Visualization, Intro

MGT 100 Week 1

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Dog==Draymond AKA Dray AKA Click Clack AKA Major Jealous

Cat==Captain Kitty AKA Liquid AKA Hunter AKA Boomer

Data Visualizations (Viz)

- “The greatest value of a picture is when it forces us to notice what we never expected to see.”

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- Boxplot Inventor John Tukey
- Great visualizations raise new questions
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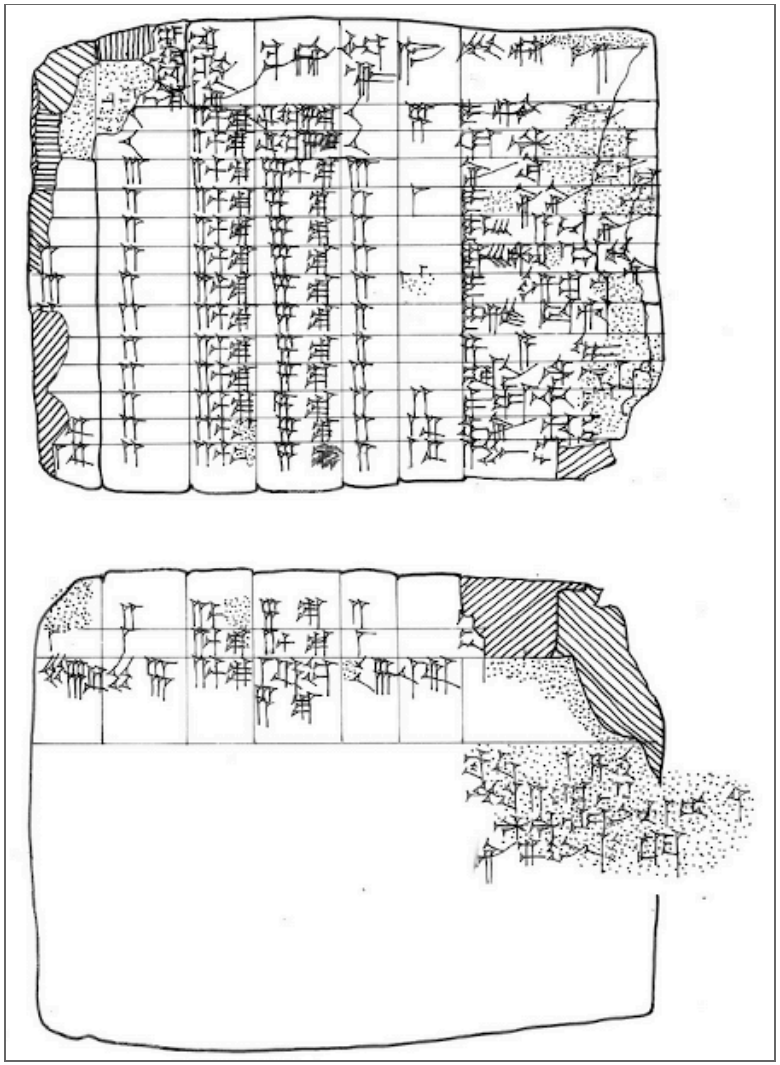
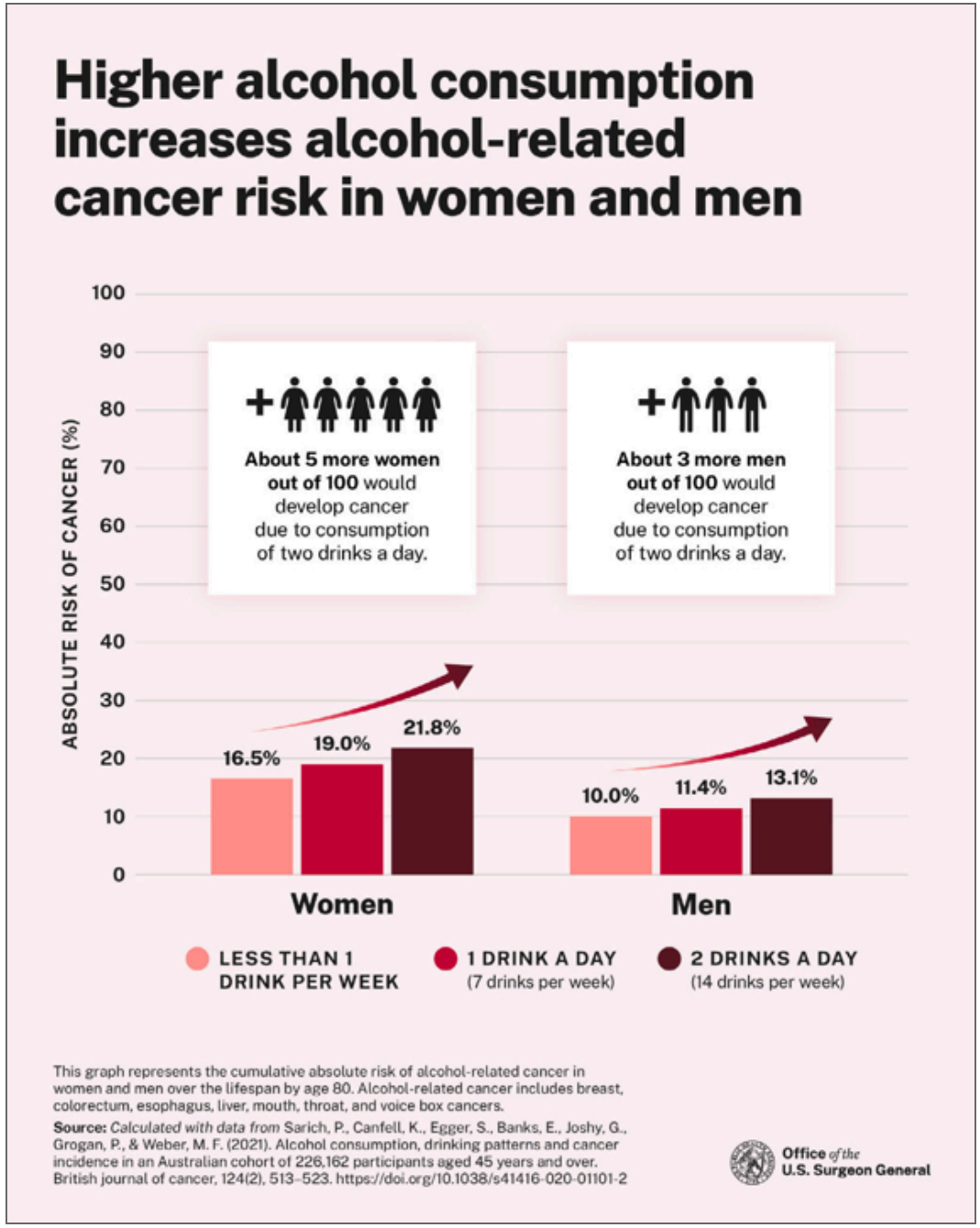
Data Viz are older than 0

