Keywords: marine transport processes; passenger flow; simulation; ferry network; cruise network; marine passenger port; logistics function; Baltic Sea; Adriatic Sea; ferry line; cruise market

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THE INFLUENCE OF EXTERNAL ENVIRONMENT TO THE FERRY LINES AND MARINE PASSENGER TERMINALS

Summary. Marine passenger ports are integrated into the transport systems of cities and regions today. If there are sufficient developed mathematical forecasting models in the class of polynomial models, probability series, and a number of others, then the models describing the influence of the external environment on ferry market are not sufficient. The developed scheme of interaction between the participants of the cruise market and the mathematical model of the port as a technical system is presented in this research. The article substantiates new purposes to use the logistic function to assess the external environment. A mathematical model and the derivation of the new basic equation of the logistic function for ferry market are given. Analytical data were collected on the ports and terminals of the Adriatic Sea and the Baltic Sea, and data were selected of ship calls at the passenger port St. Petersburg "Marine Facade" (2019–2020). The article proposes the consideration of new various proportionality factors that will determine the demand for cruise transportation modeling in the short-term forecasting interval. A complete mathematical model is given taking into account the real schedule of the sea passenger port. The logistic function proposed in the article allows us to solve the forecasting problem in a new way in relation to the selection and evaluation of a cruise product. Moreover, it allows us to solve a group of economic problems related to promotion problem for particular cruise product on the market, allows us to evaluate the activity of passengers when they are choosing a cruise product, and allows us to make adjustments to the planned port working schedules and to make timely adjustments. The main advantage of the proposed model is an analytical assessment of the effect of the external environment, both on passenger ports and on ferry and cruise companies.

1. INTRODUCTION

The market of marine ferry and sea cruises is the one of the most promising and rapidly developing markets for international marine transport. At the same time, there are significant dynamics of changes in route networks, work intensities, and strategies of marine companies for a particular region of the sea, such as the Baltic Sea and the Adriatic Sea. Nowadays, the Black Sea passenger ferry transportation market has begun to develop, route networks are expanding, and new ferry companies are being created. Transportation by ferries within the seas on the international market is the most demanded, as it allows passengers to be very mobile, traveling by their own choice of means of transport. The prevalence of short and medium routes determines the frequent movement of ships, a clear schedule which is supported by demand from passengers in the regions. The total number of ferry lines, for example, throughout the Baltic region is constantly growing [1, 2]. A large number of ferry lines includes domestic lines connecting parts of states with island territories, which also expands the transportation market. Sea ferries have become an inextricable marine chain among land routes in most countries. This factor is effective both in the Adriatic and in the Baltic Sea, where ferry lines are connected to the European continent through a thousand islands [3]. If we consider the Baltic region, the main incentive in the Baltic ferry market is the ports of Finland, Estonia, Russia, and their connections with other European countries in the region.

Today, in maritime transport, serious changes are observed, not only in route networks but also in development and promotion strategies on the market. In view of global trends reflected in the passenger terminal's desire to increase passenger flow, we have to increase the size of cruise and ferry vessels [4 - 6]. Moreover, we observed changes in the interests of passengers, in planning and management strategies, and the requirements for observing environmental standards. Such significant changes require the usage of new models and methods taking into account dynamic parameters. For example, today a high-speed ferry, the speed of which exceeds 30 knots or more, successfully competes with air transport in passenger traffic. New so-called "cruise ferries" are entering the market - heavy and comfortable, providing high-level service for passengers. If we consider systematically, the cruise industry is directly dependent on the interest of passengers, the interests and policies of particular city or region, the interests of passenger ports and terminals, and the interests of carriers. The increase in the number of passengers today is observed not only in the main cruise markets, such as the Mediterranean or the Adriatic Sea, but also in secondary markets, such as the Baltic Sea.

Let us consider another example. According to some sources [7, 8], MSC Cruises, the world's largest private cruise company, has announced plans to create a new cruise terminal in the port of Miami. The new terminal will provide high-quality customer service, both during boarding and disembarking guests on the MSC Cruises' cruise liners, and will significantly expand the company's presence in North America and the Caribbean. SC Cruises has received permission to design, build, operate, and maintain the building, which houses two cruise terminals (AA and AAA), as well as two cruise berths in the port. It means that the MSC Cruises' terminal in Miami will be able to receive two giant cruise liners at the same time, which will allow the company to serve a traffic flow of up to 28,000 passengers per day.

According to official data sources, there has been a significant increase in passenger traffic in seaports and terminals, which is also an indicator of increase of interest in this industry. If we consider all passenger ports of the Baltic Sea and Adriatic Sea, then, of course, the average amounts (trend) of passenger traffic still increase. According to the source of Eurostat Data [6] for passenger ports of Croatia, the following statistics are presented in table 1.

Table 1

Passenger traffic of Croatian sea passenger ports and terminals
(in thousands of passengers)

Region	2017Q3	2017Q4	2018Q1	2018Q2	2018Q3	2018Q4	2019Q1	2019Q2	2019Q3
Croatia	8 375	1 888	1 369	4 294	8 718	1 999	1 440	4 392	9 023
Dubrovnik	777	117	30	374	827	130	33	431	850
Split	2 190	591	445	1 212	2 369	625	452	1 242	2 493
Zadar	960	372	322	551	980	375	336	564	1 027

The graphical functions of changes (dynamics in time) of passenger flow for selected seaports and terminals in Croatia are shown in Fig. 1.

