FORMATION ADVERTISING STRATEGIES OF UKRAINIAN PHARMACEUTICAL COMPANIES WITH THE USE OF IMITATIVE MODEL-SIMULATORS

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ABSTRACT

The purpose of the article is to study the various processes in the development of advertising strategies of pharmaceutical companies, based on using tools in a multilevel simulation platform – AnyLogic. From this, the specifics of advertising companies in the pharmaceutical market are determined. The study takes into account the influence of various factors of the market environment on the functioning of pharmaceutical firms, their acceptance of specific advertising strategies, and forecasting the results of their implementation in uncertain conditions. The proposed imitative model-simulator is used to prepare advertising strategies for enterprises in the pharmaceutical industry. The performance of the model is displayed through the results of situational simulation experiments, using the leading Ukrainian Pharmaceutical Company OJSC "Farmak" as an example. The processes of carrying out experiments of different types and the possibilities of parametric adjustment to the experiments are demonstrated. The model is proposed to be used in the process of making strategic decisions and during operational monitoring of pharmaceutical products by an advertising company. Thanks to the modularity and sufficiency of the model, it is possible to customize it to specific industry enterprises.

Keywords: Advertising strategy, Pharmaceutical company, Simulation modeling, Model-simulator, Situational simulation experiment.

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PROBLEM DEFINITION

The pharmaceutical industry is one of the dominant segments of global trade, and the pharmaceutical market is one of the most saturated consumer markets. Therefore, the maintenance of market positions by its players

(manufacturers, suppliers, distributors, sales representatives) requires the use of special tools to promote products to attract users. Commodity advertising occupies a significant place among the main areas of pharmaceutical promotion.

In the Ukraine, the pharmaceutical industry is one of the critical operating sectors of the economy, and strategies for promoting products are essential components of the marketing activities of domestic pharmaceutical companies. The presence of systemic problems in the Ukrainian pharmaceutical industry (the inability to provide the population with the main nomenclature of medicinal products with a full cycle of production in the country, low technological levels of production, and insufficient levels of innovation) put promotion before the objective choice of innovation as a way of further development (in contrast to the inertial direction). Innovation, however, involves intensification of competition, in which correctly formulated marketing strategies play a significant role.

The formation of pharmaceutical enterprises' advertising strategies is carried out under the influence of many stochastic factors of their internal and external environments. First, it involves the definition of the target, then researching the target audiences (target markets). Next, the companies set goals and select advertising concepts and facilities. Finally, they define their advertising budget and evaluate advertising effectiveness. For this reason, advertising strategies involve making decisions in conditions of risk and uncertainty, which, in turn, requires the involvement of particular mathematical research, as well as the construction of models for developing alternative advertising strategies to maintain a diverse perspective.

Understanding that the pharmaceutical industry is one of the most complex for developing effective advertising management strategies is important for this context. Today, the process of using advertising funds is shifting increasingly to a higher quality approach in its development, due to: significant segmentation and market diversification of pharmaceutical goods; high level of competition; import dependence; significant state control; and creation of new information and communication technologies. The result is the establishment of new types of users with complex behaviors, as well as dynamic changes in benefit demands.

In the given context, using the device of imitative modeling is proposed to produce model-simulators that preliminarily test various advertising strategies and their possible consequences. The development and application of such management tools requires flexible mathematical algorithms based on advanced software simulation platforms.

In this study, the hypothesis of the expediency of forming an advertising strategy that employs imitation is put forward in connection with the impossibility of obtaining an unambiguous analytical decision on all strategic components due to the lack of explicit algorithmic dependencies and the presence of recursive formulas.

Finally, the research shows the possibility of determining the impact of various factors of market environment functions of pharmaceutical companies on their specific advertising strategies and forecasting the results of their implementation. Taking into account the nonlinear dynamic nature of processes and the availability of feedback makes this conclusion possible.

ANALYSIS OF RECENT RESEARCH AND PUBLICATIONS

The basis for the formation of any advertising strategy is to study the target audience (target market), which is called direct advertising. Although there is a significant amount of research in this area (in particular: Jain, Rakesh and Chaturvedi (2018); Kulshreshtha, Tripathi Bajpai (2017); Liu (2016); Liu, Kramarczuk Megits (2014); Sharma and Kaur (2018)), the specifics of the pharmaceutical industry place particular demands concerning the close, combined relationship of the pharmaceutical market with the health sector. Pharmaceutical products have a considerable amount of specific nomenclature, which is continuously in dynamic change. Each group of drugs has its own characteristics of production and distribution, and each possesses different

degrees of control and legal support. These factors must be taken into account to fully understand the process of strategic advertising.

Thus, studying target audiences within the pharmaceutical market becomes a continuous process. For example, Luceri, Vergura and Zerbini (2017) present a survey of the behavior of the target audience of non-proprietary drug users. The behavior model takes into account numerous demographic factors (gender characteristics, education, income, etc.), self-identification factors, trust in specific brands, previous behavior, and risk sensitivity. Experiments were conducted on representative samples of groups of Italian consumers. As a result, marketing is focused on maximizing user awareness of the characteristics of unapproved drugs in order to reduce the risks of their use and distribution.

The study of the behavior of users of pharmaceutical products has been continuously deeply researched in relevant medical academic publications. Examples of such studies include Sachan, Kumari, Dubey and Pujari (2016). Target groups are ranked according to the sources of information to which they are most responsive in the selection process of pharmaceutical products. The purpose of the examinations is to determine the behavior of users according to their relationship to pharmaceutical information.

The results of studying the marketing strategies of many leading pharmaceutical companies throughout the world are presented by Kalotra (2014). Researchers studied the relationship of selected marketing strategies with the specific target groups to which they are directed.

Conducting such experiments is based on substantial empirical "field" studies that are labor intensive but are of great value. Vveinhardt, Streimikiene, Awais and Ahmed (2016) give examples of empirical research aimed at identifying market factors that determine acceptable hospital medical staff and pharmaceutical personnel who help guide patients using certain drugs. They conducted a cross-sectional study with a delay of doctors in public and private hospitals in the city Karachi, as well as of the staff of national and multinational pharmaceutical companies operating in Pakistan. The results were directed at improving the marketing strategies of pharmaceutical companies, taking into account the mediation effect of hospitals and pharmaceutical manufacturers. Due to the complexity of the research, only two mediators and five marketing factors were presented in the article. Data processing was done using the AMOS 7 package.

Similar studies were conducted in Bangladesh by Ferdousy and Biswas (2016). In the course of their research, they emphasized the differences within pharmaceutical marketing itself. The outcome of the empirical studies directed at determining the effect of personal contact (indirect) in advertising are presented by Carter, Chou, King and Costea (2012).

One of the most important unresolved problems at present is the formation of an advertising budget and an assessment of the effectiveness of specific advertising strategies. In practice, most companies spend significant advertising funds within selected advertising strategies without assessing the effectiveness of such investments. The research conducted around the world in this field is also not clear about the relationship of costs and the impact of advertising.

