Team 14 Stochastic ASM 3

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## Summary

Appshop, Inc is deciding how to go about implementing a major Oracle software project known as OS-7. Ultimately, they have three options on which to decide, however, bonuses, gain-sharing, and competitive pricing make the decision more complex. In order to make the best choice, we created a decision tree that shows the likelihood and payout of each option and calculated their respective expected values. Based on our calculations, we recommend that Appshop choose Option 2 (Bonus), as it yields the highest expected value of the three options.

## Analysis

*Start the section with a paragraph explaining the approach that you are going to take to solve the problem.*

The following are the three options available:  
– **Option 1 (Fixed)**: A fixed monthly payment of $155,000 over 24 months.  
– **Option 2 (Bonus)**: A monthly payment of $125,000 over 24 months with a potential bonus of $1.5 million after said 24 months contingent on whether or not the work is completed with commendable performance and passes specified benchmarks.  
– **Option 3 (RFP)**: Bid $150,000 monthly in an RFP (Request for Proposal) versus four other competitors for a chance to win the contract.

#### Option 1 (Fixed) Valuation

pmt <- 155000 ; cost <- 140\*1000 ; profit <- pmt-cost ; r <- 0.005  
  
Present\_value <- c()  
for (i in 1:24){  
 Present\_value[i] <- 1/(1+r)^i  
}  
  
sum\_pv <- sum(Present\_value)  
  
(ev\_fixed <- sum\_pv\*profit) #EV(Option 1)

## [1] 338443

The expected value of Option 1 (Fixed) is $338442.99.

*Explain in words how your team obtained the payoffs.*

Calculate the sum of discounted profit for the total of 24 months, which will be the valuation for the first option.

#### Option 2 (Bonus) Valuation

p\_with\_bonus <- 0.7 ; pmt2 <- 125000 ; cost <- 140\*1000 ; profit2 <- pmt2-cost  
present\_value\_notadd\_bonus <- profit2\*sum\_pv ; Bonus <- 1500000 ; r\_year <- 0.0617  
n <- 2 ; pv\_bonus <- Bonus/(1+r\_year)^2 ; after\_bonus\_pv <- present\_value\_notadd\_bonus+pv\_bonus  
  
p\_without\_bonus <- 0.3  
without\_bonus <- profit2\*sum\_pv  
  
(ev\_bonus <- after\_bonus\_pv\*p\_with\_bonus + without\_bonus\*p\_without\_bonus) #EV(Option 2)

## [1] 593063

The expected value of Option 2 (Bonus) is $593063.02.

*Explain in words how your team obtained the payoffs.*

We first calculated the present value of total payment if not receiving the bonus and the present value with bonus after two years completion. And we know that the probability with bonus is 70% therefore, without bonus is 30%.

The expected value for option 2 is the sum of the product of the probability with bonus and the total PV with bonus and the product of the probability without bonus and the total discounted profit for 24 months.

#### Option 3 (RFP) Valuation

library(dplyr) ; library(triangle) ; set.seed(1)  
pmt3 <- 150000 ; profit3 <- pmt3-cost ; present\_value3 <- profit3\*sum\_pv  
savings<-rtriangle(n=100000,a=3.2,b=12.8,c=5.6) #simulate savings(in millions)  
lessthan4<-0 ; between4and6<-0 ; between6and8<-0 ; greaterthan8<-0  
  
for (i in 1:length(savings)) {  
 if(savings[i]<4){  
 lessthan4<-c(lessthan4,savings[i])}  
 else if(savings[i]>4 & savings[i]<6){  
 between4and6<-c(between4and6,savings[i])}  
 else if(savings[i]>6 & savings[i]<8){  
 between6and8<-c(between6and8,savings[i])}  
 else{  
 greaterthan8<-c(greaterthan8,savings[i])}  
}  
  
avg\_bin1 <- mean(lessthan4) ; avg\_bin2 <- mean(between4and6) ; avg\_bin3 <- mean(between6and8) ; avg\_bin4 <- mean(greaterthan8)  
  
gainshareFactor1 <- 0 ; gainshareFactor2 <- .2 ; gainshareFactor3 <- .4 ; gainshareFactor4 <- .6  
gainshareBonus3 <- .4 ; gainshareBonus4 <- 1.2  
  
pless4 <- ptriangle(4,a=3.2,b=12.8,c=5.6)  
pb46 <- ptriangle(6,a=3.2,b=12.8,c=5.6) - ptriangle(4,a=3.2,b=12.8,c=5.6)  
pb68 <- ptriangle(8,a=3.2,b=12.8,c=5.6) - ptriangle(6,a=3.2,b=12.8,c=5.6)  
pgreater8 <- 1-ptriangle(8,a=3.2,b=12.8,c=5.6)  
  
winshare1 <- avg\_bin1\*gainshareFactor1 #winners share for less than 4 million  
ev1 <- winshare1\*pless4\*1000000 #expected value bin 1  
  
winshare2 <- (avg\_bin2-4)\*gainshareFactor2 #winners share for between 4 and 6  
disc\_winshare2 <- winshare2/(1+r\_year)^n #discount gain sharing2  
ev2 <- disc\_winshare2\*pb46\*1000000 #expected value bin 2  
  
winshare3 <- ((avg\_bin3-6)\*gainshareFactor3)+gainshareBonus3 #winners share for between 6 and 8  
disc\_winshare3 <- winshare3/(1+r\_year)^n #discount gain sharing3  
ev3 <- disc\_winshare3\*pb68\*1000000 #expected value bin 3  
  
winshare4 <- ((avg\_bin4-8)\*gainshareFactor4)+gainshareBonus4 #winners share for greater than 8  
disc\_winshare4 <- winshare4/(1+r\_year)^n #discount gain sharing4  
ev4 <- disc\_winshare4\*pgreater8\*1000000 #expected value bin 4  
  
prob\_winbid <- 0.45  
  
(ev\_rfp <- (present\_value3+ev1+ev2+ev3+ev4)\*prob\_winbid) #EV(Option 3)

## [1] 521407

The expected value of Option 3 (RFP) is $521407.01.

*Explain in words how your team obtained the payoffs.*

Since the software company conclude that the savings would follow a triangular distribution, we simluated a triangular distribution using R for savings and used if else condition statement in R to separate the simulated data points into 4 brackets as the savings is defined in 4 brackets and calculated the mean value for each brackets. This is the expected value that we could get for each brackets.

We then used ptriangle function to calculate the probability for the savings would fall into each bin range.

To calcuate the expected profit the company would gain from option 3, we sum the expected value for each bracket and then multiply the expected profit by the probability of winning the bid.

The expected value for each bracket is calculated the percentage of savings plus the bonus (if there is one), discounted this number to present value, times the probability.

## Illustration

## Conclusion

In order to obtain the most profitable outcome, Appshop should choose Option 3, as it has the highest expected value of $593063.02. Even so, there may be potential pitfalls associated with this choice, including \_\_\_\_,\_\_\_\_\_,\_\_\_\_. We may have not taken into account \_\_\_\_\_\_\_\_\_\_\_\_\_.

*Restate your recommendation and any potential pitfalls in your analysis. Discuss the risks taken by the company within the business context.*