

ACCT 420: Course Logistics + R Refresh

Dr. Richard M. Crowley

rcrowley@smu.edu.sg

<https://rmc.link/>

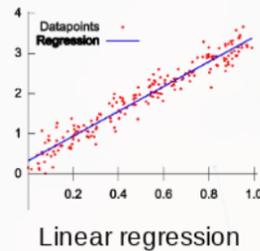
Front Matter

Learning objectives

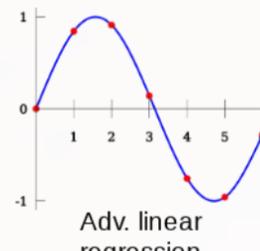
Foundations



Forecasting

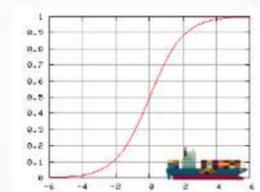


Linear regression



Adv. linear regression

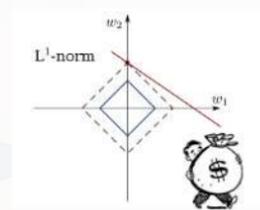
Binary classification



Logistic regression for contracting



Leveraging research for bankruptcy



Lasso regression for fraud

Advanced methods



Natural Language



Anomaly detection



AI/ML

- **Theory:**
 - What is analytics?
- **Application:**
 - Who uses analytics? (and why?)
- **Methodology:**
 - Review of **R**
- Almost every class will touch on each of these three aspects

About Me

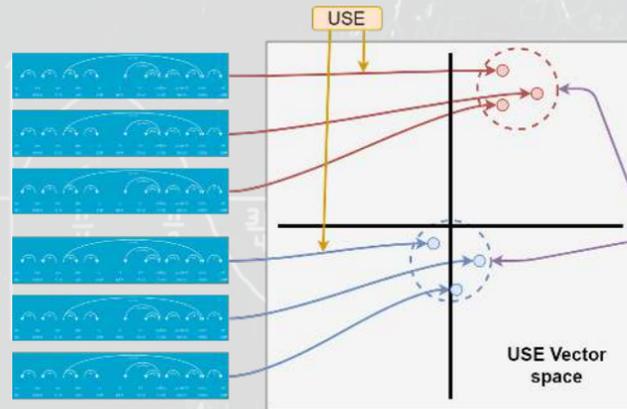
Teaching

- At SMU since 2016
- Teaching:
 - IDIS 700, Machine Learning for Social Science
 - A country-wide PhD course on *empirical* machine learning
 - ACCT 703, Analytical Methods in Accounting
 - Theory of accounting through the lenses of economics, history, and philosophy
 - ACCT 420, Forecasting and Forensic Analytics
 - You are here!
 - ACCT 101, Financial Accounting
- Before SMU: Completed my PhD at University of Illinois Urbana-Champaign



Research

- Accounting disclosure: What companies say, and why it matters
 - Focus on social media and regulatory filings
- Approach this using AI/ML techniques



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OVERVIEW HISTORICAL PRICES **ADVANCED CHARTING** MAJOR U.S. STOCK INDEXES MAJOR INTERNATIONAL STOCK INDEXES

Chart Range

1D 5D 10D 1M 3M 6M YTD 1Y 2Y 3Y 5Y 10Y All Custom

Frequency

Daily

Display

Line

Indicators

Chart Overlays



Lower Charts



Events



News



Compare

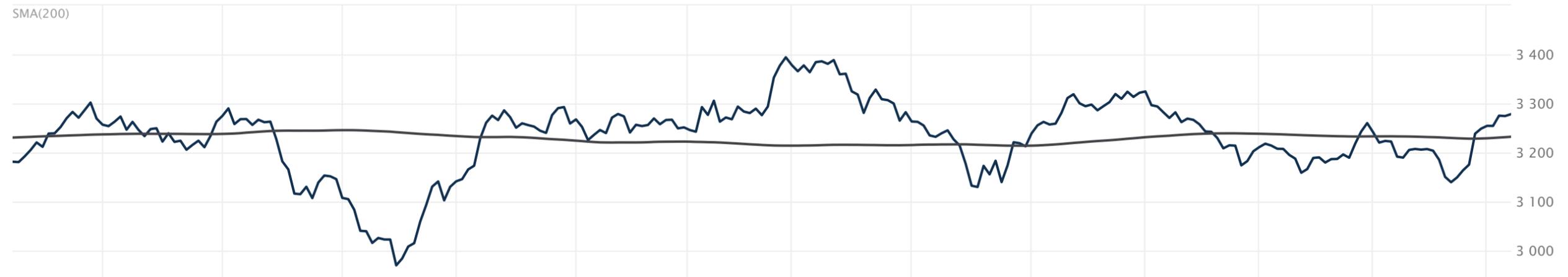
Symbol

ADD

Clear Settings

SG:STI Simple Moving Average Edit | x

SMA(200)



Research highlights

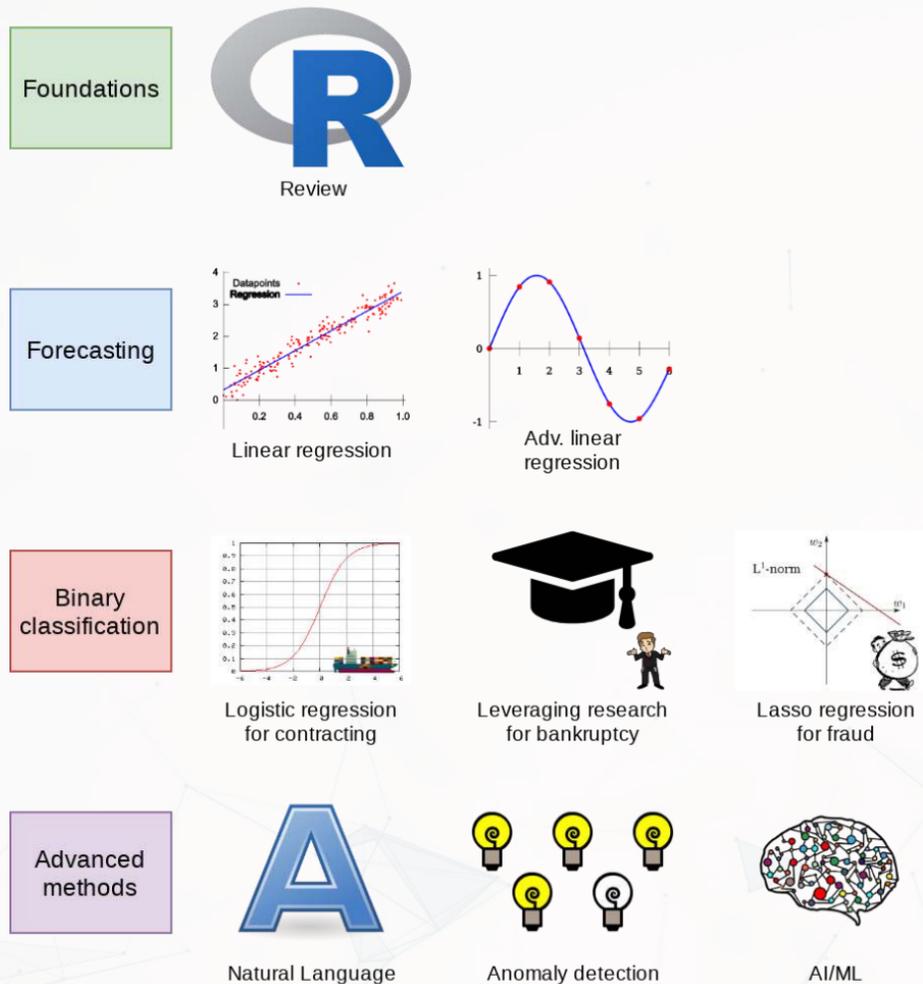
1. An advanced model for detecting financial misreporting using annual report text.
2. Multiple projects on Twitter showcasing:
 1. How companies disclose when financials are not normal or expected
 2. That executives' disclosures are as important on Twitter as their firms' disclosures
 3. That ESG disclosure on Twitter is not credible
3. Newer work on
 - Misinformation laws (e.g., POFMA)
 - Foundational problems of text-based sentiment in accounting and finance
 - COVID-19 reactions worldwide

What is the common thread?

All of the above use text-based data paired with AI/ML algorithms. A secondary thread is the importance of *content*, while some papers also push for better *causality* in research.

About this course

What will this course cover?



1. Foundations (*today*)

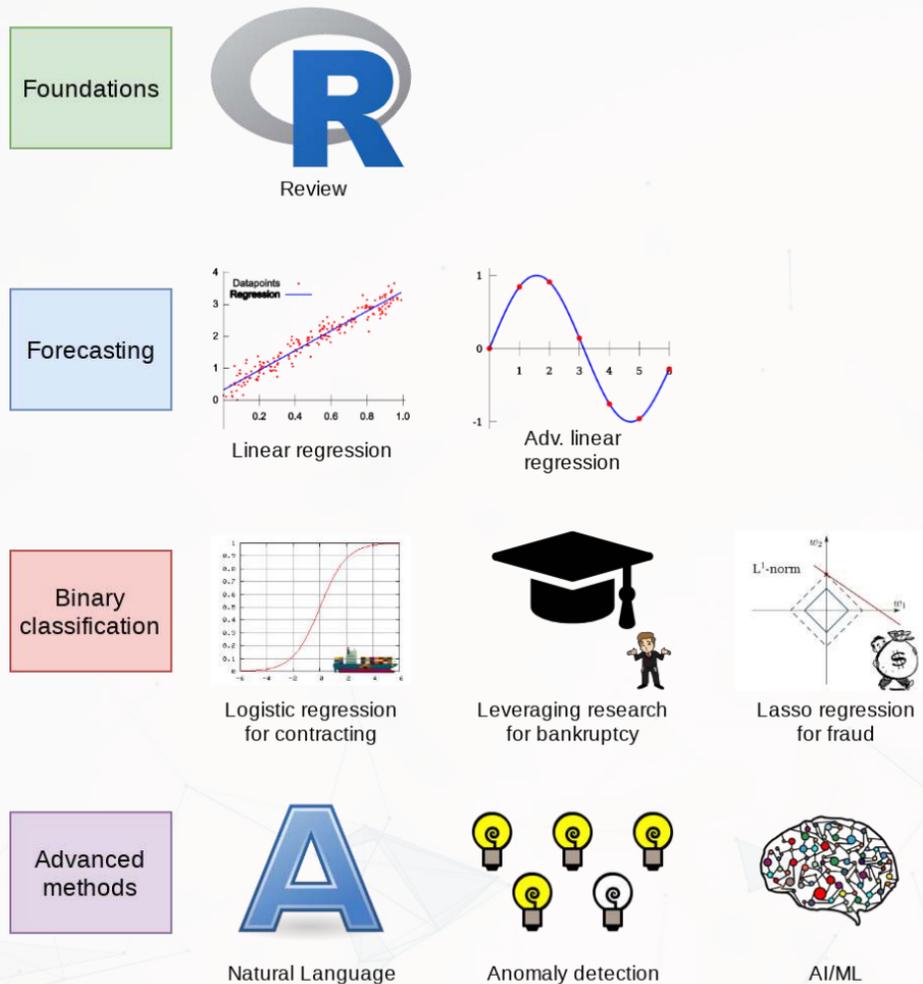
- Thinking about analytics
- In class: Setting a foundation for the course
- Outside: Practice and refining skills on Datacamp
 - Pick any R course, any level, and try it out!

2. Financial forecasting

- Predict financial outcomes
- Linear models

Getting familiar with forecasting using **real** data and R

What will this course cover?



3. Binary classification

- Event prediction
- Classification & detection

4. Advanced methods

- Non-numeric data (text)
- Clustering
- AI/Machine learning (AI/ML)
 - Ethics of AI
 - Current developments, including LLMs (e.g., ChatGPT)

Higher level financial forecasting, detection, and AI/ML

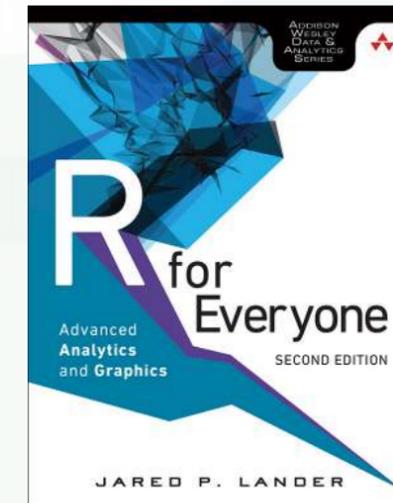
Datacamp

- Datacamp is providing *free* access to their *full* library of analytics and coding online tutorials
 - You will have free access for 6 months (Usually \$25 USD/mo)
- Online tutorials include short exercises and videos to help you learn R
- I have suggested some limited materials via a Datacamp class
 - These are entirely optional
 - If you are struggling with coding, do make use of this resource!
 - Sign up through the link on eLearn
 - Make sure you sign up in the *first week* of the class!
- You are encouraged to go beyond the assigned materials

Datacamp's tutorials teach R from the ground up, and are mandatory unless you can already code in R.

