

## Lasso Your Business Users by Designing Information Pathways to Optimize Standardized Reporting in SAS® Visual Analytics

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### ABSTRACT

SAS® Visual Analytics opens up a world of intuitive interactions, providing report creators the ability to develop more efficient ways to deliver information. Business-related hierarchies can be defined dynamically in SAS Visual Analytics to group data more efficiently—no more going back to the developers. Visualizations can interact with each other, with other objects within other sections, and even with custom applications and SAS® stored processes. This paper provides a blueprint to streamline and consolidate reporting efforts using these interactions available in SAS Visual Analytics. The goal of this methodology is to guide users down information pathways that can progressively subset data into smaller, more understandable chunks of data, while summarizing each layer to provide insight along the way. Ultimately the final destination of the information pathway holds a reasonable subset of data so that a user can take action and facilitate an understood outcome.

### INTRODUCTION

SAS Visual Analytics can be broken into two distinct business intelligence paths, exploring or reporting data. As seen in Figure 1, there are two separate buttons when initially logging into the SAS Visual Analytics Hub which showcases these two paths. Both paths have key differences in functionality, presentation, and purpose. Explorations are tailored more for the power user while reports are more for general consumers of information.

- **Exploration** – Finding the questions you should ask about your data.
- **Report** – Presenting data around the questions you already know or have discovered using a standardized approach.

Note: This paper is based on SAS Visual Analytics version 7.1.

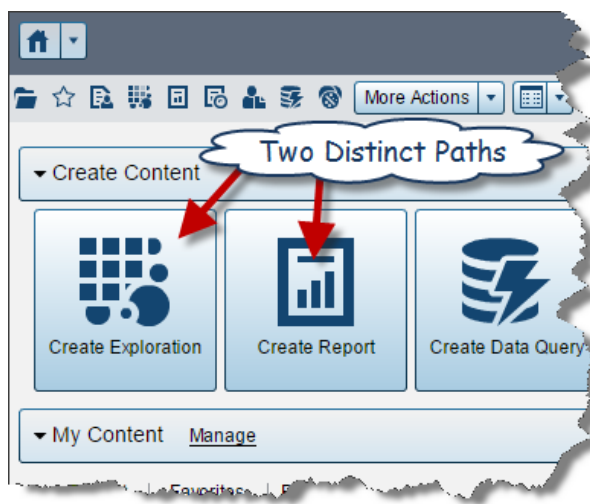


Figure 1: Distinct Paths in SAS Visual Analytics.

This paper revisits and extends the concept of information pathways first presented at SAS Global Forum 2012 in paper 020-2012. The overall purpose is still the same, utilize the power of SAS to guide the report viewer down a predetermined workflow of reporting and analysis using multiple layers of interactions. These interactions continually subset data into smaller segments until a clear and concise answer is reached. SAS Visual Analytics reports utilize information pathways extremely well because of the advanced interactions and visualization techniques available. SAS Visual Analytics explorations provide a wealth of capability but are not covered in the scope of this paper.

Readers of this paper should have a basic understanding of how SAS Visual Analytics is used to report and analyze data. Readers of this paper will be given the knowledge to plan, design, and develop information pathways to deliver more effective reporting using SAS Visual Analytics. These reporting techniques can be applied across any industry or organization. This paper focuses on a specific example within the Anti-Money Laundering industry (AML).

## DATA PREPARATION, EVERYTHING STILL STARTS AND ENDS WITH THE DATA

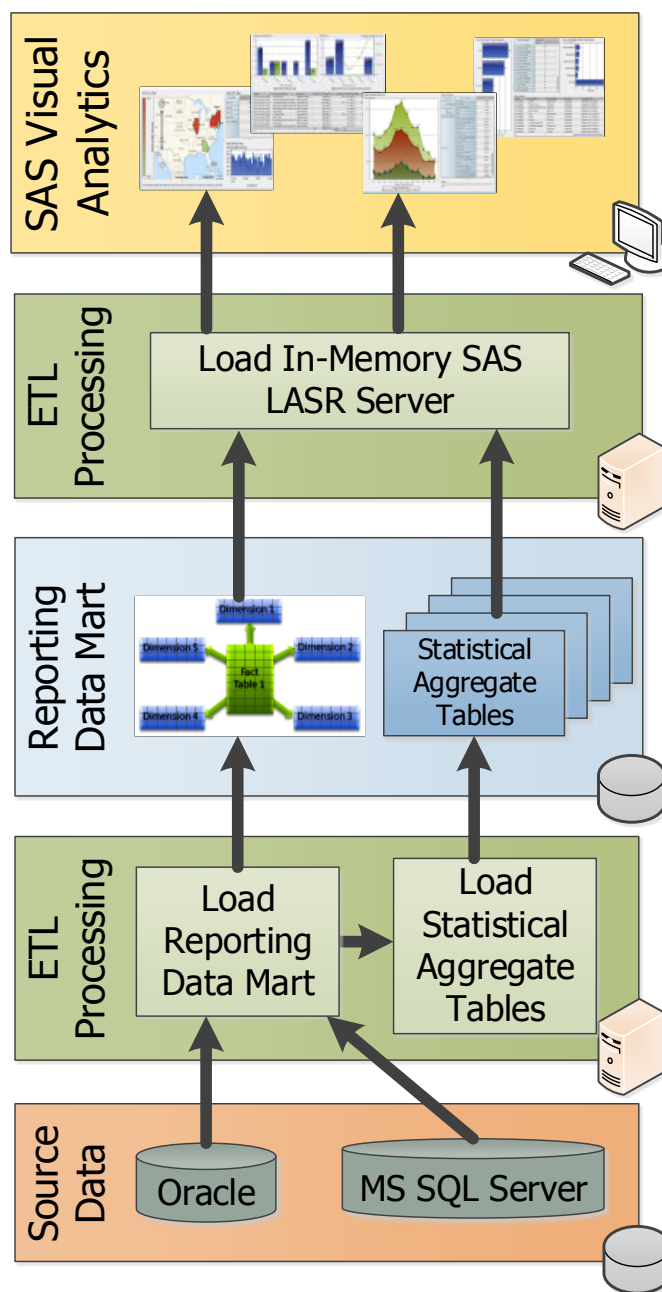
The same principals and methodologies can be used to standardize a SAS Visual Analytics reporting environment through techniques such as a data warehouse or data mart.

Aside from very intuitive visualizations, the most critical aspect of SAS Visual Analytics is preparing and loading data into the LASR server from something like a reporting data mart or other source of data. The LASR server is a SAS library which physically resides within memory behind SAS Visual Analytics, either on a single server node or across multiple nodes in a distributed environment. SAS Visual Analytics requires data to exist physically in-memory and have valid registration within a LASR server in order to report and analyze.

Loading a centralized reporting data mart into LASR can be as simple as de-normalizing dimensions and fact tables into their logical subject areas, then loading into memory. Data resides in-memory until the LASR server is restarted, data is unloaded, or until the server itself is rebooted. Adhoc methods can also be used to load flat tables or other sources of data as well. For more information on loading data into the LASR server refer to the SAS Visual Analytics Administration Guide.

### EXAMPLE DATA FLOW INTO LASR

The example diagram in Figure 2 shows a logical flow of data from source systems into a classic reporting data mart then finally into the LASR Server in order to use SAS Visual Analytics. For some environments, taking the additional step to load finalized reporting data into LASR can be as cumbersome as populating the underlying data mart itself. For others it can take minimal effort to develop a process, but does require consideration with regards to the age of data to be reported.



