

MEDLEY:

Intent-based Recommendations to Support Dashboard Composition



Aditeya Pandey
Northeastern University

 @aaditeya



Arjun Srinivasan
Tableau Research

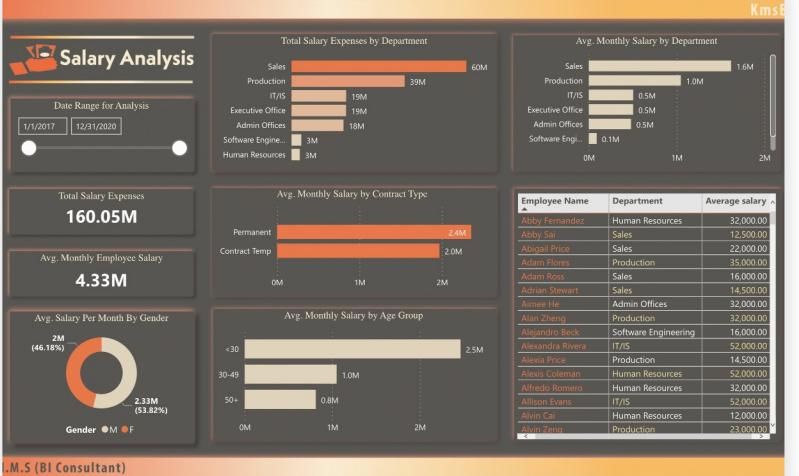
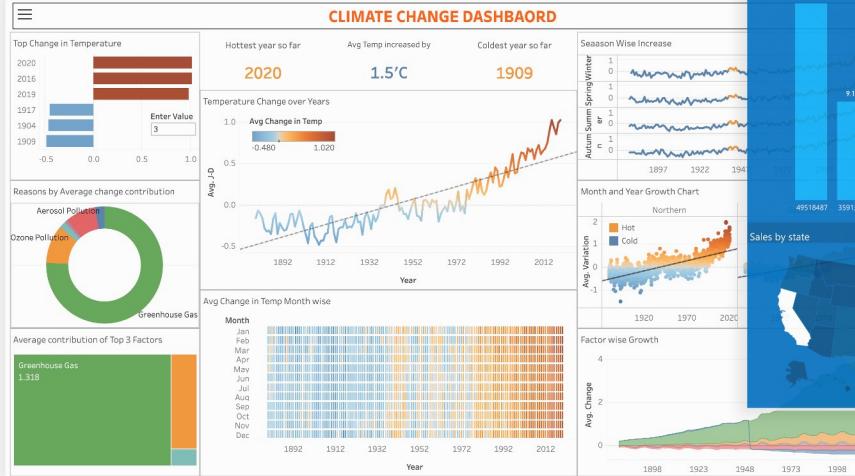
 @10_arjun



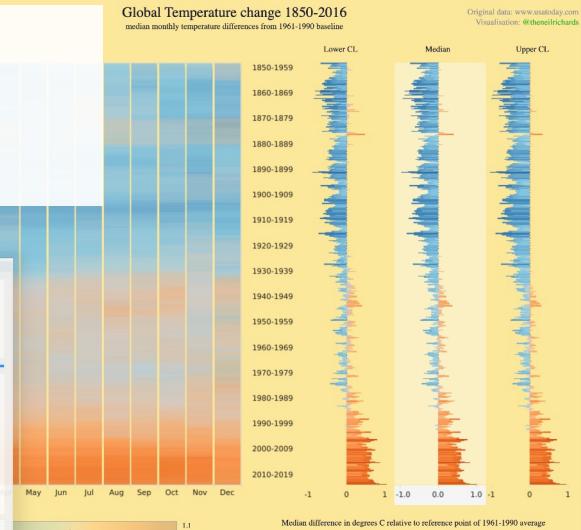
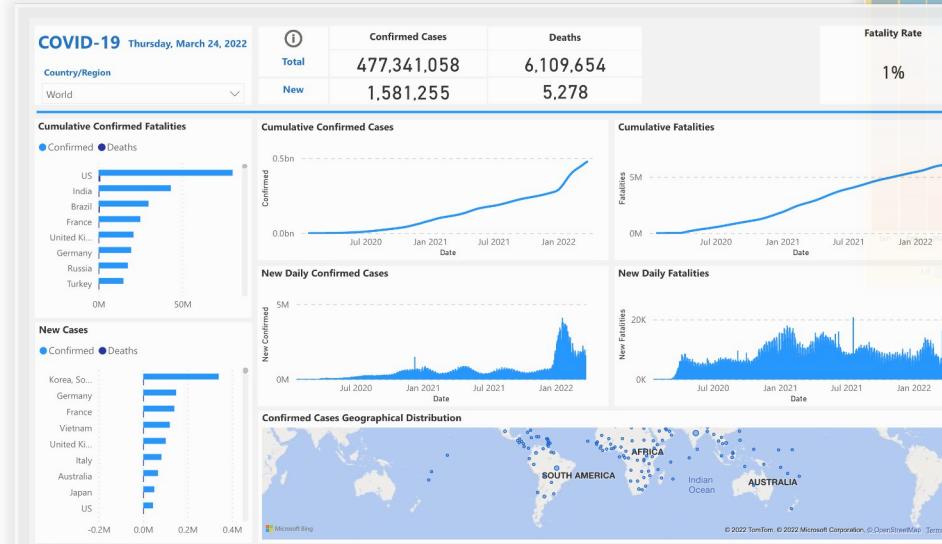
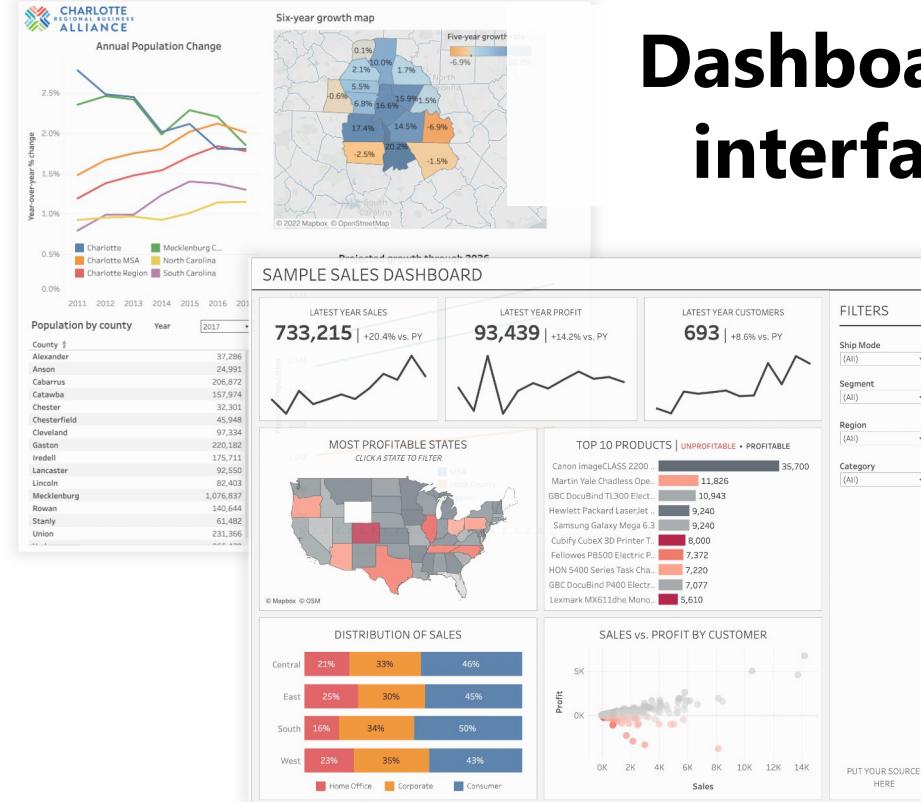
Vidya Setlur
Tableau Research

