



Economic-Mathematical Modelling of the Distribution of Investments in the Tourism and Hospitality

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Abstract: Among the world's leading concepts for the development of the tourism industry, a special place is occupied by the distribution of investments in tourism and hospitality. The theoretical aspects of the distribution of investments are analyzed in sufficient detail in scientific works, but there is a clear deficit of serious research on the mathematical modelling of the distribution of investments in the field of tourism and hospitality. The article presents the economic-mathematical model of the distribution of investments in tourism and hospitality. In this work, the investment strategy of activity of the travel agent is developed, depending on the received plan of realization of the developed tours.

Keywords : Economic-Mathematical Modelling, Investments, Hospitality, Tourism.

I. INTRODUCTION

In the context of globalization and the integration of countries into world space, the question arises of creating our competitive advantages based on the real potential of natural, human, financial, capital resources and their effective use [1]. One of the priority sectors, which can become its competitive advantage, is tourism. However, the presence of a significant amount of resources in the tourism sector is not supplemented by an adequate system for ensuring its development and effective functioning. Along with the opportunities that will open up, challenges will also arise in finding the optimal combination of maximizing the socio-economic effects of tourism and hospitality and minimizing its negative impact on the environment and local socio-cultural potential [2-3]. In this regard, studies in the field of assessing the distribution of investments in tourism and hospitality, which are advisable to

carry out at all levels of management: international, national, regional, local, become extremely important.

II. THE ROLE AND IMPORTANCE OF THE STRATEGIC DEVELOPMENT OF TOURISM AND HOSPITALITY SERVICES

Intensive tourism development in the second half of the XX century led to the formation of one of the most significant areas of the global economy. Currently, the tourism and hospitality industry has become a leading industry in the world economy, which ranks third in income among the largest export sectors of the world economy, second only to the oil industry and the automotive industry. Revenues from international tourism in the most critical regions of the world are presented in Table. 1. It shows that in 2018, the hospitality and tourism industry generated revenue of \$ 1 trillion 317 billion 169 millions (Fig 2). The map shows not only tourism income but also indirectly - the dependence of the economy of different countries on the international tourism market (Fig 1).

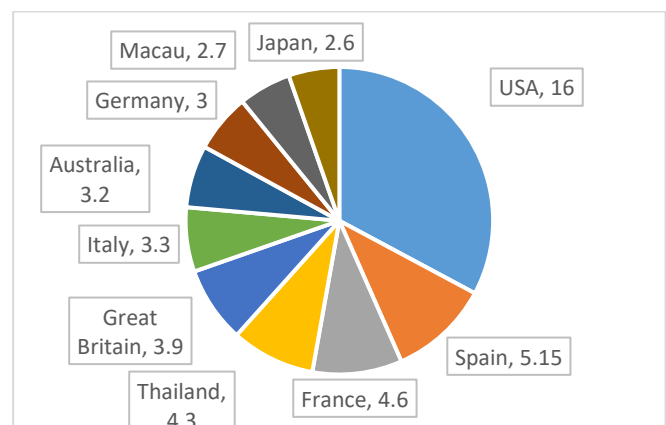


Fig. 1. TOP-10 countries where tourist spends most (AS 2017)

Such factors determined high rates of development of the tourism and hospitality sector as the growth of social wealth and incomes of the population, the reduction of working hours and the increase in free time, the development of transport, including high-speed modes, the development of communications and information technologies. In the coming decade, a marked increase in tourism and hospitality is projected.