If we compare quarterly, we can see the average increase of 1.091-1.2 times, in relation to quarters. Similar dependencies (Fig. 2 and Table 2) were determined for the Passenger Port of Saint Petersburg "Marine Façade" (Saint-Petersburg), which is the first specialized sea passenger port in the Baltic region [9]. Passenger Port of Saint Petersburg "Marine Façade" (PLC) is an active participant of the global cruise market and appears regularly at international cruise industry events and exhibitions. The Port is a member of Association of Commercial Seaports, CLIA (Cruise Lines International

Association), Cruise Industry Members Association, Cruise Europe, and Association of Marine Tourism Enterprises. Currently, Passenger Port of Saint Petersburg includes six berths, place for border and custom's inspection, business center etc.

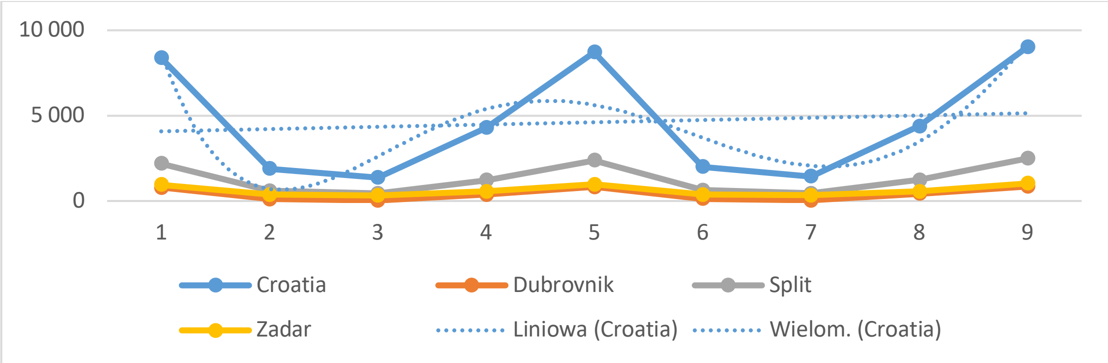

Fig. 1. The increase in passenger traffic for the sea ferry and cruise lines in Croatian ports from 2017 to 2019 year

Table 2

Passenger traffic of the Passenger Port of St. Petersburg " Marine Facade " (St. Petersburg)

Year	Passenger flow (pax)	Year	Passenger flow (pax)
2009	490110	2015	964818
2010	698044	2016	912990
2011	807492	2017	995757
2012	822714	2018	1091763
2013	965348	2019	1104479
2014	947674		

When constructing changes in passenger flow, a linear trend [10 - 12] of the second degree is presented owing to the linear nature of the increase in passenger flow. The forecast value for the next two years is presented on a diagram in fig. 2.

On a diagram in fig. 2, we can see the annual passenger flow values until 2020, and then graph of trend function is constructed. Based on data, the trend of passenger traffic remains to increase for marine passenger port St. Petersburg. Traffic and cruise route networks are also increasing.

The main profit in this market is coming from passenger transportation, from car transportation, from trade and services provided in ferry shops, from restaurants, etc. Today, associated logistic digital services, which accelerate the process of registration and purchase of tours, are bringing the profit, too.

Owing to the increase in passenger traffic, there is an increase in load on the port infrastructure. Passenger ports are affected by the environment. Under the influence of the external environment, for example, the tendency to build large new generation cruise and ferry liners, seaports, and terminals should increase the length of the berths. Otherwise, the cruise ship will not be able to moor and the city and region will lose profits. Here are few examples in the area of completing the construction of new ferry and cruise ships. According to the source [13], 2019 was a record year for the number of cruise ships launched by the end of the year; 24 new ships are scheduled to be launched. The largest sea-liner, which will be commissioned in November, will be Costa Smeralda with a capacity of 5,224 passengers. This liner will be the first one starting to work on liquefied natural gas, which makes it one of the most environmentally friendly liners in the world cruise industry. The Grandiosa MSC, a Meraviglia-plus class ship, also debuts in November. It will accommodate a little less than 5,000 guests. At the same time, these vessels are equipped with modern digital technologies. To accelerate the processing of passengers, Royal Caribbean Cruises introduces face recognition technology on the entrance of the liners so that the check-in process will be faster, improving the ship safety and operational monitoring.

On the contrary, decision-making models from before, for example, from five years ago, require significant adjustments. The work intensity has changed in the direction of accelerating processes. Today, it is necessary to develop new methods of planning and forecasting that should allow us to take into account both the influence of the external environment and the conditions that influence on passenger traffic. This article provides a solution to this practical problem using the logistic function and with inclusion of variables that determine the interest of passengers on a particular cruise, and the speed of buying tickets for a cruise or ferry ship.

