APPLICATION OF "COST-VOLUME-PROFIT" ANALYSIS AS A MODEL FOR MAKING PRODUCTION DECISIONS UNDER CONDITIONS OF RISK AND UNCERTAINTY

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ABSTRACT

In recent years, Bulgarian companies have been operating in vague and uncertain economic conditions. These ambiguity and uncertainty were further reinforced by the emerged global economic and financial crisis.

The application of the model "Cost-Volume-Profit" is a possible tool for taking into account the conditions of risk and uncertainty with the assumption that some of model parameters are regarded as random (uncertain) variables. A probabilistic approach and analysis model (including random variables) are presented in the paper.

Key words:
Activity volume, costs, sales revenues, financial result, risk.

INTRODUCTION

In recent years, many Bulgarian companies operate in an environment of increased economic risk and uncertainty, and adverse conditions significantly affect their profitability and financial results.

Market risk as a fundamental element of the economic risk is usually defined as the probability of sales reduction due to adverse effects of market factors, such as: reduced consumption, emergence of new competitors, etc. Changes in sales volumes strongly influence revenues and financial results. It may be argued that the future prosperity and financial position of each company will depend on the correct assessment of the business environment (including the level of economic risk).

This paper aims to present a probabilistic approach, which would successfully assist mangers within the process of decision-making concerning the production activity.

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METHODOLOGY ESSENCE

Effective management of a company requires continuous monitoring and study of the relationship between activity volume, costs, revenues and financial result. The implementation of such a study is possible by applying the "Cost-Volume-Profit" analysis, also known as Break-even point analysis. The traditional "Cost-Volume-Profit" analysis is based on individual estimates of the studied parameters, which are considered as certain values (constants). It does not take into account the existing in market-oriented economy business risks.

Some approaches and methods could be used in order to take into account the conditions of risk. The application of "Cost-Volume-Profit" analysis, but with the special feature that some of the parameters entering into it are treated as uncertain values, is a possibility in this direction. In other words, a new approach is applied, where the model includes probabilistic quantities. In this case, one or more of the parameters examined are accepted not as single estimates, but as average ones.

The implementation of "Cost-Volume-Profit" analysis with the features presented above will be demonstrated by sample data for company "XYZ". The developed for this company model considers the selling price, fixed costs and variable costs as certain values. In contrast to them, both the sales volume and financial result are considered as uncertain (random) variables. According to the theory of management accounting, the sales volume could be presented by the normal probability distribution.

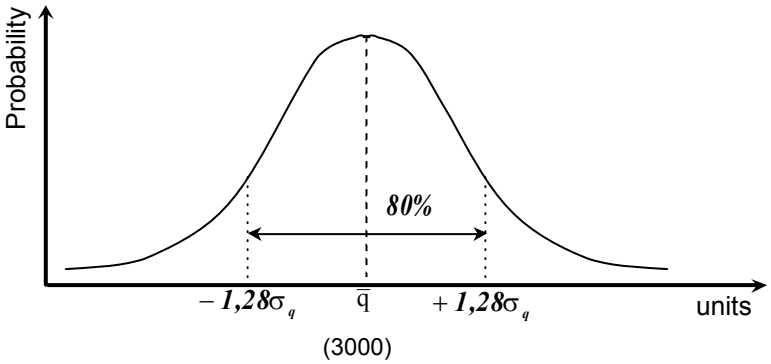

Fig. 1

The expected value of sales volume is obtained by arithmetic average. In this connection, the dispersion (variance) of sales volume should be assessed (determining the degree of sales volume variation at a given confidence level). This is achieved by calculating the standard deviation (σ) (form parameter of the normal probability distribution).

In developing the model for Break-even point analysis (taking into account the specificities of "XYZ" company) the following parameters values were used:

-selling price per unit (p)-50 Euro;

-variable costs per unit (b)-30 Euro;

-fixed operating costs (a)-55000 Euro;

-forecast sales volume for the period of study ($\bar{q}$)-3000 units.

The forecast sales volume is an average which is computed on the basis of data for sales volumes concerning some past reporting periods (years).

Let us assume that the expected sales volume (as a random variable) follows normal distribution with parameters: $\overline{q}$=3000 units and σ_q =370 units. Then, the confidence interval of forecast sales volume can be obtained using the sext formula:

$$\overline{q} \pm z.\sigma_q \,, \qquad (1)$$

where:

$\overline{q}$ -expected sales volume of the activity;

z -confidence coefficient (depending on the previously chosen confidence level);

σ_q -sales volume standard deviation (in this example 370 units).

Next, the confidence level (with which the confidence interval will be constructed) should be considered, and let it be 0,8. In this case (having in mind the features of the normal probability distribution [2]) z=1,28. Thus, the confidence interval of the sales volume is as follows:

$$3000 - 1{,}28 \times 370 \le \overline{q} \le 3000 + 1{,}28 \times 370$$
$$2526 \le \overline{q} \le 3474$$

This result could be interpreted as follows: with confidence level of 0,8 the actual sales volume will fall within the obtained above interval (Fig.1).