 @vsetlur

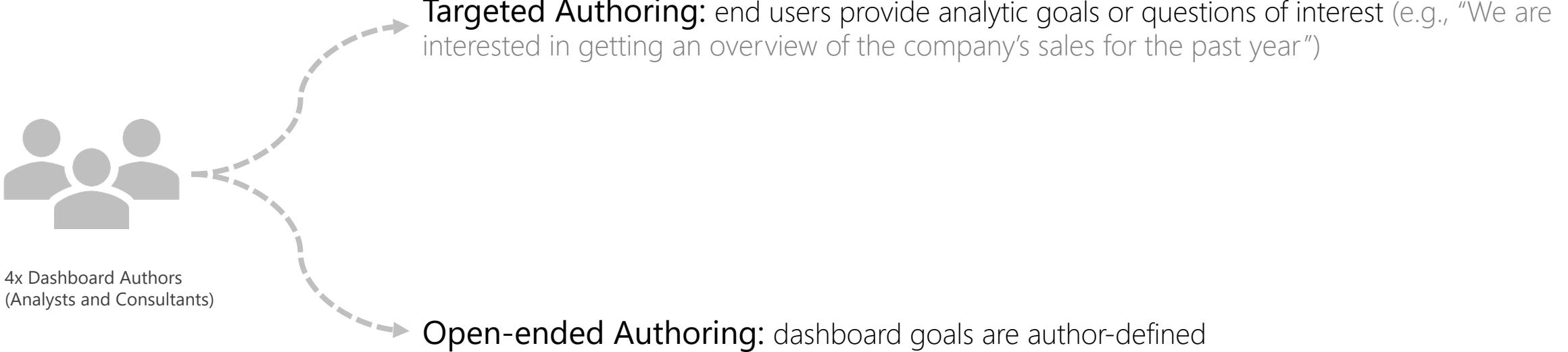
 Slides and paper:
[bit.ly/
medley-vis22](https://bit.ly/medley-vis22)



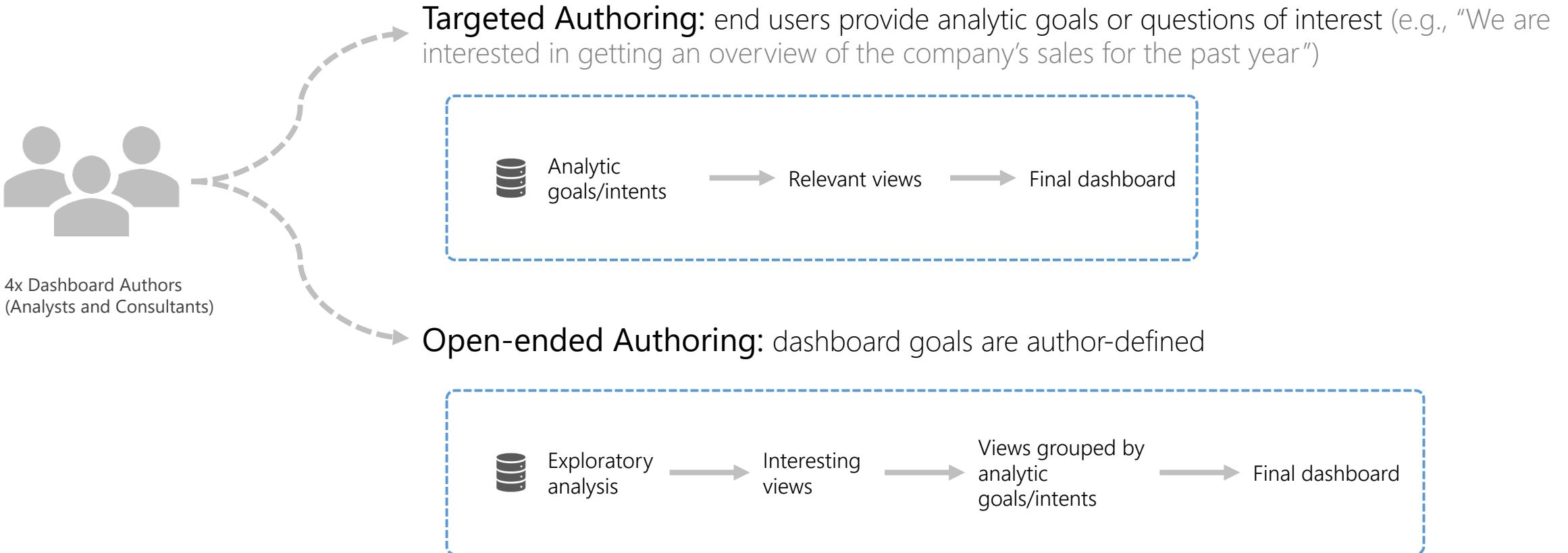
Dashboards are ubiquitously used as interfaces to data across domains



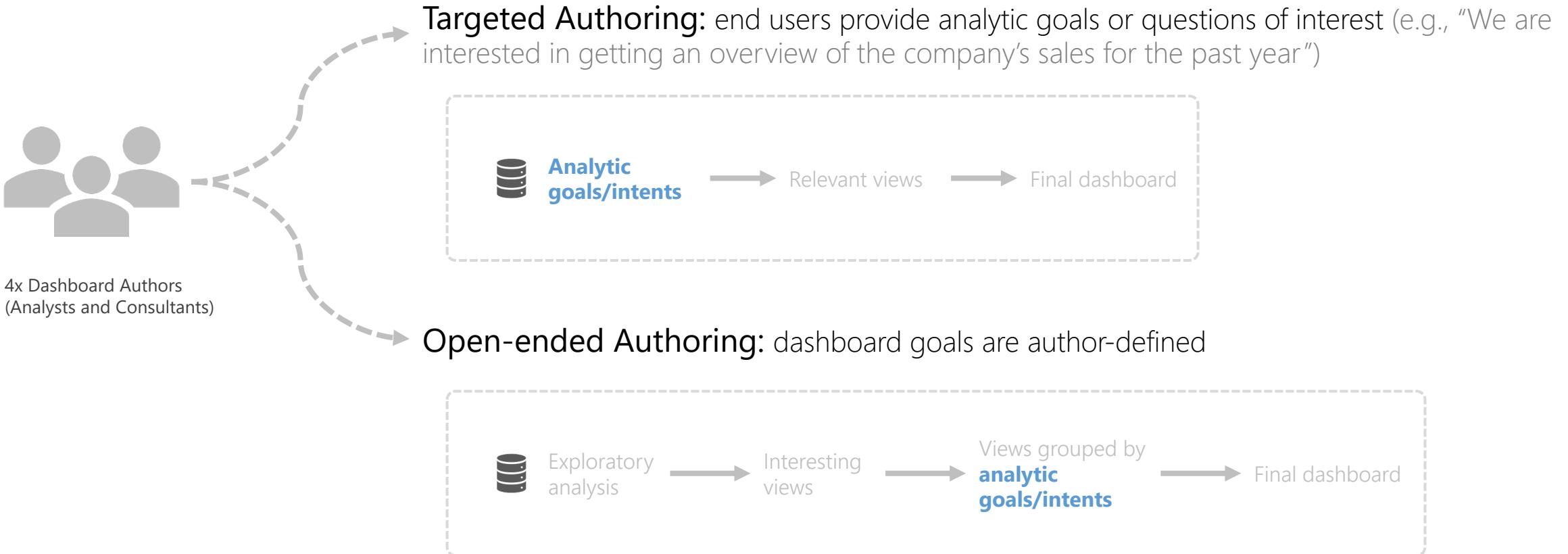
Dashboard Authoring Process



Dashboard Authoring Process



Dashboard Authoring Process



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](#)

Dataset:

Superstore

Select intents or attributes to view dashboard collections.

