Santa Monica Data Academy

DA101

Data Basics

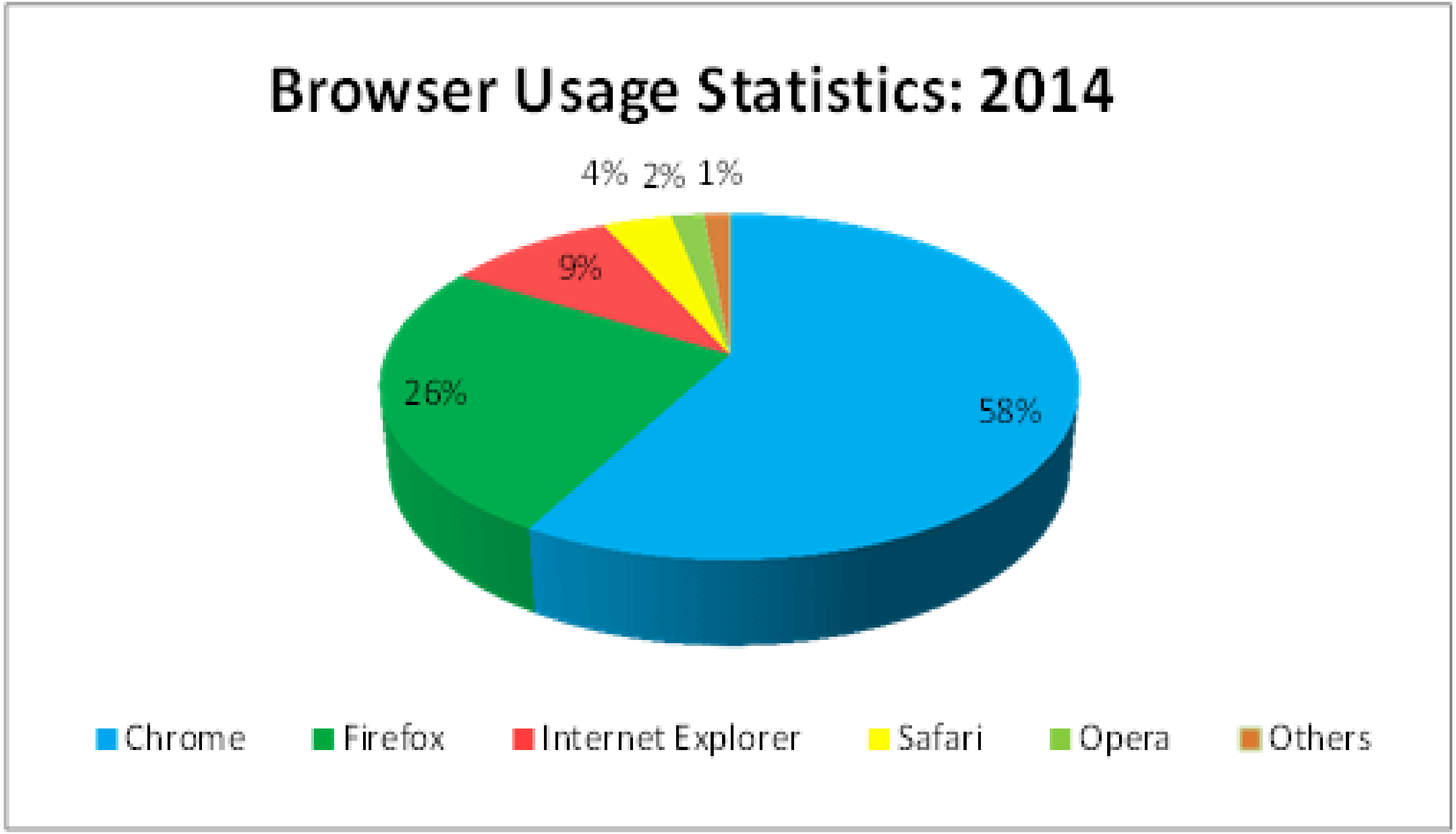
Welcome!

- Your name
- Your role (i.e. what you *actually do*)
- Why are you taking this class?

Is it data?

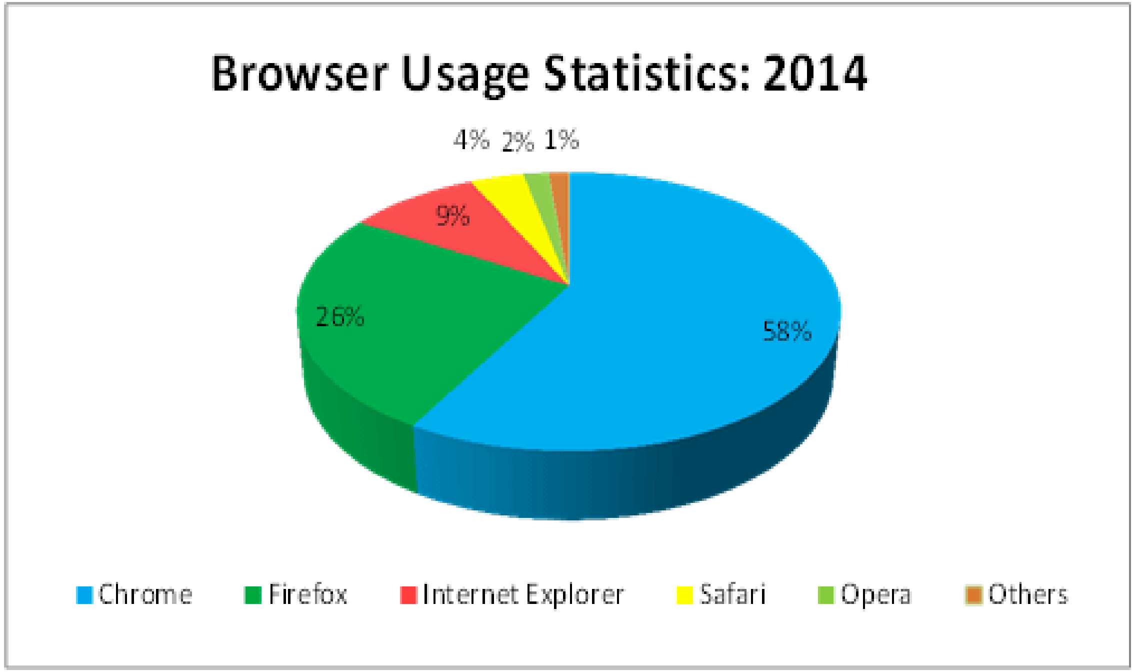
- 4 examples
- In your group, decide if the answer is **Yes** or **No**
- Come up with one or two reasons **why** you chose your answer

Is it data?


Browser Usage Statistics: 2014
4%
2%
1%
9%
26%
58%
Chrome
Firefox
Internet Explorer
Safari
Opera
Others

Is it data?

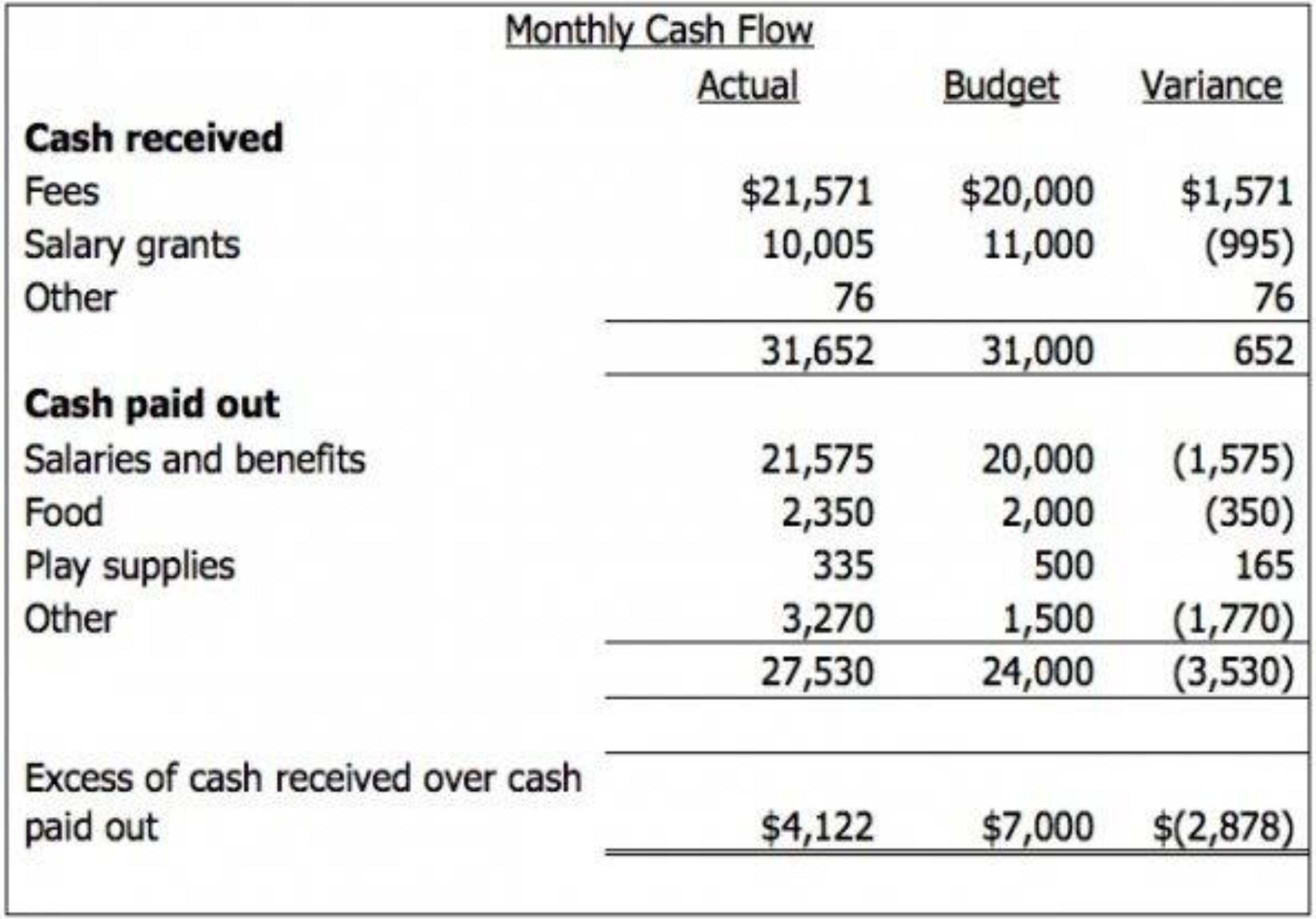
NO: This is a **data visualization** (*pie chart*)



- What is the total that each percentage is derived from?

