

The estimation of a virtual shop's success by using the Monte Carlo Method¹

STANCA LIANA-MARIA

Faculty of Economics Sciences and Business Management
BABES-BOLYAI UNIVERSITY
Address TH. Mihaly Street, F.N. 400591; Cluj-Napoca
ROMANIA

Abstract: - The development of virtual shop by using latest informatics' technologies isn't the only condition that guarantees the success of this kind of business. This paper presents a method that finds whether a virtual shop will have or not success as early as his first year of functioning. The article presents theoretical and particle aspects of the Monte Carlo method. This one is used in order to determinate whether the electronic business, that is not yet launch, will be prosperous or not at all.

Key-Words: - e-commerce, e-shop, benefit, Monte Carlo, statistic analysis

1 Introduction

The recent progresses in domains like technology, computers software and telecommunications have changed completely the population's lifestyle. This change was not even imagined 20 years ago.[11][7][8] On this background, the passing from industrial era to informational era has been accomplished. In the informational era it's important to administrate in a very efficient way the time, because the time is the success key to any electronic business. In this context, conceive, projection and implementation of an electronic business, an e-shop, is compulsory, generating a lot of advantages, not only for consumers but also for producers.

The first step in launching any e-business, an e-shop, is realizing some evaluations and plans of all concerned aspects. As part of those evaluations and plans it is also imposed to realize a traffic analysis, and also an analysis of the volume of done transactions. All that is for knowing customers behavior and the economical situation (benefit or not) in its first year of performing. The e-business that we propose in this article is about selling electronic products over the Internet for that, an e-shop using ASP technology has been built; the data base was created using MySql Front. Before launching the e-shop, we have used the Monte Carlo Method in order to estimate the average number of visitors in his first year of functioning. Knowing this number we will be able to estimate the total average benefit that is

generated for the "TELEVISION" product by applying the Monte Carlo Method again. In this way, we will determine whether the proposed business will be a success or not

2 Theoretical aspects of Monte Carlo Method

The simulation method Monte Carlo [1] could be defined as method to modelate random variables, in order to calculate characteristics of their probability distribution. Steps that should be taken for realizing the simulation using Monte Carlo method are:[1]

1. Identification of factors;
2. Wording a model;
3. Determination of probability distributions for considered factors;
4. Realizing the simulation;
5. The analysis and the interpretation of simulation's result.

The success of a product that is marketed through an e-shop depends on some factors as:[2][1]

1. The area of the market;
2. The market segment to whom it's dedicated the launch and promoting costs;
3. The life of the product.

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The estimation of benefits involves the estimation of a probability distribution for possible values of the product's benefit. By simulation, the most probable combinations are generated more often, and the less probable combinations are generated not so often.

3 Practical aspects of the Monte Carlo Method

The Monte Carlo method it's imposed to be applied in order to find the benefit of the e-shop in his first year of activity for the "TELEVISION" product. This technique allows us to obtain the trust interval for the average number of visitors that an e-shop has per day. The steady and variable expenses that the e-shop is having have been obtained thought the average benefit that the e-shop datelines in his first year.

So, by applying the Monte Carlo simulation method we estimate the average number of visitors that the e-shop has in his first year. Knowing this number we can estimate the total average benefit, generated for the chosen product. For that we will apply the Monte Carlo method again.

Using the cumulate probability distribution and original generator for random numbers will make using Monte Carlo method the realization of the simulation. Those numbers belong to the [0,1) interval, realized in Visual Basic. In our case, the random number is the number of visitors/day of the e-shop.

3.1 Subsection Determining the average number of visitors/day

We will continue by presentation steps to make in order to obtain the average number of visitors per day of an e-shop.

The data that we have analyzed are taken from "Trafic.ro" The analyzed e-shop was launched in 01.03.2006 and it has the fallowing Internet address "www.f2.ro". The number of visitors/day has been analyzed since the first month of functioning, those data being the starting point in realizing the simulation. The real situation from where the simulation from where started is:

NR DAYS WORKED/ MONTH	NO VISITOR / DAY
1	1
2	1
3	3
4	4
5	4
6	4
7	2
8	6

9	2
10	7
11	7
12	5
13	3
14	5
15	1
16	2
17	4
18	6
19	8
20	7

Table1. Random numbers [9][4]

First Step: The determination of probability distributions

The relative probability was calculated like this: first we have determined the total number of visitors in a month (20 work days). The number is the result 82 and it is presented in the following table: The relative probability was calculated like this: (number of visitors per day)/(sum of e-shop visitors in a month, meaning 82)[4]

The cumulated probability is calculated like this: the first value is the relative probability, and the following values are obtains by auditioning the previous cumulated probabilities. The formula is: [1][2][3]

$$P_k = \sum_{i=1}^k p_i, \quad i=1, \dots, 20 \text{ where } p_i \text{ are relative probabilities}$$

associated to random factors.