As such, Rao and Lewis (2015) cite results from 25 field experiments with significant American retailers and brokerage companies, most of which cover millions of customers and spend over $2.8 million on digital advertising. Statistical methods are complex and influence the advertizing cost. At the same time, it is emphasized that such studies need to be conducted in the event of obtaining new independent information.

Studying the formation the dynamic budget distribution of accepted advertising strategies and evaluate the impact of their implementation is the most expedient option. At the same time, reducing the cost of experiments to make them accessible for a wide range of companies is also necessary. Therefore, not only is the nature of research conducted during the formation of advertising strategies of pharmaceutical companies important, but the mathematical tools used are as well.

Simulation model-simulators and forecast experiments conducted on them can expand the

spectrum of problem coverage, reduce the complexity and cost of research, and most importantly, conduct experiments that are dynamic with the simulation effects of many stochastic factors in the market environment of advertising processes.

There are also specific investigations using the given mathematical apparatus for the definition of advertising strategies. Among the most significant developments in the field of advertising pharmaceutical products is the possibility of highlighting model applications, as presented in the writings of Landsman, Stremersch and Avagyan (2017); Wieringa and Leeflang (2010); Bommier, Jullien and Bardey (2010). These studies, however, disregard many issues of an analytical and predictive nature that are necessary for the effective organization of advertising processes.

Regarding modeling various aspects of advertising activities in the pharmaceutical industry, some investigations in particular should be noted, the results of which are highlighted in the following sources. Plotnikov and Berezovskaia (2015) consider the problems of determining the optimal set and duration of use for product promotion using the Internet as a means of advertising. The simulation dynamic model is offered as a solution, providing the possibility of conducting computer experiments in order to choose the optimal set of advertising methods under the conditions of minimizing expenses for their implementation. The model is implemented using the AnyLogic system platform.

Modeling user behavior in the Internet services market is presented by authors Solodov, Kravchenko and Katalevskii (2012), who, in particular, raise the issues surrounding advertising and pricing policies of internet service providers (ISPs). Techniques for modeling advertising budgets within the framework of general advertising strategies at the micro-level are presented in the model applications work of (Pesikov, 2003).

Thus, specific products and services for different target market actors are supported mostly by modern advertising tools based on powerful Internet marketing platforms and, in particular, on the instrumental database of simulations.

At the same time, emphasizing the uneven use of mathematical simulation tools in advertising research of different types based on enterprises in various industries is necessary. Regardless, a number of results can be successfully adapted for advertising in the pharmaceutical industry.

Generally, models developed by the research study field are regularly submitted at international forums for simulation model development: Winter Simulation Conference (WSC) (Winter, 2018), International System Dynamics Conference (The 36th, 2018), ASIM (German-language simulation community) (Arbeitsgemeinschaft, 2018), IMMOD ("Imitation Modeling, Theory and Practice") (Simulation, 2017), European Congress of EUROSIM (Eurosim, 2018), as well as in webinars and publications by one of the world's leading corporations in the simulation industry – The AnyLogic Company (AnyLogic, 2018).

Summing up the range of unresolved issues within the scope of the problem under investigation, and in accordance with the above hypotheses of this study, the following should be noted:

The problems of forming effective advertising strategies for enterprises, in particular the pharmaceutical industry, based on the use of modern mathematical tools remains to be not fully understood. On one hand, this is due to the specifics of advertising companies in this area; on the other hand, the problem also lies with difficulties in the process of creating and implementing model applications.

The means of creating and implementing models and planning simulation experiments need to improve. This could be achieved by the further development of software platforms for simulation by creating a single research space within specific integrated systems. This will lead to a transition from outdated concepts of organizing and conducting simulations, to the practical implementation of a systematic approach to simulation research.

In this regard, developing model applications using multi-approach paradigms of simulation on the corresponding integrated systems software platforms, as well as involving modern Internet technologies to operate ready-made models, is highly important. One of the most effective software platforms for creating models

and conducting simulation experiments is the AnyLogic system.

FORMULATION OF OBJECTIVES FOR ARTICLE

The goal of this paper is to research the processes by which the advertising strategies of pharmaceutical enterprises are formed, based on application of tools using the multilevel simulation of the AnyLogic platform.

The peculiarities of the advertised object and the target audience, the specifics of perception of pharmaceutical products by potential users, the necessity to observe the norms of legislative regulation, and pharmaceutical organizations' self-regulation of their activity determine the specifics of advertising the pharmaceutical products.

Any company is interested in increasing sales and expanding its customer base, but the means to achieve these goals are not always obvious. Professionals need to analyze a huge number of factors that influence success to select the most rational marketing and sales strategies, for example: income levels, product features, competitors' actions, trends in the development of modern technologies, market and customer requirements, production capacity, market segmentation, and national peculiarities of potential buyers, among others. In addition, most of the factors need to be considered dynamically.

Simulation models offer many advantages over implementing experiments on a real system, as well as over the use of other methods. These benefits are, namely: cost, time, accuracy, visibility, universality, etc.

The choice of a concrete or mixed (multi-approach) paradigm model on the AnyLogic platform depends in each case on of the research object specifics, the researchers' goals, and the degree of aggregation of the system depending on the goal.

The choice of the AnyLogic platform is based on the peculiarities of pharmaceutical companies functioning within a framework of an uncertain, highly competitive environment, which consists of intense changes in the supply of new products, changing market demands, seasonal components, the particularities of storing and transporting medicinal products, and so on.

The emergence of original applications in the AnyLogic platform, within the framework of solving tasks of behavioral and informational economics, creates new opportunities for promoting products in various industries. In particular, this concerns the processes of working out various tasks inherent in the development of industrial enterprises' advertising strategies.

Multiagent models that demonstrate the evolution of the population of economic agents, and reproduce the behavior of users of various products and services under the influence of advertising, allow a new level of investigation and prediction of the effects of advertising efforts in conditions of uncertainty, environmental risk, and competitors' activities.

A comparative analysis of the simulation experiments' results thus becomes possible for different social strata of the population, as well as for different administrative-territorial units, etc. The benefits of this kind of research are the ability to analyze the sensitivity of advertising processes to variations within certain parameters, negative and positive influences, price factors, benefits for the population, and factors of conservatism, among others.

The explanation for the expediency of using of imitation models is that in the field of economics, models of stable "equilibrium" modes usually do not correspond to reality. The creation of models that allow the analysis of the formation of rules and trends of global behavior as integral characteristics of the behavior of many active players is more appropriate. This fully complies with the concepts implemented in the AnyLogic environment.

PRESENTATION OF KEY RESEARCH FINDINGS

Within the framework creating a complex model of marketing activities of pharmaceutical companies, an analysis of the advertising strategies of OJSC "Farmak" was carried out. A fragment of the model is presented in Figure 1.

