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Modeling the Demand for the Healthcare Services Using Data Analysis Techniques

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Abstract : Rapidly evolving modern data analysis technologies in healthcare play a large role in understanding the operation of the system and its characteristics. Nowadays, one of the key tasks in urban healthcare is to optimize the resource allocation. Thus, the application of data analysis in medical institutions to solve optimization problems determines the significance of this study. The purpose of this research was to establish the dependence between the indicators of the effectiveness of the medical institution and its resources. Hospital discharges by diagnosis; hospital days of in-patients and in-patient average length of stay were selected as the performance indicators and the demand of the medical facility. The hospital beds by type of care, medical technology (magnetic resonance tomography, gamma cameras, angiographic complexes and lithotripters) and physicians characterized the resource provision of medical institutions for the developed models. The data source for the research was an open database of the statistical service Eurostat. The choice of the source is due to the fact that the databases contain complete and open information necessary for research tasks in the field of public health. In addition, the statistical database has a user-friendly interface that allows you to quickly build analytical reports. The study provides information on 28 European for the period from 2007 to 2016. For all countries included in the study, with the most accurate and complete data for the period under review, predictive models were developed based on historical panel data. An attempt to improve the quality and the interpretation of the models was made by cluster analysis of the investigated set of countries. The main idea was to assess the similarity of the joint behavior of the variables throughout the time period under consideration to identify groups of similar countries and to construct the separate regression models for them. Therefore, the original time series were used as the objects of clustering. The hierarchical agglomerate algorithm k-medoids was used. The sampled objects were used as the centers of the clusters obtained, since determining the centroid when working with time series involves additional difficulties. The number of clusters used the silhouette coefficient. After the cluster analysis it was possible to significantly improve the predictive power of the models: for example, in the one of the clusters, MAPE error was only 0,82%, which makes it possible to conclude that this forecast is highly reliable in the short term. The obtained predicted values of the developed models have a relatively low level of error and can be used to make decisions on the resource provision of the hospital by medical personnel. The research displays the strong dependencies between the demand for the medical services and the modern medical equipment variable, which highlights the importance of the technological component for the successful development of the medical facility. Currently, data analysis has a huge potential, which allows to significantly improving health services. Medical institutions that are the first to introduce these technologies will certainly have a competitive advantage.

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