Textbook

- There is no required textbook
 - Datacamp is taking the place of the textbook
- If you prefer having a textbook...
 - [R for Everyone](#) by Jared Lander is a good one on R



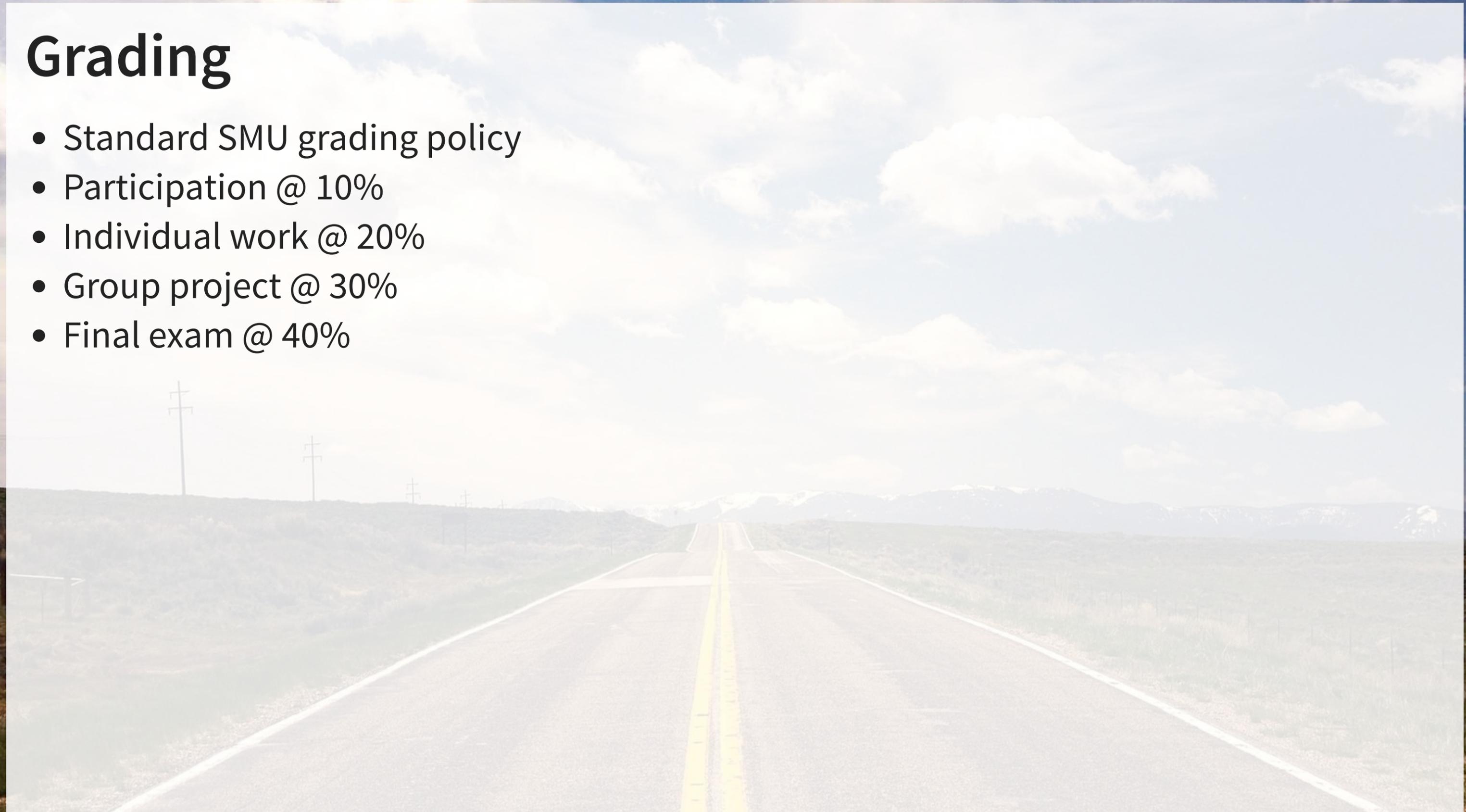
- Other course materials (slides and articles) are available at:
 - eLearn
 - <https://rmc.link/acct420>
 - This includes html versions of the slides with interactive content
- Announcements will be only on eLearn

Teaching philosophy

1. Analytics is best learned by doing it
 - Less lecture, more thinking
2. Working with others greatly extends learning
 - If you are ahead:
 - The best sign that you've mastered a topic is if you can explain it to others
 - If you are lost:
 - Gives you a chance to get help the help you need

Grading

- Standard SMU grading policy
- Participation @ 10%
- Individual work @ 20%
- Group project @ 30%
- Final exam @ 40%



Participation

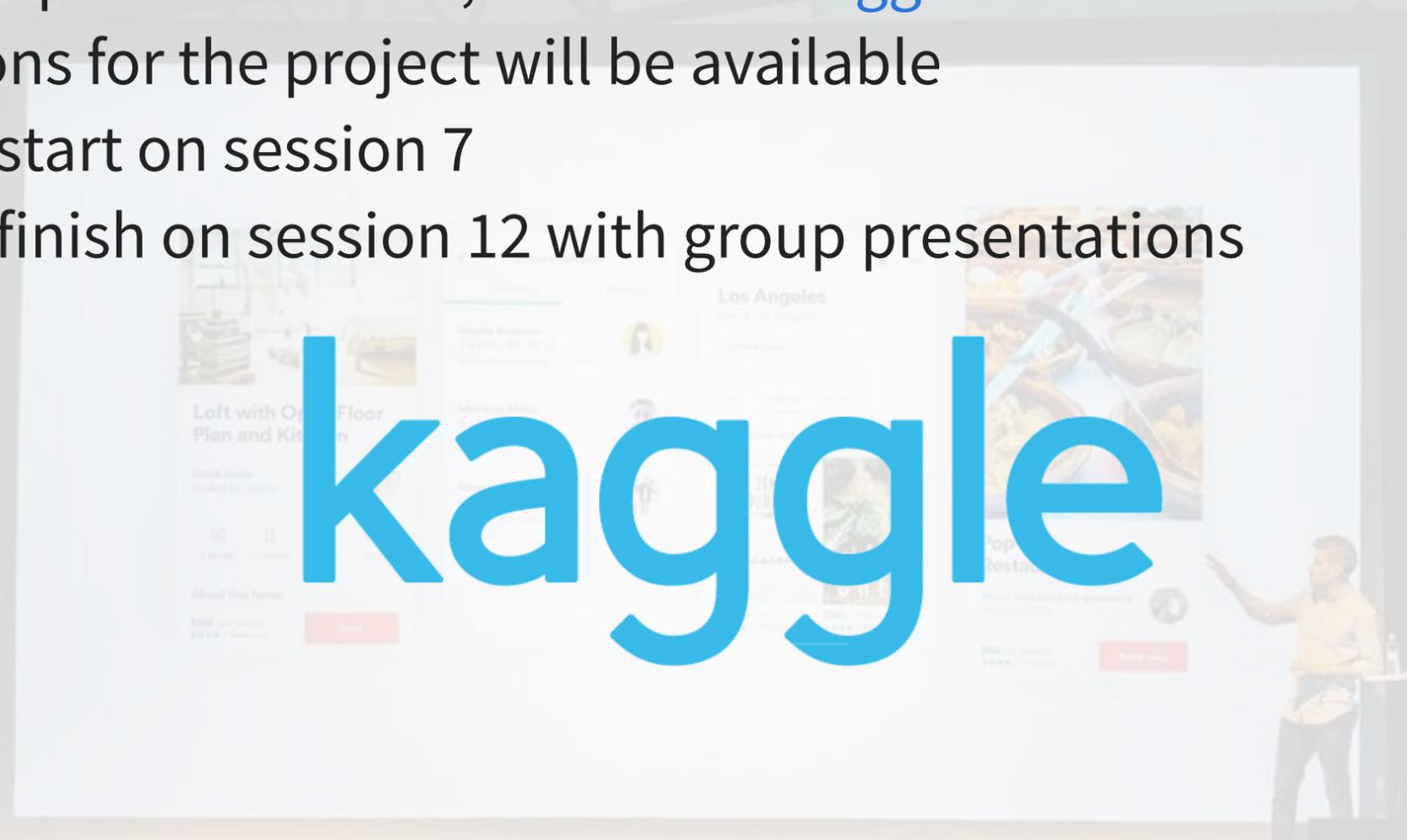
- Come to class
 - If you have a conflict, email me
 - Excused classes do not impact your participation grade
- Ask questions to *extend or clarify*
- Answer questions and explain answers
 - Give it your best shot!
- Help those in your group to understand concepts
- Present your work to the class
 - Come up with effective and creative solutions to the problems!

Outside of class

- Verify your understanding of the material
- Apply to other real world data
 - Techniques and code will be useful after graduation
- Answers are expected to be your own work, unless otherwise stated
 - No sharing answers (unless otherwise stated)
- Submit on eLearn
- I will provide snippets of code to help you with trickier parts

Group project

- Data science competition format, hosted on [Kaggle](#)
 - Multiple options for the project will be available
- The project will start on session 7
- The project will finish on session 12 with group presentations



kaggle

Final exam

- Why?
 - Ex post indicator of attainment
- How?
 - 2 hours long
 - Most of it is Long format: problem solving oriented
 - A small amount of MCQ focused on techniques

Expectations

In class

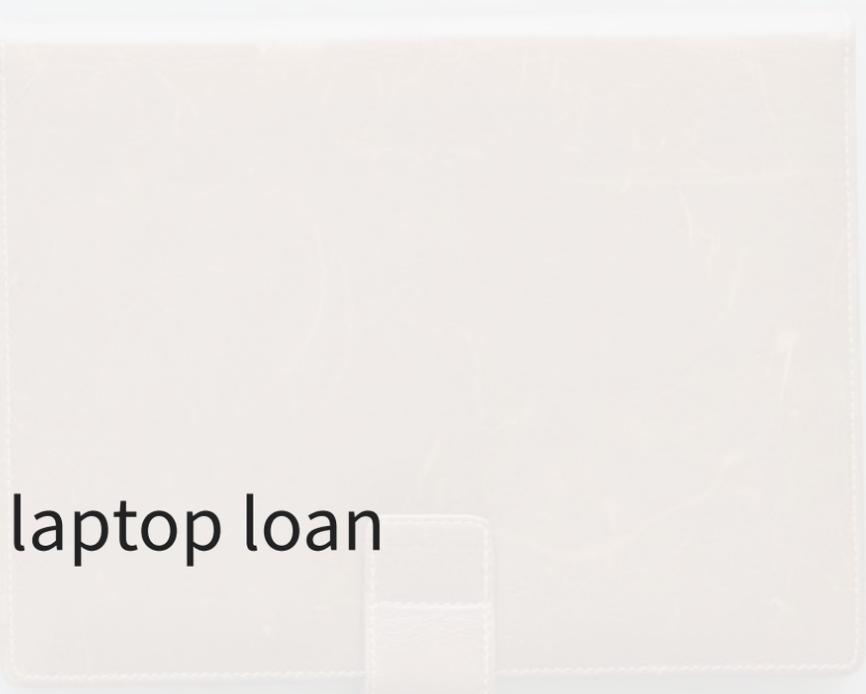
- Participate
 - Ask questions
 - Clarify
 - Add to the discussion
 - Answer questions
 - Work with classmates

Out of class

- Check eLearn for course announcements
- Do the assigned tutorials on Datacamp
 - This will make the course much easier!
- Do individual work on your own (unless otherwise stated)
 - Submit on eLearn
- Office hours are there to help!
 - Short questions can be emailed instead

Tech use

- Laptops and other tech are OK!
 - Use them for learning, not messaging
 - Furthermore, you will *need* a computer for this class
 - If you do not have access to one, I can provide you a laptop loan
- Examples of good tech use:
 - Taking notes
 - Viewing slides
 - Working out problems
 - Group work
- Avoid during class:
 - Messaging your friends on Telegram
 - Working on homework for the class in a few hours
 - Watching livestreams of pandas or Hearthstone



Office hours

- Prof office hours:
 - Bookable at rmc.link/4200H
- **Short** questions can be emailed
 - I try to respond within 24 hours

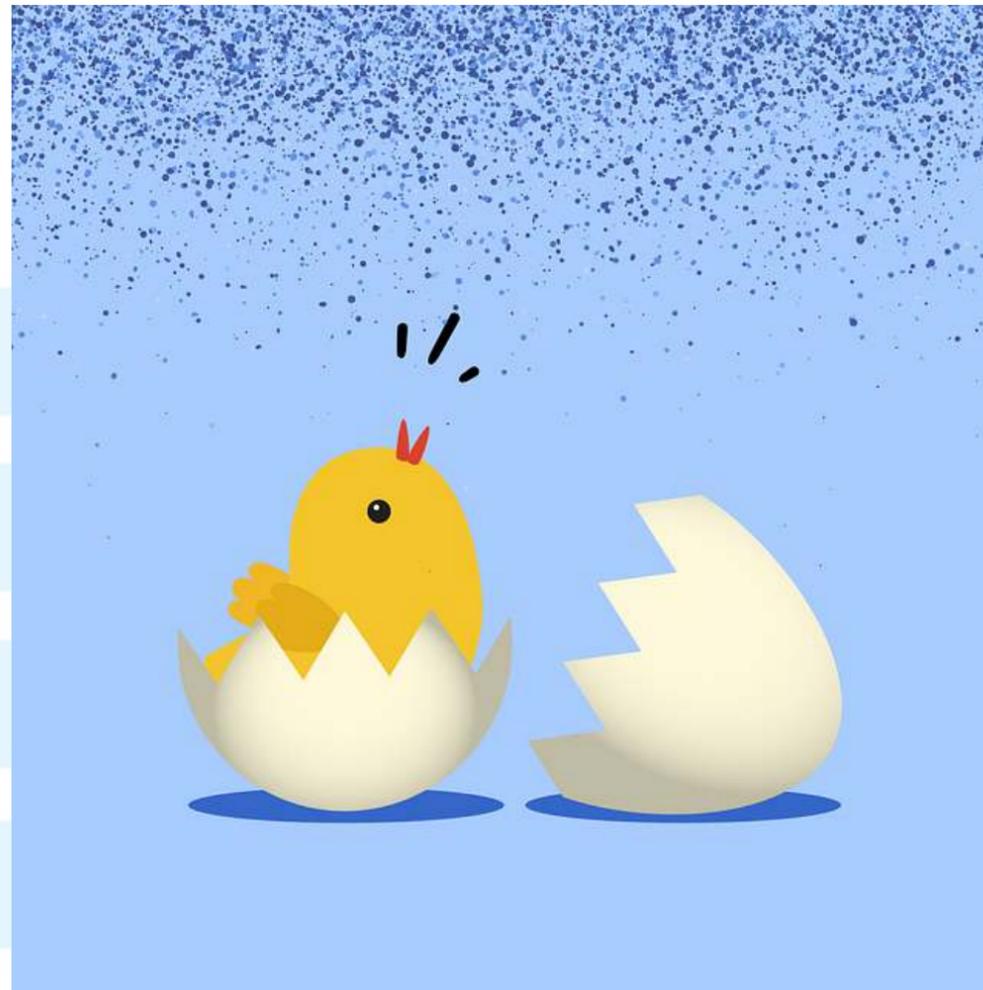
Lastly...

- I don't expect everything to run 100% smoothly on either side, and there will be leniency to account for this as needed
 - If you will miss an in-person session, let me know the reason in advance, and then work with your peers to catch up
 - If you will miss a Zoom session, please let me know the reason in advance, and then work through the recording on your own
- I always provide a survey at the end of each class session that allows you to anonymously voice anything you liked or didn't like about a session. Do use this channel if you encounter any difficulties. Common agreed-upon problems will be addressed within 1-2 class sessions.
 - The survey link is on eLearn (under the session's folder) and will be on the last slide I present each week.

