COMMUNICATE CLEARLY:
APPLYING VISUAL DESIGN BEST PRACTICES IN REPORTING
MICHAEL HEWITT
SQL SATURDAY ATLANTA 2024 - BI & DATA ANALYTICS
FEBRUARY 10, 2024

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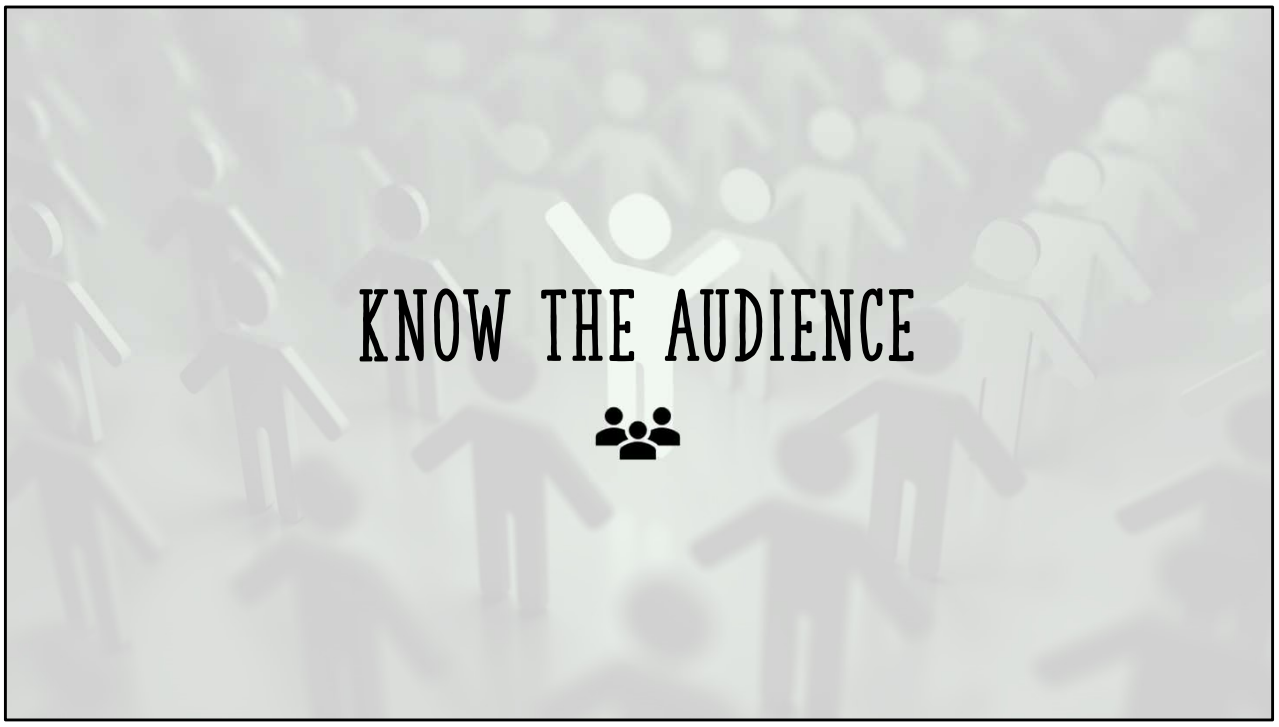
PUG NASHVILLE
NEW SONG Nashville
REDS
OHIO STATE

AGENDA

- Prerequisites for good report design
- Simplify charts by eliminating noise
- Gestalt's Principles of Perception
- Report page layouts
- Choose colors
- Designing for visual impairments

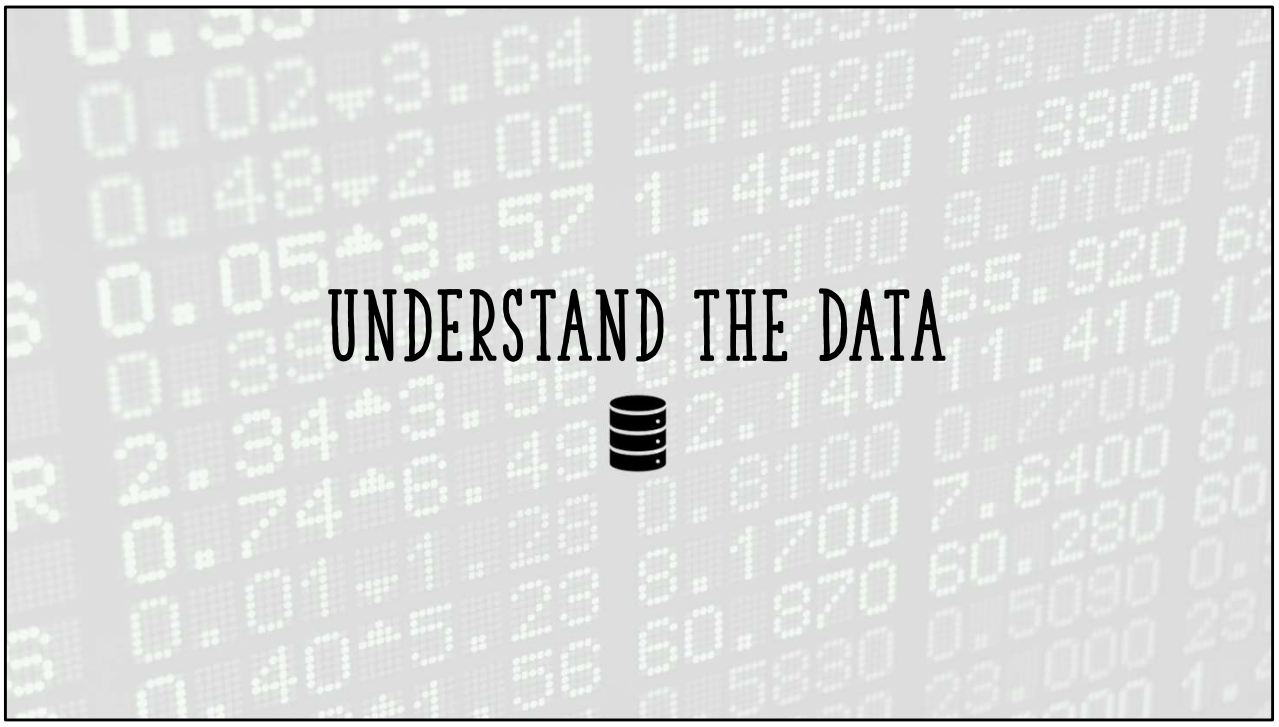
Taking time to gather good requirements will inform the decisions you need to make later as a designer. Design choices are subjective!

This is first and foremost



Executives are different from the sales team is different from the marketing team, and so on.

Understand the data literacy of the audience.
Can they read and comprehend a variety of chart types? Which ones?
How are they used to consuming data?
Do they already understand the data?



Understand the data source(s), structures, metrics, purposes, collection methods (if applicable)

UNDERSTAND THE DATA STORY

What is the data telling us?
What questions are we answering with the data?

It's beyond the scope of this talk to go deep on crafting a data story

Cole Nussbaumer Knaflic's book Storytelling with Data is a good resource

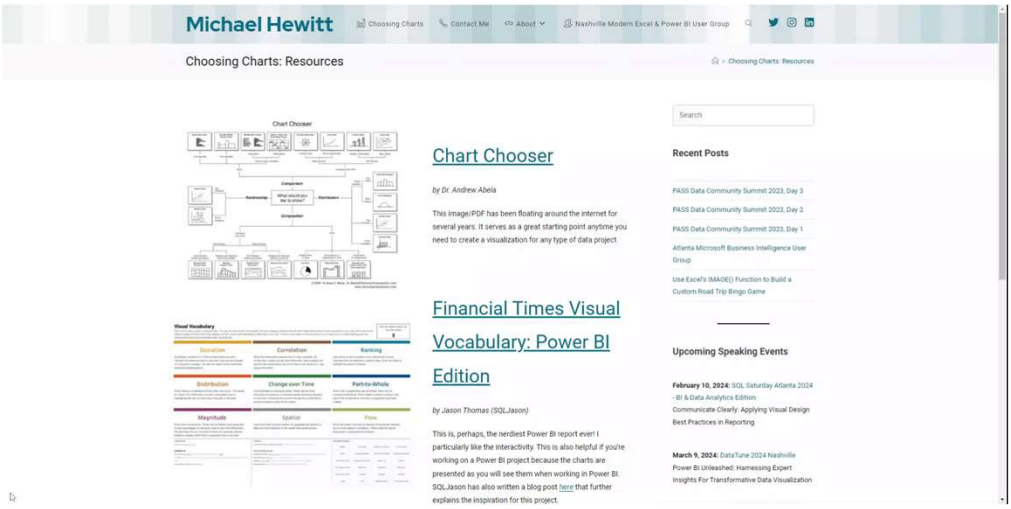
Interactive report or dashboard?
Printed handout?
Live presentation?
Emailed document?
Charts that are part of a larger, detailed report?
Single use or recurring?

Knowing the presentation format helps guide your decision on the correct tool(s) to visualize the data and subsequently any abilities or limitations of the tool

CHOOSE THE CORRECT CHART(S)