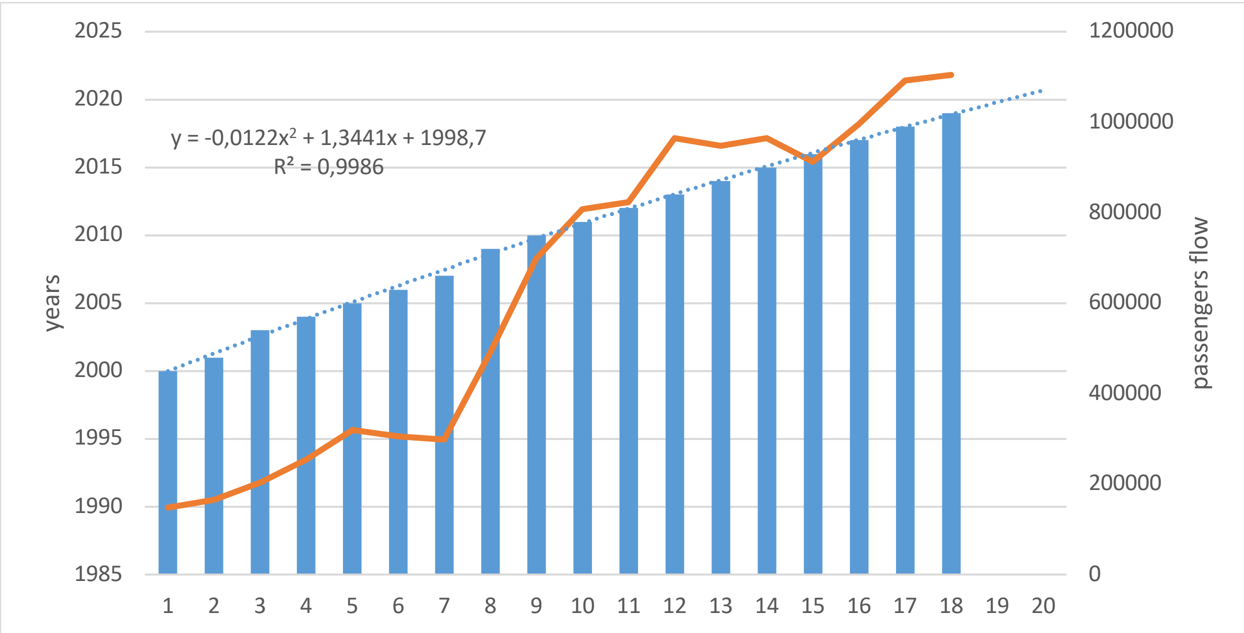

Fig. 2. The increase in passenger traffic of cruise and ferry lines for St. Petersburg from 2000 to 2019

2. MATHEMATICAL MODEL FOR WORK PLANNING OF A SEA PASSENGER PORT OR TERMINAL

The marine passenger terminal is a unique transportation facility. It is a point of convergence for both the land routes and the route network of carriers. The most important and very difficult task is to optimize processes in the passenger sea port or terminal, operational management, development planning, and forecasting for high-quality decision-making on infrastructure modernization and maintaining profitability. In view of the wide coverage of all issues related to socio-economic, transport and infrastructural, technical, organization activities, effective management, and consideration of the environmental impact, it is necessary to apply new models and methods based on systematic multi-criteria analysis of the study.

The marine terminal system is under the continuous influence of the environment, the global geopolitical situation, which greatly complicates the development of a long-term effective decision-making system for effective management and strategic long-term forecasting. The passenger sea port is a continuous system for which the port calls-in schedule is formed; delays and delays are possible, which introduce stochasticity into the system. The mathematical model of the processes of the sea passenger port as a technical system can be represented as a system of generalized second-order stochastic differential equations [14]:

$$F^{*}(Y,\dot{Y},\ddot{Y},\Lambda,t)=0, \quad (1)$$

where, when will we accept t=0 $Y(0),\dot{Y}(0)$ – vectors of initial conditions of system; $t\in[0,T]$ – research time interval; F^{*} – real nonlinear vector function of its arguments; $F^{*}=(F^{*}_{1},...,F^{*}_{n}), Y=(y_{1},...,y_{n}), \dot{Y}, \ddot{Y}$ – vectors of phase coordinates and their first and second order derivatives (time functions); $X=(x_{1},...,x_{n})$ – vector of parameters of random (stochastic) variables; and $\Lambda=(\lambda_{1},...,\lambda_{n})$ – vector of disturbing influences on the system.

The vector of disturbing influences on the system can be represented as a set of functions: the impact of the global economy, pricing policy, seasonality, interest among the population, competition between companies and terminals on the market in the sea region, the availability of logistics information services, and transport accessibility of each terminal. Theoretically, any process that directly affects the “sea passenger port - cruise company or ferry company” systems can be attributed to disturbing influences.

The active element of this system is the passenger with its target settings. The organization of the entire transportation system will directly depend on the behavior and choice of the passenger. Moreover, passenger behavior is difficult to describe by a set of classical equations. If at the micro level passenger behavior can be described by a set of models, such as models for traffic and passenger flows, proposed by Greenberg H., Greenshields B.D., and Daganzo C. F; model of attractive forces; models of queuing systems; and models based on cellular automata [15 - 17], then to solve the assessment problem at the macro level, a new approach is needed.

