Mathematical Models of the Closed Business Situations

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Abstract. *Conception of the closed and opened systems is considered, the method of construction of their mathematical model as make-out point is grounded, in particular the linear case is enough grounded from the point of view of the dataware for calculation of make-out point, and developed DSS allows instantly to conduct this computation.*

Keywords

Decision support system (DSS), make-out point, opened and closed systems, maximum deposit, model oriented DSS, actual profitability of investments.

1 Introduction

The environment of the system consists of the separate elements, that are found out of the system, that is they do not belong to the inputs, processes and outputs of the system, however they affect productivity and possibilities of the system from point of achievement of its goals. The elements of surroundings can be social, political, legal, physical and economic. Often they make other systems.

The system is separated from the surroundings by means bounds. The business system is found into the border, in that time as an environment lies outside. Bound can be expressed physically or to be outlined by not physical factors (for example, consideration of some business system can be limited to the time bounds, in particular to put a task to limit the analysis of the system to the certain period - year, month and others like that). Narrowing of region of the system simplifies its analysis. For the decision support system in a management its bounds are designed.

With notion of bounds of the system such conceptions as closed and opened systems are directly linked. As for creation of the decision support systems these categories of the system, from one side, have the important value exceptionally, and from the second - in literature the determination of these notions is absent, there is a necessity to explore them.

2 Theoretical Part

The closed system is the some outlined aggregate within the framework of all continuum of systems and elements, where the separateness represents the degree of independence from other systems. The closed system is fully independent, in that time as an open system relies on the environment substantially. The open system takes inputs (information, energy, material) from an environment and can pass the production of products, services, information to the environment.

At determination of influencing of decision on the open system it is needed to define its relationship with an environment and with other systems. For the closed system it does not need to determine, as it is isolated by definition. Here it is necessary to underline that in nature there are no independent systems, and conferment to the system of status of closed though and simplifies its analysis, but results in some inaccuracy of eventual results of such analysis. A lot of the computer information systems, such as the systems of transactions processing, are considered as the closed systems. In contrast to this the decision support systems are the open systems by definition.

It is possible to do some summarizing conclusions in relation to descriptions of the closed systems which have the principle value from point of view of creation of decisions. For the closed systems:

- input information fully accessible and is determined. Thus input factors can have probabilistic nature, but the laws of distributing are beforehand known. Influencing of external environment is expressed through input information only and all other facilities of influencing are ignored;
- output information (consequences of the recommended actions) is fully determined and accessible for the use. Influence of the system on an environment is expressed through output information exactly. Other influencing of the system is not foreseen;
- system is functionate in exactly determined bounds. Time of existence of the system either is stipulated by external factors, or designed by the developers of the system, but it is fully determined.

For the open systems these positions have the polar value.

The model of make-out point is the mathematical model of the closed business situations.

A lot of accounting and financial models can combine in a specific model oriented class of DSS. For example, the target return pricing is the widespread method of determination of realization cost of a new product. This tool of marketing is based on two models. At first an analyst determines a make-out point for a new product and control value of return on investment (ROI), and a realization price is determined after the analysis „what ...., when ....?". Model oriented DSS can help to analyse correlation between prices, charges on advertising and incomes depending on quality and production volume of goods. Models can be used for the make-out analysis or charges - profit, at computation of level of profitability of capital investments [1].

Determination of make-out point consists in the calculation of production volume, for which charges equal profits, that is at such circumstances the zero level of income takes place. The production volume subject to the condition make-out can be calculated by a few methods. For one of approaches the fixed charges are divided by a contribution margin that to find the make-out amount of products. A contribution margin (margin, income) equals a realization price for unit of products minus its prime cost. Also the amount of products at a make-out can be calculated by means the solving of equation:

(*price* x *volume of sales*) - (*fixed charges* + (*variable charges per unit of products* x *volume of sales*)) = 0.

An unknown value is „*volume of sales*".

The amount of products at a make-out can be calculated in a spreadsheet by means the use of possibility of goal-seeking in relation to evaluation of income, that equals a zero.

That is in other words, a make-out point is the volume of sale of certain good, on which general charges equal general incomes (profit), stipulating current incomes to equal a zero [2]. Current incomes as a difference between a size of sale and general charges (constant plus variables) are calculated by a formula

$$W = (P - V)\,Q - F,$$

where P - middle cost of sale per unit of products; Q - amount of the realized units of products; V - variable cost (variable charges) per unit of products; F – constant cost (administrative, rent, advertising and others like that)

From a condition $W = 0$ we have a make-out point Q_{mo}:

$$Q_{mo} = F / (P - V).$$

A make-out point is used for planning of production of new products and in the financial analysis, in particular for computation of internal rate of return (IRR). IRR is the interest rate that corresponds to the zero value net present value (NPV).

