

Distribution of Bunch of Bananas with the Stem through Monte-Carlo Simulation Technique

V.K. Radhakrishnan¹, S. Fazilath Banu²

¹Assistant Professor, ²M.Phil. Research Scholar

^{1,2}Department of Mathematics

Sri Chandrasekharendra Saraswathi Viswa Mahavidyalaya
Enathur, Kanchipuram

*corresponding author: vkraki@kanchiuniv.ac.in

Article Info

Volume 82

Page Number: 11494 - 11503

Publication Issue:

January-February 2020

Article History

Article Received: 18 May 2019

Revised: 14 July 2019

Accepted: 22 December 2019

Publication: 21 February 2020

Abstract

In this paper, the distribution of a bunch of bananas with the stem to different customers from a Wholesale Market at Madurantakam town has been studied and presented it as a mathematical model to find the average distribution for the customers, respective of their demand of a number of varieties. The three varieties of the bunch of bananas with the stem that are distributed among different customers for a period of time have been studied, it is simulated for the next six months using Monte Carlo simulation technique and listed for different customers and different varieties as well. The distribution model for retail customer is also studied and enlisted here.

Keywords: Mathematical Modelling, Simulation, Monte Carlo Simulation, Madurantakam.

I. INTRODUCTION

Madurantakam town is situated at Kanchipuram district. In Madurantakam town, there are four mandis sale bananas in wholesale. All these four mandis ordering the bananas from a single vendor countryman from Trichy.

There are three types of varieties in bunch of bananas with the stem, namely, Variety I – (First Category – Muthal Vazhai – Number of bananas (130-150)), Variety II – (Next Category – Maru Vazhai – Number of bananas (180-200)), Variety III – (Last Category – Moondram Vazhai – Number of bananas (240-250)). The number of bananas is approximate in this numbers. The count and the size of bananas of the above said three varieties differ from one another. Also, averagely Second Variety (Maru Vazhai) has more demand due to the fact of having averagely more bananas and perfectly sized.

For the present study, one shop out of four wholesale shops, in Madurantakam town, have been approached and the data have been collected for the period of ten months which will help to the

read the uniformity in distributing the bunch of bananas with the stem to the customers and also the average count that the different customers buying. The data has been collected by visiting the shop once a week.

II. METHODOLOGY

It is observed that there are four regular customers who are buying the bunch of bananas of with the stem from wholesale marketer in frequently. Regular Customer: A person who purchases products or services from a person or business frequently.

Based upon the sale to that regular customer, the wholesale marketer keeps the remaining bananas to his retail marketing. The four regular customers are: Petty Shop 1, Petty Shop 2, Office Canteen, Temple Shop and the balance bunch of bananas will be kept and sold in retail by the same shop.

In total, there are totally 128 days the customers bought the bunch of bananas with the stem from the wholesale vendor. For clarity, the collected data has been divided into three different days

based on the demand and selling days in a month, Ordinary Days (Normal Days) 56 days, Festival Days (Hindu Festivals Days) 18 days, Auspicious Days (Marriages and Some other function Days) 54 days. With the help of this sorting, we are able to understand the distribution of bunch of bananas with the stem to the four regular customers with much knowledge.

With the help of this data, one can forecast / predict the distribution of the bunch of bananas with the stem in future for the customers. For the purpose, Simulation technique in mathematics can help. The necessary definitions for mathematical simulations and in particular Monte-Carlo simulation are given in detail below:

Mathematical Simulation: A Simulation is an approximate limitation of the operation of a process or system; the act of simulating first

requires a model is developed. This model is a well-defined description of the simulation subject, and represents its key characteristics, such as its behaviour, functions and abstract or physical properties.

Monte Carlo methods or Monte Carlo experiments are a broad class of computational algorithms that rely on repeated random sampling to obtain numerical results. Their essential idea is using randomness to solve problems that might be deterministic in principle.

