Tools and Techniques for Data Science

Lecture 1

Dr. Faisal Kamiran

Data Scientist and Professor

Dr. Faisal Kamiran

- PhD, Eindhoven University of Technology, The Netherlands (TU/e) – Rank 125 in the world (QS World University rankings 2021)
- Director, Data Science Lab (DSL) ITU.
- **Heading MS Data Science Program.**

ITU PUNJAB
INFORMATION TECHNOLOGY UNIVERSITY

ADDO AI

DATA SCIENCE LAB

Quality Research Capability

More than 45 Research Publications include:

- Four ICDM Papers (A* rank)
- Papers in ECML/PKDD, EMNLP, CIKM, **PAKDD, KAIS, Information Systems**, etc.

Awards

> Received a prestigious World Bank (WB) Research innovation award worth $100,000 funding for Gender Based Violence work (with Washington DC think tank) from WB and SVRI.

Data Science Lab Director Awarded World Bank Grant

Information Technology University (ITU) faculty member and Data Science Lab Director Dr Faisal Kamiran has won a World Bank innovation award for...

TECHNOLOGYREVIEW.PK

Our Projects

World Bank Research Innovation Award

- World Bank (WB) Research innovation award in Spring 2017.
- WB and SVRI gave $100,000 fundinding for our Gender Based Violence work (with Washington DC think tank.

Funded Projects

CIPL (Crime Investigation and Prevention Lab)

- *80 Million PKR Funding.*
- *Working on the Punjab Police data for Smart Police Surveillance project.*

- *Analysed 90M CDRs in* ***Zainab Murder Case*** *to assist Kasur Police*

SMS Financial Fraud Detection and Prevention

- *KARANDAAZ (Melindaa Gates Foundation) funded project .*

- *Using machine learning and AI techniques , identifying content based fraudulent schemes to help secure DFS (Digital Financial Services) in Pakistan*

Disease Surveillance System

- *Using AI models, a disease surveillance platform was built to prepare health resources, drugs and bed availability.*
- *3.6 Million PKR funding.*

Semester Schedule

Week 1: Introduction to Data Science

Week 2: Data Understanding and Acquiring

Week 3: Data Pre-processing and Cleaning

Week 4: Exploratory Data Analysis

Week 5-6: Machine Learning: Decision Trees

Week 7-8: Performance Evaluation and Ensembles

Semester Schedule

Week 9: Nearest Neighbour and Bayes Classifier

Week 10: Regression

Week 11-12: Association Rule Mining

Week 13-14: Clustering

Week 15-16: Advance Topics and Project Reservation

Text Book and Reference Material

Vijay Kotu and Bala Deshpande

"Data Science: Concepts and Practice"

2nd Edition

Reference Material:

- VanderPlas, Jake. *"Python data science handbook: essential tools for working with data"*. O'Reilly Media, Inc., 2016.
- Boschetti, Alberto, and Luca Massaron. *"Python data science essentials"*

Course Grading

Quizzes	13%
Assignments	12%
Midterm	25%
Final	35%
Group Project	15%
Total	100%

Course Project

- This will be a group project, where each team takes on a particular Data Science related problem.

- Each team will start from scratch, including finding/constructing the relevant data sets.

- Every group will be free to work on any problem they want but it needs to be approved by Dr. Faisal Kamiran and TA's.

Google Classroom

The homework assignments, and projects will be submitted by Google Classroom, so sign up with your ITU official accounts.

Google Classroom URL : classroom.google.com

Press the “+” button on top right side and give the access code:

Google Classroom Access Code : jv7u7vk

What is today's agenda?

Today we are going to learn following things :

- What is Data Science?
- Why learn Data Science?
- How do we learn Data Science?
- Who is helping you learn Data Science?

20th Century Innovation

In the 20th century Engineering and Computer Science played key role in many fields. Some of them are listed below:

- Cars
- Airplanes
- Power grid
- Television
- Air conditioning and central heating
- Nuclear power
- Digital computers
- The internet

But how about these 20th Century questions?

- Does fertilizer increase crop yields?
- Does Streptomycin cure Tuberculosis?
- Does smoking cause lung-cancer?

What is the difference?

- Deterministic versus random

- Deductive versus empirical

- Solutions deduced mostly from theory versus solutions deduced mostly from **data**

Data : The Difference

- Does fertilizer increase crop yields?
  - Answer: Collect and analyze agricultural experimental **data**

- Does Streptomycin cure Tuberculosis?
  - Anwer: Collect and analyze randomized trials **data**

- Does smoking cause lung-cancer?
  - Answer: Collect and analyze observational studies **data**

Analyzing these was the job of: boring old **statisticians**

Moving Towards 21st Century

Data is Everywhere.

21st Century

- **2021 Era of Data Science**

“I keep saying the sexy job in the next ten years will be statisticians. People think I'm joking, but who would've guessed that computer engineers would've been the sexy job of the 1990s?”

Hal Varian, Chief Economist at

Google On **January 2009**

21st Century

- **2021 Era of Data Science**

"Information is the oil of the 21st Century, and Analytics is the combustion engine."

- Peter Sondergaard

Senior Vice President, Gartner Research

October 2011

21st Century

- **2021 Era of Data Science**

"There were 5 exabytes of information created between the dawn of civilization through 2003, but that much information is now created every 2 days."

- Eric Schmidt

Former CEO, Google (2001-2011)

Big Data by Andrew McAfee

“The world is one Big Data Problem.”

