Beam Journal of Economic Studies | Volume: 06 / N°: 01 (2022), p 638-653

# The Monte Carlo Simulation as A Piler For Financial Evaluation And Comparison Between investment projects under conditions of risk and uncertainty - Comparison Case Between Producing Tomato Seedlings project And Strengthening The Durum Wheat Production Network project In Amor Benamor Complex in Guelma-

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*Received: 12/10/2021* *Accepted: 14/03/2022* *Published: 15/03/2022*

**Abstract:**

This study aims to propose Monte Carlo simulation as one of the main pillars to make a rational investment decision in a way that aligns with investment environment's changes and facing the risks and uncertainties that involved. By applying Monte Carlo simulation at Benamor complex to include the risk and uncertainty, and determine its efficiency to compare producing tomato seedlings project and creation of network to improve hard wheat's quality, the results showed the method's ability to Modeling cases of uncertainty, and monitoring the important variables impact on proposed projects feasibility, to lead to accept producing tomato seedlings project as the best, given its significant returns compared to second alternative.

**Keywords:** Monte Carlo Simulation; Investment Decision; Project Evaluation; Risk; Uncertainty.
**Jel Classification Codes**: C44, G11.

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## 1. INTRODUCTION

The challenges imposed by the global openness of markets and the intensification of competition for economic institutions necessitate work to adapt to this reality in order to be able to maximize their value and achieve their continuity and growth. Therefore, these institutions seek to direct all of their decisions to serve their strategic goals, especially the decisions of internal and external expansion that are closely related to the implementation of large-scale investments. However, its adoption of such a decision calls for the necessity of good scrutiny and extensive study of all investment opportunities and alternatives available to it, especially as it is active in an investment environment that is constantly changing and involves a degree of risk and uncertainty, which necessitates the need to take note of it, and to be guided by appropriate scientific methods to serve its evaluation process. and trade-off the comparison between them and enhances the decisions taken in these circumstances. Monte Carlo simulation is one of the most effective methods adopted in this field due to its ability to deal with complex problems, especially those characterized by a large number of variables, as well as the effectiveness that provides in achieving solutions to the problems at hand, and if it is not ideal, it is very close to reality.

- **The problem of the study:** From the above, the features of the study problem are clear, which can be formulated in the form of the following question:

**To what extent did Monte Carlo simulation contribute to the financial evaluation of the two projects for the production of tomato seedlings and the strengthening of the durum wheat production network in the Amor Benamor complex, and thus in supporting the decision to compare between them?**

- **Study Objectives:** Through this study, it aims to reach:
  - Getting acquainted with the basics of evaluating investment alternatives, especially in light of risk and uncertainty, and the most important criteria adopted in this framework;
  - Learn about Monte Carlo simulation as a method for financial evaluation of investment projects, and its ability to face the elements of risk and uncertainty in the investment environment;
  - Standing through a field study of the Amor Benamor complex in Guelma on the effectiveness of Monte Carlo simulation in supporting the decision to compare between projects and making investment decisions and rationalizing them at its level, under the conditions of risk and uncertainty.
- **Study Methodology:** In this study, we relied on the descriptive analytical approach that is most appropriate for the theoretical part to present the various concepts related to the project evaluation process and investment decision-making. On the other hand, a case study method was adopted for the field sampling, with the use of the XLSTAT program due to its effectiveness in facilitating the use of the Monte Carlo simulation method in evaluating the two projects and making the investment decision and simplifying it.

## 2. An introduction to making an investment decision:

**2.1 The concept of the investment decision**:

the investment decision is an action related to the transfer of financial resources into fixed assets during a certain period of time, by studying and evaluating the available investment alternatives and making a comparison between them (Pike & Bill Neale, 2009, p. 06). As for the rational investment decision, it is a decision based on choosing the investment alternative that gives the largest investment return from among two alternatives or more, and based on a set of feasibility studies that precede the selection process, and go through several stages that end with choosing this alternative for implementation within a certain methodological framework according to the objectives and nature of the investment project (Brauner & sonja, 2020, p. 123) .

**2.2 Methods of financial evaluation of investment projects:**

**2.2.1 Financial evaluation of investment projects under conditions of certainty**

In this case, the decision maker has complete information about what will happen in the future. Among the criteria for making an investment decision in these circumstances, we distinguish:

- **Payback period criterion (PP):** This criterion represents the period required to recover the capital invested in the project by collecting the expected returns from it. Which is expressed in the case of an investment that yields a regular cash flow by the following relationship: DR= $I_0/CF_i$, where: $I_0$: the initial investment, CFi: the regular net flow of liquidity.

  But if the cash flows are variable, then: DR= n.

