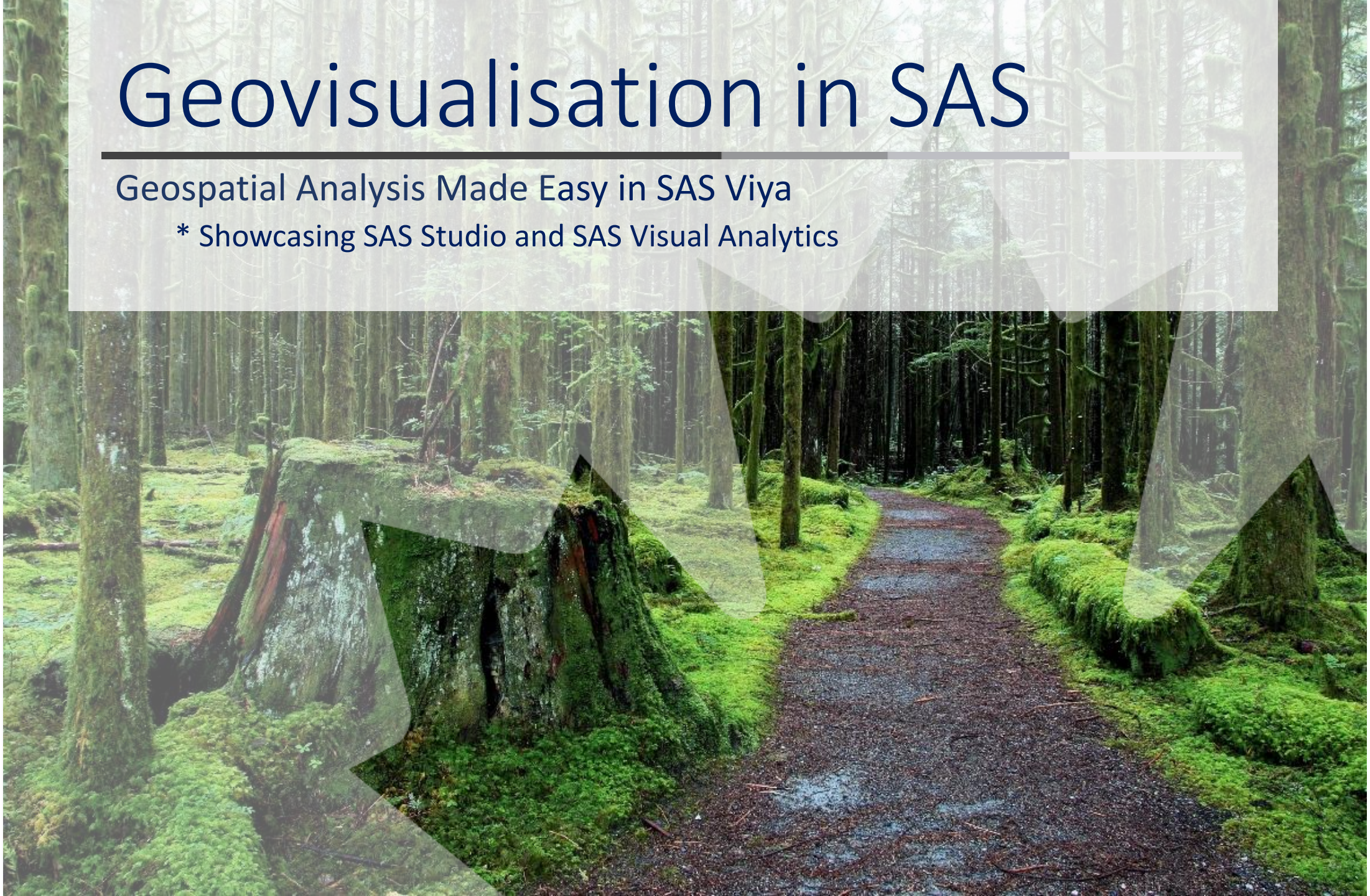
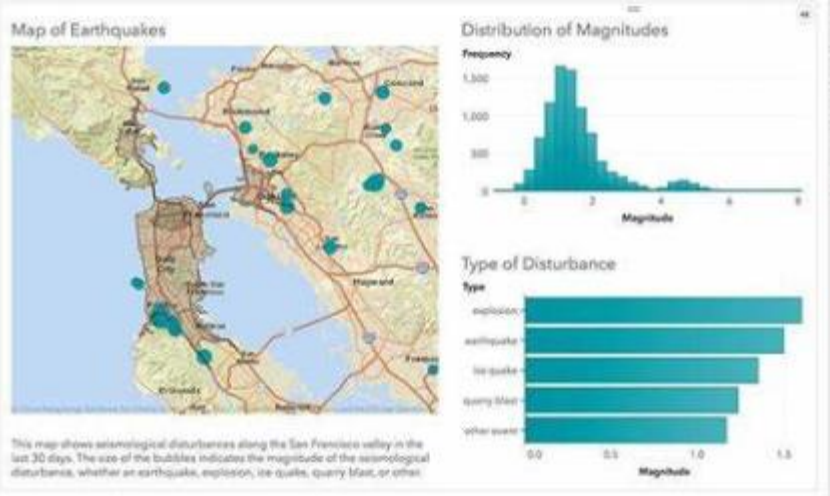
# Geovisualisation in SAS

## Geospatial Analysis Made Easy in SAS Viya

* Showcasing SAS Studio and SAS Visual Analytics



# Agenda



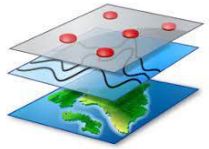

- Introduction
- Geographic analysis and definitions
  - SAS Visual Analytics Infographics
- Exploring the main concepts and demoing in SAS Viya
  - SAS Studio
  - SAS Visual Analytics
- Moving forward with advanced maps in SAS Visual Analytics
- Conclusion

# Geographic Analysis and Definitions

**Geospatial Data**

Information that is portrayed on a map.

- Two dimensions: longitude and latitude only
- Three dimensions: above or below the earth
- Four dimensions: time



**Geovisualisation**

Communicates geospatial information in ways that, when combined with human understanding, allow for data exploration and decision-making processes.

**Geographic Information System (GIS)**

A computer system for capturing, storing, checking, and displaying data related to positions on Earth's surface.

**Combine**

Art, design, science and technology.

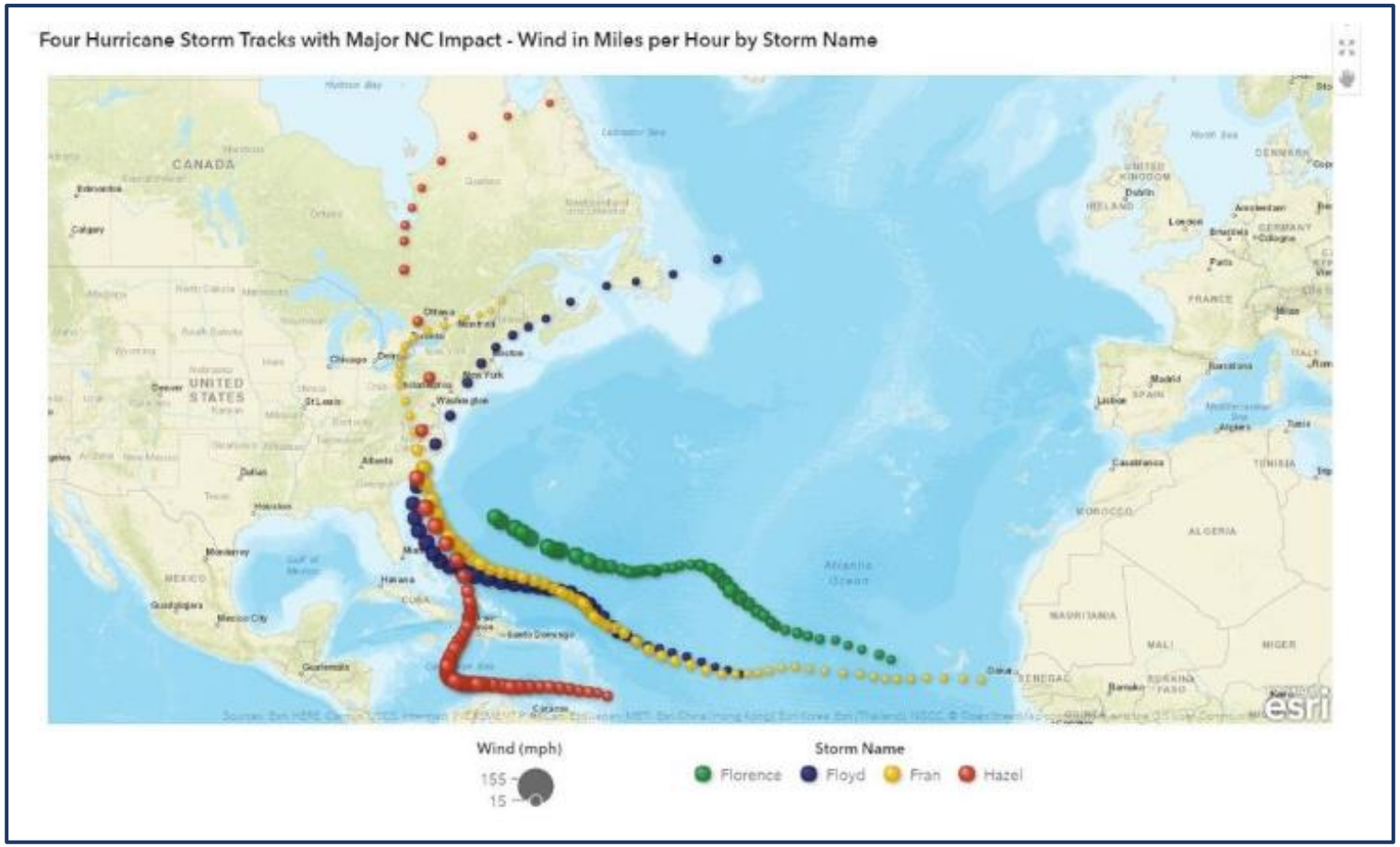
**Support**

Data analytics and graphics applications in decisions-making process.

**Challenges**

- Portray large-scale data and geovisualisation.
- Geospatial multi-scale data integration and analysis.

# The Continuum between Geovisualisation and Analytics



# Flight cancellations and delays in the U.S.

Data: http://www.transportation.gov

SAS Viya

**Cancelled** by Day Of Week

Thursday

Friday Monday

Tuesday Sunday

Saturday

Wednesday

Cancelled

3,567

891

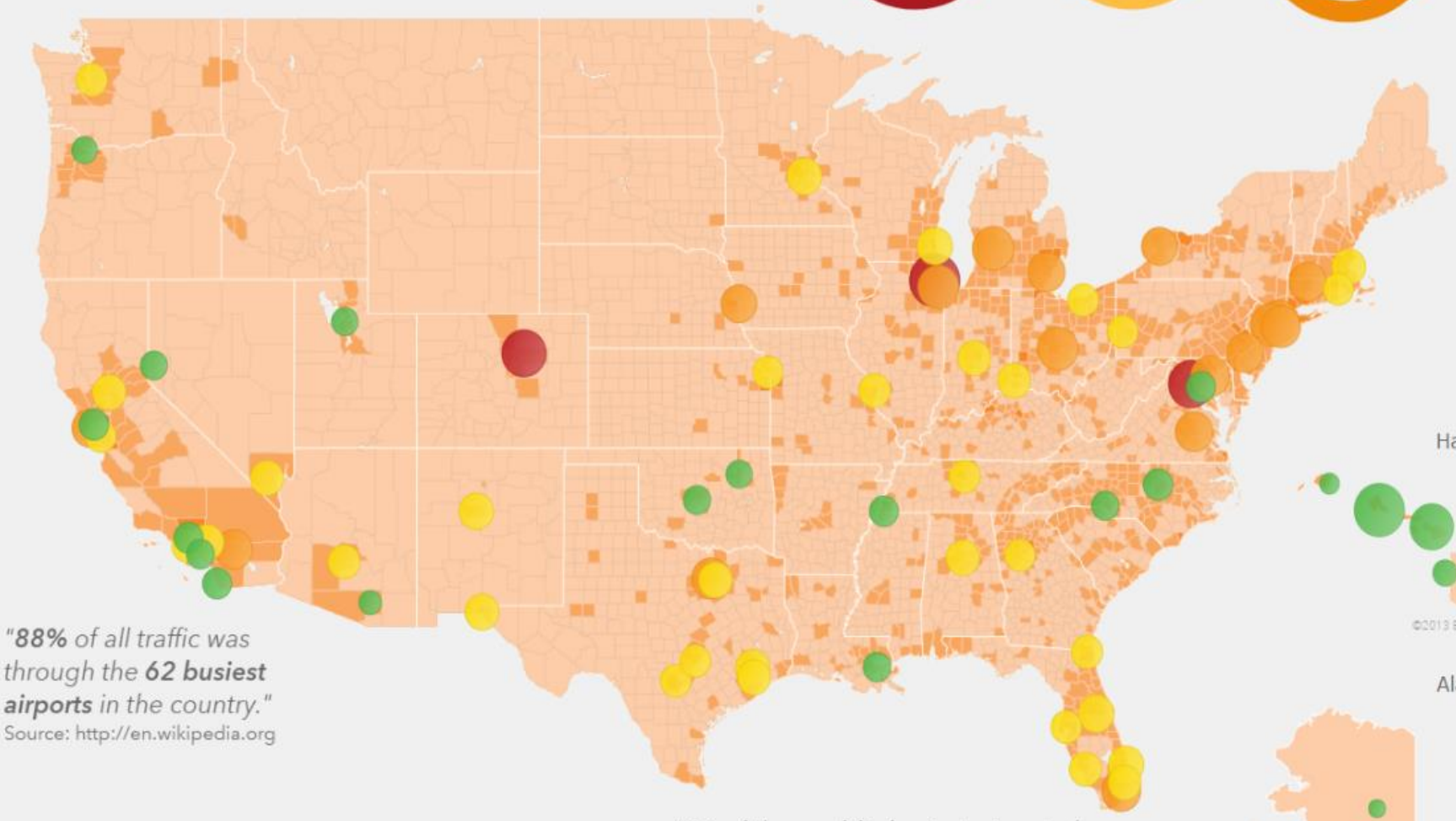
**Reason for cancellation** by frequency

Cancelled 7,018 Weather

Cancelled 2,087 National Air System

Cancelled 2,874 Carrier

**Risk of cancellation** by Airport (with more than 1,000 flights per month)



Hawaii, U.S.

Alaska, U.S.

