Module 3: Lecture 3b.
Measuring Health Inequalities

Matthew Robson

Erasmus School of Economics
Erasmus University Rotterdam

Economics of Health and Health Care

Overview

Objective: Learn to visualise and measure health inequalities

Methods:

- Univariate - Histograms, Parades and Ranges
- Bivariate - Scatters, Gaps and Gradients
- Indices - Gini and Concentration

Univariate Inequality

Inequality in the Age at Death

- Histogram
- Pen's Parade of Inequality
- Range and Interquartile Range

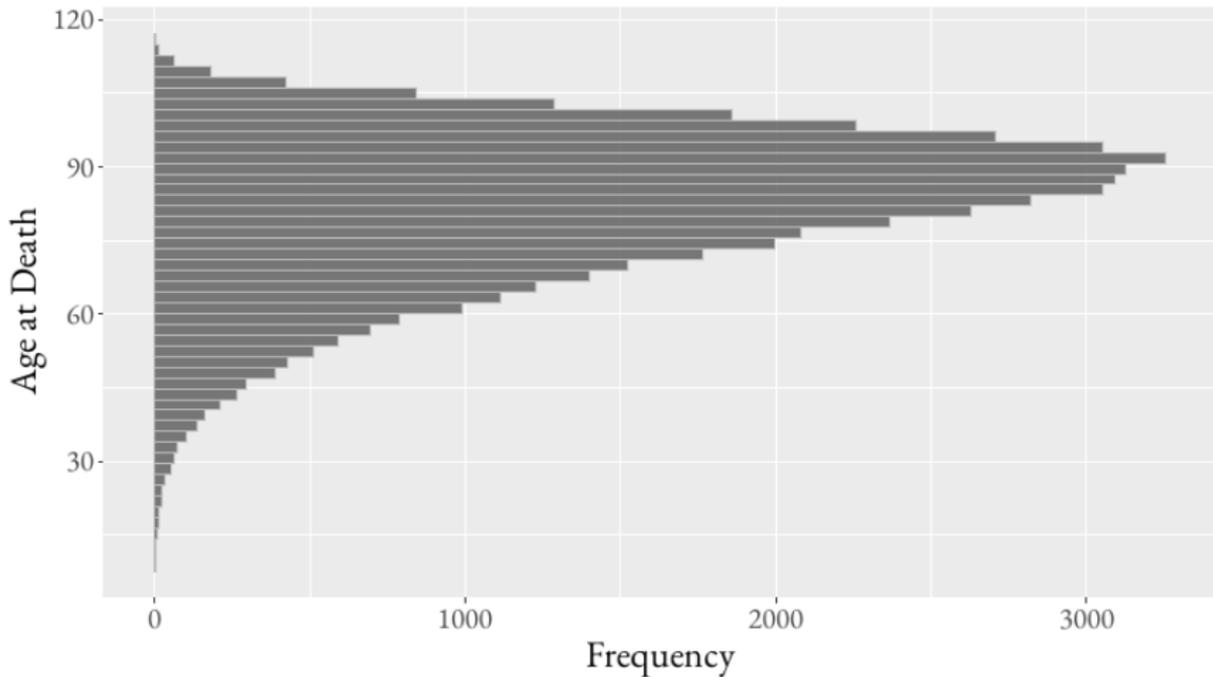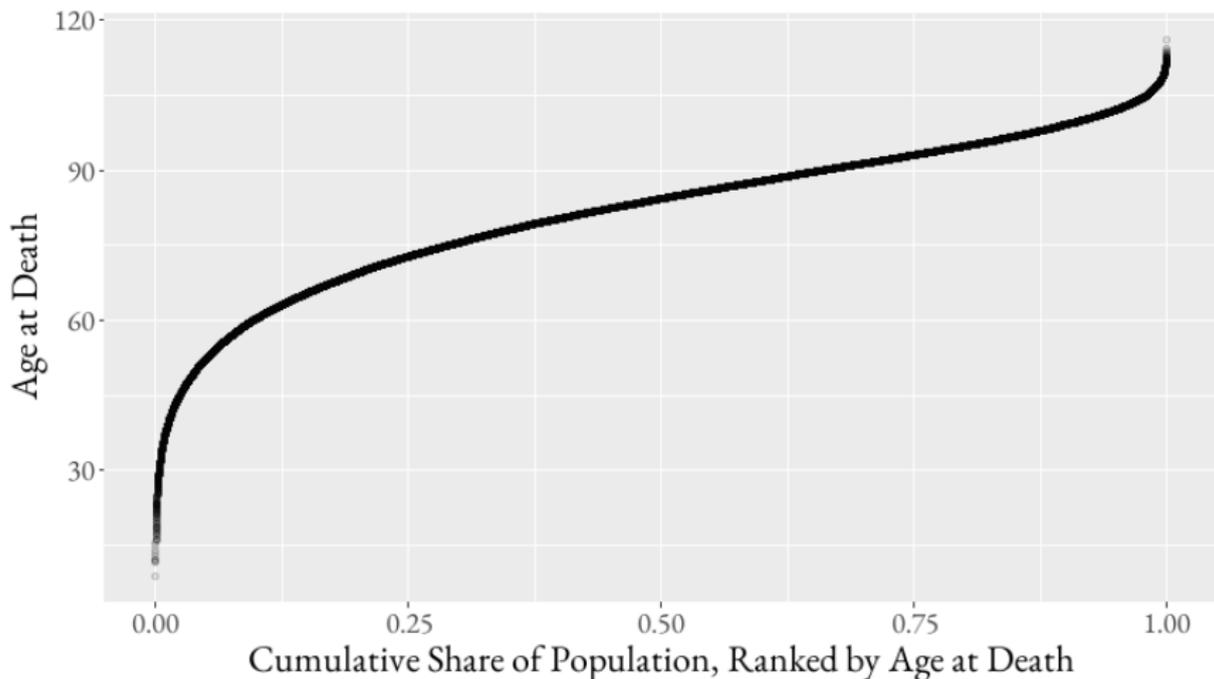Figure: Distribution of Age at Death: Histogram

Figure: Cumulative Distribution of Age at Death: Pen's Parade

Note: Pen, J., (1971), Income distribution: facts, theories and policies → Dutch Economist

