

Artificial Intelligence and Machine Learning in Tableau

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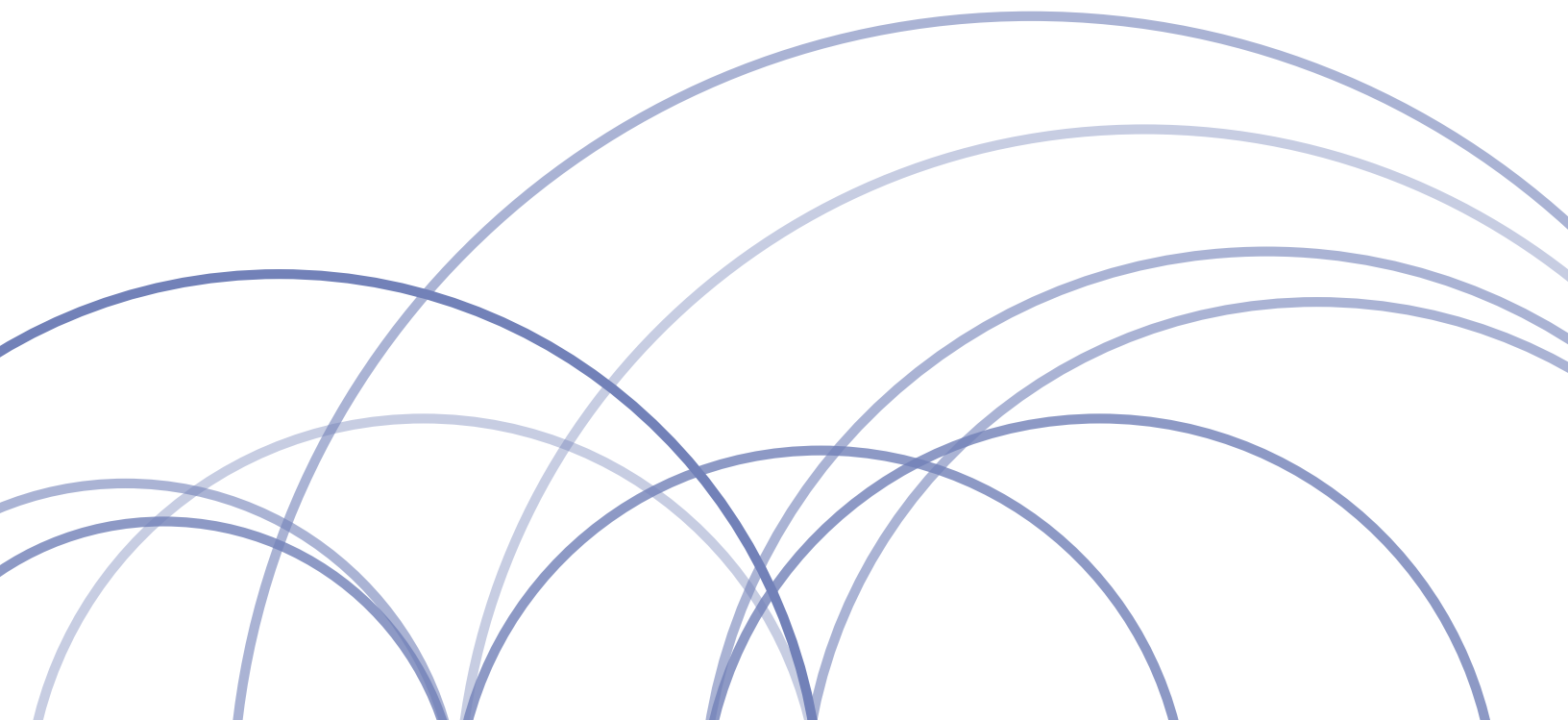


Visually driven AI and ML

At the center of the Tableau experience is seeing and understanding data. Combining Tableau visual analytics with the power of Artificial Intelligence (AI) and Machine Learning (ML) keeps the human at the center of decision-making while unlocking advanced analytics across the entire organization that is typically limited to highly technical teams within an organization. The platform's ease of use provides users at all levels of expertise the ability to tap into visually-driven, advanced AI and ML-based analytics to get immediate time to value and uncover unanticipated insights.

At the core of Tableau's approach to AI and ML are three themes:

1. AI and ML naturally integrate into the users' workflow to enhance their analysis while avoiding disrupting their thought process and flow.
2. Full-featured AI and ML capabilities are usable regardless of experience and expertise.
3. AI and ML results are transparent, interpretable, and trusted.



AI throughout the analytics flow

Tableau offers a complete, integrated analytics platform. AI and ML will enhance decisions throughout the analytics flow. Whether it's handling missing data or understanding the 'why' behind a data point, Tableau has integrated central AI and ML functions to assist human-decision making throughout the analytics flow:

Explain Data

Quickly determine how policy levers will affect an outcome

Analytics Pane Models

Understand where an organization's expenditures are likely headed through forecasting and trends

Predictive Calculated Fields

Fill in missing data with estimates to assist decision-making

Ask Data

Use plain language questions to return answers and visualizations from data

Einstein Discovery

Automatically assess grant application risk towards finding successful candidates

Python

Extract people, organizations, and locations from documents for visual exploration to assist policy and legislative processes