The generalized interaction scheme of the participants of the cruise market is presented in Fig. 3

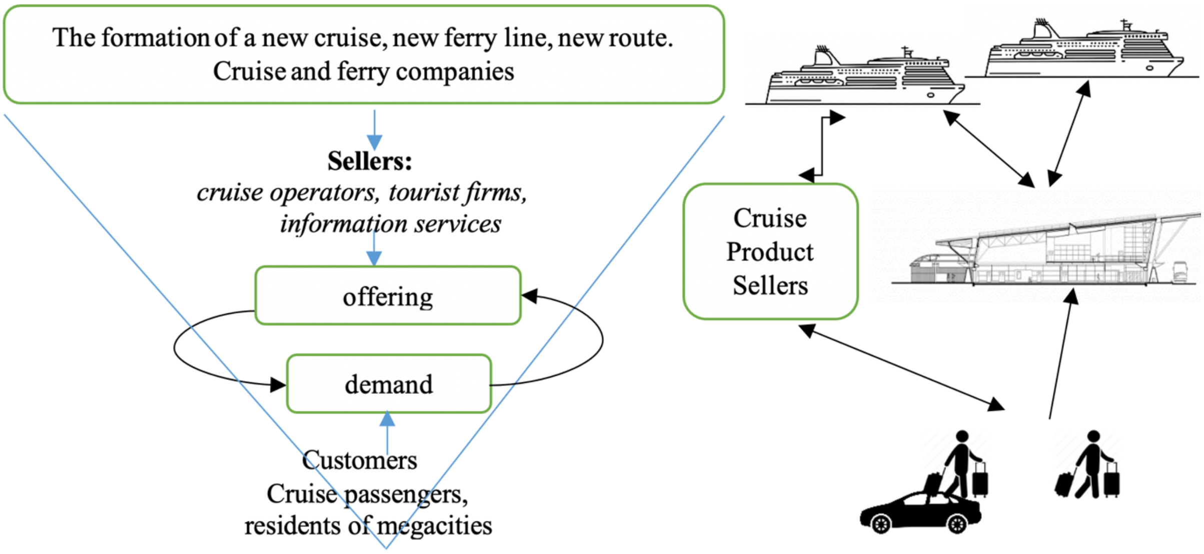

Fig. 3. Scheme of interaction of participants in the cruise market

Taking into account the mobility of the population during linear transportation by sea passenger transport (in figure 3, the passenger is shown with a car), the motivations for traveling of passengers are much broader: a change of residence, labor migration, a trip to another region (country) for a period of more than a year, visiting friends and relatives, etc.

To address the planning and strategic positioning of the sea passenger port in the region, it is necessary to use forecasting models and methods. The authors' article [18] presents a solution for positioning a passenger sea port based on Circos Graph pie charts. At the same time, seaport management should research developments and trends, as well as analyze new challenges.

The process of determining the trends and prospects of various states of the sea port system, which is based on the analysis of data on the past and present conditions, requires a large amount of analytical data. Analytical data determine some state of the port system at a selected point in time. One of the most significant characteristics when making a forecast is the forecast lead time (interval or period). By lead time, conditionally forecasts are divided into the following:

• operational (lead time is up to one month);
• short-term (lead-time is from one or several months to a year);
• medium-term (lead-time period is more than one year, but does not exceed five years); and
• long-term (with a lead period of more than 5 years).

Considering the need for forecasting, we present a diagram of the boundaries of the forecast tasks for the sea passenger port (Fig. 4).

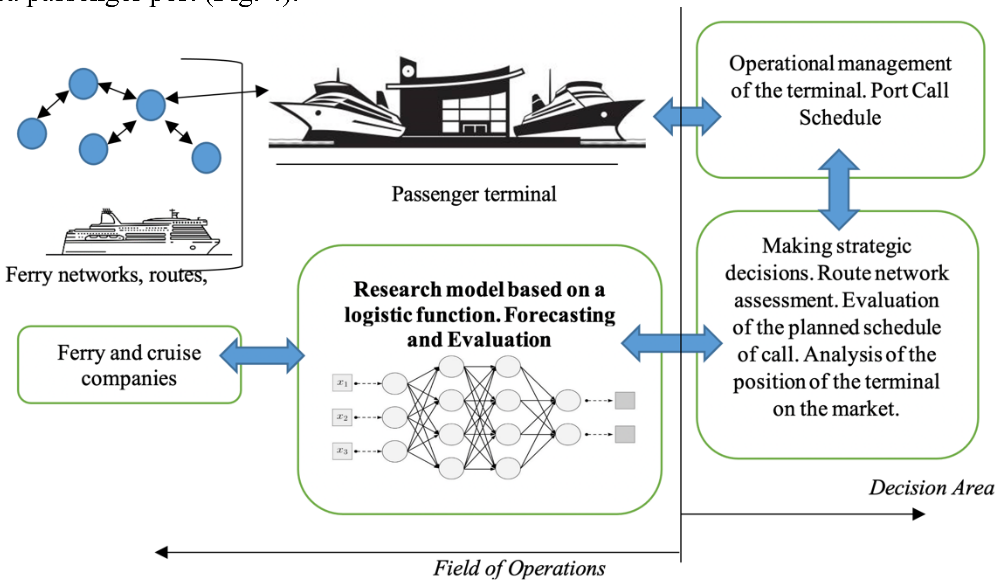

Fig. 4. Conceptual research model using the logistic function to predict the operation for both: the passenger port and the cruise line

The author's article [3] presents special model for forecasting of the new ferry or cruise route [19, 20] between different ports. But how can the leader or decision maker evaluate the market and passenger activity?

