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SAS® Visual Analytics: “Where” Can Tell You “Why”

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ABSTRACT

Everything happens somewhere and much of our data includes location information. Internet of Things (IoT) sensors include x,y coordinates in their data and the mobile apps we depend upon use location to provide specialized, targeted information. How are you gaining insight from location information in your dashboards and data explorations? Gain deeper insight with SAS® Visual Analytics, which includes many location analytics capabilities out-of-the-box, as well as access to advanced location analytics capabilities through integration with Esri. With location analytics, you can do the following: visualize data on a map; enhance your existing data by geocoding or enhancing with Esri demographics data; gain insights through dense data; perform travel-time and travel-distance analysis; include your multi-layer web maps; and more in SAS Visual Analytics. **Attend this session to see how “where” can tell you “why” using location analytics in SAS Visual Analytics.**

INTRODUCTION

Human brains are hardwired to build maps. Aside from blindly following the commands from a GPS, we navigate the world around us through the creation of mental maps that assemble abstract landmarks and build spatial relationships between them. Maps have been found dating back to 25,000-30,000 years ago, and the 2014 Nobel Prize for physiology was **awarded to scientists who discovered the brain’s “GPS System”**. While lines, bars, and pies are worthy data visualizations, they do not have the lineage, artistry, scientific backing, or general appeal of maps.

SAS Visual Analytics embraces the hardwired appeal of maps by supporting a range of location analytics capabilities that are available out-of-the-box and through our partnership with Esri. These location analytics capabilities, include:

- Display your data on a map using the following:
 - coordinate (latitude/longitude for plotting your data on a map)
 - region (country boundaries, sales territories, floor plans, stadium sections)

Stadium Seating Section Classes



Tickets by Month grouped by Section Price Class

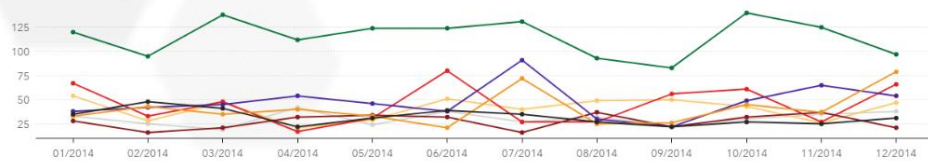


Figure 1. Example: Using Custom Geo Regions in SAS Visual Analytics to Show Stadium Sections

- o contour (heatmap representation of coordinate data)
- o network (origination/destination between coordinates)

