Cardiovascular Disease

vs

Social Determinants

Increasing our understanding of the relationship between heart disease and social determinants

BACKGROUND

- **Heart Disease** is the leading cause of death in the United States[1]

Every 33 seconds,
someone dies from **heart disease**[1]

QUESTIONS & OBJECTIVES

SUB-QUESTIONS

Does **income** affect the mortality rate of cardiovascular disease?

INCOME **EDUCATION** **INSURANCE**

Does **education level** affect the mortality rate of cardiovascular disease?

Does **insurance type** affect the mortality rate of cardiovascular disease?

HOW?

EXPLORATORY DATA ANALYSIS (EDA)

- **Dataset Sources**
  - 2018 United States Census Tract Data[2]
  - Rates and Trends in Coronary Heart Disease and Stroke Mortality Data Among US Adults (35+) by County – 1999-2018[3]
    - Two Disease Types
      - Coronary Heart Disease (CDH)
      - Stroke
    - Two Age Groups
      - Ages 35-64 years old
      - Ages 65 years and older

EXPLORATORY DATA ANALYSIS (EDA)

- **Merging Datasets**
  - Selected relevant columns
  - 2018 Data only
  - Averaged income per state
  - Separated education into two levels:
    - Above High School Degree
    - High School Degree and Below

EXPLORATORY DATA ANALYSIS (EDA)

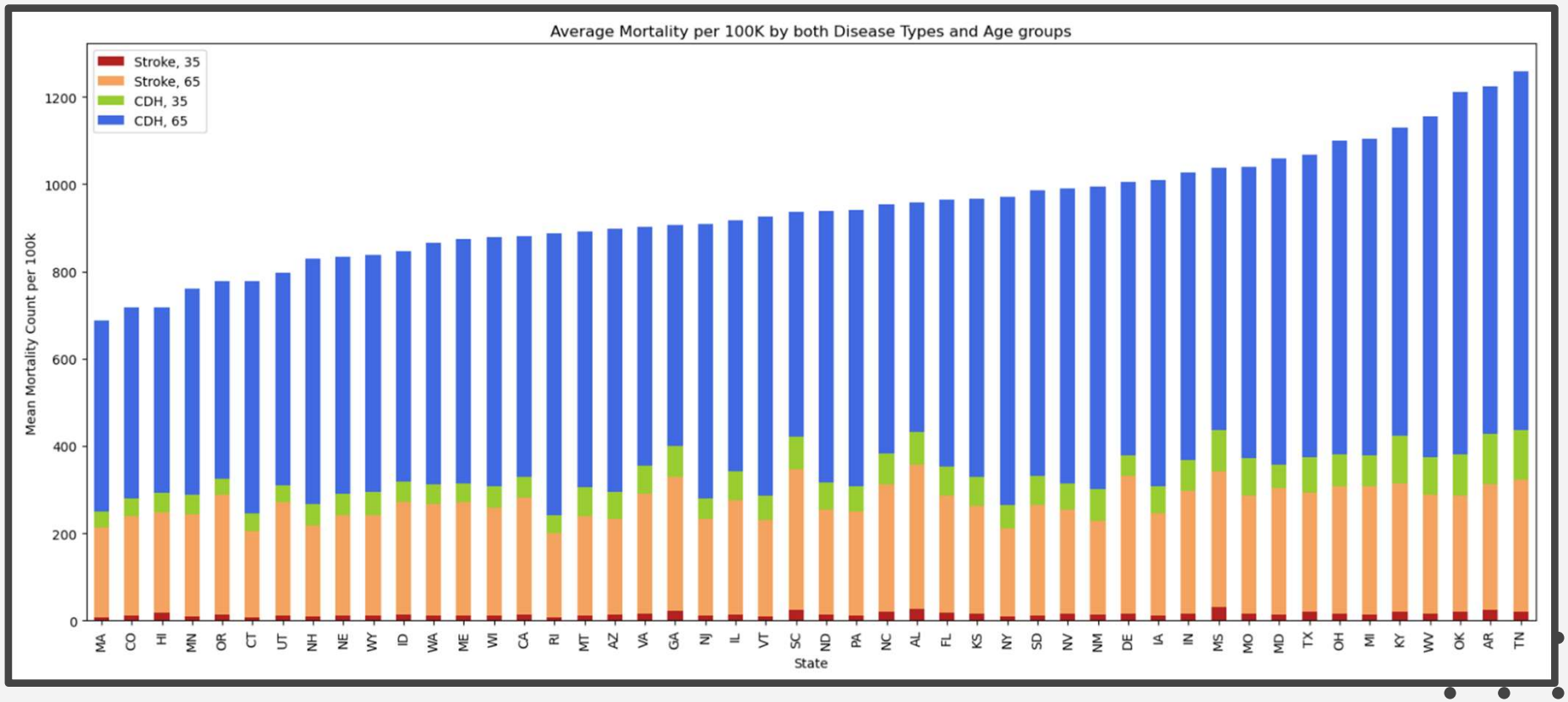
Summary Statistics for Mortality Rate by Disease Type and Age Group

