

# Data Literacy and Establishing a Data-Driven Culture

Harshil Parikh, Tuva

Milo Schield, Quant-Fluent

Marc Isaacson, Quant-Fluent

# Attendee Registration

[tuva.la/2oD9TH9](https://tuva.la/2oD9TH9)

@tuvalabs  
@Quant\_Fluent

#DataLiteracy  
#GartnerDA

# Harshil Parikh

- Co-Founder of Tuva (tuvalabs.com)
- Tuva is one of leading data literacy companies
- Data literacy solutions across K-12, Higher Ed, & Enterprise
- Global Business Development at Greenlight Planet
- Studied Physics, Statistics, Finance

# Milo Schield

## 13 years experience in business

- Sr. Consultant and Sr. Operations Research Manager

## Over 20 years experience with statistical literacy:

- Designed the first statistical literacy course in 1998
- Launched the #1 website dedicated to statistical literacy: [www.StatLit.org](http://www.StatLit.org): 280,000 visits in 2017
- 70 papers on statistical literacy that have 660 citations.
- Described as “the movement’s leading voice.”

# Marc Isaacson

- 10 years experience in business
- 15 years experience in Statistical Literacy
- Designed 1<sup>st</sup> online course on statistical literacy (2003)
- Designed assessment activities and questions
- Assessed undergrad and MBA students
- Expert in objective assessment of data & statistical literacy

# Agenda

## Session I

- Data literacy on the ground
- How do we make quantitative decisions?
- Data & Statistical Literacy Competency Maps
- Statistical Literacy
- Data Visualization
- Group Activity

## Break

# Agenda

## Session II

- Diagnostic assessment sample report
- Sample assessment
- How can you begin to build data literacy across your organization?
- Q&A
- Wrap Up



# Session I

# Data Literacy Is an Organizational Practice

Literacy :: Society

Data Literacy :: Organization

- 1850: 10% of the world's adult population could read or write
  - 2000: 80% of the world's adult population could read or write
- 1.2 billion in 1850 to 7 billion today



# Data Literacy On the Ground - I

“...Virtually all respondents (99%) say their firms are trying to move in that direction, but only about one-third have succeeded at this objective. This gap appears every year in the surveys, and the level of success hasn’t improved much over time. Clearly firms need more-concerted programs to achieve data-related cultural change”.

- Harvard Business Review: Big Companies are Embracing Analytics But Most Still Don’t Have a Data-Driven Culture

# Data Literacy On the Ground - III

“Data literacy is not optional for success in our society and our economy. It is imperative.”

– UGA President Jere Morehead while announcing a grant program for seniors in need

“...mastering three new literacies: technological literacy, data literacy, and human literacy”

– Joseph Aoun, President of Northeastern University on preparing learning for an age of Artificial Intelligence



# Where Do Quantitative Insights Come From?



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“Saying quantitative insights come from data is like saying babies come from hospitals.”



It's generally true but leaves out a lot of details



# Where Do Quantitative Insights Come From?



# Quantitative Insights Come From a Process

## The Process:

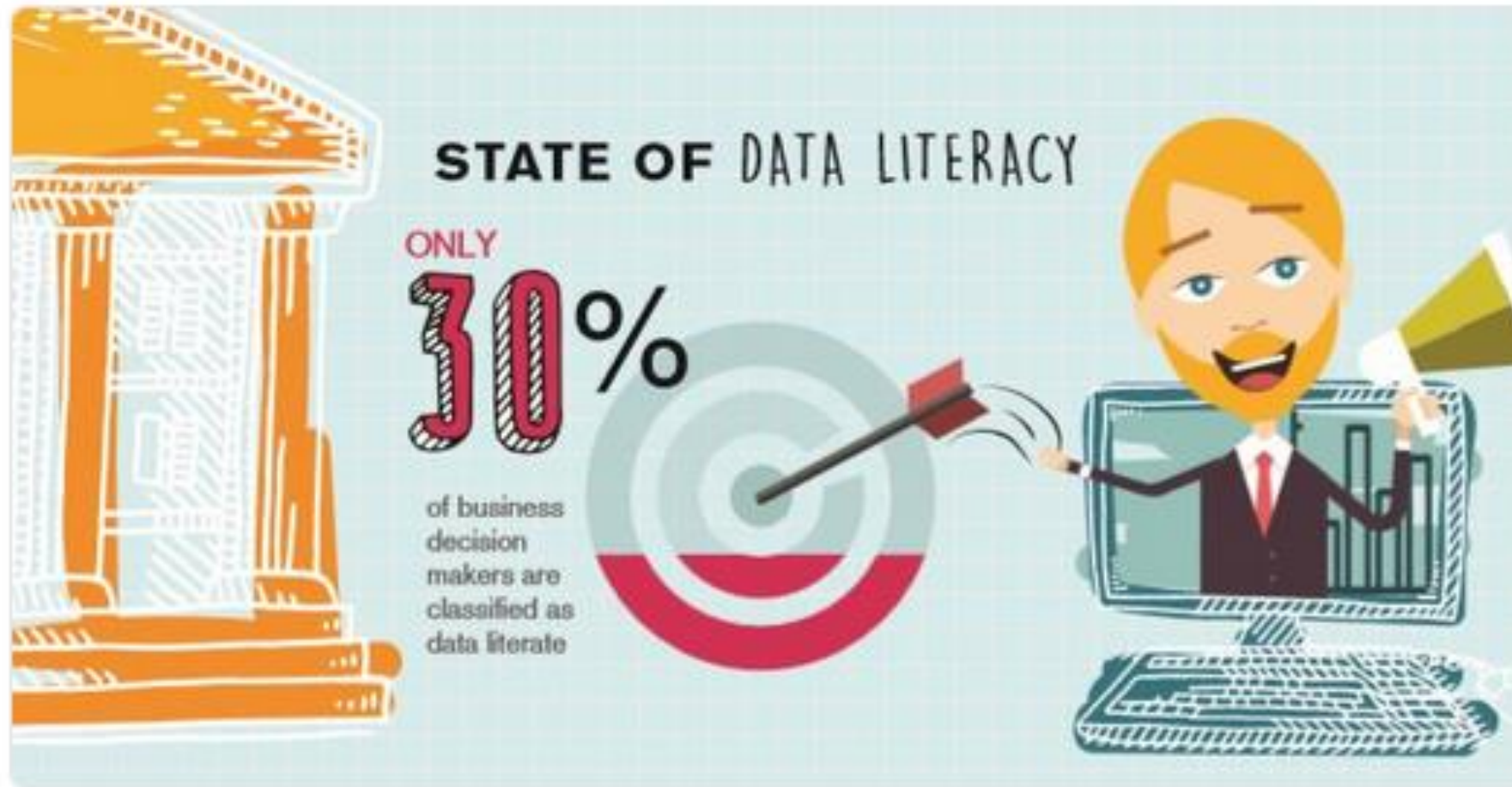
- A Question of Interest
- Data Collection / Retrieval
- Analysis and Calculations
- Communication of Results
- Evaluation and Decision

# Data Literacy – Definition

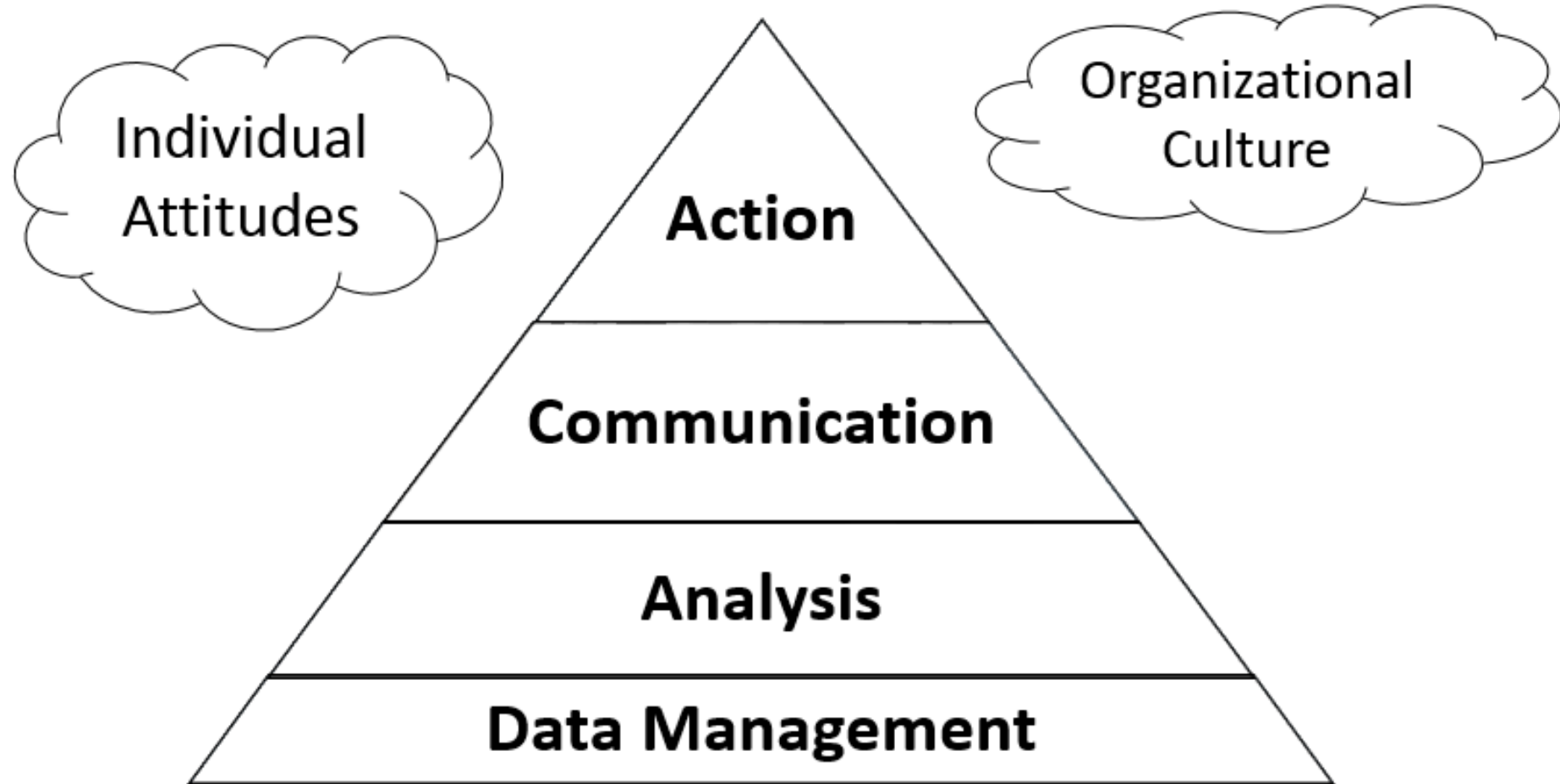
The ability of an organization (or individual) to:

- extract information from data
- communicate it effectively
- utilize it to make business decisions