In this article, the usage of the logistic function is proposed to determine the dynamics of passenger flow. It allows us to connect the characteristics of the region with demands for ferry and cruise routes, and to determine the time of passengers' activity, with choosing of the appropriate existing cruise or new cruise from existing list of routes from terminal.

3. MODEL FOR RESEARCHING THE CHOICE OF CRUISES AND PASSENGER ACTIVITY BASED ON THE LOGISTIC FUNCTION

If decision maker will use a systemic point of view, the processes of creating a tourist cruise product could be represented in the form of some organization types:

- particular cruise tour;
- comfortable stay of a passenger on board;
- coastal tourist services in terminals and near-port infrastructure; and
- providing to the passenger both: stay on board the vessel and when passing through the terminal.

Based on the existing direct influence of the external environment on the system of marine passenger terminals, it is necessary to have a methodology for inclusion of this effect. If we consider the current state of the system, then it will consist of the following variables:

$$X_{i+1}(t) = X_0(t) \pm \lambda(t), t = 1,2,3,..,n \tag{2}$$

where it is $X_{i+1}(t)$ – new state of the port system: $X_0(t)$– some initial state accepted as a standard by the decision maker; $\pm\lambda(t)$ – taking into account the environmental influence factor, both positive and negative.

The cruise market is organized in such a way that it is more profitable for the user, the potential (future) passenger, to book a tour in advance. As the starting date of the tour is approaching, the price for the cabin will increase. Thus, the market encourages passengers to make decisions in advance, which affects the load on the cruise ship and the effective organization of the cruise itself. In some situations when the number of seats on the cruise was sold with insignificant number, the carrier company use to offer a cabin for another tour, which starts earlier or at similar time, where the percentage of filling of the cruise ship is greater.

It is proposed to take into account the influence of the external environment, so it is proposed to use an analytical model based on the logistic function. The proposal is based on the similarity of processes: saturation of a population group with some information. In fact, a logistic function or logistic curve [21], which models the curve of the growth of an event probability, as the control parameters change in time. The controlling parameters can be both risk factors and a strategy for promoting, in our case, cruise services in the market.

The logistic curve refers to *S-shaped* curves. Probability *P* should be interpreted as achieving the desired parameters, for example, filling (loading) ferry vessel, creating conditions for opening new ferry destinations. Suppose that, in some initial point in time, the information about a new cruise from the cruise company was only beginning to advance, and plans to include the marine passenger terminal in the route, the cruise on the defined route will be realized only if the threshold of at least breakeven were reached. The initial stage of growth corresponds to an exponential function, as the number of interested people who have uniquely chosen this cruise increases. Then, as it saturates, growth decreases and additional market mechanisms are required to attract new potential passengers.

The logistic function can be presented by the following relation:

$$P(t) = \frac{1}{1+e^{-t}}, \tag{3}$$

where is: *P(t)* – dependence on time function (search function); *t* – process time.

The situation about modeling of cruise information is as follows. The capacity set of a cruise or ferry ship is known. This value is constant and the function should strive for this number. For a given point of time, the route information begins to be formed. A cruise ship appears in the port call schedule. At each moment of time, the segment (number) of users who knows about the cruise can be represented as follows:

$$\begin{aligned}
&t_1 : N - x_1;\\
&t_2 : \left(N - x_1\right) - x_2;\\
&t_3 : \left(\left(N - x_1\right) - x_2\right) - x_3;\\
&\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\\
&t_n : ((N - x_{j-1}) - x_{j-2}) - x_{j-3}) - \ldots . x_{j-N})\\
&F(N - x_j) \to \max_t, t \in [t_0, t_s]
\end{aligned} \tag{4}$$

Function $F(N - x_j)$ - is a certain objective function, which strives to the maximum in time, which means the fastest selling tickets for a cruise. The time interval is assigned by the decision maker. Typically, decision maker can take as the initial point of time when the information about a new cruise was released. Then the speed of distribution of information about the cruise can be represented by the following system of equations, taking into account the transformations:

$$\begin{aligned}
&\frac{dx}{dt} = kx\left(N - x_1\right); \frac{dx}{x\left(N - x\right)} = kdt; \int \frac{dx}{x\left(N - x\right)} = \int kdt; \frac{1}{N}\ln\frac{x}{N-x} = kt + C;\\
&\frac{x}{N-x} = e^{Nkt+C}; x\left(t\right) = \frac{N}{1+Ee^{-Nkt}},
\end{aligned} \tag{5}$$

where *k* – proportionality coefficient; E – variable reflecting the character distribution curves of information, *E=(α–1)*; α - degree of communication between users (passengers) with each other.

Accept by default $\alpha>0$. As this function is dependent on many factors, it is necessary to research it separately as a function of time $\alpha(t)$.