Some software for modeling can directly calculate a make-out point (as additional application of goal-seeking).

On fig. 1 is screenshot of developed by the authors of original DSS, created in Microsoft Excel, which allows to the user easily to change initial conditions and get a result in tabular and graphic views. Excel can be used as a DSS-generator, therefore for its help it is possible to develop DSS for the make-out analysis, in which to build the buttons for the entering of input information by an user (prices, variable charges per unit of products, administrative charges, charges on rent and advertising), and also foresee standard facilities of interface user.

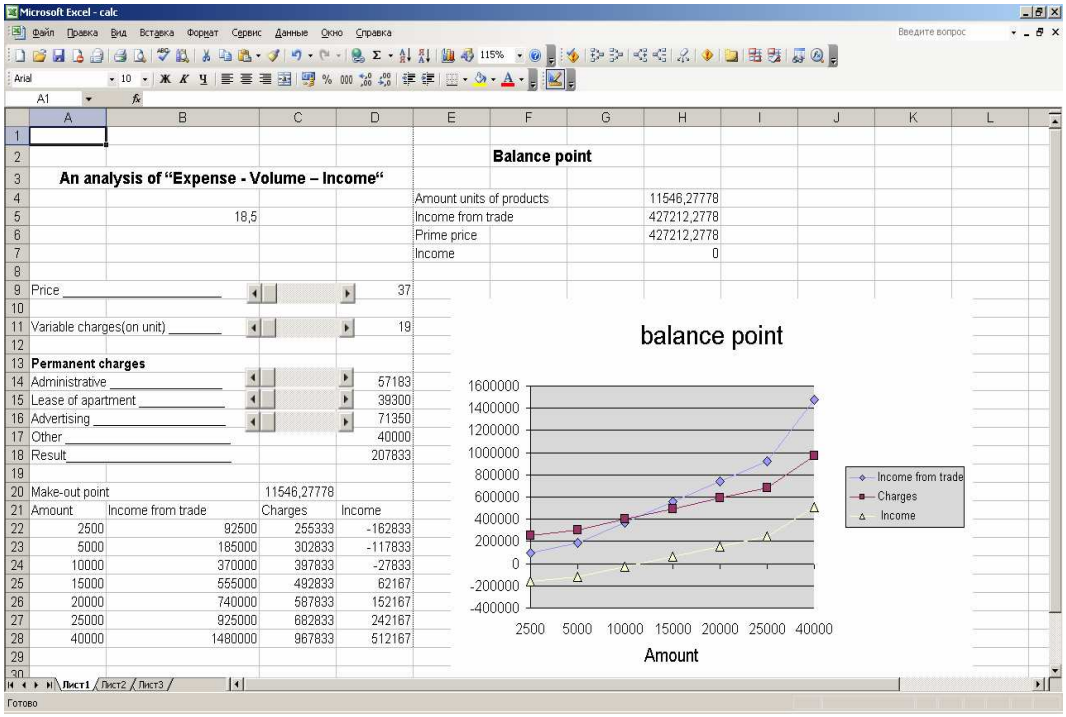

Fig. 1. Screenshot of DSS for determination of make-out point.

How visible from fig. 1, the functions of charges $\psi(x)$ and $\varphi(x)$ as functions from variable x, that means the volume of produce, are linear, therefore a make-out point identifies the solution of the system of two linear equations. In a theoretical plan these functions can have a nonlinear kind. In particular, in [3] the explored cases, when the function of charges presented by the polynomial of the second order:

$$\psi(x) = a_0 + a_1 x + a_2 x_2$$

and function of income by logistic curve

$$\varphi(x) = a_0 (1 + a_2 e^{-ax})^{-1}$$

thus both functions have identical coefficients a_0 and a_2. Functions have two intersections.

A problem consists not in that to explore different types of curves $\psi(x)$ and $\varphi(x)$ (on the given time enough effective methods and software of finding of solution of the system of two nonlinear equations are developed), and in that to define the specific type of such functions, having in a kind, that the question is about a new type of product, for which no reliable statistical base is in relation to prognosis

computations. In this context the presented in the article linear case is enough grounded from point of the information providing of computation of make-out point, and developed DSS allows to conduct this computation in real-time.

3 Conclusion

Thus, such DSS with the use of make-out model provides real-time computation of correlation between a price, volume of sale and income. Determination of the real fixed and variable charges can be heavy, but mostly managers can do reasonable assumptions. Also the make-out analysis ignores future demand on products, therefore desirably, that a manager used different models of prediction of demand in combination with the make-out analysis.

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