



Profit Simulation

Inventory Management and Pricing Strategies

Richard Tseng





Business Value of Simulation

- Purpose of Simulation: simulation can be used to predict the future behavior of a “system” and determine what you can do to influence that future behavior.
- Business Value: unlike most predicting models, simulation gives you a systematical view rather than a point of forecast.

Real Application of Simulation

Analysis

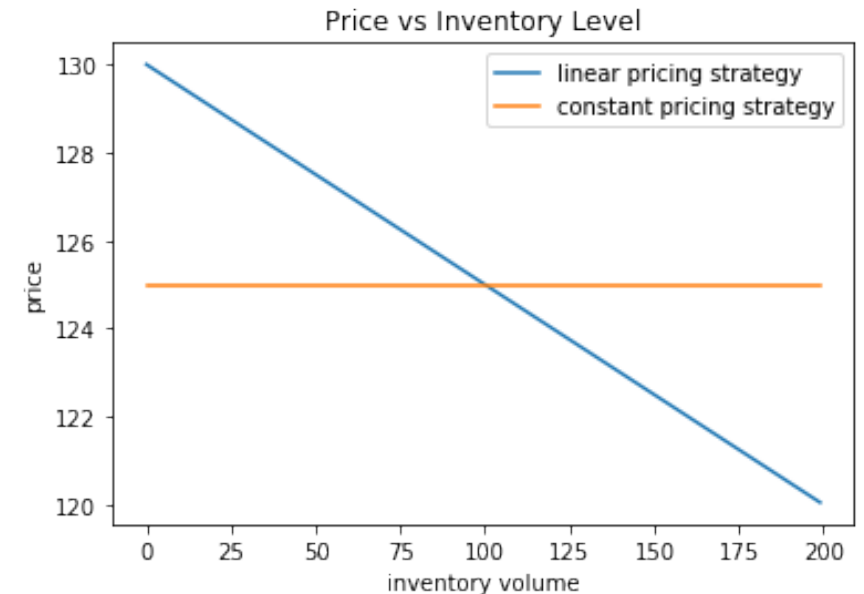
1. Collecting and visualizing data
2. Building models
3. Answering questions based on the predictions
 - What influence the tobacco manufacturing time?
 - What is the demand of tobacco in the future?

How does increasing one more production line influence our profit in the future?

Other business questions ...

Project Overview

- Maximize our profit by choosing the combination of pricing strategy and inventory refill strategy
- Pricing strategy: constant price / linear price (affected by current inventory level)
- Refill strategy: refill our inventory when there is 30%, 15% or 8% inventory left
- 6 strategy combinations and we will simulate each combination for 1000 times
- Choose the combination of strategies with the highest average profit



Discrete Event Simulation

- Poisson Process:
 - Exponential Distribution: the probability distribution of the time between events
 - Homogeneous Poisson Process: the arrival rate of a poisson process does not change by time – the manufacturing time of tobacco
 - Nonhomogeneous Poisson Process: the arrival rate is a function of time – the demand of tobacco (people probably buy more tobacco during holiday season)

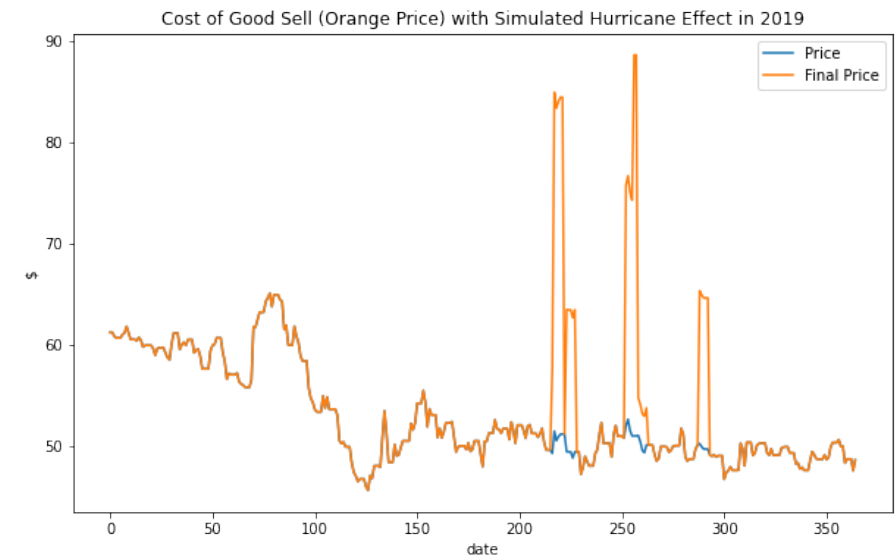
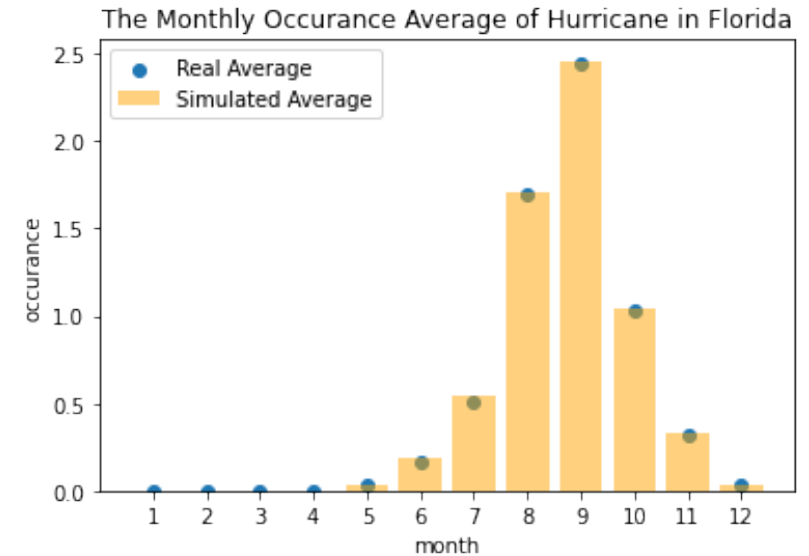


