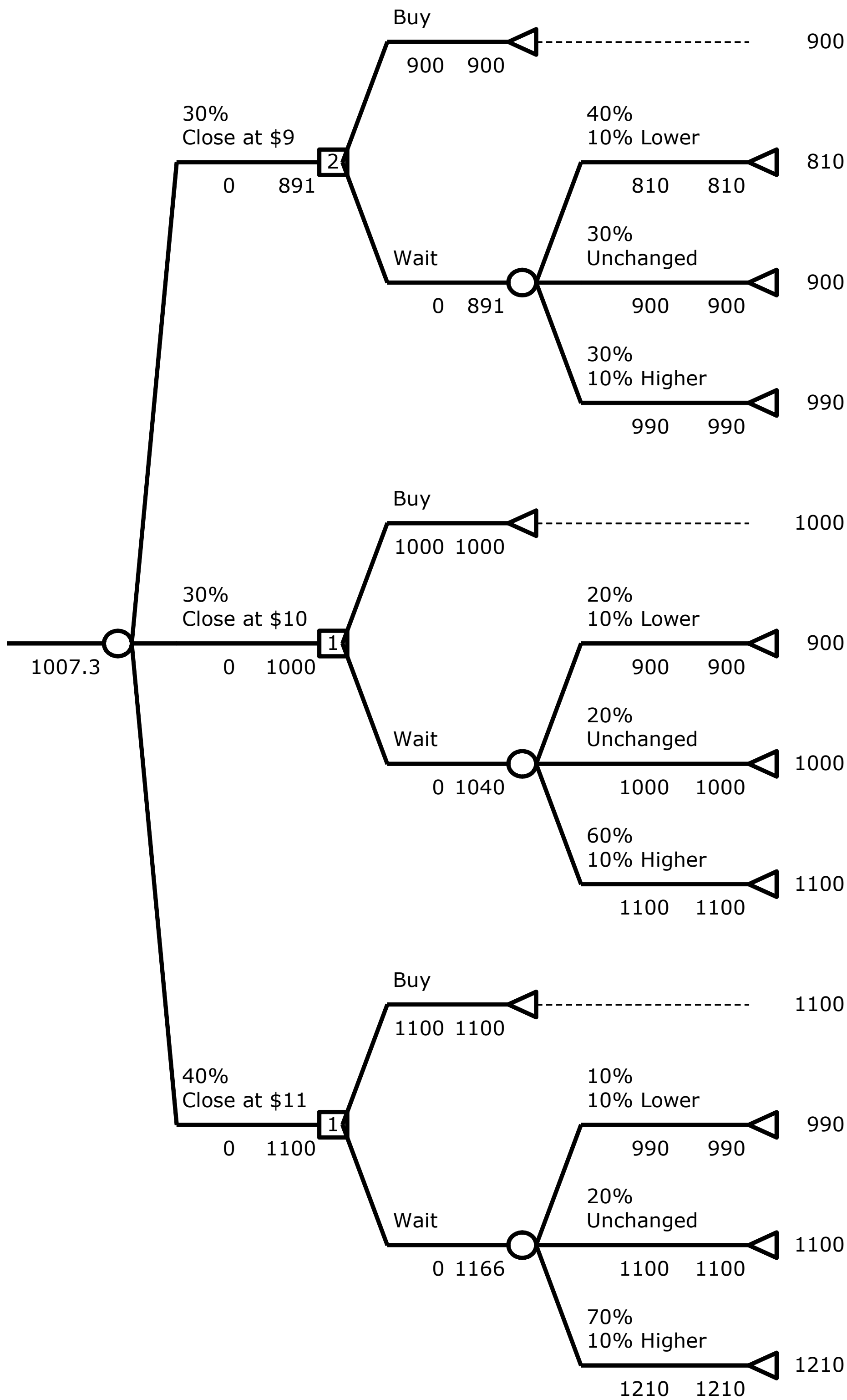


16.5-4.


70%
Growth
24 144
144
Stocks Y2
0 133.2
30%
Recession
-12 108
108
70%
Growth
20 133.2
1
70%
Growth
6 126
126
Bonds Y2
0 127.8
30%
Recession
12 132
132
Stocks Y1
100 122.94
20%
Growth
18 108
108
Stocks Y2
0 82.8
70%
Recession
-9 81
81
10%
Depression
-45 45
45
30%
Recession
-10 99
2
20%
Growth
4.5 94.5
94.5
Bonds Y2
0 99
70%
Recession
9 99
99
10%
Depression
18 108
108
1
122.94


Bonds Y1
100 117.885
70%
Growth
5 116.55
Stocks Y2
0 116.55
70%
Growth
21 126
126
30%
Recession
-10.5 94.5
94.5
Bonds Y2
0 111.825
70%
Growth
5.25 110.25
110.25
30%
Recession
10.5 115.5
115.5
30%
Recession
10 121
Stocks Y2
0 101.2
20%
Growth
22 132
132
70%
Recession
-11 99
99
10%
Depression
-55 55
55
Bonds Y2
0 121
20%
Growth
5.5 115.5
115.5
70%
Recession
11 121
121
10%
Depression
22 132
132

16.5-5.

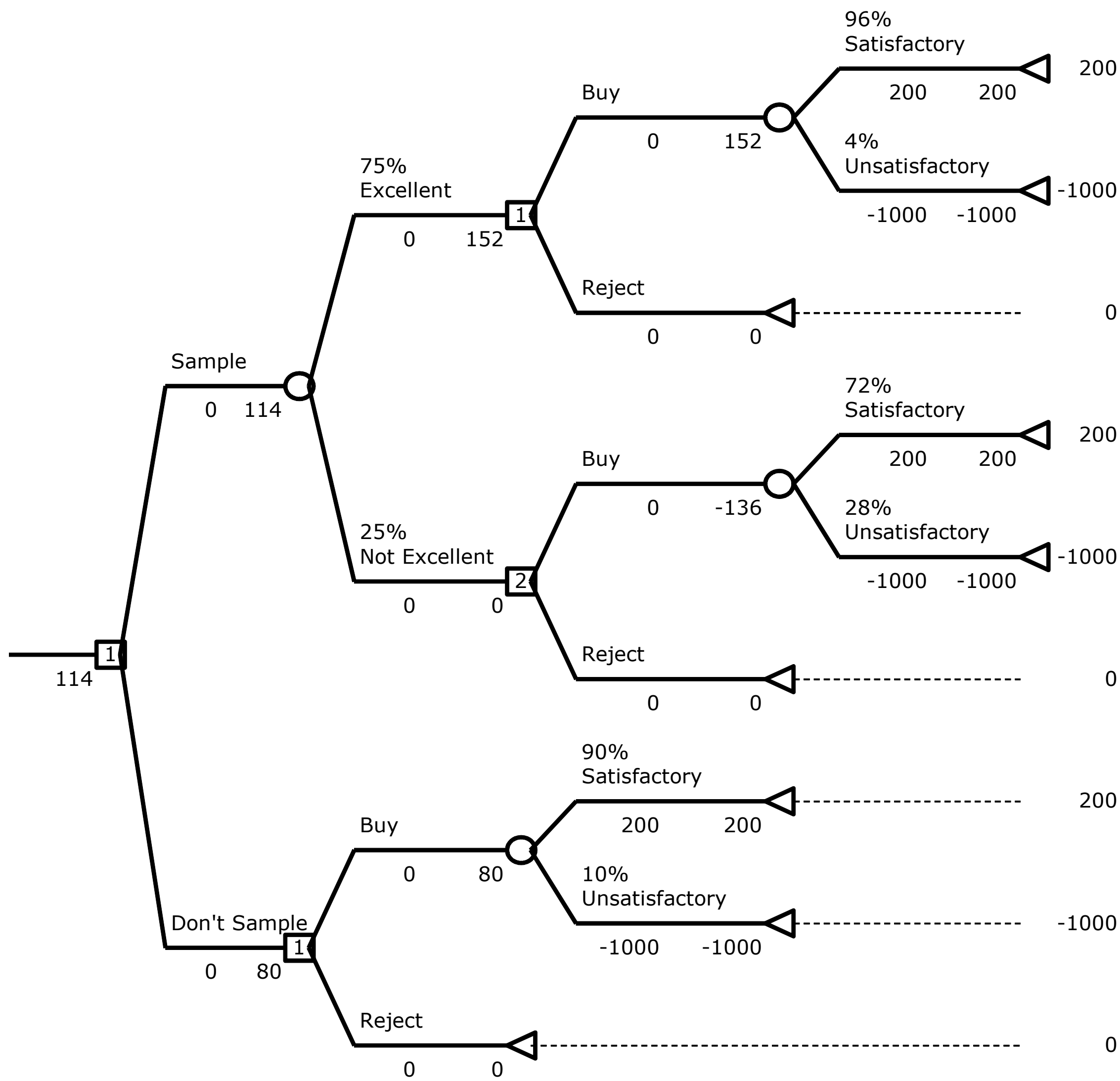


The optimal policy is to wait until Wednesday to buy if the price is $9 on Tuesday. If the price is $10 or $11 on Tuesday, then buy on Tuesday.

16.5-6.

<table>
<tr><td>Data:</td><td></td><td colspan="2">P(Finding | State)</td></tr>
<tr><td>State of</td><td>Prior</td><td colspan="2">Finding</td></tr>
<tr><td>Nature</td><td>Probability</td><td>Excellent</td><td>Not Excellent</td></tr>
<tr><td>Satisfactory Box</td><td>0.9</td><td>0.8</td><td>0.2</td></tr>
<tr><td>Unsatisfactory Box</td><td>0.1</td><td>0.3</td><td>0.7</td></tr>
</table>

<table>
<tr><td>Posterior</td><td></td><td colspan="2">P(State | Finding)</td></tr>
<tr><td>Probabilities:</td><td></td><td colspan="2">State of Nature</td></tr>
<tr><td>Finding</td><td>P(Finding)</td><td>Satisfactory Box</td><td>Unsatisfactory Box</td></tr>
<tr><td>Excellent</td><td>0.75</td><td>0.960</td><td>0.040</td></tr>
<tr><td>Not Excellent</td><td>0.25</td><td>0.720</td><td>0.280</td></tr>
</table>



The optimal policy is to sample the fruit and buy if it is excellent and reject if it is unsatisfactory.

16.5-7.

(a) Choose to introduce the new product with expected payoff of \$12.5 million.

