

# MEDLEY:

## Intent-based Recommendations to Support Dashboard Composition



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Tableau Research

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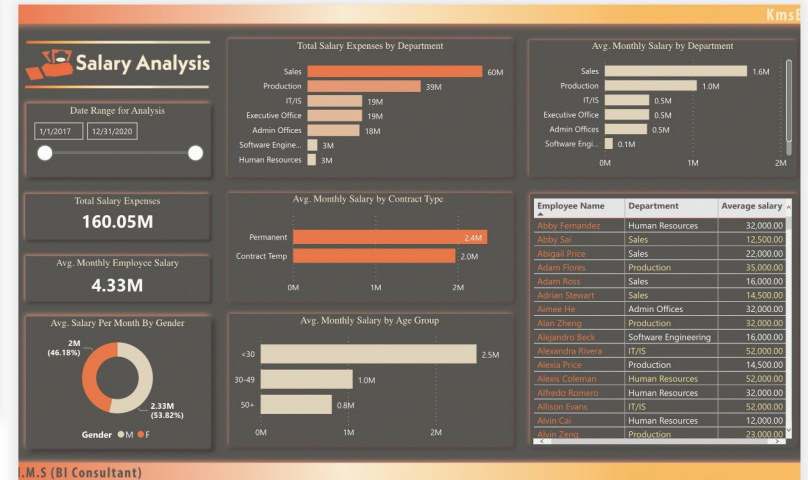
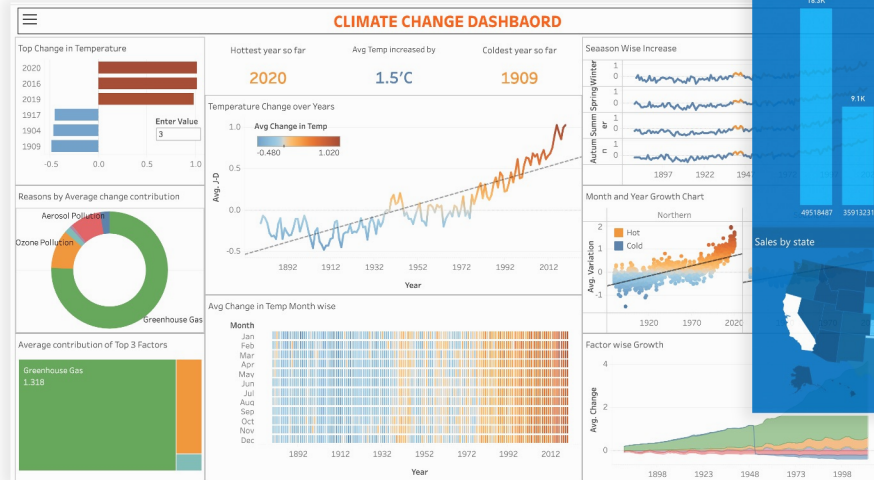


Vidya Setlur  
Tableau Research

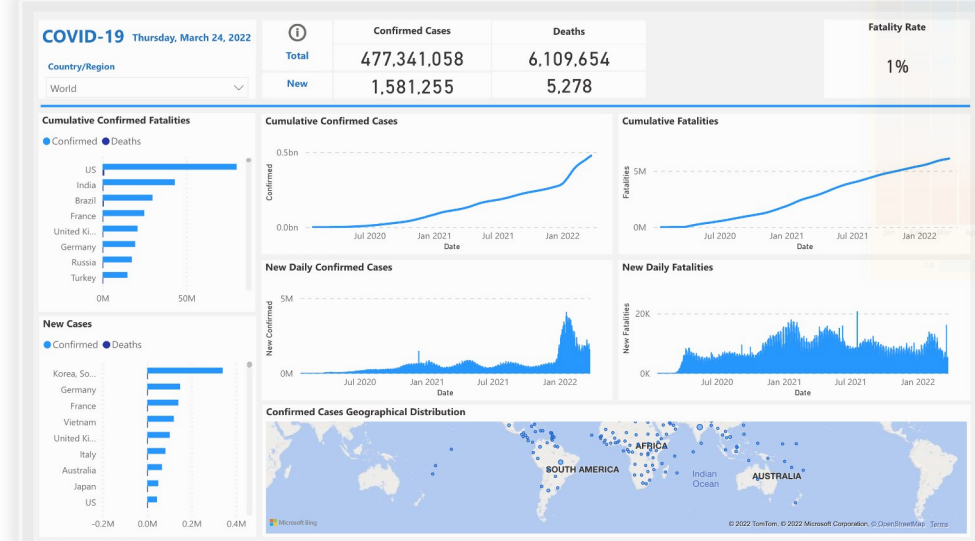
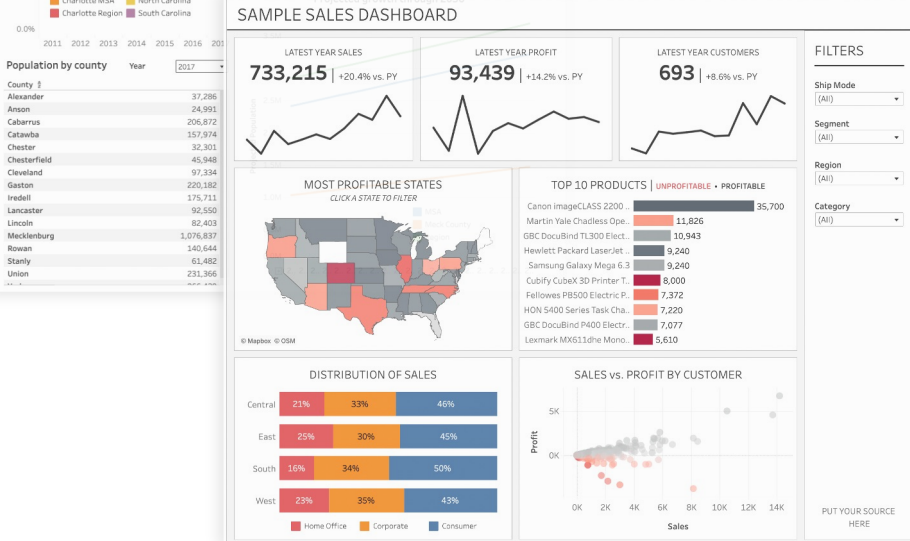
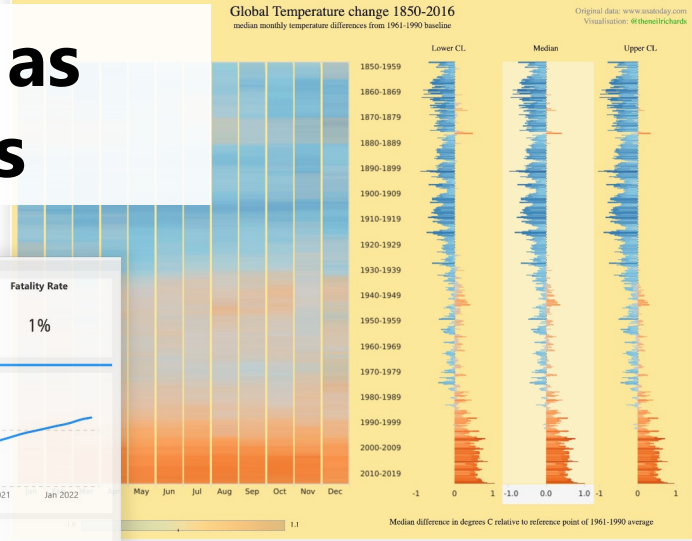
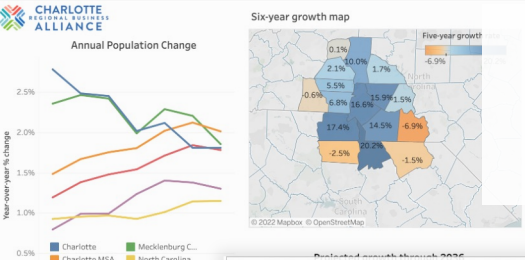
 @vsetlur

 Slides and paper:  
[bit.ly/  
medley-vis22](https://bit.ly/medley-vis22)





# Dashboards are ubiquitously used as interfaces to data across domains



# Dashboard Authoring Process



4x Dashboard Authors  
(Analysts and Consultants)

**Targeted Authoring:** end users provide analytic goals or questions of interest (e.g., “We are interested in getting an overview of the company’s sales for the past year”)

**Open-ended Authoring:** dashboard goals are author-defined

# Dashboard Authoring Process

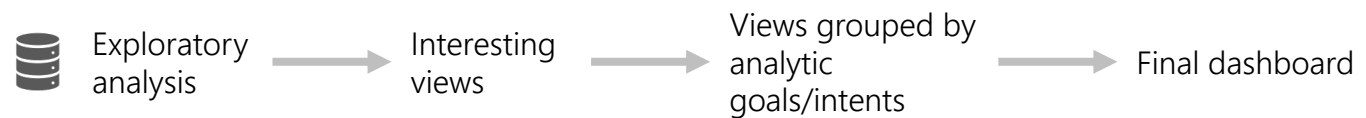


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# Dashboard Authoring Process



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How can we leverage the notion of **dashboard intents to assist dashboard composition** and make it a more active part of the analytic process?

< Input

### Recommended Collections

Aggregation Sum

Update Recommendations

### Dashboard Canvas



Dataset:

Superstore

Attributes

Clear

# Discount

# Profit

# Quantity

# Sales

State

A Category

A Customer

A Product

A Region

A Segment

A ShipMode

Date

Intent

Clear

Measure Analysis

Category Analysis

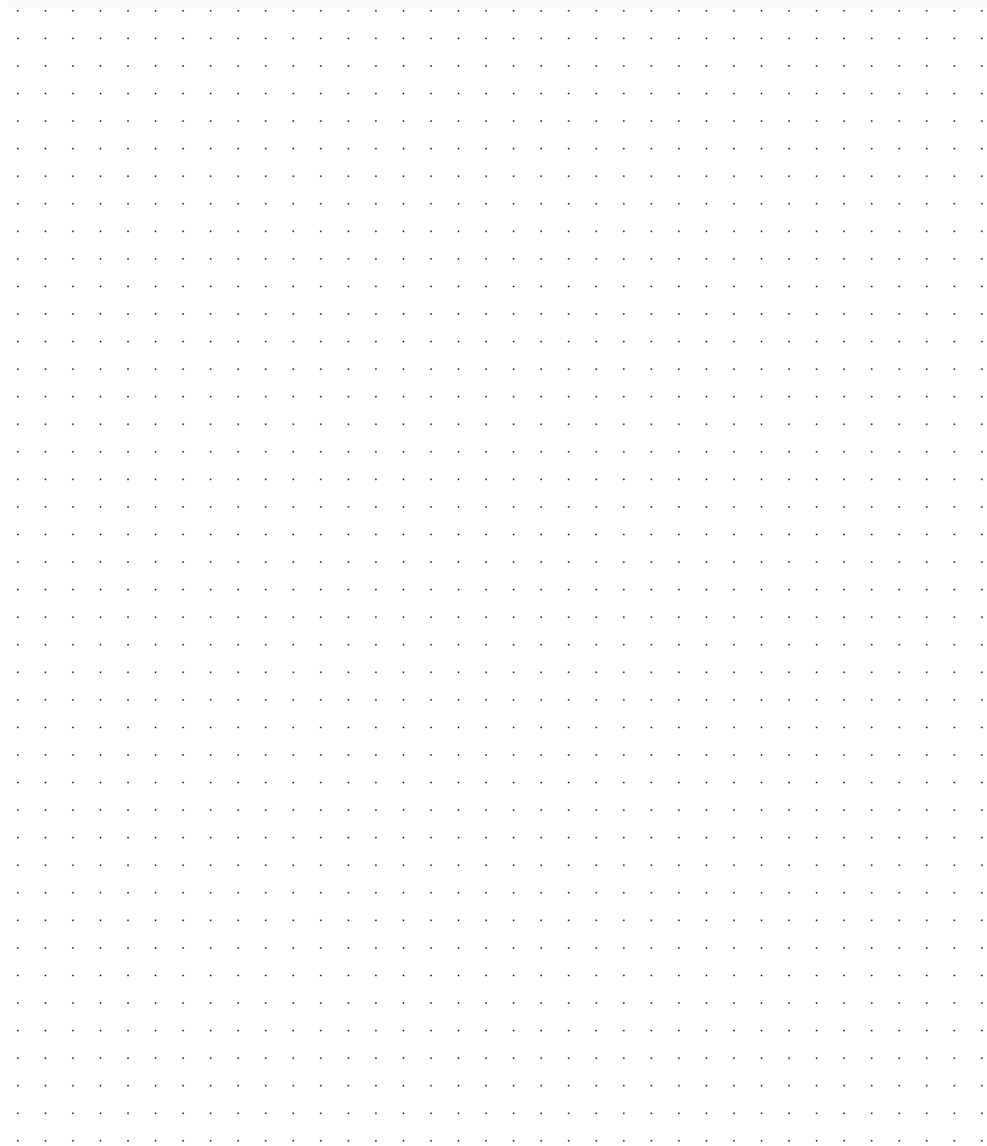
Change Analysis

Distribution Analysis

Select intents or attributes to view dashboard collections.