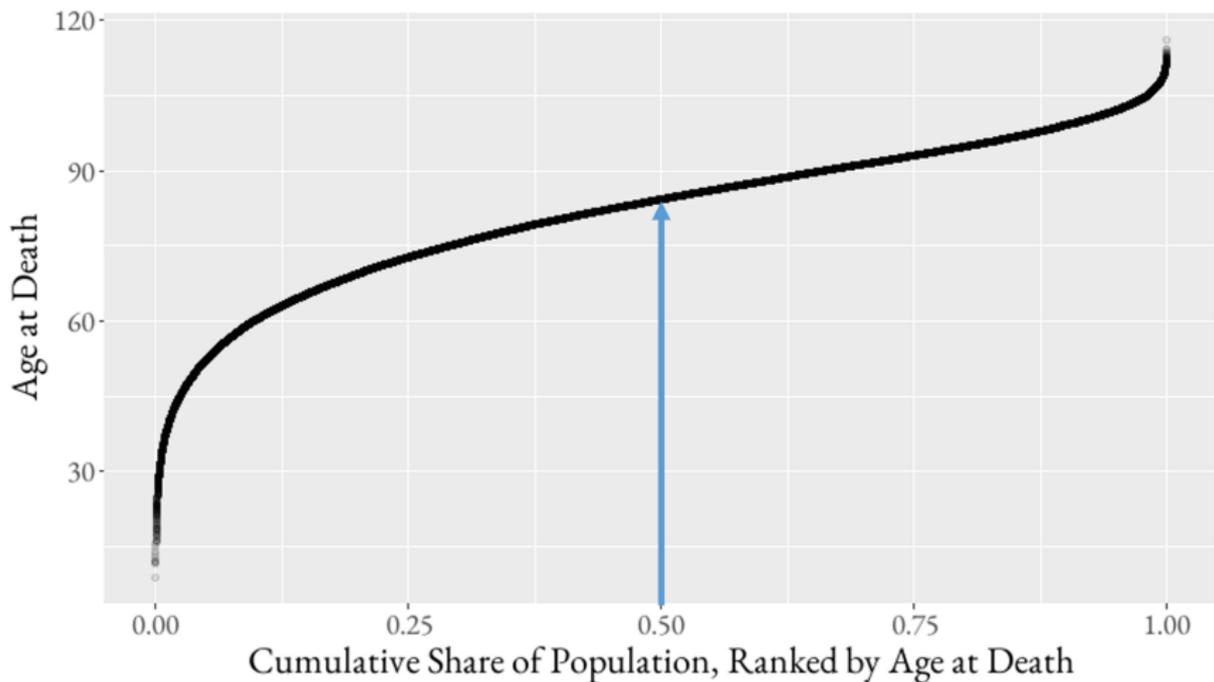Figure: Cumulative Distribution of Age at Death: Median

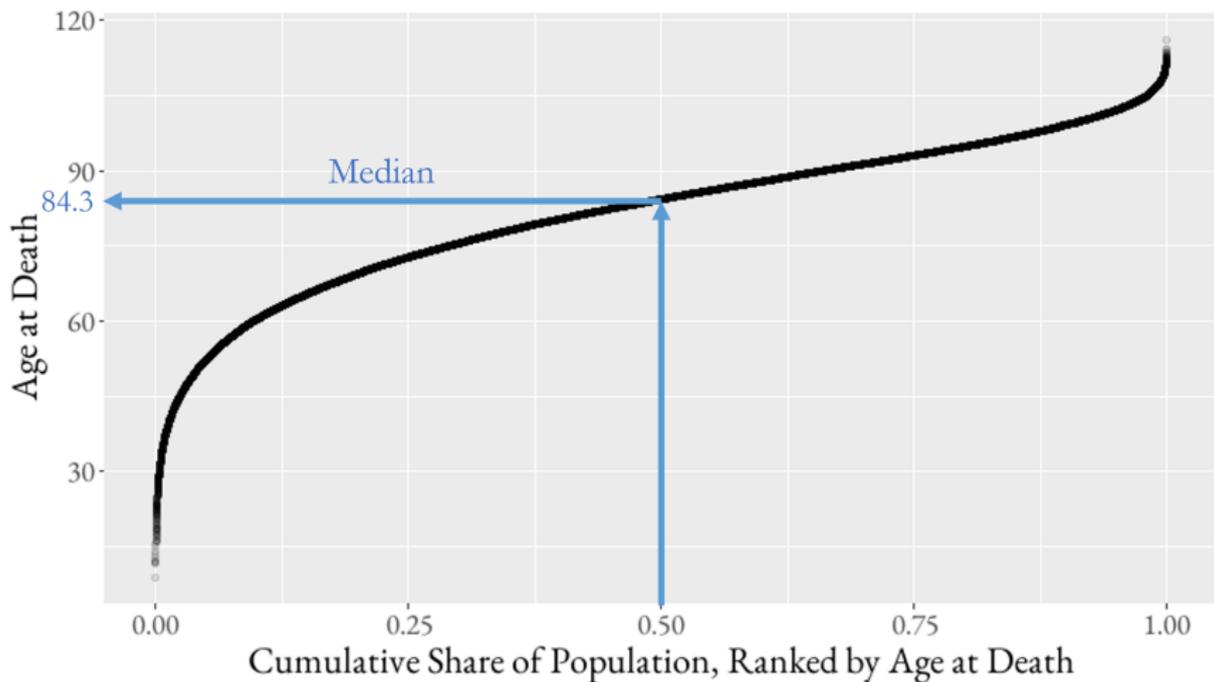Figure: Cumulative Distribution of Age at Death: Median

