1. The Campus Bookstore at East Tennessee State University must decide how many economics textbooks to order for the next semester's class. The bookstore believes that seven, eight, nine or ten sections of the course will be offered next semester; each section contains 40 students. The publisher is offering bookstores a discount if they place their orders early. If the bookstore orders too few texts and runs out, the publisher will air express additional books at the bookstore's expense. If it orders too many texts, the store can return unsold texts to the publisher for a partial credit. The bookstore is considering ordering 280, 320, 360 or 400 texts in order to get the discount. Taking into account the discounts, air express expenses, and credits for returned texts, the bookstore manager estimates the following resulting profits.

	Number of Introductory Economic Classes Offered			
Number of Textbooks to Order	7	8	9	10
280	$2,800	$2,720	$2,640	$2,480
320	$2,600	$3,200	$3,040	$2,880
360	$2,400	$3,000	$3,600	$3,440
400	$2,200	$2,800	$3,400	$4,000

a. What is the optimal decision if the bookstore manager uses the maximax criterion?
The manager would order **400** textbooks (the maximum of the maximum decision alternatives).

b. What is the optimal decision if the bookstore manager uses the maximin criterion?
280 has a minimum of $2,480
320 has a minimum of $2,600
360 has a minimum of $2,400
400 has a minimum of $2,200
The maximum of the decision alternative is 320; the manager would order **320** books.

c. What is the optimal decision if the bookstore manager uses the minimax regret criterion?
280 has a maximum regret of 1520
320 has a maximum regret of 1120
360 has a maximum regret of 560
400 has a maximum regret of 600
The minimum of these maximum regrets is 560; the manager would order **360** books.

d. What is the optimal decision if the bookstore manager uses the principle of insufficient reason criterion?
280 has a total of 10,640
320 has a total of 11,720
360 has a total of 12,440
400 has a total of 12,400
The maximum is 12,440; the manager would order **360** books.

2. Consider the data given in problem 1. Based on conversations with the chair of the economics department, suppose the bookstore manager believes that the following probabilities hold:

P(7 classes offered) = .10
P(8 classes offered) = .30
P(9 classes offered) = .40
P(10 classes offered) = .20

a. Using the expected value criterion, determine how many economics books the bookstore manager should purchase in order to maximize the store's expected profit. Do you think the expected value criterion is appropriate for this problem?

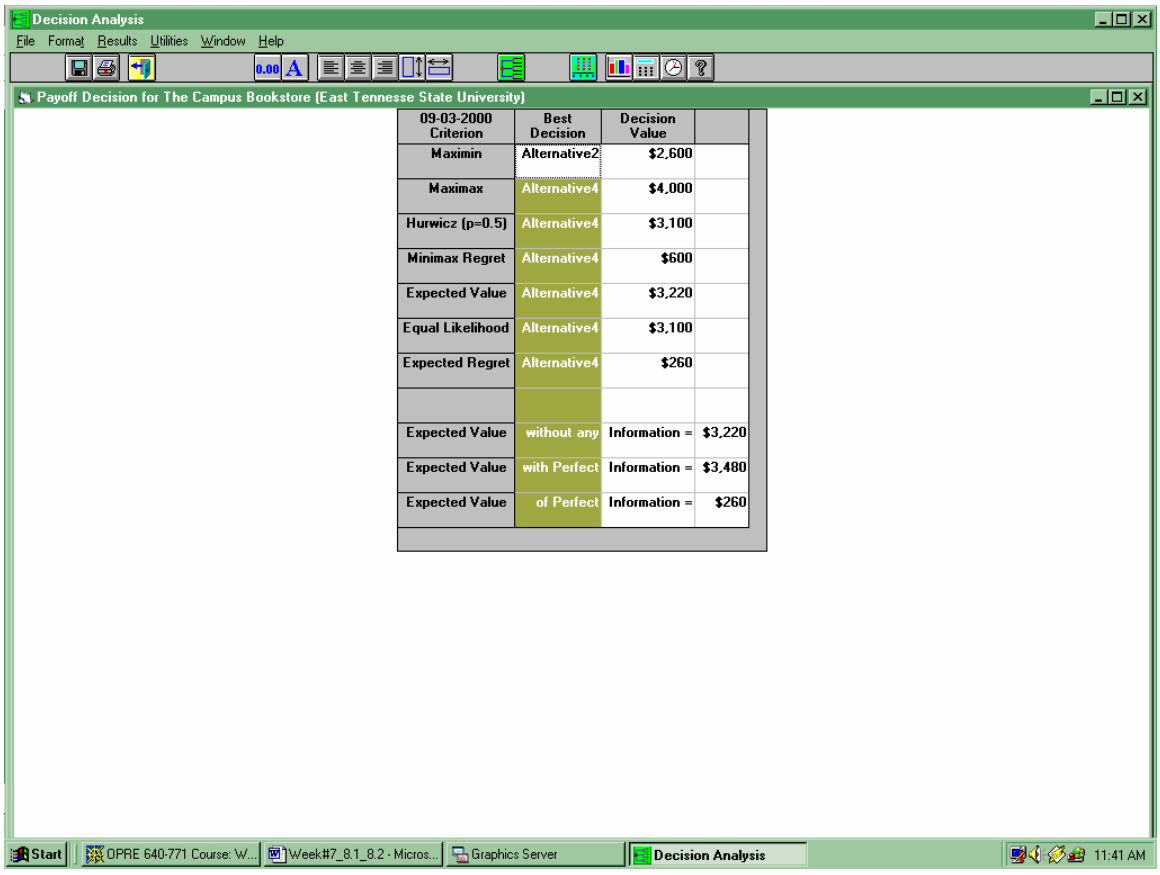
EV(280) = $2,648
EV(320) = $3,012
EV(360) = $**3,268**
EV(400) = $3,220