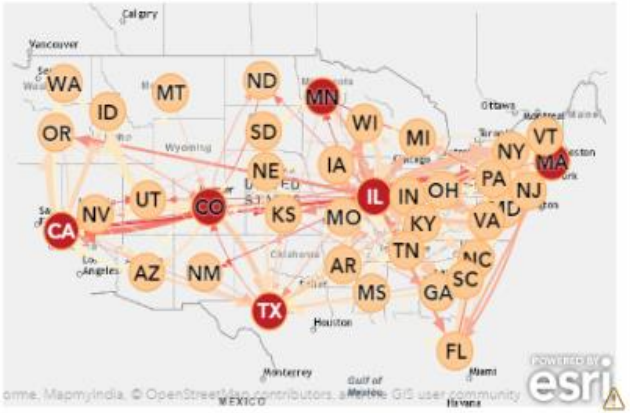
*"**88%** of all traffic was through the **62 busiest airports** in the country."*

Source: http://en.wikipedia.org

*"**16** of the **world's busiest airports** by passenger volume are in the U.S."*

Source: http://en.wikipedia.org

Cross State **Departure Delay**



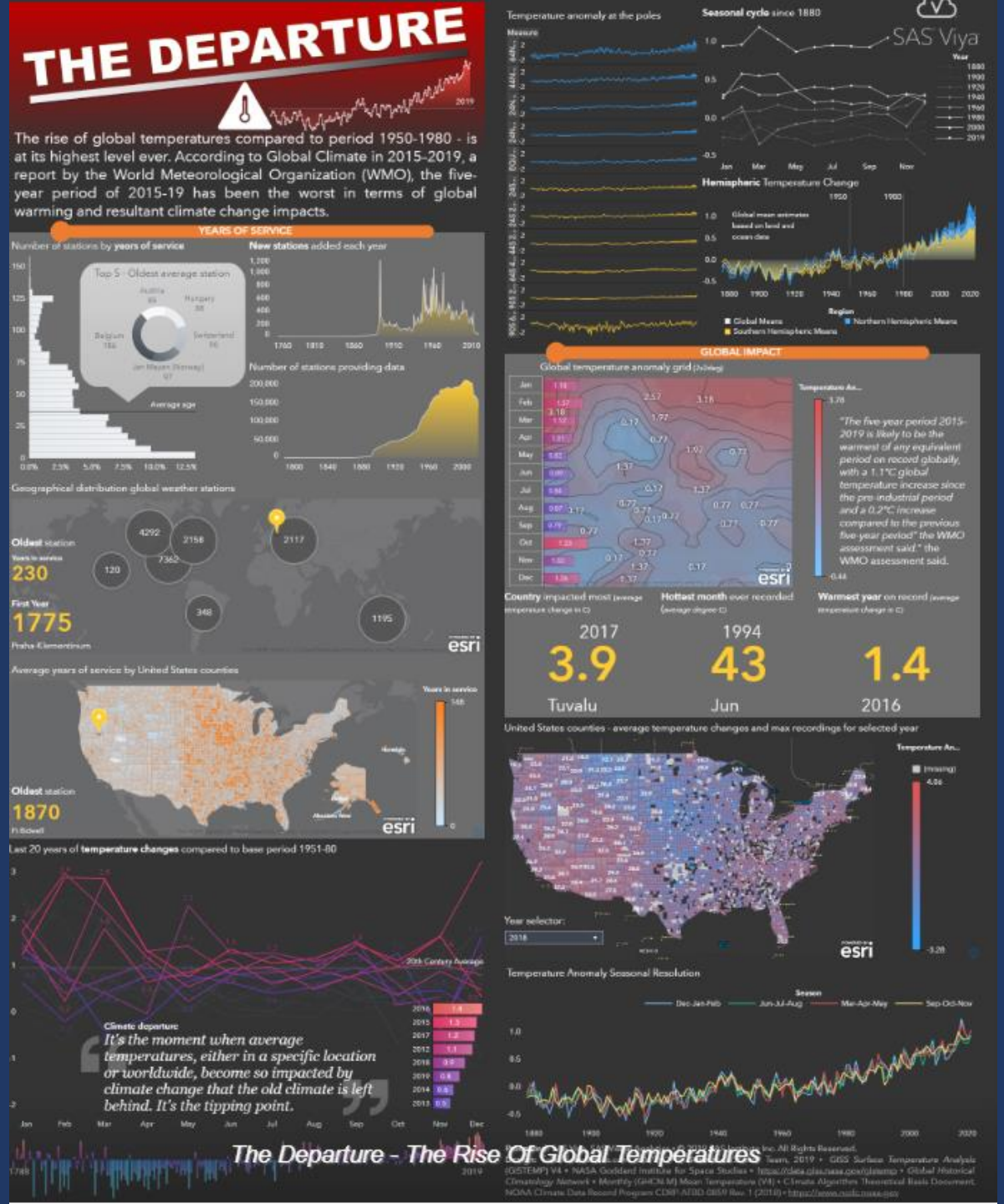

**Arrival Delay, Departure Delay** by Day Of Week

Cancellation Risk Class

Low Medium High Very High

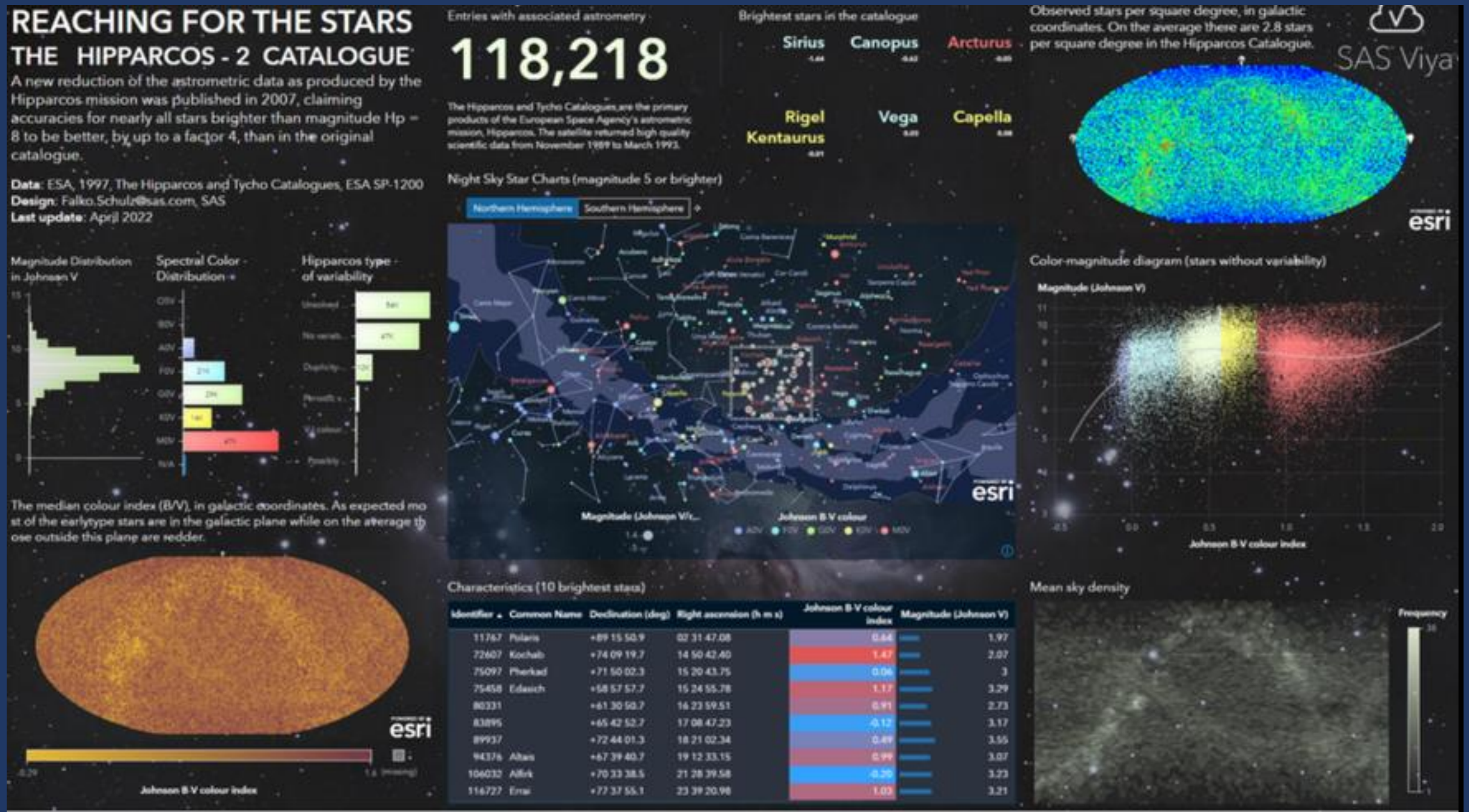
0:20 ≤0:07 Departure Delay (Avg)

Positive Negative




The Departure - The Rise Of Global Temperatures

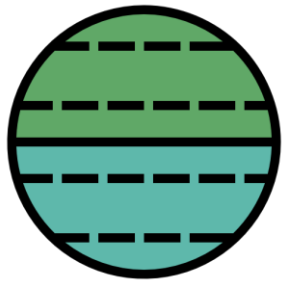
# Reaching for the stars with SAS Visual Analytics - SAS Support Communities



# Requirements for a Geovisualisation

A traditional map data set must contain at least three (3) variables:

**Longitude (X)**



**Latitude (Y)**

**Identification Variable (ID)**

**Identification Variable (ID), Statistic(s) or Information**

# Example of Geo-coordinate Map

| ID | Longitude | Latitude |
|---|---|---|
| Ottawa | -75.713 | 45.395 |
| Toronto | -79.363 | 43.689 |
| Windsor | -82.990 | 42.287 |
| London | -81.228 | 42.986 |
| Belleville | -77.395 | 44.192 |

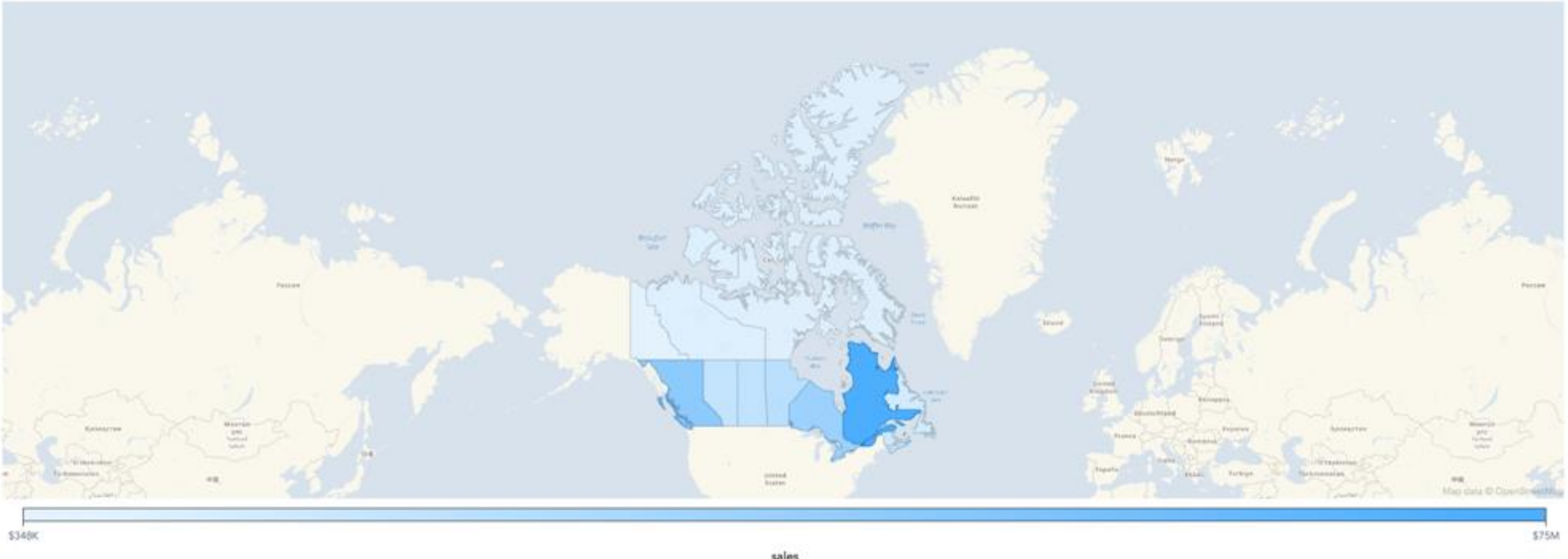
| ID | Unit Sold | Total Sales ($) |
|---|---|---|
| Ottawa | 2,300 | 1,200,000 |
| Toronto | 50,000 | 3,450,000 |
| Windsor | 28,000 | 10,345,000 |
| London | 12,000 | 567,000 |
| Belleville | 6,000 | 450,000 |

**Map tile as a background**

# Choropleth Geovisualisation

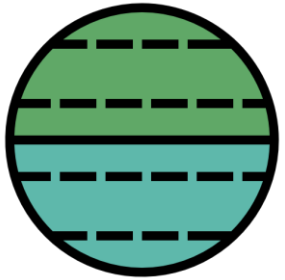
Choropleth map for sales by province in Canada

**Sales by Province Code – Geo Region**



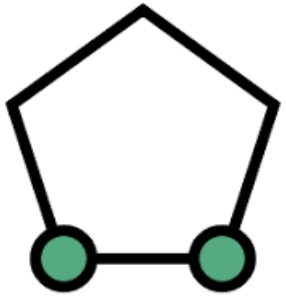
# Requirements for a Choropleth Geovisualisation

