

## **TARIFF ANALYSIS OF URBAN TRANSPORT ENTERPRISES IN DIFFERENT CITIES**

**Zhang Min, Gorovyi D.A.**

*National Technical University «Kharkiv Polytechnic Institute», Kharkiv*

A hypothesis was proposed to analyze tariffs that the tariff size depends on the area of the city and its population. For the analysis, it was selected over 100 transport companies in different world cities. They have both common fare for all types of transport (i.e. all urban transport operated by a single company), and different transport types are operated by different carriers. Totally, more than 100 different tariff plans were considered. The criteria for city selection was the internet data availability, a representation of different continents and a presence of extensive urban transport system. For example, the African cities (Johannesburg, Algiers, Cairo, Alexandria, Nairobi and Lagos) were removed from the selection because of the urban transport clear system lack (the majority of urban transportation is conducted without a clear fare system by route taxi).

Since in each city there are simultaneously different fares according to their tariffs, the minimum fare in each tariff was chosen for the study. Therefore, all types of tariffs were included (single, sectional, time, zone, even free tariff of Luxembourg), while the minimum value was taken from each tariff. Data were collected from internet. This is due to the need to bring the fare to a single rule, since the time, zone or sectional fare already takes into account the distance in the fare. In addition, a special fare (for example, for a trip to the airport) can be fundamentally different from the rest of the fare step in the city. All fares in national currencies were changed into Euro due to the rate of currencies in January 2022 according to [1]. In addition cities' square (area) and population were added. Square and population was taken from open data in Wikipedia [2] for mainland territories without suburbs and water territories. A three-dimensional graph was built using MS Excel 2016 with analysis package, in which the axes are the area of the city (X-axis), the population (Y), and the size of the bubble indicates the size of the tariff. It shows that there is a "core of tariffs" that can be posted and processed (Fig. 1). In addition, the correlation fields tariff on square and population were plotted, and at the same time a trend line was built (Fig. 2). For its construction, a function was chosen that provides the maximum reliability of the approximation.

Since the construction of the correlation fields on the general graph did not allow us to identify the dependence with a high coefficient of approximation reliability, there was proposed to cut off the results that are far from the "core of the group" (standard deviation of more than 33%) and analyze the core indicators.

Although this proposition increase the coefficient of approximation for trends of both graphs up to  $R^2=0.1799$  only.

So, for future analysis it is proposed to take into account the volume of minimal salary in the country [3] with its transition into Euro or to build the correlation fields for each tariff type (single, sectional, time, and zone).