  The comparison is made here on the basis of the investment that recovers its money within the shortest possible period of time (cabane, 2014, p. 248);
- **Net Present Value (NPV):** The net present value of an investment project is the difference between the sum of the present values of the project's cash flows and the investment cost. It is calculated according to the following relationship (khiari, 2019, p. 657):

  NPV $=\sum_{i=0}^{n} \frac{Rt}{(1+i)^t} - I0$ ،where: i: discount rate, $R_t$: the annual cash flow, n: the useful life of the asset, t: number of timer periods $I_0$: the initial investment cost.

  The investment decision is made by achieving a positive net present value. In the case of a comparison between several investment projects, the project with the largest positive net present value is selected;

  **Profitability Index (PI)**: This indicator aims to measure the profitability achieved (return generated) for each unit of money of invested capital. Moreover, The profitability index is calculated as follows: PI = (NPV /$I_0$) +1 (cabane, 2014, p. 245). And the general rule for accepting or rejecting projects is to compare their PI with the correct one (1). If the indicator is greater than 1, it is a profitable project.
- **The internal rate of return (IRR):** represents the discount rate at which the present value of the cash inflows equals the present value of the cash outflows. The profitability of the project is determined according to this rate, so it is acceptable if IRR is more than RRR, where RRR represents the required rate of return (popiolek, 2006, p. 11).

**2.2.2 Financial evaluation of investment projects under conditions of risk and uncertainty:**

Risk represents a situation characterized by the possibility of an adverse deviation from the expected desired result. However, uncertainty represents the case in which it is not possible to identify the specifications of natural states, which prompts reliance on self-experience with the use of some criteria. Among the most important methods adopted in making an investment decision in the two cases we distinguish:

- **Sensitivity analysis method:** This method indicates the extent to which the decision taken is responsive to changes, so that this decision remains optimal in a certain range of change. If the optimal decision does not also result in a limited change in the natural state or its possibilities, then the alternative decision is sensitive (not flexible), but if the range of the optimal decision is wide, it will be more flexible in response (Refafa & souar, 2020, p. 528);
- **Break-even analysis:** Break-even analysis is a graphical or algebraic tool that helps determine the relationship between volume-revenue-cost, and to determine the volume of outputs at which total costs are equal to total returns. The break-even model is a guiding tool for the organization in many decision problems such as: the on-site break-even model when comparing sites, introducing a new product or selecting equipment (Pierluigi & Tajani, 2013, p. 1831).
- **Decision tree:** A decision tree is defined as a schematic representation that resembles a horizontal tree that shows the actions that can be taken, the states of nature and their probabilities, as well as the benefits associated with each pair of actions and states of nature. They are often used when deciding on large-scale or multi-stage problems (popiolek, 2006, p. 17);
- **Monte Carlo simulation:** This method is considered one of the most powerful quantitative methods used in making decisions, as the organization resorts to developing simulation models to help it make decisions related to inventory control, maintenance programs and network models, and especially investment planning.

## 3. Monte Carlo simulation as a modern method in the financial evaluation of projects and making investment decisions under conditions of risk and uncertainty

### 3.1 Definition of Monte Carlo simulation:

Simulation as seen by researchers, led by Shannon, is the process of designing a model that represents a particular real system, with experiments based on the same model to understand the behavior of the real system or to evaluate the various strategies of its operation according to the limits of the values set and the existing parameters (Robert.E. S, 1975, p. 02). As for the Monte Carlo method, it is a method used to solve problems that depend heavily on probabilistic problems, where it is practically impossible to conduct real experiments and use mathematical equations, so that the Monte Carlo method is the method that gives a reasonable approximation to the practical answer to the problem under study. It represents a method for selecting random values from probability distributions for use in an experiment or a special course of simulation study courses or experiments (Wassila & BEDRANI, 2019, p. 43).

### 3.2 Monte Carlo simulation model and investment project evaluation

#### 3.2.1 Building a general model for Monte Carlo simulation to evaluate investment projects:

The Monte Carlo simulation model consists of the following components (Kelton, 2000, p. 206):

- **Constants and Model Parameters**: They are the input variables that are determined and whose estimation is controlled by the decision maker. The most important of these parameters are: the depreciation rate for the year, the unit selling price per year, the risk-free rate, and the number of simulation cycles. It is assumed that both the selling price of the product or service as well as the discount rate are among the constants of the Monte Carlo model, which remains constant during the simulation cycles;
- **External or Exogenous variables:** They are random variables that cannot be controlled, and therefore are not determined in the form of a single number or the so-called estimation at a point, but only in the form of probability distributions. Among them: the required initial investment, the economic life of the project, fixed and variable operating costs...
- **Internal variables:** They are the outputs or performance variables and they are known as dependent variables, as they are determined by: the sales units generated by the project in the year, the total revenue generated by the project in the year, the depreciation for the period, the total variable costs, and the net income after taxes in the year.
- **Equivalencies and operating equations:** They represent the mathematical definitions that are the basis of the simulation, showing how the internal variables or outputs are related to the constants and external variables or the inputs (abdelaziz & youcef, 2019, p. 410).