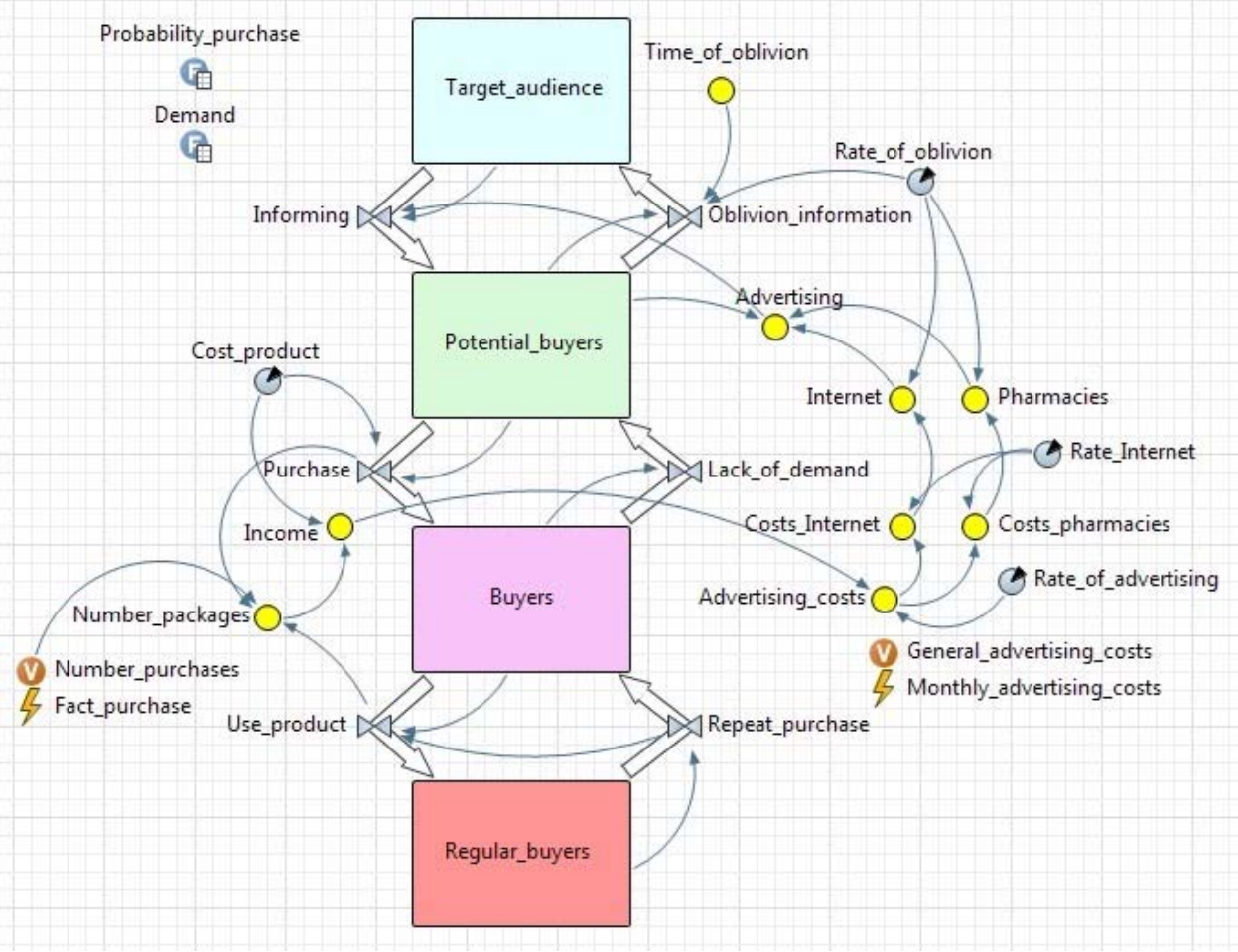


Figure 1. Model of formation advertising strategy of the enterprise.
Source: Developed by authors.

The given system-dynamic fragment contains the following main elements:

- Reservoirs:
  1. Target_audience;
  2. Potential_buyers;
  3. Buyers;
  4. Regular_buyers.
     - Streams:
  1. Informing;
  2. Oblivion_information;
  3. Purchase;
  4. Lack_of_demand;
  5. Use_product;
  6. Repeat_purchase.

The content of the flows is formed through parameters, variables, or table functions.

The demand function may be formed by different algorithms depending on the particular market situation being simulated.

The process of informing the target audience is described by the Nerlove-Arrow Model (N-A model), which is a differential equation of the 1st order:

$$\frac{dA}{dt} = b \cdot q(t) - k \cdot A, \qquad (1)$$

A(t) – awareness about product (number of informed people about product in period t);

q(t) – advertising activity (advertising costs in period t);

b – advertising effectiveness (rating of the source of advertising);

k – the speed of oblivion of information. In the simulation model this coefficient is defined as a random variable of 10% to 80%, which is due to the forgetting curve of Ebbinghaus (Figure 2).

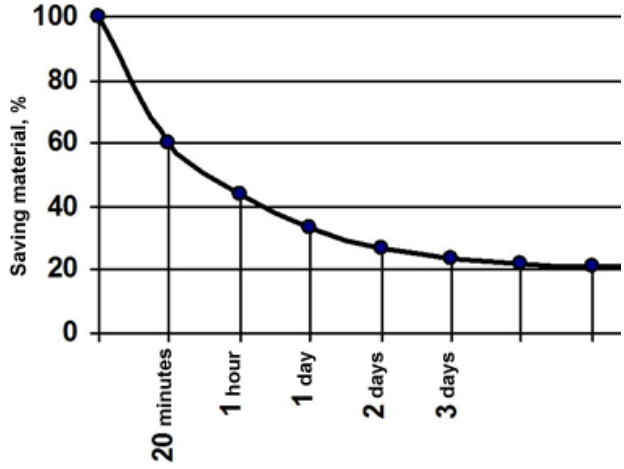


Figure 2. Forgetting curve of Ebbinghaus.

Imitation experiments can be performed for different time periods with different durations of the simulation. Time periods are determined by the user in the process of directly configuring the experiment.

The work of the module allows for the adjustment of the necessary amount of expenses for advertising tools. These include determining the reasonable cost of pharmaceutical products, optimizing the efficiency of marketing costs, maximizing income from advertising campaigns, the number of regular buyers, and calculating the sales volume in kind. The simulation model provides the possibility of conducting computer experiments in order to make variations for significant environmental factors by choosing the optimal level of prices, revenues, and number of buyers when analyzing different regions of the country, provided that the costs of advertising campaigns are minimized. A model-simulator of the marketing activity of the pharmaceutical company allows for an analysis of the current state of affairs to optimize the current activity of the enterprise, reducing advertising costs and developing a plan for further action in a short amount of time.