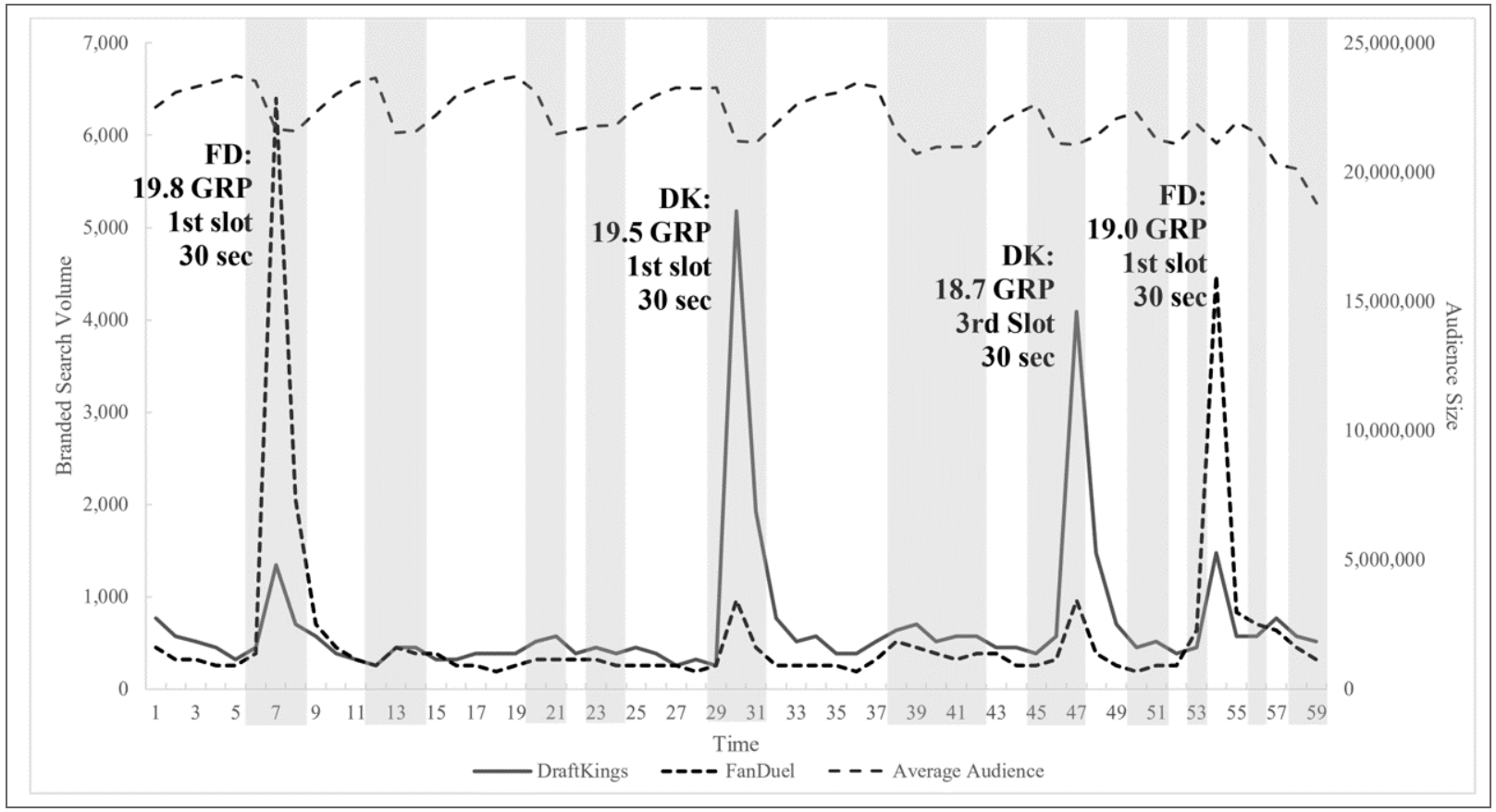


Translated

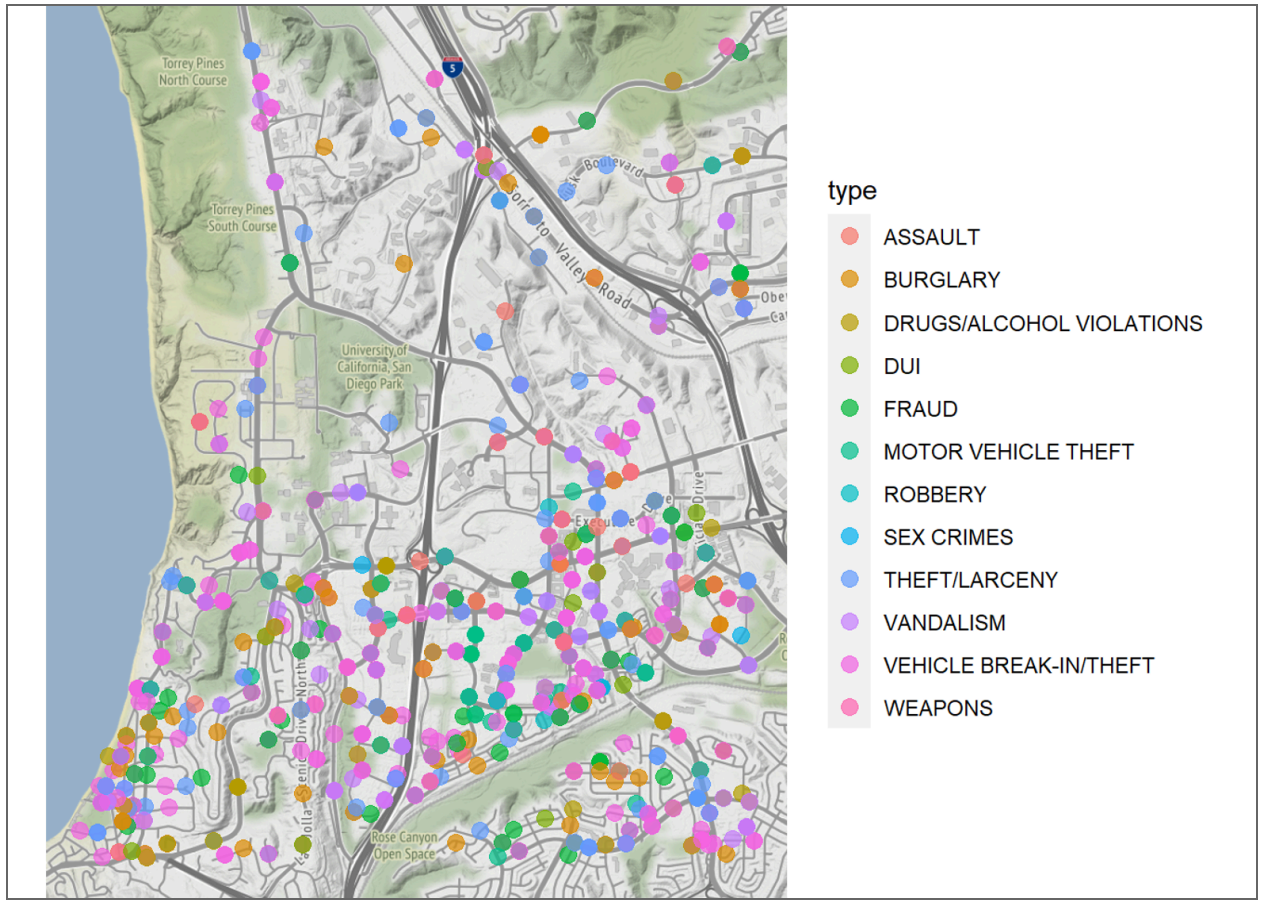
A	B	C	D	E	F	G
[15]	10	2½ s.	⅓ m. 5 s.	10	5	Igigi
[10]	10	2½ s.	⅓ m. 5 s.	10		Awat-Šamaš
[3]	3	2½ s.	7½ s.	3		Nidittum
[3]	2	2½ s.	5 s.	2	1	The sons of Ili-iddinam
[2]	2	2½ s.	5 s.	2		The sons of Ahuni
[2]	2	2½ s.	5 s.	2		The sons of Sin-šamuh
3	2	2½ s.	5 s.	2	1	The son of Imgurrum
2	2	2½ s.	5 s.	2		Isi-dare
[2]	2	2½ s.	5 s.	2		Zayyalum
[2]	2	2½ s.	5 s.	2		Silli-Ištar
[4]	2	2½ s.	5 s.	2	2	Paqatiya
[3] ⅓	2	2½ s.	5 s.	2	1⅓	Perhum
[3] ⅓	2	2½ s.	5 s.	2	1⅓	Abum-ili
[2]	2	2½ s.	5 s.	2		[*Sin-ašareda*]
[1]	1	2½ s.	[2½ s.]	1		Aplum
57 [⅔]	46	2½ s.	1⅚ m. 5 s.	46	11⅔	
Tašritum (Month VI), [day...]						
Year: the third after Isin was destroyed by the great weapons of An, Enlil and Enki						

A = "Troops, available assets"
B = "Those who were sent *from* Sin's dyke"
C = "Earth, the (daily) work assignment of 1 man"
D = "Its earth"
E = "Check made"
F = "Arrears"
G = "Its name"


Higher alcohol consumption increases alcohol-related cancer risk in women and men
ABSOLUTE RISK OF CANCER (%)
100
90
80
70
60
50
40
30
20
10
0
About 5 more women out of 100 would develop cancer due to consumption of two drinks a day.
About 3 more men out of 100 would develop cancer due to consumption of two drinks a day.
16.5%
19.0%
21.8%
10.0%
11.4%
13.1%
Women
Men
LESS THAN 1 DRINK PER WEEK
1 DRINK A DAY (7 drinks per week)
2 DRINKS A DAY (14 drinks per week)
This graph represents the cumulative absolute risk of alcohol-related cancer in women and men over the lifespan by age 80. Alcohol-related cancer includes breast, colorectum, esophagus, liver, mouth, throat, and voice box cancers.
Source: Calculated with data from Sarich, P., Canfell, K., Egger, S., Banks, E., Joshy, G., Grogan, P., & Weber, M. F. (2021). Alcohol consumption, drinking patterns and cancer incidence in an Australian cohort of 226,162 participants aged 45 years and over. British journal of cancer, 124(2), 513-523. https://doi.org/10.1038/s41416-020-01101-2