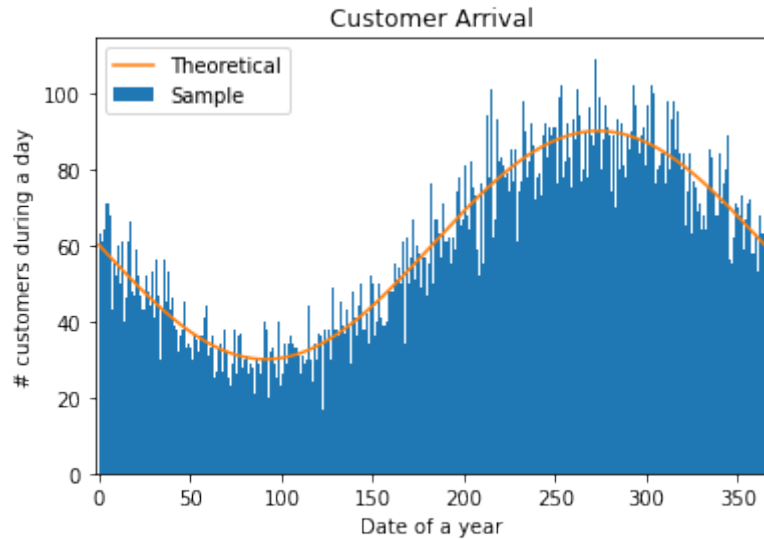
Settings

- The company is a fruit store that only sells oranges.
- Inventory
 - Maximum Inventory level: 200 units
 - Start Unit: 50 units
 - Refill Unit: 50 units
 - Freshness Score: (100, 0~5d), (60, 6~10d), (20, 11~15d), (0, above 16d)
 - Queue - First In First Out

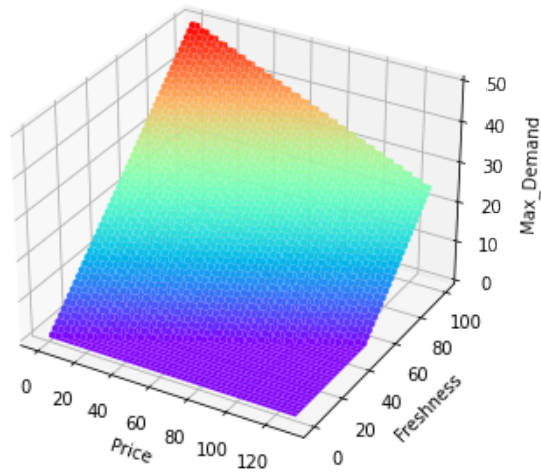
Settings

- Supply:
 - Orange price: 2019 Orange Juice Future Price
 - Natural Disaster (Hurricane): simulated from NOAA Florida Hurricane Historical data
 - Damage Level: Uniform(0, 1) and will make a 5 days orange price strike





Theoretical Relationship between Price, Freshness and Max_Demand



Settings

- Demand
 - Daily customer arrival: follow a nonhomogeneous poisson process
 - Willingness: depends on current orange price and freshness



Business Problems

- how many customers come without buying anything (arrived but didn't buy any oranges)
- how many days the inventory level equals to 0
- how many times we refill the inventory
- how many times we cannot fulfill customers' demand (the inventory level is smaller than the demand)
- what is the average orange freshness we sell to our customers
- how many units of orange are decayed and throwed away
- what is the effect of hurricane on the revenue of recommended strategy?