Choose based on audience understanding AND what best supports the data story

CHOOSE THE CORRECT CHARTS

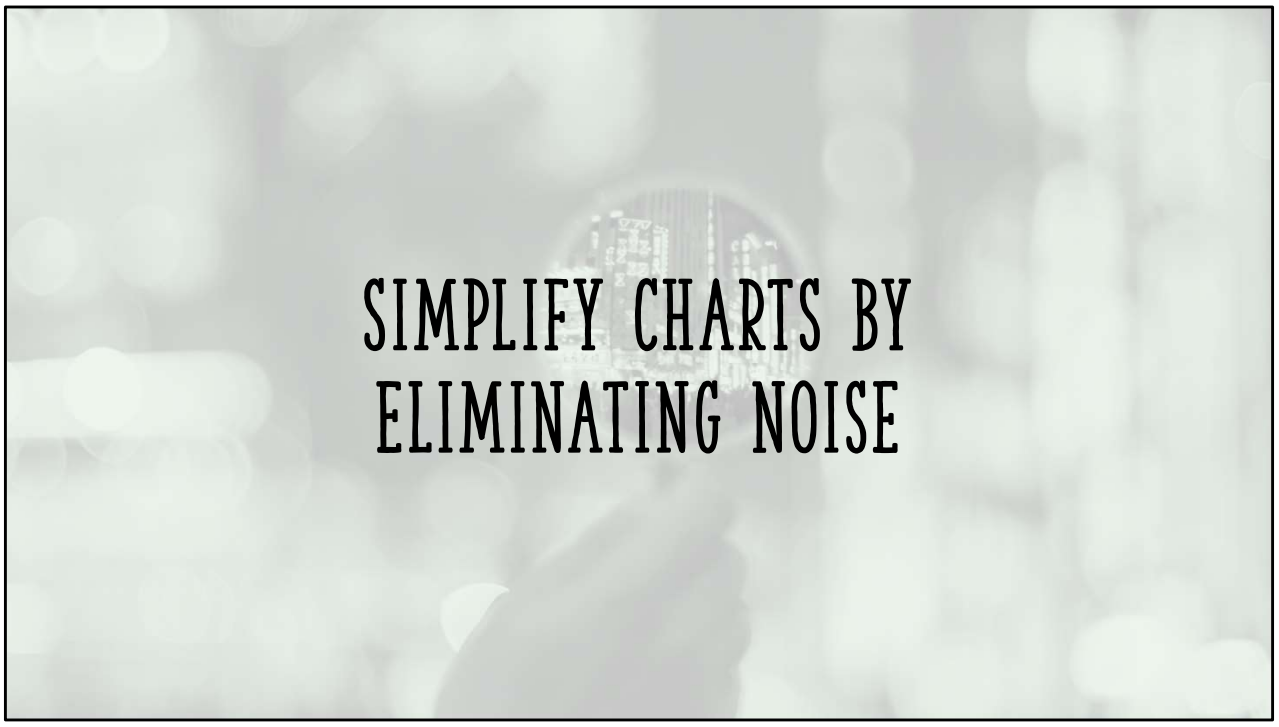


Tools like The Data Visualisation Catalouge are valuable
More tools available at www.michaelhewitt.net/choosingcharts/

EXAMPLES IN THIS TALK

- NYC Green Taxi dataset
- Green taxis “are restricted to picking up passengers in areas outside of Manhattan, such as Upper Manhattan, the Bronx, Brooklyn, Queens, and Staten Island”[1]

Dataset: https://learn.microsoft.com/en-us/azure/open-datasets/dataset-taxi-green?tabs=azureml-opendatasets
NYC Taxi Zones: https://data.cityofnewyork.us/Transportation/NYC-Taxi-Zones/d3c5-ddgc
(1) https://www.citysignal.com/whats-the-difference-between-green-cabs-yellow-cabs-other-taxis-in-nyc/


SIMPLIFY CHARTS BY
ELIMINATING NOISE

WHAT IS NOISE?

Anything in a visualization, report, or dashboard that does not help tell the data story

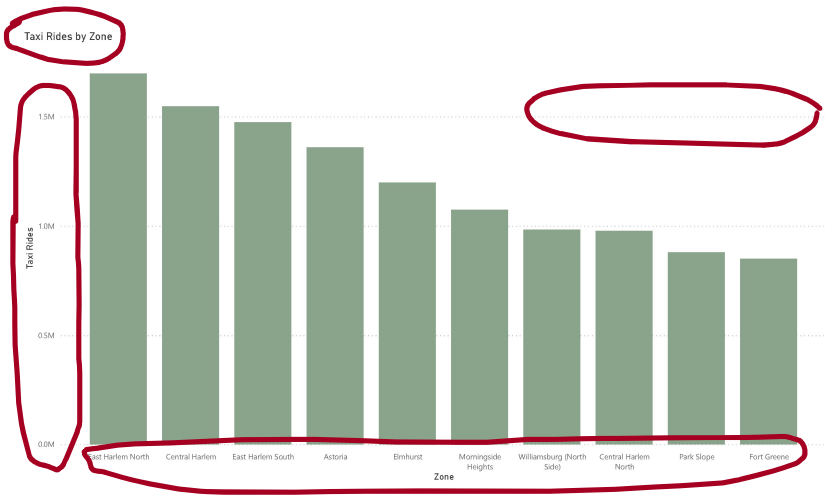
NOISE CAN BE…

- Ambiguous, unclear titles
- Gridlines
- Dividers
- Borders or boxes
- Lack of whitespace
- Overcrowded data labels
- Too many data points

Common examples

EXAMPLE 1

How many pickups were made in the top 10 green taxi zones?



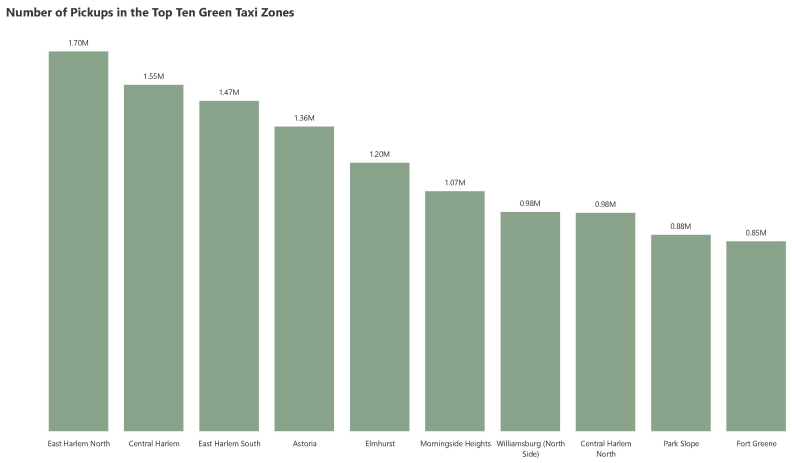
Column chart created in Power BI using all default options except for the color

Noise in this chart

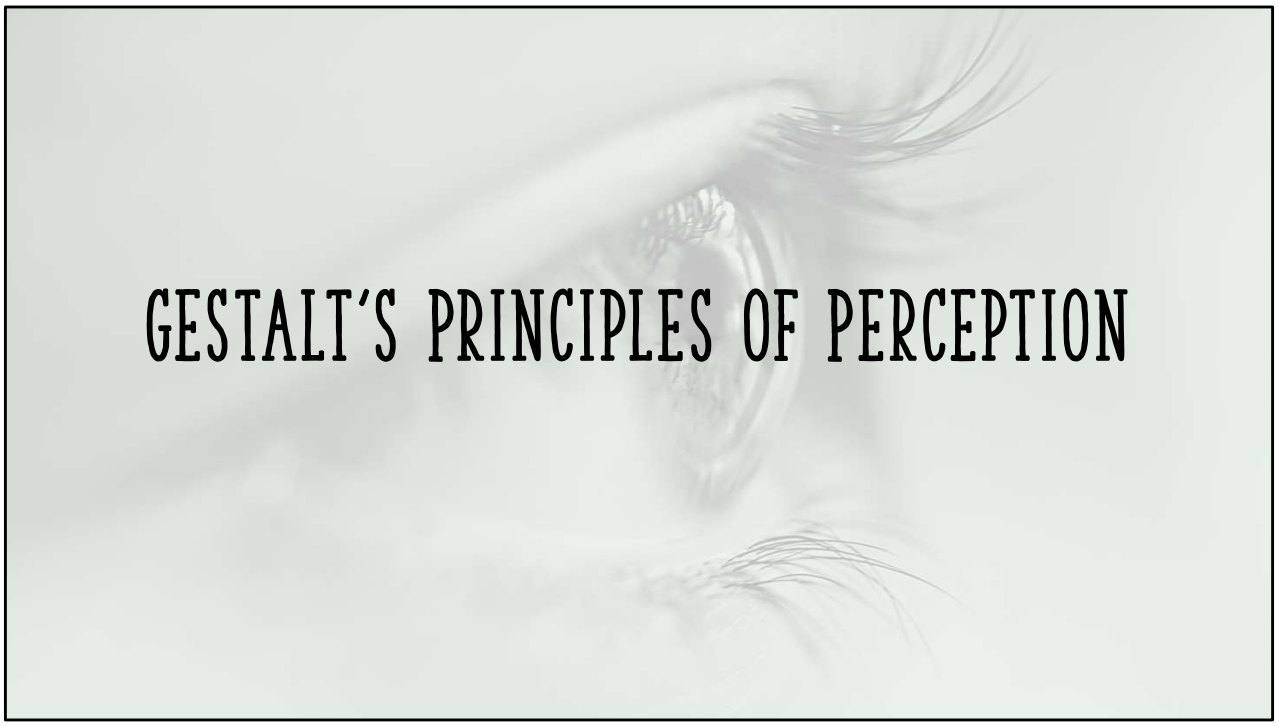
1. Title does not accurately describe what we want to show
2. If we want more accurate numbers, the Y-axis does not help us
3. Y-axis gridlines are hard to see by default. They also only help us get an idea of how many pickups occurred in each zone.
4. X-axis labels are tough to read. We can't eliminate them but we need to make them more clear

EXAMPLE 1

How many pickups were made in the top 10 green taxi zones?



1. Adding a more descriptive title gives more context to the chart and eliminates the need for the axis titles
2. Data labels on the bars give us more accurate pickup numbers
3. Data labels also made Y-axis gridlines unnecessary
4. Darker labels on X-axis labels are easier to read



https://lawsofux.com/
https://www.usertesting.com/resources/topics/gestalt-principles

WHAT IS GESTALT?

School of Psychology

and

Theory of Perception

Founded in early 20th century by German psychologists

Max Wertheimer

Kurt Koffka

Wolfgang Köhler

Shape

Form

Pattern

Configuration

The whole is greater than the sum of its parts

GESTALT PRINCIPLES - LAW OF...

- Emergence
- Closure
- Common Region
- Continuity or Continuation
- Proximity
- Multistability
- Connectedness
- Figure / Ground
- Invariance
- Prägnanz
- Similarity
- Symmetry and Order
- Common Fate

This list varies depending on the source

GESTALT PRINCIPLES - LAW OF...