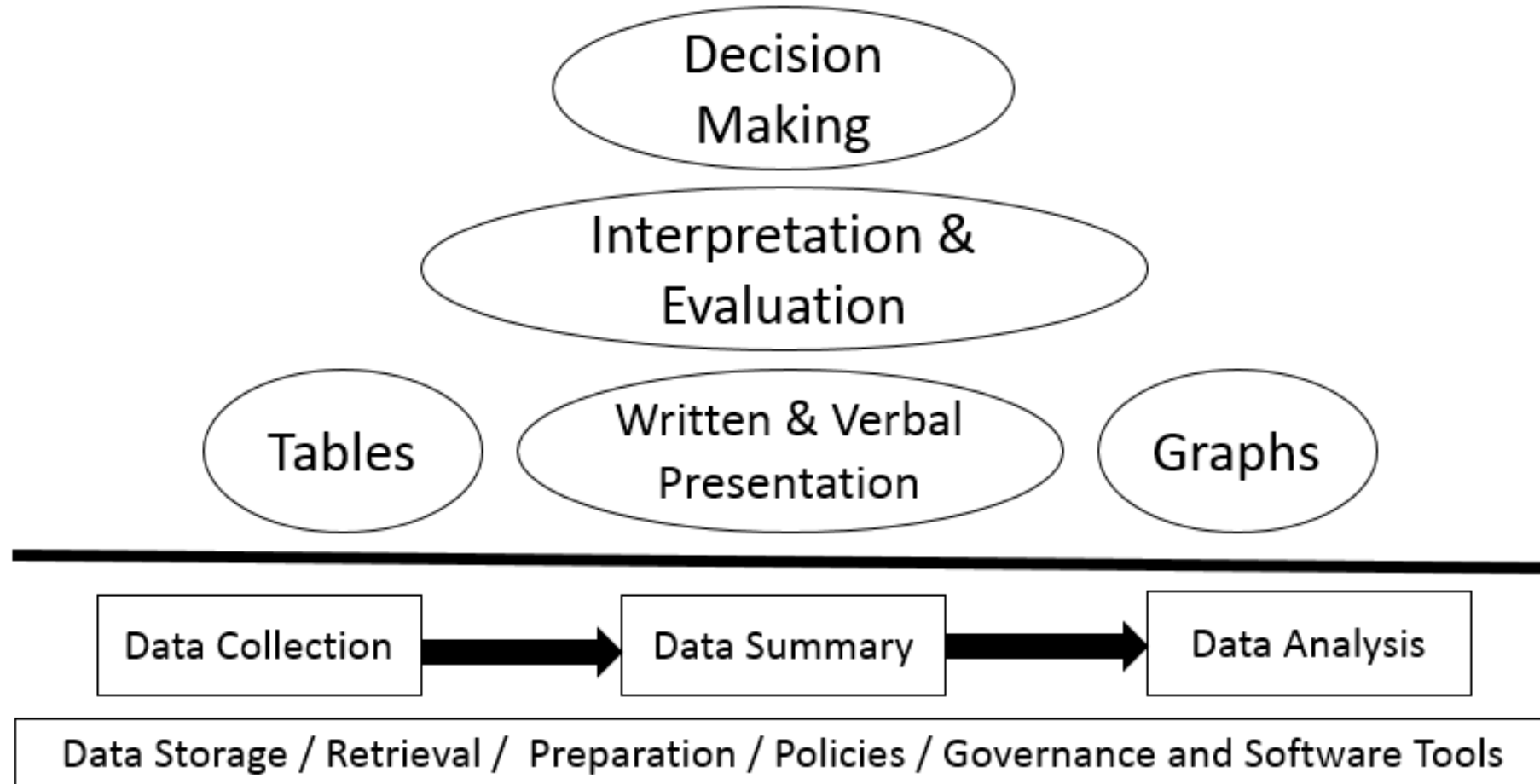
# Fluency with #'s Requires Critical Thinking



# Data Literacy Pyramid

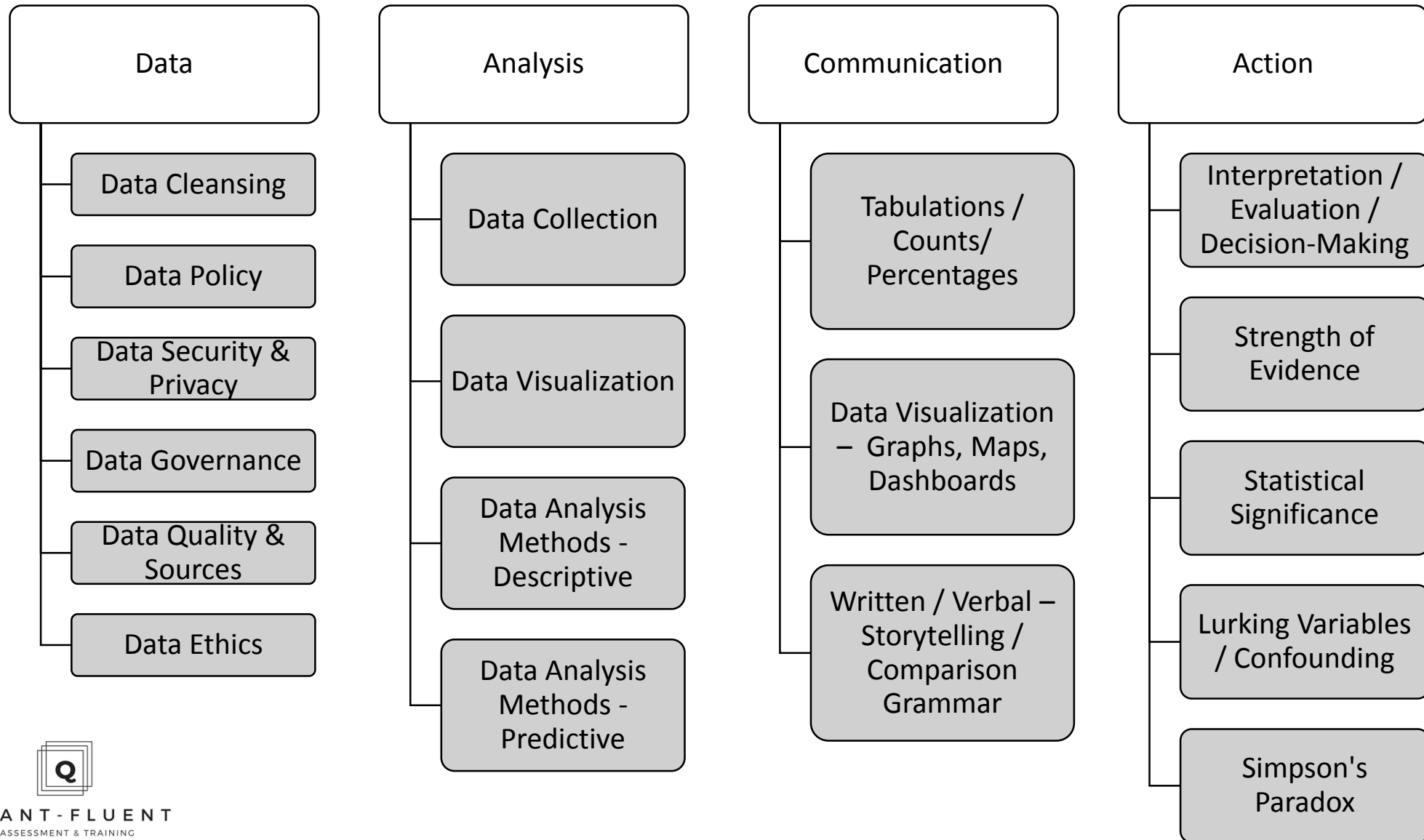


# Statistical and Data Literacy Competency Map





# Data & Statistical Literacy Competency Map



# Statistical Literacy



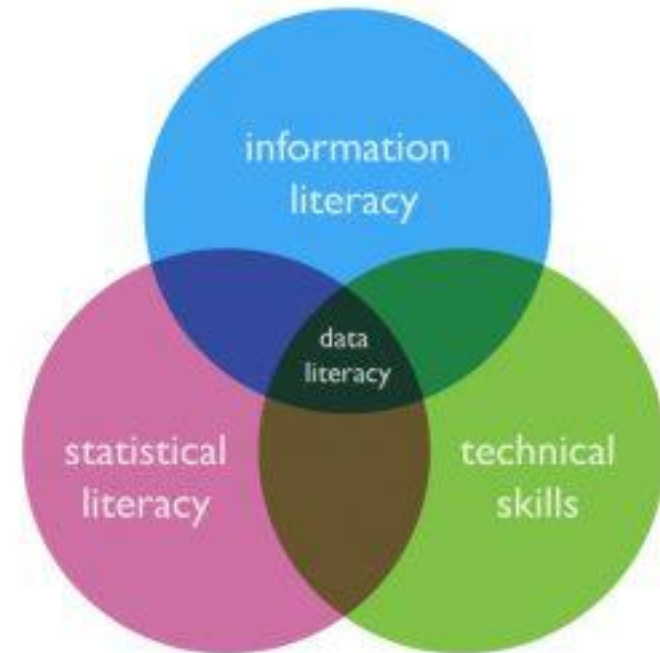
# Statistical Literacy

Statistically literate: able to read, interpret and evaluate statistics as evidence in arguments

Audience is consumers: those who use statistics to make decisions

What are the two most fundamental ideas?

1. Statistics are numbers in context
2. All statistics are socially-constructed.



# Statistics: numbers in context

Statistics are  
numbers in context;  
**the words matter!**

Numbers: 6 plus 7 =  
13

$60\% + 70\% = 130\%$

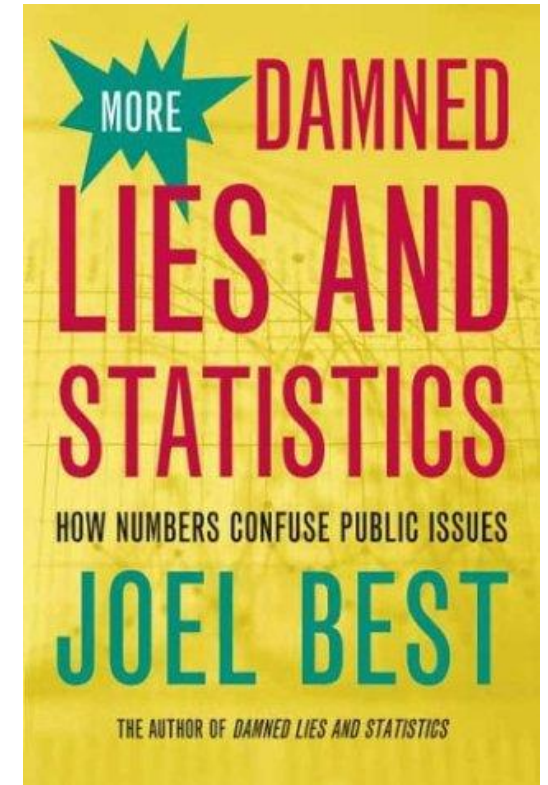
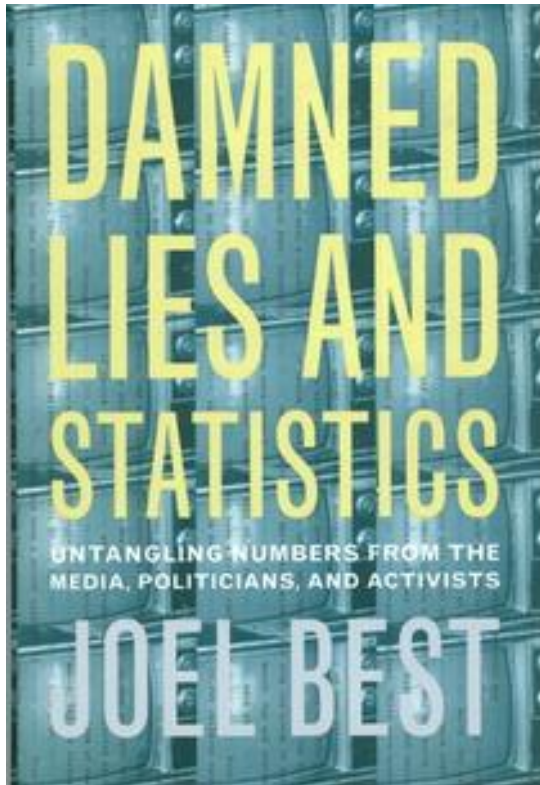
Company has 60% market share on East half of  
US; 70% market share on West half.

