**CHAPTER 1 SUPPLEMENT**

**OPERATIONAL DECISION-MAKING TOOLS: DECISION ANALYSIS**

**ANSWERS TO PROBLEMS AND CASE PROBLEMS**

**Answers to Problems**

*(Answers may vary due to rounding)*

S1-1. a. Minimin:

South Korea 15.2

China 17.6

Taiwan 14.9

Poland 13.8

Mexico 

**Select Mexico**

b. Minimax:

South Korea 21.7

China 

Taiwan 19.2

Poland 22.5

Mexico 25.0

**Select China**

c. Hurwicz 

South Korea: 

China: 

Taiwan: 

Poland: 

Mexico: 

**Select Taiwan**

d. Equal likelihood:

South Korea:

China:

Taiwan: 🡸 minimum

Poland:

Mexico:

**Select Taiwan**

S1-2. 









**Select Taiwan**

Expected value given perfect 



The EVPI is the maximum amount the *cost* of the facility could be reduced (.9 million) if perfect information can be obtained.

S1-3. a. Maximax criteria:

Office building 

Parking lot 2.4

Warehouse 1.7

Shopping mall 3.6

Condominiums 3.2

**Select office building**

b. Maximin criteria:

Office building 0.5

Parking lot 

Warehouse 1.0

Shopping mall 0.7

Condominiums 0.6

**Select parking lot**

c. Equal likelihood:

Office building: 🡸maximum

Parking lot:

Warehouse:

Shopping mall: 🡸maximum

Condominiums:

**Select office building or shopping mall**

d. Hurwicz criteria 

Office building: 

Parking lot: 

Warehouse: 

Shopping mall: 

Condominiums: 

**Select parking lot**

S1-4. a. 







EV (Condominiums)=🡸 maximum

**Select Condominium project**

b. Expected Value with Perfect Info:

EVPI = Expected value given perfect information–expected value without perfect information = 3.01–2.26 = $0.75 million

S1-5. a. Maximax: Risk fund, maximax 

b. Maximin: Savings bond maximin 

c. Equal likelihood: Bond fund, maximum 

d. Best decision, given probabilities: Bond fund, maximum 

e. expected value given perfect information = 10000\*(0.1\*5+0.2\*4+0.4\*4.2+0.2\*9.3+0.1\*16.7) = 65100. The maximum amount she should pay to analyst = 65100 – 35000 = 30100

S1-6. a. Maximax: Pass for a gain of 20 yd

b. Maximin: Option for a loss of 1 yd

c. Equal likelihood: Option for a gain of 7 yds.

d. Plays ranked best to worst:

|  |  |
| --- | --- |
| **Play** | **EV** |
| Pass | 6.4 |
| Option | 5.3 |
| Toss sweep | 4.8 |
| Off tackle | 3.2 |
| Screen | 2.3 |
| Draw | 1.6 |

With a 60% chance of a blitz they should run the option, with an expected value of 11.5 yd. In 70% of cases (when Laurier uses Blitz or Nickel), Guelph will make the first down. If the only thing Guelph cares about is securing the first down, they could also run the Toss Sweep (also a 70% chance of getting the first down).

S1-7. a.

|  |  |
| --- | --- |
| **Product** | **Expected Value** |
| Widget |  |
| Hummer |  |
| Nimnot |  |

The best option is to introduce the widget.

b. EV given perfect information:



EV without perfect information: Widget at $62,000.

Value of perfect information: 

The company would consider this a maximum; since perfect information is rare, it would probably pay less than $24,000.

c. Maximax: Introduce widget, maximax 

Maximin: Introduce nimnot, maximin 

Minimax regret: Maximum regret for Widget = 🡸 min

Maximum regret for Hummer =

Maximum regret for Nimnot =

Introduce widget, Minimax 

Equal likelihood: Introduce widget, maximum

S1-8. a. Maximax: Major physical revision, maximum payoff  $972,000

b. Maximin: Paperback, maximum payoff  $68,000

c. Equal likelihood: Major content revision, maximum payoff  $423,667

d. Hurwicz: Major content revision, maximum payoff  $273,900

S1-9.

|  |  |
| --- | --- |
| **Publication Decision** | **Expected Value** |
| Paperback | $216,290 |
| Similar revision | 386,340 |
| Major content revision | 468,780 |
| Major physical revision | 405,970 |

Best decision  major content revision

Overall “best” decision appears to be a “major content revision”

EVPI  (.23)(68,000)  (.46)(515,000)  (.31)(972,000)  468,780  $85,080

This is the maximum amount Wiley would pay an “expert” for additional information about the future competitive market.

S1-10. a. Maximax: Singapore, maximum payoff  $71 million

b. Maximin: Kaohsiung, maximum payoff  -$15 million

c. Equal likelihood: Kaohsiung, maximum payoff  $28.33 million

d. Hurwicz: Singapore, maximum payoff  $37.8 million

e. Minimax regret: Singapore, minimum regret  $9 million

S1-11. Expected value

|  |  |
| --- | --- |
| **Port** | **Expected Value** |
| Hong Kong | $22.99 |
| Singapore | 34.52 |
| Shanghai | 24.54 |
| Busan | 28.30 |
| Kaohsiung | 33.66 |

a. Best decision  Singapore

b. Singapore appears to be the best “overall” decision.

S1-12. Expected value

|  |  |
| --- | --- |
| **Lease Decision** | **Expected Value** |
| 1 – year | $65,980 |
| 2 – year | 103,010 |
| 3 – year | 133,810 |
| 4 – year | 154,300 |
| 5 – year | 114,210 |

The 4 year lease is the best decision using EV.

S1-13. EVPI  (.17)(1,228,000)  (.34)(516,000)  (.49)(16000)  154,300

 $237,740

This is the maximum amount the restaurant owner would pay an energy “expert” for additional information about future energy prices.