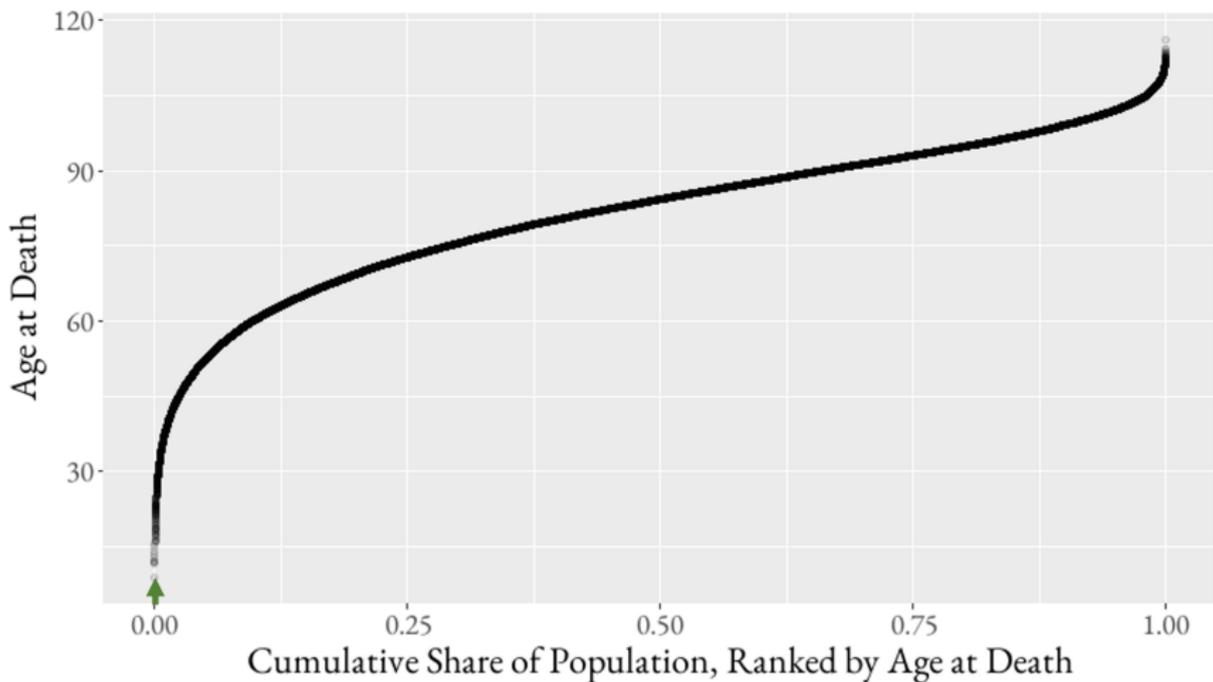Figure: Cumulative Distribution of Age at Death: Minimum

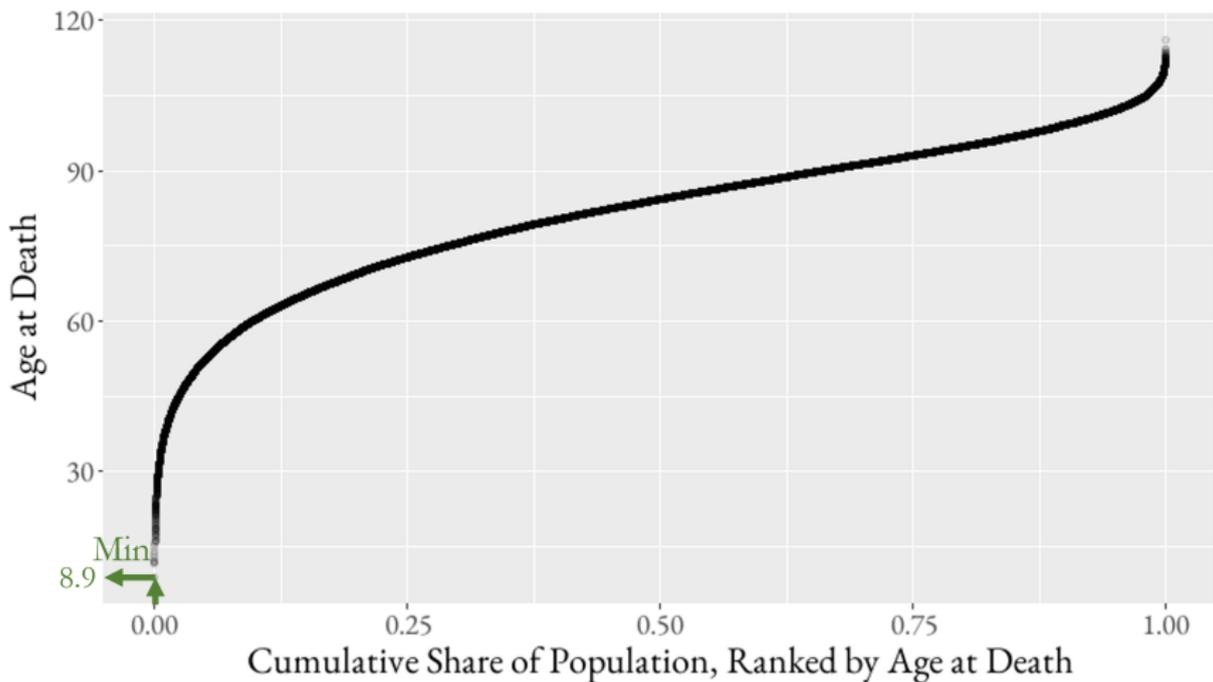Figure: Cumulative Distribution of Age at Death: Minimum

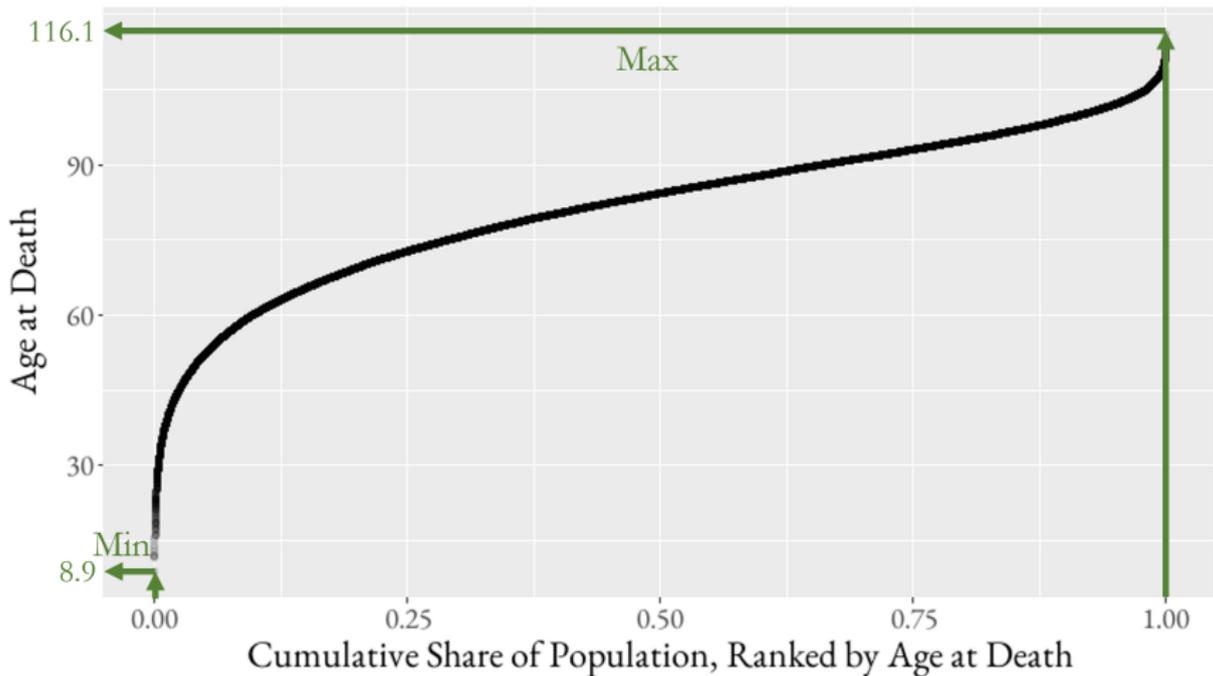Figure: Cumulative Distribution of Age at Death: Range

