Numerical Methods for Macroeconomists

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Introduction and Objectives

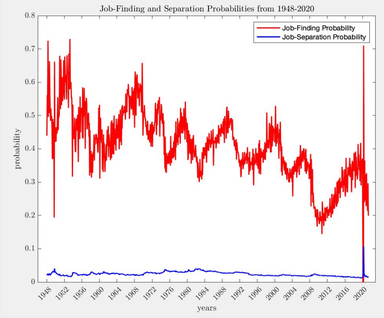
- We were tasked with preparing for Penn's Economics 245 course, Numerical Methods for Macroeconomists, which is taught by Professor Greenwood. It consisted of refining references, proofreading every chapter, and reformatting TeX into LyX format.
- The textbook taught us the foundations of solving economics problems and gave us insight into modern-day economics and techniques used.
- Then, we learned technical skills in R, Excel, and MATLAB, and used it to analyze current economic trends and data in the following "mini-projects" we conducted.

Cyclicality of Job-to-Job Transitions

Analyzed employment to unemployment rates and vice versa by using data from CPS (Current Population Survey)

- Using the paper "The Cyclicality of Hires, Separations, and Job-to-Job Transitions" by Robert Shimer, extracted the equation to calculate the job-finding probability (unemployment to employment) and separation probability (employment to unemployment)
- Calculated the job-finding probability and separation probability using MATLAB code and created data visualization graphs from 1948 - May 2021.
- **Markov Chain** - created a stationary distribution with the transition matrix obtained from the previous MATLAB code

Key Takeaway: Job-finding probability is steadily declining, big spike in separation rate due to COVID.



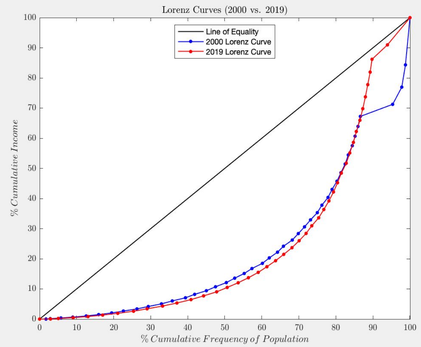
Income Inequality

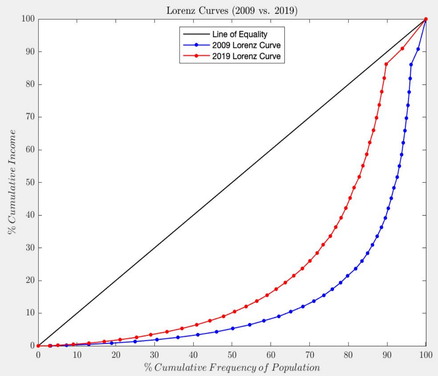
A **Lorenz Curve** is a graphical representation of income inequality. As the curve further deviates from the line of equality (y = x diagonal line, the more unequal it is.

Methodology:

- Analyzed income inequality by using data from BLS/Census CPS
- Used 2000, 2009, and 2019 data to compile the data first in Excel files
- In Excel, determined the % households by income distribution of the population and % share of cumulative income in order to create Lorenz curves.
- Observed that the income brackets weren't quite well defined for the highest-income people, as there is only a single bracket for incomes $250,000 and above

Key Takeaway: 2009 is more unequal compared to 2000 and 2019, probably due to the financial crisis of 2008.



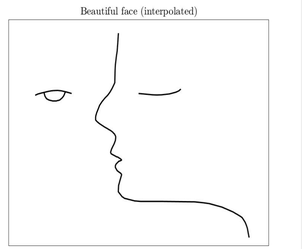


Spline Functions

Explored how spline functions worked in MATLAB and attempted to replicate an image using the interpolation method.

- Used graphreader.com to generate coordinate points after dividing up the face image into the top of the left eye, bottom of the left eye, main face, and right eye.
- Wrote MATLAB code and by using 5000 query points, was able to simulate the face image visually in MATLAB.

Key Takeaway: We used mathematical tools to create art.



