Fachhochschule Kiel
University of Applied Sciences

Data Visualization and Visual Analytics
Introduction to Tableau, PowerBI & Co.

Study Program Data Science
Prof. Dr. Tillmann Schwörer

Lecture Roadmap

Data Domains

Comparing Categories | Relationships | Geospatial | Time |
Part-to-whole | Distributions | Uncertainty | …

Storytelling

Perception + Visualization Design

Python + Tools

Interactive Visualization

Different users

Data Scientist

- Visualization as part of the data science workflow (data understading, cleaning, model evaluation, …)
- Flexibel visualization options, e.g. using Python packages (matplotlib, seaborn, plotly, streamlit)

Business User

- No code, self-service visual exploration (PowerBI, Tableau, Qlik, Looker)
- Data scientist prepares the data models and BI tools behind the scenes → empower business users to explore on their own

Different purposes

Exploration

Making sense of data *for yourself*

- Find patterns or problems in data
- Iterative, exprimental, messy
- Prerequisite of downstream use cases (knowledge communication, machine learning, etc.)

Explanation

Making sense of data *for others*

- Communicate insights effectively
- Clean, deliberate design choices

Use cases overview

This week: Tableau, PowerBI, Streamlit
Main output of your „Interactive Visualization“ task

	Data Scientist	Business User
Exploration	Visual data analysis and cleaning; Visual model evaluation	Interactive Dashboards
Explanation	Visual reports and Visual storytelling	KPI Dashboard

Main focus of our DataViz lecture in general
Main output of your Capstone Project

Overview of Tools

Figure 1: Magic Quadrant for Analytics and Business Intelligence Platforms

Gartner (June 2024)

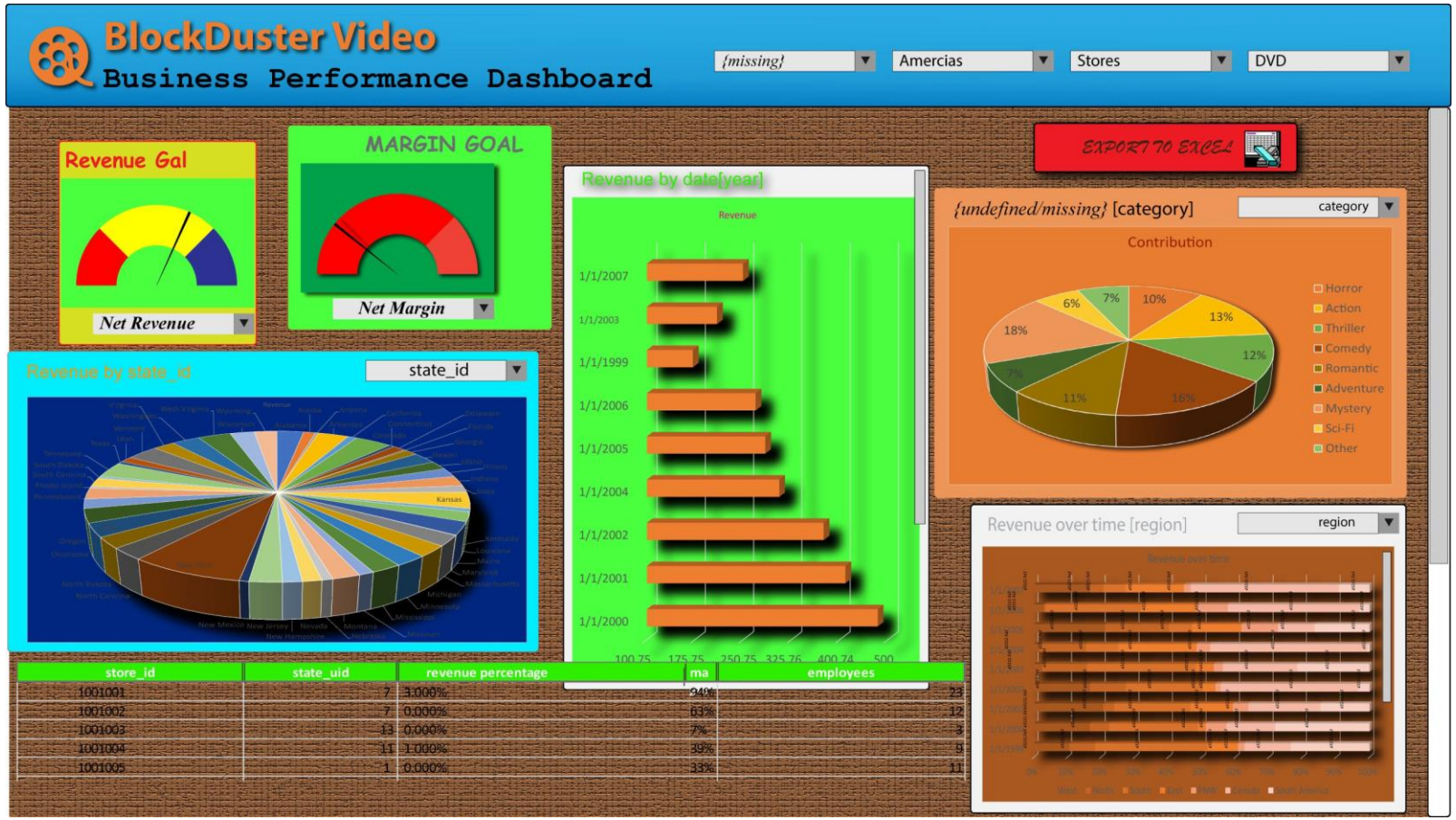
Gartner

- **Microsoft: Power BI**
- **Salesforce: Tableau**
- QlikSense and QlikView
- Google: Looker

Source: https://powerbi.microsoft.com/en-us/blog/microsoft-named-a-leader-in-the-2024-gartner-magic-quadrant-for-analytics-and-bi-platforms/


Dashboard Design

Design for Dashboards



Which design principles are violated?