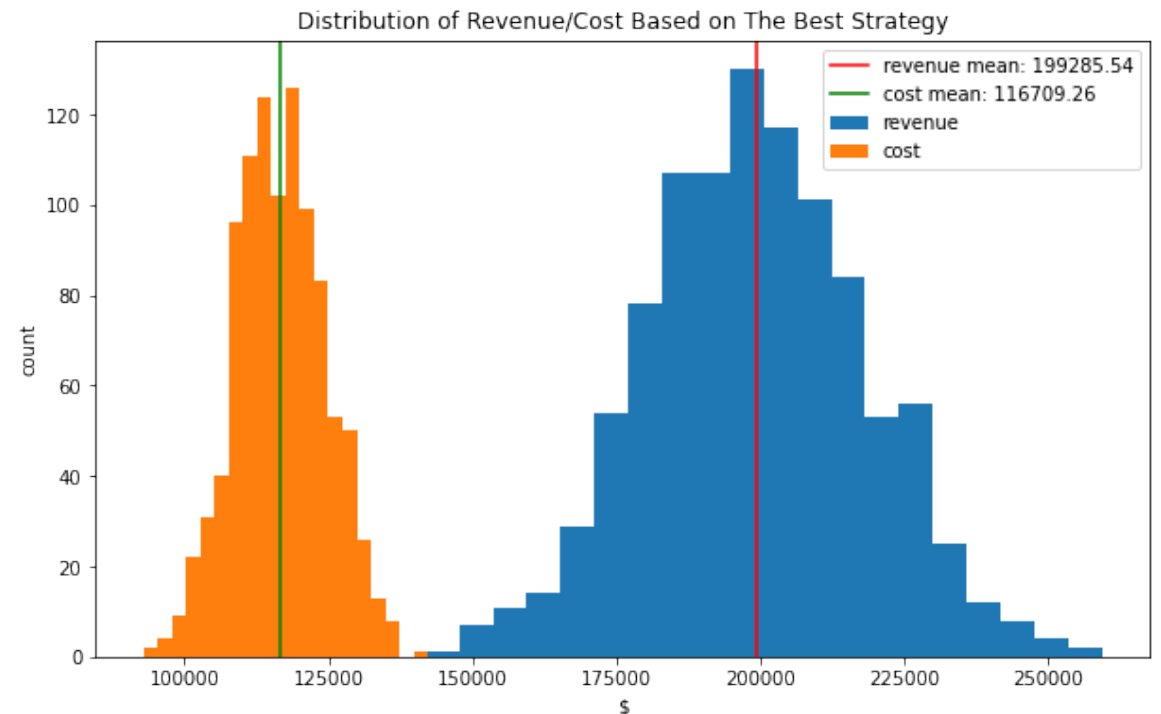
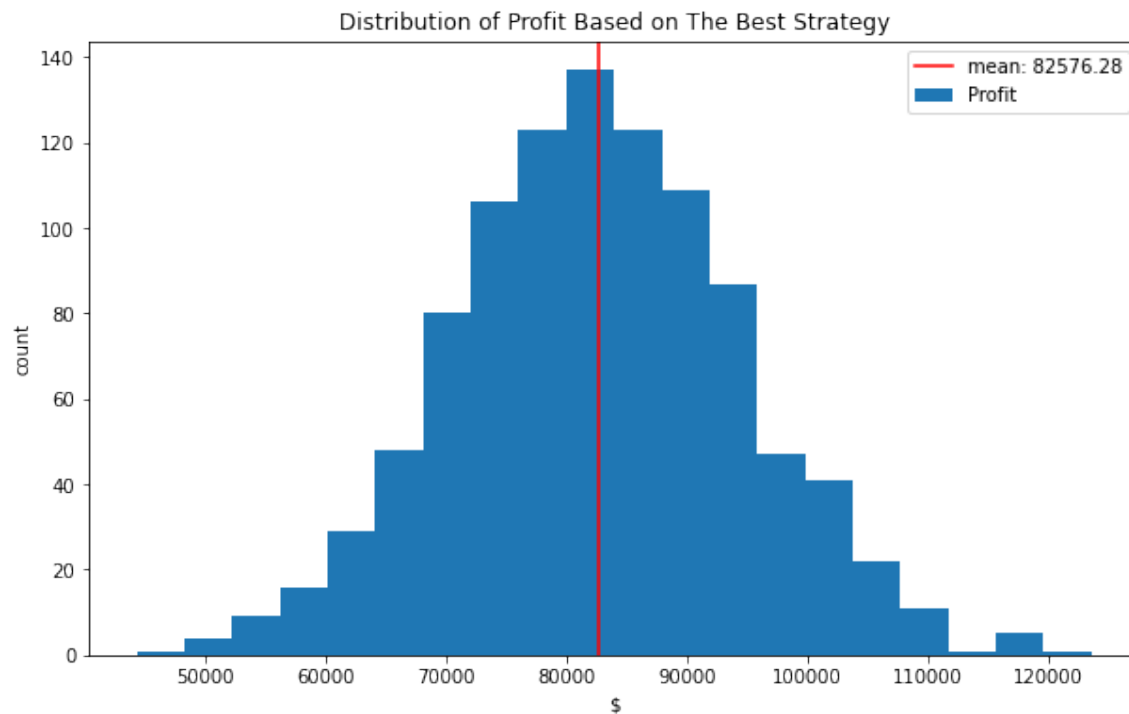
Simulation Results

By using linear Pricing and setting refill level at 8%, we can get the highest average profit. The best strategy is 11 times higher than the worst one.

Pricing / Refill level / Average Profit	8%	15%	30%
Constant pricing	78520.05	63133.78	6579.76
Linear pricing	82576.28	65250.20	7989.22

