

# Application of Monte Carlo Simulation Technique in Whole Sale Fruits Purchase by Dealers

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**Abstract:** This paper is the first in a series of papers on modeling mathematically and optimizing the wholesale Fruit business. It presents a statistical account of the quantum of various Fruits purchased by a dealer on various days over a year. Monte Carlo Technique in Operation Research is applied to this data to simulate the data for five more years. Then the recommended quantum of Fruits for any random day of the year along with the expected cost is given in the form of tables. This will give the dealer a scientific advice on the quantum of Fruits to be purchased based on experience. The case study has been done in Arakkonam Market. Our research is to build a mathematical model for the entire Fruit wholesale business and to optimize from the points of view of Dealer, Retailer, and Customer.

**Keywords:** Monte Carlo Simulations, Operation Research

## I. INTRODUCTION

The mechanism of Fruit trade is very different as compared to the trade of other agricultural commodities. Fruits are seasonal produce and the decisions are based on primitive experience or speculation rather than a scientific approach. Hence, there exists a need to model the trade of Fruits in the wholesale market to avoid wastage of Fruits and to optimize the profits / costs of all the stakeholders. Very few researchers that have studied the demand forecasting of Fruits in the wholesale market. Among these, most of the studies are either focusing on price forecasting or forecasting the demand on an aggregate level. Researchers have generally considered all the Fruits as a single commodity and have tried to forecast the demand of Fruits. But there is a need for forecasting the demand of an individual Fruits such as Banana, Papaya, and Oranges. It is also found that the papers are generally forecasting the demand on a weekly or monthly level. But, in real life situation, the farmers may need the daily demand to take their harvesting decisions due to the short selling horizon and perishable nature of the Fruits. Adding to it is the high price fluctuations and availability of substitute products that further increases the uncertainty of forecasted demand of an individual product on a daily basis. However, there exists almost forecasting the demand of an individual fresh produce on a daily basis.

It is a case study of the model in the wholesale fruit market at Arakkonam. The quanta of fruits vary throughout the year depending upon the day. We have generally classified the days into four categories – Winter season (December, January, Feb); Spring season(March, April, May); Summer season(June, July, August); Fall (or) Autumn season (Sep, Oct, Nov). Having collected the data on the quanta of fruits purchased over the previous year we segregated the data to fit into these four categories. Then Monte Carlo Simulation was done for the next five years using spreadsheets considering the number of fruits. The sample outcome of simulation for the four categories are given below – 37 fruits in all the four categories. Then the consolidated tables of average quanta and cost of each fruit for each category follow. The unit of fruits is in Kilograms and the costs are in Indian rupees.

## II. MONTE - CARLO SIMULATION FOR WINTER SEASON

**Table 1**  
Monte - Carlo Simulation for winter season– Sample Table for Oranges

	Quantity	Probability	Cumulative Probability	Quantity	Random Number	Year	Simulated Quantity
Oranges			0	455	0.198144	1	465
	455	0.08	0.08	465	0.659207	2	475
	465	0.17	0.25	475	0.323528	3	475
	475	0.25	0.5	485	0.897925	4	475
	485	0.42	0.92	495	0.015093	5	455
	495	0.08	1			Average	469

It is observed from the Table 1 that first year's Simulated Quantity of Oranges in winter season is 465 kgs; 475 kgs of Oranges are having second year, third year and fourth year and the fifth year, 455 kgs of Oranges are purchased by the dealers. Maximum Simulated Quantity for winter season is having 475 kgs second, third and fourth year, Minimum Simulated Quantity for winter season of Oranges are having 455 kgs the fifth year and Average Simulated Quantity for winter season of Oranges is having 469 kgs.

**Table 2**  
Simulated Average Purchase and Cost over Five Years – winter season

Name	Today's cost	Averages (in kgs)	cost
Oranges	62.5	469	29312.5
Red banana	70	77.2	5404

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Kiwi	220	42	9240
Papayas	20	235	4700
Banana	20	323	6460
Avacados	130	77	10010
Apricots	90	53.2	4788
Apple	180	407	73260
<b>Total</b>		<b>1683.4</b>	<b>143174.5</b>

Table 2, gives the composition of arrival of fruits in the Arakkonam Town winter season market yard where data on 8 different fruits are recorded. The top most positions are occupied by Oranges (469 Kgs) and Apple (407 kgs) followed by Banana, Papayas, Red banana, Avocados, Apricots and Kiwi. It may be mentioned that banana is also one of the major fruits consumed in the Arakkonam Town area, but currently only a small quantity is traded through the winter season market yard and hence it ranks 3rd among the 8 fruits.

Name	Today's cost	Averages (in kgs)	cost
Cherries	270	33	8910
Melons	50	160.4	8020
Mango	89	525	46725
Strawberry	130	25.8	3354
Pineapple	45	111.2	5004
Orange	62.5	227	14187.5
Lychee	180	23	4140
Jackfruit	230	329	75670
Papayas	20	231	4620
Banana	20	329	6580
Avacados	130	76.6	9958
Apricots	90	53.2	4788
Apple	180	423	76140
<b>Total</b>		<b>2547</b>	<b>268096.5</b>

Table 4, gives the composition of arrival of fruits in the Arakkonam Town spring season market yard where data on 13 different fruits are recorded. The top most positions are occupied by Mango (525 Kgs) and Apple (423 kgs) followed by Banana, Jackfruit, Papayas, Orange, Melons, Pineapple, Avocados, Apricots, Cherries, Strawberry and Lychee. It may be mentioned that banana is also one of the major fruits consumed in the Arakkonam Town area, but currently only a small quantity is traded through the Spring season market yard and hence it ranks 3rd among the 13 fruits.