- Andrew McAfee

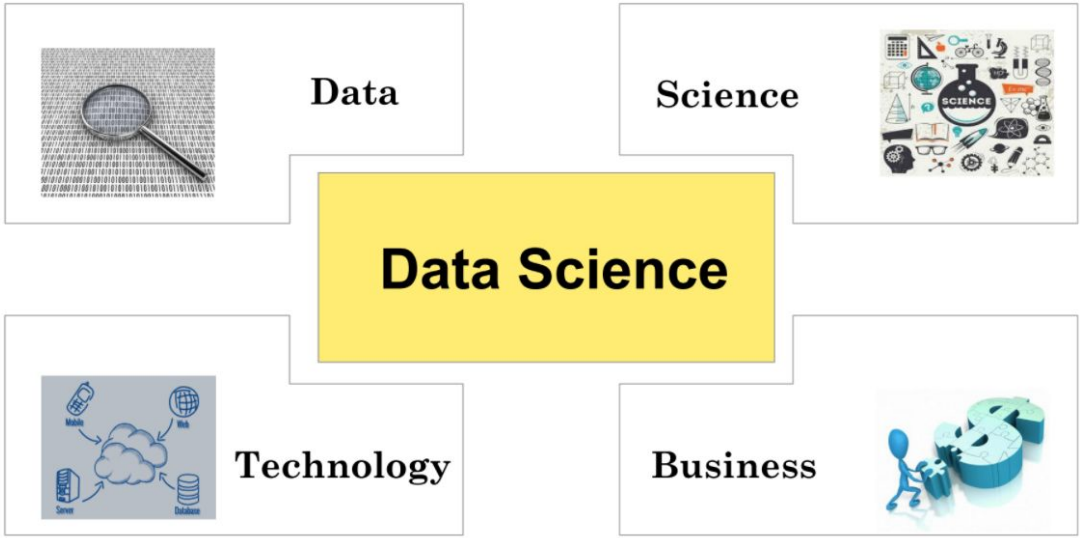
Co-director at the MIT Initiative

Data Science Applications

- Spell Checkers
- Speech Recognition
- Language Translators
- Digitizing Books
- Social Sciences
- Medical Diagnostics
- Personalized Medicine
- Basic Biology
- Much More

What is Data Science ?

“An interdisciplinary field that employs sophisticated tools and techniques to extract knowledge and actionable insights from structured or unstructured data in order to optimize business objectives.”



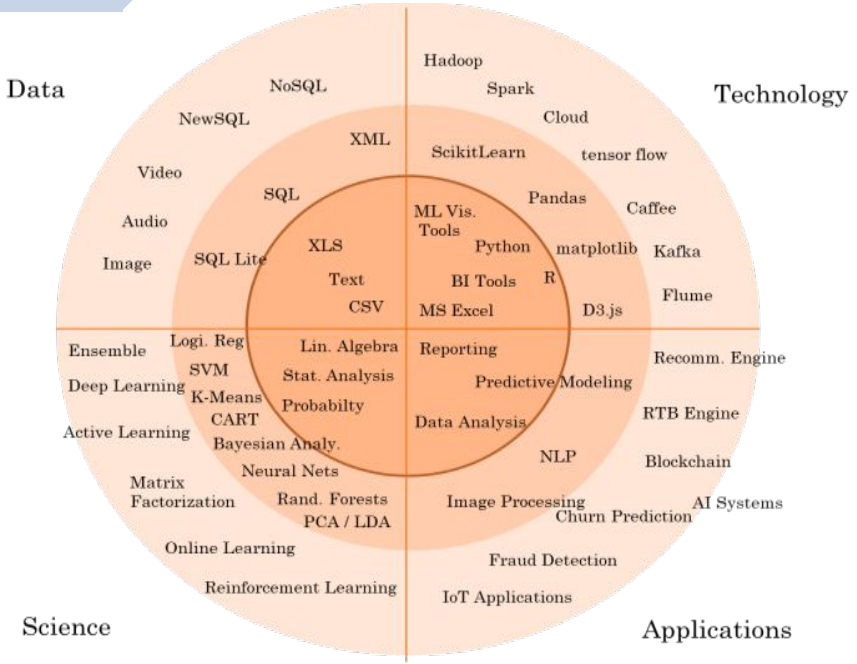
What is Data Science ?

Like any emerging field, it is well defined and incorporates elements of:

- Exploratory Data Analysis and Visualization
- Machine Learning and Statistics
- High-Performance Computing technologies for dealing with scale.