Likely schedule adjustment

Expect one class session to be cancelled in mid-to-late October

- Some class session may be moved to Zoom as well, as needed



About this course: Online version addendum

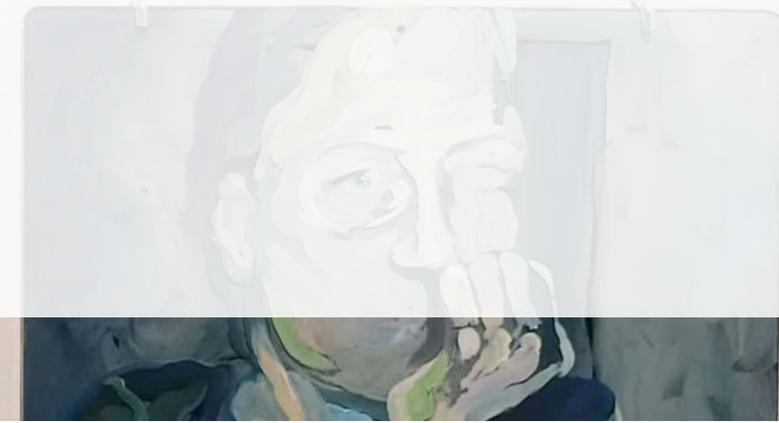
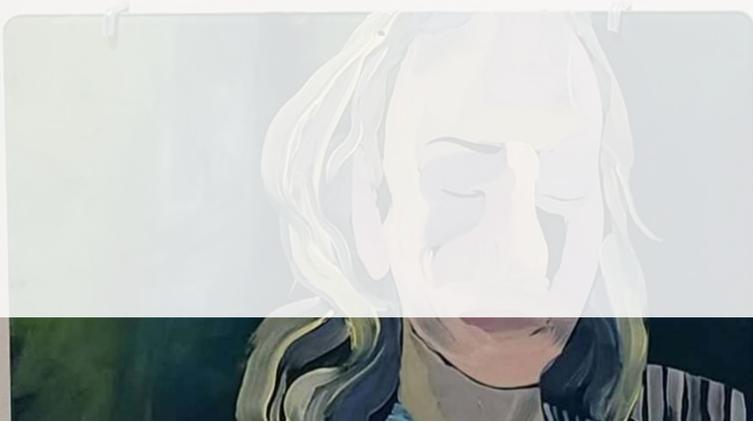
General Zoom etiquette

- Keep your mic muted when you are not speaking
 - 20+ mics all on at once creates **a lot** of background noise
- You are welcome to leave your video on – seeing your reactions helps me to gauge your learning of the course content
 - If you are uncomfortable doing so, please have a profile photo of yourself
 - To do this, click yourself in the participants window, click “more” or “...” and then “Edit Profile Picture”
- Feel free to use Zoom’s built in functionality for backgrounds
 - Just be mindful that this is considered a professional environment and that the class sessions are recorded

All sessions will be recorded to provide flexibility for anyone missing class to still see the material. It also allows you to easily review the class material.

Asking questions

- If you have a question, use the *Raise Hand* function
 - Where to find it:
 - Desktop: Click *Reactions* and then *Raise hand*
 - Mobile: Under *More* in the toolbar
 - When called on:
 1. Unmute yourself.
 2. Turn on your video if you are comfortable with it
 3. Ask your question.
 4. You are always welcome to ask follow up questions or clarifications in succession
 5. After your question is answered, **mute your mic.**



Group work on Zoom

- I will make use of the Breakout room functionality
- Your group can use the “Share screen function” to emulate crowding around one laptop
- If your group is stuck or needs clarification, you can use the *Ask for help* function to get my attention
- I will drop by each group from time to time to check in and see how you are doing with the problem
- I may also ask your group to present something to the class after a breakout session is finished.

Before project groups are settled, groups will be randomized each class session to encourage you to meet each other. Once group project groups are set, breakout sessions will be with your group project group.



About you

About you

- Survey at rmc.link/aboutyou
- Results are anonymous
- We will go over the survey next week at the start of class





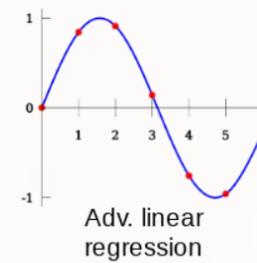
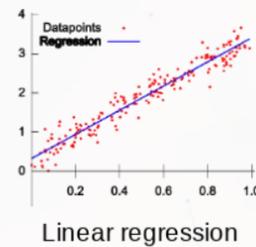
Analytics

Learning objectives

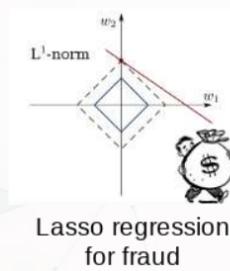
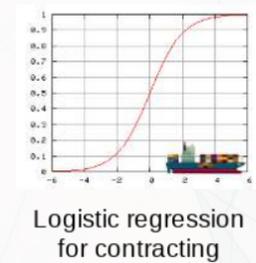
Foundations



Forecasting



Binary classification



Advanced methods



Natural Language



Anomaly detection



AI/ML

- **Theory:**

- What is analytics?

- **Application:**

- Who uses analytics? (and why?)

- **Methodology:**

- Review of **R**

*Almost every class will touch on each of these three aspects

What is analytics?



What is analytics?

Oxford: The systematic computational analysis of data or statistics

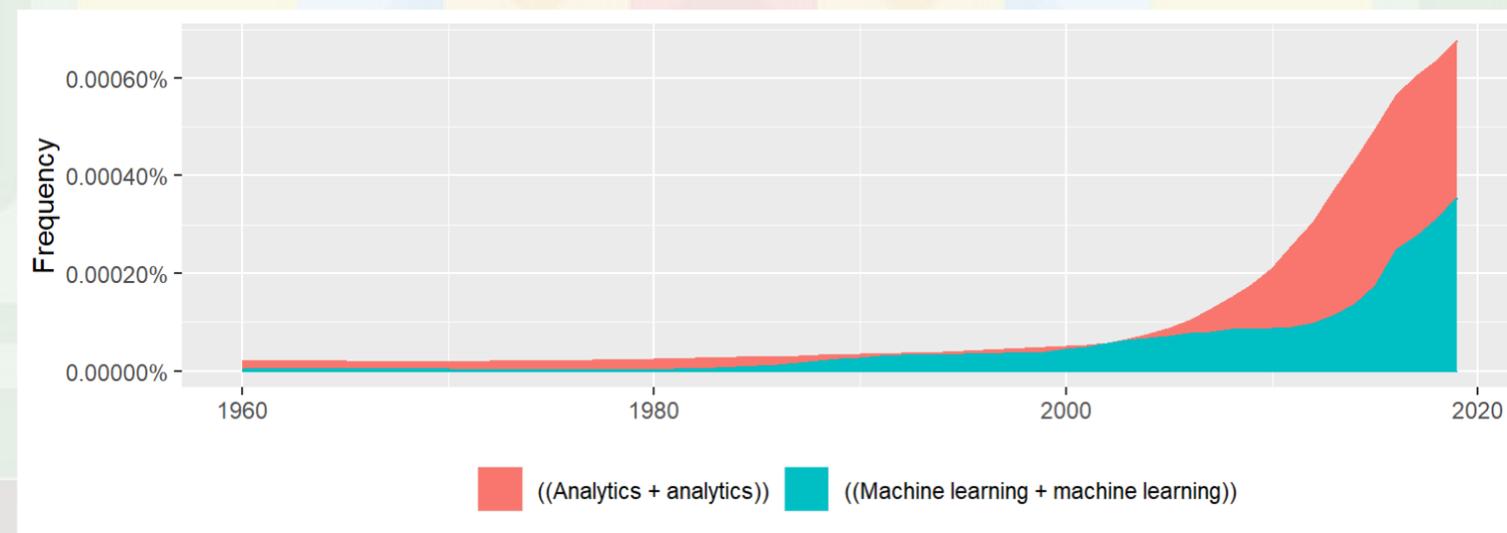
Webster: The method of logical analysis

Gartner: catch-all term for a variety of different business intelligence [...] and application-related initiatives

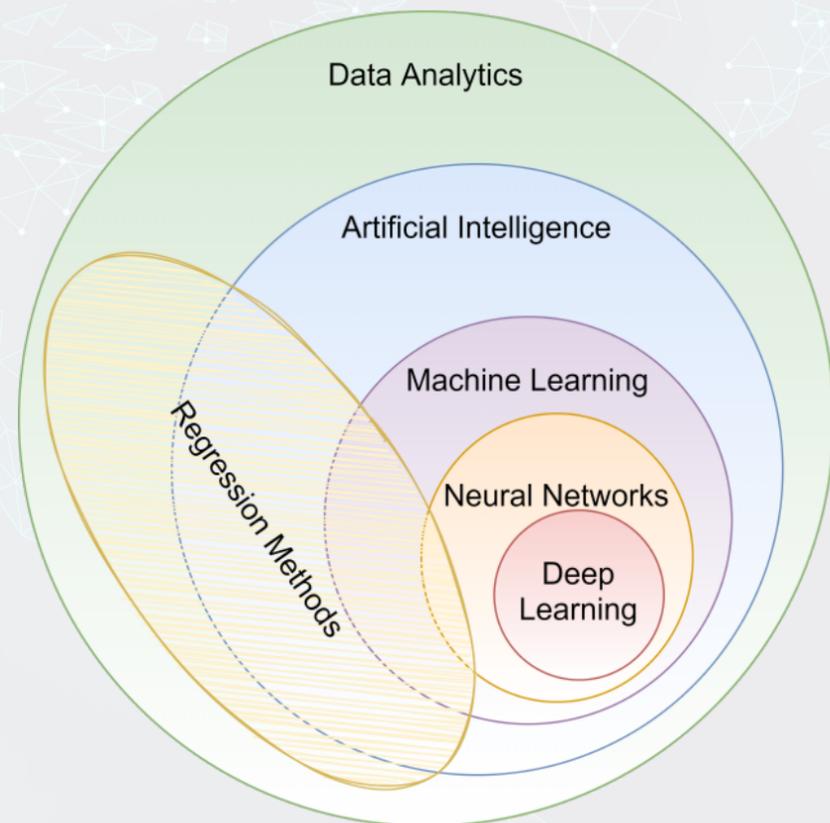
What is analytics?

Simply put: Answering questions using data

- Additional layers we can add to the definition:
 - Answering questions using *a lot of* data
 - Answering questions using data *and statistics*
 - Answering questions using data *and computers*



Analytics vs AI/machine learning



- In class reading:
 - [AI Will Enhance Us, Not Replace Us](#)
 - By DataRobot's VP of AI Strategy
 - Short link: rmc.link/420class1



How will Analytics/AI/ML change society and the accounting profession?

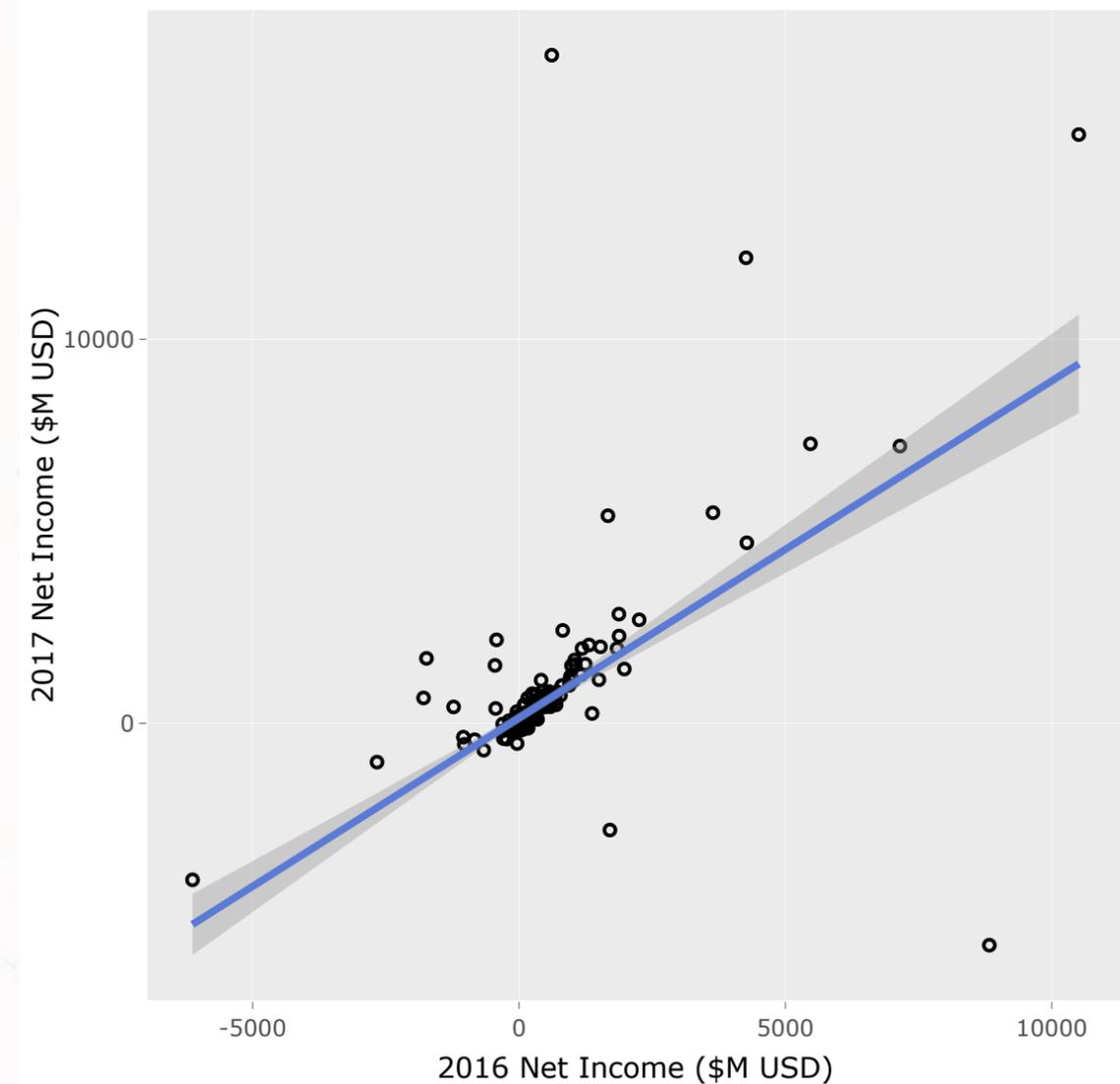
What are forecasting analytics?

