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A MATHEMATICAL-STATISTICAL EVALUATION OF CULTURAL TOURISM DEMAND AND OFFER - A CASE STUDY ON THE ATTRACTION OF THE MUSEUMS AND ITS ECONOMIC IMPACT IN BULGARIA

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Abstract

The current article presents a mathematical-statistical evaluation of cultural tourism demand in Bulgaria in terms of museum visits by region in the period 2013-2022. In parallel, the information related to the number of museums and exhibits is also examined. These indicated data are stored in a built relational database. The necessary information, for each of the six regions considered, is searched and extracted from it. Three sets of indicators are calculated and evaluated in connection with the subsequent processing of the studied elements. Hierarchical cluster analysis is also applied to the surveyed data. The results show that the pace of growth of the indicator (museum visits) in five of the mentioned regions is relatively fast in 2021-2022. The studied indicator decreases only in the North-West region during 2021, but there is an increase of about 24% in 2022. In the time interval 2016-2022, the number of museums does not change. The situation for this indicator in the period between 2018- 2022 is similar for the North Central region. The number of museums grows by about 26.67% and 12.50% for the South-East and South Central regions, respectively, in 2022. The largest number of exhibits is in five regions in 2022. Grouping the regions according to the number of museum visits presents two clusters. Grouping the regions according to the number of museums and exhibits leads to forming three and four clusters, respectively.

***Key words*:** *database, mathematical-statistical evaluation, museum visits, regions, time series*

INTRODUCTION

Tourism is a driving force in the Bulgarian economy, according to Penchev P. and Kenarova-Pencheva, I., 2018 [11]. The significance of cultural tourism for the overall development of the tourism sector is indisputable (Todorova L., 2018 [14]). The study of Vasileva V., 2010 [15] notes also that the growing popularity of cultural tourism today is connected with the overall increase in the educational level of the population [15].

Cultural tourism, and in particular museum visits, is not only an indicator of cultural engagement but also a reflection of broader social and economic dynamics. Exploring these trends provides valuable insights for cultural institutions, and researchers aiming to enhance the role of museums as drivers of sustainable tourism development.

The current work investigates data from a time series of museum visits in Bulgaria. They are presented on the website of the Bulgarian National Statistical Institute (NSI) [9], [10]. The information on the number of museums and exhibits [9], [10] is also examined. These data from time series are extracted from the website of the indicated organisation. The above-listed elements are organized in a relational database containing the following eight tables:

- Districts (id_d, district, id_r);
- Museums (id, visits, exhibits, id_d, year, number);
- Personnel (id, total, researchers and curators, id_d, year);
- Regions (id_r, name, id_c);
- Revenues (id, total, year, id_r);
- Expenditures (id, expenditure, year, id_r).
- Country (id_c, name);
- Summary_objects (total number, year, id_c).

The data on respective revenue, expenditure and personnel of the museums by regions in Bulgaria is saved in the following three tables: Revenues, Expenditures and Personnel.

The Districts table is related to two tables - Museums and Personnel. The Regions table is related to three others - Districts, Revenues and Expenditures. The Country table is related to tables Regions and Summary_objects. The relationships between the mentioned tables are of one-to-many type.

Information from the relevant database tables can be used to explore regional differences and factors influencing museum visits.

The database can be updated [7], [1] annually by entering new objects [2], [3] into indicated tables. It should be pointed out that there are cases when it is also necessary to design new tables [4], [12].

The current article aims to present a mathematical-statistical evaluation of museum visits data by region in Bulgaria. By focusing on quantitative analysis, the study seeks to reveal regional trends and key factors influencing cultural tourism, ultimately offering actionable insights for cultural and economic policymakers.