Or

See default recommendations



Dataset:

Superstore

Attributes

Clear

# Discount

# Profit

# Quantity

# Sales

State

Category

Customer

Select intents or attributes to view dashboard collections.

Or

See default recommendations



| Order ID       | Order Date | Date     | Ship Mode      | Customer ID | Customer        | Segment   | Country       | City            | State      | Postal Code | Region | Product ID      | Category        | Sub-Category | Product  | Sales    | Quantity | Discount | Profit   |
|----------------|------------|----------|----------------|-------------|-----------------|-----------|---------------|-----------------|------------|-------------|--------|-----------------|-----------------|--------------|--|----------|----------|----------|----------|
| CA-2013-152156 | 11/9/20    | 11/12/20 | Second Class   | CG-12520    | Claire Gute     | Consumer  | United States | Henderson       | Kentucky   | 42420       | South  | FUR-BO-10001798 | Furniture       | Bookcases    | Bush Somerset Collection Bookcase                                | 261.96   | 2        | 0        | 41.9136  |
| CA-2013-152156 | 11/9/20    | 11/12/20 | Second Class   | CG-12520    | Claire Gute     | Consumer  | United States | Henderson       | Kentucky   | 42420       | South  | FUR-CH-10000454 | Furniture       | Chairs       | Hon Deluxe Fabric Upholstered Stacking Chairs, Rounded Back      | 731.94   | 3        | 0        | 219.582  |
| CA-2013-138688 | 6/13/20    | 6/17/20  | Second Class   | DV-13045    | Darrin Van Huff | Corporate | United States | Los Angeles     | California | 90036       | West   | OFF-LA-10000240 | Office Supplies | Labels       | Self-Adhesive Address Labels for Typewriters by Universal        | 14.62    | 2        | 0        | 6.8714   |
| US-2012-108966 | 10/11/19   | 10/18/19 | Standard Class | SO-20335    | Sean O'Donnell  | Consumer  | United States | Fort Lauderdale | Florida    | 33311       | South  | FUR-TA-10000577 | Furniture       | Tables       | Bretford CR4500 Series Slim Rectangular Table                    | 957.5775 | 5        | 45       | -383.031 |
| US-2012-108966 | 10/11/19   | 10/18/19 | Standard Class | SO-20335    | Sean O'Donnell  | Consumer  | United States | Fort Lauderdale | Florida    | 33311       | South  | OFF-ST-10000760 | Office Supplies | Storage      | Eldon Fold 'N Roll Cart System                                   | 22.368   | 2        | 20       | 2.5164   |
| CA-2011-115812 | 6/9/18     | 6/14/18  | Standard Class | BH-11710    | Brosina Hoffman | Consumer  | United States | Los Angeles     | California | 90032       | West   | FUR-FU-10001487 | Furniture       | Furnishings  | Eldon Expressions Wood and Plastic Desk Accessories, Cherry Wood | 48.86    | 7        | 0        | 14.1694  |
| CA-2011-115812 | 6/9/18     | 6/14/18  | Standard Class | BH-11710    | Brosina Hoffman | Consumer  | United States | Los Angeles     | California | 90032       | West   | OFF-AR-10002833 | Office Supplies | Art          | Newell 322   | 7.28     | 4        | 0        | 1.9656   |
| CA-2011-115812 | 6/9/18     | 6/14/18  | Standard Class | BH-11710    | Brosina Hoffman | Consumer  | United States | Los Angeles     | California | 90032       | West   | TEC-PH-10002275 | Technology      | Phones       | Mitel 5320 IP Phone VoIP phone                                   | 907.152  | 6        | 20       | 90.7152  |
| CA-2011-115812 | 6/9/18     | 6/14/18  | Standard Class | BH-11710    | Brosina Hoffman | Consumer  | United States | Los Angeles     | California | 90032       | West   | OFF-BI-10003910 | Office Supplies | Binders      | DXL Angle-View Binders with Locking Rings by Samsill             | 18.504   | 3        | 20       | 5.7825   |
| CA-2011-115812 | 6/9/18     | 6/14/18  | Standard Class | BH-11710    | Brosina Hoffman | Consumer  | United States | Los Angeles     | California | 90032       | West   | OFF-AP-10002892 | Office Supplies | Appliances   | Belkin F5C206VTEL 6 Outlet Surge                                 | 114.9    | 5        | 0        | 34.47    |
| CA-2011-115812 | 6/9/18     | 6/14/18  | Standard Class | BH-11710    | Brosina Hoffman | Consumer  | United States | Los Angeles     | California | 90032       | West   | FUR-TA-10001539 | Furniture       | Tables       | Chromcraft Rectangular Conference Tables                         | 1706.184 | 9        | 20       | 85.3092  |
| ...            | ...        | ...      | ...            | ...         | ...             | ...       | ...           | ...             | ...        | ...         | ...    | ...             | ...             | ...          | ...  | ...      | ...      | ...      | ...      |

Change Analysis

Distribution Analysis



< Input

Dataset:

Superstore

Attributes

Clear

# Discount

# Profit

# Quantity

# Sales

State

A Category

A Customer

A Product

A Region

A Segment

A ShipMode

Date

Intent

Clear

Measure Analysis

Category Analysis

Change Analysis

Distribution Analysis

### Recommended Collections

Aggregation **Sum**

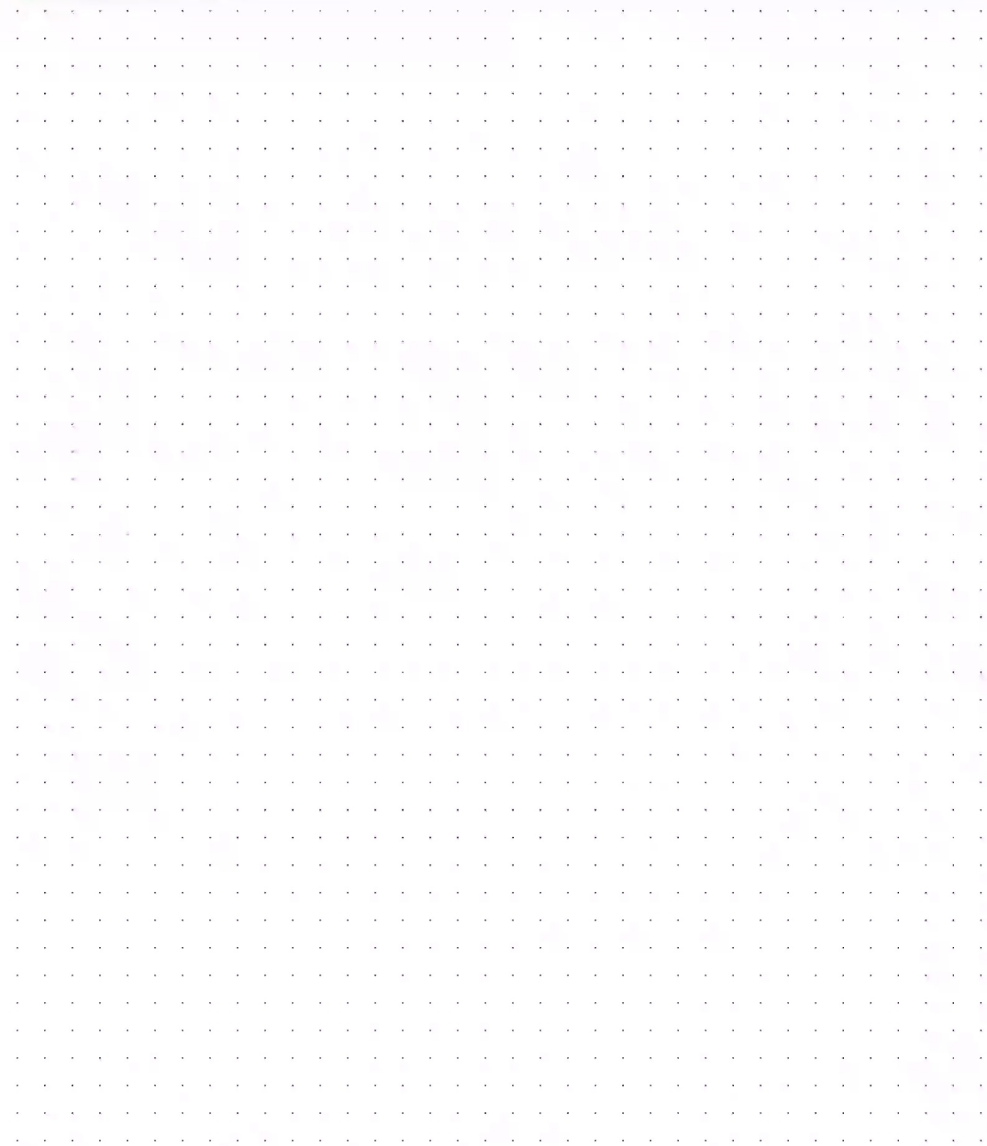
Update Recommendations

Select intents or attributes to view dashboard collections.

Or

See default recommendations

### Dashboard Canvas



< Input

### Recommended Collections

Aggregation **Sum** ▾

 Update Recommendations

Dataset:  
Superstore ▾

Attributes Clear

# Discount

# Profit

# Quantity

# Sales

🌐 State

A Category

A Customer

A Product

A Region

A Segment

A ShipMode

📅 Date

Intent Clear

Measure Analysis

Category Analysis

Change Analysis

Distribution Analysis

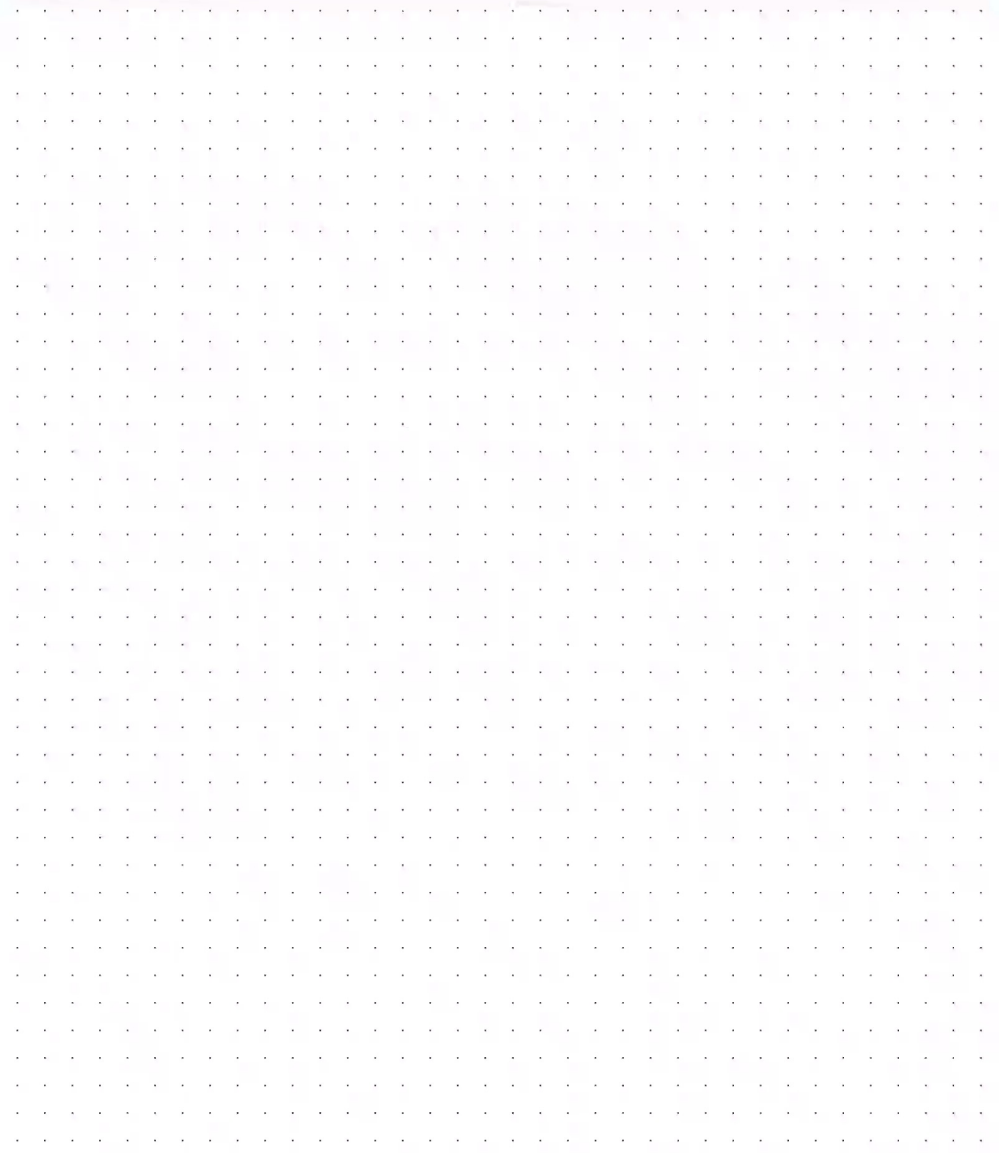
Select intents or attributes to view dashboard collections.