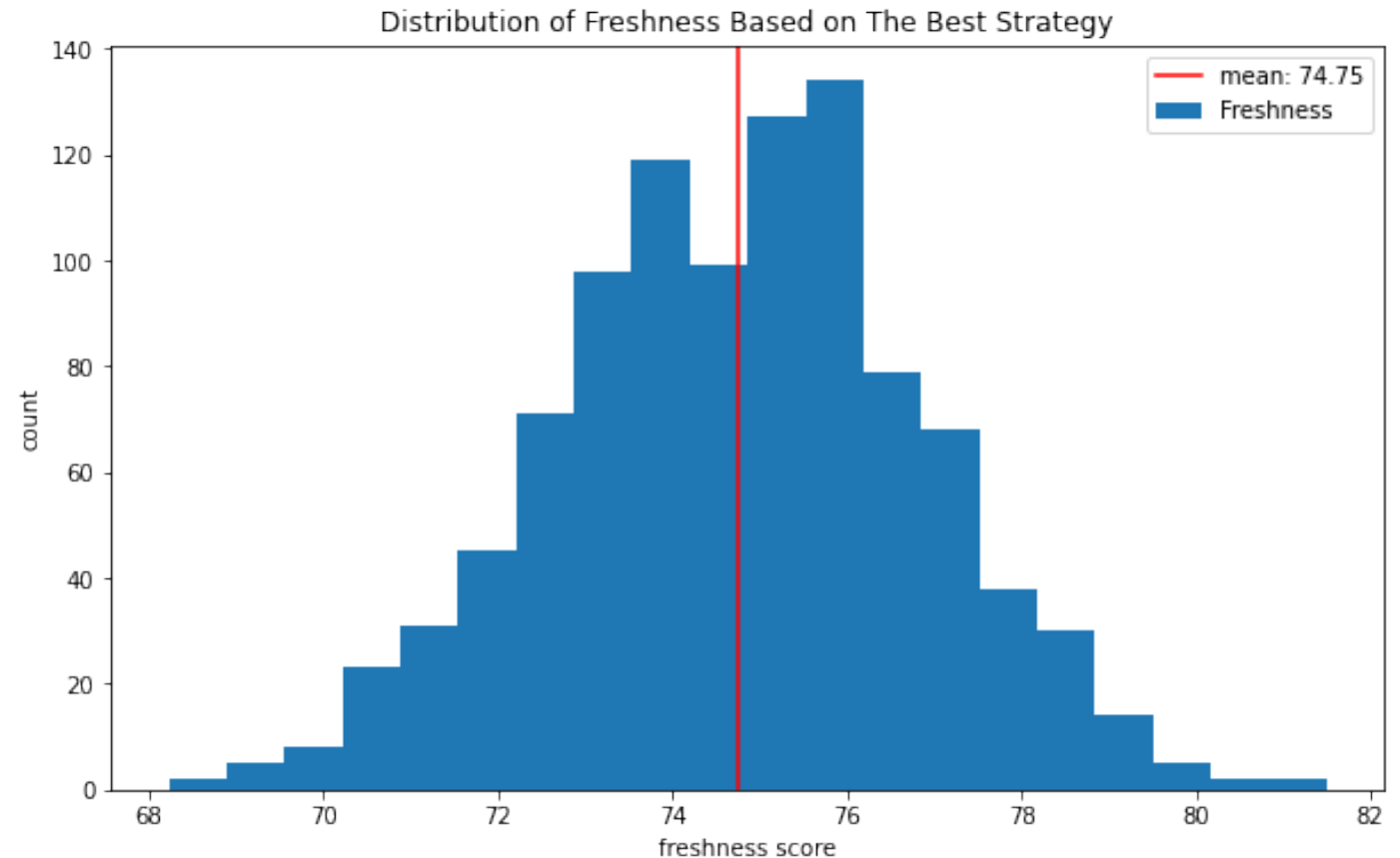
Simulation Results

- The expected revenue is \$199k and the expected cost is \$116k. This makes the expected yearly profit around \$85k. And the gross margin is around 41.7%