Then we get the desired equation of the logistic function about the distribution of information about the new cruise in the following form:

$$X(t)=\frac{N}{1+(\alpha-1)e^{-Nkt}}, \tag{6}$$

When choosing about the logistic function for decision making of the cruise, we will not consider the values presented in the negative plane. Only values of $X(t)>0$ are taken into consideration.

Depending on the constant value, the nature of increasing public awareness about the cruise in the early stages is changing, but sooner or later, for any k = *cost*, the logistic function reaches a given level of saturation, which corresponds to the sale of cruise tours. Passengers will completely arrive to the terminal at the specified time.

4. INITIAL DATA FOR MODELING AND SOLVING THE FORECAST PROBLEM FOR FERRY ROUTES

According to the statistics of the Passenger Port of Saint Petersburg "Marine Façade, there is a significant increase of the passenger traffic and the intensity of cruise ships, compared to 2016–2017. To form the conditions for effective research related to the effectiveness of the usage of the logistic function for the marine passenger terminal, we will choose cruise and ferry line intensities as the basis for forecasting. Based on the analysis of port call schedules for 2019, passenger capacity was determined in Table 3. Based on this analytic information, decision maker can investigate the load of the terminal, then he/she can plan the terminal and, if possible, he/she can optimize it. It means that we can make a selection of various cruise and ferry vessels, including planned schedules of calls for 2020 year (this is presented in table 3 and in fig. 5). As it is planned, the first cruise ship «Sky Princess» should open the navigation and regular port operations on May 1, 2020.

Table 3

List of cruise and schedule of calls for ferry ships at the port for navigation in 2019/2020 at Passenger Port of Saint Petersburg "Marine Façade" for simulation and evaluation of the market and passenger activity based on logistic function

Cruise ship	Berths in port	Arrival – Departure time	Passenger capacity
Princess Anastasia	3	8:00 26.09.2019– 18:00 27.09.2019	2500
Viking Jupiter	7	7:00 25.09.2019 – 18:00 26.09.2019	944
Sky Princess	7	6:30 01.05.2020 –18:00 02.05.2020	4402

5. CALCULATION RESULTS USING THE LOGISTIC FUNCTION

The object of research, based on the logistic function, is the simulation and forecasting the various scenarios how to fill a cruise ship, choosing a cruise by passengers. Based on the simulation, the following graphs were obtained.

The time period is assumed to be the same for fixing a different reaction rate of a community, same as for a cruise product. Theoretically we can say, the same conditions and a constant economic situation are accepted for the whole short-term planning interval (period).

It is proposed to introduce the following coefficients - characteristics of the environment as shown in table 4.

To assess the activity of passengers, it is necessary to choose intervals for the proportionality coefficient K={0,1;0,3;0,4;0,7;0,9;1}.

Table 4

Correspondence of the proportionality coefficients to the characteristics of the society (community) environment (k – proportionality coefficient)

Change range	The characteristic of the distribution of information in society. Characteristics of market behavior strategies
$K \in [0– 0,4]$	Information about the new cruise is spreading slowly, without any jumps in the promotion of information. With this coefficient, passengers are not very interested in cruises.
$K \in [0,4– 0,6]$	Information is distributed evenly, also without any special jumps. For the same (equal) period of time, the same amount of new cruise packages is acquired. In community (society), there are a large number of people already interested in similar cruise.
$K \in [0,6 – 1]$	The cruise will cause great interest. Cruise tickets will be sold quickly enough. In community (society), there are many people interested in a such cruise.

The results of simulation are as follows:

1. For the ferry ship "Princess Anastasia" (Fig. 5)

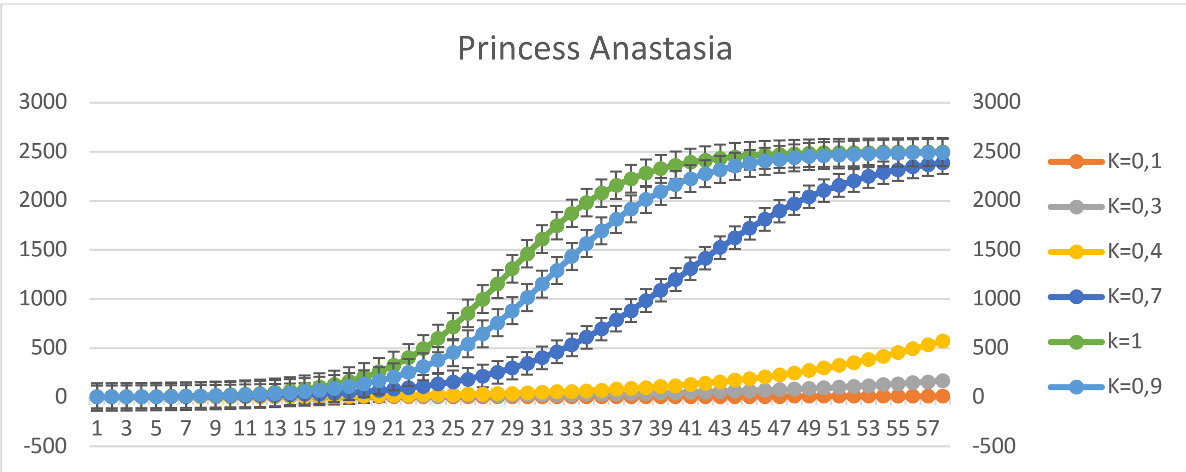

Fig. 5. Modeling the situation of the choosing the cruise with the "Princess Anastasia" ferry ship by passengers, filling it with various proportionality factors and environmental assessment