Or

See default recommendations

### Dashboard Canvas



< Input

Dataset:

Superstore

Attributes

Clear

# Discount

# Profit

# Quantity

# Sales

State

Category

Customer

Product

Region

Segment

ShipMode

Date

Intent

Clear

Measure Analysis

Category Analysis

Change Analysis

Distribution Analysis

### Recommended Collections

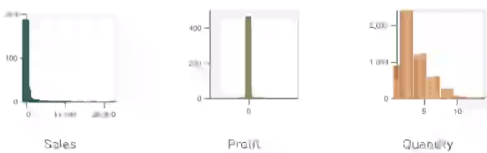
Aggregation Sum

Update Recommendations

Showing collection recommendations for **all intents**.

#### Distribution Analysis 12 Views

Distribution of all variables in the dataset

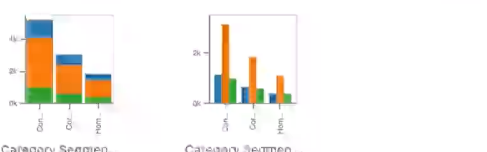
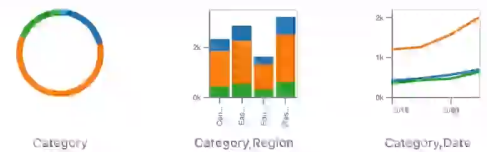


#### Widgets

No widgets recommended with this collection.

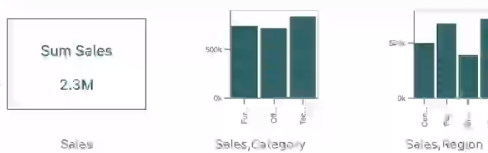
#### Category Analysis 5 Views

Count of records by Category



#### Measure Analysis 8 Views

Analysis of Sales across dimensions

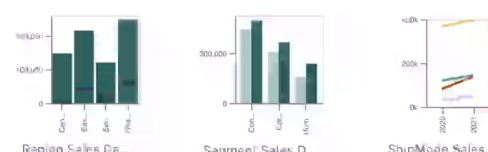


#### Widgets

ShipMode  State  Date

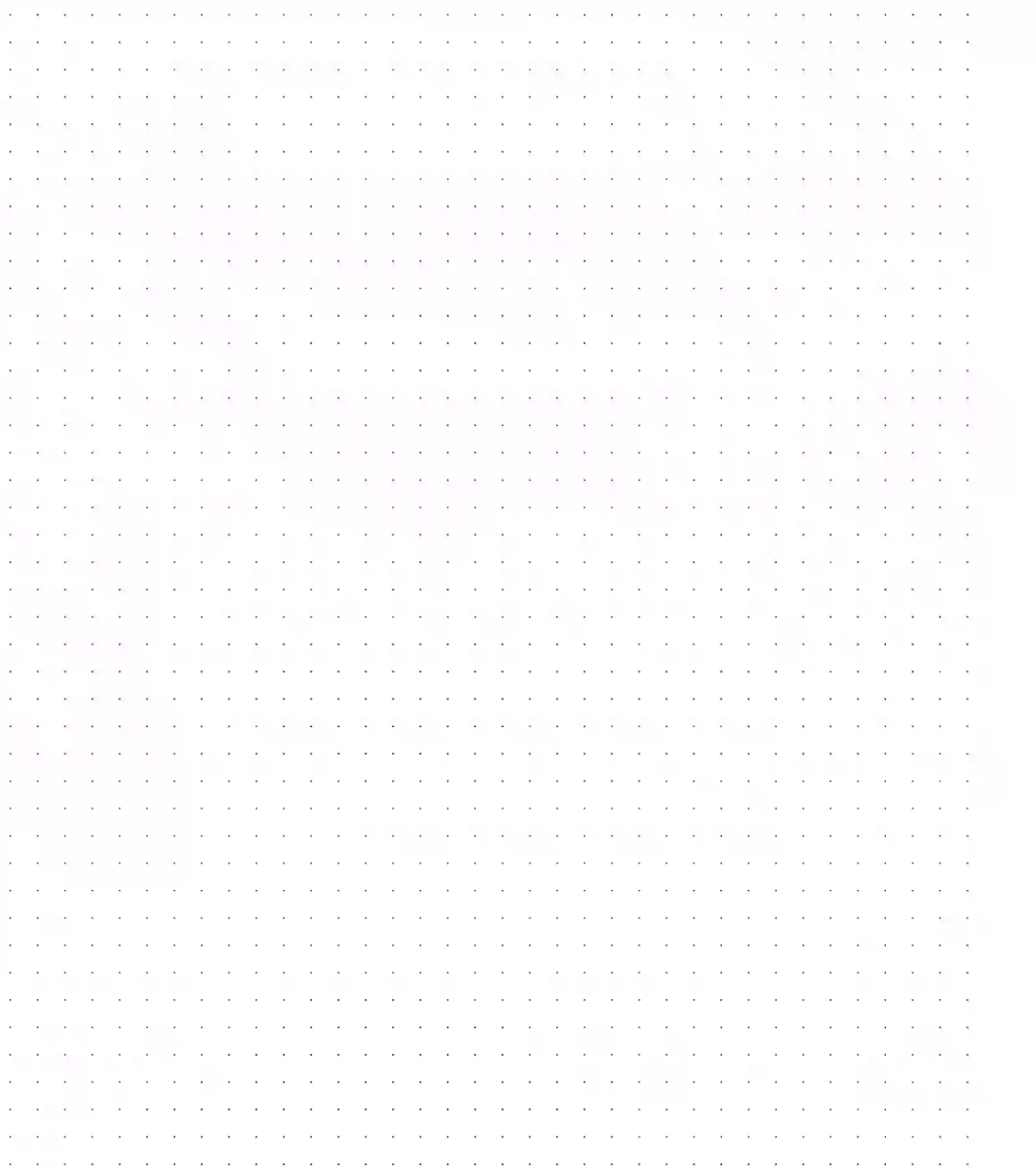
#### Change Analysis 6 Views

YoY change in Sales (2021 vs. 2020)



### Dashboard Canvas

Refresh, Rotate, Download, Menu icons



< Input

### Recommended Collections

Aggregation Sum

Update Recommendations

### Dashboard Canvas



Dataset:

Superstore

Attributes

Clear

# Discount

# Profit

# Quantity

# Sales

State

A Category

A Customer

A Product

A Region

A Segment

A ShipMode

Date

Clear

Intent

Measure Analysis

Category Analysis

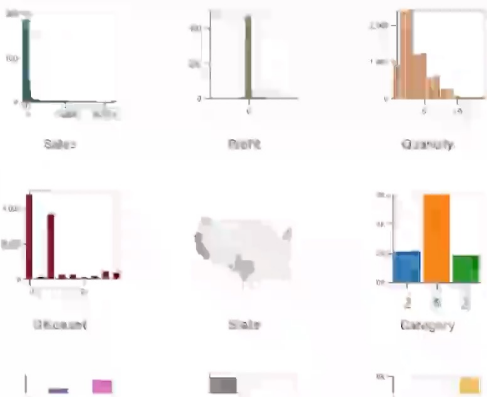
Change Analysis

Distribution Analysis

Showing collection recommendations for **all intents**.

#### Distribution Analysis 12 Views

Distribution of all variables in the dataset

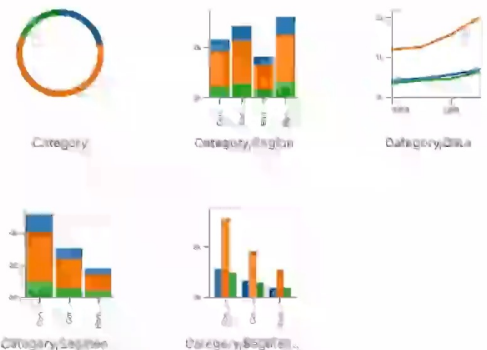


Widgets

No widgets recommended with this collection.

#### Category Analysis 5 Views

Count of records by Category



#### Measure Analysis 6 Views

Analysis of Sales across dimensions

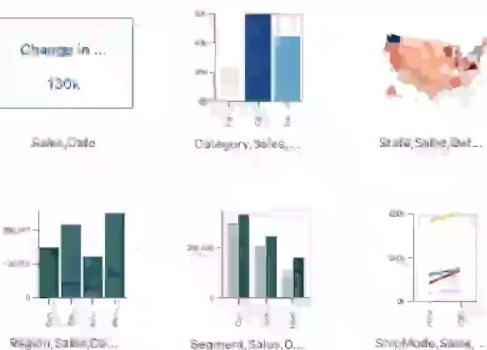


Widgets

ShipMode  State  Date

#### Change Analysis 6 Views

YoY change in Sales (2021 vs. 2020)



KPI Summary

Sum Sales  
2.3M

Sum of Sales by State

sum of Sales  
454,699  
688



< Input

Dataset:

Superstore

Attributes Clear

# Discount

# Profit

# Quantity

# Sales

State

A Category

A Customer

A Product

A Region

A Segment

A ShipMode

Date

Intent Clear

Measure Analysis

Category Analysis

Change Analysis

Distribution Analysis

### Recommended Collections

Aggregation Sum Update Recommendations

Showing collection recommendations for Change Analysis

Change Analysis Views +

YoY change in Sales (2021 vs. 2020)



Change Analysis 6 Views +

Summary of change in Sales and Profit



Widgets

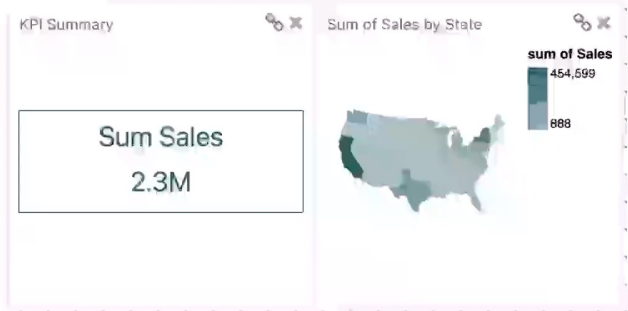
Date

Widgets

Date

### Dashboard Canvas

Refresh Fullscreen Download Close Menu



**< Input**

**Dataset:**  
Superstore

**Attributes** Clear

- # Discount
- # Profit
- # Quantity
- # Sales
- State
- Category
- Customer
- Product
- Region
- Segment
- ShipMode
- Date

**Intent** Clear

- Measure Analysis
- Category Analysis
- Change Analysis**
- Distribution Analysis

### Recommended Collections

Aggregation **Sum** Update Recommendations

Showing collection recommendations for **Change Analysis**

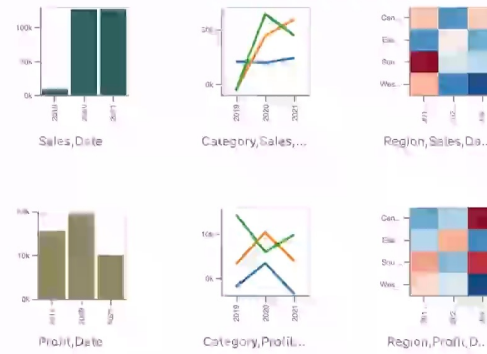
#### Change Analysis 6 Views +

YoY change in Sales (2021 vs. 2020)



#### Change Analysis 6 Views +

Summary of change in Sales and Profit



#### Widgets

Date

#### Widgets

Date

### Dashboard Canvas

Refresh Fullscreen Download Close Menu



- < Input
- Dataset: Superstore
- Attributes: # Discount, # Profit, # Quantity, # Sales, State, Category, Customer, Product, Region, Segment, ShipMode, Date
- Intent: Measure Analysis, Category Analysis, Change Analysis, Distribution Analysis

### Recommended Collections

Aggregation **Sum** Update Recommendations

Showing collection recommendations for **Change Analysis**, focusing on the **attribute(s): Profit**.