EV(360) has the highest expected payoff; the manager should purchase 360 books.
The expected value criterion only assures us that the decision will be optimal in the long run when the problem is faced over and over again. In this situation, the bookstore manager is facing the problem only once and basing an optimal decision solely on expected value may not be optimal.

b. Based on the probabilities given in part (a), determine the expected value of perfect information and interpret its meaning.

The expected return with perfect information is .1(2800) + .3(3200) + .4(3600) + .2(4000) = $3,480
The expected value of perfect information is 3480 – 3268 = **212.** This represents the gain in expected return resulting by knowing the probabilities of how the classes are going to be assigned.

Here are the WINSQB results:



3. National Foods has developed a new sports beverage it would like to advertise on the Super Bowl Sunday. National's advertising Agency can purchase either one, two or three 30second commercials advertising the drink. It estimated that the return will be based on Super Bowl viewer ship, which in turn based on fan's perceptions whether the game is "dull" "average"," above average" , or "exiting" Nationals foods ad agency has constructed the following payoff table giving the estimate of the expected profit (in $100,000) resulting from purchasing one, two, three advertising spots.(Another possible decision is for National foods is not to advertise at all during the super bowl.) The states of nature correspond to the game being "dull" "average"," above average" , or "exiting"

Number of 30-Second Commercials	Perceived Game Excitement			
	Dull	Average	Above Average	Exciting
One	-2	3	7	13
Two	-5	6	12	18
Three	-9	5	13	22

a) What is the optimal decision if the National Foods advertising manager is optimistic?

b) What is the optimal decision if the National Foods advertising manager is pessimistic?

c) What is the optimal decision if the National Foods advertising manager wishes to minimize the firms maximum regret?

Number of 30-second Commercials Purchased	Perceived Game Excitement					
	Dull	Average	Above average	Exciting		Maximum Payoff
One	-2	3	7	13		13
Two	-5	6	12	18		18
Three	-9	5	13	22		22
a) Optimal decision if the advertising manager is optimistic						
This is a Max-max approach.						
The optimal decision is to buy 3 30-second commercials expecting the game to be exciting						
b) Optimal decision if the advertising manager is pessimistic						
This is a Max-min approach, and the manager wants to choose						

The solution with the maximum payoff in the worst-case scenario.
In this case the optimal decision is to buy one 30-second commercial.
The manager could also decide to not buy anything at all if he is pessimistic. However,
This would result in 0 profit which, is not the worst-case scenario!

c) The optimal decision if the advertising manager wishes to minimize the firm's maximum regret.