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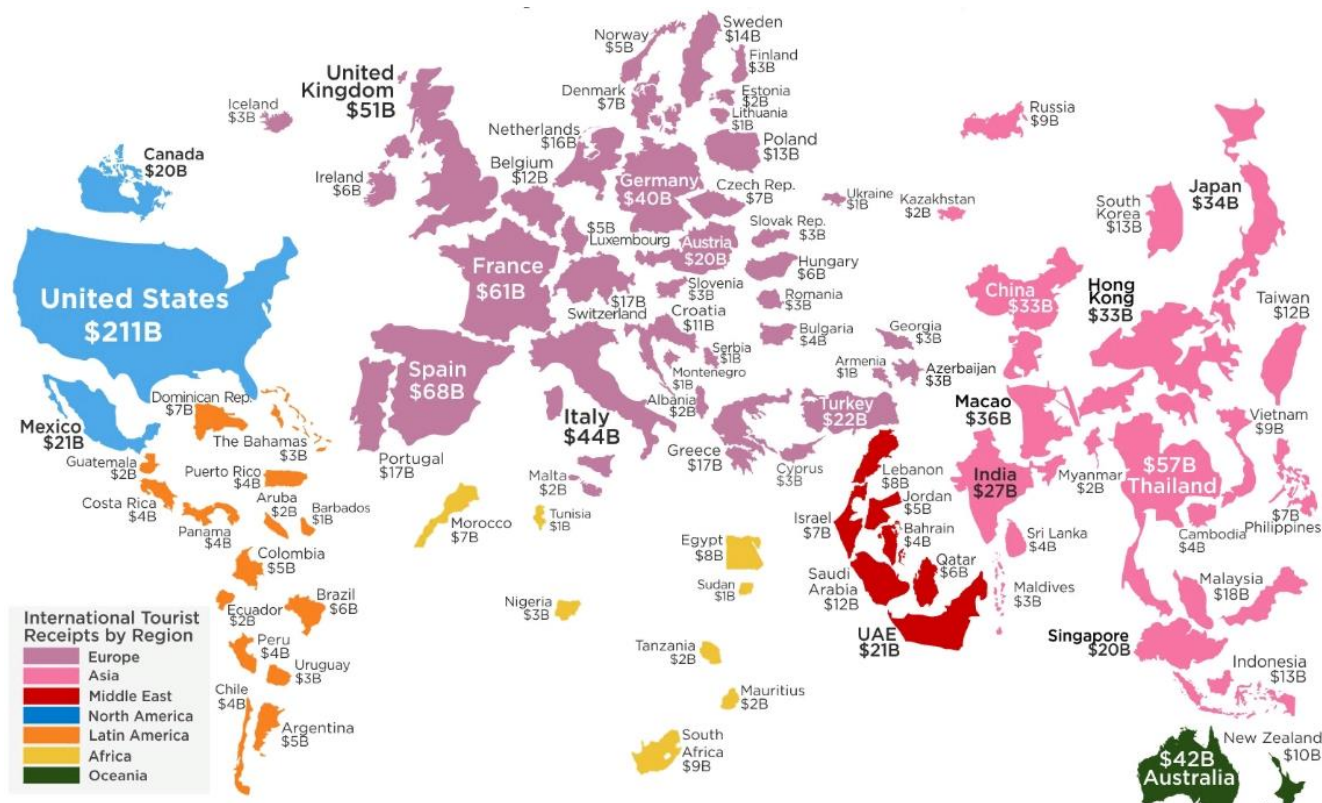


Fig. 2. Tourism Income Map 2018

The impact of tourism and hospitality on the life of the local population can be both positive and negative. The positive aspects include the creation of jobs, an increase in income, which leads to an increase in the standard of living of the local population, an increase in the attractiveness of the region, and the revitalization of local cultural life [4]. The development of this service sector contributes to the influx of currency into the country, improvement of infrastructure, etc. The tourism and hospitality industry, represented by diverse types and organizational forms, balances and brings together personal and public interests, it forms a healthy lifestyle, which contributes to human longevity, strengthening the institution of the family, reducing morbidity, etc.

The negative aspects include polarization and commercialization of the interests of various groups of the population, which leads to complete disregard for the interests of various parties, an increase in the share of unskilled labour, loss of identity of a particular tourist destination, conflicts between the local population and tourists.

The negative impact of tourism and hospitality is expressed in environmental risks and problems associated with land use and arising from poor planning, placement, design and construction of tourist facilities and enterprises. It is also possible to disturb the market balance ("import of inflation") when the arrival of a large number of tourists with high purchasing power leads to an increase in prices for goods in high demand.

To obtain maximum benefits from the tourism and hospitality industry, each state develops a policy for the development of this field of activity, which is one of the inherent elements of socio-economic policy. Economic efficiency from the sphere of tourism and hospitality means receiving a gain (economic effect) from the organization of tourism and hospitality at the

state level, tourist and recreational services for the population of the region, production and service activities of a tourist company.

The general laws governing the development of tourism and hospitality are as follows:

- increasing requirements for the quality of tourism and hospitality services initiates the processes of diversification and specialization of services;
- the growing interest of the population in ecological tourism causes an increase in the investment attractiveness of tourist and recreational areas as objects of tourism and hospitality;
- the dominant development of the tourist and recreational sector of the resort regions contributes to the development of individual measures and programs that offset the seasonal fluctuations in demand for tourism and hospitality services;
- state investment in the development of transport infrastructure generates a significant increase in private investment in the development of tourism and hospitality infrastructure.