#### Change Analysis 6 Views +

YoY change in Profit (2021 vs. 2020)

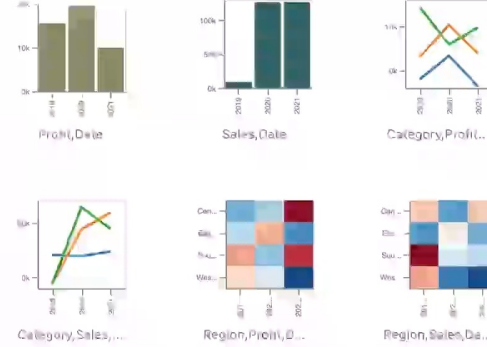


Widgets

Unit

#### Change Analysis 6 Views +

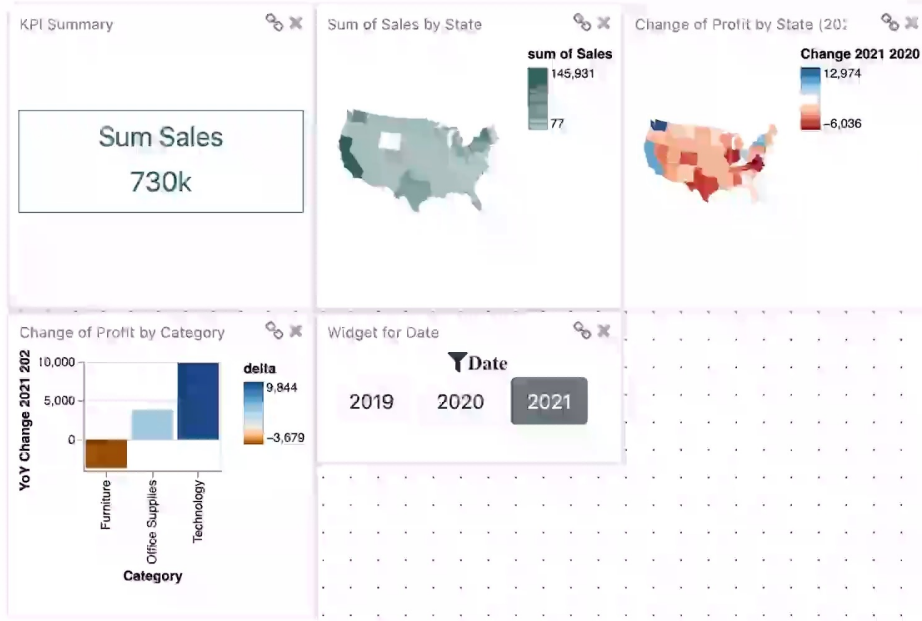
Summary of change in Profit and Sales



Widgets

Date

### Dashboard Canvas



< Input

Dataset:

Superstore

Attributes

Clear

# Discount

# Profit

# Quantity

# Sales

State

A Category

A Customer

A Product

A Region

A Segment

A ShipMode

Date

Intent

Clear

Measure Analysis

Category Analysis

Change Analysis

Distribution Analysis

Recommended Collections

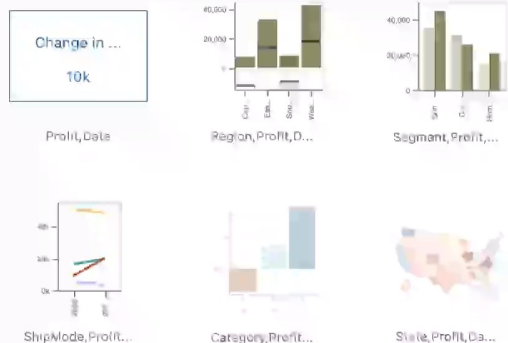
Aggregation **Sum**

Update Recommendations

Showing collection recommendations for **all intents**, focusing on the **attribute(s): Profit**.

Change Analysis 6 Views

YoY change in Profit (2021 vs. 2020)



Widgets

Date

Measure Analysis 8 Views

Analysis of Profit across dimensions



Widgets

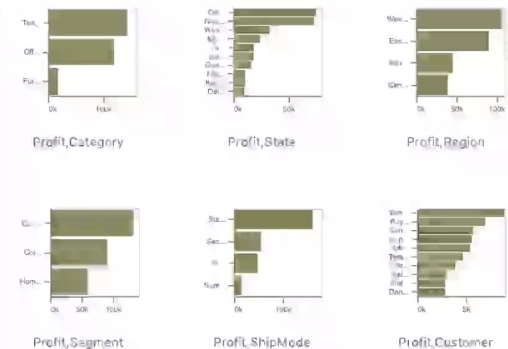
ShipMode

State

Date

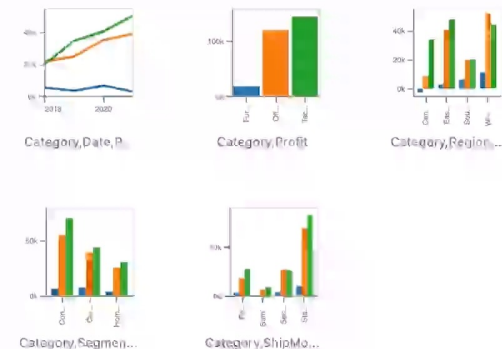
Measure Analysis 6 Views

Top Profit categories across dimensions



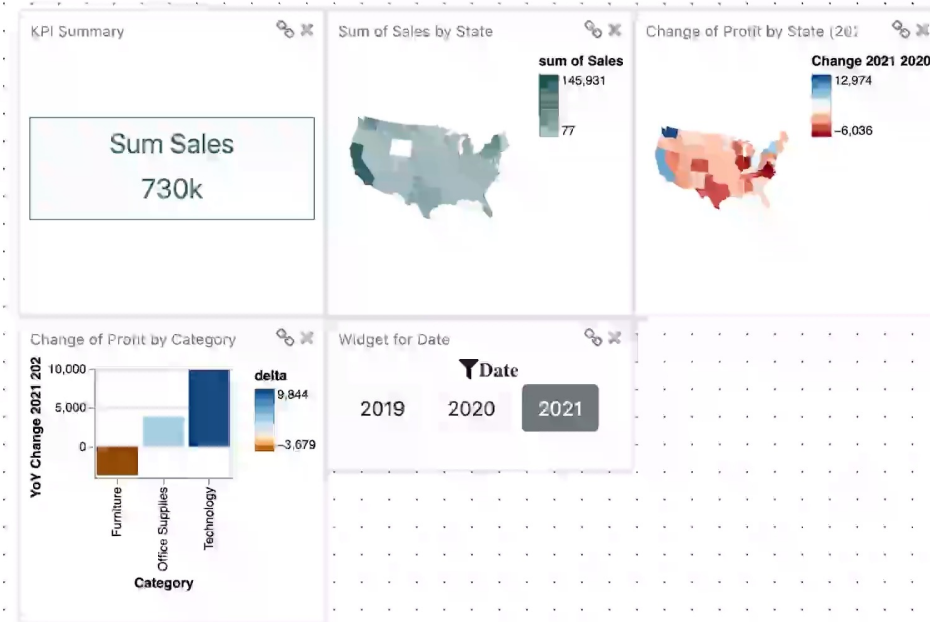
Category Analysis 5 Views

Summary of Profit for Category



Dashboard Canvas

Refresh, Home, Download, Close, Menu





< Input

Dataset:

Superstore

Attributes

# Discount

# Profit

# Quantity

# Sales

State

A Category

A Customer

A Product

A Region

A Segment

A ShipMode

Date

Intent

Measure Analysis

Category Analysis

Change Analysis

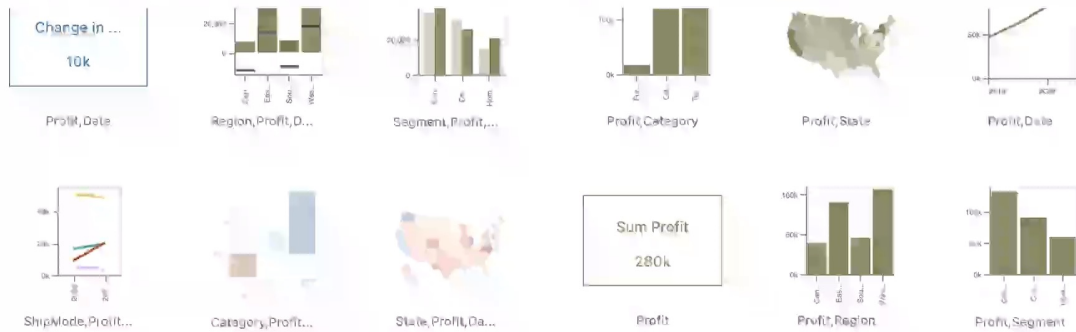
Distribution Analysis

Recommended Collections

Aggregation Sum

Update Recommendations

Showing collection recommendations for all intents, focusing on the attribute(s): Profit.

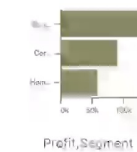


Widgets

Date

Measure Analysis 6 Views

Top Profit categories across dimensions



Widgets

Profit

Widgets

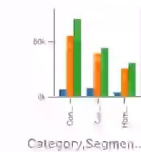
ShipMode

State

Date

Category Analysis 5 Views

Summary of Profit for Category



Widgets

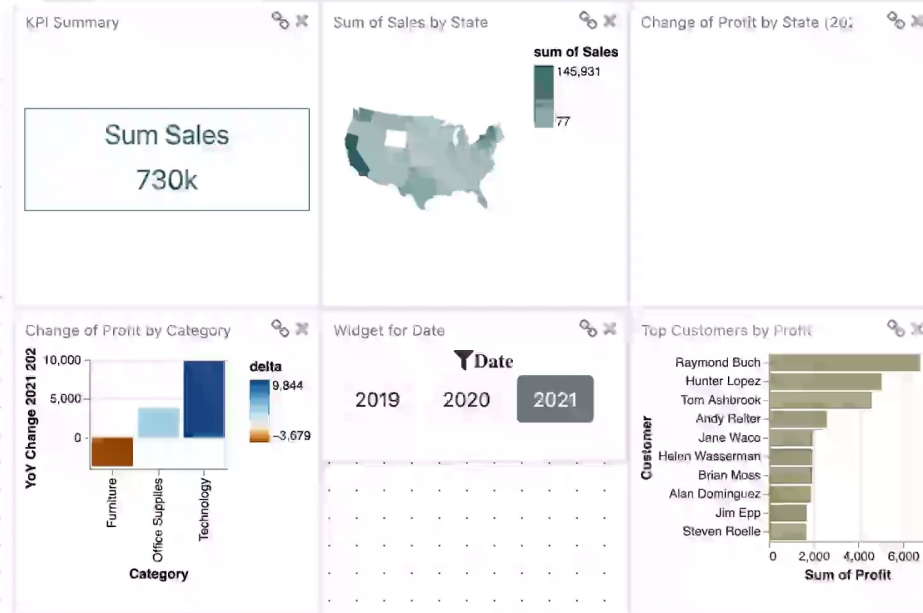
Category

Date

Profit

Dashboard Canvas

Refresh, Home, Download, Close, Menu icons



**Intent**

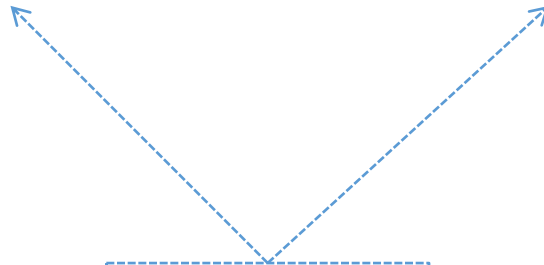


**Attributes**







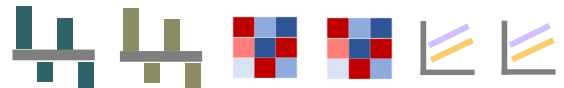





**Collection**  
(Views + Widgets)

Heuristics



Details in the paper

| Intent  | (ID) Objective   | Attributes       | Collections (Views and Widgets)   |
|---|--|------------------|---|
| <b>Measure Analysis</b><br>(Dashboard should focus on quantitative fields)      | M1: Summarize a single measure   | Q, 3C, G, T      |    |
|   | M2: List top categories for a measure  | Q, 5C, G         |    |
|   | M3: Compare two measures   | Q, Q, 3C, G, T   |    |
|   | M4: Summarize two measures   | Q, Q, 3C, G, T   |    |
|   | M5: Summarize three measures   | Q, Q, Q, C, G, T |    |
| <b>Change Analysis</b><br>(Dashboard should display changes over time)          | CH1: Summarize change in a measure between two timestamps (e.g., year-over-year) | Q, T, 4C, G      |    |
|   | CH2: Summarize changes for two measures over time                                | Q, Q, T, 2C      |    |
| <b>Category Analysis</b><br>(Dashboard should focus on a categorical field)     | CAT1: Compare categories for a field across other dimensions                     | C, Q, 3C, T      |   |
|   | CAT2: Compare categories for two fields across other dimensions                  | C, C, Q, C, T    |  |
| <b>Distribution Analysis</b><br>(Dashboard should provide univariate summaries) | D1: Display univariate summaries of all available data fields                    | All Attributes   |  |