Regret table

Number of 30-second Commercials Purchased	Perceived Game Excitement				
	Dull	Average	Above average	Exciting	Maximum regret
One	0	3	6	9	9
Two	3	0	1	4	4
Three	7	1	0	0	7

The optimal decision is to buy 2 30-second commercials.

Analysis with WinQSB

```
Payoff Decision for National Foods

            Best        Decision
Criterion   Decision    Value
Maximin     One    ($2)  (Pessimistic Manager)
Maximax     Three $22    (Optimistic Manager)
Hurwicz (p=0.5)   Two   $6.50
Minimax Regret    Two   $4    (Minimize maximum regret)
Expected Value    Two   $6.80
Equal Likelihood  Two   $7.75
Expected Regret   Two   $1.30

Expected Value without any Information =  $6.80
Expected Value with Perfect Information = $8.10
Expected Value of Perfect Information =   $1.30
```

As shown above, utilizing the WinQSB application produces the same results as those calculated mathematically by hand.

4. Consider the data given on problem 3 for National Foods. Based on the past Super Bowl games, suppose the decision maker believes the following probabilities hold for the states of nature;

P (Dull game) = .20
P(Average Game) = .40
P(Above Average Game) = .30
P(Exciting Game) = .10

a) Using the expected value criterion, determine how many commercials National Foods should purchase.

b) Based on the probabilities given here, determine the expected value of perfect information.

Perceived Game Excitement

	Number of 30-Second			
Commercials Purchased	Dull	Average	Above Average	Exciting
One commercial	$-200,000	$300,000	$700,000	$1,300,000
Two commercial	$-500,000	$600,000	$1,200,000	$1,800,000
Three commercial	$-900,000	$500,000	$1,300,000	$2,200,000

P(Dull game) = .20
P(Average Game) = .40
P(Above Average Game) = .30
P(Exciting Game) = .10

Expected Return

1 Commercial = .20(-200,000) +.40(300,000) +.30(700,000) +.10(1,300,000) = $420,000
2 Commercial = .20(-500,000) +.40(600,000) +.30(1,200,000) +.10(1,800,000) = $680,000
3 Commercial = .20(-900,000) +.40(500,000) +.30(1,300,000) +.10(2,2000,000) = $630,000

a. Expected Value Criterion -- 2 commercials

Expected Value without any Information = $680,000
Expected Value with Perfect Information = $810,000
Expected Value of Perfect Information = $130,000

b. EVPI -- $130,000

5. Consider the data given in problems 3 and 4 for National Foods. The firm can hire the noted sport's pundit Jim Worden to give his opinion as to whether or not the Super Bowl game will be interesting. Suppose the following probabilities hold for Jim's predictions:

P(Jim predicts game will be interesting game is dull) = .15
P(Jim predicts game will be interesting game is average = .25
P(Jim predicts game will be interesting game is above average = .50
P(Jim predicts game will be interesting game is exciting = .80
P(Jim predicts game will not be interesting game is actually dull) = .85
P(Jim predicts game will not be interesting game is average) = .75
P(Jim predicts game will not be interesting game is above average) = .50
P(Jim predicts game will not be interesting game is exciting) = .20

a. Jim predict the game will be interesting, what is the If probability the game will be dull?

States of Nature Si	Prior Probabilities P(Si)	Conditional Probabilities P(Interesting|Si)	Joint Probabilities P(InterestingnSi)	Posterior Probabilities P(Si|Interesting)
Dull Game	.20	.15	.03	.03/.36 = .08
Average Game	.40	.25	.10	.10/.36 = .28
Above Average	.30	.50	.15	.15/.36 = .42
Exciting Game	.10	.80	.08	.08/.36 = .22
			P(Interesting) = .36	

States of Nature Si	Prior Probabilities P(Si)	Conditional Probabilities P(Non Interesting|Si)	Joint Probabilities P(Non InterestingnSi)	Posterior Probabilities P(Si|Non Interesting)
Dull Game	.20	.85	.17	.17/.64 = .27
Average Game	.40	.75	.30	.30/.64 = .47
Above Average	.30	.50	.15	.15/.64 = .23
Exciting Game	.10	.20	.02	.02/.64 = .03
			P(Non Interesting) = .64	

a) If Jim predicts that the game will be interesting, there is 8.3% probability that the game will be dull

b)

