Optimizing promotional campaigns and evaluating their efficiency using simulation modeling

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Abstract. The article is devoted to analysing and researching market behaviour when using promotional campaigns for identical products. The main points influencing the work of advertising campaigns and users' behaviour are investigated. An algorithm for conducting an optimization experiment is proposed and recommendations for the promotion are given. The proposed comprehensive approach allows you to reduce the cost of advertising campaigns and determine the product optimal competitive price

Keywords: Promotional campaign, simulation modelling, advertising, simulation model, promotional activities.

1   Introduction

Currently, the problem of optimizing promotional campaigns and the duration of using advertising funds is becoming more urgent. Any company and enterprise strives to reduce advertising budgets as much as possible, while increasing the market share of the product. The growth of the advertising direction is due to the fact that great competition among the same products encourages business owners to buy more and more advertising. However, not every campaign is successful, as it is influenced by many external factors.

Advertising will be effective only if it is implemented successfully, and it will also contribute to the quick and uninterrupted sale of products. For a competent launch, you need to develop a promotional campaign strategy. Most of the Russian owners and management companies tend to use single promotional campaigns. Often they resort to them in extreme cases as "first aid" and expect immediate positive results. [5]

This approach can hardly be called promotion in the modern sense of the word, and it is unlikely to bring the expected results in the form of the increased sales of products or services.

Developing the strategies helps to avoid mistakes in advertising. It allows minimizing the risks associated with the consumer's misunderstanding, and also allows in-

creasing the advertising effectiveness. That means that developing a promotional campaign strategy allows the company to successfully cope with its sales problems, even gives an opportunity to compete more prosperously with other companies.

If a firm develops a strategy for a promotional campaign, it avoids a lot of mistakes in its implementation and makes the advertising that is aimed at the consumer more accurately than those rash and meaningless promotions, which sometimes just harm the company.

To build a simulation model, the AnyLogic package is chosen, developed by The AnyLogic Company, which is of Russia heritage.

The developers of this product did not limit the user to one modelling paradigm, allowing him to choose from three main areas of modelling: discrete-event modelling, system dynamics, agent-based modelling. Another distinguishing feature of the AnyLogic package is its object-oriented approach to modelling. It helps to greatly simplify the work with complex systems, making the process of representing the complex system structure more natural, which ultimately allows facilitating and speeding up the model creation. Another feature of the AnyLogic package is the ability to combine various modelling directions within one model (for example, agent-based modelling and system dynamics). Another AnyLogic package concept is to represent the model as a set of parallel functioning activities, consisting of both one instance of active objects and several ones that independently interact with the environment. Another important part of the package is a user-friendly and intuitive interface supplied with all kinds of support tools. These tools allow new users to quickly adapt to applying this product, and simplify the process of creating models. [1].

1.1   Formulating the problem

Developing simulation modelling allows solving the problems of the Internet – entrepreneur, providing him with a clear vision of the possible consequences when making decisions for advertising. This tool gives you an opportunity you to quickly analyze the current state of affairs, optimize the enterprise present activities, reduce advertising costs, and develop a plan for further actions. [2]

The tasks of simulation modelling include creating an accurate, adequate model of a real object and the dynamics of its functioning.

Due to the minimal distortion of the object structure, the results obtained are as close as possible to the real ones.

Thus, a properly constructed model is an almost accurate representation of a real object with the properties of interest.

Working with models allows experimenting with real social objects and tracking the possible reaction to a particular promotional campaign, as well as avoiding the risk of unsuccessful budget investment in advertising.

The promotional campaign model described in AnyLogic software will help sociologists and marketers who know in advance human behavioural principles to analyze how the population will perceive this innovation; will allow drawing conclusions. [1]

1.2 The problem of modeling promotional campaigns

At first sight, the advertising market allows many companies to get the largest share of customers, while the cost of advertising is usually reflected in the product price category. As a result, when using advertising tools in the company, clients are brought in each attracted client performs such actions as:

— comes to the trade or commercial premises;
— visits the website looking for the right product or orders a service;
— contacts the manager or seller;
— draws up a deal;
— pays for the product [3].

The more advertising attracts customers, the more profitable the business will be. However, the amount of funds spent on advertising is not always directly proportional to increasing customers. Sometimes your advertising budget is wasted, which is the main problem of promotional campaigns.

2 Materials and methods

2.1 Promotional campaign model algorithm

An abstract consumer market and the competition with the influence of promotional campaigns on consumers are selected for modelling and studying. Consumers live in five different towns and buy a certain product. The product is manufactured by three competing companies. Each consumer has one favourite type of product (and shows a certain group loyalty), but may switch to a different type due to the influence of other consumers, prices, promotions, or by accident. Consumers can move from one town to another and interact with other people in the same city.