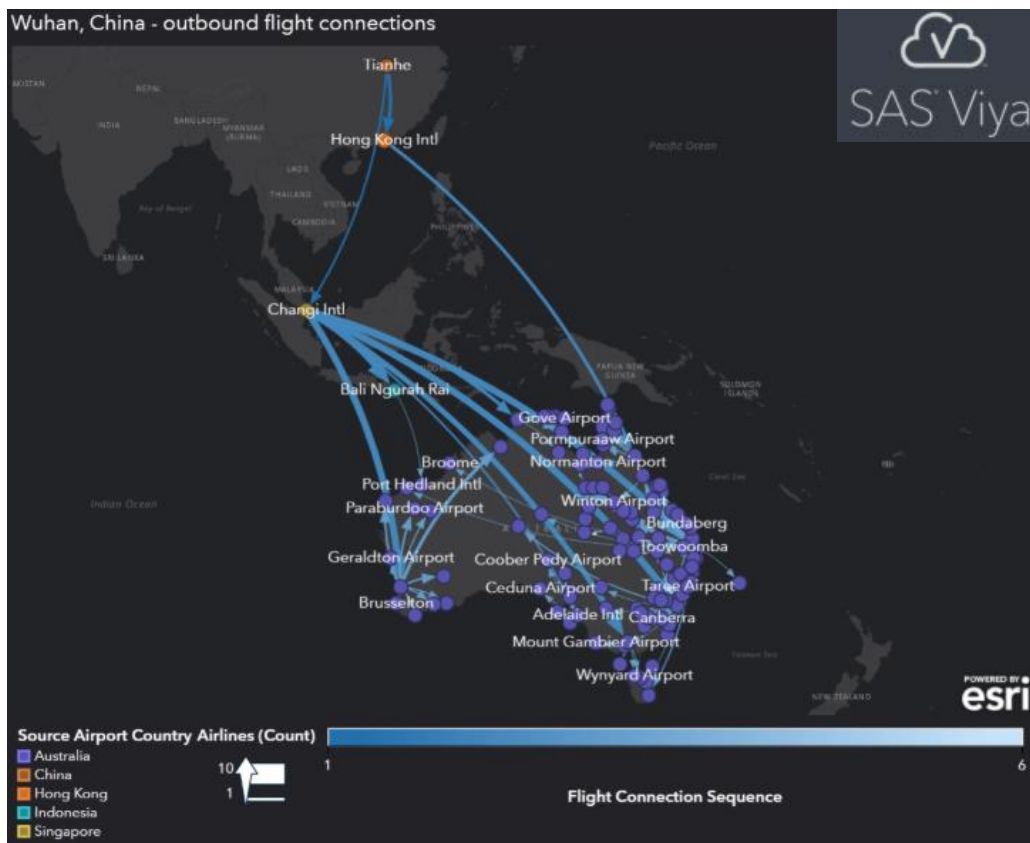


Figure 2. Example: Using a Geo Network in SAS Visual Analytics to Show Connecting Airports for Airline Flights

- Display multiple data layers using the following:

- Color, markers, or regions that are based on distinct category or gradient fill that is based on a continuous measure.
 - Gradient fill of a continuous measure for contour maps.
 - Size of marker that is based on a category or measure.
- Create maps that use regions that mean something to you. out-of-the-box, SAS Visual Analytics supports pre-geocoded data sets. There is also support for adding custom regions to let you design maps that have the most impact to your users.
- Drop a pin and explore points of interest.
 - Add geographic selection areas around your pins based on distance or travel time, and then select the data points that appear within your selection area.
 - Request Esri demographics information for the selected region to enhance exploration by including additional relevant information.
- Find optimal routes between points of interest or measure the straight-line distance between locations.
- Is your data too dense to make sense of? View dense data on a map using proximity clustering, contour maps, or subset your data using data filtering or interactive filtering.
- Leverage your Esri content by embedding multi-layer web maps as interactive backgrounds with your SAS Visual Analytics data layered on top.
- Enhance your data with geographic content to perform deeper, more informed analysis using the following:
 - Geocode your data by accessing the Esri Geocoding service to add latitude and longitude columns for each record in your data.
 - Geo-enrich your data by joining it with Esri demographics data.

This paper focuses on combining multiple geographic data layers in one visualization through the following examples:

1. Using SAS Visual Analytics out-of-the-box support for multiple geographic data layers.
2. Building custom geographic objects to support four interactive data layers.

MULTIPLE GEOGRAPHIC DATA LAYERS

Working with geographic data you can learn a lot by plotting your data on a map to see, **spatially, where all your data “lives”** or display a choropleth map to understand areal information.