	State of Nature		Exp.
Alternative	Successful	Unsuccessful	Payoff
Introduce New Product	\$40 million	$-$\$15 million	\$12.5 million
Don't Introduce New Product	0	0	0
Prior Probabilities	0.5	0.5	

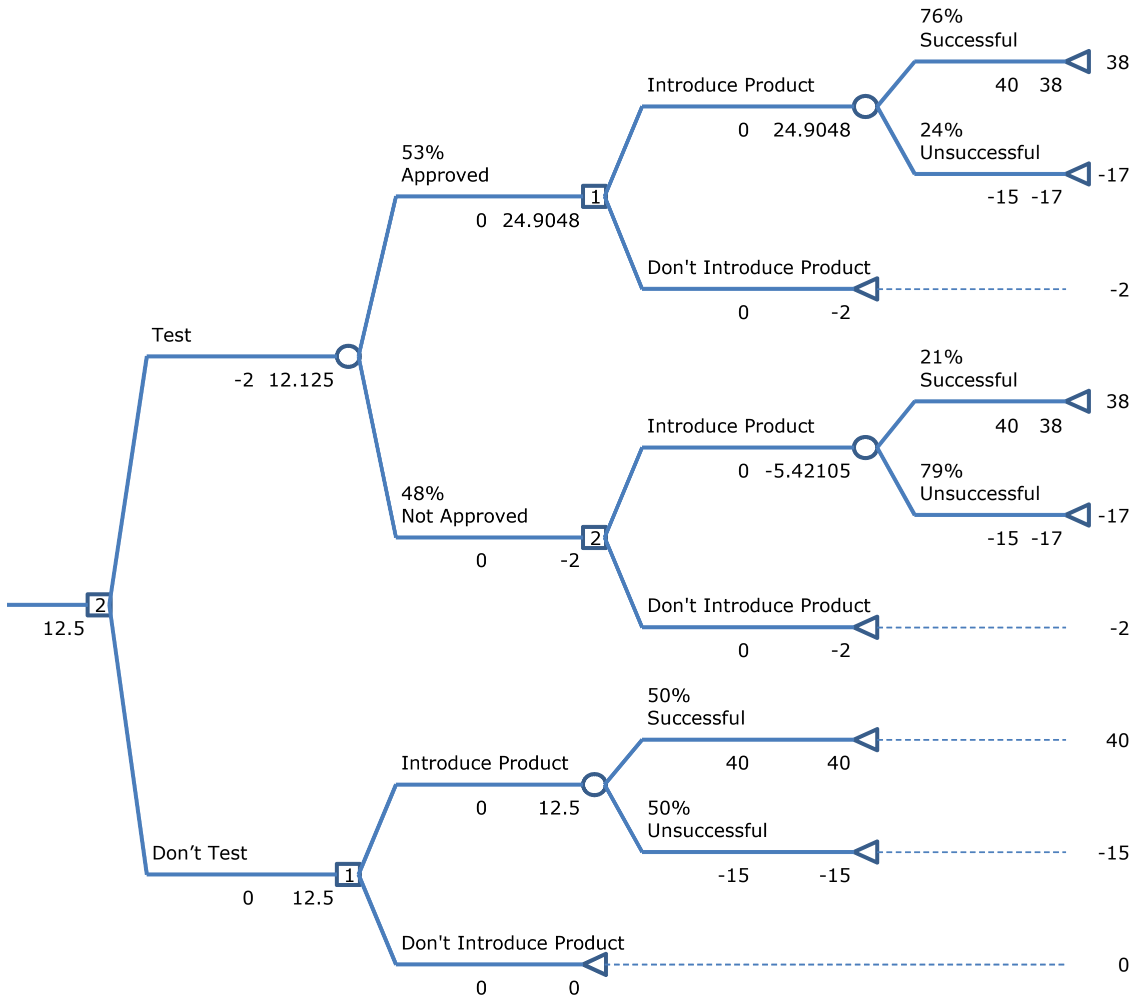
(b) With perfect information, Morton Ward should introduce the product if it will be successful and not introduce it if it will not be successful.

Expected Payoff with Perfect Information: $0.5(40) + 0.5(0) = 20$
Expected Payoff without Information: 12.5
EVPI $= 20 - 12.5 =$ \$7.5 million

(c) The optimal policy is to not test but to introduce the new product, with expected payoff \$12.5 million.

Data:		P(Finding | State)	
State of	Prior	Finding	
Nature	Probability	Approved	Not Approved
Successful	0.5	0.8	0.2
Unsuccessful	0.5	0.25	0.75

Posterior		P(State | Finding)	
Probabilities:		State of Nature	
Finding	P(Finding)	Successful	Unsuccessful
Approved	0.525	0.762	0.238
Not Approved	0.475	0.211	0.789



(d)

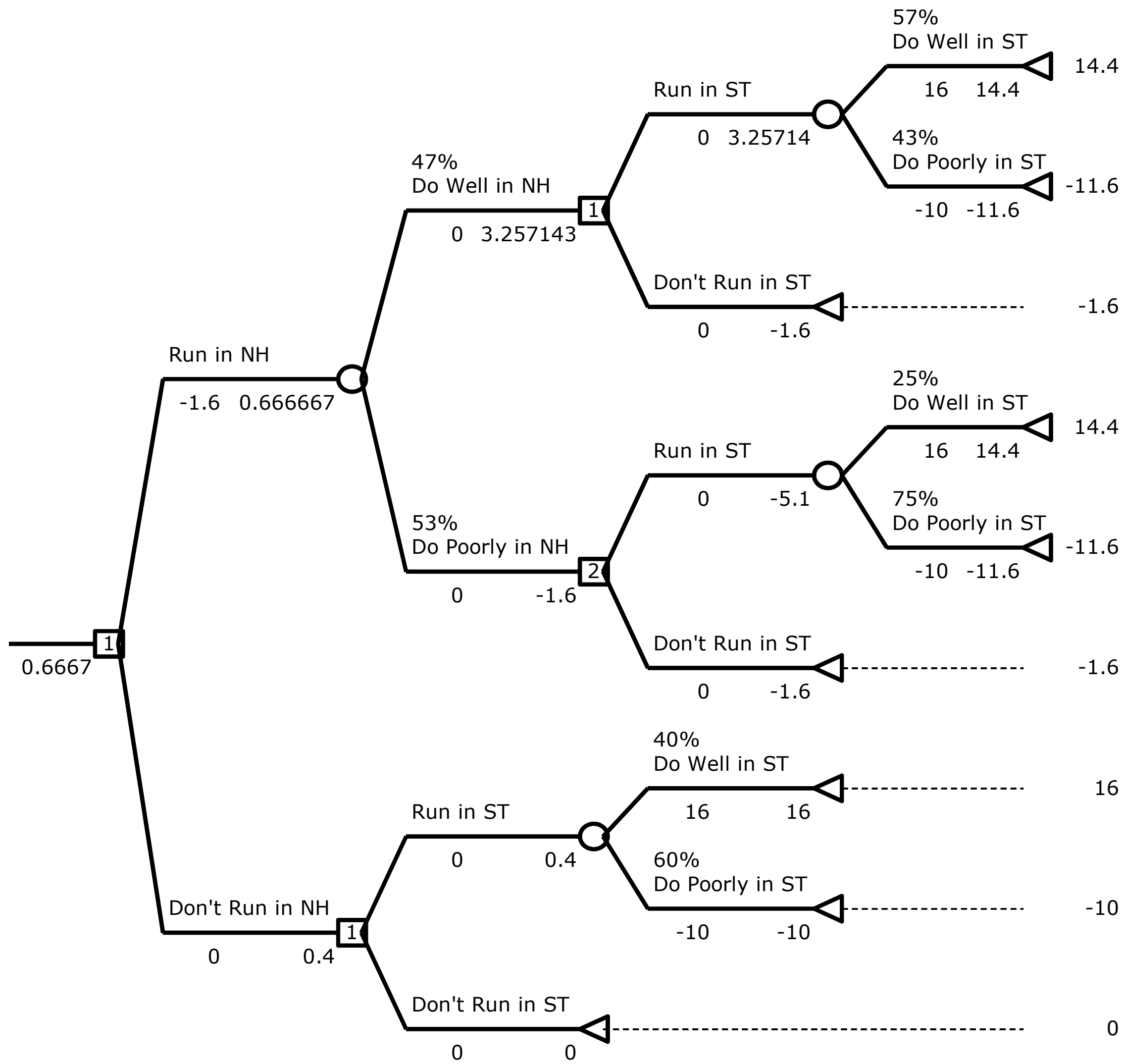
Prior(Successful)	Action 1	Action 2	Expected Payoff
	Don't Test	Introduce	12.5
0	Don't Test	Don't Introduce	0
0.1	Don't Test	Don't Introduce	0
0.2	Test	Introduce if Approved	1.4
0.3	Test	Introduce if Approved	4.975
0.4	Test	Introduce if Approved	8.55
0.5	Don't Test	Introduce	12.5
0.6	Don't Test	Introduce	18
0.7	Don't Test	Introduce	23.5
0.8	Don't Test	Introduce	29
0.9	Don't Test	Introduce	34.5
1	Don't Test	Introduce	40

(e) If the net profit if successful is only $30 million, then the optimal policy is to test and to introduce the product only if the test market approves. The expected payoff is $8.125 million. If the net profit if successful is $50 million, then the optimal policy is to skip the test and to introduce the product, with an expected payoff of $17.5 million. If the net loss if unsuccessful is only $11.25 million, then the optimal policy is to skip the test and to introduce the product, with an expected payoff of $14.375 million. If the net loss if unsuccessful is $18.75 million, then the optimal policy is to conduct the test and to introduce the product only if the test market approves. The expected payoff is \$11.656 million. For each combination of financial data, the expected payoff and the optimal policy are as shown below.

Successful	Unsuccessful	Optimal Policy	Expected Profit
\$30 million	-\$11.25 million	Skip Test, Introduce Product	\$9.375 million
\$30 million	-\$18.75 million	Test, Introduce Product if Approved	\$7.656 million
\$50 million	-\$11.25 million	Skip Test, Introduce Product	\$19.375 million
\$50 million	-\$18.75 million	Test, Introduce if Approved	\$15.656 million

16.5-8.

(a) Chelsea should run in the NH primary. If she does well, then she should run in the ST primaries. If she does poorly in the NH primary, then should not run the ST primaries. The expected payoff is \$666, 667.



(b)

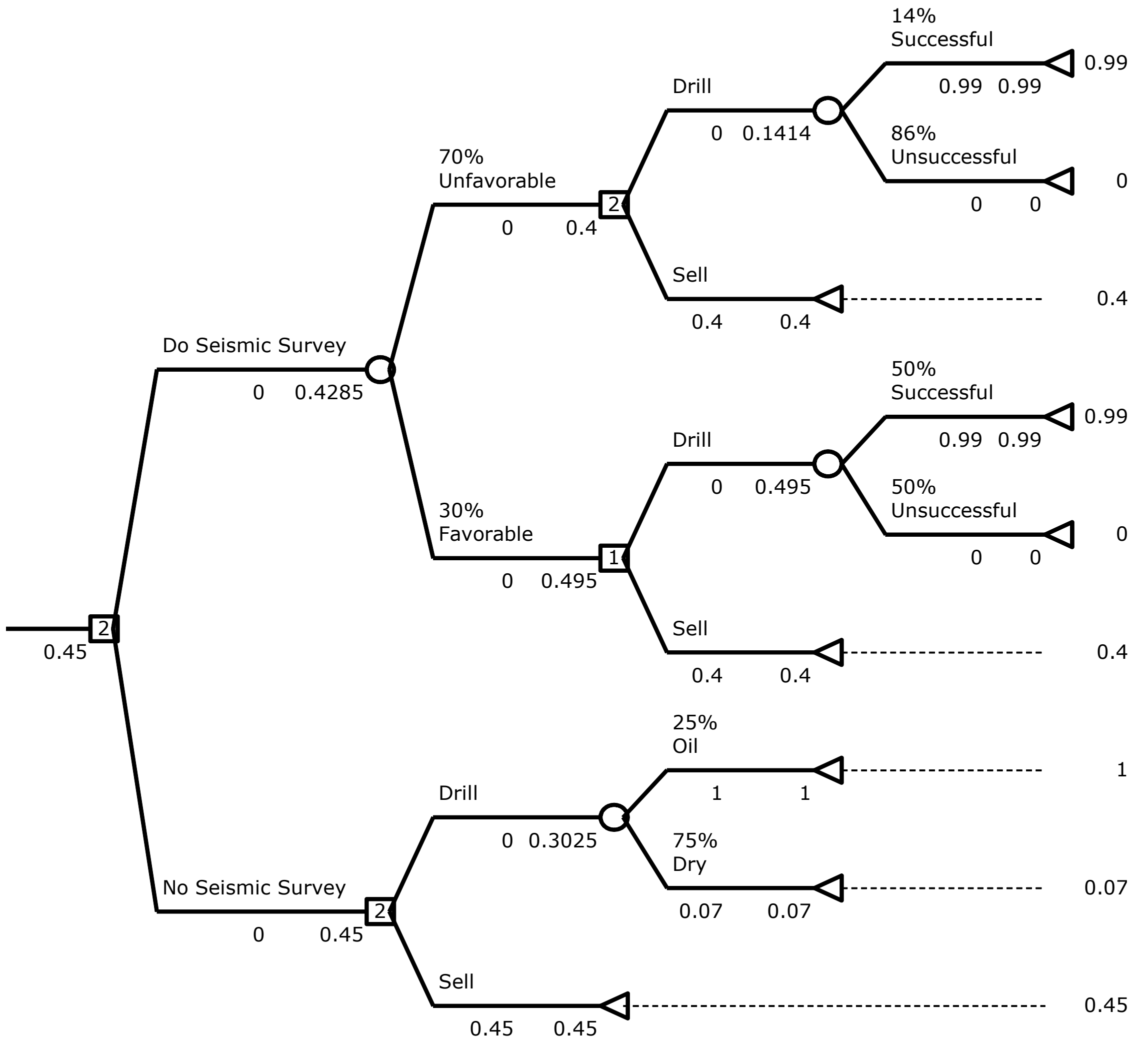
Prior(Well in NH)	Action 1	Action 2	Expected Payoff
	Run in NH	Run in ST if do well in NH	0.6667
0.0000	Don't Run in NH	Run in ST	0.4000
0.0667	Don't Run in NH	Run in ST	0.4000
0.1333	Don't Run in NH	Run in ST	0.4000
0.2000	Don't Run in NH	Run in ST	0.4000
0.2667	Don't Run in NH	Run in ST	0.4000
0.3333	Don't Run in NH	Run in ST	0.4000
0.4000	Don't Run in NH	Run in ST	0.4000
0.4667	Run in NH	Run in ST if do well in NH	0.6667
0.5333	Run in NH	Run in ST if do well in NH	0.9905
0.6000	Run in NH	Run in ST if do well in NH	1.3143
0.6667	Run in NH	Run in ST if do well in NH	1.6381
0.7333	Run in NH	Run in ST if do well in NH	1.9619
0.8000	Run in NH	Run in ST if do well in NH	2.2857
0.8667	Run in NH	Run in ST if do well in NH	2.6095
0.9333	Run in NH	Run in ST if do well in NH	2.9333
1.0000	Run in NH	Run in ST if do well in NH	3.2571