Figure: Cumulative Distribution of Age at Death: Range

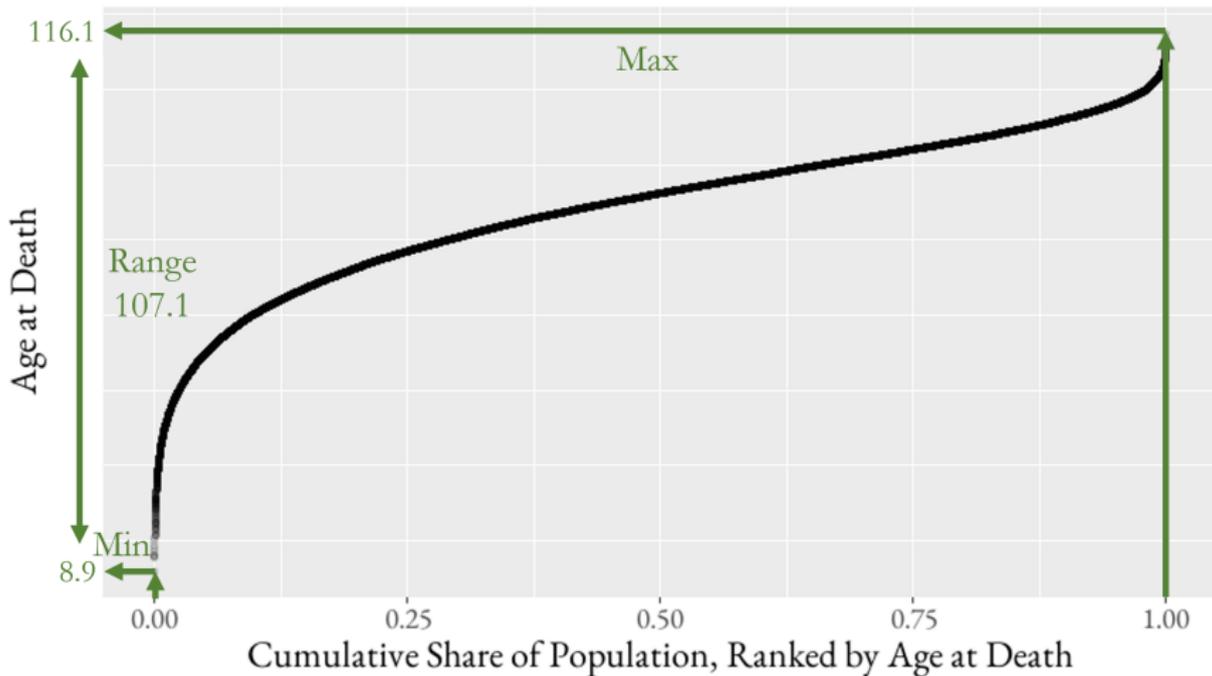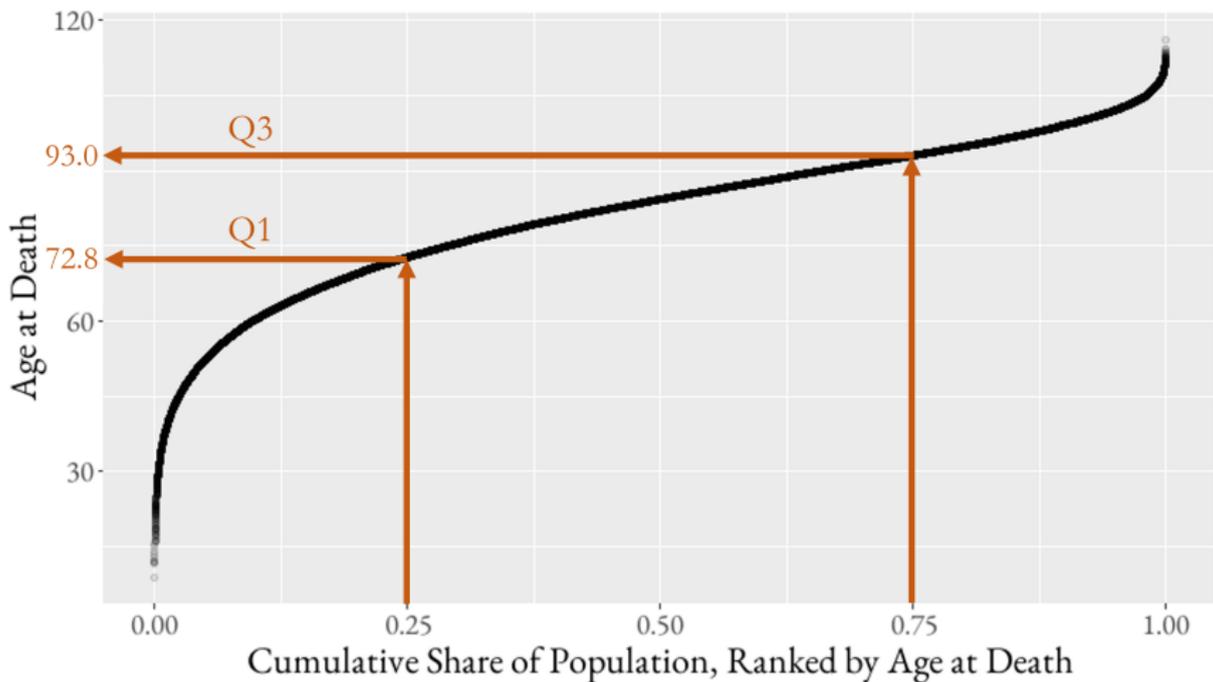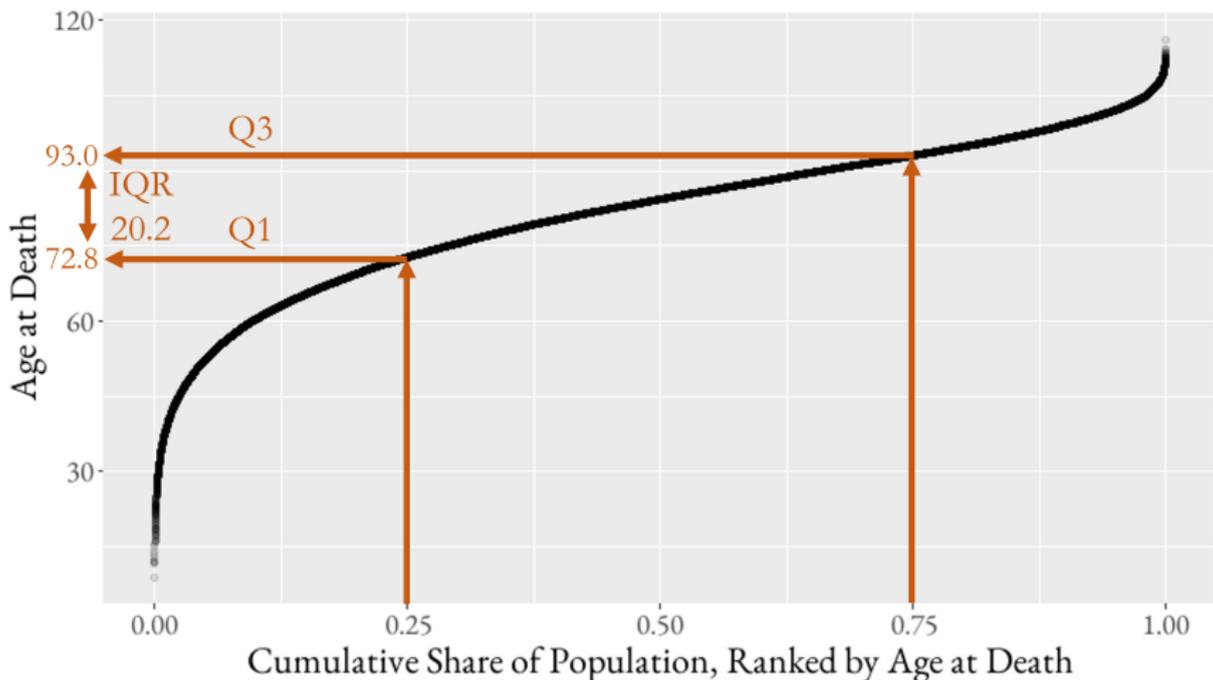Figure: Cumulative Distribution of Age at Death: Interquartile Range