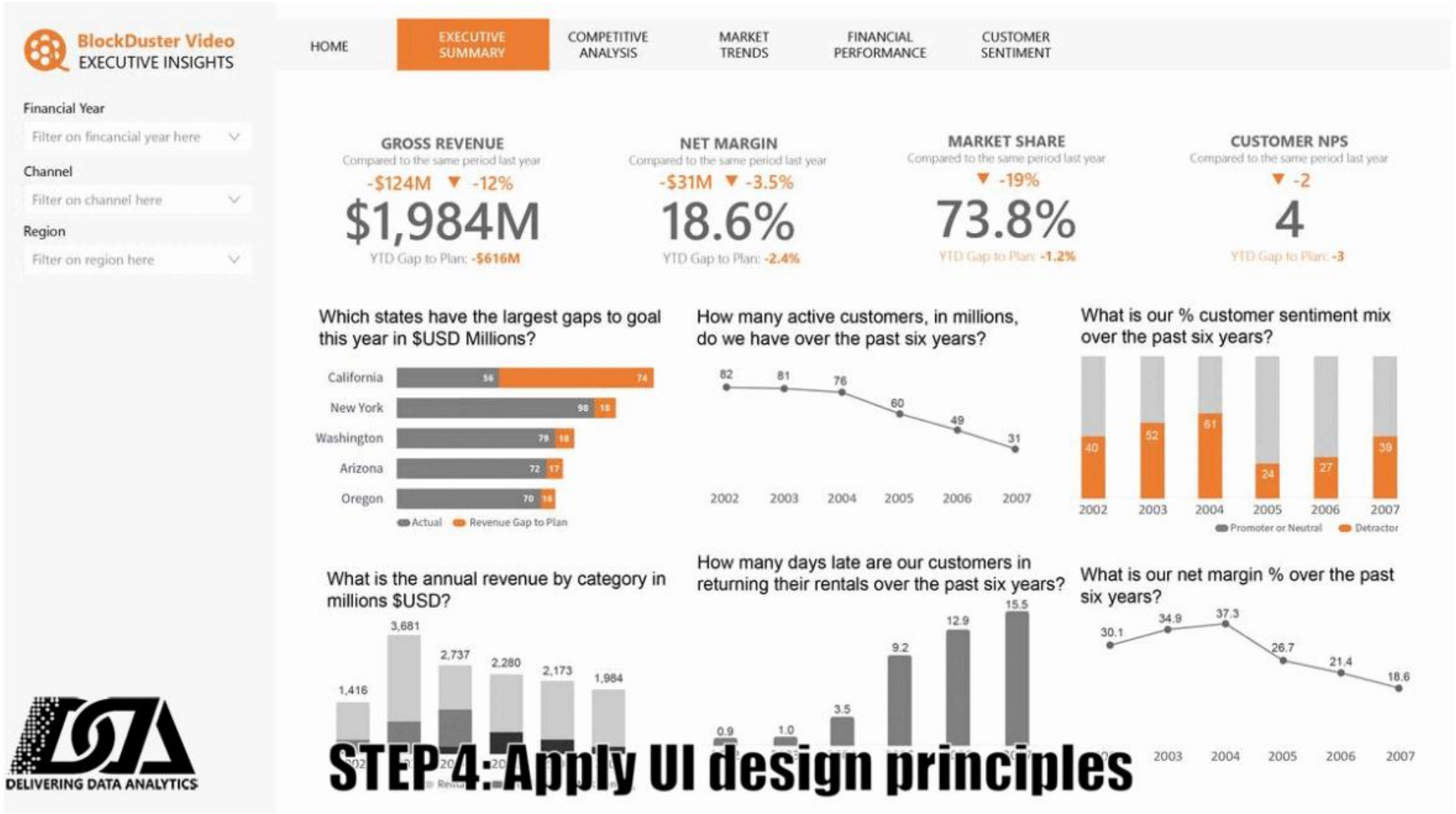
- Pie charts are perceptually bad
- 3 D pie chart violates principle of proportional ink
- Low signal-to-noise ratio

CRAP:

- **Contrast**: bad color contrasts
- **Repetition**: styles are not used consistently
- **Alignment**: charts are not aligned
- **Proximity:** legend entries are far off

Source: https://deliveringdataanalytics.com/confessions-of-a-dashboard-designer-how-to-avoid-ugly-data-visualizations/

Graphic Design for Dashboards



DELIVERING DATA ANALYTICS

STEP 4: Apply UI design principles

KPI Dashboard vs. Interactive Dashboard

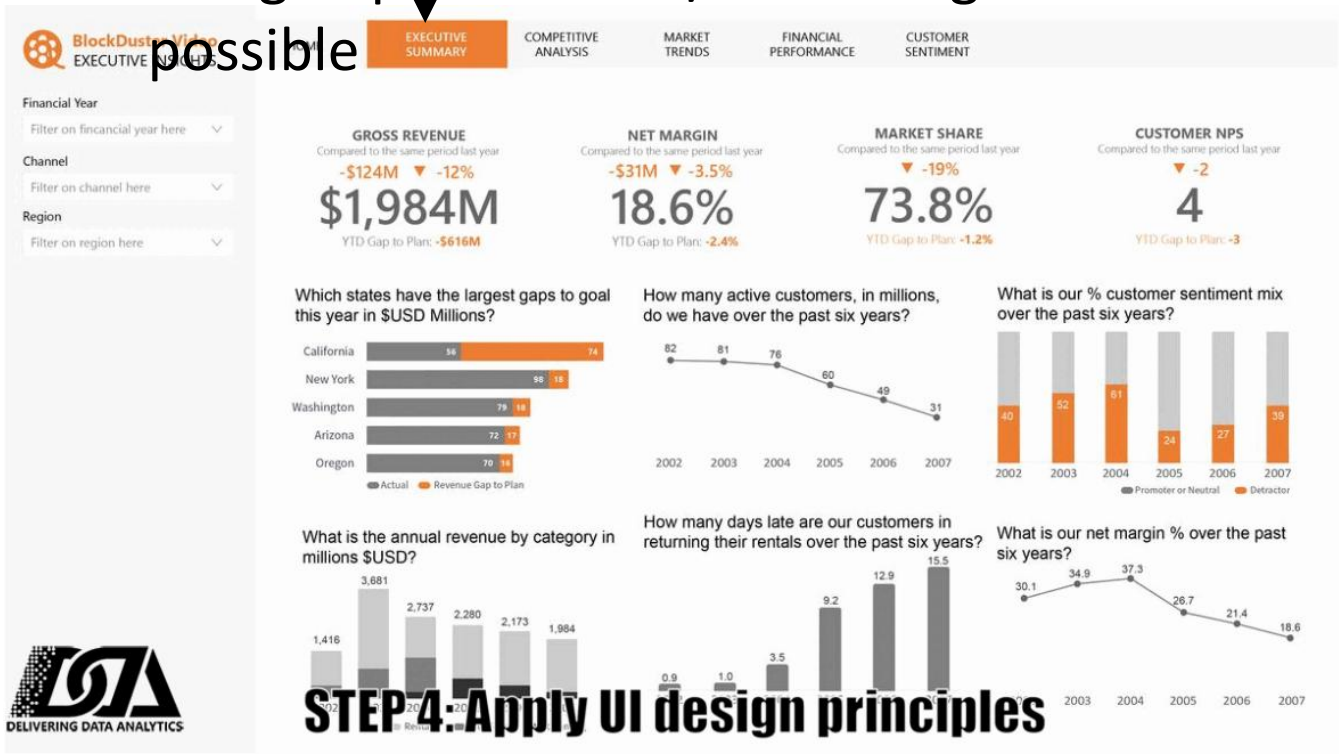
Explanation vs. Exploration

KPI Dashboard for executives

- No or https://public.tableau.com/app/learn/sample-data interactions
- Design optimizations/finetuning are possible

Interactive Dashboards for business analysts

- More user interactions allowed
- Design optimizations more difficult



Example Workflow using Tableau

Tableau Resources

- **Register with Tableau and download**: Tableau Desktop: Public Edition
- Information for students: https://www.tableau.com/academic/students
- Sample data: https://public.tableau.com/app/learn/sample-data
- Tableau Training Videos: https://www.tableau.com/en-gb/learn/training
- Datacamp - Introduction to Tableau: https://app.datacamp.com/learn/courses/introduction-to-tableau