- Forecasting is about making an educated guess of events to come in the future
 - Who will win the next soccer game?
 - What stock will have the best (risk-adjusted) performance?
 - What will Singtel's earnings be next quarter?
- Leverage *past* information
 - Implicitly assumes that the past and the future predictably related



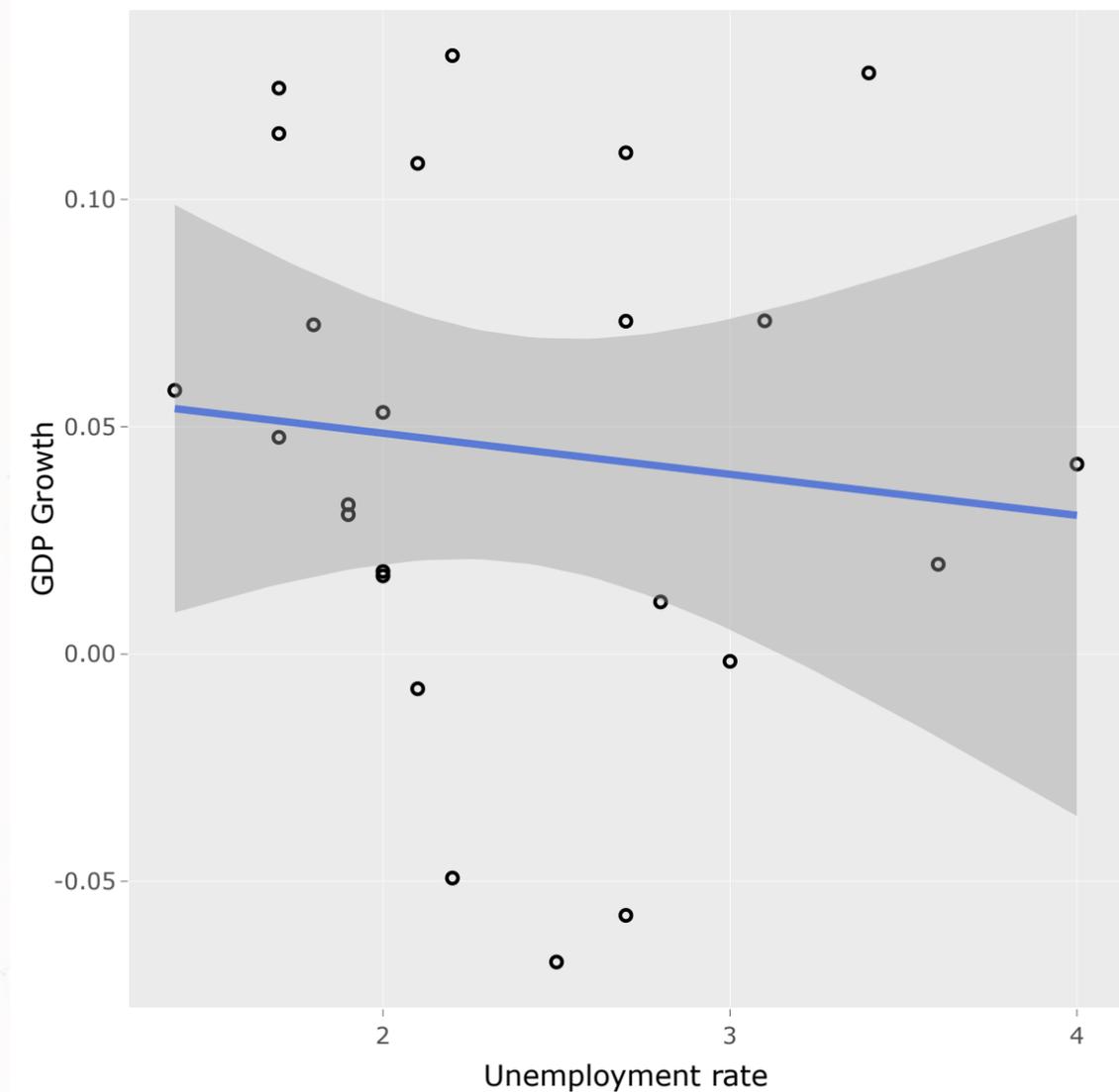
Past and future examples

- Past company earnings predicts future company earnings
 - Some earnings are stable over time (Ohlsson model)
 - Correlation: 0.7400142



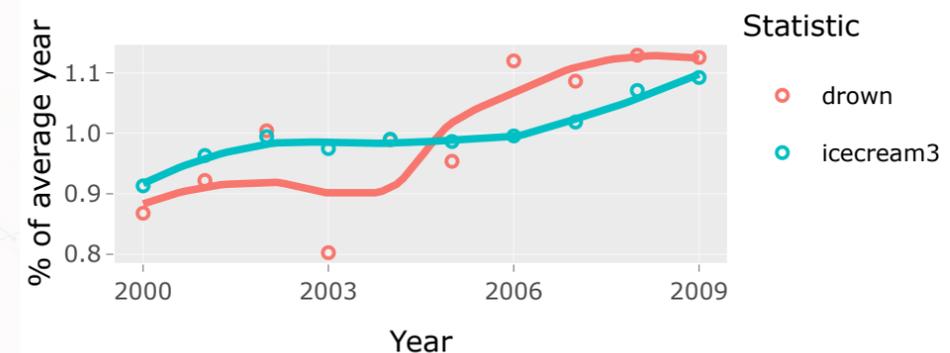
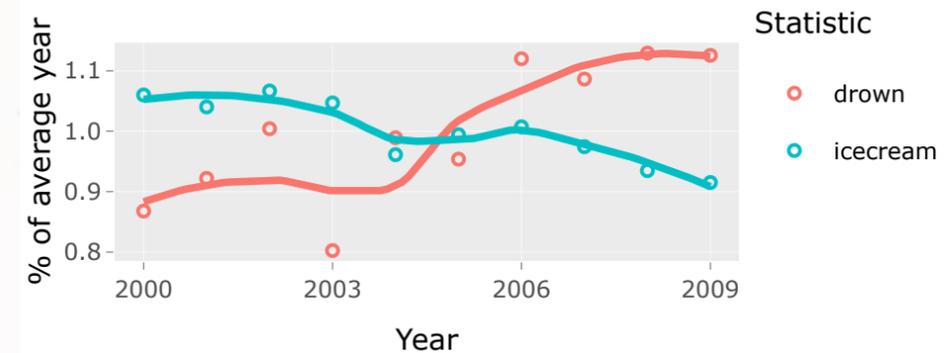
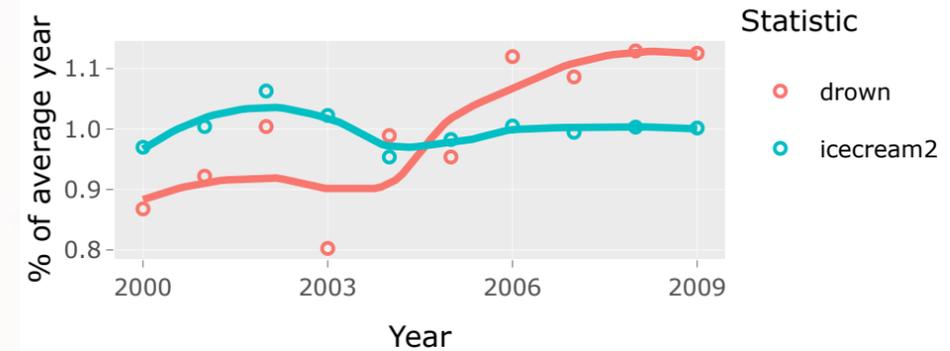
Past and future examples

- Job reports predicts GDP growth in Singapore
 - Economic relationship
 - More unemployment in a year is related to lower GDP growth
 - Correlation of -0.1047259



Past and future examples

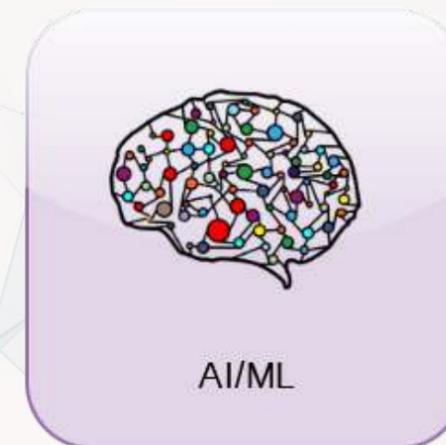
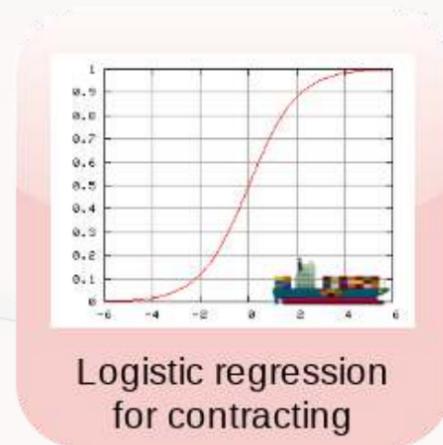
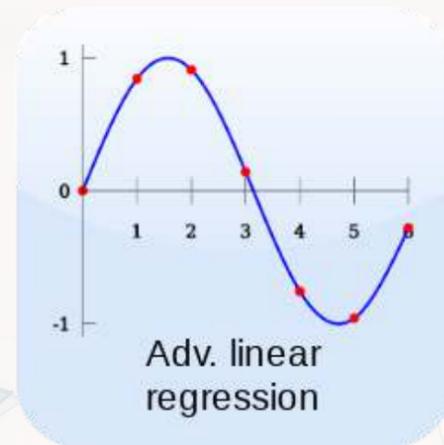
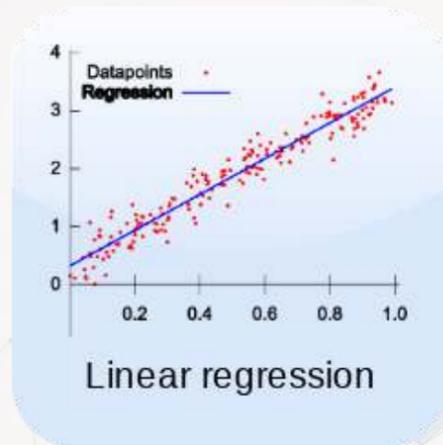
- Ice cream revenue predicts pool drownings in the US
 - ???
 - Correlation is... only 0.0502886
- What about units sold?
 - Correlation is negative!!!
 - -0.720783
- What about price?
 - Correlation is 0.7872958



This is where the “educated” comes in

Forecasting analytics in this class

- Revenue/sales
- Shipping delays
- Bankruptcy
- Machine learning applications



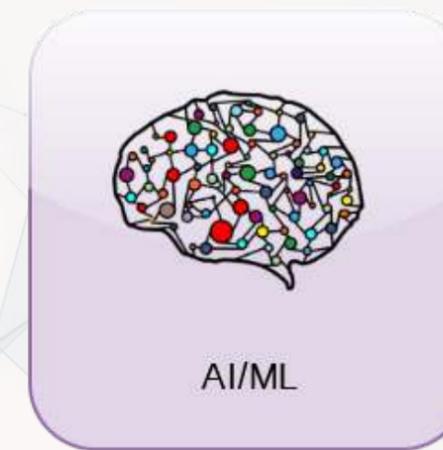
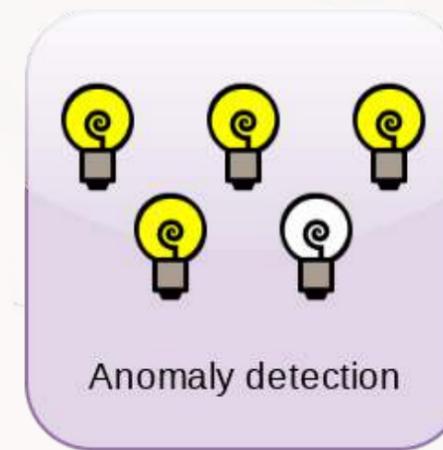
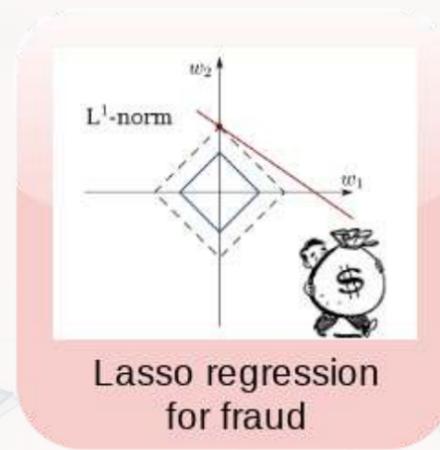
What are forensic analytics?

- Forensic analytics focus on *detection*
 - Detecting crime such as bribery
 - Detecting fraud within companies
 - **Looking at a lot of dog pictures** to identify features unique to each breed



Forensic analytics in this class

- Fraud detection
- Working with textual data
- Detecting changes
- Machine learning applications



Forecasting vs forensic analytics

- Forecasting analytics requires a time dimension
 - Predicting *future* events
- Forensic analytics is about understanding or detecting something
 - Doesn't need a time dimension, but it can help

These are not mutually exclusive. Forensic analytics can be used for forecasting!



Who uses analytics?

In general

- Companies
 - Finance
 - Manufacturing
 - Transportation
 - Computing
 - ...

- Governments
 - AI.Singapore
 - Big data office
 - “Smart” initiatives
- Academics
- Individuals!

53% of companies were using big data in a [2017 survey!](#)

What do companies use analytics for?

- Customer service
 - Royal Bank of Scotland
 - Understanding customer complaints
- Improving products
 - Siemens' Internet of Trains
 - Improving train reliability
- Their business
 - \$18.3B USD market in 2017
 - Just a small portion of overall IT spending (\$3.7T USD)

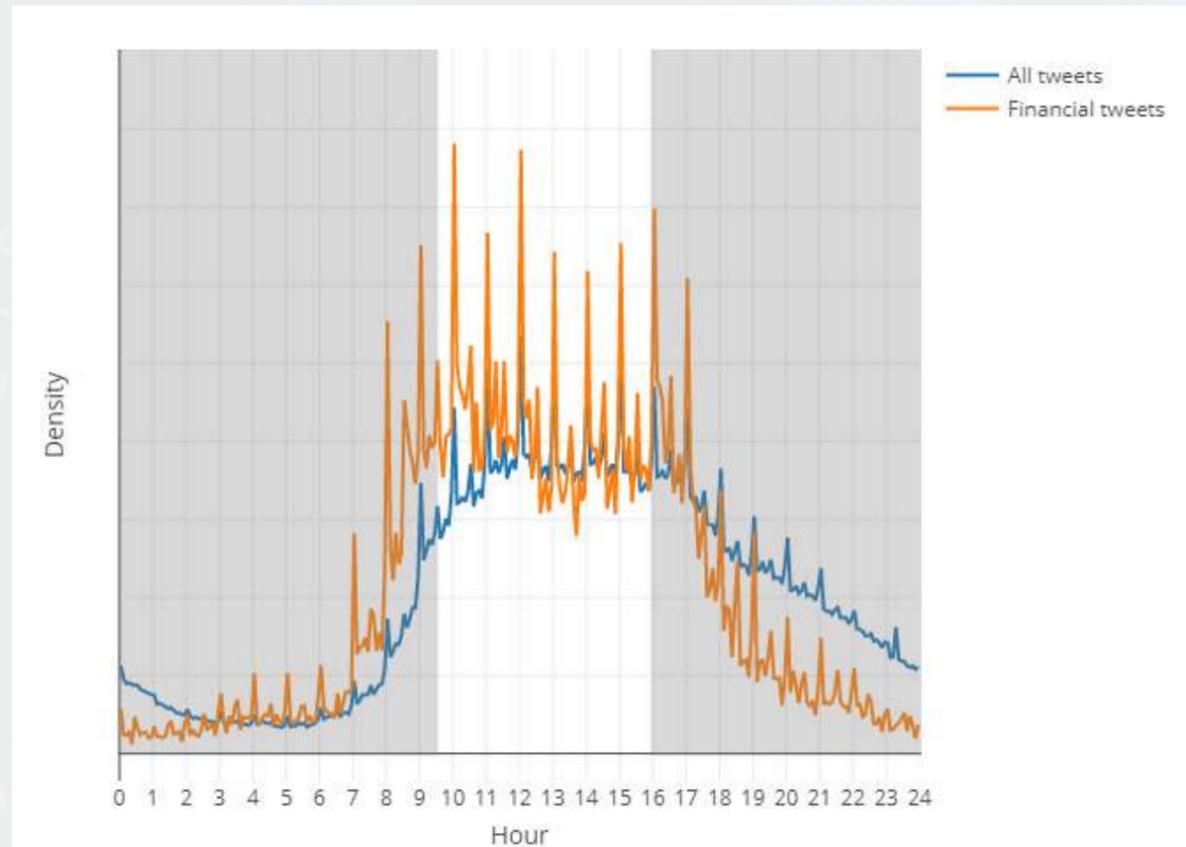


What do governments use analytics for?