Figure: Cumulative Distribution of Age at Death: Interquartile Range

Simple Measures of Univariate Inequality

Table: Range

	Age at Death
Minimum	**8.9**
Maximum	116.1
Range	**107.1**

Table: Interquartile Range

	Age at Death
Q1	72.8
Q3	93.0
IQR	**20.2**

Univariate Inequality Measures

- These graphs and measures are useful for understanding the distribution of health and the extent of the inequalities in health
- But, they do not help us understand whom the inequalities are between and whom to target if we wish to reduce health inequalities
- For that, we can turn to measures of bivariate inequality

Bivariate Inequality

Bivariate Inequalities

- Scatter Plots
- Conditional Means and Gaps
- Gradients

Socioeconomic-Health Inequalities

- Socioeconomic-health inequalities are one type of bivariate inequality
- Frequently used measures of socioeconomic status are: neighbourhood deprivation, income, education, and occupation
- But this could be any measure which can be used to rank individuals in society from "worst-off" to "best-off"

Figure: Age at Death and Socioeconomic Rank: Scatter Plot
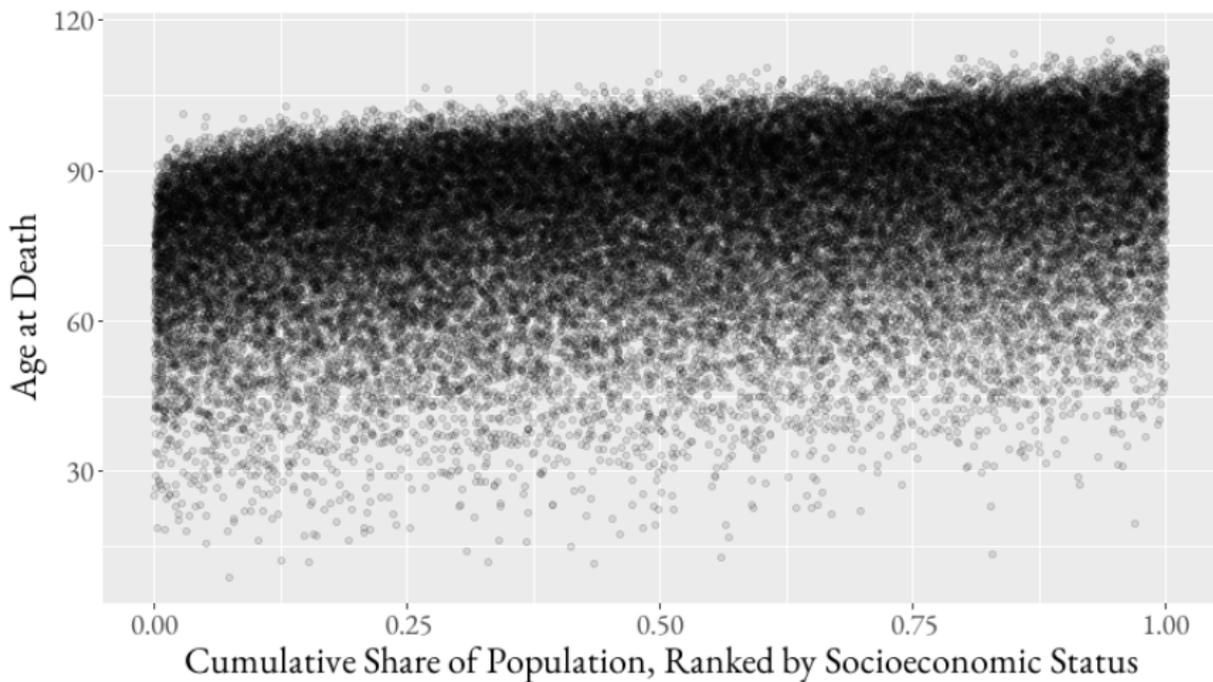
Age at Death by Socioeconomic Group
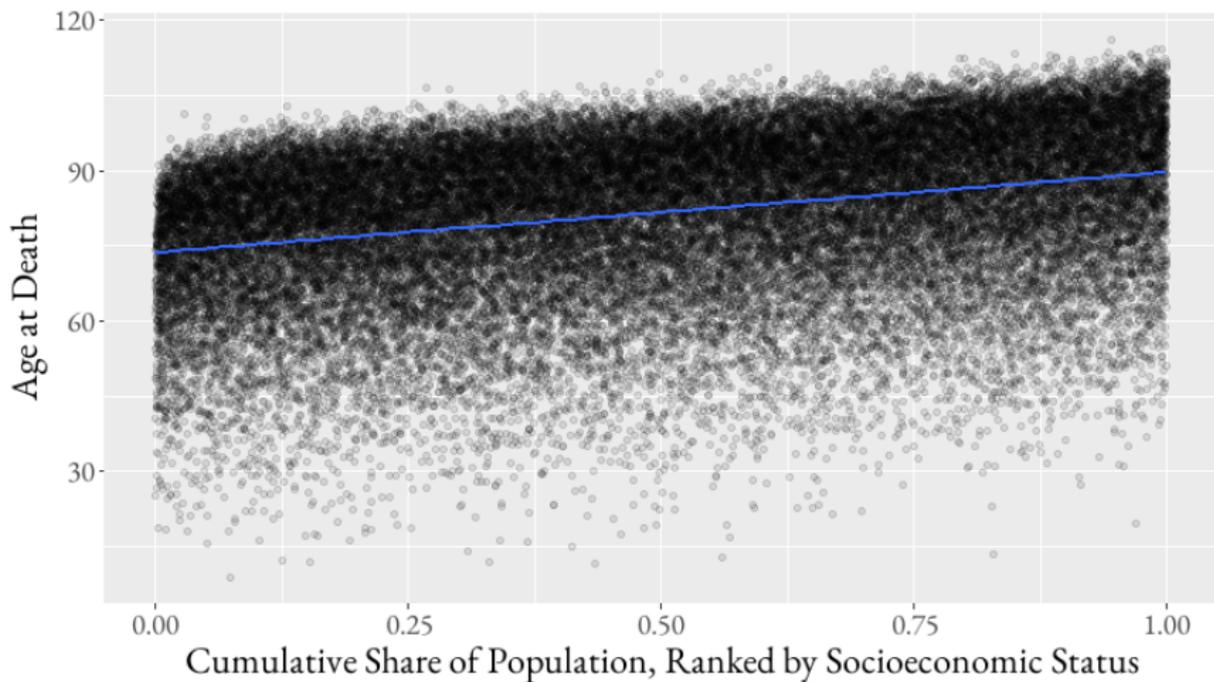
Table: Age at Death by Socioeconomic Group

Socioeconomic Group	Age at Death (Mean)
Poorest	75.5
Lower-Middle	80.0
Upper-Middle	83.7
Richest	87.5
Rich-Poor Gap	12.0

Socioeconomic-Health Gradient: Regression

$$AgeAtDeath_i = \beta_0 + \beta_1 SocioeconomicRank_i + \varepsilon_i \qquad (1)$$

	(1) Age at Death Coef./(S.E.)
Socioeconomic Rank	15.94***
	(0.227)
Constant	73.71***
	(0.131)
R^2	0.0899

Figure: Socioeconomic-Health Gradient

Other Bivariate Health Inequalities

- These measures can be used for other types of bivariate inequality
- *Gaps* are useful for binary or categorical variables; such as sex, ethnicity, smoking status, or urban-rural
- *Gradients* are useful for ordered or continuous variables; such number of cigarettes smoked, distance from hospital
- They provide a simple summary measure of inequalities in health between individuals identified by certain characteristics.

Indices of Inequality

Indices

- Gini Coefficient - Univariate
- Concentration Index - Bivariate

Indices of Inequality

Gini Coefficient

- Measure of univariate health inequality, bounded between 0 and 1
- G=0 represents lowest possible inequality (i.e. equality)
- G=1 represents the highest possible inequality
- Compares the cumulative share of the population ranked by health, against the cumulative share of total health.

