MATHEMATICAL METHODS, MODELS AND INFORMATION TECHNOLOGIES IN ECONOMY

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MATHEMATICAL DESIGN IN ECONOMY: DESIGN AND ANALYSIS OF SYSTEMS

Basic historical information and general concepts and general meanings about models and designs are presented in the article. Importance of application is analyzed and real examples of application of models and design in economic researches ware shown. It was analyzed in detail concept «black box» and structural diagram of the system.

Keywords: model, design, system, structural diagram of the system, «black box».

Introduction. The method of models, which leads economic researches to the mathematical tasks, arose up a long ago. Creation of the computing engineering in last century opened for it the real prospect to become powerful instrument of scientific analysis. Appearance of this technique brought in a number of new conceptions and ideas in the methods of researches, infinitely extending the tool of researcher. The considerable overvalue of existent methods of analysis took place, the new appeared, special role in which began to play the methods of the formalized models, method of examinations and their synthesis, so-called imitation systems. This tool must remarkable possibilities study processes and phenomena which take place in a public sphere. Therefore, knowing a result, consequences of our decisions, we always can carry out the basic act of management: to make decision, which answers a purpose, which is pursued a person (or by persons), responsible for taking a decision. So, knowledge – almost a synonym of management. Service of models of economy, at its presence, can give invaluable information guidance in solving of different questions of economic policy and choice of the programs. A person which does not own the methods of models can not apply on the role of economist.

Section 1. Historical information

History of development of mathematical design is investigated, for example, in the monograph of Dzh. Dantsiga "Linear programming, its generalization and application". It was noticed, that economists began mathematically to describe the economic systems in the eighteenth age. The simple example of model was built by Kene in the economic table, trying to define interconnection between the landed interests, farmers and craftsmen. In a middle of 19th century JI. Valras offered a linear mathematical model with permanent technological coefficients. The majority of specialists was engaged in the analysis of theoretical problems, connected with possibility of economic equilibrium and its efficiency in the conditions of competition or monopoly. However to 30th of the last century all works in this industry carried separate character.

In 30th of the twentieth age the group of Austrian and German economists conducted work on generalization of linear technological model L. Valrasa. As a result of this work there were certain questions which stimulated appearance of work of mathematician Dzh. fon Neymana (in 1932) "Model of general economic equilibrium". He shown that market forces would maximize the rate of growth

of economy, and proved that this maximum is equal to the interest rate on a capital, invested in a production. Thus, Neyman took into consideration that economy is the closed system with the permanent rate of growth. This work, as well as most theoretical works, that time, belongs to the high-quality analysis of economy, in which the purpose of mathematical design consisted in description of connection inside system probably from high-quality, than from quantitative side; manipulation equalizations appeared the comfortable method of receipt of logical conclusion than suppositions.

Prosecution of general model of the linear programming conducted fully regardless of afore-mentioned works and pursued practical application. As a result V.V. Leontyev built the mathematical model of the real American economy (1919-1939) in order that it is possible it was to trace influence of policy of government and tendencies in the field of purchases on connected industrial branches. From the formal point of view a Leontyev model can be examined as the simplified model of Valrasa. Basis of analysis of "expense – an issue" in this model makes a table of coefficients, which is named or by the matrix of "expense – an issue", or by a "economic table". A column in this matrix answers the charges of different commodities on one dollar of cost of issue of certain commodity. A column answers every commodity which is produced. Consequently, a formal model becomes the real, if an economic table is built on the basis of the real data. To estimate a difference between formal and real models, it follows to remind that the capture of data, necessary for the real model, needs large enough charges of time and other resources. After that as all information is collected about a model, the second complication is appeared – making of the very large system of linear equations. And, in the end, there were difficulties of "sale" of results of such researches. Consequently, initiative of Leontyev from the beginning was solved with a permanent risk.

Section 2. About models and designs.

A role of mathematics in different areas was and is different. Two basic factors influenced and influence now on it: level of development of mathematical task and level of maturity of knowledge about real object, which is studied, possibility to describe it the most substantial lines and properties by the language of mathematical concepts or, as accepted to talk, possibility to build the mathematical model of object.

Object is a concrete or abstract object, operating or designed system, existent or designed process.