MATERIALS AND METHODS

The created relational database is the source from which the examined data is searched. The studied period covers ten years, from 2013 to 2022. The indicated data concerning museum visits by regions (North-East, North-West, North Central, South-West, South-East as well as South Central) in Bulgaria are extracted from four database tables (Country, Regions, Districts and Museums). The information related to the number of museums and exhibits is also searched from the listed tables. In connection with the subsequent processing of the considered elements, the following three sets of indicators are calculated and evaluated for the mentioned six regions:

Tourism demand for visiting museums (X, S, C, L, Q, V)

- $X_p = x_{p1} + x_{p2} + ... + x_{p5}$;

$S_p = s_{p1} + s_{p2} + ... + s_{p4}$;

$C_p = c_{p1} + c_{p2} + ... + c_{p5}$;

$L_p = l_{p1} + l_{p2} + ... + l_{p5}$;

$Q_p = q_{p1} + q_{p2} + ... + q_{p5}$;

$V_p = c_{p1} + c_{p2} + ... + c_{p4}$;

where X_p, S_p, C_p, L_p, Q_p and V_p - the sum of museum visits in the districts of each of the considered regions - North-West, North-East, North Central, South-West, South Central and South-East region respectively, for p-th year; $p = 1 \div 10$;

Tourism offer of museums (Y, A, D, W, N, U) and exhibits (Z, B, F, J, T, R):

- $Y_p = y_{p1} + y_{p2} + ... + y_{p5}$;

$A_p = a_{p1} + a_{p2} + ... + a_{p4}$;

$D_p = d_{p1} + d_{p2} + ... + d_{p5}$;

$W_p = w_{p1} + w_{p2} + ... + w_{p5}$;

$N_p = n_{p1} + n_{p2} + ... + n_{p5}$;

$U_p = u_{p1} + u_{p2} + ... + u_{p4}$;

where: A_p, Y_p, W_p, D_p, U_p and N_p - the total number of museums for the considered districts from the respective regions (North-East, North-West, South-West, North Central, South-East and South Central) during a given year of the time interval; $p = 1 \div 10$;

- $Z_p = z_{p1} + z_{p2} + ... + z_{p5}$;

$B_p = b_{p1} + b_{p2} + ... + b_{p4}$;

$F_p = f_{p1} + f_{p2} + ... + f_{p5}$;

$J_p = j_{p1} + j_{p2} + ... + j_{p5}$;

$T_p = t_{p1} + t_{p2} + ... + t_{p5}$;

$R_p = r_{p1} + r_{p2} + ... + r_{p4}$;

where: B_p, Z_p, F_p, J_p, T_p and R_p - the total number of exhibits in museums for the districts in the respective regions (North-East, North-West, North Central, South-West, South Central and South-East) for p-th year; $p = 1 \div 10$;

The current work investigates the pace of change [8] of the variables from these three mentioned sets for the considered regions from 2013 to 2022.

The percentage change in the number of museums and exhibits, number of museum visits and museum personnel, as well as the revenues and expenses of museums for each year of the period compared to the previous year is calculated. The aim is to assess these 6 indicators in order to track the development of cultural tourism in the country.

Hierarchical cluster analysis [5], [6], [13], [16] is applied to the obtained information about museum visits, number of exhibits and museums by regions in Bulgaria. The presented results are discussed and summarised.

RESULTS AND DISCUSSIONS

The necessary data for calculating the indicators from the above sets are searched and extracted from the database.

Tourism demand for visiting museums by region

Graphical analysis of the data shows that in the North-West and North Central regions, a smooth increase in variables X_p and C_p is established until 2019 (Fig. 1). The variable S_p related to the studied information for the North-East region increased intensively (over 1.3 times) until 2016, after which its values gradually increased in the period 2018-2019.

As a result of the performed calculations, it can be summarised that the museum visits in the North-West, North Central and North-East regions increased by about 24.10%, 25.79% and 37.19% respectively, for these 7 years.

During the first three years of the surveyed period, a specific decrease in the values of V_p is observed in the South-East region. However, the growth pace of this variable is relatively smooth in the time interval 2014-2019.

Overall, it can be noted that the museum visits in the indicated region in 2019 are about 0.6% smaller compared to those for the first year (2013) of the examined period.

