simulation_statistics_code

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Simulation example

Using R, I used simulation to determine the different levels of expected profit based on the capacity level of a building. This problem was taken from my Prob & Stats final in the fall.

Problem

The annual demand for Wozac, a prescription drug manufactured and marketed by the NuFeelCompany,is normally distributed with mean 50,000 and standard deviation 12,000. We assume that demand during each of the next 10 years is an independent random draw from this distribution. NuFeel needs to determine how large a Wozac plant to build to maximize its expected pro???t over the next 10 years. If the company builds a plant that can produce x units of Wozac per year, it will cost $16 for each of these x units. NuFeel will produce only the amount demanded each year, and each unit of Wozac produced will sell for $3.70. Each unit of Wozac produced incurs a variable production cost of $0.20. It costs $0.40 per year to operate a unit of capacity. 1. Among the capacity levels of 30K,35K,40K,45K,50K,55K,and 60K units per year, which level maximizes expected profit? Use simulation to answer the question.

Which level maximizes expected profit?

50K maximizes expected profit.

```
#Drugs
rm(list=ls())


capacity_levels = seq(from=30000,to=60000,by = 5000)  #7 different capacity
levels

set.seed(1)
sims=20000 #running 20,000 simulations

#annual demand is normally distributed mean 50,000 and SD 12,000
demand = rnorm(n=sims, mean = 50000, sd = 12000)
sum_profit = 0
initial_production_cost = c()
profit = c()
net_profit = c()
```

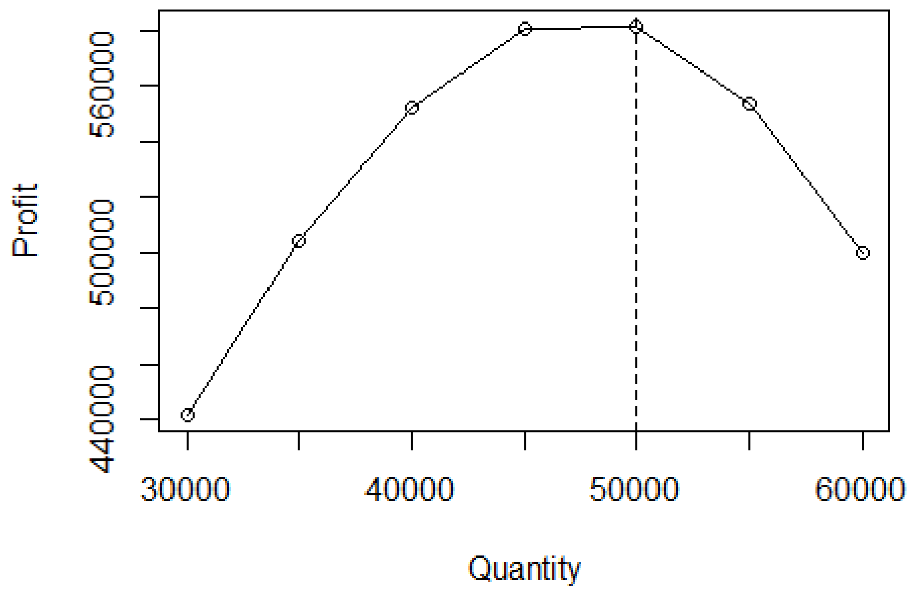
```
for (k in 1:sims){ #this outer for loop runs the simulations 20,000 times
      for (j in 1:7){
            initial_production_cost[j] = 16 * capacity_levels[j] #different
production cost depending on what the capcity level is
            min <- min(c(capacity_levels[j],demand[k])) #min of demand and
capacity level will be the units solds

            for (i in 1:10){ #10 different years of profit
                  (profit[i] = 3.70 * (min) - .2 * (min) - .40 *
(capacity_levels[j]))
            }
            net_profit[j] = sum(profit) - initial_production_cost[j]
      }
      sum_profit = sum_profit+net_profit
}

Profs <- matrix(data= c(capacity_levels,sum_profit/sims), nrow=7,ncol=2)
#putting different profit levels into a matrix form
dimnames(Profs) <- list(NULL,c('Quantity','Profit'))
Profs

##      Quantity   Profit
## [1,]    30000 441596.0
## [2,]    35000 503734.2
## [3,]    40000 552310.6
## [4,]    45000 580233.1
## [5,]    50000 581268.9
## [6,]    55000 553424.7
## [7,]    60000 499624.5

plot(Profs)
lines(Profs)
abline(v=Profs[,1][which.max(Profs[,2])],lty=2)
```




```
optimal_capacity = Profs[,1][which.max(Profs[,2])]
expected_profit = Profs[,2][which.max(Profs[,2])]

print(paste("Running 20,000 simulations, the optimal capacity is",
optimal_capacity ))

## [1] "Running 20,000 simulations, the optimal capacity is 50000"

print(paste("This will yield an average return of $",
round(expected_profit,2)))

## [1] "This will yield an average return of $ 581268.89"
```