**Chapter 21**

**Decision Analysis**

**Learning Objectives**

1. Learn how to describe a problem situation in terms of decisions to be made, chance events and consequences.

2. Understand how the decision alternatives and chance outcomes are combined to generate the consequence.

3. Be able to analyze a simple decision analysis problem from both a payoff table and decision tree point of view.

4. Be able to determine the potential value of additional information.

5. Learn how new information and revised probability values can be used in the decision analysis approach to problem solving.

6. Understand what a decision strategy is.

7. Learn how to evaluate the contribution and efficiency of additional decision making information.

8. Be able to use a Bayesian approach to computing revised probabilities.

9. Understand the following terms:

|  |  |
| --- | --- |
| decision alternatives | expected value of perfect information (EVPI) |
| consequence chance event | decision strategy |
| states of nature | expected value of sample information (EVSI) |
| payoff table | Bayesian revision |
| decision tree | prior probabilities |
| expected value approach | posterior probabilities |

**Solutions:**

1. a.



b. EV(*d*1) = .65(250) + .15(100) + .20(25) = 182.5

EV(*d*2) = .65(100) + .15(100) + .20(75) = 95

The optimal decision is *d*1

2. a. EV(*d*1) = 0.5(14) + 0.2(9) + 0.2(10) + 0.1(5) = 11.3

EV(*d*2) = 0.5(11) + 0.2(10) + 0.2(8) + 0.1(7) = 9.8

EV(*d*3) = 0.5(9) + 0.2(10) + 0.2(10) + 0.1(11) = 9.6

EV(*d*4) = 0.5(8) + 0.2(10) + 0.2(11) + 0.1(13) = 9.5

Recommended decision: *d*1

b. The best decision in this case is the one with the smallest expected value; thus, *d*4, with an expected cost of 9.5, is the recommended decision.

3. a. EV(own staff) = 0.2(650) + 0.5(650) + 0.3(600) = 635

EV(outside vendor) = 0.2(900) + 0.5(600) + 0.3(300) = 570

EV(combination) = 0.2(800) + 0.5(650) + 0.3(500) = 635

The optimal decision is to hire an outside vendor with an expected annual cost of $570,000.

b. EVwPI = .2(650) + .5(600) + .3(300) = 520

EVPI = = 50 or $50,000

4. a. The decision to be made is to choose the type of service to provide. The chance event is the level of demand for the Myrtle Air service. The consequence is the amount of quarterly profit. There are two decision alternatives (full price and discount service). There are two outcomes for the chance event (strong demand and weak demand).

b. EV(Full) = 0.7(960) + 0.3(–490) = 525

EV(Discount) = 0.7(670) + 0.3(320) = 565

Optimal Decision: Discount service

c. EV(Full) = 0.8(960) + 0.2(–490) = 670

EV(Discount) = 0.8(670) + 0.2(320) = 600

Optimal Decision: Full price service

5. a. There is only one decision to be made: whether or not to lengthen the runway. There are only two decision alternatives. The chance event represents the choices made by Air Express and DRI concerning whether they locate in Potsdam. Even though these are decisions for Air Express and DRI, they are chance events for Potsdam.

The payoffs and probabilities for the chance event depend on the decision alternative chosen. If Potsdam lengthens the runway, there are four outcomes (both, Air Express only, DRI only, neither). The probabilities and payoffs corresponding to these outcomes are given in the tables of the problem statement. If Potsdam does not lengthen the runway, Air Express will not locate in Potsdam so we only need to consider two outcomes: DRI and no DRI. The approximate probabilities and payoffs for this case are given in the last paragraph of the problem statements.

The consequence is the estimated annual revenue.

b. Runway is Lengthened

|  |  |  |  |
| --- | --- | --- | --- |
| New  Air Express Center | New  DRI Plant | Probability | Annual Revenue |
| Yes | Yes | 0.3 | $600,000 |
| Yes | No | 0.1 | $150,000 |
| No | Yes | 0.4 | $250,000 |
| No | No | 0.2 | -$200,000 |

EV(Runway is Lengthened) = 0.3($600,000) + 0.1($150,000) + 0.4($250,000) – 0.2($200,000)

= $255,000

c. EV(Runway is Not Lengthened) = 0.6($450,000) + 0.4($0) = $270,000

d. The town should not lengthen the runway.

e. EV(Runway is Lengthened) = 0.4(600,000) + 0.1($150,000) + 0.3($250,000) – 0.2(200,000)

= $290,000

The revised probabilities would lead to the decision to lengthen the runway.