| Intent  | (ID) Objective   | Attributes          | Collections (Views and Widgets) |
|---|--|---------------------|---------------------------------|
| <b>Measure Analysis</b><br>(Dashboard should focus on quantitative fields)      | M1: Summarize a single measure   | Q , 3C, G, T        |                                 |
|   | M2: List top categories for a measure  | Q , 5C, G           |                                 |
|   | M3: Compare two measures   | Q , Q , 3C, G, T    |                                 |
|   | M4: Summarize two measures   | Q , Q , 3C, G, T    |                                 |
|   | M5: Summarize three measures   | Q , Q , Q , C, G, T |                                 |
| <b>Change Analysis</b><br>(Dashboard should display changes over time)          | CH1: Summarize change in a measure between two timestamps (e.g., year-over-year) | Q , T , 4C, G       |                                 |
|   | CH2: Summarize changes for two measures over time                                | Q , Q , T , 2C      |                                 |
| <b>Category Analysis</b><br>(Dashboard should focus on a categorical field)     | CAT1: Compare categories for a field across other dimensions                     | C, Q , 3C, T        |                                 |
|   | CAT2: Compare categories for two fields across other dimensions                  | C, C, Q , C, T      |                                 |
| <b>Distribution Analysis</b><br>(Dashboard should provide univariate summaries) | D1: Display univariate summaries of all available data fields                    | All Attributes      |                                 |

< Input

Dataset: Superstore

Attributes Clear

# Discount

# Profit

# Quantity

# Sales

State

A Category

A Customer

A Product

A Region

A Segment

A ShipMode

Date

Intent Clear

Measure Analysis

Category Analysis

Change Analysis

Distribution Analysis

Recommended Collections Aggregation Sum Update Recommendations

Showing collection recommendations for Change Analysis, focusing on the attribute(s): Profit.

Change Analysis 6 Views +

YoY change in Profit (2021 vs. 2020)

Change Analysis 6 Views +

Summary of change in Profit and Sales

Widgets

- Date

Widgets

- Date

Dashboard Canvas

Menu icon

< Input

Dataset:

Superstore

Attributes

# Discount

# Profit

# Quantity

# Sales

State

A Category

A Customer

A Product

A Region

A Segment

A ShipMode

Date

Intent

Measure Analysis

Category Analysis

Change Analysis

Distribution Analysis

## Recommended Collections

Aggregation Sum

Update Recommendations

Showing collection recommendations for Change Analysis, focusing on the **attribute(s):** Profit.

**Change Analysis** 6 Views +

YoY change in Profit (2021 vs. 2020)

State,Profit,Date

Profit,Date

Category,Profit,Date

Region,Profit,Date

Segment,Profit,Date

ShipMode,Profit,Date

**Widgets**

☑ Date

**Change Analysis** 6 Views +

Summary of change in Profit and Sales

Profit,Date

Sales,Date

Category,Profit,Date

Category,Sales,Date

Region,Profit,Date

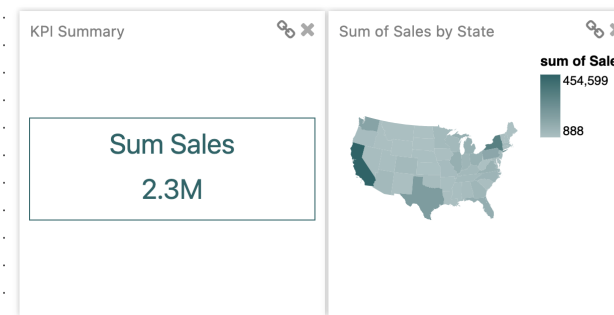
Region,Sales,Date

**Widgets**

☑ Date

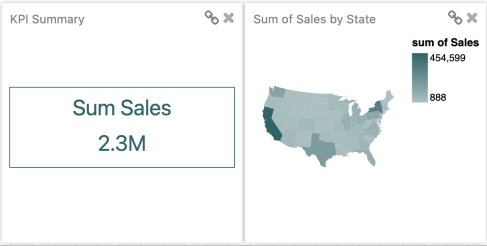
## Dashboard Canvas

Refresh, Share, Download, Close, Menu



# Profit

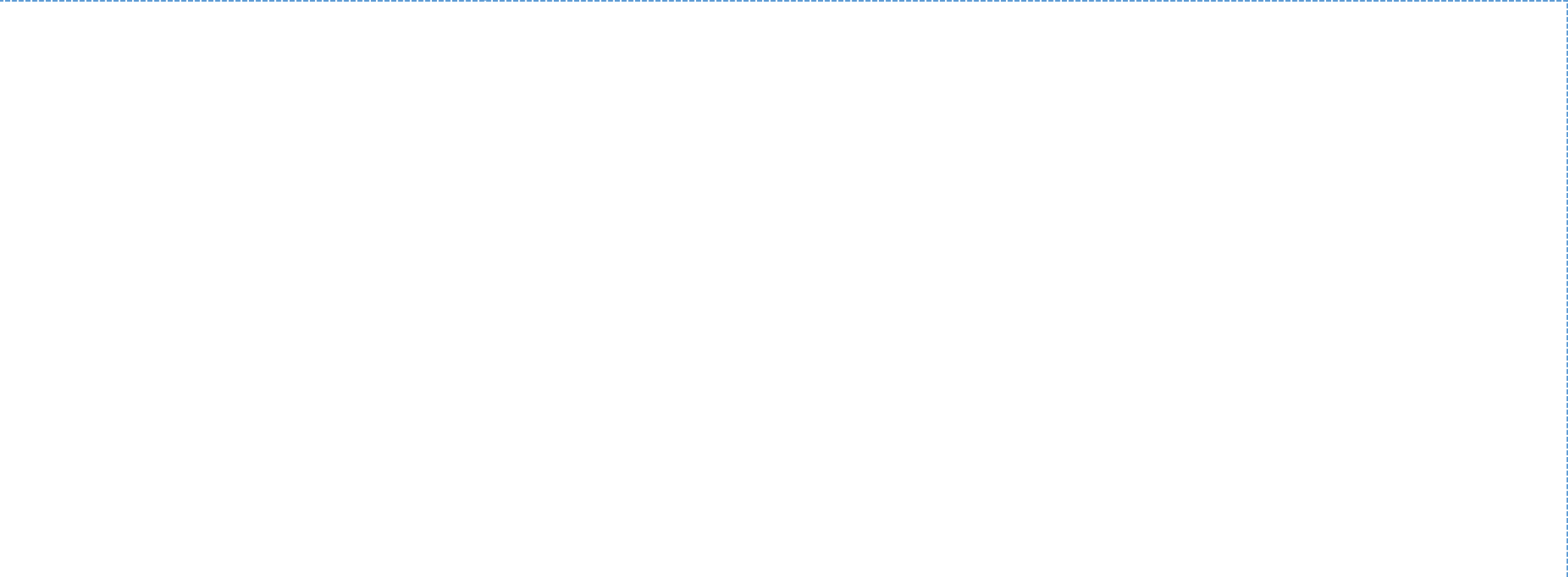
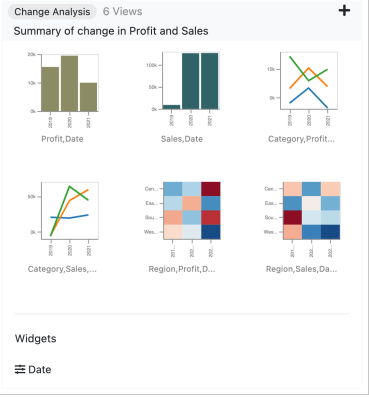
Change Analysis



(Implicit attributes from charts: Sales, State)

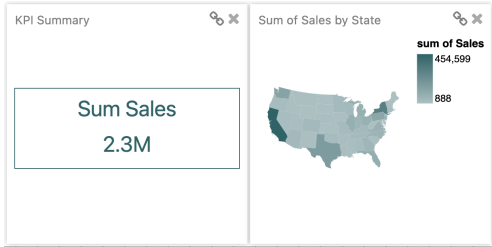


Recommendation Engine

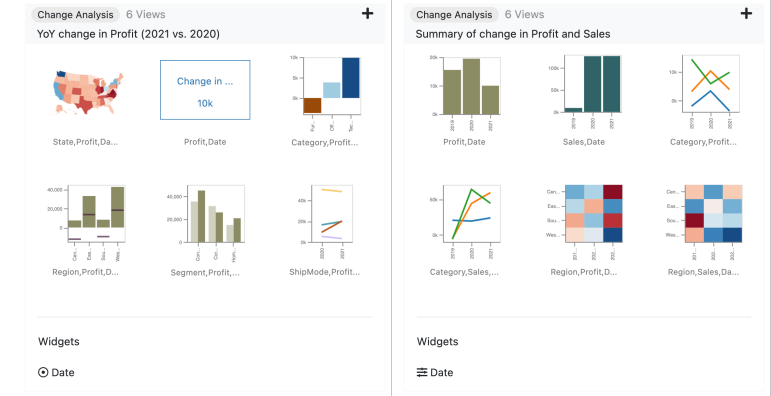


# Profit

Change Analysis



Recommendation Engine



M1: Summarize a single measure

M2: List top categories for a measure

M3: Compare two measures

M4: Summarize two measures

M5: Summarize three measures

CH1: Summarize change in a measure between two timestamps

CH2: Summarize changes for two measures over time

CAT1: Compare categories for a field across other dimensions

CAT2: Compare categories for two fields across other dimensions

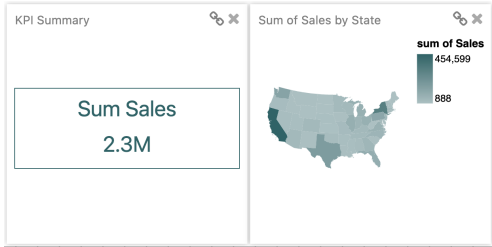
D1: Display univariate summaries of all available data fields

Collection Filtering



# Profit

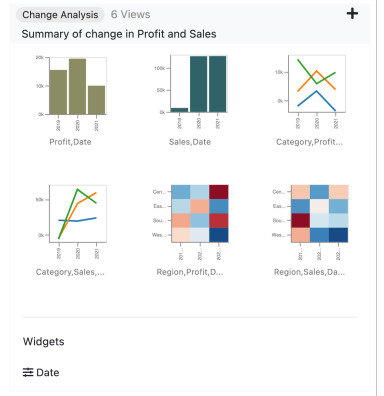
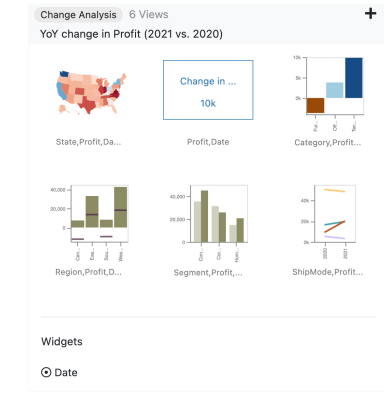
Change Analysis



(Implicit attributes from charts: Sales, State)



Recommendation Engine

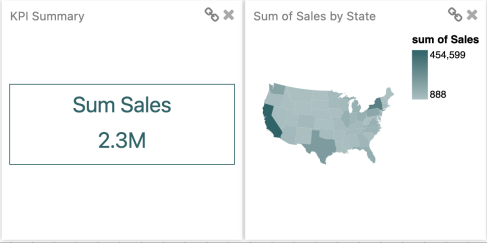


- M1: Summarize a single measure
- M2: List top categories for a measure
- M3: Compare two measures
- M4: Summarize two measures
- M5: Summarize three measures
- CH1: Summarize change in a measure between two timestamps**
- CH2: Summarize changes for two measures over time**
- CAT1: Compare categories for a field across other dimensions
- CAT2: Compare categories for two fields across other dimensions
- D1: Display univariate summaries of all available data fields