Below the distribution of bunch of bananas with the stem to different regular customers based on the three varieties are listed, rendering to the days of importance with their probabilities and cumulative probabilities and the next table shows the simulated values for next 10 days

Table 1. Ordinary Days – Customer 1 – Frequency Distribution Table											
Variety I				Variety II				Variety III			
Count	Freq.	Prob.	Cum. Prob.	Count	Freq.	Prob.	Cum. Prob.	Count	Freq.	Prob.	Cum. Prob.
0	3	0.0536	0.0536	0	0	0	0	0	16	0.2857	0.2857
1	18	0.3214	0.375	1	2	0.0357	0.0357	1	34	0.6071	0.8928
2	33	0.5893	0.9643	2	29	0.5179	0.5536	2	6	0.1071	1.0000
3	2	0.0357	1	3	24	0.4286	0.9822	3	0	0	1.0000
4	0	0	1	4	1	0.0179	1.0000				
				5	0	0	1.0000				

Table 2. Ordinary Days – Simulation Table for Customer 1									
Variety I			Variety II			Variety III			
Random	Days	Count	Random	Days	Count	Random	Days	Count	
0.040799802	1	0	0.880316433	1	3	0.712216812	1	1	
0.260692237	2	1	0.294270384	2	2	0.64135129	2	1	
0.258504359	3	1	0.146725088	3	2	0.094887364	3	0	
0.65152807	4	2	0.107713321	4	2	0.531849364	4	1	
0.38791256	5	2	0.13389177	5	2	0.731381735	5	1	
0.879320317	6	2	0.920032166	6	3	0.599764245	6	1	
0.960388576	7	2	0.864848829	7	3	0.234199414	7	0	
0.740189198	8	2	0.619177998	8	3	0.961949409	8	2	
0.261381424	9	1	0.106126946	9	2	0.46273831	9	1	

0.767304479	10	2	0.682724805	10	3	0.576300352	10	1
-------------	----	---	-------------	----	---	-------------	----	---

Table 3. Ordinary Days – Customer 2 – Frequency Distribution Table											
Variety I				Variety II				Variety III			
Count	Freq.	Prob.	Cum. Prob.	Count	Freq.	Prob.	Cum. Prob.	Count	Freq.	Prob.	Cum. Prob.
0	17	0.3036	0.3036	0	1	0.0179	0.0179	0	27	0.4821	0.4821
1	21	0.375	0.6786	1	9	0.1607	0.1786	1	25	0.4464	0.9285
2	17	0.3036	0.9822	2	42	0.75	0.9286	2	4	0.0714	1.0000
3	1	0.0179	1.0000	3	4	0.0714	1	3	0	0	1.0000
4	0	0	1.0001	4	0	0	1				

Table 4. Ordinary Days – Simulation Table for Customer 2									
Variety I			Variety II			Variety III			
Random	Days	Count	Random	Days	Count	Random	Days	Count	
0.124242262	1	0	0.027635423	1	1	0.139900512	1	0	
0.440748645	2	1	0.884619105	2	2	0.174832709	2	0	
0.464419165	3	1	0.924231341	3	2	0.08702206	3	0	
0.186736764	4	0	0.719833918	4	2	0.722028909	4	1	
0.211548973	5	0	0.758014316	5	2	0.771872417	5	1	
0.187377435	6	0	0.212199509	6	2	0.881913778	6	1	
0.932378517	7	2	0.735792511	7	2	0.019557354	7	0	
0.56644897	8	1	0.710619779	8	2	0.710365414	8	1	
0.782627262	9	2	0.404751016	9	2	0.60982789	9	1	
0.005400948	10	0	0.662561346	10	2	0.925927694	10	1	

Table 5. Ordinary Days – Customer 3 – Frequency Distribution Table											
Variety I				Variety II				Variety III			
Count	Freq.	Prob.	Cum. Prob.	Count	Freq.	Prob.	Cum. Prob.	Count	Freq.	Prob.	Cum. Prob.
0	28	0.5	0.5	0	4	0.0714	0.0714	0	45	0.8036	0.8036
1	21	0.375	0.875	1	26	0.4643	0.5357	1	11	0.1964	1
2	7	0.125	1	2	26	0.46428571	1	2	0	0	1
3	0	0	1	3	0	0	1				

Table 6. Ordinary Days – Simulation Table for Customer 3									
Variety I			Variety II			Variety III			
Random	Days	Count	Random	Days	Count	Random	Days	Count	
0.334668141	1	0	0.591156581	1	2	0.664597146	1	0	
0.138029355	2	0	0.487502555	2	1	0.931925673	2	1	
0.598613784	3	1	0.207744309	3	1	0.533521851	3	0	
0.785842399	4	1	0.709971314	4	2	0.542152854	4	0	