**Longitude (X)**

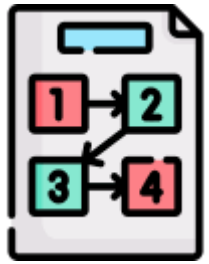


**Latitude (Y)**

**Identification Variable (ID)**



**Segment**




**Sequence**

**Identification Variable (ID), Statistic(s) or Information**

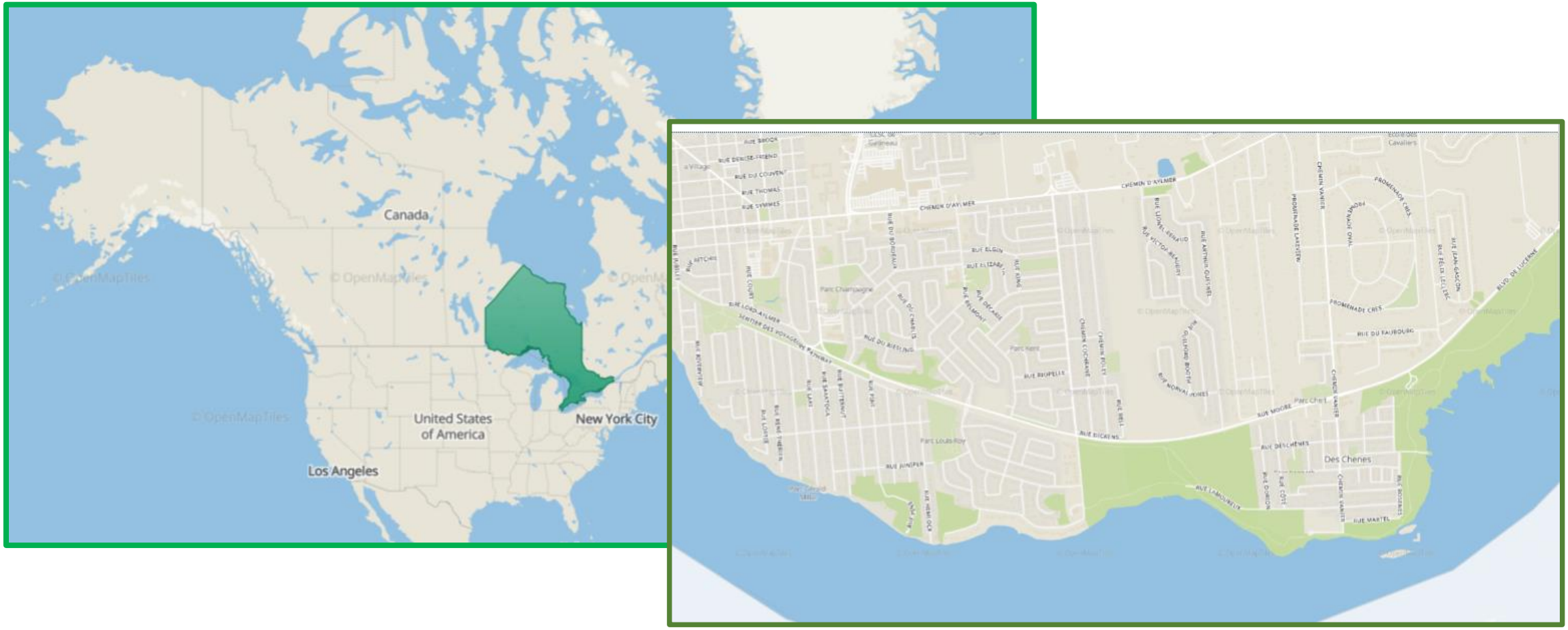
# Example of data needed for a Choropleth Map

**ID**

| Province | Sequence | Segment | Longitude | Latitude |
|---|---|---|---|---|
| Ontario | 1 | 1 | -95.153151 | 52.840573 |
| Ontario | 2 | 1 | -94.977998 | 52.948701 |
| Ontario | 3 | 1 | -94.737225 | 53.095931 |
| Ontario | 4 | 1 | -94.5 | 53.239418 |
| Ontario | 5 | 1 | -94.269735 | 53.37722 |
| Ontario | 6 | 1 | -93.954913 | 53.555865 |
| Ontario | 7 | 1 | -93.702754 | 53.70601 |
| Ontario | 8 | 1 | -93.629883 | 53.750073 |
| Ontario | 9 | 1 | -93.520524 | 53.831454 |
| … | … | … | … | … |

Ontario has a total of 964,286 observations and 267 different areas.

# Background Tile - OpenStreetMap



# Working With Maps Libraries in SAS and ESRI

## MAPSGFK

MAPSGFK data is updated more frequently.

MAPSGFK data sets standardize the variables in the data set.

X and Y variables always contain the projected values.

LONG and LAT variables always contain the unprojected values.

## SAS-ArcGIS Bridge

Enables you to work seamlessly between ArcGIS and SAS.

Seamlessly pass ArcGIS data to SAS.

Access to ArcGIS spatial data, spatial algorithms, and powerful mapping and SAS Visual Analytics capabilities.

## MAPS / MAPSAS

Traditional Maps - data sets contain outdated data. These libraries will not be updated.

Contains X and Y only.

Some traditional maps have unprojected LONG and LAT.

The MAPSSAS library points to the same location as the MAPS library.

# Let’s Take a Deeper Look - MAPSGFK Library

| ID | ID1 | SEGMENT | X | Y | LONG | LAT | RESOLUTION | DENSITY | LAKE |
|---|---|---|---|---|---|---|---|---|---|
| CA-1001 | CA-10 | 1 | 0.47846154 | -0.08423097 | -52.937996 | 48.17102 | 8 | 5 | 0 |
| CA-1001 | CA-10 | 1 | 0.47850072 | -0.08420780 | -52.934159 | 48.170669 | 2 | 2 | 0 |
| CA-1001 | CA-10 | 1 | 0.47850601 | -0.08421955 | -52.934425 | 48.169945 | 8 | 6 | 0 |
| CA-1001 | CA-10 | 1 | 0.47848968 | -0.08424770 | -52.936998 | 48.169251 | 8 | 5 | 0 |
| CA-1001 | CA-10 | 1 | 0.47850018 | -0.08424552 | -52.936182 | 48.168974 | 8 | 6 | 0 |
| CA-1001 | CA-10 | 1 | 0.47850625 | -0.08425884 | -52.936478 | 48.168151 | 8 | 5 | 0 |
| CA-1001 | CA-10 | 1 | 0.478 | | | | | | |
| CA-1001 | CA-10 | 1 | 0.478 | | | | | | |
| CA-1001 | CA-10 | 1 | 0.478 | | | | | | |
| CA-1001 | CA-10 | 1 | 0.478 | | | | | | |
| CA-1001 | CA-10 | 1 | 0.478 | | | | | | |
| CA-1001 | CA-10 | 1 | 0.478 | | | | | | |
| ... | ... | ... | . | | | | | | |

Canada dataset

| ID | ID1 | IDNAME | ID1NAME | ISO | ISOALPHA2 | ISOALPHA3 | CONT | ISONAME | ... |
|---|---|---|---|---|---|---|---|---|---|
| CA-1001 | CA-10 | Division No. 1 | Newfoundland and Labrador | 124 | CA | CAN | 91 | CANADA | ... |
| CA-1002 | CA-10 | Division No. 2 | Newfoundland and Labrador | 124 | CA | CAN | 91 | CANADA | ... |
| CA-1003 | CA-10 | Division No. 3 | Newfoundland and Labrador | 124 | CA | CAN | 91 | CANADA | ... |
| CA-1004 | CA-10 | Division No. 4 | Newfoundland and Labrador | 124 | CA | CAN | 91 | CANADA | ... |
| CA-1005 | CA-10 | Division No. 5 | Newfoundland and Labrador | 124 | CA | CAN | 91 | CANADA | ... |
| CA-1006 | CA-10 | Division No. 6 | Newfoundland and Labrador | 124 | CA | CAN | 91 | CANADA | ... |
| CA-1007 | CA-10 | Division No. 7 | Newfoundland and Labrador | 124 | CA | CAN | 91 | CANADA | ... |
| CA-1008 | CA-10 | Division No. 8 | Newfoundland and Labrador | 124 | CA | CAN | 91 | CANADA | ... |
| CA-1009 | CA-10 | Division No. 9 | Newfoundland and Labrador | 124 | CA | CAN | 91 | CANADA | ... |
| CA-1010 | CA-10 | Division No. 10 | Newfoundland and Labrador | 124 | CA | CAN | 91 | CANADA | ... |
| CA-1011 | CA-10 | Division No. 11 | Newfoundland and Labrador | 124 | CA | CAN | 91 | CANADA | ... |
| CA-1101 | CA-11 | Kings | Prince Edward Island | 124 | CA | CAN | 91 | CANADA | ... |
| ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |

Canada_Attr dataset

# Choropleth Map of Canada by Census Division

**Polygons for Census Division**

| ID | ID1 | SEGMENT | X | Y | LONG | LAT | RESOLUTION | DENSITY | LAKE |
|---|---|---|---|---|---|---|---|---|---|
| CA-1001 | CA-10 | 1 | 0.47846154 | -0.08423097 | -52.937996 | 48.17102 | 8 | 5 | 0 |
| CA-1001 | CA-10 | 1 | 0.47850072 | -0.08420780 | -52.934159 | 48.170669 | 2 | 2 | 0 |
| CA-1001 | CA-10 | 1 | 0.47850601 | -0.08421955 | -52.934425 | 48.169945 | 8 | 6 | 0 |
| CA-1001 | CA-10 | 1 | 0.47848968 | -0.08424770 | -52.936998 | 48.169251 | 8 | 5 | 0 |
| CA-1001 | CA-10 | 1 | 0.47850018 | -0.08424552 | -52.936182 | 48.168974 | 8 | 6 | 0 |
| CA-1001 | CA-10 | 1 | 0.47850625 | -0.08425884 | -52.936478 | 48.168151 | 8 | 5 | 0 |
| CA-1001 | CA-10 | 1 | 0.47850353 | -0.08428912 | -52.938254 | 48.166872 | 5 | 4 | 0 |
| CA-1001 | CA-10 | 1 | 0.47851214 | -0.08429054 | -52.937754 | 48.166499 | 8 | 6 | 0 |
| CA-1001 | CA-10 | 1 | 0.47851273 | -0.08430473 | -52.938461 | 48.165833 | 8 | 6 | 0 |
| CA-1001 | CA-10 | 1 | 0.47852651 | -0.08430858 | -52.937744 | 48.165164 | 8 | 6 | 0 |
| CA-1001 | CA-10 | 1 | 0.47852929 | -0.08432069 | -52.938196 | 48.164514 | 8 | 5 | 0 |
| CA-1001 | CA-10 | 1 | 0.47855027 | -0.08432039 | -52.936779 | 48.163776 | 2 | 2 | 0 |
| ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |

```
proc gmap data = mapsgfk.canada
          map = mapsgfk.canada;
    id id; /*Census Division*/
    choro id / nolegend;
run;
quit;
```

# Choropleth Map of Sales by Census Division

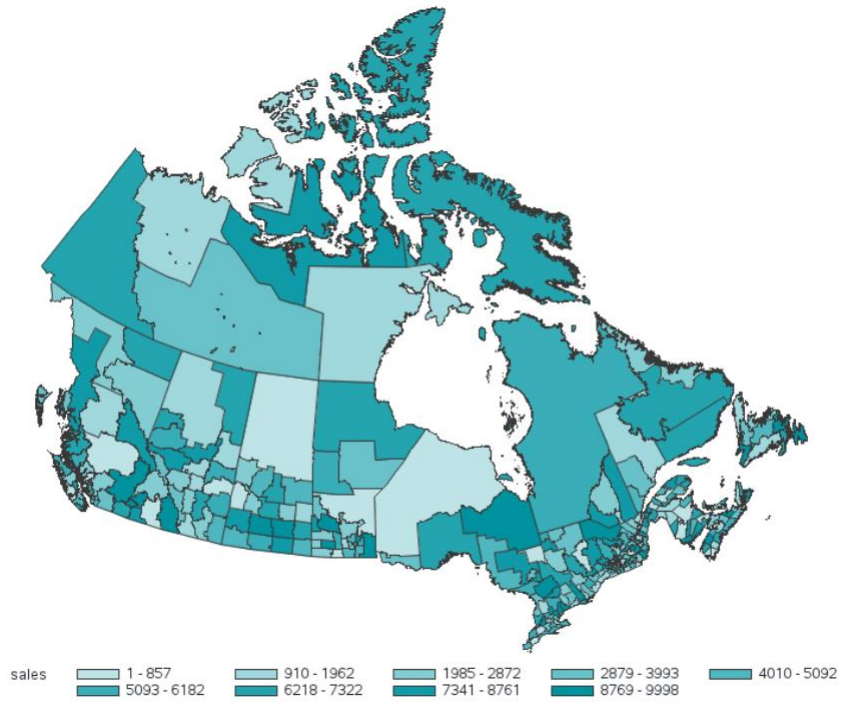
**Polygons by Census Division**

| ID | ID1 | SEGMENT | X | Y | LONG | LAT | RESOLUTION | DENSITY | LAKE |
|---|---|---|---|---|---|---|---|---|---|
| CA-1001 | CA-10 | 1 | 0.47846154 | -0.08423097 | -52.937996 | 48.17102 | 8 | 5 | 0 |
| CA-1001 | CA-10 | 1 | 0.47850072 | -0.08420780 | -52.934159 | 48.170669 | 2 | 2 | 0 |
| CA-1001 | CA-10 | 1 | 0.47850601 | -0.08421955 | -52.934425 | 48.169945 | 8 | 6 | 0 |
| CA-1001 | CA-10 | 1 | 0.47848968 | -0.08424770 | -52.936998 | 48.169251 | 8 | 5 | 0 |
| CA-1001 | CA-10 | 1 | 0.47850018 | -0.08424552 | -52.936182 | 48.168974 | 8 | 6 | 0 |
| CA-1001 | CA-10 | 1 | 0.47850625 | -0.08425884 | -52.936478 | 48.168151 | 8 | 5 | 0 |
| CA-1001 | CA-10 | 1 | 0.47850353 | -0.08428912 | -52.938254 | 48.166872 | 5 | 4 | 0 |
| CA-1001 | CA-10 | 1 | 0.47851214 | -0.08429054 | -52.937754 | 48.166499 | 8 | 6 | 0 |
| CA-1001 | CA-10 | 1 | 0.47851273 | -0.08430473 | -52.938461 | 48.165833 | 8 | 6 | 0 |
| CA-1001 | CA-10 | 1 | 0.47852651 | -0.08430858 | -52.937744 | 48.165164 | 8 | 6 | 0 |
| CA-1001 | CA-10 | 1 | 0.47852929 | -0.08432069 | -52.938196 | 48.164514 | 8 | 5 | 0 |
| CA-1001 | CA-10 | 1 | 0.47855027 | -0.08432039 | -52.936779 | 48.163776 | 2 | 2 | 0 |
| ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |

**Sales by Census Division**

| ID | sales |
|---|---|
| CA-1101 | 5690267 |
| CA-1102 | 12930949 |
| CA-1103 | 7124543 |
| CA-1201 | 14222087 |
| CA-1202 | 11800400 |
| CA-1203 | 5264483 |
| CA-1204 | 5895182 |
| CA-1205 | 2105678 |
| CA-1206 | 14776255 |
| CA-1207 | 2365106 |
| CA-1208 | 3766812 |
| CA-1209 | 35590651 |
| ... | ... |

```
proc gmap map = mapsgfk.canada
          data = work.salesCD;
   id id;
   choro sales;
run;
quit;
```