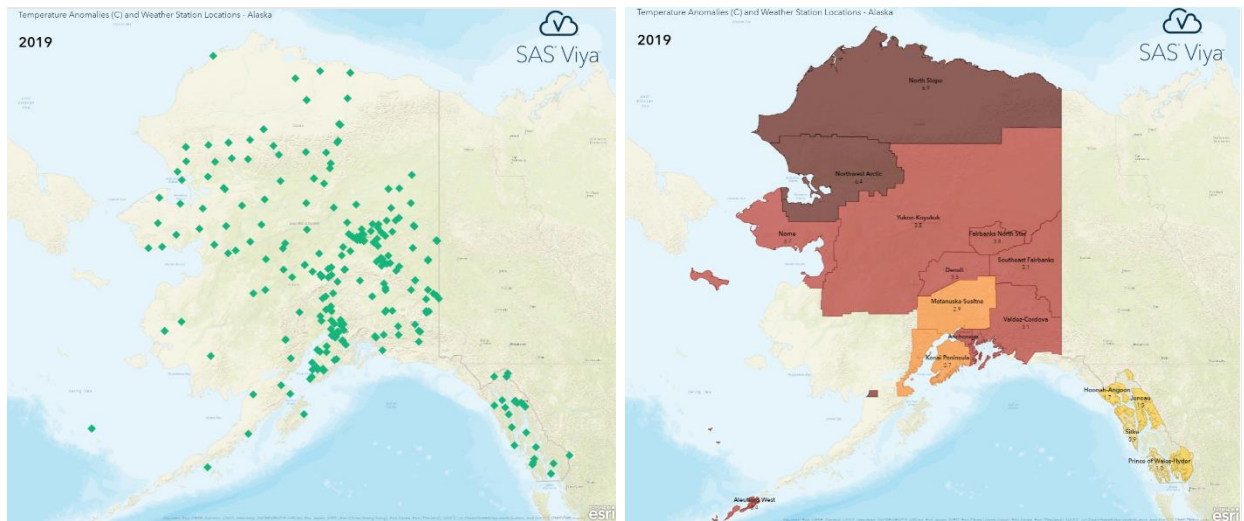


Figure 3. A Coordinate Map of Weather Stations and A Region Map of Temperature Anomalies

The maps in Figure 3 show 2019 information about the location of weather stations and average temperature anomalies at the county-level. These individual maps are informative, but when combined, they deliver more impact and deeper insight.

GEO REGION – COORDINATE OBJECT

The combination of coordinate and region information gives us deeper context by providing more data in one visualization and allows us to see how the data layers interact.