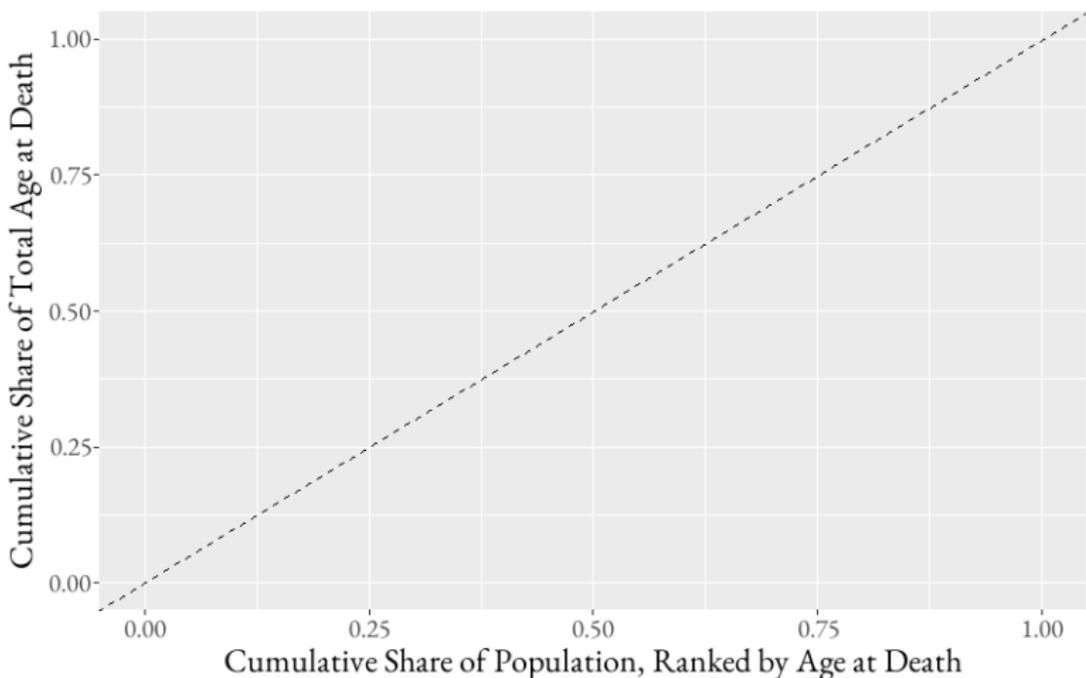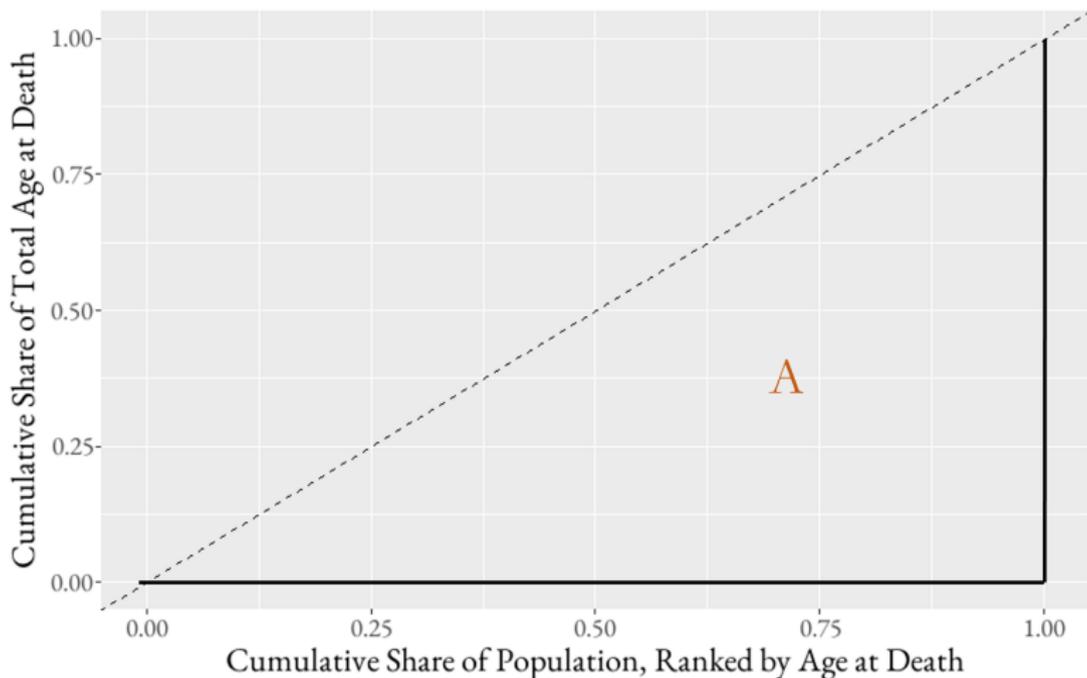Figure: Inequality in Age at Death: Lorenz Curve Explanation

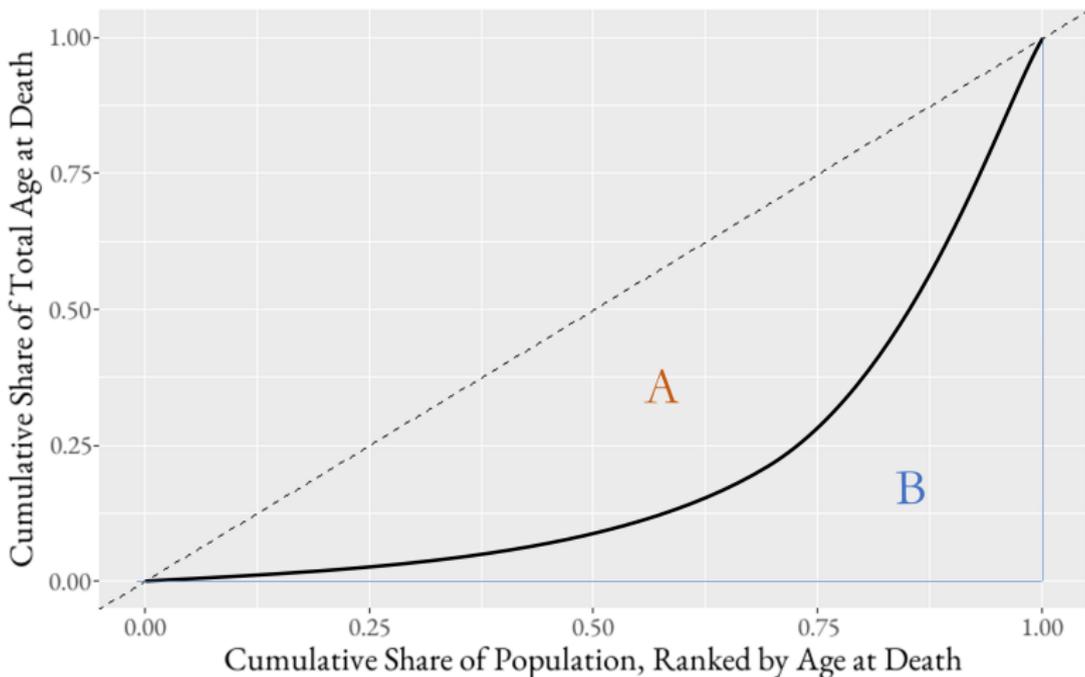Figure: Inequality in Age at Death: Lorenz Curve Explanation