What is their market share in the entire US?

130%? No! 'Market share' changes the context.

# Statistics: Socially Constructed

Statistics are like diamonds!



# Gatlinburg: \$95 / night

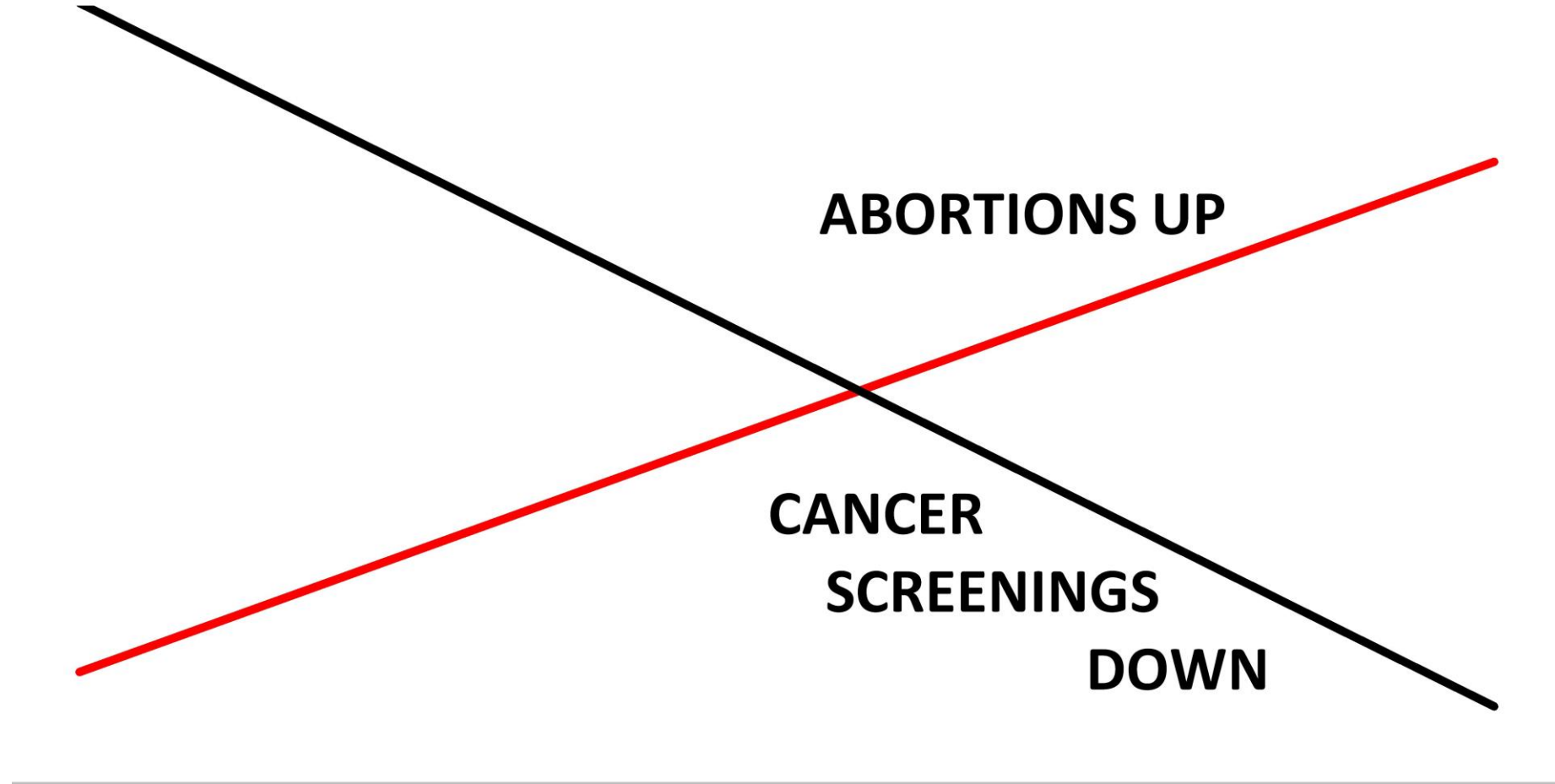


Avg rate per night

**\$95**

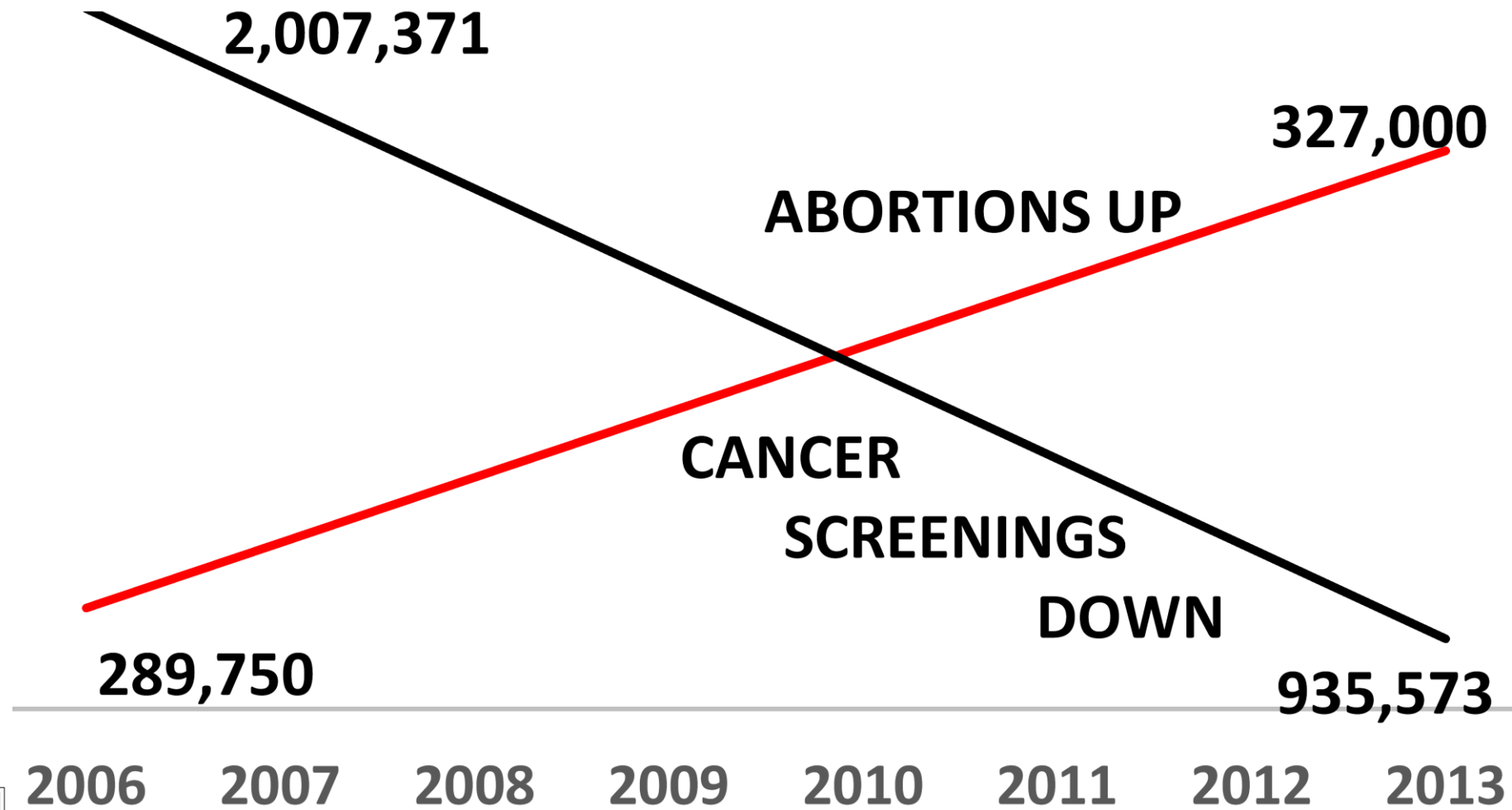
Excludes \$162.00 daily  
property fee

# Planned Parenthood

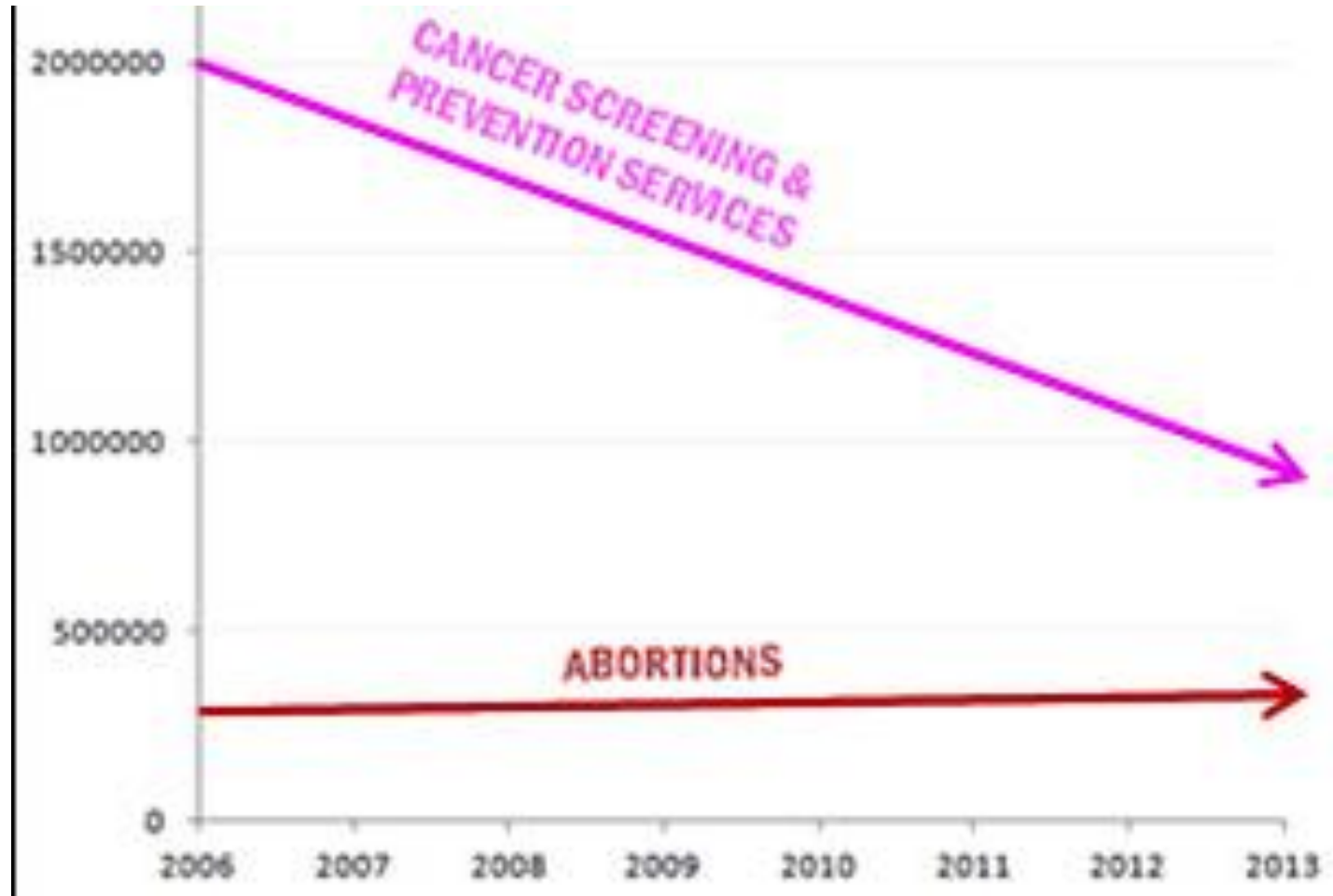




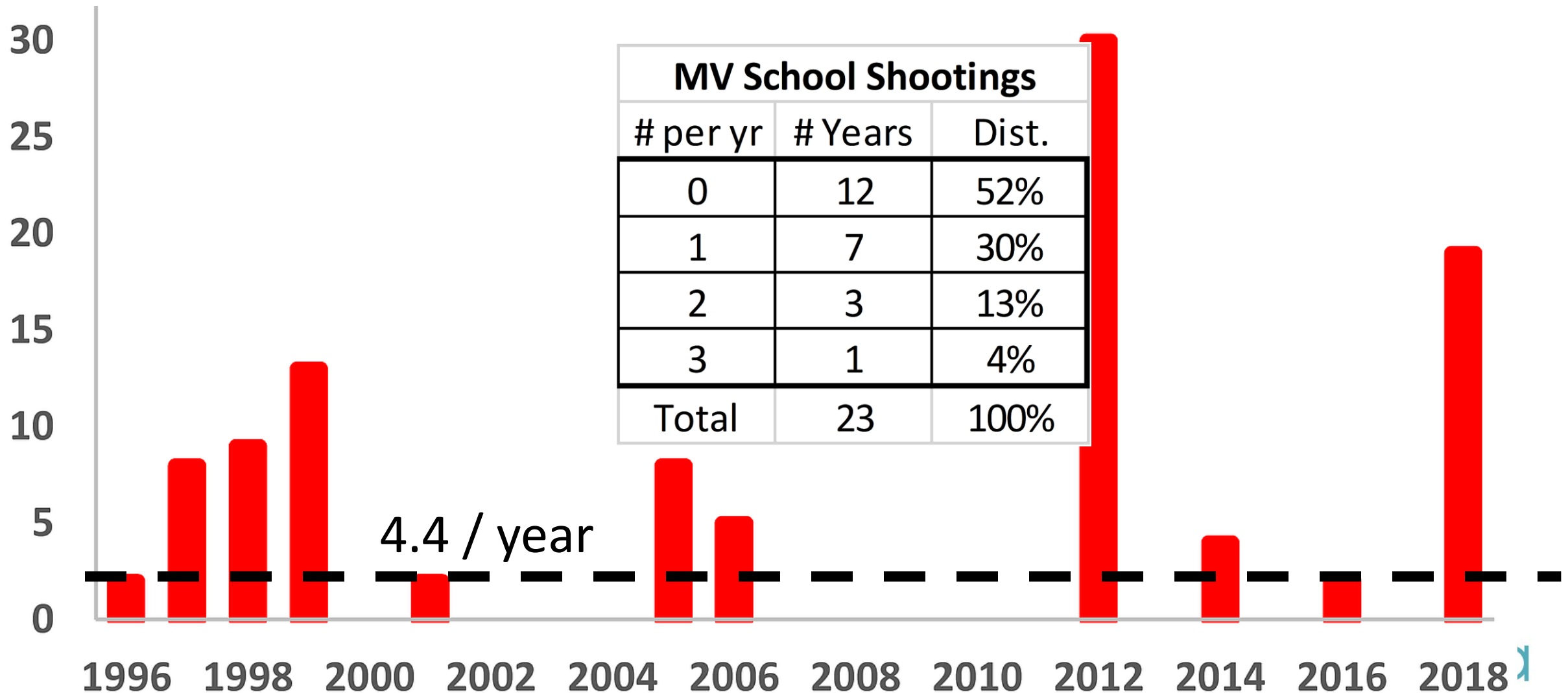
# Look Closely at the Numbers!



# Ask Questions

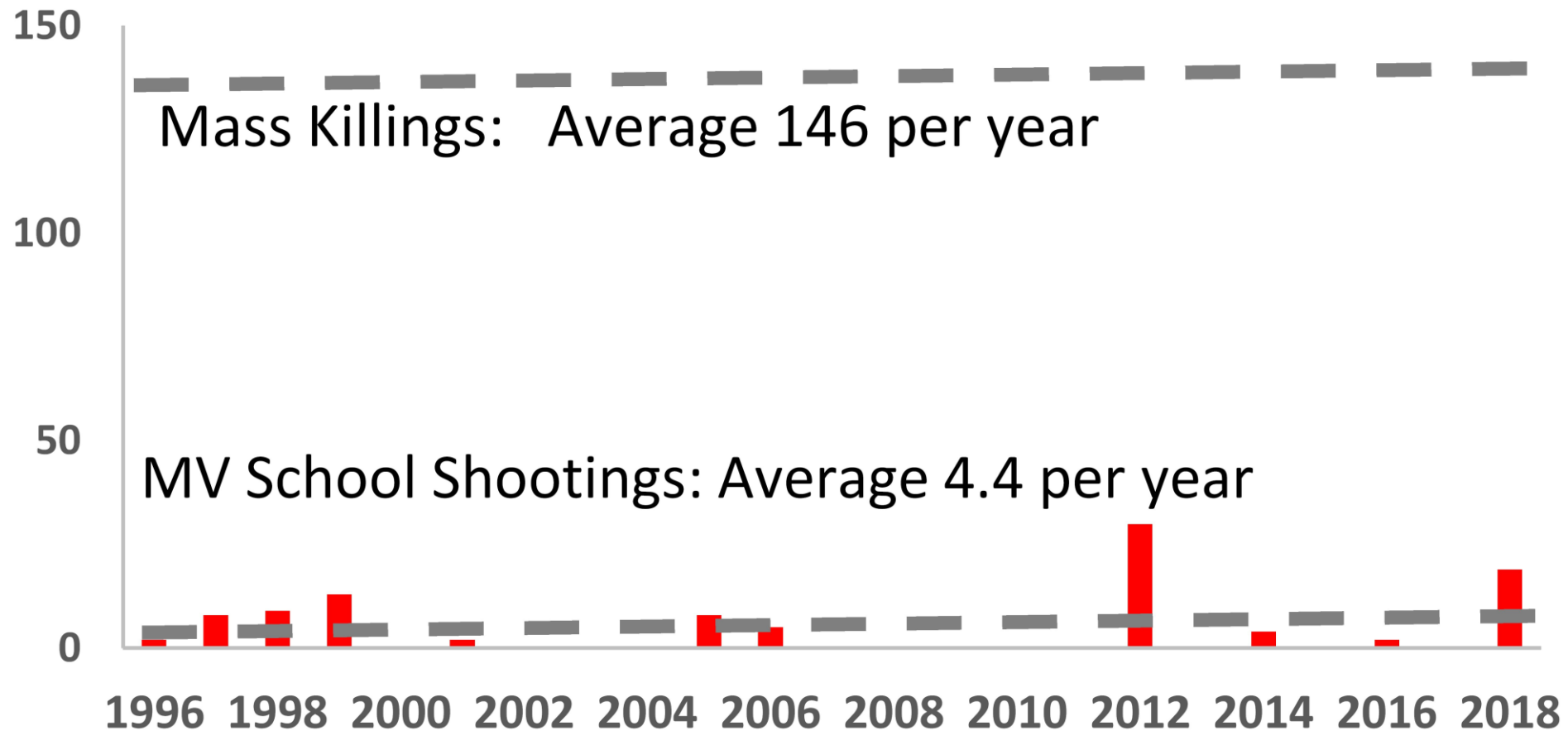


# Victims – MV School Shootings





# School Shootings, Mass Killings



# Statistical Literacy – An Art! Evaluate Strength of Evidence

Classify all the influences on a statistic into four groups:

**C: Context/confounding:** Study design; effect size; control for; ordinary English for rates, %.

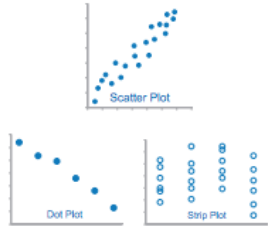
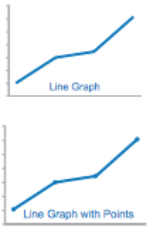

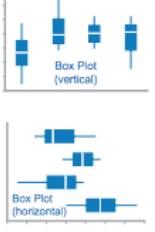
**A: Assembly:** definitions, groups and measures

**R: Randomness:** margin of error, statistical significance; Coincidence; Confounder effect on statistical significance

**E: Error or Bias** (subject, measurement and sampling)

# Data Visualization

# Graph Choice Chart

	Value-Encoding Objects			
	Points	Lines	Bars	Boxes
<b>Featured Relationships</b>				