6. a. The decision is to choose what type of grapes to plant, the chance event is demand for the wine and the consequence is the expected annual profit contribution. There are three decision alternatives (Chardonnay, Riesling and both). There are four chance outcomes: (W,W); (W,S); (S,W); and (S,S). For instance, (W,S) denotes the outcomes corresponding to weak demand for Chardonnay and strong demand for Riesling.

b. In constructing a decision tree, it is only necessary to show two branches when only a single grape is planted. But, the branch probabilities in these cases are the sum of two probabilities. For example, the probability that demand for Chardonnay is strong is given by:

*P*(Strong demand for Chardonnay) = *P*(S,W) + *P*(S,S)

= 0.25 + 0.20

= 0.45



c. EV(Plant Chardonnay) = 0.55(20) +0.45(70) = 42.5

EV(Plant both grapes) = 0.05(22) + 0.50(40) + 0.25(26) + 0.20(60) = 39.6

EV(Plant Riesling) = 0.30(25) + 0.70(45) = 39.0

Optimal decision: Plant Chardonnay grapes only.

d. This changes the expected value in the case where both grapes are planted and when Riesling only is planted.

EV(Plant both grapes) = 0.05(22) + 0.50(40) +0.05(26) + 0.40(60) = 46.4

EV(Plant Riesling) = 0.10(25) + 0.90(45) = 43.0

We see that the optimal decision is now to plant both grapes. The optimal decision is sensitive to this change in probabilities.

e. Only the expected value for node 2 in the decision tree needs to be recomputed.

EV(Plant Chardonnay) = 0.55(20) + 0.45(50) = 33.5

This change in the payoffs makes planting Chardonnay only less attractive. It is now best to plant both types of grapes. The optimal decision is sensitive to a change in the payoff of this magnitude.

7. a. EV(Small) = 0.1(400) + 0.6(500) + 0.3(660) = 538

EV(Medium) = 0.1(–250) + 0.6(650) + 0.3(800) = 605

EV(Large) = 0.1(–400) + 0.6(580) + 0.3(990) = 605

Best decision: Build a medium or large-size community center.

Note that using the expected value approach, the Town Council would be indifferent between building a medium-size community center and a large-size center.

b. The Town's optimal decision strategy based on perfect information is as follows:

If the worst-case scenario, build a small-size center

If the base-case scenario, build a medium-size center

If the best-case scenario, build a large-size center

Using the consultant's original probability assessments for each scenario, 0.10, 0.60 and 0.30, the expected value of a decision strategy that uses perfect information is:

EVwPI = 0.1(400) + 0.6(650) + 0.3(990) = 727

In part (a), the expected value approach showed that EV(Medium) = EV(Large) = 605.

Therefore, EVwoPI = 605 and EVPI = 727 – 605 = 122

The town should seriously consider additional information about the likelihood of the three scenarios. Since perfect information would be worth $122,000, a good market research study could possibly make a significant contribution.

c. EV(Small) = 0.2(400) + 0.5(500) + 0.3(660) = 528

EV(Medium) = 0.2(–250) + 0.5(650) + 0.3(800) = 515

EV(Large) = 0.2(–400) + 0.5(580) + 0.3(990) = 507

Best decision: Build a small-size community center.

d. If the promotional campaign is conducted, the probabilities will change to 0.0, 0.6 and 0.4 for the worst case, base case and best case scenarios respectively.

EV(Small) = 0.0(400) + 0.6(500) + 0.4(660) = 564

EV(Medium) = 0.0(–250) + 0.6(650) + 0.4(800) = 710

EV(Large) = 0.0(–400) + 0.6(580) + 0.4(990) = 744

In this case, the recommended decision is to build a large-size community center. Compared to the analysis in Part (a), the promotional campaign has increased the best expected value by $744,000 – 605,000 = $139,000. Compared to the analysis in part (c), the promotional campaign has increased the best expected value by $744,000 – 528,000 = $216,000.

Even though the promotional campaign does not increase the expected value by more than its cost ($150,000) when compared to the analysis in part (c), it appears to be a good investment. That is, it eliminates the risk of a loss, which appears to be a significant factor in the mayor's decision-making process.