Extensions

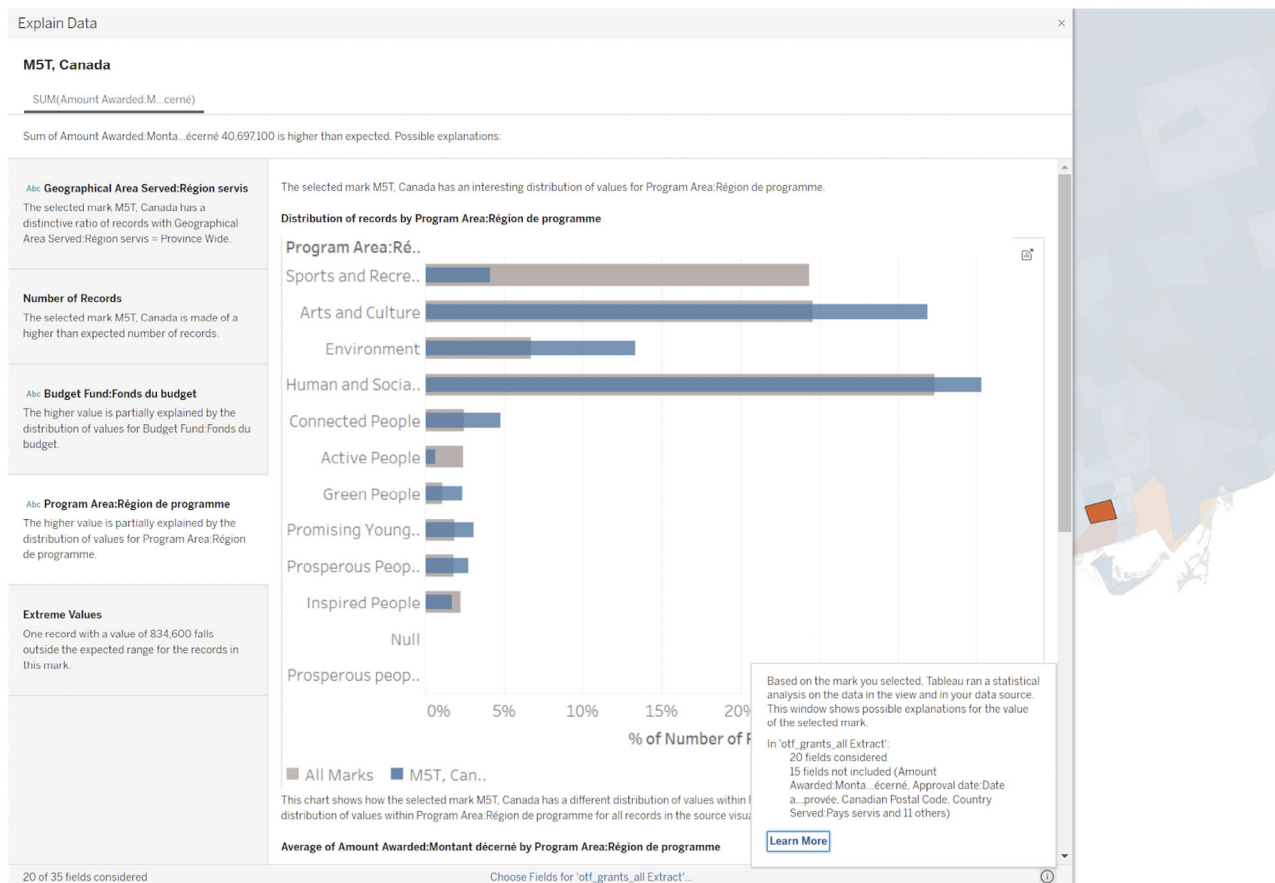
Plain language interpretation of results in Tableau for readability and consumption

1. **Explain Data** – Utilize intelligent AI modeling at the click of a button to quickly understand the Why behind a data point in your Tableau visualization.
2. **Ask Data** – Create data visualizations and dashboards using simple questions in natural language.
3. **Tableau Analytics Pane** – Drag and drop machine learning to predict future outcomes based on historical data with forecasting, determine future trends for your data using various models, or understand the relationships between data points with clustering.
4. **Integrated Predictive Modeling Functions** – Engage in predictive analytics and fill in missing data using Tableau's built-in calculated fields.
5. **Einstein Discovery in Tableau** – Build AI-powered predictive and prescriptive analytics with automated & guided model building, and embed these actionable custom predictions anywhere users can see Tableau.
6. **Supported R, Python, and MATLAB Integrations** – Make the most widely used data science languages interactive in Tableau with TabPy, Rserve, and the Analytics Extensions API.
7. **Tableau AI/ML Extension Ecosystem** – Use drag and drop extensions to take the power of AI and ML Tableau Partner technologies through Tableau's Extension Gallery.

Explain Data

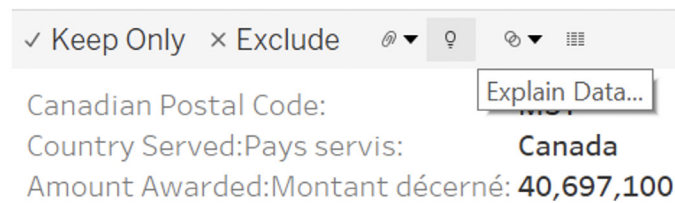
Explain Data accelerates analytics by leveraging AI's power to explain exceptional data points and their drivers in visualizations with a single click. Based on advanced statistical modelling, Explain Data presents a focused set of transparent explanations to answer the why and avoid spending time on dead ends.

Use: Identify potential policy levers in your data for future exploration. Determine the standout programmatic funding and distribution for a given postcode at the click of a button. This series of answers means a policymaker can quickly determine whether funding meets a geographic area's needs.

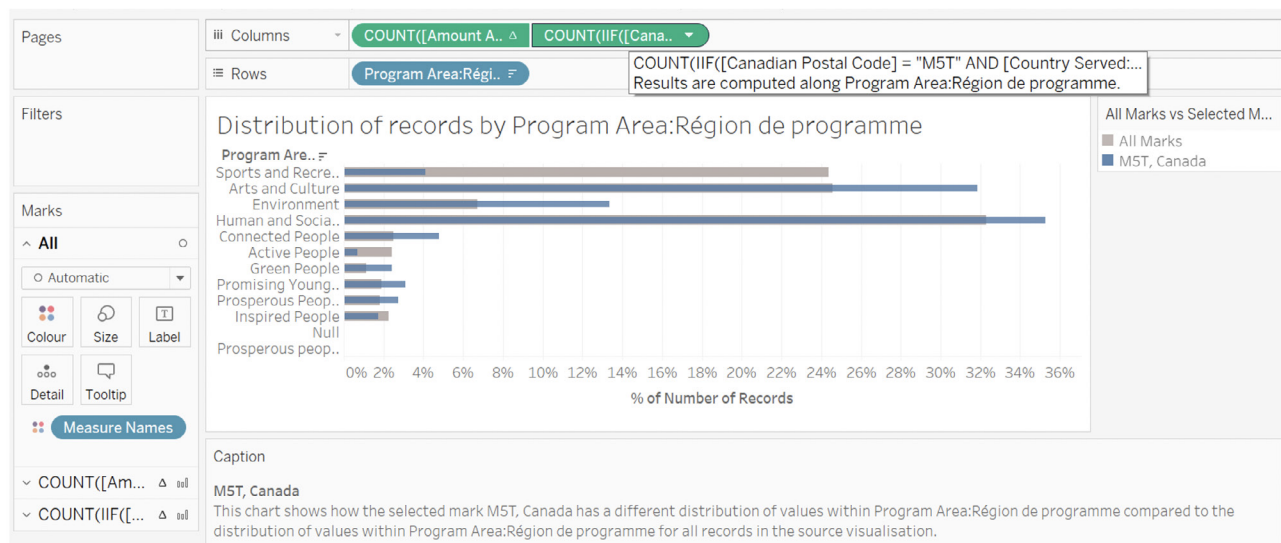


Accessing Explain Data is a tool-tip away for all of the data points. This ease of access enables all users to quickly access augmented intelligence insights when they find a data point of interest. No additional input is required as results generate automatically based on Explain Data's selection of appropriate data points.

Explain Data will intelligently select the underlying data points to compare and draw out avenues for the user to explore the “why” behind their data. Insights are visualization-centric to quickly show the user what’s unique about Explain Data’s findings. For the more advanced users, selecting the Explain Data fields under your data in the menu will let them refine the model and experiment with various combinations on the fly.