EV (one/interesting) = .083*(-200,000) + 0.278*300,000 + 0.417*700,000 + 0.222*1,300,000 =

= -(16,600) + 83,400 + 291,900 + 288,600 = $647,300

EV (two/interesting) = .083*(-500,000) + 0.278*600,000 + 0.417*1,200,000 + 0.222*1,800,000 =

= -(41,500) + 166,800 + 500,400 + 399,600 = $1,025,300

EV (three/interesting) = .083*(-900,000) + 0.278*500,000 + 0.417*1,300,000 + 0.222*2,200,000 =

= -(74,700) + 139,000 + 542,100 + 488,400 = **$1,094,800**

National optimal strategy would be to buy three commercials, if Jim predicts the game to be interesting

EV (one/not interesting) = 0.266*(-200,000) + 0.469*300,000 + 0.234*700,000 + 0.031*1,300,000 =
= -(53,200) + 140,700 + 163,800 + 40,300 = $291,600

EV (two/not interesting) = .266*(-500,000) + 0.469*600,000 + 0.234*1,200,000 + 0.031*1,800,000 =
= -(133,000) + 281,400 + 280,800 + 55,800 = **$485,300**

EV (three/interesting) = .266*(-900,000) + 0.469*500,000 + 0.234*1,300,000 + 0.031*2,200,000 =
= -(239,400) + 234,500 + 304,200 + 68,200 = $367,500

National optimal strategy would be to buy two commercials, if Jim predicts the game to be not interesting

c)
Expected Return with Sample Information (ERSI) = 0.36* $1,094,800 + 0.64* $485,300 = $394,128 + $310,592 = $704,720

From Problem 6.4 Expected Return Without Additional Information (EREV) = $680,000 (from buying 2 commercials)

Expected Return with Sample Information (ERSI) = 0.36* $1,094,800 + 0.64* $485,300 = $394,128 + $310,592 = $704,720

From Problem 6.4 Expected Return Without Additional Information (EREV) = $680,000 (from buying 2 commercials)

Expected Value of Jim's Information (EVSI) = $704,720 - $680,000 = **$24,720**

Therefore:
Expected Return with Sample Information (ERSI) = 0.36* $1,094,800 + 0.64* $485,300 = $394,128 + $310,592 = $704,720

From Problem 6.4 Expected Return Without Additional Information (EREV) = $680,000 (from buying 2 commercials)

Expected Value of Jim's Information (EVSI) = $704,720 - $680,000 = **$24,720**

Solve using WinQSB
Using the conditional probabilities of Jim's predictions, WinQSB calculated the joint probabilities as follows:

Posterior or Revised Probabilities for National Foods

Indicator\State	State1	State2	State3	State4
Indicator1	0.0833	0.2778	0.4167	0.2222
Indicator2	0.2656	0.4688	0.2344	0.0313

The joint probabilities were also calculated by WinQSB:

Joint Probabilities for National Foods

State\Indicator	Indicator1	Indicator2
State1	0.03	0.17
State2	0.1	0.3
State3	0.15	0.15
State4	0.08	0.02

The payoff decision table for National Foods calculated by WinQSB confirms the results obtained above as illustrated in the table below.
Payoff Decision for National Foods

	If Outcome =	Decision	If Outcome =	Decision
Criterion	Interesting	Value	Not Interesting	Value
Maximin	One	($2)	One	($2)
Maximax	Three	$22	Three	$22
Hurwicz (p=0.5)	Two	$6.50	Two	$6.50
Minimax Regret	Two	$4	Two	$4
Expected Value	Three	$10.94	Two	$4.86
Equal Likelihood	Two	$7.75	Two	$7.75
Expected Regret	Three	$0.86	Two	$1.16
Expected Value	without any	Information =	$6.80	
Expected Value	with Perfect	Information =	$8.10	
Expected Value	of Perfect	Information =	$1.30	
Expected Value	with Sample	Information =	$7.05	
Expected Value	of Sample	Information =	$0.25	
Efficiency (%)	of Sample	Information =	19.23%	

6. Steve Greene is considering purchasing fire insurance for his home. According to statistics for Steve's county, Steve estimates the damage from fire to his home in a given year is as follows:

Amount of Damage	Probability
0	.975
$10,000	.010
$20,000	.008
$30,000	.004
$50,000	.002
$100,000	.001

a. If Steve is risk neutral, how much should he be willing to pay for the fire insurance?