In the fallowing table we present the values that we have obtained for relative probabilities, and cumulate probabilities corresponding to analyzed values.

Intervals of random numbers, corresponding to data from our example have been determined. If the sum of relative probabilities is one it means that we have correctly calculated.

A basic property in the theory of probabilities says that the sum of probabilities of a random variable is 1. We can see that even in our case this property is checked.

$\left(\begin{matrix} 1 & 1 & 3 & 4 & 4 & 4 & 2 & 6 & 7 & 7 & 5 & 3 & 5 & 1 & 2 & 2 & 4 & 6 & 8 & 7 \\ 0012 & 0012 & 0036 & 0048 & 0048 & 0048 & 0024 & 0073 & 0024 & 0085 & 0085 & 0060 & 0036 & 0060 & 0012 & 0024 & 0048 & 0073 & 0097 & 0083 \end{matrix} \right)_{\sum p_i = 1}$
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Table 2: Probability distribution

Step 2: The generation of random numbers was realized with a program that we have created in Visual Basic and have realized 12 simulations of 20 values, because the year has 12 months. We supposed that each month has 20-work day.

This is the window corresponding to the programs that generated random number:[4]

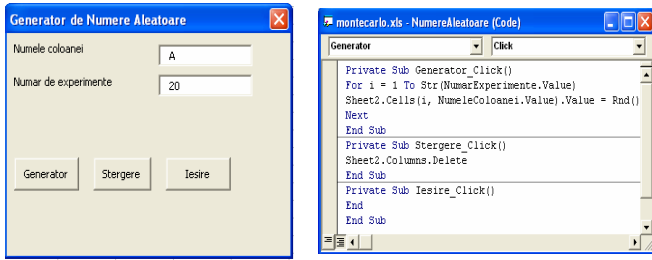


Fig1. Random number generator

We can see that the A column contains numbers generated with this program. We will realize 12 simulations by 20 values, because the year has 12 months and the real data belong to the first month of e-shop's functioning.

The number of tests that we have made is N=240.[4] After the first test, formed by 20 random numbers it is noticed that the number of experiments (20) is smaller than the number of tests (240), so we will repeat this step 11 times. After all this 11 times we pass to the next step. Next we will associate the $[P_{k-1}, P_k]$ interval to the obtained random numbers. The first obtained number through simulation is 0,875. This number belongs to the [0,817; 0,915] interval. In a different column we will note the value *NO visitor / day* that corresponds to the interval that contain the generate number. This procedure is repeated 239 times.

No vizit. day	P. relative	P.cumu lated	Interval	No exp	No aleator	No viz/ day
1	0,012	0,012	[0;0.012]	1	0,875	8
1	0,012	0,024	[0.012;0.024]	2	0,062	4
3	0,037	0,061	[0.024;0.061]	3	0,278	6
4	0,049	0,110	[0.061;0.110]	4	0,778	6
4	0,049	0,159	[0.110;0.159]	5	0,915	7
4	0,049	0,207	[0.159;0.207]	6	0,415	7
2	0,024	0,232	[0.207;0.232]	7	0,739	4
6	0,073	0,305	[0.232;0.305]	8	0,089	4
2	0,024	0,329	[0.305;0.329]	9	0,839	8
7	0,085	0,415	[0.329;0.415]	10	0,730	4
7	0,085	0,500	[0.415;0.500]	11	0,922	7
5	0,061	0,561	[0.500;0.561]	12	0,284	6
3	0,037	0,598	[0.561;0.598]	13	0,130	4
5	0,061	0,659	[0.598;0.659]	14	0,539	5
1	0,012	0,671	[0.659;0.671]	15	0,519	5
2	0,024	0,695	[0.671;0.695]	16	0,114	4
4	0,049	0,744	[0.695;0.744]	17	0,800	6
6	0,073	0,817	[0.744;0.817]	18	0,675	2
8	0,098	0,915	[0.817;0.915]	19	0,340	7
7	0,085	1	[0.915;1]	20	0,040	3

Table 3. Simulation

Step 3: The statistic analysis of data

The average number of visitors: [1][2]

$$nrmv = \frac{\sum_{i=1}^N nrv_i}{N}$$

The average number represents the probability distribution's value round who all given values fluctuate.