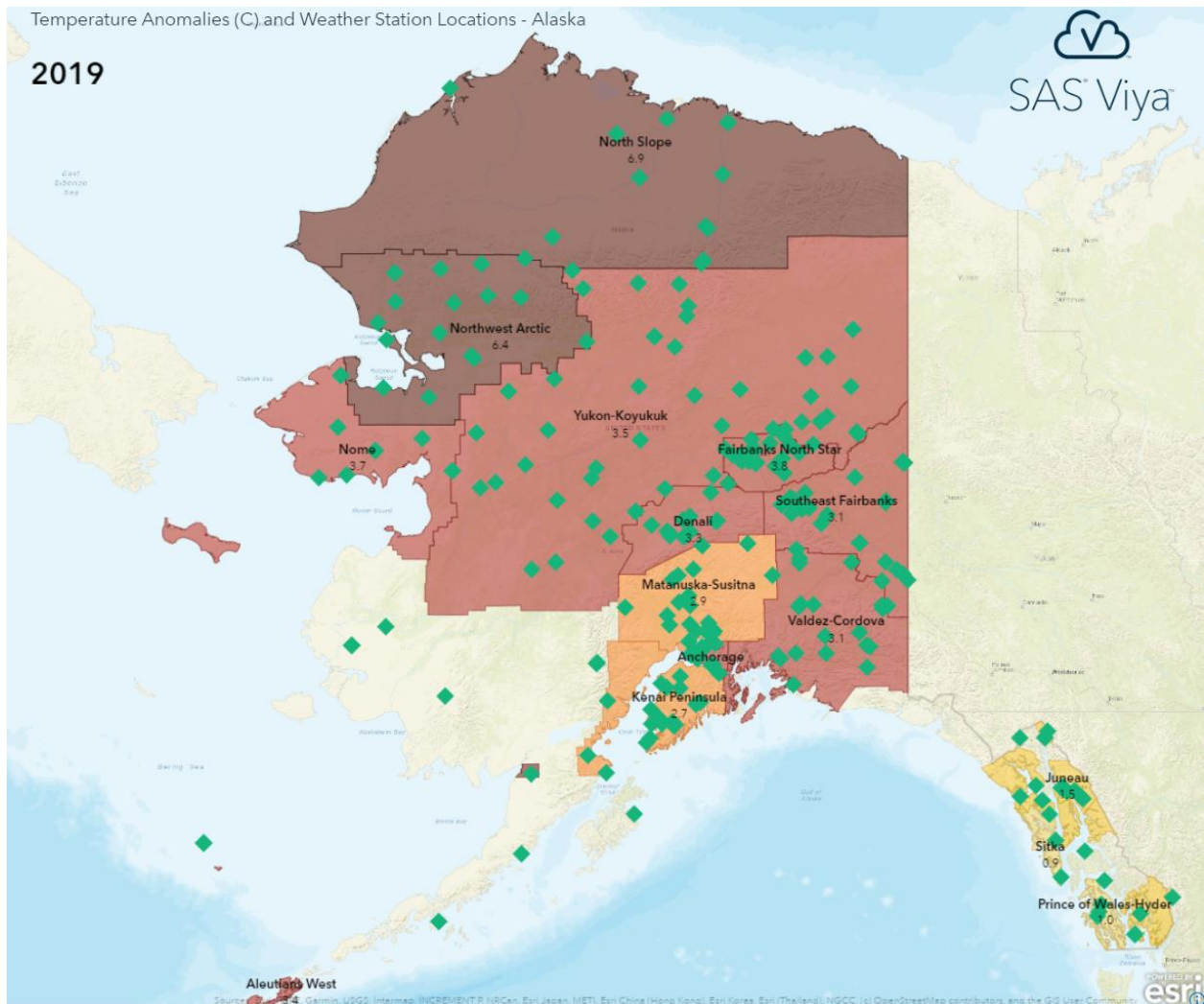


Figure 4. A Region-Coordinate Map of Weather Stations and Temperature Anomalies

We clearly see that as we move north, the positive temperature anomaly increases, and overall in 2019 most counties report warmer than normal average temperatures. Through the combination of coordinates and regions, we see that Northwest Arctic county has consistent spacing of their weather stations, which allows them to recognize isolated temperatures anomalies. We also notice that North Slope county, with the highest average temperature anomaly, has the lowest weather station-coverage. We also notice that Matanuska-Susitna county has weather stations that overlap while other areas with no coverage.

The SAS Visual Analytics geo region-coordinate object, which is available out-of-the-box, allows you to set two geographic items to a map: region and coordinate, and to assign columns from your data for region color, and coordinate size and color.

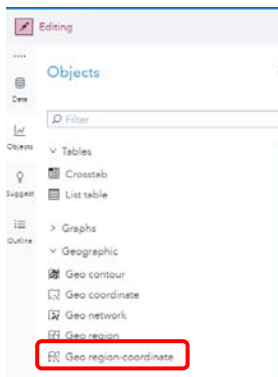


Figure 5. SAS Visual Analytics Geographic Objects

Adding to the usefulness of this object is the ability to toggle on/off the two data layers on the map. Simply click the **“Hide or show layers”** menu item to access.



Figure 6. The Layers Menu Lets You Show and Hide Layers

CUSTOM GEOGRAPHIC OBJECT – EVEN MORE GEO LAYERS!

The geo region-coordinate object does a great job of addressing the use case where you have two data layers that you want to understand. What about when you have more data layers you want to show on a map? SAS provides the ability for you to create custom graph objects using SAS® Graph Builder, which you access through the **“Build Custom Graphs”** action.

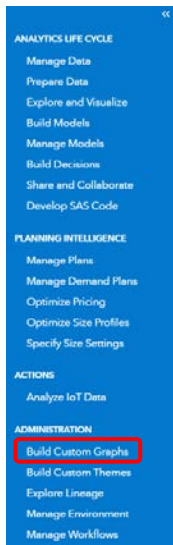


Figure 7. **The “Build Custom Graphs”** Option in the Side Menu

SAS Graph Builder enables a report designer in SAS Visual Analytics to create custom visualizations using the 17 visual graph elements it provides. These graph elements can be

combined through the point and click design environment to build the visualizations you need to convey the stories in your data.

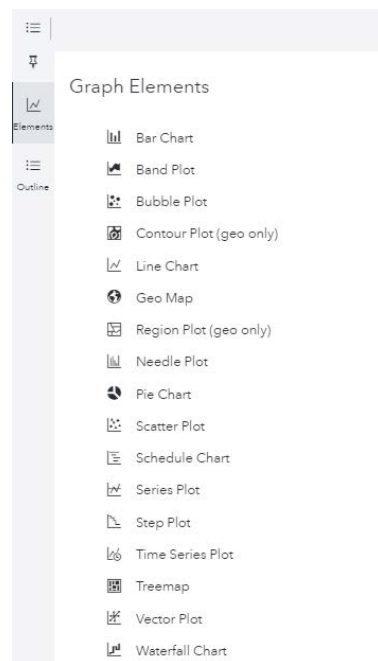


Figure 8. The 17 Custom Graph Elements

The location analytics (or geo) objects that are available for custom visualizations are the following:

- Bubble plot
- Contour plot
- Geo map
- Region plot
- Scatter plot

You can assemble these objects in any combination to create a custom geo object to visualize the geographic content in your data.