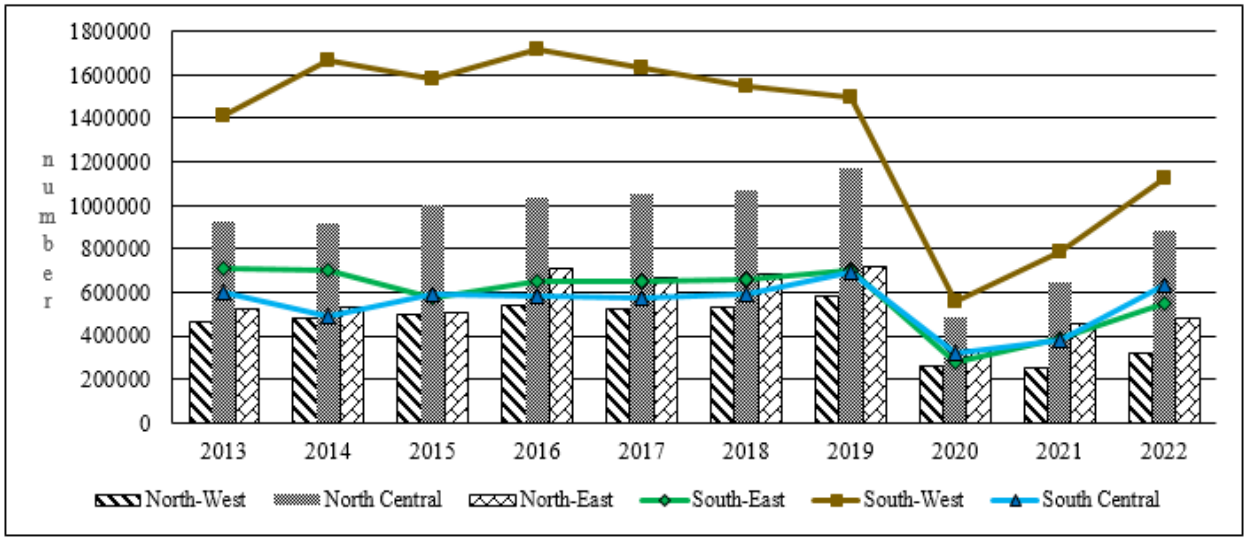

Fig. 1. Results for the museum visits by regions during 2013-2022
Source: Own calculations based on the data from NSI [9, 10].

The obtained results for the following two variables L_p and Q_p are also analyzed. The first of them L_p increased in 2014 and 2016. A decline is observed between 2017 and 2020. In this case, the museum visits in the South-West region during the mentioned four years continuously decreased (Fig. 1). A decrease in the values of the second variable Q_p is obtained in three non-consecutive years: 2014, 2016-2017. However, the reverse process was observed in 2018-2019. Here, the pace of growth for museum visits in the South-West region for these two years is relatively fast.

As can be assumed, the studied indicator (museum visits) for the six regions is significantly reduced in 2020. This is the time segment where the Covid-19 pandemic has already appeared. In the next two years, the pace of growth of the mentioned indicator in five regions (North-East, North Central, South-West, South Central and South-East) is relatively fast. It should be noted that this indicator only in the North-West region is

reduced during 2021, but in the next year, an increase of about 24% is obtained.

Tourism offer in terms of number of exhibits and museums by region

Offer in terms of the museums number

The processed data from the second studied subset concerning the total number of museums are presented in Fig. 2. The variable Y_p does not change in a 7-year period from 2016 to 2022. In this case, the number of museums remains unchanged for the indicated time interval in the North-West region.

The situation is similar to the other studied variable D_p in the period from 2018 to 2022 for the North Central region.

The change in the two variables A_p and W_p is significant at the end of the considered time segment. In this case, a reduction in the number of museums is established. The decline of the studied indicator is about 31.25% for the North-East region and 21.15% for the South-West region (Fig. 2).

An entirely different situation is observed for the studied data concerning two other regions. The values of the variables U_p and N_p have an inevitable increase.

The examined indicator (number of museums) increases by about 26.67% and 12.50% for the South-East and South Central regions, respectively, in 2022 (Fig. 2).