A model is presentation, produced in imagination of man-researcher, about those or that properties of object (real, abstract) and their connection, designed as description of this object and it is fixed on a paper the language of picture, chart, equalization, formulas, and others like that, or it is realized as models, mechanisms, built on, and others like that.

The construction of models is based on different family suppositions, as the unique method to unstuck from facts truth of which yet needs to be checked up. The role of suppositions (hypotheses) in science is so considerable, that it is vividly possible to say the following: all advanced study consists of advancement and verification of hypotheses.

The main value of models as forms of knowledge consists in that they contain objective truth, that in something correctly represent designed. But, except for sure veritable maintenance in a model conditionally true, that faithful only at certain terms, and consequently, can be erroneous.

Mathematical models are characterized absolute exactness, but, to reach to their use in this industry, in particular, in an economy, it is necessary to be enriched for this purpose sufficient knowledge. After the utterances of Kant and Marks, any area of knowledge can those with greater basis be named science, what in a greater measure mathematics is used in it. Science "Not mathematical" of science, think, its scientific "uncharacterized" does not mean, but is investigation of complication, insufficient cognition of its object, and is the temporal phenomenon.

But, will underline, mathematics allows the unique rank to describe the phenomena and processes, carry out their analysis, provide for as itself it will be to move object under various conditions, that to forecast the results of future supervisions. Well, and prognostication always difficult problem; prognoses which are carried out are the article of the special pride of every science.

Materialistic models (that the real, physical models) are created from real object and processes on the basis of relation of similarity between object and by a model.

A design is research of objects on their models to which the methods of thought are used for analogies, a design is a having a special purpose reflection of object. A purpose is ideal appearance of the desired result, that appearance of that which must be, it would be carried out (part would underline circumstance that aims are both realization and impracticable). From that a model which has a special purpose reflection, multiplicity of models of the same object appeared; for different aims, obviously, different models may need.

A model represents not in itself object- original, but that what gives interest to us, that which answers the put purpose. Exactly the having a special purpose appointed of models allows the plural of models to divide into cognitive and pragmatic, that answers dividing of aims into theoretical and practical.

A cognitive model is the form of organization and representation of knowledge about object, by the mean of joining of new knowledge with present. A pragmatic model is the mean of management of object, mean of practical actions, method of presentation exemplary of correct actions or their result, that is working presentation of purpose. In other words, a cognitive model represents existing, and pragmatic – not existing, but desired and, possibly, feasible.

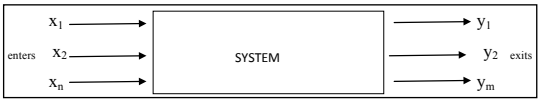
Other principle of classification of design aims can be dividing of models into static and dynamic. For one aims the model of the concrete state of object can be necessary for us, like "moment picture". Such models are named static. In those cases, when our aims of are connected not with one state of object, but with its different states, with their varieties, there is a necessity for the reflection of process of state transition (for example, state transitions in time). Such models are named dynamic.

A section 3. Is the "Black box"

As marked already, purposeful character has a design. A purpose is subjective appearance of the non-existent, but desired state of object (it is, that pragmatic models are examined).

Achieving it only due to own possibilities of subject or external facilities which it has now, it is possible very rarely. Such coincidence is named a problem situation. Consequently, activity which would be instrumental in the decision of this problem must be directed on achievement of the put purpose. Means of achievement of this purpose are named the system. Ratio by aims and systems can be ambiguous: one system can be connected by a few aims, the different systems can answer one purpose.

In this determination of the system an accent is done on setting of the system as means of achievement of the put purpose, but there is nothing said about its internal structure. Therefore the system can be represented as an opaque small "box", selected from an external environment, but not fully isolated from this environment. Then purpose which try to attain this system, there are the beforehand planned changes in an external environment, some results functioning of the system, which are used behind it. Otherwise, system which is connected with an environment and by the help of connections influences on him. These connections are called the outputs of the system. Outputs in this system answer a word "aim" in the verbal model of the system. In addition, in determination it is said about the presence of connection of the second type: the system is means, that is why ways of the use of these means must exist, possibility of influence, on the system, that such connections, which are directed from outwardly, from an environment, in the system. These connections are named the entrances of the system. The described model of the system is named «black box». The graphic model of «black box» can be illustrated on pic. 1.



