

Advancing Your Business Intelligence With Location Analytics



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Mapping out new intelligence

In 1854, London's Soho area experienced a deadly outbreak of cholera, an infectious bacterial disease of the small intestine. The germ theory had not yet been developed, and cholera was believed to be spread by miasma, a noxious form of bad air.

The source of the outbreak was a mystery until physician Dr. John Snow did something extraordinary - he mapped the cases. It became immediately apparent that illnesses and deaths were clustered around a pump on Broad Street. Was it the water?

If so, what would explain the outliers - 10 deaths among people who lived closer to a different pump? So Snow enriched the mapping with external data. He found that those who lived (and died) farther away had sent daily for water from the Broad Street pump or attended school near the pump.

Why did certain clusters of others near the Broad Street pump not get sick? Snow found that workers at a nearby brewery were permitted to drink all the beer they wanted. It wasn't believed they drank water at all. And a nearby workhouse had its own water supply.

By layering information over a map, Snow - contrary to the oft-quoted line about his *Game of Thrones* namesake - actually knew a lot of things, and quickly spotted relationships that might otherwise have been missed. He created insights that inspired fundamental changes in London's water and waste systems and changed the course of epidemiology.

This concept is the core of today's location analytics. Location analytics is the process of integrating geographical data into business intelligence (BI) and analytics-led decision making. Location analytics creates meaningful insight from relationships found in geospatial data to solve a broad variety of business and social problems.

Location data is found everywhere - with an item or a device, in a conversation or behavior, in machines or sensors, tied to a customer or competitor, attached to a database record or recorded from vehicles or other moving objects. Organizations want to take advantage of location data to improve decisions, create better customer engagement and experiences, reduce risks and automate business processes.

Location analytics augments decision making in four ways:

Reveals insights other types of graphs do not. By adding geographic location to business data and mapping it, organizations can dramatically enhance their insights into tabular data. Maps and spatial analytics provide a whole new context that is simply not possible with tables and charts. This context helps users discover new insights almost immediately and more effectively share their findings using maps as a common language.

Enriches business data by adding what is already known about a location. Location analytics can add essential context. For instance, when you know someone's home address, you can get additional, valuable information about other aspects of that

Location analytics blends business data and geographic location data to reveal the relationship of location to people, events, transactions, facilities and assets.

person, such as median household income, home value, average spending on a category of product or service, or drive time to specific locations.

When you use that data to augment existing business intelligence (BI) data, you can unlock all sorts of new relationships and insights. For example, when you see that stores in certain regions are most successful, you can ask, what are the commonalities among them and what are their customers' characteristics? Then you can better understand your target customer profiles and make better decisions.

Helps optimize operations. Location information can support smarter operational decisions based on location-related attributes such as supply chain delivery time, customer drive time or the location-related demographics of other successful entities. Or ask, what's the best way to organize sales territories? If we acquire this clinic, how will it affect our existing clinics?

Puts context to information to support better decisions. Organizations can make smarter decisions based on location-related attributes specific to their enterprise. For example, is the path of this hurricane in line with homes we insure? Are we providing sufficient infrastructure for all the residents of our service area?

Why has location analytics been underappreciated?

People have thought too narrowly about it. Many people think of this as geocoding an address - latitude and longitude - but it's much more than that. Sometimes there are thousands of additional variables that can be brought in to augment traditional data to help data scientists make predictions. Even when they are aware they have location information in their data, folks tend to look at the "who," "when" and "how" but not the "where" dimension.

The blend of GIS and BI skills is rare, while demand is increasing. "Spatial analysis, like many areas of analytics, has traditionally been the purview of specialists with domain expertise in the mathematics and theory of map-making and geospatial information," according to *The Forrester Wave™: Geospatial Analytics Tools And Platforms, Q3 2016*. "The tools they used were too esoteric for much of the organization, and cycles of insight production were slow."

Analysts have worked within their own specialties. Analysts might be doing something with spatial data in the GIS department and with non-spatial data in the BI department, but they are not necessarily talking to each other. They could really benefit from working together - bringing location intelligence into business intelligence and vice versa.

Integrating GIS and BI is a challenge. Some mature organizations have integrated maps and spatial analytics with their business data using GIS technology and netted powerful results. However, this approach has not become widespread because of the expense of custom integration with enterprise systems and because the capabilities of GIS were beyond the technical knowledge of the business analytics users.

Business analysts, marketing directors, operations managers and other decision makers typically lack easy access to spatial tools that visualize and analyze data in a geographic context.