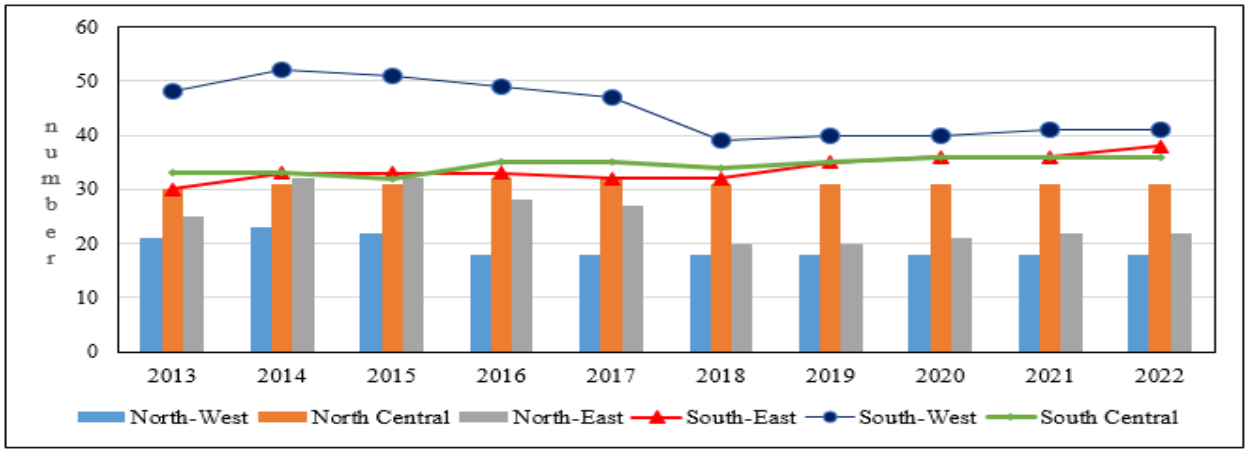

Fig. 2. Results concerning the examined indicator - number of museums
Source: Own calculations on the basis of data from NSI [9, 10].

Offer in terms of the number of exhibits in the studied museums

The obtained results for the values of the considered variables (Z_p, B_p, F_p, J_p, T_p and R_p) from the third group show that they are constantly changing in the segment 2013 - 2022. In this case, they increase and then decrease for specific years or vice versa (Fig. 3). Therefore, the number of exhibits during the mentioned 10-year time interval in the studied regions constantly varies. In addition, it should be noted that the number of exhibits in 2022 is the largest in the five surveyed regions.

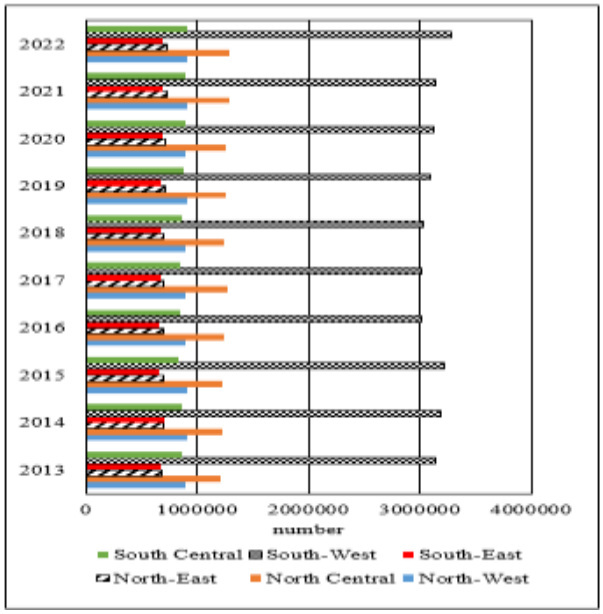

Fig. 3 The change in number of exhibits in the museums by region for the period 2013-2022
Source: Own calculations based on the data from NSI [9, 10].

In this case, they are North-West, North-East, North Central, South-West and South Central regions.

However, the most significant value of the indicator (number of exhibits) for the South-East region is obtained in 2014 (Fig. 3).

The decline of this indicator for the mentioned region at the end of the examined period is about 3%.

Evaluation of the development of cultural tourism in the museums

The article studies the dynamics of cultural tourism in the interval 2013-2022. In this connection, the percentage change of six indicators for each year of the time period compared to the previous one is calculated. These indicators include:

- number of museums.
- number of exhibits in museums.
- number of museum visits.
- number of museum personnel.
- revenues of museums.
- expenditures of museums.

Summarizing the results of Table 1, it can be seen that the change in two of the indicators (number of exhibits and personnel) is relatively smooth. They grow almost throughout the studied period. The values of the both variables decrease only in two of the considered years. For the first indicated variable, the interval includes 2014-2015, while for the second these are the years 2015 and 2020.

The pace of growth of the next variables - revenues and expenditures of museums is relatively faster, especially in the segment 2021-2022. But it should be pointed out that during 2017 compared to 2016, the expenditures of museums decreased by 10.03%. The calculations also show that in 2020 compared to 2019, the revenues of museums decreased by about 4.51%.