HAPPINESS SURVEY + TRAFFIC ACCIDENTS + CULTURAL ACTIVITIES

We have data from a *Happiness Survey* conducted by Research Institute of the Community of Rotterdam (OBI). The survey interviews citizens every two years to determine their overall happiness. The data includes the neighborhood and district where each survey respondent lives. Our custom graph needs two region plot layers to represent the neighborhoods and the districts. A geo region hierarchy would be nice, but unfortunately Rotterdam neighborhoods do not nicely fit into districts in a hierarchical fashion.

We want to explore the impact of traffic accidents and cultural activities on happiness and we have traffic and activities data with that information. Both are coordinate data, so we need two scatter plot layers, as well. To represent all my data in one object, we need a custom geographic object with two region plots and two scatter plots.

Here are the steps for creating the example:

1. Using SAS Graph Builder, drag two region plots and two scatter plot graph elements onto the design canvas, and then add a geo map element for the map background. In SAS Graph Builder, the geo map element does not allow the base map to be

modified. However, once the custom graph is imported into SAS Visual Analytics, the base map can be set to more informative and visually interesting with Esri base maps.

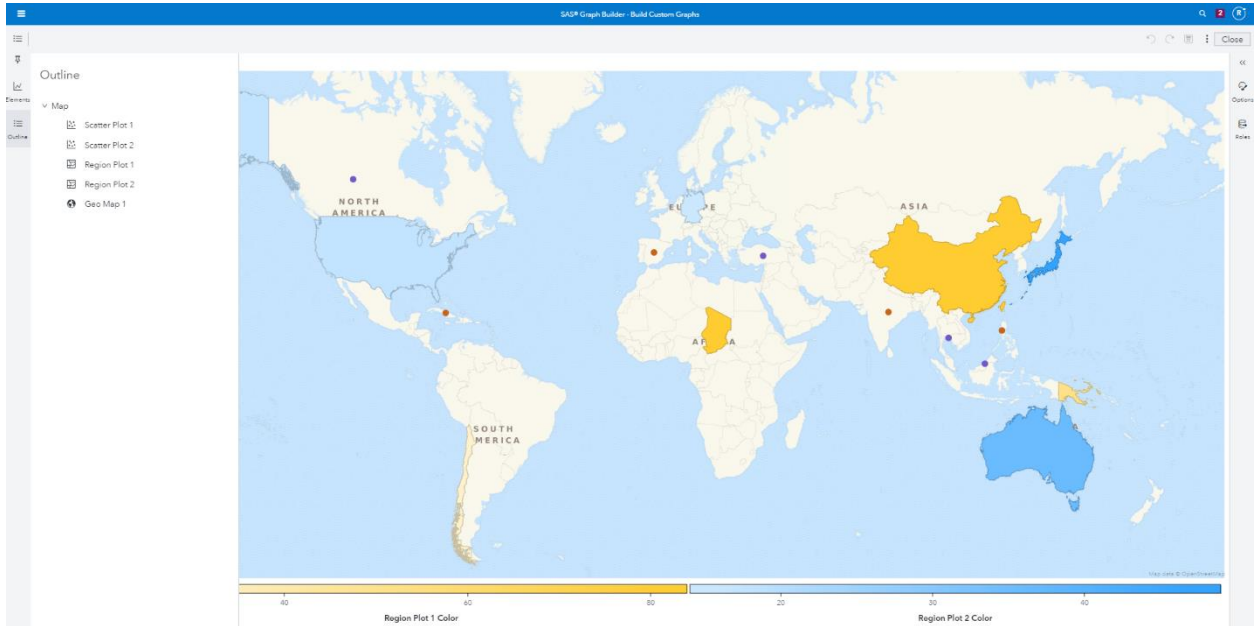


Figure 9. A SAS Graph Builder Custom Object with Two Scatter Plots, Two Region Plots, and a Geo Map Background

2. Save the custom graph to the informative name, `2Regions-2Scatters`. Then, go to SAS Visual Analytics.
3. Import the custom graph object by, clicking the Actions menu in the Objects pane, and selecting Import custom graph.