Or

Attributes

[Clear](#)[See default recommendations](#)

Discount

Profit

Quantity

Sales

⊕ State

Ⓐ Category

Ⓐ Customer

Ⓐ Product

Ⓐ Region

Ⓐ Segment

Ⓐ ShipMode

📅 Date

Intent

[Clear](#)

Measure Analysis

Category Analysis

Change Analysis

Distribution Analysis

Dashboard Canvas



≡

< Input

Recommended Collections

Aggregation Sum ▾

⟳ Update Recommendations

Dashboard Canvas



Dataset:

Superstore

Select intents or attributes to view dashboard collections.

Or

Attributes

Clear

See default recommendations

Discount

Profit

Quantity

Sales

State

Category

Customer



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

Recommended Collections

Aggregation **Sum** ▾ Update Recommendations

Dashboard Canvas



Dataset:

Superstore ▾

Select intents or attributes to view dashboard collections.

Or

Attributes Clear

Discount

Profit

Quantity

Sales

⊕ State

Ⓐ Category

Ⓐ Customer

Ⓐ Product

Ⓐ Region

Ⓐ Segment

Ⓐ ShipMode

🕒 Date

Intent Clear

Measure Analysis

Category Analysis

Change Analysis

Distribution Analysis

Input

Recommended Collections

Aggregation **Sum** ▾

Update Recommendations

Dashboard Canvas



Dataset:

Superstore ▾

Select intents or attributes to view dashboard collections.

Or

Attributes Clear

See default recommendations

Discount

Profit

Quantity

Sales

State

Category

Customer

Product

Region

Segment

ShipMode

Date

Intent Clear

Measure Analysis

Category Analysis

Change Analysis

Distribution Analysis

< Input

Recommended Collections

Aggregation Sum

Update Recommendations



≡

Dataset:

Superstore

Attributes

Clear

Distribution Analysis 12 Views

+

Distribution of all variables in the dataset

Discount

Profit

Quantity

Sales

State

Category

Customer

Product

Region

Segment

ShipMode

Date

Intent

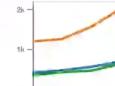
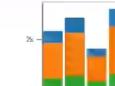
Clear

Measure Analysis

Category Analysis

Change Analysis

Distribution Analysis



Category

Category, Region

Category, Date

Category, Segment...

Category, Segment...

Region, Sales, Da...

Category, Segmen...

Category, Segmen...

Segment, Sales, D...

Measure Analysis 6 Views

+

Analysis of Sales across dimensions

Sum Sales 2.3M

Sales

Sales, Category

Sales, Region

Sales

Sales, Segment

Sales, State

Sales, Data

Widgets

No widgets recommended with this collection.

Widgets

ShipMode State Date

Category Analysis 5 Views

+

Count of records by Category

Change Analysis 6 Views

+

YoY change in Sales (2021 vs. 2020)

Change in ... 130k

Sales, Date

Category, Sales, ...

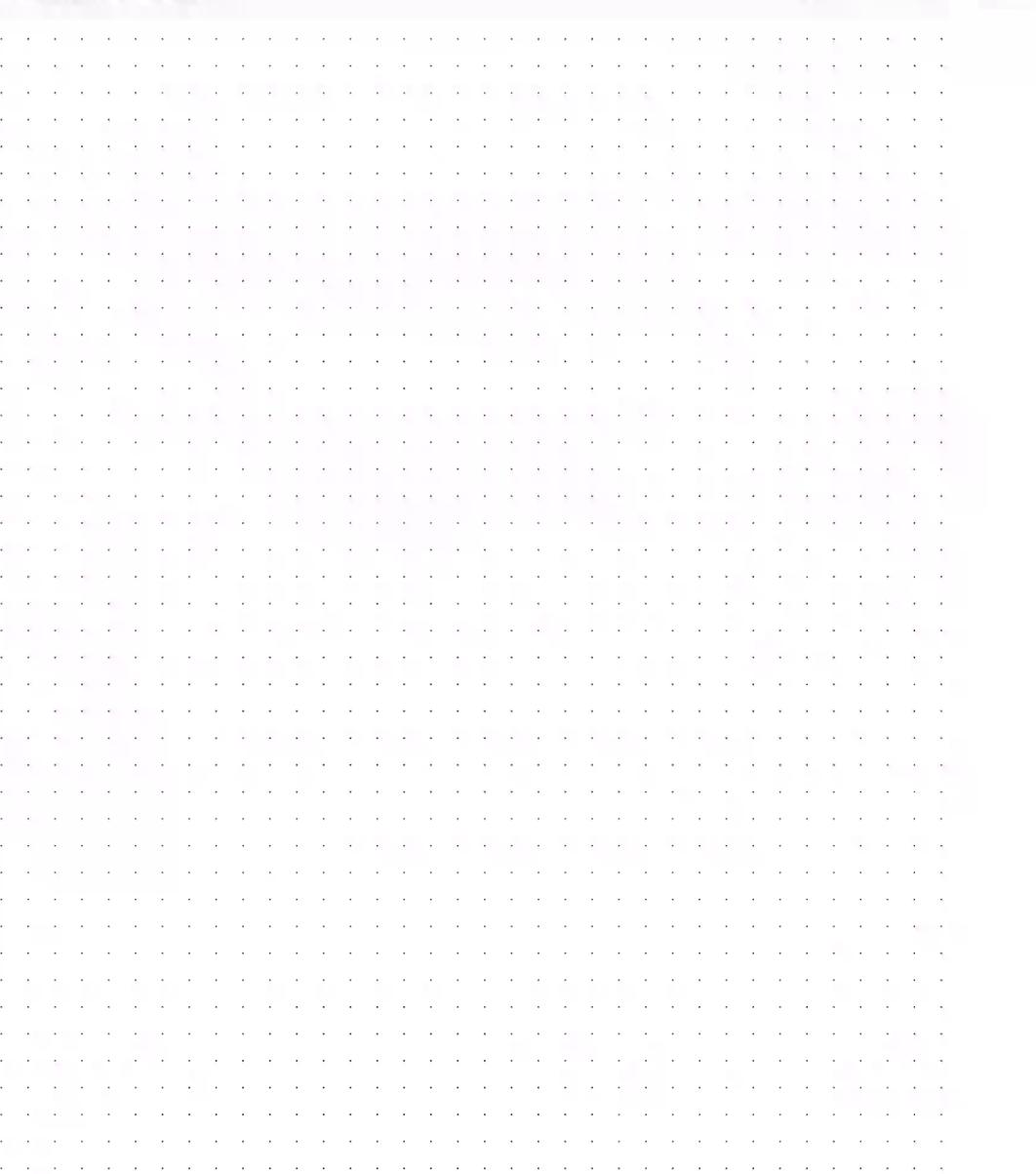
State, Sales, Da...