Connect

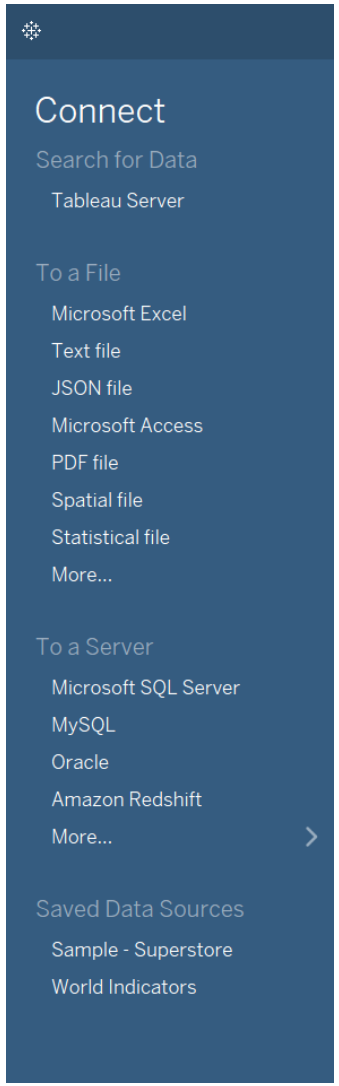


Tableau supports many data sources

- Files
- Databases
- Cloud Services

Prepare

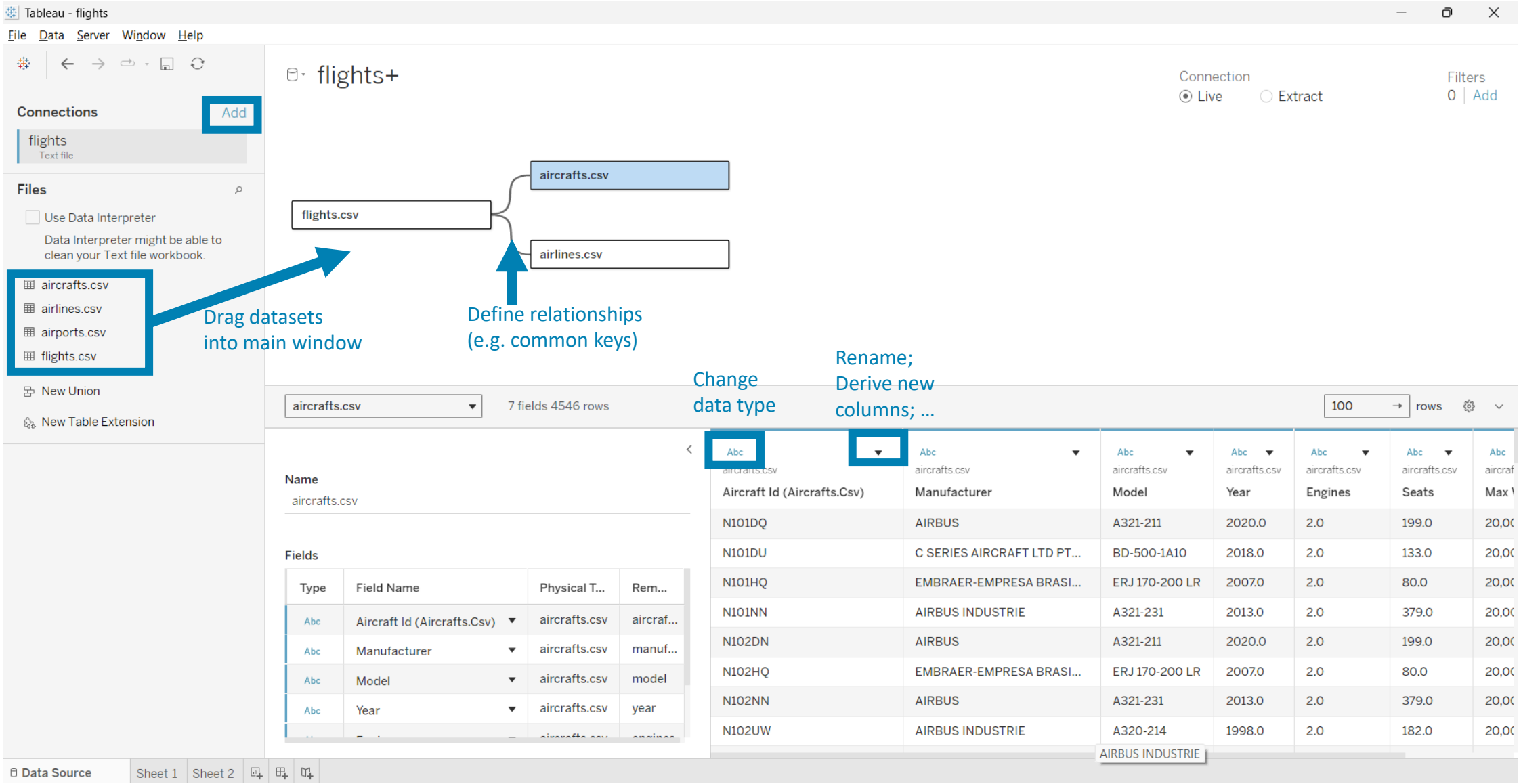
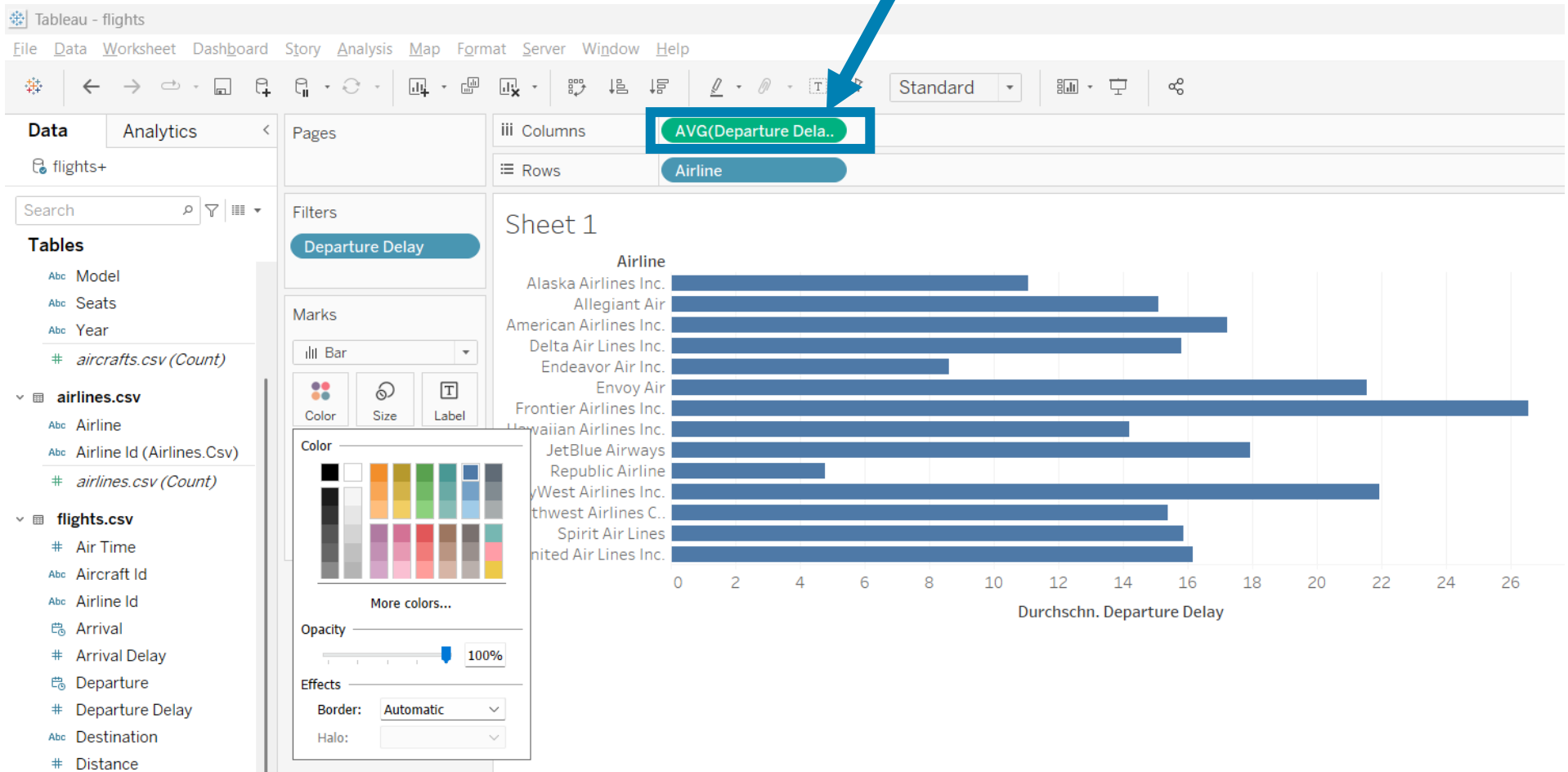