Disease Type	Age Group	Mean	Median	Std	Minimum	Maximum
Coronary Heart Disease	Ages 35-64 years	70.898076	64.2	31.149991	13.3	300.7
	Ages 65 years and older	628.655387	605.9	175.914496	207.1	1609.8
Stroke	Ages 35-64 years	16.864551	15.3	6.306468	5.6	48.1
	Ages 65 years and older	267.846506	262.2	48.985936	107.9	596.4

- There is greater mortality in CDH
- There is greater mortality in ages 65 years and older

EXPLORATORY DATA ANALYSIS (EDA)

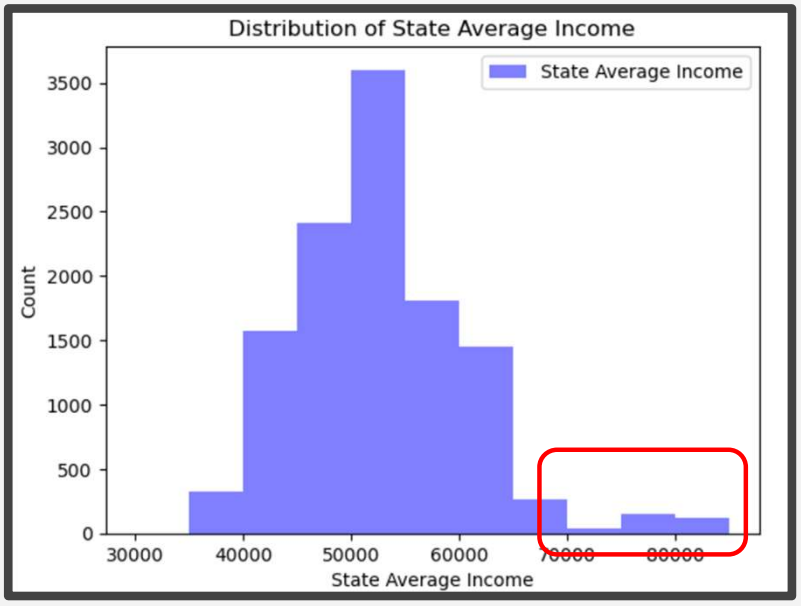
Bar Chart for Mortality Rate by State

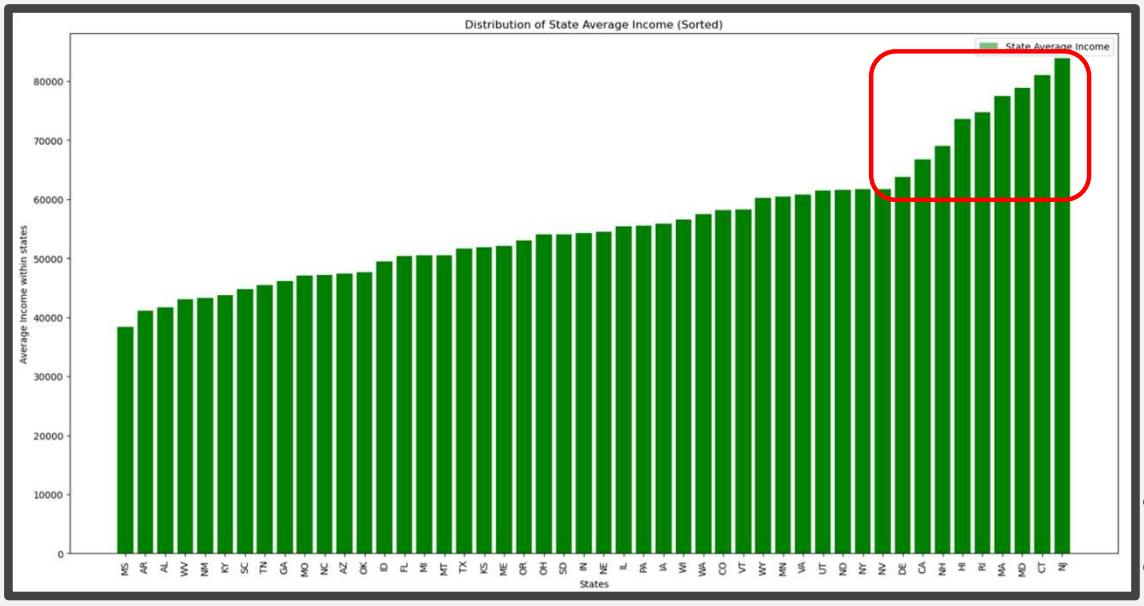


EXPLORATORY DATA ANALYSIS (EDA)

Summary Statistics and Graphs for State Average Income

	Mean	Median	Std	Minimum	Maximum
State Average Income	52286.68	51642.75	7823.4	38350.88	83854.98