0.946503891	5	2	0.767845433	5	2	0.916340856	5	1
0.448705747	6	0	0.924796926	6	2	0.695174205	6	0
0.894941519	7	2	0.253718558	7	1	0.949096365	7	1
0.252378683	8	0	0.331922502	8	1	0.420729397	8	0
0.564176209	9	1	0.188218121	9	1	0.516544113	9	0
0.83329672	10	1	0.705524496	10	2	0.434903148	10	0

Table 7. Ordinary Days – Customer 4 – Frequency Distribution Table

Variety I				Variety II				Variety III			
Count	Freq.	Prob.	Cum. Prob.	Count	Freq.	Prob.	Cum. Prob.	Count	Freq.	Prob.	Cum. Prob.
0	22	0.3929	0.3929	0	0	0	0	0	25	0.4464	0.4464
1	26	0.4643	0.8572	1	3	0.0536	0.0536	1	28	0.5	0.9464
2	8	0.1429	1.0000	2	50	0.8929	0.9465	2	2	0.0357	0.9821
3	0	0	1.0000	3	3	0.0536	1.0000	3	1	0.0179	1
				4	0	0	1.0000	4	0	0	1

Table 8. Ordinary Days – Simulation Table for Customer 4

Variety I			Variety II			Variety III		
Random	Days	Count	Random	Days	Count	Random	Days	Count
0.310540086	1	0	0.601193655	1	2	0.461503397	1	1
0.897855284	2	2	0.395567643	2	2	0.240652797	2	0
0.790018389	3	1	0.431207421	3	2	0.051512859	3	0
0.564323199	4	1	0.132811322	4	2	0.72716114	4	1
0.138366926	5	0	0.486710501	5	2	0.030863102	5	0
0.556843182	6	1	0.132890285	6	2	0.28835054	6	0
0.263910196	7	0	0.352866839	7	2	0.543438816	7	1
0.904301015	8	2	0.690277572	8	2	0.519996193	8	1
0.253037786	9	0	0.997836805	9	3	0.395460254	9	0
0.058826936	10	0	0.188891926	10	2	0.023359115	10	0

Similarly here we are listing the probability distribution table and the simulation for different customers and different varieties below during the festival days and auspicious days:

Table 9. Festival Days – Customer 1 – Frequency Distribution Table

Variety I				Variety II				Variety III			
Count	Freq.	Prob.	Cum. Prob.	Count	Freq.	Prob.	Cum. Prob.	Count	Freq.	Prob.	Cum. Prob.
0	0	0	0	0	0	0	0	0	0	0	0
1	3	0.1667	0.1667	1	0	0	0	1	7	0.3889	0.3889
2	5	0.2778	0.4445	2	0	0	0	2	8	0.4444	0.8333
3	5	0.2778	0.7223	3	7	0.3889	0.3889	3	3	0.1667	1

4	4	0.2222	0.9445	4	4	0.2222	0.6111	4	0	0	1
5	1	0.0556	1.0000	5	3	0.1667	0.7778				
6	0	0	1.0000	6	3	0.1667	0.9445				
				7	1	0.0556	1.0000				
				8	0	0	1.0000				

Table 10. Festival Days – Simulation Table for Customer 1

Variety I			Variety II			Variety III		
Random	Days	Count	Random	Days	Count	Random	Days	Count
0.359138995	1	2	0.150062508	1	3	0.742963683	1	2
0.003476264	2	1	0.704778339	2	5	0.013170047	2	1
0.118104755	3	1	0.234620747	3	3	0.926742332	3	3
0.274639984	4	2	0.252834448	4	3	0.615040919	4	2
0.886384447	5	4	0.225864848	5	3	0.894035653	5	3
0.796343556	6	4	0.849193301	6	6	0.64806919	6	2
0.686914827	7	3	0.173264197	7	3	0.982635346	7	3
0.265121916	8	2	0.775886367	8	5	0.531628559	8	2
0.937780851	9	4	0.521096507	9	4	0.797836612	9	2
0.702185579	10	3	0.107271015	10	3	0.182554755	10	1

Table 11. Festival Days – Customer 2 – Frequency Distribution Table

Variety I				Variety II				Variety III			
Count	Freq.	Prob.	Cum. Prob.	Count	Freq.	Prob.	Cum. Prob.	Count	Freq.	Prob.	Cum. Prob.
0	0	0	0	0	0	0	0	0	4	0.2222	0.2222
1	3	0.1667	0.1667	1	0	0	0	1	10	0.5556	0.7778
2	9	0.5	0.6667	2	5	0.2778	0.2778	2	4	0.2222	1
3	5	0.2778	0.9445	3	10	0.5556	0.8334	3	0	0	1
4	1	0.0556	1.0000	4	2	0.1111	0.9445				
5	0	0	1.0000	5	1	0.0556	1.0000				
				6	0	0	1.0000				