Tableau - flights
File Data Server Window Help
Connections
Add
flights
Text file
Files
Use Data Interpreter
Data Interpreter might be able to clean your Text file workbook.
aircrafts.csv
airlines.csv
airports.csv
flights.csv
New Union
New Table Extension
flights+
Connection
Live
Extract
Filters
0 Add
aircrafts.csv
airlines.csv
flights.csv
Drag datasets into main window
Define relationships (e.g. common keys)
Change data type
Rename; Derive new columns; …
aircrafts.csv
7 fields 4546 rows
100 rows
Name
aircrafts.csv
Fields
Type
Field Name
Physical T...
Rem...
Aircraft Id (Aircrafts.Csv)
Manufacturer
Model
Year
Engines
Seats
N101DQ AIRBUS A321-211 2020.0 2.0 199.0
N101DU C SERIES AIRCRAFT LTD PT... BD-500-1A10 2018.0 2.0 133.0
N101HQ EMBRAER-EMPRESA BRASI... ERJ 170-200 LR 2007.0 2.0 80.0
N101NN AIRBUS INDUSTRIE A321-231 2013.0 2.0 379.0
N102DN AIRBUS A321-211 2020.0 2.0 199.0
N102HQ EMBRAER-EMPRESA BRASI... ERJ 170-200 LR 2007.0 2.0 80.0
N102NN AIRBUS A321-231 2013.0 2.0 379.0
N102UW AIRBUS INDUSTRIE A320-214 1998.0 2.0 182.0
AIRBUS INDUSTRIE
Data Source
Sheet 1
Sheet 2

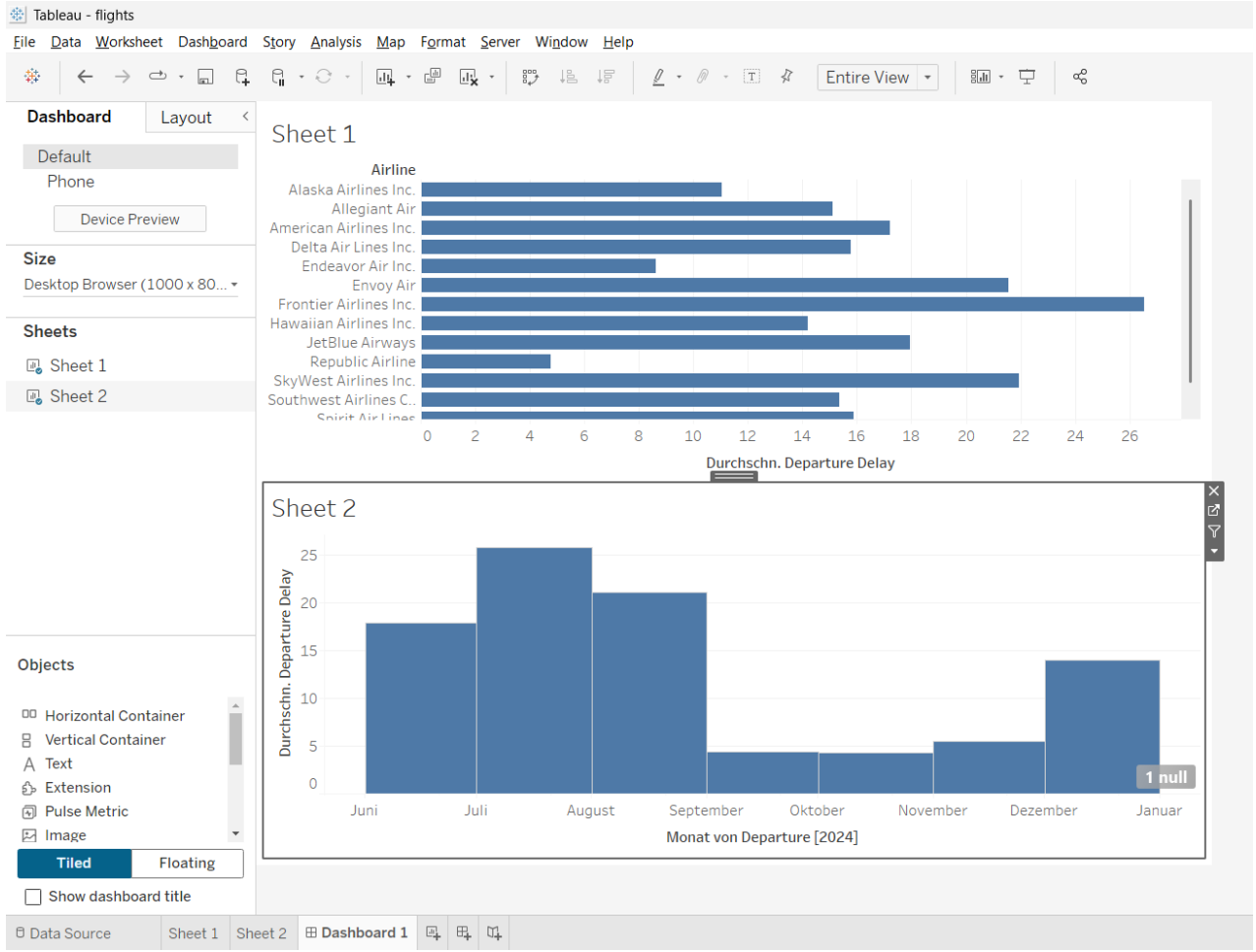
Visualize

By default, Tableau aggregates numeric columns → Change aggregation type (sum, avg, median, …) if needed



