Determination of the level of confidence in the equilibrium point of a process

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Abstract

The purpose of this research article is to determine the level of confidence in the equilibrium point, to assess risk as a strategy for decision-making, by means of Operations Research, Formulation and Evaluation of projects and supporting the ISO 31000, favoring in the first instance the industry in the most vulnerable points to those that are identified as risk.

Keywords: Break-even point, forecasts, risk analysis, ISO 31000, ISO 9001-2015

1. INTRODUCTION

Law of Supply and Demand [1] Munch, (2015)

As noted [2] Izar, (2015) the offer is defined as the amount of products that manufacturers are willing to offer at a certain price to consumers. On the other hand [3]Porter (2008), indicates the model of the five forces that are within the factors that affect the offer, intensity of the competition, power of suppliers, Substitute products, power of buyers, new products indicating that the intensity of the competition It is the most important component according to your model, see figure 1
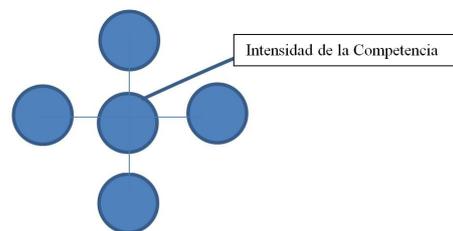

Figure 1 Model of the five forces. (Porter 2008)

[4]Forecast (Duncan 2010)

The forecast of the demand is to estimate the sales of a product during a certain future period. Executives first calculate the demand across the industry or market and then predict the sales of the company's products in them.

Fixed costs
Fixed costs are those costs that the company must pay regardless of its level of operation, that is, whether or not it produces, it must pay for them.

Variable costs
Variable cost refers to production costs that vary depending on the level of production

Breakeven
Corresponds to the concept used in a project or in the finance area that refers to the level of sales where fixed and variable costs are covered, there is no loss. This means that the company, at its point of equilibrium, has a benefit that is equal to zero (it does not make money, but it does not lose either).
At the point of equilibrium, therefore, a company manages to cover its costs. By increasing your sales, you will be able to place yourself above the break-even point and get a positive benefit. On the other hand, a drop in sales from the break-even point will generate losses.

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The break-even point estimate will allow a company, even before starting operations, to know what level of sales it will need to recover the investment. In case that it does not cover the costs, the company must make modifications until reaching a new equilibrium point.

In this case, if what a company wants to know is the number of units of its product or products that it must sell to reach the aforementioned equilibrium point, the operation is very simple. You must divide what are the fixed costs between the result of subtracting the unit variable cost from the sale price per unit.

If, on the other hand, what is desired is to know this equilibrium point by calculating for sales, the formula would be the following: divide the fixed costs by the result of dividing the total variable cost by total sales.

An equally interesting way to calculate and be able to see clearly where the equilibrium point of a company in question is by using a chart in question. In this way, on the X-axis, the units to be produced and sold would be established, while the Y-axis would represent the value of the revenues (sales), costs and expenses.

To find its balance point, the company must know what their costs are. This calculation should consider all disbursements (that is, all cash outflows from the company's coffers). It is also necessary to classify costs into variables (they vary according to the level of activity) and fixed. The next step is to find the unit variable cost, which is the result of the division between the number of units manufactured and the units sold.

Normal distribution and confidence level

Considering the proposal of [5] Lind et al, (2010) the use of the sample distribution of the mean is an important analysis, because the decisions taken in business are based on the results of a sampling, using the central limit theorem to calculate probabilities. The present article is based on the calculation of z-value to convert any normal distribution into a standard normal distribution using the following formula 1

$$Z = \frac{x - \mu}{\sigma} \dots\dots 1$$

Where x, is the value of the random variable μ, is the population mean and σ, is the standard deviation of the population.

Risk management

According to [6] Izar, (2015) in the case of investment projects, risk management must be a defined process within the organization, with the aim of ensuring that correct decisions are made in a timely manner and with the information available and adequate, in such a way that they are prevented reduce and contain the negative impacts of the risks, maximizing the opportunities and benefits that may arise.

Management Systems based on the ISO 9001: 2015 Standard
For a company to adopt a management model is a requirement of order now, especially if it is sought to be a supplier of the automotive industry is a requirement to be certified under ISO 9001: 2015 currently with a structure of ten elements [7] Platas & Cervantes (2015). The aforementioned standard requires risk analysis, which enters as an important change in this version and is based on the risk analysis of the ISO 31000 IMNC 2018 Risk Management Principles and Guidelines. Where in essence the norm indicates in the element 6.1 the actions to address risks and opportunities that the letter indicates:

"NOTE 1 Options to address risks may include: avoiding risks, taking risks to pursue an opportunity, eliminating the source of risk, changing the probability or consequences, sharing risk or maintaining risk through informed decisions."

"NOTE 2 Opportunities can lead to the adoption of new practices, launching new products, opening new markets, approaching new clients, establishing partnerships, using new technologies."

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2. Problem

Currently the micro and small companies in Mexico, is estimated according to [8] INEGI, (2016) that between the four years since its creation, suffer from production decrease or establishment in the industrial market, is done with this research a study that provides a tool for continuous improvement, in order to use the statistics for analysis, control and improvement of the variations of the production process.

Therefore, a tool that helps companies to avoid risks, control variations in existing risks and improve processes by eliminating and / or reducing the variables of said variation is developed with this research.