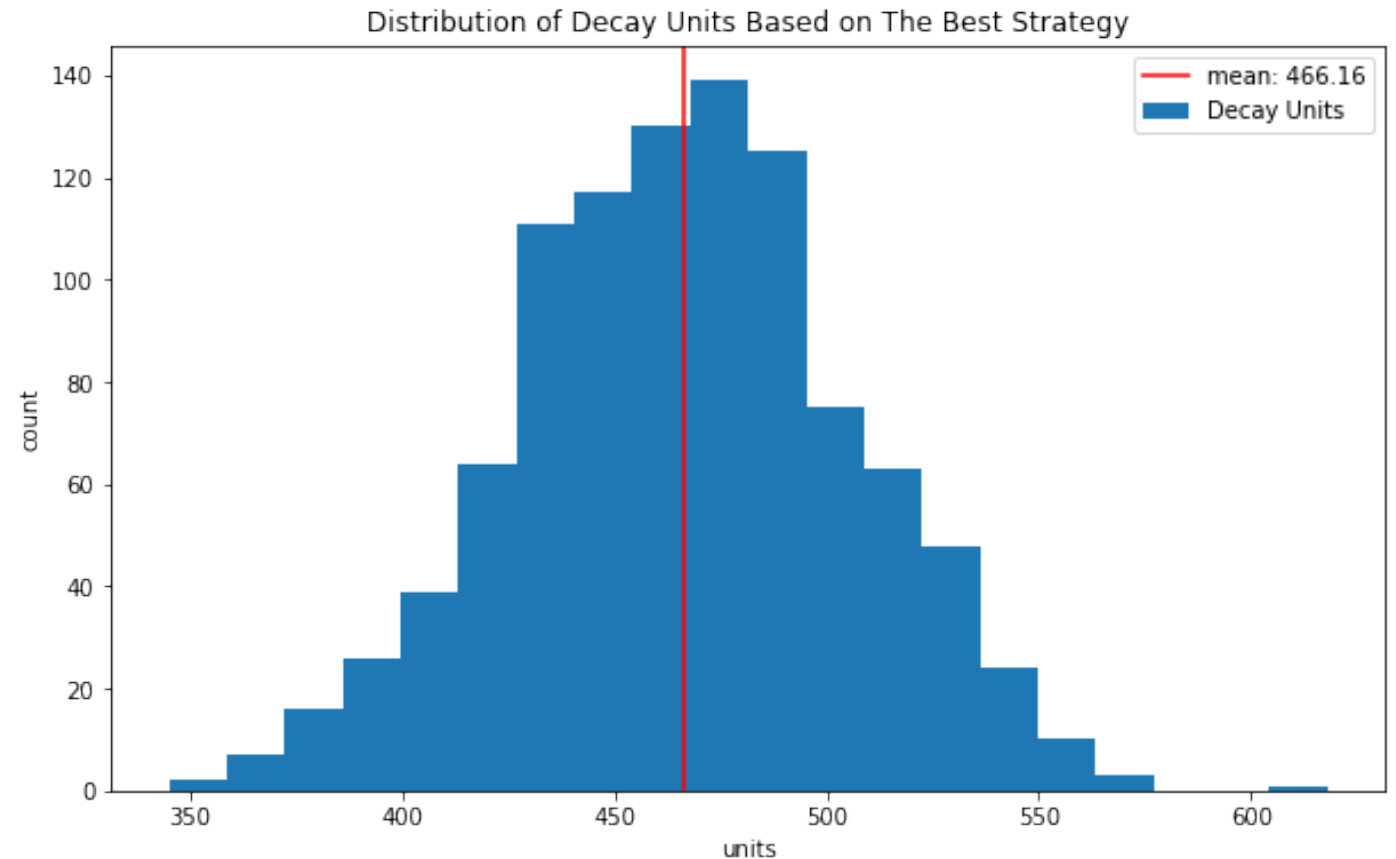
Simulation Results

- What is the average orange freshness we sell to our customers
- The average freshness level is 74.6 out of 100. As a result, the company may face risk of losing customers if they have higher expectations of freshness.



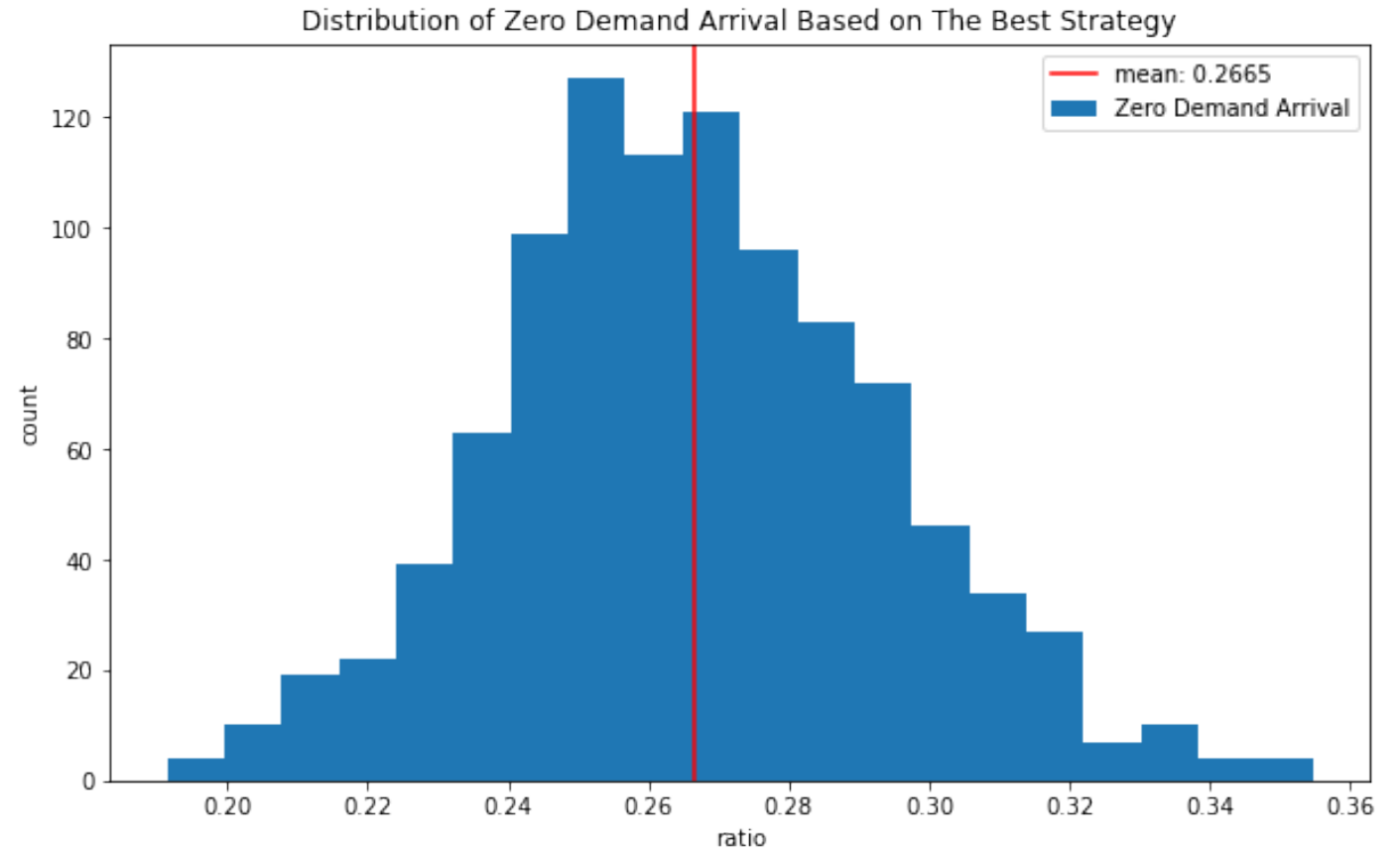
Simulation Results

- How many units of orange are decayed and throwed away per year
- The average number of decayed oranges is around 466 units. This is worth of \$14~\$20k revenue according to the average selling price.