As is quite typical for the enterprises in the studied area, the model-simulator allows for the creation of the basis for making grounded decisions. This is facilitated by the large number of types of experiments that offer modern platforms of multilevel simulation modeling. AnyLogic tools allow various experiments to be conducted by type of analysis:

- Standard (simple) experiment. Launches a model with predefined values of parameters, supports virtual and real time modes, animation, and debugging of the model.
- Optimization. Finds the values of the parameters at which the optimal value of the given target function is achieved. There may be a number of constraints on the values of the parameters and variables of the model. The optimization progress schedule is displayed.
- Variation of parameters. Performs several "runs" of the model with variations of one or more parameters, with the ability to use replication.
- Comparison of "runs." Allows for interactively setting different parameter values and running a model with these values. Visually compares the results of "runs" in scalar form or in the form of data sets.
- Sensitivity analysis. Performs several "runs" of the model, varying the value of parameters and showing how the simulation results depend on these changes.
- Calibration. With the help of the optimizer, finding the values of the model parameters, with which the results of the simulation most accurately correspond to the given data. Data can be given in scalar form or in the form of data sets. The visualization of the calibration progress and the correspondence of the results to each given criterion is carried out.
- Monte-Carlo. Gets and displays a set of simulation results for a stochastic model or for a model with stochastically changing parameters.

- Non-standard. Launches an experiment with a non-standard script that is completely written by the user. The experiment does not have built-in graphical interface or definite behavior.

Various studies of advertising companies for pharmaceutical enterprises in the regions of Ukraine were carried out on the presented model (according to OJSC Farmak). Here, some results of the implementation the standard experiment, variation of parameters, optimization, and comparison of "runs" are considered.

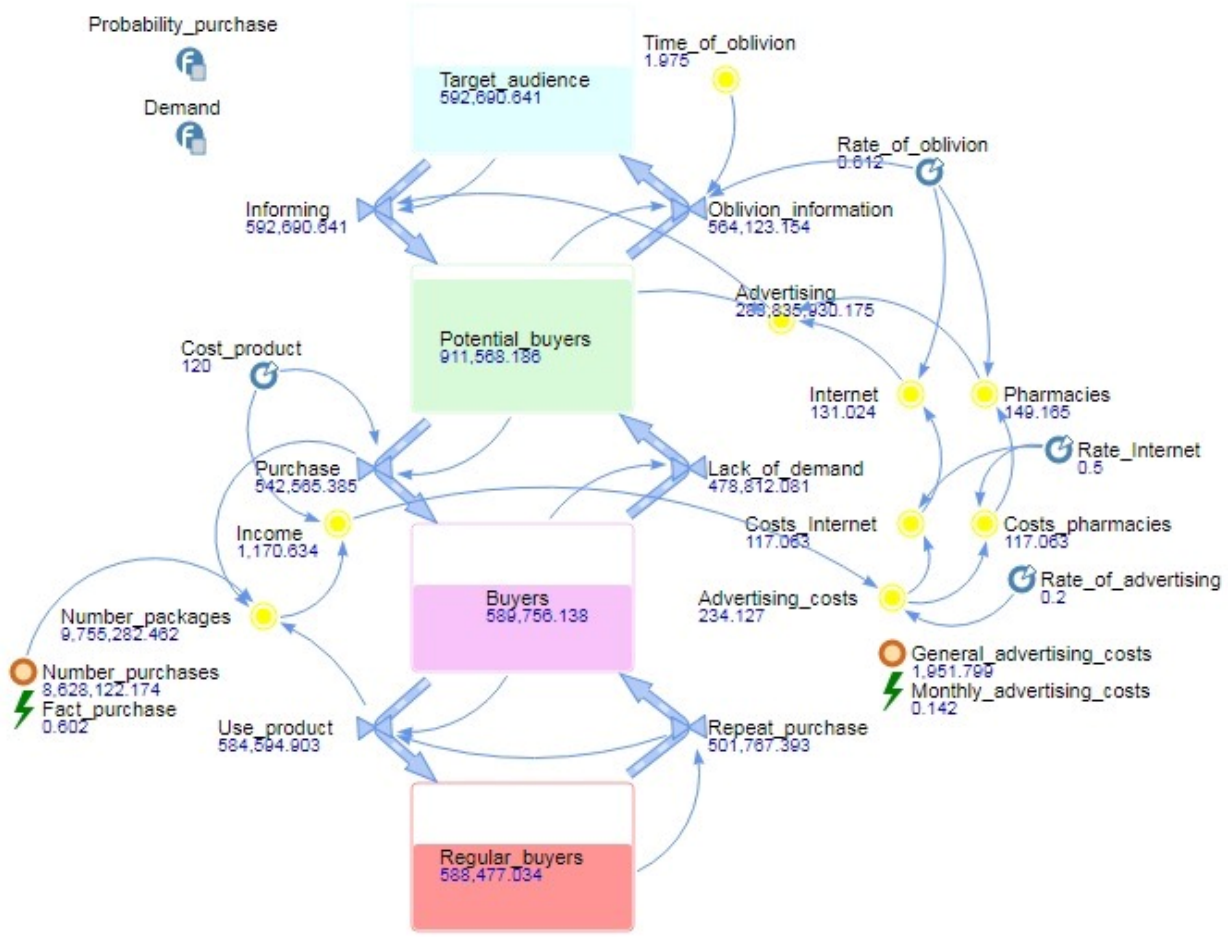


Figure 3. Execution of Standard experiment of model.
Source: Developed by authors.

A simple experiment is used in most cases when developing and analyzing models created in AnyLogic. Arranging some simple experiments with different values of input and output factors is possible, making one of these experiments current for running the model. When the model is developed, one simple experiment is automatically created, called the simulation. The standard experiment is the simplest type of experiment. It launches a model with predefined values of parameters, supports virtual and real time modes, animation, and debugging of the model (Figure 3).

Experiments were carried out based on specific regions with the goal of efficiently allocating funds through sources of advertising during the term of the advertising company's contract, setting prices for medicinal products, and placement of medicines in pharmacies

depending on demand, among other factors.

The experiments conducted for the southern and northern regions of the Ukraine showed concrete results. In the southern region, with an even distribution of the advertising budget during the chosen timeframe for the model showed the following dynamics (Figure 4):