S1-14. a. Maximax: Food court, maximum payoff  $87,000

b. Maximin: Child care center, maximum payoff  $17,000

c. Hurwicz: Lockers and showers, maximum payoff  $32,250

d. Equal likelihood: Lockers and showers, maximum payoff  $35,333

S1-15.

|  |  |
| --- | --- |
| **Service Facility** | **Expected Value** |
| Child care center | $30,560 |
| Swimming pool | 7,610 |
| Lockers and showers | 44,150 |
| Food court | 15,440 |
| Spa | 20,580 |

Best decision = Lockers and showers

S1-16. a. Payoff table using 12 kg in 5th row

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **Demand (kg)** | | | | | **EV** |
|  | **10**  **0.10** | **10.5**  **0.20** | **11**  **0.30** | **11.5**  **0.30** | **12**  **0.10** |  |
| **Stock (kg)** |  |
| 10 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 |
| 10.5 | 4.63 | 5.25 | 5.25 | 5.25 | 5.25 | 5.19 |
| 11 | 4.25 | 4.88 | 5.50 | 5.50 | 5.50 | 5.25 |
| 11.5 | 3.88 | 4.50 | 5.13 | 5.75 | 5.75 | 5.13 |
| 12 | 3.50 | 4.13 | 4.75 | 5.38 | 6.00 | 4.81 |

Payoff table using 22kg in 5th row (as written in 2nd Canadian edition of text)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **Demand (kg)** | | | | | **EV** |
|  | **10**  **0.10** | **10.5**  **0.20** | **11**  **0.30** | **11.5**  **0.30** | **22**  **0.10** |  |
| **Stock (kg)** |  |
| 10 | 5.00 | 5.00 | 5.00 | 5.00 | 5.0 | 5.00 |
| 10.5 | 4.63 | 5.25 | 5.25 | 5.25 | 5.2 | 5.19 |
| 11 | 4.25 | 4.88 | 5.50 | 5.50 | 5.5 | 5.25 |
| 11.5 | 3.88 | 4.50 | 5.13 | 5.75 | 5.7 | 5.13 |
| 22 | -4.00 | -3.38 | -2.75 | -2.13 | 11.0 | -1.44 |

Order 11 kg of apples for a profit of $5.25.

b. Maximax: Stock 22 kg for a maximax profit of $11.

(or stock 12 kg for a maximax profit of $6.00)

Maximin: Stock 10 kg for a maximin profit of $5.00.

S1-17. a. Payoff table:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **Demand** | | | | | |
| **Stock**  **(boxes)** | **25**  **0.10** | **26**  **0.15** | **27**  **0.30** | **28**  **0.20** | **29**  **0.15** | **30**  **0.10** |
| 25 | 50 | 50 | 50 | 50 | 50 | 50 |
| 26 | 49 | 52 | 52 | 52 | 52 | 52 |
| 27 | 48 | 51 | 54 | 54 | 54 | 54 |
| 28 | 47 | 50 | 53 | 56 | 56 | 56 |
| 29 | 46 | 49 | 52 | 55 | 58 | 58 |
| 30 | 45 | 48 | 51 | 54 | 57 | 60 |



















Best decision: Stock 28 boxes, for a profit of $53.30.

b. Expected value with perfect information:

EVwPI = 50(0.10)+52(0.15)+54(0.30)+56(0.20)+58(0.15)+60(0.10) = 54.9



S1-18. a. Stock 25, maximum of minimum 

b. Stock 30, maximum of maximum 

c.       stock 30 boxes.

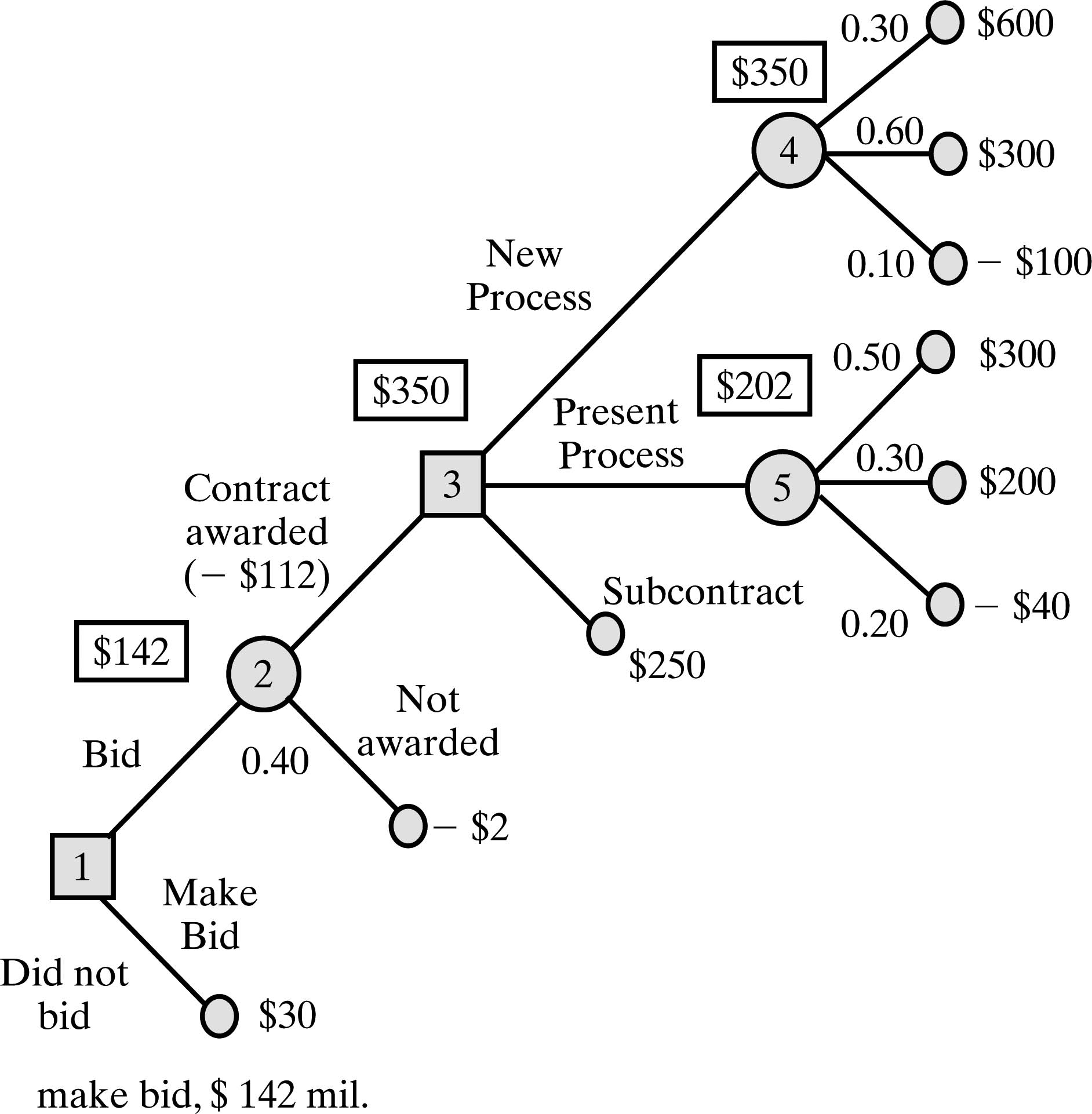
d. Stock 28 or 29 boxes; minimum 

S1-19. 