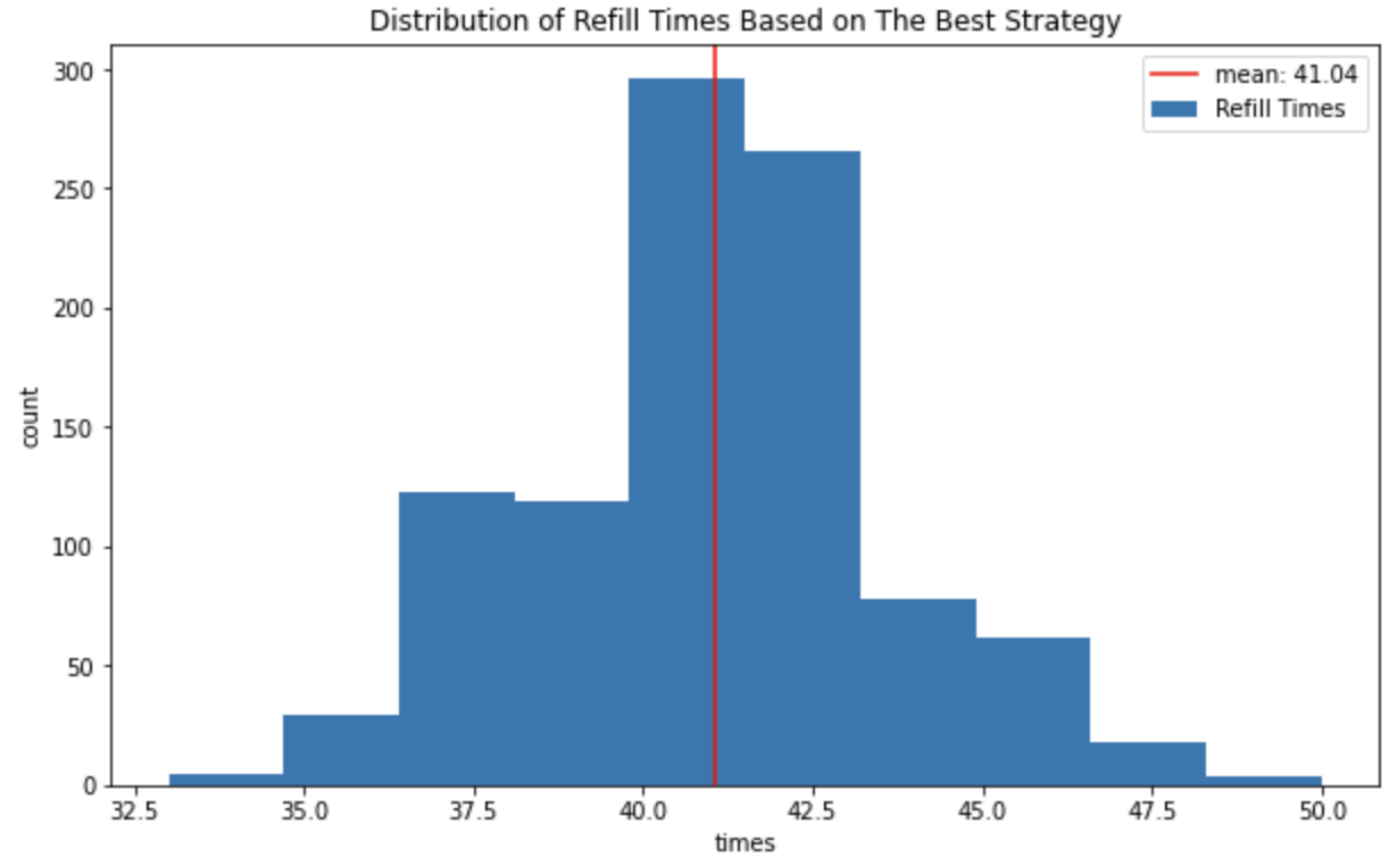
Simulation Results

- How many customers come without buying anything (arrived but didn't buy any oranges)
- Nearly a quart of customers did not buy any orange.