Office of the U.S. Surgeon General


FD:
19.8 GRP
1st slot
30 sec
DK:
19.5 GRP
1st slot
30 sec
DK:
18.7 GRP
3rd Slot
30 sec
FD:
19.0 GRP
1st slot
30 sec
Branded Search Volume
Audience Size
Time
DraftKings
FanDuel
Average Audience

SDPD Crime Reports Near UCSD



- When is data zero vs. missing? Provenance is key
- What kind of decisions could this inform?

Data *Provenance*

- describes people, entities, and activities involved in producing, compiling, transforming & sharing data

  - Verifiability requires source data & cleaning scripts

- Crucial in determining quality, reliability, trustworthiness

  - Investigating provenance requires and deepens domain expertise
  - Typically turns up unexpected information, and sometimes errors

- When can you trust provenance information?

  - Best to treat provenance as hypotheses to be verified in the data
  - Usually, provenance descriptions are missing or imperfect
  - Financial info is most likely to be accurate due (accounting, auditing)
  - Considerations: Consent; Privacy; Missingness; Permissible uses
  - Sometimes, provenance descriptions are marketing documents

Questions to ask

- Data Origin, Measures, Quality, Verifiability
    - How were the data produced?
    - Who collected it, when and why?
    - How is each variable measured? (surveys, APIs, sensors, etc; units)
    - Is there a data dictionary or changelog?
    - How can I verify individual datapoints?
    - Certified by any third party? Who relies on them, for what?
- Processing & Transformation
    - What cleaning or manipulation was done?
    - Who performed it and why? Can I see their scripts?
    - Were missing values imputed? How?
    - How were outliers handled?