# Choropleth Map of Sales by Province

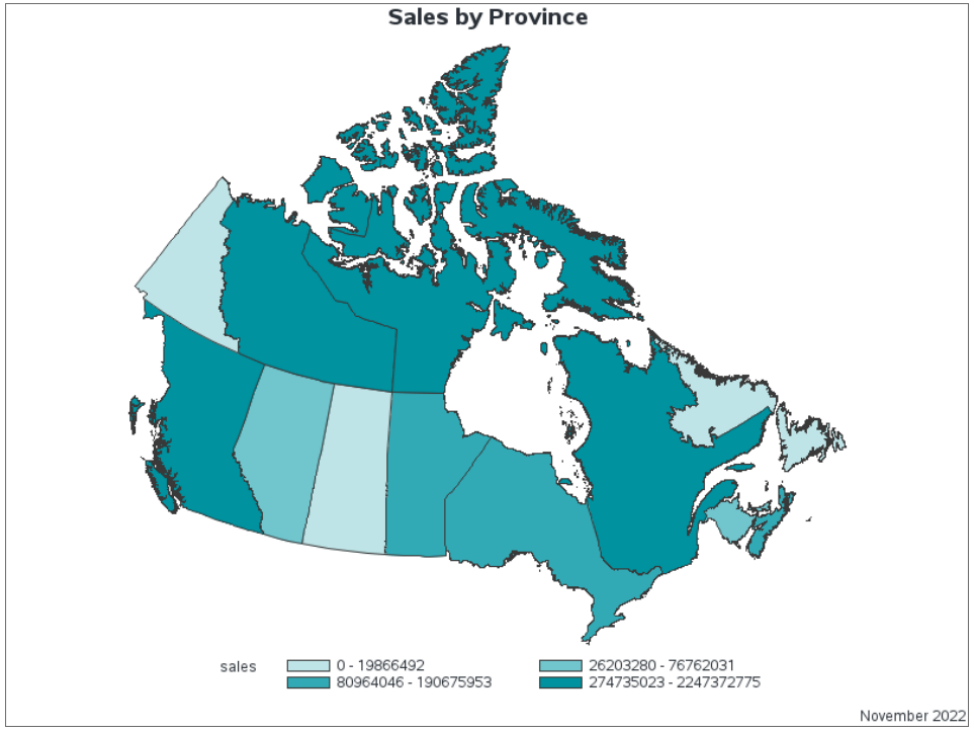
**Sales by Province**

| ID1 | sales |
|---|---|
| CA-10 | 0 |
| CA-11 | 26138649 |
| CA-12 | 184521380 |
| CA-13 | 68176370 |
| CA-24 | 626005533 |
| CA-35 | 191765304 |
| CA-46 | 80693395 |
| CA-47 | 20362971 |
| CA-48 | 77386109 |
| CA-59 | 715953251 |
| CA-60 | 7570923 |
| CA-61 | 276322547 |
| CA-62 | 2243293827 |

```
proc gremove data = mapsgfk.canada (keep = id id1 segment X Y )
        out = work.provinces;
        by id1; /*Province code*/
        id id;    /*Census division code*/
run;

proc gmap map = work.provinces
          data = work.salesProv;
    id id1;
    choro sales;
run;
quit;
```

| ID | ID1 | SEGMENT | X | Y | LONG | | | | |
|---|---|---|---|---|---|---|---|---|---|
| CA-1001 | CA-10 | 1 | 0.47846154 | -0.08423097 | -52.937996 | [illegible] | | | |
| CA-1001 | CA-10 | 1 | 0.47850072 | -0.08420780 | -52.934159 | 48[illegible] | | | |
| CA-1001 | CA-10 | 1 | 0.47850601 | -0.08421955 | -52.934425 | 48[illegible] | | | |
| CA-1001 | CA-10 | 1 | 0.47848968 | -0.08424770 | -52.936998 | 48[illegible] | | | |
| CA-1001 | CA-10 | 1 | 0.47850018 | -0.08424552 | -52.936182 | 48.168974 | 8 | 5 | 0 |
| CA-1001 | CA-10 | 1 | 0.47850625 | -0.08425884 | -52.936478 | 48.168151 | 8 | 5 | 0 |
| CA-1001 | CA-10 | 1 | 0.47850353 | -0.08428912 | -52.938254 | 48.166872 | 5 | 4 | 0 |
| CA-1001 | CA-10 | 1 | 0.47851214 | -0.08429054 | -52.937754 | 48.166499 | 8 | 6 | 0 |
| CA-1001 | CA-10 | 1 | 0.47851273 | -0.08430473 | -52.938461 | 48.165833 | 8 | 6 | 0 |
| CA-1001 | CA-10 | 1 | 0.47852651 | -0.08430858 | -52.937744 | 48.165164 | 8 | 6 | 0 |
| CA-1001 | CA-10 | 1 | 0.47852929 | -0.08432069 | -52.938196 | 48.164514 | 8 | 5 | 0 |
| CA-1001 | CA-10 | 1 | 0.47855027 | -0.08432039 | -52.936779 | 48.163776 | 2 | 2 | 0 |
| ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |




**Polygons for Census Division**

# Choropleth Map of Sales by Country

- ✓ World
- ✓ World_attr
- ✓ World_cities
- ✓ Etc.

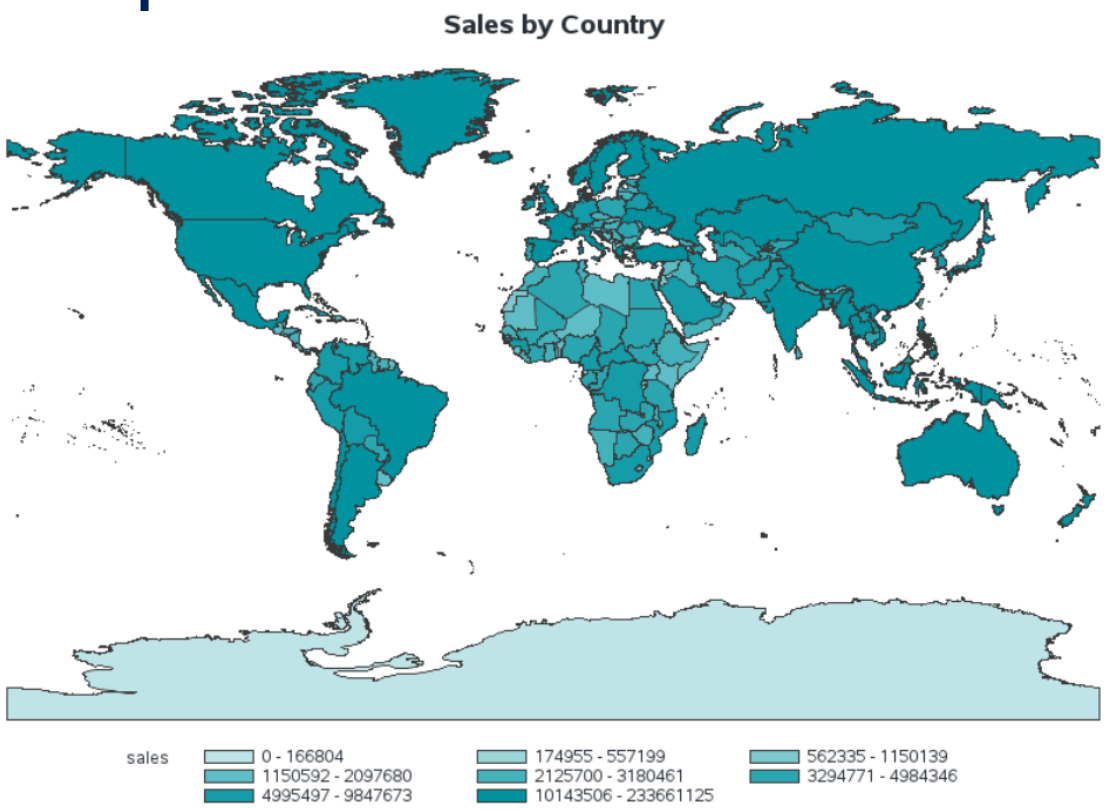
**Sales by Country**

| ID | SALES |
|---|---|
| AD | 136219 |
| AE | 3638396 |
| AF | 4995497 |
| AG | 510843 |
| AI | 174955 |
| AL | 1593326 |
| AM | 1904740 |
| AO | 4647843 |
| AQ | 0 |
| AR | 15884841 |
| ... | ... |

```
proc gmap map = mapsgfk.world
          data = work.sales;
    id id;
    choro sales;
run;
quit;
```

**Polygons by Country**

| ID | IDNAME | SEGMENT | LONG | LAT | X |
|---|---|---|---|---|---|
| AD | Andorra | 1 | 1.725869 | 42.502808 | -17904.5 |
| AD | Andorra | 1 | 1.703392 | 42.491107 | -17905.3 |
| AD | Andorra | 1 | 1.669611 | 42.505067 | -17906.5 |
| AD | Andorra | 1 | 1.656894 | 42.467819 | -17906.9 |
| AD | Andorra | 1 | 1.599332 | 42.468434 | -17908.9 |
| AD | Andorra | 1 | 1.581269 | 42.450062 | -17909.5 |
| ... | ... | ... | ... | ... | ... |



# Choropleth Map in Viya Visual Analytics

**Automation : Loading tables in-memory for Visual Analytics**

```
cas ;
caslib _all_ assign;
```

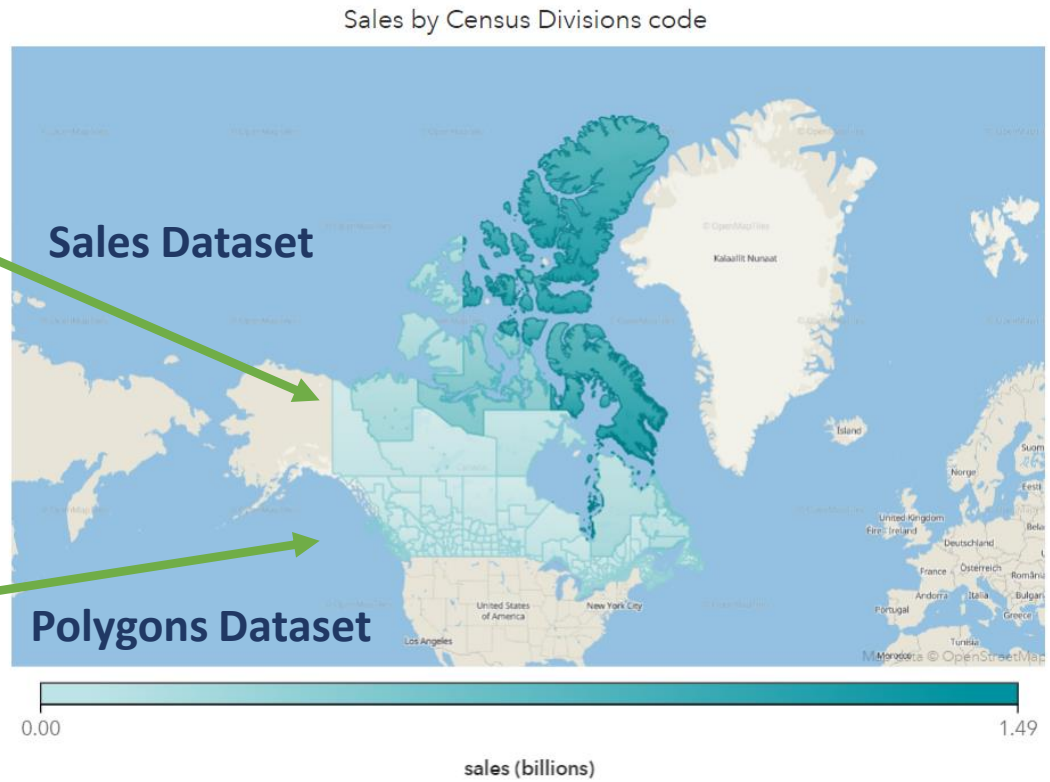
```
proc casutil;
  droptable casdata = “SalesCD" incaslib = "Public" quiet;
run;
```

```
proc casutil;
        load data = work.SalesCD outcaslib = "Public"
        promote casout = "SalesCD";
run;
```

```
proc casutil;
  droptable casdata = "CanadaCD" incaslib = "Public" quiet;
run;
```

```
proc casutil;
        load data = work.CanadaCD outcaslib = "Public"
        promote casout = "CanadaCD";
run;
```

## SAS Visual Analytics Demo



Data : Example - On Cities Example - Provinces Demo

| province | city | Geocoded Latitude (DEGREES) | Geocoded Longitude (DEGREES) |
|---|---|---|---|
| Ontario | Windsor | 42.295 | -82.992 |
| Ontario | London | 42.981 | -81.236 |
| Ontario | Toronto | 43.649 | -79.380 |
| Ontario | Belleville | 44.168 | -77.372 |
| Ontario | Ottawa | 45.421 | -75.697 |

| province | city | sales | UnitSold |
|---|---|---|---|
| Ontario | London | $567,000 | 12,000 |
| Ontario | Ottawa | $1,200,000 | 2,300 |
| Ontario | Toronto | $3,450,000 | 50,000 |
| Ontario | Windsor | $10,345,000 | 28,000 |
| Ontario | Belleville | $450,000 | 6,000 |
| | | **Sum: $16,012,000** | **Sum: 98,300** |

SAS® Visual Analytics - Explore and Visualize

Editing

# VA_01_example_geocodeCities_ON

Demo +

## Data

GEOCODED_ONTARIOCITIES

Filter

+ New data item

Category

- _MATCHED_ - 1
- countryID - 1
- Demo_City - 5
- Demo_Province - 1
- ID1name from map dataset - 1
- ISO Country Name - 1

Geography

city - 5

Name:

city

Classification:

Geography

Category

Geography

Measure

- Frequency
- Geocoded Latitude (DEGREES)
- Geocoded Longitude (DEGREES)
- M_OBS

Clear selection

| nce | city | Geocoded Latitude (DEGREES) | Geocoded Longitude (DEGREES) |
|---|---|---|---|
| | Windsor | 42.295 | -82.992 |
| | London | 42.981 | -81.236 |
| | Toronto | 43.649 | -79.380 |
| | Belleville | 44.168 | -77.372 |
| | Ottawa | 45.421 | -75.697 |

| province | city | sales | UnitSold |
|---|---|---|---|
| Ontario | London | $567,000 | 12,000 |
| Ontario | Ottawa | $1,200,000 | 2,300 |
| Ontario | Toronto | $3,450,000 | 50,000 |
| Ontario | Windsor | $10,345,000 | 28,000 |
| Ontario | Belleville | $450,000 | 6,000 |
| | | Sum: $16,012,000 | Sum: 98,300 |

6 Days Left

SAS® Visual Analytics - Explore and Visualize

Editing

VA_01_example_geocodeCities_ON

Data

GEOCODED_ONTARIOCITIES

Filter

+ New data item

Category

- _MATCHED_ - 1
- countryID - 1
- Demo_City - 5
- Demo_Province - 1
- ID1name from map dataset - 1
- ISO Country Name - 1