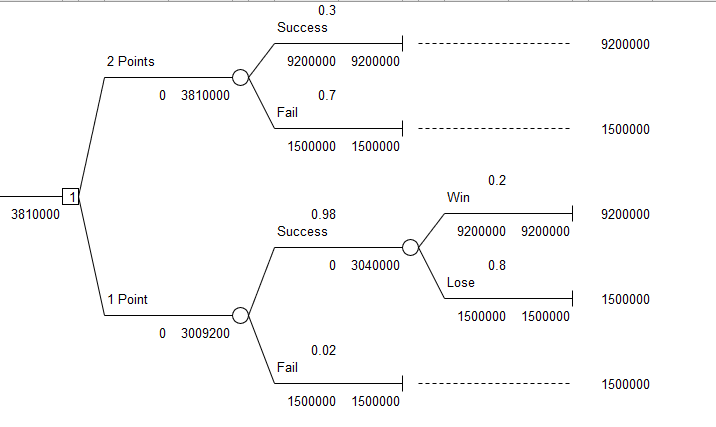


 purchase press.

S1-20.



S1-21.



They should go for the two point play.

3.81M=0.02\*1.5M+0.98\*(9.2M\*p+1.5M\*(1-p))

p=0.3061

If Tech’s probability of winning in overtime is 30.61%, they are indifferent between the one and two point play.

S1-22. a. Maximax = Real Estate

b. Maximin = Nursing

c. Equal Likelihood: **select Real Estate**

Graphic design = $170,000

Nursing = $187,500

**Real Estate = $202,500**

Medical Technology = $195,000

Culinary technology = $170,000

Computer information technology = $186,250

d. Hurwicz (alpha = 0.25): **select Nursing**

Graphic design = $141,250

**Nursing = $161,250**

Real Estate = $158,750

Medical Technology = $157,500

Culinary technology = $136,250

Computer information technology = $158,750

S1-23. EV(Graphic design) = $164,250

EV(Nursing) = $183,500

EV(Real Estate) = $174,400

**EV(Medical Technology) = $187,500**

EV(Culinary technology) = $149,250

EV(Computer information technology) = $174,750

S1-24. a. Minimin= Philippines

b. Minimax = Mexico

c. Equal likelihood:

China= $4.3

India = $4.13

**Philippines =$ 4.03 SELECT**

Brazil = $4.57

Mexico = $4.87

d. minimax regret= Philippines, minimum regret = $70000

:

S1-25. a. EV(China)= $5.328

EV(India) = $ 5.375

EV(Philippines) = $5.218

**EV(Brazil)= $ 5.178 SELECT**

EV(Mexico) = $ 5.202

b. EVwPI= 1.7\*(0.09) + 3.8\*(0.27) + 5.4\*(0.64) = $4.635

EVPI= 5.178-4.635= $0.543

The maximum they should pay to the analyst is $54300 (original data in $100,000s).

S1-26. a. Maximax = Hong Kong

b. Maximin = Pusan

c. Equal likelihood:

Shanghai = $0.44 billion

Singapore = $0.37 billion

Pusan = $0.43 billion

Kaoshiung = $0.41 billion

**Hong Kong = $0.47 billion**

d. Hurwicz (alpha = .55):

Shanghai = $0.47 billion

Singapore = $0.41 billion

Pusan = $0.46 billion

Kaoshiung = $0.51 billion

**Hong Kong = $0.77 billion**

S1-27. EV(Shanghai) = $0.608 billion

EV(Singapore) = $0.606 billion

EV(Pusan) = $0.502 billion

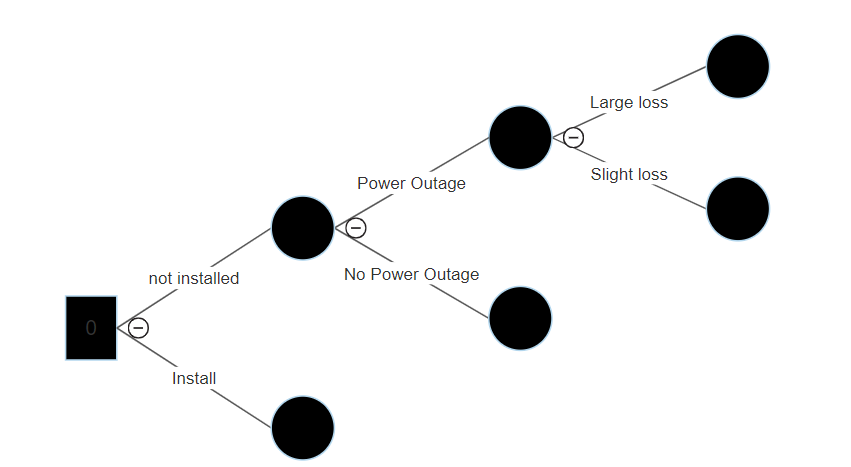
EV(Kaoshiung) = $0.487 billion

**EV(Hong Kong) = $0.724 billion**

S1-28. 

The cost of the snow blower ($575) is much more than the annual cost of the snow shovelling service, thus on the basis of one year the snow blower should not be purchased. However, the snow blower could be used for an extended period of time such that after approximately 6 years the cost of the snow blower would be recouped. Thus, the decision hinges on whether or not the decision maker thinks 6 years is too long to wait to recoup the cost of the snow blower.

S1-29.



$552,000

$5,520,000

$552,000

$2,000,000

$90,000,000

$900,000

$0

%96

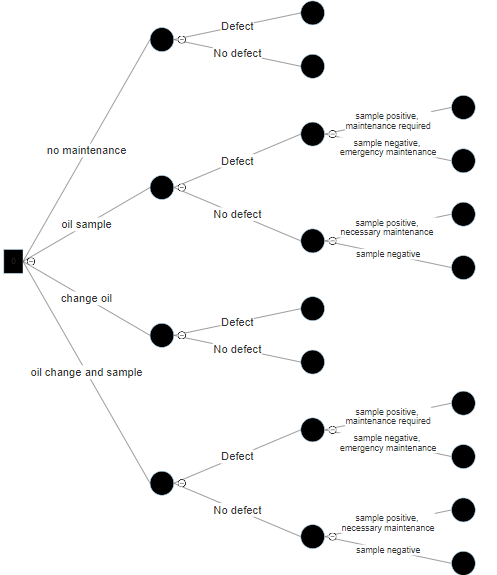
%4

%90

%10

Since cost of installation ($900,000) is greater than expected value of not installing ($552,000), do not install an emergency power generator

S1-30.