2. For the cruise ship "Sky Princess" (Fig. 6)

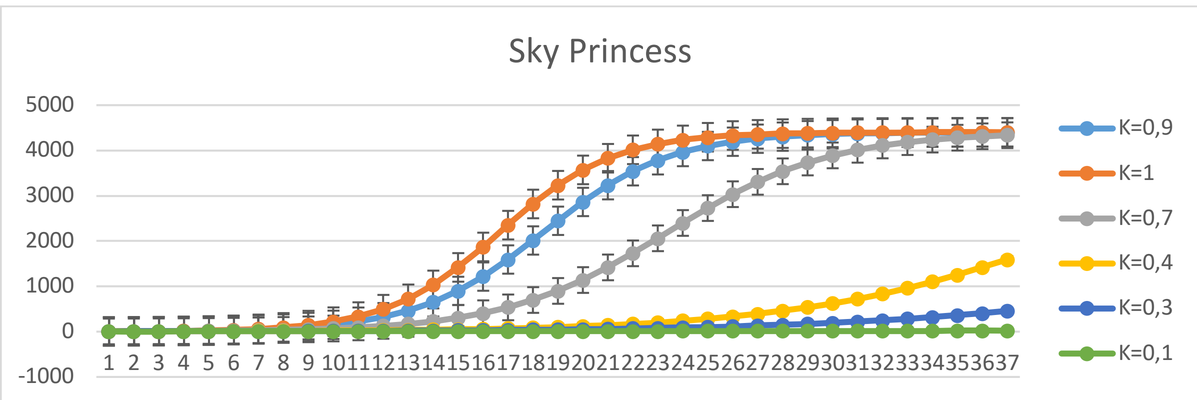

Fig. 6. Modeling the situation of the choosing the cruise with the "Sky Princess" ferry ship by passengers, filling it with various proportionality factors and environmental assessment

3. For the cruise ship "Viking Jupiter" (Fig. 7)

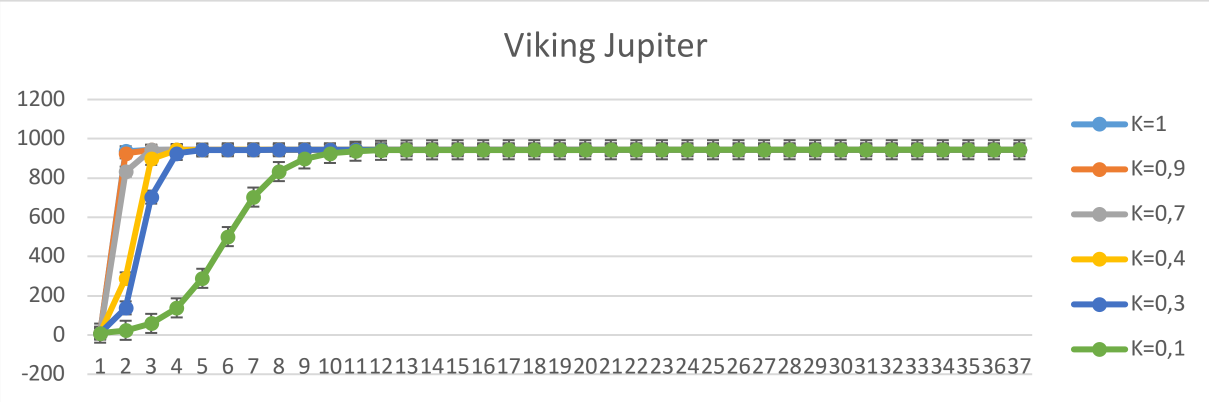

Fig. 7. Modeling the situation of the choosing the cruise with the "Viking Jupiter" ferry ship by passengers, filling it with various proportionality factors and environmental assessment

Due to the availability of the schedule of calls for all cruise and ferry vessels to the passenger port, the general mathematical model for all cruises will be as follows:

$$X(t)=(\frac{N_1}{1+(\alpha_1-1)e^{-N_1k_1t}}+\frac{N_2}{1+(\alpha_2-1)e^{-N_2k_2t}}+\frac{N_3}{1+(\alpha_3-1)e^{-N_3k_3t}}+\ldots+\frac{N_n}{1+(\alpha_n-1)e^{-N_nk_nt}}),$$

$$X_{marine\_passenger\_port}(t_i)=\sum_{i,m}^{N,M}\frac{N_N}{1+(\alpha_1-1)e^{-N_Nk_it_m}};k\in[0;1] \quad (7)$$

where, unlike the main formula, the presented formula has: $N_1, N_2, ..N_n$ – the number of passengers on each individual cruise equal to the capacity of each vessel; $K_1,..,K_n$ – proportionality factors representing interest of passengers in each individual cruise.