(c) If the payoff for doing well in ST is only \$12 million, Chelsea should not run in either NH or ST, with expected payoff of \$0. If the payoff for doing well in ST is \$20 million, Chelsea should not run in NH, but run in ST, with expected payoff of \$2 million. If the loss for doing poorly in ST is \$7.5 million, Chelsea should not run in NH, but run in ST, with expected payoff of \$1.9 million. If the loss for doing poorly in ST is only \$12.5 million, Chelsea should run in NH and run in ST if she does well in NH, with expected payoff of \$166, 667. For each combination of financial data, the expected payoff and the optimal policy is as shown below.

Well in ST	Poorly in ST	Optimal Policy	Expected Funds
\$12 million	-\$7.5 million	Run in ST Only	\$300,000
\$12 million	-\$12.5 million	Don't Run in Either	\$0
\$20 million	-\$7.5 million	Run in ST Only	\$3.5 million
\$20 million	-\$12.5 million	Run in NH, Run in ST if Well	\$1.233 million

16.6-1.

(a) - (b) The optimal policy is to not conduct a survey and to sell the land.



16.6-2.

(a) Choose to not buy insurance with expected payoff $\$249,840$.

	State of Nature		Exp.
Alternative	Earthquake	No Earthquake	Payoff
Buy Insurance	$249,820$	$249,820$	$249,820$
Not Buy Insurance	$90,000$	$250,000$	$249,840$
Prior Probability	0.001	0.999	

(b) $U(\text{insurance}) = U(250,000 - 180) = \sqrt{249,820} = 499.82$

$U(\text{no insurance}) = 0.999U(250,000) + 0.001U(90,000) = 499.8$

The optimal policy is to buy insurance.

16.6-3.

Expected utility of $\$19,000$: $U(19) = \sqrt{25} = 5$

Expected utility of investment: $0.3U(10) + 0.7U(30) = 0.3\sqrt{16} + 0.7\sqrt{36} = 5.4$

Choose the investment to maximize expected utility.

16.6-4.

Expected utility of A_1 = Expected utility of A_2

$$pU(10) + (1-p)U(30) = U(19)$$

$$0.3U(10) + 0.7(20) = 16.7 \Rightarrow U(10) = 9$$

16.6-5.

(a) Expected utility of A_1 = Expected utility of A_2

$$pU(10) + (1-p)U(0) = U(1)$$

$$0.125U(10) + 0.875(0) = 1 \Rightarrow U(10) = 8$$

(b) Expected utility of A_1 = Expected utility of A_2

$$pU(10) + (1-p)U(0) = U(5)$$

$$0.5625(8) + 0.4375(0) = U(5) \Rightarrow U(5) = 4.5$$

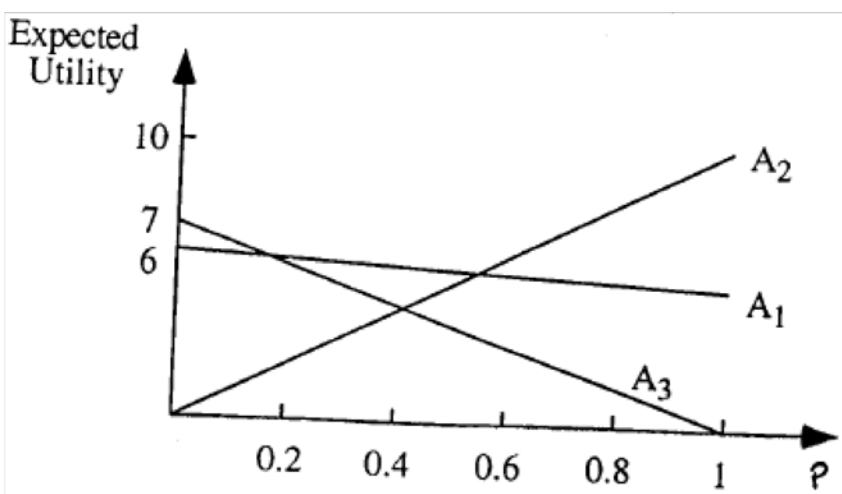
(c) Answers will vary.

16.6-6.

(a) Expected utility of $A_1 = pU(25) + (1-p)U(36) = 5p + 6(1-p) = 6 - p$

Expected utility of $A_2 = pU(100) + (1-p)U(0) = 10p + 0 = 10p$

Expected utility of $A_3 = pU(0) + (1-p)U(49) = 0 + 7(1-p) = 7 - 7p$



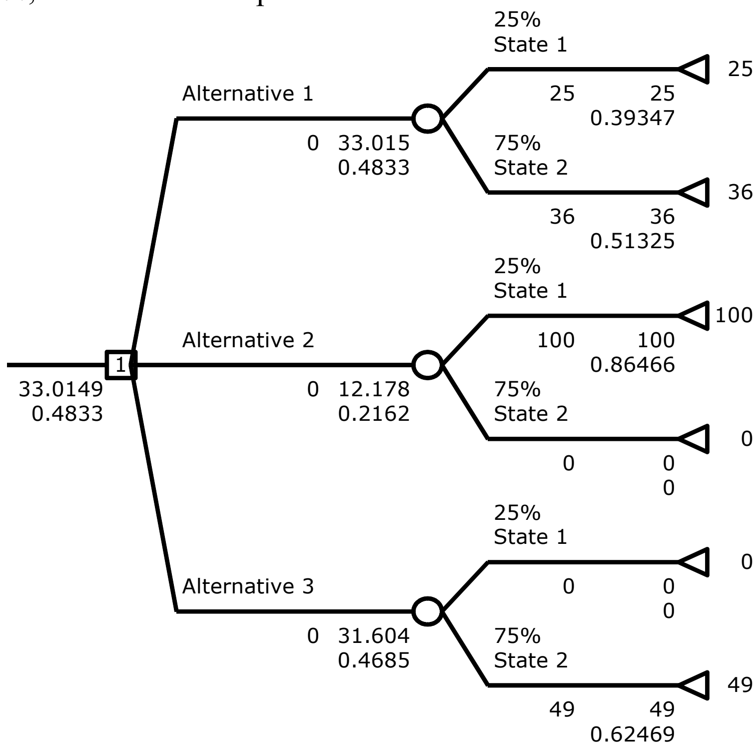
A_1 and A_3 cross when $6 - p = 7 - 7p \Rightarrow p = \frac{1}{6}$.

A_1 and A_2 cross when $6 - p = 10p \Rightarrow p = \frac{2}{3}$.

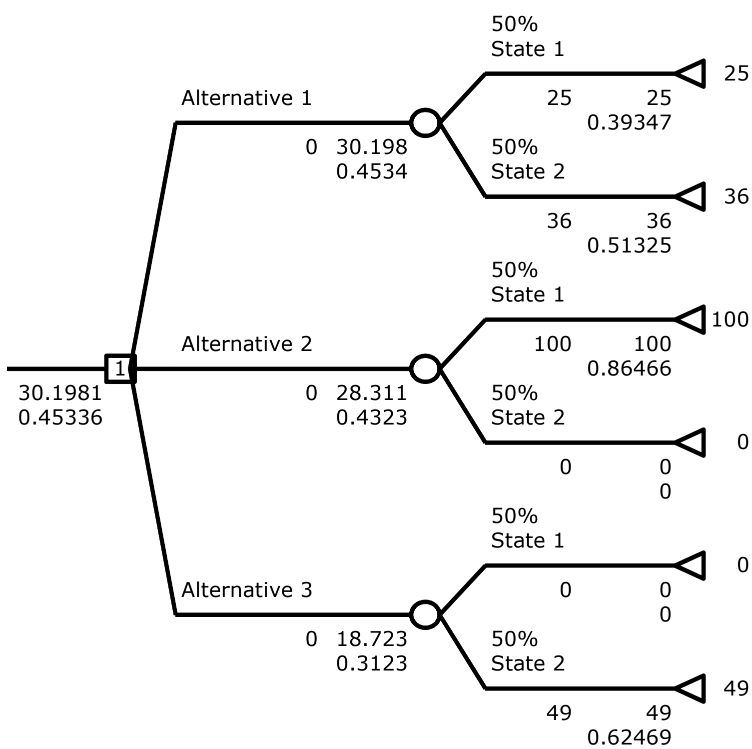
Thus, A_3 is best when $p \leq \frac{1}{6}$, A_1 is best when $\frac{1}{6} \leq p \leq \frac{2}{3}$, and A_2 is best when $p \geq \frac{2}{3}$.