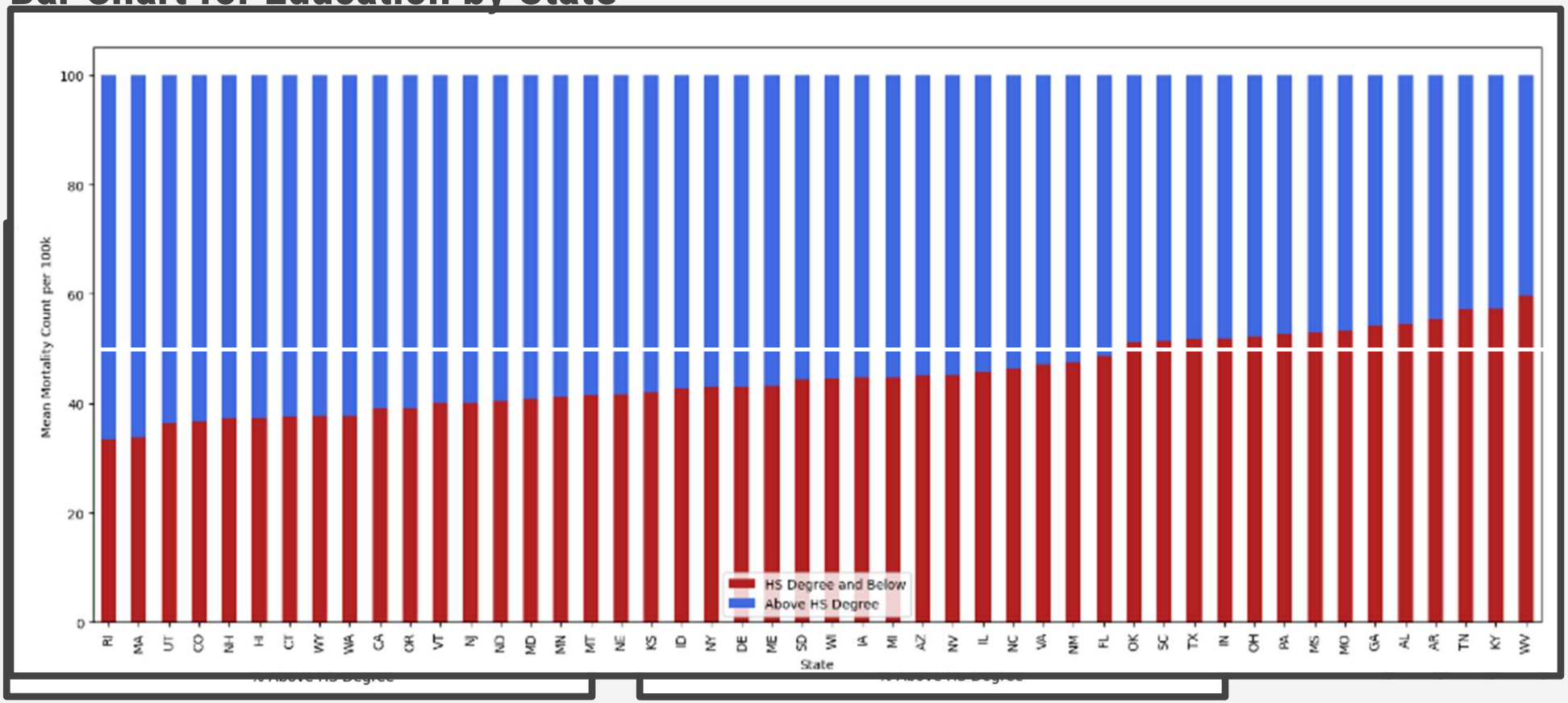




EXPLORATORY DATA ANALYSIS (EDA)