**Figure 2: Logical Data Flow from Source Data into SAS Visual Analytics.**

Reporting from “real time” data sources would not be possible unless SAS® Stored Processes are leveraged within SAS Visual Analytics reports to access operational sources directly. This paper does not cover SAS Stored Processes nor methods to report real time data. Additional information regarding how to leverage SAS Stored Processes within a SAS Visual Analytics report can be found in the SAS Visual Analytics User Guide.

## CONCEPTUAL APPROACH TO INFORMATION PATHWAYS

An information pathway is a predetermined series of “clicks” through dashboards, reports, sections, or objects within report sections using interactions within SAS Visual Analytics. Each click filters data further to guide the report viewer through a common thought process. The starting point for an information pathway is the highest logical point of aggregation for a particular subject area of data to be reported. Subsequent “clicks”, or interactions within SAS Visual Analytics, step through data until the lowest subset of data is available. In the end, the user is presented with a more reasonable amount of data to consume as well as relative context to make a more educated decision.

The following list provides a general example of an information pathway:

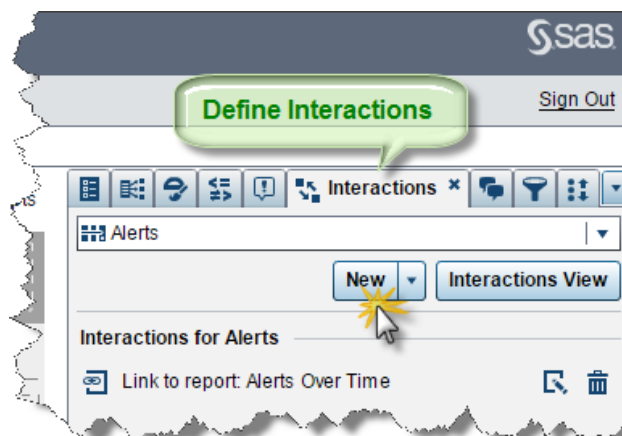
1. Use a series of dashboard widgets in a single report to present the highest level of key metrics for the current month.
2. Provide supplemental reports behind each of the dashboard widgets using report linking.
3. Each supplemental report expands the time frame from the current month into multiple months over time.
4. Within each supplemental report, bar charts or line graphs are used to visualize trends of the key metric over time. Clicking a month on the bar chart updates additional visualizations within the report to provide further breakdown of information by other categorical dimensions.
5. Section linking is used to subset data further into additional charts, treemaps, heatmaps, or other useful visualizations to understand the smaller subset of data.
6. The final “click” ends the information pathway at a table listing of records which make up the series of implicit filtering accomplished through report linking, interactions, and section linking.

Using this approach provides a single point of entry and provides the ability to click through each high level metric if more information is desired. Notes can also be provided within each report to give the user quick information about what to click and where it leads. Remember to provide target metrics (if possible) to give the business user context as to what is good or bad on a particular dashboard gauge or widget.

## BUILDING AN INFORMATION PATHWAY USING SAS VISUAL ANALYTICS

SAS Visual Analytics has multiple ways to guide users through an information pathway. Report linking is a common method for linking a user from one report to another. In the SAS® Enterprise BI platform, SAS Web Report Studio provided the same conceptual functionality but required more work behind the scenes to accomplish report linking which filters data with each click. SAS Information Maps had to be designed to support report linking. Paper 020-2012 from SAS Global Forum 2012 provides additional detail on how information pathways are developed using the SAS Enterprise BI platform.

SAS Visual Analytics automatically handles passing parameters and filtering data when defining interactions. To define interactions within a SAS Visual Analytics report, click the “Interactions” tab on the right hand side when designing a report in the Visual Analytics Designer application. Select an object in the report, then click the New button to define a new interaction with another object in the report. This is shown in Figure 3.



**Figure 3: Define Interactions within SAS Visual Analytics.**

## REPORT LINKING

Linking reports is the broadest level of defining interactivity within SAS Visual Analytics. Reports are stored in SAS Metadata, similar to a file system on a computer. A report link basically opens a specific report when a user double clicks a visualization. There can be multiple links within a single report if there are multiple objects to link from. When designing a report, start off by selecting a report object and clicking the New button on the Interactions tab, then select Report Link as shown in Figure 4 below.

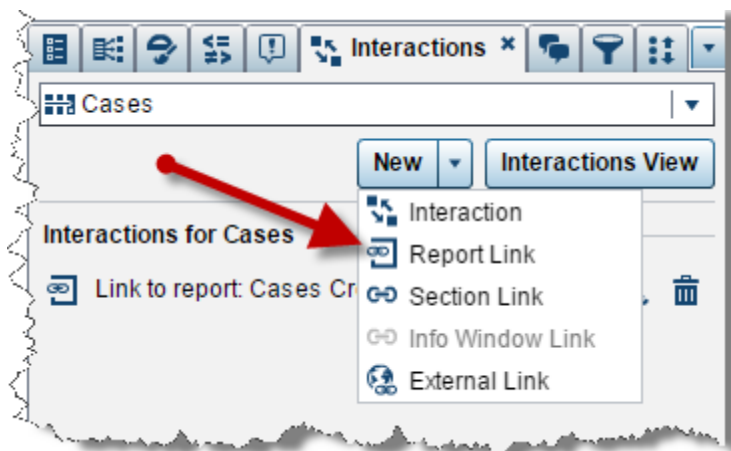


Figure 4: Creating a Report Link in SAS Visual Analytics.

After selecting “Report Link”, a window pops up to select the target report to link to. Browse through SAS Metadata folders and select the report to link. Once a report is selected, another window pops up which allows you to link directly into a specific section inside the target report. If the target report is built from the same data source, filters are mapped automatically. If the target report is built from a different set of data the selected section will open or you can map data elements manually. This is shown in Figure 5 below.

