Assignment - 2

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Problem 1: Suppose 37 percent of a company's computer keyboards are manufactured in Los Angeles and 63 percent are made in Detroit. Suppose 2 percent of those made in Los Angeles has some problem, and 5.3 percent of those from Detroit are defective. Calculate the probability that a given defective keyboard was manufactured in Los Angeles, and also the probability that it came from Detroit.

Sol:

Given,

- 37 percent of keyboards made in Los Angeles and 63 percent made in Detroit.

  P(la) = 0.37, P(de)=0.63
- 2 percent of keyboards made in LA and 5.3 percent of keyboards made in Detroit are turned to be faulty. P(la/f)=0.02, P(de/f)=0.053
- We need to calculate the probability of the faulty keyboards are from LA and Detroit. P(f/la), P(f/de)

From Bayes Law,

P(f/la)= P(la/f)*P(la) / (P(la/f)*P(la)+P(de/f) * P(de))

P(f/la)= 0.02*0.37 / (0.02*0.37+0.053*0.63)

P(f/la)= 0.0074 / 0.04079

P(f/la)= 0.1814

The probability that faulty keyboards are from LA= 0.18

To calculate P(f/de), we follow similar process

P(f/de)= P(de/f)*P(de) / (P(de)*P(de/f) + P(la)*P(la/f))

P(f/de)= 0.053*0.63 / (0.02*0.37)+(0.053*0.63)

P(f/de)= 0.03339 / 0.04079

P(f/de)= 0.8185

The Probability that faulty keyboards are from Detroit= 0.82

Problem 2: An aircraft carrier is attacked with 5 missiles. The probability that the ship's self-defence system will destroy a missile is 0.8. It takes 2 or more missiles to sink the ship. What is the probability that the ship will survive?

Sol:

The probability of the ship surviving the air attack is 0.8, which takes the aeroplane 2 out of 5 hits to sink the ship. For the ship to survive the attack, 0 or 1 out of 5 missiles to hit the ship.

The probability of the ship surviving is ${}^5C_0 + {}^5C_1$

${}^5C_0 = 0.8*0.8*0.8*0.8*0.8 = 0.32768$

${}^5C_1 = 0.8*0.8*0.8*0.8*0.2 = 0.4096$

${}^5C_0 + {}^5C_1 = 0.32768+0.4096= 0.73728$

So the probability of ship not getting hit is 0.73728

Problem 3: A set of data is analyzed to have a normal distribution with a mean of 5 and a standard deviation of 2. What is the probability that the data will be

Given, Mean and Standard Deviation of a normal distribution are 5 and 2.

To find the probability of data, we need to calculate the z scores of 3, 4, 2.5 and 7.5

a. Less than 3

b. Greater than 4

c. Between 2.5 and 7.5

Z3= 3-(5/2)= -1

Z4= 4-(5/2)= -0.5

Z2.5= 2.5-(5/2)= -1.25

Z7.5= 7.5-(5/2)= 1.25

From the Z score tables,

P(-1)= 0.15

P(-0.5)= 0.69

P(-1.25)= 0.11

P(1.25)= 0.89

(2.5<P<7.5)= 0.89-0.11= 0.78

Problem 4: A nuclear power company is deciding whether or not to build a nuclear power plant at Diablo Canyon or at Roy Rogers City. The cost of building the plant is $10 million at Diablo and $20 million at Roy Rogers City. If the company builds at Diablo, and an earthquake occurs during the next five years, construction will be terminated and the company will lose the $10 million, and will also still have to build at Roy Rogers City. A-priori, the company believes there is a 20% chance that an earthquake will occur at Diablo during the next five years. For $1 million, a geologist can be hired to analyze the fault structure at Diablo Canyon. He will either predict that an earthquake will occur or that the earthquake will not occur. The geologist's past record indicates that he will predict and earthquake on 95% of the occasions for which an earthquake will occur and no earthquake on 90% of the occasions for which an earthquake will not occur.

(a) Draw the decision tree. Should the power company hire the geologist? Where should they build? (note you will need to calculate the posterior probabilities for this problem)

(b) Compute the EVSI and EVPI.

If the company hires a geologist and he predicts an earthquake

Total value at the diablo canon becomes

-31*0.95 - 11*0.05 = -30

The Roy Rogers city value is smaller than this.

The smaller -21 is chosen.

If the company hires a geologist and predicts no earthquake

-31*0.1 - 11*0.9 = -13

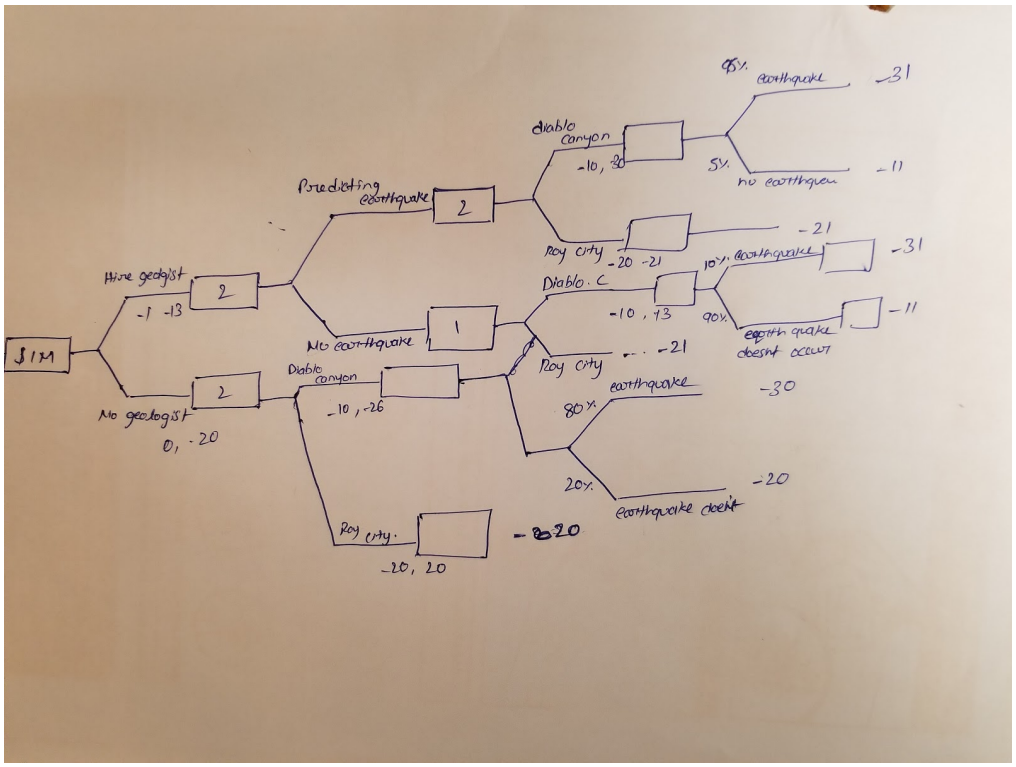
Compared to Roy rogers -13 is smaller. So they had to choose -13.

If the company do not hire a geologist

The total value of the diablo canyon becomes

-30*0.8 + (-10*0.02) = -0.26

Compared to Roy Rogers -0.26 is higher. So the company had to choose -21.



Out of all the decisions taken, the smallest value obtained is -13, which is the best solution to hire a Geologist.

EVSI and EVPI

From the diagram, we know that the EVSI(Hiring Geo) and EVSI (Noy Hiring Geo) are -20 and -12

The value of EVSI = -12-(-20) = 20-12= 8

EVSI is $8 million.