Location analytics has widespread usefulness

All industries benefit from location analytics, because all business happens somewhere. The nature of that business is often influenced by location-related factors, such as population density, proximity to services, labor markets, customer base or risk of a natural disaster. The potential is enormous in so many areas:

- **Commercial transportation.** Courier and postal services can track the locations of delivery vehicles and packages in real time. Trucking companies can optimize routes based on a multitude of constraints. Fleet managers learn more about how their vehicles are being used. Urban transportation planners can determine the best routes and locations for bus or train stops.
- **Personal transportation.** On-vehicle monitoring devices can transmit information on drivers' routes, speed and drive time, which helps a business know where to locate or what products to market. With data on driving habits, warranty analysts can estimate wear and tear on a vehicle; insurance companies can determine the right insurance rate for a driver.
- **Retail.** Chain retailers can analyze the historical spending habits of customers from different areas to better understand where to locate new stores, how to maximize per-store sales, or compare sales territory revenue and perform new types of market analysis.
- **Marketing and customer experience.** Location analytics adds richness to your profile of the business ecosystem and its influences, such as culture, lifestyle, labor market, health care, cost of living, crime, economic climate and education. When you can visualize on a map where your customers live, work and shop, you can make better decisions about all aspects of attracting and serving them.
- **Public services.** Local, state or federal entities are prime candidates for location analytics. So many public service activities have a location element, such as census updates, law enforcement crime analysis, emergency response, environmental and land management, electoral redistricting, tax jurisdiction assignment and urban planning.
- **Public infrastructure.** Governments can visualize growth and determine where to build roads, schools, water lines and parks. Mapping earthquakes, hurricanes and other natural disasters reveals where it's necessary to impose stricter building codes or concentrate anti-flooding efforts. In an era where the public demands transparency, government agencies can use map-based visualizations to clearly show taxpayers where and how money is spent.
- **Utilities and communications.** Location analytics provides a powerful tool for predicting energy consumption, putting utilities in the best locations, determining the scope and impact of outages (and diverting resources as required), determining the best course of action from sensor data, designing communication networks, identifying new markets and more.
- **Health care.** Combine location data with other analytics to determine what's important, such as the optimal location for health care facilities and physicians based on such factors as local demographics or drive time to stay in-network.
- **Public health.** Like 19th-century Dr. Snow, public health analysts can understand population health at the neighborhood level – or now on a global scale. Determine demand for new vaccines or track epidemics such as the Zika virus, antibiotic resistance or opioid addiction. For example, mapping the locations of physicians who prescribe unusual amounts of painkillers can quickly hone an investigation.

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*The Forrester Wave™:
Geospatial Analytics Tools
And Platforms, Q3 2016*

Optimize business process by adding and analyzing the “where” dimension.

All these use cases are possible because business intelligence and analytics platforms can take advantage of location as another data source to enrich what you know about the business question at hand.

There's more location data than ever

Location data pours in from GPS systems, IP networks, RFID sensors, Wi-Fi and Bluetooth devices. It comes from smartphones and smart watches, wearable devices, medical and industrial monitoring systems, drones, social media and more – streaming from an estimated 6.4 billion to 9 billion internet-connected devices worldwide.

“As the variety of channels and devices that connect customers, companies and physical assets increases, so too do the ways to measure and analyze spatial information,” states the Forrester Wave report. “The internet of things (IoT) presents a massive opportunity for companies to uncover insights from spatial relationships, as every connected device can be located by some means.”¹

Information about location is pervasive in the business systems organizations use every day. Customers and constituents have a location. Assets, whether fixed or mobile, have locations, as do staff members and suppliers. With the ubiquitous use of mobile devices and social media, location data is becoming even more pervasive.

About 70 percent to 80 percent of today's business data contains some level of location information. However, business analysts rarely use location data within their business intelligence and analytics workflows.

Location analytics: Bringing GIS and BI together

At SAS, we see location analytics as an extension of BI. So it was only natural for SAS to partner with Esri, the company Forrester calls “an authoritative standard for GIS ... with some of the most extensive capabilities for capturing spatial data and the analysis, presentation and delivery.”

The location analytics platform is designed for business analysts who spend much of their day using self-service BI and analytics tools such as SAS Visual Analytics to see patterns and relationships in transaction data. Now they can access self-service mapping and spatial analytics from within the analytic systems they use every day.

