Introduction to the Minitrack on Location Intelligence in the System Sciences

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Abstract

This mintrack on Location Intelligence Research in System Sciences continues the sixth year of minitracks on a wide variety of location-based research projects areas across the system sciences. For HICSS-58, two papers concern Japan: one examines locational aspects of determining variables and forecasting demand for Japan's national integrated care system, while the second analyzes ways to integrate curricula of K1-6 and K7-9 schools into a K1-9 school, taking into account geography. A third paper proposed a deep learning application that can locate prospective parking lot locations based on low resolution satellite imagery, while a fourth paper offers a system to collect and extrapolate simulation of cycles small load carriers. Finally, two social-science driven papers perform a geodemographic analysis of social media in counties in the US and propose a system to interpolate from census small-area units to neighborhood units.

Keywords: Spatial, models, GIS, complex modeling, spatial component

1. Introduction

From this year's papers emerges a theme of GIS as a component in a simulation, forecasting, clustering, and interpolation modeling. In analytics terms, the approaches in the minitrack represent descriptive, predictive, or, in one case, prescriptive modeling. Early in the development of GIS, models that merely mapped a set of points, say the population of US states, were helpful in contrast to a table of the same data. These maps later were referred to as "dots on a map," in order to distinguish them from maps having spatial analysis, i.e. to create simple spatial models of relationships among attribute variables or between spatial layers. Today, the same process is occurring but for much more complex models, ones that approach the levels of simulation or forecasting models with spatial analysis as a part of the model but not necessarily the dominant feature. Going back to the example of mapping US states, a complex simulation of a national fleet of semi-trucks, based on their size, fuel consumption, and state-based consumer demand, could include a spatial module that computes semi-truck miles per day by location in states and shows the results in a table and statewide map of the US. Most of the papers in this minitrack fall into this category of complex descriptive, predictive, or prescriptive modeling that includes but is not dominated by spatial analysis. Prescriptive modeling is applied in the paper on integrating K1-6 and K7-9 schools into K1-9 ones. The decision of which pairs of elementary schools to combine is based on a linear programming solution that minimizes commuting distance while maximizing a similarity index. This type of complex modeling with spatial as one of the modules is appropriate for decision support of complicated problems of the real world, which involve the challenges of how, why, when, what, as well as where.

2. Papers in the Minitrack

The next six sections describe each paper. The authors are listed in the references.

2.1. Developing Indicators and Forecasting Demand for Enhanced Regional Community-Based Integrated Care Systems in Japan.

The paper presents extensive indicators through radar charts of 73 indicators for the 1,889 municipalities in Japan. The standardized charts allow comparison between municipalities. The system projects service and personnel demands, and it is designed to provide policymakers with means to compare the policies for long-term significance. This includes aggregating municipality data up to the prefecture level for whisker charts for each variable and line charts for the municipalities in prefectures by variable. A spatial engine underpins this projection.

2.2. Integration of Two Types of School Districts

The Japanese government has sought recently to combine 6-year elementary school districts with 3-year

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junior high districts into 9-year school districts that integrate the two prior districts. This model seeks to arrange the most comparable pairs of districts across 117 schools in Nara City, based on multiple factors, many of them spatial, including commuting cost, numbers of student affected, commonality of city sections, adjacency of city sections, commuting flow sizes between sections, and min./max. ratio of students enrolled in a school. The Adjusted Rand Index (RAI) is used to assess similarities and a linear programming solution applied to Nara City.

2.3 Towards an Approach on Location Data Analysis for Reusable Small-load Carriers

This paper presents an approach that results in multi-site small load carrier (SLC) models that simulate the logistics cycles of SLCs. Two sub-studies of location-based technologies for SLC cycles are described. Each of them involves using different sensor technologies to collect data. They are utilized to test the model that extrapolates their data, which includes 8-10 runs, 2-4 routes, and 2-4 locations for each of them. The approach compared to existing ones has reduced time consumption and greater ease in implementing compared to prior existing approaches.

2.4. Deepot: Parking Lost Identification using Low-Resolution Satellite Imagery

This paper seeks to use improved object detection methods to determine siting for parking lots of large trucks across regional areas. The proposed system, Deepot, uses deep learning to identify truck parking sites through retrieving geospatial data for the area and optimizing image resolution, which predicts initial parking lots. The results are then coverted to Lat-Long coordinates and input into a Google Map to yield high resolution images of lot detections. Deepot allows a greater range of satellite imagery to be utilized and enables inputs into a well-known planning tool for medium and heavy duty truck parking lot planning.

2.5. A Geodemographic Analysis of Social Media Access in U.S. Counties

This paper analyzes the socioeconomic and demographic influences on social media access for the 3,076 counties in the lower 48 states of the U.S. The analysis of Facebook, Twitter (now X), LinkedIn, Instagram, and YouTube is done through descriptive statistics, k-means cluster analysis, regression analysis and spatial autocorrelation. The study reveals differences across U.S. counties are associated with extent of urbanization, race/ethnic proportions, age structure, and occupations. Implications are identified related to the digital divide of the country.

2.6. Interpolating Socioeconomic Data for Crime Regression Models at the Neighborhood Level

This paper proposes steps to interpolate from U.S. Census geographical units of block groups and tracts to neighborhood boundary units. The paper evaluates neighborhood definitions, and brings up the spatial issue of the modifiable areal unit problem (MAUP), which cautions against using data from one type of geographical unit to apply to larger-sized geographical units. The interpolation approach is tested on Milwaukee, Wisconsin, which has 210 census tracts and 567 block groups, the attributes of which are interpolated to the city’s 190 neighborhoods. The approach utilizes principal component analysis with varimax rotation. Data on crime is utilized to test the approach, and the findings of spatial regression show a high level of variance is determined by the model. The paper indicates that this approach can be applied to other disciplines beyond criminology, which was used in the testing.

3. References

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