**3.2.2 the process of running the Monte Carlo simulation model and conducting experiments:**

- **The basics of running the monte Carlo simulation model for evaluating investment projects:** The simulation model is run as follows:
  - Reading the constants and assumptions of the simulation model and the probability distributions of each external variable;
  - Determining the number of cycles to know the number of experiments to be conducted to study the behavior of the system;
  - Generating a value for each external variable in each simulation by randomly selecting it from the reality of its probability distribution;
  - Calculate the value of each internal variable with an equation based on the generated random values and the values of the constants;
  - collecting the observations generated by each simulation cycle to obtain the empirical distribution for calculating normal statistics, and making probabilistic lists of the probabilities of the internal variables;
  - Taking the decision from the empirical distributions of the internal variables and counting them after completing the simulation cycles.
- **Sampling and reducing variance**: By preparing certain statistical samples, it becomes clear that there are more efficient estimates than others due to deviations in lower estimates than others, because the collected statistics are likely to have their own

deviations, so applying the simulation method is a way to reduce these deviations by increasing the number of experiments simulation, because each simulation cycle is equivalent to one sample.

- **Analysis of the empirical results of the Monte Carlo simulation model for project evaluation and decision-making**: The main outputs of the Monte Carlo model play a role in providing empirical aspects and statistical measures such as: measures of central tendency or measures of dispersion expressing the risk surrounding the investment project, which are collected from each experimental distribution. Analyzing the experimental results of the simulation model through graphs or statistical tables and their interpretation with the information they provide is the basis for deciding whether to accept the investment or not, on the basis of balancing the return and risk of the project under evaluation, which would make a comparison between alternatives in a way that achieves the maximum benefit for the institution in uncertain conditions.

## 4. A case study of financial evaluation and comparison between the two projects of the production of tomato seedlings and the strengthening of the durum wheat production network in Benamor complex in Guelma according to the Monte Carlo simulation method:

### 4.1 Introducing the two investment projects:

Within the framework of the expansion strategy pursued by the complex, two investment projects were identified. The first project is the production of tomato seedlings and the transition to the traditional method of producing root plants to the seedling system, by introducing tomato varieties with high potential and profitability by adopting modern agricultural techniques for treatment and irrigation. As for the second project, its idea revolves around the establishment of a network to improve and enhance the quality of durum wheat in the eastern region of the country, through which it seeks to allow Algeria to produce wheat of a high degree of quality.

### 4.2 Initial financial evaluation of the two investment projects according to the net present value method:

The two projects are evaluated based on the net present value, which is an indicator to judge the profitability of the project or not under conditions of complete certainty, which requires the necessity to determine the annual cash flows for each project as follows:

**Table 1.** The annual discounted cash flows of the two investment projects under evaluation

| **Life of the investment project: 3 years; Discount rate(r): 11%** | | **Tomato seedling production project initial investment cost: 1534057 DZD** | | **Durum wheat quality improvement network project initial investment cost: 1046023 DZD** | |
|---|---|---|---|---|---|
| **Year** | **$(1+r)^t$** | **cash flow 1 (DZD)** | **Discounted cash flow 1** | **cash flow 2 (DZD)** | **Discounted cash flow 2** |
| **1** | $(1+0.11)^1$ | 1034057 | 931582.9 | 1089456 | 981491.9 |
| **2** | $(1+0.11)^2$ | 2690112 | 2183355.2 | 1563982 | 1269362.9 |
| **3** | $1+0.11)^3$ | 3517025.8 | 2571618.9 | 1765980 | 1291269.4 |

| | | | |
|---|---|---|---|
| **∑present value1** | 5686557 | **∑present value 2** | 3542124.2 |

**Source:** by researchers using Microsoft Excel and based on the Academy's internal documents

Therefore, the project's net present value (1) (NPV) = total present values (1) (∑VA1) – the cost of the initial investment ($I_0$1) = 5686557-1534057 = 4152500 DZD. It is a positive value indicating that the project is profitable and acceptable from an economic point of view, which means that this project can be adopted. And In order to determine the returns and profits generated by this project, the profitability index of the project (PI) is determined as follows:

PI = (NPV/ $I_0$) +1 = (4152500/ 1534057) +1 = 2.7

The resulting value of the profitability indicator reflects the profitability of the studied project and its acceptance, as every 1 DZD invested in this project will achieve 1.70 DZD as an added value, which is a relatively high value for this indicator in view of the approved discount rate (11%), which is a rather high rate. This indicates that the investment project must be implemented in view of the profits it generates for the existing company and its realization of a net present value of the amount invested in the project estimated at 4152500 DZD. As for the second project, following the same previous steps, it achieved a net present value estimated at 2496101.2 DZD, which indicates its economic acceptance due to the returns it generates, which is reflected in the profitability index estimated at 2.38, which indicates the achievement of 1.38 DZD as an added value for every 1 dinar invested in this project.