Pic. 1. A graphic model is a «black box»

Such model, not because of external simplicity and on absence of information about the interior of the system, often it appears useful. If maximally to formalize a model "black box", we come to taking of two plurals of X={x1,x2,… ,xn} i Y={y1, y2,..., yт} of entrance and initial variables which no relations are known.

If between these variables some relations are known, it already will be not "black"

and "transparent" small box. As a rule, output variables are dependency variables, and entrance – by independent variables, that y1, y2,..., yт is functions, and x1,x2,…,xn – – by the arguments of these functions. Basic task which decides by this model there is determination of existent functional dependence. *Y=f(X).*

$$y_1=f_1(x)=f_1(x_1,x_2,\ldots,x_n),$$
$$y_2=f_2(x)=f_2(x_1,x_2,\ldots,x_n),\ldots, \quad (1)$$
$$y_m=f_m(x)=f_m(x_1,x_2,\ldots,x_n)$$

Therefore design with the use of model "black box" name a functional design, and system of functions (1) – by the functional model of object. This model is built in general in two stages. On first from them general functional dependence of Y from X and unknown parameters of A={a1,a2.,.ap}: Y=f(X, A). This dependence is determined, as a rule, on the basis of knowledges of researcher about the designed object-original, on his intuition. On the second stage, as the stage of adaptation of model, the values of unknown parameters are determined, on the basis of statistical information about the possible values of entrance variables and the proper values of weekend of variables them, what the functional model of the system, which represents functional dependence of Y from X, turns out as a result of. Methods of forming of information about the value of variables X and Y can be different, in particular, they can be formed as a result of experiment, conducted above real object, or as a result of calculations on the basis of existent norms.

Not because of simplicity of model "black box", there always is a danger of incompleteness of list of entrances and outputs, both by virtue of that the important can be attributed to unimportant and by virtue of that some of them can be unrecognized in the moment of construction of the system.

Section 4. Structural diagram of the systems

An interior of "box", generally speaking, is heterogeneous, that enables to distinguish its component parts. In same queue, some parts of the system also can be broken up to pieces et cetera Those component systems which are examined by us as indivisible are named the elements of this system; parts which consist more than of one element are named the subsystems of the system. As a result of such selection of elements and subsystems the model of composition of the system which is description of that is built, from what subsystems and elements it consists of. Terms which specify on the hierarchy of parts of the system are if necessary used, for example, a "sub subsystem", or "subsystem of the second level", is the subsystem of subsystem of this system, or subsystem of subsystem of the first level. In connection with it the system can be counted, legalistically, by the subsystem of zero level. Point out, the model of composition of the system is determined ambiguously. By different researchers, possibly, at different aims, for the same object the fully different models of composition of the system can be built.

As already marked, a construction of model of composition of the system is not synonymous. If to give the different researchers of task to define composition of the same system, their job performances will be different, even from that they can have different levels of knowledge about the system; a the same researcher, at different terms, also can offer different models. It is in addition, possible to select three reasons of this fact.

Conclusions. Must be noticed, under a concept the analysis of the systems is quite often understood approach of the systems, that certain sequence of executions, alhorytmychnost, which is the important mean of development of practical activity. Here concept the analysis of the systems is used in the narrow understanding – as an analysis of the systems. An analysis of the system is a division it on element with the selection of properties of each, connection with each other and by an external environment. Purpose of analysis – to separate substantial properties and relations in the system from unimportant and to pass to its more deep study. Analysis of the system closely connected with its synthesis. Synthesis of the system – it is connection of separate elements, properties and connection in one unit with a purpose to get more complete picture of it in form of a model. Consequently, the signs of the system is structural, interconnection of parts, subordination of i a certain goal.

Design algorithms (rules) do not exist. A design is an art. A model is built by a researcher

so that to represent descriptions of object: properties, interconnection, structural and functional parameters, and others like that, substantial for this purpose. A parameter is an index (size a value of which is permanent within the limits of the examined task), which characterizes some property of some process, structure, resource, products, and others like that. Constructing of model on the basis of previous study of object and selection of its substantial descriptions, experimental and theoretical analysis of model, comparison of results, with information about object, correction of models et cetera make maintenance of mathematical design.

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