An integrated approach to making a decision on the most favourable product price and the number of promotional campaigns is proposed:

— Visual observation and the indicator analysis such as market share, sales dynamics, weekly revenue and total revenue.
— Creating a consumer behaviour model in AnyLogic.
— Graphic representation of towns and consumer group interaction.
— Testing the proposed solutions on a simulation model to identify their advantages and disadvantages.
— Modernizing a particular company work by adjusting the parameters affecting the user's behaviour and the promotional campaigns themselves.

On the basis of the proposed integrated approach, an algorithm for optimizing a promotional campaign is developed and implemented to increase the market share of a particular company (Figure 1).
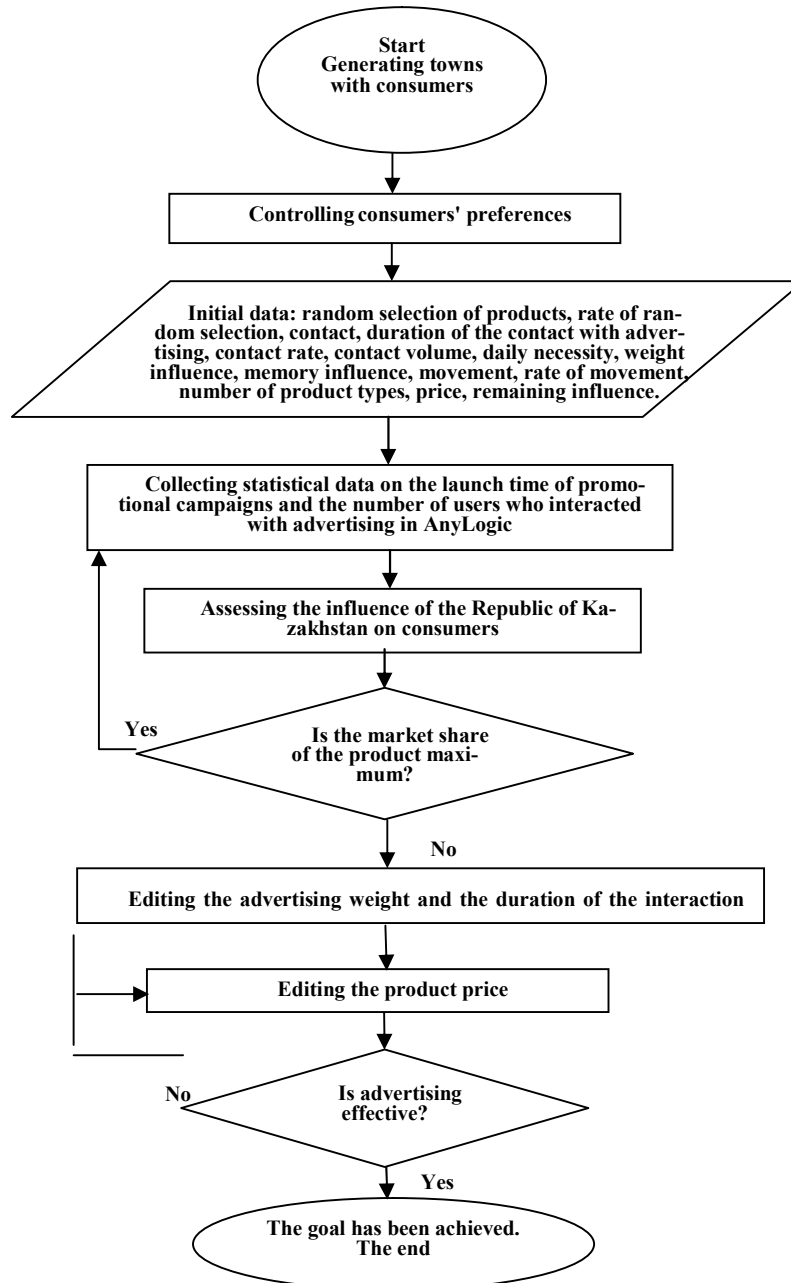
Fig.1 Algorithm for optimizing a promotional campaign.

2.2 Developing a simulation model in the AnyLogic environment

A simulation model of influencing a promotional campaign on the consumer market is built.

A number of agents are created to implement the model. In the agent-based modelling, an agent is a model element that can have behaviour, memory, contacts, etc. [4] Agents simulate the target audience, publishing campaign impact, the town, as well as the general environment of Main.

Parameters are used to create an agent's static characteristics. With their help, you can set different parameter values for various agents of the same type, which is required in cases where agents have similar behaviour, but they have different characteristics. For the "Action Impact" agent, the following parameters are set:

— type of product;
— duration of the campaign;
— start of the campaign;
— volume.