Collection Filtering

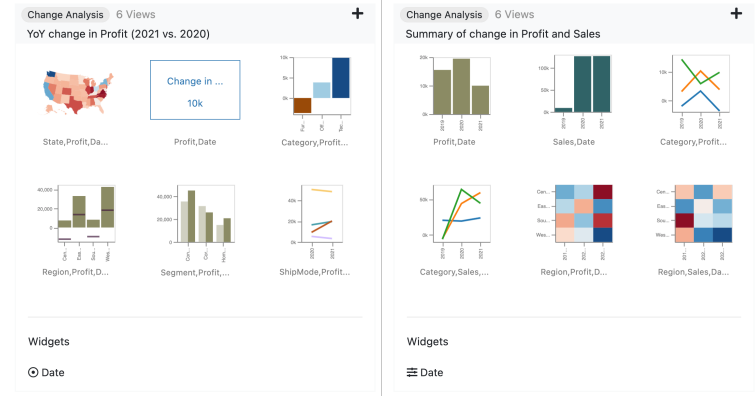
# Profit

Change Analysis



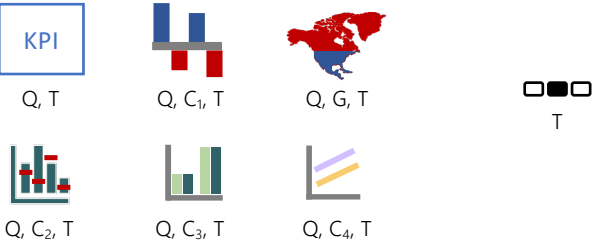
(Implicit attributes from charts: Sales, State)

# Recommendation Engine



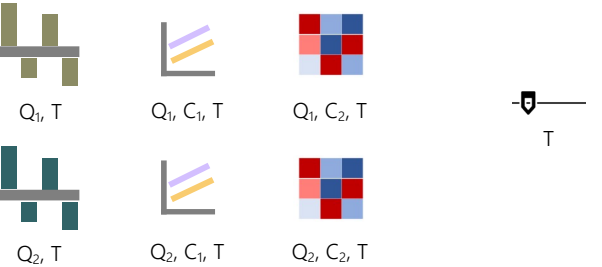
### CH1: Summarize change in a measure between two timestamps

{Q, T, C<sub>1</sub>, C<sub>2</sub>, C<sub>3</sub>, C<sub>4</sub>, G}



### CH2: Summarize changes for two measures over time

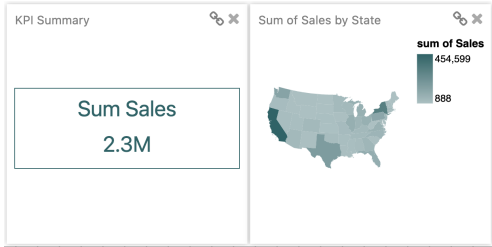
{Q<sub>1</sub>, Q<sub>2</sub>, T, C<sub>1</sub>, C<sub>2</sub>}



Collection Filtering

# Profit

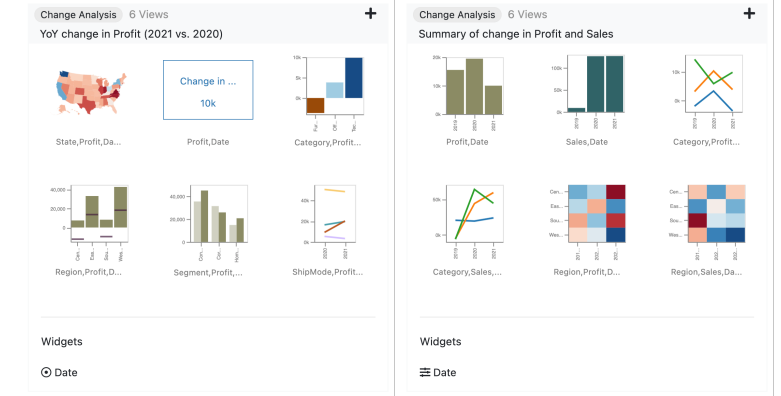
Change Analysis



(Implicit attributes from charts: Sales, State)



Recommendation Engine



CH1: Summarize change in a measure between two timestamps  
{Q, T, C<sub>1</sub>, C<sub>2</sub>, C<sub>3</sub>, C<sub>4</sub>, G}

- {Profit, Date, Category, Customer, Product, Region, State}
- {Profit, Date, Category, Product, Region, Segment, State}
- {Profit, Date, Category, Region, Segment, ShipMode, State}
- {Profit, Date, Customer, Product, Region, Segment, State}
- ...

CH2: Summarize changes for two measures over time  
{Q<sub>1</sub>, Q<sub>2</sub>, T, C<sub>1</sub>, C<sub>2</sub>}

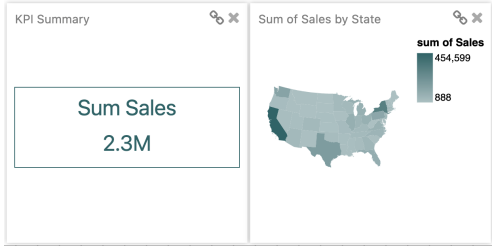
- {Profit, Sales, Date, Category, Customer}
- {Profit, Sales, Date, Category, Product}
- {Profit, Sales, Date, Category, Region}
- {Profit, Sales, Date, Category, Segment}
- ...

Collection Filtering

Parameterization

# Profit

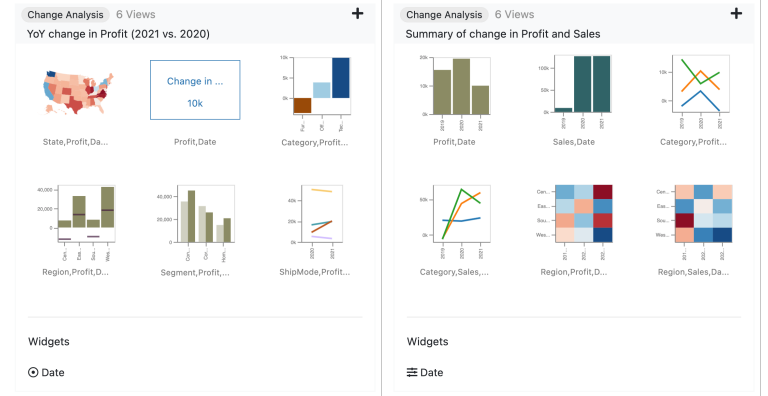
Change Analysis



(Implicit attributes from charts: Sales, State)



Recommendation Engine



CH1: Summarize change in a measure between two timestamps  
{Q, T, C<sub>1</sub>, C<sub>2</sub>, C<sub>3</sub>, C<sub>4</sub>, G}

CH2: Summarize changes for two measures over time  
{Q<sub>1</sub>, Q<sub>2</sub>, T, C<sub>1</sub>, C<sub>2</sub>}

Collection Filtering

- {Profit, Date, Category, Customer, Product, Region, State}
- {Profit, Date, Category, Product, Region, Segment, State}
- {Profit, Date, Category, Region, Segment, ShipMode, State}**
- {Profit, Date, Customer, Product, Region, Segment, State}
- ...

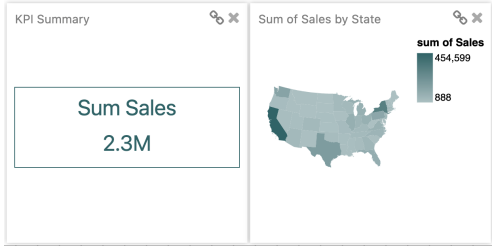
- {Profit, Sales, Date, Category, Customer}
- {Profit, Sales, Date, Category, Product}
- {Profit, Sales, Date, Category, Region}**
- {Profit, Sales, Date, Category, Segment}
- ...

Parameterization

Selected based on a combination of prior user actions and statistical "interestingness"

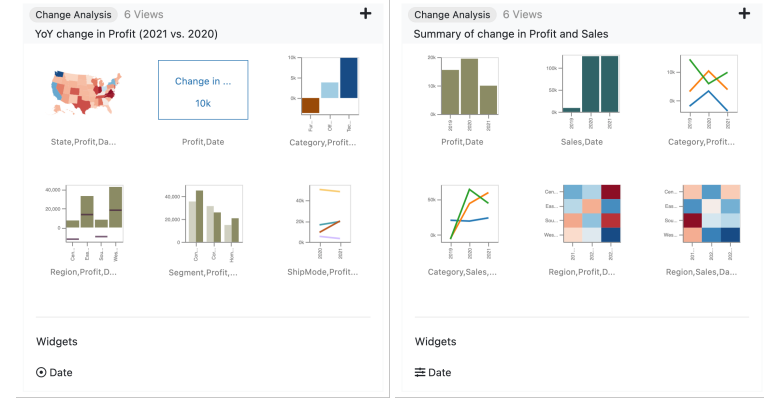
# Profit

Change Analysis



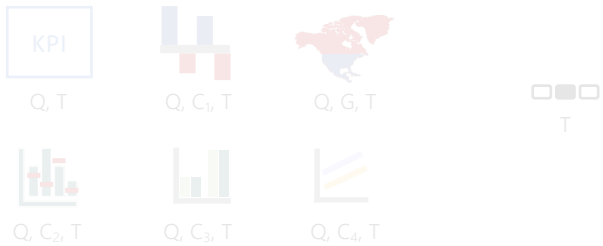
(Implicit attributes from charts: Sales, State)