We can create visualizations using drag-and-drop

Create dashboard



We can

- combine multiple visualizations into a dashboard
- add selection widget
- add click interactions
- …

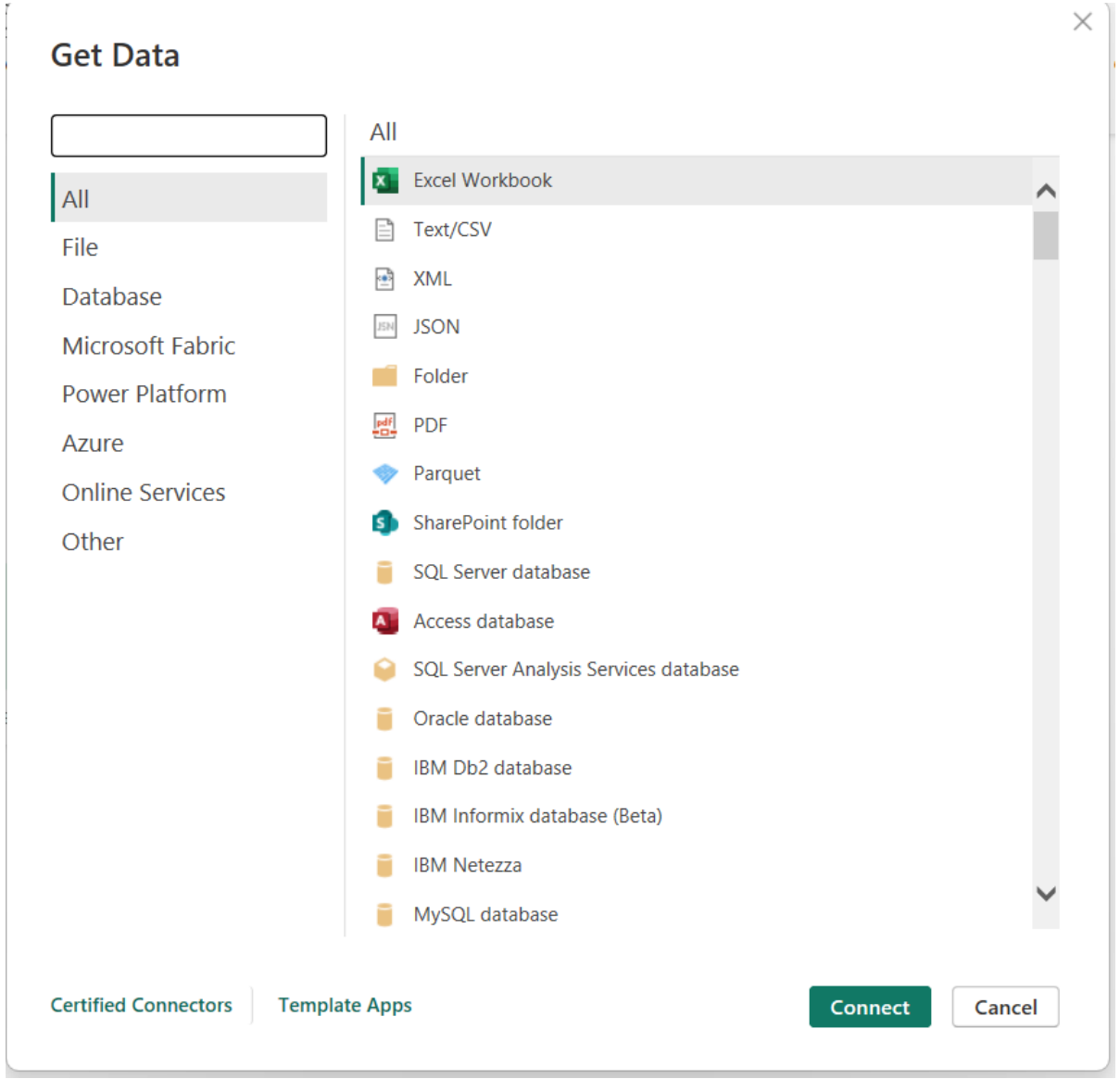
Publish

We can share / publish the final dashboard via

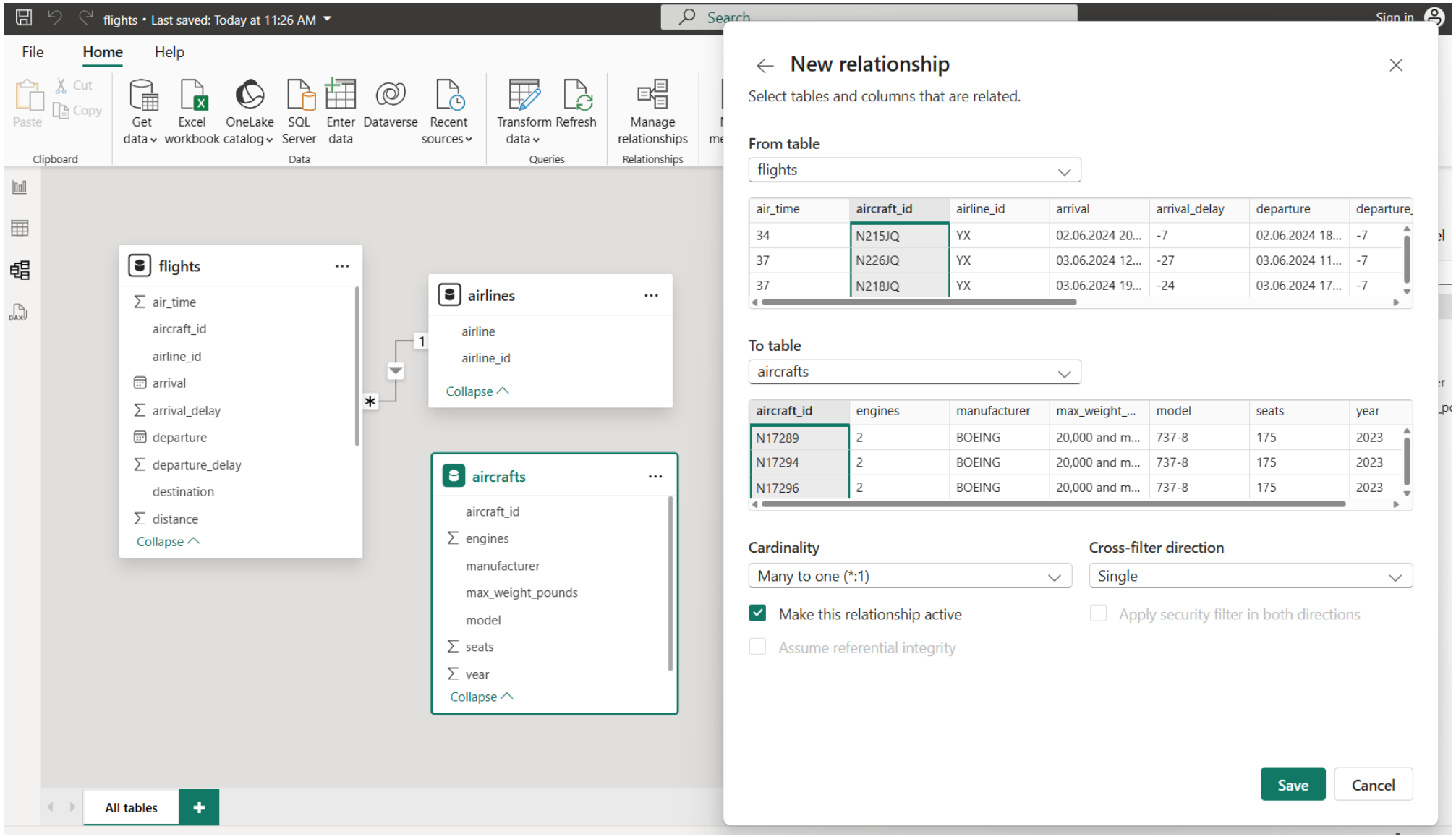
- twbx files (standalone – includes data) or txb file (without data)
- Publish to Tableau Server or Tableau Public
- Embed in websites or internal tools
- Export as a static PDF or image