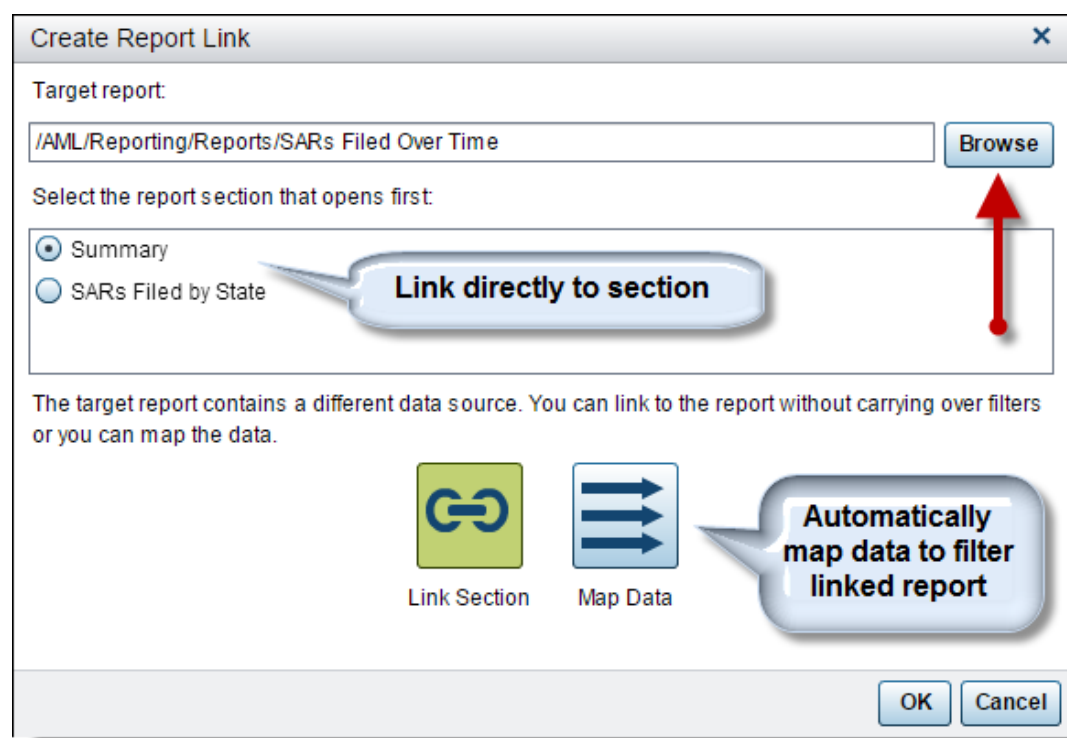
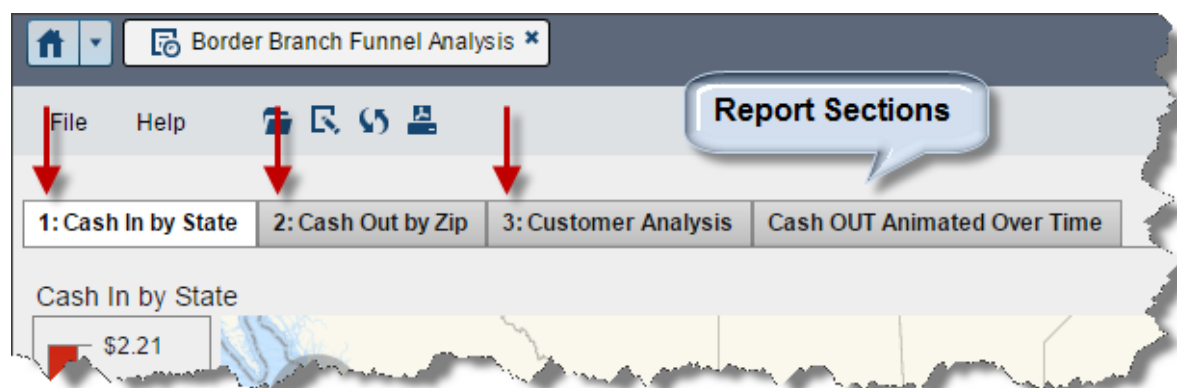


Figure 5: Define a Report Link in SAS Visual Analytics.

Moving between separate reports changes the report viewer's entire frame of reference to another report. Remember to use Report Linking for high level steps within your information pathway.

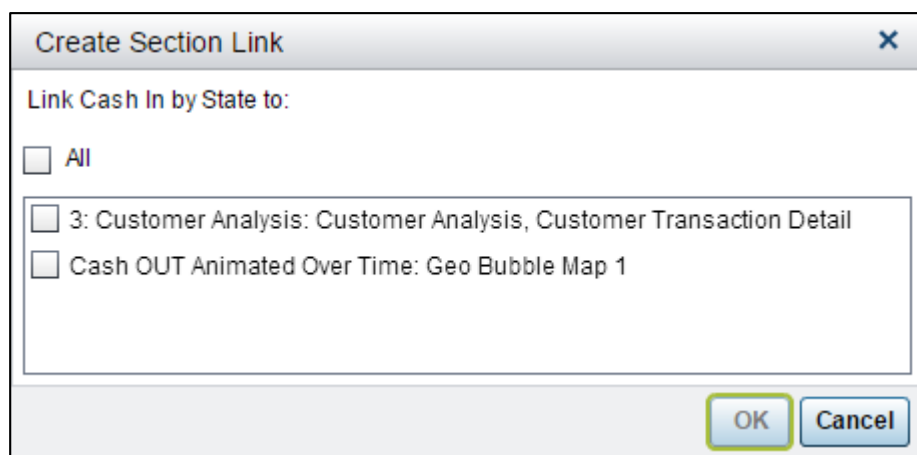
## SECTION LINKING

Sections can be created within a report to organize different ways to visualize data. At a very high level, entirely different datasets can be analyzed across multiple sections. Report sections are also useful for guiding a user down an information path. As you can see below in Figure 6, sections are used to organize different levels of the information pathway. A simple numbering scheme is used to signify the steps in the information pathway.



**Figure 6: Sections within SAS Visual Analytics reports.**

Select the report object to link from and use the same New button on the Interactions tab to create the section link. A window pops up to specify which section to link. This is shown in Figure 7 below.



**Figure 7: Defining a section link within SAS Visual Analytics.**

Section linking changes the report viewer's screen layout, but does not leave the current report. Section linking is good for high level steps within your information pathway or drilling into specific focus areas within a subject area of data.

## INTERACTIONS

Functionally speaking, report linking and section linking are available in SAS's Enterprise BI platform, but require considerable effort and expertise on the infrastructure side to support effective information pathways which drill into data and pass parameters. Interactions within SAS Visual Analytics introduces a new way to link objects in a report. Not to be confused with the Interactions tab within the report designer, specific interactions can be defined for visualizations on a single report screen using the Interaction option shown in Figure 8.

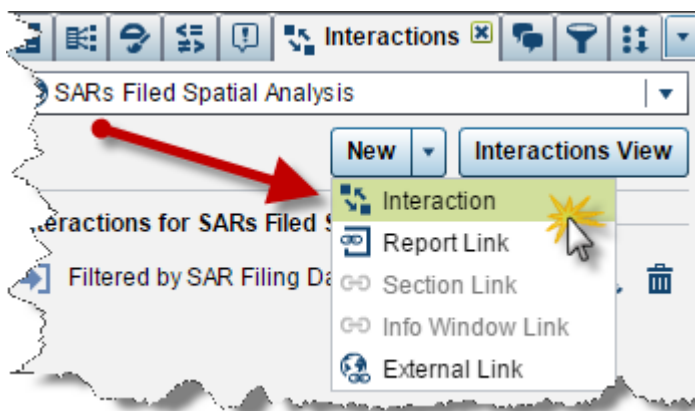


Figure 8: Defining a new interaction between report objects.

Interactions are very useful and intuitive in SAS Visual Analytics. Data is automatically filtered because the report section utilizes the same dataset. Grouped items or selections on the originating report object are automatically used to filter data on the target report object. For example, selecting a region from a bar chart can filter another chart by that region using interactions.

To create a specific interaction between report objects, select the New button shown in Figure 8, then select Interaction. As shown in Figure 9, a window pops up to link the originating visualization to the target visualization. Use the dropdown menu to select the report object to filter. A visual reference is shown to confirm which objects are linked through the interaction.