In general, a certain decline in the number of museums is observed for the time interval from 2015 to 2018. Over the next four years, the increase in the values of this indicator is gradual , as can be seen from Table 1.

Table 1. Percentage change of the examined six indicators during the considered time period

Year	Museums (%)	Exhibits (%)	Museum visits (%)	Revenues (%)	Expenditures (%)	Personnel (%)
2014	9.09%	1.93%	2.97%	2.93%	5.53%	8.60%
2015	-1.47%	-0.79%	-0.37%	13.59%	9.51%	-2.74%
2016	-2.99%	-2.39%	9.79%	12.52%	14.70%	4.27%
2017	-2.05%	0.63%	-2.30%	9.93%	-10.03%	2.35%
2018	-8.90%	0.17%	-0.48%	11.14%	6.73%	2.23%
2019	2.87%	1.48%	5.32%	6.68%	11.94%	3.34%
2020	1.68%	0.28%	-58.24%	-4.51%	4.23%	-1.20%
2021	1.10%	0.99%	30.37051	13.89%	26.88%	0.36%
2022	1.09%	2.37%	37.26019	38.18%	36.72%	0.44%

Source: Own calculations based on the data from NSI [9, 10].

A more moderate rate of decrease in the number of museum visits is observed for the period 2015, 2017-2018, while in the years 2014, 2016 and 2019 a certain increase in the values of this indicator is established. The case for the remaining three years of the investigated period is quite different. During 2020, as compared to 2019, the number of museum visits is reduced significantly by about 58.24%. This indicator grows at a relatively fast pace in 2021-2022 (Table 1).

The present work also analyzes the percentage change of the listed six indicators by regions in 2022 (the last year of the time interval) compared to the first year of the period -2013 (Table 2). The calculations show that the indicators -revenues and expenditures of the museums grow significantly in the examined regions. The values of two studied indicators (number of personnel and number of exhibits) are also increasing.

The case is very different for the other two surveyed indicators - number of museum visits and number of museums. The number of museum visits decreased in five of the regions in 2022 compared to the first investigated year of the interval (2013). A growth in the values of this indicator by about

5.78% is calculated only for the South Central region, as can be seen from Table 2.

The number of museums decreases in 3 of the considered regions (North-West, North-East and South-West). In the other three regions, the reverse process is observed. It should be mentioned here that the increase in the indicator is the largest for the South-East region (Table 2).

Table 2. Percentage change of the studied indicators by regions

Indicator	North-West region	North Central region	North-East region	South-East region	South-West region	South Central region
Museums:- (%)	-14.29%	3.33%	-12.00%	26.67%	-14.58%	9.09%
Museum visits:- (%)	-31.85%	-4.59%	-8.14%	-21.92%	-20.30%	5.78%
Exhibits:- (%)	1.95%	7.41%	7.22%	1.35%	4.23%	5.89%
Personnel:- (%)	1.83%	19.22%	36.72%	17.17%	8.41%	30.90%
Revenues:- (%)	140.90%	127.90%	188.00%	164.04%	147.61%	217.81%
Expenditures:- (%)	119.27%	124.58%	146.91%	139.66%	183.40%	182.67%

Source: Own calculations based on the data from NSI [9, 10].

The dynamics observed in the examined indicators reflect both internal museum policies and external influences. The significant decrease in museum visits during 2020 highlights the profound impact of the COVID-19 pandemic on cultural tourism. The strong rebound in museum revenues and expenditures during 2021–2022 likely reflects recovery efforts and increased public and private support for the cultural sector. These findings underline the importance of adaptability and targeted investments in ensuring the resilience of museums as key cultural and educational institutions.

Hierarchical cluster analysis

A hierarchical cluster analysis was also applied to the considered data in the current work.

Grouping the regions according to the number of museum visits is presented in Figure 4.

In this case, the following two clusters are obtained:

- South Central, North-East, and South-East regions form one cluster. Subsequently, the North-West region is joined to it.
- South-West and North Central regions are included in a separate cluster. Here, the values of the studied indicator are much higher compared to those in the other 4 regions.