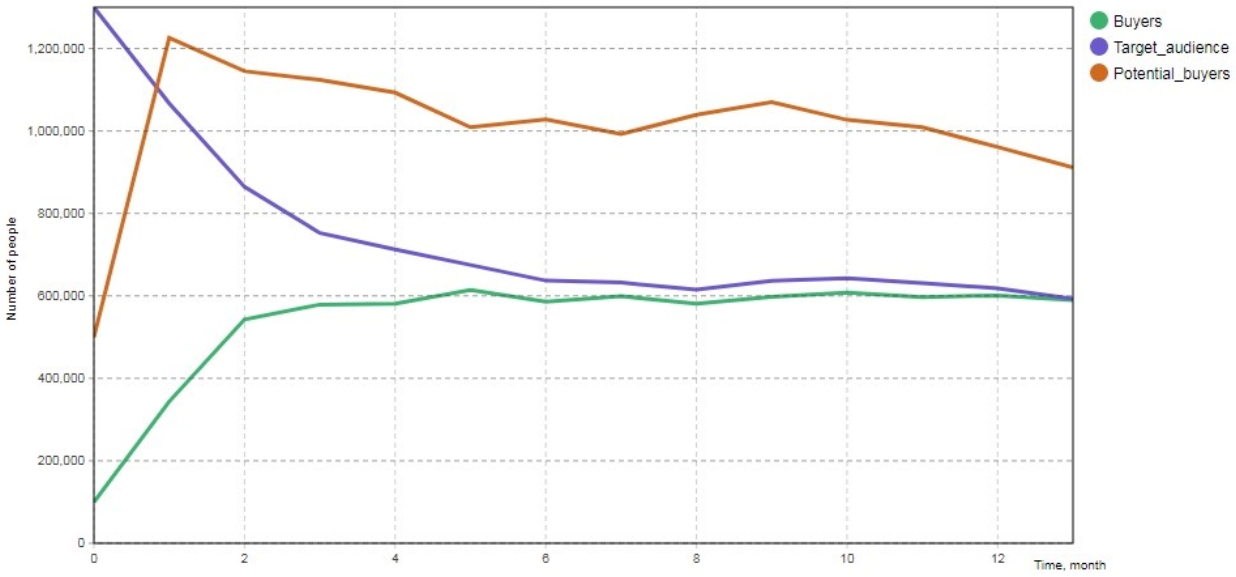


Figure 4. Time charts of parameters Target_Audience, Potential_Buyers and Buyers.
Source: Developed by authors.

That is, the first 5-6 months of advertising is quite effective, but starting from the 7th month, advertising costs are unreasonable and do not receive the expected response of the target audience.

The same pattern is observed for the northern region. If advertising ceases after the 6th month, the number of users, as well as the number of carriers of information, rapidly decreases (Figure 5).

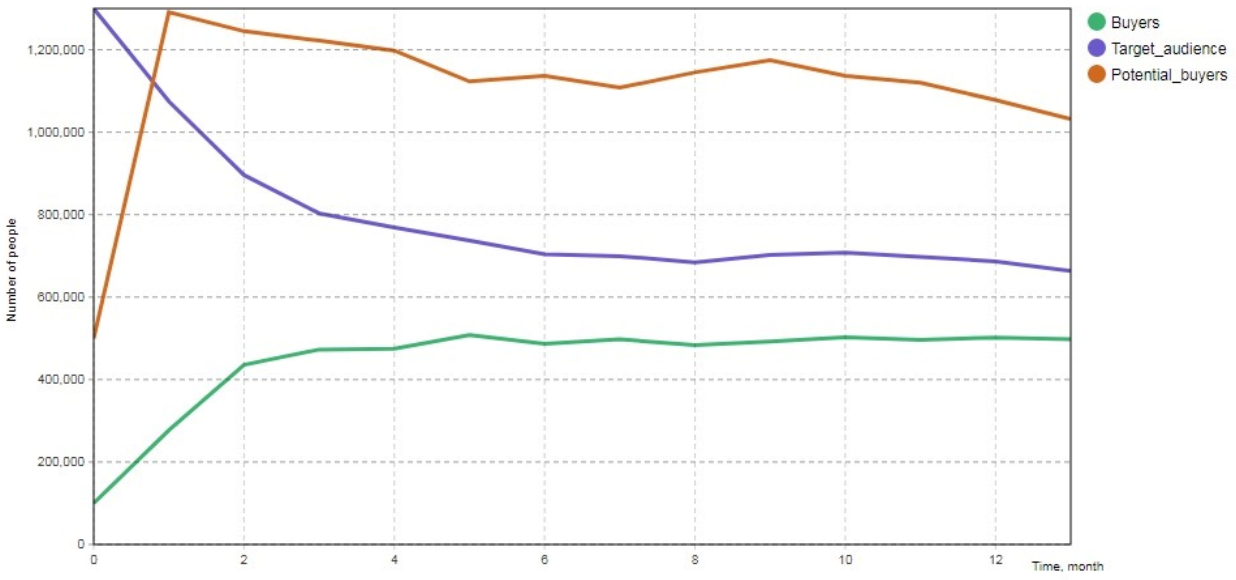


Figure 5. Time charts of parameters Target_Audience, Potential Buyers and Buyers.
Source: Developed by authors.

The strategy of uneven distribution of the advertising budget is the most justifiable (corresponding data for the northern region is given in Figure 6). Between the first and last months of advertising, the number of users stays at a rather high level. The number of purchases in the first months grows significantly, and a high proportion of the target audience are carriers of information.

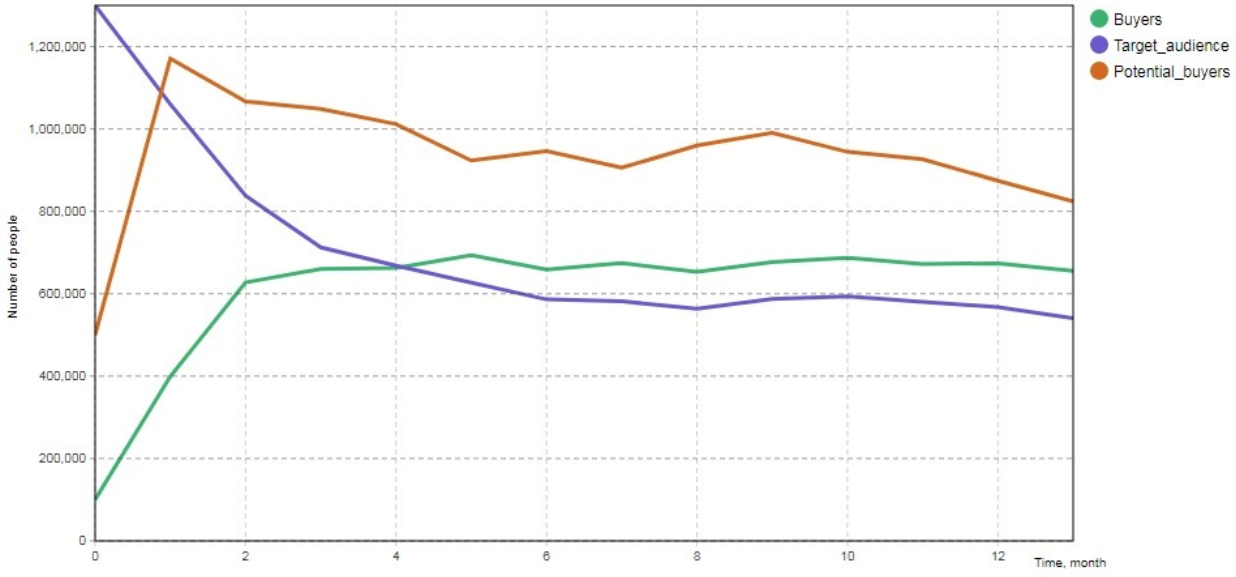


Figure 6. Time charts of parameters Target_Audience, Potential_Buyers and Buyers.
Source: Developed by authors.