$98.8

$1600

0.08

$98.8

$128

$152.4

$34.8

$136

$54.8

$40

$0

$81.2

$50

$830

$64

$112.4

$50

$830

$128

$0

$250

$1600

$500

$0

$1600

$0

$250

$1600

$500

$0

0.80

0.20

0.30

0.70

0.80

0.20

0.30

0.70

0.96

0.96

0.92

0.92

0.04

0.04

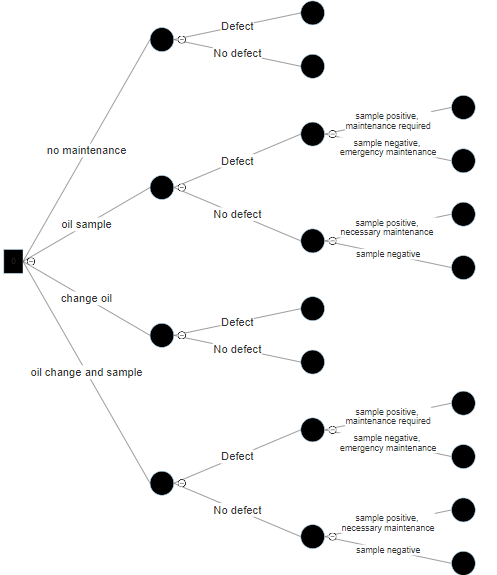
0.08

Select strategy 3; Change oil regularly; EV = $98.80

S1-31.

$15,000

0.08



$716.4

$716.4

$1200

$466.4

$5900

$5900

$1200

$15000

$15000

$15000

$742.8

$200

$800

$250

$50

$0

$240

$600

$692.8

$240

$0

$1200

$2000

$0

$0

$1200

$2000

$0

0.80

0.20

0.30

0.70

0.80

0.20

0.30

0.70

0.96

0.96

0.92

0.92

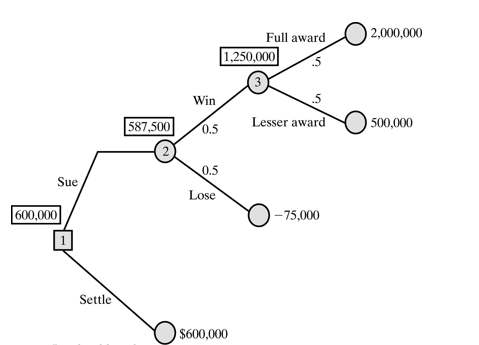
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0.04

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Select Strategy 4; Change oil and sample; EV = $716.40

S1-32.



Mary should settle

S1-33. The following table includes the medical costs for all the final nodes in the decision tree (including all monthly costs and out of pocket expenses):

|  |  |  |  |
| --- | --- | --- | --- |
| **Expense** | **Plan 1** | **Plan 2** | **Plan 3** |
| 100 | 484 | 160 | 318 |
| 500 | 884 | 560 | 438 |
| 1,500 | 984 | 1,290 | 738 |
| 3,000 | 1,134 | 1,440 | 1,188 |
| 5,000 | 1,334 | 1,640 | 1,788 |
| 10,000 | 1,834 | 2,140 | 3,288 |