Table 12. Festival Days – Simulation Table for Customer 2

Variety I			Variety II			Variety III		
Random	Days	Count	Random	Days	Count	Random	Days	Count
0.323407986	1	2	0.745843833	1	3	0.065463858	1	0
0.632484084	2	2	0.717297769	2	3	0.220222719	2	0
0.7801175	3	3	0.9307723	3	4	0.072537871	3	0
0.609870366	4	2	0.342619001	4	3	0.700772015	4	1
0.469359393	5	2	0.298922923	5	3	0.99187462	5	2
0.01615877	6	1	0.994406334	6	5	0.132829128	6	0
0.12828967	7	1	0.655370203	7	3	0.973994927	7	2

0.529248002	8	2	0.379571232	8	3	0.498066087	8	1
0.370542292	9	2	0.855039469	9	4	0.312470476	9	1
0.148251029	10	1	0.501380408	10	3	0.144024583	10	0

Table 13. Festival Days – Customer 3 – Frequency Distribution Table

Variety I				Variety II				Variety III			
Count	Freq.	Prob.	Cum. Prob.	Count	Freq.	Prob.	Cum. Prob.	Count	Freq.	Prob.	Cum. Prob.
0	5	0.2778	0.2778	0	0	0	0	0	13	0.7222	0.7222
1	12	0.6667	0.9445	1	3	0.1667	0.1667	1	5	0.2778	1
2	1	0.0556	1.0000	2	15	0.8333	1	2	0	0	1
3	0	0	1.0000	3	0	0	1				

Table 14. Festival Days – Simulation Table for Customer 3

Variety I			Variety II			Variety III		
Random	Days	Count	Random	Days	Count	Random	Days	Count
0.233576729	1	0	0.512989908	1	2	0.33390348	1	0
0.065739587	2	0	0.832011168	2	2	0.306602968	2	0
0.711805818	3	1	0.735166437	3	2	0.367235207	3	0
0.682554555	4	1	0.416667816	4	2	0.515574775	4	0
0.205970439	5	0	0.943316128	5	2	0.468052397	5	0
0.308395574	6	1	0.620800456	6	2	0.635063319	6	0
0.325761268	7	1	0.817290918	7	2	0.739978154	7	1
0.497085272	8	1	0.192270341	8	2	0.244063259	8	0
0.481272952	9	1	0.52522032	9	2	0.575046207	9	0
0.193564876	10	0	0.357322139	10	2	0.150772538	10	0

Table 15. Festival Days – Customer 4 – Frequency Distribution Table

Variety I				Variety II				Variety III			
Count	Freq.	Prob.	Cum. Prob.	Count	Freq.	Prob.	Cum. Prob.	Count	Freq.	Prob.	Cum. Prob.
0	2	0.1111	0.1111	0	0	0	0	0	0	0	0
1	3	0.1667	0.2778	1	0	0	0	1	12	0.6667	0.6667
2	8	0.4444	0.7222	2	7	0.3889	0.3889	2	6	0.3333	1
3	4	0.2222	0.9444	3	7	0.3889	0.7778	3	0	0	1
4	0	0	0.9444	4	3	0.1667	0.9445				
5	1	0.0556	1	5	0	0	0.9445				
6	0	0	1	6	1	0.0556	1.0000				
				7	0	0	1.0000				

Table 16. Festival Days – Simulation Table for Customer 4

Variety I			Variety II			Variety III		
-----------	--	--	------------	--	--	-------------	--	--

Random	Days	Count	Random	Days	Count	Random	Days	Count
0.143810441	1	1	0.385527997	1	2	0.861172688	1	2
0.894135629	2	3	0.313079302	2	2	0.170115182	2	1
0.621025053	3	2	0.604416885	3	3	0.533127924	3	1
0.842342715	4	3	0.336379028	4	2	0.059852023	4	1
0.157322815	5	1	0.692900186	5	3	0.22935548	5	1
0.811465956	6	3	0.40533461	6	3	0.458909162	6	1
0.138681235	7	1	0.812574549	7	4	0.220819616	7	1
0.08215284	8	0	0.095150105	8	2	0.397242798	8	1
0.345555228	9	2	0.579907473	9	3	0.196142401	9	1
0.060671333	10	0	0.25527439	10	2	0.242097013	10	1