- Govtech
 - Open data
 - Data.gov.sg
 - City of New York
- AI Singapore
 - Talent matching
 - 100 Experiments
 - Grand Challenges



What do academics use analytics for?



- Tweeting frequency by S&P 1500 companies ([paper](#))
- Aggregates every tweet from 2012 to 2016
- Shows frequency in 5 minute chunks
 - Note the spikes every hour!
- The white part is the time the NYSE is open

What do academics use analytics for?

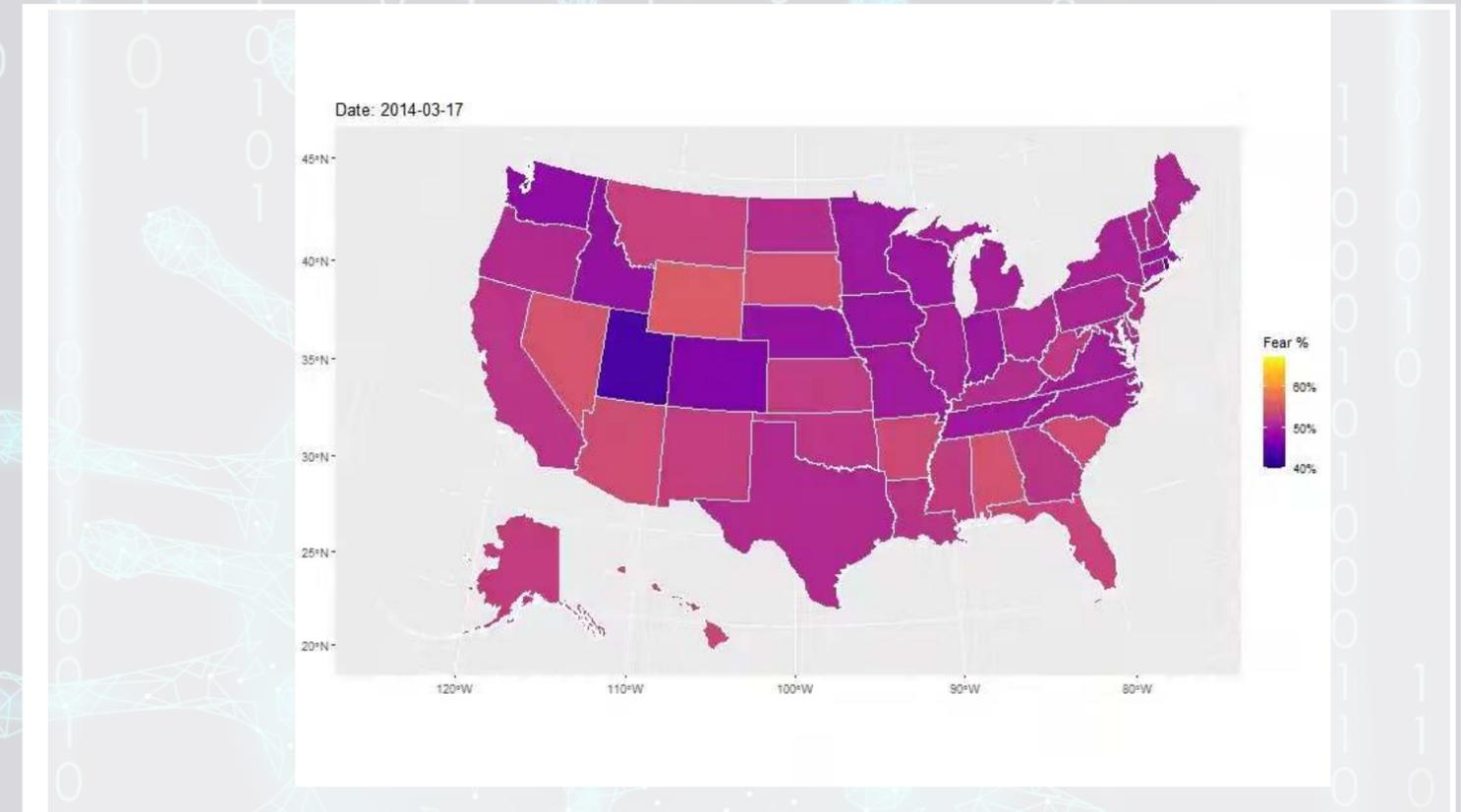
- Annual report content that predicts fraud ([paper](#))
- For instance, discussing income is useful
 - first row is decreases, second is increases
 - But if it's good or bad depends on the year
 - For instance, in 1999 it is a red flag
 - And one that Enron is flagged for



What do academics use analytics for?

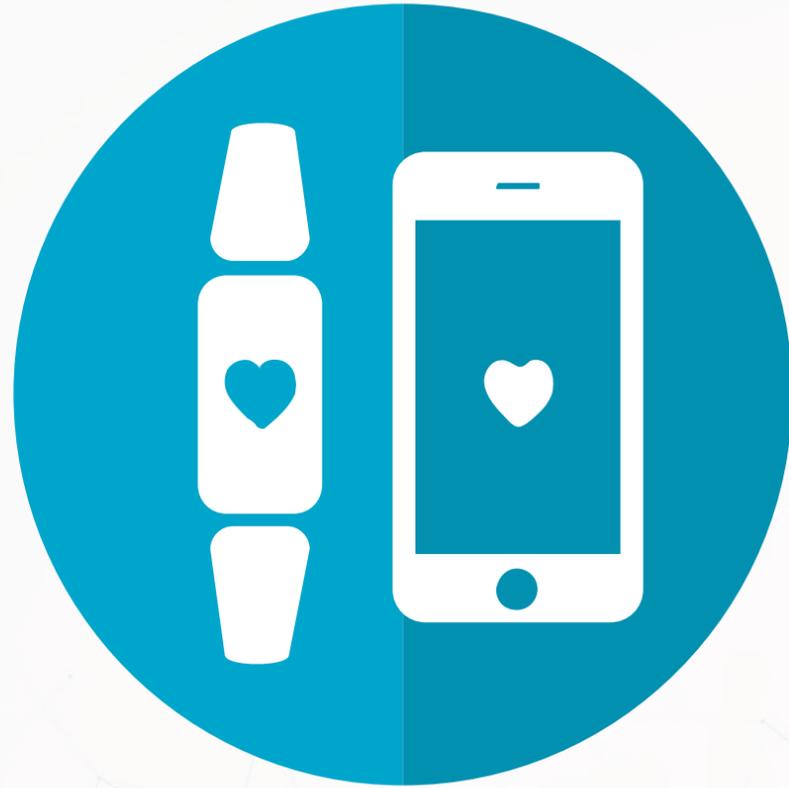
- COVID-19 fear on Twitter, 2020 Mar to Oct
- Helps us to understand socioeconomic reactions to events

What do the spikes indicate?



To learn more, [check out these slides](#)

What do individuals use analytics for?



- Consulting
 - [Radim Rehurek](#): Maintainer of [gensim](#), freelance consultant
- Investing
 - [Quantnet discussions](#)
- Health
 - Smart watches and other wearables

Why should you learn analytics?

- Important skill for understanding the world
 - **Good timing to learn it, too!**
- Gives you an edge over many others
 - Particularly useful for your career
- Jobs for “Management analysts” are expected to expand by 14% from 2016 to 2026
 - Accountants and auditors: 10%
 - Financial analysts: 11%
 - Average industry: 7%
 - All figures from US Bureau of Labor Statistics

Review of R

What is R?

- R is a “statistical programming language”
 - Focused on data handling, calculation, data analysis, and visualization
- We will use R for all work in this course



Why do we need R?

- Analytics deals with more data than we can process by hand
 - We need to ask a computer to do the work!
- R is one of the de facto standards for analytics work
 - Third most popular language for data analytics and machine learning ([source](#))
 - Fastest growing of all mainstream languages
 - Free and open source, so you can use it anywhere
 - It can do most any analytics
 - Not a general programming language

Programming in R provides a way of talking with the computer to make it do what you want it to do

Alternatives to R



- Extremely popular
- Free and open source
- Very strong AI/ML support



TensorFlow



- Fast and free
- Mathematics oriented
- Still young though



- Fast and free
- Focused on scalability, basis of Apache Spark

Setup for R

Setup

- For this class, I will assume you are using RStudio with the default R installation
 - [RStudio downloads](#)
 - [R for Windows](#)
 - [R for \(Max\) OS X \(Download R-4.1.1.pkg\)](#)
 - [R for Linux](#)
- For the most part, everything will work the same across all computer types
- Everything in these slides was tested on R 4.1 and 4.3 on Windows and Linux

How to use R Studio

1. R markdown or Quarto file

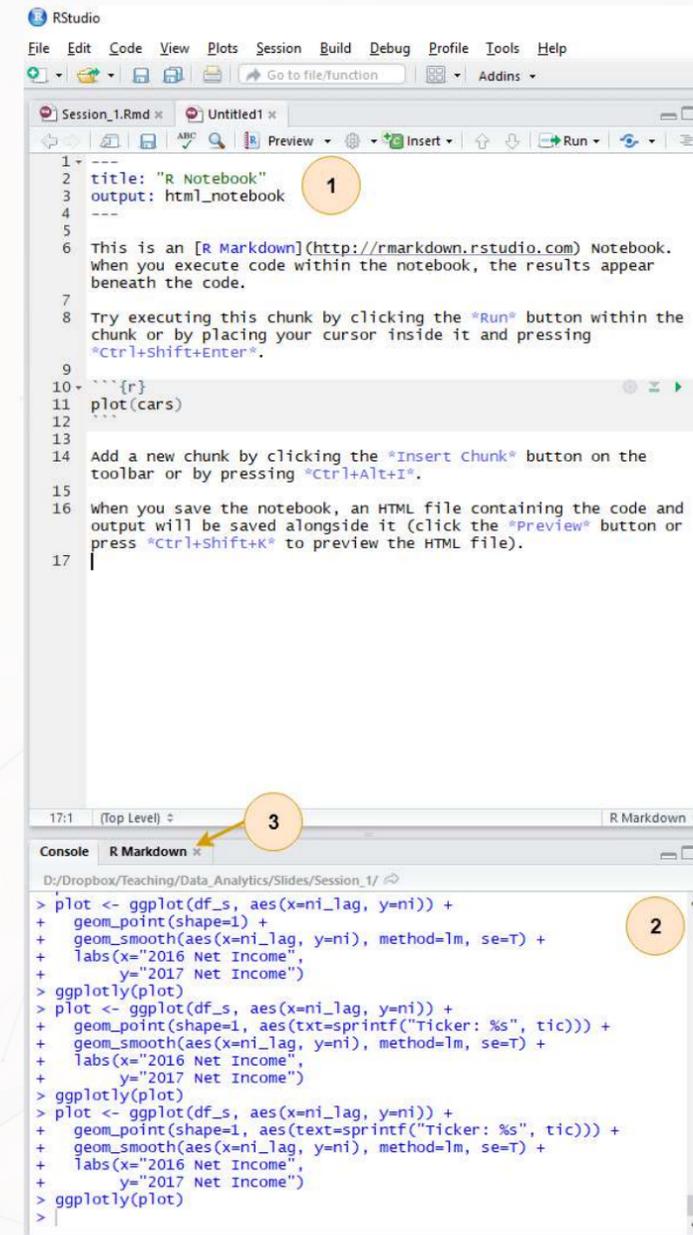
- You can write out reports with embedded analytics

2. Console

- Useful for testing code and exploring your data
- Enter your code one line at a time

3. R Markdown console

- Shows if there are any errors when preparing your report



How to use R Studio

4. Environment

- Shows all the values you have stored

5. Help

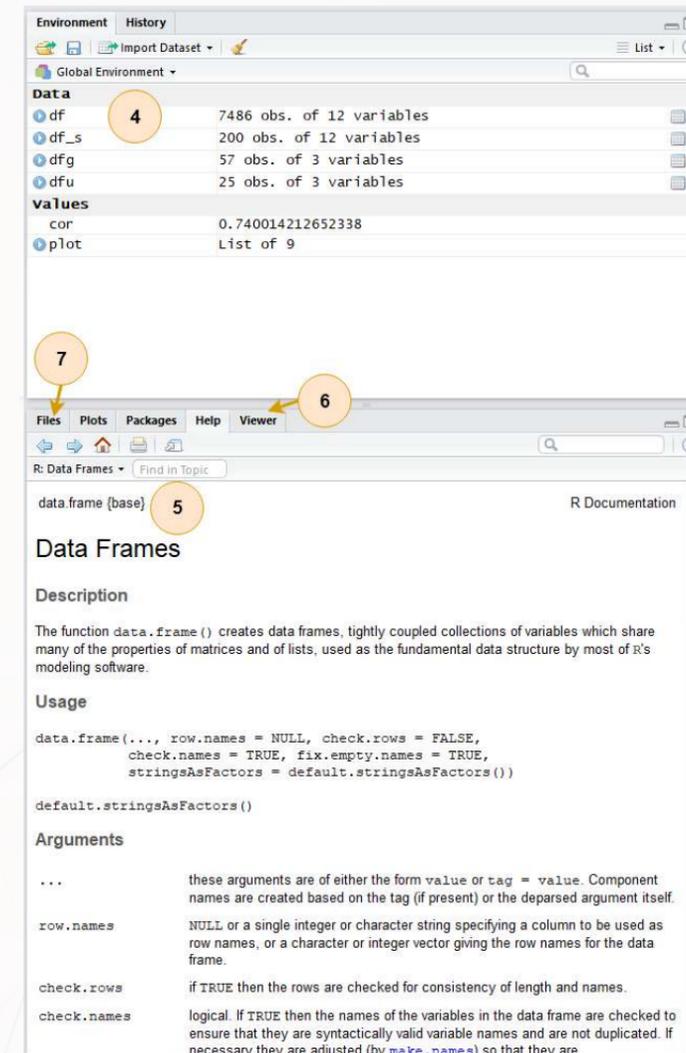
- Can search documentation for instructions on how to use a function

6. Viewer

- Shows any output you have at the moment.