Despite natural disasters, economic crises, conflicts, terrorist acts, wars around the world, there has been a steady increase in tourism and hospitality. The explanation for this phenomenal success lies in the ongoing shift in consumption patterns - for many, tourism and hospitality are no longer luxury, but a natural necessity.

Exploring the role of tourism and hospitality, it is essential to determine the market for tourism and hospitality services. Under the demand of tourism and hospitality services understand [5-7]:

- the aggregate of consumers of a tourist product who have the means to buy it today or tomorrow (potential purchasing power);
- the system of world economic relations, in which the process of converting tourism and hospitality services into money and the reverse transformation of money into tourism and hospitality services is underway. In this context, we can say that the tourism and hospitality market is formed by countries - exporters and importers of tourism and hospitality.

The market of tourism and hospitality services has its specific features, which must be taken into account when organizing the tourism business, including the distribution of investments.

III. DISTRIBUTION OF INVESTMENTS IN THE TOURISM AND HOSPITALITY

The task of rational allocation of scarce resources is a traditional task of management practice, including for tourism and hospitality. The official problem statement is this: there is some limited resource that needs to be reasonably distributed among consumers [8].

An investment strategy is a certain system of coordinated actions of an enterprise, which determines the strategic directions of investment activity, providing it with the necessary investment resources and planning their effective use. The concept of "investment strategy" in modern economical literature is interpreted as forming a system of long-term goals of investment activity and choosing the most effective ways to achieve them. An investment strategy identifies opportunities to improve an entity's economic performance through investments; that is, it outlines the areas of investment for profit and to increase its assets. Concerning the overall economic development strategy, the investment strategy is subordinate and must agree with the goals and stages of implementation. It should be noted that the investment strategy can also be considered as a process of strategic management of investment activity. In this case, it will include:

- tactical management of investment activities through the formation of an investment portfolio;
- operational command of investment activities through the operational management of individual investment projects and programs.

The process of developing an investment strategy is an integral part of the overall system of strategic choice of the enterprise and includes [10-11]:

- setting goals of the investment strategy;
- optimization of the structure of investment resources and their distribution;
- development of investment policy on the most important aspects of investment activity;
- support of relations with the external investment environment.

The purpose of each investment project is profit, which depends on the return on the project and the intensity of its implementation. The investment decision model replaces the original object and is used to study it. The model can display both your investment decision-making system and the relationships between its components. In the process of choosing one or another solution, it is advisable to use

mathematical modelling to form a system of mathematical relationships that will present and characterize the process of occurrence of individual problems in the implementation of a particular investment decision.

In addition, modelling can help you identify the major risk factors and adjust your decision accordingly, or, in the case of very high risk, abandon a particular solution.

It is advisable to carry out mathematical modeling of investment decision-making in the conventional stages: study and description of the economic and organizational nature of the problem; development of a mathematical model to obtain a suitable solution; model verification and solution quality analysis; model correction and decision in case of insufficient conformity of the model to the real process; implementation of the decision.

Diagnosis of an investment object involves its qualitative analysis, which is necessary to identify the main risk factors. At this stage, it is advisable to form a preliminary idea of the investment decision options, the criteria for their effectiveness, the scheme of evaluation and comparison of different criteria, which can be used when choosing a particular solution.

IV. ECONOMIC-MATHEMATICAL MODEL OF THE DISTRIBUTION OF INVESTMENTS IN TOURISM AND HOSPITALITY

Building a mathematical model includes:

- 1) determination of input data;
- 2) establishing the content and form of the source information;
- 3) the mathematical form of the relationship between the elements of the investment object and its performance indicators, taking into account the possible investments.

Because of the above, let us proceed to the direct construction of an economic and mathematical model. As a result of the project, the company operates at maximum capacity and all products are fully sold. As a criterion for evaluating the economic efficiency of an investment project, net present income is considered:

$$NPV = \sum_{t=0}^n \frac{FCF_t}{(1+r)^t} \quad (1)$$

where t is the period number of the investment project, FCF_t is the free cash flow of the investment project in period t , n is the planning duration, which is measured by the number of periods, r is the discount rate.

Cash flow from operating activities is calculated as:

$$OCF_t = \left(\frac{f(1-\mu)(P_t - C_t)}{P_t} + \mu * na \right) FA_0 \quad (2)$$

Figures and Tables

where P_t is the cost of selling the product; C_t is the cost of the product; μ - income tax; na - depreciation rate; FA_0 is the value of an enterprise's fixed assets for new investments.