(b) $U(M) = \cancel{50}(1 - e^{-M/50})$

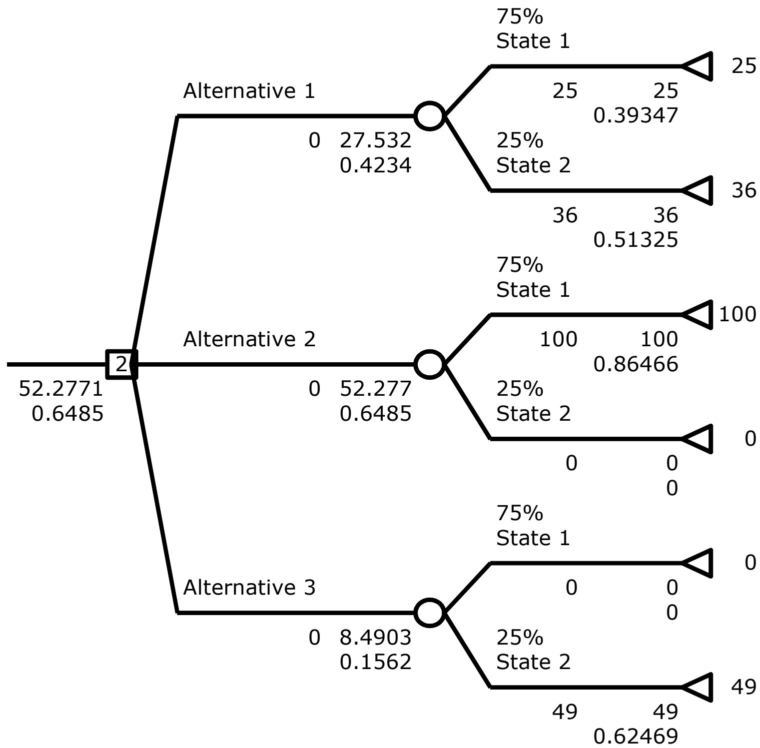
$p = 25\%$, alternative 1 is optimal



$p = 50\%$, alternative 1 is optimal

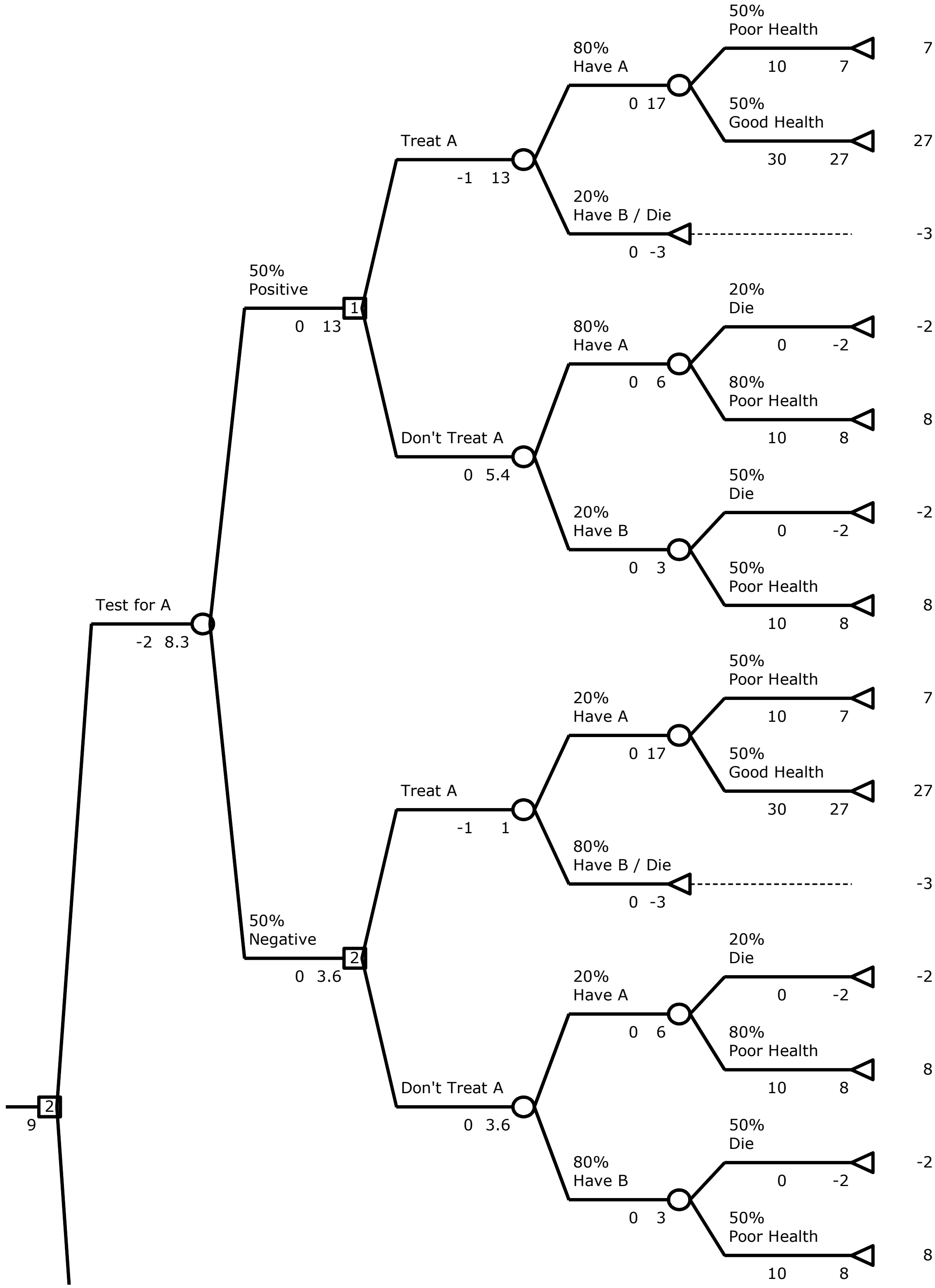


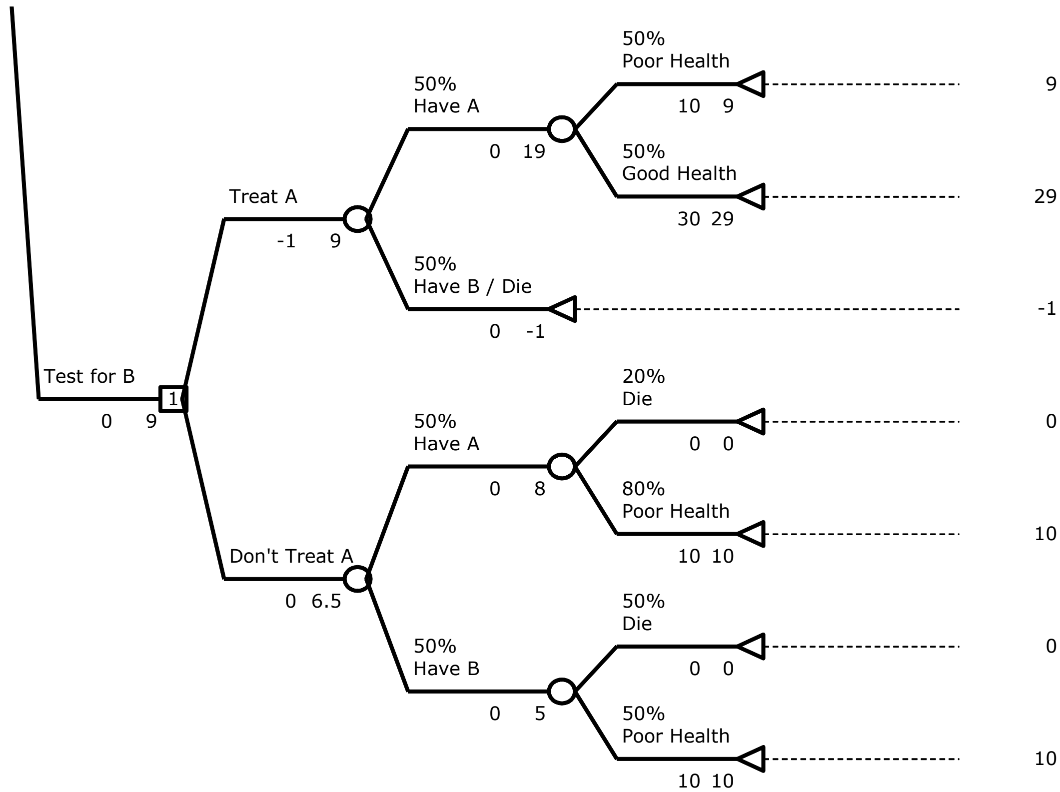
$p = 75\%$, alternative 2 is optimal



16.6-7.

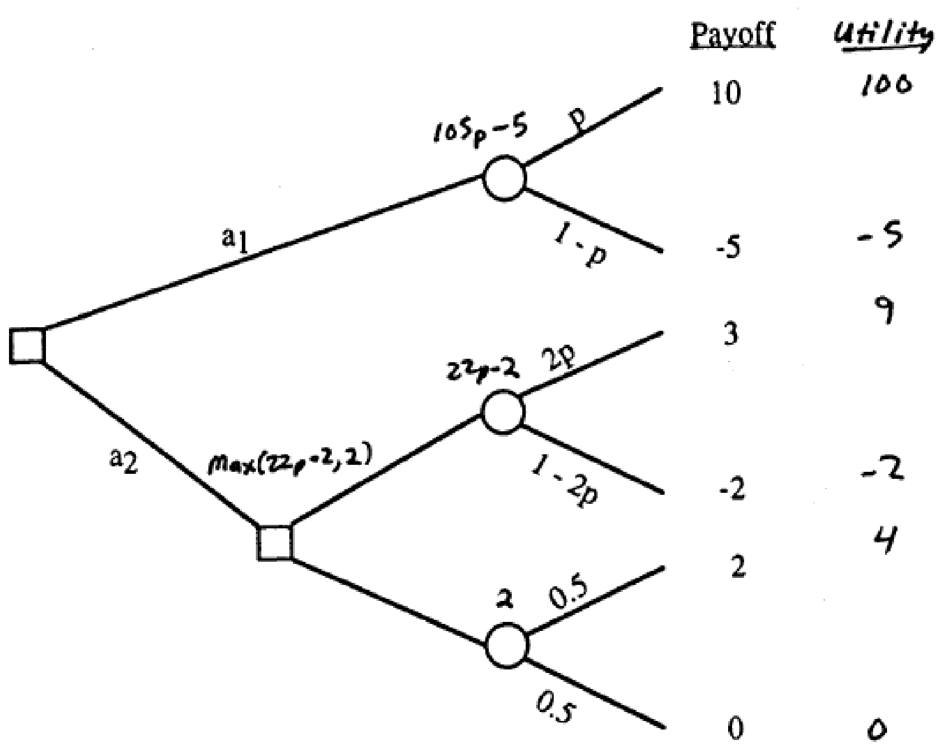
The optimal policy is to not test for disease A, but to treat disease A.





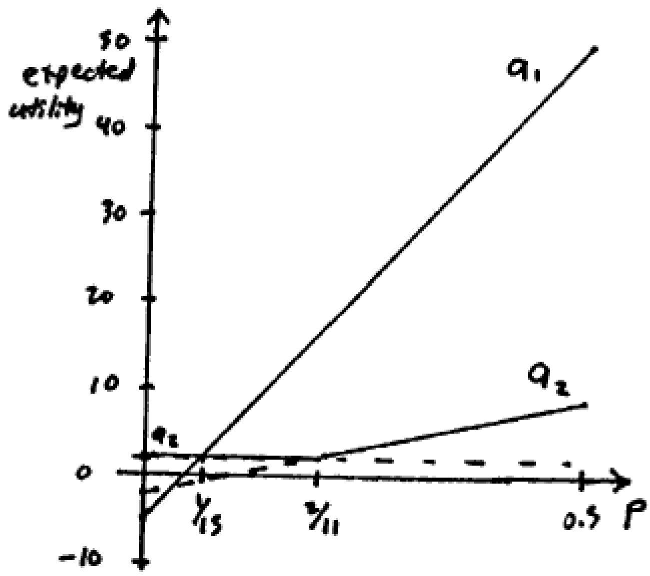
16.6-8.

(a)



At $p = 0.25$, $105p - 5 = 21.25$ and max $(22p - 2, 2) =$ max $(3.5, 2) = 3.5$, so A_1 is optimal.

(b)