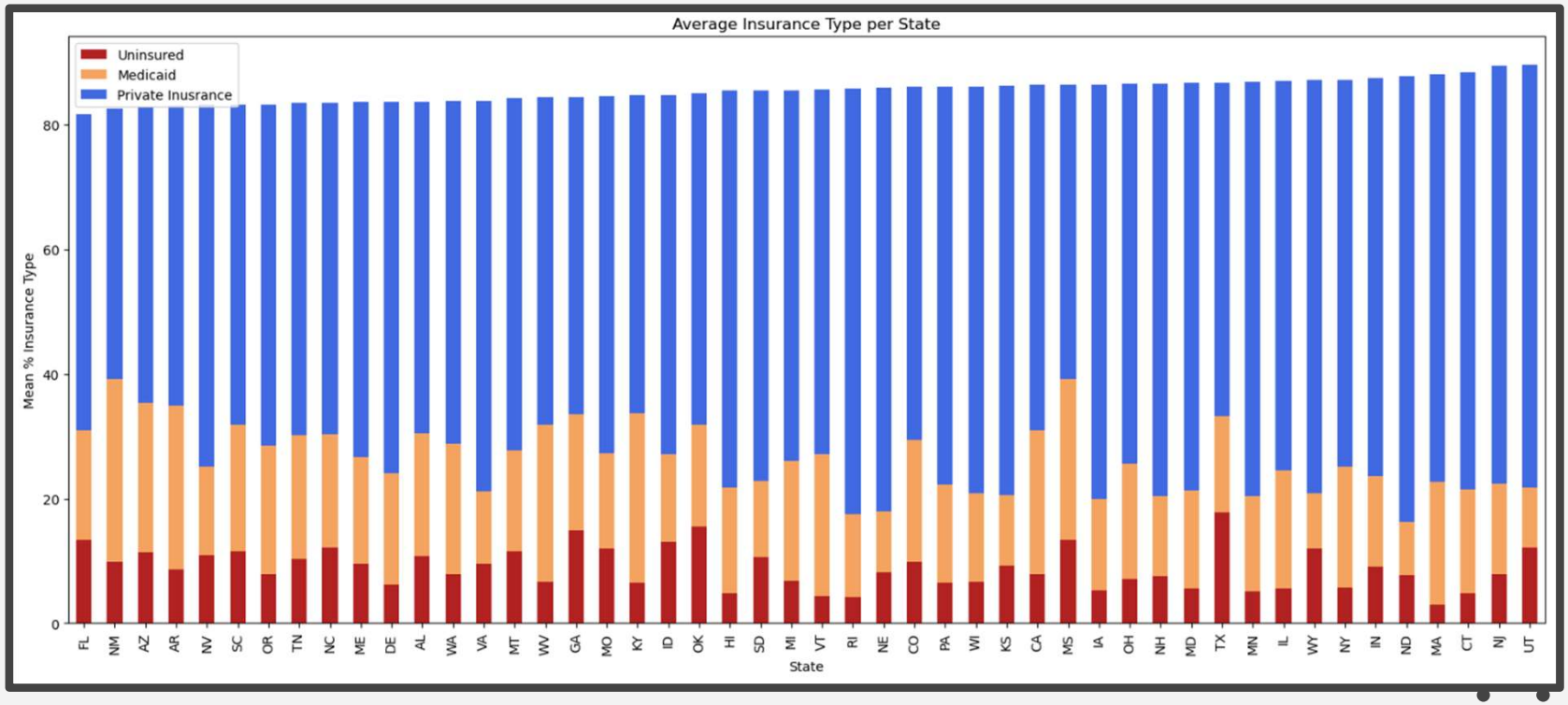
Summary Statistics and Graphs for Education Levels