- How many “Others” are there, and what are they?

Is it data?

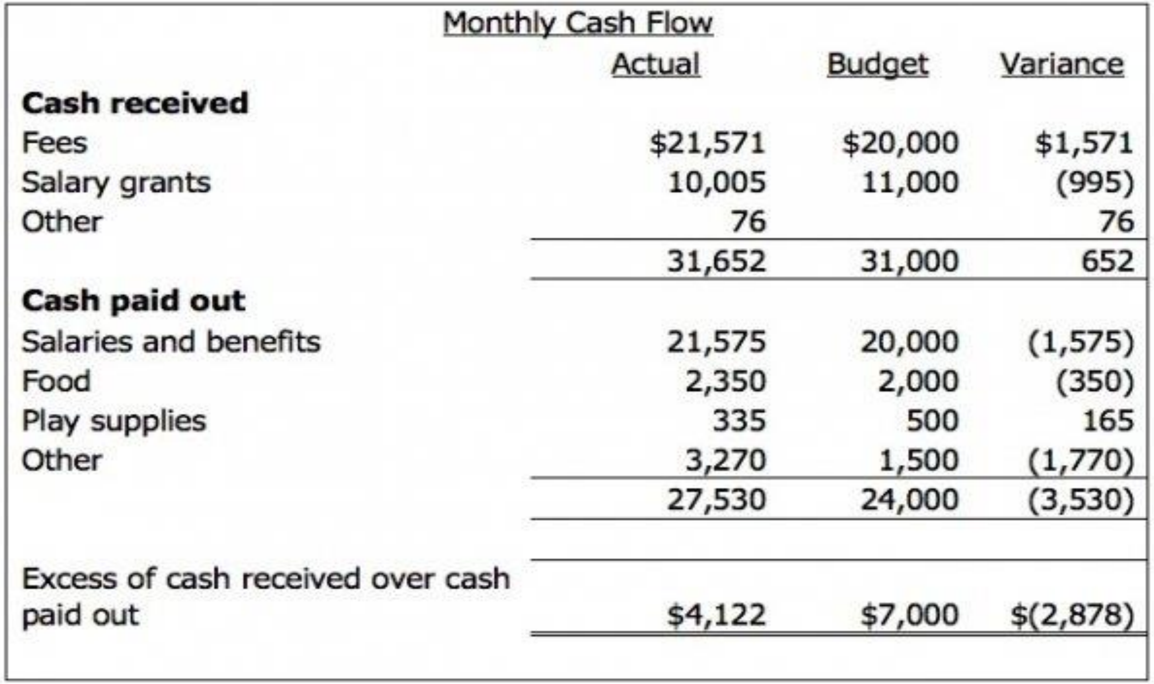


Monthly Cash Flow

	Actual	Budget	Variance
Cash received			
Fees	$21,571	$20,000	$1,571
Salary grants	10,005	11,000	(995)
Other	76		76
	31,652	31,000	652
Cash paid out			
Salaries and benefits	21,575	20,000	(1,575)
Food	2,350	2,000	(350)
Play supplies	335	500	165
Other	3,270	1,500	(1,770)
	27,530	24,000	(3,530)
Excess of cash received over cash paid out	$4,122	$7,000	$(2,878)

Is it data?

NO: This is a report



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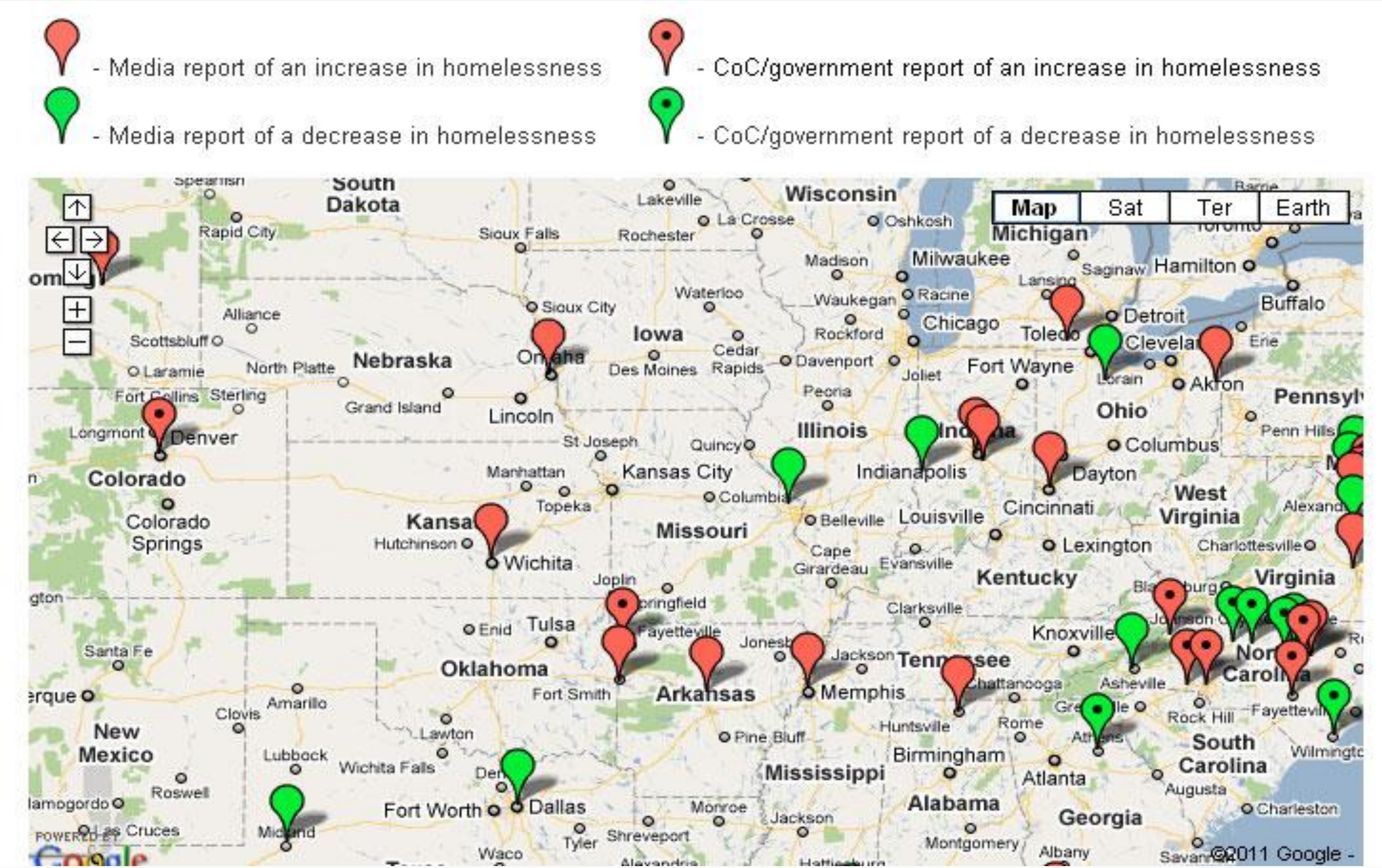
	27,530	24,000	(3,530)
Excess of cash received over cash paid out	$4,122	$7,000	$(2,878)

- How does this month compare to last month?
- Which category is the most over-budget?

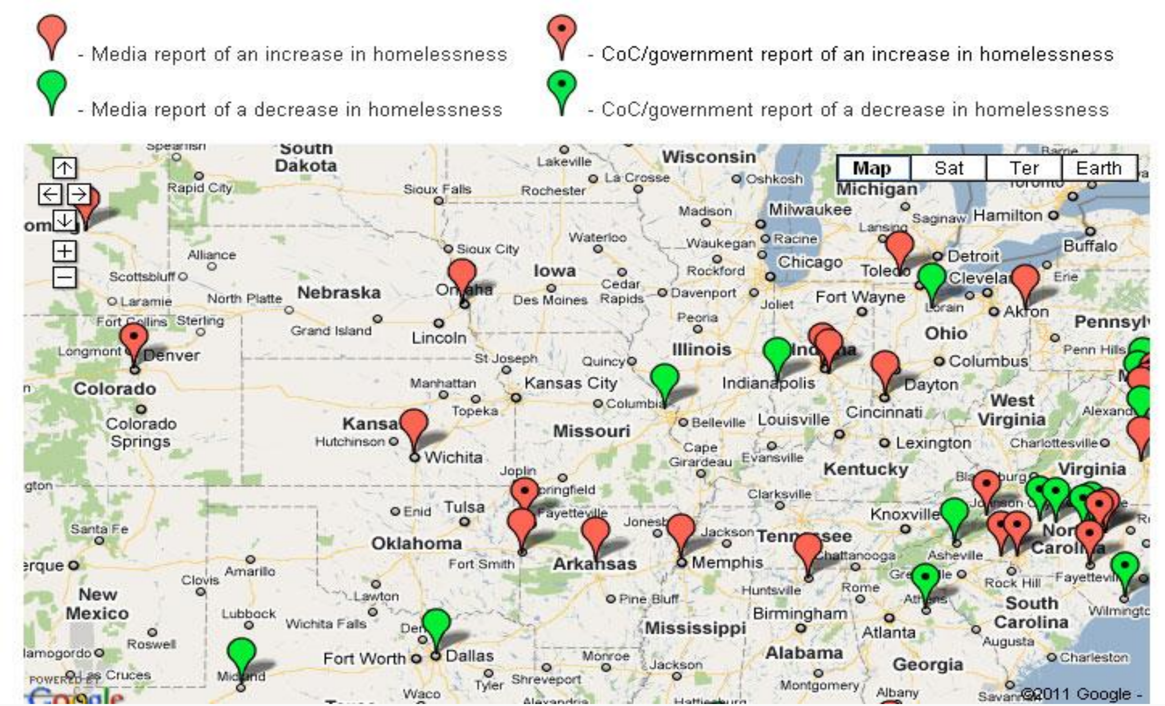
Is it data?



