UDC 656.71:005.52(043.2)

**K. A. Turchyna**
*Student of Faculty of Transport, Management and Logistics,*
*National Aviation University*
**D. V. Medynskyi**
*Assistant of Faculty of Transport, Management and Logistics,*
*National Aviation University*

# MODELS THAT TAKE INTO ACCOUNT THE MAIN FACTORS OF FORECASTINGIN AIR TRANSPORT

In long-term forecasting, it is necessary to take into account the nature of the factors that determine the quantity-demand. Where it is necessary to carry out a complete analysis of demand, the forecasting methodology should include the following steps:

- examining trends in the past;
- identification of external factors that act as substitutes for the main factors, causing changes in the level of demand for air travel;
- collection of initial data characterizing the socio-economic situation of the population, the nature of the area and its development;
- establishing a form of relationship between expected variables and levels of demand for air transportation, including changes in these levels;
- forecasting expected levels of external factors in the project year;
- forecasting the future levels of demand for transportation at the established levels of external factors [1].

*Market analysis.* In market analysis, it is usually assumed that the share of air travel among other modes of transport is constant over time. The total aggregate national demand for transport transport remains for a given period, straightforwardly determined using the trend forecasting method or the cross-classification method (categorization method). In short-term forecasting, the assumption that the total market share is constant can be considered quite reasonable. However, as economic demographic conditions change, the analyst may be less optimistic about the accuracy of this assumption [2].

*Regression analysis.* In the case of applying the method of regression analysis to air transport, a statistical relationship is established between the growth rate of the generation of air flights (dependent variable) and a number of predicted independent variables. Regression analysis is usually performed using raw data characterizing the generation of air flights and statistics on demand levels and their changes depending on the socio-economic data of the area and the physical characteristics of the general air-ground transport system at the point of origin and destination. By applying correlation analysis, factor analysis, or other multivariate statistical methods, the appropriate variable values are selected that best suit the simulation of air flight generation. Regression models can then be built to describe the relationship between the dependent and independent variables. These models are used to predict the generations of air flights in the future.

Usually the mathematical model is written in the following form:

$$T = a0 + alxl + a2x2 + ... + anxn \tag{1}$$

where T - the predicted number of generated air flights (response function); a0,…a*n* - regression coefficients; X1,…X*n* - are independent variables or factors influencing the investigated response function.

Models of this kind are suitable for forecasting both on a local and national scale. When determining the volume of transport traffic, it is generally accepted to take into account the following factors most often: population size, financial situation, occupation and the convenience of passengers entering the airport.

As an example, below is a mathematical model for predicting the total number of flight (trip) generations at an airport, developed in the state of Virginia:

$$\ln\frac{Ei}{Pi} = 10{,}8 - 0{,}172Fi + 1{,}41\ln li \tag{2}$$

where $Ei$ - is the expected number of passengers carried in i-m airport; $Pi$ - is the population size in the i-th district; $Fi$ - the average cost of a flight per 1 mile in the USA; $Ii$ - profit per capita in the $i$-th region.

Air traffic volume elasticity:

$$da / A = kidFi / Fi \tag{3}$$

where $A$ - air traffic volume; $d$ - increase in the volume of air traffic; $ki$ - where the coefficient of elasticity of the volume of air transportation from the $i$-th factor; $k\ i\ \ F\ i$ quantitative characteristic of the $i$-th factor; $ki\ dFi$ - is the increment of the factor attribute.

The coefficient of elasticity of the volume of air transportation is calculated:

$$ki = \frac{dA}{A} / \frac{dF3}{F3} \tag{4}$$

where $F3$ - is the increase in the average income of the population.

Flight distribution models between a specific pair of airports. The most widely used in solving such a transport problem is the weight model. The use of the weighted model makes it possible to determine the number of trips between a pair of flights, which makes it possible to predict the exchange of the size of their specific cities (attractiveness), taking into account such constraining factors as the cost of matching the attractiveness of travel, time [3].

By the beginning of 1943 the legitimacy of using a weight model to predict the exchange of air flights between cities was proved.

The model was as follows:

$$Tij = \frac{kPiPj}{d\frac{x}{y}} \tag{5}$$

where $Tij$ - is the number of passengers traveling by air between cities $i$ and $j$; k - is the proportionality factor; P$i$ - is the population of the city of departure; P, population of the destination city; d$ij$ - is the distance between cities $i$ and $j$; $x$ -mis a constant coefficient.

It was found that the value of $x$ changes from 1.3 to 1.8 if the distance between cities is taken as the factor constraining travel. Other forms of models have also been developed for the case when other parameters, rather than distance, are taken as a constraining factor.

When used as a deterrent to the cost of the flight, the following model was obtained:

$$Tij = \frac{kTiTj}{c\frac{x}{y}} \tag{6}$$

where T$i$ – is the total number of air flights generated in the $i$-th city;
$k$ - proportionality factor;
T$i$ - is the total number of air flights generated in the j-th city;
C$y$ is the cost of a flight between cities $i$ and $j$;
$x$ - is a constant coefficient.

In a statewide study of airline air travel, it was found that this model can only be used when the distance between city pairs is less than 1,280 km. At long distances between cities, the volume of traffic does not depend on the cost of the travel distance, but depends only on the level of travel generation at each node. For air flights over long distances, the shape of the model may look like

$$Tij = k(Ti - Tj)^p \tag{7}$$

where $p$ - is a constant parameter.

A modified form of the weight model was developed by the British Airports. Authority for the Western European Airports Association:

$$Yit = ai(Fit)^{ai}(lit)^{\beta i}(l + \gamma i)^{t-1} \tag{8}$$

where $Yit$ - is the number of air flights of the i-th category performed in the (th year; B i is the category of the flight, set taking into account the purpose of the flight (business or vacation), place of residence of the passenger (resident of Europe or not) and flight range(near or far); $a$ - is the regression parameter; $F$ - is the real cost of tickets in the *t*- th year; *I* - is the real profit in the 1-th year; *y* - is the autonomous trend; $\alpha$ - coefficient of elasticity of demand, taking into account changes in the cost of travel; $\beta$ - coefficient of elasticity of demand, taking into account changes in profits.

The coefficient of elasticity shows the ratio of the change in percentage of one feature (air travel) with a 1% change in another feature (income of the population). According to the coefficient of elasticity, one can determine the possible change in the volume of traffic in the billing period according to the dynamics of income [4].

The coefficient of elasticity varies from time to time, therefore We need to use this model with caution in forward-looking forecasting, especially when economic conditions (e.g. tariffs) change. Determination of the coefficient of elasticity associated with the processing of a large amount of statistical information, which, as a rule, does not reflect the actual demand for air transportation. Therefore, the forecast results will have an error, the degree of which is difficult to quantify due to the lack of data on dissatisfied demand.

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