Geography

- city - 5
  - Name: city
  - Classification: Geography
- province - 1

Measure

- Frequency
- Geocoded Latitude (DEGREES)
- Geocoded Longitude (DEGREES)
- M_OBS
- sales

Edit Geography Item

Name: city

Based on: city

Geography data source: Latitude and longitude in data

Latitude (y):* Geocoded Latitude (DEGREES)

Longitude (x):* Geocoded Longitude (DEGREES)

Coordinate Space: World Geodetic System (WGS84)

100% mapped

Preview: Scatter

Map data © OpenStreetMap

OK Cancel

6 Days Left

SAS® Visual Analytics - Explore and Visualize

Editing

VA_01_example_geocodeCities_ON

Data

GEOCODED_ONTARIOCITIES

Filter

+ New data item

Category

- _MATCHED_ - 1
- countryID - 1
- Demo_City - 5
- Demo_Province - 1
- ID1name from map dataset - 1
- ISO Country Name - 1

Geography

- city - 5
- province - 1

Name:

province

Classification:

Geography

Measure

- Frequency
- Geocoded Latitude (DEGREES)
- Geocoded Longitude (DEGREES)
- M_OBS
- sales

## Edit Geography Item

Name:

province

Based on:

province

Geography data source:

Geographic name or code lookup

Name or code context:

Subdivision (State, Province) Names

Country/Region:

Canada

100% mapped

Preview:

Scatter

Map data © OpenStreetMap

OK Cancel

6 Days Left

SAS® Visual Analytics - Explore and Visualize

Editing

# VA_01_example_geocodeCities_ON

Data | Example - On Cities | Example - Provinces | Demo

## Sales by Province - Geo Region

$16M

sales

## Sales by City Sized by UnitSold - Geo Cluster

$1.7M

50K

$11M UnitSold

sales (Sum)

## Sales by City Sized by UnitSold - Geo Bubble

$450K

$10M

50K

≤10K

sales

UnitSold

Safari

## Geo Map of Selected Items - Geo Region-coordinate

$16.012

sales (millions)

$2 $4 $6 $8 $10

sales (millions)

50K

2.3K

UnitSold

6 Days Left

## Data Roles

Geo bubble - city 2

- Geography
  - city
- Size
  - UnitSold
- Color
  - sales
- Data tip values
  - city
  - sales
  - UnitSold
  - + Add
- Data labels
  - + Add
- Hidden
  - + Add
- Animation
  - + Add

Data | Objects | Suggest | Outline | Review

Options | Roles | Actions | Rules | Filters | Ranks

## Sales by Province - Geo Region

$16M

sales

## Sales by City Sized by UnitSold - Geo Cluster

$1.7M

$11M

50K

UnitSold

sales (Sum)

## Sales by City Sized by UnitSold - Geo Bubble

$450K

$10M

50K

≤10K

sales

UnitSold

## Geo Map of Selected Items - Geo Region-coordinate

$16.012

sales (millions)

$2 $4 $6 $8 $10

sales (millions)

50K

2.3K

UnitSold

6 Days Left

# Loading Custom Polygons in Visual Analytics

[Census Geography (Statistics Canada)]

**Figure**

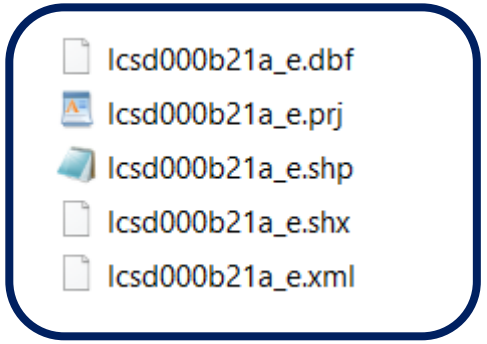
Example of a cartographic boundary file and a digital boundary file (provinces and territories)

# Importing Shapefiles

```
proc mapimport datafile = “/home/kd/lcsd000b21a_e.shp”
                    out = work.statCanPolygons;
run;

proc gproject data = work.statCanPolygons
                out = work.UnprojData
          from = "EPSG:3347"
          to = "EPSG:4326“ ;
          id csduid;
run;

data work.CanadaCSD;
          set work.Unprojdata;
          sequence = _n_;
run;
```



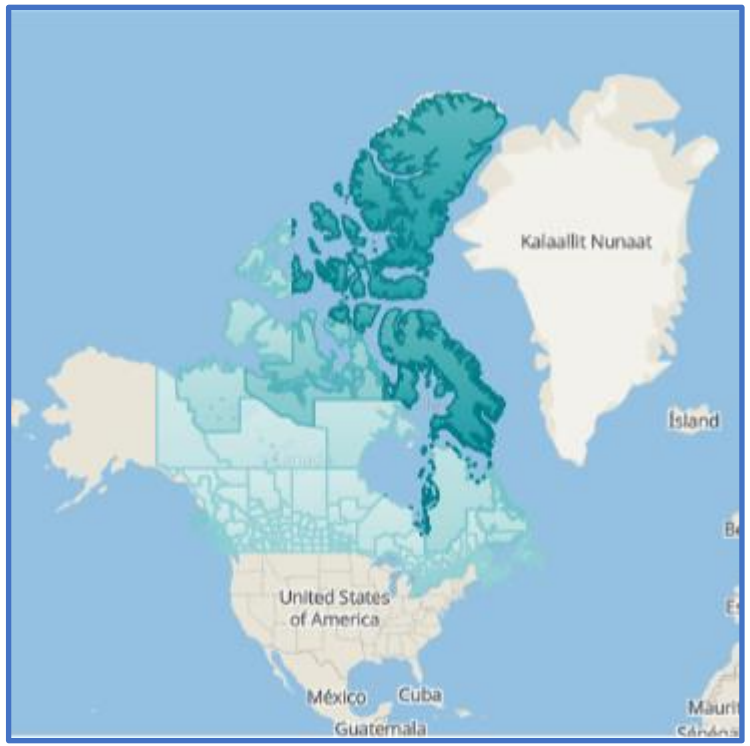

EPSG.io: Coordinate Systems Worldwide

Statistics Canada Lambert - EPSG:3347

World Geodetic System 1984 - EPSG:4326

# Loading Custom Polygons Maps in Visual Analytics

[SAS Visual Analytics Demo]

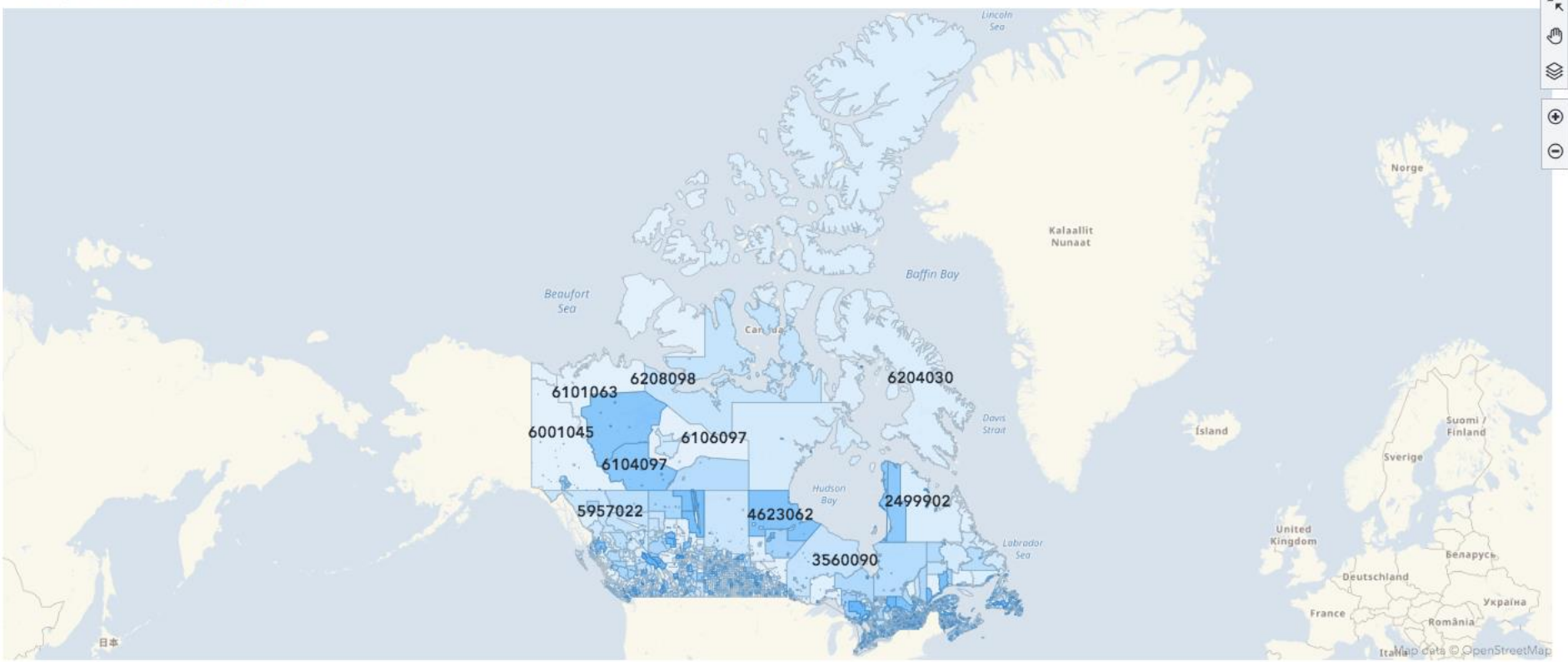


SAS® Visual Analytics - Explore and Visualize

Editing

# VA_02_example_SalesCSD

sales by CSDUID (cartographic)




$0 — $991K

sales

CSDUID (cartographic)

sales

6 Days Left

## Data Roles

Geo region - CSDUID (cartographic) 1

- Geography
  - CSDUID (cartographic)
- Color
  - sales
- Data tip values
  - CSDUID (cartographic)
  - sales
  - + Add
- Data labels
  - + Add
- Data values
  - + Add
- Hidden
  - + Add
- Animation
  - + Add

Data | Objects | Suggest | Outline | Review | Options | Roles | Actions | Rules | Filters | Ranks

SAS® Visual Analytics - Explore and Visualize

Editing

VA_02_example_SalesCSD

Data

CANADASALESCSD

Filter

+ New data item

Category

CSDUID - 831

DEMO_CSDUID - 831

Geography

CSDUID (cartographic) - 831

CSDUID (digital) - 831

Name:

CSDUID (digital)

Classification:

Geography

PRUID - 4

Measure

Frequency

price

sales

unitSold

Aggregated Measure

Frequency Percent

Edit Geography Item

Name:

CSDUID (digital)

Based on:

CSDUID (digital)

Geography data source:

Geographic data provider

Geographic data provider:*

Canada Census Sub-Division Reduced

Click on the dots

ID Column:*

CSDUID (digital)

Latitude (y):

Choose column

Longitude (x):

Choose column

100% mapped

Preview:

Scatter

Map data © OpenStreetMap

OK

Cancel

Data Roles

List table - CSDUID (digital) 1

Columns

CSDUID (digital)

PRUID

CSDUID (cartographic)

sales

+ Add

Hidden

+ Add

6 Days Left

SAS® Visual Analytics - Explore and Visualize

Editing

VA_02_example_SalesCSD

province map (SAS Code) | DATA _ DEMO | DEMO

## Data

CANADASALESCSD

Filter

+ New data item

- Category
  - CSDUID - 831
  - DEMO_CSDUID - 831
- Geography
  - CSDUID (cartographic) - 831
  - CSDUID (digital) - 831
    - Name: CSDUID (digital)
    - Classification: Geography
  - Province - 4
  - PRUID - 4
- Measure
  - Frequency
  - price
  - sales
  - unitSold
- Aggregated Measure
  - Frequency Percent

| PRUID | sales |
|---|---|
| 10 | $325,458 |
| 10 | $66,882 |
| 10 | $10,672 |
| 10 | $336,064 |
| 10 | $14,823 |
| 10 | $165,360 |
| 10 | $116,056 |
| 10 | 1001234 |
| 10 | 1001240 |
| 10 | 1001254 |

Sum:

### Edit Geography Item

Name: CSDUID (digit

Based on: CSDUID (dig

Geography dat: Geographic d

Geographic dat: Canada Ce

ID Column:* CSDUID (di

Latitude (y): Choose colum

Longitude (x): Choose colum

OK | Cancel

### Edit Geographic Data Provider

Name:* Canada Census SD Reduced

Label:* Canada Census Sub-Division Reduced

Type: CAS Table

Server: cas-shared-default

Library: Public

Table: CANADACSD

Delete | OK | Cancel

### Edit Geography Item

Name: CSDUID (digit

Based on: CSDUID (dig

Geography dat: Geographic d

Geographic dat: Canada Ce

ID Column:* CSDUID (di

Latitude (y): Choose colum

Longitude (x): Choose colum

### Edit Geographic Data Provider

CSDUID

Sequence Column: SEQUENCE

Advanced

Segment Column: SEGMENT

Latitude (y) Column: Projected Latitude: PROJ.4

Longitude (x) Column: Projected Longitude: PROJ.4

Coordinate Space:* EPSG:3347

Delete | OK | Cancel

OK | Cancel

## Data Roles

List table - CSDUID (digital) 1

- Columns
  - CSDUID (digital)
  - PRUID
  - CSDUID (cartographic)

