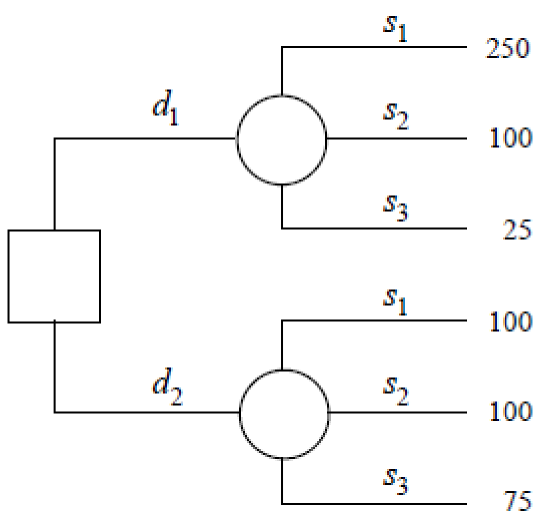
QM 350

Operations Research
Chapter 8
Answers

Problem 1

1. a.



b.

Decision	Maximum Profit	Minimum Profit
d_1	250	25
d_2	100	75

Optimistic approach: select d_1

Conservative approach: select d_2

Regret or opportunity loss table:

	s_1	s_2	s_3
d_1	0	0	50
d_2	150	0	0

Maximum Regret: 50 for d_1 and 150 for d_2; select d_1

a. If s_1 then d_1 ; if s_2 then d_1 or d_2; if s_3 then d_2

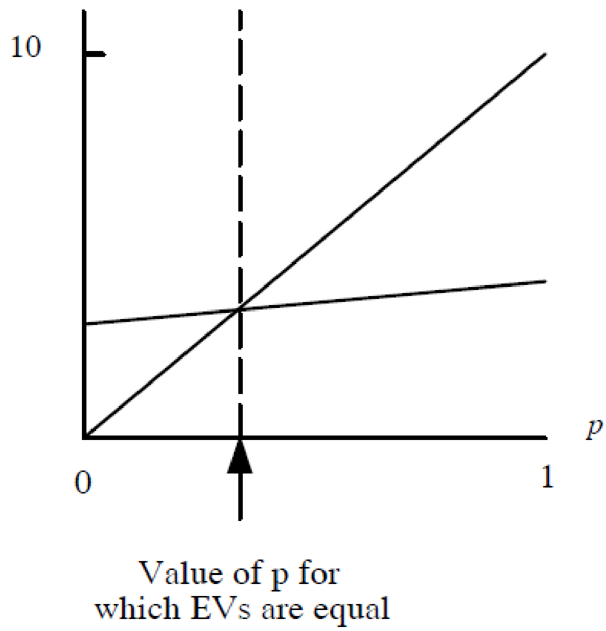
b. EVwPI = .65(250) + .15(100) + .20(75) = 192.5

c. From the solution to Problem 5 we know that EV(d_1) = 182.5 and EV(d_2) = 95; thus, the recommended decision is d_1. Hence, EVwoPI = 182.5.

d. EVPI = EVwPI - EVwoPI = 192.5 - 182.5 = 10

Problem 2

a. $$EV(d_1) = p(10) + (1 - p)(1) = 9p + 1$$
$$EV(d_2) = p(4) + (1 - p)(3) = 1p + 3$$



$9p + 1 = 1p + 3$ and hence $p = .25$

d_2 is optimal for $p \leq 0.25$; d_1 is optimal for $p \geq 0.25$.

b. The best decision is d_2 since $p = 0.20 < 0.25$.

EV(d_1) = 0.2(10) + 0.8(1) = 2.8
EV(d_2) = 0.2(4) + 0.8(3) = 3.2

c. The best decision in part (b) is d_2 with $EV(d_2) = 3.2$. Decision d_2 will remain optimal as long as its expected value is higher than that for d_1 ($EV(d_1) = 2.8$).

Let s = payoff for d_2 under state of nature s_1. Decision d_2 will remain optimal provided that

$EV(d_2) = 0.2(s) + 0.8(3) \geq 2.8$
$0.2s \geq 2.8 - 2.4$
$0.2s \geq 0.4$
$s \geq 2$

As long as the payoff for s_1 is ≥ 2, then d_2 will be optimal.