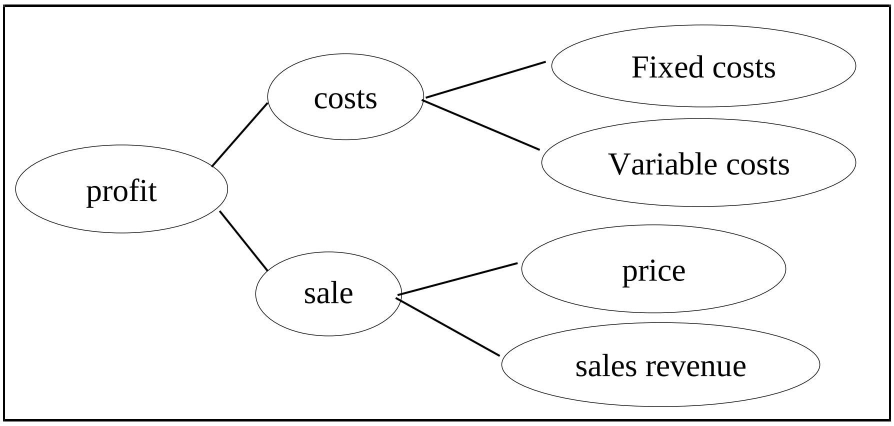
### 4.3 Applying Monte Carlo simulation to the decision problem:

To compare between the two proposed investment alternatives, it is required to estimate the profit achieved from each project, taking into account the uncontrollability of production costs and the demand for the products of the sector in question, which means that uncertainty prevails for both cost and sales of two alternatives. In order to apply the Monte Carlo simulation method to such a problem, it is necessary to follow the next steps:

#### 4.3.1 Determining the factors affecting the returns of each investment alternative:

As a first step, the application is being started on one of the two investment alternatives represented in the "tomato seedling production project", where all factors affecting the profit derived from this investment alternative are discussed, depending on the decision tree method in determining and defining these factors, so that in the end it is possible to give probabilistic distributions of possible values for each of the factors, as shown in the following figure:

**Fig.1.** Factors affecting the return of the investment alternative (profit)




**Source:** by researchers based on the internal data of Amor Benamor Complex

It is clear from the previous figure that it is a simple specific analysis of the factors affecting "profit", which are mainly fixed costs and variable costs, sales returns, in addition to price and sales. It should be noted that the form of this analysis is not limited to what is shown only, as it can be expanded by dividing fixed costs into fixed production preparation costs and fixed advertising costs, as well as dividing sales into local and foreign sales and so on...etc.

### 4.3.2 Formulation of the mathematical model:

At this step, an illustrative mathematical model is formulated for how the predetermined factors, whose probability distributions can be evaluated, affect the studied variable "profit".
This model is expressed for the project under study as follows: $P = (SP_U - VC_U)\ Q - FC$, where:
P: profit, $SP_U$: unit selling price, VC: unitary variable cost, Q: sales quantity, FC: fixed costs.
Here, this simplified model was sufficient with the possibility of affecting a larger number of factors on profit, which were not included in the model, in order to strike a balance between the need to keep it simple and understandable, and the need for an acceptable and reasonable representation of the real problem.

### 4.3.3 Primary sensitivity analysis:

through which all factors that do not need probability distributions are eliminated by:

- Determining the maximum, minimum, and most weighted values for each factor affecting the profit of the studied company, in light of the stability of the selling price at 75 DZD, which means the absence of uncertainty for this factor.
  The results of this process were as shown in the following table:

**Table 2.** Maximum, Minimum and Most weighted Values of Factors Affecting Profit

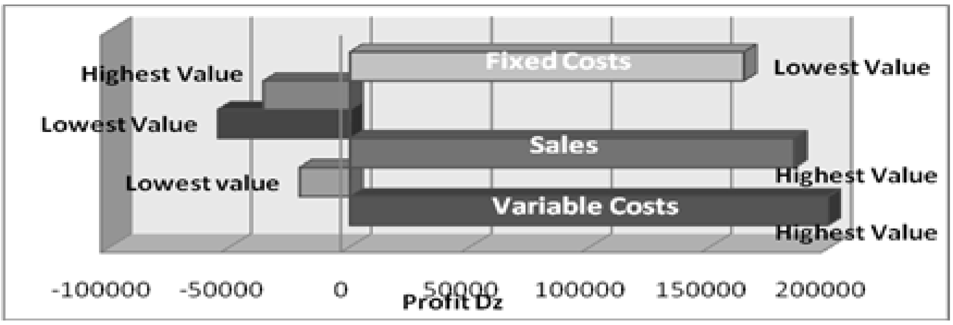
| Influencing factor | Most weighted Value (DZD) | Minimum value (DZD) | Max value (DZD) |
|---|---|---|---|
| **Variable costs** | 63 | 60 | 68 |
| **the sales** | 27000 | 13500 | 33500 |
| **fixed costs** | 216000 | 160000 | 360000 |