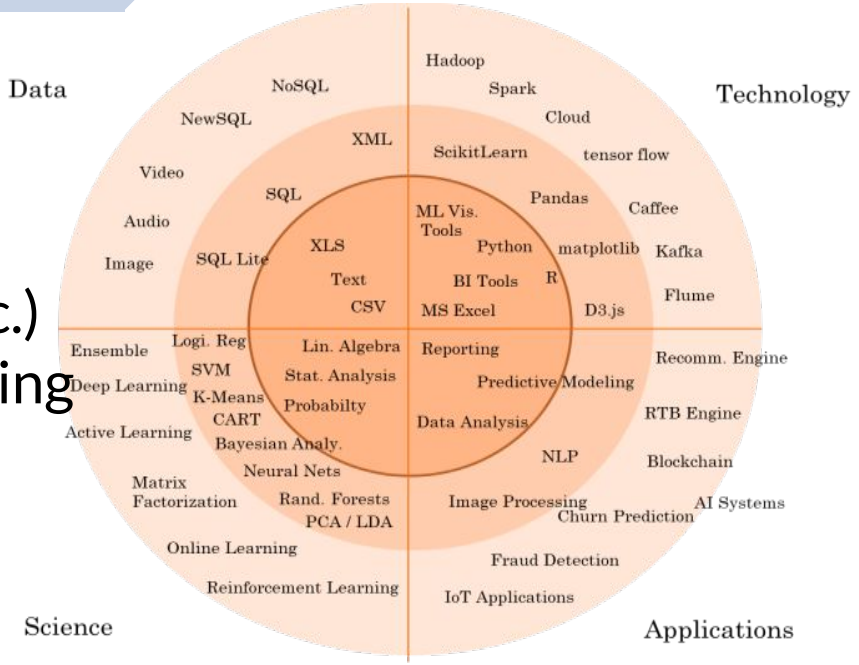
Ingredients of Data Science ?

- Data
  - Structured/UnStructured
  - Audio/Video/Image
  - Document/Graphs
- Technology
  - Python, Java
  - Libraries (Pandas, Numpy etc.)
  - Excel, BI Tools



Ingredients of Data Science ?

- Science
  - Linear Algebra/ Statistics
  - Probability
  - Algorithms (K-Means, KNN etc.)
  - Machine Learning/Deep Learning
- Applications
  - Reporting
  - Predictive Modeling
  - Computer Vision/ NLP
  - Blockchain, Recommendation Systems etc.



Industries benefiting from Data Science ?

Automotive

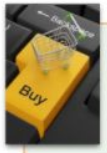
Electronics

Defense

Logistics

Banking

Insurance



E-commerce

Retail

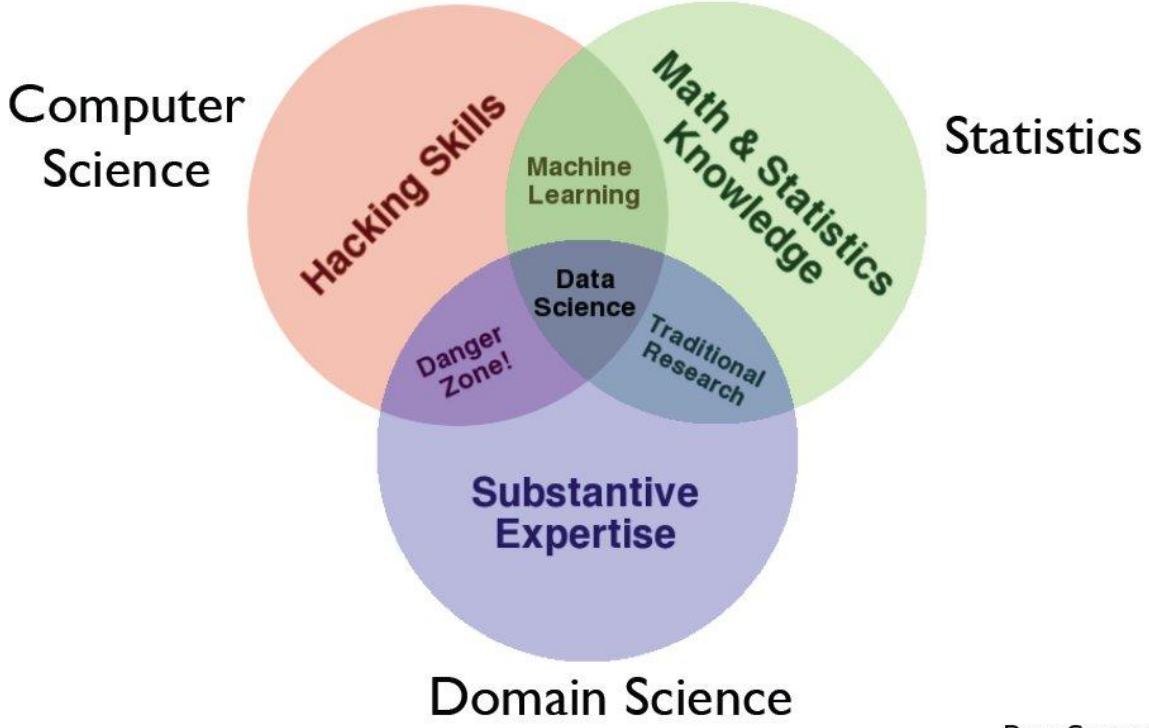
Energy

Marketing

Manufacturing

Healthcare

Skill Sets for Data Science



Drew Conway

Appreciating Data

- Computer Scientists do not naturally appreciate data: it's just stuff to run through a program.

- The usual way to test algorithm performance is to run the implementation on "random data".

- But interesting data sets are a scarce resource, which requires hard work and imagination to obtain.

Develop Curiosity

- The good data scientist develops a curiosity about the domain/application they are working in.

- They talk shop with the people whose data they are working on.

- They read different news, articles and updates to get a broader perspective on the world.

- They keep on searching for open research areas in their field.

Asking Good Questions

Software developers are not encouraged to ask questions, but data scientists are:

- What exciting things might you be able to learn from a given data set?
- What things do you/your people really want to know?
- What data sets might get you there?

