Assignment09

4. Provide the answers to Question 1 and Question 2 above into Word:

Question 1: What is the probability that a property worth at least $150,000 in year 1 ends up worth $200,000 or more in year 5? (**Hint:** Think about numerator and denominator to answer this question. How many properties are there overall? How many properties start out at $150,000+ and then end up at $200,000+ in year 5?)

ans:

```
>my_data<-read.csv("C:/Users/intro_to_Data_Science/module_5/problem_set-9-M
opps_with_commas.csv",header = TRUE)
> nrow(my_data)
[1] 200
> sum(my_data$y1_val>=150000&my_data$y5_val>=200000)
[1] 141
```

there are 200 observations(properties) overall in the dataset, so the denominator is 200; there are 141 properties that start out at $150,000 or more and then end up at $200,000 or more, so the probability that that a property worth at least $150,000 in year 1 and ends up worth $200,000 or more in year 5 is 141/200=70.5%

Question 2: What is the probability that a property worth at least $150,000 in year 1 ends up worth more than $279,000 in year 5? (**Hint**: Think about numerator and denominator to answer this question. How many properties are there overall? How many properties start out at $150,000+ and then end up at $279,000+ in year 5?)

Ans:

```
> sum(my_data$y1_val>=150000&my_data$y5_val>=279000)
[1] 105
```

Since there are 200 observations(properties) totally in the dataset, so the denominator is 200; there are 105 properties that start out at $150,000 or more and then end up at $279,000 or more, so the probability that that a property worth at least $150,000 in year 1 and ends up worth more than $279,000 in year 5 is 105/200=52.5%

According to problem description, the conditional probability of favorable report given the business will be viable (P(YR|YV)) is 60%, and conditional probability of unfavorable report given the business will not be viable (P(NRT|NV)) is 70%, With 52.5% as probability of that business is going to be viable, I calculate the probabilities as following:

	positive (YR)	negative (NR)	MARGINAL PROB
Viable (YV)	31.5%	21.0%	52.5%
Not viable (NV)	14.25%	33.25%	47.5%
MARGINAL PROB	45.75%	54.25%	1

P(YR|YV)=	60%	P(NR|YV)=	40%
P(YR|NV)=	30%	P(NR|NV)=	70%

Conditional Probabilities:

P(YV|YR)=	68.85%	P(NV|YR)=	31.15%
P(YV|NR)=	38.71%	P(NV|NR)=	61.29%

5. Further provide the answers to the questions that follow:

a. Describe and interpret what is going on in this tree in about 250 words.

First , the potential business owner in the hoomaflopper industry need to decide if he hire Dustin to do further market research or not, this is rood decision node in the decision tree.

If the business owner prefer not to do research, there is no expenditure needed, then he need to make the next decision on whether to buy the business Dustin recommended to him or not:

1) If he choose to buy the business, then he need to invest $2480,00 to run the business. The business is viable or not is a chance event:
    1) there are 52.5% chance that the business is viable and then earn $500,000 in the first year;
    2) there are also 47.5% chance that the business is not viable and the business owner will lost all of investment ($248,000).

2) if the business owner choose not to buy the business, then he will lost nothing and of course will earn nothing.

If the business owner chooses to hire Dustin to do market research, he will have to pay $16,000 Mr Dustin, namely the cost of doing research is $16,000. The report of market research will turn out to be favorable or unfavorable, it is a chance event:

1) there is 45.75% chance that the report result is favorable(YR), according to the previous calculation. If the report is favorable, the business owner needs to decide whether to buy the business or not:
    a) if he decide to buy the business, he need to make further investment of $248,000 to make the business run. Even if the business run normally, it may be viable to not viable, it is also chance event:
        i.   the business will have 68.85% chance to be viable given the market research result is favorable, if the business is viable, the owner will earn $500,000 in the first year and have $236,000 payoff (net profit);
        ii.   there is also 31.15% chance that business will not be viable given the research result is favorable. In this case, business owner will lost all of his investment ($264,000)
    b) If he decide not to buy the business, he will lost his research investment($1,6000)

2) the research result will be not favorable(NR) with the probability of 54.25%. if the research result turns out to be not favorable, then the business owner need to decide to buy or not to buy the business:
    a) if he decide to buy the business, despite the unfavorable research result, he need to make further investment of $248,000 to make the business run. Even if the business run normally, it may be viable to not viable, it is also chance event:
        i.   the business will have 38.71% chance to be viable given the market research result is not favorable, if the business is viable, the owner will earn $500,000 in the first year and have $236,000 payoff (net profit);
        ii.   there is also 61.29% chance that business will not be viable given the research result is unfavorable. In this case, business owner will lost all of his investment ($264,000)
    b) If he decide not to buy the business, he will lost his research investment($1,6000)

b. Include a discussion on what the optimal strategy is and why is it the optimal strategy?
   Ans: based on the expected value calculated, the optimal strategy is that conducting the market research first, although it needs $16,000 of research cost, then if the research result is favorable, choosing to buy the business; if the research result turns out to be unfavorable, choosing not to buy the