8. a.



b. EV(node 6) = 0.57(100) + 0.43(300) = 186

EV(node 7) = 0.57(400) + 0.43(200) = 314

EV(node 8) = 0.18(100) + 0.82(300) = 264

EV(node 9) = 0.18(400) + 0.82(200) = 236

EV(node 10) = 0.40(100) + 0.60(300) = 220

EV(node 11) = 0.40(400) + 0.60(200) = 280

EV(node 3) = Max(186,314) = 314 *d*2

EV(node 4) = Max(264,236) = 264 *d*1

EV(node 5) = Max(220,280) = 280 *d*2

EV(node 2) = 0.56(314) + 0.44(264) = 292

EV(node 1) = Max(292,280) = 292

∴ Market Research

If Favorable, decision *d*2

If Unfavorable, decision *d*1

9. The decision tree is as shown in the answer to problem 16a. The calculations using the decision tree in problem 16a with the probabilities and payoffs here are as follows:

a,b. EV(node 6) = 0.18(600) + 0.82(–200) = –56

EV(node 7) = 0

EV(node 8) = 0.89(600) + 0.11(–200) = 512

EV(node 9) = 0

EV(node 10) = 0.50(600) + 0.50(–200) = 200

EV(node 11) = 0

EV(node 3) = Max(–56,0) = 0 *d*2

EV(node 4) = Max(512,0) = 512 *d*1

EV(node 5) = Max(200,0) = 200 *d*1

EV(node 2) = 0.55(0) + 0.45(512) = 230.4

Without the option, the recommended decision is *d*1 purchase with an expected value of $200,000.

With the option, the best decision strategy is

If high resistance *H*, *d*2 do not purchase

If low resistance *L*, *d*1 purchase

Expected Value = $230,400

c. EVSI = $230,400 – $200,000 = $30,400. Since the cost is only $10,000, the investor should purchase the option.

10. a. Outcome 1 ($ in 000s)

|  |  |
| --- | --- |
| Bid | -$200 |
| Contract | -2000 |
| Market Research | -150 |
| High Demand | +5000 |
|  | $2650 |

Outcome 2 ($ in 000s)

|  |  |
| --- | --- |
| Bid | -$200 |
| Contract | -2000 |
| Market Research | -150 |
| Moderate Demand | +3000 |
|  | $650 |

b. EV(node 8) = 0.85(2650) + 0.15(650) = 2350

EV(node 5) = Max(2350, 1150) = 2350 Decision: Build

EV(node 9) = 0.225(2650) + 0.775(650) = 1100

EV(node 6) = Max(1100, 1150) = 1150 Decision: Sell

EV(node 10) = 0.6(2800) + 0.4(800)= 2000

EV(node 7) = Max(2000, 1300) = 2000 Decision: Build

EV(node 4) = 0.6 EV(node 5) + 0.4 EV(node 6) = 0.6(2350) + 0.4(1150) = 1870

EV(node 3) = MAX (EV(node 4), EV(node 7)) = Max (1870, 2000) = 2000

Decision: No Market Research

EV(node 2) = 0.8 EV(node 3) + 0.2 (–200) = 0.8(2000) + 0.2(–200) = 1560

EV(node 1) = MAX (EV(node 2), 0) = Max (1560, 0) = 1560

Decision: Bid on Contract

Decision Strategy:

Bid on the Contract

Do not do the Market Research

Build the Complex

Expected Value is $1,560,000

c. Compare Expected Values at nodes 4 and 7.

EV(node 4) = 1870 Includes $150 cost for research

EV(node 7) = 2000

Difference is 2000 – 1870 = $130

Market research cost would have to be lowered $130,000 to $20,000 or less to make undertaking the research desirable.

11. a.



b. Using node 5,

EV(node 10) = 0.20(–100) + 0.30(50) + 0.50(150) = 70

EV(node 11) = 100

Decision Sell Expected Value = $100

c. EVwPI = 0.20(100) + 0.30(100) + 0.50(150) = $125

EVPI = $125 – $100 = $25

d. EV(node 6) = 0.09(–100) + 0.26(50) + 0.65(150) = 101.5

EV(node 7) = 100

EV(node 8) = 0.45(–100) + 0.39(50) + 0.16(150) = –1.5

EV(node 9) = 100

EV(node 3) = Max(101.5,100) = 101.5 Produce

EV(node 4) = Max(–1.5,100) = 100 Sell

EV(node 2) = 0.69(101.5) + 0.31(100) = 101.04

If Favorable, Produce

If Unfavorable, Sell EV = $101.04

e. EVSI = $101.04 – 100 = $1.04 or $1,040.

f. No, maximum Hale should pay is $1,040.

g. No agency; sell the pilot.