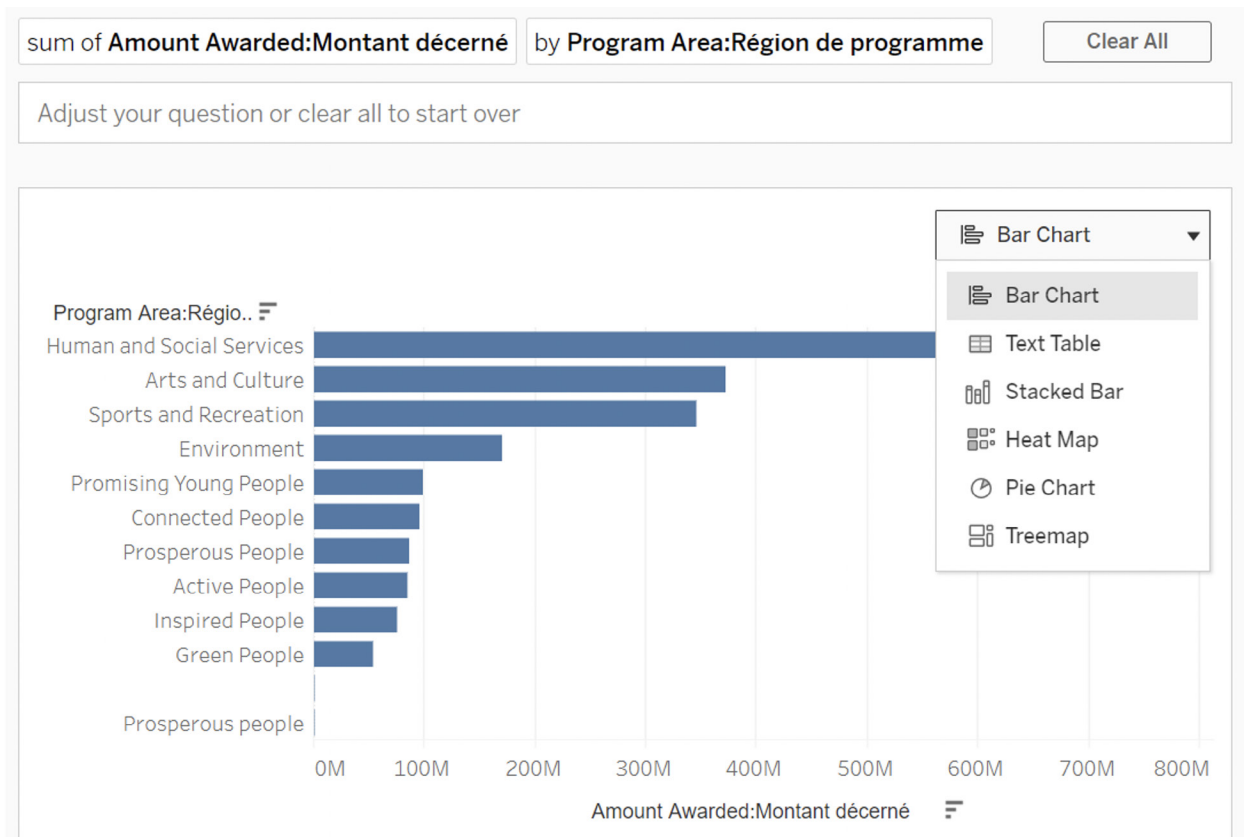
The Explanations Window and Pre-built worksheets use plain language to explain the data point’s uniqueness and underlying relationships with other data. Dive deeper into the insights and transparent explanations through automated visualizations in the worksheet.



Ask Data

With Ask Data, you can use natural language to ask questions and instantly get a response right in Tableau without understanding the data's structure. Answers come in the form of rich data visualizations without understanding the data structure to get answers faster. Fully integrated into the Tableau platform, Ask Data works with existing data sources with no additional setup.

Use: Ask Data will democratize any data source with no additional effort. Evidence locked up in data now becomes accessible to knowledge workers across the organization through simple plain language queries. This means no drawn-out implementation process to create a dashboard. Instead, any data source can become the foundation for evidence-based policy.



Accessing Ask Data is available by selecting any data source within your Tableau Server. Once in, Ask Data presents a free text query box found throughout popular search engines. When typing into this intuitive interface using plain language, the user is then presented with a series of options that Ask Data thinks will answer their question. Getting at the heart of the answer will usually require refinement, so Ask Data allows for follow-up questions to delve deeper and provide the recommended visualization containing the answer or enable the user to select their preferred option manually.

Ask Data results are presented directly through text or intelligently selected visualizations without a need for prompting. Users unfamiliar with the data or creating a visualization automatically receive a visualization they can use to create a new dashboard or answer their questions without additional expertise.

Advanced users can use Ask Data to work through complex and large datasets by asking probing questions that may need to find a known value in a column or answer questions-on-the-fly during meetings.

The screenshot shows the Tableau Ask Data interface for the 'OTF Grant Data' source. The top navigation bar includes 'Explore / Governance / Finance / Grants and Contributions / OTF Grant Data'. Below this, the source name 'OTF Grant Data' is displayed with its owner 'Joshua Gillmore' and a description 'Grant data from 2000 to 2019.'. A 'New' button is visible. The main interface is divided into three sections: 'Data' on the left, 'Ask Data' in the center, and 'Suggested Questions' on the right. The 'Data' section lists various fields like 'Age Group: Groupe d'âge', 'Approval date: Date app...', 'Budget Fund: Fonds du ...', 'Canadian Postal Code', 'Co-Application: Co-de...', 'Country Served: Pays s...', 'Cross-catchment indic...', 'Description (English/A...', 'Description (French/Fr...', 'Fiscal Year: Année fiscal', 'Funding Org: Org subve...', 'Geographical Area Ser...', 'Grant Programme: Titre...', 'Grant Result: Résultat...', 'Identifier: Identificateur', 'Last modified: Mise à j...', 'Organization name: No...', 'Population Served: Pop...', 'Program Area: Régio...', 'Province Served: Provi...', 'Recipient Org: Charitab...', 'Recipient Org: City Org...', 'Recipient Org: Incorpor...', 'Recipient Org: Postal C...', 'Rescinded/Recovered ...', 'Rescinded/Recovered: ...', 'Submission date: Date ...', and 'Table Names'. The 'Ask Data' section features a search bar and a 'Suggested Questions' dropdown menu. The 'Suggested Questions' dropdown is open, showing a list of questions under the 'Basic Data Analysis' category. The selected question is 'sum of Amount Applied For: Montant demandé by Age Group: Groupe d'âge'. The 'Suggested Questions' section also includes a 'Set Up Ask Data' link and a 'Get Started with Ask Data' link. The 'Set Up Ask Data' link is highlighted with a gear icon and the text 'Learn how to structure and roll out Ask Data so users in your organization can find answers fast. Learn more'. The 'Get Started with Ask Data' link is highlighted with a magnifying glass icon and the text 'Not sure what questions to ask of your data? Learn the basics in our how-to guide. Learn more'.