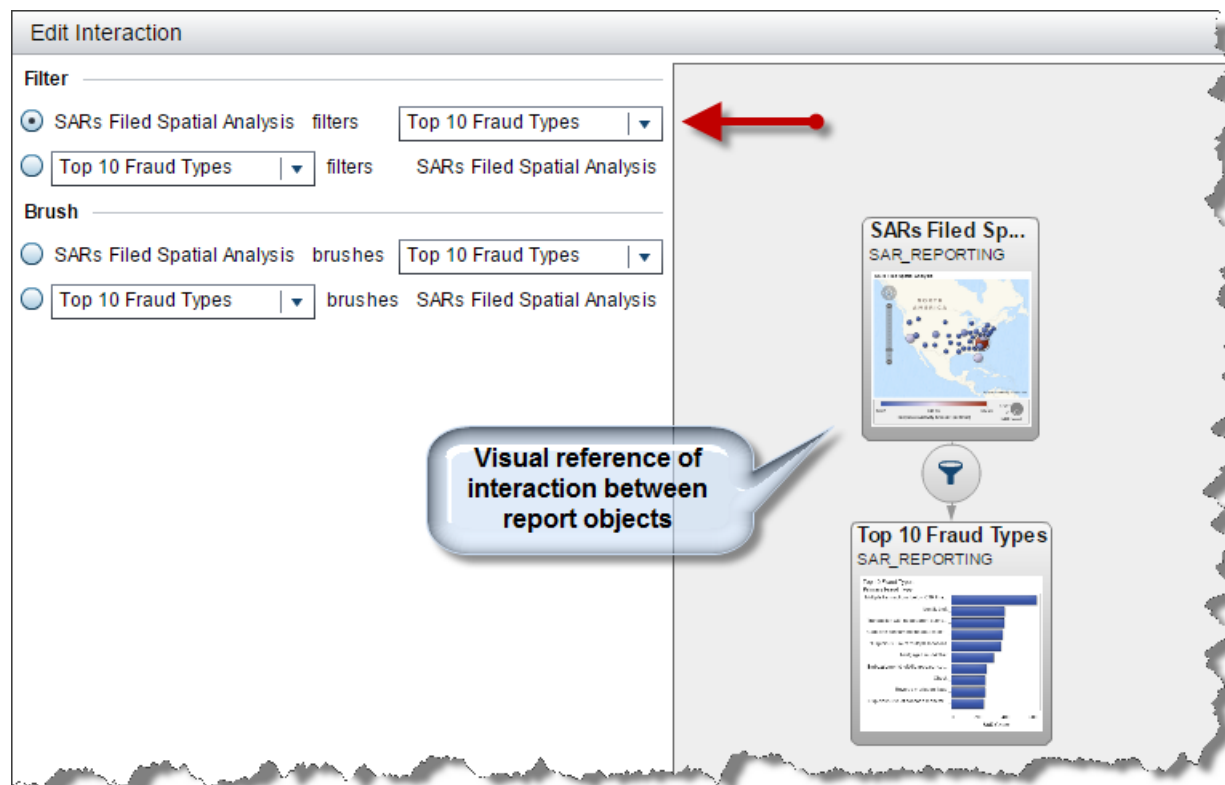


Figure 9: Creating a report object interaction with filtering.

Defining report interactions at this level is useful for very specific steps in your information pathway. For example, once a user has clicked through 1-3 higher level report or section links, report interactions are



useful to provide supplemental analysis or simply list record level detail. Some objects cannot filter others. If this is the case, you will not be able to define the interaction and options will be disabled.

## HIERARCHIES

Using hierarchies within an information pathway is useful for drilling down categorical data within a single report visualization. Most visualizations can utilize hierarchies. Geomaps and crosstabs are visually effective because the user can easily follow a path, i.e. your information pathway!

Defining a hierarchy within SAS Visual Analytics is extremely easy. Simply click the down arrow near the data source selection box and select New Hierarchy. This is shown in Figure 10 below. A window pops up which allows you to select which attributes define the hierarchy. This is shown in Figure 11 below. Once the hierarchy is defined, many visualizations can utilize on any categorical or geographical dimension.

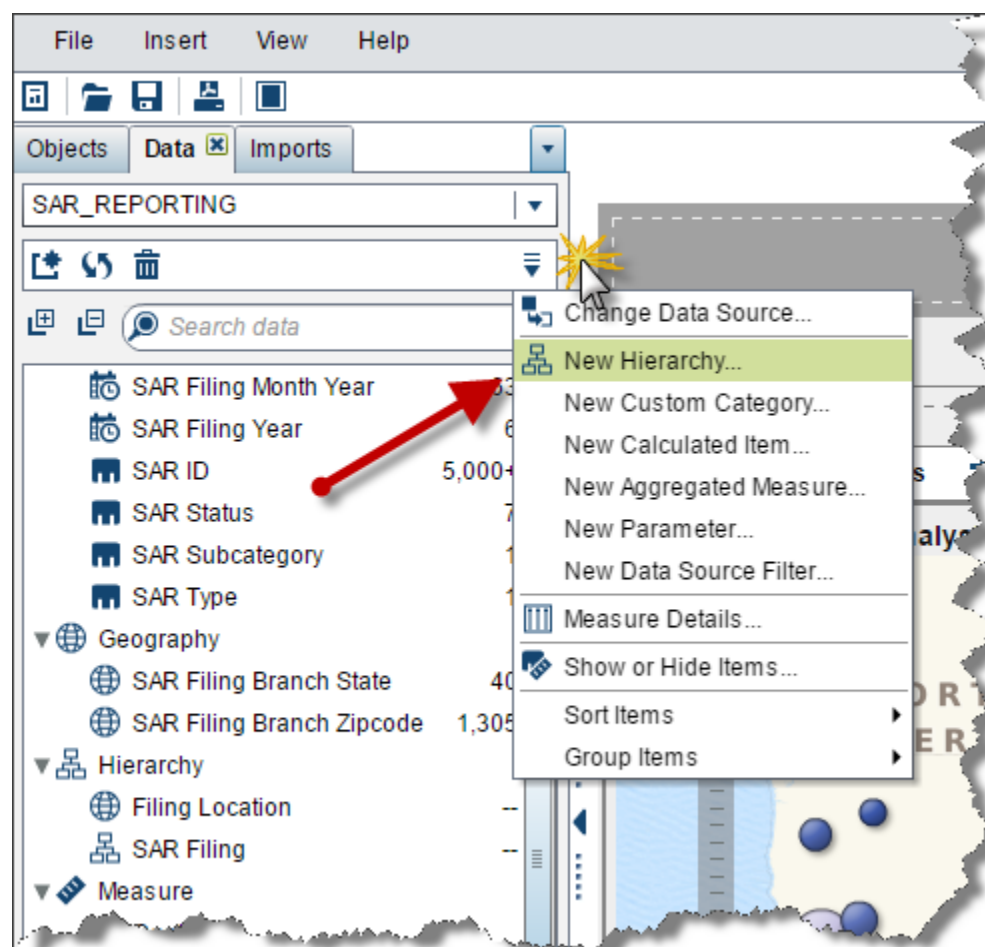


Figure 10: Defining a new hierarchy within SAS Visual Analytics.