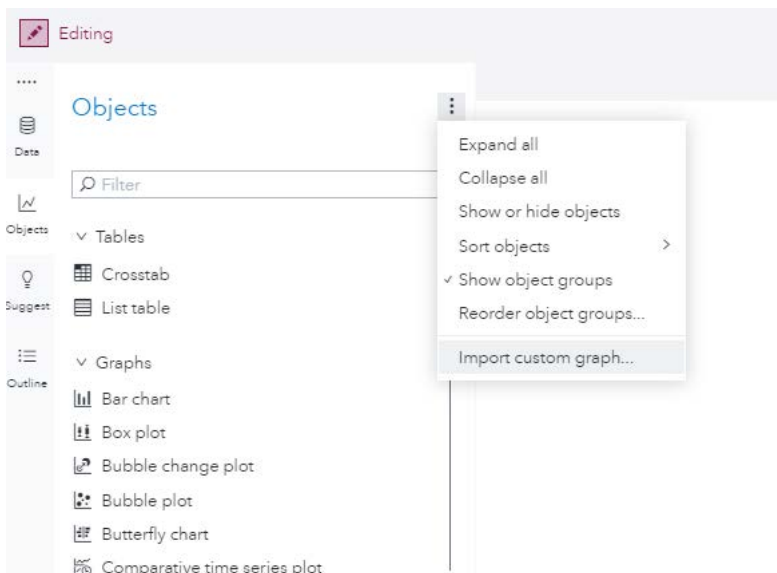


Figure 10. The Actions Menu for Importing Custom Graphs

4. In the Choose an Item window, select the `2Regions-2Scatter` object from the location it was saved from SAS Graph Builder.