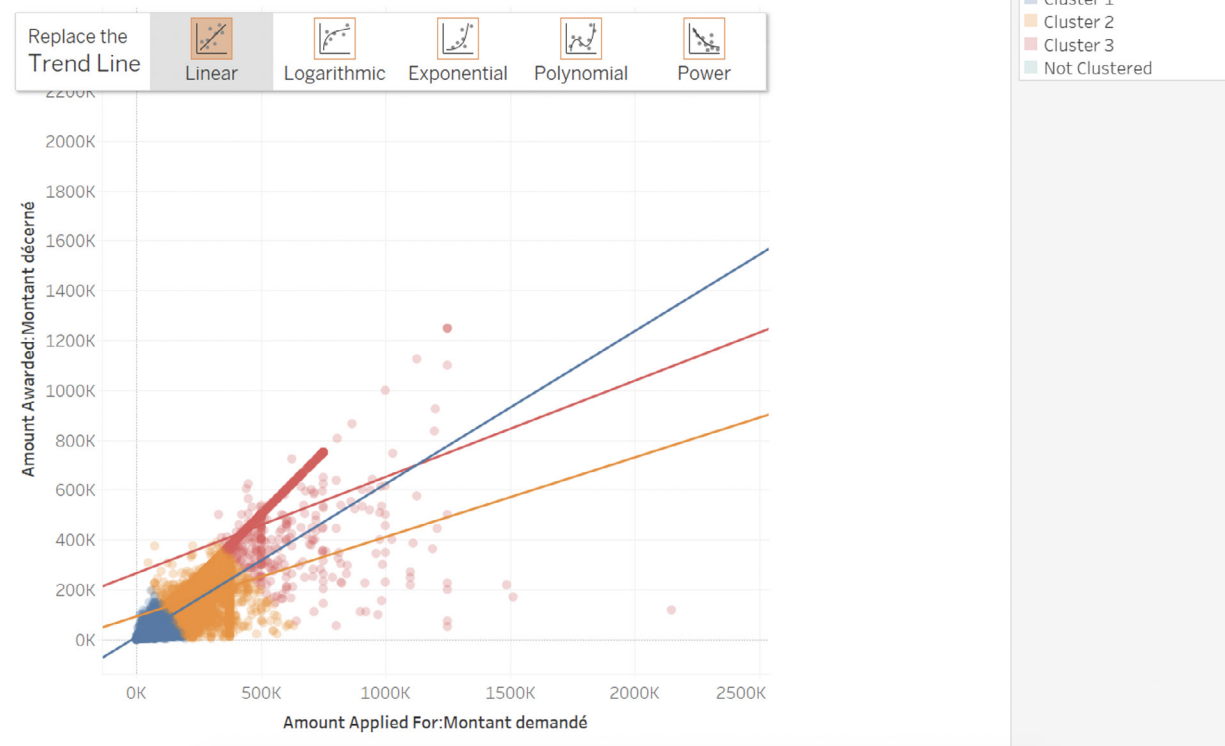
While typing queries, Ask Data will show and suggest functions to generate the visualization as queries. Once generated, visualizations will contain a list of questions to retrace the underlying questions behind the visualization.

Analytics Pane models

The Analytics Pane is Tableau's equivalent of having a drag and drop machine learning-enabled statistician on demand. In addition to the typical statistical workhorses commonly used, like mean and median, the Analytics Pane offers a series of models to help predict your data's likely future with forecasting, its overall patterns with trends, and its closest relationships with clustering.

Use: Understand the likely direction of organization expenditures using machine learning-based forecasts and trends. Like a rainy day, use this information to better prepare.

Amount Applied vs. Received Cluster

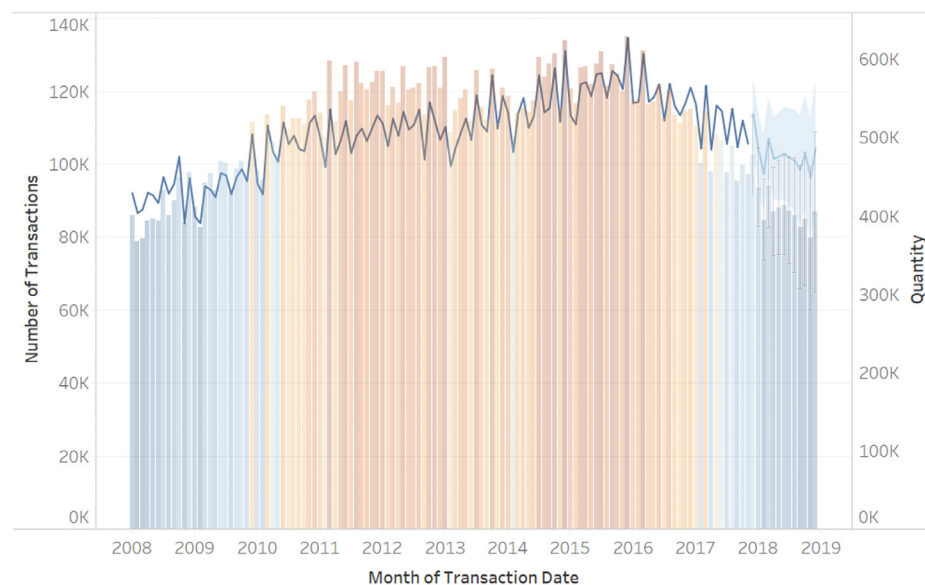


The Analytics Pane is available throughout the visualization creation process in Tableau Desktop to immediately enrich data through drag and drop functionality. Functions will provide guidelines on the required data to visualize and produce a series of options with visual queues to help users of all levels make the right decision and understand how their data will impact the outcome. This drag and drop functionality makes it easy to experiment and determine the best fit for data-driven decision-making. Further interactions with the data through visualization will dynamically update the analytics outcomes to continue assisting human-driven decisions.

Tableau is using machine learning intelligence to select the best fit models based on available data. Users of all levels applying these models will benefit from Tableau's intelligent guidance for the best fit. Additional visual cues throughout the drag and drop process make it intuitive and easy to understand what data the analytics is considering and the type of outcome a user expects. This simple method to apply models means experimentation for users to find the best suit quickly.

Transactions Over Time

Tableau automatically produces visual confidence bands where applicable or allows users to generate model descriptions that will provide in-depth information on underlying information that may include descriptive statistics, formulas, or variables, to name a few.