Emergence
Closure
Common Region
Continuity or Continuation
Proximity
Multistability
Connectedness
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Prägnanz
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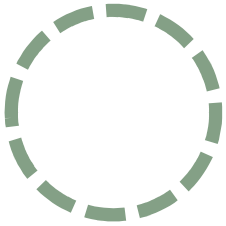
Symmetry and Order
Common Fate

Although all of these principles are useful, we will focus on the highlighted items

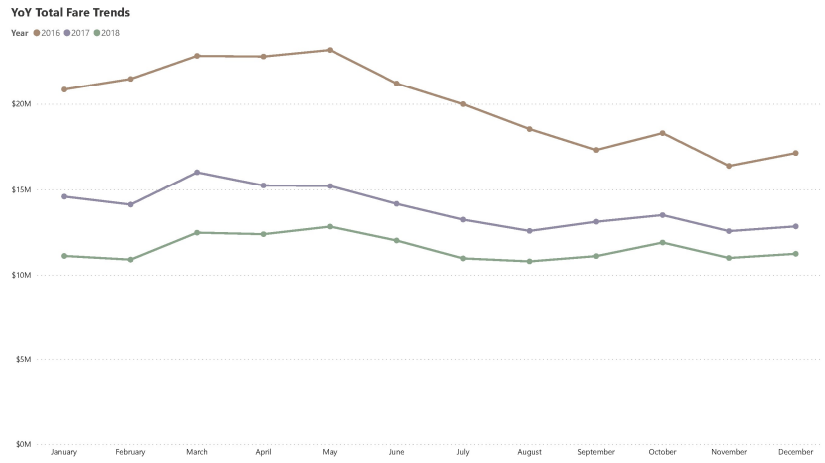
LAW OF CLOSURE

Objects that are incomplete are perceived as complete



EXAMPLE 2

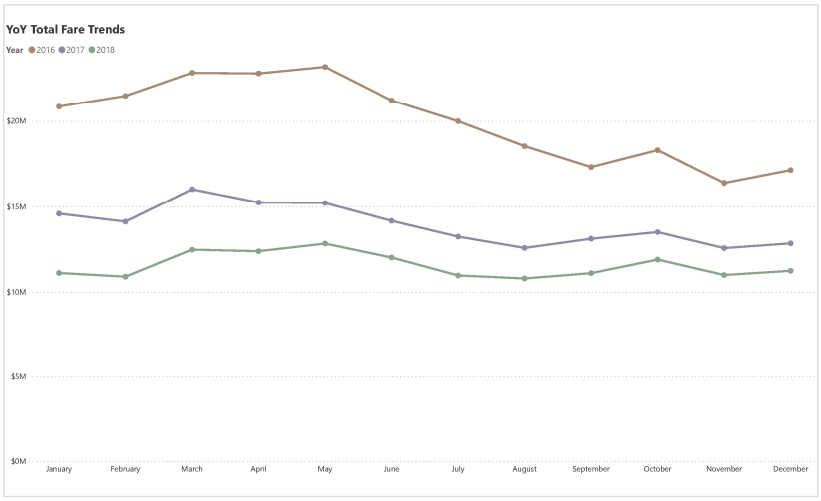
The Law of Closure in action



The X an Y axis give is the sense of a box enclosing this chart even though there's not physically one present

EXAMPLE 2

The Law of Closure in action

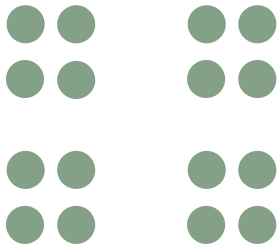


The X an Y axis give is the sense of a box enclosing this chart even though there's not physically one present

This law gives us permission to remove noisy borders from our charts!

LAW OF PROXIMITY

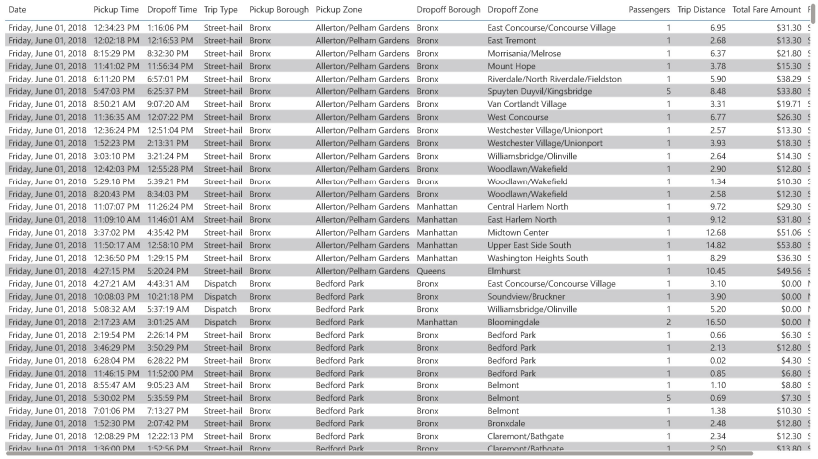
Objects that appear close together tend to be grouped together



We tend to see this a 4 groups with 4 dots in each group

EXAMPLE 3

The Law of Proximity in action



Date	Pickup Time	Dropoff Time	Trip Type	Pickup Borough	Pickup Zone	Dropoff Borough	Dropoff Zone	Passengers	Trip Distance	Total Fare Amount
Friday, June 01, 2018	12:34:23 PM	1:16:06 PM	Street-hail	Bronx	Allerton/Pelham Gardens	Bronx	East Concourse/Concourse Village	1	6.95	$31.30
Friday, June 01, 2018	12:02:18 PM	12:16:53 PM	Street-hail	Bronx	Allerton/Pelham Gardens	Bronx	East Tremont	1	2.68	$13.30
Friday, June 01, 2018	8:15:29 PM	8:32:30 PM	Street-hail	Bronx	Allerton/Pelham Gardens	Bronx	Morrisania/Melrose	1	6.37	$21.80
Friday, June 01, 2018	11:41:02 PM	11:56:34 PM	Street-hail	Bronx	Allerton/Pelham Gardens	Bronx	Mount Hope	1	3.78	$15.30
Friday, June 01, 2018	6:11:20 PM	6:57:01 PM	Street-hail	Bronx	Allerton/Pelham Gardens	Bronx	Riverdale/North Riverdale/Fieldston	1	5.90	$38.29
Friday, June 01, 2018	5:47:03 PM	6:25:37 PM	Street-hail	Bronx	Allerton/Pelham Gardens	Bronx	Spuyten Duyvil/Kingsbridge	5	8.48	$33.80
Friday, June 01, 2018	8:50:21 AM	9:07:20 AM	Street-hail	Bronx	Allerton/Pelham Gardens	Bronx	Van Cortlandt Village	1	3.31	$19.71
Friday, June 01, 2018	11:36:35 AM	12:07:22 PM	Street-hail	Bronx	Allerton/Pelham Gardens	Bronx	West Concourse	1	6.77	$26.30
Friday, June 01, 2018	12:36:24 PM	12:51:04 PM	Street-hail	Bronx	Allerton/Pelham Gardens	Bronx	Westchester Village/Unionport	1	2.57	$13.30
Friday, June 01, 2018	1:52:23 PM	2:13:31 PM	Street-hail	Bronx	Allerton/Pelham Gardens	Bronx	Westchester Village/Unionport	1	3.93	$18.30
Friday, June 01, 2018	3:03:10 PM	3:21:24 PM	Street-hail	Bronx	Allerton/Pelham Gardens	Bronx	Williamsbridge/Olinville	1	2.64	$14.30
Friday, June 01, 2018	12:42:03 PM	12:55:28 PM	Street-hail	Bronx	Allerton/Pelham Gardens	Bronx	Woodlawn/Wakefield	1	2.90	$12.80
Friday, June 01, 2018	5:29:10 PM	5:39:21 PM	Street-hail	Bronx	Allerton/Pelham Gardens	Bronx	Woodlawn/Wakefield	1	1.34	$10.30
Friday, June 01, 2018	8:20:43 PM	8:34:03 PM	Street-hail	Bronx	Allerton/Pelham Gardens	Bronx	Woodlawn/Wakefield	1	2.58	$12.30
Friday, June 01, 2018	11:07:07 PM	11:26:24 PM	Street-hail	Bronx	Allerton/Pelham Gardens	Manhattan	Central Harlem North	1	9.72	$29.30
Friday, June 01, 2018	11:09:10 AM	11:46:01 AM	Street-hail	Bronx	Allerton/Pelham Gardens	Manhattan	East Harlem North	1	9.12	$31.80
Friday, June 01, 2018	3:37:02 PM	4:35:42 PM	Street-hail	Bronx	Allerton/Pelham Gardens	Manhattan	Midtown Center	1	12.68	$51.06
Friday, June 01, 2018	11:50:17 AM	12:58:10 PM	Street-hail	Bronx	Allerton/Pelham Gardens	Manhattan	Upper East Side South	1	14.82	$53.80
Friday, June 01, 2018	12:36:50 PM	1:29:15 PM	Street-hail	Bronx	Allerton/Pelham Gardens	Manhattan	Washington Heights South	1	8.29	$36.30
Friday, June 01, 2018	4:27:15 PM	5:20:24 PM	Street-hail	Bronx	Allerton/Pelham Gardens	Queens	Elmhurst	1	10.45	$49.56
Friday, June 01, 2018	4:27:21 AM	4:43:31 AM	Dispatch	Bronx	Bedford Park	Bronx	East Concourse/Concourse Village	1	3.10	$0.00
Friday, June 01, 2018	10:08:03 PM	10:21:18 PM	Dispatch	Bronx	Bedford Park	Bronx	Soundview/Bruckner	1	3.90	$0.00
Friday, June 01, 2018	5:08:32 AM	5:37:19 AM	Dispatch	Bronx	Bedford Park	Bronx	Williamsbridge/Olinville	1	5.20	$0.00
Friday, June 01, 2018	2:17:23 AM	3:01:25 AM	Dispatch	Bronx	Bedford Park	Manhattan	Bloomingdale	2	16.50	$0.00
Friday, June 01, 2018	2:19:54 PM	2:26:14 PM	Street-hail	Bronx	Bedford Park	Bronx	Bedford Park	1	0.66	$6.30
Friday, June 01, 2018	3:46:29 PM	3:50:29 PM	Street-hail	Bronx	Bedford Park	Bronx	Bedford Park	1	2.13	$12.80
Friday, June 01, 2018	6:28:04 PM	6:28:22 PM	Street-hail	Bronx	Bedford Park	Bronx	Bedford Park	1	0.02	$4.30
Friday, June 01, 2018	11:46:15 PM	11:52:00 PM	Street-hail	Bronx	Bedford Park	Bronx	Bedford Park	1	0.85	$6.80
Friday, June 01, 2018	8:55:47 AM	9:05:23 AM	Street-hail	Bronx	Bedford Park	Bronx	Belmont	1	1.10	$8.80
Friday, June 01, 2018	5:30:02 PM	5:35:59 PM	Street-hail	Bronx	Bedford Park	Bronx	Belmont	5	0.69	$7.30
Friday, June 01, 2018	7:01:06 PM	7:13:27 PM	Street-hail	Bronx	Bedford Park	Bronx	Belmont	1	1.38	$10.30
Friday, June 01, 2018	1:52:30 PM	2:07:42 PM	Street-hail	Bronx	Bedford Park	Bronx	Bronxdale	1	2.48	$12.80
Friday, June 01, 2018	12:08:29 PM	12:22:13 PM	Street-hail	Bronx	Bedford Park	Bronx	Claremont/Bathgate	1	2.34	$12.30
Friday, June 01, 2018	1:36:00 PM	1:52:56 PM	Street-hail	Bronx	Bedford Park	Bronx	Claremont/Bathgate	1	2.50	$13.80