Introduce the concept of profitability of fixed assets of the project in the form of cash flow REN:

$$REN_t = \frac{OCF_t}{FA_t} = \left(\frac{f(1-\mu)(P_t - C_t)}{P_t} + \mu * na \right) \quad (3)$$

We describe the problem of making investment decisions as the task of optimal control of the discrete process. As management, we will accept the investments needed to invest in the project.

We formulate the problem of optimal management: knowing the initial cost of the fixed assets of the project $FA_0 = FA_0$, it is necessary to choose the following distribution of investments by n quarters to maximize net income.

So our model will look like:

$$\left\{ \begin{array}{l} NPV_t = \sum_{t=0}^n \frac{(REN_t + \varphi_i k_t) FA_t - U_t}{(1+r)^t} \rightarrow max; \\ FA_{t+1} = FA_t - k_t FA_t + U_t; t = 0, n; \\ REN_t = \frac{OCF_t}{FA_t} = \left(\frac{f(1-\mu)(P_t - C_t)}{P_t} + \mu * na \right); \\ \sum_{t=0}^n U_t \leq U; \\ U_t > U_n; \\ FA = FA_0 \end{array} \right. \quad (4)$$

where OCF is cash flows from operating activities, k_t is the depreciation ratio of fixed assets. The essence of the φ_i coefficient is that it reflects the number of funds needed to invest in working capital gains while increasing the value of fixed assets by one monetary unit to increase production.

To solve this problem, we use the discrete maximum principle. Price risk should be taken into consideration to determine the optimum moments and sales volumes in the context of each quarter. If future market prices are undetermined, then the owner of the product (service) always has the risk of earning less than expected in the future. The proposed methodology allows for the best consideration of the individual owner's attitude to this risk, based on his or her economic interests.

In multicriteria optimization, we believe that the limits of variation in the expected total net income and standard deviation of income are known on many effective calendar plan options. Valid levels of these criteria are also identified. Among all useful variants of the implementation plan, the one that best reflects the individual preferences of the product owner is calculated.

The scheduling technique for solving the problem of optimizing the inventory schedule for product inventory, subject to price risk, consists of three steps.

In the first step, the limits of variation in the expected total net income and standard deviation of income on many effective plans are calculated. First, the best values for these metrics are calculated:

$$\bar{z}_{max} = (\bar{p}_{t*} - c_{t*})a \quad (5)$$

where \bar{z}_{max} is the maximum revenue, \bar{p}_{t*} is the price of selling the unit of production at time t, c_{t*} is the cost associated with storing the unit of production until the time min t ($t = \bar{1}, \bar{T}$), $\sigma(z)_{min}$ is the minimum variance, a - volume of production, T - duration of the planning period.

$$\sigma(z)_{min} = \frac{a}{\sqrt{\sum_{t=1}^T \frac{1}{\sigma_t^2}}} \quad (6)$$

The following are the worst-case benchmarks for many effective calendar plan options:

$$\bar{z}_{min} = \frac{a}{\sqrt{\sum_{t=1}^T \frac{1}{\sigma_t^2}}} \sum_{t=1}^T \frac{\bar{p}_t - c_t}{\sigma_t^2} \quad (7)$$

$$\sigma(z)_{max} = a\sigma_{t*} \quad (8)$$

In the second stage, after acquaintance with the range of variation of the benchmarks, the owner of the product reports the following levels of these indicators \bar{z}_0 and σ_0 :

$$\bar{z}_{min} \leq \bar{z}_0 < \bar{z}_{max}, \sigma(z)_{min} < \sigma_0 \leq \sigma(z)_{max} \quad (9)$$

The third stage determines the optimal calendar for the implementation of inventory. This plan $x^* = (x_1^*, \dots, x_T^*)$ is calculated by solving the convex programming problem:

$$\left\{ \begin{array}{l} f = \sum_{t=1}^n OCF_t x_t - \sum_{t=1}^n \sigma_t^2 x_t^2 \rightarrow max; \\ \sum_{t=1}^n OCF_t x_t \geq z_0 + s(z_{max} - z_0); \\ \sum_{t=1}^n \sigma_t^2 x_t^2 \leq \sigma_0^2 - s(\sigma_0^2 - \sigma(z)_{min}); \\ \sum_{n=1}^k x_n = Q_t; \\ z_0 > 0; \\ \sigma_0 > 0 \end{array} \right. \quad (10)$$

Solving equations (10) at each iteration of the model (4) will provide not only a plan for investment activity but also a plan for sales of manufactured products. This model should improve the accuracy of the results obtained.

