Geospatial Analytics with IBM SPSS Modeler

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Executive summary

There is growing recognition by public and private sector organizations alike that an understanding of location and place is a vital element in effective decision making. However, while businesses understand the benefits of spatial analysis, the tools they are using may not allow them to take advantage of this type of robust data. A Ventana Research study indicates that spreadsheets were used 49 percent of the time to analyze location data, while spatial/Geographical Information Systems (GIS) were in use only 23 percent of the time.[1]

Organizations in every industry are turning to new data types and new forms of analysis to remain competitive. Advancements in geospatial analytics are rapidly transforming science, society and decision-making. Geospatial data, also referred to as location data or spatial data, enables businesses to add the context of time and location to traditional data, so they can see changes over time and exactly where those changes are taking place. Geospatial data can provide answers not found in charts or tables and can be instrumental in helping organizations answer critical questions such as:

- What are customers buying and where are they buying it?
- What infectious diseases are on the rise?
- Where are high unemployment or crime rates?
- Who are your competitors and where are they located?

The demand for geospatial insights has created a distinct need for accessible, self-service tools that enhance predictive analytics through the use of new algorithms designed specifically for the analysis of geospatial data—tools that can better support the business data analysis process and help organizations make more informed decisions. Geospatial analytics augments and enhances the rigor of predictive models by adding dimensions to the data through elements of time and space.

Geospatial analytics

The geospatial services industry is expanding widely with continued growth across all industries—approximately 500,000 people are employed with approximately $75 billion being generated in annual revenue. Advancements in geospatial analytics are rapidly transforming science, society and decision-making.

This white paper provides an overview of geospatial analytics and why it is important to organizations seeking deeper insights about their business, customers or constituents. It then describes the geospatial analytics capabilities offered in IBM® SPSS® Modeler, and how these capabilities can enhance predictive models by augmenting traditional forms of business data with time and location-based intelligence.

Geospatial analytics overview

Increasingly, companies are looking to a variety of data types and new forms of analysis in order to remain competitive. Forward looking companies are developing analytics ecosystems that make use of disparate kinds of data, including text data, social media data, and geospatial data.

Geospatial data or geographic information is the data or information that identifies the geographic location of features and boundaries on Earth, such as natural or constructed features, oceans, and more. Spatial data is usually stored as coordinates and topology, and is data that can be mapped. Spatial data is often accessed, manipulated or analyzed through Geographic Information Systems (GIS).

Geospatial data often describes address-related data (a specific address, point of interest, ZIP code, and so on), which can be matched to a specific latitude and longitude using a process known as geocoding. Geocodes for addresses and points of interest can also be integrated with other data sources to enhance analysis in dashboards, visualizations, and more advanced modeling.

Geospatial data sources include:

- **Global positioning system (GPS) data** is gathered through satellite and ground-based radio navigation systems. A GPS-enabled smartphone can provide the location of a person, for instance.
- **Remote sensing** involves specialized instruments, including satellites, scanners and radar systems, that capture data which be converted into digital form.

Geospatial analytics

Geospatial analytics is useful in many industries and applications:

- **A retail chain can strategically plan for store expansion by understanding areas in which the supply of product is predicted to be lower than the demand.**
- **A healthcare organization can study disease outbreaks over time at specific locations and more adequately prepare for potential epidemics.**
- **Law enforcement agencies can study past geospatial data to see crime "hot spots" and use that insight to predict and prevent future crimes in those areas.**
- **Insurers can incorporate geospatial insights into their underwriting process to determine which customers are at higher risk of flood, hurricanes, or earthquakes.**
- **Government agencies can detect fraud in social programs, such as the Supplemental Nutrition Assistance Program (food stamps) or Medicare.**
- **Financial services firms can use the geographic location of transactions to spot potential credit card fraud.**

Geospatial analytics in your organization

Geospatial analytics improves predictive insights by accounting for both time and space in predictive models, so you can more accurately forecast events at a specific location for any future point in time. This can help you see patterns and trends in a familiar geographic context, so they're easier to understand and respond to; anticipate and prepare for changing spatial conditions or location-based events; and develop targeted solutions to business challenges that may require different responses in different locations.

Geospatial analysis is useful in many business functions, from marketing to operations, and has applications in just about any industry.

Market segmentation

Marketers have traditionally relied on spreadsheets, graphs and charts to tell them who their customers are, what they buy and how much they spend. But integrating geographic information such as where people live or where they make purchases can dramatically enhance the effectiveness of marketing campaigns. Geospatial analytics in marketing can help target new customers and maximize promotional opportunities through similar characteristics, such as age, income or interests. This type of market segmentation can help improve promotions and retention and obtain more loyal customers. For example, retailers and other businesses might use loyalty card information and ZIP codes to help visualize where customers in a particular segment live. In addition, location data can be used from the GPS on the target segment's smartphones to push offers during a certain timeframe, or while the customers are in-store, to influence certain types of purchases or to determine how to reward their most loyal customers.