Let’s Practice Asking Good Questions

Who, What, Where, When, and Why on the following datasets:

- Baseball-reference.com
- International Movie Database (IMBb)
- Google ngrams
- NYC taxi cab records

Baseball-Reference.com Data

BASEBALL-REFERENCE.COM

play index | players | teams | seasons | managers | leaders | awards | postseason | boxes | japan | nlb | minors

Mobile Site **You Are Here** > Home > Encyclopedia of Players > R Listing > **Babe Ruth Statistics and Histor**

News: s-r blog:KBO Stats back to 1999 – Baseball-Reference.com

Babe Ruth Player Page » Batting | Pitching | Fielding | Minors | News Archive (1456) | Bullpen | Oracle

Babe Ruth

Like 1,213 people like this. +1 +25 Recommend this

George Herman Ruth (Babe, The Bambino or The Sultan Of Swat)

Positions: Outfielder and Pitcher
Bats: Left, **Throws:** Left
Height: 6' 2", **Weight:** 215 lb.

Born: February 6, 1895 in Baltimore, MD
High School: St. Mary's HS (Baltimore, MD) (All Transactions)
Debut: July 11, 1914 (Age 19.155)
Rookie Status: Exceeded rookie limits during 1915 season [*]
Teams (by GP): Yankees/RedSox/Braves 1914-1935

Final Game: May 30, 1935 (Age 40.113)
Inducted into the Hall of Fame by BBWAA as Player in 1936 (215/226 ballots). Induction ceremony in Coopers
View **Babe Ruth Page** at the Baseball Hall of Fame (plaque, photos, videos).
Died: August 16, 1948 in New York, NY (Aged 53.192)
Buried: Gate of Heaven Cemetery, Hawthorne, NY
View Player Bio from the **SABR BioProject**
About biographical information

Transactions

July 9, 1914: Purchased with Ernie Shore and Ben Egan by the Boston Red Sox from Baltimore (International) for more than $25000. more than $25000
December 26, 1919: Purchased by the New York Yankees from the Boston Red Sox for $100,000.
February 26, 1935: Released by the New York Yankees.
February 26, 1935: Signed as a Free Agent with the Boston Braves.

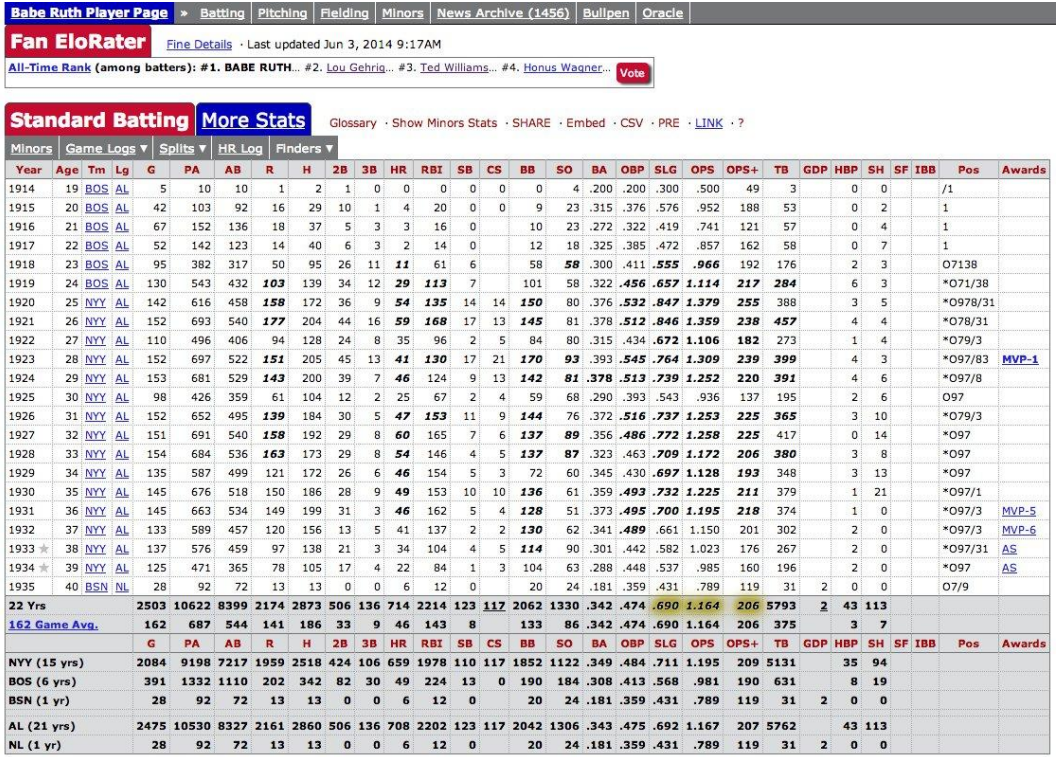
The transaction information used here was obtained free of charge from and is copyrighted by RetroSheet. We attempt to update transactions throughout the season.