# Recommendation Engine



## CH1: Summarize change in a measure between two timestamps

{Q, T, C<sub>1</sub>, C<sub>2</sub>, C<sub>3</sub>, C<sub>4</sub>, G}



## CH1: Summarize change in a measure between two timestamps

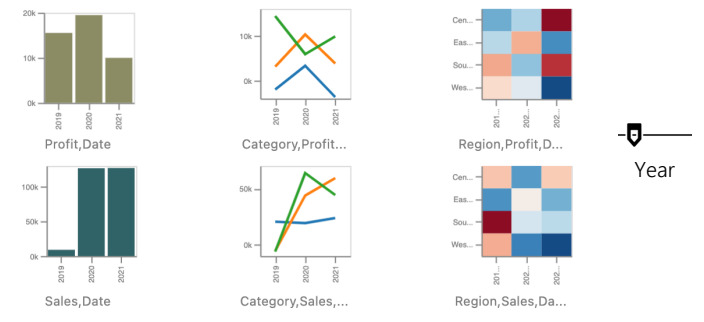


## CH2: Summarize changes for two measures over time

{Q<sub>1</sub>, Q<sub>2</sub>, T, C<sub>1</sub>, C<sub>2</sub>}



## CH2: Summarize changes for two measures over time

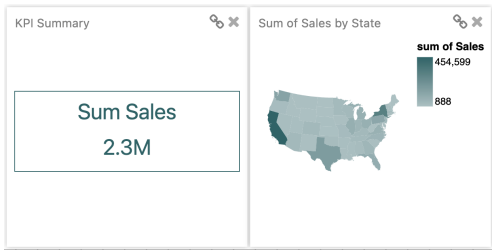


Collection Filtering

Parameterization

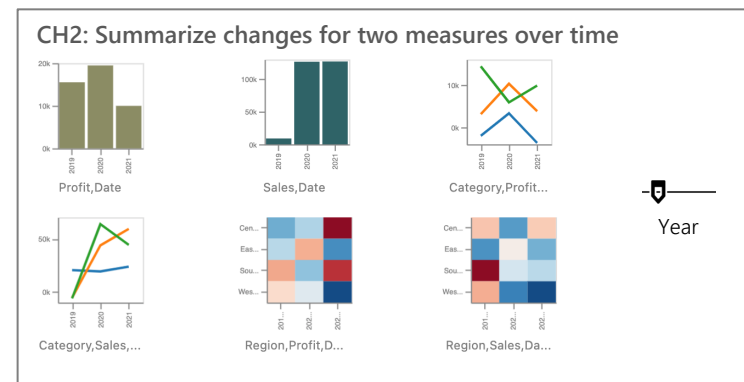
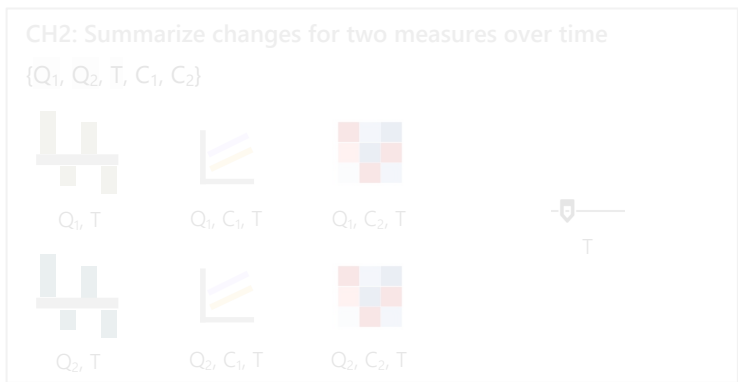
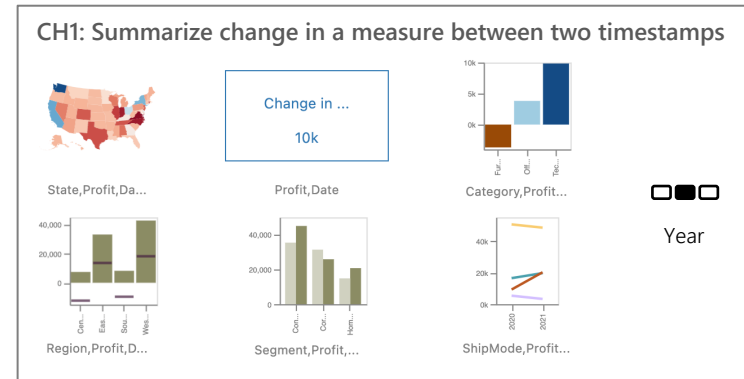
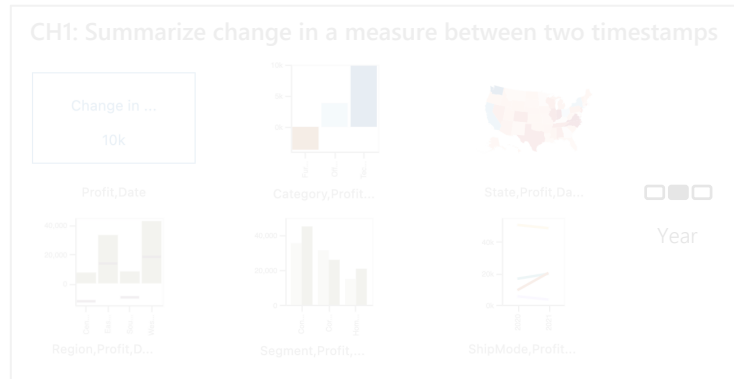
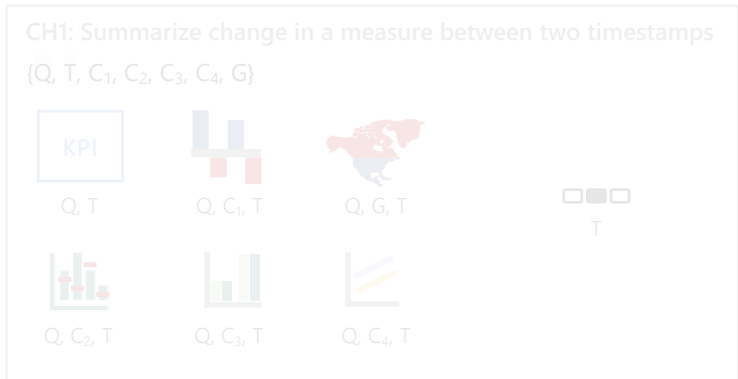
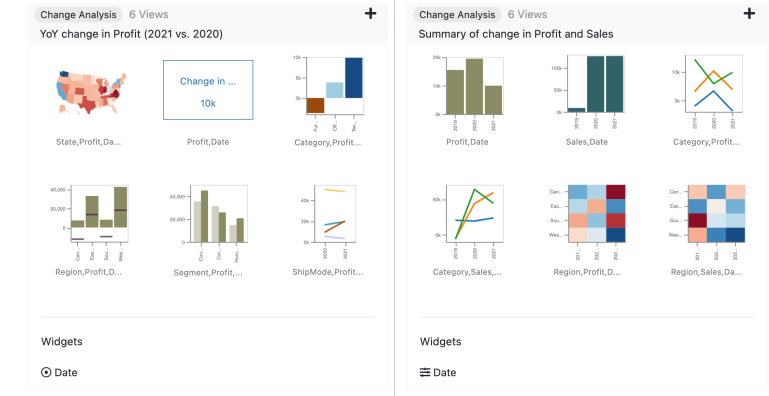
# Profit

Change Analysis



(Implicit attributes from charts: Sales, State)

# Recommendation Engine



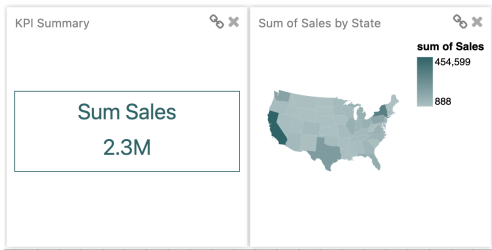
Collection Filtering

Parameterization

Ranking

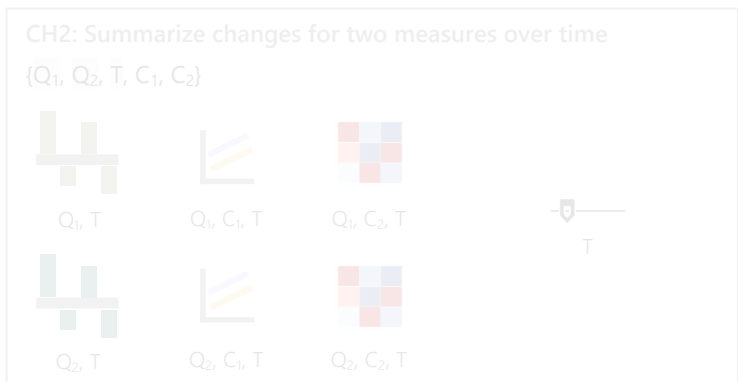
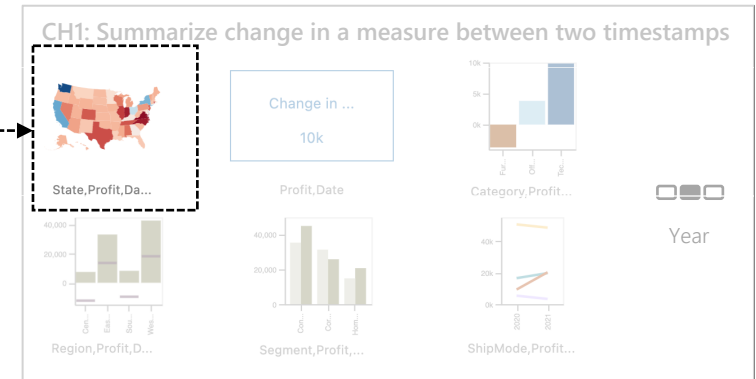
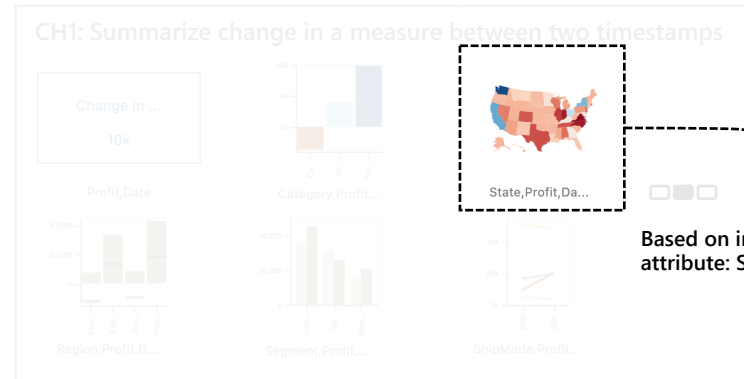
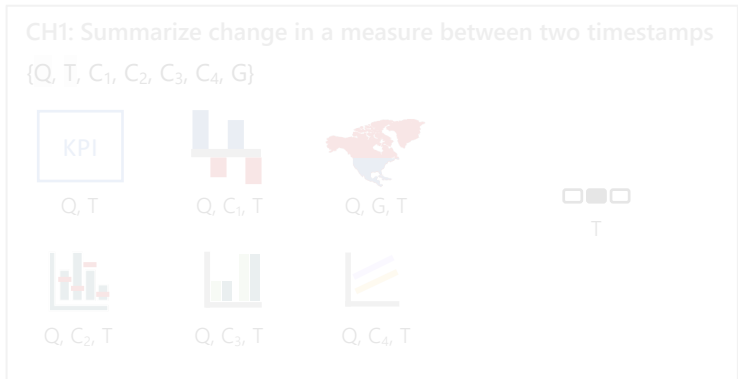
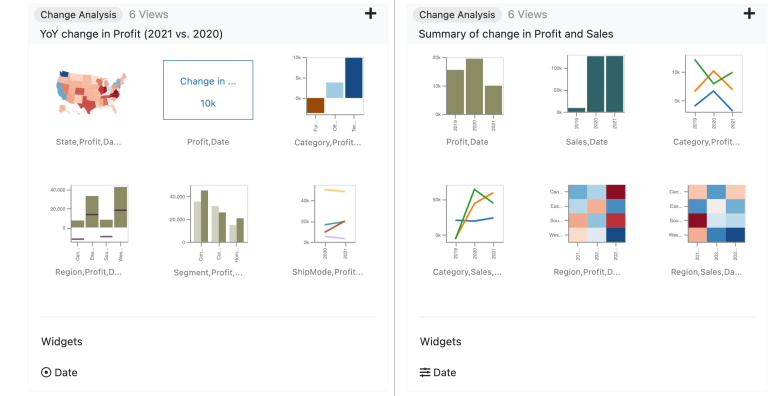
# Profit

Change Analysis



(Implicit attributes from charts: Sales, State)

# Recommendation Engine



Collection Filtering

Parameterization

Ranking

# User Study: Overview



13 participants



Interview + Likert-scale questions



Two task types:

- **Targeted**



Superstore

(e.g., Create a dashboard to summarize the differences between product segments)

- **Open-ended**



World Indicators



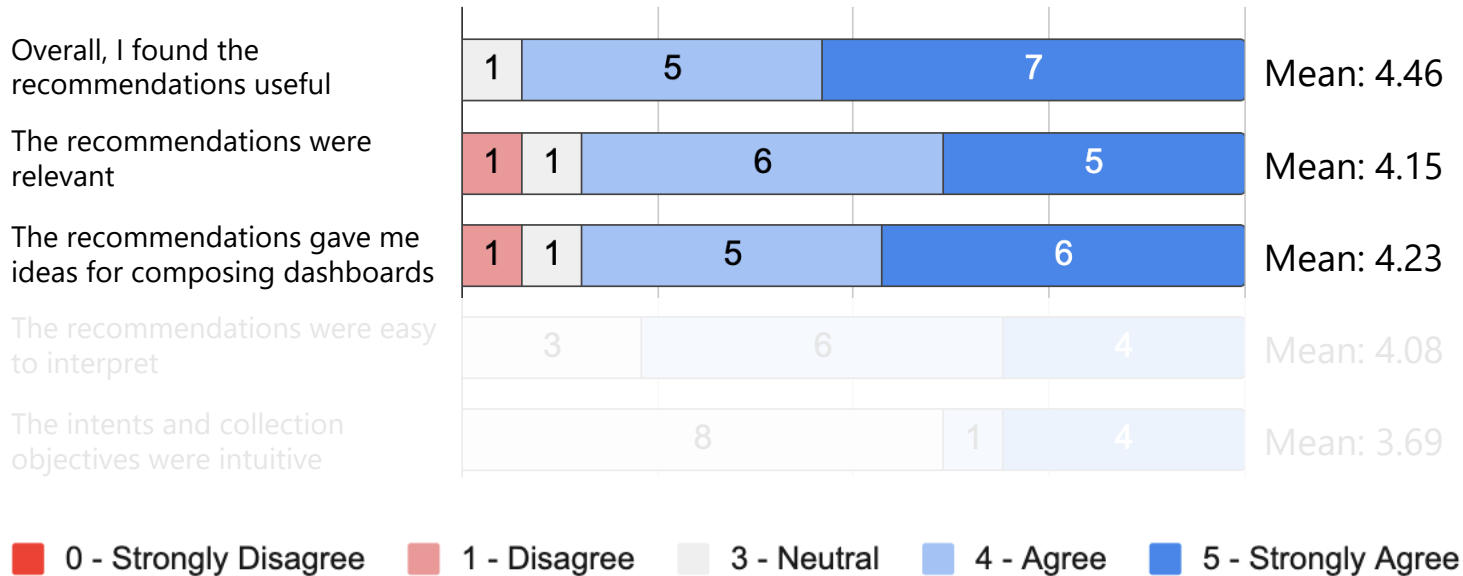
Olympic Medal Winners



40-64 min. (Mean: 55 min)