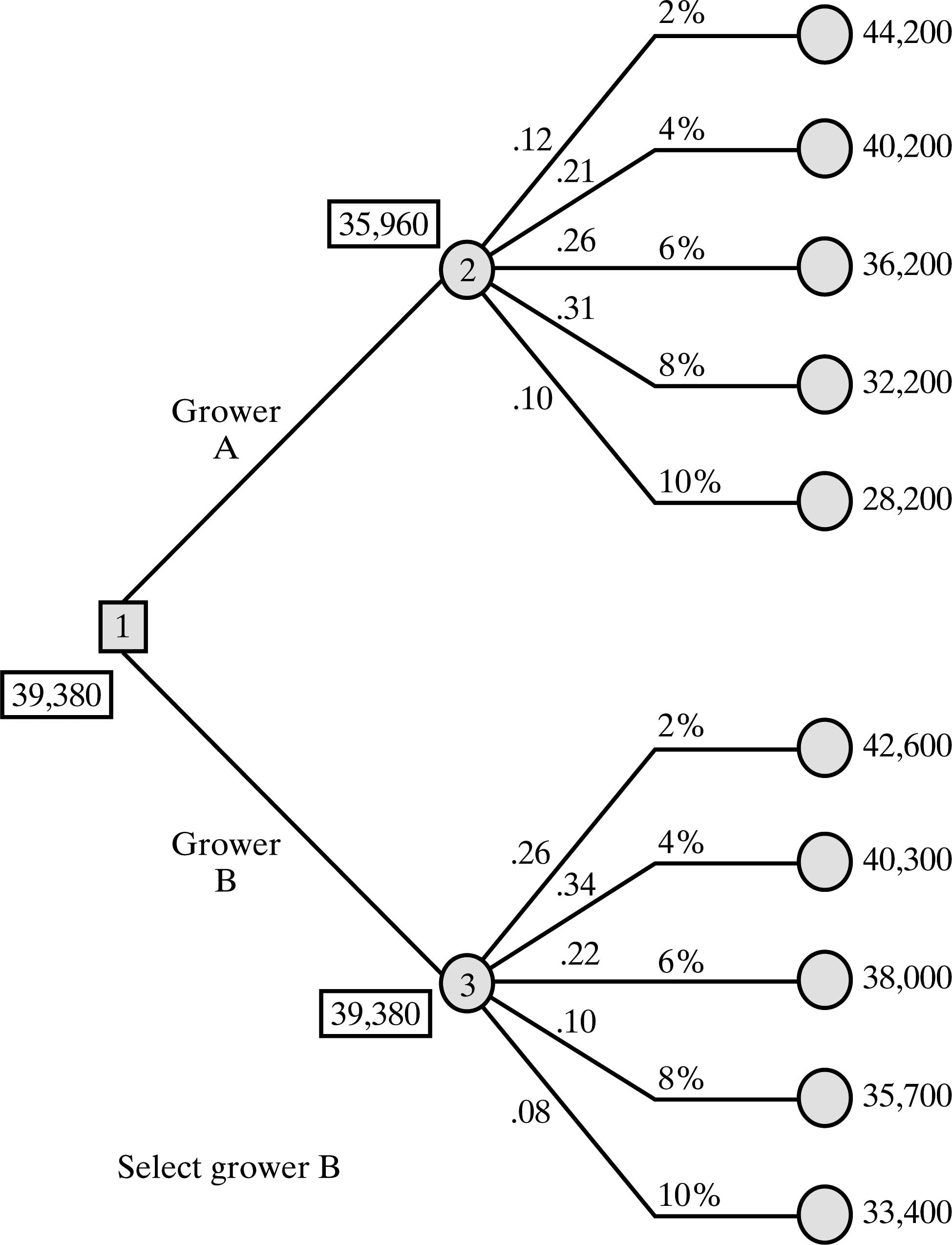




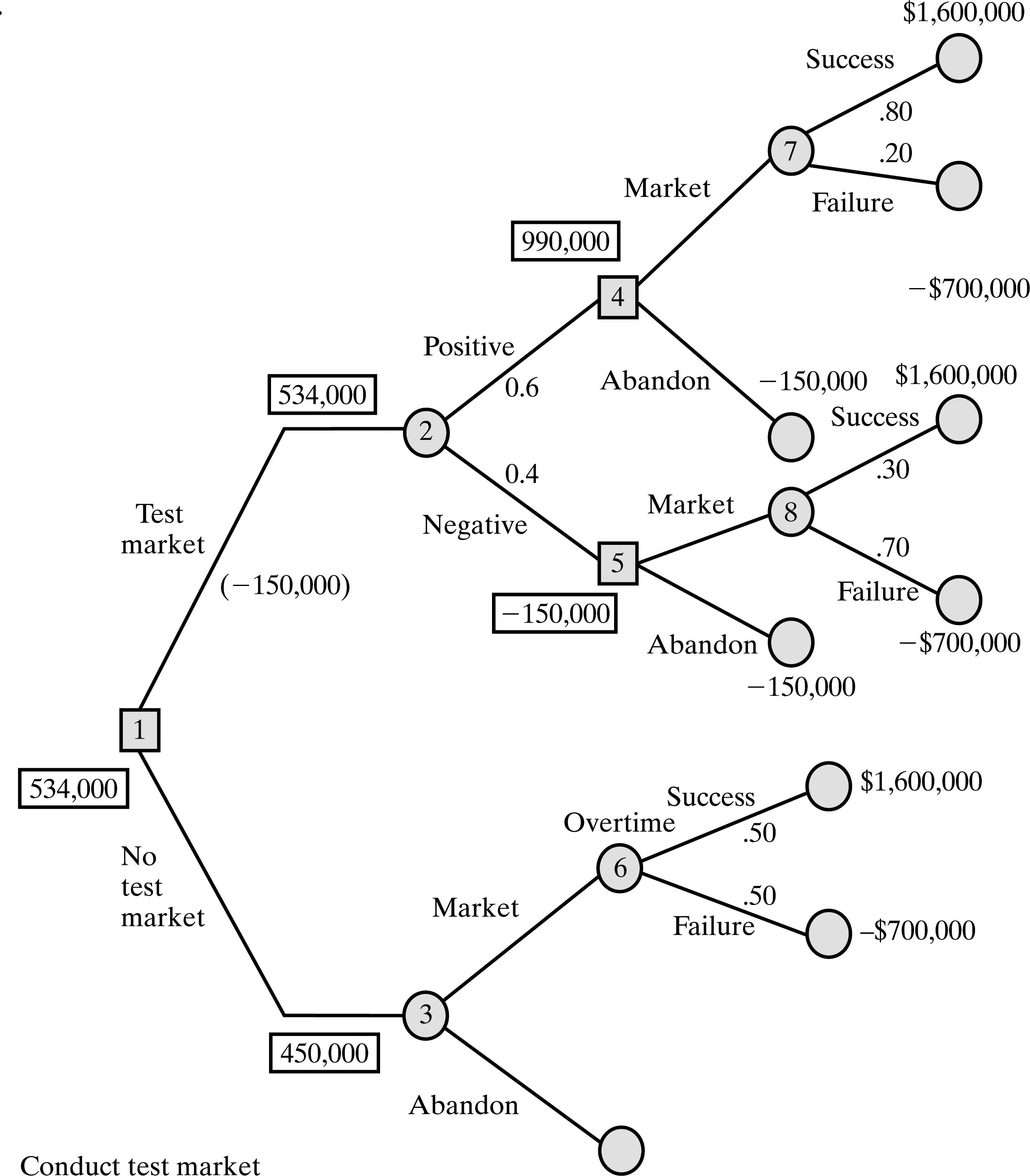


Select plan 3

S1-34.



S1-35.



If result is positive, then market.

If result is negative, then abandon.

S1-36.

1. Minimin = Thailand
2. Minimax = India
3. Equal likelihood:

China= $13000000

**India = $9000000 SELECT**

Thailand = $11000000

Philippines = $10000000

1. Philippines with minimum regret $2,000,000

S1-37

EV(China)= $10910000

**EV(India) = $7210000 SELECT**

EV(Thailand) = $9770000

EV(Philippines) = $7540000

**Answers to Case Problem S1.1: Whither an MBA at Brandon?**

a. Maximax: IT, maximum payoff  $517,000

b. Maximin: Health Administration, maximum payoff  $75,000

c. Equal likelihood: Nursing, maximum payoff  $114,500

d. Hurwicz: Nursing, maximum payoff  $86,000

e. They do not have sufficient insight into the probability of the future success of the programs to indicate either optimism or pessimism; or for “political” reasons they feel it is imprudent to express a “preference.” Hurwicz with alpha = 0.5 ends up selecting the choice that best balances a good best case against a not so bad worst case.

f. Best decision  Nursing

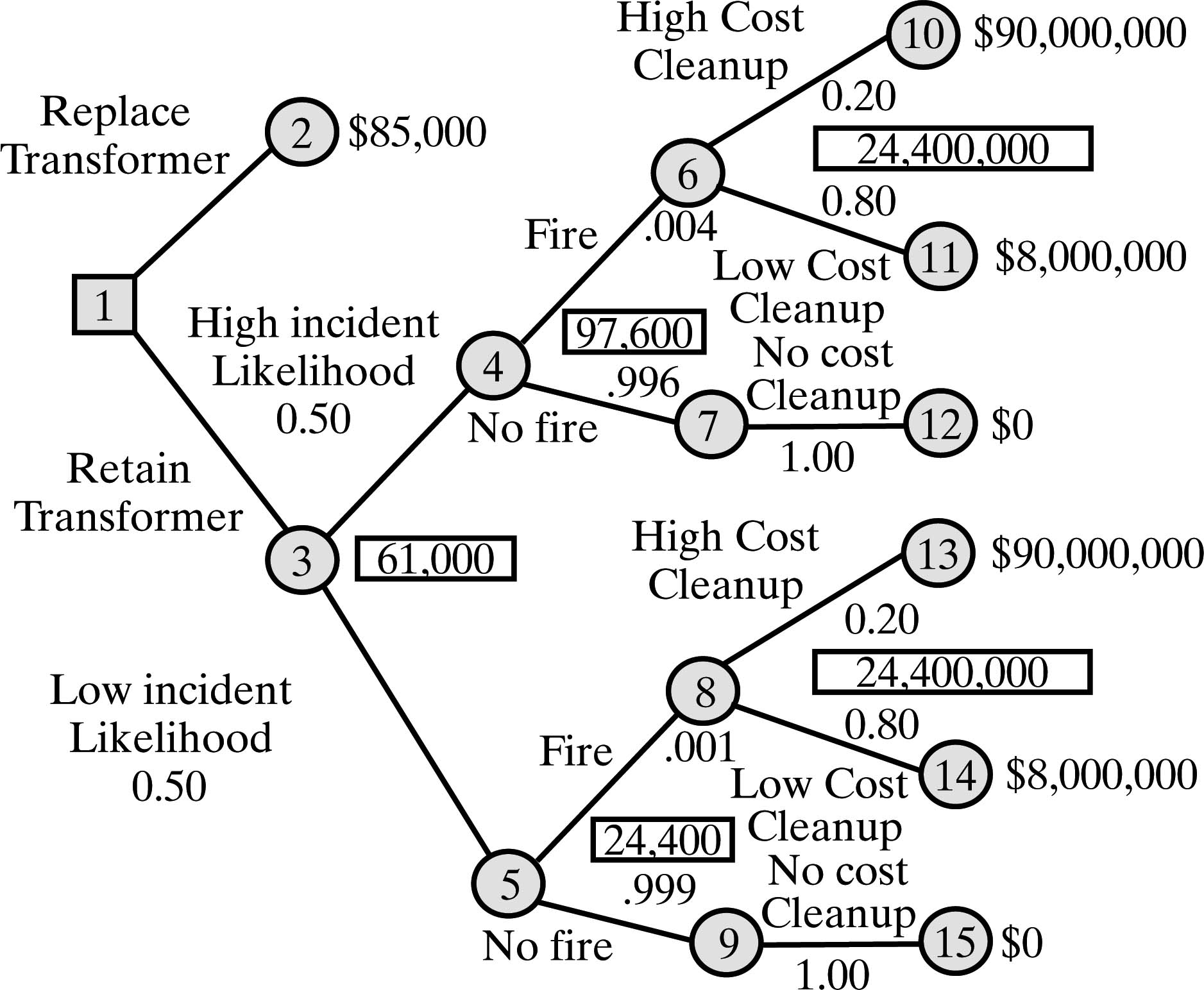
|  |  |
| --- | --- |
| Graduate Program | Expected Value |
| MBA | 27,470 |
| Computer Science | 45,000 |
| Information Technology | 10,790 |
|  |  |
| Nursing | **126,760** |
| Health Administration | 124,250 |