Describe Clusters ×

Summary Models

Inputs for Clustering
Variables: Sum of Amount Applied For:Montant demandé
Sum of Amount Awarded:Montant décerné
Level of Detail: Identifier:Identificateur
Scaling: Normalised

Summary Diagnostics
Number of Clusters: 3
Number of Points: 25770
Between-group Sum of Squares: 92.423
Within-group Sum of Squares: 27.182
Total Sum of Squares: 119.6

Clusters	Number of Items	Centres	
		Sum of Amount Applied For:Montant demandé	Sum of Amount Awarded:Montant décerné
Cluster 1	18770	50038.0	40300.0
Cluster 2	6118	2.1476e+05	1.6017e+05
Cluster 3	882	5.6782e+05	4.8461e+05
Not Clustered	16		

☐ Show scaled centres

Copy to Clipboard [Learn more about the cluster summary statistics](#)

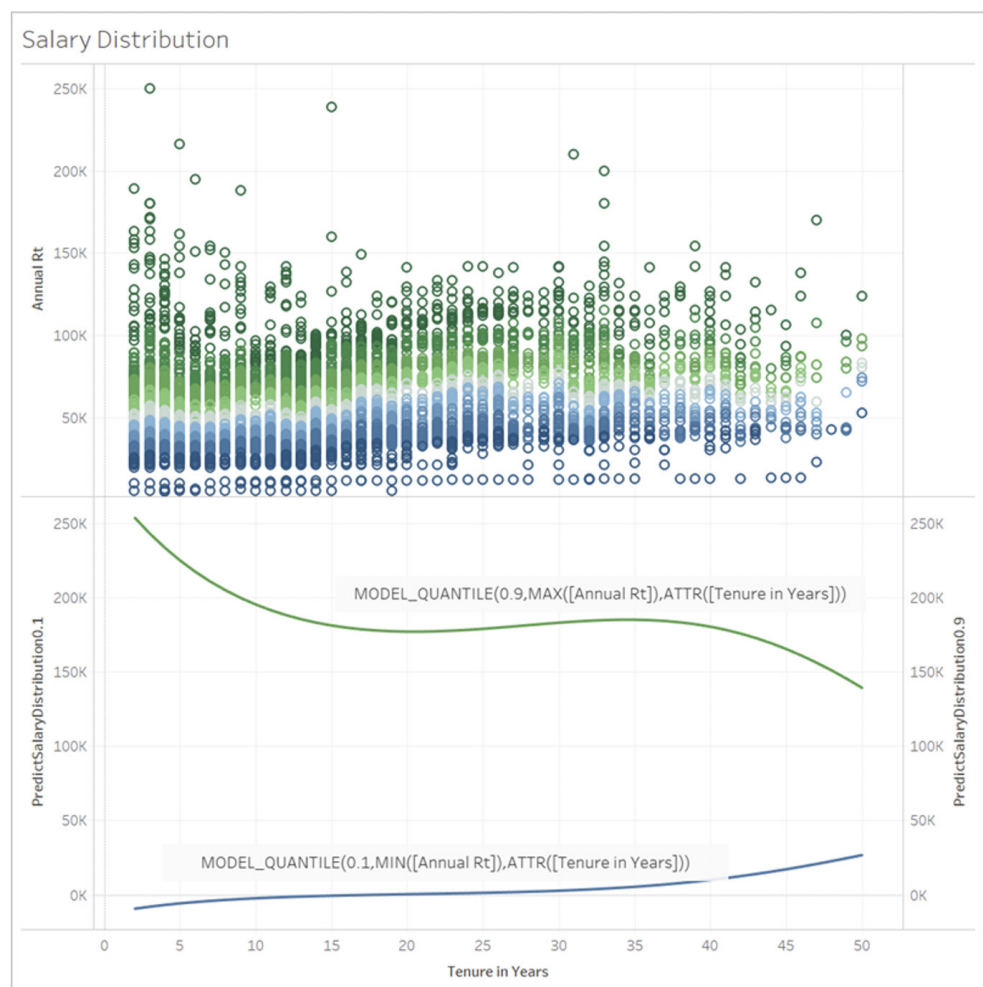
Close

Predictive analytics in calculated fields

Tableau's Calculated Fields produce data on the fly using intuitive functions akin to those found in widely-used spreadsheet software. Predictive analytics functions are available within the list of functions to help fill in missing data and understand how changes in data are likely to affect the outcomes in other places. Generating these new calculated fields means they become available for users to integrate into their visualization or for analytics consumers to see the results as they explore visualizations.

Use: A perfect world contains perfect data. Real-world scenarios generally have missing and incomplete data. Predictive modeling can fill these holes in your data using previous values or other sources to ensure continuity and fewer assumptions in your decision-making process.

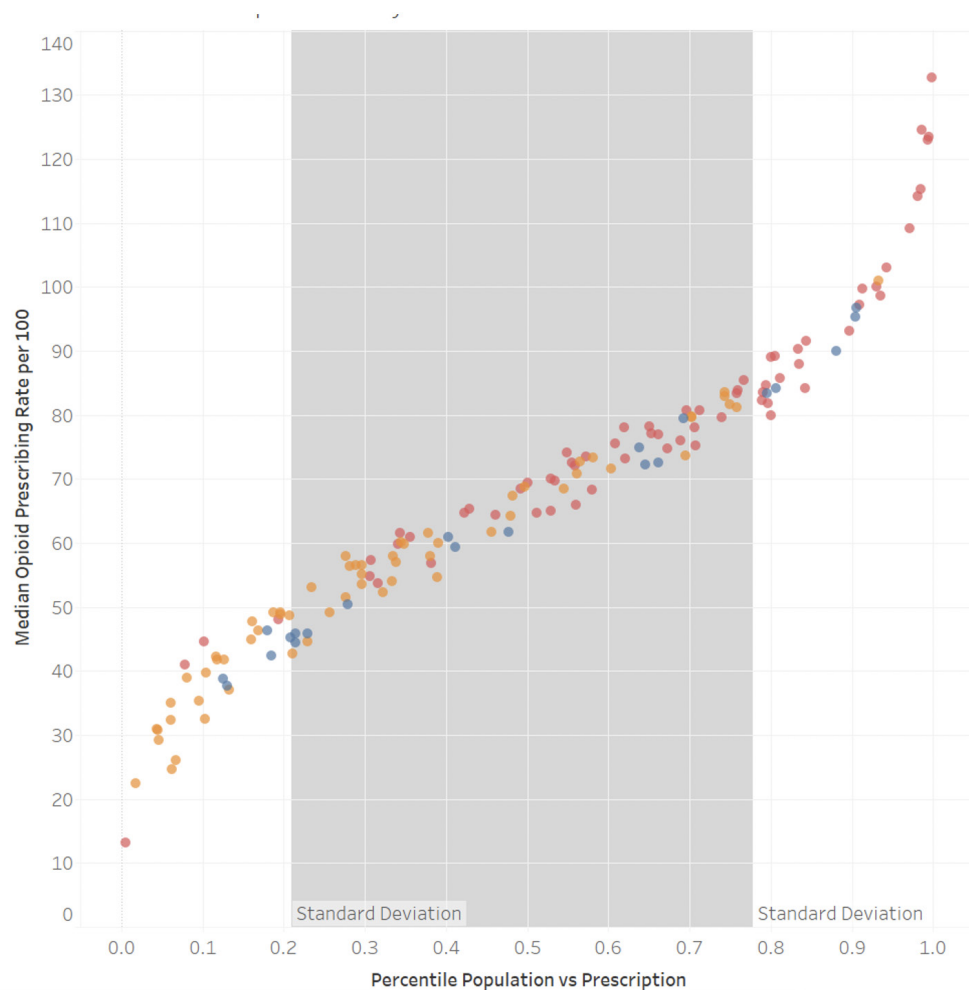
Creating a calculated field is as simple as right-clicking on the Data Pane and selecting the option. A series of functions are available for the analyst to choose that include the two predictive functions. Entering these functions will prompt the user to specify the required dimensions or measure, in addition to validating to ensure all the required data is present.