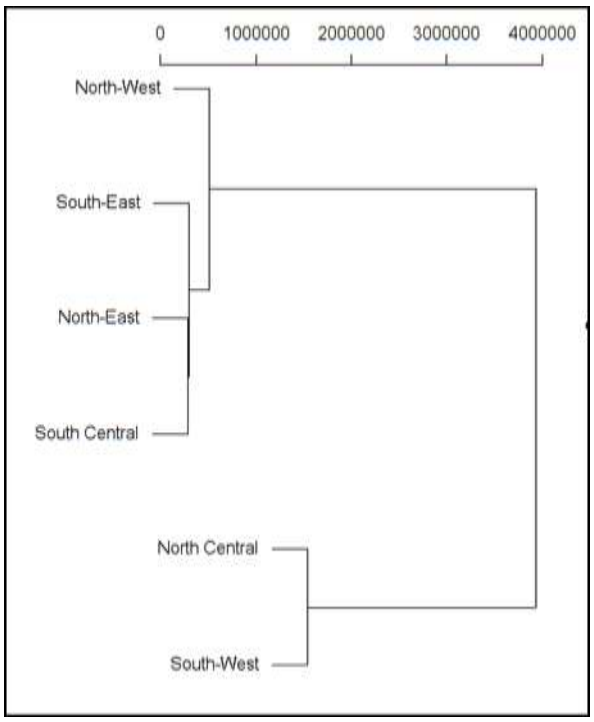

Fig. 4. Grouping the number of museum visits by regions according to their values

Source: Own calculations based on the data from NSI [9, 10].

This clustering suggests that the South-West and North Central regions serve as cultural hubs, attracting a larger number of visitors. This could be due to their larger population, better-developed infrastructure or the presence of flagship museums and events that draw more interest. The other regions, while grouped together, likely share similar characteristics in terms of museum attendance, possibly due to lower population

density or fewer high-profile cultural institutions.

Clustering the considered regions according to the indicator's values (number of museums) is shown in Fig 5. Here, the following three clusters are presented:

- North-West and North-East regions form one cluster. The values of the indicator in these two listed regions are relatively lower compared to the other considered regions.
- South Central and South-East regions are included in a separate cluster. Subsequently, the North Central region is joined to it.
- The South-West region is presented in one cluster. It should be noted that this region has the most museums.

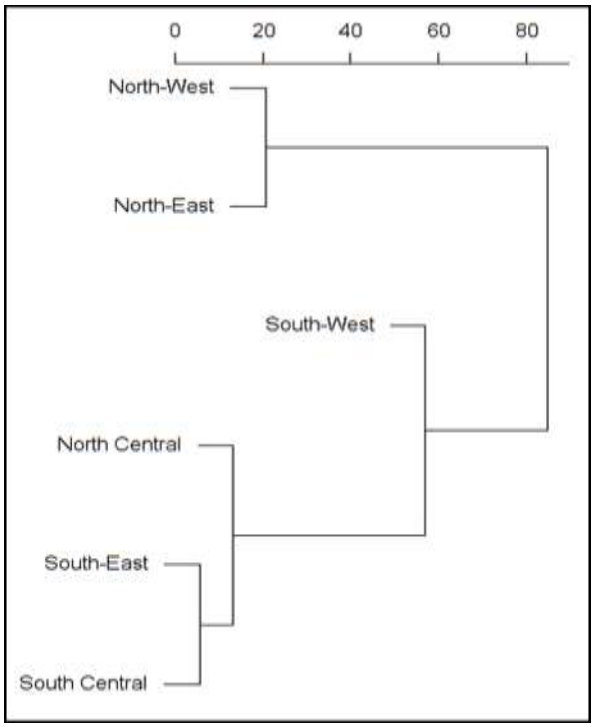

Fig. 5. Grouping the number of museums in the considered regions according to the values of the studied indicator
Source: Own calculations on the basis of data from NSI [9, 10].

The South-West region stands out from the rest, given its high concentration of museums - a phenomenon influenced by the capital city Sofia's role as home to a significant portion of the nation's museum institutions. The grouping of North-West and North-East regions with lower values for this indicator likely reflects economic and demographic challenges in these regions that limit museum development.