Before: tables are often formatted with alternating row colors to help consumers read data across each row. This technique can be effective but…

EXAMPLE 3

The Law of Proximity at use in Table visuals

Date	Pickup Time	Dropoff Time	Trip Type	Pickup Borough	Pickup Zone	Dropoff Borough	Dropoff Zone	Passengers	Trip Distance	Total Fare A
Friday, June 01, 2018	12:34:23 PM	1:16:06 PM	Street-hail	Bronx	Allerton/Pelham Gardens	Bronx	East Concourse/Concourse Village	1	6.95	
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Friday, June 01, 2018	5:47:03 PM	6:25:37 PM	Street-hail	Bronx	Allerton/Pelham Gardens	Bronx	Spuyten Duyvil/Kingsbridge	5	8.48	
Friday, June 01, 2018	8:50:21 AM	9:07:20 AM	Street-hail	Bronx	Allerton/Pelham Gardens	Bronx	Van Cortlandt Village	1	3.31	
Friday, June 01, 2018	11:36:35 AM	12:07:22 PM	Street-hail	Bronx	Allerton/Pelham Gardens	Bronx	West Concourse	1	6.77	
Friday, June 01, 2018	12:36:24 PM	12:51:04 PM	Street-hail	Bronx	Allerton/Pelham Gardens	Bronx	Westchester Village/Unionport	1	2.57	
Friday, June 01, 2018	1:52:23 PM	2:13:31 PM	Street-hail	Bronx	Allerton/Pelham Gardens	Bronx	Westchester Village/Unionport	1	3.93	
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Friday, June 01, 2018	5:29:18 PM	5:39:21 PM	Street-hail	Bronx	Allerton/Pelham Gardens	Bronx	Woodlawn/Wakefield	1	1.34	
Friday, June 01, 2018	8:20:43 PM	8:34:03 PM	Street-hail	Bronx	Allerton/Pelham Gardens	Bronx	Woodlawn/Wakefield	1	2.58	
Friday, June 01, 2018	11:07:07 PM	11:26:24 PM	Street-hail	Bronx	Allerton/Pelham Gardens	Manhattan	Central Harlem North	1	9.72	
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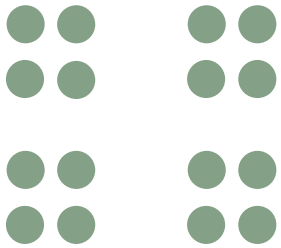
Friday, June 01, 2018	3:37:02 PM	4:35:42 PM	Street-hail	Bronx	Allerton/Pelham Gardens	Manhattan	Midtown Center	1	12.68	
Friday, June 01, 2018	11:50:17 AM	12:58:10 PM	Street-hail	Bronx	Allerton/Pelham Gardens	Manhattan	Upper East Side South	1	14.82	
Friday, June 01, 2018	12:36:50 PM	1:29:15 PM	Street-hail	Bronx	Allerton/Pelham Gardens	Manhattan	Washington Heights South	1	8.29	

After: we can apply the law of proximity using whitespace to naturally group columns and rows together.

Note: this example is exaggerated for real life purposes and this approach may not work in all situations

LAW OF COMMON REGION

Objects enclosed in the same region are perceived as a group



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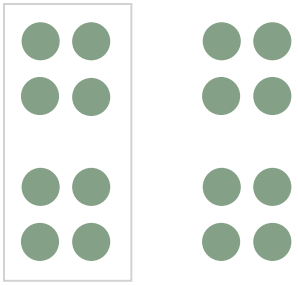

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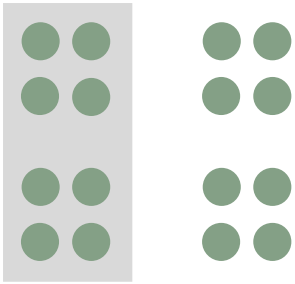
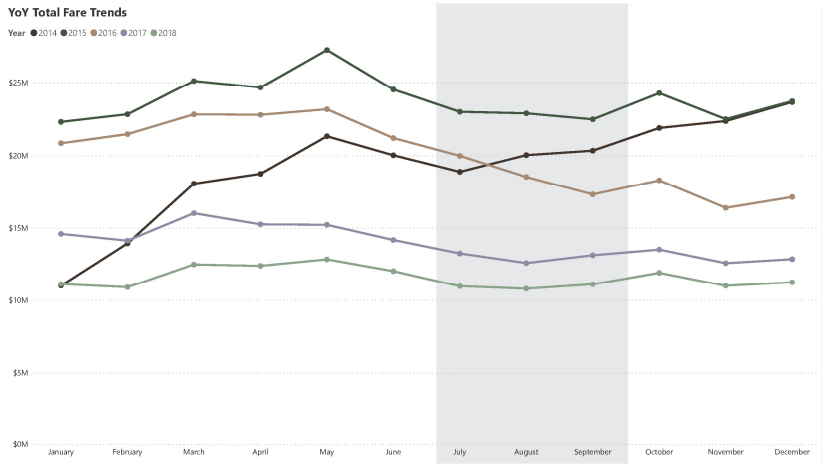


EXAMPLE 3

The Law of Common Region in action

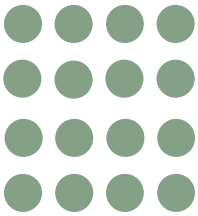


Can be used to group different parts of a chart together, like this example highlighting Q3 data

This law is also very useful when designing report pages, we'll look at an example of that in a moment

LAW OF SIMILARITY

Objects that appear similar in color, shape, size, or orientation tend to be grouped together, even if the objects are separated



These 16 dots all appear to be 1 group

LAW OF SIMILARITY

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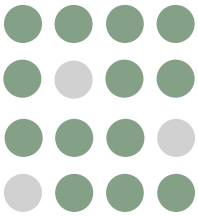

Now we see 2 groups

LAW OF SIMILARITY

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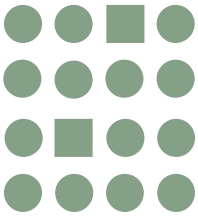
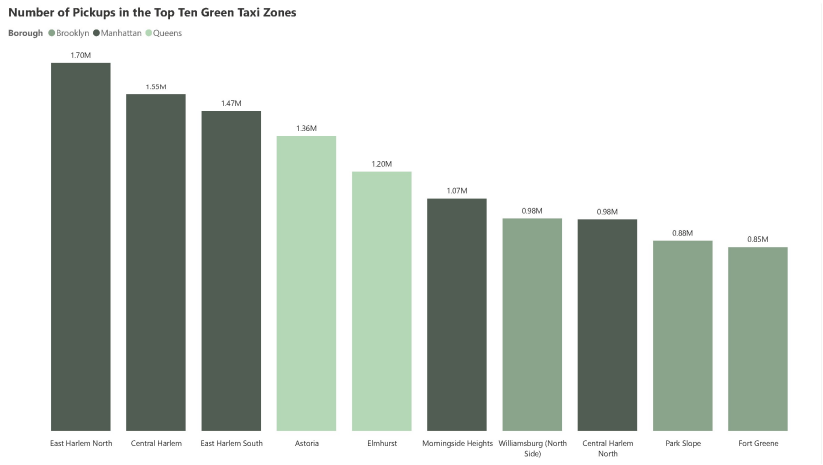


Again, 2 groups

EXAMPLE 4

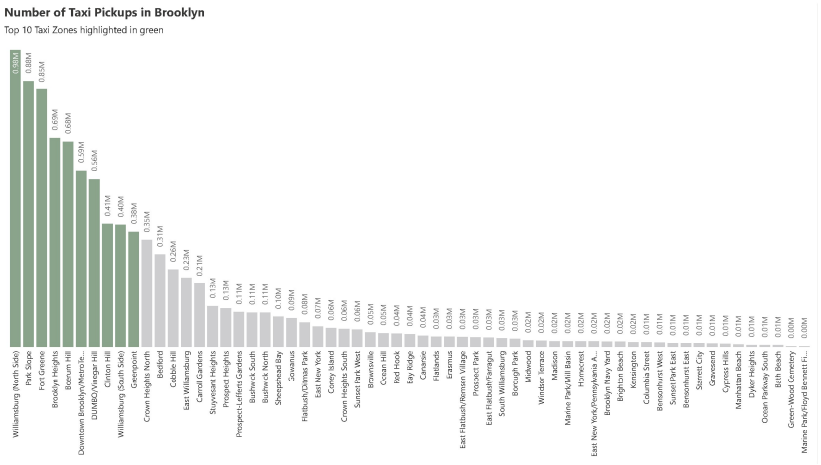
The Law of Similarity in action



Use similarity to group data points together

EXAMPLE 5

The Law of Similarity in action



Use the law of similarity to draw attention to specific data points

LAW OF CONNECTEDNESS

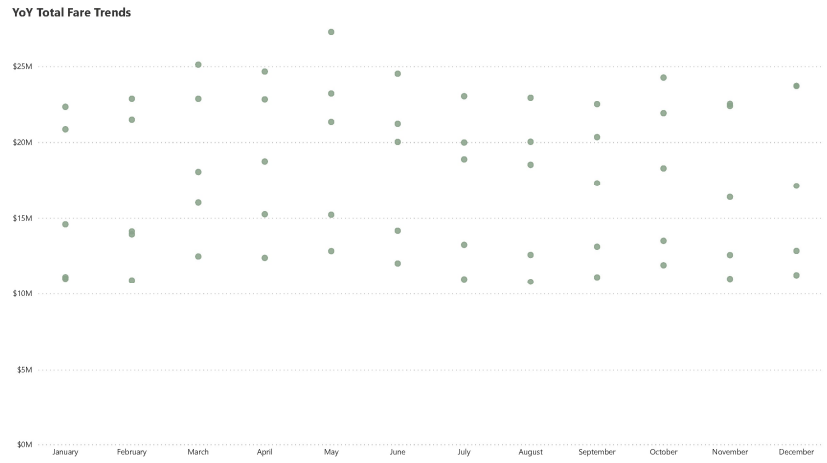
Objects that connected physically connected are part of a group