12. a.

b. Using Node 5,

EV(node 10) = 0.4(3500) + 0.3(1000) + 0.3(–1500) = 1250

EV(node 11) = 0.4(7000) + 0.3(2000) + 0.3(–9000) = 700

Decision: *d*1 Blade attachment Expected Value $1250

c. EVwPI = 0.4(7000) + 0.3(2000) + 0.3(–1500) = $2950

EVPI = $2950 – $1250 = $1700

d. EV(node 6) = 0.35(3500) + 0.30(1000) + 0.35(–1500) = 1000

EV(node 7) = 0.35(7000) + 0.30(2000) + 0.35(–9000) = –100

EV(node 8) = 0.62(3500) + 0.31(1000) + 0.07(–1500) = 2375

EV(node 9) = 0.62(7000) + 0.31(2000) + 0.07(–9000) = 4330

EV(node 3) = Max(1000,–100) = 1000 *d*1 Blade attachment

EV(node 4) = Max(2375,4330) = 4330 *d*2 New snowplow

If normal, blade attachment

If unseasonably cold, snowplow $1666

The expected value of this decision strategy is the expected value of node 2.

EV(node 2) = 0.8(1000) + 0.2(4330) = 1666

Recommend: Wait until September and follow the decision strategy.

13. a. EV(1 lot) = 0.3(60) + 0.3(60) + 0.4(50) = 56

EV(2 lots) = 0.3(80) + 0.3(80) + 0.4(30) = 60

EV(3 lots) = 0.3 (100) + 0.3(70) + 0.4(10) = 55

Decision: Order 2 lots Expected Value $60,000

b. The following decision tree applies.



Calculations

EV(node 6) = 0.34(60) + 0.32(60) + 0.34(50) = 56.6

EV(node 7) = 0.34(80) + 0.32(80) + 0.34(30) = 63.0

EV(node 8) = 0.34(100) + 0.32(70) + 0.34(10) = 59.8

EV(node 9) = 0.20(60) + 0.26(60) + 0.54(50) = 54.6

EV(node 10) = 0.20(80) + 0.26(80) + 0.54(30) = 53.0

EV(node 11) = 0.20(100) + 0.26(70) + 0.54(10) = 43.6

EV(node 12) = 0.30(60) + 0.30(60) + 0.40(50) = 56.0

EV(node 13) = 0.30(80) + 0.30(80) + 0.40(30) = 60.0

EV(node 14) = 0.30(100) + 0.30(70) + 0.40(10) =55.0

EV(node 3) = Max(56.6,63.0,59.8) = 63.0 2 lots

EV(node 4) = Max(54.6,53.0,43.6) = 54.6 1 lot

EV(node 5) = Max(56.0,60.0,55.0) = 60.0 2 lots

EV(node 2) = 0.70(63.0) + 0.30(54.6) = 60.5

EV(node 1) = Max(60.5,60.0) = 60.5 Prediction

Optimal Strategy:

If prediction is excellent, 2 lots

If prediction is very good, 1 lot

c. EVwPI = 0.3(100) + 0.3(80) + 0.4(50) = 74

EVPI = 74 – 60 = 14

EVSI = 60.5 – 60 = 0.5

The EVPI is $14,000, but the V.P's recommendation is only valued at EVSI = $500. This indicates additional information is probably worthwhile. The ability of the consultant to forecast market conditions should be considered.

14.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| State of Nature | *P*(*s*j) | *P*(*I* ⏐ *s*j) | *P*(*I* ∩ *s*j) | *P*(*s*j ⏐ *I*) |
| *s*1 | 0.2 | 0.10 | 0.020 | 0.1905 |
| *s*2 | 0.5 | 0.05 | 0.025 | 0.2381 |
| *s*3 | 0.3 | 0.20 | 0.060 | 0.5714 |
|  | 1.0 | *P*(*I*) = 0.105 | | 1.0000 |

15. a. EV(*d*1) = 0.8(15) + 0.2(10) = 14.0

EV(*d*2) = 0.8(10) + 0.2(12) = 10.4

EV(*d*3) = 0.8(8) + 0.2(20) = 10.4

Decision *d*1 Expected Value 14

b. EVwPI = 0.8(15) + 0.2(20) = 16

EVPI = 16 – 14 = 2

c. Indicator I

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| State of Nature | Prior Probabilities | Conditional Probabilities | Joint Probabilities | Posterior Probabilities |
| State *s*1 | 0.8 | 0.20 | 0.16 | 0.52 |
| State *s*2 | 0.2 | 0.75 | 0.15 | 0.48 |
|  |  | *P*(I) = 0.31 | | 1.00 |

EV(*d*1) = 0.5161(15) + 0.4839(10) = 12.6

EV(*d*2) = 0.5161(10) + 0.4839(12) = 11.0

EV(*d*3) = 0.5161(8) + 0.4839(20) = 13.8

If indicator I occurs, decision *d*3 is recommended.