🟥 - Media report of an increase in homelessness
🟥 - CoC/government report of an increase in homelessness
🟩 - Media report of a decrease in homelessness
🟩 - CoC/government report of a decrease in homelessness
Map
Sat
Ter
Earth
South Dakota
Wisconsin
Michigan
Iowa
Nebraska
Illinois
Indiana
Ohio
Pennsylvania
Colorado
Kansas
Missouri
Kentucky
West Virginia
Virginia
Tennessee
North Carolina
South Carolina
Oklahoma
Arkansas
Mississippi
Alabama
Georgia
New Mexico
Rapid City
Sioux Falls
Rochester
La Crosse
Oshkosh
Madison
Milwaukee
Lakeville
Lansing
Saginaw
Hamilton
Toronto
Buffalo
Detroit
Toledo
Cleveland
Erie
Akron
Lorain
Waukegan
Racine
Chicago
Rockford
Waterloo
Sioux City
Omaha
Des Moines
Cedar Rapids
Davenport
Joliet
Fort Wayne
Peoria
Alliance
Scottsbluff
Laramie
North Platte
Fort Collins
Sterling
Grand Island
Lincoln
Longmont
Denver
St Joseph
Quincy
Manhattan
Kansas City
Topeka
Columbia
Indianapolis
Dayton
Columbus
Penn Hills
Colorado Springs
Hutchinson
Wichita
Belleville
Louisville
Cincinnati
Lexington
Charlottesville
Alexandria
Cape Girardeau
Evansville
Joplin
Springfield
Fayetteville
Clarksville
Knoxville
Johnson City
Enid
Tulsa
Santa Fe
Jonesboro
Jackson
Memphis
Chattanooga
Asheville
Albuquerque
Fort Smith
Amarillo
Clovis
Lawton
Pine Bluff
Huntsville
Rome
Greenville
Rock Hill
Fayetteville
Athens
Lubbock
Wichita Falls
Denton
Roswell
Birmingham
Atlanta
Augusta
Wilmington
Alamogordo
Fort Worth
Dallas
Monroe
Jackson
Charleston
Las Cruces
Midland
Tyler
Shreveport
Montgomery
Albany
Savannah
Waco
Alexandria
Hattiesburg
Texas
©2011 Google
POWERED BY Google

Is it data?

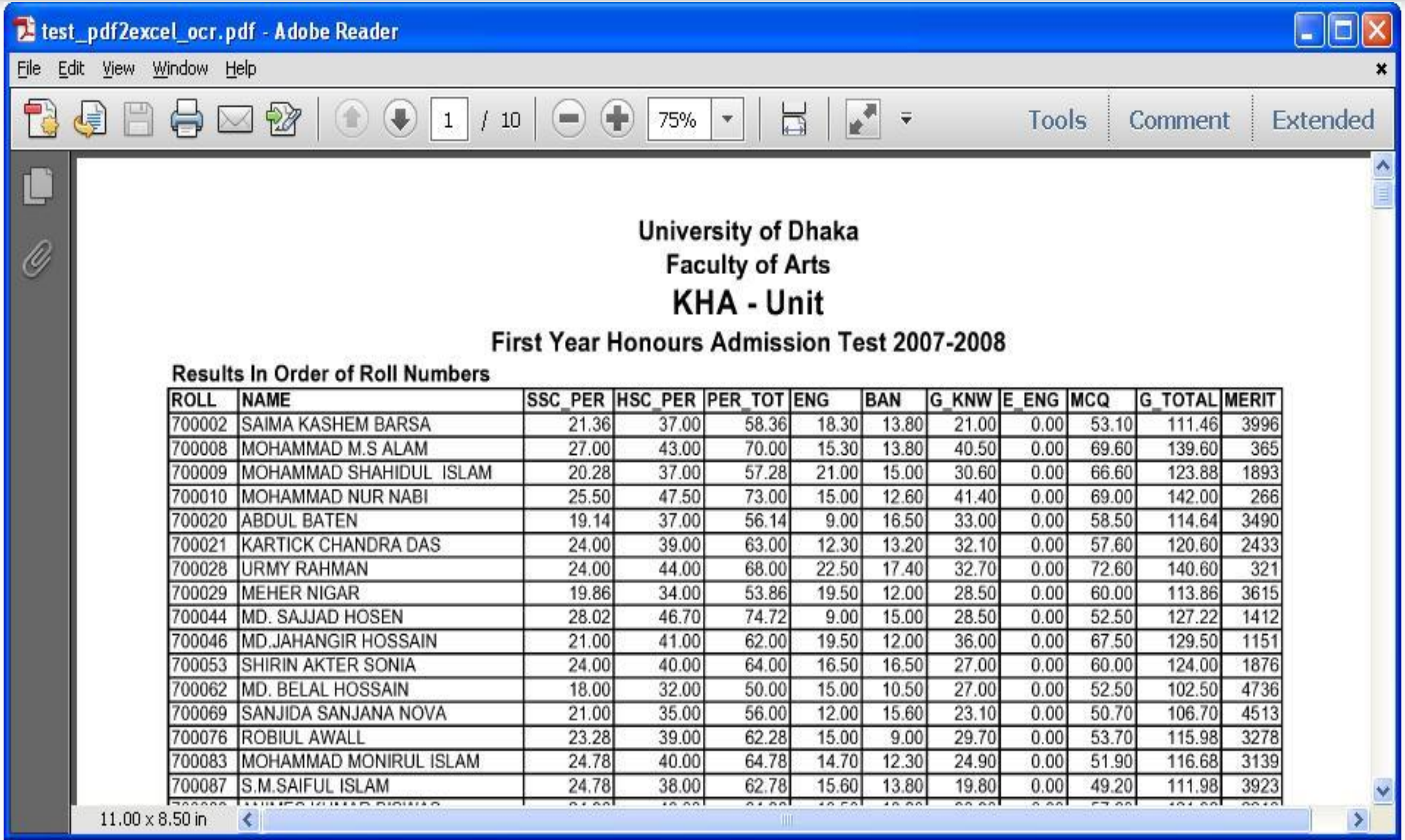
NO: This is a map/visualization



- Which regions/states are seeing the most change?

- What does a “report” mean? Are there numbers to back it up?

Is it data?



University of Dhaka
Faculty of Arts

KHA - Unit

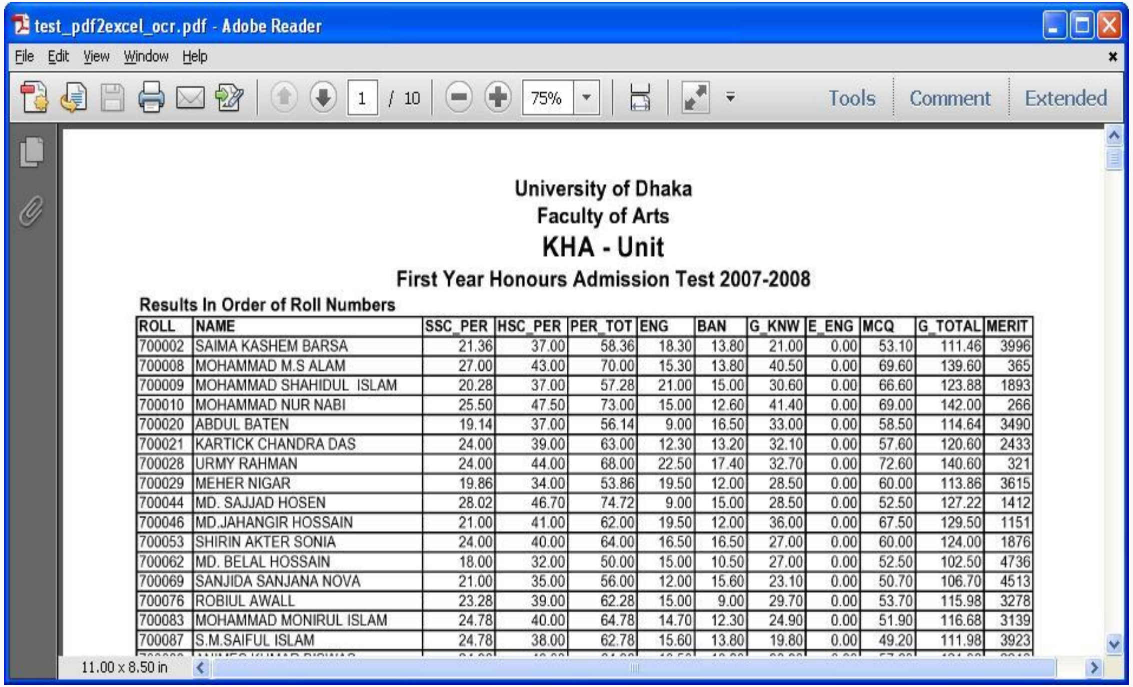
First Year Honours Admission Test 2007-2008