LAW OF CONNECTEDNESS

Objects that connected physically connected are part of a group

EXAMPLE 6

The Law of Connectedness in action

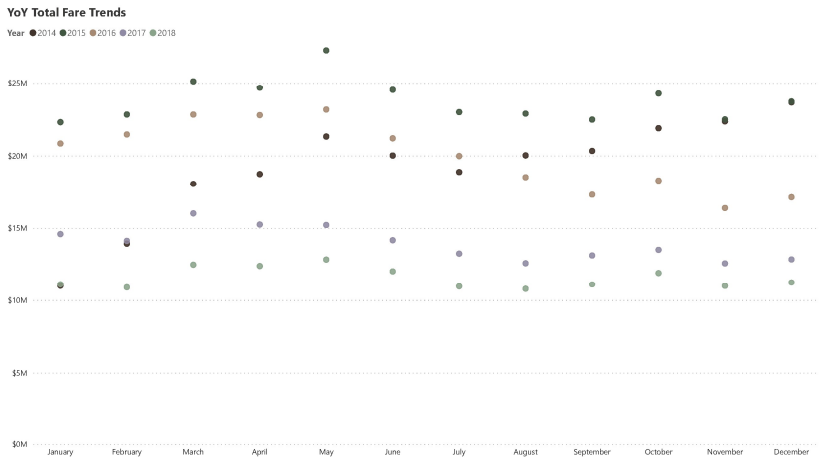


This is the same chart as before, but with more data

We can get a sense of what the connections could be, but some of the paths are ambiguous

EXAMPLE 6

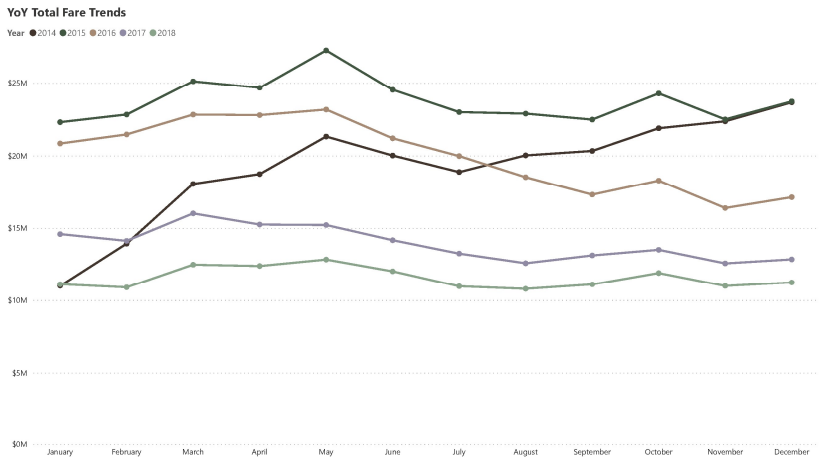
The Law of Connectedness in action



Adding color helps because of the law of similarity but the chart is still tough to read.

EXAMPLE 6

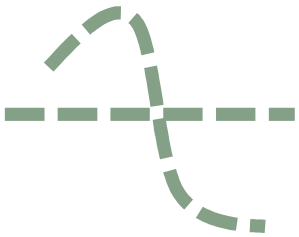
The Law of Connectedness in action



Adding the lines is powerful! Feel how much easier it is for your brain to process this chart compared to the previous chart!

LAW OF CONTINUITY OR CONTINUATION

Objects that appear on a simple, continuous path appear to follow the path in that direction



If we see a straight line and a curve, we tend to see the curve as a continuous line and the straight line as a separate line

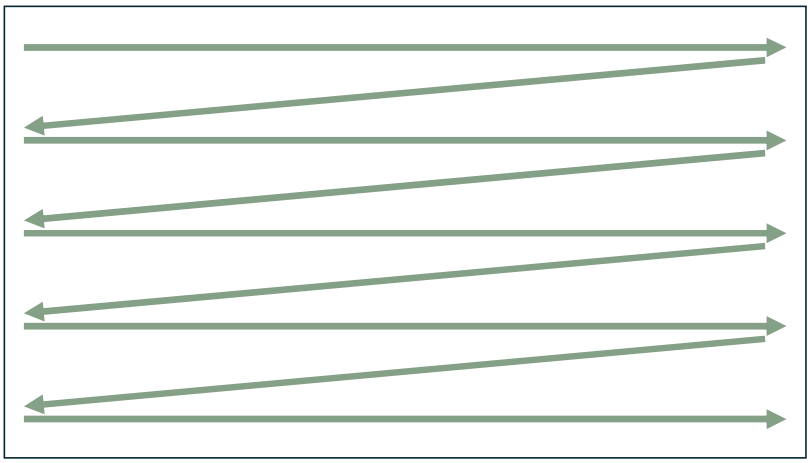
This law is also applied well when designing report pages, good examples of this are in that section

REPORT PAGE LAYOUTS

TOP TO BOTTOM, LEFT TO RIGHT

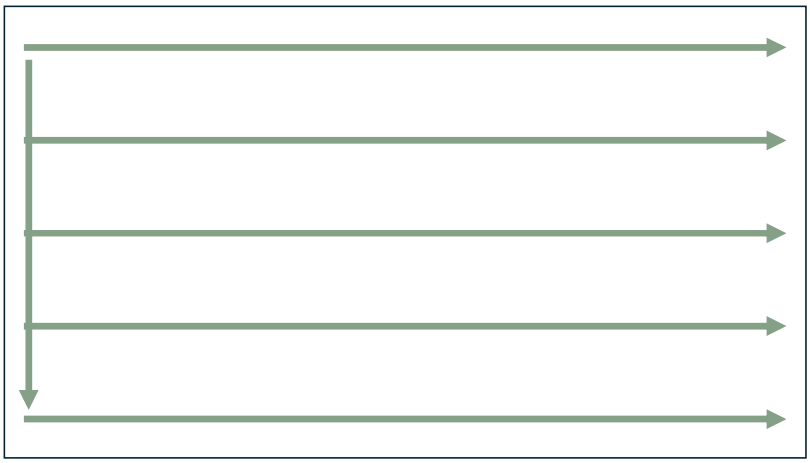
Lean in to the natural way that we read (at least in Western culture!)

TOP TO BOTTOM, LEFT TO RIGHT



Use a Z format

TOP TO BOTTOM, LEFT TO RIGHT



Or an E or F format

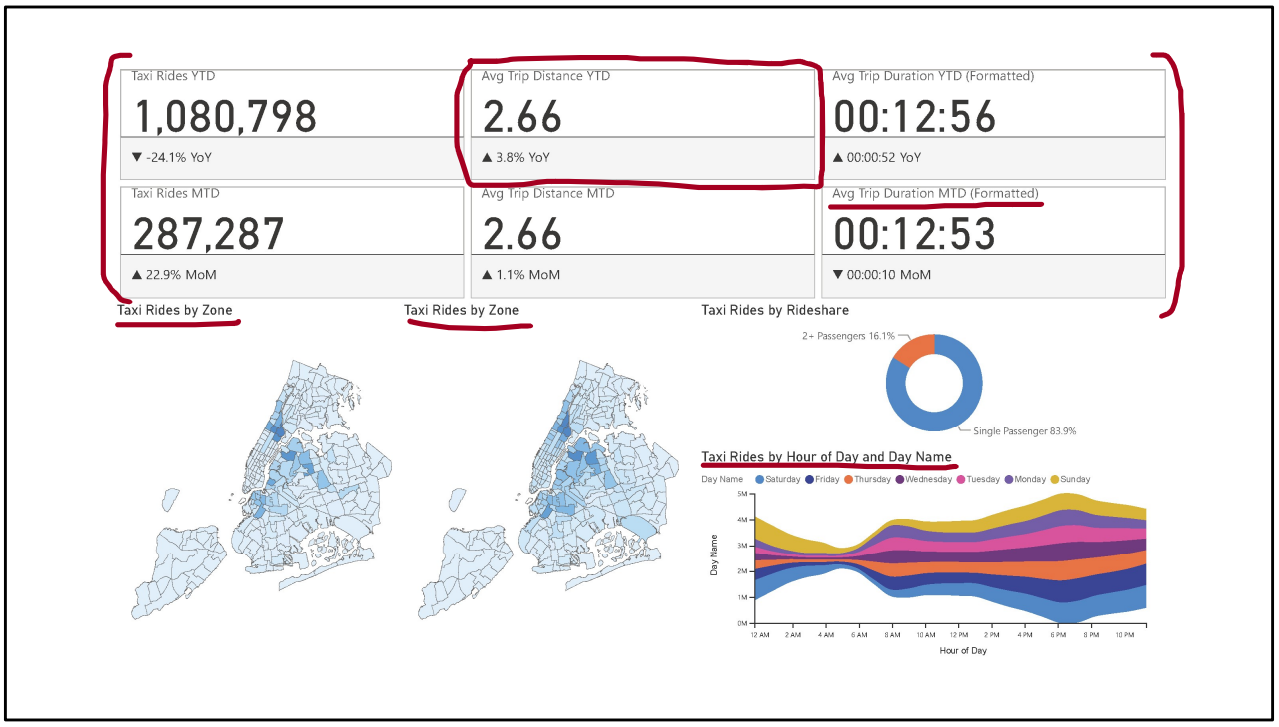
TOP TO BOTTOM, LEFT TO RIGHT

Most and Least are relative terms, supported by the requirements and data story

NYC GREEN TAXI OPERATIONS DASHBOARD

- Customers are opting for Uber or Lyft instead of taking a taxi
- Operational changes will be implemented to make getting a taxi more convenient for customers
- Monitor key metrics versus previous month and previous year
  - Taxi ride counts
  - Average trip distance
  - Average trip duration
- See popular pickup and drop off zones. Where are more taxis needed?
- When are people using taxis most often?
- Are people using taxis to ride alone or with others?
- Users need the ability to interact with visuals as filters – best presentation format is dashboarding tool, i.e. Power BI, Tableau, Looker
- Chart types have already been chosen