business. The strategy shows that the decision of buying business or not depends on the research result is favorable or not, that means the market information provided by research is crucial to the business decision. This strategy is optimal because the expected value of this alternative is much higher than that of the alternative of not doing research. The essential point of this strategy is that having the information of market provided by research report, the business owner can make choice of buying or not buying the business much more wisely: if the research result is favorable, there is much higher probability for the business to be viable (68.85%), compared with the viable probability of business (52.50%) without the market information (not conduct research), so the owner should choose to buy the business, it is much likely to earn money; if the research report is unfavorable, the business has the higher probability of 61.29% not to be viable, it is very risky for business owner to buy the business, so the owner should choose not to buy it in order to avoid the lost of further investment ($264,000). For alternative of not doing research, the owner have to make blind choice: buy the business with 52.5% probability of earning money and 47.5% chance of losing all investment of $248,000, which is much more than the lost of $16,000 in strategy that conducting research first and when the report is unfavorable, choose not to buy the business.

In brief, conducting market research with reasonable cost can provide the business owner the better market information and help owner to make better decision on buying the business or not, and reduce the risk of losing money.

c. Include a statement of what the *expected value* is? What does expected value mean here?
Ans: Expected value is a way to measure the relative merit of decision alternatives, it is mathematical combination of probabilities and payoffs . In the case here, the expected values of decision alternatives mean the expected payoffs for respective decision alternative, for example, the decision of doing research has $28,034 expected possible payoff.

d. Change the values in cells B:20 to B:26. These contain the costs and payouts. Change these *one at a time and calculate sheet*. Discuss what threshold values flip the decision tree to recommending a different strategy?
Ans:
1) For research cost: the threshold values to flip the decision tree is $29,540, corresponding expected value for alternative of doing research is 14500, which is same as that of alternative of not doing research, if the research cost is less than it, the decision tree recommend to choose to conduct research, on the contrary, if the research cost is more than $29,540, the decision tree recommend to choose not to do research. This threshold indicate that if the cost of research is more than this threshold value, the benefit brought by conducting research will be overweighted by the cost of it and the decision tree will recommend not to do research.
2) For the cost of business: the threshold values to flip the decision tree is $163,042, corresponding expected value for alternative of doing research is 39458, which is same as that of alternative of not doing research. If the buying cost is more than or equal to $163,042, the decision tree will recommend the business owner to do research; if the buying cost is less than $163,042, the decision tree will recommend to not do research. This threshold value implies that if the value of buy business is less than this threshold value, the cost of research become relatively significant compared with the cost of buying the business and then the benefit of research become less important because of its significant cost, so the decision tree recommend not to do research.
3) For the cost of system audit and refurbish, the threshold value is $35,042, corresponding expected value for alternative of doing research is 39458, If the system audit and refurbish cost is more than or equal to $163,042, the decision tree will recommend the business owner to do research; if this cost is less than $163,042, the decision tree will recommend to not do research.

Similar with the threshold cost of buying business, The threshold value of system audit and refurbish means that if the cost of system audit and refurbish is less than this threshold value, the cost of research become relatively significant compared with the cost of total business investment and then the benefit of research become less important because of its significant cost, so the decision tree recommend not to do research.

4) For the total cost of business investment, since it is the sum of the cost of buying business and the cost of system audit and refurbish, its threshold value is equal to $223,042(the value when one of two costs reaches its threshold value respectively and at same time the other one stay same), in fact, this total cost of business investment is the one with which the cost of research is compared finally. When the total cost of investment is more than this threshold value, the cost of research is relatively insignificant and the benefit of research outdo its cost, the decision tree recommend to do research; on the contrary, if the total cost of investment is less than this threshold value, the cost of research is relatively significant and the benefit of research is outdone by its cost, then the decision tree recommend not to do research.

5) For the potential payout, the threshold value is $410,984, if the potential payout(revenue) is less than or equal to this threshold value, the decision tree will recommend to not take research; if the potential payout is more than this threshold value, the decision tree will recommend to conduct research. This threshold reflect the fact that when the potential payout of the business less than a certain value(threshold), the cost of research become relatively significant compared with the potential revenue of the business, so the benefit of conducting research is outdone by its relatively significant cost, so it is not worth to do research at all, therefore the decision tree will recommend not to conduct research and make blind decision on buying or not buying business directly.

6. Highlight your final tree in Excel, Copy it, and Paste Image at the end of your word document.

52.50%
Viable (YV)

Buy $252,000

($248,000)   14500 $500,000 $252,000

47.50%
not Viable (NV)

No Research   ($248,000)

0   14500   0   ($248,000)

Don't Buy

$0 $0 $0

68.85%
Viable (YV)

Buy $236,000

($248,000)   80250 $500,000 $236,000

31.15%
Not Viable (NV)

45.75%
Positive Research (YR)   ($264,000)

0   80250   0   ($264,000)

Don't Buy

28034.38   ($16,000)

0   ($16,000)

Research

($16,000)   28034.38

38.71%
Viable (YV)

Buy $236,000

($248,000)   -70450 $500,000 $236,000

61.29%
Not Viable (NV)

54.25%
Negative Research (NR)   ($264,000)

0   -16000   0   ($264,000)

Don't Buy

($16,000)

0   ($16,000)