Once the calculation is complete, the calculated field becomes a part of the drag and drop selection for inclusion in dashboards for visual exploration.

Analysts and data scientists are the users who will intuitively understand how to create predictive outcomes that will benefit key business questions. Once created, these calculated fields are available for use by the broader group of business users when making Tableau visualizations and analytics consumers exploring visualizations with predictive embedded.

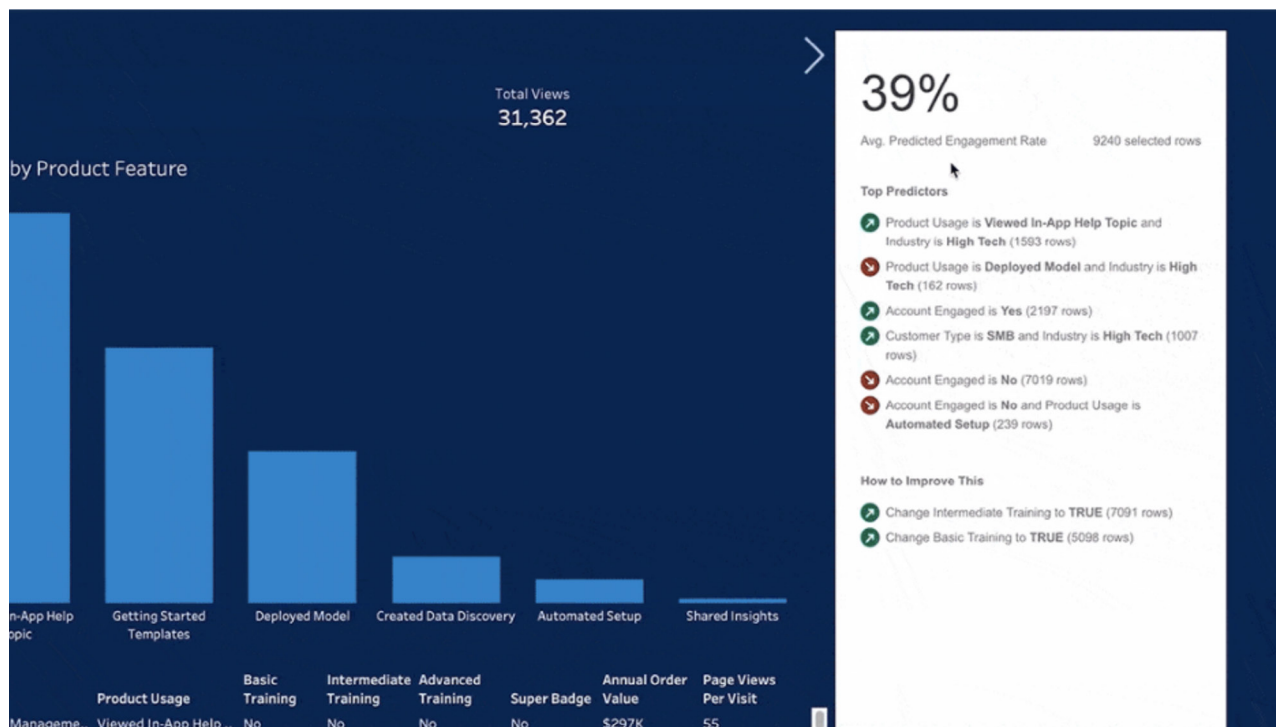
Any visualization containing the predictive calculation will appear in a pill where a user can open up the calculated field to understand further the fields feeding the predictive calculation and any comments originally included.



Einstein Discovery integration

With Einstein's powerful AI technology, you can quickly operationalize predictive intelligence for your entire organization in Tableau without writing a single line of code. Einstein Discovery automatically examines millions of data points from many sources, enabling analysts to rapidly train and deploy predictive models. Tableau surfaces predictions, allows for visual interactivity to explore possible outcomes, and includes the underlying reasons for the predictions.

Use: Einstein Discovery will help process a pile of grant applications and reduce total time on the evaluation. By taking your previous grant applications and their outcomes, Einstein will provide predictive insights that will help identify high-quality referrals and provide explanatory insights when you need to shift your funding portfolio and assess additional risk.