- **SAS Visual Analytics** provides a modern platform for governed data discovery so that users of all skill levels can visually explore data, create interactive reports and dashboards, and predict future outcomes using self-service analytics. Powerful in-memory technologies enable faster computations and scalable workloads.
- **The Esri integration** adds an array of mapping visualizations (color-coded, temporal, clustered, heat maps, etc.), spatial analytics, and geographic enrichment data such as demographics, consumer and lifestyle data, environment and weather, social media and business data.

Location analytics combines geographic data on assets, infrastructure, transportation and the environment with data on an organization's operations and customers to discover powerful answers to business challenges and share those insights with the rest of the organization.

Traditionally, location data has been relegated to mapping and GIS purposes. Not many business analysts have taken advantage of incorporating location data into their analytical workflows.

¹ Curran, Rowan; *The Forrester Wave™: Geospatial Analytics Tools And Platforms, Q3 2016: The Six Providers That Matter Most And How They Stack Up*, Aug. 31, 2016

Users gain these Esri capabilities from within the familiar, easy-to-use SAS BI environment and information workflow - making location analytics accessible to users across the business without requiring them to be GIS experts.

More than putting dots on a map

Location analytics is more than just putting points on a map. It's part of a much larger picture of using location to provide context in visualizations, reports and analytics. Location data is used for geographic mapping and downstream analysis, and used with analytics to drive appropriate decisions. This integration of GIS and BI provides yet another way for business users to dig into data and get a visual understanding of information and make the best decisions.

Go beyond simple maps

Putting points on a map is nice, but it's really just scratching the surface. More powerful spatial analysis techniques are essential for unlocking business value and making sense of millions of records - turning structured and unstructured data into intelligence. Capabilities such as automated clustering, heat maps, data aggregation and color coding reveal more information from data, quickly surpassing the basic dots-on-a-map approach.

Clustering automatically groups points that are in close proximity. Each group of points is represented by a symbol, typically a circle. The size of the circle is determined by the number of clustered points it references. A number in the center of the circle represents the number of points clustered.

Spatial queries let you analyze an area that you define. For example:

- Distance creates a circular selection based on the distance in miles or kilometers.
- Drive-distance creates an irregular selection based on the driving distance using roads.
- Drive-time creates an irregular selection based on the distance that can be driven in the specified time.
- Nearest-neighbor analysis finds the closest entities of a specific type near a given location.

Spatial modeling helps you understand what-if questions such as, What effect will opening a new facility in this location have on sales in existing stores?

Heat maps indicate how and where points are clustered. Point density is reflected by the colors used. An area of high density might be colored red, while an area of low density would be colored blue.

Data aggregation (combining data to regions) can give a clear view of what's going on. For example, sales from individual stores aggregated by postal codes can be mapped by postal code areas.

Creating interactive maps inside existing business intelligence systems can enable users to quickly see patterns that tables and graphs cannot reveal.

Using geographic data in descriptive and predictive analytics helps companies discover new patterns, identify location-specific opportunities, and get a complete picture before making business decisions.

Use the map to perform spatial queries by selecting areas on the map either by drawing an area of interest or defining a specific region, for example, the area that is not served within 10 miles by a big box discount retailer.

Suppose you're trying to determine the potential of a new store in a proposed location - or a marketing program for an existing store. You may want to know households' average driving time to the site, ease of access, proximity to the population and demographic mix. By bringing location into the assessment, you can gain a clearer picture of likely outcomes such as potential store traffic and revenue per store.

Maps can become the new information vehicle for breaking down barriers across your organization. Presenting the results of predictive analytics along with location data on maps provides easy-to-understand visualizations and helps everyone understand the business, because most people find maps easy to comprehend. You can even share maps across devices so anyone can use them on tablets, smartphones or desktops, and they are available everywhere.