Results In Order of Roll Numbers

ROLL	NAME	SSC_PER	HSC_PER	PER_TOT	ENG	BAN	G_KNW	E_ENG	MCQ	G_TOTAL	MERIT
700002	SAIMA KASHEM BARSA	21.36	37.00	58.36	18.30	13.80	21.00	0.00	53.10	111.46	3996
700008	MOHAMMAD M.S ALAM	27.00	43.00	70.00	15.30	13.80	40.50	0.00	69.60	139.60	365
700009	MOHAMMAD SHAHIDUL ISLAM	20.28	37.00	57.28	21.00	15.00	30.60	0.00	66.60	123.88	1893
700010	MOHAMMAD NUR NABI	25.50	47.50	73.00	15.00	12.60	41.40	0.00	69.00	142.00	266
700020	ABDUL BATEN	19.14	37.00	56.14	9.00	16.50	33.00	0.00	58.50	114.64	3490
700021	KARTICK CHANDRA DAS	24.00	39.00	63.00	12.30	13.20	32.10	0.00	57.60	120.60	2433
700028	URMY RAHMAN	24.00	44.00	68.00	22.50	17.40	32.70	0.00	72.60	140.60	321
700029	MEHER NIGAR	19.86	34.00	53.86	19.50	12.00	28.50	0.00	60.00	113.86	3615
700044	MD. SAJJAD HOSEN	28.02	46.70	74.72	9.00	15.00	28.50	0.00	52.50	127.22	1412
700046	MD.JAHANGIR HOSSAIN	21.00	41.00	62.00	19.50	12.00	36.00	0.00	67.50	129.50	1151
700053	SHIRIN AKTER SONIA	24.00	40.00	64.00	16.50	16.50	27.00	0.00	60.00	124.00	1876
700062	MD. BELAL HOSSAIN	18.00	32.00	50.00	15.00	10.50	27.00	0.00	52.50	102.50	4736
700069	SANJIDA SANJANA NOVA	21.00	35.00	56.00	12.00	15.60	23.10	0.00	50.70	106.70	4513
700076	ROBIUL AWALL	23.28	39.00	62.28	15.00	9.00	29.70	0.00	53.70	115.98	3278
700083	MOHAMMAD MONIRUL ISLAM	24.78	40.00	64.78	14.70	12.30	24.90	0.00	51.90	116.68	3139
700087	S.M.SAIFUL ISLAM	24.78	38.00	62.78	15.60	13.80	19.80	0.00	49.20	111.98	3923

Is it data?

NO: This is a PDF



test_pdf2excel_ocr.pdf - Adobe Reader
File Edit View Window Help
1 / 10
75%
Tools
Comment
Extended
11.00 x 8.50 in

University of Dhaka
Faculty of Arts
KHA - Unit
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- What is the average MERIT score?
- Who had the highest overall performance?

Learning Objectives

- Understand what ***data*** is*
- Learn basic data ***vocabulary***
- Perform basic ***operations*** on data

What do we mean when we say **data**?

What do we mean when we say data?

Wikipedia: *Data (computing)*, October 2018 https://en.wikipedia.org/wiki/Data_(computing)

Data is any sequence of one or more symbols given meaning by specific act(s) of interpretation.

Data [...] requires interpretation to become information.

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Data is measured, collected and reported, and analyzed, whereupon it can be visualized using graphs, images or other analysis tools.

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Data is **measured**, **collected** and **reported**, and **analyzed**, whereupon it can be **visualized** using graphs, images or other analysis tools.

What do we ***really*** mean when we say **data**?

What do we *really* mean when we say data?

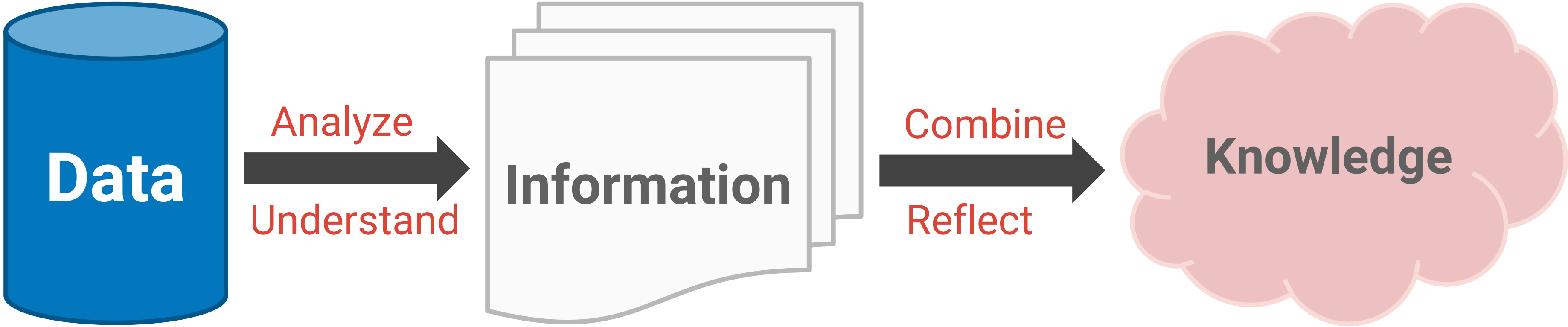
- Digital
- Raw
- Structured

What do we *really* mean when we say data?

- **Digital** (so we can use software tools)
- As **Raw** As Possible
- As **Structured** As Possible

Let’s **zoom out** a little…

The Bigger Picture



Data

Analyze

Understand

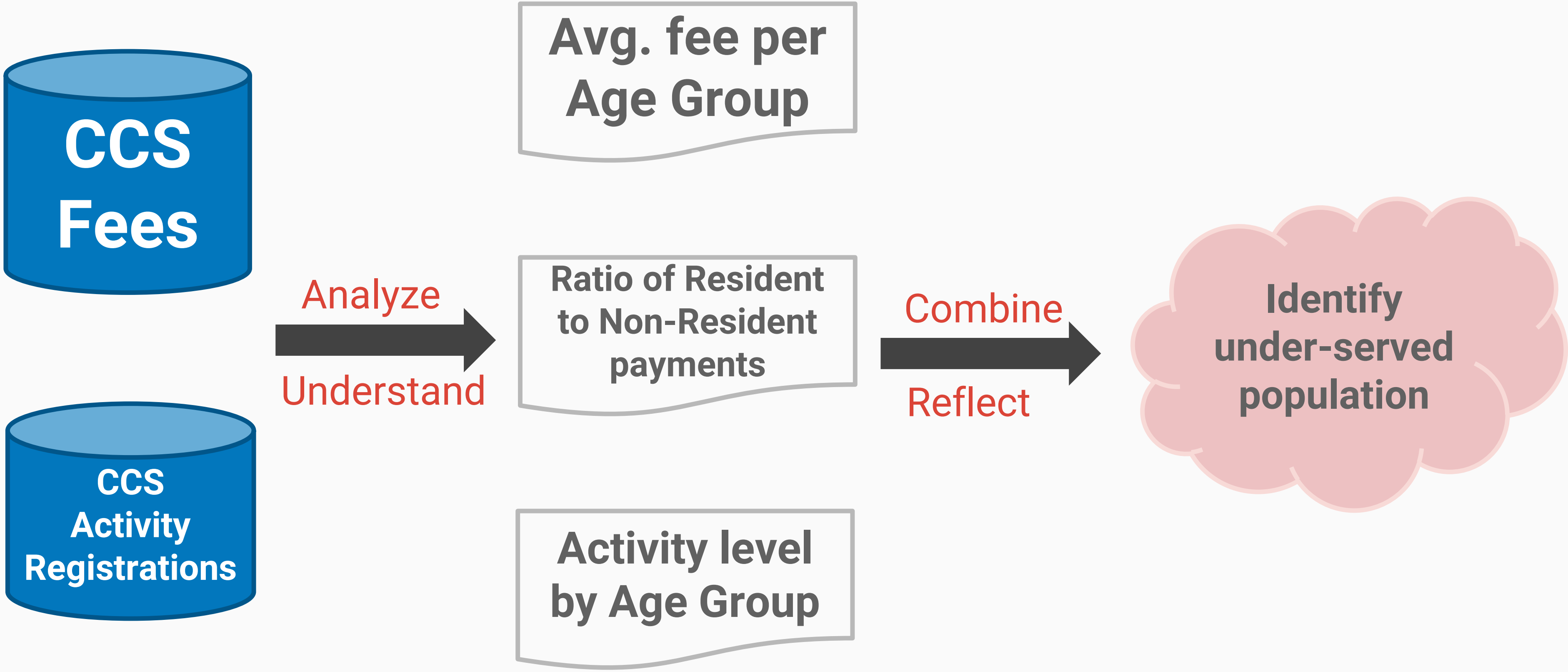
Information

Combine

Reflect

Knowledge

The Bigger Picture



CCS Fees

CCS Activity Registrations

Analyze

Understand

Avg. fee per Age Group

Ratio of Resident to Non-Resident payments

Activity level by Age Group

Combine

Reflect

Identify under-served population

This process is called

data driven decision making

Organizing data with **tables**

Also known as *tabular data*

Employee ID	Name	Date of Birth	Zip Code
20100	Harry	1980-11-12	90401
10401	Tom	1966-03-22	90405
52200	Rick	1986-09-28	90401

The header

Employee ID	Name	Date of Birth	Zip Code
20100	Harry	1980-11-12	90401
10401	Tom	1966-03-22	90405
52200	Rick	1986-09-28	90401

The header

Describes the data by naming individual ***attributes***

Also known as the ***fields*** or ***properties*** of the data

Employee ID	Name	Date of Birth	Zip Code
20100	Harry	1980-11-12	90401
10401	Tom	1966-03-22	90405
52200	Rick	1986-09-28	90401

The rows

Employee ID	Name	Date of Birth	Zip Code
20100	Harry	1980-11-12	90401
10401	Tom	1966-03-22	90405
52200	Rick	1986-09-28	90401

The rows

Individual items or observations in the data

Also known as the ***records*** of data

A record contains ***values*** for all of the attributes

Employee ID	Name	Date of Birth	Zip Code
20100	Harry	1980-11-12	90401
10401	Tom	1966-03-22	90405
52200	Rick	1986-09-28	90401

The columns

Employee ID	Name	Date of Birth	Zip Code
20100	Harry	1980-11-12	90401
10401	Tom	1966-03-22	90405
52200	Rick	1986-09-28	90401

The columns

Contain values of the same ***type*** for all records

Ideally a column represents a ***single attribute*** of the data

Employee ID	Name	Date of Birth	Zip Code
20100	Harry	1980-11-12	90401
10401	Tom	1966-03-22	90405
52200	Rick	1986-09-28	90401

Why does **structure** matter?