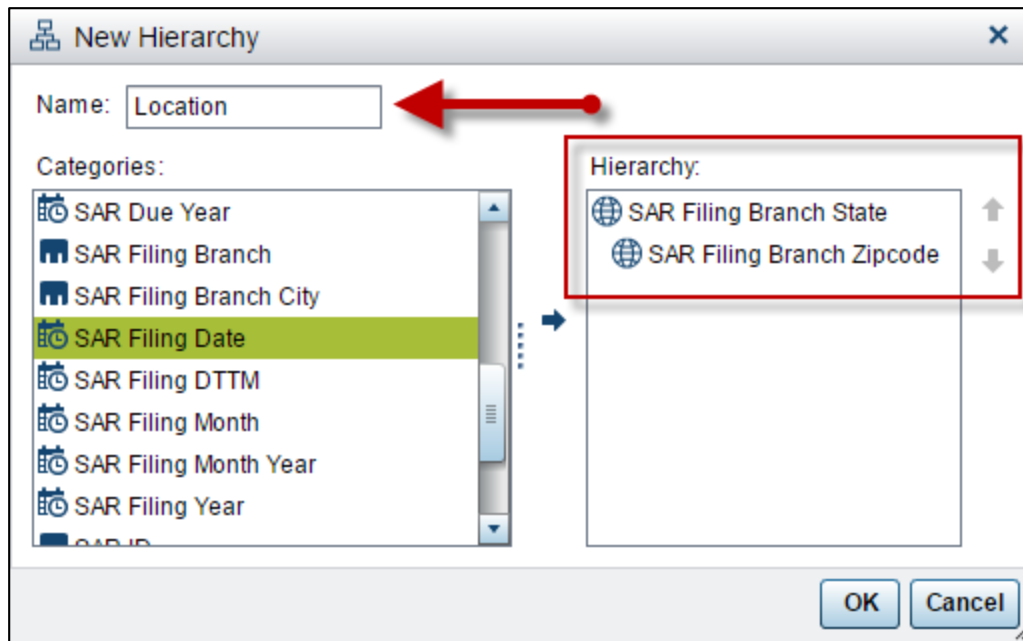


Figure 11: Creating a hierarchy within SAS Visual Analytics.

## USING THE GEOMAP VISUALIZATION FOR INFORMATION PATHWAY DRILL THROUGH

Another key differentiator with SAS Visual Analytics is geospatial analysis. Compared to prior methods within SAS's Business Intelligence products, creating an interactive geographical map to visualize data is night and day in terms of effort. Using a hierarchy to drill down an information pathway within a geographical map is a very nice feature to add to any report which has geographical data points. It usually appeals to many users because of the ability to relate to a visual map and have the functionality to drill down and interact with other report objects. An example report which utilizes the geomap visualization and report interactions is shown below in Figure 12.

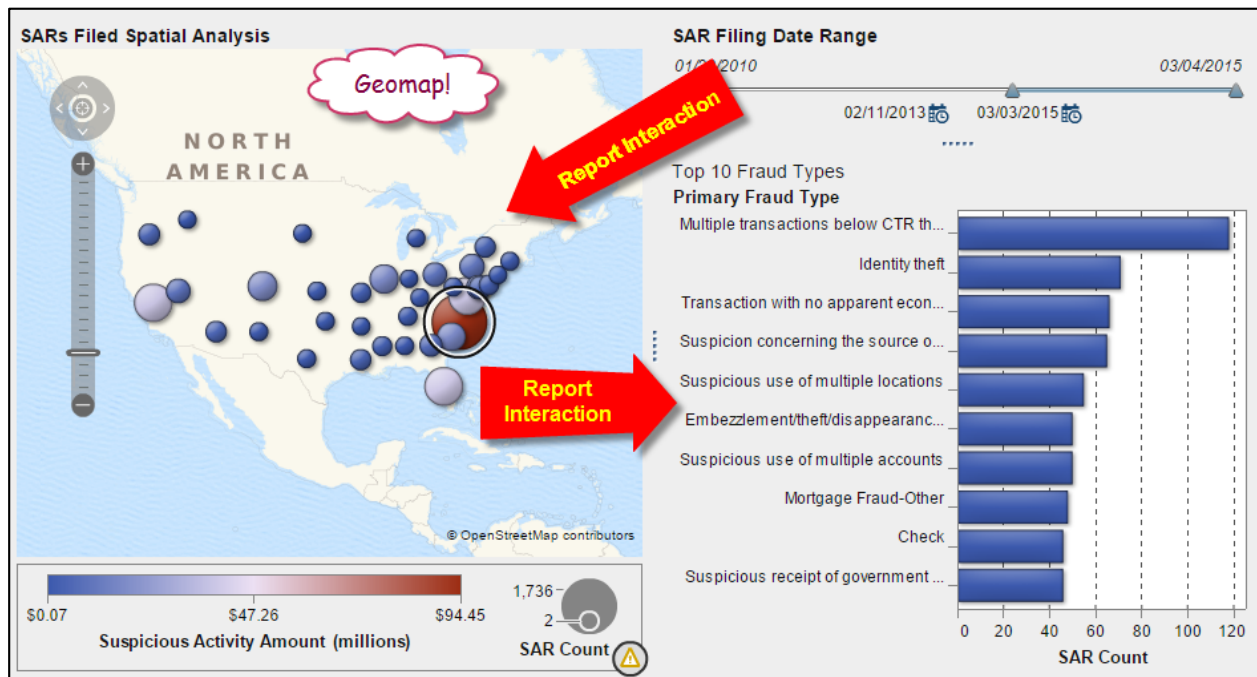


Figure 12: Example SAS Visual Analytics report using a geomap and report interactions.



Data must contain at least one attribute that can be classified as geographical. The most common attributes are 5 digit zip codes, 2 digit state codes, 2 digit country codes, or latitude and longitude coordinates. Refer to the SAS Visual Analytics User Guide for more detail on how to define geographical variables and how to create a geomap.

## **EXAMPLE INFORMATION PATHWAY: FUNNEL ACCOUNT ANALYSIS**

The following funnel account analysis is used to demonstrate the purpose and effectiveness of information pathways in SAS Visual Analytics. This type of analysis is specific to the Anti-Money Laundering (AML) industry within the banking sector. Prior to creating the report used in this example, a thorough understanding of the underlying data was performed using SAS Visual Analytics Explorer. Techniques described in this paper are used to demonstrate the effectiveness of information pathways in SAS Visual Analytics.

### **BACKGROUND**

What is a funnel account? The Financial Crimes Enforcement Network (FinCEN) defines a funnel account as an individual or business account which is used to launder cash from one geographic area to another. Typically funnel accounts are used to transfer cash from banks or ATMs in the northern part of the United States to a branch located along the US border to Mexico. When cash is withdrawn from border branches it is physically carried across the border into Mexico. Transactions often occur below cash reporting thresholds and within a short period of time.

### **PREPARING THE DATA**

Prior to creating the report in SAS Visual Analytics, a thorough analysis is performed to understand the structure and context of the source data. Bank transactions are typically very specific and at a very low grain in terms of what represents a record in the source data. For example, transactions represent a specific dollar amount for a transaction type, date, account number, and many other attributes of that individual transaction. Transactions are restructured and aggregated so that cash in and cash out values are grouped into explicit columns by customer number along with necessary attributes of the cash transaction that was deposited into an account (debit) and withdrawn from the account (credit).

The following list represents the minimum required columns needed to perform a funnel account analysis.

- Customer Account Number
- Transaction Date (Cash In)
- Amount (Cash In)
- Zip (Cash In)
- State (Cash In)
- Latitude (Cash In)
- Longitude (Cash In)
- Transaction Date (Cash Out)
- Amount (Cash Out)
- Zip (Cash Out)
- State (Cash Out)
- Latitude (Cash Out)
- Longitude (Cash Out)

The lowest grain of this data is the customer account, cash in transaction, and cash out transaction. Location details must be included for each group of columns for cash in and cash out. Latitude and longitude coordinates are preferred, but zip codes can be used for the branch or ATM location.

## BUILDING THE INFORMATION PATHWAY

When designing a report, it will take multiple iterations to build an effective information pathway. After understanding the structure and nature of source data, it is common to try multiple techniques for guiding the report viewer down an Information Pathway. For simplicity, this paper will cover the final information pathway chosen for the Funnel Account Analysis. Figure 13 below conceptually shows the information pathway used to guide a user through a funnel account analysis.