<b>Time Series</b> Values display how something changed through time (yearly, monthly, etc.)	<b>Yes</b> (as a <i>dot plot</i> , when you don't have a value for every interval of time)	<b>Yes</b> (to feature overall trends and patterns and to support their comparisons)	<b>Yes</b> (vertical bars only, to feature individual values and to support their comparisons)	<b>Yes</b> (vertical boxes only, to display how a distribution changes through time)
<b>Ranking</b> Values are ordered by size (descending or ascending)	<b>Yes</b> (as a <i>dot plot</i> , especially when the quantitative scale does not begin at zero)	<b>Yes</b> (as a <i>bumps chart</i> , to show how rankings change through time)	<b>Yes</b>	<b>Yes</b> (to display a ranked set of distributions)
<b>Part-to-Whole</b> Values represent parts (proportions) of a whole (for example, regional portions of total sales)	No	<b>Yes</b> (to display how parts of a whole have changed through time)	<b>Yes</b>	No
<b>Deviation</b> The difference between	<b>Yes</b> (as a <i>dot plot</i> , especially when the	<b>Yes</b> (when also featuring a time series)	<b>Yes</b>	No

## Data Relationships

Time Series  
Ranking  
Part-to-Whole  
Deviation  
Distribution  
Correlation  
Geospatial  
Nominal

Source: Stephen Few, Perceptual Edge

# Displaying Quantitative Information

Purpose	Displays
Lookup	Lookup Report
Monitor	Explanatory Report
Exploratory Data Analysis	Infographic
Guided Data Analysis	Live Presentation
Narrative	Dashboard
	Analytical Application
	EDA Tool
	Predictive Model