To obtain the forecast critical sales volume ($q_{C_{PU}}$), the amount of fixed costs (a) is divided by marginal revenue per unit ($m = p - b$) using the formula:

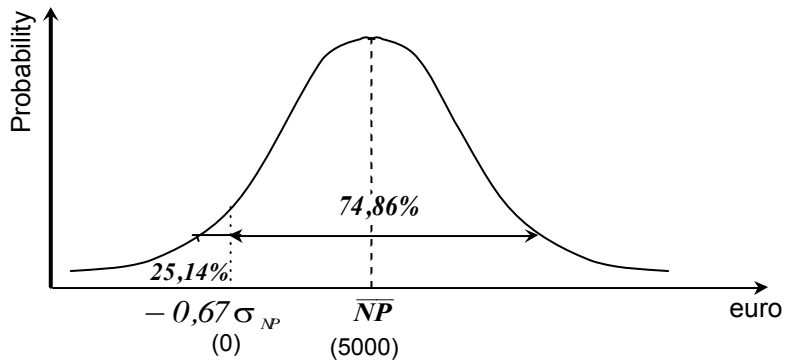

Fig. 2

$$q_{C_{PU}} = \frac{0+a}{m} = \frac{0+55000}{20} = 2750 \ units \qquad (2)$$

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Therefore, if the realized sales volume coincides with the lower limit of the confidence interval of the volume of actually implemented activity, the company will realize a loss.

The determination of an average value of the expected financial result is the next point of application of the method. This is achieved through a marginal approach:

$$\overline{NP} = \overline{q} \times m - a = 3000 \times 20 - 55000 = 5000 \ \ Euro. \qquad (3)$$

The profit standard deviation (σ_{NP}) is obtained on the basis of the standard deviation of sales volume and average marginal income through the next formula:

$$\sigma_{NP} = \sigma_q \times m = 370 \times 20 = 7400 \ \ Euro. \tag{4}$$

Applying the theory of normal probability distribution, the number of standard deviation (z) for any desired financial result ($NP*$) can be calculated (to determine its probability):

$$z = \frac{NP* - \overline{NP}}{\sigma_{NP}}. \tag{5}$$

In case of zero financial result:

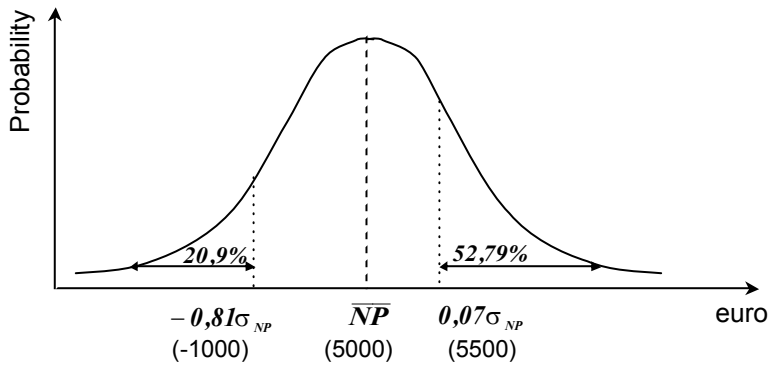

Fig. 3

$$z = \frac{0 - 5000}{7400} = -0,67.$$

This result indicates that the financial result of zero is -0.67 standard deviations from the average value of financial results (Fig. 2). To determine the probability of a negative financial result, the probability that the actual results will fall to the left of $-0,67\sigma_{NP}$ has to be found. In this case, this probability is equal to 0,2514 (by the usage of the tables in respect of the normal probability distribution). It follows that the probability of a positive financial result is 0,7486 (the area under the normal curve is 1.00).

The discussed approach allows us to determine the probability of achieving different levels of the financial result. For example, the probability that the negative financial result is greater than 1000 Euro will be determined as follows:

$$z = \frac{-1000 - 5000}{7400} = -0,81.$$

Loss greater than 1000 Euro is located to the left of $-0,81\sigma_{NP}$ and its probability (obtained as described above) is 0,209 (Fig. 3).

In case that, the probability of a profit greater than 5500 Euro has to be find we have:

$$z = \frac{5500 - 5000}{7400} = 0,07.$$

This result shows that to meet such a condition, the profit will be located to the right from $0,07\sigma_{NP}$. The probability of this case is 0,5279 (Fig. 3).

CONCLUSION

The proposed model for studying the critical point (taking into account the risk of a future reporting period) could be implemented for short-term forecasting of the volume of transport activity in which the probability of loss is zero.

This model allows the determination of:

-critical sales volume with a confidence interval calculated on the basis of various confidence levels;

-probability of achieving different values of the financial result (negative or positive).

REFERENCES

[1] Chavas J. *Risk Analysis in Theory and Practice*. Elsevier Inc, 2004.

[2] Georgiev N. *Foundations of the Reliability Theory*. Higher School of Transport, Sofia, 2009.

[3] Lichev I., Atanasov B. *Management Accounting*, University of Economics – Varna, Bulgaria, 1997.

[4] Trifonov T. *Accounting Analysis of the Company*. Ciela, Sofia, 2000.

[5] Willan A., Briggs A. *Statistical Analysis of Cost-Effectiveness Data*, John Wiley & Sons Ltd, Chichester, UK, 2006.

Článok recenzoval:
doc. Ing. Ladislav Novák, PhD.

EDUCATION • SECURITY • SAFETY

Project title:	**Competency Based e-portal of Security and Safety Engineering**
Project number:	***502092-LLP-1-2009-1-SK-ERASMUS-EMHE***
	2009-3320/001-001
Project acronym:	**eSEC**
Sub-programme:	Erasmus Multilateral Project-Modernisation of Higher Education -EMHE
Project website:	***http://www.esecportal.eu/***
Period:	From: **01/10/2009** To: **30/09/2012**