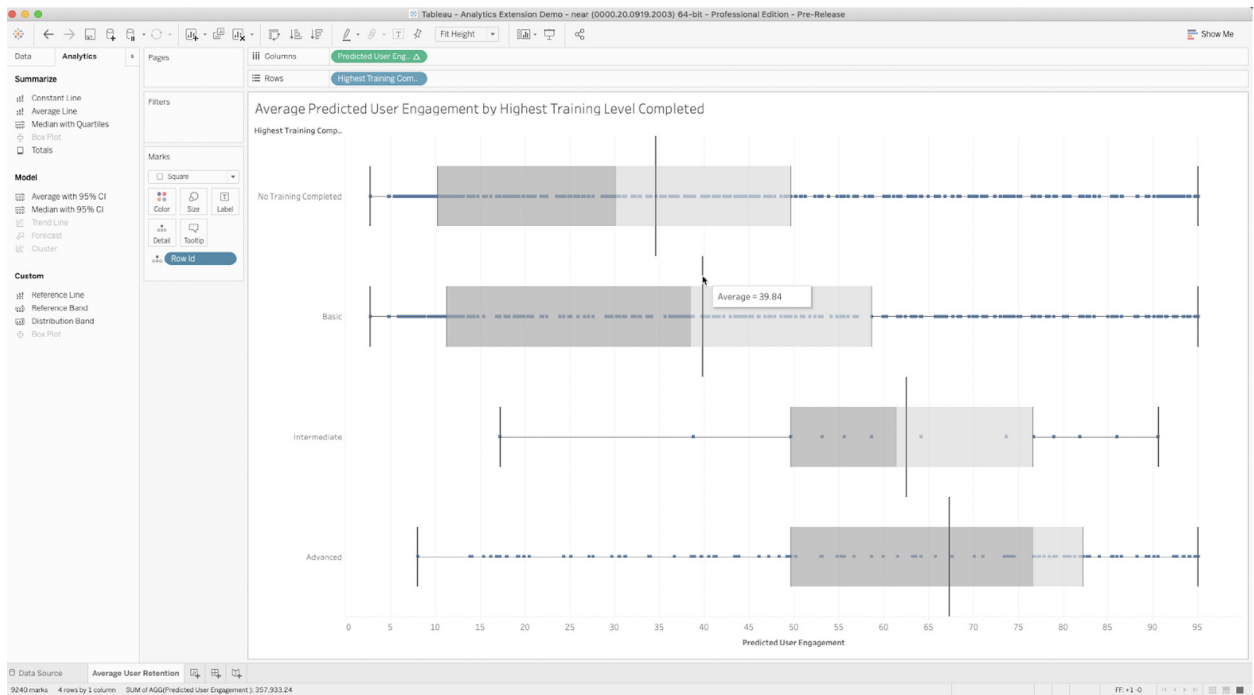


Einstein Discovery in Tableau integrations benefit business users to seasoned data scientists. The new dashboard extension arms Tableau users with automated discovery, no-code machine learning that builds automated predictions, bias protection, and transparent predictive analytics within consumable Tableau visualizations for business users. Einstein Discovery calculated fields allow seasoned analysts to generate new data using Einstein Discovery to enable users with a drag and drop feature into Tableau visualizations for real-time predictions. The Tableau Prep upstream predictive data enrichment means that Tableau users of all levels downstream benefit from advanced analytics and predictive factors towards better decision-making.

The screenshot displays the Tableau Prep interface. At the top, a data flow diagram shows the process: Training Usage and User Adoption data are processed through 'Fix Nulls' steps, then joined ('Join 2'), followed by a 'Super Prediction' step (highlighted with a blue box), then 'Calculate Fields', and finally 'Customer Adoption' (showing 150% completion). Below the flow, the 'Super Prediction 1' output is shown as a table with 7 fields and 9K rows. The table includes columns for various attributes and a 'Prediction' column.

TJF	Completed_Basic_T...	Product_Usage	TJF	Completed_Intermediate...	Industry	Customer_Type	#	Prediction
False	Deployed Model	False	Supply Chain Management	Enterprise	94.13640156071477			
True	Getting Started Templates	True	Human Resource Management	Commercial	8.7529756321768			
False	Deployed Model	False	Business Administration	Commercial	22.46524130130617			
False	Deployed Model	False	Media and Advertising	Commercial	67.74832138114195			
False	Deployed Model	False	IT Projects Management	Enterprise	93.41166415810552			
False	Deployed Model	False	Business Administration	Commercial	73.48902502657515			
False	Viewed In-App Help Topic	False	High Tech	Enterprise	58.68942491048542			
False	Deployed Model	False	Human Resource Management	Enterprise	74.18294790663602			
True	Deployed Model	True	Banking, Investment And Insurance	Enterprise	92.56280537111056			
True	Deployed Model	True	Human Resource Management	Enterprise	74.18294790663602			
False	Deployed Model	False	Marketing Management	Enterprise	76.76659383181486			
True	Viewed In-App Help Topic	True	Finance Management	Enterprise	77.38034710253372			
True	Deployed Model	True	Supply Chain Management	Enterprise	94.13640156071477			

Einstein Discovery provides predictions in a consolidated view that identified top predictors, the relationship strength to the outcome, and the strength. Going deeper into Einstein will reveal additional findings and details on the models supporting the outcome. Integration within Tableau will display the raw data underpinning the predictions by record for visualization and sharing.

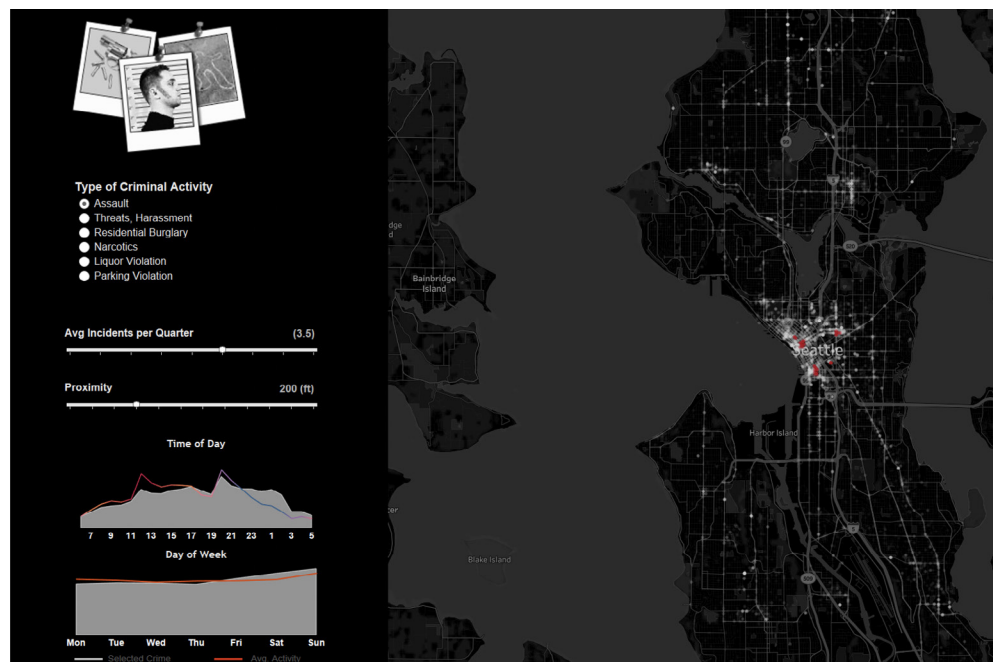


Analytics integration

When you convert your Python, R or Matlab scripts to run in Tableau, you open up a world of new opportunities and democratize data science by making advanced algorithms accessible to everyone in your organization with a simple drag and drop. It also allows your teams to see, understand, and explore a script's results in a visual, interactive format.