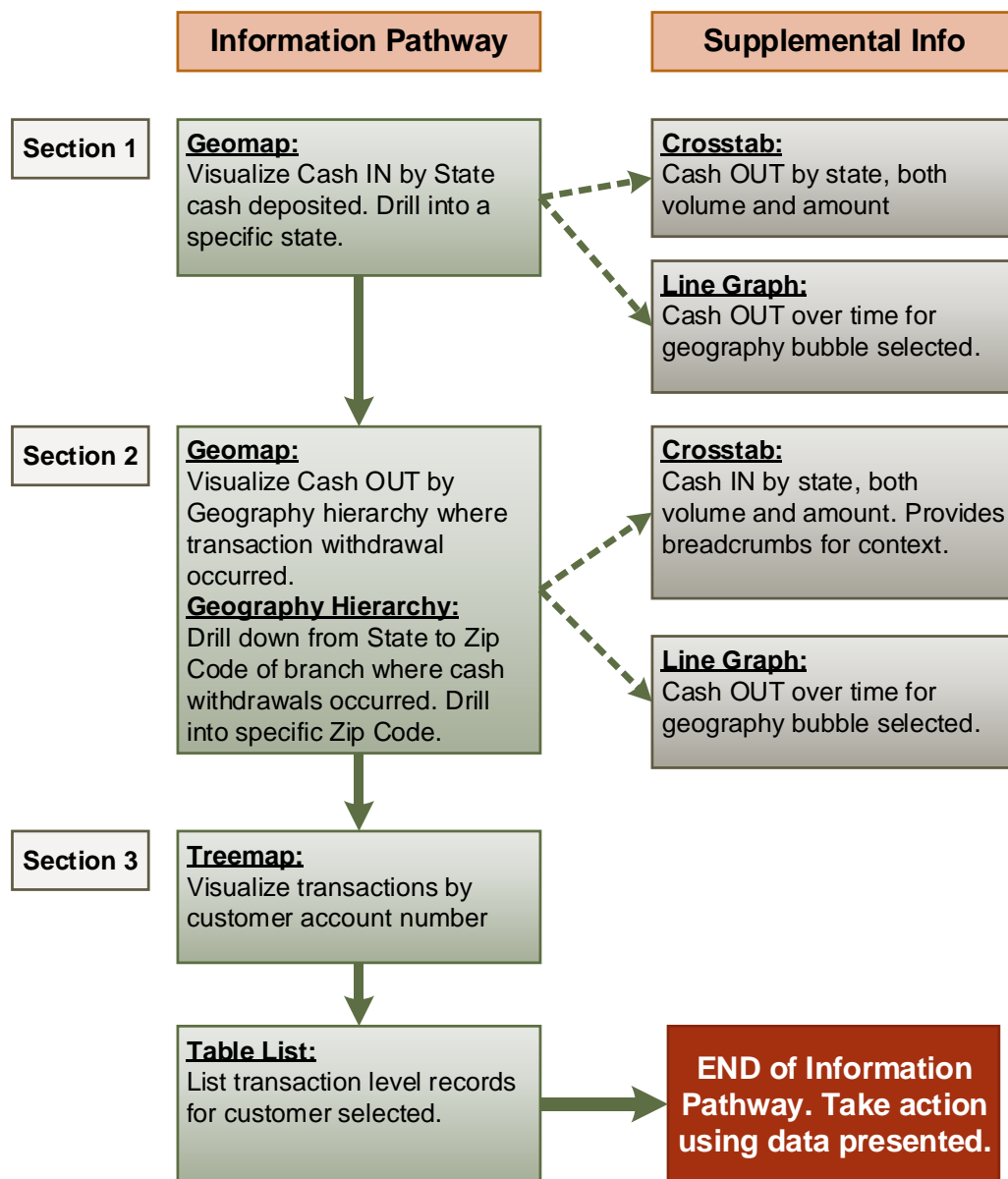


Figure 13: Conceptual Information Pathway to guide users through funnel account analysis report.

The Funnel Account Analysis report begins at the highest effective aggregate level of the source data. Every interaction in this Information Pathway subsets data further until a reasonable amount of transactions are presented at a very low grain of data. Each section across the top is numbered and linked in the logical order of the analysis.

## Section 1: Cash In by State

The first section provides context to understand the first part of what defines potential funnel account activity by looking at volumes of cash going into bank accounts. The geomap is used to visualize cash in by state. Clicking each state interacts with the crosstab and line graph on the right side of the section. The crosstab provides details on where the cash is going, which will be covered in greater detail in section 2. The line graph provides a visualization of cash out over time. Additional notes are provided at the bottom of the section for instructions to the end user. In this part of the analysis, the report viewer is looking for states which high volumes of cash going into accounts. This is represented by red colors on the geomap. A screenshot of section 1 is shown below in Figure 14.

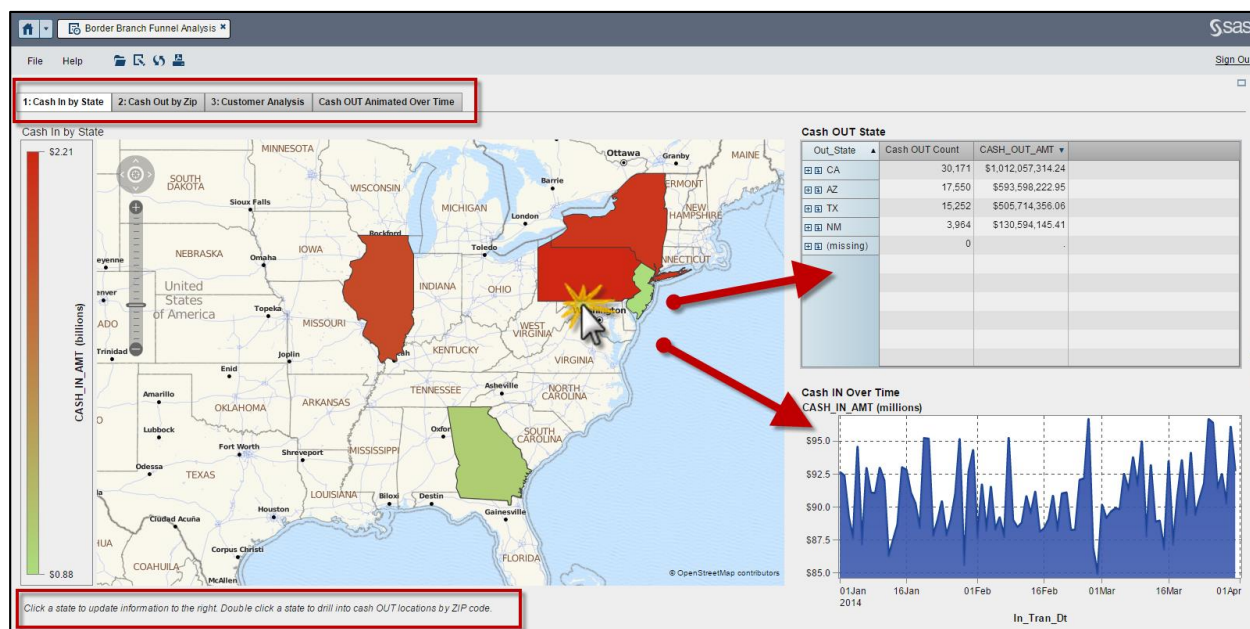
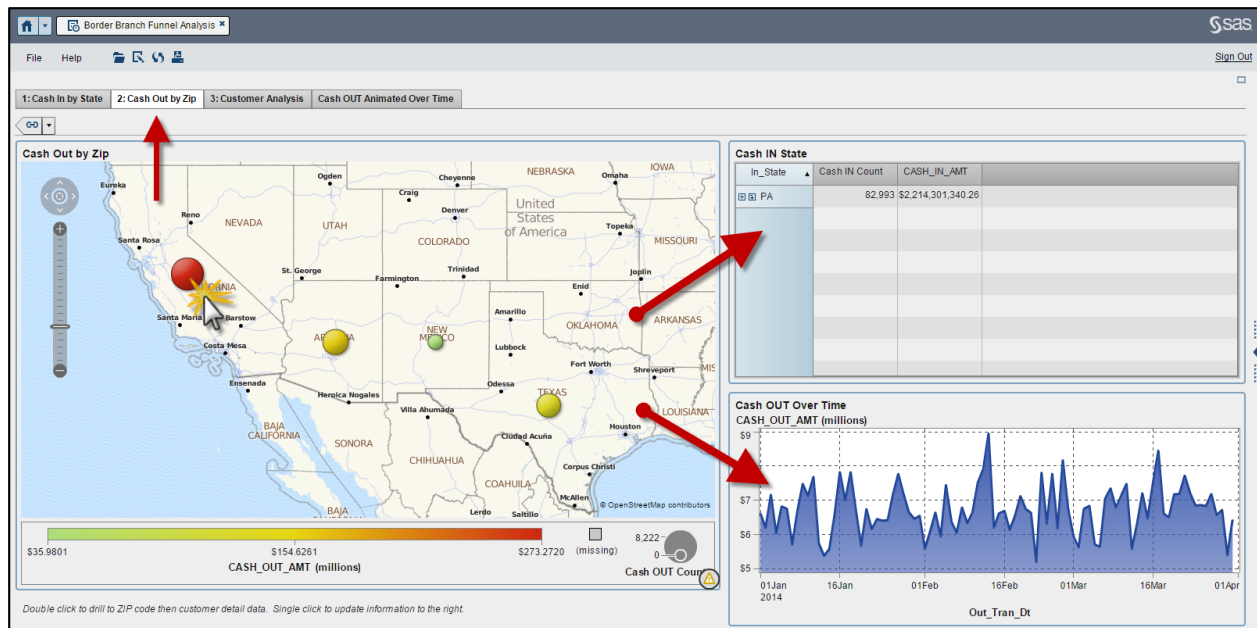