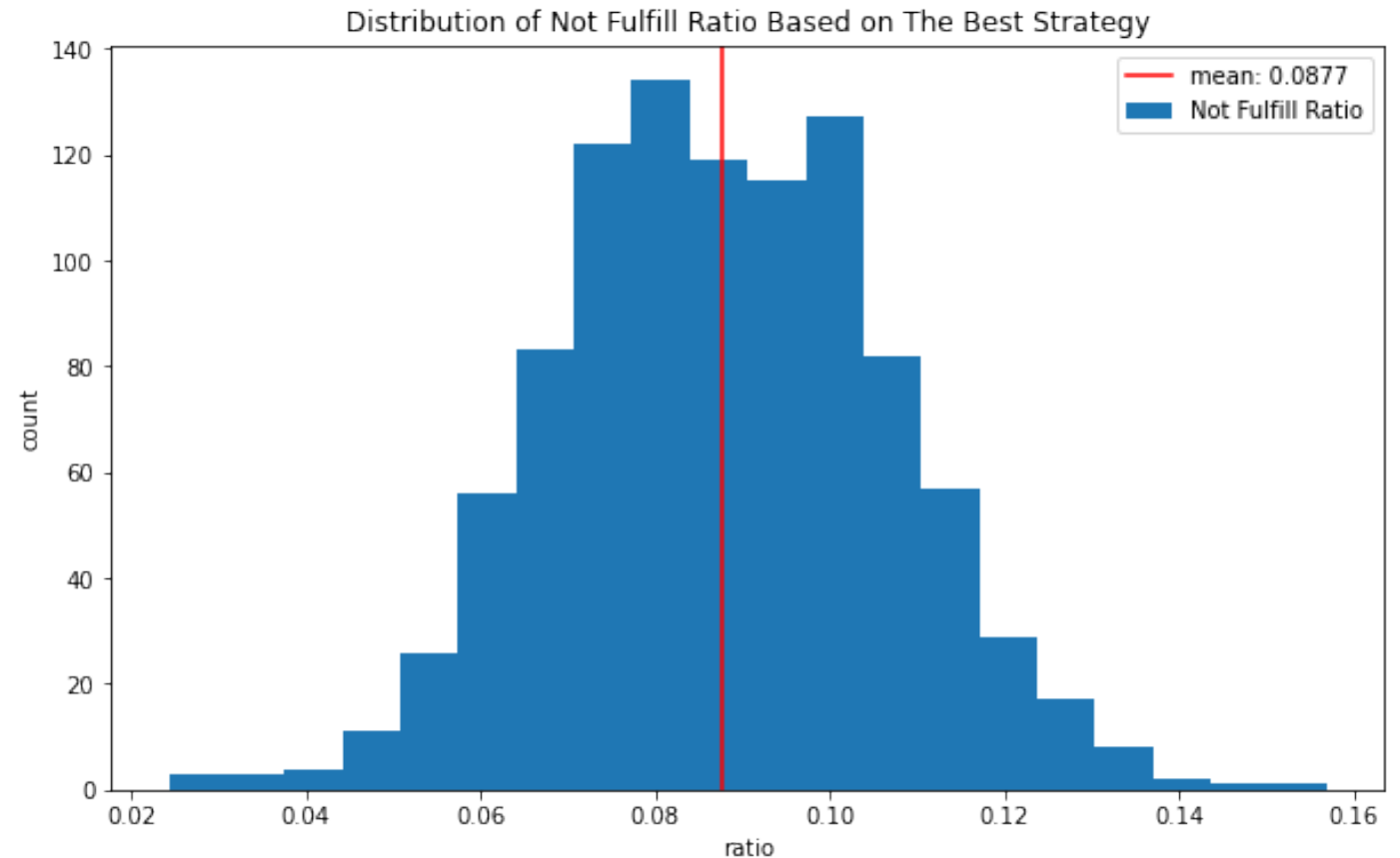
Simulation Results

- How many times did we refill the inventory
- The average inventory refill times is around 41 times per year.
- Every 8-9 days, the company will need to refill again, and the frequency will change correspondingly during the peak and trough.