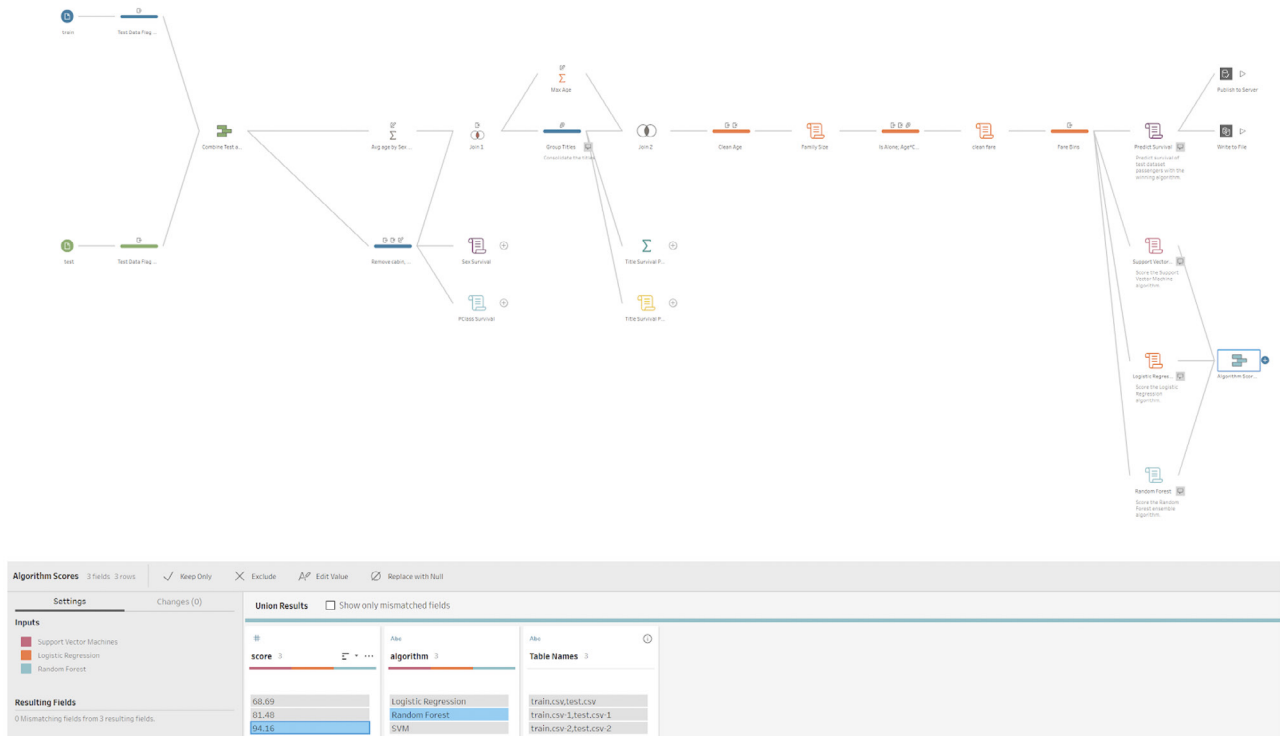
Use: Deep learning and natural language processing is typically tricky for an analyst, subject matter experts, and decision-makers to interpret. Pairing the underpinning technologies with data visualization in Tableau means opening up these technologies for programmatic and policy decisions in a consumable format that minimizes the data science team's overhead and allows them to focus on their expertise, data science.

Tableau Prep and Desktop include multiple locations to integrate Python and R scripts. Connecting to TabPy or R services is a simple process that can be started in as little as two values. Implementing a script is a guided process in the Tableau Prep user interface. It uses Tableau's built-in calculated fields in Tableau Desktop by including the script directly in the prompt.



Even users without any scripting background can connect scripts for enrichment upstream in Tableau Prep, or use the visual queues in Tableau Desktop. This means that complex scripts created by data scientists are available for use within the Tableau analytics process. Re-use of content previously created in future dashboards is also an option to take advanced analytics in new directions. Tableau offers more advanced solutions for more experienced users by combining data generated on the fly through calculated fields or tapping into stored predictive models using TabPy.

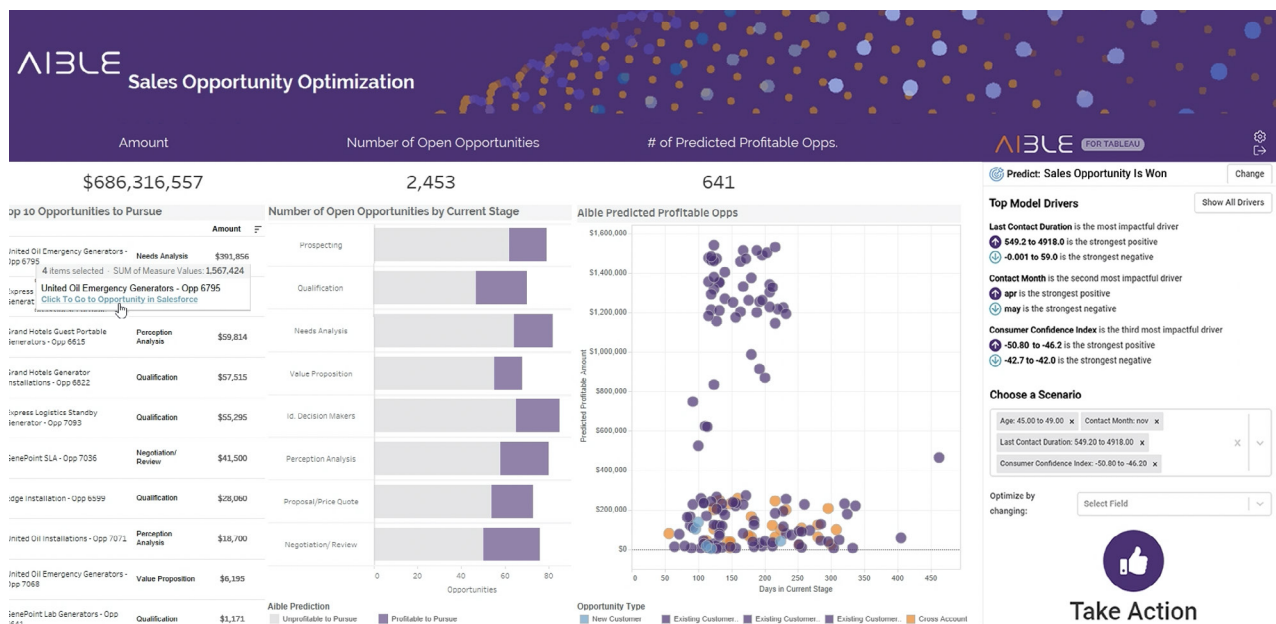
Rserve and TabPy consoles and logs provide real-time feedback on the functions being performed and issues encountered. Throughout the process, users can open up the R or Python functions being applied in the calculated fields or use Tableau Prep to access the script's location for direct access with the proper permissions.



Extensions

Tableau Extensions are widely available through the Tableau Extension Gallery and maintain a simple drag and drop approach for implementation. Tableau has a rich ecosystem of partners utilizing the Tableau Extension ecosystem to enhance and augment Tableau's data Visualization capabilities that include extensions with AI and ML capabilities.

Use: An AI and ML technological revolution is abounding. Several of these technologies exist across many Tableau partners. Extensions allow for simple integration to realize all the benefits of these technologies in your Tableau analytics workflow. This means plain language interpretation of your results in Tableau by combining the natural language generation technologies.



Extensions will typically contain simple graphical user interfaces for any level of Tableau user to simplify enrichment of their data using AI and ML technologies with no programming required.

Newly created enriched data in these extensions may assist with predictive outcomes, scenario analysis, and what-if analysis. Combining this enriched data with Tableau visualizations will allow for real-time exploration of results that update on-the-fly through Tableau user interaction. In some instances, the extension may include new data visualizations natively built on the AI and ML results to assist with the analytics process for all experience levels.



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