16. a,b. The revised probabilities are shown on the branches of the decision tree.



EV(node 7) = 30

EV(node 8) = 0.98(25) + 0.02(45) = 25.4

EV(node 9) = 30

EV(node 10) = 0.79(25) + 0.21(45) = 29.2

EV(node 11) = 30

EV(node 12) = 0.00(25) + 1.00(45) = 45.0

EV(node 13) = 30

EV(node 14) = 0.85(25) + 0.15(45) = 28.0

EV(node 3) = Min(30,25.4) = 25.4 Expressway

EV(node 4) = Min(30,29.2) = 29.2 Expressway

EV(node 5) = Min(30,45) = 30.0 Queen City

EV(node 6) = Min(30,28) = 28.0 Expressway

EV(node 2) = 0.695(25.4) + 0.215(29.2) + 0.09(30.0) = 26.6

EV(node 1) = Min(26.6,28) = 26.6 Weather

c. Strategy:

Check the weather, take the expressway unless there is rain. If rain, take Queen City Avenue.

Expected time: 26.6 minutes.

17. a. *d*1 = Manufacture component *s*1 = Low demand

*d*2 = Purchase component *s*2 = Medium demand

*s*3 = High demand



EV(node 2) = (0.35)(–20) + (0.35)(40) + (0.30)(100) = 37

EV(node 3) = (0.35)(10) + (0.35)(45) + (0.30)(70) = 40.25

Recommended decision: *d*2 (purchase component)

b. Optimal decision strategy with perfect information:

If *s*1 then *d*2

If *s*2 then *d*2

If *s*3 then *d*1

Expected value of this strategy is 0.35(10) + 0.35(45) + 0.30(100) = 49.25

EVPI = 49.25 – 40.25 = 9 or $9,000

c. If *F –* Favorable

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| State of Nature | *P*(*s*j) | *P*(*F* ⏐ *s*j) | *P*(*F* ∩ *s*j) | *P*(*s*j ⏐ *F*) |
| *s*1 | 0.35 | 0.10 | 0.035 | 0.0986 |
| *s*2 | 0.35 | 0.40 | 0.140 | 0.3944 |
| *s*3 | 0.30 | 0.60 | 0.180 | 0.5070 |
|  |  | *P*(*F*) = 0.355 | |  |

If *U -* Unfavorable

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| State of Nature | *P*(*s*j) | *P*(*U* ⏐ *s*j) | *P*(*U* ∩ *s*j) | *P*(*s*j ⏐ *U*) |
| *s*1 | 0.35 | 0.90 | 0.315 | 0.4884 |
| *s*2 | 0.35 | 0.60 | 0.210 | 0.3256 |
| *s*3 | 0.30 | 0.40 | 0.120 | 0.1860 |
|  |  | *P*(*U*) = 0.645 | |  |

The probability the report will be favorable is *P*(*F* ) = 0.355

d. Assuming the test market study is used, a portion of the decision tree is shown below.



Summary of Calculations

|  |  |
| --- | --- |
| Node | Expected Value |
| 4 | 64.51 |
| 5 | 54.23 |
| 6 | 21.86 |
| 7 | 32.56 |

Decision strategy:

If *F* then *d*1 since EV(node 4) > EV(node 5)

If *U* then *d*2 since EV(node 7) > EV(node 6)

EV(node 1) = 0.355(64.51) + 0.645(32.56) = 43.90 = EVwSI

e. EVSI = ⏐EVwSI – EVwoSI⏐ = ⏐43.90 – 40.25⏐ = 3.65 or $3,650

18. a. The expected value for the Large-Cap Stock mutual fund is as follows:

EV = 0.1(35.3) + 0.3(20.0) + 0.1(28.3) + 0.1(10.4) + 0.4(–9.3) = 9.68

Repeating this calculation for each of the mutual funds provides the following expected annual returns:

|  |  |
| --- | --- |
| Mutual Fund | Expected Annual Return |
| Large-Cap Stock | 9.68 |
| Mid-Cap Stock | 5.91 |
| Small-Cap Stock | 15.20 |
| Energy/Resources Sector | 11.74 |
| Health Sector | 7.34 |
| Technology Sector | 16.97 |
| Real Estate Sector | 15.44 |