6 Days Left

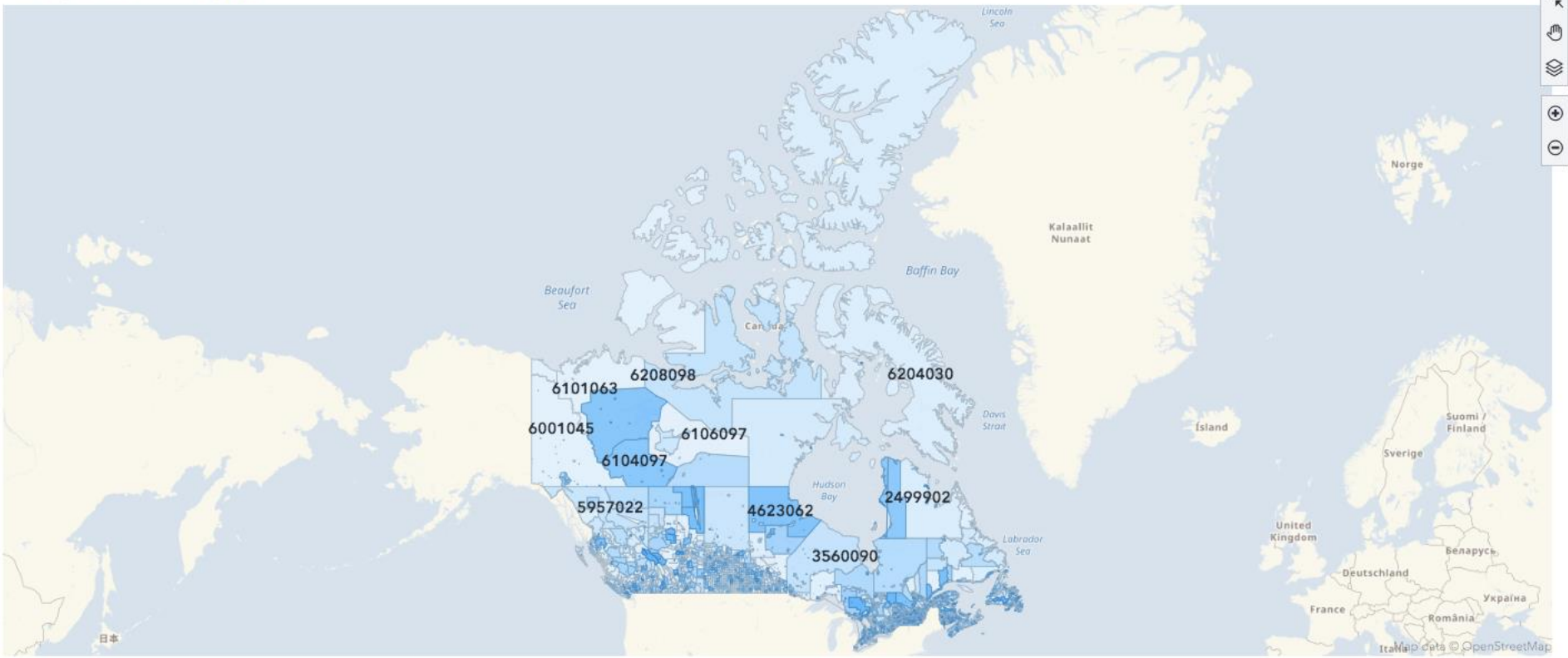
SAS® Visual Analytics - Explore and Visualize

Editing

# VA_02_example_SalesCSD

Data
Objects
Suggest
Outline
Review

sales by CSDUID (cartographic)




$0 — $991K

sales

CSDUID (cartographic)

sales

6 Days Left

## Data Roles

Geo region - CSDUID (cartographic) 1

- Geography
  - CSDUID (cartographic)
- Color
  - sales
- Data tip values
  - CSDUID (cartographic)
  - sales
  - + Add
- Data labels
  - + Add
- Data values
  - + Add
- Hidden
  - + Add
- Animation
  - + Add

Options
Roles
Actions
Rules
Filters
Ranks

# From an Address to a Specific Polygon ID

| Department | Address | City | Province | Country |
|---|---|---|---|---|
| Canada Revenue Agency YT | 300 Main Street | Whitehorse | Yukon | Canada |
| Canada Revenue Agency BC Vic. | 1415 Vancouver Street | Victoria | British Columbia | Canada |
| Canada Revenue Agency BC Van. | 468 Terminal Ave | Vancouver | British Columbia | Canada |
| Canada Revenue Agency AB | 9700 Jasper Avenue | Edmonton | Alberta | Canada |
| Canada Revenue Agency ON | 441 University Avenue West | Windsor | Ontario | Canada |
| Canada Revenue Agency NS | 100-145 Hobsons Lake Drive | Halifax | Nova Scotia | Canada |

**Identification Variable (ID)**

**Proc Geocode**

| Department | Address | City | Longitude | Latitude |
|---|---|---|---|---|
| Canada Revenue Agency YT | 300 Main Street | Whitehorse | -135.055974 | 60.71957152 |
| Canada Revenue Agency BC-VIC | 1415 Vancouver Street | Victoria | -123.355785 | 48.42679649 |
| Canada Revenue Agency BC VAN | 468 Terminal Ave | Vancouver | -123.094106 | 49.27160868 |
| Canada Revenue Agency AB | 9700 Jasper Avenue | Edmonton | -113.486536 | 53.54278264 |
| Canada Revenue Agency ON | 441 University Avenue West | Windsor | -83.0438512 | 42.31649555 |
| Canada Revenue Agency NS | 100-145 Hobsons Lake Drive | Halifax | -63.6749374 | 44.64124729 |

| Polygon |
|---|
| ? |
| ? |
| ? |
| ? |
| ? |
| ? |

**Proc Ginside**

| Polygon |
|---|
| A |
| B |
| B |
| C |
| D |
| E |

# From an Address to a Specific Polygon ID (2)

```
proc ginside data = work.craOffice
             map = work.canadaCSD
             out = work.craOfficeCSD;
        id CSDUID;
run;
```

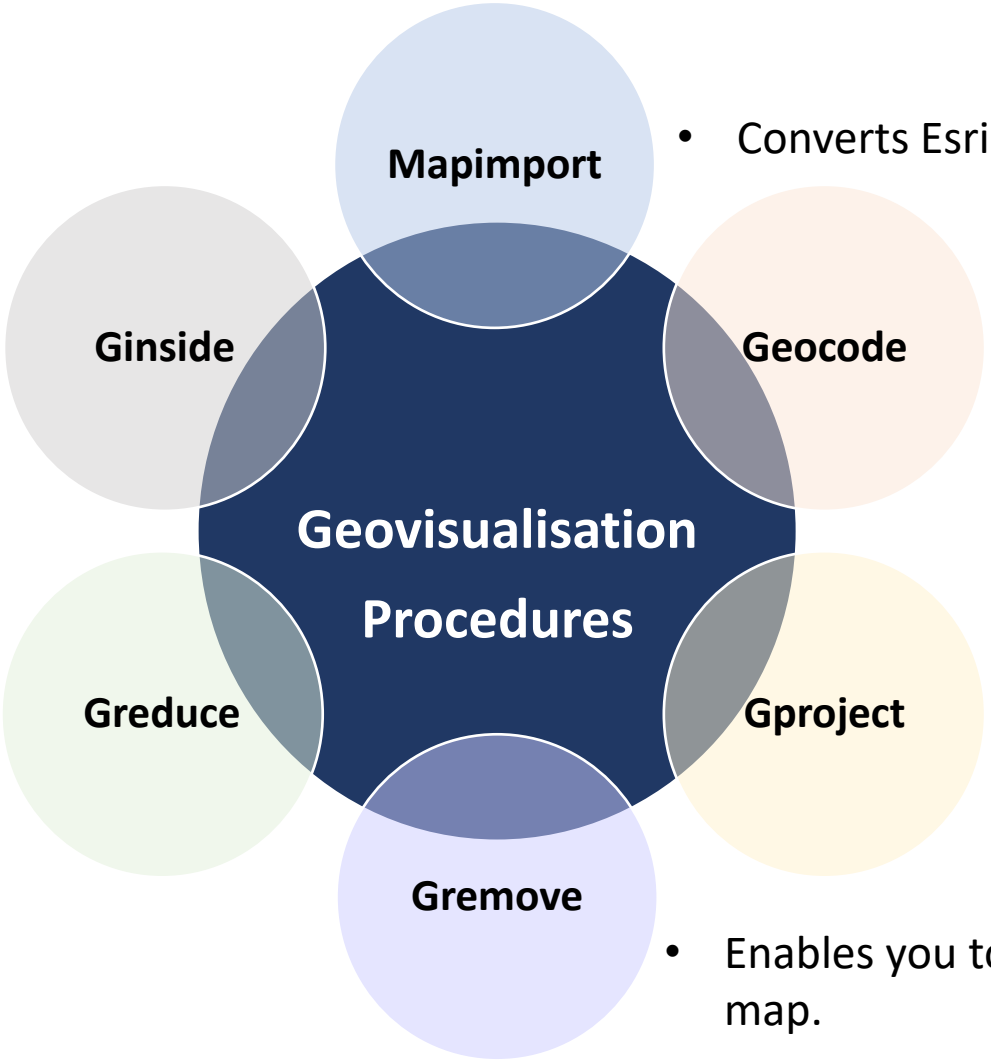
**SAS Visual Analytics Demo**

Assigning the proper Census Subdivision (CSD) code

| Department | Address | City | Longitude | Latitude | Census Sub-Division |
|---|---|---|---|---|---|
| Canada Revenue Agency YT | 300 Main Street | Whitehorse | -135.055974 | 60.71957152 | ? |
| Canada Revenue Agency BC Vic. | 1415 Vancouver Street | Victoria | -123.355785 | 48.42679649 | ? |
| Canada Revenue Agency BC Van. | 468 Terminal Ave | Vancouver | -123.094106 | 49.27160868 | ? |
| Canada Revenue Agency AB | 9700 Jasper Avenue | Edmonton | -113.486536 | 53.54278264 | ? |
| Canada Revenue Agency ON | 441 University Avenue West | Windsor | -83.0438512 | 42.31649555 | ? |
| Canada Revenue Agency NS | 100-145 Hobsons Lake Drive | Halifax | -63.6749374 | 44.64124729 | ? |

| Census Sub-Division |
|---|
| 6001009 |
| 5917034 |
| 5915022 |
| 4811061 |
| 3537039 |
| 1209034 |

# SAS Procs Related to GIS (A Review)




- Converts Esri shapefiles into SAS map data sets.

- Compares a data set of X and Y coordinates to a map data set containing map polygons.

- Adds geographic coordinates to data sets that contain information such as street addresses. The coordinates typically represent the center of a geographic region.

- Enables you to reduce the number of points in the data set.

- Enables you to choose how geographic maps are projected.

- Enables you to remove boundary lines within a map.

# Advanced Maps in Visual Analytics

- Geo Bubble
- Geo Cluster
- Geo Contour
- Geo Coordinates
- Geo Line
- Geo Line-Coordinate
- Geo Network
- Geo Pie
- Geo Region
- Geo Region-Coordinate

SAS Visual Analytics Demo

# Examples

SAS® Visual Analytics - Explore and Visualize

Editing

VA_03_example_SalesProvinces

Data ALL | Data | Dashboards | Sales Geo Pie | Census Division | Page 6 | +

Data | Objects | Suggest | Outline | Review

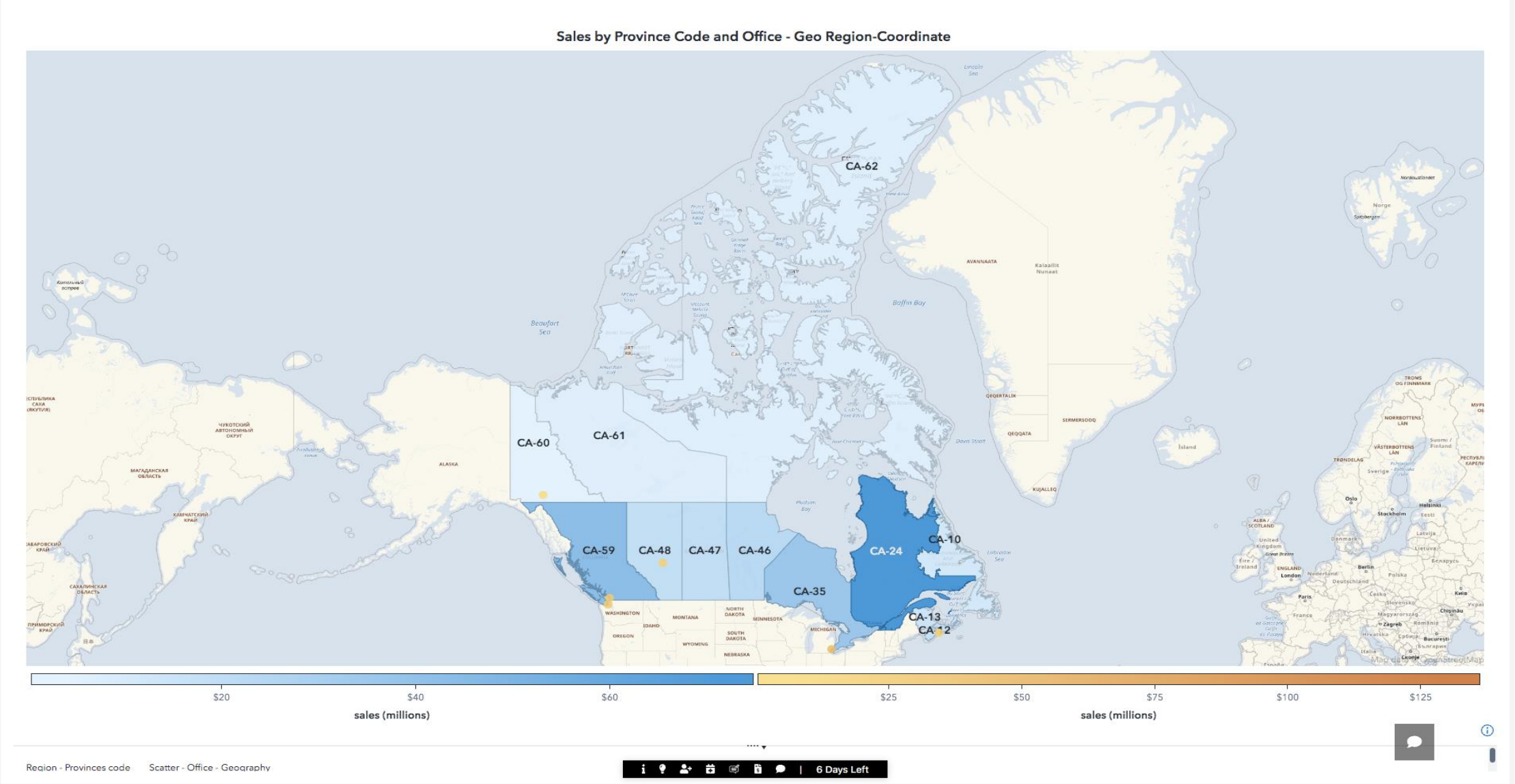
Options | Roles | Actions | Rules | Filters | Ranks