Problem 3

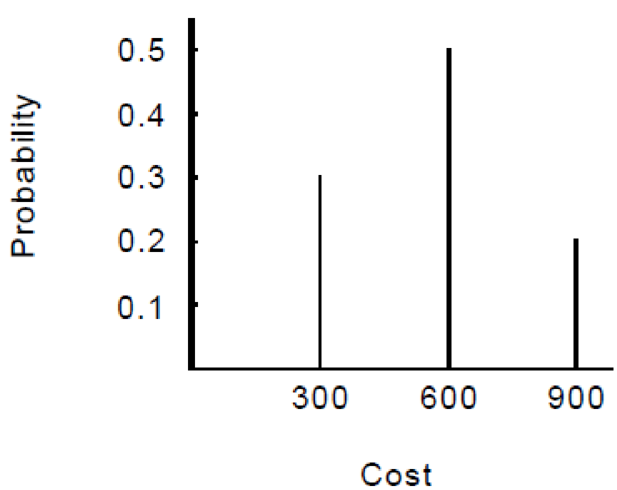
7. a. EV(own staff) = 0.2(650) + 0.5(650) + 0.3(600) = 635
EV(outside vendor) = 0.2(900) + 0.5(600) + 0.3(300) = 570
EV(combination) = 0.2(800) + 0.5(650) + 0.3(500) = 635

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

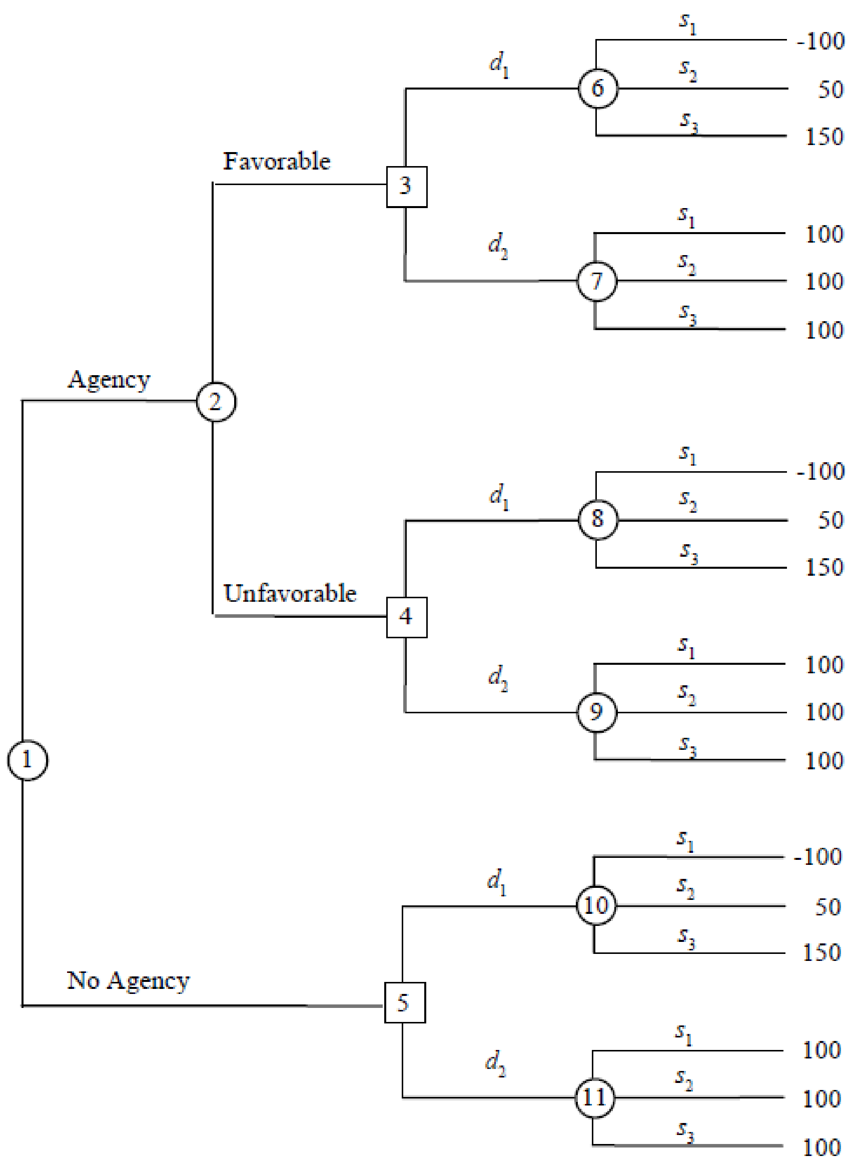
b. The risk profile in tabular form is shown.