The standard deviation is:[1][2]

$$s = \sqrt{\frac{\sum_{i=1}^N (nrmv - nrv_i)^2}{N - 1}}$$

The standard deviation shows how much the values of the probability distribution divert from the average number of visitors. Most of this distribution values are in the $(nrmv-s, nrmv+s)$. For $N \geq 30$, the trust interval is found thanks to: [1][2][3]

$$\left(nrmv - z_{\alpha/2} * \frac{s}{\sqrt{N}}, nrmv + z_{\alpha/2} * \frac{s}{\sqrt{N}} \right)$$

where $\alpha = 0,05$ is significant level; $(1-\alpha) = 0,95$ is probability (so $\alpha/2 = 0,025$). Estimations like the trust intervals allow us to indicate the interval that contains mean, we always want to estimate mean with a probability dose to 1.

The value of the normal distribution $z_{\alpha/2} = 1,96$ can be found in the T ("Student") distribution table, on the last line of this one.

The variation coefficient is calculated like this:[1][2][3]

$$C_v \% = \frac{s}{nrmv} \cdot 100$$

As we can see from the above formula the variation coefficient of a distribution is a ratio between the standard deviation and mean. The variation coefficient shows the percent of mean that is the standard abating. If $CV\% > 20\%$ we call a distribution with a big variation.[4]

In our case we found the average number of visitors to be **5,25**. The standard deviation is **1,88**, meaning the number of visitors variants from the mean number **5,25** with **1,88**. The number that represents most of visitors will be in the $(nrmv - s, nrmv + s)$, interval. In our case, they will be not more then **7,14** visitors/day and not less than **3,37** visitors/day.[4]

In our case $N = 240 \geq 30$, meaning the Z test will be applied. The trust interval of the average number of visitors is **(5,02 ; 5,49)**, meaning that the average number of visitors variants in this interval with a 0,95 probability.

The value of the variation coefficient is **36%**. The distribution has a high variation.

3.2 Determining the average benefit on the first year

We will continue by applying the Monte Carlo Method to determine the e-shop's average benefit in the first year of life

The benefit is determined as a difference between the volume of sold products and the costs that they

generated. Because a virtual shop contains a lot of product and this one is the "TELEVISION".

The steps distinguished in the simulation are:[2]

1. Identifying factors that influence the profit and the model's formulation, starting from:

Benefit=incomes from selling-expenses from producing
 Incomes from selling=unitary price at the moment of sale * volume of sales;

Expenses=steady costs + variable costs

Variable costs=variable unitary cost * volume of sales

- Benefit= unitary price at sale * volume of sales – steady costs – variable unitary cost * volume of sales
- Benefit= volume of sales *(unitary price at sale-unitary variable cost)-steady costs

These factors can be detailed on more levels but for simplifying the problem we will consider only the ones presented above.

2. Determining the probability distributions: we will suppose that the unitary price at sale for the "TELEVISION" product, Panasonic Plasma TH-50PHD8EK-S is 475 Euro/ unit, price that doesn't contain the TVA.[10] The steady costs are 2.428,59 Euro/month and the variable cost is 402 Euro/unit

For determining the average number of buyers/day we will generate 12 numbers through a generator built in Visual Basic.

Each of random number will be multiplied with the average number of visitors/day. In this way we will obtain the average number of buyers/day. This number will be multiplied with the number of working days and we will obtain the average number of buyers/month.