Asset and field management

There is a growing trend toward using location information and map visualization for asset management in industries such as manufacturing, energy and utilities, telecommunications, transportation and construction, where geospatial insights can be critical when managing physical assets in multiple, widely dispersed locations. Geospatial analysis can help organizations analyze and improve service areas, study the relationship between signal coverage and customer service, keep track of vehicles in a fleet, or manage facilities more efficiently and cost effectively.

Crime forecasting

Geospatial data is integral to law enforcement agencies in the prediction and prevention of crime. Predictive analytics is advancing rapidly to help uncover unknown patterns, and to give law enforcement better insight into where to best place resources at the right place and at the right time. Instead of scanning addresses and names on paper documents, investigators can view crime locations on a map along with information about known criminals in the area. Seeing the different types of data in one place enables departments to identify and apprehend suspects faster. Analysis can also be used for issuing alerts, identifying high crime rate areas and predicting when and where a crime is likely to occur. Geospatial data can also help agencies map calls for service, reports of suspicious activity, assist in emergency management incidents, and help detect and prevent terrorist threats.

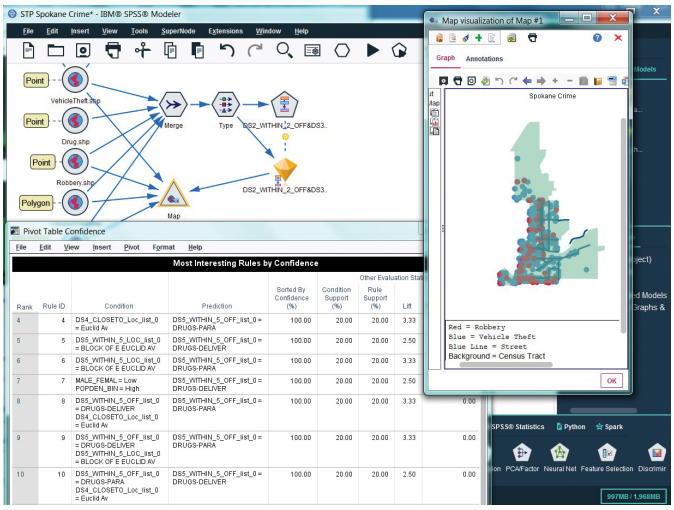

Figure 1: In this example, specialized procedures within SPSS Modeler were used to predict hot spots in which thefts are most likely to occur based on demographic information for a specific region.

Risk reduction

Businesses in industries such as communications, insurance, utilities, energy and finance are vulnerable to a range of threats and risks, from natural disasters to network outages. Hundreds or even thousands of lives can be affected by these events—some of which are foreseeable, and many others which are not. Effective disaster and risk reduction and management can be achieved with the help of geospatial data, which can be critical during every phase of the risk management process, including prevention, mitigation, preparedness, response and relief. Geospatial analytics, combined with layered data on all impacted infrastructure, can help organizations construct predictive models to help governments, developers, and others better understand risk and manage it accordingly.

Travel and transportation logistics

Travel and transportation providers have a long list of challenges to confront, including economic stagnation and fluctuating demand; proliferation of sales channels, loss of market-making power, and commoditization; demanding and empowered customers; high fixed costs for equipment and infrastructure; fuel price volatility and cost escalation, and safety and security requirements. Geospatial analytics can help transportation companies maximize fleet utilization, monitor actual versus planned time to improve routes, monitor service activity, optimize operations and meet response time targets.

Strategic location and market optimization

Identifying strategic business locations often becomes a market optimization exercise in which the planners need to understand the interplay of various factors that can affect the choice of a specific location for a new store or bank branch. Possessing a thorough understanding of the marketplace in which retail operations or financial institutions function or would like to operate is integral to profitable growth. For example, geospatial data helps banks measure the reach of each branch, understand network gaps and redundancies, define a trade area around the branch, and identify its market potential. Geospatial analytics technology can also be used to create "what if" scenarios and perform dynamic segmentation to locate multiple classes of assets.

Fraud detection and prevention

The number of people and businesses falling victim to fraud has increased at an alarming rate. As technology continues to improve, fraudsters are finding new and creative methods to continue their work. Financial theft is not the only issue; there is also the cost directly related to business disruption and loss of productivity. Organized fraud activity, medical billing fraud, credit card fraud and staged accident rings are only a few methods unscrupulous individuals and groups are using, costing industries billions of dollars. Geospatial data can help companies detect and prevent fraud by providing information about where fraud might occur.