Why does structure matter?

Wikipedia: *Data structure*, October 2018 https://en.wikipedia.org/wiki/Data_structure

A **data structure** is a collection of data values, the relationships among them, and the functions or operations that can be applied to the data.

Why does structure matter?

Wikipedia: *Data structure*, October 2018 https://en.wikipedia.org/wiki/Data_structure

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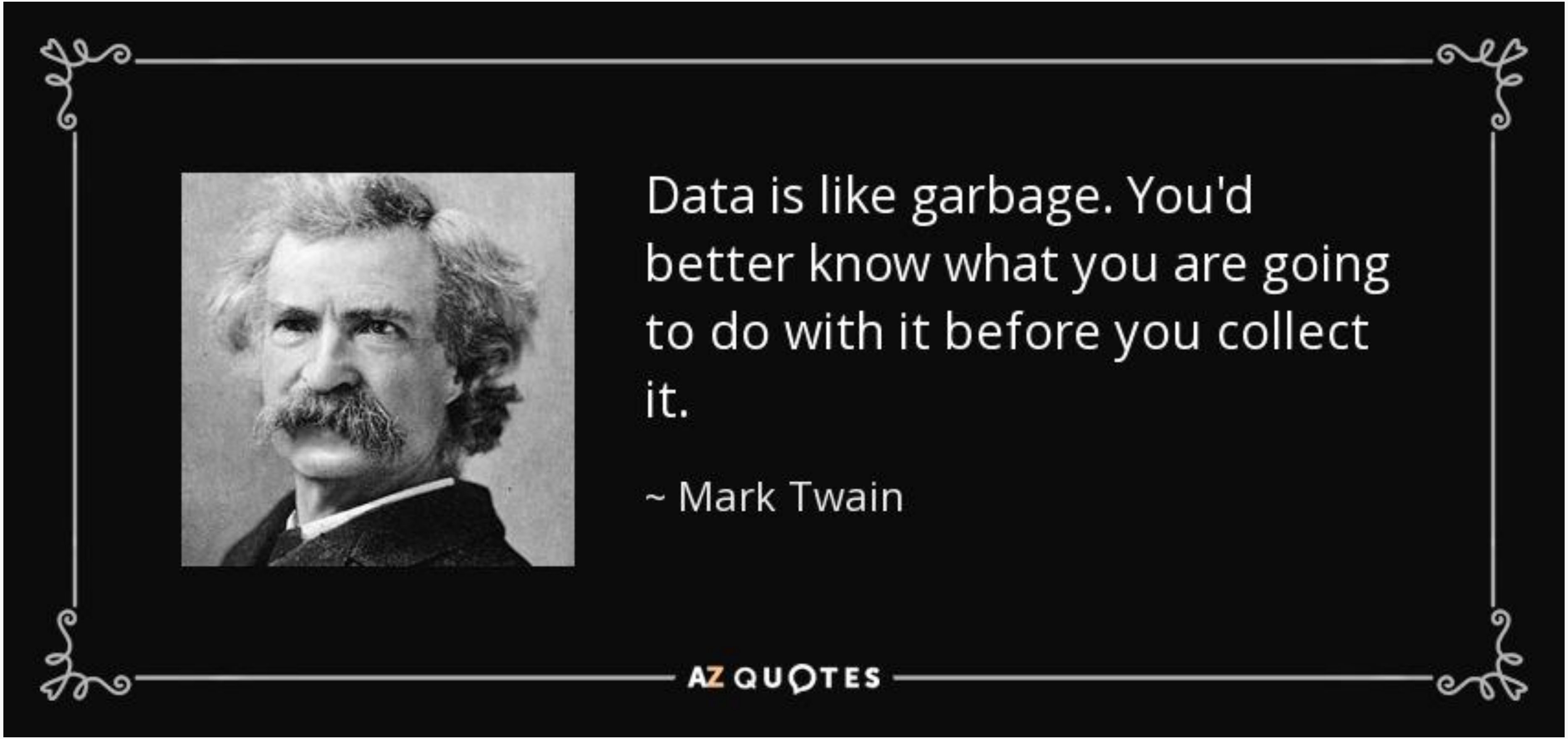
Why does structure matter?



Data is like garbage. You'd better know what you are going to do with it before you collect it.

~ Mark Twain

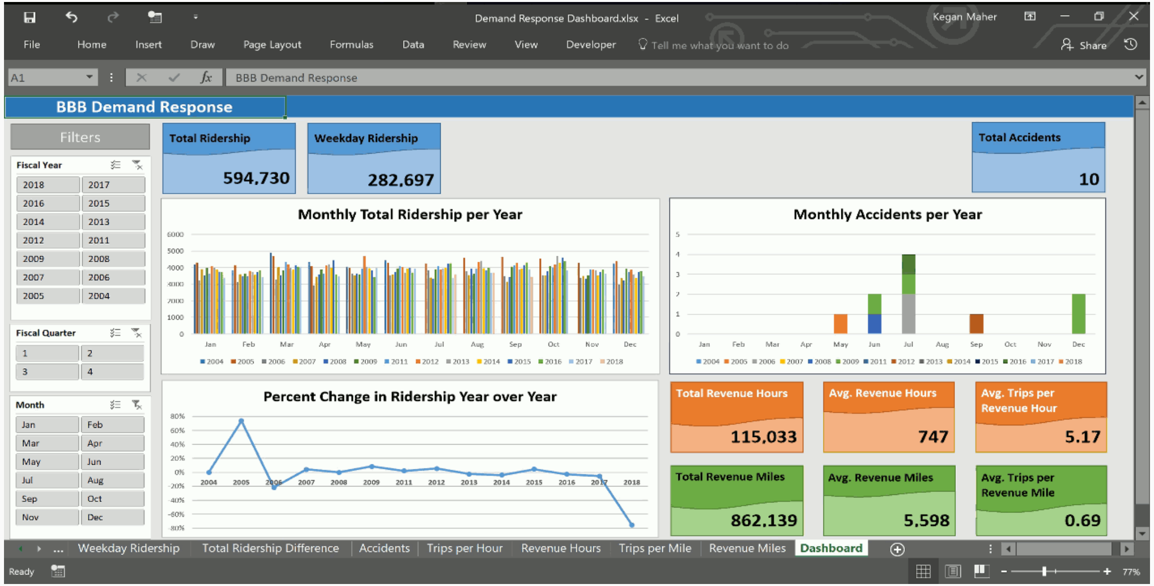
Data Collection and Storage

Data Sources and Collection

CITY OF SANTA MONICA
CALIFORNIA

COMPREHENSIVE ANNUAL FINANCIAL REPORT

For the year ended June 30, 2017



BBB Demand Response

Filters

Fiscal Year: 2018, 2017, 2016, 2015, 2014, 2013, 2012, 2011, 2009, 2008, 2007, 2006, 2005, 2004

Fiscal Quarter: 1, 2, 3, 4

Month: Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov, Dec

Total Ridership	Weekday Ridership	Total Accidents
594,730	282,697	10

Monthly Total Ridership per Year

Monthly Accidents per Year

Percent Change in Ridership Year over Year

Total Revenue Hours	Avg. Revenue Hours	Avg. Trips per Revenue Hour
115,033	747	5.17

Total Revenue Miles	Avg. Revenue Miles	Avg. Trips per Revenue Mile
862,139	5,598	0.69

Spectrum of Data Sources and Destinations

Spectrum of Data Sources and Destinations

SD^2

Spectrum of Data Sources and Destinations

Initial investment/data collection

Almost no time/$

How much time/$
do you have?

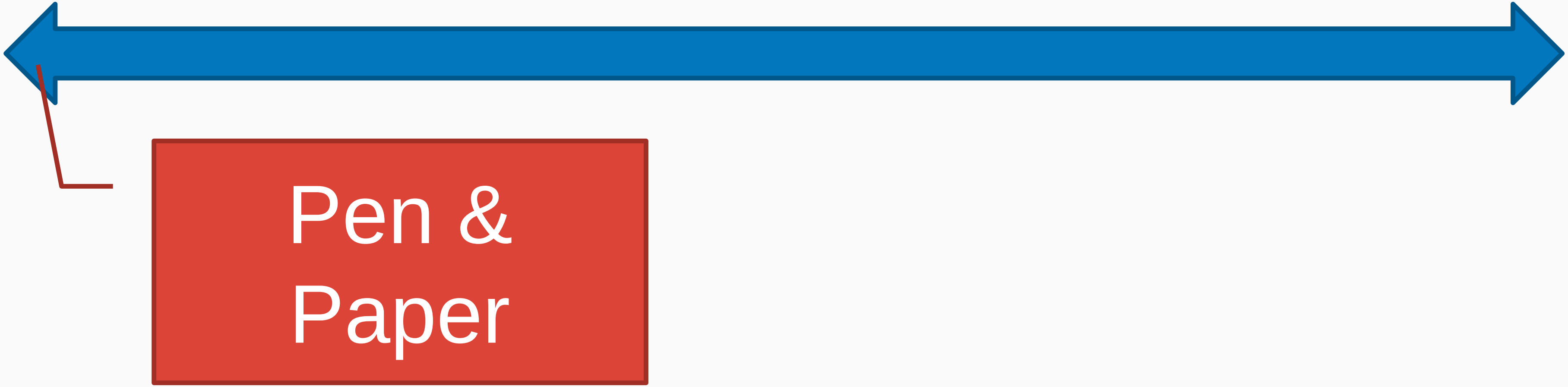
Spectrum of Data Sources and Destinations