7. Files

- Shows files on your computer



Basic R commands

Arithmetic

- Anything in boxes like those on the right in my slides are R code
- The slides themselves are made in R, so you could copy and paste any code in the slides right into R to use it yourself
- Blue boxes: Code
 - Lines starting with `#` are comments
 - They only explain what the code does
- White boxes: Output

```
R | # Addition uses '+'  
  | 1 + 1  
[1] 2  
R | # Subtraction uses '-'  
  | 2 - 1  
[1] 1  
R | # Multiplication uses '*'  
  | 3 * 3  
[1] 9  
R | # Division uses '/'  
  | 4 / 2  
[1] 2
```

Arithmetic

- Exponentiation
 - Write x^y as $x \wedge y$
- Modulus
 - The remainder after division
 - Ex.: $46 \bmod 6 = 4$
 1. $6 \times 7 = 42$
 2. $46 - 42 = 4$
 3. $4 < 6$, so 4 is the remainder
- Integer division (not used often)
 - Like division, but it drops any decimal

```
R | # Exponentiation uses '^'  
  | 5 ^ 5
```

```
[1] 3125
```

```
R | # Modulus (aka the remainder) uses '%%'  
  | 46 %% 6
```

```
[1] 4
```

```
R | # Integer division uses '%/%'  
  | 46 %/% 6
```

```
[1] 7
```

Variable assignment

- Variable assignment lets you give something a name
 - This lets you easily reuse it
- In R, we can name almost anything that we create
 - Values
 - Data
 - Functions
 - etc...
- We will name things using the `<-` operator

```
R # Store 2 in 'x'  
x <- 2  
  
# Check the value of x  
x
```

```
[1] 2
```

```
R # Store arithmetic in y  
y <- x * 2  
  
# Check the value of y  
y
```

```
[1] 4
```

Variable assignment

- Note that values are calculated at the time of assignment
- We previously set $y \leftarrow 2 * x$
- If we change the values of x and y remain unchanged!

```
R # Previous value of x and y  
cat(x, y)
```

```
2 4
```

```
R # Change x, then recheck the value  
# of x and y  
x <- 200  
  
cat(x, y)
```

```
200 4
```

Application: Singtel's earnings growth

Set a variable `growth` to the amount of Singtel's earnings growth percent in 2018

```
R # Data from Singtel's earnings reports, in Millions of SGD
singtel_2017 <- 3831.0
singtel_2018 <- 5430.3

# Compute growth
growth <- singtel_2018 / singtel_2017 - 1

# Check the value of growth
growth
```

```
[1] 0.4174628
```

Recap

- So far, we are using R as a glorified calculator
- The key to using R is that we can scale this up with little effort
 - Calculating *every* public companies' earnings growth isn't much harder than calculating Singtel's!

Scaling this up will give use a lot more value

- How to scale up:
 1. Use data structures to hold collections of data
 - Could calculate growth for **all** companies instead of just Singtel, using the same basic structure
 2. Leverage **functions** to automate more complex operations
 - There are many functions built in, and **many** more freely available

Data structures

The background of the slide is a dark blue gradient with a complex network graph overlay. The graph consists of numerous small, glowing blue nodes connected by thin, light blue lines, creating a dense, interconnected web of connections. The nodes and lines vary in brightness, with some appearing more prominent than others, suggesting a dynamic or active network structure.

Data types

- Numeric: Any number
 - Positive or negative
 - With or without decimals
- Boolean: **TRUE** or **FALSE**
 - Capitalization matters!
 - Shorthand is **T** and **F**
- Character: “text in quotes”
 - More difficult to work with
 - You can use either single or double quotes
- Factor: Converts text into numeric data
 - Categorical data

```
R | company_name <- "Google" # character  
  | company_name
```

```
[1] "Google"
```

```
R | company_name <- 'Google' # character  
  | company_name
```

```
[1] "Google"
```

```
R | tech_firm <- TRUE # boolean  
  | tech_firm
```

```
[1] TRUE
```

```
R | earnings <- 12662 # numeric, $M USD  
  | earnings
```

```
[1] 12662
```

Scaling up...

- We already have some data entered, but it's only a small amount
- We can scale this up using ...
 - Vectors using `c()` – holds only 1 type
 - Matrices using `matrix()` – holds only 1 type
 - Lists using `list()` – holds anything (including other structures)
 - Data frames using `data.frame()` – holds different types by column

Vectors: What are they?

- Remember back to linear algebra...

Examples:

$$\begin{pmatrix} 1 \\ 2 \\ 3 \\ 4 \end{pmatrix} \quad \text{or} \quad (1 \ 2 \ 3 \ 4)$$

A row (or column) of data

Vector example: Profit margin for tech firms

```
R # Calculating profit margin for all public US tech firms
# 715 tech firms in Compustat with >1M sales in 2017

# Data:
#   earnings_2017: vector of earnings, $M USD
#   revenue_2017: vector of revenue, $M USD
#   names_2017: a vector of tickers (strings)

# Naming the vectors
names(earnings_2017) <- names_2017
names(revenue_2017) <- names_2017

earnings_2017[1:6]
```

AVX CORP	BK TECHNOLOGIES	ADVANCED MICRO DEVICES
4.910	-3.626	43.000
ASM INTERNATIONAL NV	SKYWORKS SOLUTIONS INC	ANALOG DEVICES
543.878	1010.200	727.259

```
R |revenue_2017[1:6]
```

AVX CORP	BK TECHNOLOGIES	ADVANCED MICRO DEVICES
1562.474	39.395	5329.000
ASM INTERNATIONAL NV	SKYWORKS SOLUTIONS INC	ANALOG DEVICES
886.503	3651.400	5107.503

Vector example: Profit margin for tech firms

```
R | # Summarizing vectors  
summary(earnings_2017)
```

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
-4307.49	-15.98	1.84	296.84	91.36	48351.00

```
R | summary(revenue_2017)
```

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
1.06	102.62	397.57	3023.78	1531.59	229234.00

```
R | # Calculating profit margin  
margin <- earnings_2017 / revenue_2017  
summary(margin)
```

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
-13.97960	-0.10253	0.01353	-0.10967	0.09295	1.02655

```
R | # Worst, midpoint, and best profit margin firms in 2017. Our names carried over :)  
margin[order(margin)][c(1, length(margin) / 2, length(margin))]
```

HELIOS AND MATHESON ANALYTIC	NLIGHT INC
-13.97960161	0.01325588
CCUR HOLDINGS INC	
1.02654899	

Matrices: What are they?

- Remember back to linear algebra...

Example:

$$\begin{pmatrix} 1 & 2 & 3 & 4 \\ 5 & 6 & 7 & 8 \\ 9 & 10 & 11 & 12 \end{pmatrix}$$

A rows *and* columns of data

Selecting from matrices

- Select using 2 indexes instead of 1:
 - `matrix_name[rows, columns]`
 - To select all rows or columns, leave that index blanks

```
R columns <- c("Google", "Microsoft", "Goldman Sachs")
rows <- c("Earnings", "Revenue")

firm_data <- matrix(data=c(12662, 21204, 4286,
                          110855, 89950, 42254), nrow=2)
# Equivalent:
# matrix(data=c(12662, 21204, 4286,
#               110855, 89950, 42254), ncol=3)

# Apply names
rownames(firm_data) <- rows
colnames(firm_data) <- columns

# Print the matrix
firm_data
```

	Google	Microsoft	Goldman
Earnings	12662	4286	89950
Revenue	21204	110855	42254

```
R | firm_data[2, 3]
```

```
[1] 42254
```

```
R | firm_data[, c("Google", "Microsoft")]
```

	Google	Microsoft
Earnings	12662	4286
Revenue	21204	110855

```
R | firm_data[1, ]
```

	Google	Microsoft	Goldman
Earnings	12662	4286	89950

```
R | firm_data["Revenue", "Goldman"]
```

```
[1] 42254
```

Combining matrices

- Matrices are combined top to bottom as rows with `rbind()`
- Matrices are combined side-by-side as columns with `cbind()`

```
R # Preloaded: industry codes as indcode (vector)
#   - GICS codes: 40=Financials, 45=Information Technology
#   - See: https://en.wikipedia.org/wiki/Global\_Industry\_Classification\_Standard
# Preloaded: JPMorgan data as jpdata (vector)

mat <- rbind(firm_data, indcode) # Add a row
rownames(mat)[3] <- "Industry" # Name the new row
mat
```

	Google	Microsoft	Goldman
Earnings	12662	4286	89950
Revenue	21204	110855	42254
Industry	45	45	40

```
R mat <- cbind(firm_data, jpdata) # Add a column
colnames(mat)[4] <- "JPMorgan" # Name the new column
mat
```

	Google	Microsoft	Goldman	JPMorgan
Earnings	12662	4286	89950	17370
Revenue	21204	110855	42254	115475

Lists: What are they?

- Like vectors, but with mixed types
- Generally not something we will create
- Often returned by analysis functions in R

```
R # Ignore this code for now...
model <- summary(lm(earnings ~ revenue, data=tech_df))
#Note that this function is hiding something...
model
```

Call:

```
lm(formula = earnings ~ revenue, data = tech_df)
```

Residuals:

Min	1Q	Median	3Q	Max
-16045.0	20.0	141.6	177.1	12104.6

Coefficients:

	Estimate	Std. Error	t value	Pr(> t)	
(Intercept)	-1.837e+02	4.491e+01	-4.091	4.79e-05	***
revenue	1.589e-01	3.564e-03	44.585	< 2e-16	***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 1166 on 712 degrees of freedom

Looking into lists

- Lists generally use double square brackets, `[[index]]`
 - Used for pulling individual elements out of a list
- `[[c()]]` will drill through lists, as opposed to pulling multiple values
- Single square brackets pull out elements as is
- Double square brackets extract just the element
- For 1 level, we can also use `$`

```
R | model["r.squared"]
```

```
$r.squared  
[1] 0.7360059
```

```
R | model[["r.squared"]]
```

```
[1] 0.7360059
```

```
R | model$r.squared
```

```
[1] 0.7360059
```

```
R | earnings <- c(12662, 21204, 4286)  
company <- c("Google", "Microsoft", "Goldman Sachs")  
names(earnings) <- company  
earnings["Google"]
```

```
Google  
12662
```

```
R | earnings[["Google"]]
```

```
[1] 12662
```

```
R | #Can't use $ with vectors
```

Structure of a list

- `str()` will tell us what's in this list

```
R | str(model)
List of 11
 $ call      : language lm(formula = earnings ~ revenue, data = tech_df)
 $ terms     :Classes 'terms', 'formula' language earnings ~ revenue
 .. ..- attr(*, "variables")= language list(earnings, revenue)
 .. ..- attr(*, "factors")= int [1:2, 1] 0 1
 .. .. ..- attr(*, "dimnames")=List of 2
 .. .. .. ..$ : chr [1:2] "earnings" "revenue"
 .. .. .. ..$ : chr "revenue"
 .. ..- attr(*, "term.labels")= chr "revenue"
 .. ..- attr(*, "order")= int 1
 .. ..- attr(*, "intercept")= int 1
 .. ..- attr(*, "response")= int 1
 .. ..- attr(*, ".Environment")=<environment: R_GlobalEnv>
 .. ..- attr(*, "predvars")= language list(earnings, revenue)
 .. ..- attr(*, "dataClasses")= Named chr [1:2] "numeric" "numeric"
 .. ..- attr(*, "names")= chr [1:2] "earnings" "revenue"
```

What are data frames?

- Data frames are like a hybrid between lists and matrices

Like a matrix:

- 2 dimensional like matrices
- Can access data with `[]`
- All elements in a column must be the same data type

Like a list:

- Can have different data types for different columns
- Can access data with `$`

Columns \approx variables, e.g., earnings

Rows \approx observations, e.g., Google in 2017

Three schools of thought on data handling

1. Use *Base R* functions (i.e., what's built in)
 - Tends to be tedious
2. Use *tidy* methods (from [tidyverse](#))
 - Almost always cleaner and more readable
 - Usually faster, sometimes slower
 - This creates a structure called a [tibble](#)
3. Use *data.table* (from [data.table](#))
 - Very structured syntax, but difficult to read
 - Almost always fastest and memory efficient – use when speed is needed
 - This creates a structure called a [data.table](#)

💡 title.optional

You can case [tibble](#) and [data.table](#) objects to a [data.frame](#) using `as.data.frame()`

Data in Base R

Note: Base R methods are explained in the [R Supplement](#)

```
R library(tidyverse) # Imports most tidy packages
# Base R data import -- stringsAsFactors is important here
df <- read.csv("../Data/Session_1-2.csv", stringsAsFactors=FALSE)
df <- subset(df, fyear == 2017 & !is.na(revt) & !is.na(ni) &
            revt > 1 & gsector == 45)
df$margin = df$ni / df$revt
summary(df)
```

gvkey	datadate	fyear	indfmt
Min. : 1072	Min. :20170630	Min. :2017	Length:715
1st Qu.: 20231	1st Qu.:20171231	1st Qu.:2017	Class :character
Median : 33232	Median :20171231	Median :2017	Mode :character
Mean : 79699	Mean :20172029	Mean :2017	
3rd Qu.:148393	3rd Qu.:20171231	3rd Qu.:2017	
Max. :315629	Max. :20180430	Max. :2017	
consol	popsrc	datafmt	tic
Length:715	Length:715	Length:715	Length:715
Class :character	Class :character	Class :character	Class :character
Mode :character	Mode :character	Mode :character	Mode :character

Data the tidy way

```
R # Tidy import
df <- read_csv("../Data/Session_1-2.csv") %>%
  filter(fyear == 2017,      # fiscal year
         !is.na(revt),      # revenue not missing
         !is.na(ni),        # net income not missing
         revt > 1,         # at least 1M USD in revenue
         gsector == 45) %>% # tech firm
  mutate(margin = ni/revt) # profit margin
summary(df)
```

gvkey	datadate	fyear	indfmt
Length:715	Min. :20170630	Min. :2017	Length:715
Class :character	1st Qu.:20171231	1st Qu.:2017	Class :character
Mode :character	Median :20171231	Median :2017	Mode :character
	Mean :20172029	Mean :2017	
	3rd Qu.:20171231	3rd Qu.:2017	
	Max. :20180430	Max. :2017	
consol	popsrc	datafmt	tic
Length:715	Length:715	Length:715	Length:715
Class :character	Class :character	Class :character	Class :character
Mode :character	Mode :character	Mode :character	Mode :character

conm

curcd

ni

revt

Length:715

Length:715

Min. : 4207.40

Min. : 1.00

Other important tidy methods

- Sorting: use `arrange()`
- Grouping for calculations:
 - Group using `group_by()`
 - Ungroup using `ungroup()` once you are done
- Keep only a subset of variables using `select()`
- We'll see many more along the way!