Sales

Segment, Sales, D...

ShipMode, Sales, ...

Dashboard Canvas



< Input

Recommended Collections

Aggregation Sum

Update Recommendations

Dataset:

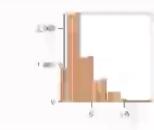
Superstore

Attributes

Clear

Distribution Analysis 12 Views

Distribution of all variables in the dataset



Sales

Profit

Quantity

Sales

Profit

Quantity

Sales

Profit

Quantity

@ State

@ Category

@ Customer

@ Product

@ Region

@ Segment

@ ShipMode

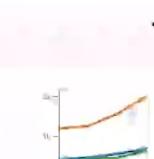
@ Date

Widgets

No widgets recommended with this collection.

Category Analysis 5 Views

Count of records by Category



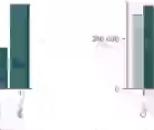
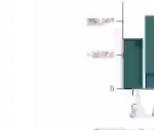
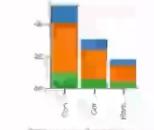
Category

Sales

Date

Change Analysis

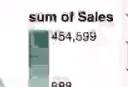
Distribution Analysis



Dashboard Canvas

RPI Summary

Sum of Sales by State



sum of Sales

454,699

688

Sum Sales

2.3M

C P D X

≡

< Input

Recommended Collections

Aggregation Sum

Update Recommendations

Dataset:

Superstore

Attributes

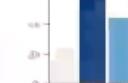
Clear

Change Analysis 6 Views

YoY change in Sales (2021 vs. 2020)



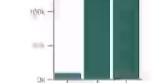
State, Sales, Date



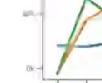
Sales, Date

Change Analysis 6 Views

Summary of change in Sales and Profit



Category, Sales, Date



Sales, Date

Change Analysis 6 Views

Region, Sales, Date



Region, Sales, Date

Sales

Profit

Quantity

Discount

State

A Category

A Customer

A Product

A Region

A Segment

A ShipMode

Date

Intent

Clear

Measure Analysis

Category Analysis

Change Analysis

Distribution Analysis

Dashboard Canvas

KPI Summary

Sum of Sales by State



Sum Sales
2.3M


✖ ✖ ✖ ✖ ✖ ✖

☰

Recommended Collections

Aggregation **Sum**

Update Recommendations

Dataset:

Superstore

Attributes

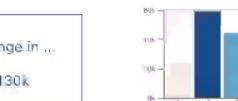
Clear

Change Analysis 6 Views

YoY change in Sales (2021 vs. 2020)



State, Sales, Date



Category, Sales, ...

Change Analysis 6 Views

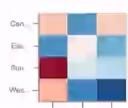
Summary of change in Sales and Profit



Category, Sales, ...

Change Analysis 6 Views

Region, Sales, Date



Dashboard Canvas

KPI Summary

Sum Sales
2.3M

Sum of Sales by State


↻ ⤒ ⤓ ⤔ ⤖

Discount

Profit

Quantity

Sales

State

Category

Customer

Product

Region

Segment

ShipMode

Date

Intent

Clear

Measure Analysis

Category Analysis

Change Analysis

Distribution Analysis

< Input

Recommended Collections

Aggregation Sum ▾

Update Recommendations

Dataset:

Superstore

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

Attributes

Clear

Discount

Profit

Quantity

Sales

State

Category

Customer

Product

Region

Segment

ShipMode

Date

Intent

Clear

Measure Analysis

Category Analysis

Change Analysis

Distribution Analysis

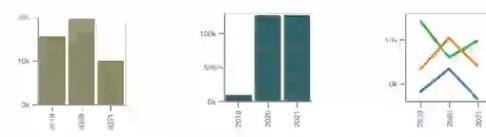
Recommended Collections

Aggregation Sum ▾

Update Recommendations

Dashboard Canvas

X

Change Analysis 6 Views
YoY change in Profit (2021 vs. 2020)Change Analysis 6 Views
Summary of change in Profit and Sales

KPI Summary

Sum Sales
730k

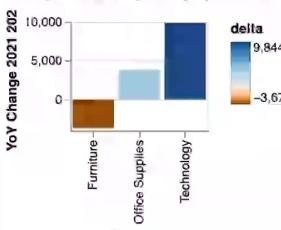
Sum of Sales by State



Change of Profit by State (2021 vs. 2020)



Change of Profit by Category



Widget for Date

Date
2019 2020 2021

Input

Recommended Collections

Aggregation Sum

Update Recommendations

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

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

Change Analysis 6 Views

YoY change in Profit (2021 vs. 2020)



Profit,Date

Region,Profit,D...

Segment,Profit,...

Measure Analysis 6 Views

Analysis of Profit across dimensions



Profit,Category

Sum of Sales by State

Change of Profit by State (2020)



Profit,State

Profit,Date



ShipMode,Profit...



Category,Profit...



Profit,Region

Profit,Segment



Category,Profit...



Sales,Profit,Da...



Profit,Category

Profit,Segment



Top Profit categories across dimensions



Profit,Category

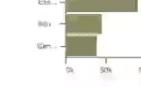


Profit,Region

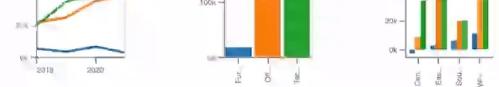
Category,Date,P



Profit,Region



Category,Date,P



Category,Profit

Category,Region,P



Profit,Segment



Profit,ShipMode



Category,Segment

Category,ShipMode

Dashboard Canvas

X

KPI Summary

Sum of Sales

Change of Profit by State (2020)

Sum Sales

730k

sum of Sales

145,931

Change 2021 2020

12,974

77

Change of Profit by Category

Yoy Change 2021 2022

Furniture

Office Supplies

Technology

delta

9,844

-3,679

Widget for Date

Date

2019

2020

2021

Input

Recommended Collections

Aggregation Sum

Update Recommendations

Dataset:

Superstore

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

Attributes

Clear

Discount

Profit

Quantity

Sales

State

Category

Customer

Product

Region

Segment

ShipMode

Date

Intent

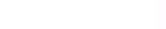
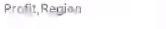
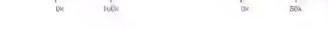
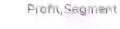
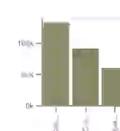
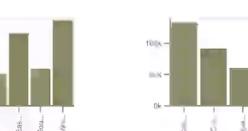
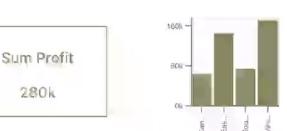
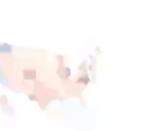
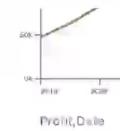
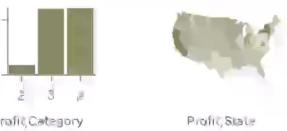
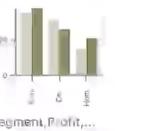
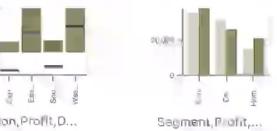
Clear

Measure Analysis

Category Analysis

Change Analysis

Distribution Analysis



Dashboard Canvas

C E D X

KPI Summary

Sum of Sales by State

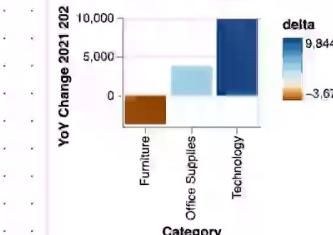
Change of Profit by State (2021)