**Source:** by researchers based on the internal documents of the Amor Benamor Complex

- Determining the potential profit for the investment alternative available to the company in light of the stability of the first factor "variable costs" at the lowest possible value of "60 DA", while the rest of the other factors are fixed at their most weighted values. Applying to the previously formulated model, we find:
  P = (75-60).27000–216000=189,000 Da
- Determining the potential profit for the investment alternative available to the company in light of the stability of the first factor “variable costs” at its maximum possible value of “68 DZD”, while the rest of the other factors are at their most weighted values. Thus, the potential profit is expressed as follows:
  P = (75-68). 27000 - 216000 = -27000 DZD.
  By repeating the process by changing each factor from the rest of the other factors between its maximum and minimum value, in light of the stability of the remaining

factors at their most weighted values, we obtain the results of the initial sensitivity analysis embodied in the figure below, which highlights the affect extent of each factor's changes between its highest and lowest possible value on Profit, which indicates the need to take plenty of time in evaluating the probability distributions of each of these factors.

**Fig.2.** Initial sensitivity analysis

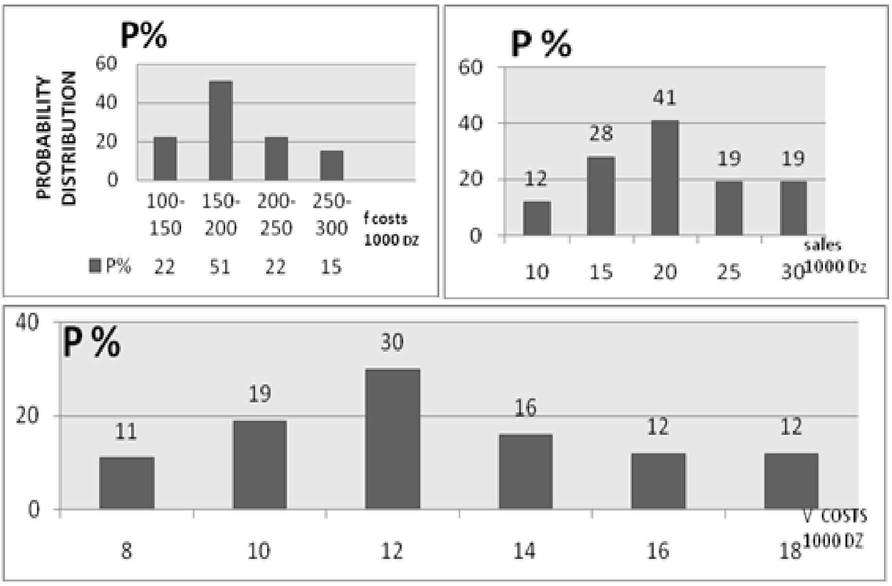



**Source:** by researchers based on the 2014 XLSTATE program

### 4.3.4 Deduction and evaluation of probability distributions:

At this step, several methods are relied on to derive the probability distributions of factors affecting profit, whether by using the direct evaluation method, the probability method of graphs, or the probability wheel. for the studied investment project, the probability method of graphs has been adopted, to show the results of the possible distributions obtained for each of the variable, fixed costs, and sales, as shown in the following figures:

**Fig.3.** Probability Distributions of Variables Affecting Profit




**Source:** by researchers based on XLSTAT 2014

### 4.3.5 Simulation application:

The XLSTAT program was relied upon in the simulation application through computer programming to produce random numbers of the variables affecting the potential return of the

first project, on the basis of which the resulting profit is calculated by applying the formulated model. The management of the complex considers that sales according to historical data follow a regular distribution ranging between (13500-33500), and that the variable costs and fixed costs of this system -for the same period- follow a regular distribution as well, ranging between (60-68) and (160000-360000), respectively.
By conducting 600 consecutive simulations, the following results were obtained:

**Table 3.** Simulation results for tomato seedling production project

| Output Profit (DZD) | simulation repeat | Probability Distributions |
|---|---|---|
| ] (-100.000) – 00.00 [ | 235 | 0.31 |
| [ 00.00- 100 .000] | 56 | 0.18 |
| [100.000- 200.000 ] | 210 | 0.24 |
| [ 200.000- 300.000] | 92 | 0.228 |
| [300.000 - 400.000] | 7 | 0.042 |
| ∑ | 600 | 01 |

**Source:** by researchers based on XLSTAT 2014

It is evident from the results of applying the simulation process and its repetition 600 times, the extent to which the investment project has a great potential to achieve profits and losses, by recording the possibility of achieving a loss of 31% in 235 operations out of 600 simulations, and in contrast, 69% was recorded as a probability of achieving Profits up to a maximum of 400,000 DZD.

**4.3.6 sensitivity analysis:**

According to the economists Hertz and Thomas, considering the Monte Carlo simulation in itself a comprehensive analysis of sensitivity, it is possible to skip this step and suffice with the results reached in this study. It should be noted that another sensitivity analysis can be conducted with different methods if there are doubts about distributions or profit prospects, and even the validity of the structured model.