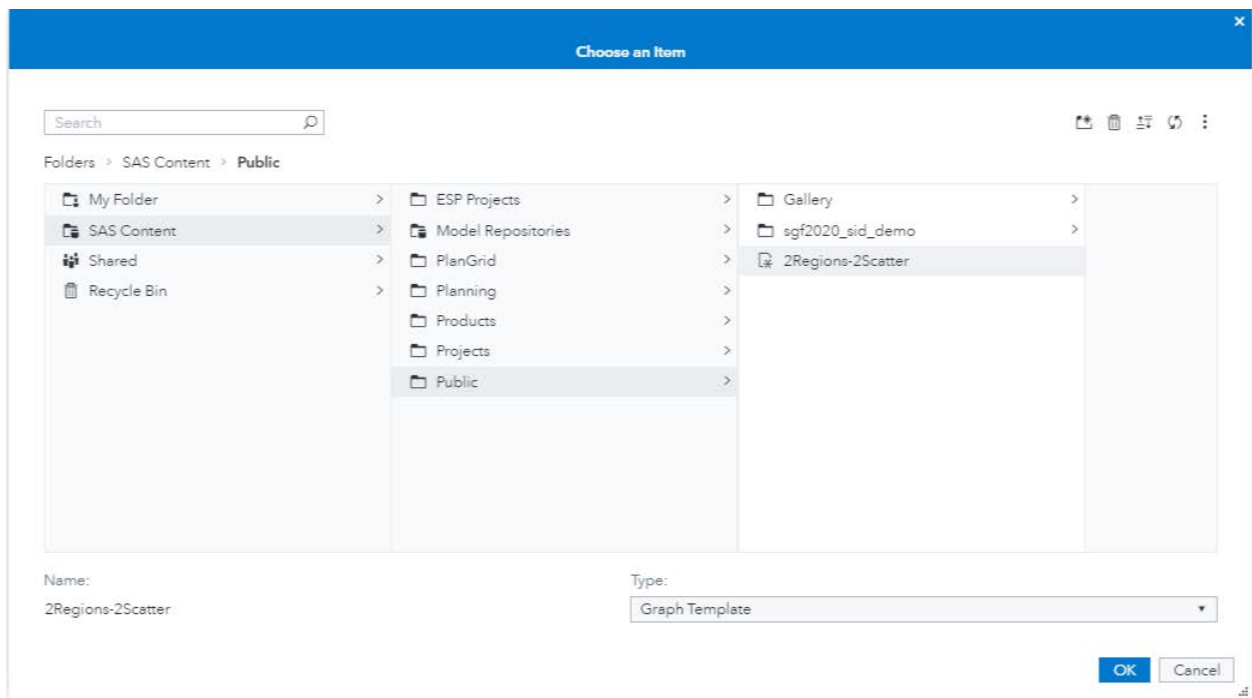


Figure 11. Selecting the Custom Graph

The custom graph is added to the list of available objects in SAS Visual Analytics.

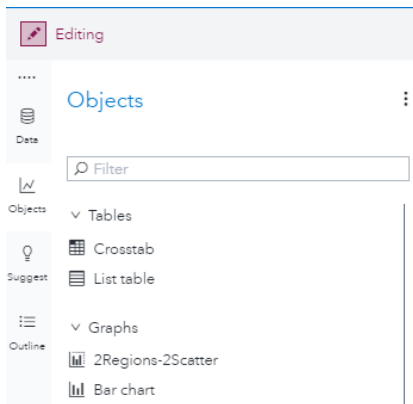


Figure 12. The Custom Graph in the Objects Pane

5. Add the custom graph to a report. You can interact with the imported object while designing or viewing the report in the same ways that you can with any of the out-of-the-box objects.
6. Assign the data roles to the custom object and set the options, which includes setting the base map to a more detailed Esri base map. Your report is ready to view.

With any challenge, you are exploring, attempting to solve, or highlight for others – the devil is in the details, and those details can become obscured by too much information. Enhancing the visual options of graph objects greatly aids in meeting this challenge by providing clarity. Setting the transparency of the overlaid regions allows for the neighborhoods to be viewable through the districts and setting the marker color for traffic accidents to red, and the social activities to green make them stand out.