This statistical use applied in the industry, favors also the decision making by the directive unit, heads or responsible for areas of the production process

Below is an example of the statistical methodology applied in a company and how you can avoid losses in the production processes, in order not to fall into risk zone, which generates the permanence of the small business

3. Methodology

1. Categorize and classify the object of study by analyzing the demand and calculating the forecast.
2. Determine the coordinates of the fixed and variable costs.
3. Determine the equilibrium point by intersecting the income with the total cost through mathematical models. (Level of production in which revenues are equal to the sum of fixed costs and variable costs).
4. Graph the equilibrium point to identify the utility area and loss zone.
5. Statistically analyze the forecast of demand to determine the area under the curve and identify the region of acceptance or rejection.
6. Determine the level of confidence at the equilibrium point.
7. Analyze the level of risk based on the forecast of the demand, which allows identifying the areas of production opportunity for decision making.

objective
Determine the level of confidence in the equilibrium point to evaluate risk as a strategy for decision making.

Hypothesis
By assessing risk using the level of confidence in the equilibrium point, decisions can be made with greater certainty.

Independent variables
Evaluate the risk using the confidence level at the equilibrium point

Dependent variable
Decision making with greater certainty

As an example for the case study of this article, the prognosis of the monthly demand is considered for the repair center of an important appliance brand based on the following registered data for refrigerators.

Table1 Refrigerator revision request

Solicitudes	Demanda	Pronóstico
1	390	374
2	445	403
3	370	432
4	450	461
5	510	490
6	480	519
7	550	548
8	620	577
9	590	606
10	640	635

Applying the linear regression method

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Where the calculated mean is equal to x = 504.5

Y = a + bx

a = 345

b = 29

r = 0.9346

When applying the method, we arrive at the following system of simultaneous equations (called normal equations of the regression line of y in x), whose solution gives the values of b0 and b1:

$$\begin{cases} \sum y_i = nb_0 + (\sum x_i)b_1 \\ \sum x_i y_i = (\sum x_i)b_0 + (\sum x_i^2)b_1 \end{cases}$$

with the following solutions:

$$b_1 = \frac{\sum x_i y_i - \frac{\sum x_i \sum y_i}{n}}{\sum x_i^2 - \frac{(\sum x_i)^2}{n}}$$

and

$$b_0 = \bar{y} - b_1 \bar{x}$$

Calculating the forecasts of the following six periods are indicated in table 2, considering table 1

Table 2 Estimation of the following six periods

Solicitudes	Demanda	Pronóstico
1	390	374
2	445	403
3	370	432
4	450	461
5	510	490
6	480	519
7	550	548
8	620	577
9	590	606
10	640	635

4. Result

The average forecast of 736.5, with a standard deviation of $\sigma = 54.5$

On the other hand, if you have fixed costs estimated at $ 1,050,000.00 and variable costs of $ 1,500. 00

The average price of repair and / or revision of the appliance is $ 3000.00, so the break-even point would be:
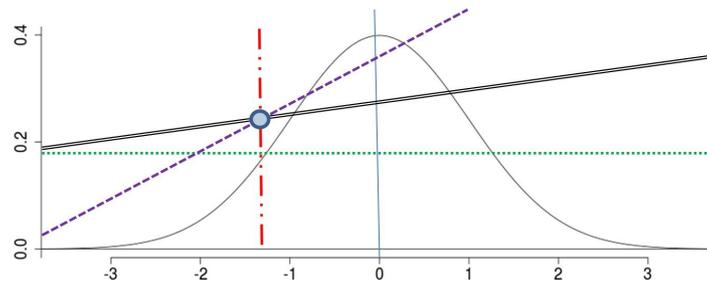
PE = CF / P-CV

PE = 1,050,000 / 3000-1500

PE = 700 Refrigerators

PE = equilibrium point

CF = Fixed costs

P = Price

CV = Variable cost

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Graph 1. Balance point

Fixed cost
Total cost
Economic entry for Repairs
Breakeven
If the value of $z = 700-736 / 54.25 = 0.6635$ is calculated
By consulting tables generates a probability of Po = 0.7453
Po = 0.7453
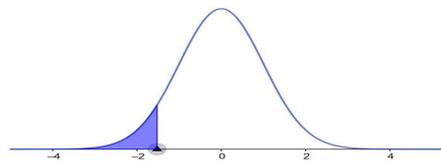Probability of risk of not reaching the average of the average profit is equal to
Pr = 0.7453-0.5 = 0.2453
The probability of risk

Risk probability zone to reach equilibrium point Pzr = 0.26
By integrating the estimated forecast, the probability of risk can be calculated.

Graph 2. Risk area

Table 3 risk calculations

Pronóstico	Z	Probabilidad	Riesgo
664	1.33	90.658	16
693	.8018	79.389	5
722	.2672	60.642	-14
751	.2672	39.358	-35
780	.8018	28.611	-54
809	1.336	9.342	-63

5. Conclusions

This model can help industries and companies to have less risk, both in quality processes and production processes, is a useful tool for the establishment of the industry before the international market and shows competence normed standards such as ISO 9001:2015

With this it can be seen that after determining the level of confidence for the desired equilibrium point, significant data are obtained for decision making

In addition, the risk region can be observed in the graph, using the forecasts obtained with a lower degree of error and better certainty; One of the contributions of this article is the correlation with the risk calculation based on the probability of the area under the curve where there is a turning point to identify the risk levels for each scenario. All of the above as a support method under the approach suggested in ISO 9001: 2015 standards for quality management systems and 31000: 2018 Risk management.

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