# Group Activity

<http://tuva.la/2H4aJ6G>

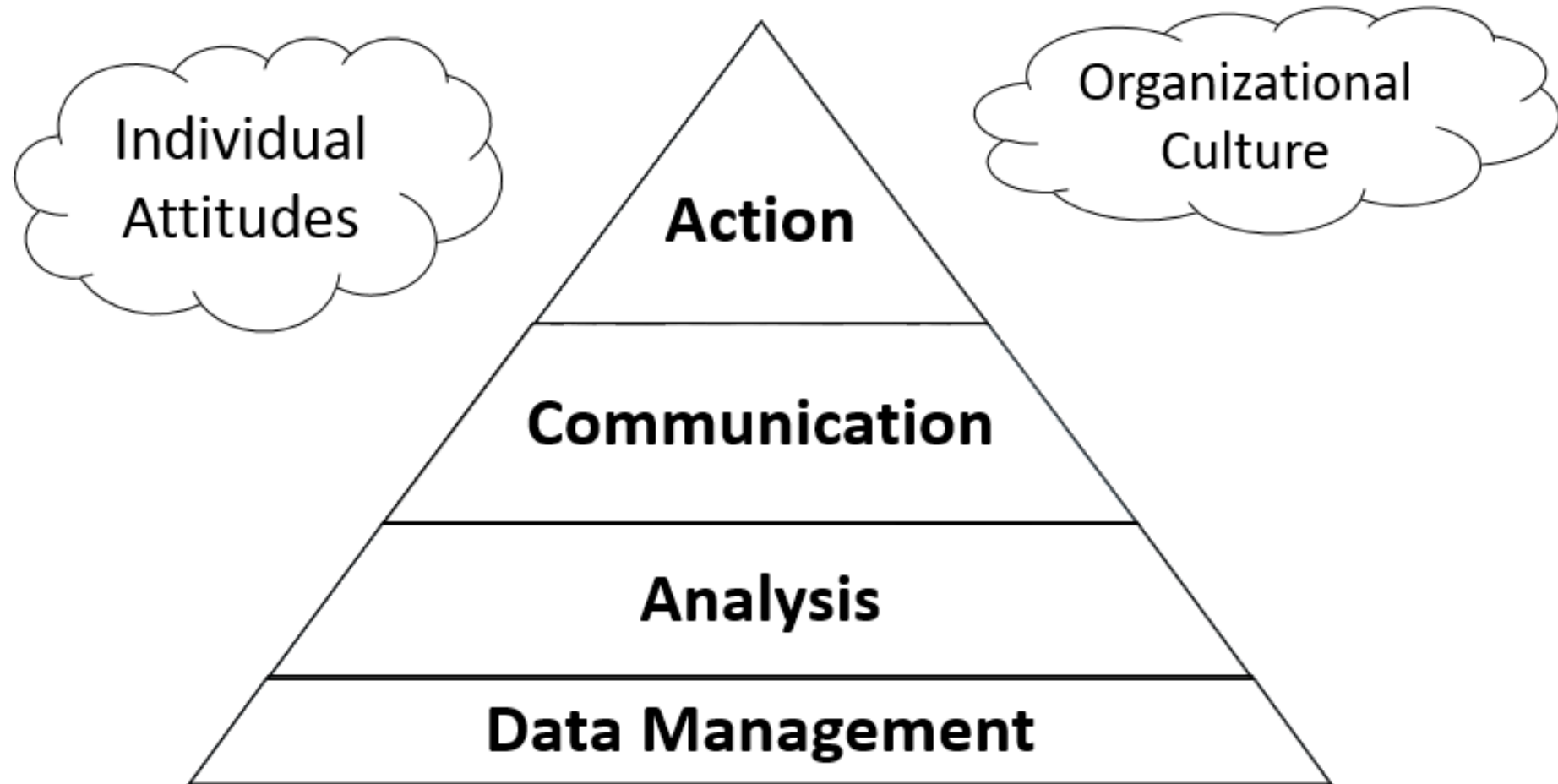
(Case Sensitive)