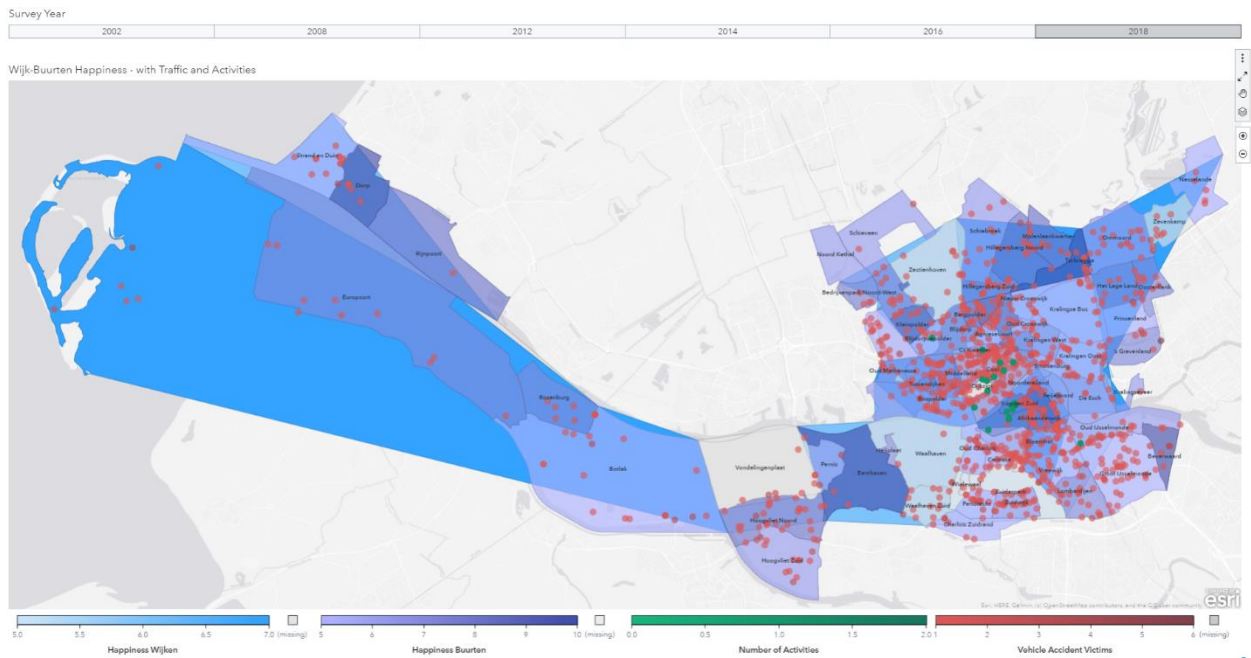


Figure 13. The Custom Object with Four Map Layers

It is often desirable to see all the data at once, but for purposes of exploration and understanding more granular situations, sometimes too much is too much. There is a lot of information being conveyed in this object; however, by simply toggling the visibility of layers **the data has room to "breathe"**.

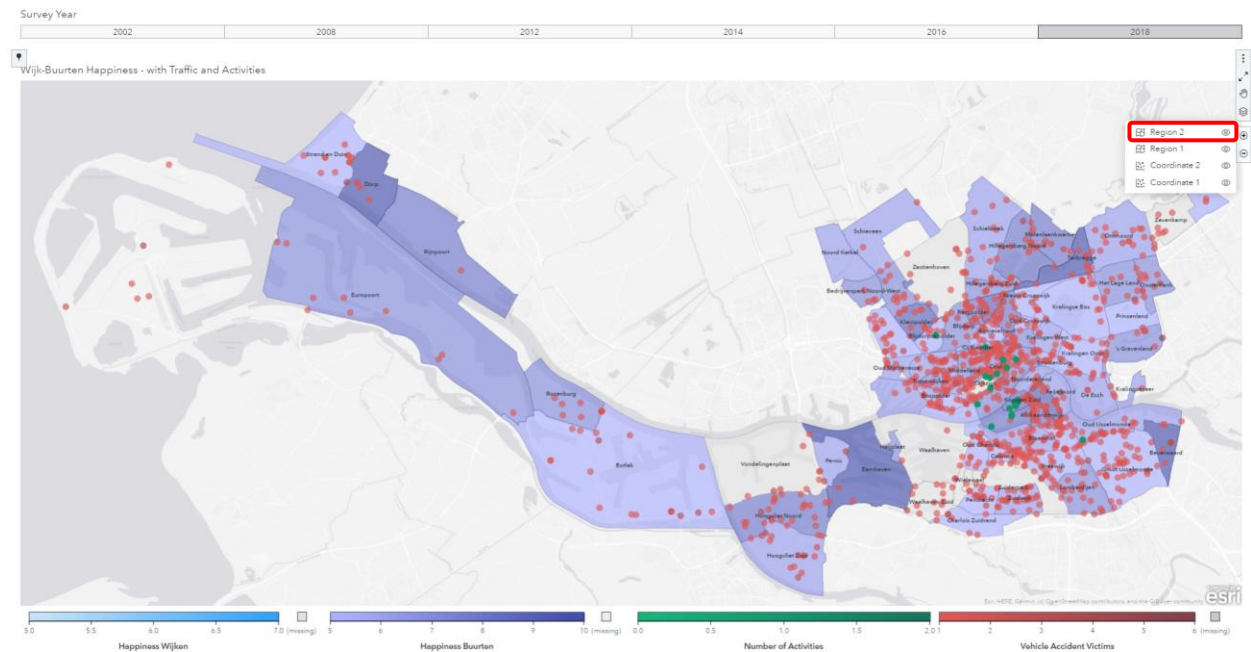


Figure 14. Toggling Off a Layer to Explore Data

Note: The show/hide icon changes in the menu when you toggle layers off and on.

Regardless the data you are exploring, creating custom graph objects provides you with flexible visual exploration options to meet your needs.

CONCLUSION

SAS Visual Analytics provides a wide range of location analytics through native capabilities and integration with Esri ArcGIS Online. Adding location analytics to your reports and explorations helps you better understand what your data has to say.

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Data for Screenshots:

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RECOMMENDED READING

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