Flexibility for analysis

Concrete

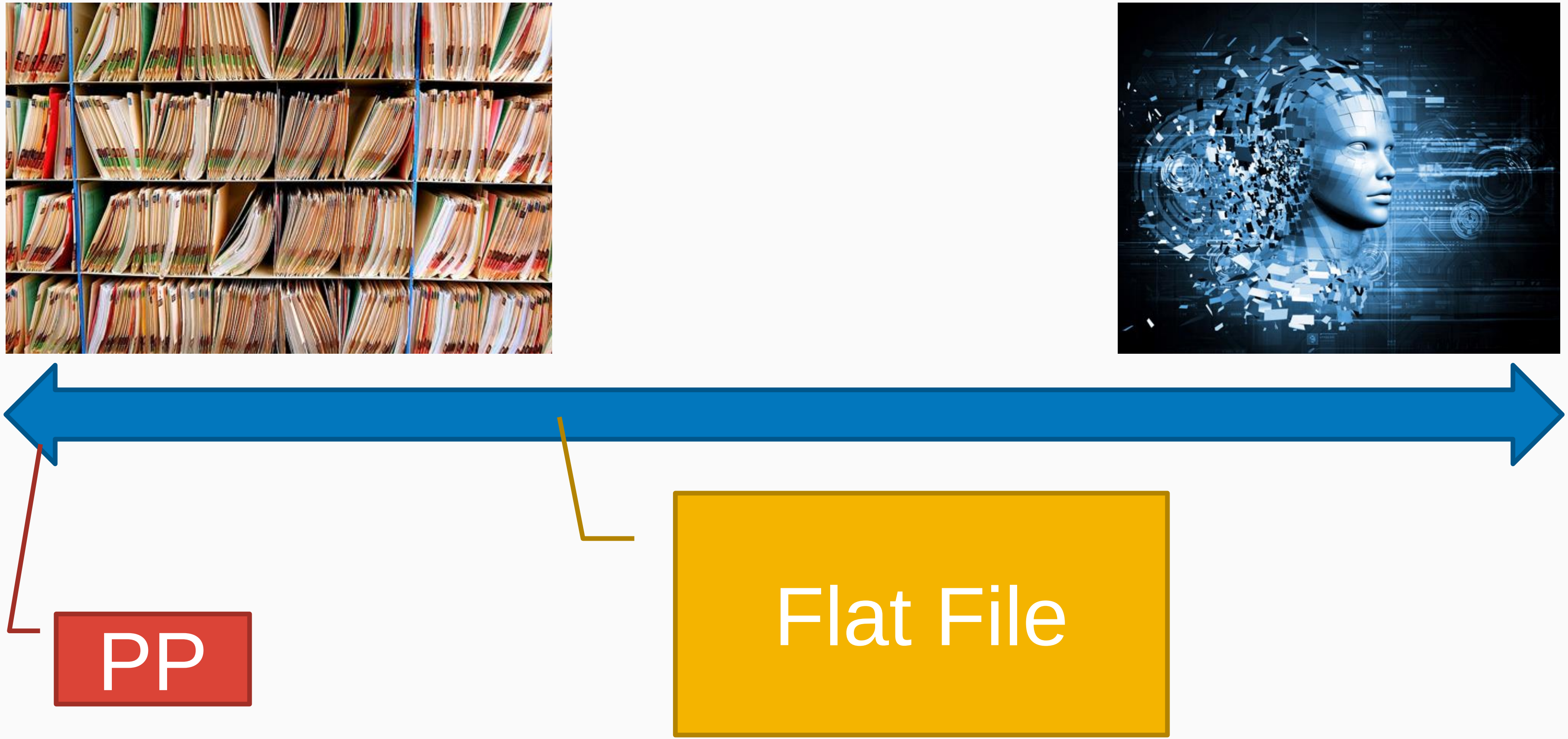
Water

Spectrum of Data Sources and Destinations



Pen & Paper

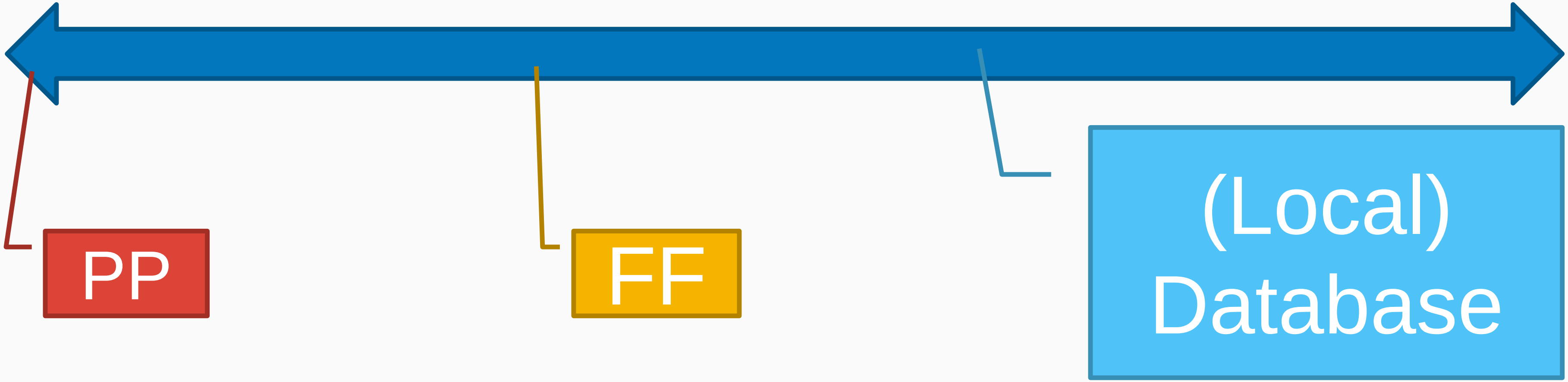
Spectrum of Data Sources and Destinations



PP

Flat File

Spectrum of Data Sources and Destinations

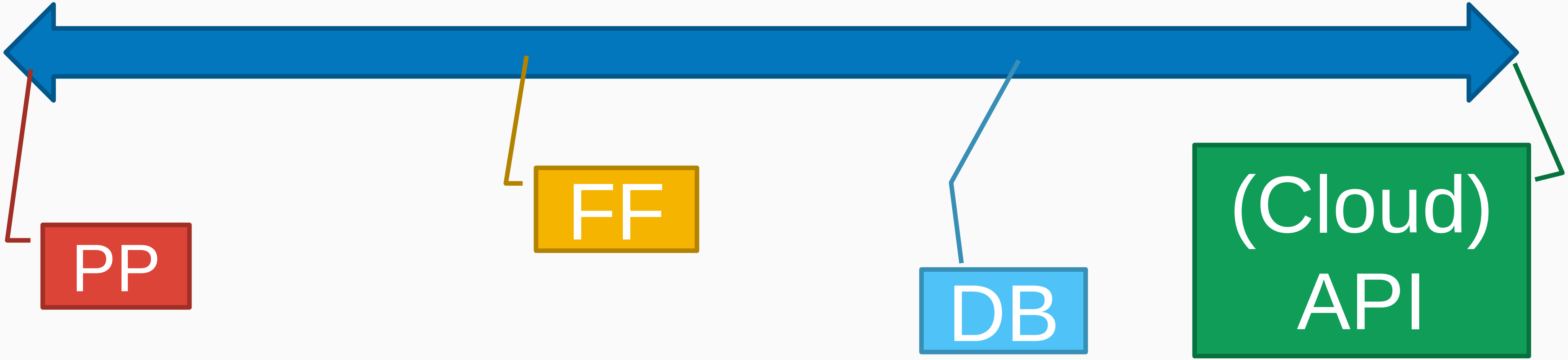


PP

FF

(Local) Database

Spectrum of Data Sources and Destinations



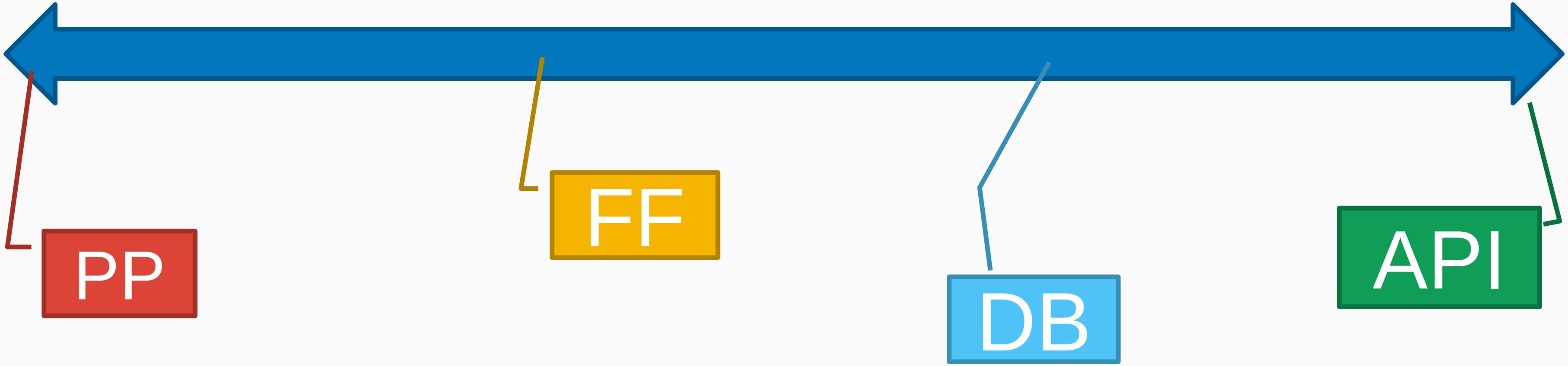
PP

FF

DB

(Cloud) API

Spectrum of Data Sources and Destinations



Collecting data: a case study

Homeless Demographic Survey

Collecting data: a case study

Homeless Demographic Survey

- 2016 and 2017
- Questions on age range, gender, race, medical conditions, etc.