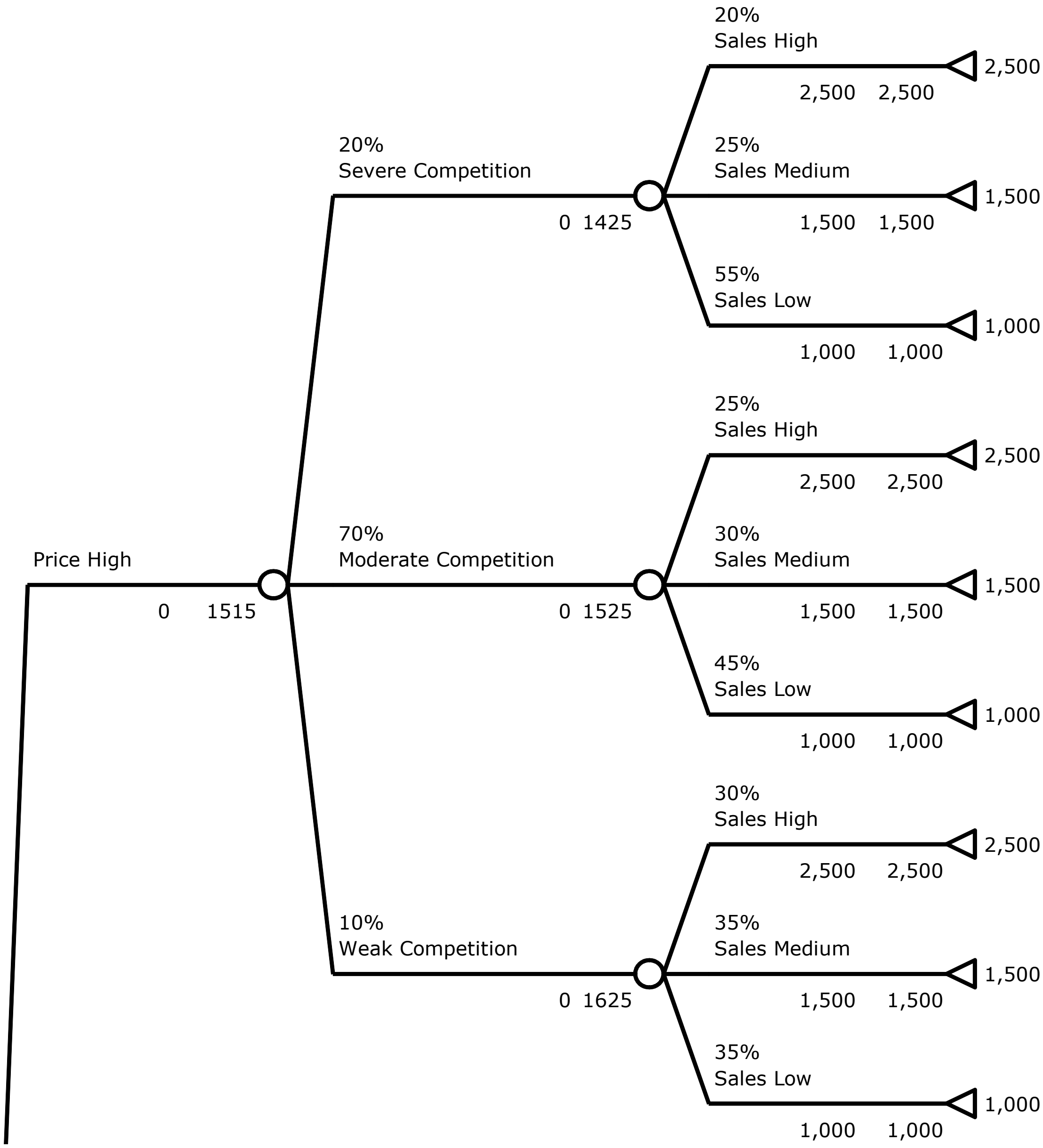
As can be seen on the graph, A_1 stays optimal for $1/15 \leq p \leq 0.5$.

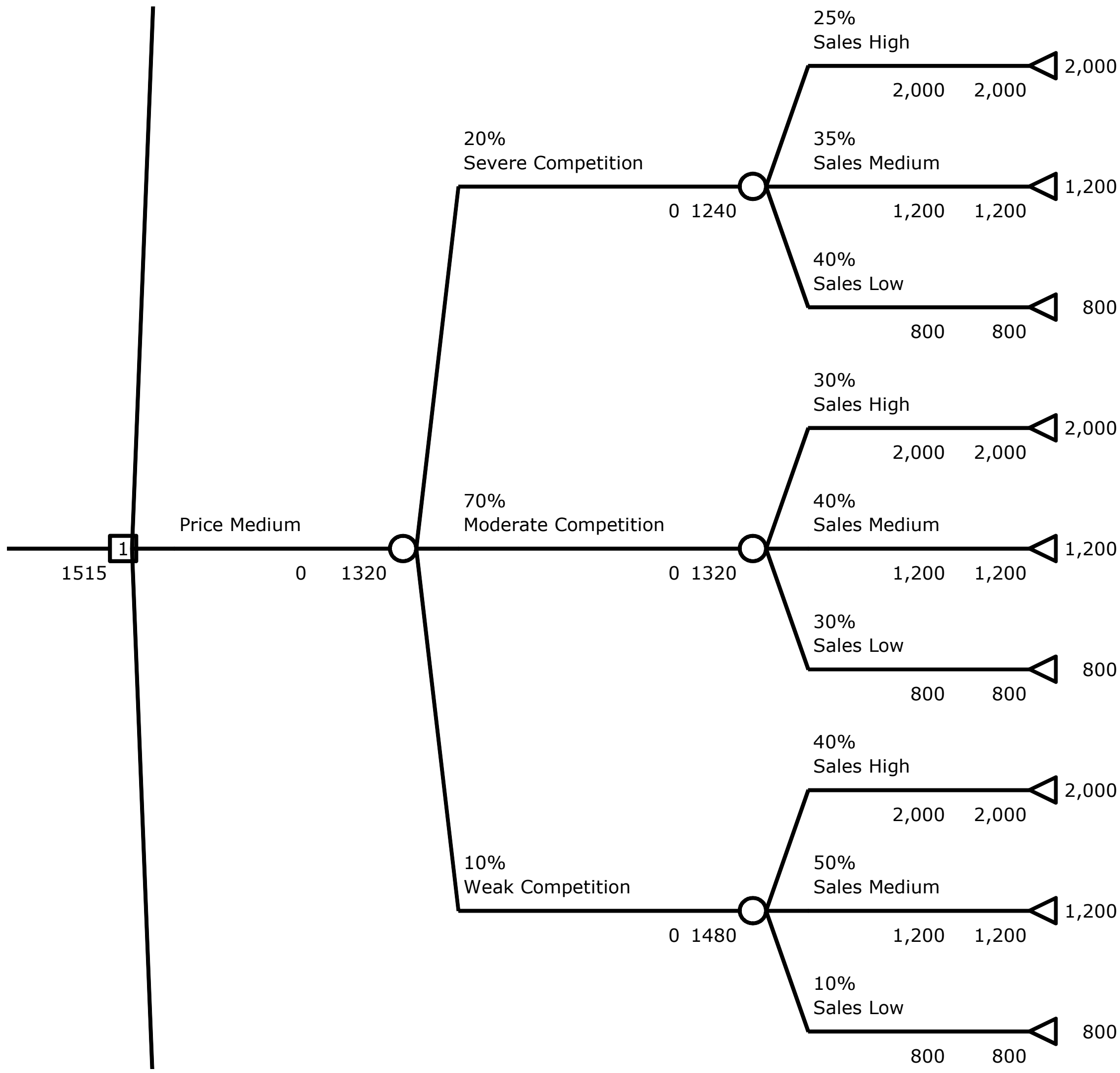
CASE 16.1 Brainy Business

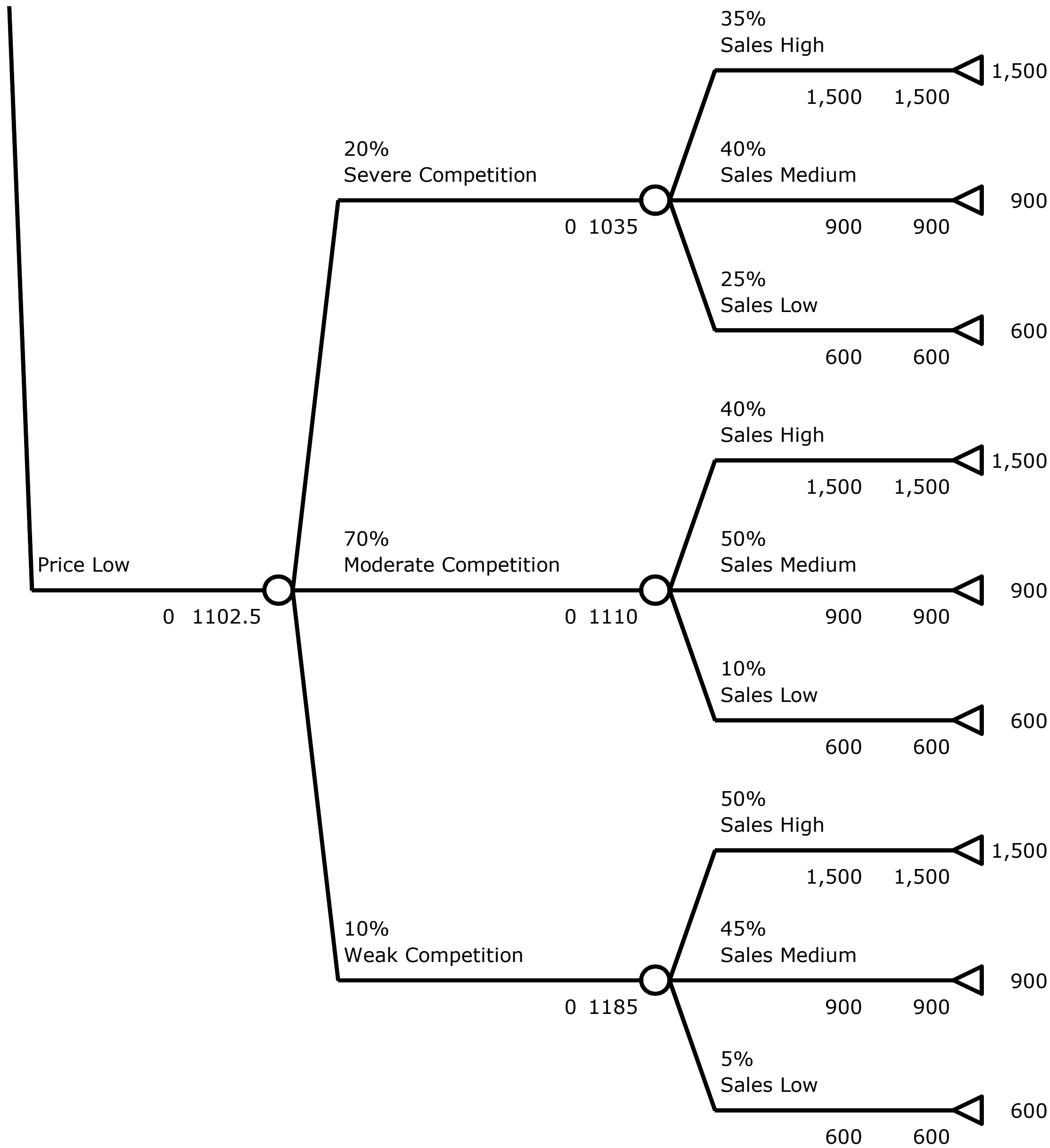
(a) The decision alternatives are to price the product high ($50), medium ($40), or low ($30), or don't market the product at all. The possible states of nature are the demand could be high (50,000), medium (30,000), or low (20,000), which in turn depends upon the price, and whether the competition is severe, moderate, or weak. The various data are summarized in the spreadsheet below. The payoff table can be generated based on the results in the far right column.

	Price			Severe	Moderate	Weak		
High	$50		Prior Probability	0.2	0.7	0.1		
Medium	$40							
Low	$30						Prior	Revenue
			High Price	Severe	Moderate	Weak	Probability	($thousands)
	Sales		Sales High	0.20	0.25	0.30	0.245	2,500
	(thousands)		Sales Medium	0.25	0.30	0.35	0.295	1,500
High	50		Sales Low	0.55	0.45	0.35	0.46	1,000
Medium	30							
Low	20		Medium Price	Severe	Moderate	Weak		
			Sales High	0.25	0.30	0.40	0.3	2,000
			Sales Medium	0.35	0.40	0.50	0.4	1,200
			Sales Low	0.40	0.30	0.10	0.3	800
			Low Price	Severe	Moderate	Weak		
			Sales High	0.35	0.40	0.50	0.4	1,500
			Sales Medium	0.40	0.50	0.45	0.475	900
			Sales Low	0.25	0.10	0.05	0.125	600

The decision tree for this probem follows (over three pages):




25%
Sales High
2,000 2,000
2,000
20%
Severe Competition
0 1240
35%
Sales Medium
1,200 1,200
1,200
40%
Sales Low
800 800
800
30%
Sales High
2,000 2,000
2,000
Price Medium
1
1515
0 1320
70%
Moderate Competition
0 1320
40%
Sales Medium
1,200 1,200
1,200
30%
Sales Low
800 800
800
40%
Sales High
2,000 2,000
2,000
10%
Weak Competition
0 1480
50%
Sales Medium
1,200 1,200
1,200
10%
Sales Low
800 800
800



(b) The scenario "moderate competition, sales of 30,000 units at a unit price of $30" has the largest total probability. Therefore, under the maximum likelihood criterion, Charlotte should price the product at $30.

To find out best maximin alternative, note that for a price of

> $30: 20,000 units at a unit price $30 is the worst case,
> $40: 20,000 units at a unit price $40 is the worst case,
> $50: 20,000 units at a unit price $50 is the worst case.

The maximum of these three is for the price of $50, so it is optimal under the maximin criterion.