No.	No. random	Average. no. buyers /day	Average. No. buyers /month
1	0,936	0,936	18,726
2	0,343	0,686	13,723
3	0,592	1,777	35,549
4	0,973	3,892	77,843
5	0,367	1,834	36,671
6	0,669	4,012	80,236
7	0,840	5,883	117,653
8	0,543	4,345	86,903
9	0,400	3,597	71,937
10	0,149	1,485	29,710
11	0,105	1,150	22,992
12	0,581	6,970	139,406

Table 4. Average number buyers/month

After determining the number of buyers/month, the benefit is determined like this:

NO. Average buyers /month	Unitary var. costs	Steady costs	Total costs	Unitary price	Total income	Benefits (lost)
98,313	402	2428,59	41950,43	475	46698,69	4748,26
36,023	402	2428,59	16909,96	475	17111,08	201,11
62,211	402	2428,59	27437,24	475	29550,02	2112,78
102,168	402	2428,59	43500,31	475	48530,01	5029,71
38,505	402	2428,59	17907,41	475	18289,65	382,24
70,206	402	2428,59	30651,52	475	33347,99	2696,47
88,239	402	2428,59	37900,86	475	41913,75	4012,89
57,030	402	2428,59	25354,57	475	27089,16	1734,59
41,963	402	2428,59	19297,71	475	19932,41	634,71
15,598	402	2428,59	8698,82	475	7408,85	-1289,97
10,973	402	2428,59	6839,86	475	5212,32	-1627,54
60,990	402	2428,59	26946,55	475	28970,22	2023,68

Table 5. The benefit

We will continue by determining the position and variation indicators for benefit, meaning the average benefit, standard deviation, variation coefficient and trust interval.

The average benefit is:[1][2][3]

$$pm = \frac{\sum_{i=1}^N p_i}{N}$$

The standard deviation is:[1][2][3]

$$s = \sqrt{\frac{\sum_{i=1}^N (pm - p_i)^2}{N - 1}}$$

For N<=30 the trust interval is built like this:[1][2][3]

$$\left(pm - t_{\alpha/2; N-1} * \frac{s}{\sqrt{N}}, pm + t_{\alpha/2; N-1} * \frac{s}{\sqrt{N}} \right)$$

where α = 0,05 is significant level; (1-α) = 0,95 is probability. The value of the normal distribution t_{α/2; N-1} can be found in the table of "T" distribution (Student)

The variation coefficient is calculated in following way: [1][2][3]

$$C_v \% = \frac{s}{pm} \cdot 100\%$$

For this simulated benefit we have found the following characteristics:

The average benefit is: **pm = 1721,58**

The standard deviation is: **s = 2176,79**

The variation coefficient is: **C_v = 79%**; meaning this distribution has high variation. The value from table is **t_{0,05/2; 12-1} = 2,20**. This last value will be used in the formula of the trust interval.

As a conclusion, the mean average benefit of our product variants between **(339,13; 3104,02)**.

4 Conclusion

The conception and the launch of an electronic business, specially a virtual shop, require an analysis of traffic and volumes of transactions realized thereon in the aim cognition of customer behaviors and the continuous adaptation of the shop to their needs. Starting from this

idea in the present frame, we have underlined that the activity of projection and implementation of a virtual shop is not an instrument of estimation for this one. The measure of utility, performances and efficiencies contextually of an average in permanently change is still objective a difficult of touches, but not impossible.

A successful virtual business, a virtual shop, enforces the determination number of former visitors' pages shops because they represent the correspondent of an audiences his broadcasts of a televisions. Therefore, a big number of former visitors' can represent a guarantee that the virtual shop is crowded over a real success on the electronic market. Starting from this idea, I have presented in this article, the application of the Monte Carlo method and how this one determines the average number of visitors of a virtual shop of electronic. After having the average number of former visitors virtual shops in first year we get the average number of former buyers in same period. Knowing the average number of former and re-enforcing the method Monte Carlo we estimate the profit average total on first year; we will see now if the shop will have or not success. On the strength of obtained results, currently item is caned noticed clearly as the suggested business generated the profit as far back as first year in year out, this having bought we active in the aim subsequent development bred the digits of businesses. Therefore, in the economic Romanian scenery, the realization of an investment in the development of a virtual shop has as aim the commercialization of electric it is advantageous because it will generate profit as far back as first year in year out. We consider this research necessary for every person who wants to saddle his own business, because these ploughs can cause as far back as incipient phase if their business will be worsted or not, other way said if it's profitable or not to invest in it. The research goes on with the determination and the elaboration of an adding algorithm of costs and of profits that an advertising campaign can generate. The Romanian market is currently found out in a period of growing up.

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