Salaries

Convert to YYYY $$'s | Salaries may not be complete (especially pre-1985) and may not include some earned bonuses

Year	Age	Team	Salary	ServTm(OpnDay)	Sources	Notes/Other Sources
1914	19	Boston Red Sox	$2,500	?	Bill James Historical Abstract	Annualized rate; came up late in season
1915	20	Boston Red Sox	$3,500	?	Bill James Historical Abstract	
1916	21	Boston Red Sox	$3,500	?	Contract at HOF	
1917	22	Boston Red Sox	$3,500	?	Contract at HOF	BJHA: $5,000; Baseball Timeline $7,000
1918	23	Boston Red Sox	$9,000	?	Allan Wood, 1918, at 183	Includes $1,000 midseason raise, $1,000 WS bonus
1919	24	New York Yankees	$10,000*	?	Michael Haupert research of HOF contracts	Contract at HOF:10000.00,
1920	25	New York Yankees	$20,000*	?	Michael Haupert research of HOF contracts	Bill James Historical Abstract:20000.00,
1921	26	New York Yankees	$20,000*	?	Michael Haupert research of HOF contracts	Bill James Historical Abstract:30000.00,Plus $5K for '20 and '21 exhibitions, $50/HR (59)m
1922	27	New York Yankees	$52,000*	?	Michael Haupert research of HOF contracts	Bill James Historical Abstract:52000.00,
1923	28	New York Yankees	$52,000*	?	Michael Haupert research of HOF contracts	Bill James Historical Abstract:52000.00,
1924	29	New York Yankees	$52,000*	?	Michael Haupert research of HOF contracts	Bill James Historical Abstract:52000.00,
1925	30	New York Yankees	$52,000*	?	Michael Haupert research of HOF contracts	Bill James Historical Abstract:52000.00,
1926	31	New York Yankees	$52,000*	?	Michael Haupert research of HOF contracts	Bill James Historical Abstract:52000.00,
1927	32	New York Yankees	$52,000*	?	Michael Haupert research of HOF contracts	5/23/27 AL letter:70000.00,
1928	33	New York Yankees	$52,000*	?	Michael Haupert research of HOF contracts	5/23/27 AL letter:70000.00,
1929	34	New York Yankees	$52,000*	?	Michael Haupert research of HOF contracts	5/23/27 AL letter:70000.00,
1930	35	New York Yankees	$70,000*	?	Michael Haupert research of HOF contracts	Bill James Historical Abstract:80000.00,
1931	36	New York Yankees	$70,000*	?	Michael Haupert research of HOF contracts	Bill James Historical Abstract:80000.00,
1932	37	New York Yankees	$70,000*	?	Michael Haupert research of HOF contracts	M. Smelser, Life That Ruth Built, p. 441:75000.00,Plus 25% of all exhibition-game profits
1933	38	New York Yankees	$80,000*	?	Michael Haupert research of HOF contracts	M. Smelser, Life That Ruth Built, p. 456:52000.00,Plus 25% of revenue from in-season exhibitions
1934	39	New York Yankees	$80,000*	?	Michael Haupert research of HOF contracts	1/16/36 TSN, per government report:36696.00,$35,000 salary plus 25% of exhibition profits
1935	40	New York Yankees	$75,000*	?	Michael Haupert research of HOF contracts	Bill James Historical Abstract:35000.00,Annualized rate; retired early in season
1936	41	New York Yankees	$52,000	?	Michael Haupert research of HOF contracts	
1937	42	New York Yankees	$35,000	?	Michael Haupert research of HOF contracts	
Career to date (may be incomplete)			**$1,020,000**			

Statistical Record of Play



Babe Ruth Player Page » Batting | Pitching | Fielding | Minors | News Archive (1456) | Bullpen | Oracle

Fan EloRater — Fine Details · Last updated Jun 3, 2014 9:17AM

All-Time Rank (among batters): #1. BABE RUTH... #2. Lou Gehrig... #3. Ted Williams... #4. Honus Wagner... Vote

Standard Batting | More Stats — Glossary · Show Minors Stats · SHARE · Embed · CSV · PRE · LINK · ?