(c) As shown in the decision tree for part a (recall that decision trees assume Bayes' decision rule), Charlotte should charge the high price ($50), since this maximizes the expected revenue ($1.515 million). Alternatively, the expected revenues for each possible decision can be calculated directly as shown in the following spreadsheet.

	Price			Severe	Moderate	Weak			
High	$50		Prior Probability	0.2	0.7	0.1			
Medium	$40								Expected
Low	$30						Prior	Revenue	Revenue
			High Price	Severe	Moderate	Weak	Probability	($thousands)	($thousands)
	Sales		Sales High	0.20	0.25	0.30	0.245	2,500	
	(thousands)		Sales Medium	0.25	0.30	0.35	0.295	1,500	1,515
High	50		Sales Low	0.55	0.45	0.35	0.46	1,000	
Medium	30								
Low	20		Medium Price	Severe	Moderate	Weak			
			Sales High	0.25	0.30	0.40	0.3	2,000	
			Sales Medium	0.35	0.40	0.50	0.4	1,200	1,320
			Sales Low	0.40	0.30	0.10	0.3	800	
			Low Price	Severe	Moderate	Weak			
			Sales High	0.35	0.40	0.50	0.4	1,500	
			Sales Medium	0.40	0.50	0.45	0.475	900	1,102.5
			Sales Low	0.25	0.10	0.05	0.125	600	

(d) With more information from the marketing research company, the posterior probabilities for the state of competition can be found using the template for posterior probabilities as follows.

Data:		P(Finding | State)		
State of	Prior	Finding		
Nature	Probability	Predict Severe	Predict Moderate	Predict Weak
Severe	0.2	0.8	0.15	0.05
Moderate	0.7	0.15	0.8	0.05
Weak	0.1	0.03	0.07	0.9

Posterior		P(State | Finding)		
Probabilities:		State of Nature		
Finding	P(Finding)	Severe	Moderate	Weak
Predict Severe	0.268	0.597	0.392	0.011
Predict Moderate	0.597	0.050	0.938	0.012
Predict Weak	0.135	0.074	0.259	0.667

To keep the decision tree from becoming too unwieldy, we will break it into parts. The first three parts consider the situation after each possible prediction by the marketing research company. The decision tree from part a is reused with the only change being the prior probabilities of severe, moderate and weak competition used in part a are replaced by the appropriate posterior probabilities calculated above, depending upon the prediction of the marketing research company. For example, if the marketing research company predicts the competition will be severe, the probability of severe, moderate, and weak competition are 0.597, 0.392, and 0.011, respectively.

The optimal decision if the marketing research company predicts severe is to price high ($50), with expected revenue of $1.466 million.

	Price			Severe	Moderate	Weak		
High	$50		Prior Probability	0.597	0.392	0.011		
Medium	$40							
Low	$30						Prior	Revenue
			High Price	Severe	Moderate	Weak	Probability	($thousands)
	Sales		Sales High	0.20	0.25	0.30	0.220709	2,500
	(thousands)		Sales Medium	0.25	0.30	0.35	0.270709	1,500
High	50		Sales Low	0.55	0.45	0.35	0.5085821	1,000
Medium	30							
Low	20		Medium Price	Severe	Moderate	Weak		
			Sales High	0.25	0.30	0.40	0.2712687	2,000
			Sales Medium	0.35	0.40	0.50	0.3712687	1,200
			Sales Low	0.40	0.30	0.10	0.3574627	800
			Low Price	Severe	Moderate	Weak		
			Sales High	0.35	0.40	0.50	0.3712687	1,500
			Sales Medium	0.40	0.50	0.45	0.4397388	900
			Sales Low	0.25	0.10	0.05	0.1889925	600
			Optimal Decision	Price High				
			Expected Revenue	1466.42				
				($thousands)				

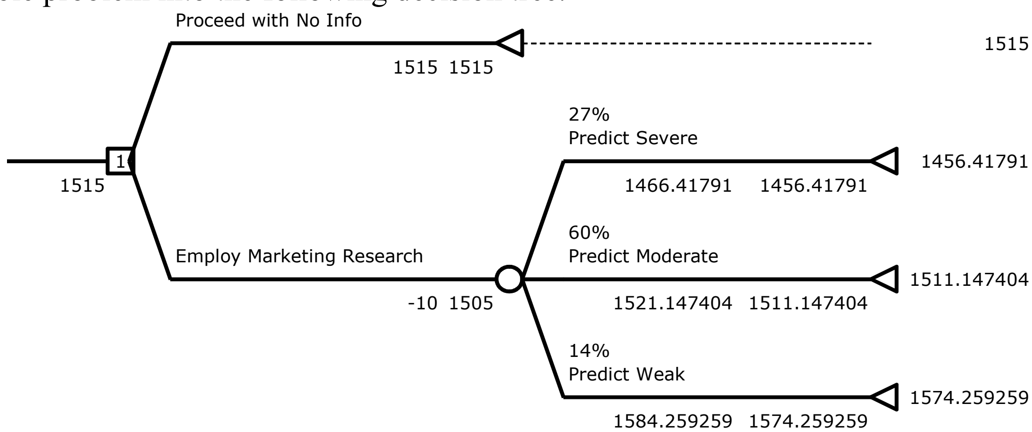
The optimal decision if the marketing research company predicts moderate competition is to price high ($50), with expected revenue of $1.521 million.

	Price			Severe	Moderate	Weak		
High	$50		Prior Probability	0.050	0.938	0.012		
Medium	$40							
Low	$30						Prior	Revenue
			High Price	Severe	Moderate	Weak	Probability	($thousands)
	Sales		Sales High	0.20	0.25	0.30	0.2480737	2,500
	(thousands)		Sales Medium	0.25	0.30	0.35	0.2980737	1,500
High	50		Sales Low	0.55	0.45	0.35	0.4538526	1,000
Medium	30							
Low	20		Medium Price	Severe	Moderate	Weak		
			Sales High	0.25	0.30	0.40	0.29866	2,000
			Sales Medium	0.35	0.40	0.50	0.39866	1,200
			Sales Low	0.40	0.30	0.10	0.3026801	800
			Low Price	Severe	Moderate	Weak		
			Sales High	0.35	0.40	0.50	0.39866	1,500
			Sales Medium	0.40	0.50	0.45	0.4943886	900
			Sales Low	0.25	0.10	0.05	0.1069514	600
			Optimal Decision	Price High				
			Expected Revenue	1521.15				
				($thousands)				

The optimal decision if the marketing research company predicts weak competition is to price high ($50), with expected revenue of $1.584 million.

	Price			Severe	Moderate	Weak		
High	$50		Prior Probability	0.074	0.259	0.667		
Medium	$40							
Low	$30						Prior	Revenue
			High Price	Severe	Moderate	Weak	Probability	($thousands)
	Sales		Sales High	0.20	0.25	0.30	0.2796296	2,500
	(thousands)		Sales Medium	0.25	0.30	0.35	0.3296296	1,500
High	50		Sales Low	0.55	0.45	0.35	0.3907407	1,000
Medium	30							
Low	20		Medium Price	Severe	Moderate	Weak		
			Sales High	0.25	0.30	0.40	0.362963	2,000
			Sales Medium	0.35	0.40	0.50	0.462963	1,200
			Sales Low	0.40	0.30	0.10	0.1740741	800
			Low Price	Severe	Moderate	Weak		
			Sales High	0.35	0.40	0.50	0.462963	1,500
			Sales Medium	0.40	0.50	0.45	0.4592593	900
			Sales Low	0.25	0.10	0.05	0.0777778	600
			Optimal Decision	Price High				
			Expected Revenue	1584.26				
				($thousands)				

Then, incorporating the expected payoff with each possible prediction by the marketing company, along with the expected revenue without information from part a, we combine the whole problem into the following decision tree.



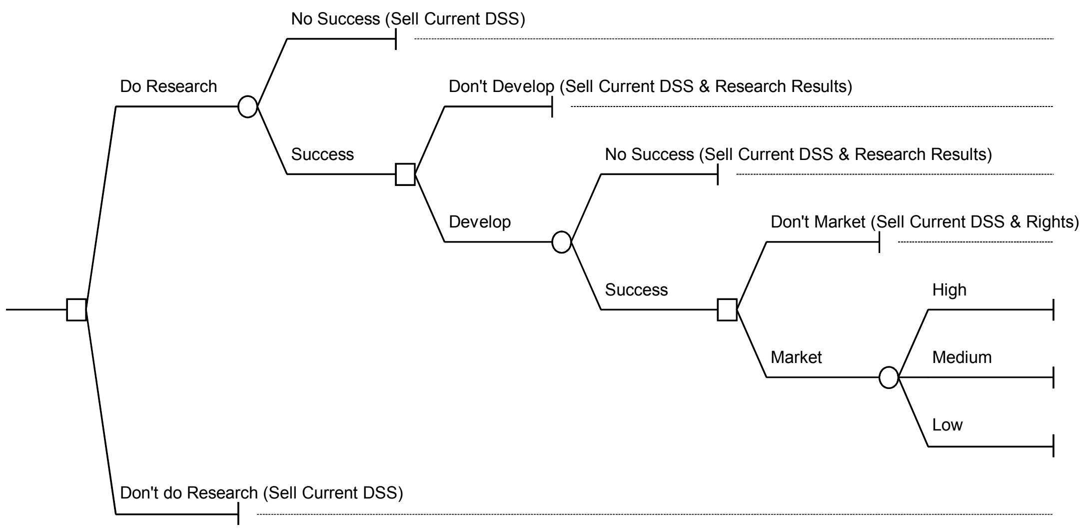
Charlotte should not purchase the services of the market research company. The information is not worth anything since it does not affect the decision. Regardless of the prediction, the optimal policy is to set the price at $50.

CASE 16.2 Smart Steering Support

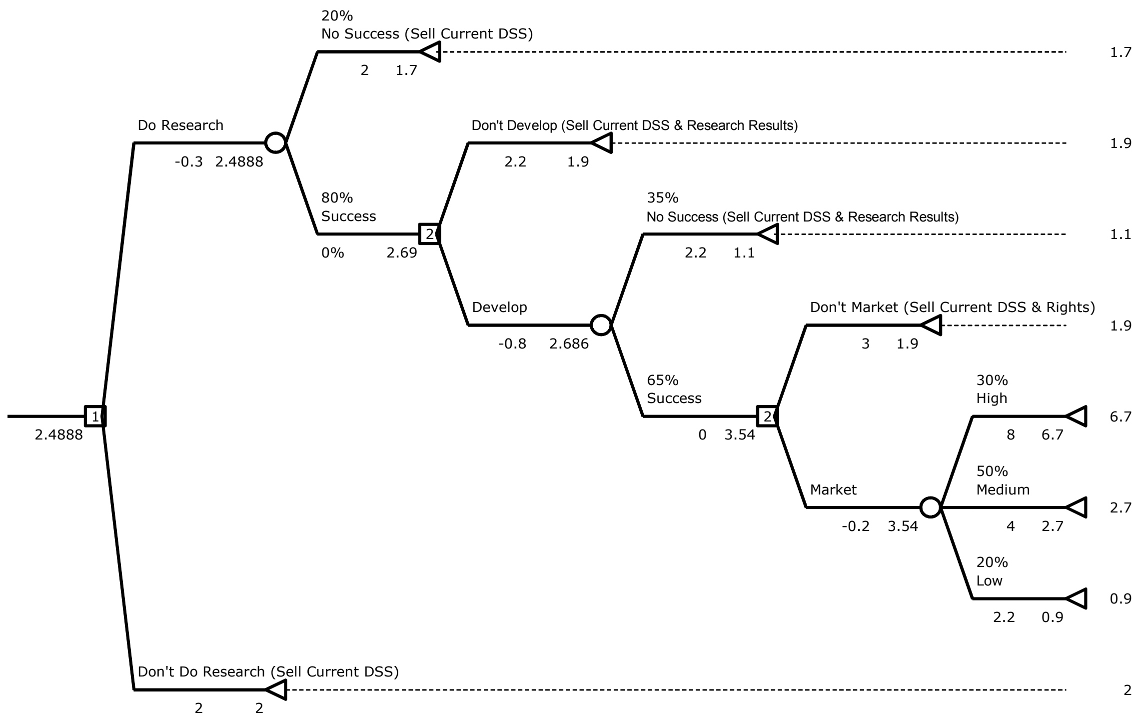
(a) The available data are summarized in the table.