Viz can build trust, understanding

- Eyeballs can interpret pictures quickly

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- Human brains are great at interpreting visual patterns, predictions
- Can detect unknown errors
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- Understandable to managers

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- Viz choices enable narrative understanding, another common brain function
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- Viz are *lingua franca* across disciplines

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- Easily replicated -> more easily trusted
- Trust can is a major issue in some corporate cultures
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- Viz succeed when they raise deeper questions

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- Asking the next question indicates acceptance
- "I wonder why that is...." or "Maybe that's because..."
- Viz usualy won't settle the matter; hence, the first step
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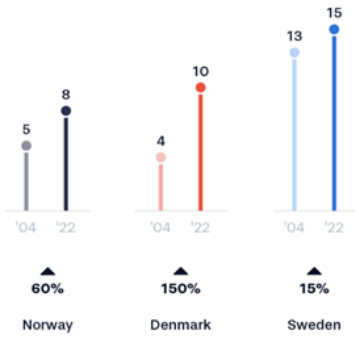
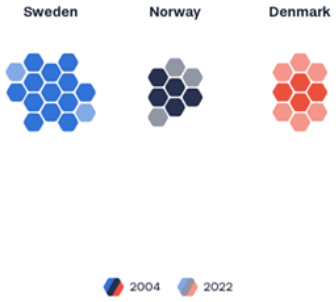
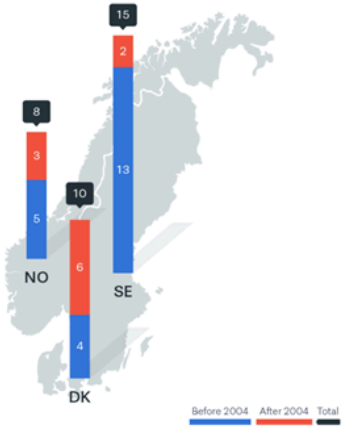
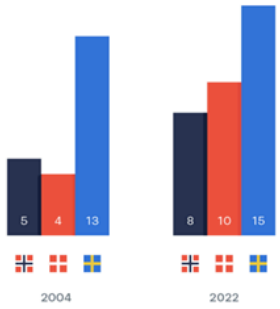
Number of World Heritage Sites

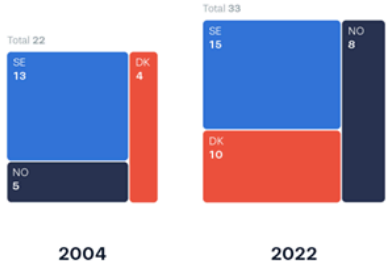
	Norway	Denmark	Sweden
2004	5	4	13
2022	8	10	15





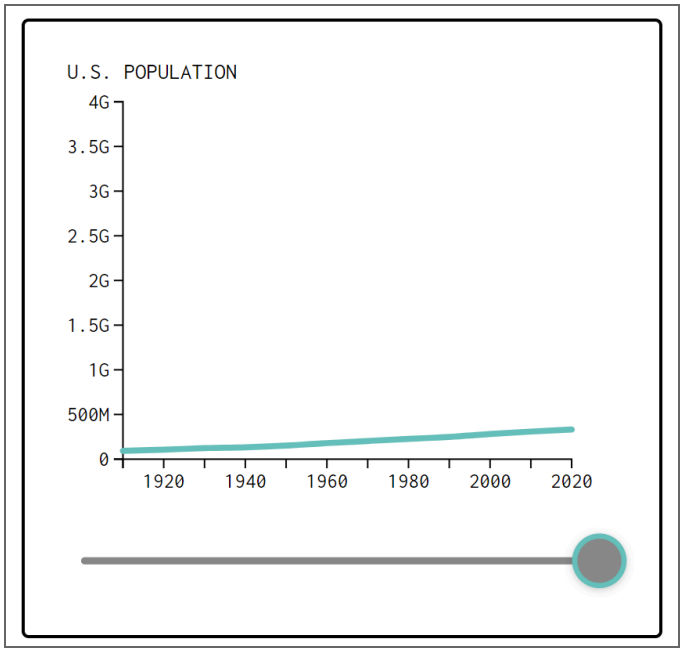






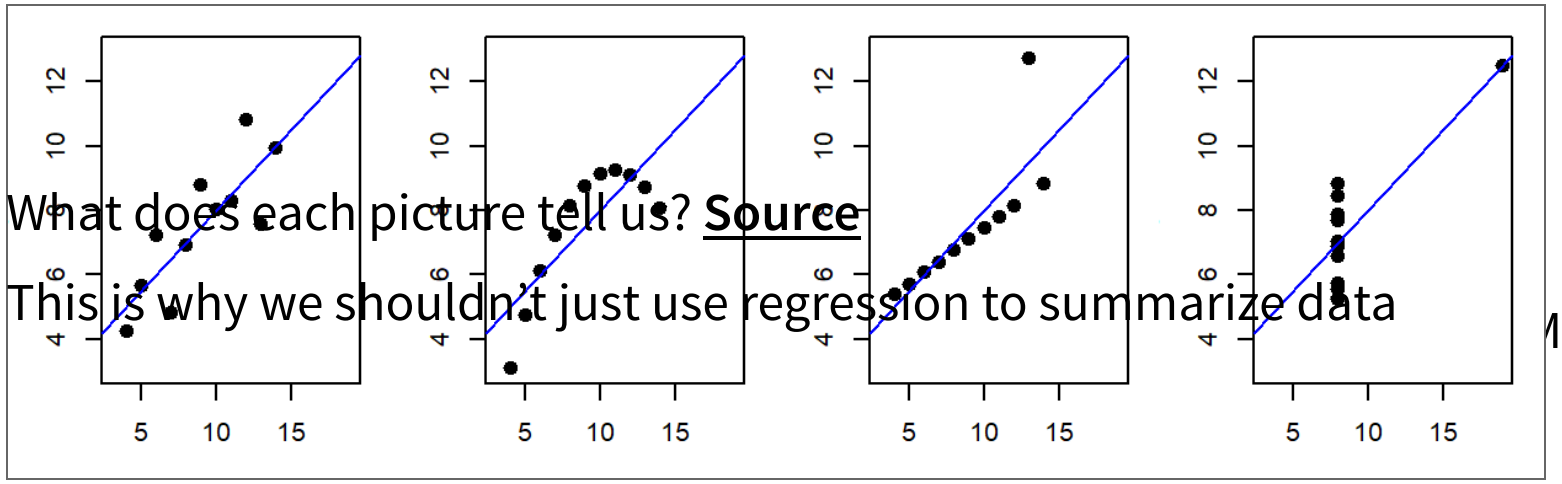
Honest Viz

1. Usually start axes from 0, choose scales judiciously
2. Show all relevant data, label accurately. Don’t edit, trim
3. Discretize and smoothe judiciously