Collecting data: a case study

2016 Homeless Demographic Survey

1. Have you ever been diagnosed with a serious medical condition?

2. Have you ever been diagnosed with a substance abuse issue?

3. Have you ever been diagnosed with a mental health issue?

Collecting data: a case study

ID	Year	Serious Medical Condition	Substance Abuse Issue	Mental Health Issue
0	2016	Yes	Yes	No
1	2016	No	Yes	Yes
2	2016	No	No	Yes

Collecting data: a case study

2017 Homeless Demographic Survey

1. Have you ever been diagnosed with any of the following?

a) Serious medical condition
b) Substance abuse issue
c) Mental health issue

Collecting data: a case study

ID	Year	Diagnosed With
3	2017	Serious medical condition
4	2017	Substance abuse issue, Mental health issue
5	2017	Serious medical condition, Mental health issue

Collecting data: a case study

ID	Year	Serious Medical Condition	Substance Abuse Issue	Mental Health Issue
0	2016	Yes	Yes	No
1	2016	No	Yes	Yes
2	2016	No	No	Yes

ID	Year	Diagnosed With
3	2017	Serious medical condition
4	2017	Substance abuse issue, Mental health issue
5	2017	Serious medical condition, Mental health issue

Santa Monica Data Academy

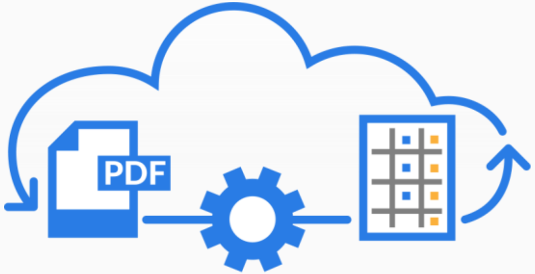
10 Minute Break

BREAK IS OVER

Organizing data with tables

Design a data table (~15 minutes)

- Study the PDF form
- Come up with a list of columns
  Decide: *Qualitative* or *Quantitative?*



- Choose a *spokesperson* to share your group’s design

TIME TO PRESENT

Organizing data with tables

Employee ID	July 2018 Hours	December 2018 Hours
0	44	0
1	20	28
2	48	48

Organizing data with tables

Employee ID	Date	Hours
0	July 2018	44
0	December 2018	0
1	July 2018	20
1	December 2018	28
2	July 2018	48
2	December 2018	48

Does it matter?

Employee ID	July 2018 Hours	December 2018 Hours
0	44	0
1	20	28
2	48	48

Employee ID	Date	Hours
0	July 2018	44
0	December 2018	0
1	July 2018	20
1	December 2018	28
2	July 2018	48
2	December 2018	48

Does it matter?

Employee ID	Date	Hours	Hourly Rate
0	July 2018	44	$18.00
0	December 2018	0	$19.00
1	July 2018	20	$15.00
1	December 2018	28	$15.00
2	July 2018	48	$25.00
2	December 2018	48	$30.00

This format of tabular data is called

Tidy Data

Operations on tabular data

Operations on tabular data

What is the average age of the people in our data?

Employee ID	Name	DOB	Zip Code
20100	Harry	1980-11-12	90401
10401	Tom	1966-03-22	90405
52200	Rick	1986-09-28	90401

Operations on tabular data

What is the average age of the people in our data?

Employee ID	Name	DOB	Zip Code
20100	Harry	1980-11-12	90401
10401	Tom	1966-03-22	90405
52200	Rick	1986-09-28	90401

Operations on tabular data: Calculated/Derived Field

What is the average age of the people in our data?

Employee ID	Name	DOB	Age	Zip Code
20100	Harry	1980-11-12	38	90401
10401	Tom	1966-03-22	53	90405
52200	Rick	1986-09-28	32	90401

Operations on tabular data: Column Aggregation (Sum)

What is the average age of the people in our data?

Employee ID	Name	DOB	Age	Zip Code
20100	Harry	1980-11-12	38	90401
10401	Tom	1966-03-22	53	90405
52200	Rick	1986-09-28	32	90401

Operations on tabular data: Column Aggregation (Sum)

What is the average age of the people in our data?

38 + 53 + 32 = 123

Employee ID	Name	DOB	Age	Zip Code
20100	Harry	1980-11-12	38	90401
10401	Tom	1966-03-22	53	90405
52200	Rick	1986-09-28	32	90401

Operations on tabular data: Column Aggregation (Avg)

What is the average age of the people in our data?

$(38 + 53 + 32 = 123) / 3 = 41$

Employee ID	Name	DOB	Age	Zip Code
20100	Harry	1980-11-12	38	90401
10401	Tom	1966-03-22	53	90405
52200	Rick	1986-09-28	32	90401

Operations Recap

- Calculate a new column (*DOB -> Age*)
- Aggregate values in a column (*average all the Ages*)

Operations on tabular data

What is the geographic distribution of people in our data?

Employee ID	Name	DOB	Zip Code
20100	Harry	1980-11-12	90401
10401	Tom	1966-03-22	90405
52200	Rick	1986-09-28	90401

Operations on tabular data: Group by Zip Code

What is the geographic distribution of people in our data?

Employee ID	Name	DOB	Zip Code
20100	Harry	1980-11-12	90401
10401	Tom	1966-03-22	90405
52200	Rick	1986-09-28	90401

Operations on tabular data: Count within Groups

What is the geographic distribution of people in our data?

Employee ID	Name	DOB	Zip Code
20100	Harry	1980-11-12	90401
10401	Tom	1966-03-22	90405
52200	Rick	1986-09-28	90401

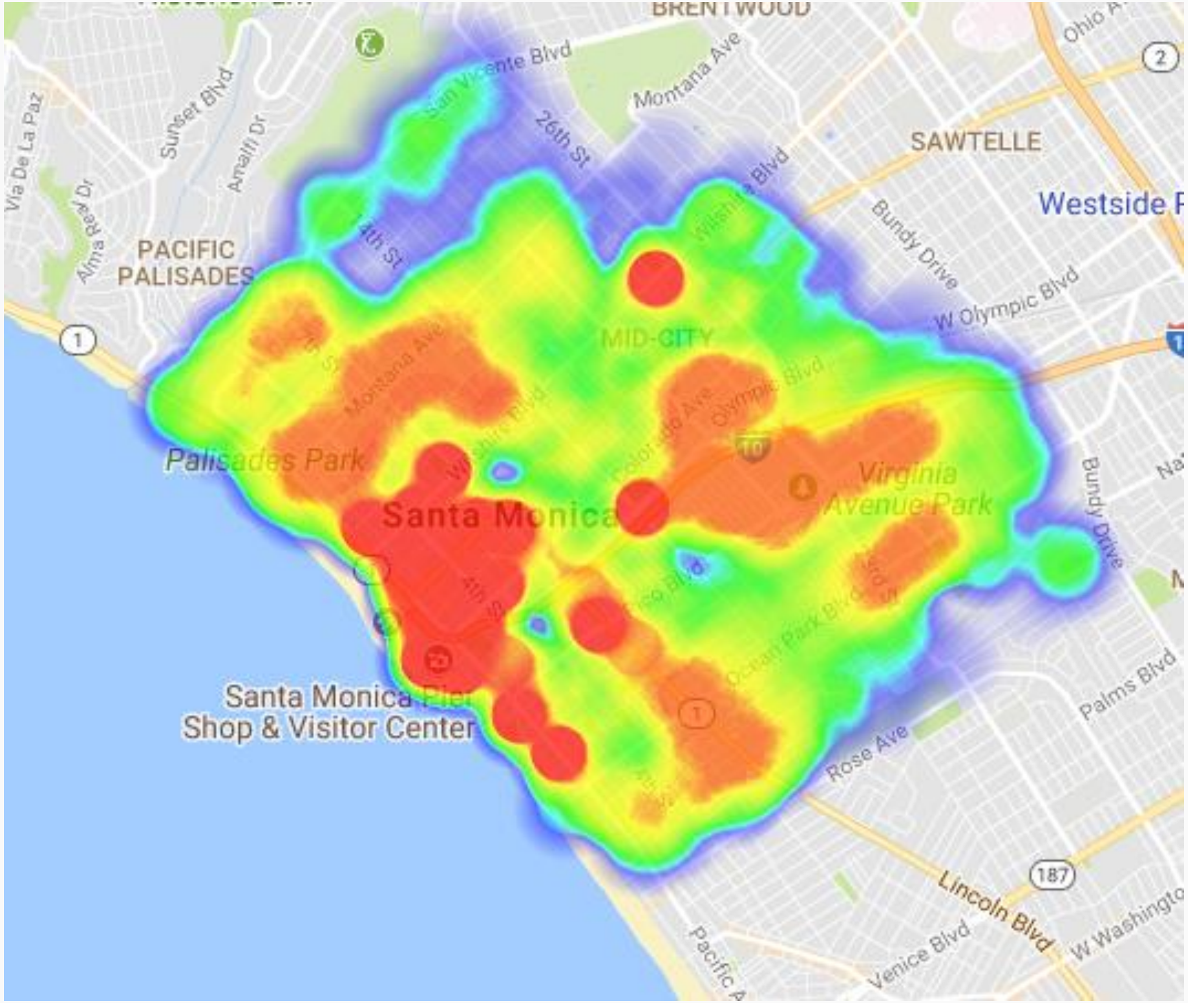
Operations on tabular data: Count within Groups

What is the geographic distribution of people in our data?

Zip Code	Count
90401	2
90405	1

Operations on tabular data

Visualize using a heatmap



Operations Recap

- Group (*by Zip Code*)
- Count (*how many rows in each group*)
- Visualize (*a heatmap shows the distribution graphically*)

Operations on tabular data

Who is the youngest person that lives in 90401?