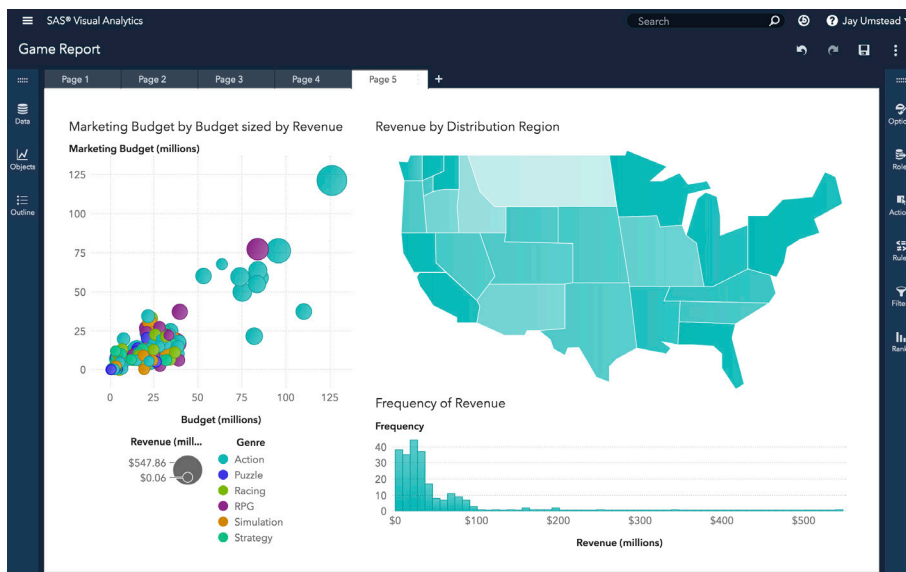


Figure 2: View the output of location analytics through the use of maps or charts, giving you options on how to visualize your data. In this example, the marketing budget is compared to revenue, allowing a viewer to quickly understand both spending patterns as well as revenue trends.

Location analytics in action

Use location data to drive downstream analysis. Imagine you're looking at sales data for various products such as shoes, children's clothes and toys. Analysts can plot the data on geographic maps to see where customers are located. The software can automatically cluster customers, find out where the most profitable customers are and create reports in BI systems that represent sales, profits and other metrics by location.

An analyst can then select an area on a geo map and use the data points to perform further analysis within the intuitive SAS Visual Analytics tool. The ability to use geo maps to produce ad hoc visualizations and analysis helps business managers identify customer patterns and drill into more details of business.

Use analytics to create location-based visualizations. Business managers always want to know projections for the next quarter, six months and year so they can plan resources and adjust expectations. SAS enables you to do predictive analysis such as forecasting sales and then visualizing the forecast results on maps. Business managers can easily see and compare current and future predicted sales - and how customer clusters are changing over time.

Bringing in the 'where' dimension

According to the Forrester Wave report:

"A transformation has taken hold in the industry, and the creation and use of spatial insights is rapidly spreading across the enterprise. Spatial insights are finding their way into sales, customer relationship management (CRM), customer support, human resources, marketing, technology management and many other areas. Crucial to this trend is the fact that these teams are not just consuming spatial insights provided by specialist teams; often they are customizing or generating their own."²

Here are the next steps to getting started.

Make location a priority in digital business initiatives

Location-based visual analytics has a multitude of potential uses across all industries. New business models and IoT devices are producing unprecedented volumes of location-referenced data. Take advantage of this wellspring to gain a deeper understanding of context, opportunities and risks in business decisions.

² *The Forrester Wave: Geospatial Analytics Tools And Platforms, Q3 2016: The Six Providers That Matter Most And How They Stack Up*, Aug. 31, 2016

Identify where the organization will benefit the most

Focus on projects or opportunities that fulfill high-priority business requirements and deliver the highest or best returns. Or start with small pilot projects where you can produce quick results, to gain buy-in. But remember that it's not just about the technology; plan ahead for the data management challenges, barriers between GIS and BI staff, availability of skills and data privacy issues.

Select BI and analytics technology that integrates with spatial analysis software

SAS Visual Analytics is now equipped to enable business users, analysts and GIS experts to access data and generate insights with spatial context. It is not just about taking location-enabled data sets and displaying them on a map with simple layers. Additional value lies in advanced capabilities:

- Custom polygons (sales territories, voting districts, floor plans, seating charts, etc.) will let you see the world as your business needs dictate.
- Geographic point clustering makes it easier to visualize high-volume location data and identify areas of interest. You can increase or decrease the level of detail at different zoom levels.
- Travel-time analysis allows you to create a selection based on the distance that can be traveled in a specified amount of time and type of traffic.
- Travel-distance analysis creates a selection based on the travel distance in miles or kilometers.
- Geoenrichment lets you visualize demographic data (population density, average income, median age, education, etc.) from Esri in a different context to reveal new insights.
- Location data combined with analytical techniques, such as clustering, allows you to define potential customer segments to pursue.

Learn more

View the [SAS Visual Analytics](#) product page.

Watch demos on [SAS Visual Analytics](#).

Visit [Esri ArcGIS](#) to learn more about sharing location-based insights.

All business happens some place. Location is an important aspect of business analysis and business data. Organizations need to pay more attention to it.

To contact your local SAS office, please visit: sas.com/offices