# BREAK

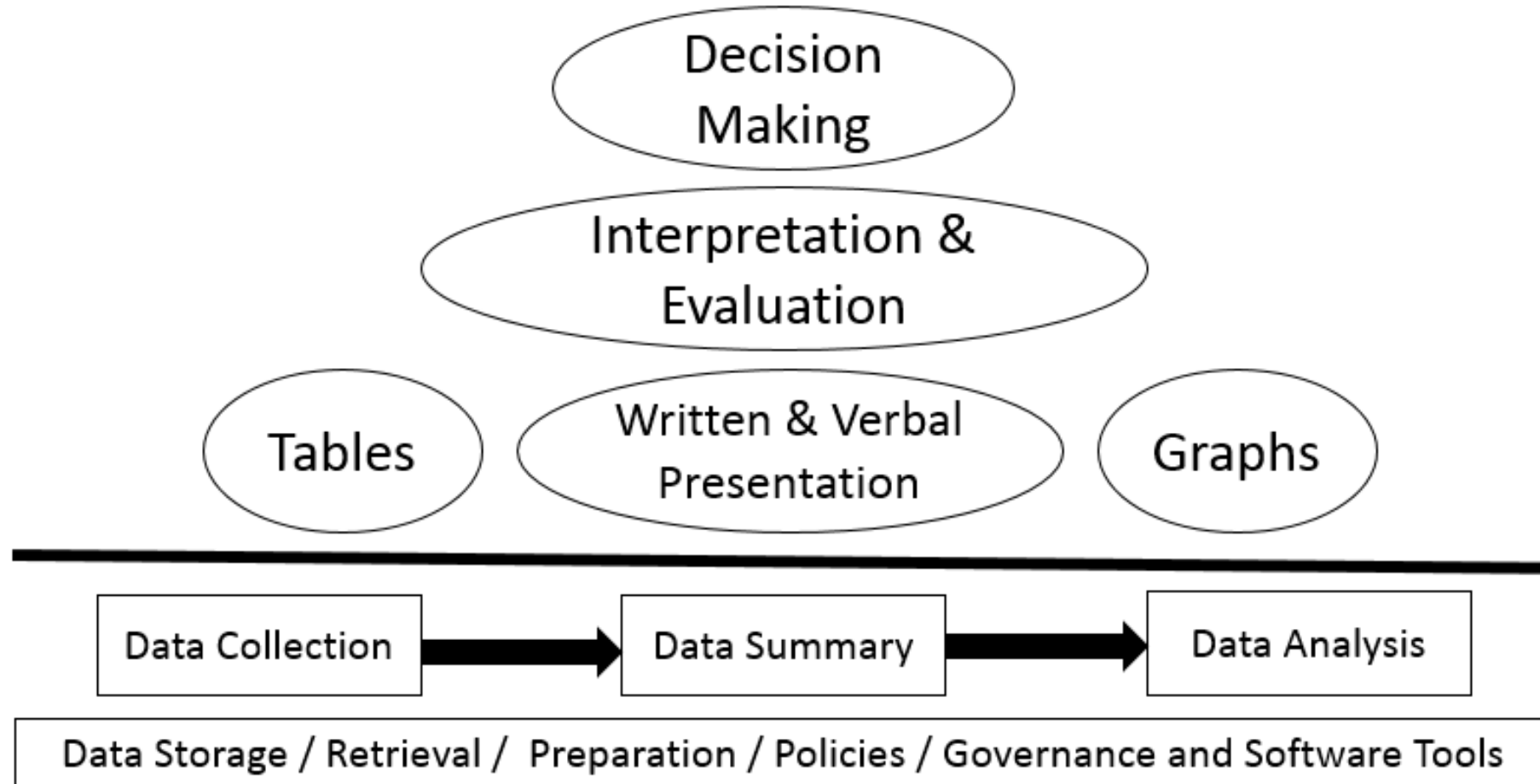
# Session II



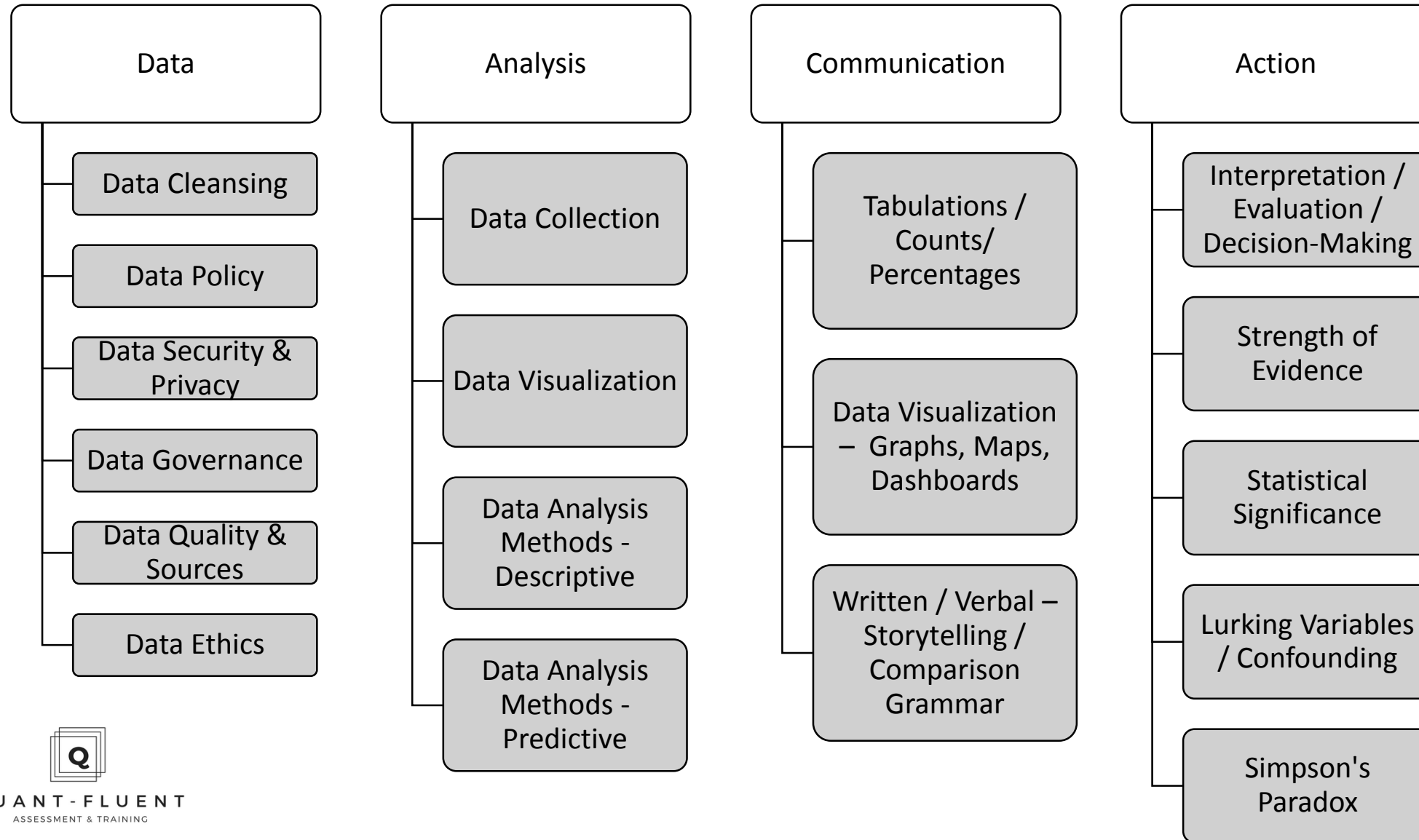
# Data Literacy Pyramid



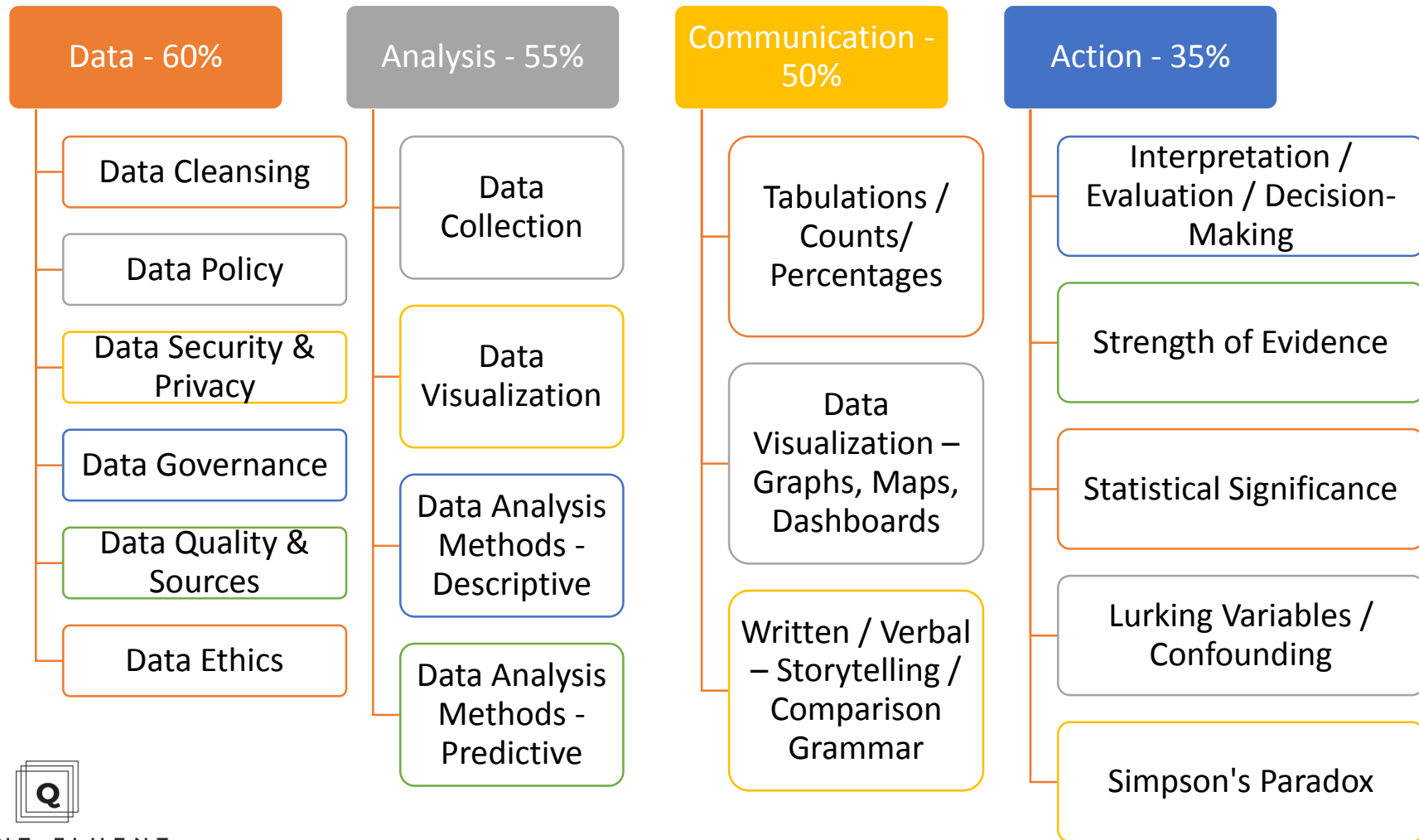
# Statistical and Data Literacy Competency Map



# Data & Statistical Literacy Competency Map



# Sample Diagnostic Assessment Report



# Diagnostic Assessments

- Go to [gartnerdatasummit.tuvalabs.com](https://gartnerdatasummit.tuvalabs.com)
- Click on Sign Up
- Click on Gartner Data Summit – Sample Assessment
- Click on Enroll

# Solutions for Enterprises

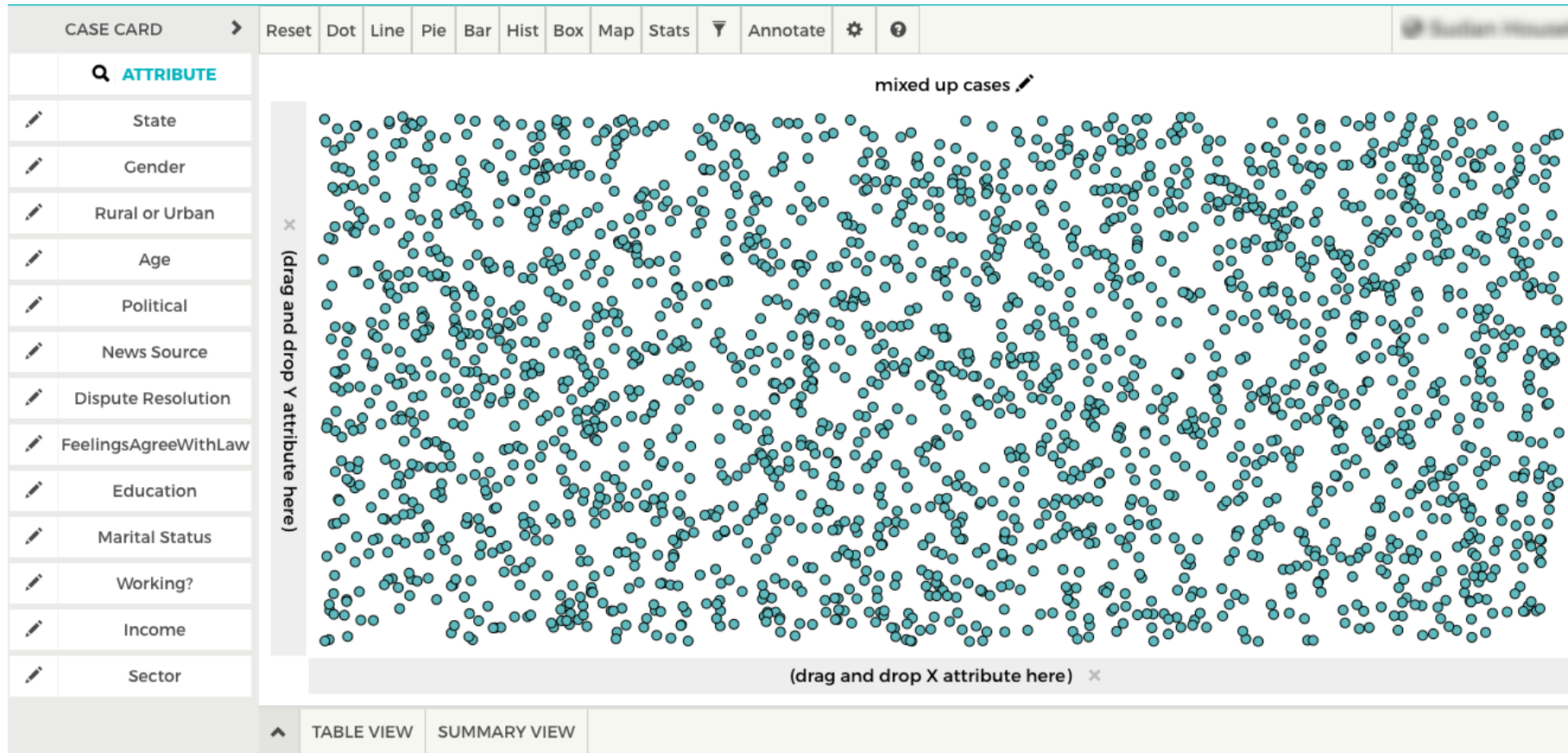
- Comprehensive Needs Assessment
- Design and Implementation of Data & Statistical Literacy Diagnostic Assessments
- Opportunities to Contextualize Based on Industry & Job Profile
- Data Analysis & Benchmarking

# Case Study – Consumer Goods





# Case Study – Public Sector





# Case Study – Corporate Social Responsibility

## San Francisco Unified School District partners with Tuva for Common Core Math and Next Generation Science Standards

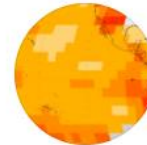
Partnership brings Tuva's data literacy platform to all middle and high school math and science teachers and over 25,000 students across the district

Showing 332 Results



### Global Change

6 Activities, Used by 435 Students  
Grades 6-8, 9-12



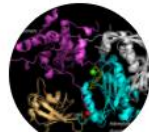
### Global Temperature Anomalies, 1880 - 2014

No Activities Yet  
Grades 9-12



### GMOs, Pesticides, and Bee Population in the US

2 Activities, Used by 371 Students  
Grades 9-12



# Q&A

# Thank You!

Harshil Parikh: [hsparikh@tuvalabs.com](mailto:hsparikh@tuvalabs.com)

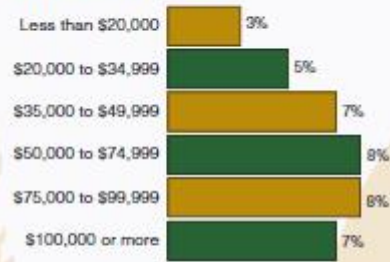
Milo Schield: [schild@augsborg.edu](mailto:schild@augsborg.edu)

Marc Isaacson: [marc@quant-fluent.com](mailto:marc@quant-fluent.com)

# Appendix:

# Assessment Item Issues

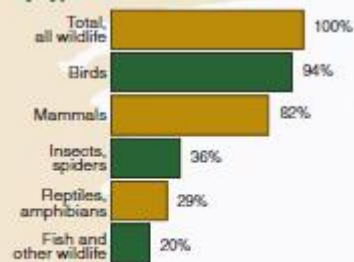
## Percent of U.S. Population Who Hunted by Household Income



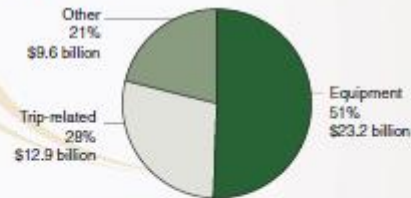
## Wildlife Watching

Wildlife Watchers (In millions)		
	Number	Percent
<b>Total participants</b>	<b>71.1</b>	<b>100</b>
<b>Away from home</b>	<b>23.0</b>	<b>32</b>
Observe wildlife	21.5	30
Photograph wildlife	11.7	16
Feed wildlife	7.1	10
<b>Around the home</b>	<b>67.8</b>	<b>95</b>
Feed wildlife	55.5	78
Observe wildlife	44.5	63
Photograph wildlife	18.8	26
Maintain plantings/natural areas	14.5	20
Visit public parks/areas	13.3	19

## Percent of Around-the-Home Observers by Type of Wildlife Observed

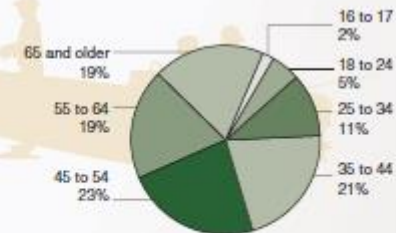
Away-From-Home Wildlife Watchers by Type of Wildlife Observed, Photographed, or Fed  
(In millions)

	Number	Percent
<b>Total, all wildlife</b>	<b>23.0</b>	<b>100</b>
Birds	20.0	87
Waterfowl	15.4	67
Birds of prey	14.0	61
Songbirds	13.7	60
Other water birds	11.5	50
Other birds	8.8	38
Land mammals	16.2	70
Fish	6.8	29
Marine mammals	2.4	15
Other (turtles, butterflies, etc.)	10.4	45

Wildlife-Watching Expenditures  
Total: \$45.7 billion

Average trip-related expenditures: \$560 per participant.  
Average trip-related expenditures: \$37 per day.