Minors | Game Logs ▾ | Splits ▾ | HR Log | Finders ▾

Year	Age	Tm	Lg	G	PA	AB	R	H	2B	3B	HR	RBI	SB	CS	BB	SO	BA	OBP	SLG	OPS	OPS+	TB	GDP	HBP	SH	SF	IBB	Pos	Awards
1914	19	BOS	AL	5	10	10	1	2	1	0	0	0	0	0	0	4	.200	.200	.300	.500	49	3		0	0			/1	
1915	20	BOS	AL	42	103	92	16	29	10	1	4	20	0	0	9	23	.315	.376	.576	.952	188	53		0	2			1	
1916	21	BOS	AL	67	152	136	18	37	5	3	3	16	0		10	23	.272	.322	.419	.741	121	57		0	4			1	
1917	22	BOS	AL	52	142	123	14	40	6	3	2	14	0		12	18	.325	.385	.472	.857	162	58		0	7			1	
1918	23	BOS	AL	95	382	317	50	95	26	11	***11***	61	6		58	***58***	.300	.411	***.555***	***.966***	192	176		2	3			O7138	
1919	24	BOS	AL	130	543	432	***103***	139	34	12	***29***	***113***	7		101	58	.322	***.456***	***.657***	***1.114***	***217***	***284***		6	3			*O71/38	
1920	25	NYY	AL	142	616	458	***158***	172	36	9	***54***	***135***	14	14	***150***	80	.376	***.532***	***.847***	***1.379***	***255***	388		3	5			*O978/31	
1921	26	NYY	AL	152	693	540	***177***	204	44	16	***59***	***168***	17	13	***145***	81	.378	***.512***	***.846***	***1.359***	***238***	***457***		4	4			*O78/31	
1922	27	NYY	AL	110	496	406	94	128	24	8	35	96	2	5	84	80	.315	.434	***.672***	**1.106**	***182***	273		1	4			*O79/3	
1923	28	NYY	AL	152	697	522	***151***	205	45	13	***41***	***130***	17	21	***170***	***93***	.393	***.545***	***.764***	***1.309***	***239***	***399***		4	3			*O97/83	MVP-1
1924	29	NYY	AL	153	681	529	***143***	200	39	7	***46***	124	9	13	***142***	***81***	***.378***	***.513***	***.739***	***1.252***	***220***	***391***		4	6			*O97/8	
1925	30	NYY	AL	98	426	359	61	104	12	2	25	67	2	4	59	68	.290	.393	.543	.936	137	195		2	6			O97	
1926	31	NYY	AL	152	652	495	***139***	184	30	5	***47***	***153***	11	9	***144***	76	.372	***.516***	***.737***	***1.253***	***225***	***365***		3	10			*O79/3	
1927	32	NYY	AL	151	691	540	***158***	192	29	8	***60***	165	7	6	***137***	***89***	.356	***.486***	***.772***	***1.258***	***225***	417		0	14			*O97	
1928	33	NYY	AL	154	684	536	***163***	173	29	8	***54***	146	4	5	***137***	***87***	.323	.463	***.709***	***1.172***	***206***	***380***		3	8			*O97	
1929	34	NYY	AL	135	587	499	121	172	26	6	***46***	154	5	3	72	60	.345	.430	***.697***	**1.128**	***193***	348		3	13			*O97	
1930	35	NYY	AL	145	676	518	150	186	28	9	***49***	153	10	10	***136***	61	.359	***.493***	***.732***	***1.225***	***211***	379		1	21			*O97/1	
1931	36	NYY	AL	145	663	534	149	199	31	3	***46***	162	5	4	***128***	51	.373	***.495***	***.700***	***1.195***	***218***	374		1	0			*O97/3	MVP-5
1932	37	NYY	AL	133	589	457	120	156	13	5	41	137	2	2	***130***	62	.341	***.489***	.661	1.150	201	302		2	0			*O97/3	MVP-6
1933 ★	38	NYY	AL	137	576	459	97	138	21	3	34	104	4	5	***114***	90	.301	.442	.582	1.023	176	267		2	0			*O97/31	AS
1934 ★	39	NYY	AL	125	471	365	78	105	17	4	22	84	1	3	104	63	.288	.448	.537	.985	160	196		2	0			*O97	AS
1935	40	BSN	NL	28	92	72	13	13	0	0	6	12	0		20	24	.181	.359	.431	.789	119	31	2	0	0			O7/9	
22 Yrs				**2503**	**10622**	**8399**	**2174**	**2873**	**506**	**136**	**714**	**2214**	**123**	**117**	**2062**	**1330**	**.342**	**.474**	***.690***	***1.164***	***206***	**5793**	**2**	**43**	**113**				
162 Game Avg.				**162**	**687**	**544**	**141**	**186**	**33**	**9**	**46**	**143**	**8**		**133**	**86**	**.342**	**.474**	**.690**	**1.164**	**206**	**375**		**3**	**7**				

	G	PA	AB	R	H	2B	3B	HR	RBI	SB	CS	BB	SO	BA	OBP	SLG	OPS	OPS+	TB	GDP	HBP	SH	SF	IBB	Pos	Awards
NYY (15 yrs)	**2084**	**9198**	**7217**	**1959**	**2518**	**424**	**106**	**659**	**1978**	**110**	**117**	**1852**	**1122**	**.349**	**.484**	**.711**	**1.195**	**209**	**5131**		**35**	**94**				
BOS (6 yrs)	**391**	**1332**	**1110**	**202**	**342**	**82**	**30**	**49**	**224**	**13**	**0**	**190**	**184**	**.308**	**.413**	**.568**	**.981**	**190**	**631**		**8**	**19**				
BSN (1 yr)	**28**	**92**	**72**	**13**	**13**	**0**	**0**	**6**	**12**	**0**		**20**	**24**	**.181**	**.359**	**.431**	**.789**	**119**	**31**	**2**	**0**	**0**				
AL (21 yrs)	**2475**	**10530**	**8327**	**2161**	**2860**	**506**	**136**	**708**	**2202**	**123**	**117**	**2042**	**1306**	**.343**	**.475**	**.692**	**1.167**	**207**	**5762**		**43**	**113**				
NL (1 yr)	**28**	**92**	**72**	**13**	**13**	**0**	**0**	**6**	**12**	**0**		**20**	**24**	**.181**	**.359**	**.431**	**.789**	**119**	**31**	**2**	**0**	**0**				

Summary statistics of each years batting, pitching, and fielding record, with teams and awards.

Baseball Questions

- How to best measure individual player's skill, value or performance?
- What is the trajectory of player's performances as they mature and age?
- To what extent does batting performance correlate with the position played?

Demographic Questions

- Do left-handed people have shorter lifespans than right-handers?
- How often do people return to where they were born?
- Do player salaries reflect past, present, or future performance?
- Are heights and weights increasing in the population?

IMDB Movie Data

IMDb | Find Movies, TV shows, Celebrities and more... | All | Movies, TV & Showtimes | Celebs, Events & Photos | News & Community | Watchlist

More at IMDbPro »

It's a Wonderful Life (1946)

Top 5000

Approved | 130 min - Drama | Family | Fantasy - 7 January 1947 (USA)

Your rating: ★★★★★★★★★★ -/10

8.7

Ratings: **8.7**/10 from 202,743 users

Reviews: 632 user | 187 critic

An angel helps a compassionate but despairingly frustrated businessman by showing what life would have been like if he never existed.