Sum Sales

730k

Change of Profit by Category

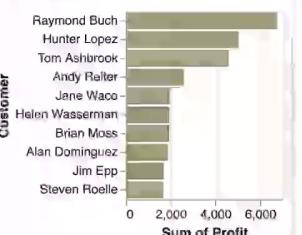


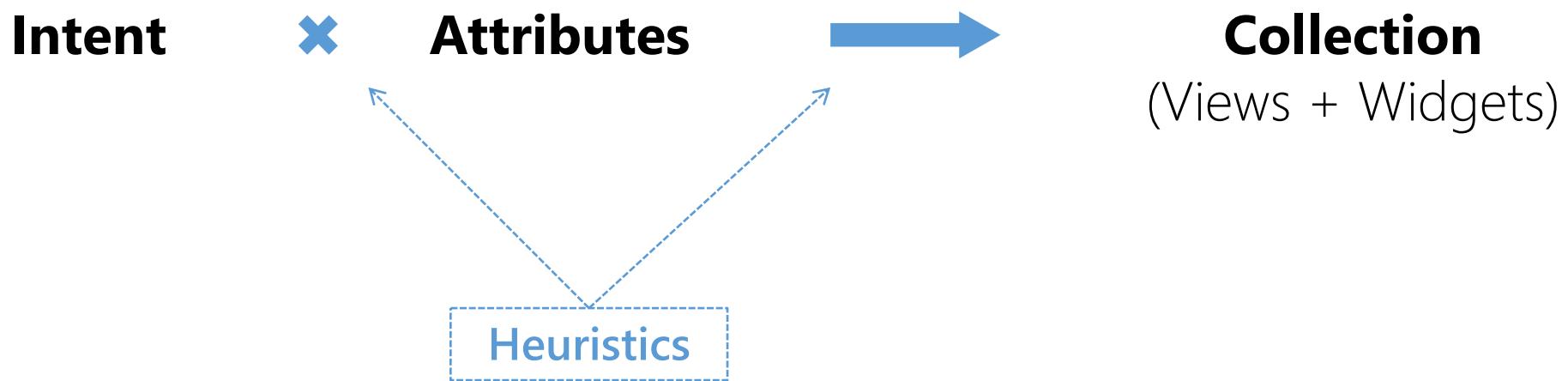
Widget for Date



2019 2020 2021

Top Customers by Profit





Details in
the paper

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

Intent	(ID) Objective	Attributes	Collections (Views and Widgets)
Measure Analysis <small>(Dashboard should focus on quantitative fields)</small>	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	
Change Analysis <small>(Dashboard should display changes over time)</small>	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	
Category Analysis <small>(Dashboard should focus on a categorical field)</small>	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	
Distribution Analysis <small>(Dashboard should provide univariate summaries)</small>	D1: Display univariate summaries of all available data fields	All Attributes	

Input

Dataset: Superstore

Attributes Clear

Profit

Quantity

Sales

State

Category

Customer

Product

Region

Segment

ShipMode

Date

Intent Clear

Measure Analysis

Category Analysis

Change Analysis

Distribution Analysis

Recommended Collections

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

Aggregation Sum

Change Analysis 6 Views

YoY change in Profit (2021 vs. 2020)

Change in ... 10k

State,Profit,D... Profit,Date Category,Profit...

Region,Profit,D... Segment,Profit,... ShipMode,Profit...

Widgets Date

Change Analysis 6 Views

Summary of change in Profit and Sales

Profit,Date Sales,Date Category,Profit...

Category,Sales,... Region,Profit,D... Region,Sales,D...

Widgets Date

Dashboard Canvas

KPI Summary

Sum of Sales by State

sum of Sales 454,599 888

Sum Sales 2.3M

< Input

Recommended Collections

Aggregation | Sum

Update Recommendations

Dataset:

Superstore

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

Attributes

Clear

Discount

Profit

Quantity

Sales

@ State

A Category

A Customer

A Product

A Region

A Segment

A ShipMode

Widgets

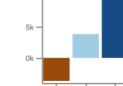
Change Analysis

6 Views
YoY change in Profit (2021 vs. 2020)

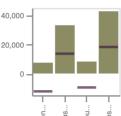
State,Profit,Da...



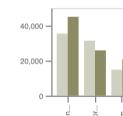
Profit,Date



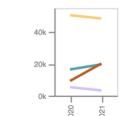
Category,Profit...



Region,Profit,D...

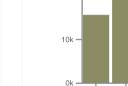


Segment,Profit,...

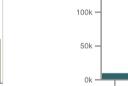


ShipMode,Profit...

Change Analysis

6 Views
Summary of change in Profit and Sales

Profit,Date



Sales,Date



Category,Profit...

Widgets

Date

Widgets

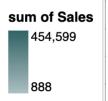
Date

Dashboard Canvas

Clear

KPI Summary

Sum of Sales by State



sum of Sales

454,599

888

Sum Sales
2.3M

Intent

Clear

Measure Analysis

Category Analysis

Change Analysis

Distribution Analysis

Profit

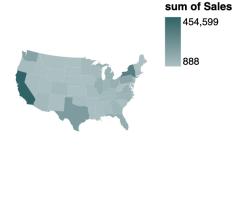
Change Analysis

KPI Summary

Sum Sales

2.3M

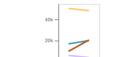
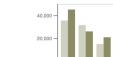
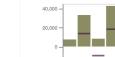
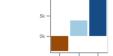
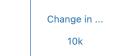
Sum of Sales by State



Recommendation Engine

(Implicit attributes from charts: Sales, State)

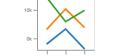
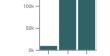
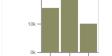
Change Analysis 6 Views
YoY change in Profit (2021 vs. 2020)



Widgets

Date

Change Analysis 6 Views
Summary of change in Profit and Sales



Widgets

Date

Profit

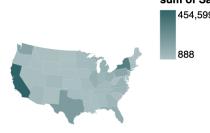
Change Analysis

KPI Summary

Sum of Sales by State

Sum Sales

2.3M



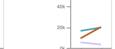
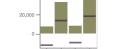
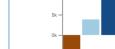
(Implicit attributes from charts: Sales, State)



Recommendation Engine



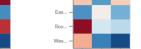
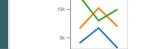
Change Analysis 6 Views
YoY change in Profit (2021 vs. 2020)



Widgets

Date

Change Analysis 6 Views
Summary of change in Profit and Sales



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

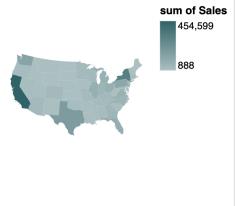
Change Analysis

KPI Summary

Sum Sales

2.3M

Sum of Sales by State



(Implicit attributes from charts: Sales, State)



Recommendation Engine



Change Analysis 6 Views
YoY change in Profit (2021 vs. 2020)



Widgets

Date

Change Analysis 6 Views
Summary of change in Profit and Sales



Change Analysis 6 Views
Summary of change in Profit and Sales



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

KPI Summary

Sum of Sales by State

Sum Sales

2.3M



(Implicit attributes from charts: Sales, State)



Recommendation Engine



Change Analysis 6 Views

YoY change in Profit (2021 vs. 2020)



State,Profit,Da...

Profit,Date

Category,Profit,...

Region,Profit,D...