The optimal decision for a risk-neutral, decision-maker can be determined using the expected value criterion on the payoff values.

.975(0) + .010(10,000) + .008(20,000) + .004(30,000) + .002(50,000) + .001(100,000) = 580.
He should be willing to pay **$580** for fire insurance.

Suppose Steve's utility values are as follows:

	Amount of Loss ($1000s)						
	100	50	30	20	10	1	0
Utility	0	.65	.75	.8	.95	.995	1

b. What is the expected utility corresponding to fire damage?
Substitute the utility value for the expected value and solve as follows:

.975(1) + .010(.95) + .008(.8) + .004(.75) + .002(.65) + .001(0) = **.9952**

c. The expected utility of .9952 is approximately = 1, which means he should be willing to spend about **$1,000**. Notice that, this approximation is conservative, therefore he is on the safe side.

7. Freda Fitness is expanding her personal training business by opening another gym location. She has three possible sites from which to choose. Freda has found that her business success follows the trend in the nutrition industry, which is expanding, stable, or declining. Given each trend, her expected profit/loss in the first year of operation for each site is shown below:

	Expanding	Stable	Decline
Site 1	50000	20000	0
Site 2	100000	50000	-40000
Site 3	80000	60000	10000

a. If Freda is an optimist and wishes to maximize her maximum profit, which site should she choose using the maximax approach?

MAXIMAX	maximum payoff	
Site 1	50,000	
Site 2	**100,000**	**maximax value**
Site 3	80,000	

She should choose site 2.

b. If Freda is a pessimist but wishes to minimize her regret, what site should she choose using the minimax regret approach?

b. Under the minimax regret approach, Freda determines the maximum regret for each decision alternative by creating a regret table and then chooses the one which has the minimum maximum regret. The regret table for this decision is shown below:

	Expanding	Stable	Declining
Site 1	50,000	40,000	10,000
Site 2	0	10,000	50,000
Site 3	20,000	0	0

MINIMAX REGRET	maximum regret	
Site 1	50,000	
Site 2	50,000	
Site 3	**20,000**	**minimax regret value**

Here, the maximum regret for Site 1 is $50,000; $50,000 for Site 2 and $20,000 for Site 3.
The site with the minimum maximum regret is Site 3 so Freda should select this site.

8. Continuation of problem No. 7, Based on long-term trends in the nutrition industry, Freda projects the following probabilities for the state of the industry:

Expanding	30%
Stable	50%
Declining	20%

Given these probabilities, what decision should Freda make to maximize her expected profit?

Given probability estimates for the states of nature, an expected value can be calculated for each decision alternative by multiplying the probability for each state of nature by the associated return and then summing these products. To maximize expected profit, Freda should choose the decision alternative with the best expected value. The expected value of each decision alternative is as follows:

Site 1 = .3(50,000) + .5(20,000) + .2(0) =	25,000
Site 2 = .3(100,000) + .5(50,000) + .2(-40,000) =	47,000
Site 3 = .3(80,000) + .5(60,000) + .2(10,000) =	56,000

The site with the highest expected value is Site 3 so Freda should select this site.

9. The CNN wants to market a new series program, whose success probability was estimated to be 0.80. Suppose a marketing research agency is hired to evaluate the program. The past experience indicates that the agency has 90% of accuracy in predicting a success and 80% of accuracy in predicting a failure. What is the probability that the program is successful given a favorable prediction? What is the probability that the program is a failure given an unfavorable prediction?

Positive

FAVORABLE	prior	conditional	joint	posterior
Successful	.80	.90	.72	.72/.76 = .95
Unsuccessful	.20	.20	.04	.04/.76 = .05
			.76	