Director: Frank Capra

Writers: Frances Goodrich (screenplay), Albert Hackett (screenplay), 4 more credits »

Stars: James Stewart, Donna Reed, Lionel Barrymore | See full cast and crew »

+ Watchlist | Watch Trailer | Share...

Edit

Details

Country: USA

Language: English

Release Date: 7 January 1947 (USA) See more »

Also Known As: The Greatest Gift See more »

Filming Locations: California, USA See more »

Box Office

Budget: $3,180,000 (estimated)

Opening Weekend: £49,845 (UK) (19 December 2008)

Gross: £682,222 (UK) (24 December 2010)

See more »

Company Credits

Production Co: Liberty Films (II) See more »

Show detailed company contact information on IMDbPro »

Technical Specs

Runtime: 130 min | 118 min (DVD edition)

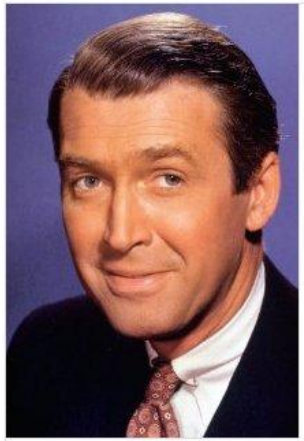
Sound Mix: Mono (RCA Sound System)

Color: Color (colorized) | Black and White

Aspect Ratio: 1.37 : 1

See full technical specs »

IMDB Actor Data



James Stewart (I) (1908–1997)

Top 5000

Actor | Soundtrack | Director

James Maitland Stewart was born on 20 May 1908 in Indiana, Pennsylvania, where his father owned a hardware store. He was educated at a local prep school, Mercersburg Academy, where he was a keen athlete (football and track), musician (singing and accordion playing), and sometime actor. In 1929 he won a place at Princeton, where he studied ... See full bio »

Born: James Maitland Stewart
May 20, 1908 in Indiana, Pennsylvania, USA

Died: July 2, 1997 (age 89) in Los Angeles, California, USA

230 photos | 42 videos | 1180 news articles »

Won 1 Oscar. Another 25 wins & 19 nominations. See more awards »

Cast

Edit

Cast overview, first billed only:

James Stewart	...	George Bailey
Donna Reed	...	Mary Hatch
Lionel Barrymore	...	Mr. Potter
Thomas Mitchell	...	Uncle Billy
Henry Travers	...	Clarence
Beulah Bondi	...	Mrs. Bailey
Frank Faylen	...	Ernie
Ward Bond	...	Bert
Gloria Grahame	...	Violet
H.B. Warner	...	Mr. Gower

Movie Questions

- Can we predict how well people will like a movie? What about its gross?
- What does the social network of actors look like? (Six degrees of Kevin Bacon)
- What is the age distribution of actors and actresses in film?
- Do stars live longer or shorter lives than the bit players or public?

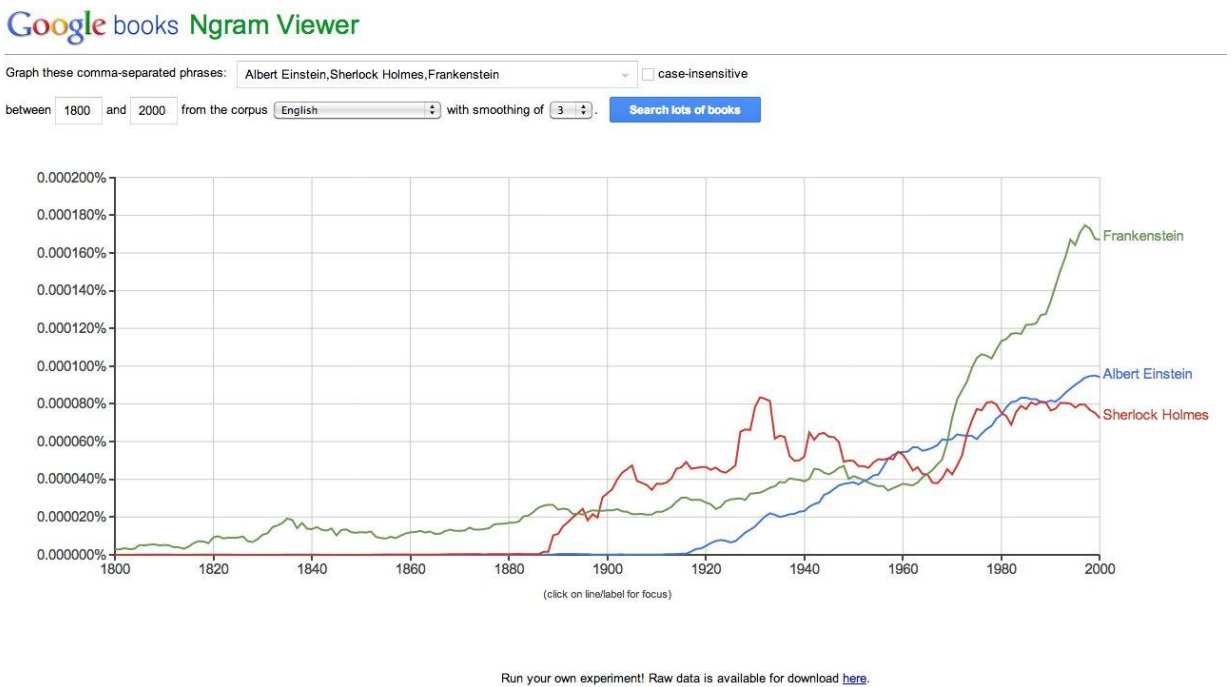
Google Ngrams

- Presents an annual time series of the frequency of every “popular” word/phrase with 1 to 5 words occurs in scanned books.