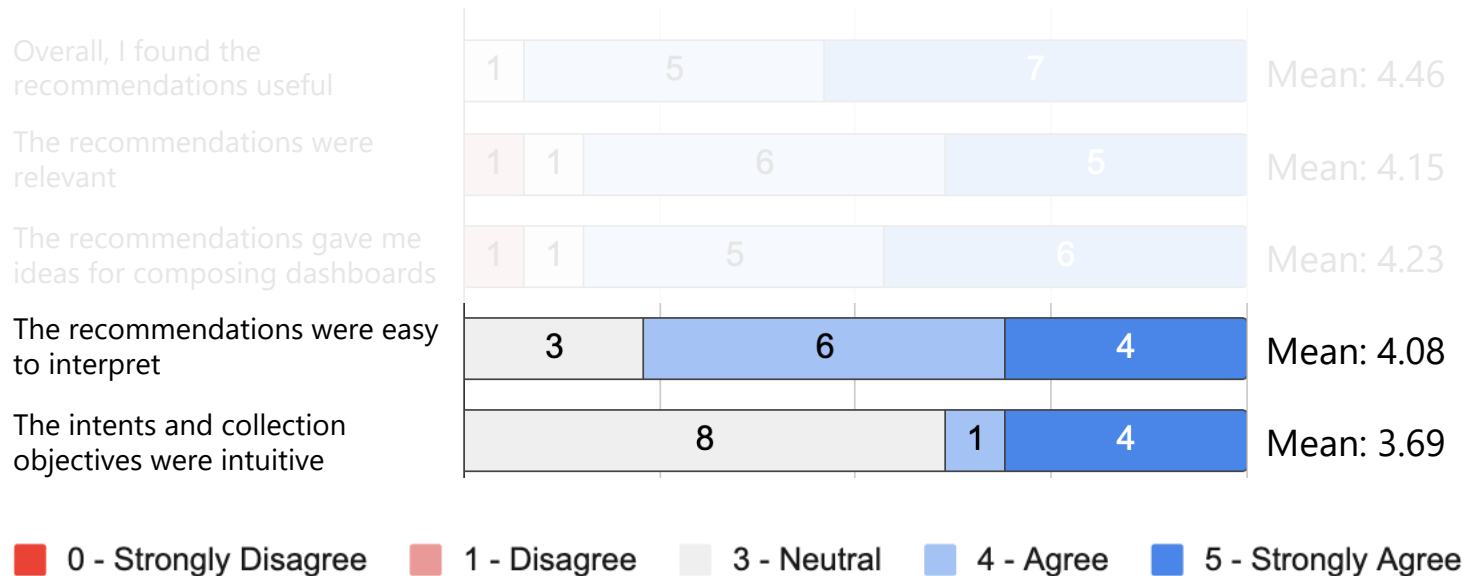
# User Study: Recommendation Feedback



*"...being able to explore and add an entire collection of relevant metrics and having a **good first cut of a dashboard** is really nice."*  
- P11

*"to see all **the grouped recommendations there, it gave me more ideas** of like, okay, that's a good way to look at it."*  
- P2

# User Study: Recommendation Feedback



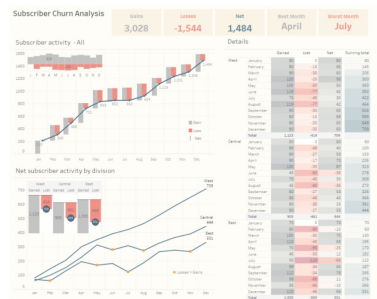
*"When you go into each intent and you look at the recommendations, **you need to spend a few minutes to understand what is being covered, but after that, it's easy to understand and use.**"*

- P7

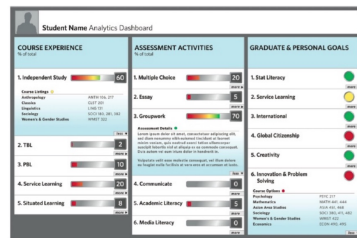
# Future Work

# Future Work

- Expanding beyond analytic dashboards



(a) Strategic Dashboard (DB001)



(b) Tactical Dashboard (DB106)



(c) Operational Dashboard (DB102)



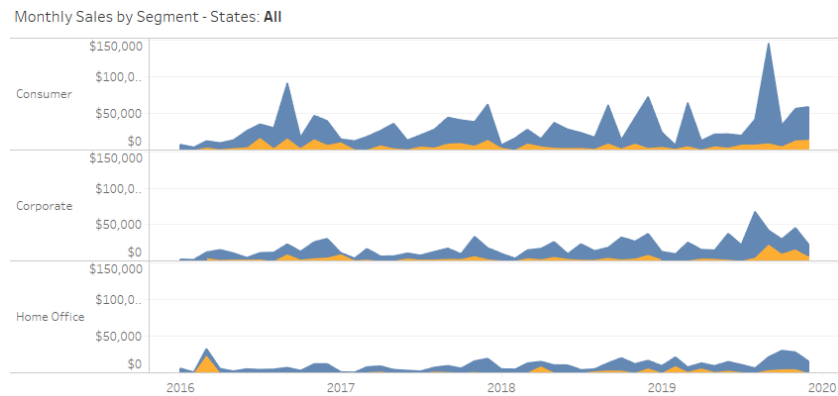
(d) Social Dashboard (DB028)

What Do We Talk About When We Talk About Dashboards?  
Sarikaya et al., IEEE VIS 2019

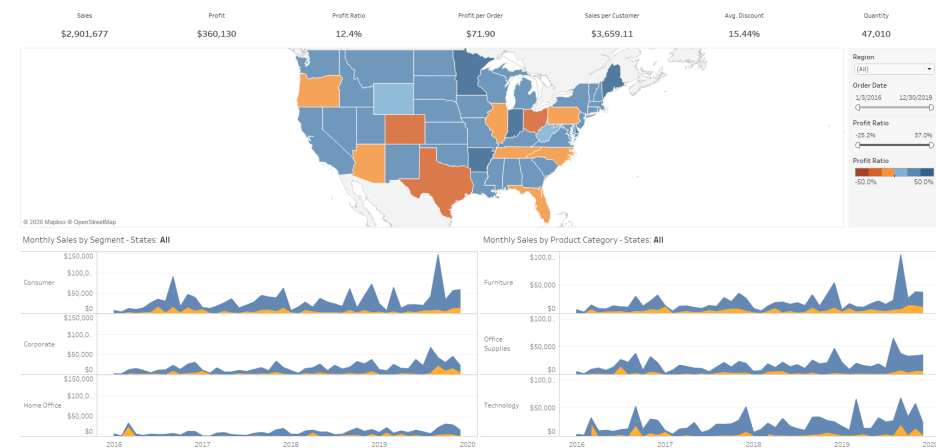
# Future Work

- Expanding beyond analytic dashboards
- Exploring natural language interfaces for dashboard authoring

*"Show me monthly sales by segments"*

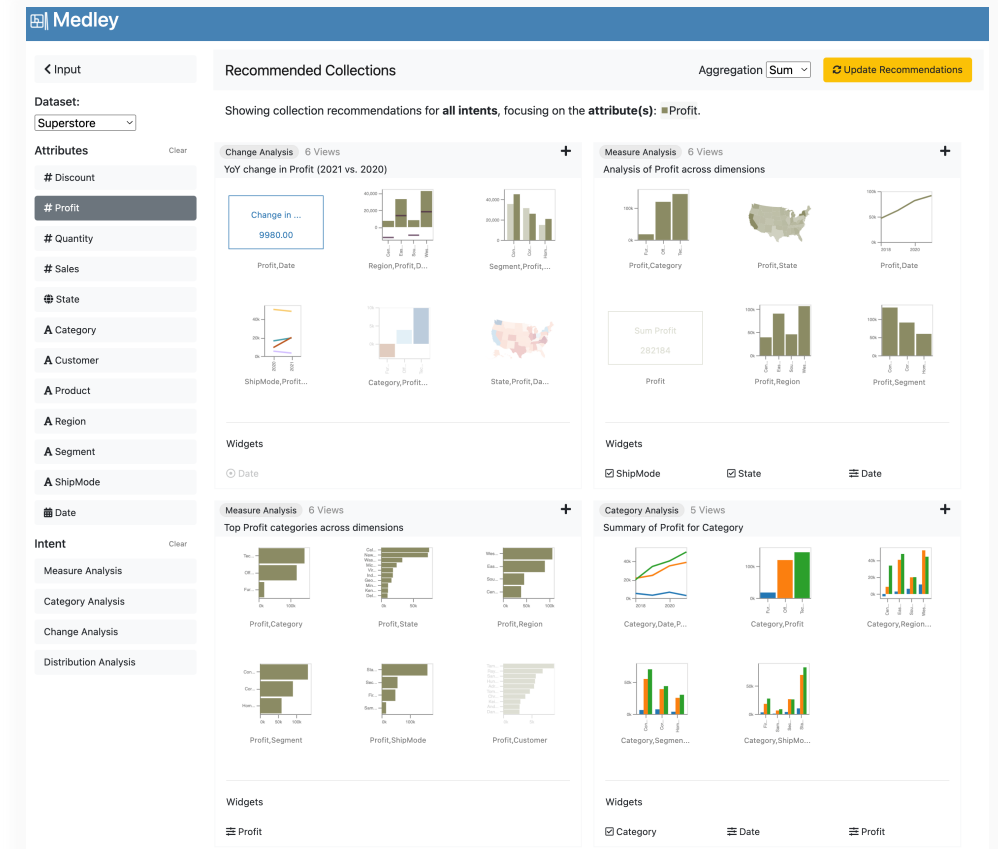


*"Display an overview of company performance over time"*



# Summary

- Intents play a critical role during dashboard composition.
- Intent-based collection recommendations can bootstrap and assist dashboard composition by providing content ideas.



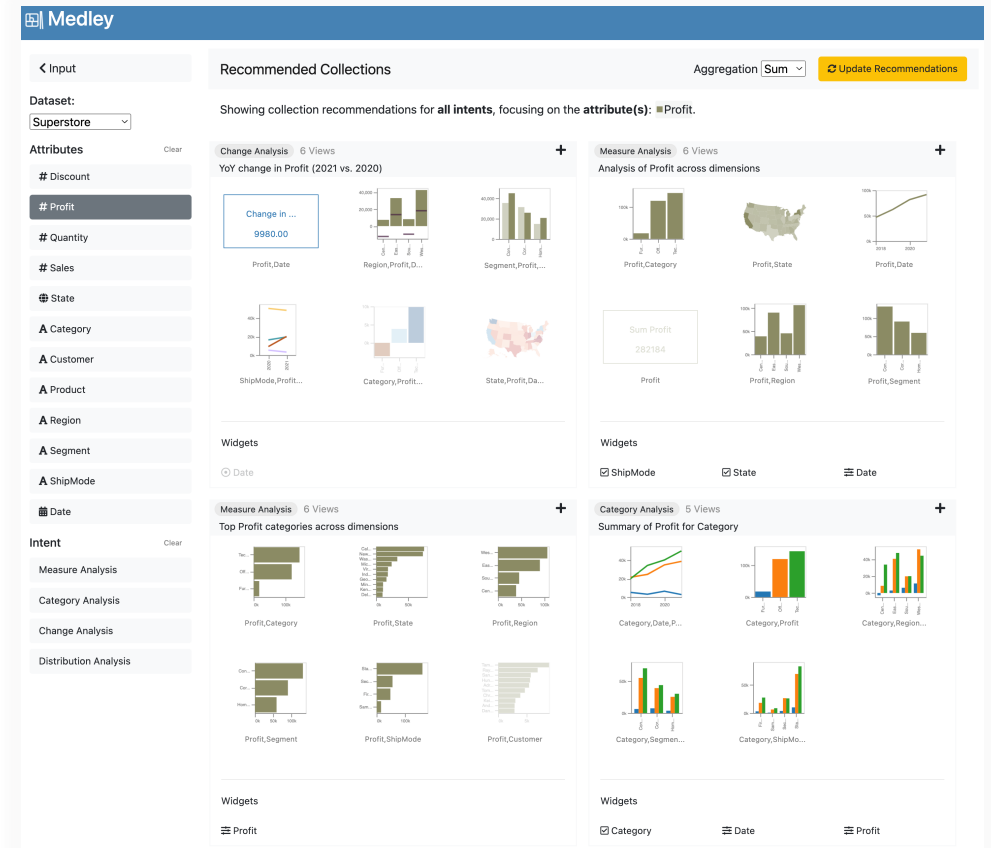
# Thank You

- Intents play a critical role during dashboard composition.
- Intent-based collection recommendations can bootstrap and assist dashboard composition by providing content ideas.



bit.ly/

medley-vis22



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