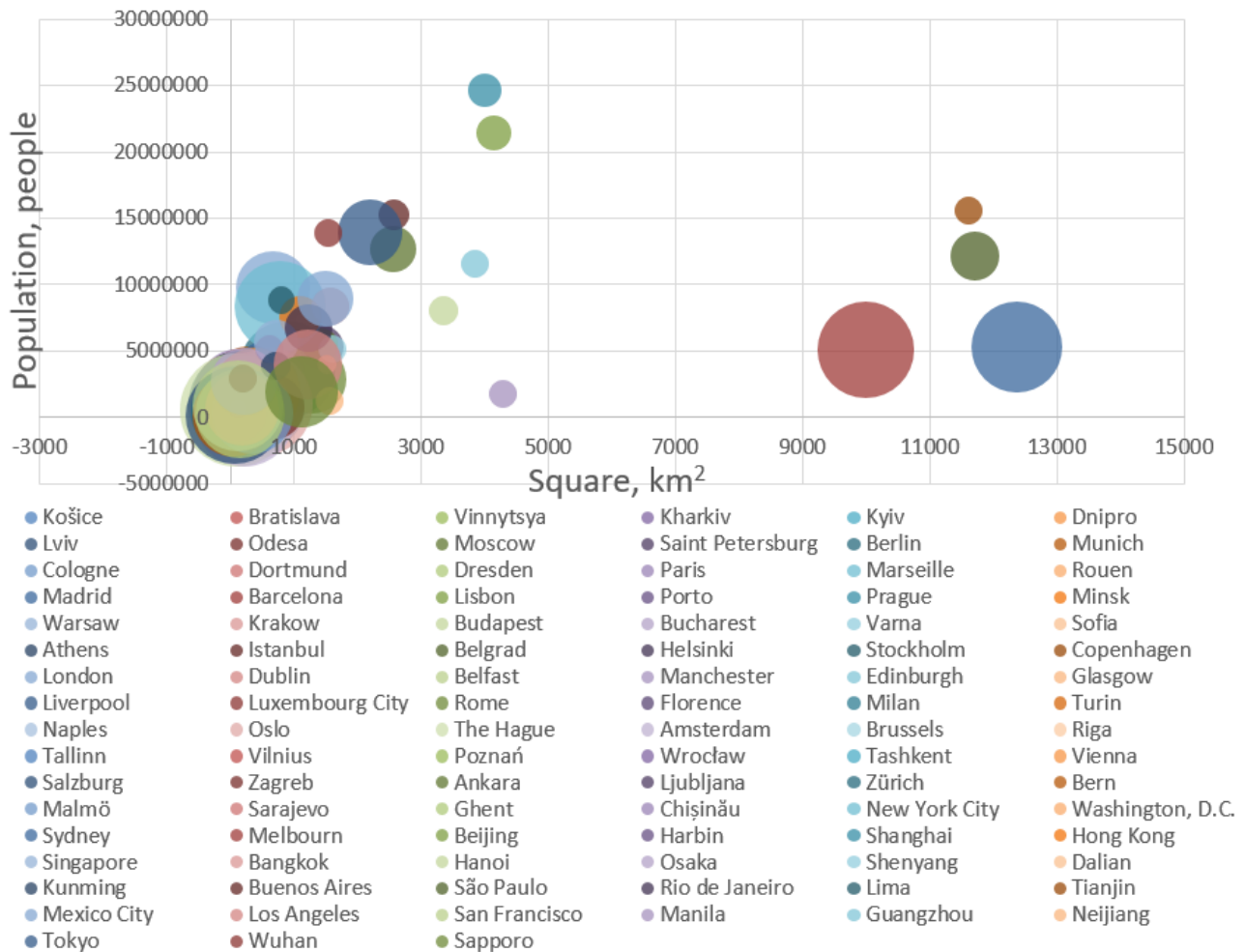


Fig. 1 – Tariff dependence on city's square and population

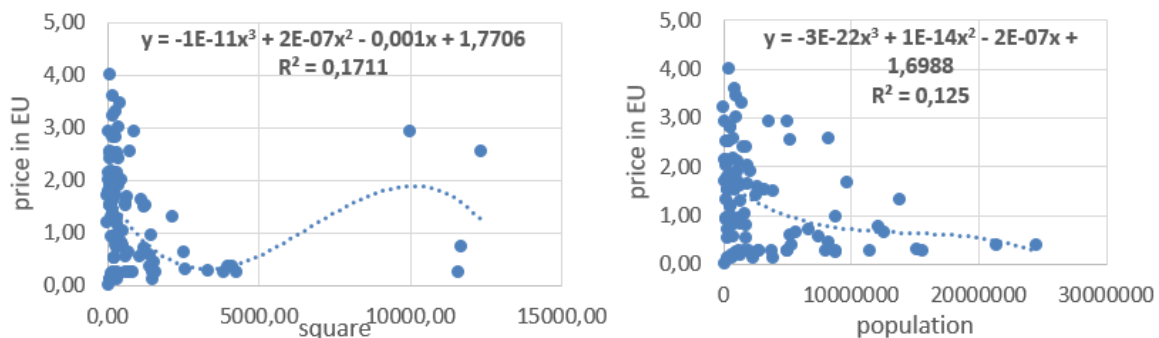


Fig. 2 – Correlation fields and their equations

#### References:

1. Xe Currency Converter. URL: <https://www.xe.com/currencyconverter/convert/>
2. Wikipedia. The free encyclopedia. URL: <https://www.wikipedia.org>
3. Counryeconomy.com. URL: <https://countryeconomy.com>