**4.3.7 Differentiation between the two investment alternatives under evaluation:**

Before commencing the comparison process, it is necessary, as a first step, to re-conduct all previous operations for the second alternative represented in “establishing a network to improve the quality of durum wheat”, where, after performing the simulation process, the probability distributions of the profit achieved for this investment alternative is as follows:

**Table 4.** Simulation results of the Durum Wheat Quality Improvement Network Project

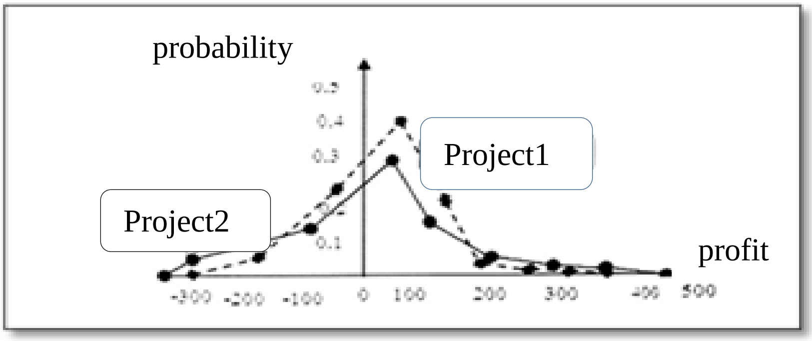
| Output Profit (DZD) | simulation repeat | Probability Distributions |
|---|---|---|
| ] (-100.000) – 00.00[ | 99 | 0.15 |
| ]00.00- 100 .000[ | 112 | 0.340 |
| ] 100.000- 200.000[ | 34 | 0.11 |
| ] 200.000- 300.000 [ | 355 | 0.40 |
| ]300.000 -  400.000[ | 00 | 00.00 |
| ∑ | 600 | 01 |

**Source:** by researchers based on XLSTAT 2014

The results in the table show that the second investment project achieved profits with a probability of 85%, with a maximum of 300,000 DZD. In contrast, 15% of the possible realization losses were recorded in 99 simulations out of 600 operations.

By representing the probability distributions of the two alternatives profit's graphically using the XLSTAT program, the graphical results represented below were obtained, which enables the comparison of the probabilities of the two alternatives achieving profit or loss.

**Fig.4.** Comparative representation of the probability distributions of the profits of the two investment alternatives




**Source:** by researchers based on XLSTAT 2014

It is clear from the above figure showing the probability distributions of the two alternatives, the extent to which the tomato seedling production project achieved greater profits and losses compared to the second alternative due to the dispersion recorded on its level, which reflects the prevailing uncertainty that this alternative enjoys compared to the distribution of the project of establishment a network for the quality improvement of durum wheat. Therefore, in order to compare between the two proposed investment alternatives, it is necessary to determine the alternative with the highest expected benefit, by finding a mathematical function for the benefit followed by a simulation to calculate the benefit of each resulting profit, which enables the calculation of the average benefits obtained and giving the expected benefit. Depending on the company's studied data, including the initial investment cost estimated at 1534057 DZD for a period of 3 years and at a discount rate of 11%, as well as the expected annual cash flows, the possibility of accepting or rejecting the proposed project is determined. As the first step, the random numbers of each cash flow are determined by computer based on the obtained cumulative probability distributions. The results obtained in this step are summarized as follows:

**Table 5.** Random Numbers Allocation's results of Annual Cash Flows for the First Project

| **CF1 (DZD)** | **P1** | **PC1** | **random numbers** | **CF2 (DZD)** | **P2** |
|---|---|---|---|---|---|
| 1034057 | 0.3 | 0.3 | 0-2 | 2690112 | 0.4 |
| 2069000 | 0.5 | 0.8 | 3-7 | 4138000 | 0.3 |
| 3619199 | 0.2 | 1.0 | 8-9 | 5136228 | 0.3 |
| **PC2** | **random numbers** | **CF3 (DZD)** | **P3** | **PC3** | **random numbers** |
| 0.4 | 0-3 | 517025.8 | 0.5 | 0.5 | 0-4 |
| 0.7 | 4-6 | 1551085.5 | 0.1 | 0.6 | 5 |

| | | | | | |
|---|---|---|---|---|---|
| 1.0 | 7-9 | 2068103.2 | 0.4 | 1.0 | 6-9 |

**Source**: by the two researchers based on the internal documents of the complex and the results of the XLSTAT program

After allocating the random numbers to the annual cash flows, the first simulation is run by choosing three random numbers, which each reflects a specific annual cash flow. Applying to the studied project, Choose the numbers (1,3,2) corresponding to the following annual cash flows: (1034057, 2690112, 517025.8) DZD, respectively. This enables the determination of the expected net present value (NPV) for this simulation experiment, which was estimated at: NPV=$\sum_{i=0}^{3}\frac{Rt}{(1+0.11)^{3}} - 1534057$ =1958869.1 DZD