g. Nursing appears to be the best overall decision.

h. The Nursing or Health Admin programs are the best options, with Nursing having better expected results in all cases except when the program is unsuccessful. Only the most pessimistic decision makers might choose Health Admin. Since Brandon is trying to increase revenue and expand, it should be encouraged to take on this small risk and choose Nursing.

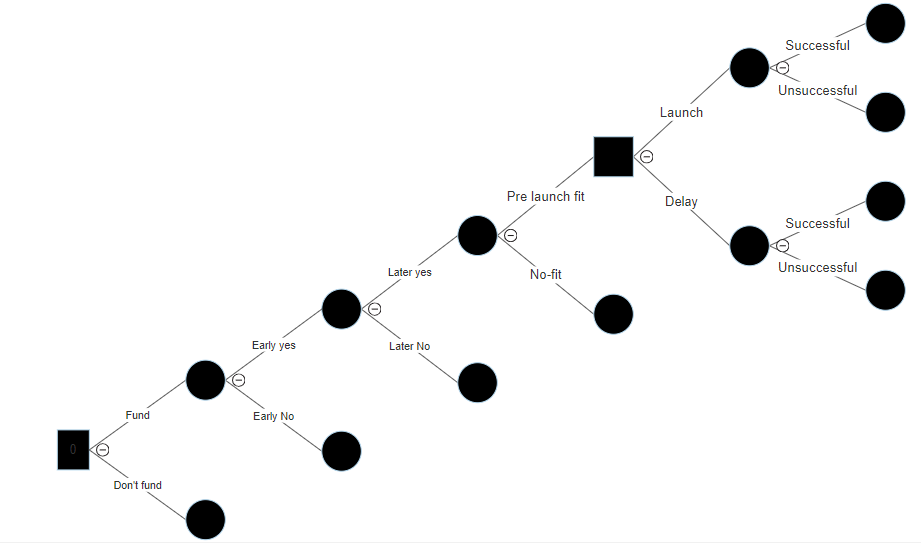
**Answers to Case Problem S1.2: Transformer Replacement at Mountain Side Electric Company**

The decision tree solution for this problem is shown below. The decision should be to retain the existing transformer; the cost of replacement ($85,000) is greater than the cost of retention ($61,000).



**Answers to Case Problem S1.3*:* Evaluating Projects at Nexcom Systems**

Project 1:



-$200,000

-$690,000

-$315,000

$2,549,000

$839,400

$404,368

$404,368

$3,580,000

$3,580,000

$3,340,000

0.28

0.72

0.4

0.6

0.2

0.8

0.2

0.8

0.4

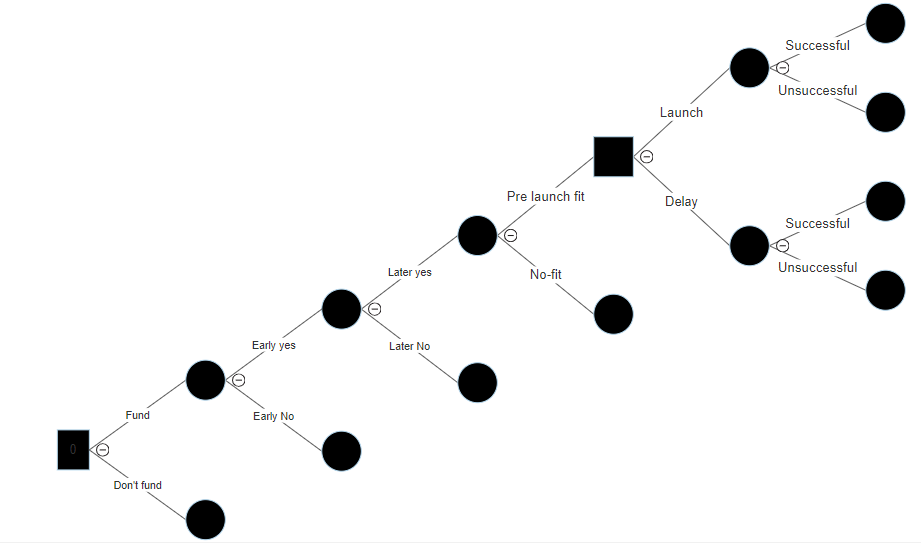
0.6

-$1,300,000

$4,500,000

-$2,000,000

$7,300,000

Project 2: 