### III. MONTE CARLO SIMULATION FOR SPRING SEASON

**Table 3**  
Monte Carlo Simulation for spring season– Sample Table for Oranges

	Quantity	Probability	Cumulative Probability	Quantity	Random Number	Year	Simulated Quantity
Cherries			0	31	0.300143	1	32
	31	0.24	0.24	32	0.83854	2	35
	32	0.18	0.42	33	0.863631	3	35
	33	0.18	0.6	34	0.122042	4	33
	34	0.23	0.83	35	0.313088	5	32
	35	0.17	1				33

It is observed from the Table 3, that first year's Simulated Quantity of Oranges in winter season is 32 kgs; 35 kgs of Oranges are having second year and third year, fourth year 33 kgs purchased and the fifth year, 32 kgs of Oranges are purchased by the dealers. Maximum Simulated Quantity for Spring season is having 35 kgs second and third year, Minimum Simulated Quantity for spring season of Oranges are having 32 kgs the first and fifth year, and Average Simulated Quantity for Spring season of Oranges is having 33 kgs.

**Table 4**  
Simulated Average Purchase and Cost over Five Years – spring season

### IV. MONTE CARLO SIMULATION FOR SUMMER SEASON

**Table 5**  
Monte Carlo Simulation for summer season– Sample Table for Black berry

	Quantity	Probability	Cumulative Probability	Quantity	Random Number	Year	Simulated Quantity
Black berry			0	76	0.453785	1	78
	76	0.17	0.17	77	0.891511	2	80
	77	0.15	0.32	78	0.484209	3	78
	78	0.26	0.58	79	0.915069	4	80
	79	0.22	0.8	80	0.89455	5	80
	80	0.2	1				79.2

It is observed from the Table 5, that first and third



year Simulated Quantity of Black berry in Summer season is 78 kgs; 80 kgs of Black berry are having second, fourth and fifth year, Black berry are purchased by the dealers. Maximum Simulated Quantity for summer season is having 80 kgs. Minimum Simulated Quantity for summer season of Black berry is having 78 kgs, and Average Simulated Quantity for spring season of Black berry is having 79.2 kgs.

**Table 6**  
**Simulated Average Purchase and Cost over Five Years – summer season**

Name	Today's cost	Averages (in kgs)	cost
Black berry	400	79.2	31680
Blue berry	1250	78	97500
Figs	220	37	8140
Mulberries	180	27	4860
Peaches	200	23	4600
Plums	160	22	3520
Sapota	25	221	5525
Strawberries	160	19	3040
Watermelon	20	229	4580
Lychee	200	23	4600
Jackfruit	180	309	55620
Papayas	18	231	4158
Banana	22	329	7238
Avacados	140	76.6	10724
Apricots	110	53.2	5852
Apple	190	427	81130
<b>Total</b>		<b>2184</b>	<b>332767</b>

Table 6, gives the composition of arrival of fruits in the Arakkonam Town summer season market yard where data on 16 different fruits are recorded. The top most positions are occupied by Apple (427 kgs), and Banana (329 kgs), followed by Jackfruit, Papayas, Watermelon, Sapota, Blackberry, Blueberry, Avacados, Apricots, Figs, Mulberries, peaches, Lychee, Plums, and Strawberries.

**V. MONTE CARLO SIMULATION FOR FALL (OR) AUTUMN SEASON**

**Table 7**  
**Monte Carlo Simulation for fall (or) autumn season– Sample Table for Sugar apple**

	Quantity	Probability	Cumulative Probability	Quantity	Random Number	Year	Simulated Quantity
Sugar Apple			0	105	0.633874	1	125
	105	0.31	0.31	115	0.057194	2	105
	115	0.2	0.51	125	0.111449	3	105
	125	0.18	0.69	135	0.247249	4	105
	135	0.18	0.87	145	0.431313	5	115
	145	0.13	1			Average	111

It is observed from the Table 7, that first year Simulated Quantity of Sugar apple in fall (or) Autumn season is 125

kgs; 105 kgs of Sugarapple are having second, third and fourth year, Sugar apple are purchased by the dealers. Maximum Simulated Quantity for summer season is having 125 kgs. Minimum Simulated Quantity for summer season of Sugar apple is having 78 kgs, and Average Simulated Quantity for fall (or) autumn season of Sugar apple is having 111 kgs.

**Table 8**  
**Simulated Average Purchase and Cost over Five Years – Fall (or) Autumn season**

Name	Todays cost	Averages (in kgs)	cost
Sugar Apple	60	111	6660
Grapes	70	417	29190
Sapota (Sapodilla)	22	325	7150
Pomegranate	115	475	54625
Pineapple	60	174	10440
Guava	40	221	8840
Papayas	20	220	4400
Banana	10	325	3250
Avacados	170	77.4	13158
Apricots	150	53	7950
Apple	170	417	70890
<b>Total</b>		<b>2815.4</b>	<b>216553</b>

Table 8, gives the composition of arrival of fruits in the Arakkonam Town fall (or) autumn season market yard where data on 11 different fruits are recorded. The top most positions are occupied by Pomegranate (475 kgs), and Apricots and Grapes (417 kgs), followed by Sapota, Banana, Guava, Papayas, Pineapple, Sugar apple, Avacados, and Apricots.

**VI. CONCLUSION**

On fall (or) autumn season, the demand for the fruits in high. During spring Seasons, the consumption in high. In summer season, people buy much Fruits. On winter season, the demand for Fruits in less. Hence before venturing into purchase on any particular season, the dealer can check for the mathematically simulated average purchase of any Fruits on any Season of the year upon finding the category into which that season falls.

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