A note on syntax: Piping

Pipe notation is never necessary and not built in to R

- Piping comes from `magrittr`
 - The `%>%` pipe is loaded with `tidyverse`
- Pipe notation is done using `%>%`
 - `Left %>% Right(arg2, ...)` is the same as `Right(Left, arg2, ...)`

Why Pipes?

Piping can drastically improve code readability. Piped code tells you the list of operations applied to a single starting object, such as a data frame.

- `magrittr` has other interesting pipes, such as `%<>%`
 - `Left %<>% Right(arg2, ...)` is `Left <- Right(Left, arg2, ...)`
 - To load these other pipes, you need to explicitly load `magrittr`

Tidy example without piping

```
R df <- mutate(  
  filter(  
    read_csv("../Data/Session_1-2.csv"),  
    fyear == 2017,      # fiscal year  
    !is.na(revt),      # revenue not missing  
    !is.na(ni),        # net income not missing  
    revt > 1,          # at least 1M USD in revenue  
    gsector == 45),    # tech firm  
  margin = ni/revt)    # profit margin  
summary(df)
```

gvkey	datadate	fyear	indfmt
Length:715	Min. :20170630	Min. :2017	Length:715
Class :character	1st Qu.:20171231	1st Qu.:2017	Class :character
Mode :character	Median :20171231	Median :2017	Mode :character
	Mean :20172029	Mean :2017	
	3rd Qu.:20171231	3rd Qu.:2017	
	Max. :20180430	Max. :2017	
consol	popsrc	datafmt	tic
Length:715	Length:715	Length:715	Length:715
Class :character	Class :character	Class :character	Class :character
Mode :character	Mode :character	Mode :character	Mode :character

com

curcd

ni

revt

Practice: Data types and structures

- This practice is to make sure you understand data types
- Do exercises 1 through 3 on today's R practice file:
 - [R Practice](#)
 - Short link: rmc.link/420r1

Useful functions

Reference

Many useful functions are highlighted in the [R Supplement](#)

1. Installing and loading packages

```
R # Install the tidyverse package from inside R
install.packages("tidyverse")

# Load the package
library(tidyverse)
```

2. Help functions

```
R # To see a help page for a function (such as data.frame()) run either of:
help(data.frame)
?data.frame
```

```
R # To see the arguments a function takes, run:
args(data.frame)
```

```
function (..., row.names = NULL, check.rows = FALSE, check.names = TRUE,
          fix.empty.names = TRUE, stringsAsFactors = FALSE)
NULL
```

Making your own functions!

- Use the `function()` function!
 - `my_func <- function(arguments) {code}`

Simple function: Add 2 to a number

```
R add_two <- function(n) {  
  n + 2  
}  
  
add_two(500)
```

```
[1] 502
```

Slightly more complex function example

```
R | mult_together <- function(n1, n2=0, square=FALSE) {  
  if (!square) {  
    n1 * n2  
  } else {  
    n1 * n1  
  }  
}  
  
mult_together(5, 6)
```

```
[1] 30
```

```
R | mult_together(5, 6, square=TRUE)
```

```
[1] 25
```

```
R | mult_together(5, square=TRUE)
```

```
[1] 25
```

Example: Currency conversion function

```
R FXRate <- function(from="USD", to="SGD", dt=Sys.Date()) {  
  options("getSymbols.warning4.0"=FALSE)  
  if (!require(quantmod)) return("Install the quantmod package for this function to work")  
  data <- getSymbols(paste0(from, "/", to), from=dt-3, to=dt, src="oanda", auto.assign=F)  
  return(data[[1]])  
}  
date()
```

```
[1] "Sat Jul 22 17:20:43 2023"
```

```
R | FXRate(from="USD", to="SGD") # Today's SGD to USD rate
```

```
[1] 1.32522
```

```
R | FXRate(from="SGD", to="CNY") # Today's SGD to CNY rate
```

```
[1] 5.44584
```

```
R | FXRate(from="USD", to="SGD", dt=Sys.Date()-90) # Last quarter's SGD to USD rate
```

```
[1] 1.33312
```

Practice: Functions

- This practice is to make sure you understand functions and their construction
- Do exercises 4 and 5 on today's R practice file:
 - [R Practice](#)
 - Short link: rmc.link/420r1



End Matter

Wrap up

- For next week:
 - Take a look at Datacamp!
 - Be sure to complete the assignment there
 - A complete list of assigned modules over the course is on eLearn
 - We'll start in on some light analytics next week
- Survey on the class session at this QR code:



Packages used for these slides

- DT
- downlit
- kableExtra
- knitr
- ngramr
- plotly
- quantmod
- quarto
- revealjs
- RColorBrewer
- tidyverse

Appendix: Getting data from WRDS

Data Sources

- WRDS
 - WRDS is a provider of business data for academic purposes
 - Through your class account, you can access vast amounts of data
 - We will be particularly interested in:
 - Compustat (accounting statement data since 1950)
 - CRSP (stock price data, daily since 1926)
- We will use other public data from time to time
 - Singapore's big data repository
 - US Government data
 - Other public data collected by the Prof

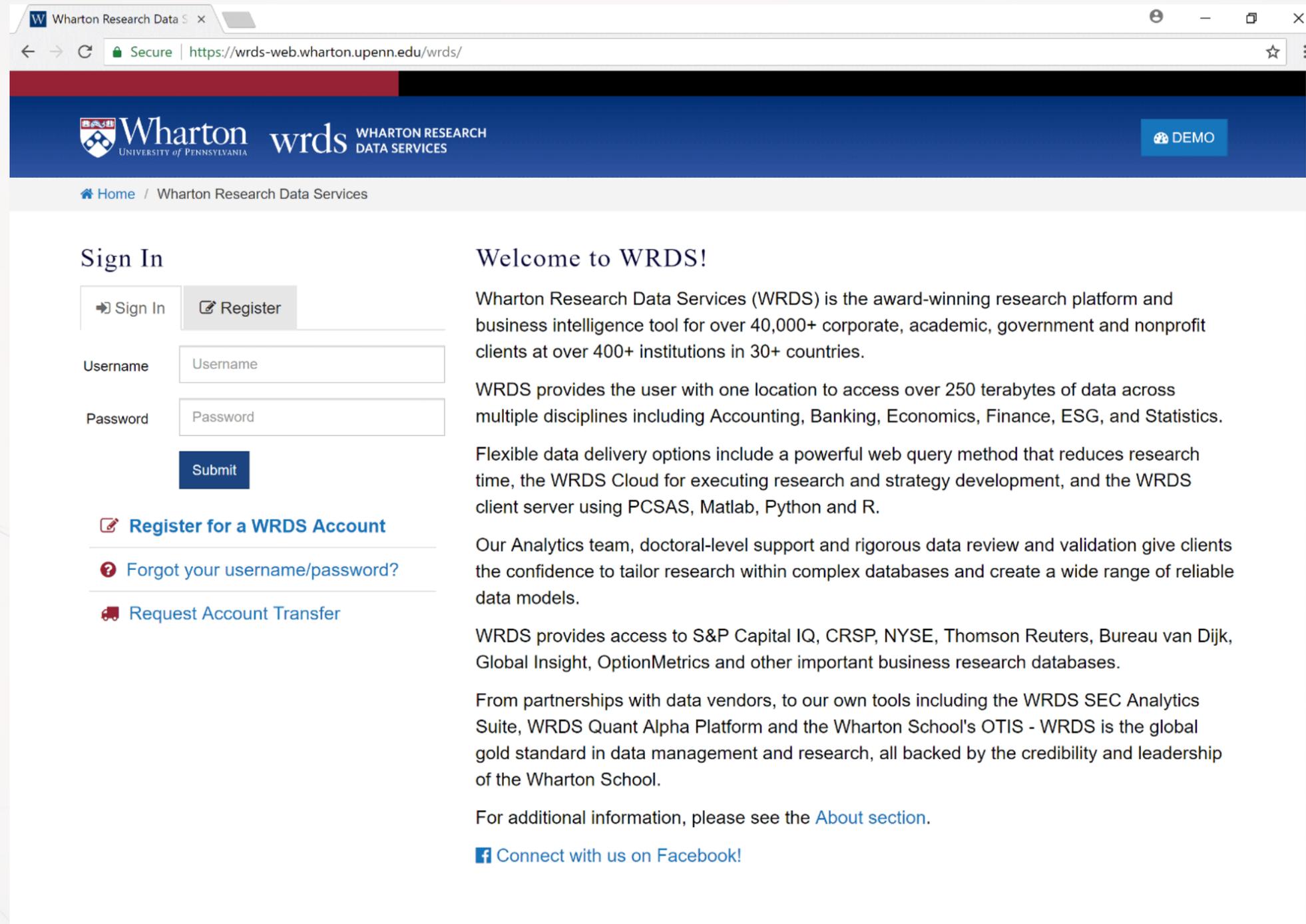


How to download from WRDS

1. Log in using a class account (posted on eLearn)
2. Pick the data provider that has your needed data
3. Select the data set you would like (some data sets only)
4. Apply any needed conditional restrictions (years, etc.)
 - These can help keep data sizes manageable
 - CRSP without any restrictions is >10 GB
5. Select the specific variables you would like export
6. Export as a csv file, zipped csv file (or other format)

A picture walkthrough is on the next set of slides

Go to **WRDS** and sign in



The screenshot shows a web browser window with the URL <https://wrds-web.wharton.upenn.edu/wrds/>. The page features the Wharton University of Pennsylvania logo and the text "wrds WHARTON RESEARCH DATA SERVICES". A "DEMO" button is visible in the top right corner. The main content area is divided into two columns. The left column is titled "Sign In" and contains a "Sign In" button (selected) and a "Register" button. Below these are input fields for "Username" and "Password", followed by a "Submit" button. Underneath the input fields are three links: "Register for a WRDS Account", "Forgot your username/password?", and "Request Account Transfer". The right column is titled "Welcome to WRDS!" and contains several paragraphs of text describing the platform's capabilities, data access options, and support services. At the bottom of the right column, there is a link to the "About section" and a Facebook social media link.

Wharton Research Data Services (WRDS) is the award-winning research platform and business intelligence tool for over 40,000+ corporate, academic, government and nonprofit clients at over 400+ institutions in 30+ countries.

WRDS provides the user with one location to access over 250 terabytes of data across multiple disciplines including Accounting, Banking, Economics, Finance, ESG, and Statistics.

Flexible data delivery options include a powerful web query method that reduces research time, the WRDS Cloud for executing research and strategy development, and the WRDS client server using PCSAS, Matlab, Python and R.

Our Analytics team, doctoral-level support and rigorous data review and validation give clients the confidence to tailor research within complex databases and create a wide range of reliable data models.

WRDS provides access to S&P Capital IQ, CRSP, NYSE, Thomson Reuters, Bureau van Dijk, Global Insight, OptionMetrics and other important business research databases.

From partnerships with data vendors, to our own tools including the WRDS SEC Analytics Suite, WRDS Quant Alpha Platform and the Wharton School's OTIS - WRDS is the global gold standard in data management and research, all backed by the credibility and leadership of the Wharton School.

For additional information, please see the [About section](#).

[Connect with us on Facebook!](#)

Pick a data provider, e.g. “Compustat - Capital IQ”

The screenshot shows the Wharton Research Data Services (WRDS) website. The browser address bar displays the URL <https://wrds-web.wharton.upenn.edu/wrds/index.cfm>. The page header includes the Wharton University of Pennsylvania logo, the text "wrds WHARTON RESEARCH DATA SERVICES", and a search bar labeled "Search WRDS". Navigation links for "Get Data", "Analytics", "Classroom", "Research", and "Support" are visible. The main content area is divided into three tabs: "Your Subscriptions", "Not Subscribed", and "Your Queries". Under "Your Subscriptions", a list of data providers is shown, including "Compustat - Capital IQ". To the right, there is a promotional banner for "BOND RETURNS by wrds" and a section titled "New Data on WRDS" featuring updates from Bureau van Dijk ORBIS, Toyo Keizai, and Cortellis-Clarivate Clinical Trials. A button at the bottom right of the "New Data on WRDS" section says "View all data available on WRDS".

Wharton Research Data Services

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- » AuditAnalytics
- » Bank Regulatory
- » Beta Suite by WRDS
- » Blockholders
- » CBOE Indexes
- » Compustat - Capital IQ
- » Contributed Data
- » CRSP
- » CSMAR
- » DMEF Academic Data
- » Dow Jones
- » Efficient Frontier by WRDS
- » ETF Global
- » Event Study by WRDS
- » Eventus
- » Fama French & Liquidity Factors
- » Federal Reserve Bank
- » Financial Ratios Suite by WRDS
- » IBES
- » Institutional Shareholder Services (ISS)
- » Intraday Indicators by WRDS
- » ISSM
- » Linking Suite by WRDS
- » MFLINKS
- » MSCI (formerly KLD and GMI)
- » MSRB
- » Option Metrics
- » Option Suite by WRDS
- » OTC Markets
- » Penn World Tables
- » Peters and Taylor Total Q
- » PHLX
- » Public
- » Research Quotient
- » SAS Visual Analytics
- » SEC Order Execution
- » TAQ
- » Thomson Reuters
- » TRACE
- » World Indices by WRDS
- » WRDS SEC Analytics Suite
- » WRDS Supply Chain

BOND RETURNS by wrds

Bond Returns

New Data on WRDS

Bureau van Dijk ORBIS Access information on 40,700 banks (28,000 US and 12,700 Non-US).

Data Coming Soon

Toyo Keizai Access the most comprehensive earnings information for all listed companies in Japan. Scheduled for release mid-May 2018.

Cortellis-Clarivate Clinical Trials Expertly curated global clinical trials information covering all Indications

View all data available on WRDS

Trial Datasets

Pick a data set, e.g. “North America - Daily”

Compustat - Capital IQ

Important Change to Compustat Update Frequency
Beginning the first week in January 2018, certain Compustat databases will be updated on a daily basis; previously, they were updated monthly or annually. This will affect both web and WRDS cloud access. More detailed information is available from [this article](#).

For more about this dataset, see the [Dataset List](#), [Manuals and Overviews](#) or [FAQs](#).