Segment,Profit,...

ShipMode,Profit...

Widgets

Date

Change Analysis 6 Views

Summary of change in Profit and Sales



Profit,Date

Sales,Date

Category,Profit,...

Category,Sales,...

Region,Profit,D...

Region,Sales,Da...

Widgets

Date

CH1: Summarize change in a measure between two timestamps

{Q, T, C₁, C₂, C₃, C₄, G}

KPI

Q, T

Q, C₁, T

Q, G, T

T

Q, C₂, T

Q, C₃, T

Q, C₄, T

CH2: Summarize changes for two measures over time

{Q₁, Q₂, T, C₁, C₂}

Q₁, T

Q₁, C₁, T

Q₁, C₂, T

T

Q₂, T

Q₂, C₁, T

Q₂, C₂, T

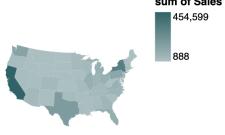
Collection Filtering

Profit

Change Analysis

KPI Summary

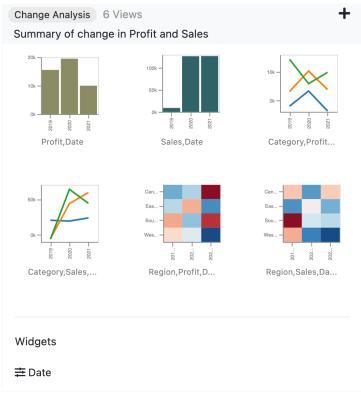
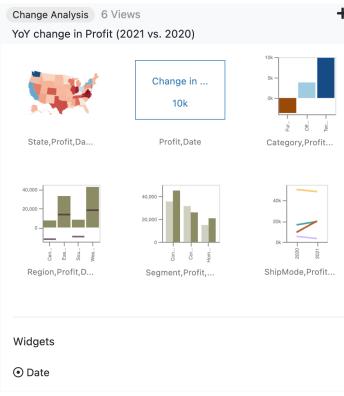
Sum of Sales by State

Sum Sales
2.3M

(Implicit attributes from charts: Sales, State)



Recommendation Engine



CH1: Summarize change in a measure between two timestamps

{Q, T, C₁, C₂, C₃, C₄, 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

{Q₁, Q₂, T, C₁, C₂}

- {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

KPI Summary

Sum of Sales by State

Sum Sales

2.3M



(Implicit attributes from charts: Sales, State)



Recommendation Engine



CH1: Summarize change in a measure between two timestamps

{Q, T, C₁, C₂, C₃, C₄, G}



CH2: Summarize changes for two measures over time

{Q₁, Q₂, T, C₁, C₂}



Collection Filtering

Parameterization

{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}
...

Change Analysis 6 Views

YoY change in Profit (2021 vs. 2020)



State, Profit, Da...

Profit, Date

Category, Profit,...

Region, Profit, D...

Segment, Profit,...

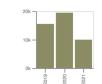
ShipMode, Profit...

Widgets

Date

Change Analysis 6 Views

Summary of change in Profit and Sales



Profit, Date

Sales, Date

Category, Profit,...

Region, Profit, D...

Category, Sales,...

Region, Sales, Da...

Widgets

Date

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

Profit

Change Analysis

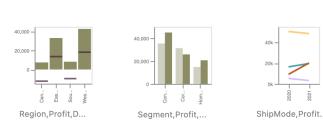
KPI Summary

Sum of Sales by State

Sum Sales
2.3M

(Implicit attributes from charts: Sales, State)

Recommendation Engine

Change Analysis 6 Views
YoY change in Profit (2021 vs. 2020)

Widgets

Date

Change Analysis 6 Views
Summary of change in Profit and Sales

Widgets

Date

CH1: Summarize change in a measure between two timestamps

{Q, T, C₁, C₂, C₃, C₄, G}

T

CH1: Summarize change in a measure between two timestamps



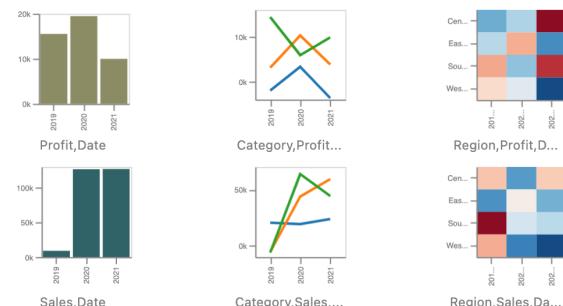
Year

CH2: Summarize changes for two measures over time

{Q₁, Q₂, T, C₁, C₂}

T

CH2: Summarize changes for two measures over time



Year

Collection Filtering

Parameterization

Profit

Change Analysis

KPI Summary

Sum of Sales by State

Sum Sales
2.3M

(Implicit attributes from charts: Sales, State)



Recommendation Engine



Change Analysis 6 Views

YoY change in Profit (2021 vs. 2020)

Change in ...
10k

State,Profit,Da...



Profit,Date



Category,Profit...



Region,Profit,D...



Segment,Profit,...



ShipMode,Profit...

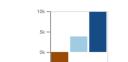


Widgets

Date

Change Analysis 6 Views

Summary of change in Profit and Sales



Sales,Date



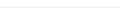
Category,Profit...



Cust.,Date



Region,Profit,D...



Region,Sales,D...



Widgets

Date

CH1: Summarize change in a measure between two timestamps

{Q, T, C₁, C₂, C₃, C₄, G}

KPI

Q, T

Q, C₁, T

Q, G, T

T

Q, C₂, TQ, C₃, TQ, C₄, T

T

CH1: Summarize change in a measure between two timestamps

{Q, T, C₁, C₂, C₃, C₄, G}Change in ...
10k

Profit,Date



Category,Profit...



State,Profit,Da...

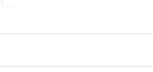


Year

Region,Profit,D...



Segment,Profit,...

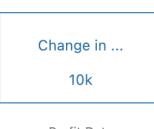


ShipMode,Profit...

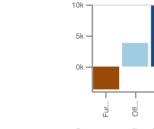
CH1: Summarize change in a measure between two timestamps

{Q, T, C₁, C₂, C₃, C₄, G}Change in ...
10k

State,Profit,Da...



Profit,Date

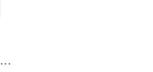


Category,Profit...



Year

Region,Profit,D...



Segment,Profit,...



ShipMode,Profit...

CH2: Summarize changes for two measures over time

{Q₁, Q₂, T, C₁, C₂}Q₁, TQ₁, C₁, TQ₁, G, T

T

Q₂, TQ₂, C₁, TQ₂, C₂, T

T

CH2: Summarize changes for two measures over time

{Q₁, Q₂, T, C₁, C₂}

Sales,Date



Category,Profit...



Region,Profit,D...



Category,Sales...

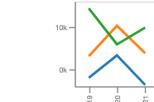
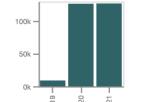


Region,Sales,D...

CH2: Summarize changes for two measures over time

{Q₁, Q₂, T, C₁, C₂}

Sales,Date



Year

Region,Profit,D...



Region,Sales,D...