	Costs		Probability
	($million)		of Success
Research	0.3		0.8
Development	0.8		0.65
Marketing	0.2		
	Revenues from R&D		
	($million)		
Sell Product Rights	1		
Sell Research Results	0.2		
Sell Current DSS	2		
	Sales		
	Revenue		
	($million)		Probability
High	8		0.3
Medium	4		0.5
Low	2.2		0.2

(b) The basic decision tree is shown below.

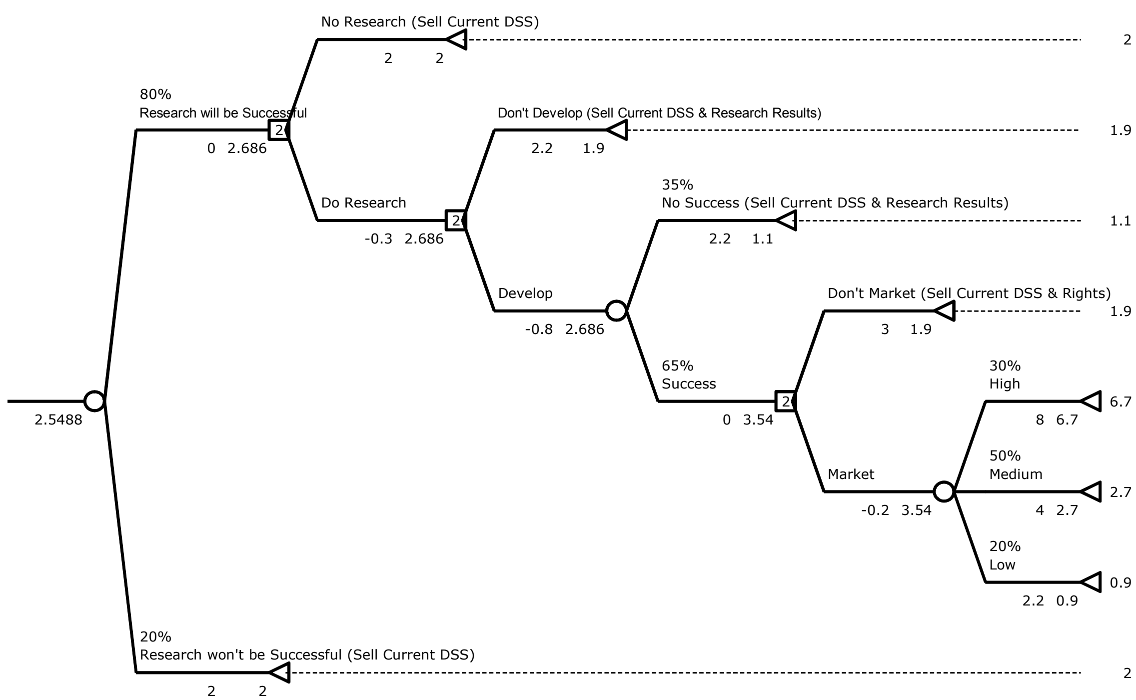


(c) The decision tree displays all the expected payoffs and probabilities.

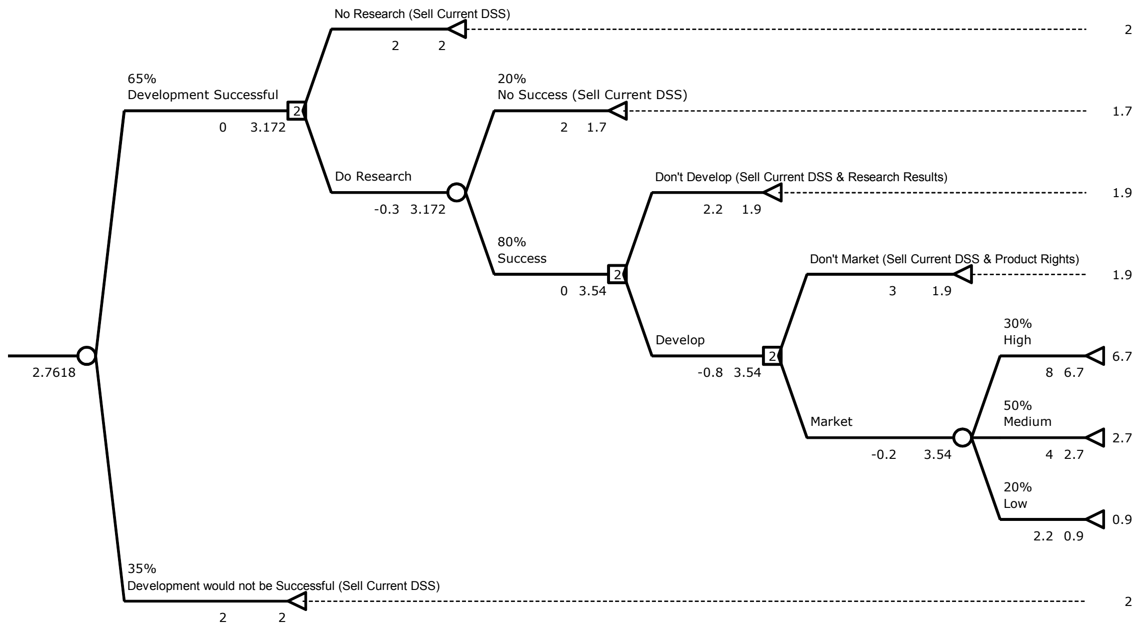


(d) The best course of action is to do the research project. The expected payoff is $2.489 million.

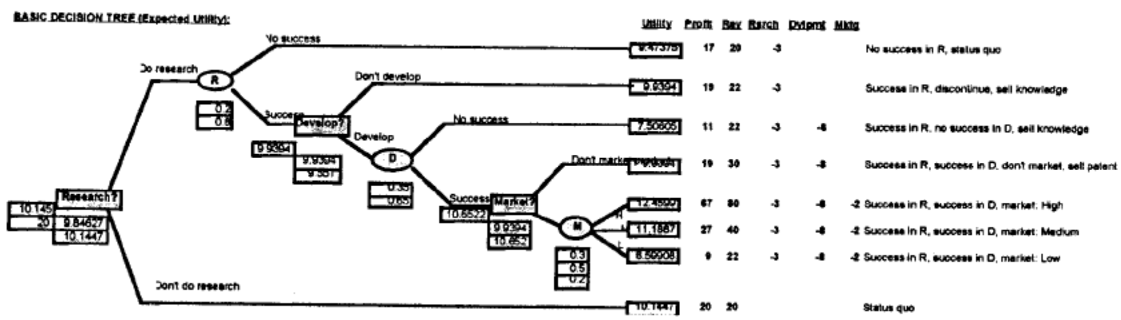
(e) The decision tree with perfect information on research is displayed. The expected value in this case equals $2.549 million. The difference between the expected values with and without information is $60,000, which is the value of perfect information on research.



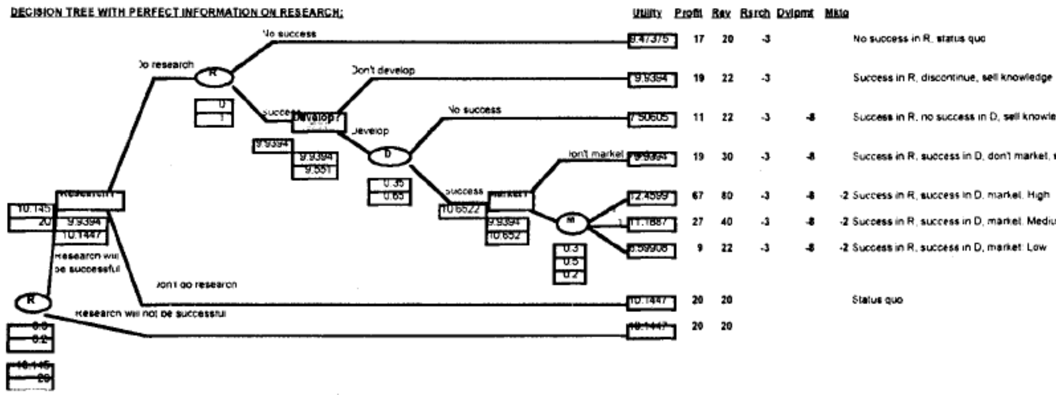
(f) The decision tree with perfect information on development is displayed. The expected value in this case equals \$2.762 million. The difference between the expected values with and without information is \$273, 000, which is the value of perfect information on development



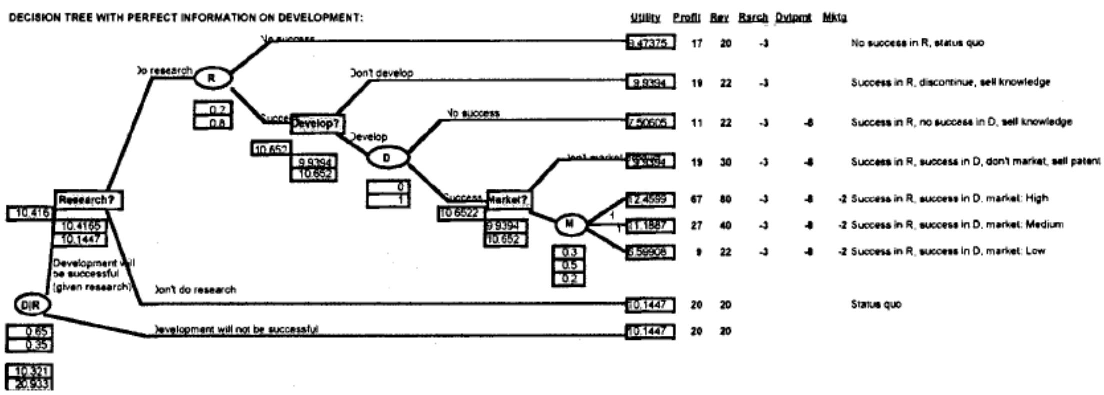
(g) - (h) - (i) The decision tree with expected utilities is displayed. The expected utilities are calculated in the following way: for each of the outcome branches of the decision tree (e.g., profit of \$6, 700, 000), the corresponding utility is computed (e.g., 12.45992). Once this is done, the expected utilities are calculated. The best course of action is to not do research (expected utility of 10.14469 vs. 9.846267 in the case of doing research).



(j) The expected utility for perfect information on research equals 9.939397, which is still less than the expected utility of not doing research (10.14469). Therefore, the best course of action is to not do research, implying a value of zero for perfect information on the outcome of the research effort.