The variation of parameters experiment automatically performs several repetitions of the simulation experiment, sequentially choosing for each run the appropriate combination of parameter values.

For each changeable parameter, the range of possible values is specified: minimum, maximum, and the value of the step that determines the valid values of this parameter within the range. The model will be launched as many times as necessary to overcome all possible combinations of values of the selected parameter.

AnyLogic provides the ability to display the results of all model runs on one graph, thereby facilitating comparison of the model's results obtained from various values of its parameters.

The analysis of the dynamics of the level of revenues at different values of the production cost was made during to the variation of parameters experiment (Figure 7).

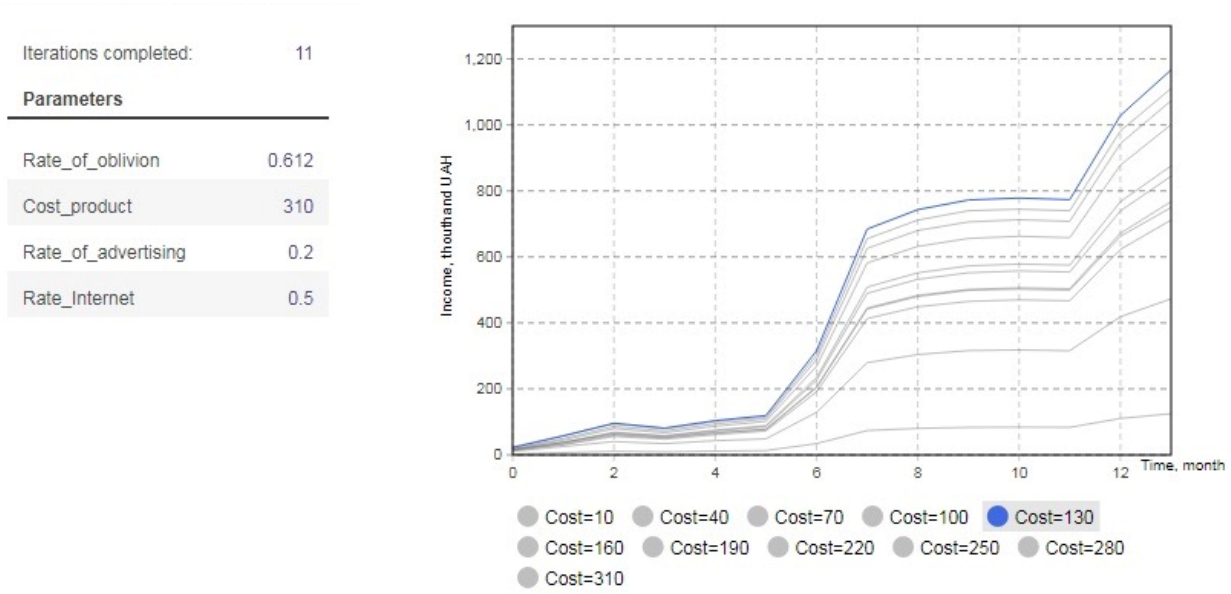
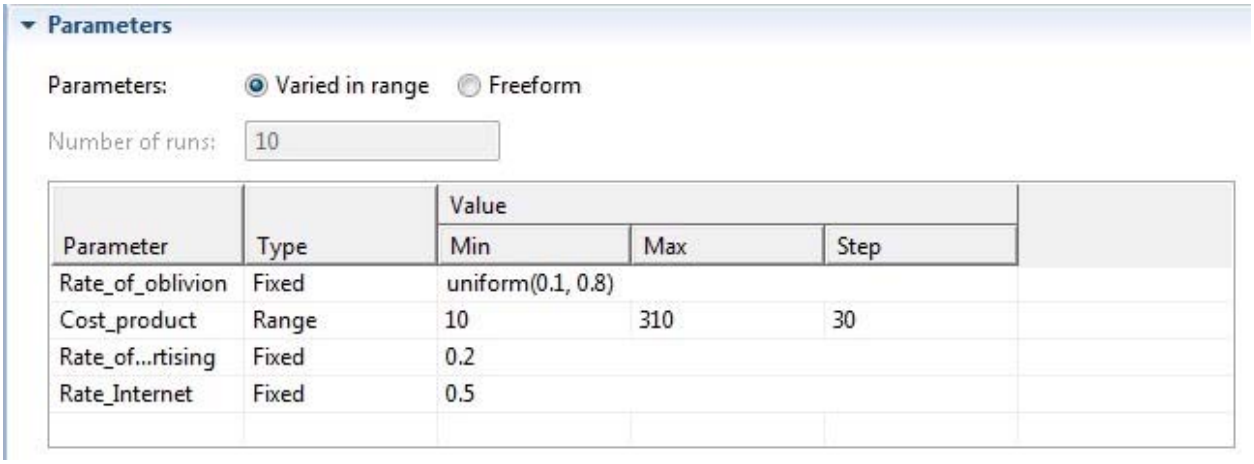


Figure 7. Variation of the parameter Cost of product
Source: Developed by authors.

Results of the variation of parameters experiment suggests that the maximum level of revenue at fixed values of other parameters is achieved at the cost of the product at the level of 130 UAH.

During the experiment, 11 iterations were performed for various values of the cost_product parameter in the range from 10 UAH to 310 UAH, step 30 UAH. The graph, respectively, displays 11 different scenarios. The parameters of the experiment are shown in the Figure 8.



Parameter	Type	Value		
		Min	Max	Step
Rate_of_oblivion	Fixed	uniform(0.1, 0.8)		
Cost_product	Range	10	310	30
Rate_of...rtising	Fixed	0.2		
Rate_Internet	Fixed	0.5		

Figure 8. Configuring parameters of experiment Variantion of parameters.
Source: Developed by authors.

Optimization is used to solve the problems of quantitative analysis (calculation of system efficiency). Finding the values of the factors that determine the best solution is called the reciprocal of imitation modeling. The reverse simulation answers the question of which solution, from the domain of admissible solutions, points to the maximum system efficiency indicator. Solving the inverse problem repeatedly solved a direct problem.

In cases where the number of possible solutions is small, the solution of the inverse problem is to simply scan all possible solutions. Comparing them with each other can reveal the optimal solution. If auditing all the solutions is not possible, then methods of directed overview with the use of heuristics can be used. The optimum, or close to the optimal solution, is found after repeated implementation of successive st*eps (solutions to the direct problem and finding the vector of resulting indicators for each set of input parameters). Properly tailored heuristics approximates the experiment to the optimal solution at every step.*

The user can use the OptQuest optimizer (built into AnyLogic) or any external optimizer as a block of registration of values of initial indicators, choice of the next approximation for optimization. The OptQuest optimizer was recently developed based on the heuristics scattersearch and tabusearch. This optimizer is the best professional optimization package for solving complex optimization problems offered on the market.

After launching the model, the optimization experiment finds the best value for the input parameters for which the target function is minimize or maximize.

An optimization experiment was conducted on the model to find the optimal parameters with which the level of revenue would be maximized (Figure 9).

