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Editorial

Sustainable Cities and Regions—Statistical Approaches

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Dynamic urbanisation leaves a significant mark on the broadly understood quality of life, regardless of the size of the city and the country or continent in which it is located. On one hand, economic progress favours the development of new technologies and the availability of many kinds of resources accessible almost without any limits to make life easier [1–5]. On the other hand, the development of urbanised areas, new transport networks, and higher demand for natural resources causes their depletion, pollution of different components of the environment, waste production, deforestation, landscape fragmentation, and biodiversity losses, leading finally to the deterioration of living conditions in the long term [6–11]. Some of these driving forces and pressures, as well as the responses of the natural environment, can be described by characterizing their regularities and patterns. Understanding the quantitative features of many components of socio-environmental systems makes it easier to undertake proper actions to mitigate undesirable phenomena. Therefore, various statistical and mathematical techniques (machine learning, regression, classification, spatial analysis, and others) can be widely used to solve crucial problems in the current development of cities and regions worldwide to face the challenge of sustainable development at different scales [12–17]. Mathematical modelling of socio-environmental dependencies allows the drawing of far-reaching conclusions supporting the decision-making process for a more sustainable future. Testing broadly understood statistical hypotheses leads to drawing conclusions about the significance of relationships.

Looking back, following mathematical rules has allowed humanity to achieve many watershed moments both in terms of architectonical objects as well as systems organizing many urban components which, at the time of completion, were considered impossible to implement. One such examples in architecture was Pantheon in Rome [18], which is presented on the cover of this book. When it comes to urban systems, advances in mathematics in Delos in ancient Greece have allowed hydraulic engineers to improve water distribution [19]. Other civilisations could also present their own examples confirming a strong relationship between mathematics and urban development. Similarly, in the current world, all solutions within smart cities and smart homes are possible to implement due to mathematical and statistical approaches. Mathematical algorithms are implemented in the controllers of almost all utility objects; being connected to the Internet, they create the Internet of Things [20]. Urban, rail, and air traffic control is supported or managed entirely by systems based on mathematics [21].

It is hard to imagine scientific research that does not use mathematics. Various statistical and mathematical techniques are widely used to solve crucial problems of the current development of cities and regions worldwide to face the challenge of sustainable development at different scales. In the present Special Issue entitled “Sustainable Cities and Regions—Statistical Approaches”, some examples of the application of mathematics in four scientific areas are included. First is the socioeconomic issue, where articles deal

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with mediation analysis in the study of the impact of socioeconomic factors on health [22], indicators influenced on urban sustainability [23], convergence analysis of the sustainability of EU states' economies using cluster analysis [24], accessing economic independence using mutual information and kernel density information [25], and the verification of the impact of the location of residential properties in relation to poverty-stricken area and ecosystem services in streets [26]. This Issue also includes a spatial analysis example for an economic model which study's the spatiotemporal interaction between Kinjiangls county transformation over 10 years [27]. The second issue discussed is environmental elements modelling, covering a nonlinear model enabling the reconstruction of missing meteorological data [28], green and low-carbon rural development metanalyses with the use of graph analysis [29], and $PM_{2.5}$ and PM_{10} prediction modelling with the use of a nonlinear autoregressive exogenous model [30]. The third topic is an issue of purifying the environment polluted by humans with the use of living organisms [31] and the analysis of the effectiveness of testing the level of its cleaning [32]. The fourth topic discussed is a real estate market seen through the prism vector autoregressive model to identify the interrelationships between the housing market based on Google Trends and housing process in Poland [33], and multiple linear regression for reading the residential real estate market based on intrinsic and extrinsic data [34].

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