Compustat Daily Updates	Capital IQ	Other Compustat
» North America - Daily 16	» Identifiers 1	» North America - Annual Updates 13
» Global - Daily 5	» S&P Credit Ratings 4	» Marginal Tax Rates 1
» Bank - Daily 2	» Transactions 2	» Preliminary History 4
» Historical Segments - Daily 2	» Capital Structure 3	» Unrestated Quarterly 2
» Execucomp - Monthly Updates 9	» Key Developments 1	» Point in Time 2
» Snapshot - Monthly Updates 7	» People Intelligence 3	» North America - Daily Updates (Non-Historical) 15
		» S&P Filing Dates 1

Legacy Compustat Tools SNL

Pick a data set, e.g. “Fundamentals Annual”

The screenshot shows a web browser window with the URL https://wrds-web.wharton.upenn.edu/wrds/query_forms/navigation.cfm?navId=83. The page header includes the Wharton logo, the text 'WRDS WHARTON RESEARCH DATA SERVICES', a search bar, and navigation links for 'Get Data', 'Analytics', 'Classroom', 'Research', and 'Support'. The breadcrumb trail is 'Home / Get Data / Compustat - Capital IQ / Compustat Daily Updates / North America - Daily'. The main heading is 'North America - Daily'. Below it, there is a link to 'Dataset List, Manuals and Overviews or FAQs'. A paragraph describes 'Compustat North America' as a database of U.S. and Canadian fundamental and market information. Another paragraph states that the files also contain information on aggregates, industry segments, banks, market prices, dividends, and earnings. A grid of 18 data set options is displayed, including 'Fundamentals Annual', 'Industry Specific Quarterly', 'Segments (Non-Historical)', 'Fundamentals Quarterly', 'Pension Annual', 'Segments (Non-Historical) - Customer', 'Index Constituents', 'Pension Quarterly', 'Simplified Financial Statement Extract', 'Index Fundamentals', 'Ratings', 'Supplemental Short Interest File', 'Index Prices', 'Security Daily', 'Industry Specific Annual', and 'Security Monthly'. The footer contains the Wharton logo and links for 'About WRDS', '3 Ways to use WRDS', 'Account Preferences', and 'WRDS Demo'.

North America - Daily

For more about this dataset, see the [Dataset List](#), [Manuals and Overviews](#) or [FAQs](#).

Compustat North America is a database of U.S. and Canadian fundamental and market information on active and inactive publicly held companies. It provides more than 300 annual and 100 quarterly Income Statement, Balance Sheet, Statement of Cash Flows, and supplemental data items. For most companies, annual history is available back to 1950 and quarterly history back to 1962 with monthly market history back to 1962.

Compustat North America files also contain information on aggregates, industry segments, banks, market prices, dividends, and earnings.

Fundamentals Annual	Industry Specific Quarterly	Segments (Non-Historical)
Fundamentals Quarterly	Pension Annual	Segments (Non-Historical) - Customer
Index Constituents	Pension Quarterly	Simplified Financial Statement Extract
Index Fundamentals	Ratings	Supplemental Short Interest File
Index Prices	Security Daily	
Industry Specific Annual	Security Monthly	

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Selecting data: Time range

Compustat Daily Updates - Fundamentals Annual

You have 3 saved queries for this dataset.

Step 1: Choose your date range.

Date Variable:
Data Date

Date range
2010-01 to 2018-06

Step 2: Apply your company codes.

TIC GVKEY CUSIP SIC NAICS CIK

Select an option for entering company codes

Company Codes Code List Name

Please enter Company codes separated by a space.
Example: IBM MSFT DELL [Code Lookup]

Browse... No file selected

plain text file (.txt), having one code per line.

Selecting data: Companies and data format

The screenshot shows a web browser window with the URL <https://wrds-web.wharton.upenn.edu/wrds/ds/compd/funda/index.cfm?navId=83>. The page is titled "Step 2: Apply your company codes." and features a sidebar on the left with various data categories: Industry Specific Quarterly, Pension Annual, Pension Quarterly, Ratings, Security Daily, Security Monthly, Segments (Non-Historical), Segments (Non-Historical) - Customer, Simplified Financial Statement Extract, and Supplemental Short Interest File.

Step 2: Apply your company codes.

TIC GVKEY CUSIP SIC NAICS CIK

Select an option for entering company codes

Please enter Company codes separated by a space.
Example: IBM MSFT DELL [[Code Lookup](#)]

No file selected

Upload a plain text file (.txt), having one code per line.

Choose from your saved codelists.

Search the entire database

This method allows you to search the entire database of records. Please be aware that this method can take a very long time to run because it is dependent upon the size of the database.

Screening Variables

Several screening variables are pre-selected to produce one record per GVKEY-DATADATE pair, while keeping the vast majority of records. Examples of excluded rows include those with restated data, different views of the same data (pro forma, pre-FASB). Click on each variable for a more detailed explanation.

Consolidation Level	<input checked="" type="checkbox"/> C	<input type="checkbox"/> N	<input type="checkbox"/> R	<input type="checkbox"/> P	<input type="checkbox"/> D	<input checked="" type="checkbox"/> Output
Industry Format			<input checked="" type="checkbox"/> INDL	<input type="checkbox"/> FS		<input checked="" type="checkbox"/> Output
Data Format	<input checked="" type="checkbox"/> STD	<input type="checkbox"/> SUMM_STD	<input type="checkbox"/> PRE_AMENDS	<input type="checkbox"/> PRE_AMENDSS		<input checked="" type="checkbox"/> Output
Population Source			<input checked="" type="checkbox"/> D	<input type="checkbox"/> I		<input checked="" type="checkbox"/> Output
Currency			<input checked="" type="checkbox"/> USD	<input checked="" type="checkbox"/> CAD		<input checked="" type="checkbox"/> Output
Company Status			<input checked="" type="checkbox"/> Active	<input checked="" type="checkbox"/> Inactive		<input checked="" type="checkbox"/> Output

Selecting data fields

The screenshot shows a web browser window with the URL <https://wrds-web.wharton.upenn.edu/wrds/ds/compd/funda/index.cfm?navId=83>. The page has a navigation bar with tabs: "Footnotes", "Data Codes", and "Data Items" (which is selected and marked with a green checkmark). Below the navigation bar, there is a section titled "How does this work?".

The main content area features a search bar labeled "Search All 0/973" and a series of tabs: "Identifying Information 0/7", "Identifying Information, cont. 0/34", and "Company Desc" (with a right-pointing arrow). Below these tabs, there is a selection interface with a "Select" button (checked) and "All" button, and a "Selected" button (unchecked) and "Clear All" button, followed by a count "(0)".

The selection interface contains a search bar labeled "Search All" and a list of data fields, each with a radio button and a help icon (question mark):

- Company Name
- Ticker Symbol
- CUSIP
- CIK Number
- Stock Exchange Code
- Fiscal Year-End
- Foreign Incorporation Code
- ADD1 -- Address Line 1
- ADD2 -- Address Line 2
- ADD3 -- Address Line 3
- ADD4 -- Address Line 4

Below the selection interface, there is a section titled "Conditional Statements (Optional)" with a link "How does this work?".

Select output formats

Compustat Daily Updates x

Secure | <https://wrds-web.wharton.upenn.edu/wrds/ds/compd/funda/index.cfm?navId=83>

[How does this work?](#)

No variables are currently selected. To set conditions on this query, please select at least one variable in the Query Variables step.

[Activate Conditional Statement Builder](#)

Step 4: Select query output.

Select the desired [format](#) of the output file. For large data requests, select a compression type to expedite downloads. If you enter your email address, you will receive an email that contains a URL to the output file when the data request is finished processing.

Output Format	Compression Type	Date Format
<input checked="" type="radio"/> fixed-width text (*.txt)	<input checked="" type="radio"/> None	<input checked="" type="radio"/> YYMMDDn8. (e.g. 19840725)
<input type="radio"/> comma-delimited text (*.csv)	<input type="radio"/> zip (*.zip)	<input type="radio"/> DATE9. (e.g. 25JUL1984)
<input type="radio"/> Excel spreadsheet (*.xlsx)	<input type="radio"/> gzip (*.gz)	<input type="radio"/> DDMMYY6. (e.g. 250784)
<input type="radio"/> tab-delimited text (*.txt)		<input type="radio"/> MMDDYY10. (e.g. 07/25/1984)
<input type="radio"/> HTML table (*.htm)		<input type="radio"/> DDMMYY10. (e.g. 25/07/1984)
<input type="radio"/> SAS Windows_32 dataset (*.sas7bdat)		<input type="radio"/> YYMMDDs10. (e.g. 1984/07/25)
<input type="radio"/> SAS Windows_64 dataset (*.sas7bdat)		
<input type="radio"/> SAS Solaris_64 dataset (*.sas7bdat)		
<input type="radio"/> dBase file (*.dbf)		
<input type="radio"/> STATA file (*.dta)		
<input type="radio"/> SPSS file (*.sav)		

E-Mail Address *(Optional)* [Edit Preferences](#)

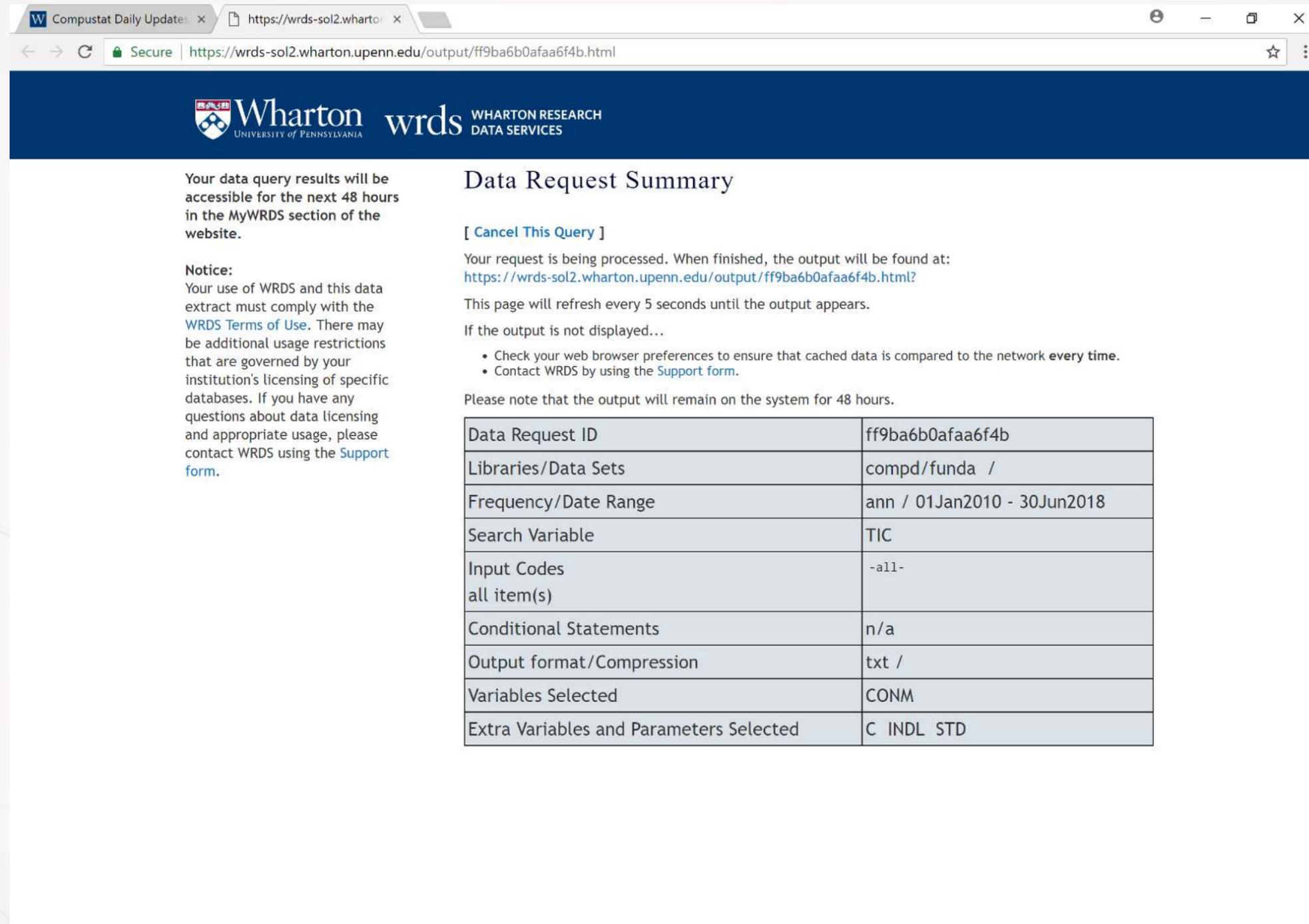
Custom Field *(Optional)*

Save this query to myWRDS

Query Name

[Submit Query](#)

Wait for the data to be prepared



Compustat Daily Updates x https://wrds-sol2.wharton x

Secure | https://wrds-sol2.wharton.upenn.edu/output/ff9ba6b0afaa6f4b.html

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Your data query results will be accessible for the next 48 hours in the MyWRDS section of the website.

Notice:
Your use of WRDS and this data extract must comply with the [WRDS Terms of Use](#). There may be additional usage restrictions that are governed by your institution's licensing of specific databases. If you have any questions about data licensing and appropriate usage, please contact WRDS using the [Support form](#).

Data Request Summary

[[Cancel This Query](#)]

Your request is being processed. When finished, the output will be found at:
<https://wrds-sol2.wharton.upenn.edu/output/ff9ba6b0afaa6f4b.html?>

This page will refresh every 5 seconds until the output appears.

If the output is not displayed...

- Check your web browser preferences to ensure that cached data is compared to the network **every time**.
- Contact WRDS by using the [Support form](#).

Please note that the output will remain on the system for 48 hours.

Data Request ID	ff9ba6b0afaa6f4b
Libraries/Data Sets	compd/funda /
Frequency/Date Range	ann / 01Jan2010 - 30Jun2018
Search Variable	TIC
Input Codes all item(s)	-all-
Conditional Statements	n/a
Output format/Compression	txt /
Variables Selected	CONM
Extra Variables and Parameters Selected	C INDL STD

Download the data!

Compustat Daily Updates x | https://wrds-sol2.wharton x

Secure | https://wrds-sol2.wharton.upenn.edu/output/ff9ba6b0afaa6f4b.html

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Your data query results will be accessible for the next 48 hours in the MyWRDS section of the website.

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Data Request Summary

Your output is complete. Click on the link below to open the output file.
[ff9ba6b0afaa6f4b.txt](#) (15.0 MB, 90706 observations 11 variables)

Warning! Your output file has more than 32,770 lines. Fixed-width files that have more than 32,770 lines have extra header lines that will cause problems when importing to other programs. If you plan to import this data into Excel for example, please use another file format instead.

Download instructions
Internet Explorer and Firefox users... Right-click and select "Save Target As..."

Citation instructions
To cite this data use the following format:
Wharton Research Data Services. "WRDS" wrds.wharton.upenn.edu, accessed 06/08/2018.

Data Request ID	ff9ba6b0afaa6f4b
Libraries/Data Sets	compd/funda /
Frequency/Date Range	ann / 01Jan2010 - 30Jun2018
Search Variable	TIC
Input Codes all item(s)	-all-
Conditional Statements	n/a
Output format/Compression	txt /
Variables Selected	CONM
Extra Variables and Parameters Selected	C INDL STD