The agent displaying all consumers of the target audience is named "CA", its graphic image of one representative of the target audience is presented in the form of an oval.

The following parameters are added for the "CA" agent:

— accidental event "accidentalSwitch";
— random event rate "accidentalSwitchRate";
— contact "contact";
— duration of the contact with advertising "contactPromotionDuration";
— contact rate "contactRate";
— contact volume "contactVolume";
— daily necessity "dailyNeed";
— weight influence "influenceWeight";
— memory influence "memoryWeight";
— movement "move";
— rate of movement "moveRate";
— number of the product types "nProductTypes";
— price "price";
— remaining influence "remainingInfluence".

Also, variables are added to the CA agent to model the agent's changing characteristics and to store the model work results.

— changing "change" with the initial parameter value of the number of the product types nProductTypes;
— favourite among the products "favoriteproductType" with the initial value of 0;
— advertising influence "influence";
— memory "memory";
— preference "preference";

— town "town".

Next, functions are created, with their help certain sequences of actions are set that are performed from different places or at various moments in the model life.
 The following functions are created:

— Searching for a specific consumer's location "findLocation".
— Calculating consumers' maximum preference.
— Since consumers can change their product preference, a function is created to switch in the user's preference for the product.
— After a consumer changes preferences, it is necessary to update the consumers' state.
— Events are created to plan any actions in the model. Events are often used to simulate delays and timeouts. In some cases, behaviour can only be modelled using events.

Therefore, the following events are generated:

— accidentally changing the product type "accidentallySwitchProductType";
— influence on other consumers "contactBuddy";
— moving to a different town "moveToAnotherTown";

Dynamic events are used to schedule an unlimited number of events that perform similar actions, which can be scheduled independently and in parallel with each other. Also dynamic events, namely the timer for the end of the influence "InfluenceEndTimer" and the timer for the beginning of the influence "InfluenceStartTimer" are added.

The agent Town is created similarly with the following parameters:

— border – boundary;
— relativeArea – area of the town.

Since a certain number of consumers live in town, it is necessary to create a group of objects called a collection which is used to define a data object that combines several elements of the same type (consumers) at once.

Next, a function is created that is responsible for the goods promotion in town (local promotional campaign).

After all the agents are created, they are linked and located in the Main environment.

The CA and Town agents are added to the diagram, the variables are created, as well as the parameters that will be used to graphically represent the model:

— currentSales – present sales;
— pickedCA – brought consumer;
— price – value;
— promotions – promotional campaign;
— totalRevenue – total receipts;
— totalSales – total sales amount;

‒ weeklyRevenue – weekly returns.

We register the functions:

‒ globalPromotion – global promotion;
‒ randomTown – selecting a random town;
‒ townArea – forming a town area;
‒ townBounds – town boundaries;
‒ updateCas – updating consumers;
‒ updateStats – updating statistics.

Next, a daily update event is created.

As a result of all the transformations, the Main agent looks like this.

The last stage of modelling is the graphical presentation of the model. When drawing by adding elements for 3 different companies, using the sliders you can adjust the price and enable the Global promotion.

Also, using the sliders, you can control the variables responsible for the product promotion.

Then we create a graphical representation of the towns.

The main information of modelling is presented in the lower part, graphs display the preferences of a random consumer, market share of the companies, sales dynamics and the company revenues (Figure 2).
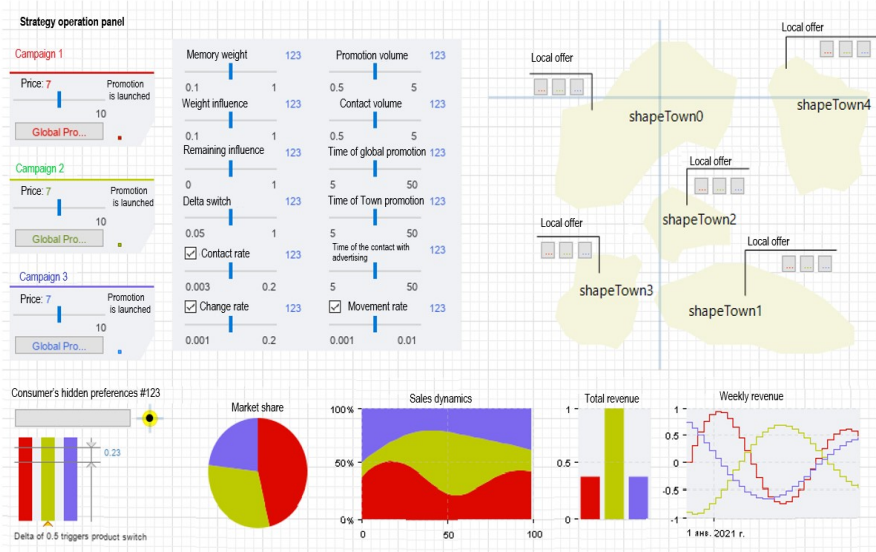

Fig. 2. Graphical representation of the model.