Table 17. Auspicious Days – Customer 1 – Frequency Distribution Table

Variety I				Variety II				Variety III			
Count	Freq.	Prob.	Cum. Prob.	Count	Freq.	Prob.	Cum. Prob.	Count	Freq.	Prob.	Cum. Prob.
0	0	0	0	0	0	0	0	0	3	0.0556	0.0556
1	9	0.1667	0.1667	1	0	0	0	1	26	0.4815	0.5371
2	32	0.5926	0.7593	2	21	0.3889	0.3889	2	24	0.4444	0.9815
3	12	0.2222	0.9815	3	23	0.4259	0.8148	3	1	0.0185	1.0000
4	1	0.0185	1.0000	4	8	0.1481	0.9629	4	0	0	1.0000
5	0	0	1.0000	5	1	0.0185	0.9814				
6	0	0	1.0000	6	1	0.0185	1.0000				
				7	0	0	1.0000				

Table 18. Auspicious Days – Simulation Table for Customer 1

Variety I			Variety II			Variety III		
Random	Days	Count	Random	Days	Count	Random	Days	Count
0.427083638	1	2	0.455439954	1	3	0.141816022	1	1
0.794376545	2	3	0.737973723	2	3	0.467943936	2	1
0.190229205	3	2	0.416084517	3	3	0.482430549	3	1
0.764954132	4	3	0.628435237	4	3	0.137491084	4	1
0.987964431	5	4	0.397488464	5	3	0.661645327	5	2
0.788052516	6	3	0.613379916	6	3	0.99466284	6	3
0.350504158	7	2	0.524979828	7	3	0.154439633	7	1
0.439666936	8	2	0.230255086	8	2	0.201174181	8	1
0.262586135	9	2	0.484829191	9	3	0.338035094	9	1
0.545118475	10	2	0.543114455	10	3	0.130786727	10	1

Table 19. Auspicious Days – Customer 2 – Frequency Distribution Table

Variety I				Variety II				Variety III			
Count	Freq.	Prob.	Cum.	Count	Freq.	Prob.	Cum.	Count	Freq.	Prob.	Cum.

			Prob.				Prob.				Prob.
0	2	0.037	0.037	0	0	0	0	0	8	0.1481	0.1481
1	19	0.3519	0.3889	1	3	0.0556	0.0556	1	34	0.6296	0.7777
2	29	0.537	0.9259	2	35	0.6481	0.7037	2	12	0.2222	1.0000
3	4	0.0741	1.0000	3	14	0.2593	0.963	3	0	0	1.0000
				4	2	0.037	1.0000				
				5	0	0	1.0000				

Table 20. Auspicious Days – Simulation Table for Customer 2

Variety I			Variety II			Variety III		
Random	Days	Count	Random	Days	Count	Random	Days	Count
0.641414049	1	2	0.903264711	1	3	0.806438542	1	2
0.207915859	2	1	0.534970544	2	2	0.761214857	2	1
0.701204304	3	2	0.854294429	3	3	0.219635874	3	1
0.22954435	4	1	0.23820215	4	2	0.832758967	4	2
0.377857679	5	1	0.87345051	5	3	0.578778429	5	1
0.951130332	6	3	0.699522615	6	2	0.536821744	6	1
0.610752221	7	2	0.459003443	7	2	0.011348551	7	0
0.720762448	8	2	0.308323373	8	2	0.767091717	8	1
0.741726762	9	2	0.035719323	9	1	0.458612782	9	1
0.953417664	10	3	0.571705048	10	2	0.102947912	10	0

Table 21. Auspicious Days – Customer 3 – Frequency Distribution Table

Variety I				Variety II				Variety III			
Count	Freq.	Prob.	Cum. Prob.	Count	Freq.	Prob.	Cum. Prob.	Count	Freq.	Prob.	Cum. Prob.
0	24	0.4444	0.4444	0	3	0.0556	0.0556	0	33	0.6111	0.6111
1	22	0.4074	0.8518	1	30	0.5556	0.6112	1	21	0.3889	1
2	8	0.1481	1	2	21	0.3889	1.0000	2	0	0	1
3	0	0	1	3	0	0	1.0000				