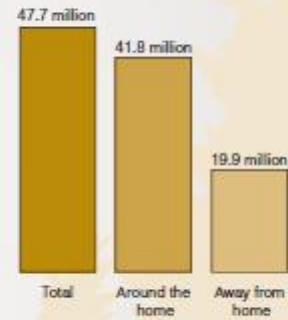
## Percent of Wildlife Watchers by Age



## Percent of U.S. Population Who Wildlife Watched by Household Income



## Bird Watchers



U.S. Department of Commerce  
Economics and Statistics Administration  
U.S. CENSUS BUREAU  
acting as collecting agent for the  
U.S. Department of the Interior  
FISH AND WILDLIFE SERVICE

Issued September 2007

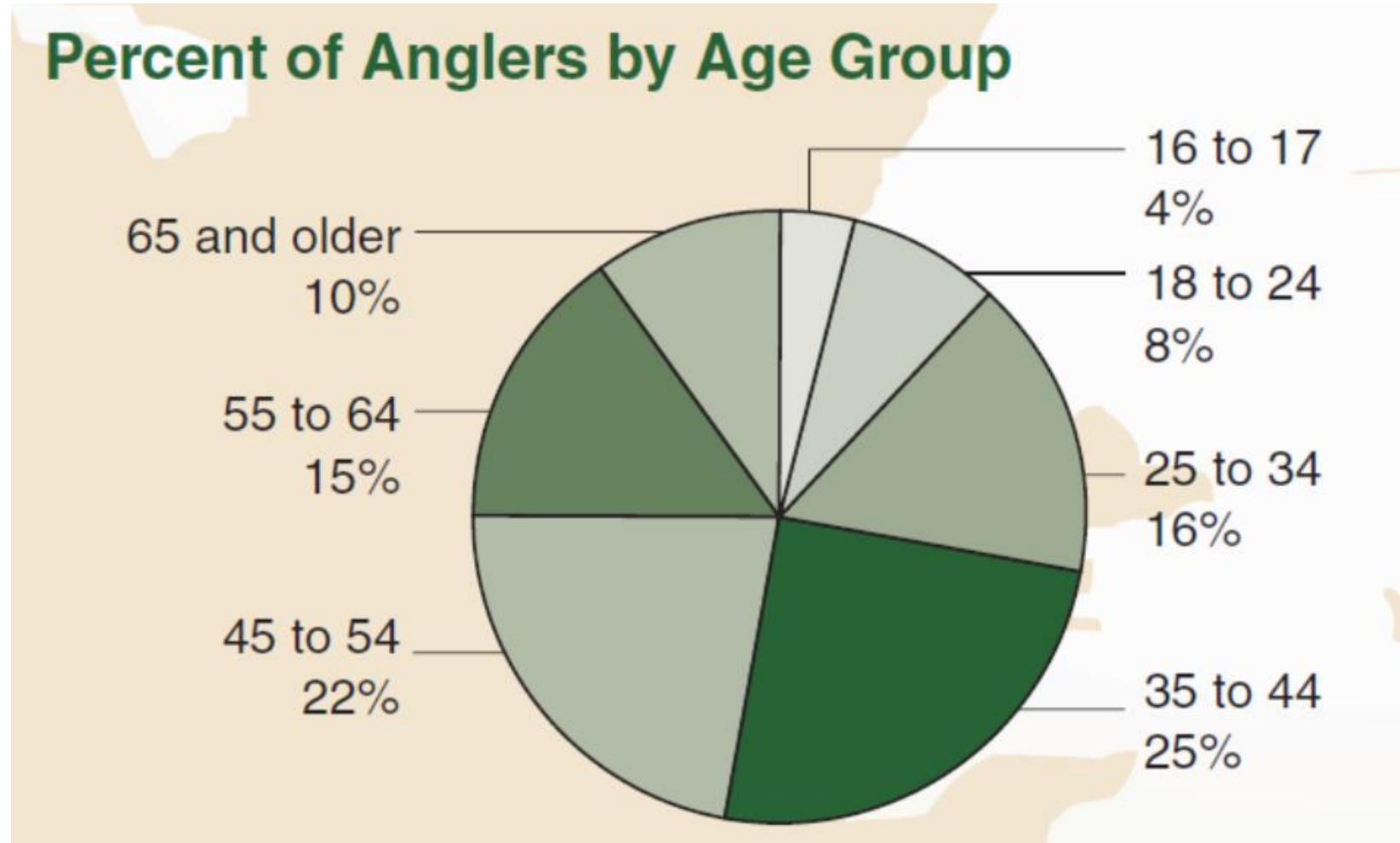
## Quick Facts

From the 2006 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation



Q: What Percentage of Anglers are 55 and older?

Q: What Percentage of Anglers are between 35 and 54?



# Reading / Interpreting Pie Charts

Q: What Percentage of Anglers are 55 and older?

Correct Answer: 25%

Results:

~ 97% Correct Answer

Q: What Percentage of Anglers are between 35 & 54?

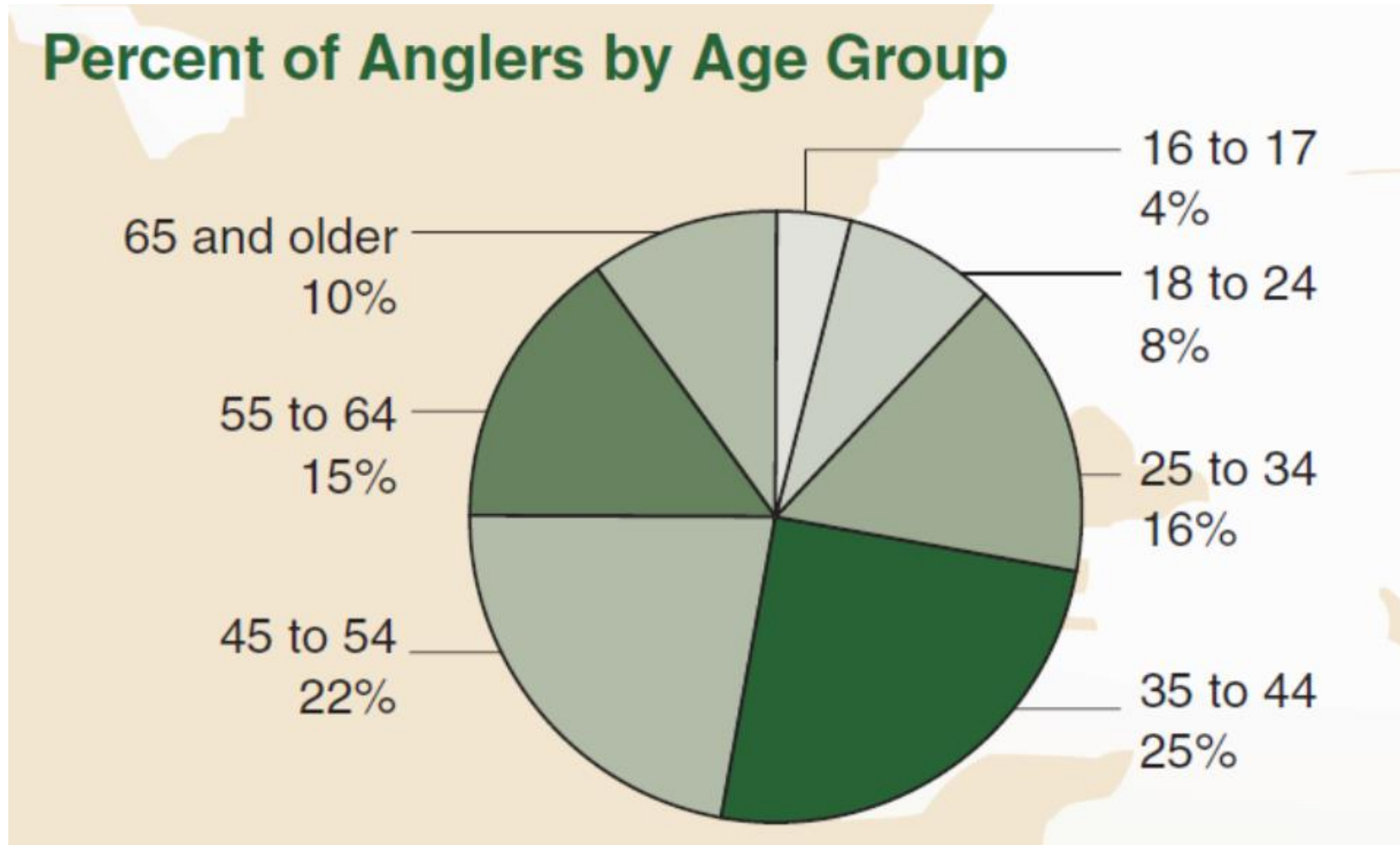
Correct Answer: 47%

Results:

~99% Correct Answer

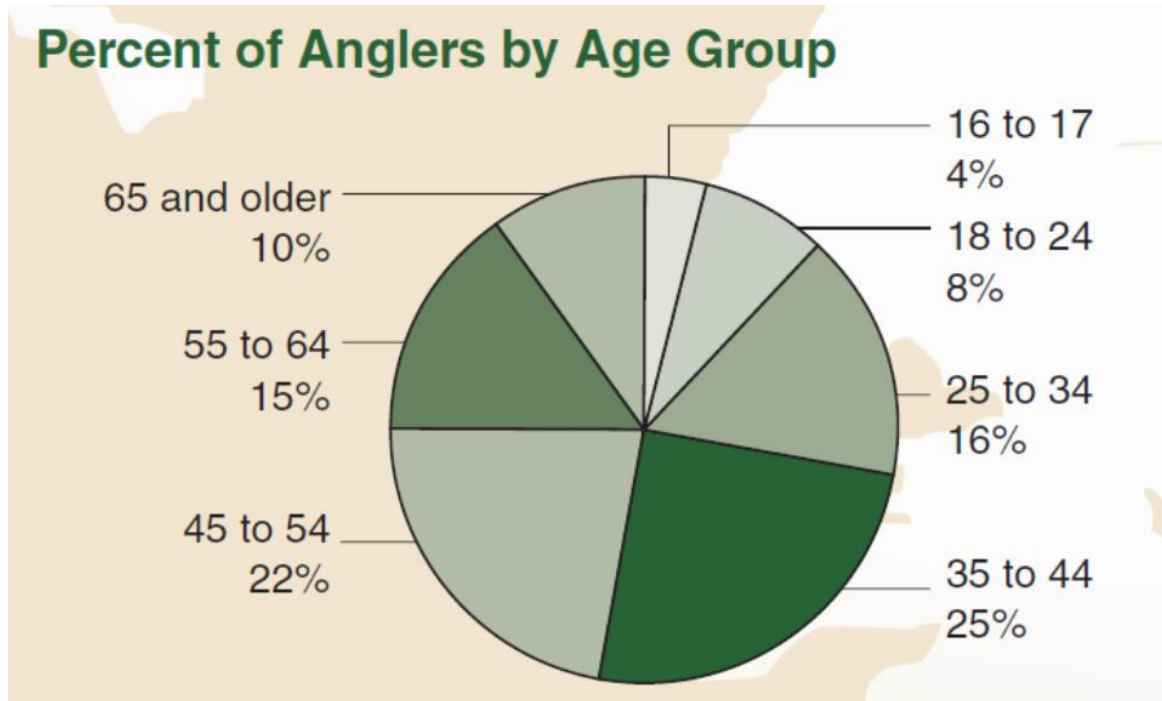


Q: What percentage of 18 to 24 year olds are anglers?