The Technology Sector provides the maximum expected annual return of 16.97%. Using this recommendation, the minimum annual return is –20.1% and the maximum annual return is 93.1%.

b. The expected annual return for the Small-Cap Stock mutual fund is 15.20%. The Technology Sector mutual fund recommended in part (a) has a larger expected annual return. The difference is 16.97% – 15.20% = 1.77%.

c. The annual return for the Technology Sector mutual fund ranges from –20.1% to 93.1% while the annual return for the Small-Cap Stock ranges from 6.0% to 33.3%. The annual return for the Technology Sector mutual fund shows the greater variation in annual return. It is considered the investment with the more risk. It does have a higher expected annual return, but only by 1.77%.

d. This is a judgment recommendation and opinions may vary. The higher risk Technology Sector mutual fund only has a 1.77% higher expected annual return. We believe the lower risk, Small-Cap Stock mutual fund would be the preferred recommendation for most investors.

19. a. The decision is to choose the best lease option; there are three alternatives. The chance event is the number of miles driven. There are three possible outcomes.

b. The payoff table for is shown below. To illustrate how the payoffs were computed, we show how to compute the total cost of the Forno Automotvie lease assuming Warren drives 15,000 miles per year.

Total Cost = (Total Monthly Charges) + (Total Additional Mileage Cost)

= 36($299) + $0.15(45,000 – 36,000)

= $10,764 + $1350

= $12,114

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Annual Miles Driven** | | |
| **Dealer** | 12,000 | 15,000 | 18,000 |
| Forno Automotive | $10,764 | $12,114 | $13,464 |
| Midtown Motors | $11,160 | $11,160 | $12,960 |
| Hopkins Automotive | $11,700 | $11,700 | $11,700 |

c. EV (Forno Automotive) = 0.5($10,764) + 0.4($12,114) + 0.1($13,464) = $11,574

EV (Midtown Motors) = 0.5($11,160) + 0.4($11,160) + 0.1($12,960) = $11,340

EV (Hopkins Automotive) = 0.5($11,700) + 0.4($11,700) + 0.1($11,700) = $11,700

Best Decision: Midtown Motors

d. EV (Forno Automotive) = 0.3($10,764) + 0.4($12,114) + 0.3($13,464) = $12,114

EV (Midtown Motors) = 0.3($11,160) + 0.4($11,160) + 0.3($12,960) = $11,700

EV (Hopkins Automotive) = 0.3($11,700) + 0.4($11,700) + 0.3($11,700) = $11,700

Best Decision: Midtown Motors or Hopkins Automotive

With these probabilities, Warren would be indifferent between the Midtown Motors and Hopkins Automotive leases. However, if the probability of driving 18,000 miles per year goes up any further, the Hopkins Automotive lease will be the best.

20. a. EV(node 4) = 0.5(34) + 0.3(20) + 0.2(10) = 25

EV(node 3) = Max(25,20) = 25 Decision: Build

EV(node 2) = 0.5(25) + 0.5(–5) = 10

EV(node 1) = Max(10,0) = 10 Decision: Start R&D

Optimal Strategy:

Start the R&D project

If it is successful, build the facility

Expected value = $10M

b. At node 3, payoff for sell rights would have to be $25M or more. In order to recover the $5M R&D cost, the selling price would have to be $30M or more.

21. a.



b. EV (node 7) = 0.75(750) + 0.25(–250) = 500

EV (node 8) = 0.417(750) + 0.583(–250) = 167

Decision (node 4)  Accept EV = 500

Decision (node 5)  Accept EV = 167

EV(node 2) = 0.7(500) + 0.3(167) = $400

Note: Regardless of the review outcome *F* or *U*, the recommended decision alternative is to accept the manuscript.

EV(node 3) = .65(750) + .35(–250) = $400

The expected value is $400,000 regardless of review process. The company should accept the manuscript.

c. The manuscript review cannot alter the decision to accept the manuscript. Do not do the manuscript review.

d. Perfect Information.

If *s*1, accept manuscript $750

If *s*2, reject manuscript –$250

EVwPI = 0.65(750) + 0.35(0) = 487.5

EVwoPI = 400

EVPI = 487.5 – 400 = 87.5 or $87,500.

A better procedure for assessing the market potential for the textbook may be worthwhile.