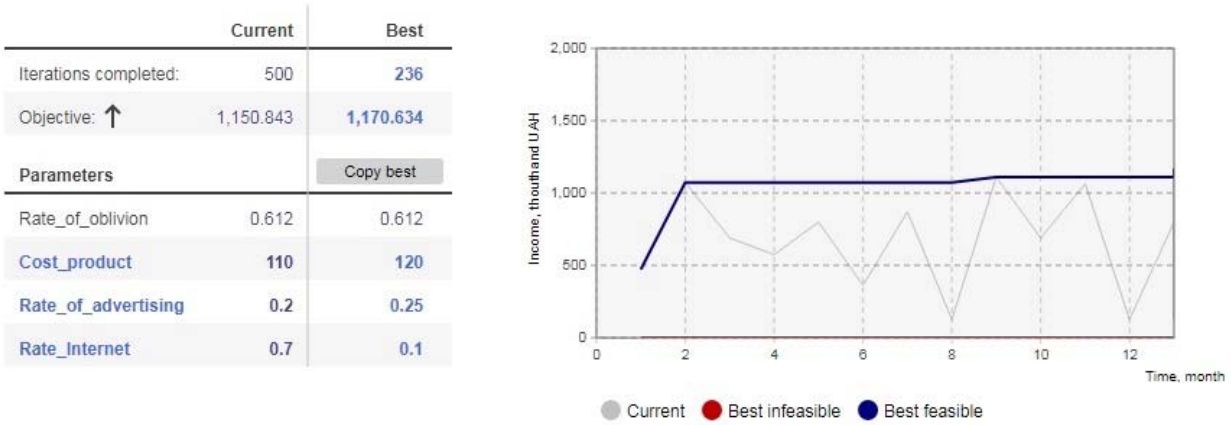


Figure 9. Optimization experiment to maximize Revenues.
Source: Developed by authors.

The results of the optimization experiment indicate that the maximum level of revenue is achieved with the following values of parameters: Cost product – 130 UAH, Rate_of_advertising – 0.25, Rate of Internet – 0.1.

AnyLogic allows additional optimization conditions to be specified, imposing constraints on the values of optimization parameters and on the optimization results obtained. The constraints are an arithmetical expression that specifies a narrower range of permissible parameter values.

Before launching an optimization with a certain combination of optimization parameters, AnyLogic verifies whether the values match the given constraint. If so, the model starts with these values; if not, then the optimizer chooses other values. The optimizer will use only allowable values of parameters that satisfy the given constraints. Thus, the search space is narrowed, making optimization faster.

The constraints for the Optimization experiment are shown on Figure 10.

Constraints on simulation parameters (are tested before a simulation run):

Enabled	Expression	Type	Bound
☑	Rate_of_advertising	<=	0.15
☑	Cost_product	<=	90.0
☑	Rate_Internet	>=	0.40

Figure 10. The constraints for the Optimization experiment.
Source: Developed by authors.

The following results were obtained during the launch of the Optimization experiment with constraints (Figure 11): Cost_of product – 90 UAH, Rate_of_advertising – 0.15, Rate of_Internet – 0.4.

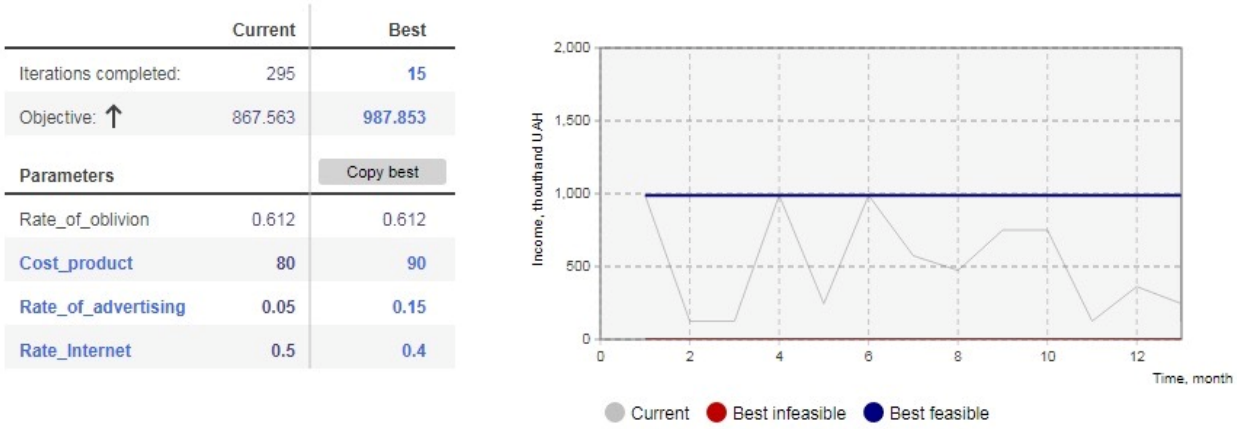


Figure 11. Optimization experiment with constraints.
Source: Developed by authors.

The experiment for the comparison of "runs" allows setting different values of parameters interactively, running a model with these values. The experiment interface contains diagrams that simultaneously reflect the results of all committed "runs" (which can be set in scalar form and in the form of datasets), thus allowing for a visual comparison of the simulation results obtained at certain values of the parameters.

The comparison of the behavior of the variables “regular buyers” and income at different values of the cost-product parameter shows that in both regions, the maximum number of regular buyers is achieved at the lowest cost of the product. The threshold price for the investigated product is 170 UAH. (Figure 12 and Figure 13). At this price, maximum income is earned both in the southern and in the northern regions. In the northern region, however, income is significantly higher at the expense of a larger population and higher levels of morbidity. At the maximum cost of a product, the number of regular buyers is kept at one level throughout the simulation period. This is the fate of buyers for whom their purchase decision does not depend on price.