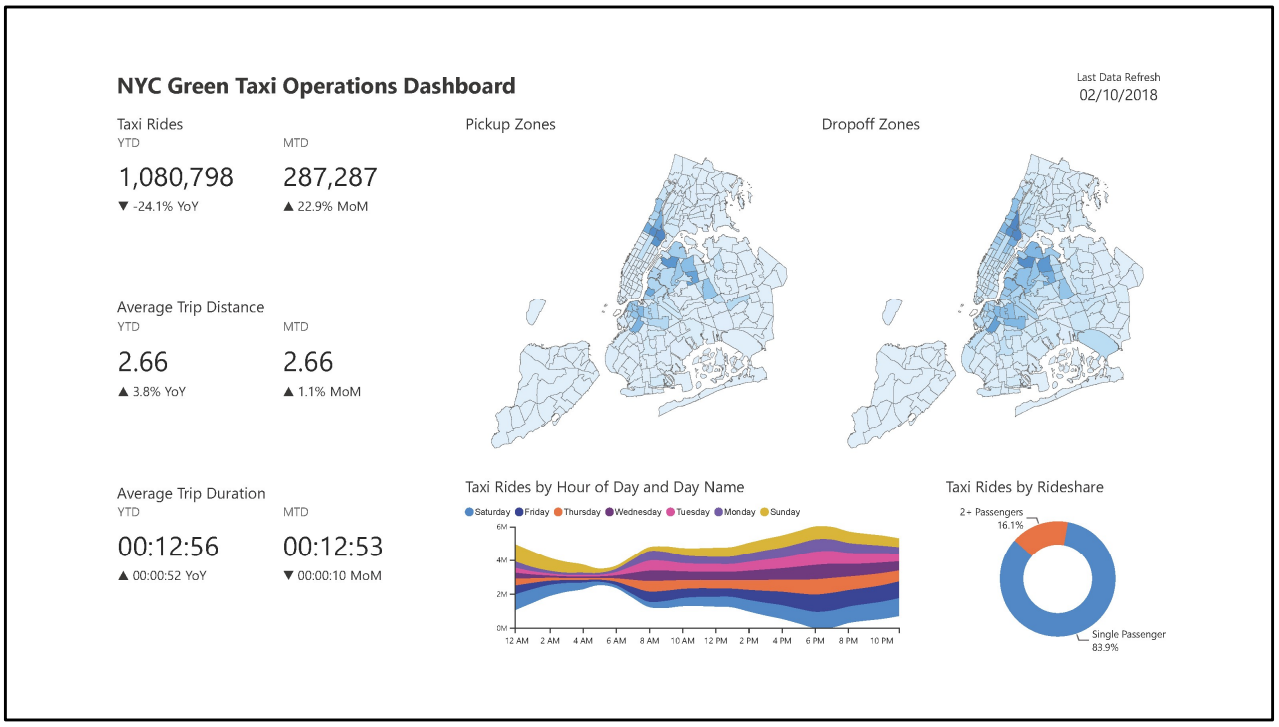
These requirements define our data story and help us to know what is most important to the report consumer



Example 7: Left a lot of the default Power BI settings, titles, etc.

This dashboard feels cluttered and unbalanced
Overall, the starting layout is not horrible.

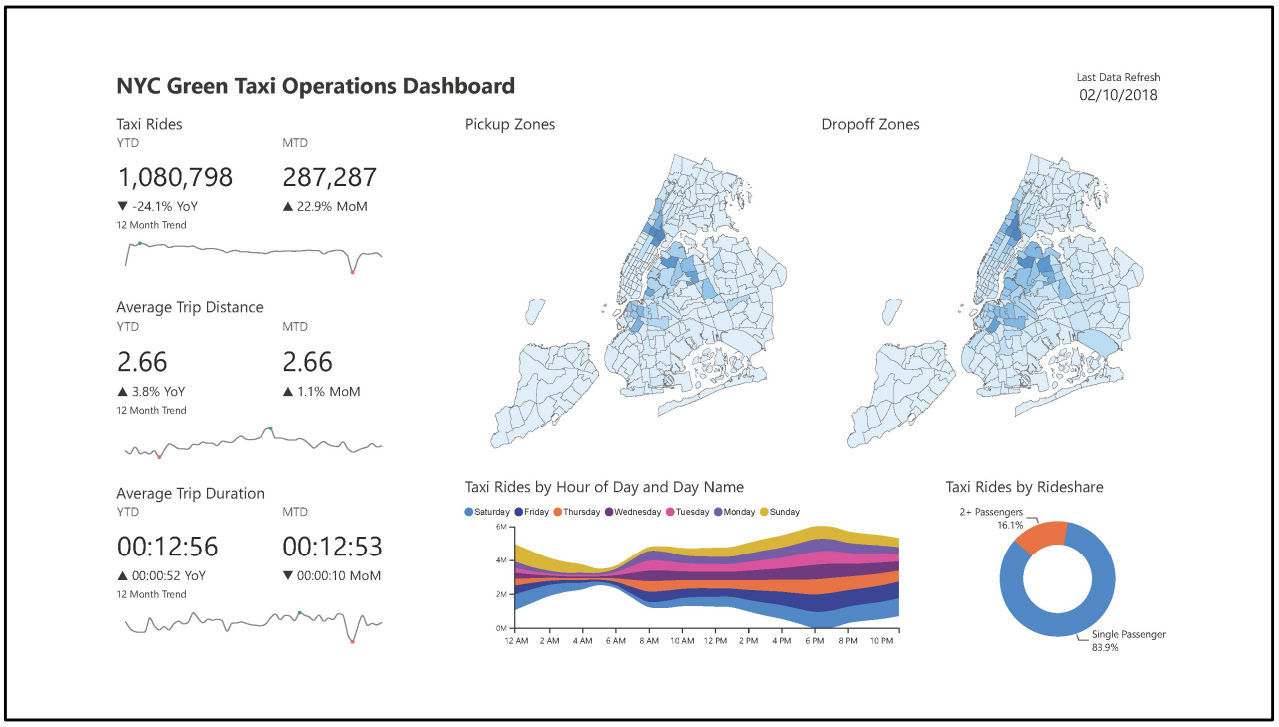
1. The page lacks overall context, a page title will help
2. The KPIs are positioned ok as the most important data points but dominate the overall page real estate
3. Because the KPIs are so large, the supporting visuals don't get the space they need to be most effective.
4. The boxes in the KPIs add noise, whitespace will help separate the numbers enough
5. Chart titles can be clarified to help tell the story



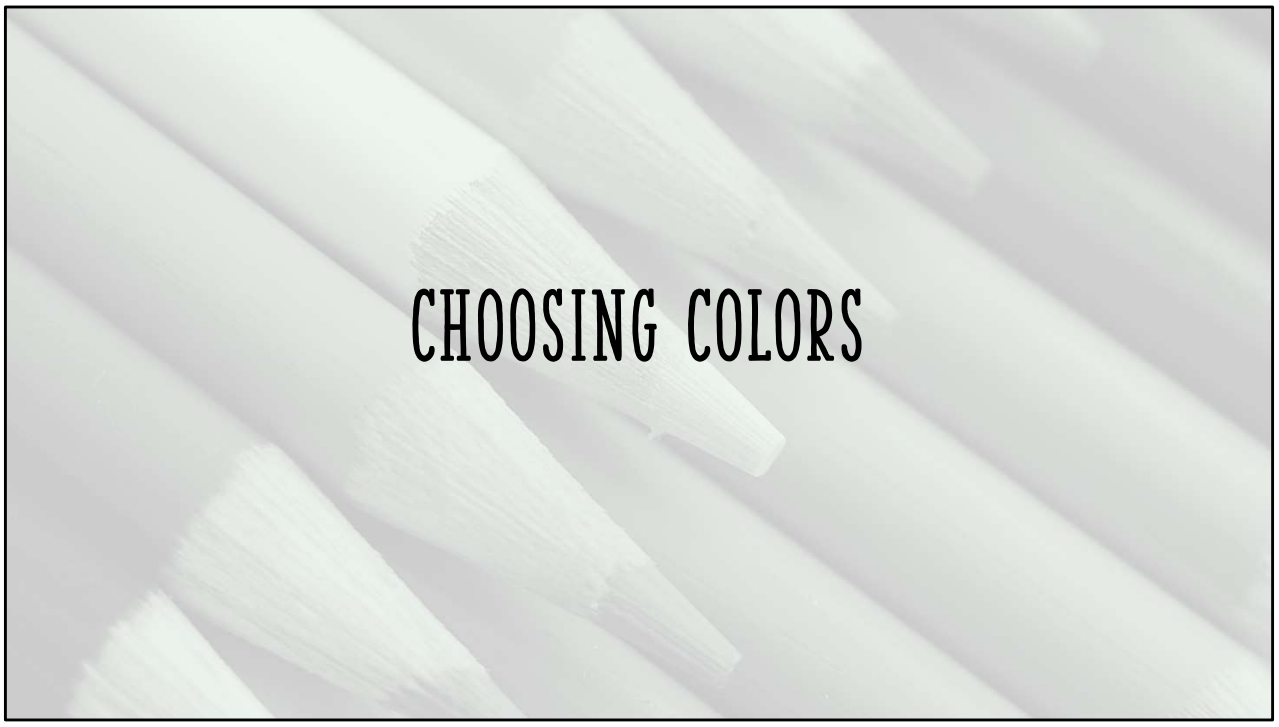
Example 7: Left a lot of the default Power BI settings, titles, etc.

This dashboard feels cluttered and unbalanced
Overall, the starting layout is not horrible.

1. Even though the context is not highly specific here, the page title does help – this becomes more helpful as the report grows to include more detailed analysis with new report pages and drillthroughs.
2. Using the “E” layout – moving the KPIs to the left makes room to enlarge the maps
3. KPIs are much cleaner to read now
4. Chart titles add more context to each individual visual



Adjusting the page layout even gives us enough room to add sparklines for additional data around KPI trends



Choosing color for data visualization can be one of the toughest but most fun parts of report design

COLOR INSPIRATION

- Corporate Branding
- Nature
- Paintings
- Wallpaper samples
- Physical Design
- Web Design
- Anywhere we see color around us!

Inspiration can come from anywhere!
I don't condone ripping off another designer's palette, but it can serve as a starting point

COLOR CONSIDERATIONS

- Start designing in grayscale
- Add color intentionally
- Don’t use more color than necessary
- Use shades of a single color rather than multiple colors
- Pay attention to your senses when looking at a palette
- There are many beautiful color palettes, but not all suit data visualization
- Develop your style!

REMEMBER, for most of us, data visualization is primarily about communicating information not creating data art. These three considerations help focus us.