Visualize data before you analyze

- 4 Datasets, Same $\hat{\beta}^{OLS}$, i.e. same $\frac{x'x}{x'y}$



- What does each picture tell us? **Source**
- This is why we shouldn't just use regression to summarize data

M. EST

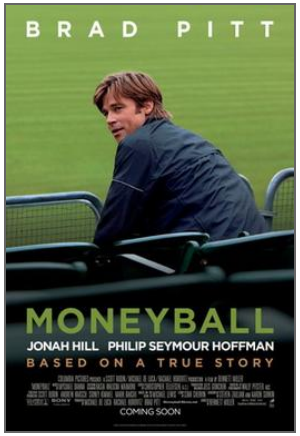
Customer Analytics

Customer

- Receives good or service in exchange for payment (money, time, attention)
- Has agency: Can say “no”
- “The purpose of business is to create and keep a customer.”
  -Drucker

Analytics

- Using data to improve decisions
- Started by Charles Taylor in the 1880s (mostly)
- Popularized by *Moneyball* (2011)
- Measurement, Heuristics, Graphics, Models, Predictions, Automation, Optimization, Personalization, …
- Can be deceptively difficult



First Law of Customer Analytics

- No Customers, No Business
- No Customers ->
  No Revenue ->
  No Profit ->
  No Business
  QED

Second Law of Customer Analytics

- More Customers, More Profits
- More Customers ->
  More Revenue ->
  More Profit
  QED

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- These are empirical tendencies, not logical necessities
- Individual customers can be unprofitable if (price-cost)<0
```

- Marketing Objective: Maximize Long-term Profits

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- Long-term focus mostly aligns our interest with customers
- Goal is not only to acquire customers; also, keep and develop them
- Sidesteps or reduces most ethical dilemmas
- Short-run objective may profit before liability; I won't teach
```

Example of Great Marketing: Netflix

- Consumer surplus

  - Suppose customer pays $20/month, watches 60 hours: $0.33 per entertainment hour, or $0.13/hour with ads, or less with shared accounts
  - A la carte rentals are more like $1-2+/hour
  - Non-video entertainment tends to be much more expensive
  - Social benefits may accrue from shared viewing
  - Other streaming services may be competitive

- Producer surplus

  - NFLX spent $13B on content in 2023, 230 million subscribers, about $4.70/user/month
  - Cost structure: High fixed, low marginal
  - Ads likely earning around $4-5 per recipient/month
  - Net profit margin about 20-22% in a competitive category

How can we use customer data?

- Businesses have 4, and only 4, ways to make money:
  Acquire, develop, retain and “fire” customers