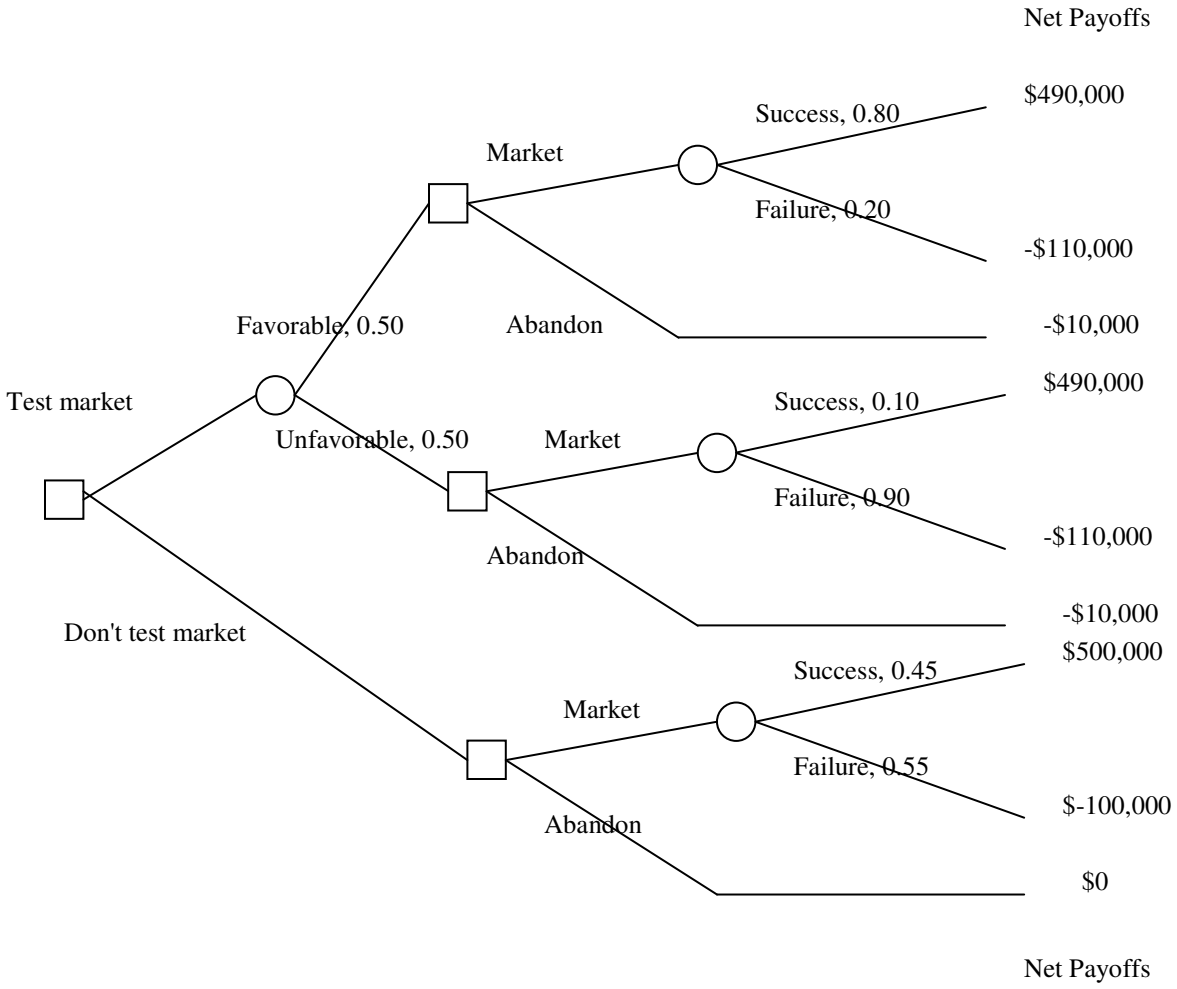
Negative

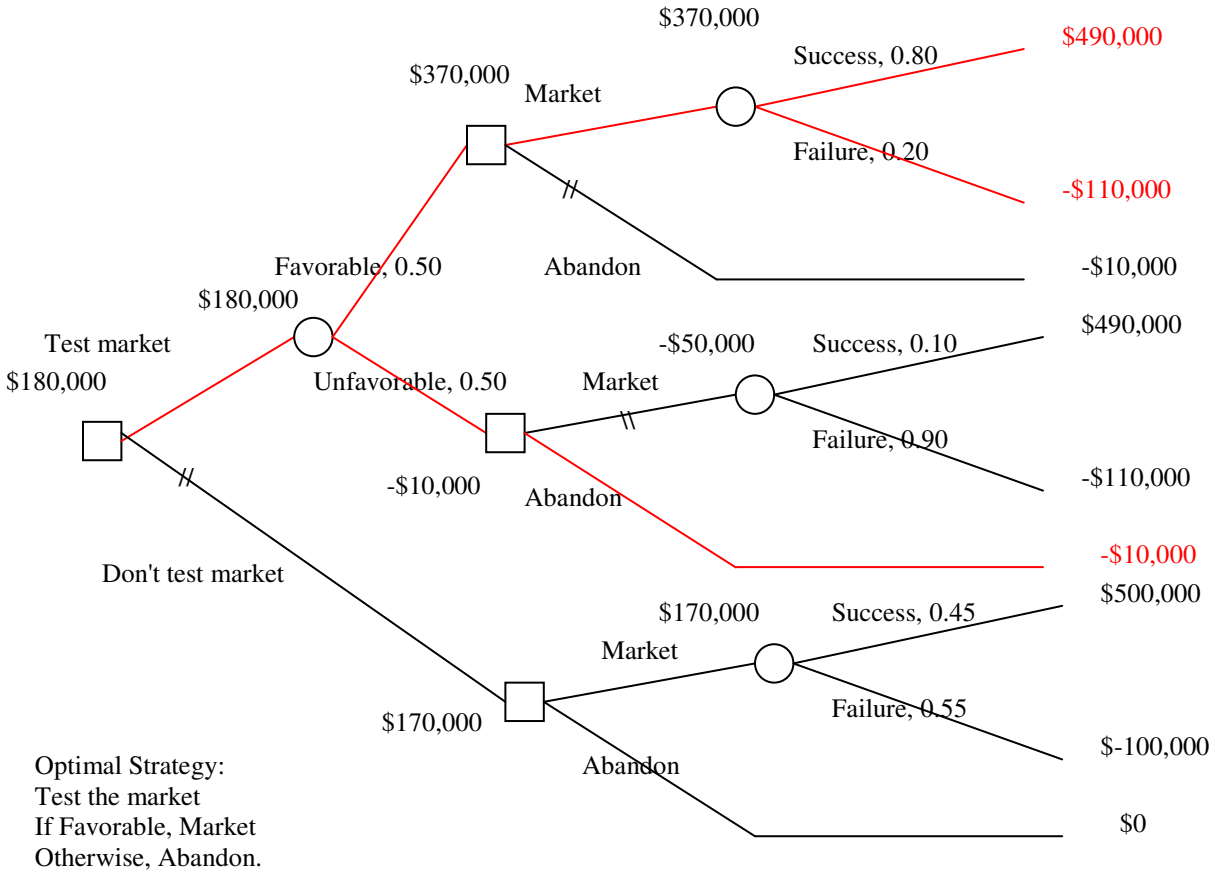
UNFAVORABLE	prior	conditional	joint	posterior
Successful	.80	.10	.08	.08/.24 = .33
Unsuccessful	.20	.80	.16	.16/.24 = .67
			.24	

10. Buzzy-B Toys must decide the course of action to follow in promoting a new whistling yo-yo. Initially, management must decide whether to market the yo-yo or to conduct a test marketing program. After test marketing the yo-yo, management must decide whether to abandon it or nationally distribute it.

A national success will increase profits by $500,000, and a failure will reduce profits by $100,000. Abandoning the product will not affect profits. The test marketing will cost Buzzy-B a further $10,000.

If no test marketing is conducted, the probability for a national success is judged to be 0.45. The assumed probability for a favorable test marketing result is 0.50. The conditional probability for national success given favorable test marketing, is 0.80, for national success given unfavorable test results, it is 0.10. Construct the decision tree diagram and perform backward induction analysis to determine the optimal course of action.




$370,000
$490,000
Success, 0.80
$370,000
Market
Failure, 0.20
-$110,000
Favorable, 0.50
Abandon
-$10,000
$180,000
$490,000
Test market
-$50,000
Success, 0.10
$180,000
Unfavorable, 0.50
Market
Failure, 0.90
-$10,000
Abandon
-$110,000
-$10,000
Don't test market
$500,000
$170,000
Success, 0.45
Market
Failure, 0.55
$170,000
$-100,000
Abandon
$0
Optimal Strategy:
Test the market
If Favorable, Market
Otherwise, Abandon.