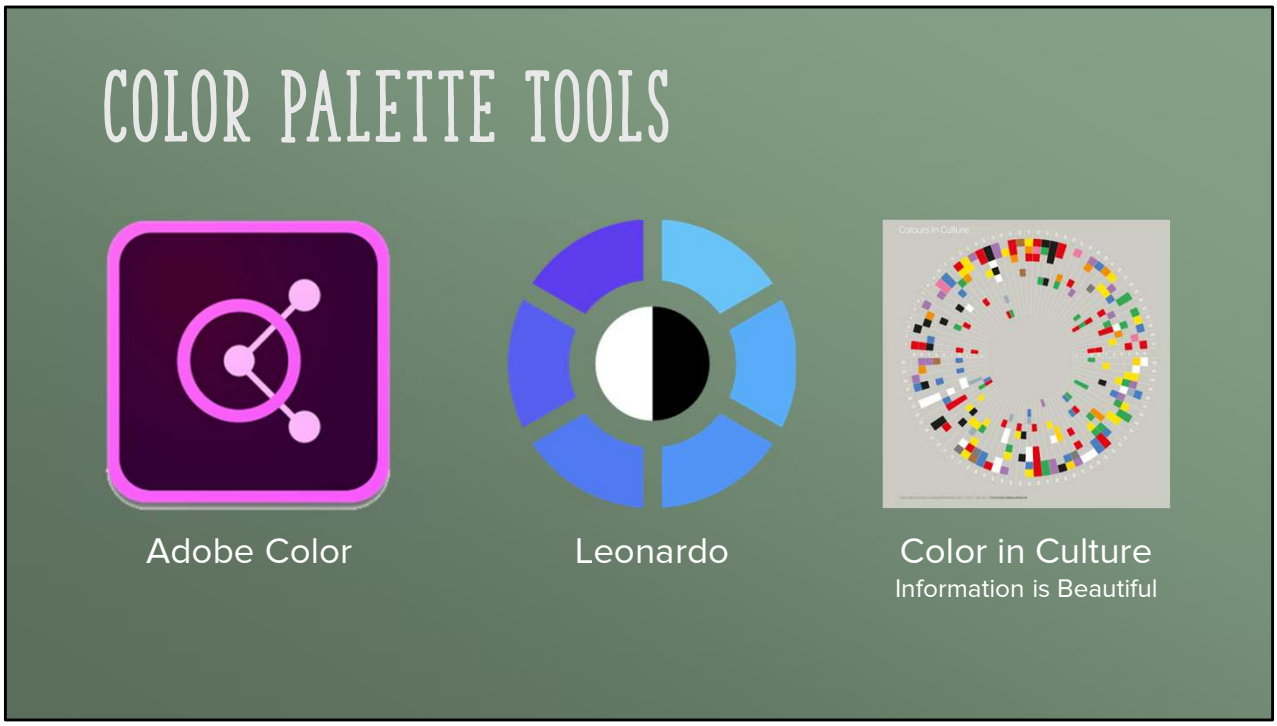
Starting in black and white helps make sure that the data is clear no matter how it ends up being consumed. If you can communicate the story well in grayscale, color will enhance the story.

1 color + gray can have a big impact, so don’t use lots of colors where one will do.

Does the palette make you feel a certain way? Is it uncomfortable to look at? If I present this palette, will people find it helpful or will it drive people away from the report?

There’s a lot of science and theory behind color, but don’t get bogged down by it! Have fun, use your creativity!

Lisa Charlotte Muth article: https://blog.datawrapper.de/beautifulcolors/

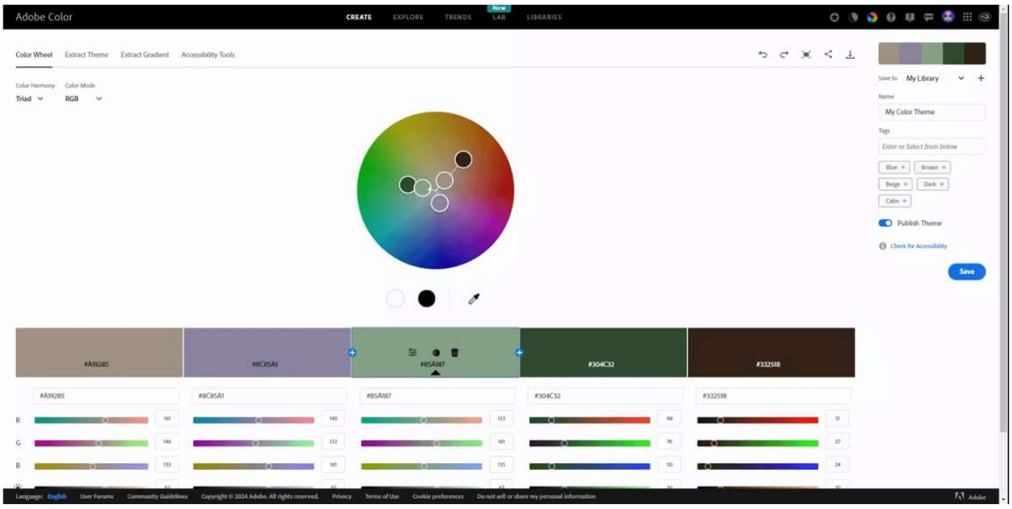


Adobe Color: https://color.adobe.com/
Good for creating a basic palette, has ability to extract color from photos

Leonardo: https://leonardocolor.io/theme#
Great tool for evaluating color scales, contrast, and building adaptive color themes

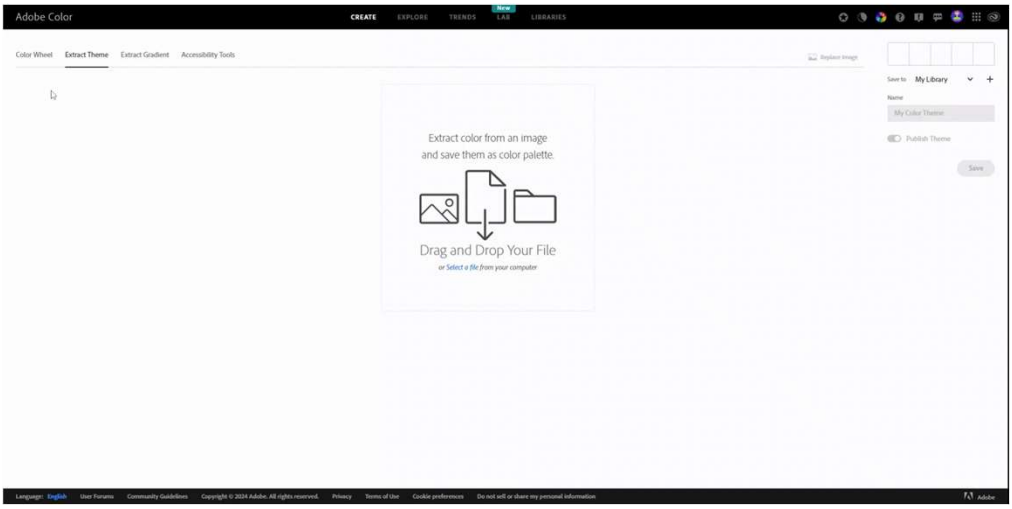
Color in Culture: https://informationisbeautiful.net/visualizations/colours-in-cultures/
Explore psychological meanings behind colors in different cultures

ADOBE COLOR

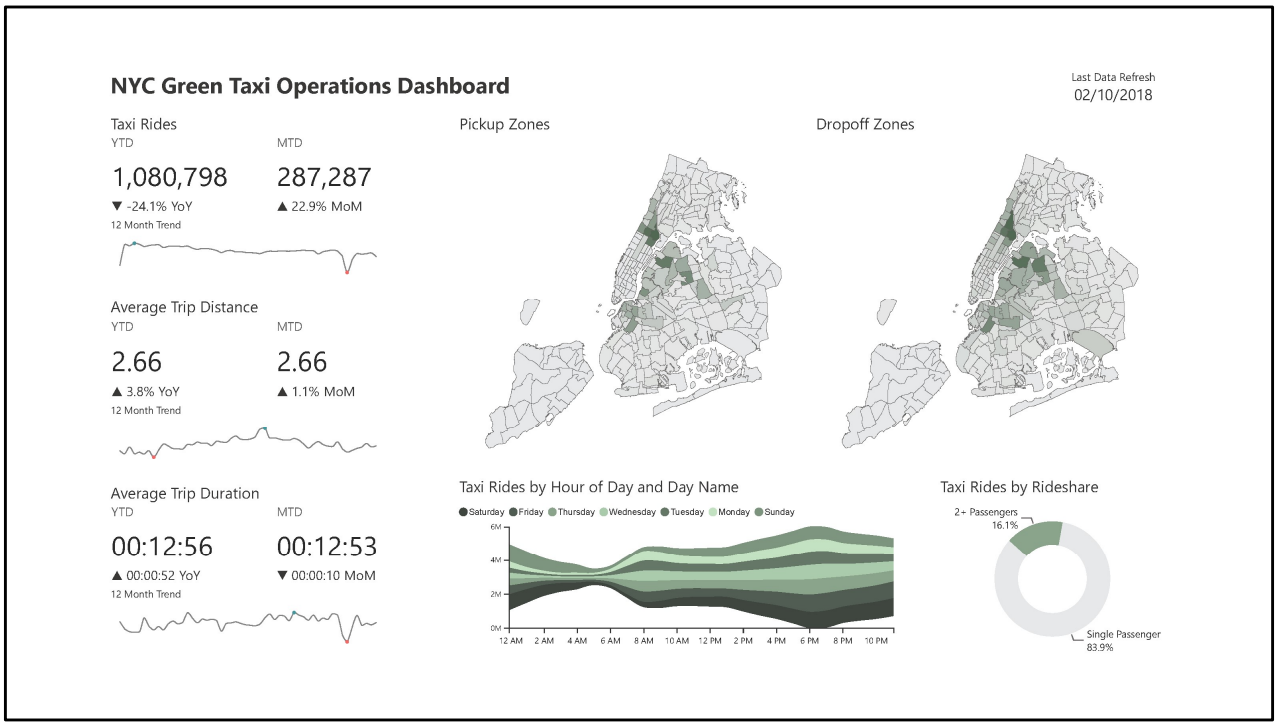


Demo of working with the color wheel

ADOBE COLOR



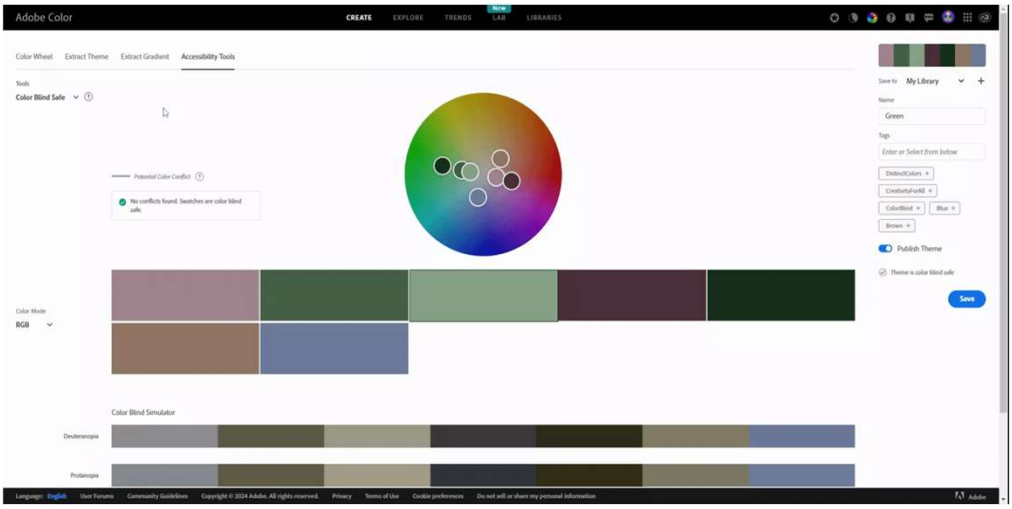
Demo of extracting color from an image file



Added green color palette
Sparser use of color draws attention to the data
More pleasant to look at and less cognitive work to discern all different colors

It’s estimated that almost 9% of the population is colorblind. And we don’t always know who is!