Q: What percentage of 18 to 24 year olds are anglers?



**Correct Answer:**

None of the Above

**Results:**

~ 30% Correct Answer

**Most Common Wrong Answer:**

8% (67% of responses)

# Reading Tables of Counts / Percents

## Anglers Pursuing Selected Fish by Type of Fishing

(In millions)

Fish sought	Number of anglers	Percent
Anglers, total . . . . .	30.0	100
<b>Freshwater except Great Lakes . . . .</b>	<b>25.0</b>	<b>83</b>
Black bass . . . . .	10.0	33
Panfish . . . . .	7.5	25
Catfish/bullhead . . . . .	7.0	23
Trout . . . . .	6.8	23
<b>Great Lakes . . . . .</b>	<b>1.4</b>	<b>5</b>
Walleye, sauger. . . . .	0.5	2
Perch . . . . .	0.5	2
Salmon . . . . .	0.4	1
Lake trout. . . . .	0.3	1
<b>Saltwater . . . . .</b>	<b>7.7</b>	<b>26</b>
Flatfish (flounder, halibut) . . . . .	2.1	7
Red drum (redfish) . . . . .	1.8	6
Sea trout . . . . .	1.5	5
Striped bass . . . . .	1.4	5

Q: What percentage of Great Lakes anglers fished for perch?

Possible Answers:

- a. 0.5% or below
- b. 2%
- c. 5%
- d. 36% or more
- e. None of the above



# Reading Tables of Counts / Percents

## Anglers Pursuing Selected Fish by Type of Fishing

(In millions)

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Sea trout . . . . .	1.5	5
Striped bass . . . . .	1.4	5

Q: What percentage of Great Lakes anglers fished for perch?

Correct Answer: d. 35% or more

$$.5 / 1.4 = 35.7\%$$

$$2\% / 5\% = 40\%$$

### Results:

Only ~ 19% answer correctly

### Most Common Wrong Answer:

2 Percent: 76% of responses



# Reading Tables of Counts / Percents

Remember: Math + Words = “Tricky”

There are 2 True Statements:



36% of all Great Lakes anglers fish for perch.

2% of all anglers fish the Great Lakes for perch.

Lesson: Slight changes in wording can have a big impact

Q: Compare the number of days spent Freshwater fishing vs. days spent Saltwater fishing

## Fishing

### Anglers and Days of Fishing

(In millions)

	Anglers		Days	
	Number	Percent	Number	Percent
<b>Total fishing . . . . .</b>	<b>30.0</b>	<b>100</b>	<b>517</b>	<b>100</b>
Freshwater, total . .	25.4	85	433	84
Freshwater, except				
Great Lakes . . .	25.0	84	420	81
Great Lakes . . . .	1.4	5	18	3
Saltwater . . . . .	7.7	26	86	17

# Task: Compare 433 million to 86 million

## Fishing

### Anglers and Days of Fishing

(In millions)

	Anglers		Days	
	Number	Percent	Number	Percent
<b>Total fishing . . . . .</b>	<b>30.0</b>	<b>100</b>	<b>517</b>	<b>100</b>
Freshwater, total . .	25.4	85	433	84
Freshwater, except				
Great Lakes . . .	25.0	84	420	81
Great Lakes . . . .	1.4	5	18	3
Saltwater . . . . .	7.7	26	86	17

Fact:

Words + Numbers = “Tricky”

How many correct answers?

Minimum: 10 different ways

# Task: Compare 433 million to 86 million

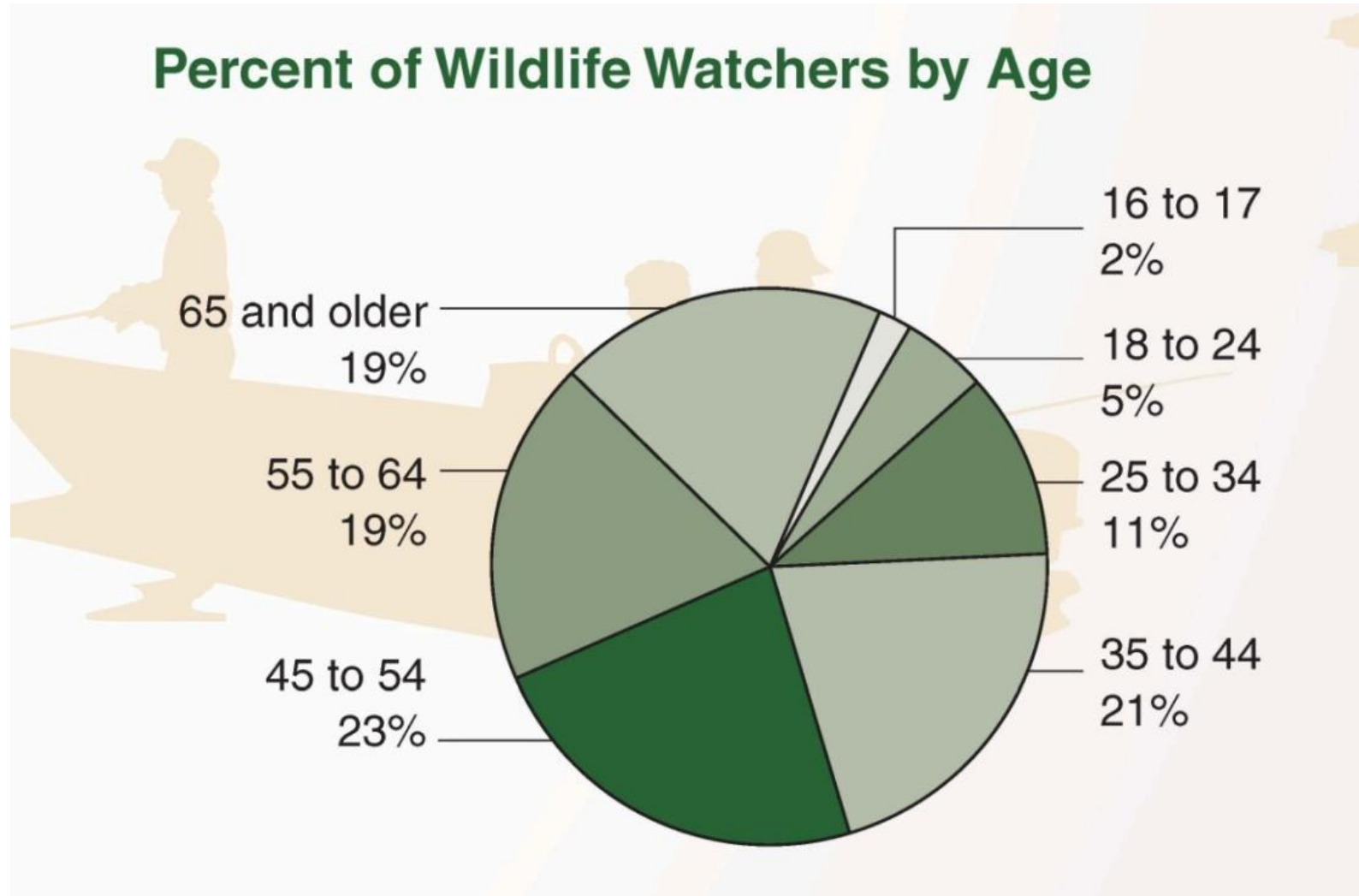
1. There were 433 million freshwater days and 86 million saltwater days.
2. There were more freshwater fishing days than saltwater days.
3. There were 347 million more freshwater fishing days than saltwater days.
4. There were ~5 times as many freshwater fishing days as saltwater.
5. There were ~400% more freshwater fishing days than saltwater.
6. There were ~4 times more freshwater days than saltwater days.

\* Flipping items 2-6 results in a total of 11 valid variations



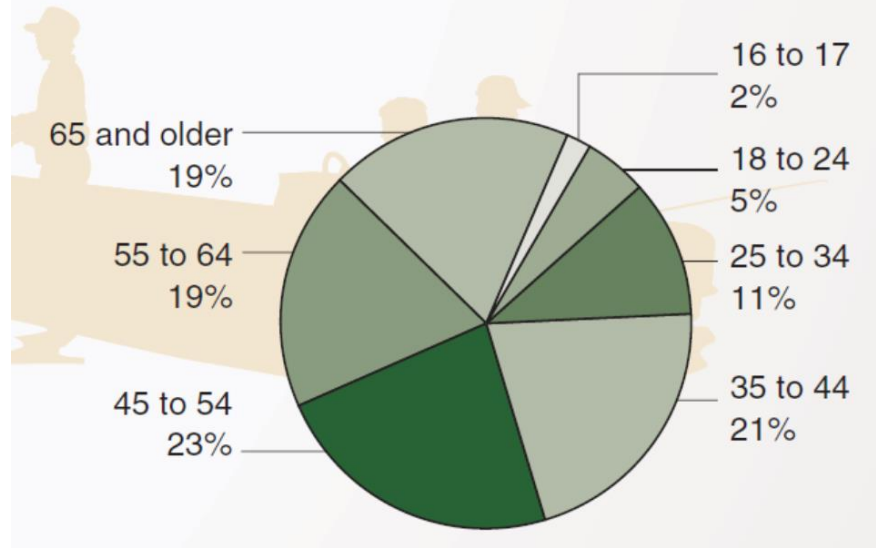
Q: What % of 35 to 44 year olds are wildlife watchers?

Q: What % of wildlife watchers are between 35 & 44 yrs of age?





Percent of Wildlife Watchers by Age



Q: What % of 35 to 44 year olds are wildlife watchers?

**Correct Answer:**

Can't Tell (with pie chart given)

**Results:** ~ 56% Correct

**Common Wrong Answer:**

21% (38% of groups)

Q: What % of wildlife watchers are between 35 & 44 yrs of age?

**Correct Answer:**

21%

**Results:** ~ 87% Correct

**Common Wrong Answer:**

Can't Tell (6% of groups)

# Data / Statistical Literacy Development Cycle

## Before Deploying More Analytics Technology:



- Assessment of Literacy Skills needed at all levels of your organization (current and future)
- Measure Current Status of your organization using Objective Assessments
- Implement needed actions to close gaps across the organization
- Repeat cycle to assess progress.