As shown, the result of the achieved net present value is positive in the sense of the project is profitable, which indicates the possibility of its acceptance, but making such a decision is not limited to conducting one simulation process, but goes beyond that to the largest possible number of experiments to obtain correct and more accurate results. By repeating the simulation 100 times using the computer media, the process yielded the results of the corresponding net present values for each simulation process, which are shown in the following table:

**Table 6.** the NPV simulation's results of the tomato seedling production project

| **Simulation number** | **NPV** | | | | |
|---|---|---|---|---|---|
| 01 | 1958869.1 | 09 | 1955869.1 | 17 | 2891249.3 |
| 02 | 3093017 | 10 | 4822459.6 | 18 | 1958869.1 |
| 03 | 4268122.9 | 11 | 3133975 | 19 | 3133975 |
| 04 | 1958869.1 | 12 | 3944136.9 | 20 | 6010664.8 |
| 05 | 3944136.9 | 13 | 4066355.2 | 21 | 4287823.5 |
| 06 | 3890079.5 | 14 | 1958869.1 | 22 | 1958869.1 |
| 07 | 1958869.1 | 15 | 4822459.6 | … | …. |
| 08 | 4268122.8 | 16 | 2891249.3 | 100 | 2891249.3 |

**Source:** by researchers based on the results of XLSTAT 2014

The benefit of calculating one hundred (100) potential values of net present values is summarized in calculating a set of measures of central tendency, in order to be able to judge the feasibility of the proposed project. Through these simulations, the average and the standard deviation of the obtained net current values were determined, and the results were as follows:

- ✓ Average net present value: A(NPV) = 3307311.3 DZD
- ✓ Standard Deviation: σ(NPV) = 263346.4
- ✓ Minimum NPV: Min (NPV) = 1958869.1 DZD
- ✓ Maximum NPV: Max (NPV)= 6010664.8 DZD

Based on the minimum and maximum value of the net present value, the latter has been grouped into categories and their probability distributions and cumulative probability distributions are determined in order to determine the importance of the project and its acceptance or not as follows:

**Table 7.** Probability Distributions of Net Present Values' simulations of the First Investment Project

| Categories | **Probability Distributions** | **Probability Distributions Cumulative** |
|---|---|---|
| ]00.00- 100 .000[ | **0.0** | **0.0** |
| ]100.000- 200.000[ | **0.20** | **0.20** |
| ]200.000- 300.000[ | **0.11** | **0.31** |
| ]300.000 - 400.000[ | **0.27** | **0.58** |
| ]400.000 - 500.000[ | **0.41** | **0.99** |
| ]500.000 - 600.000[ | **0.01** | **1.00** |

**Source:** by researchers based on the results of XLSTAT 2014

It is noticed from the results shown above that the studied project has an opportunity to achieve significant profits, especially since the probability of obtaining a negative net present value is zero, which means that there is no possibility of realizing a loss, which would encourage the decision to accept investment in it.

As for the second alternative, by re-applying all the previous steps related to calculating the potential benefit derived from the investment in the "Establishment of a Durum Wheat Quality Improvement Network" project, and after repeating the simulation process 100 times, the following results were obtained:

- ✓ Average net present value: A (NPV) =826827.825 DZD
- ✓ Standard Deviation: σ (NPV) = 173633.843
- ✓ Minimum NPV: Min (NPV) = - 1602345.4 DZD
- ✓ Maximum NPV: Max (NPV) = 3617419.2 DZD

**Table 8.** Probability Distributions of Net Present Values' simulations of the Second Investment Alternative

| **Categories** | **Probability Distributions** | **Cumulative Probability Distributions** |
|---|---|---|
| [(-2000.000) -(-1000.000)] | 0.13 | 0.13 |
| [ 00.00– (-1000.000) ] | 0.10 | 0.23 |
| [ 00.00- 1000.000] | 0.19 | 0.42 |
| [1000.000- 2000.000] | 0.47 | 0.89 |
| [2000.000- 3000.000] | 0.08 | 0.97 |
| [3000.000- 4000.000] | 0.03 | 01 |

**Source:** by researchers based on the results of XLSTAT 2014

The results of the probability distributions shown above resulted in achieving a negative net present value for the project of establishment a network for improving the quality of durum wheat, which means that it can achieve a loss, with an estimated probability of 23%. On the other hand, it is possible to achieve positive net present values ranging from 1,000,000 to 4,000,000 DZD at a rate of 77%, with the possibility of obtaining the largest net present value for this project, which is estimated at 3617419.2 DZD with an estimated probability of 3%, which is a weak possibility of a low net present value compared to the highest Possible realization value for the first project, estimated at 6010664.8 DZD, which indicates that this (second) alternative has an opportunity to achieve lower returns compared to the first investment project represented in the "production of tomato seedlings" in which there is no possibility of obtaining a negative net present value, which means that there is no possibility achieve a loss.