V. PRACTICAL IMPLEMENTATION OF THE MODEL ON THE EXAMPLE OF A TRAVEL AGENCY

Consider the model described in the example of the travel agent "World Travel". Investments are made at the entity's own expense. It is necessary to determine the distribution of investment over time in the development of two rounds - Tour A and Tour B. The duration of the study period - 3 quarters. Net investment income is considered as a criterion for evaluating the economic efficiency of an investment project. Where $Pt = [117,124,136]$ is the price of realization of Tour A by quarters; $Ct = [85,96,104]$ is the cost of Tour A by quarter; $\mu = 0.18$; $na = 0.4$; $FA_0 = 25000$, $r = 0.18$; $f = 1,24$; $k 0.01$. (Fig. 3).

We use an investment strategy to develop Tour B. Where $Pt = [122,135,145]$ is the price of realization of Tour B by quarters; $Ct = [104,120,137]$ is the cost of Tour B by quarter; $\mu = 0.18$; $na = 0.4$; $FA_0 = 25000$, $r = 0.18$; $f = 1,24$; $k 0.01$. (Fig. 3).

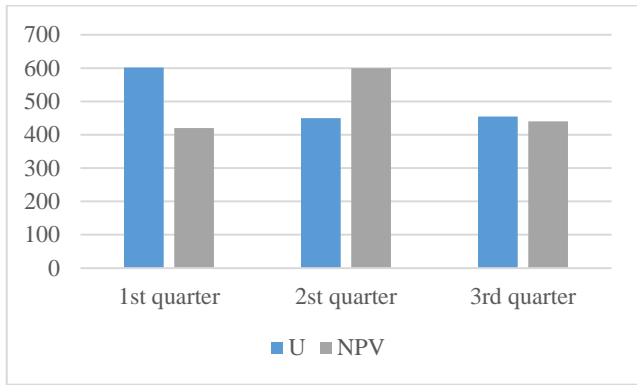


Fig. 3. Plan of investment activity in development of tour A.

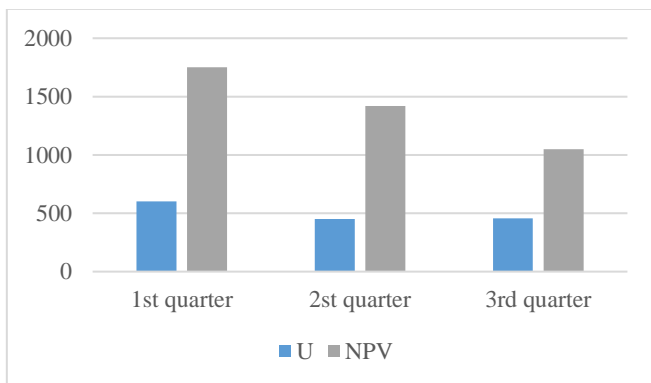


Fig. 4. Plan of investment activity in development of tour B.

Fig. 5 shows a graphical interpretation of the solution to the problem.

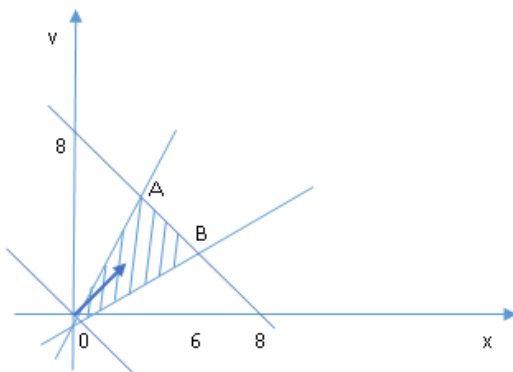


Fig. 5. Graphical interpretation.

VI. RESULT AND DISCUSSION

In this work, the investment strategy of activity of the travel agent is developed, depending on the received plan of realization of the developed tours. An economical and mathematical model, using a discrete maximum principle, reproduces the links between elements of the investment decision-making system in the context of price risks. Using the developed strategy, the optimal investment plan is built on the example of a travel agent. Using research results can prevent instability in the enterprise. Taking into account the stochastic nature of the demand for travel agency products is a direction for further research by the authors.

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