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This is called Customer relationship management (CRM): week 9
```

- Marketing mix (“4 P’s”): Improve product offerings, prices, promotion, distribution
- Incorporate customer heterogeneity for targeting, personalization, recommendations, product development…
- Privacy and security, e.g. misuse, theft, regulatory compliance

Example: Nielsen

CONSUMER PANEL DATA

- The Consumer Panel Data include longitudinal data beginning in 2004 with annual updates. These data track a panel of 40,000–60,000 US households and their purchases of fast-moving consumer goods from a wide range of retail outlets across all US markets.

RETAIL SCANNER DATA

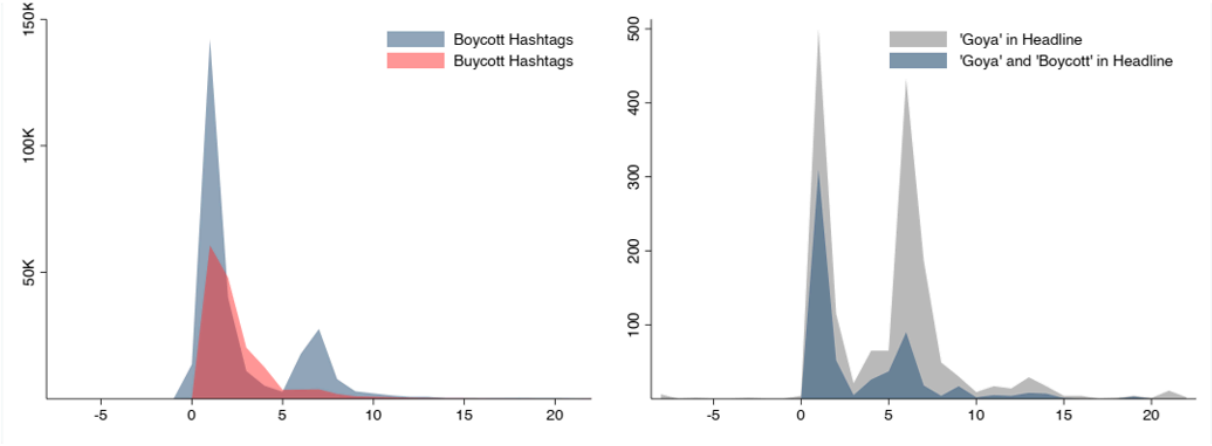
- Retail Scanner Data consist of weekly pricing, volume, and store environment information generated by point-of-sale systems from more than 90 participating retail chains across all US markets. Data begin in 2006 and include annual updates.

Figure 1: Images of Tweets Triggering Goya Boycott and Buycott

Figure 2: Goya Related Daily Tweets and Media Coverage in July 2020

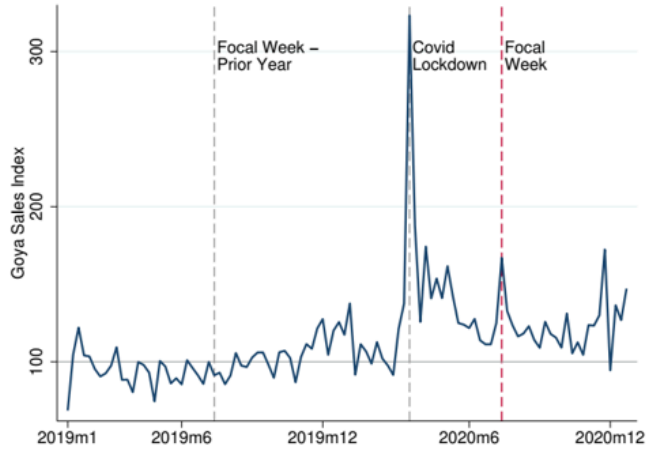
(a) Daily Tweets

(b) Daily Media Articles



Notes: Day 0 is July 9th, 2020. Panel (a) depicts the number of daily tweets in July 2020 that use boycott- or buycott-related hashtags. Web Appendix A.3 details the classification procedure and Table A1 lists the hashtags. Panel (b) plots the number of daily media articles that include 'Goya' and 'Boycott' in the headline. Only 18 articles included buycott related keywords so they are not depicted. In both panels, the second spike is triggered by President Trump and his daughter's tweets in support of Goya.

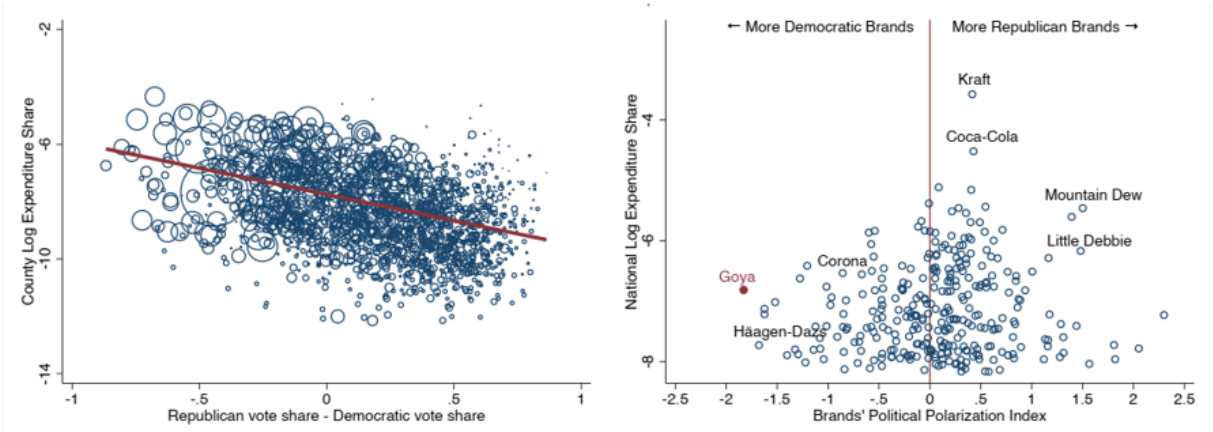
Figure 3: Total Weekly Spending Index on Goya Products



Notes: This figure depicts weekly spending index on Goya products from 2019-2020. The pre-pandemic sales average is normalized to 100. The red vertical dashed line indicates the focal week of the scandal (July 9-15). The spike and subsequent dip in November 2020 is due to bunching in purchases around the Thanksgiving holiday. Please see Appendix B.8 for a replication of the sales trend using Nielsen RMS data.

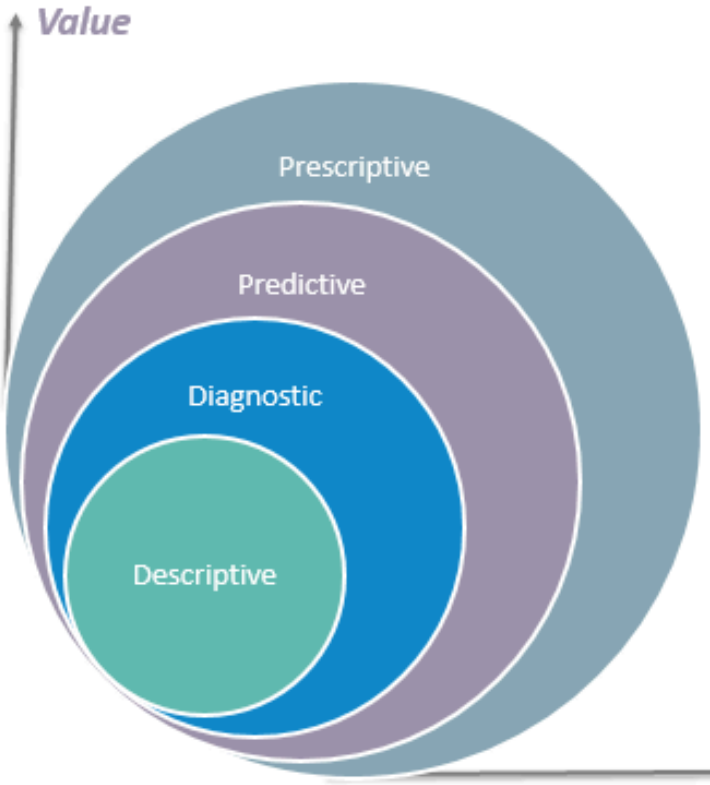
Figure 5: Polarization in Brand Popularity: Goya vs Other Top Brands

(a) Goya Market Share and Vote Margin **(b)** Polarization of Goya and Other Top Brands