-$380,000

-$730,000

-$420,000

$2,658,750

$758,900

$105,696

$105,696

$4,105,000

$4,105,000

$3,000,000

0.36

0.64

0.44

0.56

0.25

0.75

0.3

0.7

0.35

0.65

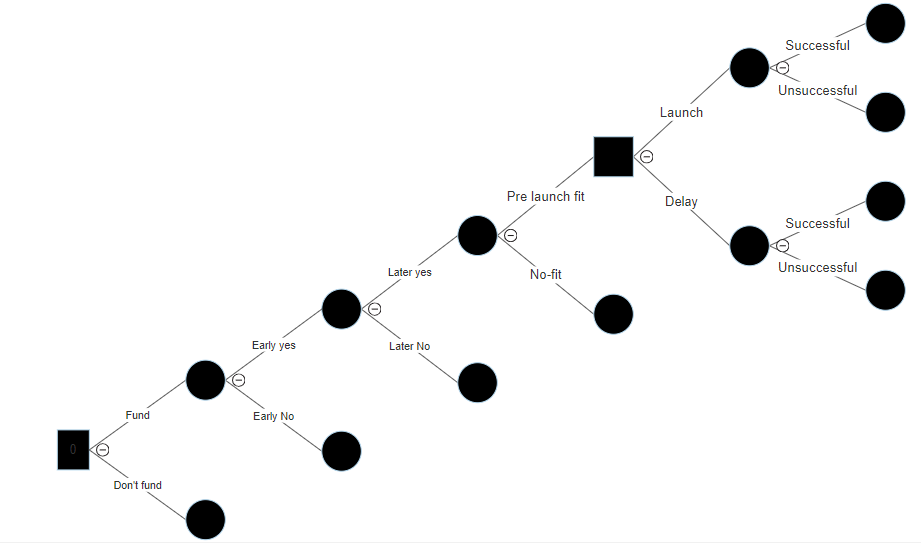
-$4,000,000

$6,000,000

-$3,500,000

$8,200,000

Project 3 :



-$270,000

-$430,000

-$390,000

$1,967,200

$848,680

$442.891

$442,891

$2,840,000

$2,840,000

$1,865,000

0.16

0.84

0.35

0.65

0.17

0.83

0.35

0.65

0.3

0.7

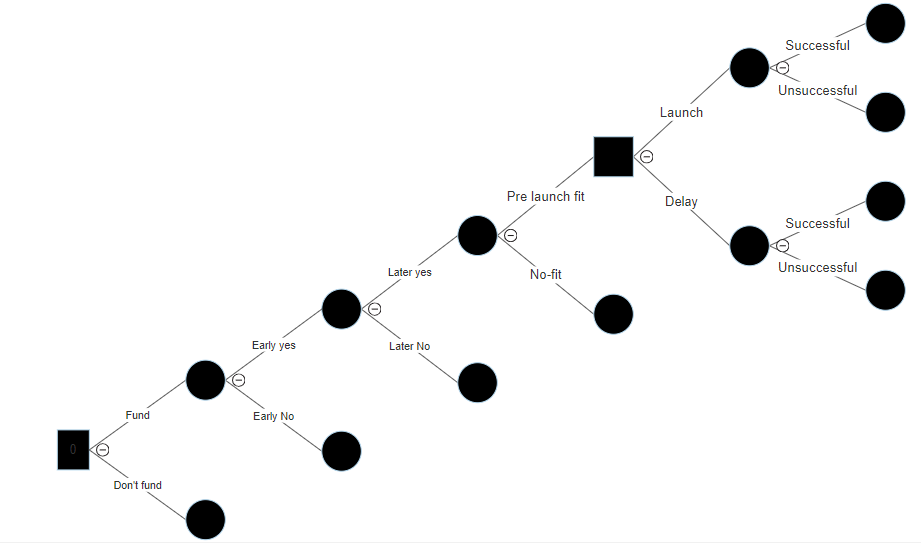
-$800,000

$3,300,000

-$1,500,000

$4,700,000

Project 4:



$344,490

-$230,000

-$270,000

-$410,000

$1,851,250

$1,025,875

$344,490

$3,375,000

$3,375,000

$1,780,000

0.44

0.56

0.3

0.7

0.33

0.67

0.2

0.8

0.25

0.75

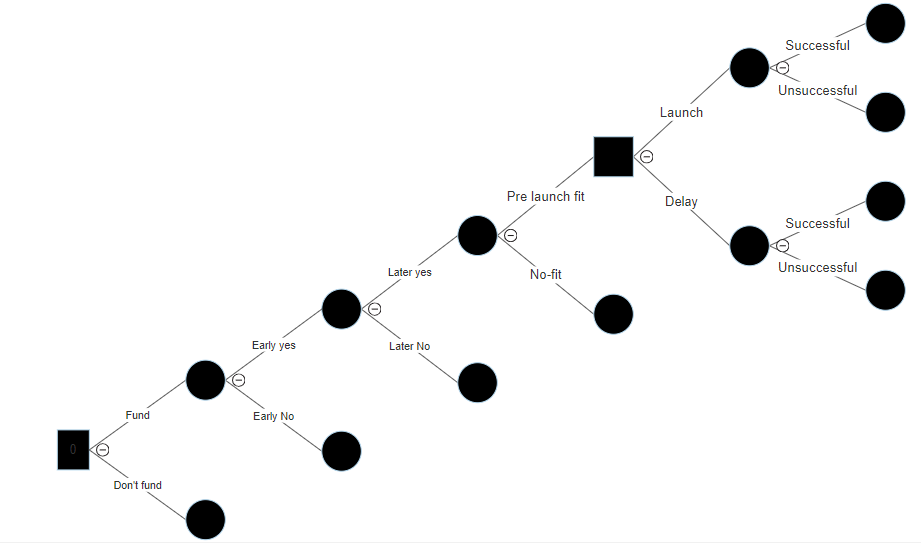
-$1,100,000

$2,500,000

-$2,100,000

$5,200,000

Project 5:



$262,252

-$400,000

-$350,000

-$270,000

$1,680,650

$860,068

$262,252

$3,001,000

$3,001,000

$2,160,000

0.23

0.77

0.28

0.72

0.35

0.65

0.15

0.85

0.17

0.83

-$900,000

$2,700,000

-$900,000

$3,800,000

|  |  |
| --- | --- |
| **Project** | **EV** |
| 1 | 404,368 |
| 2 | 105,696 |
| **3** | **442,891** |
| 4 | 344,490 |
| 5 | 262,252 |