Example Workflow using Power BI

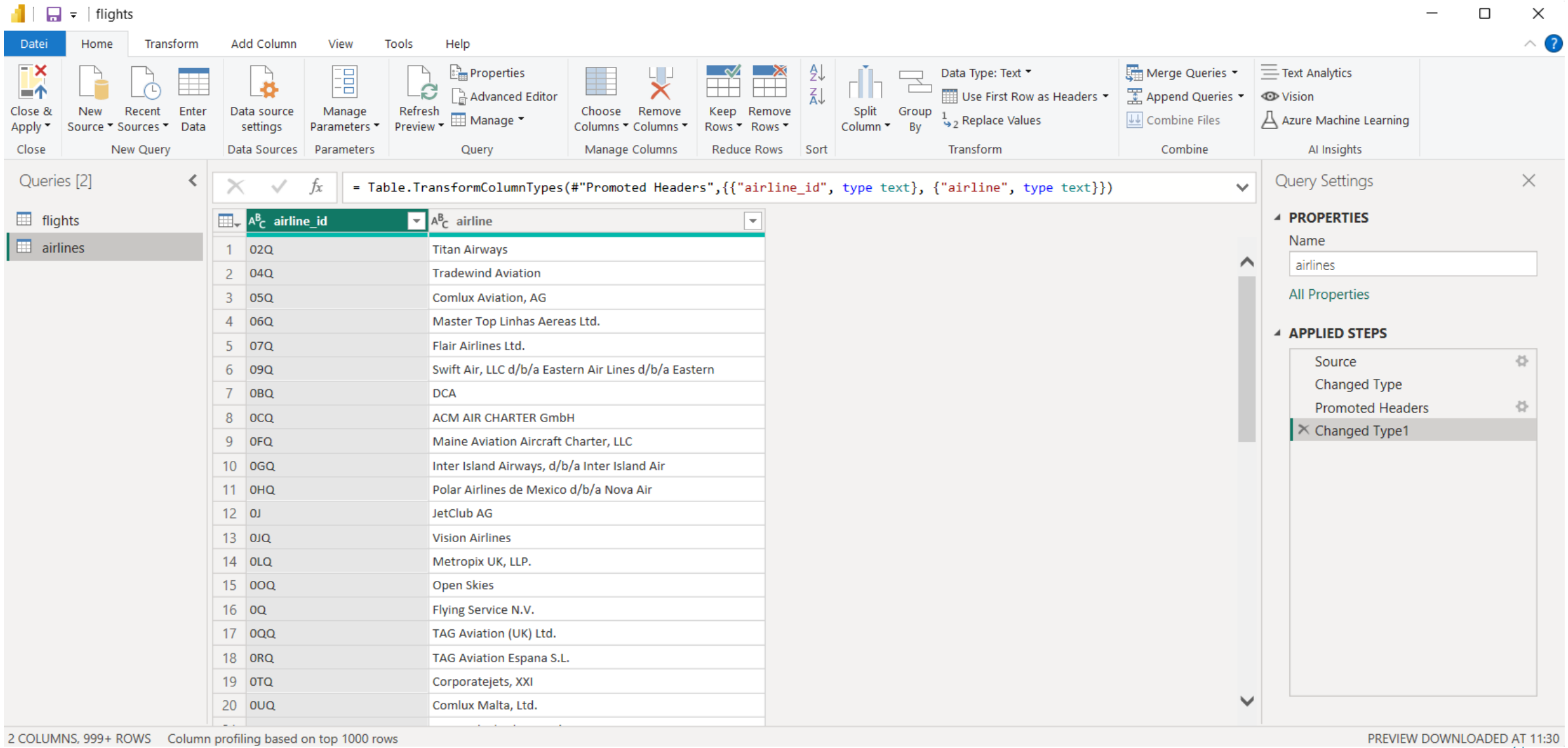
Connect


Get Data
All
File
Database
Microsoft Fabric
Power Platform
Azure
Online Services
Other
All
Excel Workbook
Text/CSV
XML
JSON
Folder
PDF
Parquet
SharePoint folder
SQL Server database
Access database
SQL Server Analysis Services database
Oracle database
IBM Db2 database
IBM Informix database (Beta)
IBM Netezza
MySQL database
Certified Connectors
Template Apps
Connect
Cancel