ADOBE COLOR ACCESSIBILITY TOOLS



As you create palettes in Adobe Color, you can use the accessibility tools to make sure that your palette is accessible with the 3 common types of colorblindness

You can also check the contrast ratios of colors from the palette to ensure that color combinations that you intend to use conform to Web Content Accessibility Guidelines

Leonardo helps you build out palettes further if WCAG is of particular concern

COBLIS - COLOR BLINDNESS SIMULATOR

As you create palettes in Adobe Color, you can use the accessibility tools to make sure that your palette is accessible with the 3 common types of colorblindness

You can also check the contrast ratios of colors from the palette to ensure that color combinations that you intend to use conform to Web Content Accessibility Guidelines

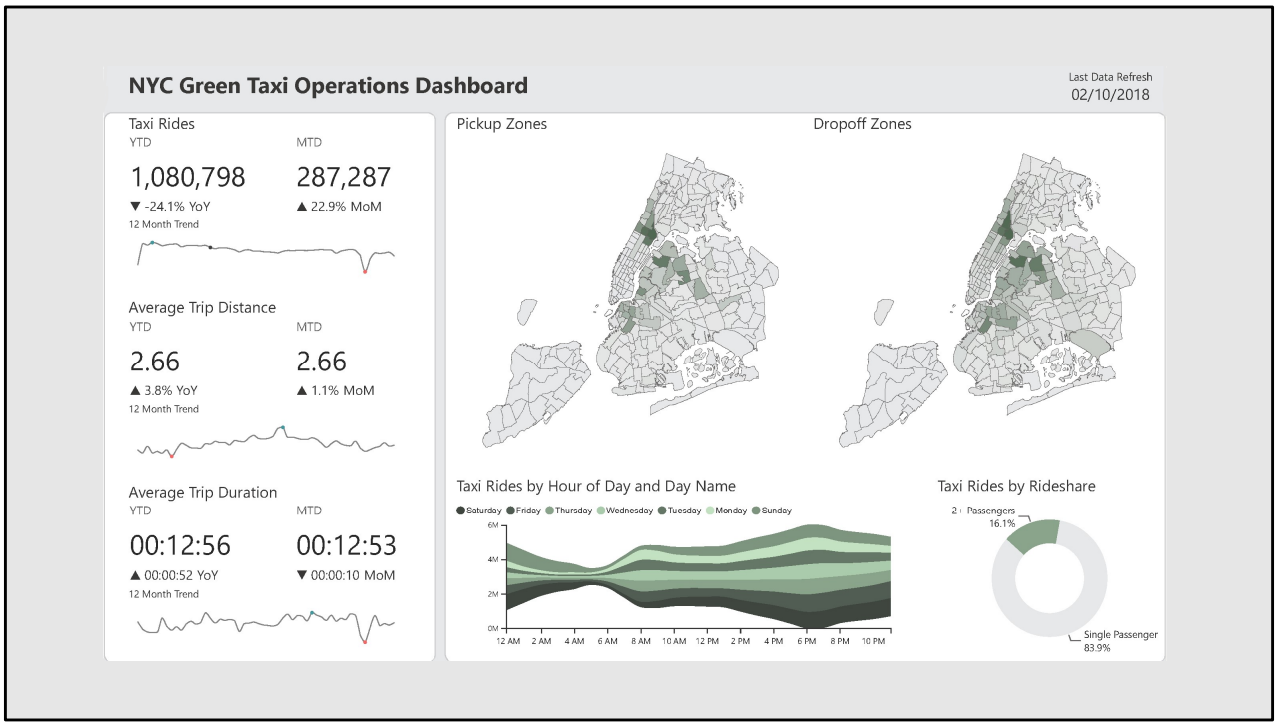
Leonardo helps you build out palettes further if WCAG is of particular concern

DESIGNING FOR VISUAL IMPAIRMENTS

- Be aware of fonts and font sizes
- Use icons
- Add Alt Text entries

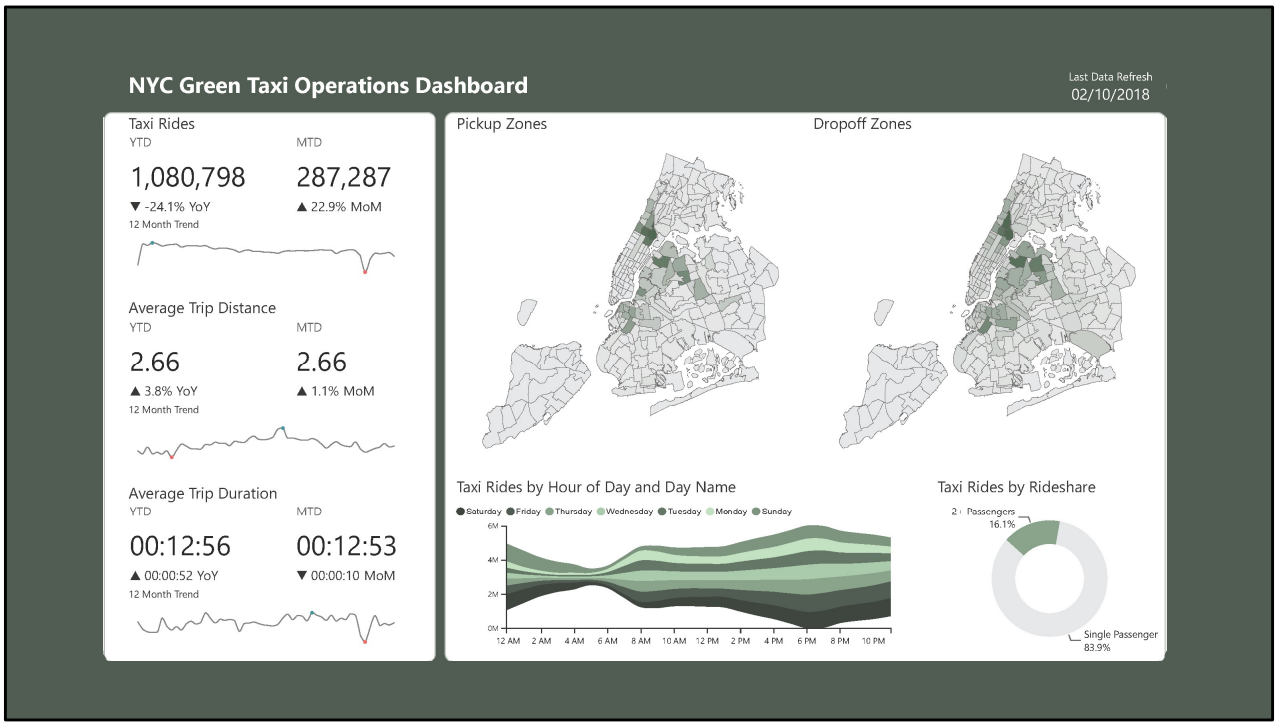
Many icons are universally understood and can be viewed by anyone

Although we're in a good spot with the operations dashboard, let's bring all the principles together to give our report a final polish



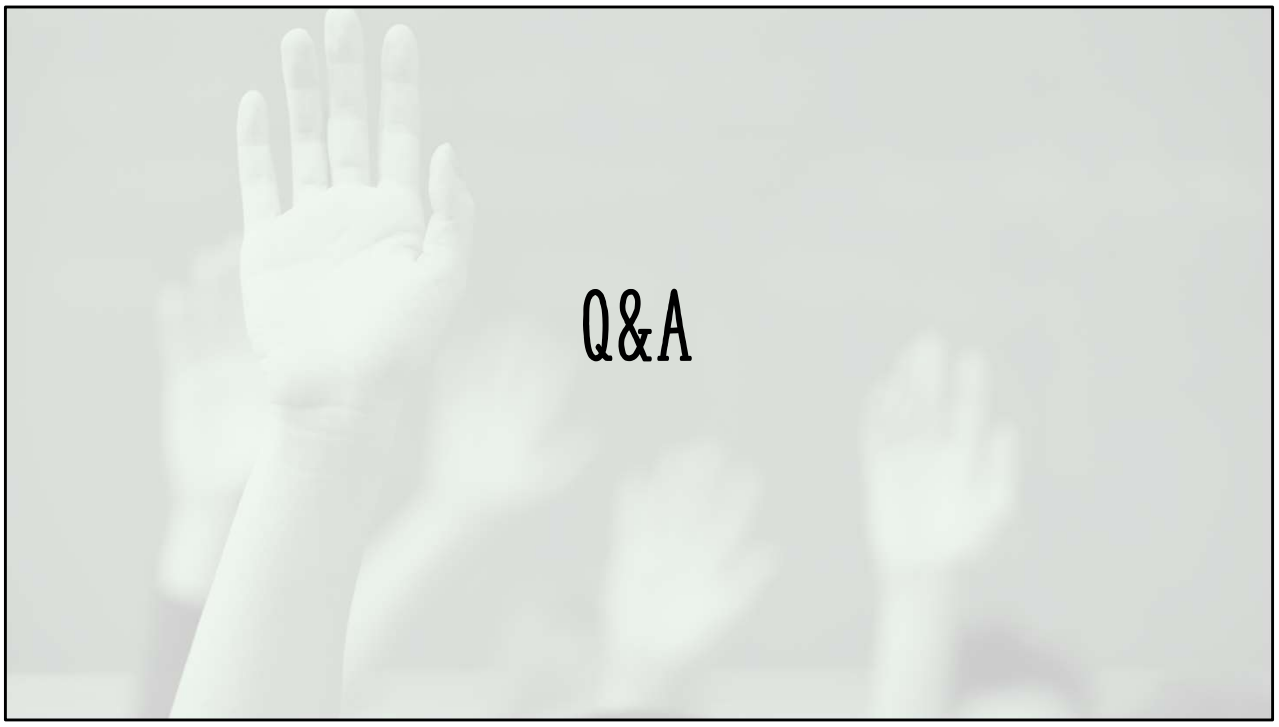
Incorporate the Law of Common Region to signify different zones in the report

Gray background makes the data jump out more and gives the report more depth



Incorporate the Law of Common Region to signify different zones in the report

Dark green background also makes the data jump out more and gives the report more depth, but is heavier feeling than the lighter gray


Q&A

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