Bar Chart for Education by State



EXPLORATORY DATA ANALYSIS (EDA)

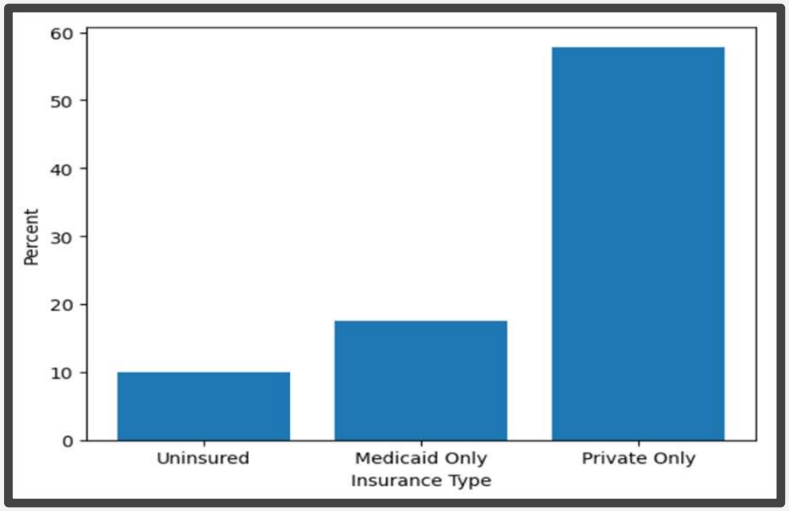
Distribution of Insurance Type by State



Summary Statistics for Insurance

	Mean	Median	Std	Minimum	Maximum
% Uninsured	9.989589	9.114	4.913097	1.686	42.38
% Medicaid Only	17.539307	16.645	7.275314	2.170	57.85
% Private Insurance Only	57.833914	58.309	10.414717	12.940	85.62