| Provinces code | Office | origin | price | sales | unitSold | Longitude | Latitude |
|---|---|---|---|---|---|---|---|
| CA-10 | | Americas | $934 | $2,695,467 | 3,044 | . | . |
| CA-10 | | EMEA | $742 | $1,633,391 | 2,391 | . | . |
| CA-10 | | Asian Pacific | $1,140 | $3,465,155 | 3,050 | . | . |
| CA-11 | | EMEA | $720 | $550,554 | 682 | . | . |
| CA-11 | | Americas | $831 | $373,955 | 570 | . | . |
| CA-11 | | Asian Pacific | $718 | $407,467 | 404 | . | . |
| CA-12 | Nova Scotia | EMEA | $829 | $3,843,293 | 5,073 | -1146.148874 | 803.54245122 |
| CA-12 | Nova Scotia | Americas | $1,134 | $4,813,073 | 4,606 | -1146.148874 | 803.54245122 |
| CA-12 | Nova Scotia | Asian Pacific | $1,166 | $4,952,614 | 4,414 | -1146.148874 | 803.54245122 |
| CA-13 | | EMEA | $1,260 | $3,881,378 | 3,090 | . | . |
| CA-13 | | Asian Pacific | $988 | $3,523,826 | 3,514 | . | . |
| CA-13 | | Americas | $963 | $3,261,052 | 3,060 | . | . |
| CA-24 | | EMEA | $1,052 | $27,113,877 | 27,185 | . | . |
| CA-24 | | Asian Pacific | $1,060 | $26,427,314 | 25,281 | . | . |
| CA-24 | | Americas | $931 | $21,195,665 | 23,466 | . | . |
| CA-35 | Ontario | EMEA | $950 | $11,319,220 | 12,349 | -4069.148708 | 2073.5082819 |
| CA-35 | Ontario | Asian Pacific | $873 | $9,804,400 | 11,414 | -4069.148708 | 2073.5082819 |
| CA-35 | Ontario | Americas | $960 | $14,026,534 | 14,898 | -4069.148708 | 2073.5082819 |
| CA-46 | | EMEA | $1,085 | $7,811,677 | 7,110 | . | . |
| CA-46 | | Asian Pacific | $1,050 | $6,474,265 | 5,402 | . | . |
| CA-46 | | Americas | $978 | $5,919,939 | 5,395 | . | . |
| CA-47 | | EMEA | $1,282 | $6,555,347 | 5,143 | . | . |
| CA-47 | | Asian Pacific | $1,096 | $5,917,690 | 5,272 | . | . |
| CA-47 | | Americas | $1,064 | $3,925,810 | 4,020 | . | . |
| CA-48 | Alberta | EMEA | $947 | $5,896,149 | 6,231 | -2156.244186 | 1017.3128702 |
| CA-48 | Alberta | Asian Pacific | $887 | $4,462,443 | 5,389 | -2156.244186 | 1017.3128702 |
| CA-48 | Alberta | Americas | $1,015 | $5,393,478 | 5,250 | -2156.244186 | 1017.3128702 |
| CA-59 | British Columbia Victoria | Americas | $946 | $6,666,571 | 7,286 | -3577.317759 | 1404.3770982 |
| CA-59 | British Columbia Vancouver | EMEA | $1,240 | $9,042,243 | 7,778 | -3569.729086 | 1428.8766517 |

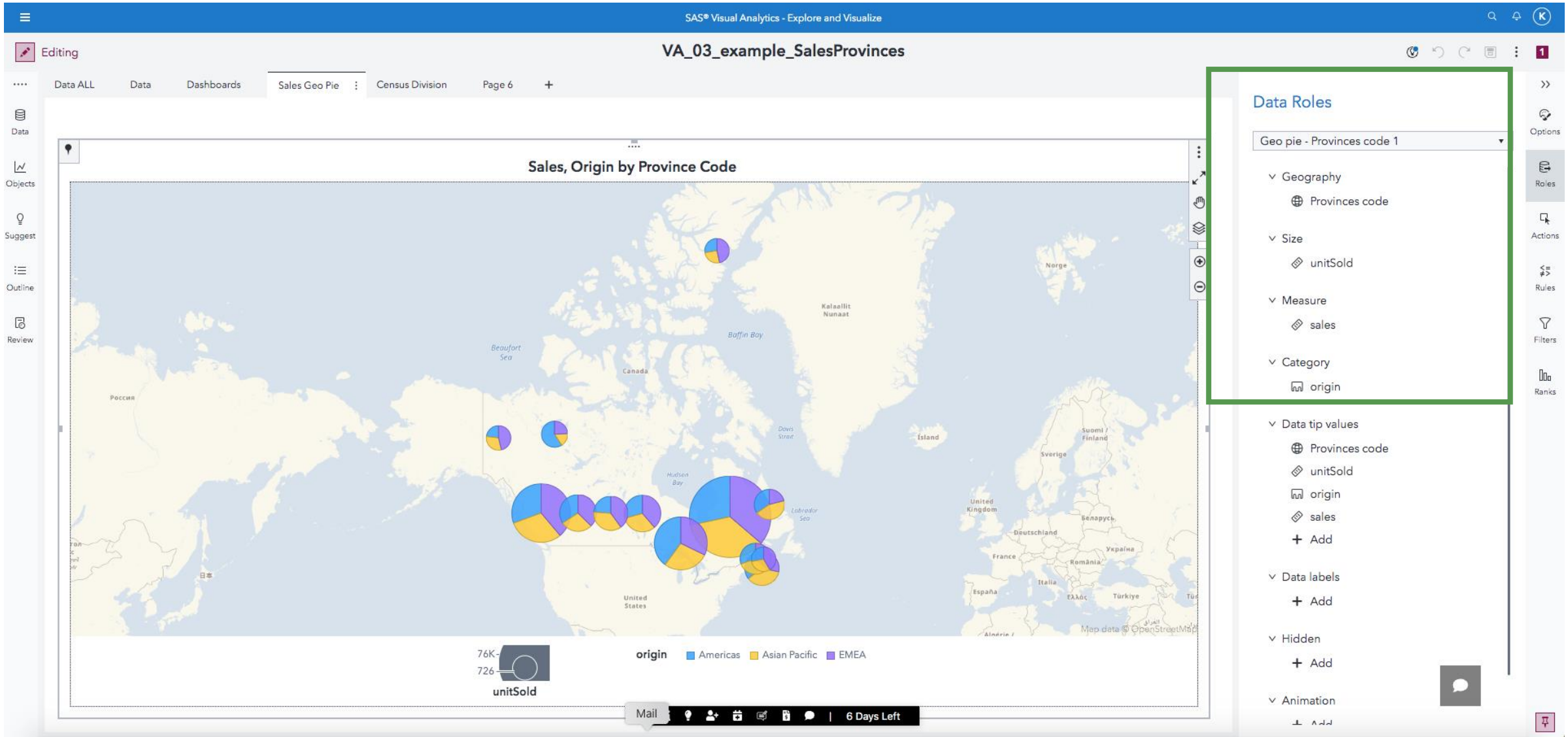
Safari

6 Days Left

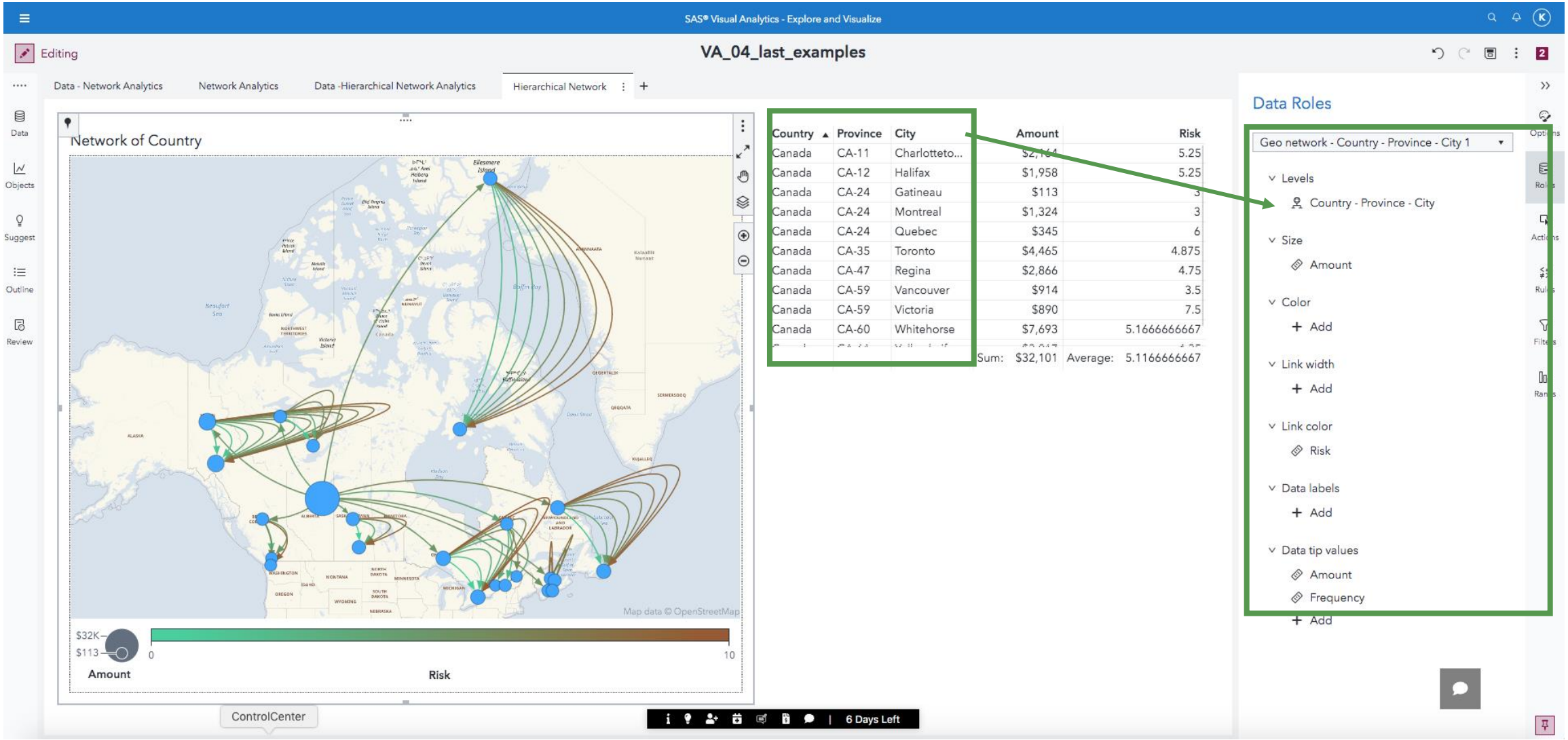
# Example (1): Geo-Region Coordinates Map



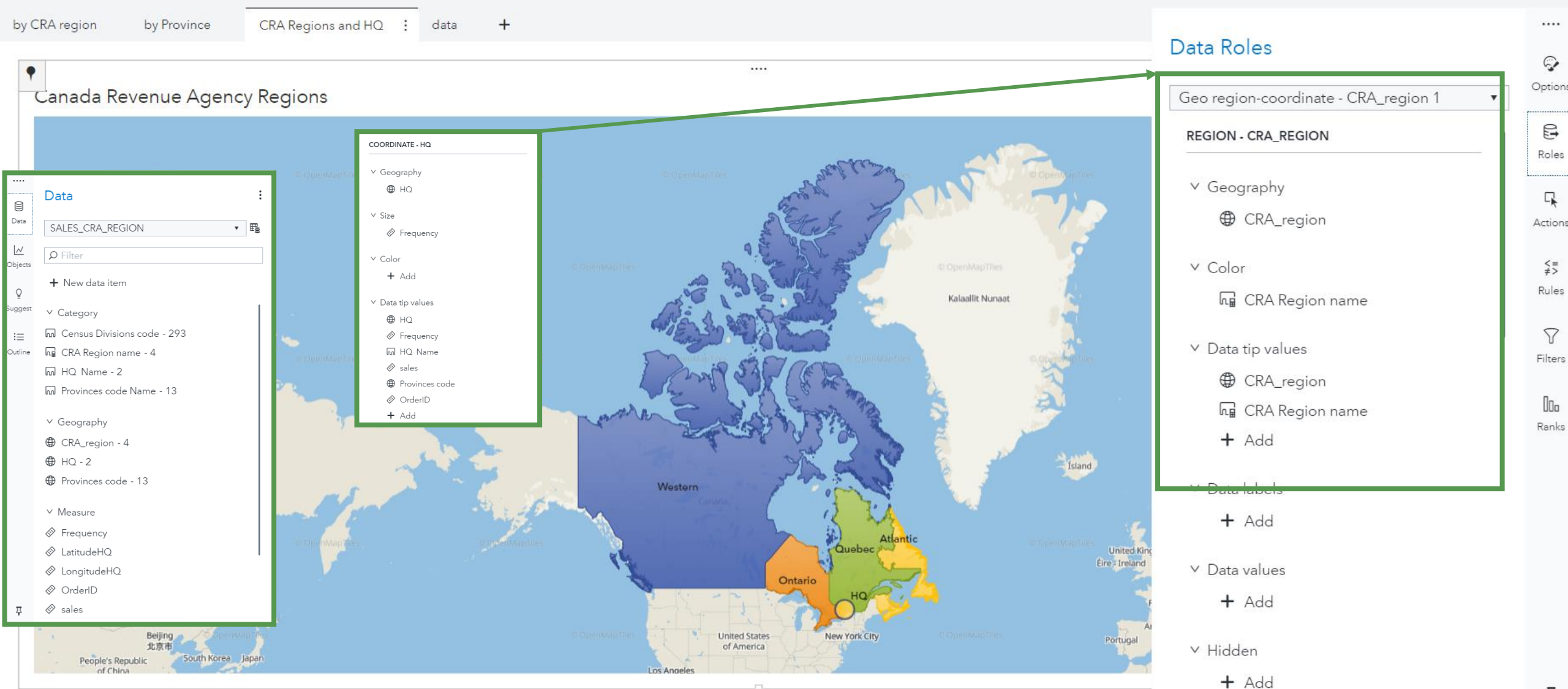
# Example (2): Geo Pie



# Example (3): Network on Map

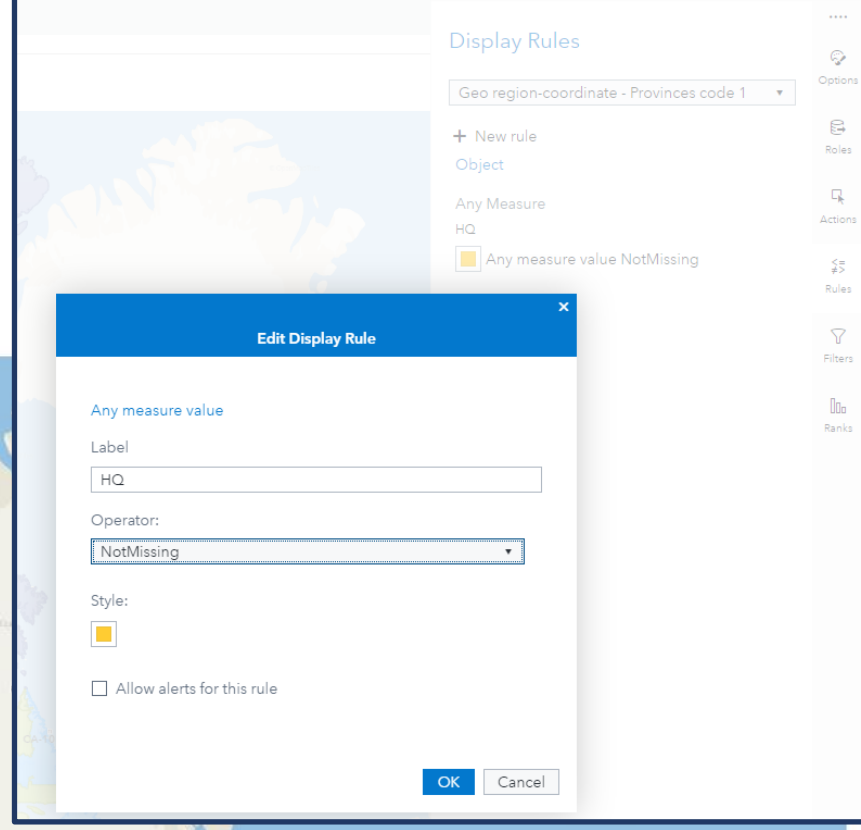


# Example (4): Display CRA Regions



# Display CRA Regions

Canada Revenue Agency Regions



# Conclusion - Takeaways

✓ **SAS Visual Analytics bring accelerated meaningful interpretability**

**Easy-to-use platform / visualisations**

Provides best practices templates that enable a quick, consistent start to building Visualisation including: Graphs, Dashboards and Reports