Collection Filtering

Parameterization

Ranking

Profit

Change Analysis

KPI Summary

Sum of Sales by State

Sum Sales

2.3M

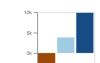


(Implicit attributes from charts: Sales, State)

Recommendation Engine

Change Analysis 6 Views

YoY change in Profit (2021 vs. 2020)



Widgets

Date

Change Analysis 6 Views

Summary of change in Profit and Sales



CH1: Summarize change in a measure between two timestamps

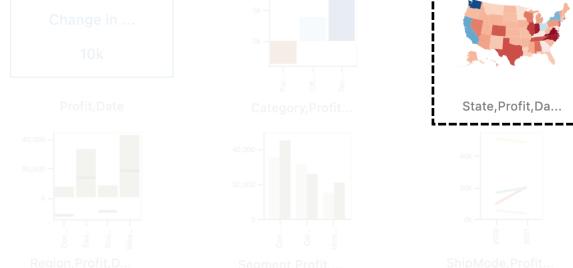
{Q, T, C₁, C₂, C₃, C₄, G}

CH2: Summarize changes for two measures over time

{Q₁, Q₂, T, C₁, C₂}

Collection Filtering

CH1: Summarize change in a measure between two timestamps

{Q, T, C₁, C₂, C₃, C₄, G}

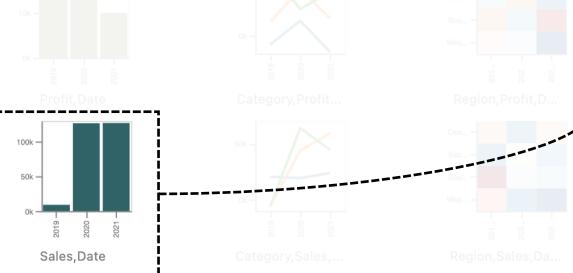
Based on implicit attribute: State

CH1: Summarize change in a measure between two timestamps

{Q, T, C₁, C₂, C₃, C₄, G}

Based on implicit attribute: Sales

CH2: Summarize changes for two measures over time

{Q₁, Q₂, T, C₁, C₂}

Based on implicit attribute: Sales

CH2: Summarize changes for two measures over time

{Q₁, Q₂, T, C₁, C₂}

Based on implicit attribute: Sales

Parameterization

Ranking

User Study: Overview



13 participants



Interview + Likert-scale questions



Two task types:

- **Targeted**



(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)

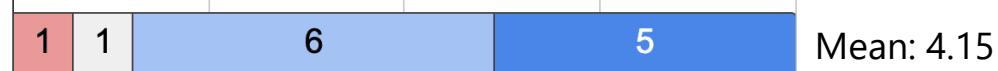
User Study: Recommendation Feedback

Overall, I found the recommendations useful



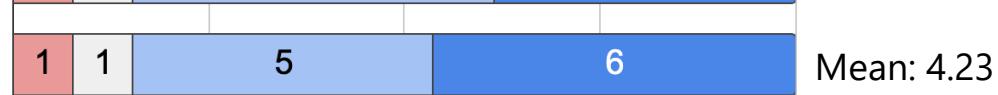
Mean: 4.46

The recommendations were relevant



Mean: 4.15

The recommendations gave me ideas for composing dashboards



Mean: 4.23

The recommendations were easy to interpret



Mean: 4.08

The intents and collection objectives were intuitive



Mean: 3.69

0 - Strongly Disagree

1 - Disagree

3 - Neutral

4 - Agree

5 - Strongly Agree

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

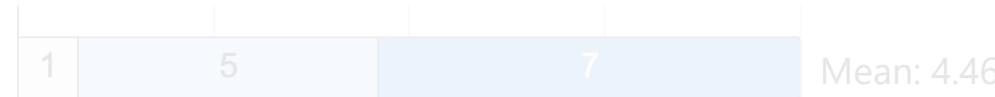
- P11

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

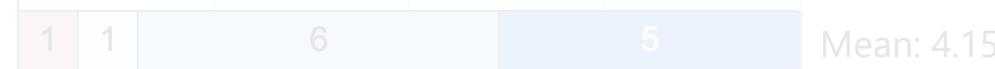
- P2

User Study: Recommendation Feedback

Overall, I found the recommendations useful



The recommendations were relevant



The recommendations gave me ideas for composing dashboards



The recommendations were easy to interpret



The intents and collection objectives were intuitive



■ 0 - Strongly Disagree

■ 1 - Disagree

■ 3 - Neutral

■ 4 - Agree

■ 5 - Strongly Agree

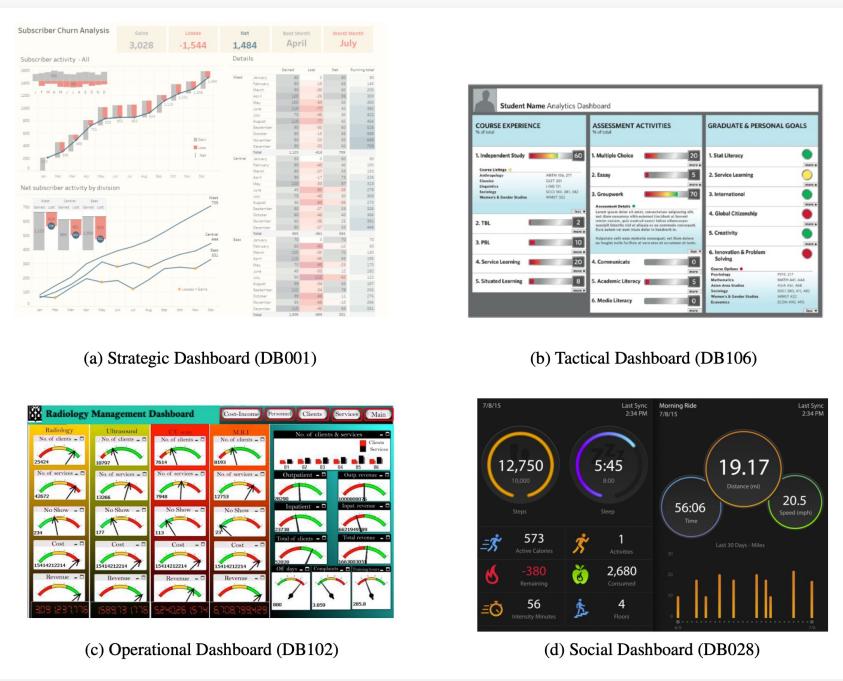
*"When you go into each intent and you look at the recommendations, **you need to spend a few minutes to understand what is being covered, but after that, it's easy to understand and use.**"*

- P7

Future Work

Future Work

- Expanding beyond analytic dashboards

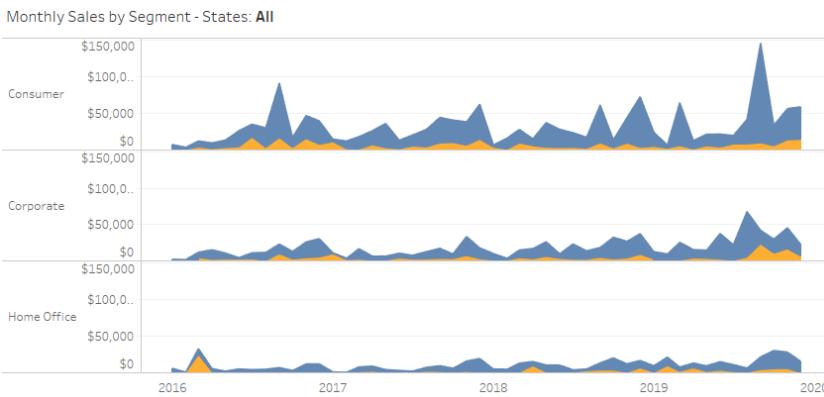


What Do We Talk About When We Talk About Dashboards?
Sarikaya et al., IEEE VIS 2019