Average % of Insurance Type for all US



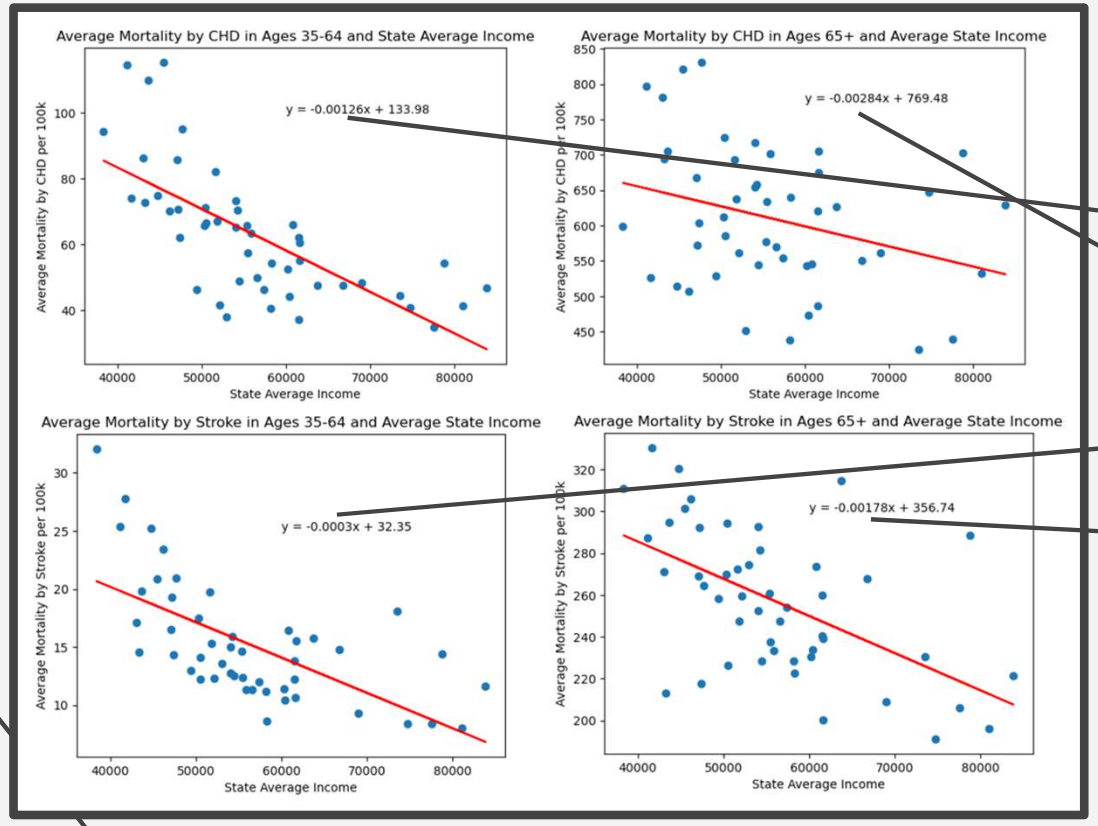
VISUAL & STATISTICAL INFERENCES

Compared to State Average Income

Ages 35-64 | Ages 65+

CDH

Stroke



SLOPES

-0.00126

-0.00284

-0.00030

-0.00178

<0

Visual & Statistical Inferences

State Average Income: Linear Equations and r-values

Disease Type	Age Group	Linear EQs	r-values
Coronary Heart Disease	Ages 35-64 years	-0.00126x + 133.98	-0.692173
	Ages 65 years and older	-0.00284x + 769.48	-0.311891
Stroke	Ages 35-64 years	-0.0003x + 32.35	-0.642087
	Ages 65 years and older	-0.00178x + 356.74	-0.556237

Negative & Moderate relationships between
ALL disease types and age groups

Visual & Statistical Inferences

Education Level: Linear Equations and r-values

Education Level	Disease Type	Age Group	Linear EQs	r-values
% HS Degree and Below	**Positive & Moderate/Strong** relationships between **ALL** disease types and age groups			>0
% Above HS Degree	**Negative & Moderate/Strong** relationships between **ALL** disease types and age groups			<0

Visual & Statistical Inferences

Insurance Type: Linear Equations and r-values

Insurance Type	Disease Type	Age Group	Linear EQs	r-values
% Uninsured				
% Medicaid Only				
% Private Insurance Only				

Positive & Weak/Moderate relationships between **ALL** disease types and age groups