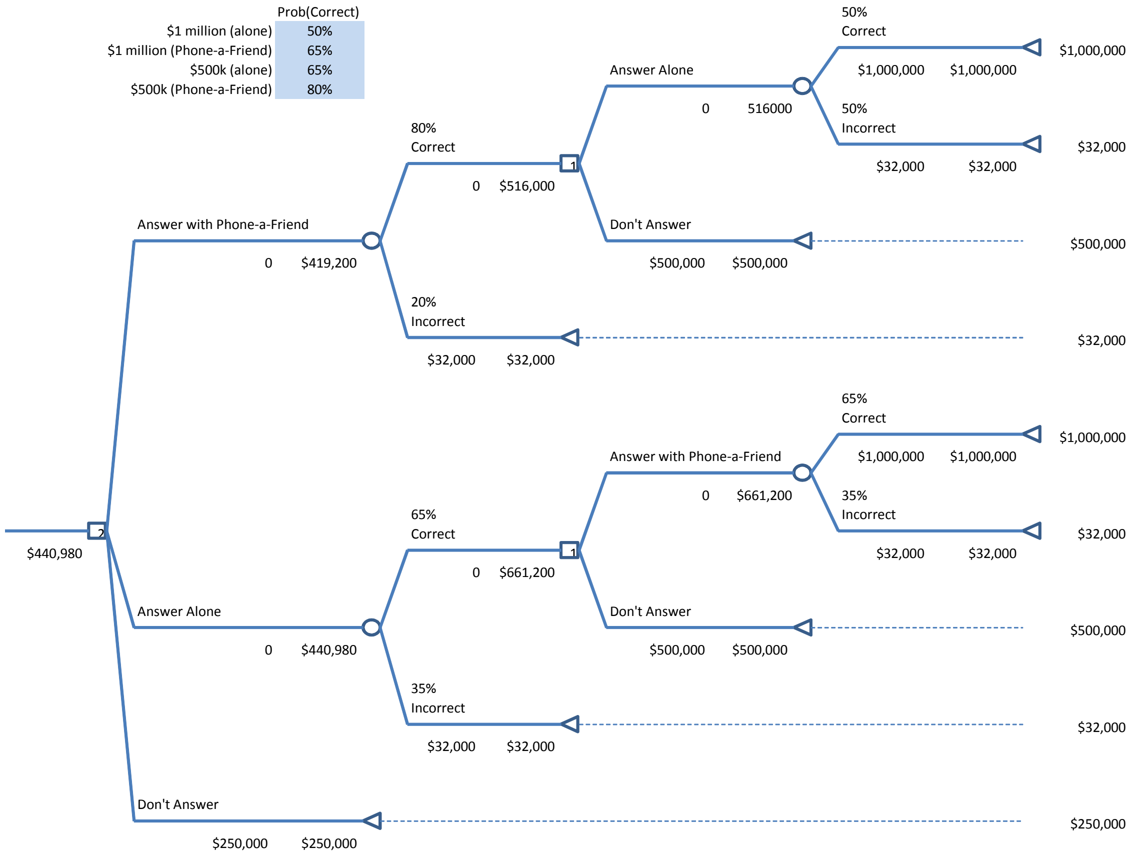


(k) The expected utility for perfect information on development equals 10.321347, which is more than the expected utility without information (10.14469). The value of perfect information on development is the difference between the inverses of these two utility values, $U^{-1}(10.321347) - U^{-1}(10.14469) = 20.93274 - 20 = 0.93274$. The value of perfect information on the outcome of the development effort is \$93.274.



CASE 16.3 Who Wants to be a Millionaire

(a) The course of action that maximizes the expected payoff is to answer \$500,000 question alone. If you get the question correct, then use the phone-a-friend lifeline to help answer \$1 million question. The expected payoff is \$440,980.



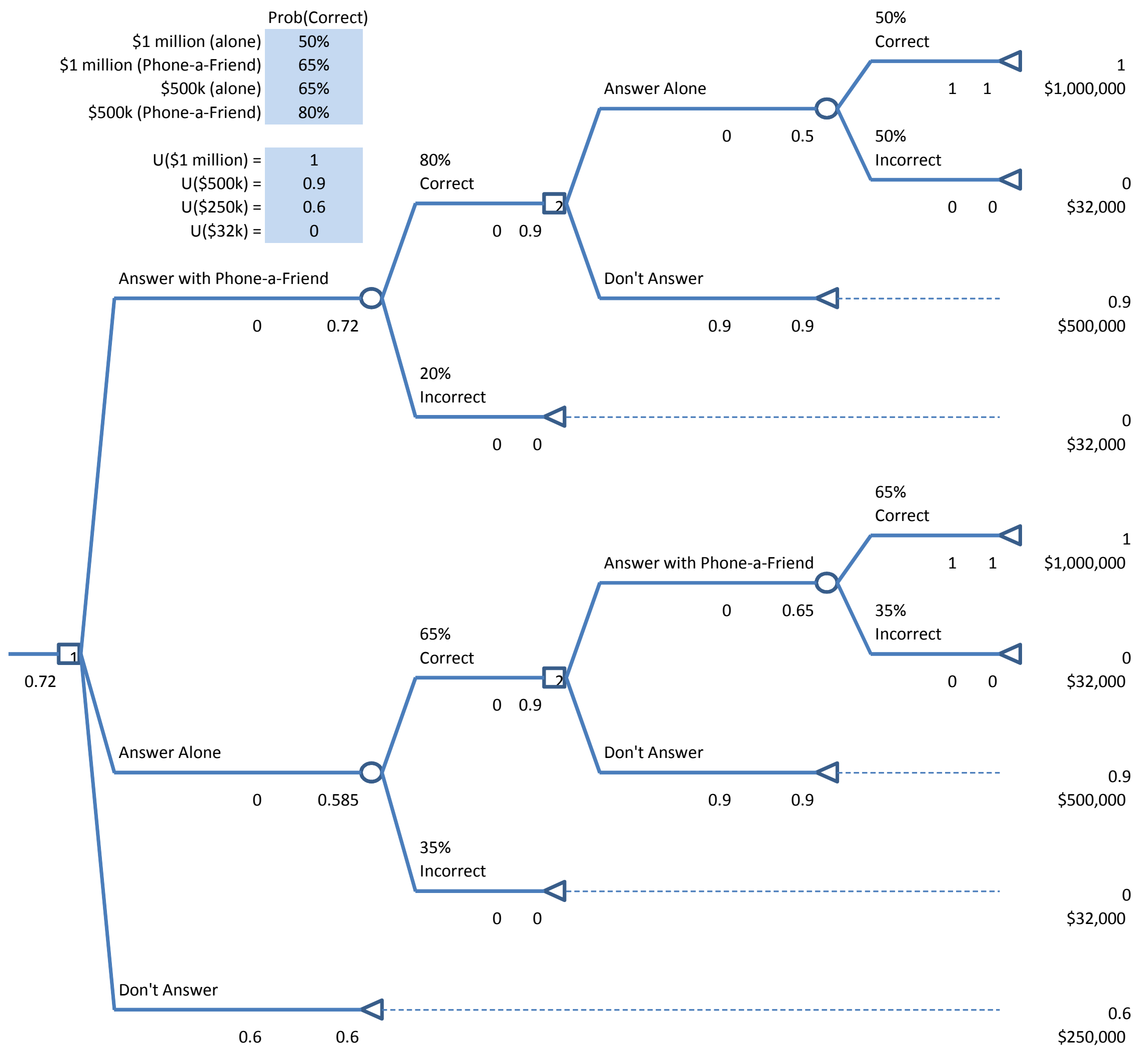
(b) Answers will vary depending on your level of risk aversion. One possible solution is obtained by setting

$$U(Maximum) = U(\$1 \text{ million}) = 1 \text{ and } U(Minimum) = U(\$32{,}000) = 0.$$

If getting \$250,000 for sure is equivalent to a 60% chance of getting \$1 million vs. a 40% chance of getting \$32,000, then $U(\$250{,}000) = p = 0.6$.

If getting \$500,000 for sure is equivalent to a 90% chance of getting \$1 million vs. a 10% chance of getting \$32,000, then $U(\$500{,}000) = p = 0.9$.

(c) With the utilities derived in part (b), the decision changes to using the phone-a-friend lifeline to help answer the $500,000 question, and then walk away.



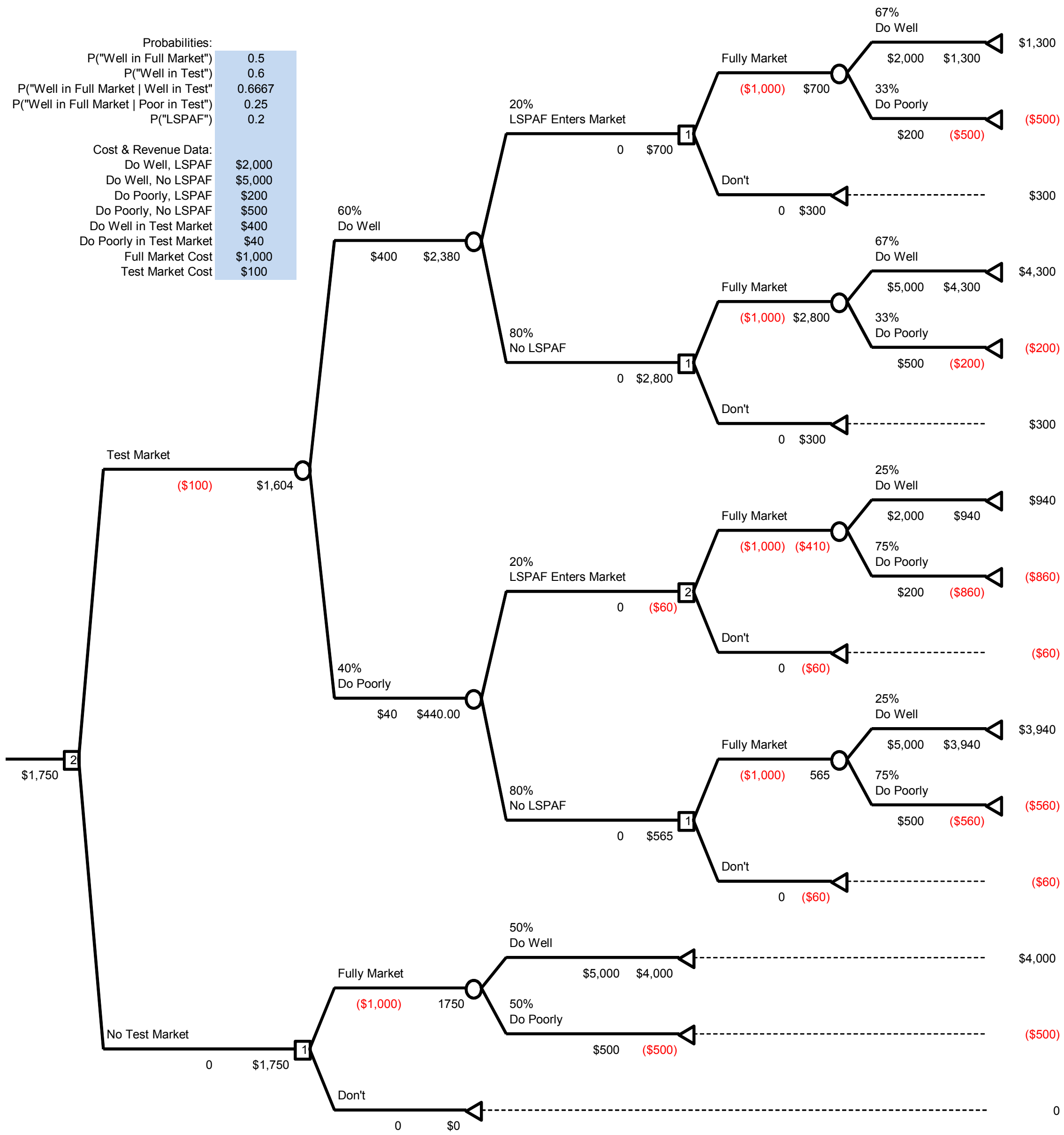
CASE 16.4 University Toys and the Business Professor Action Figures

(a)

Data:		P(Finding | State)	
State of	Prior	Finding	
Nature	Probability	Well in Test	Poor in Test
Well in Full Market	0.5	0.8	0.2
Poor in Full Market	0.5	0.4	0.6

Posterior		P(State | Finding)	
Probabilities:		State of Nature	
Finding	P(Finding)	Well in Full Market	Poor in Full Market
Well in Test	0.6	0.6667	0.3333
Poor in Test	0.4	0.25	0.75

(b) The best course of action is to skip the test market, and immediately market the product fully. The expected payoff is $1750.



(c) If the probability that the LSPAFs enter the market before the test marketing would be completed increases this would make the test market even less desirable, so it would still not be worthwhile to do. However, if the probability decreases, this would make the test market more desirable. It might reach the point where the test market is worthwhile.

(d) Let p denote the probability that the LSPAFs will enter and EP the expected payoff.

p	EP	Test Market?
	\$1,750	No
0.0	\$1,906	Yes
0.1	\$1,755	Yes
0.2	\$1,750	No
0.3	\$1,750	No
0.4	\$1,750	No
0.5	\$1,750	No
0.6	\$1,750	No
0.7	\$1,750	No
0.8	\$1,750	No
0.9	\$1,750	No
1.0	\$1,750	No

(e) It is better to perform the test market if the probability that the LSPAFs will enter the market is 10% or less. It is better to skip the test market if this probability is greater than 10%.