**In-Class Assignment 9**

1. A Michigan Manufacturer is looking to decide whether to produce a component for its product itself, or instead purchase the product from a third party. Because of high capital costs, low demand for its product will make manufacturing the product unprofitable, while it will be highly profitable in the case of high demand. The payoff for each scenario is given by the following table (in 1,000’s of dollars):



Marketing is estimating that the probability of the low, medium, and high demand scenarios is 35%, 35%, and 30%. With these probabilities, which choice maximizes the expected profit?

Ans 1. k means 1000 dollars

Manufacture - -20k\*0.35 + 40k\*0.35 + 100k\*0.30 = **37 k** dollars

Purchase- 10k\*0.35 + 45k\*0.35 + 70k\*0.30 = **40.25k** dollars

2. Suppose in (1) above, that the low demand scenario is still 35%, but the probabilities of the medium and high demand scenarios are unknown.

(a) Find the expected values of the alternatives as a function of the probability of a high-demand scenario.

Ans

Let p be the probability of high-demand scenarios

The probability for medium-demand scenarios is (0.65-p)

Expected values for manufacture = -20k\*0.35 + 40k\*(0.65-p) + 100k\*p = 16p +19

Expected values for purchase = 10k\*0.35 + 45k\*(0.65-p) + 70k\*p = 25p + 32.75

(b) Graph the alternatives’ expected values (note that p will not go to 1 in this case).

seq <- seq(0,0.65,0.01)

x <- 60\*seq + 19

y <- 25\*seq + 32.75

plot(seq,x, type = "l")

lines(seq, y, type = "l", col = "red")

Chart, line chart

Description automatically generated

(c) Find the point at which the expected values are equal and state for which probabilities will one vs. the other have the higher expected values.

The expected values are equal, so for a probability of **0.392** (p) i.e p(higher) we will have equal expected value which is **42.5k** dollars

|  | | **x** | **y** |
| --- | --- | --- | --- |
| solutionn | | 0.39285714285714 | 42.571428571429 |
|  | |

|  |
| --- |
|  |

So for **x < 0.392** purchasing will have a higher expected value and for x > 0.392 manufacturing would be a better idea.

3. You are a product manager who has to pick one of 3 products to develop. Product A has a 30% chance of success, and if successful will yield $5,000,000 in revenue. Product B will be successful but will yield a random amount uniformly distributed between $1,000,000 and $5,000,000. Product C will also be successful but will yield revenue given by an exponential distribution with mean $3,200,000.

(a) Which one has the highest expected value?

Product 1 expected value – 0.3\*5000000 = 1500000

product 2 expected value – (1000000 + 5000000)/2 = 3000000

product 3 expected value – 1/lambda = mean = 3200000

**Product 3** has the highest expected value

(b) which one is most likely to achieve at least $4,000,000 in revenue?

Product 1 has 30 % chances,

Product 2 has 25 % chances as it is an uniform distribution

Product 3 has

xa <- rexp(n = 1000000, rate = 1/3200000)

mean(xa[ ] > 4000000)

= 28.64 %

So **Product 1** is most likely to achieve at least 400000 dollars in revenue