Notes: Panel (a) depicts the relationship between Goya's log expenditure share in a given county in 2019 and the vote margin in that county. The size of the bubble is proportional to the number of panelists in a given county. Panel (b) plots the estimated political polarization index for each of the top 301 CPG brands. The index quantifies the extent to which the market share of a brand varies with political preferences. Goya's national expenditure share is 0.11% (the log of its national expenditure share is −6.81). See Web Appendix A.1 for more detail.

4 types of Data Analytics



What is the data telling you?

Descriptive: ***What's happening in my business?***

- Comprehensive, accurate and live data
- Effective visualisation

Diagnostic: ***Why is it happening?***

- Ability to drill down to the root-cause
- Ability to isolate all confounding information

Predictive: ***What's likely to happen?***

- Business strategies have remained fairly consistent over time
- Historical patterns being used to predict specific outcomes using algorithms
- Decisions are automated using algorithms and technology

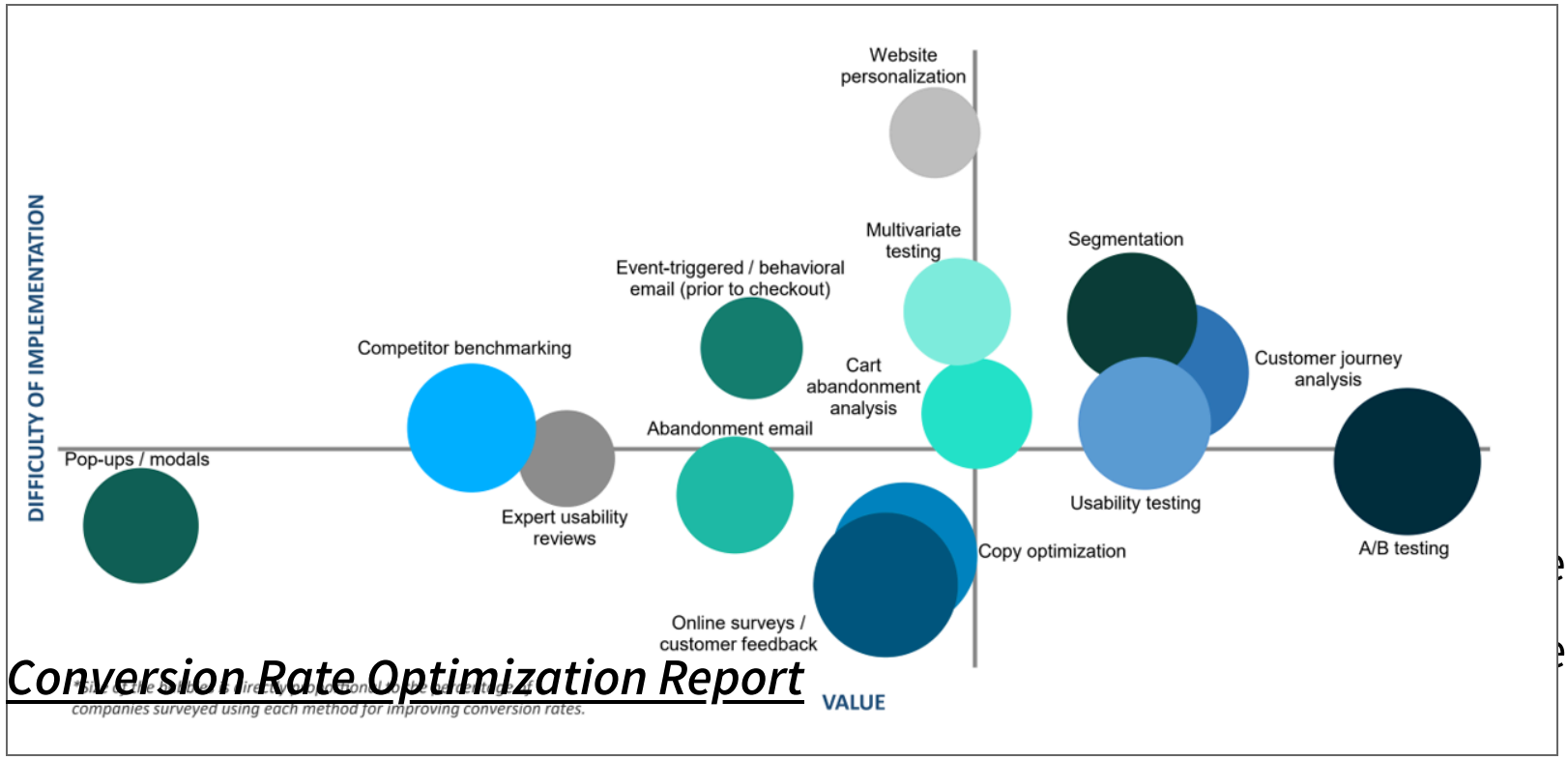
Prescriptive: ***What do I need to do?***

- Recommended actions and strategies based on champion / challenger testing strategy outcomes
- Applying advanced analytical techniques to make specific recommendations

Principa
www.principa.co.za


E-commerce Funnel
Acquire Users
Activate Users
Convert Users
Retain Customers
Facilitate Next Purchase
Get a Referral

E-commerce Analytics



- ers?
- egies

Conversion Rate Optimization Report

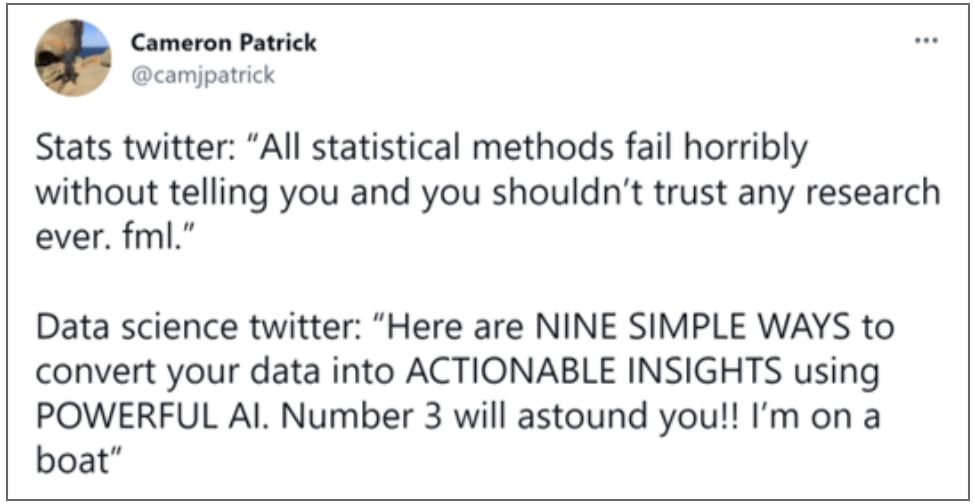
Using Customer Data for Customer Analytics

How do we “do” customer analytics?

- Decide objectives & outcome metrics
- Collect, wrangle, clean & verify relevant data
- Analyze data
- Communicate analyses and recommendations
- Make decisions
- Implement data-driven decisions
- Retrospectively evaluate and improve
- Repeat
- …Once you have a stable process, automate carefully & monitor

Challenges: Executives

- May be territorial, or incentivized to be
- May worry that analytics will constrain or replace them
- May think data == magic
- May prefer hunches or misunderstand uncertainty



Challenges: Analysts

- Expensive
- Hard to find
- Not always current
- Not always interested in business

Challenges: Cultural

- Do analytics make or justify decisions?
- High- or low-trust environment? Tolerance for uncertainty?

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- You have limited credibility. You may only get a few strikes
```