Employee ID	Name	DOB	Zip Code
20100	Harry	1980-11-12	90401
10401	Tom	1966-03-22	90405
52200	Rick	1986-09-28	90401

Operations on tabular data: Filter

Who is the youngest person that lives in 90401?

```
Zip Code = 90401
```

Employee ID	Name	DOB	Zip Code
20100	Harry	1980-11-12	90401
10401	Tom	1966-03-22	90405
52200	Rick	1986-09-28	90401

Operations on tabular data: Filter

Who is the youngest person that lives in 90401?

```
Zip Code = 90401
```

Employee ID	Name	DOB	Zip Code
20100	Harry	1980-11-12	90401
52200	Rick	1986-09-28	90401

Operations on tabular data: Column Aggregation (Max)

Who is the youngest person that lives in 90401?

Employee ID	Name	DOB	Zip Code
20100	Harry	1980-11-12	90401
52200	Rick	1986-09-28	90401

Operations on tabular data: Column Aggregation (Max)

Who is the youngest person that lives in 90401?

```
Max(1980-11-12, 1986-09-28) = 1986-09-28
```

Employee ID	Name	DOB	Zip Code
20100	Harry	1980-11-12	90401
52200	Rick	1986-09-28	90401

Operations on tabular data: Filter

Who is the youngest person that lives in 90401?

```
DOB = 1986-09-28
```

Employee ID	Name	DOB	Zip Code
20100	Harry	1980-11-12	90401
52200	Rick	1986-09-28	90401

Operations on tabular data: Filter

Who is the youngest person that lives in 90401?

```
DOB = 1986-09-28
```

Employee ID	Name	DOB	Zip Code
52200	Rick	1986-09-28	90401

Operations on tabular data: Select a column

Who is the youngest person that lives in 90401?

Employee ID	Name	DOB	Zip Code
52200	Rick	1986-09-28	90401

Operations Recap

- Filter (*keep only rows with Zip Code = 90401*)
- Aggregate values in a column (*get the maximum DOB*)
- Filter (*keep only rows with a matching DOB*)
- Select (*the name field from the remaining row*)

We talked about quite a few

data operations

Data Operations

- Calculate new columns
- Aggregate columns
- Select columns

- Count rows
- Group rows
- Filter rows
- Visualize

POP QUIZ

What day had the most **Requests Closed?**

07-Aug (14 *Full Release* closed)

What is the proportion of **Activities** marked for *Full Release* vs. *No Records Exist?*

524 (Full Release)
74 (No Records Exist)

What is the **Avg. Days to Close** per month?

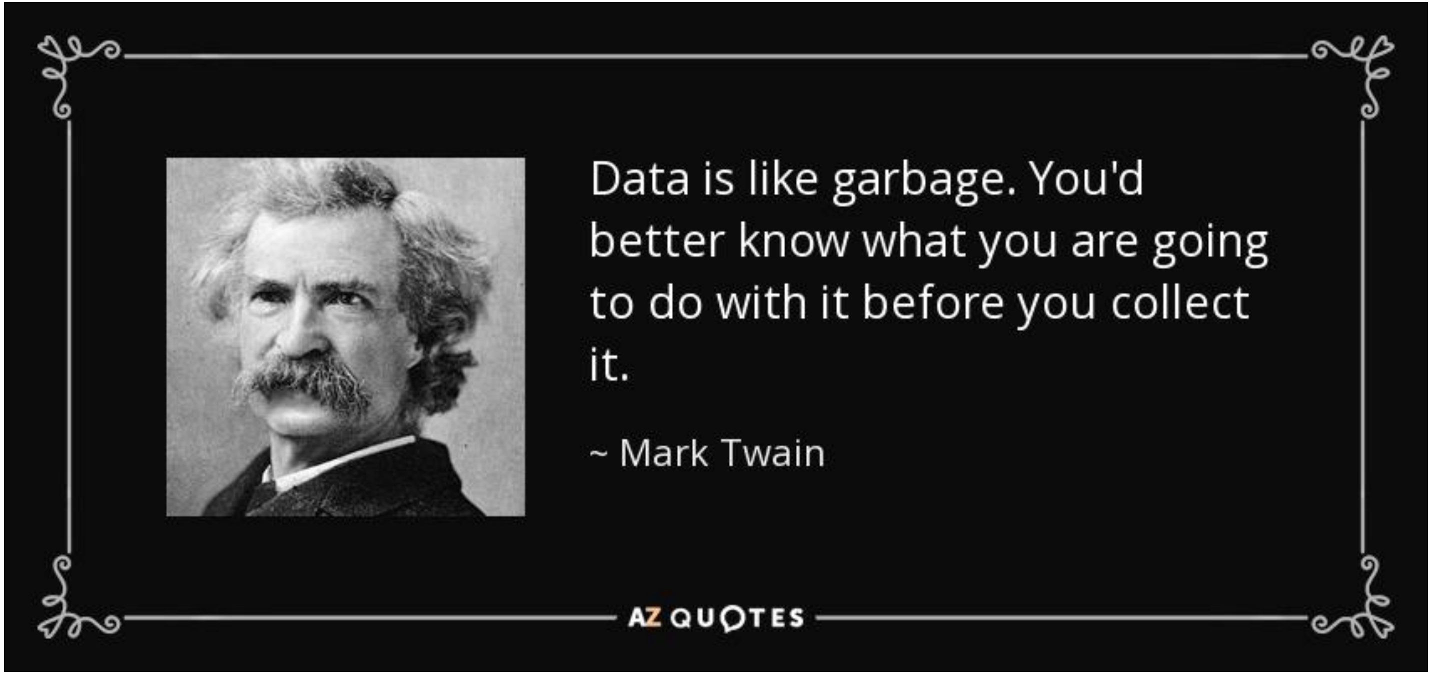
Mar	3.9
Apr	6.9
May	6.6
Jun	6.1
Jul	7.8
Aug	7.3

Wrapping up

What do we *really* mean when we say data

- **Digital** (so we can use software tools)
- As **Raw** As Possible
- As **Structured** As Possible

Data source and structure matter!



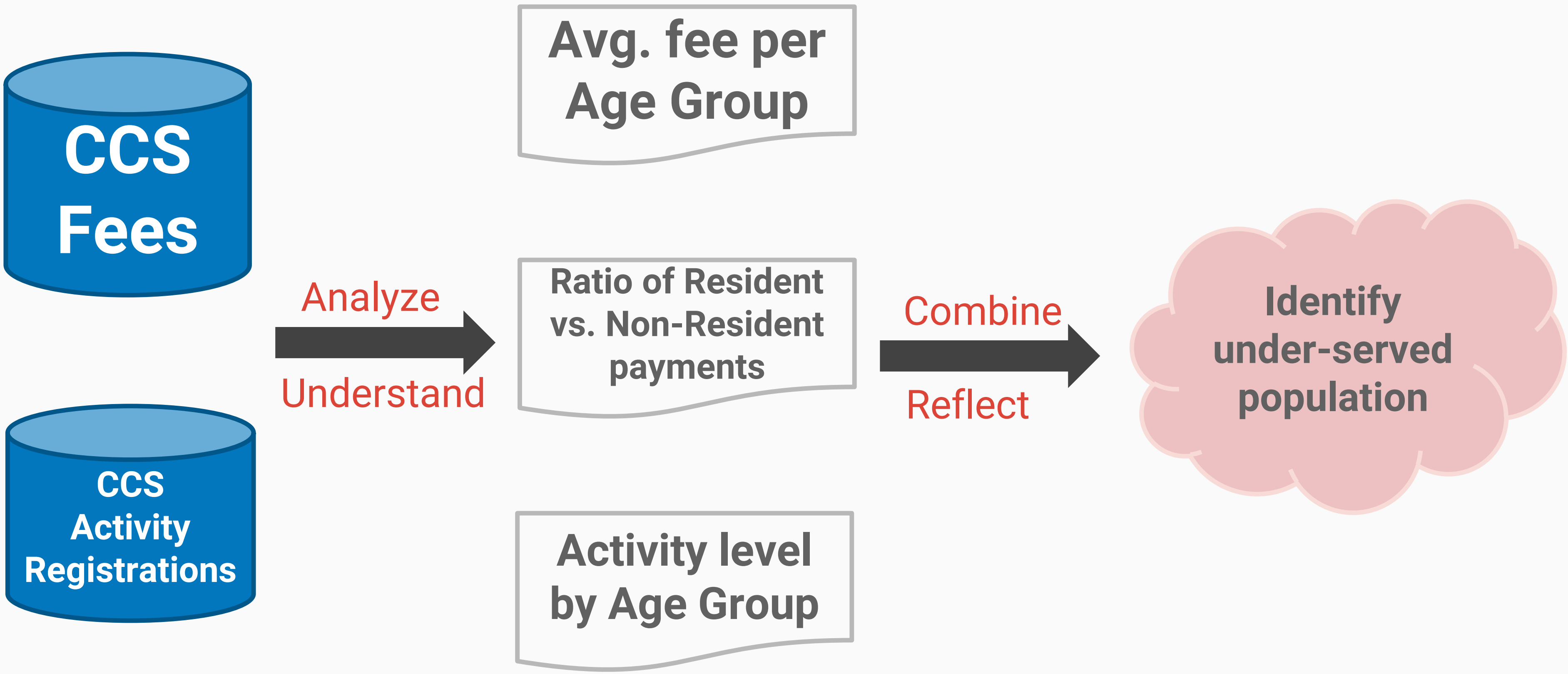
Data is like garbage. You'd better know what you are going to do with it before you collect it.

~ Mark Twain

Operations on tabular data

- Calculate new columns
- Aggregate values in a column
- Select columns
- Count rows
- Filter rows
- Group rows

The Bigger Picture: Data Driven Decision Making



CCS Fees

CCS Activity Registrations

Analyze

Understand

Avg. fee per Age Group

Ratio of Resident vs. Non-Resident payments

Activity level by Age Group

Combine

Reflect

Identify under-served population

Thank You For Joining Us!

Please fill out the feedback form before leaving ☺

Materials for today's course:

santamonica.gov/DA101

Questions, feedback anytime: **data@smgov.net**