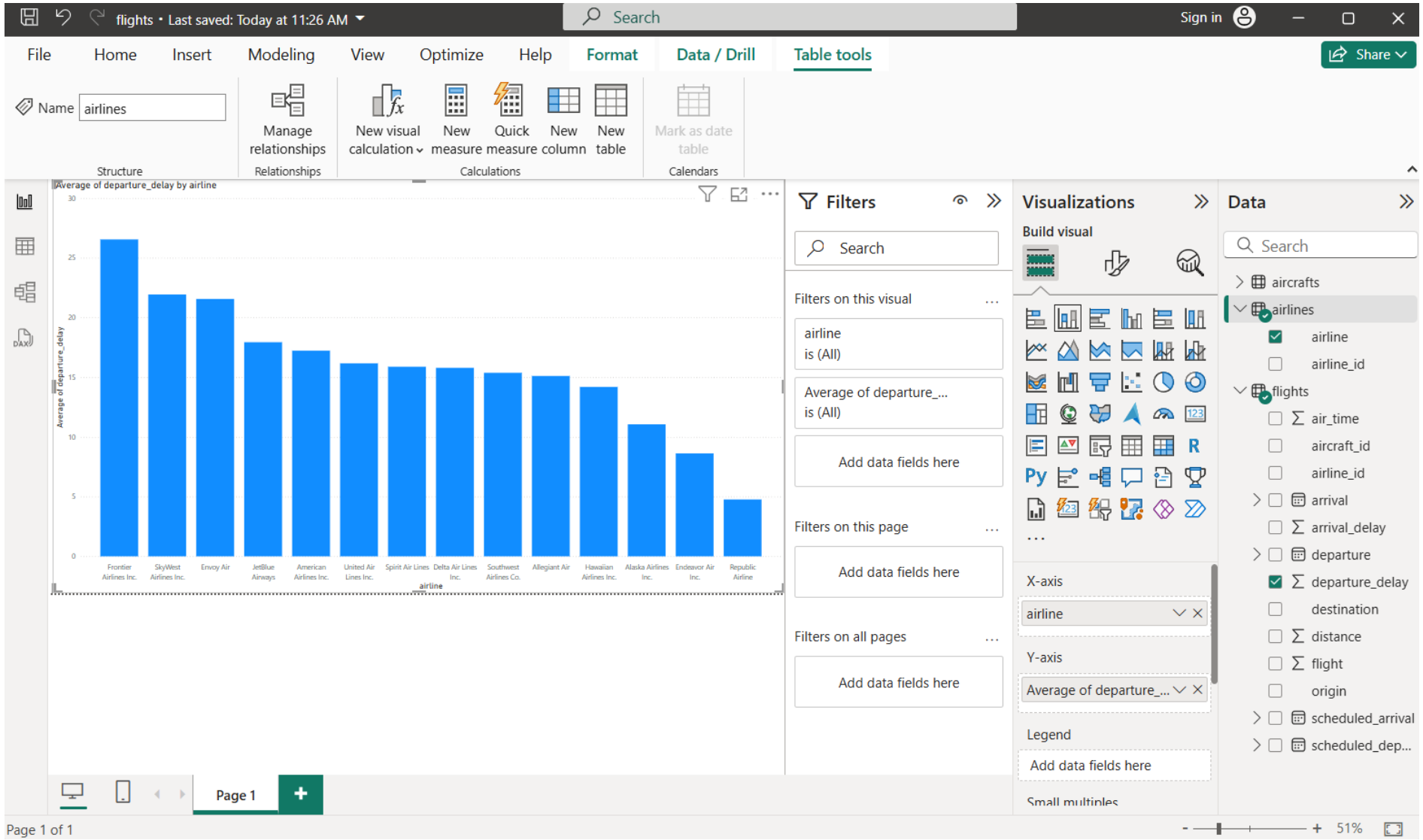
Prepare


flights • Last saved: Today at 11:26 AM
Search
Sign in
File
Home
Help
Cut
Copy
Paste
Get data
Excel workbook
OneLake catalog
SQL Server
Enter data
Dataverse
Recent sources
Transform data
Refresh
Manage relationships
Clipboard
Data
Queries
Relationships
flights
air_time
aircraft_id
airline_id
arrival
arrival_delay
departure
departure_delay
destination
distance
Collapse
airlines
airline
airline_id
Collapse
aircrafts
aircraft_id
engines
manufacturer
max_weight_pounds
model
seats
year
Collapse
1
*
All tables
New relationship
Select tables and columns that are related.
From table
flights
air_time | aircraft_id | airline_id | arrival | arrival_delay | departure | departure_
34 | N215JQ | YX | 02.06.2024 20... | -7 | 02.06.2024 18... | -7
37 | N226JQ | YX | 03.06.2024 12... | -27 | 03.06.2024 11... | -7
37 | N218JQ | YX | 03.06.2024 19... | -24 | 03.06.2024 17... | -7
To table
aircrafts
aircraft_id | engines | manufacturer | max_weight_... | model | seats | year
N17289 | 2 | BOEING | 20,000 and m... | 737-8 | 175 | 2023
N17294 | 2 | BOEING | 20,000 and m... | 737-8 | 175 | 2023
N17296 | 2 | BOEING | 20,000 and m... | 737-8 | 175 | 2023
Cardinality
Many to one (*:1)
Cross-filter direction
Single
Make this relationship active
Apply security filter in both directions
Assume referential integrity
Save
Cancel