It should be noted that the comparison between two investment proposals in the event of a convergence between the arithmetic averages is due to the comparison between the standard deviation values that show the most variable cases, but by looking at the results of the arithmetic average of the two projects it becomes clear how far their values are, which makes the comparison of the standard deviation useless to express the extent of the change. Therefore, the coefficient of variation is calculated to determine the amount of fluctuations and expected risks compared to the expected return on investment in the two proposed projects, which expresses the standard deviation ratio of the arithmetic average. By calculating the coefficient of variation for the two projects, we find:
$CV1 = \sigma(NPV1) / A(NPV1) = 0.07$, $CV2 = \sigma(NPV2) / A(NPV2) = 0.21$

It is noticed from the results that the coefficient of variation in the first case is less than in the second, where the standard deviation of the average return is less, which means that the relationship of investment risk with return is better. On the other hand, the second alternative recorded an increased coefficient of variation compared to the first project, which means that The change in values in the second case is greater, and it is a value that shows the extent to which it agrees with the probability distribution of rejecting the project in return for its losses, estimated at 23%. The latter, which is considered as a risk ratio, The latter, which is considered as a risk ratio, is dealt with according to the nature of the project owner, so it can be rejected and excluded if the investor is rational, and it can be also beared and risk investing in it if the investor is speculative ( risk-loving), especially in light of the positive relationship that links the profits ratio and the risk ratio. Finally, and based on the results of the Monte Carlo simulation of the two proposed investment projects, the feasibility of the tomato seedling production project compared to the second project "Establishment a Durum Wheat Quality Improvement Network" becomes clear. Therefore, it is in the interest of the Amor Benamor Complex to make the decision to invest in the tomato seedling production project, as it is the most suitable, best, and most appropriate project for it, given the significant returns that it generates compared to the 2$^{nd}$ project.

## 5. CONCLUSION

The constant change that characterizes the investment environment requires the inclusion of the elements of risk and uncertainty in the evaluation of investment projects, especially in light of the fact that these projects are linked to the factor of time and unexpected future events. that makes good scrutiny and extensive study of all investment opportunities an inevitable necessity by being guided by appropriate scientific methods such as Monte Carlo simulation, which is one of the most effective methods for making investment decisions and rationalizing them, especially in cases of risk and uncertainty, which was evident through the application of this method in evaluating the "Production of tomato seedlings" project and the "Establishment of a network for improving the quality of durum wheat" and the comparison between them to take The right and proper decision.

Based on the contents of this study, a number of results were reached that can be presented through the following points:

- The process of evaluating investment projects is the basis and main pillar for deciding whether to accept or reject the investment project, which is related to the factor of time, that makes the process of taking it based on a number of methods, some of which are under conditions of certainty, and another in conditions of risk and uncertainty;
- In light of the investment environment's changes, hedging is necessary by the decision-maker in the institution, by adopting methods that enable the integration of the risk and uncertainty factors that characterize the investment reality, especially: "Monte Carlo simulation", which gives the decision taken on the proposed project a kind of rationality and confidence, as well as A correct understanding of quantitative analysis models and the relationship that governs the inputs and outputs of investment projects, which supports the institution's decisions about its evaluation of the proposed projects;
- Through the field study in which the projects "Production of tomato seedlings" and "Establishment of a network to improve the quality of durum wheat" were evaluated using Monte Carlo simulation method, it is sought that the latter is one of the most effective methods in facing the conditions of uncertainty and the complexity of potential variables affecting the value of the investment. The development of data processing devices contributed to simplifying the use of the Monte Carlo method based on the XLSTAT program in the differentiation between the project of producing tomato seedlings and the project of establishing a network to improve the quality of durum wheat in the institution under study, the results of which reflected the extent of the enormous ability of this method to model uncertainties, and provide confidence areas included The minimum and maximum limits of the approved indicators, which made them effective in monitoring the most important influencing variables, and their impact on the feasibility of the proposed projects, while imparting tremendous flexibility in decision-making. Which proves the validity of the main hypothesis "Monte Carlo simulation is one of the most effective quantitative methods used in making and rationalizing investment decisions related to the risk environment and uncertainty in the studied institution" due to the accurate results it achieves that support the institution's decision in its selection of investment opportunities.

**Suggestions:** Based on the findings, some suggestions can be made and presented as follows:

- The need to include the elements of risk and uncertainty in the evaluation of investment projects and not to be limited to one criterion without another in evaluating and making investment decisions, as well as benefiting from statistical analyzes To address the case of risk and uncertainty by using complementary methods to analyze such cases, such as the Monte Carlo simulation, which limits the stumbling of investment projects after entering the practical reality;
- Using specialists and experts in the field of project evaluation study, and working on training those in charge of preparing feasibility studies and evaluating projects at the

level of economic institutions continuously, so that they can be informed of the latest scientific developments in this field.

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