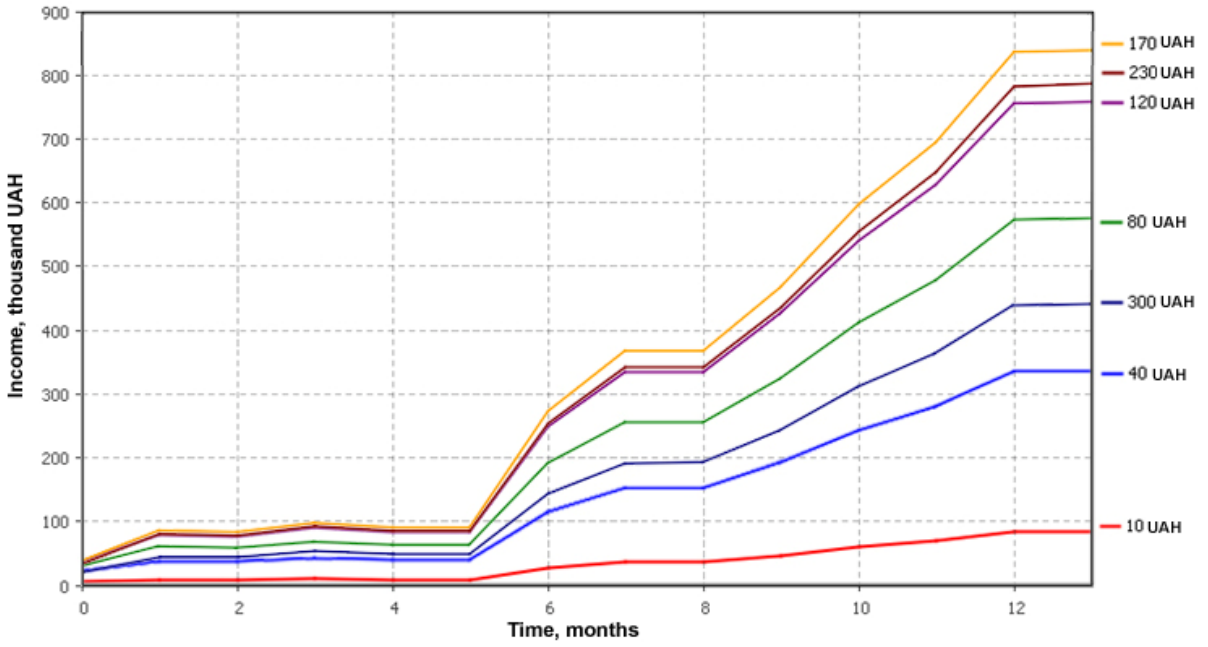


Figure 12. Comparison of "runs" for the parameter Income of South region.
Source: Developed by authors.

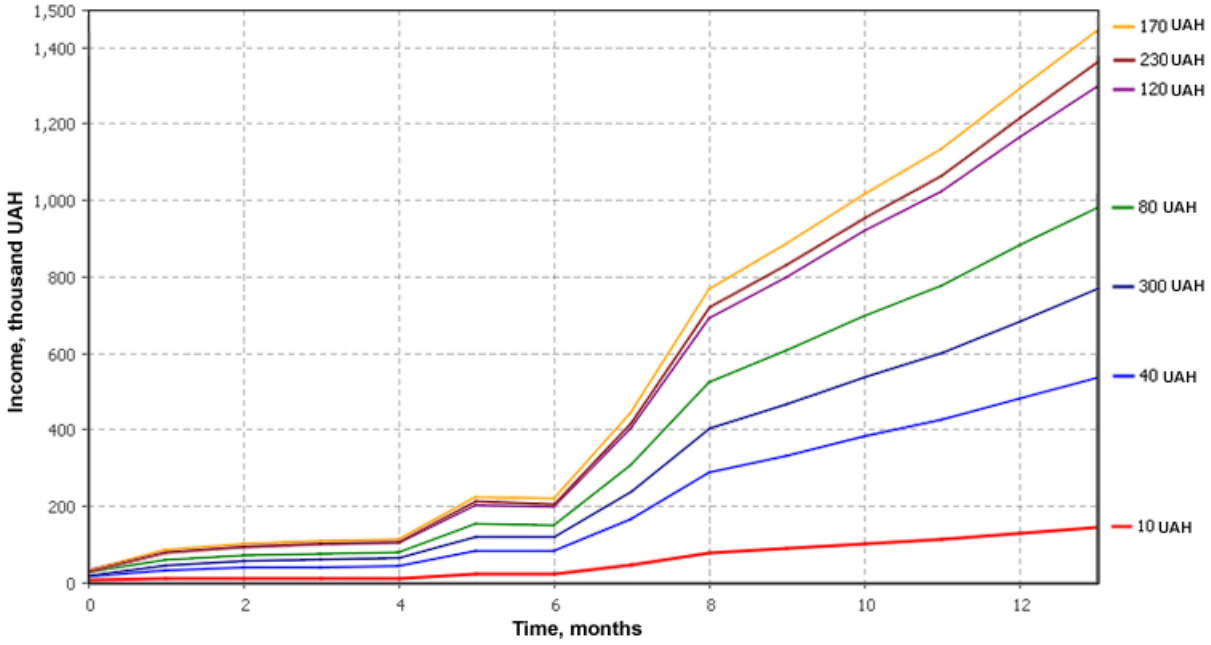


Figure 13. Comparison of "runs" for the parameter Income of Nothern region.
Source: Developed by authors.

CONCLUSIONS AND RECOMMENDATIONS

1. The obtained results indicate that a systematic application of multi-approach modeling platforms creates a unified theoretical and instrumental basis for supporting the processes of forming advertising strategies for pharmaceutical companies, due to the following:
2. Maximum account of the peculiarities of the implementation of advertising companies during the task setting according to the specifics of products and trends in the pharmaceutical market.
3. Account for the various influences of deterministic and stochastic factors, which reproduces the entropy of the environment of processes, as well as the emergence of inherent risks.
4. Investigation of certain processes in dynamics in virtual and in real time.
5. Parametric adjustment of models in the beginning and during the run of simulation experiments.
6. Possibility of implementing various types of simulation experiments on the base model in order to deepen the analysis and refine the results forecast for the investigated pharmaceutical product advertising companies.
7. Various forms of presentation the results of experiments (in particular, animations in 2D and 3D space).
8. Possibility of collecting significant data of precedents from previous advertising strategies including appropriate strategies enterprises-analogue and list of competitors with the available technology of the future valid information.
9. Involvement of cloud technologies to operate the model and conduct simulation experiments.

According to the above, the development of model applications on the AnyLogic multi-approach simulation modeling platform contributes to the achievement of the main goal - to create an effective model-simulator for the preliminary development of advertising strategies to promote the pharmaceutical products. The flexible interface of the models provides ease in monitoring the advertising company and raises the efficiency of making managerial decisions.

The model is modular and rather typical, which makes it possible to customize it to the properties of specific industry enterprises.

Further research is planned for the following areas:

- Detailing the components of pharmaceutical companies' advertising strategies by expanding the range of factors affecting their internal and external environment, examining the reproduction and comparative analysis of consumer behavior within the various innovative product groups in the pharmaceutical market.
- Increasing the experimental base for studying the relationship between advertising budgets and their returns. Accordingly, this would also include increasing the number of investigated enterprises in the Ukrainian pharmaceutical industry.
- Additional reproduction of the advertising strategies of competitors in model-simulators for the investigated enterprises, with prediction of their influence on the final indicators of basic imitation objects.
- Modeling the investment strategies to support advertising companies for certain types pharmaceutical products by simulating the stages of its life cycle, forecasting the final financial results, and determining the levels of investment risks.

Another task that remains is the reproduction of various situations of implementation that advertising companies for both domestic pharmaceutical companies and foreign companies operating in the Ukrainian pharmaceutical market might use, taking into account the actions of product users and the competitiveness of the environment in different regions.

The instrumental platform will be strengthened by the hybrid paradigm of simulation and expansion of the introduction of cloud technologies.

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