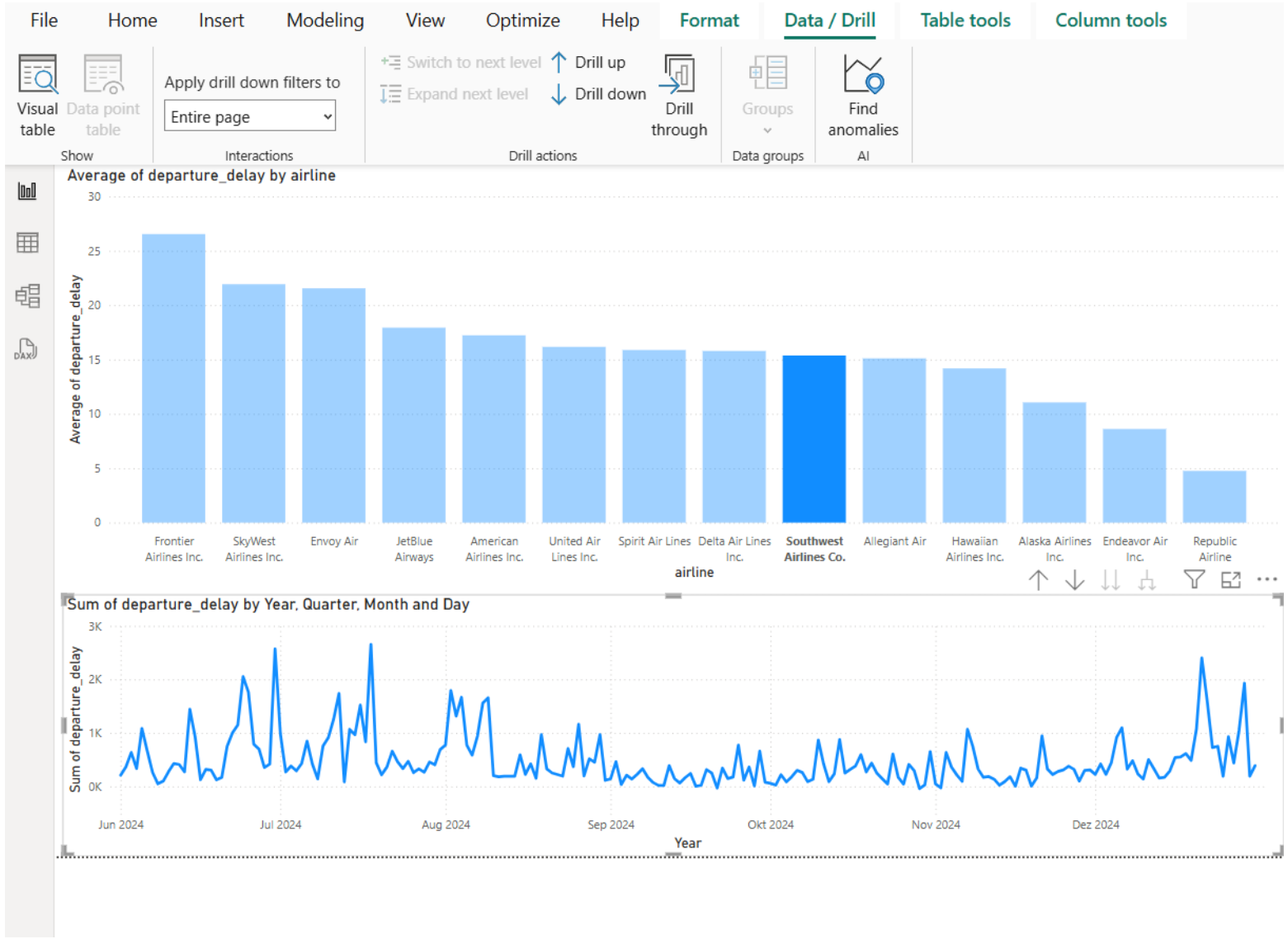
Prepare


flights
Datei
Home
Transform
Add Column
View
Tools
Help
Close & Apply
New Source
Recent Sources
Enter Data
Data source settings
Manage Parameters
Refresh Preview
Properties
Advanced Editor
Manage
Choose Columns
Remove Columns
Keep Rows
Remove Rows
Split Column
Group By
Data Type: Text
Use First Row as Headers
Replace Values
Merge Queries
Append Queries
Combine Files
Text Analytics
Vision
Azure Machine Learning
Close
New Query
Data Sources
Parameters
Query
Manage Columns
Reduce Rows
Sort
Transform
Combine
AI Insights
Queries [2]
flights
airlines
= Table.TransformColumnTypes(#"Promoted Headers",{{"airline_id", type text}, {"airline", type text}})
airline_id
airline
1 02Q Titan Airways
2 04Q Tradewind Aviation
3 05Q Comlux Aviation, AG
4 06Q Master Top Linhas Aereas Ltd.
5 07Q Flair Airlines Ltd.
6 09Q Swift Air, LLC d/b/a Eastern Air Lines d/b/a Eastern
7 0BQ DCA
8 0CQ ACM AIR CHARTER GmbH
9 0FQ Maine Aviation Aircraft Charter, LLC
10 0GQ Inter Island Airways, d/b/a Inter Island Air
11 0HQ Polar Airlines de Mexico d/b/a Nova Air
12 0J JetClub AG
13 0JQ Vision Airlines
14 0LQ Metropix UK, LLP.
15 0OQ Open Skies
16 0Q Flying Service N.V.
17 0QQ TAG Aviation (UK) Ltd.
18 0RQ TAG Aviation Espana S.L.
19 0TQ Corporatejets, XXI
20 0UQ Comlux Malta, Ltd.
Query Settings
PROPERTIES
Name
airlines
All Properties
APPLIED STEPS
Source
Changed Type
Promoted Headers
Changed Type1
2 COLUMNS, 999+ ROWS
Column profiling based on top 1000 rows
PREVIEW DOWNLOADED AT 11:30

Visualize


flights • Last saved: Today at 11:26 AM
Search
Sign in
File
Home
Insert
Modeling
View
Optimize
Help
Format
Data / Drill
Table tools
Share
Name
airlines
Manage relationships
New visual calculation
New measure
Quick measure
New column
New table
Mark as date table
Structure
Relationships
Calculations
Calendars
Average of departure_delay by airline
Average of departure_delay
airline
Frontier Airlines Inc.
SkyWest Airlines Inc.
Envoy Air
JetBlue Airways
American Airlines Inc.
United Air Lines Inc.
Spirit Air Lines
Delta Air Lines Inc.
Southwest Airlines Co.
Allegiant Air
Hawaiian Airlines Inc.
Alaska Airlines Inc.
Endeavor Air Inc.
Republic Airline
Filters
Search
Filters on this visual
airline
is (All)
Average of departure_...
is (All)
Add data fields here
Filters on this page
Add data fields here
Filters on all pages
Add data fields here
Visualizations
Build visual
X-axis
airline
Y-axis
Average of departure_...
Legend
Add data fields here
Small multiples
Data
Search
aircrafts
airlines
airline
airline_id
flights
air_time
aircraft_id
airline_id
arrival
arrival_delay
departure
departure_delay
destination
distance
flight
origin
scheduled_arrival
scheduled_dep...
Page 1
Page 1 of 1
51%

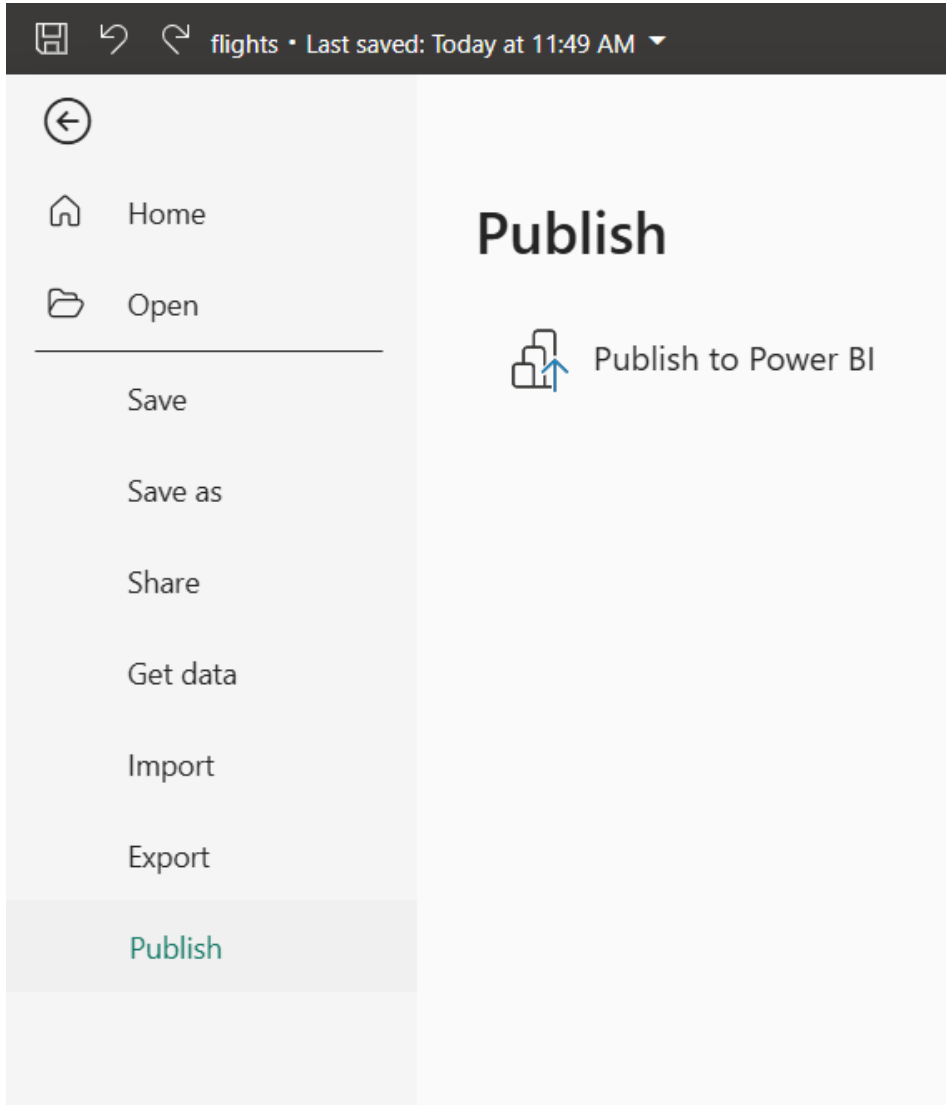
Create Dashboards



In Power BI visualizations are connected with each other by default

- cross-filtering
- cross-highlighting

Publish



We can share / publish the final dashboard via:

- pbix files (standalone – includes data)
- We can publish the dashboard project to Power BI cloud
- Sharing with other people requires the payed subscription

Power BI Learning Resources

- Datacamp - Introduction to Power BI: https://app.datacamp.com/learn/courses/introduction-to-power-bi
- Power BI Tutorial (example): https://learn.microsoft.com/en-us/training/paths/prepare-visualize-data-power-bi/