**Point and click comprehensive environment for multiple different communities of personas:**

**Integrated platform with geovisualisation**

- ESRI files
- Integration of R programming and Python scripts from SWAT

**Return of Investment (ROI) versus Minimum Viable Product (MVP)**

# Questions

TM

# Related Readings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- Computer, Society and Nature, November « 2019 « Computers, Society, and Nature (mcgill.ca), WordPress, McGill, 2019.
- Coordinate Systems Worldwide, Coordinate reference systems for "Canada" (epsg.io), Maptiler, 2002.
- Powell, Robby, Add the "Where" to the "What" with Location Analytics in SAS® Visual Analytics 8.3, Cary, NC, SAS Institute Inc., 2019.
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- Rostovtseva, Daria, Troubleshooting custom polygon maps in SAS Visual Analytics, Cary, NC, SAS Institute Inc., 2018.
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- Royal Canadian Geographical Society, The Royal Canadian Geographical Society (rcgs.org), Canada.
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- Surratt, Marcia, MAPS, MAPSGFK and MAPSSAS, Oh my! - SAS Users, Cary, NC, SAS Institute Inc., 2016.
- Wagoner, Bobbie, Creating a regional map with custom polygons in SAS Visual Analytics, Cary, NC, SAS Institute Inc., 2018.

# Contact


## Karine Désilets

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Data Analytics and Exploration Section | Section d’analytique de données et d’exploration

Innovation and Analytics Division | Division de l’innovation et de l’analyse

Research and Innovation Lab | Laboratoire de recherche et d’innovation

Service, Innovation and Integration Branch | Direction générale du service, de l’innovation et de l’intégration

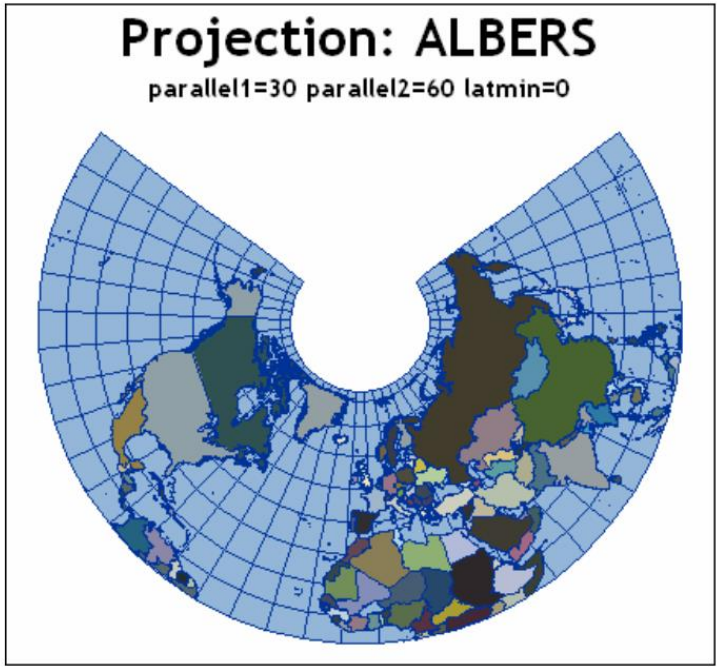
Canada Revenue Agency | Agence du revenu du Canada

karine.desilets@cra-arc.gc.ca / 819-661-3079

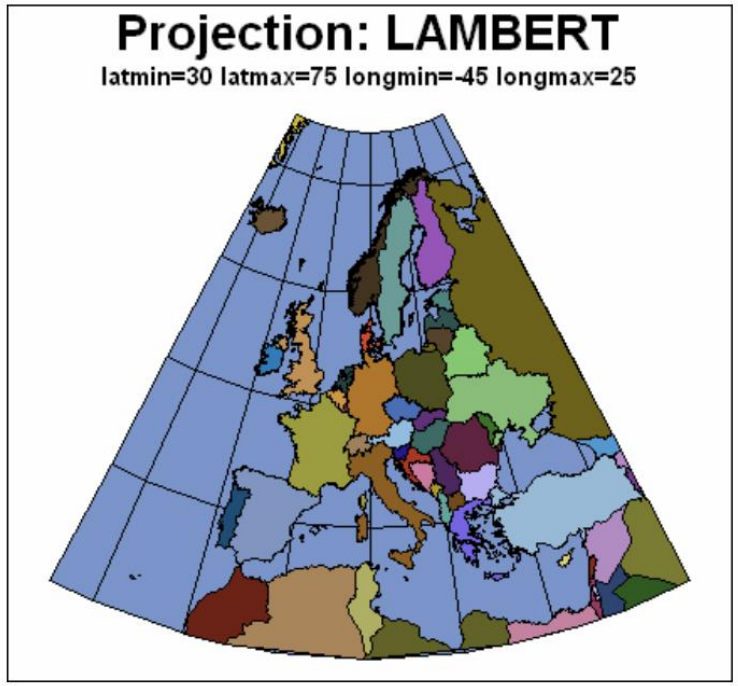

***Do More With Data – En faire plus avec les données***

# Q1 – Difference between each Projection Type

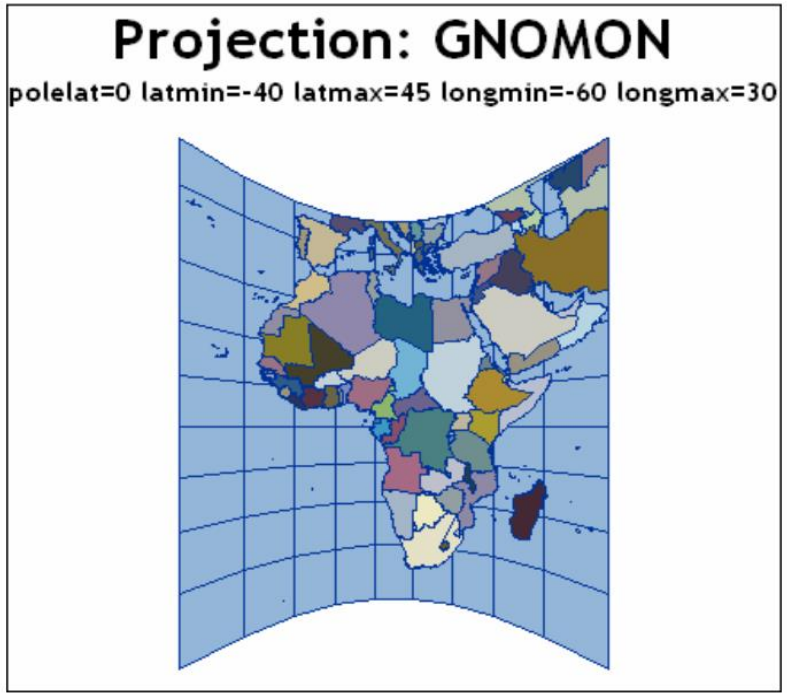
Albers' Projection



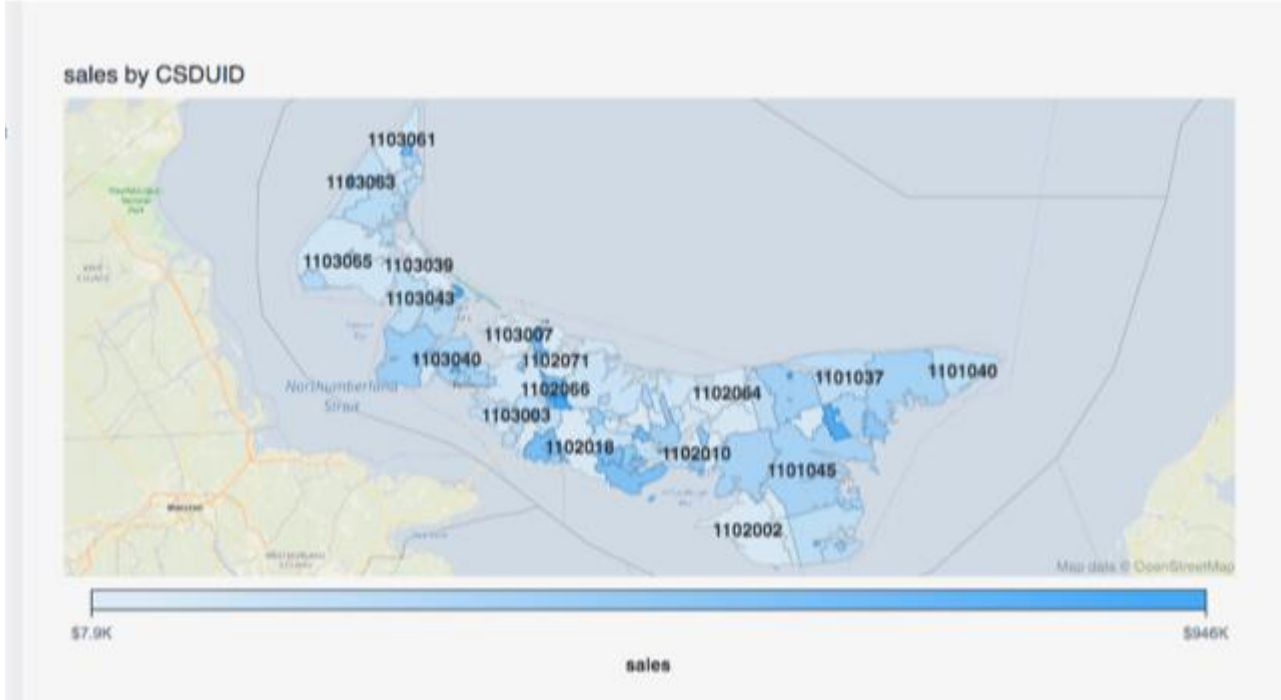
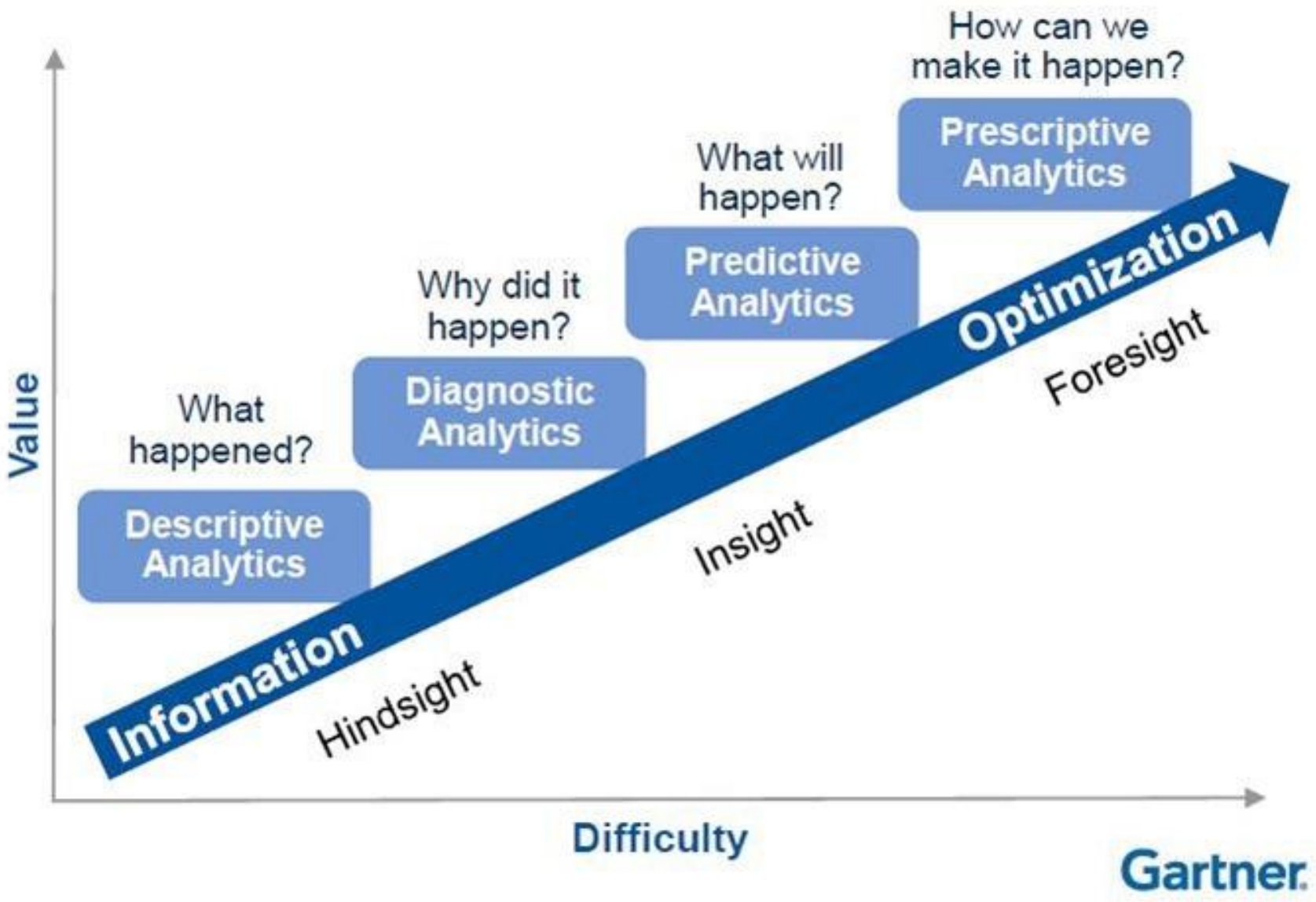

Lambert's Projection




Gnomonic Projection



# Q2 – Sales by Census Subdivision for PEI



# Analytics Maturity Model