>0

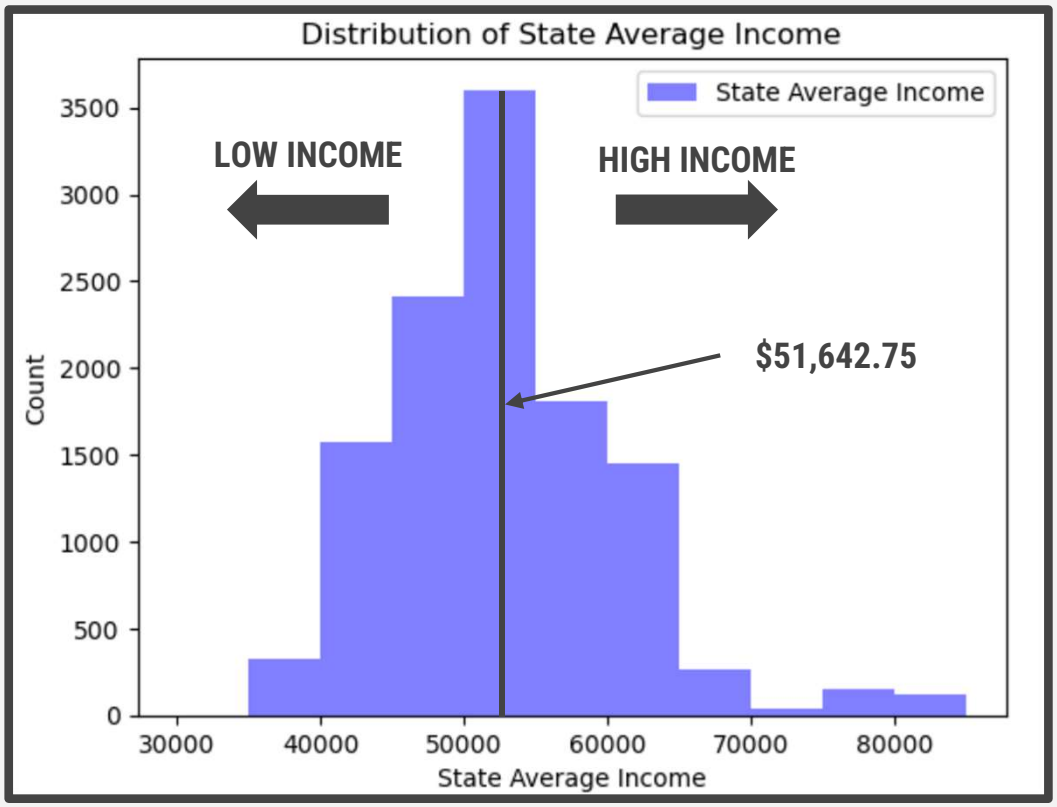
Negative & Weak/Moderate/Strong relationships between **ALL** disease types and age groups

<0

Visual & Statistical Inferences

Splitting the Data based on Income

- Split dataset into two groups:



Visual & Statistical Inferences

Test & Hypotheses

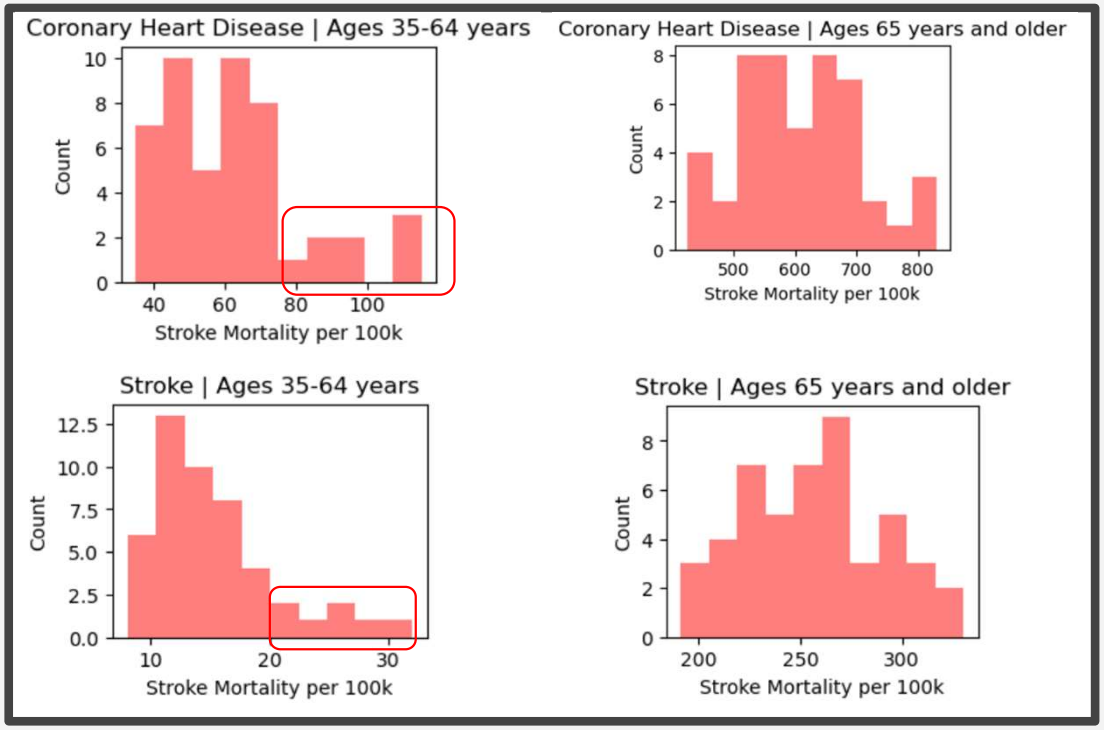
- Test used: **One Tailed Two-Sample T-test**
  - Comparing low income states (LIS) against high income states (HIS) **mean mortality rates**
  - Controlled for disease type and age group
  - Four two-sample t-tests will be done in total
- Hypotheses:
  - H_0: $\mu_{LISmortality} = \mu_{HISmortality}$
  - H_α: $\mu_{LISmortality} > \mu_{HISmortality}$
  - $\alpha = 0.05$

NOTE! μ is “mu,” a variable that represents the population mean

VISUAL & STATISTICAL INFERENCES

Checking Assumptions for Two-Sample T-tests

- Data is continuous ✓
- Simple Random Sample ✓
- Normally Distributed ✓
- Independent Samples ✓



VISUAL & STATISTICAL INFERENCES

Comparing High and Low Income Groups:

T scores & p-values

Disease Type	Age Group	T scores	p-values
Coronary Heart Disease	**Ages 35-64 years**	22.151561	4.994800e-101
	Ages 65 years and older	6.744408	9.235061e-12
Stroke	**Ages 35-64 years**	31.464938	5.086354e-188
	Ages 65 years and older	19.718548	1.247302e-81

All p-values are **significant** (<0.05)

Reject H_0;

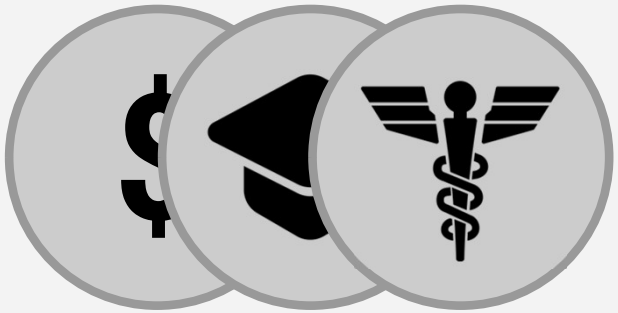
CONCLUSIONS

Greater levels of income mean **lower rates of mortality**

Higher levels of education mean **lower rates of mortality**

Better (private) insurance means **lower rates of mortality**

CONCLUSIONS



GENERAL CONCLUSION:

Higher Socioeconomic status leads to reduced mortality rates

THE END

BIBLIOGRAPHY

1. National Center for Health Statistics. Multiple Cause of Death 2018–2021 on CDC WONDER Database. Accessed February 2, 2023.
2. Tsao CW, Aday AW, Almarzooq ZI, Beaton AZ, Bittencourt MS, Boehme AK, et al. Heart Disease and Stroke Statistics—2023 Update: A Report From the American Heart Association. Circulation. 2023;147:e93–e621.
3. National Center for Health Statistics. Percentage of coronary heart disease for adults aged 18 and over, United States, 2019—2021. National Health Interview Survey. Accessed February 17, 2023.