Table 22. Auspicious Days – Simulation Table for Customer 3

Variety I			Variety II			Variety III		
Random	Days	Count	Random	Days	Count	Random	Days	Count
0.2998694	1	0	0.088900352	1	1	0.813051306	1	1
0.763506272	2	1	0.145787572	2	1	0.414936087	2	0
0.327716081	3	0	0.267353768	3	1	0.133812292	3	0
0.603463451	4	1	0.009494635	4	0	0.415930892	4	0
0.479362308	5	1	0.087426033	5	1	0.574874437	5	0
0.629260727	6	1	0.266773588	6	1	0.236525493	6	0
0.412143803	7	0	0.372368626	7	1	0.240329601	7	0
0.361731462	8	0	0.399483339	8	1	0.273476005	8	0

0.004306452	9	0	0.964711506	9	2	0.90134142	9	1
0.895247448	10	2	0.597709873	10	1	0.749338336	10	1

Table 23. Auspicious Days – Customer 4 – Frequency Distribution Table

Variety I				Variety II				Variety III			
Count	Freq.	Prob.	Cum. Prob.	Count	Freq.	Prob.	Cum. Prob.	Count	Freq.	Prob.	Cum. Prob.
0	3	0.0556	0.0556	0	0	0	0	0	10	0.1852	0.1852
1	18	0.3333	0.3889	1	12	0.2222	0.2222	1	36	0.6667	0.8519
2	31	0.5741	0.963	2	29	0.537	0.7592	2	8	0.1481	1
3	2	0.037	1	3	12	0.2222	0.9814	3	0	0	1
4	0	0	1	4	1	0.0185	1.0000				
				5	0	0	1.0000				

Table 24. Auspicious Days – Simulation Table for Customer 4

Variety I			Variety II			Variety III		
Random	Days	Count	Random	Days	Count	Random	Days	Count
0.57782965	1	2	0.849497545	1	3	0.389972799	1	1
0.717677095	2	2	0.469151665	2	2	0.810773021	2	1
0.390422536	3	2	0.59727892	3	2	0.156067687	3	0
0.78123616	4	2	0.798415186	4	3	0.678809717	4	1
0.520260965	5	2	0.926597456	5	3	0.174423224	5	0
0.09682048	6	1	0.326797905	6	2	0.397126981	6	1
0.762121098	7	2	0.013249247	7	1	0.840013407	7	1
0.73492909	8	2	0.841211175	8	3	0.790441134	8	1
0.728069395	9	2	0.061785114	9	1	0.566193601	9	1
0.850869345	10	2	0.840304256	10	3	0.664883497	10	1

III. CONCLUSION

In this paper, the application of simulation techniques in the distribution of bunch of bananas with the stem to the customer from the wholesale market. This helps the wholesale vendor to expect the amount of bunch of bananas with the stem for his customers accordingly in placing the order for the same by knowing the demands of different varieties.

IV. ACKNOWLEDGEMENT

The authors acknowledge the wholesale vendor Mr. H. Sharfudeen, Madurantakam, who accepted the request and

came forward to share the original data regarding the distribution of bunch of bananas with the stem to his customers.

V. REFERENCE

- [1] Doucet, Arnaud, Nando De Freitas, and Neil Gordon. "An introduction to sequential Monte Carlo methods." *Sequential Monte Carlo methods in practice*. Springer, New York, NY, 2001. 3-14.
- [2] Kroese, Dirk P., et al. "Why the Monte Carlo method is so important today." *Wiley Interdisciplinary Reviews: Computational Statistics* 6.6 (2014): 386-392.
- [3] Raychaudhuri, Samik. "Introduction to monte carlo simulation." *Simulation*

- Conference, 2008. WSC 2008. Winter. IEEE, 2008.
- [4] Hillier, Frederick, and Mark Hillier. *Introduction to Management Science w/Student CD-ROM*. McGraw-Hill, Inc., 2002.
- [5] Han, Song, et al. "Design optimisation and simulation of structure parameters of an eggplant picking robot." *New Zealand Journal of Agricultural Research* 50.5 (2007): 959-964.
- [6] Etemadnia, Hamideh, et al. "Optimal wholesale facilities location within the fruit and vegetables supply chain with bimodal transportation options: An LP-MIP heuristic approach." *European Journal of Operational Research* 244.2 (2015): 648-661.