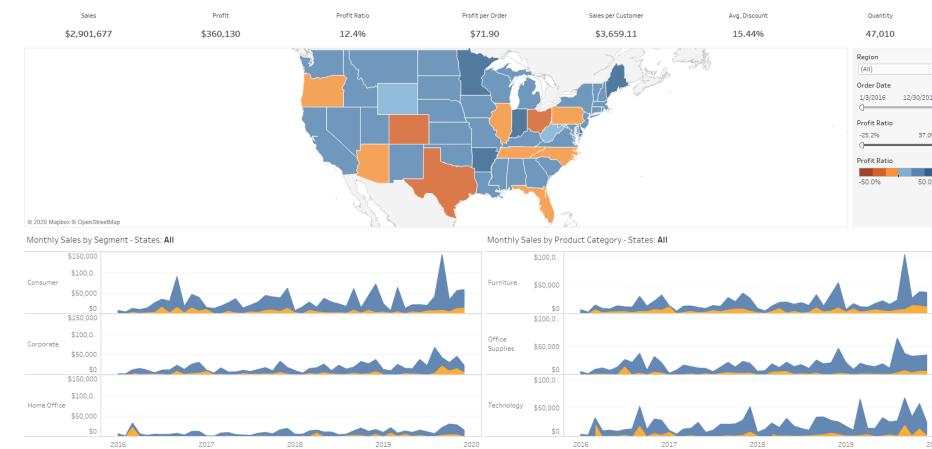
Future Work

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

"Show me monthly sales by segments"

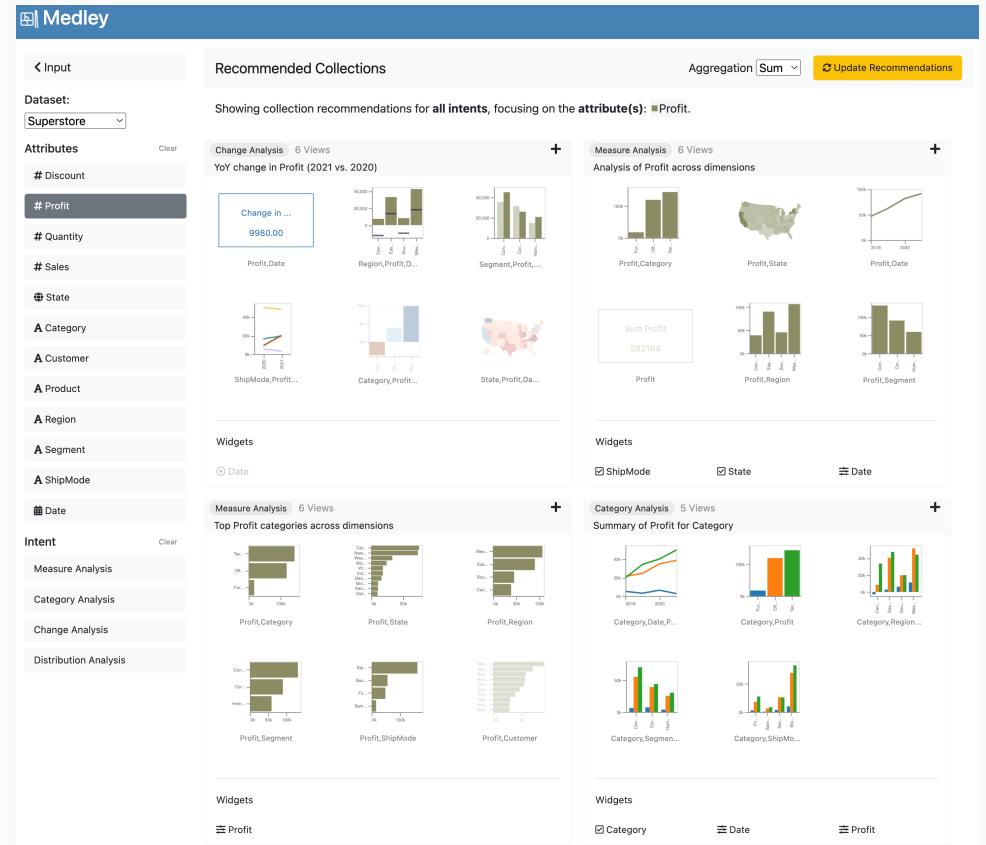


"Display an overview of company performance over time"



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.



Aditeya Pandey

Northeastern University

@aaditeya



Arjun Srinivasan

Tableau Research

@10_arjun



Vidya Setlur

Tableau Research

@vsetlur



bit.ly/
medley-vis22

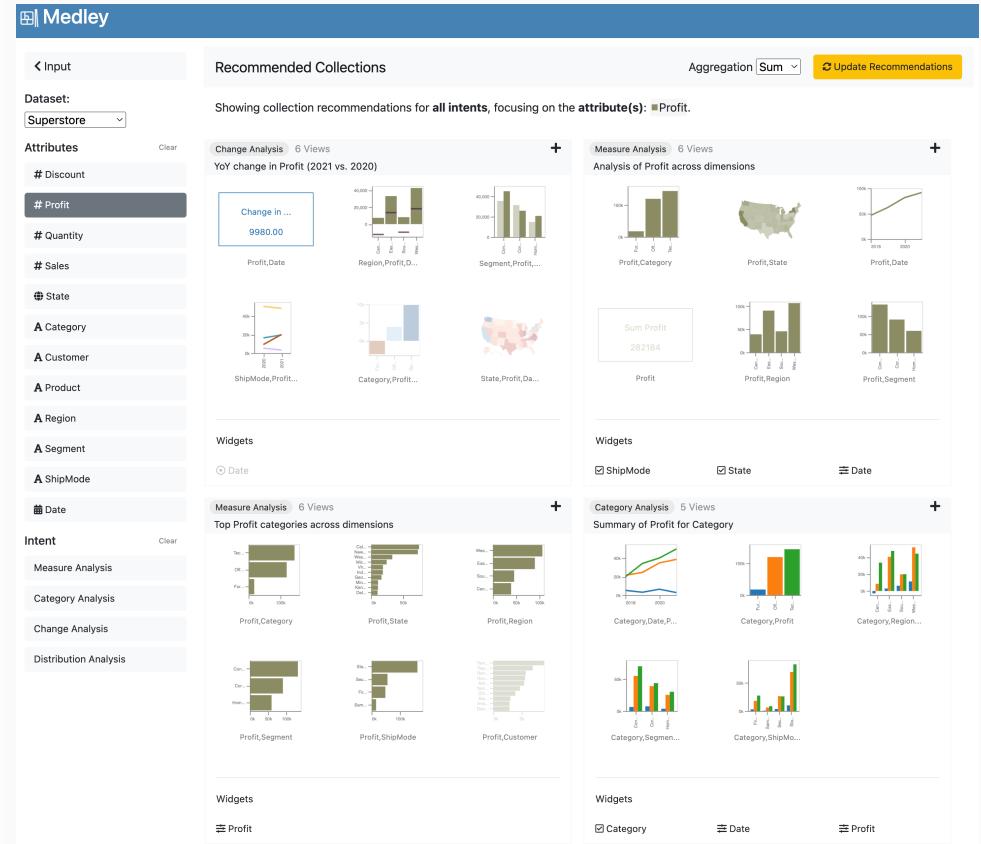


tableau
research