IBM SPSS Modeler for geospatial analytics

IBM SPSS Modeler can help you explore the relationship of data elements that can be tied to a location and perform geographic spatial analysis of your data to reveal insights that would not be visible in charts or tables. With spatial mining, you can easily mine geospatial data using ESRI shape files. By analyzing both non-spatial and spatial data, overall model accuracy is improved and you are able to gain deeper insights into people and events.

You can use SPSS Modeler to apply association rules that will help you uncover insightful relationships among spatial and non-spatial attributes. Using spatial temporal prediction, you can fit linear models for measurements taken over locations in 2D space, enabling you to easily predict "hot" areas and how those areas will change over time. You can apply this technology to mine geospatial data in fields such as retail and banking, crime pattern analysis, epidemic surveillance, building management and branch performance analysis.

Esri

A police department turns to IBM Business Partner Esri for an IBM SPSS solution to analyze crime patterns and develop effective strategies to reduce crime while optimizing police resources.

- **Identifies crime "hot spots" and focuses police resources at these locations, helping lower crime rates by 19 percent over four years**
- **Enables creation of color-coded maps to visualize crime patterns**
- **Helps organized crime units and task forces develop plans for special actions and interventions**

IBM SPSS Modeler is a powerful predictive analytics platform that is designed to bring predictive intelligence to decisions made by individuals, groups, systems and your enterprise. SPSS Modeler scales from desktop deployments to integration with operational systems to provide you with a range of advanced algorithms and techniques. Applying these techniques to decisions can result in rapid ROI and can enable organizations to proactively and repeatedly reduce costs while increasing productivity.

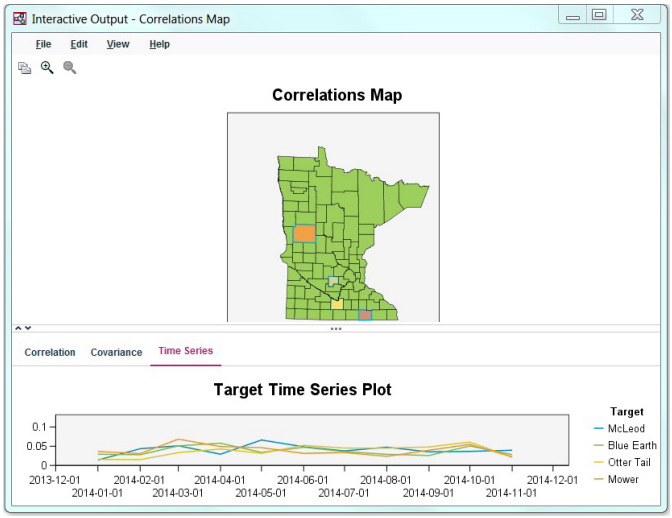

Figure 2: Correlations map and target time series analysis in SPSS Modeler.

Conclusion

Journalists, researchers and police investigators often use a formula comprised of six basic information-gathering questions to ensure they tell the complete story. These questions are who, what, where, when, why and how. This same approach can apply to data analytics, which is the process of telling a story with data. People and organizations use analytics to convert data to information, turn information into knowledge, and use that knowledge to transform business.

Organizations have traditionally used data to answer the questions who, what and why. While the answers can be insightful, they do not tell the whole story because they do not extract all potential insights from the data. By investing in an analytical solution that provides location analytics capabilities, organizations are able to discover where and when events are occurring, increasing the value of their information by telling a more complete story through data. This enhanced insight can provide a rapid return on investment by improving customer service, reducing fraud, speeding innovation and reducing risk. Such factors are considered to be key sources of competitive advantage in many organizations.

In response to the need for more comprehensive insights on which to base decisions, and the potential that can be gained by augmenting traditional analytics with geospatial data, IBM offers IBM SPSS Modeler. This self-service analytical tool empowers users to combine and extract insights from all types of data, including data that contains elements of time and space, to tell a complete story about their customers, constituents, patients, students, assets and operations. With this enhanced knowledge, organizations are able to make decisions that lead to better outcomes.

For more information

To learn more about SPSS Modeler visit: **ibm.co**/1yLMLHL.

To explore prescriptive analytics, which can help you decide how to act on the insights gained through the use of geospatial analytics, visit: **ibm.co**/1E6dyPz.

To learn more about geospatial analytics with IBM SPSS Modeler, please contact your IBM representative or IBM Business Partner, or visit the following website:
ibm.com/developerworks/library/ba-mine-spatial-data-spss-r/

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1 http://smartdatacollective.com/mark-smith/194681/technology-makes-difference-location-analytics

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