Figure 14: Section 1 of Funnel Account Analysis.

Double clicking a state drills into data for that particular state and steps down the information path by linking the user into section 2.

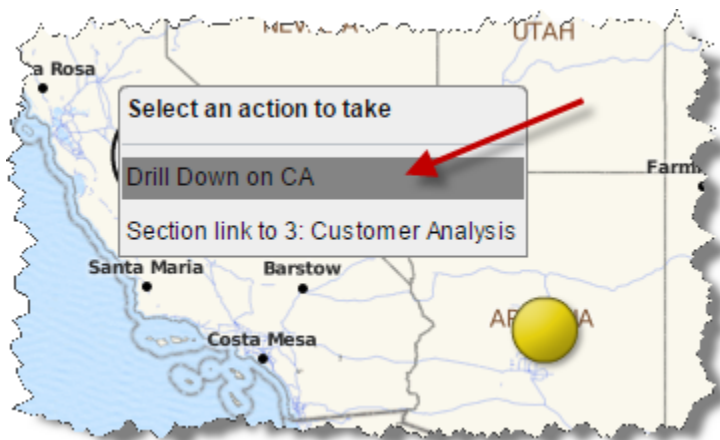
## Section 2: Cash Out by Zip

Section 2 visualizes cash out for the transactions which originated from the state that was double clicked from section 1. Clicking each bubble on the geomap interacts with the crosstab and line graph on the right side of the section. The crosstab provides breadcrumb-like information on where cash was deposited by state (cash in), which is the same state the user double clicked from section 1. The line graph provides additional details about cash out volumes over time for each bubble clicked on the geomap. A screenshot of section 2 is shown below in Figure 15.



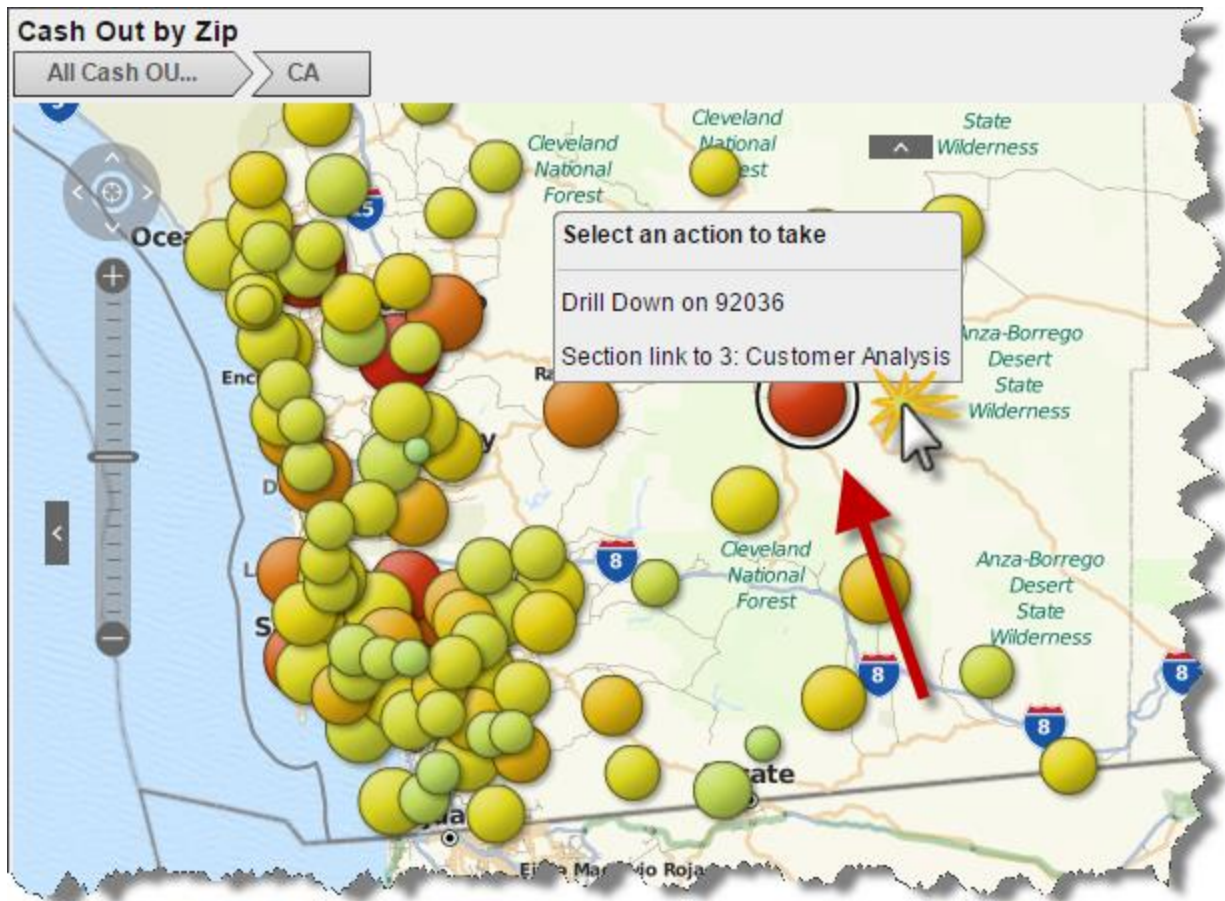
**Figure 15: Section 2 of Funnel Account Analysis.**

Double clicking a bubble allows the user to drill down the geography hierarchy to visualize cash out by zip code. This is shown in Figure 16 below.