Clustering the considered regions according to the indicator's values (number of exhibits in the museums)

The studied regions are grouped according to the values of the number of exhibits. In this case, the results are visualised in the dendrogram of Fig 6. The obtained four clusters are the following:

- Two regions (South Central and North-West) are included in one cluster;
- South-East and North-East regions are presented in a separate cluster;
- The North Central region forms the third cluster;
- The South-West region is presented in a separate cluster. The surveyed indicator in this region has the highest values.

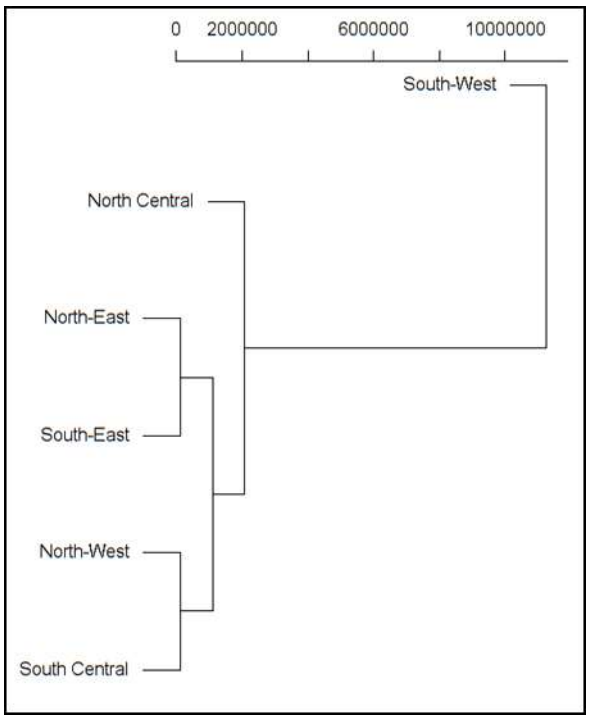

Fig. 6. Visualization of the dendrogram
Source: Own calculations on the basis of data from NSI [9, 10].

The clustering based on the number of exhibits highlights the South-West region as a leader in terms of museum collections, which aligns with its role as a national cultural center. The grouping of South-East and North-East regions reflects their relatively balanced development, while the grouping of South Central and North-West regions

suggests similarities in their collection strategies or funding for exhibits. This analysis underscores the regional disparities in cultural resources, which may require targeted policies to support museum development in underrepresented areas.

CONCLUSIONS

The current work presents a mathematical-statistical evaluation of data on museum visits by regions in Bulgaria from 2013 to 2022. The indicated elements are searched and extracted from the built relational database. In parallel, the information on the number of museums and exhibits is also examined. Three sets of indicators related to the mentioned objects are calculated and evaluated. Hierarchical cluster analysis is also applied to the investigated data. The performed analyses show the following:

- The museum visits in North-West, North Central and North-East regions increased by about 24.10%, 25.79% and 37.19%, respectively, for the time interval 2013-2019. In general, museum visits in the South-East region are about 0.6% smaller in 2019 than in 2013. The growth of the mentioned indicator in five regions (North-East, North Central, South-West, South Central and South-East) is relatively fast in 2021-2022. The indicator is reduced only in the North-West region during 2021, but an increase of about 24% is obtained in 2022.
- The number of museums in the North-West region in 2016-2022 remains unchanged. A similar result for the North Central region is obtained for this indicator in 2018-2022. The examined indicator (number of museums) increased by about 26.67% for the South-East and 12.50% for the South Central region in 2022.
- The number of exhibits is the largest in five considered regions (North-West, North-East, North Central, South-West and South Central) in 2022.
- Grouping the regions according to the number of museum visits presents two clusters. Grouping the regions according to the number of museums and exhibits leads to forming three and four clusters, respectively.

The findings underline the importance of regional differences in cultural tourism development and provide valuable insights into the dynamics museum attendance and infrastructure. The significant growth in museum visits in 2021–2022 highlights the sector's resilience and recovery following the COVID-19 pandemic, likely supported by targeted policies and increased interest in domestic tourism.

The results of the study suggest the following recommendations:

- Focused investment in cultural tourism infrastructure in underperforming regions to stimulate museum visits and support local economic development.
- Encouragement of innovative approaches, such as digitalization and interactive exhibits, to attract more visitors, particularly in regions with lower attendance.
- Further analysis of factors influencing museum visits, such as population density, accessibility, and marketing strategies, to inform region-specific development plans.

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