Cost	Probability
300	0.3
600	0.5
900	0.2
	1.0

A graphical representation of the risk profile is also shown:



Problem 4



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

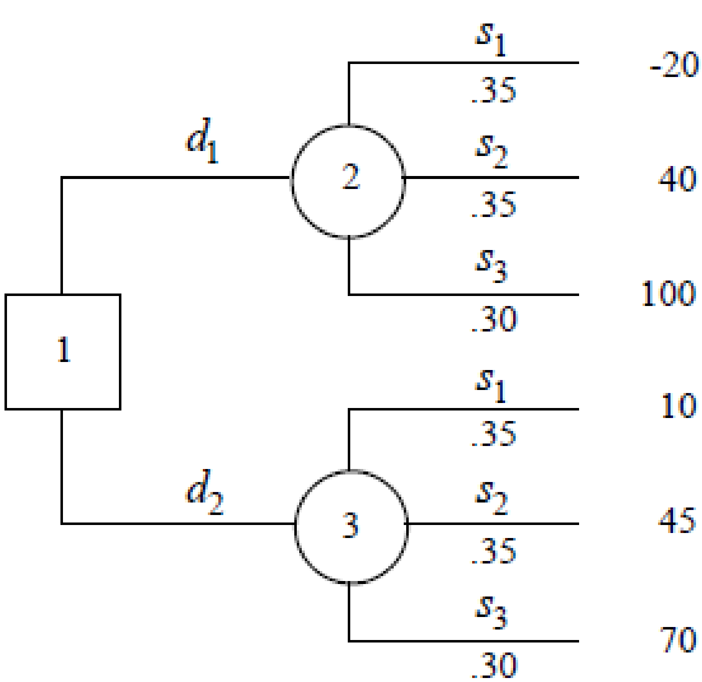
If Unfavorable, Sell EV = $101.04

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.

Problem 5



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

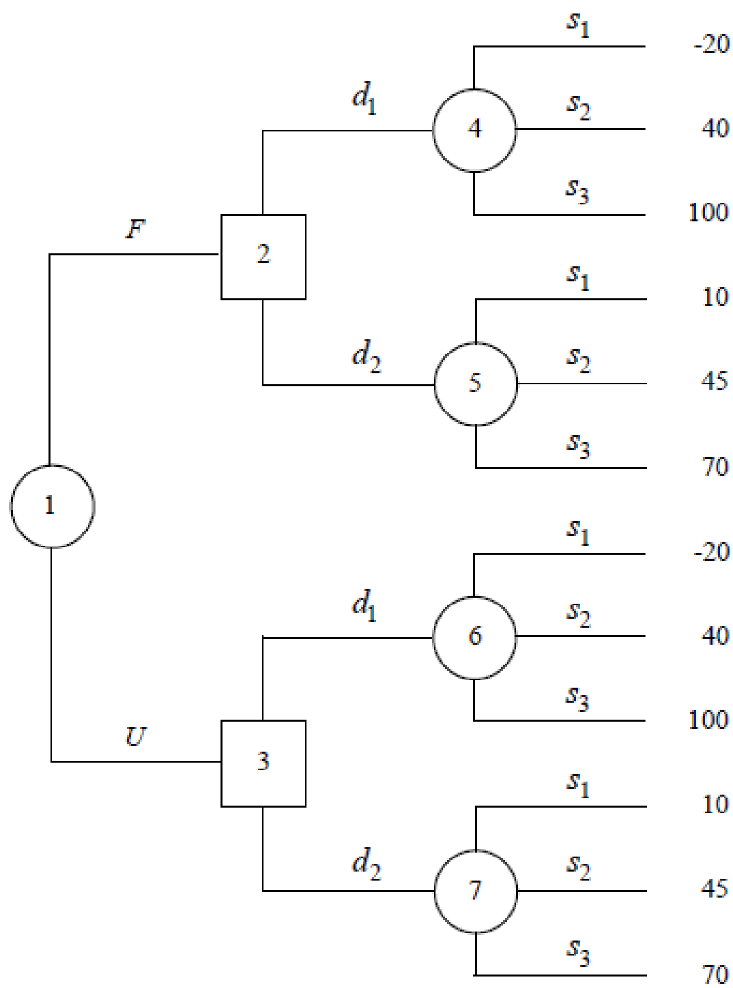
State of Nature	$P(s_j)$	$P(F \mid s_j)$	$P(F \cap s_j)$	$P(s_j \mid F)$
s_1	0.35	0.10	0.035	0.0986
s_2	0.35	0.40	0.140	0.3944
s_3	0.30	0.60	0.180	0.5070
		$P(F) =$	0.355	

If *U* - Unfavorable

State of Nature	$P(s_j)$	$P(U \mid s_j)$	$P(U \cap s_j)$	$P(s_j \mid U)$
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

e. With no information:

EV(d1) = 0.35(-20) + 0.35(40) + 0.30(100) = 37

EV(d2) = 0.35(10) + 0.35(45) + 0.30(70) = 40.25

Recommended decision: d2

f. Optimal decision strategy with perfect information:

If s1 then d2

If s2 then d2

If s3 then d1

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

Efficiency = (3650 / 9000)100 = 40.6%