In variant of non-fulfillment of the cruise, cancellation of the call at the passenger sea port, the corresponding element is assigned as negative value.

Consider, for example, the situation presented at the official source [22] of Norwegian Cruise Line. The cruise company canceled all cruises until April 11, 2020. Starting April 12, the company plans to resume all scheduled cruises. For tourists with canceled cruises, Norwegian Cruise Line offers 2 options:

Certificate of 125% reimbursement of the fare in the form of a future cruise is offered. A loan that can be applied to any future cruise until December 31, 2022.

To the tourists, who do not want to use the Future Cruise Credit Certificate, it will be returned 100% of the paid fare. Funds will be returned within 90 days after filling out the refund request form.

In similar situations, the cancellation of cruises can be quickly included in the decision-making process on adjustment of the passenger loading in the sea port.

If the cruise or ferry selection process can be presented as the model with discrete function, then decision makers (passengers) are selected with individual discrete values. In the case that some cruiser/ferry ship is filled by passengers at certain points of time, then the speed of this process and its dynamics can be determined (Fig. 9).

Based on the model in form of logistic function and practical simulation, the following conclusions can be drawn:

1. Cruise on passenger ship "Viking Jupiter" is in high demand. The cruise route will take place and upon re-entry to the market will also be popular.
2. Due to the large number of passengers, cruises on "Sky Princess" and "Princess Anastasia" ships take longer to fill with passengers. In this case, there is a likelihood of negative environmental effect in which cruise ships will be incomplete. In this case, the question about the economic efficiency of the route will arise.
3. Analytical studies were carried out under the same conditions, related to variables and environmental factors.

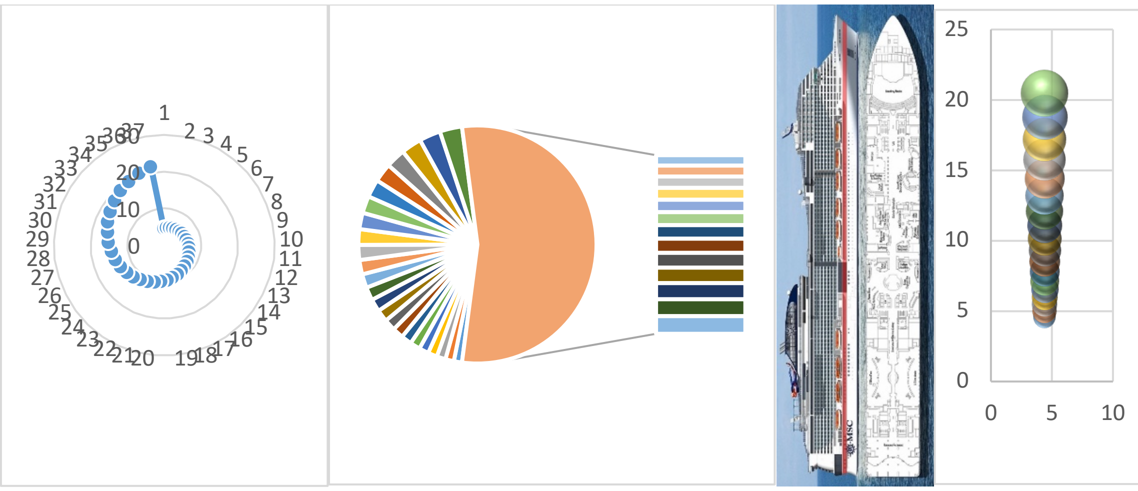

Fig. 8. With graphical functions, based on the logistic function, we can determine the speed of the cruise ship's filling by passengers for the cruise ship "Sky Princess"

6. CONCLUSION

In the aspect of the practical use of data from the use of the logistic function, the obtained forecast values are included in the characteristics of the state of marine passenger port systems. Based on the obtained values, an analysis of the forecast for the implementation of the cruise route can be performed. Thus, it is possible to answer the question: is it objective that routes can be implemented through the passenger terminal on the basis of applications only? The cruise route can be canceled and then the system will incur losses and downtime. On the contrary, by the number of calls made on cruise routes, it is possible to determine the tourist attractiveness of the region.

Using this model, you can answer the following questions important for work planning, forecasting development, and evaluating trends in the transportation market:

– in the process of forecasting and launching of the new cruise route, you can determine how popular the route will be;
– as the result is a function of time, it is possible to perform monitoring and determine at what point of time and how many potential people will book a route;
– based on the logistic function of the distribution of information in the environment, you can choose strategies for promotion of a cruise product on the market;
– it is possible to carry out modeling of various states of the regional economic system;
– decision maker can determine the activity of the population and its interest in new cruise and ferry routes;
– based on the planned schedule of calls, you can make an adjustment with the condition for possible cancellation of the cruise;
– this method can evaluate the effectiveness of logistics in the field of cruise and ferry services.

This method allows us to evaluate the influence of the external environment on the system of passenger ports and ferry companies. Based on this model, decision maker can make corrections to the decision-making system, and can achieve much greater reliability. The presented model is correct for micro, macro, and mezzo levels of transport planning for marine passenger terminals and ferry companies.

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Received 22.07.2019; accepted in revised form 03.12.2020