3 Discussion

When you launch the model, you can visually see the distribution of a particular product depending on the promotion parameters.

Let us conduct an experiment, i.e. we will set the minimum price for one company without considering the promotion, for the second we will set the average price and consider one global promotion, and for the third we will set the maximum price and consider the largest number of global promotions.

Then, after 130 days, you can see that the most popular products are those of company 1 (Figure 3).

Thus, we can conclude that with a strong difference in price, consumers choose the cheapest product. However, at the same price, promotion becomes a decisive factor in the product selection.

4 Conclusion

In conclusion, it can be noted that the most important condition for effective market activity is creating and producing competitive goods and services.
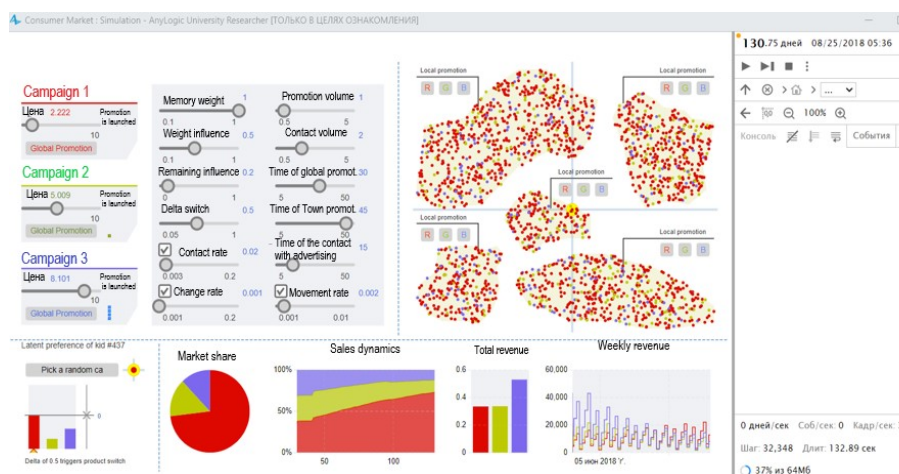

Fig. 3. Experiment results.

A well-thought-out promotional campaign influences various aspects of entrepreneurial activity, encouraging the initiative in producing new products, using the achievements of scientific and technological progress, the fashion factor, and so on.

Advertising promotes the sale of products, the process of converting goods into money, contributes to the accelerated and successful completion of the turnover process, that is, to the reproduction at the firm level. It can design and manage the demand and the market. Advertising is a channel for disseminating information in the market, as well as a prerequisite for the feedback from it.

Then we will make the price the average for all the goods and track the subsequent results (Figure 4).
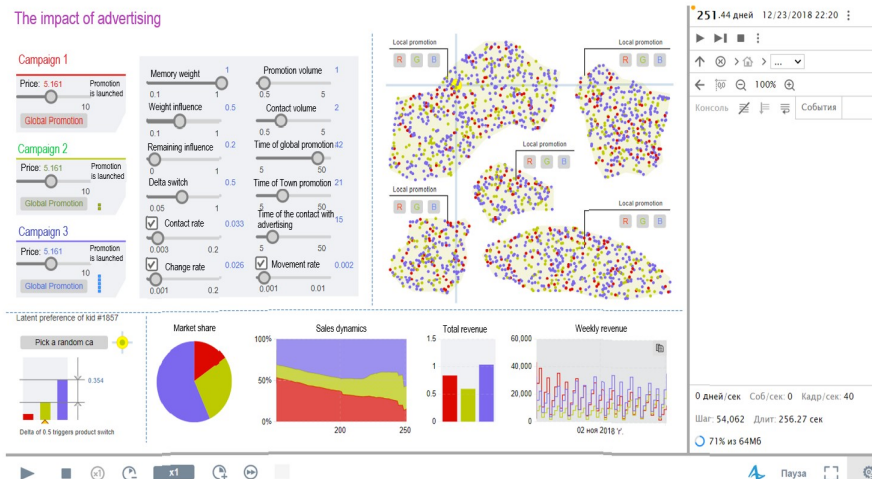
Fig. 4 Results of the modified experiment.

The effectiveness of promotion is achieved not only by means of the simultaneous use of many advertising tools and techniques, some of which complement and enhance the action of others, but also by means of a competitive price. The model shows that at very different prices for similar products, the user will choose a cheap analogue rather than an advertised brand.

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