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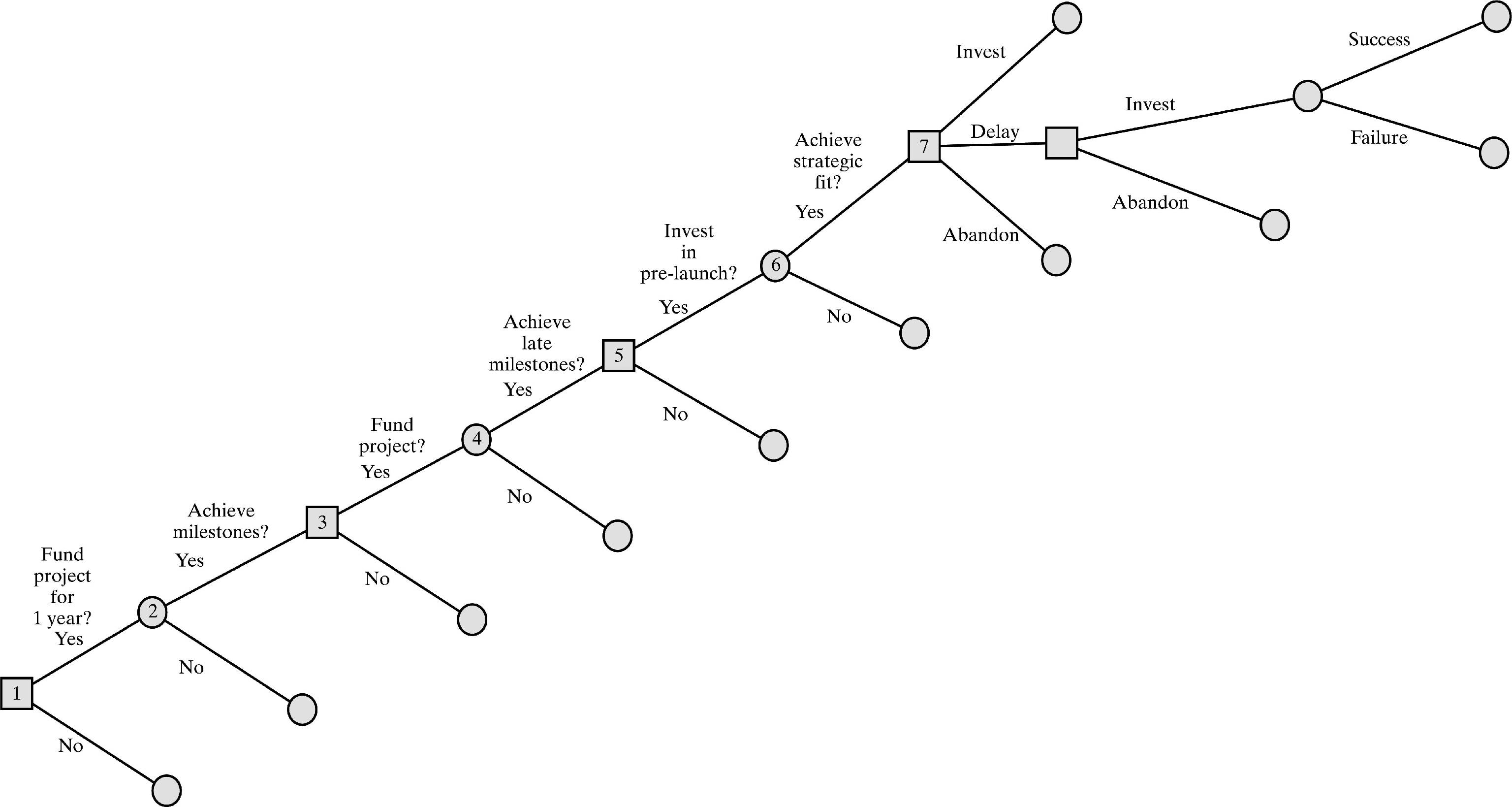
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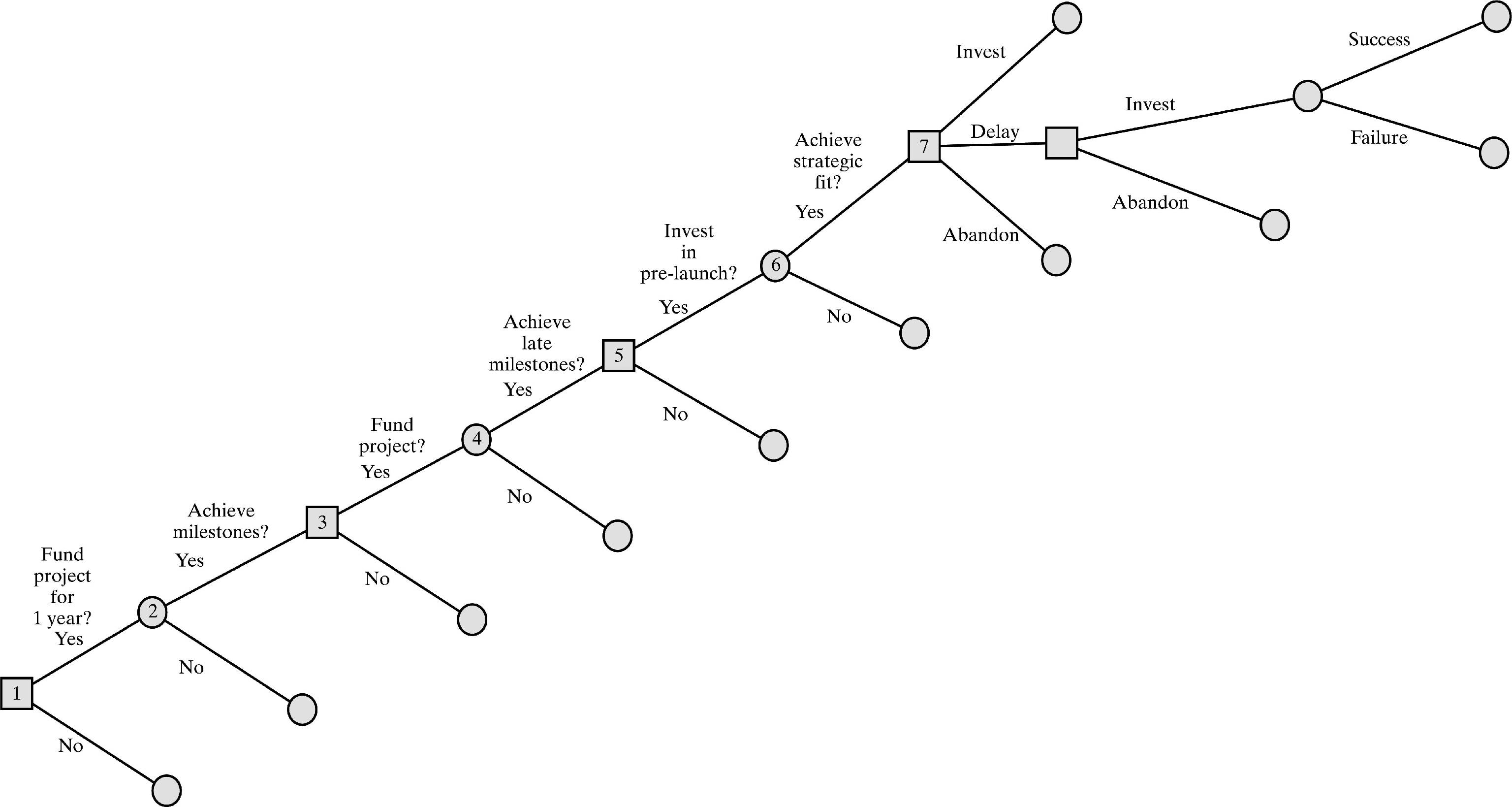
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