LCA Programs

Used fundamentals of R to analyze 2008-2020 data on LCA, specifically H-1B program to see observe data on foreign professionals working in the US

- Obtained data from US Department of Labor from fiscal years 2008 - 2020 on LCA Programs and organized into Excel files.
- Loaded all the data into R code and cleaned up the data to aggregate over a million rows into a single data table without duplicates.
- Obtained summary statistics to observe the cities, states, years, and industry data by the number of firms to see data easily in a single document

Key Takeaway: Summary of statistics and SOC code show higher % of people in bigger cities and in computer tech fields.

Table 1: Number of firms in each city

city	# of firms	city	# of firms
NEW YORK	75550	FLUSHING	2753
HOUSTON	22362	ARLINGTON	2746
SAN FRANCISCO	19216	LAS VEGAS	2705
LOS ANGELES	16840	BELLEVUE	2639
CHICAGO	15045	SANTA MONICA	2631
MIAMI	11100	NEWARK	2619
WASHINGTON	8812	TROY	2537
DALLAS	8749	DENVER	2514
BOSTON	8618	HERNDON	2469
ATLANTA	8168	ORLANDO	2466
SAN JOSE	7798	SAN MATEO	2462
BROOKLYN	7054	COLUMBUS	2386
SAN DIEGO	6230	SAN ANTONIO	2376
AUSTIN	6035	PISCATAWAY	2375
SEATTLE	5774	BALTIMORE	2350
IRVING	5610	ROCKVILLE	2312
SANTA CLARA	5515	MINNEAPOLIS	2234
IRVINE	5242	PORTLAND	2231
EDISON	4576	COLUMBIA	2220
FREMONT	4569	INDIANAPOLIS	2189
PHILADELPHIA	4011	REDWOOD CITY	2179
SUNNYVALE	3734	PASADENA	2152
PALO ALTO	3689	CITY OF INDUSTRY	2136
CAMBRIDGE	3574	TORRANCE	2097
PRINCETON	3513	ISELIN	2055
PHOENIX	3433	RESTON	1996
JERSEY CITY	3331	WALTHAM	1986
PLANO	3293	FARMINGTON HILLS	1972
ALPHARETTA	3060	STAMFORD	1943
MOUNTAIN VIEW	3017	ST. LOUIS	1933
TAMPA	2987	JACKSONVILLE	1872
CHARLOTTE	2979	SCHAUMBURG	1860
PITTSBURGH	2925	WILMINGTON	1850

Table 4: Number of firms per SOC name

SOC name	# of firms
SOFTWARE DEVELOPERS, APPLICATIONS	167841
COMPUTER SYSTEMS ANALYSTS	90665
COMPUTER PROGRAMMERS	58881
COMPUTER OCCUPATIONS, ALL OTHER	55392
SOFTWARE DEVELOPERS, SYSTEMS SOFTWARE	44307
OCCUPATIONS IN SYSTEMS ANALYSIS AND PROGRAMMING	44162
MARKET RESEARCH ANALYSTS AND MARKETING SPECIALISTS	42566
ACCOUNTANTS AND AUDITORS	41784
FINANCIAL ANALYSTS	39176
MECHANICAL ENGINEERS	34128
MANAGEMENT ANALYSTS	33373
DATABASE ADMINISTRATORS	30826
OPERATIONS RESEARCH ANALYSTS	27370
COMPUTER AND INFORMATION SYSTEMS MANAGERS	26019
ELECTRICAL ENGINEERS	25139
NETWORK AND COMPUTER SYSTEMS ADMINISTRATORS	24943
MARKETING MANAGERS	20612
COMPUTER SOFTWARE ENGINEERS, APPLICATIONS	20113
INDUSTRIAL ENGINEERS	19424
CIVIL ENGINEERS	18091
STATISTICIANS	17559
PHYSICIANS AND SURGEONS, ALL OTHER	17194
GRAPHIC DESIGNERS	15534
GENERAL AND OPERATIONS MANAGERS	15326
ACCOUNTANT, AUDITORS, AND RELATED OCCUPATIONS	13967
FINANCIAL MANAGERS	12818
ENGINEERS, ALL OTHER	12370
ELECTRONICS ENGINEERS, EXCEPT COMPUTER	12091
SALES ENGINEERS	11126
CHEMISTS	10835
PUBLIC RELATIONS SPECIALISTS	10194
LAWYERS	10002
MEDICAL SCIENTISTS, EXCEPT EPIDEMIOLOGISTS	9892