- Do messengers get rewarded or shot?
- Are data available and integrated?
- Do teams work together or compete?

Signs of a great analytics org

- C-level champion(s), i.e. C{D,E,A,F,M,O}O
- Centralized team regulates data, arch., standards & tools
- Decentralized analysts collaborate with execs
- Analytics career tracks are well established
- Careful in-housing/outsourcing decisions about analytics
- Good examples?

Analytics truisms

- Analytics matters more in B2C than B2B (why?)
- Selection effects are usually large

```
treatment effects are usually small
Key exceptions: Price or "free" giveaways
```

- Demographics don’t predict behavior very well
- Agencies lie about data sometimes
- “If it’s written in LaTeX, it’s probably correct”

MGT 100

- I am assuming you read the syllabus carefully

Course Design Principles

- Survey the field broadly, pointers for deeper learning
- Focus on conceptual understanding:
  “When it comes to LLMs, skillful prompting leaves amateurs in the dust.”
- Strict communication policies

```
1. Website for class content
2. Canvas for study groups & grades
3. Piazza for all asynchronous interaction. No email or canvas messages
4. After class, break or office hours for live discussions
```

- **Course site & schedule**

Gen AI effects on productivity

Pulling up the ladder

Impact of generative AI on the gap between high- and low-performing workers

Study	Topic	Inequality
Peng et al. (2023)	Coding efficiency	↓
Brynjolfsson, Li and Raymond (2023)	Customer chat	↓
Noy and Zhang (2023)	Writing quality	↓
Dell'Acqua et al. (2023)	Product design	↓
Chen and Chan (2023)	Ad effectiveness	↓
Choi, Monahan and Schwarcz (2023)	Legal analysis	↓
Otis et al. (2023)	Profits and revenue	↑
Roldan-Mones (2024)	Debating points	↑
Toner-Rodgers (2024)	Material discovery	↑
Kim et al. (2024)	Investment decisions	↑

Source: *The Economist*

Tips to max your learning

- Read the syllabus carefully
- Attend and contribute as suggested in the syllabus
- Budget 5-10 hours/week
- Between classes:

```
1. Step through script carefully, understand everything.
2. Do homework questions on your own
3. Check homework with group, resolve differences
4. Monitor Piazza and read for the next class
5. Compile notes and homework answers to facilitate exam prep
```

Studying and Integrity

- We assign attending students to study groups in week 2
- It is OK to share homework scripts and answers

```
- We do not collect or assess homeworks.
- We do not provide homework answers.
- Exam questions will test your familiarity and understanding of homework answers. More details
forthcoming
```

- We encourage you to use Gen AI thoughtfully; we use it too

```
- LLMs are poor substitutes for human understanding
- Be advised, you may get what you pay for
- Free models are sometimes worse than useless
```

- Please write down your intentions for this class.
- How will you measure your effort?
- Exams are open-paper, closed-device. Live attendance required, please plan ahead.
- How does Gen AI use differ from other classes? | Why?

Vocab

Common language helps communication

Customer level

- Core need: identifiable problem a customer wants to solve. Could be functional, emotional, social, profit-motivated, etc. Related: desire, want, pain point
- Core benefit: Customer's desired outcome of a purchase. E.g., commuters need to get to school, not necessarily cars
- Consumer: Entity that experiences the core benefit
- Customer: Entity that purchases and pays

Product level

- Product/service/experience: Distinct offering that provides the core benefit
- Features: Aspects of a product that provide additional tangible or intangible benefits
- Value proposition: utility(Core benefit + features - price)
- Contribution margin: Price — marginal cost
- Competitor: Any paid or free alternative that addresses the core need. E.g., commute by bike, walk, bus, trolley, Uber, scooter, skateboard; work from home

Market level

- Market: Potential customer group with common core need
- Segment: Distinct subgroup of similar customers
- Targeting: Which segment(s) a firm tries to serve
- Positioning: Specification of product features to suit targeted segments
- Marketing: Practice of meeting customer needs profitably

```
  - Marketing: Business discipline that focuses most on customers
  - Ads & sales: Worthless without good value prop and positive margin
  - Poor implementation commonly leads to confusion with bullshit ("persuasive speech without
regard for the truth" --Frankfurt 2005)
```

Legacy Terms

- 3/4/5 C’s: Customer, Competitor, Company;
  Context; Complementors
- STP: Segmentation, Targeting, Positioning AKA Marketing Strategy
- 4/…/10 P’s:
  Price, Product, Promotion, Place AKA distribution AKA Marketing Tactics

```
    - You need to know these well if you interview for marketing roles
    - Generations of marketing professionals were educated to think this way, e.g. MGT 103 and
Harvard MBAs
    - Still relevant, but less, thanks to customer data abundance & analytics
```

How to be good at marketing On Bullshit

Coding & Script

Coding errors

- “The good news about computers is that they do what you tell them to do. The bad news is that they do what you tell them to do.”
- Conjecture:
  (debugging difficulty) is exponential in (lines of code)
- We can code fast or slow

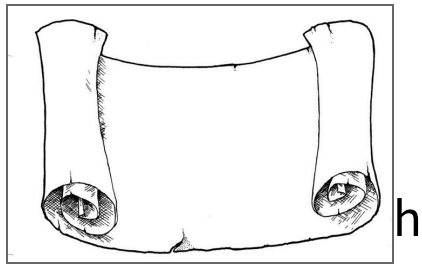
Coding Habits

- Good habit: Test chunks as you code
- Test = Manipulate text, verify output matches expectation
- “Go slow to go fast”

Pipe |>

- y <- f(g(x)) is the same as
- y <- x |>
  g |>
  f
- Why?
- Old pipe was %>% ; remains widely used

Today's script

- **Install/update R and Rstudio**
- **Posit.Cloud**
- Data Import/export
- Data manipulation, summarization
- 5 verbs: Summarize, select, filter, arrange, mutate, group_by
- Univariate statistics
- Univariate plots
- Bivariate statistics
- Bivariate plots
-  he script, run it, see where it breaks
- Digression: Production code vs prototype code

Wrapping up

Recap

- Customer analytics :
  Using customer data to improve decisions
- Data Viz should be the first step in customer analytics
- Marketing : Meeting customer needs profitably
- Analytics types:
  Descriptive, Diagnostic, Predictive, Prescriptive
- Summarize, select, filter, arrange, mutate, group_by

Going further

- **Marketing Analytics for Data-Rich Environments**
- **GGplot2 YT video**
- *R for Data Science (2e)*
- **Big Book of R**: Lovingly curated, well organized, free resource directory for nearly any R problem