**Figure 16: Drill down geography hierarchy to analyze cash out by zip code.**

In this section of the analysis, the report viewer is looking for high volumes of cash leaving near the border. This is represented by red colors on the geomap shown in Figure 17 below. The geospatial capabilities of SAS Visual Analytics are very useful in this step of the Information Pathway.



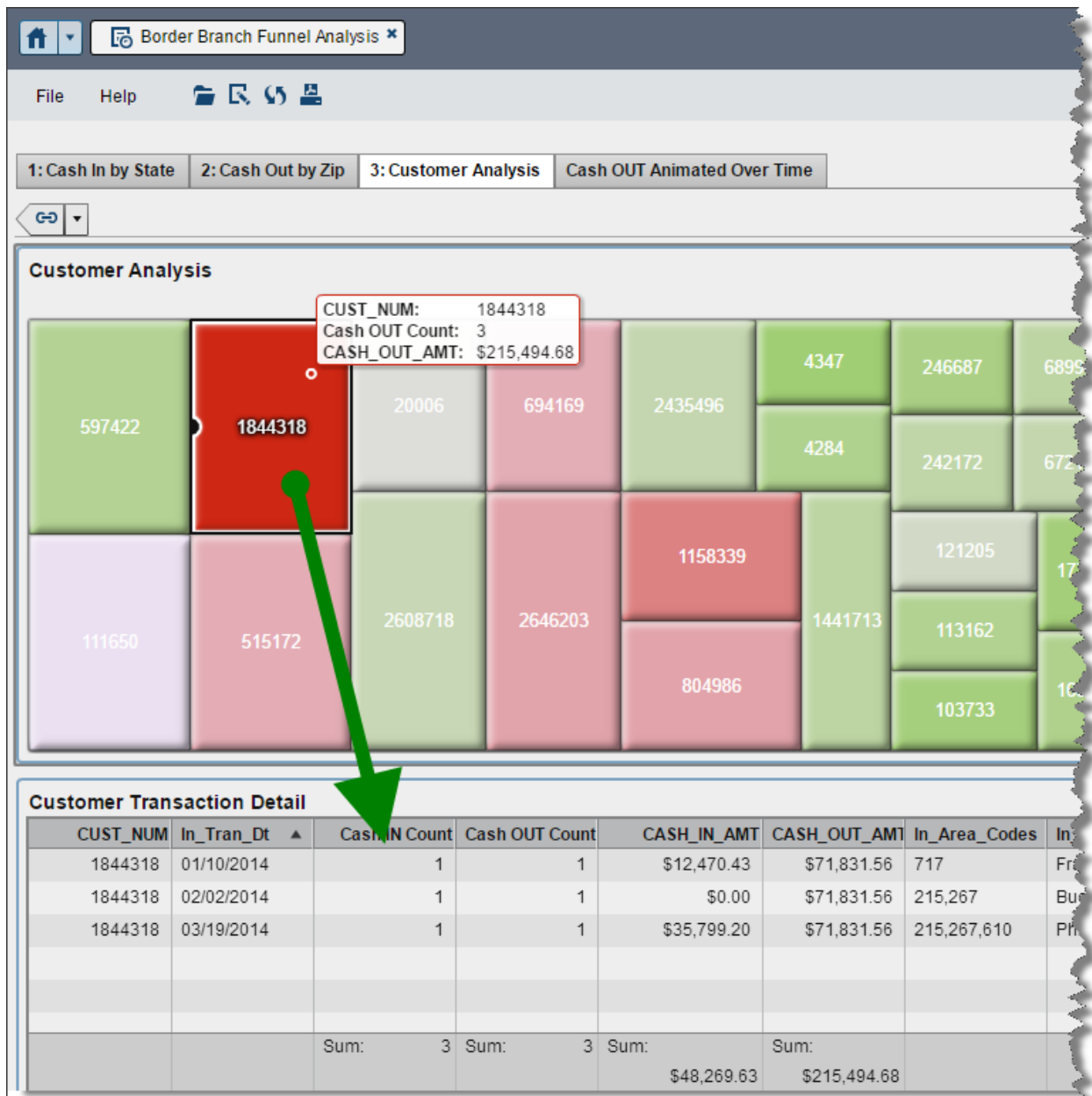
**Figure 17: Drill into zip code to analyze potential funnel account activity.**

As shown in Figure 17, double clicking a bubble links to section 3 to provide customer specific details for transaction activity that originated from a specific state identified through section 1 and left through a specific zip code identified in section 2.

### Section 3: Customer Analysis

Through prior sections in this report, the report viewer has drilled into higher levels of aggregation in order to understand and follow a predefined analysis of potential funnel account activity. Customer level information is now available and visualized using a treemap in section 3. Darker shades of red indicate higher volumes of cash out activity for the specific state selected in section 1 and specific zip code selected in section 2. Clicking a customer number in the treemap interacts with the table listing to provide the lowest grain of data available for this analysis based on the data preparation work performed. This is shown in Figure 18 below.





**Figure 18: Treemap summarizes customer level data while a table listing provides specific details.**

The report viewer has reached the end of the information pathway used to analyze potential funnel account activity. At this point, data can be exported and used to start and document a formal customer due diligence investigation.

When regulators ask banks to describe steps taken to detect, analyze, and prevent funnel account activity, this example SAS Visual Analytics report can provide a standardized approach to answering those questions. Each logical step is organized using a conceptual information pathway to guide the report viewer from high volumes of transaction activities into a specific subset of activity for an individual customer. It is much easier to investigate a single customer and have a basis for suspicious activity rather than no guidance whatsoever. Refer to FinCEN advisory FIN-2014-A005 in the References section of this paper for more information about funnel accounts.



## CONCLUSION

Using information pathways within SAS Visual Analytics can improve overall efficiencies within an organization by delivering information more effectively. SAS Visual Analytics provides excellent functionality to guide reporting and analysis using the concepts of an information pathway described in this paper. Each technique can be used to step report viewers through an information pathway to standardize the consumption of information and provide enhanced visibility of each step of analysis along the way. In the end, reporting and analysis delivered within SAS Visual Analytics is only as effective as the decisions stakeholders take to drive measurable improvements within their respective organization.

## REFERENCES

Overton, Stephen. April 2012. Paper 020-2012. "Lost in Wonderland? Methodology for a Guided Drill-Through Analysis Out of the Rabbit Hole." Proceedings of the SAS Global 2010 Conference, Orlando, FL. Available at <http://support.sas.com/resources/papers/proceedings12/020-2012.pdf>.

U.S. Department of the Treasury, Financial Crimes Enforcement Network (FinCEN). May 28, 2014. "Advisory FIN-2014-A005: Update on U.S. Currency Restrictions in Mexico: Funnel Accounts and TBML." Available at [http://www.fincen.gov/statutes\\_regs/guidance/pdf/FIN-2014-A005.pdf](http://www.fincen.gov/statutes_regs/guidance/pdf/FIN-2014-A005.pdf).

## RECOMMENDED READING

- *SAS® Visual Analytics User's Guide*
- *SAS® Visual Analytics Administration Guide*

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