- ‘Popular’ means appears >40 times in total.

- Google has scanned about 15% of all books ever published, making this resource quite comprehensive.

Google Ngrams Viewer



Ngram Questions

- How has the amount of cursing changed over time?
- What is the lifespan of fame and technologies? Is it increasing/decreasing?
- How often do new words emerge? Do they stay in common usage?
- What words are associated with other words, i.e. can you build a language model?

Taxi Cab Data

- Gives driver/owner, pickup/dropoff location, and fare data for every taxi trip taken.
- Data obtained from NYC via Freedom of Information Act Request (FOA)

4													
5	Trip data, 2013 ->												
6													
7	medallion	hack_license	vendor_id	rate_code	pickup_datetime	dropoff_datetim	passenger_c	trip_time_	trip_distance	pickup_longitud	pickup_latitude	dropoff_longitude	dropoff_latitude
8	89D227B655E5C82AEC	BA96DE419E7116	CMT	1	1/1/13 15:11	1/1/13 15:18	4	382	1	-73.978165	40.757977	-73.989838	40.751171
9	0BD7C8F5BA12B88E0B	9FD8F69F0804BD	CMT	1	1/6/13 0:18	1/6/13 0:22	1	259	1.5	-74.006683	40.731781	-73.994499	40.75066
10	0BD7C8F5BA12B88E0B	9FD8F69F0804BD	CMT	1	1/5/13 18:49	1/5/13 18:54	1	282	1.1	-74.004707	40.73777	-74.009834	40.726002
11	...												
12													
13													
14	Fare data, 2013 ->												
15													
16	medallion	hack_license	vendor_id	pickup_datetime	fare_amount	surcharge	mta_tax	tip_amou	tolls_amount	total_amount			
17	89D227B655E5C82AEC	BA96DE419E7116	CMT	1/1/13 15:11	6.5	0	0.5	0	0	7			
18	0BD7C8F5BA12B88E0B	9FD8F69F0804BD	CMT	1/6/13 0:18	6	0.5	0.5	0	0	7			
19	0BD7C8F5BA12B88E0B	9FD8F69F0804BD	CMT	1/5/13 18:49	5.5	1	0.5	0	0	7			

Taxi Cab Questions

- How much do drivers make each night?
- How far do they travel?
- How much slower is traffic during rush hour?
- Where are people traveling to/from at different times of the day?
- Do faster drivers get tipped better?

How do we do Data Science ?

Skills We Will Learn

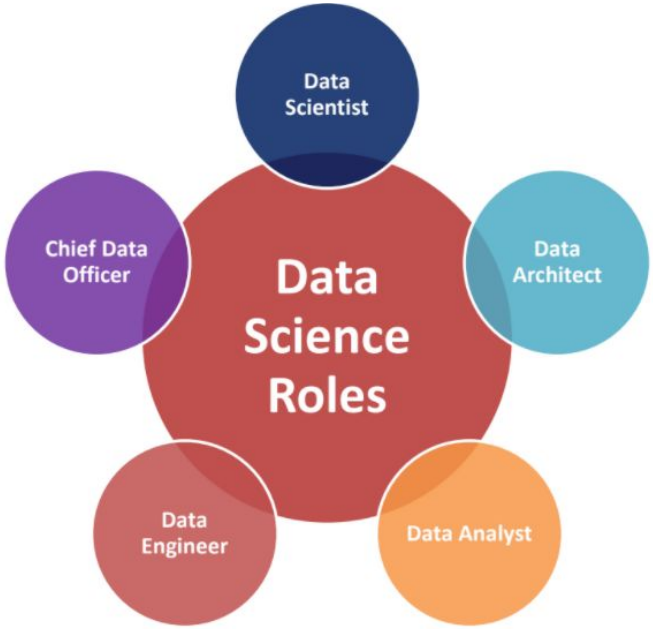
- **Science**
  - determining what questions can be answered with data and what are the best datasets for answering them
- **Computer programming**
  - using computers to analyze data
- **Data wrangling**
  - getting data into analyzable form on our computers
- **Statistics**
  - separating signal from noise
- **Machine learning**
  - making predictions from data
- **Communication**
  - sharing findings through visualization, stories and interpretable summaries

Specific Concepts and Principles

- **Science**
  - Gain experience asking questions.
- **Computer programming**
  - Python, GitHub, cloud computing.
- **Data wrangling**
  - Python libraries for reading data tables and scraping web pages.
- **Statistics**
  - Exploratory data analysis, inference, estimation, conditional probabilities, regression, modeling, Bayesian statistics, and more.
- **Machine learning**
  - Support vector machines, k-nearest neighbors, regression trees, random forests, boosting, decision trees.
- **Communication**
  - Python graphing packages and in-class practice

Data Science - Key Roles

- Chief Data Officer
- Data Architect
- Data Engineer
- Data Analyst
- Data Scientist



Questions ?