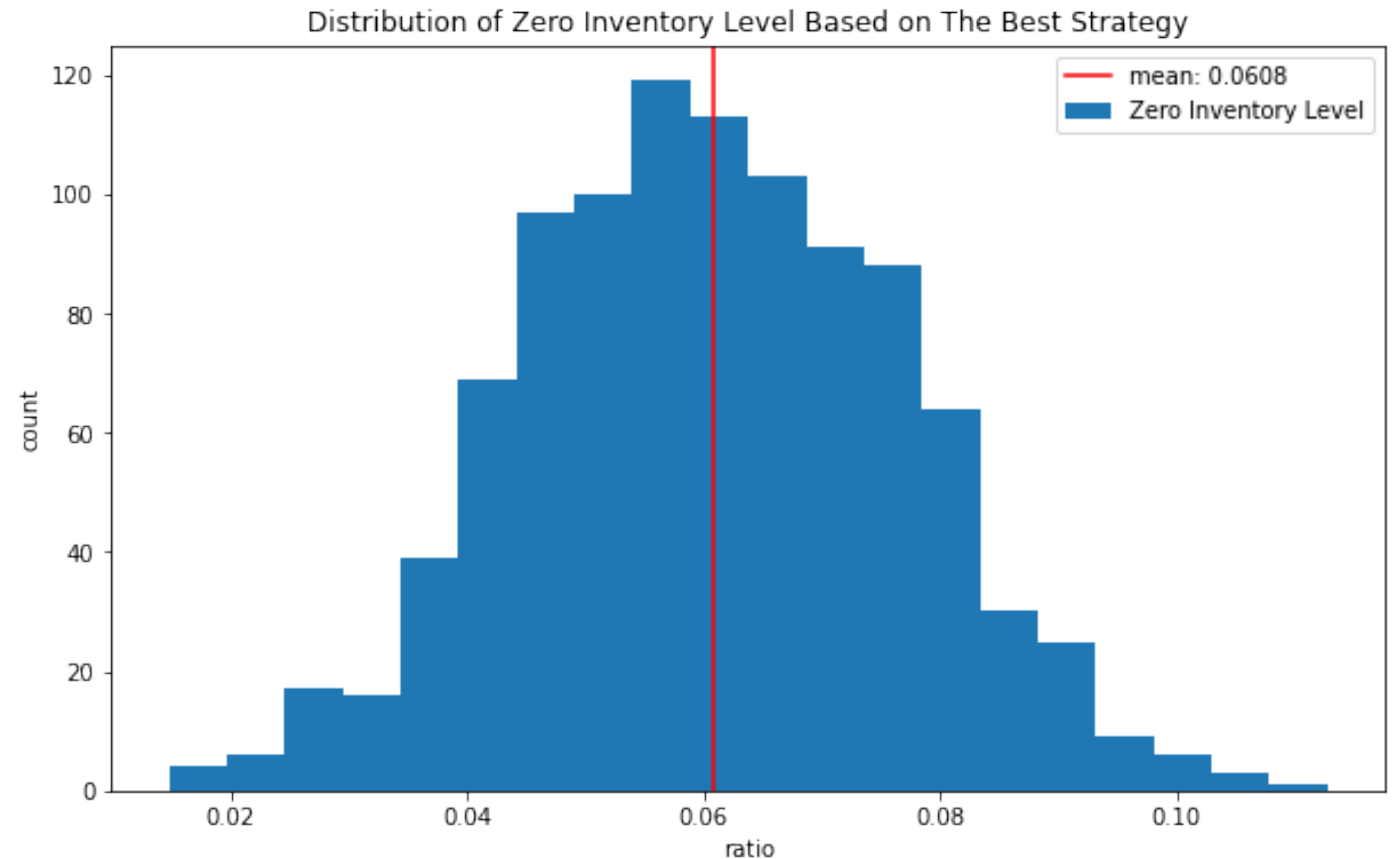
Simulation Results

- How many times we cannot fulfill customers' demand (the inventory level is smaller than the demand)
- The probability that the company cannot meet the customer's demand due to lack of inventory is 9%.



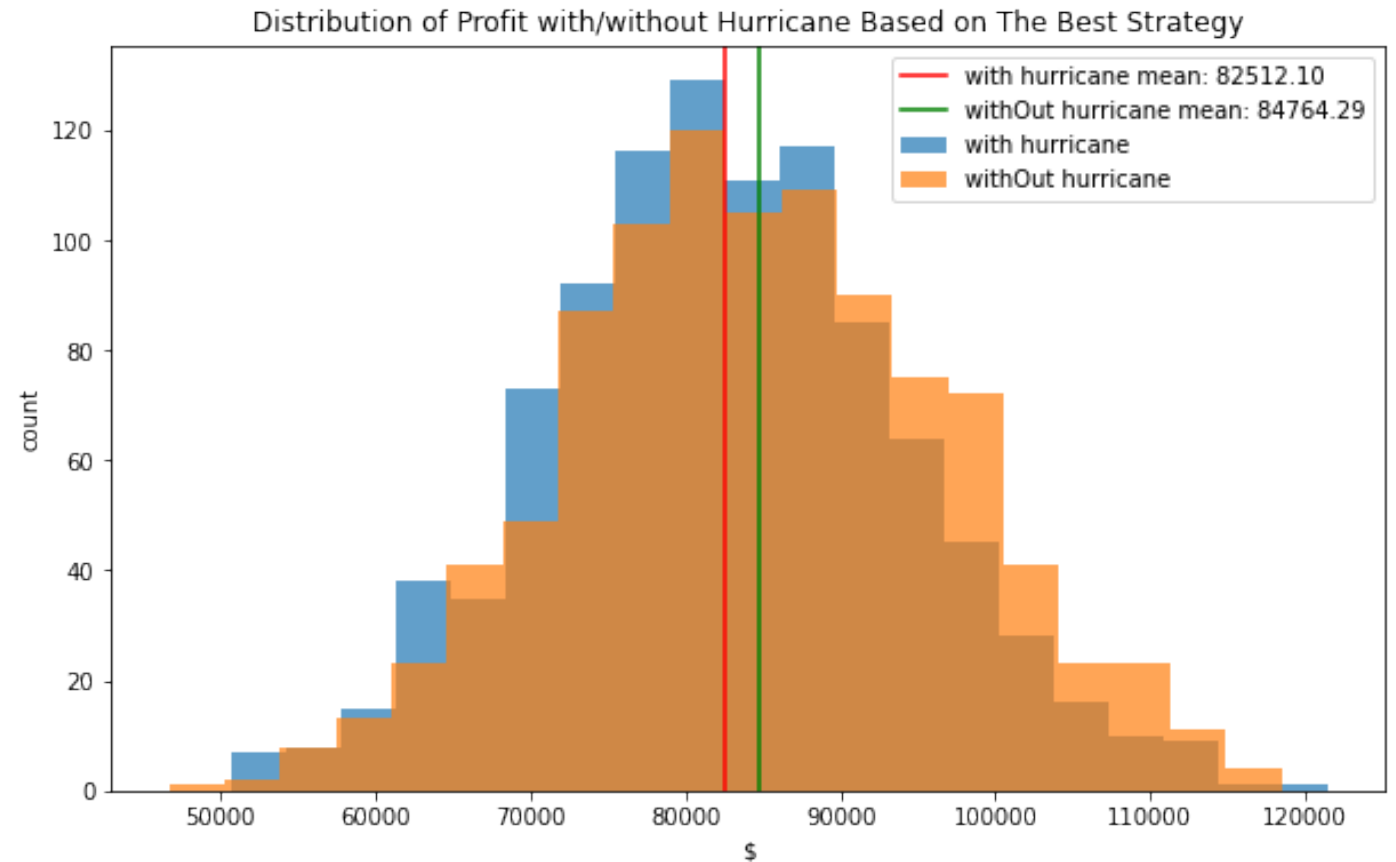
Simulation Results

- How many days the inventory level equals to 0?
- The probability that the company will end a day without any oranges is around 6%.
- To some extent, the current supply chain is efficient enough to meet the demand.



Simulation Results

- What is the effect of hurricane on the best strategy?
- The effect of hurricane is around \$3k profit annually, which is around 3.5% profit. Therefore, the influence of natural disaster is under control.





Conclusions

- The best strategy is 11 times higher than the worst one.
- To increase profit, we should make more complicated inventory strategies.
- The supply chain is efficient for the current condition.
- The influence of hurricane is under control.
- To make the system more complicated, the price should consider the age of inventory, the damage level of hurricane should be more precise, and we should also include more product to be more realistic.
- The settings are relatively simple. In real case, we should also consider the risk of management fault, unexpected competitions, extreme climate change and so on.