$$G = A/(A + B) = 0$$

Figure: Inequality in Age at Death: Lorenz Curve Explanation

$$G = A/(A + B) = 1$$

Figure: Inequality in Age at Death: Lorenz Curve Explanation

$$G = A/(A + B) = 0.56$$

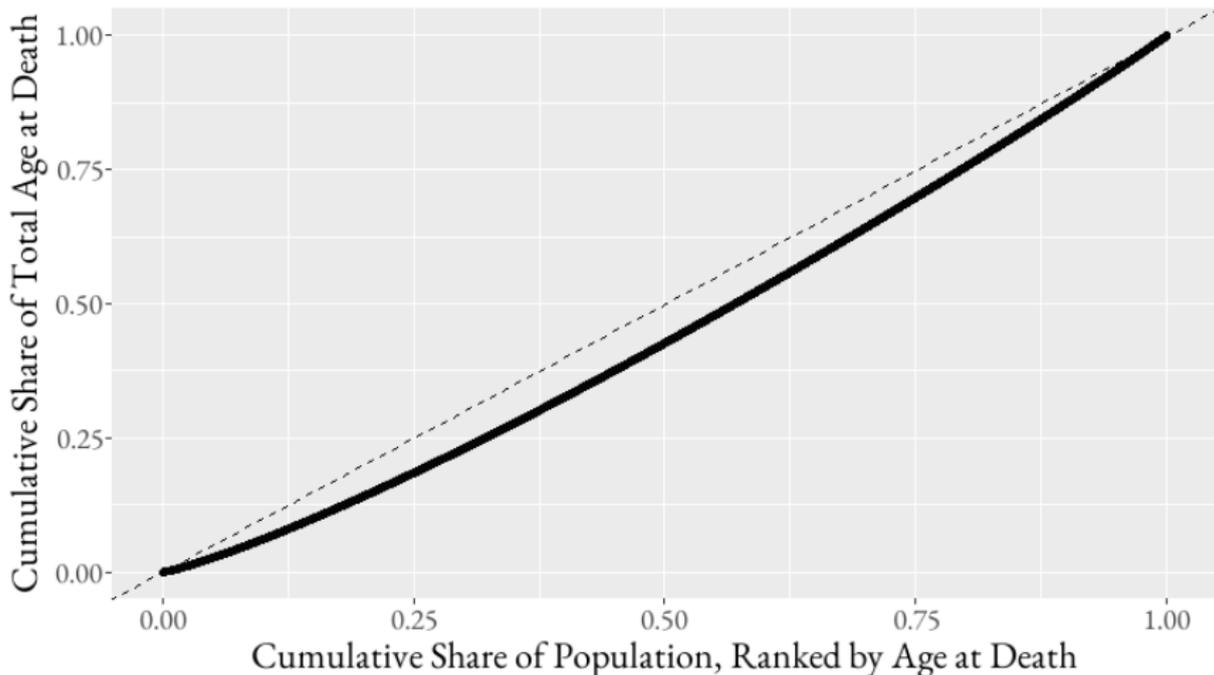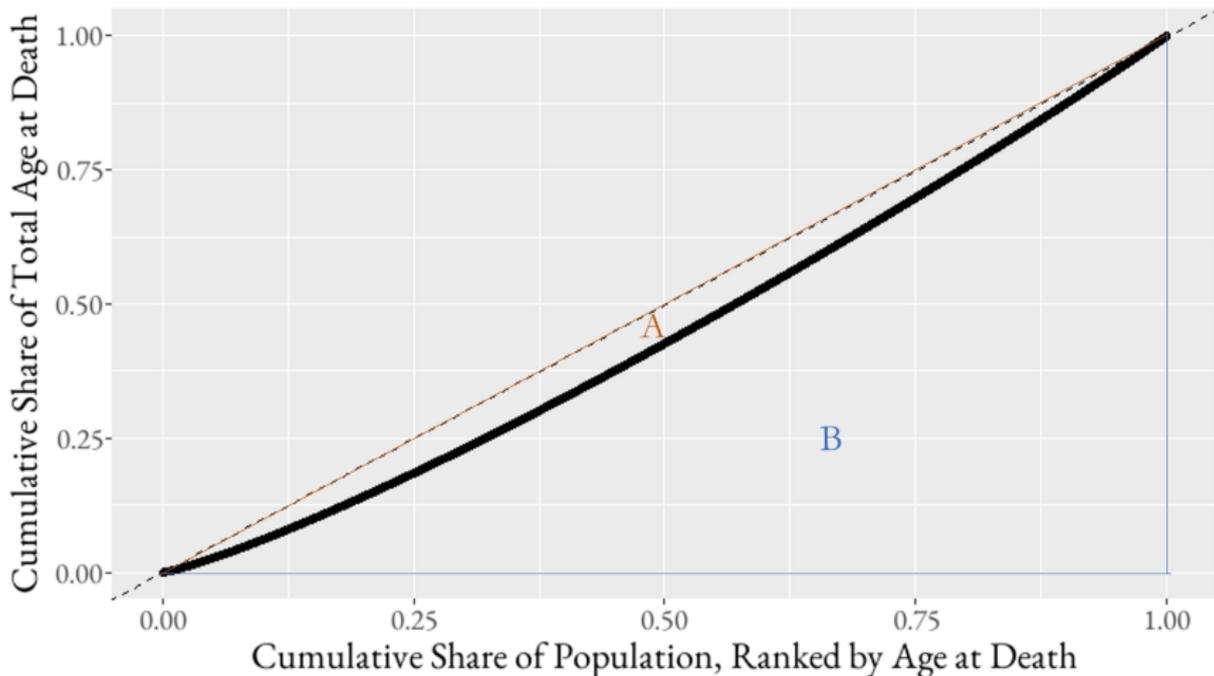## Figure: Inequality in Age at Death: Lorenz Curve

Figure: Inequality in Age at Death: Lorenz Curve

$$G = A/(A + B) = 0.1039$$

Indices of Inequality

Concentration Index

- Measure of bivariate health inequality, (approximately) bounded between -1 and 1
- CI $= 0$ represents lowest possible bivariate inequality
- CI $\rightarrow 1$ health concentrated amongst the "best-off"
- CI $\rightarrow$ -1 health concentrated amongst the "worst-off"
- Compares the cumulative share of the population ranked by some characteristic (e.g. socioeconomic status), against the cumulative share of total health.

Figure: Socioeconomic-Health Inequality: Concentration Curve Explanation

Figure: Socioeconomic-Health Inequality: Concentration Curve Explanation

$$CI = 2A = 0$$
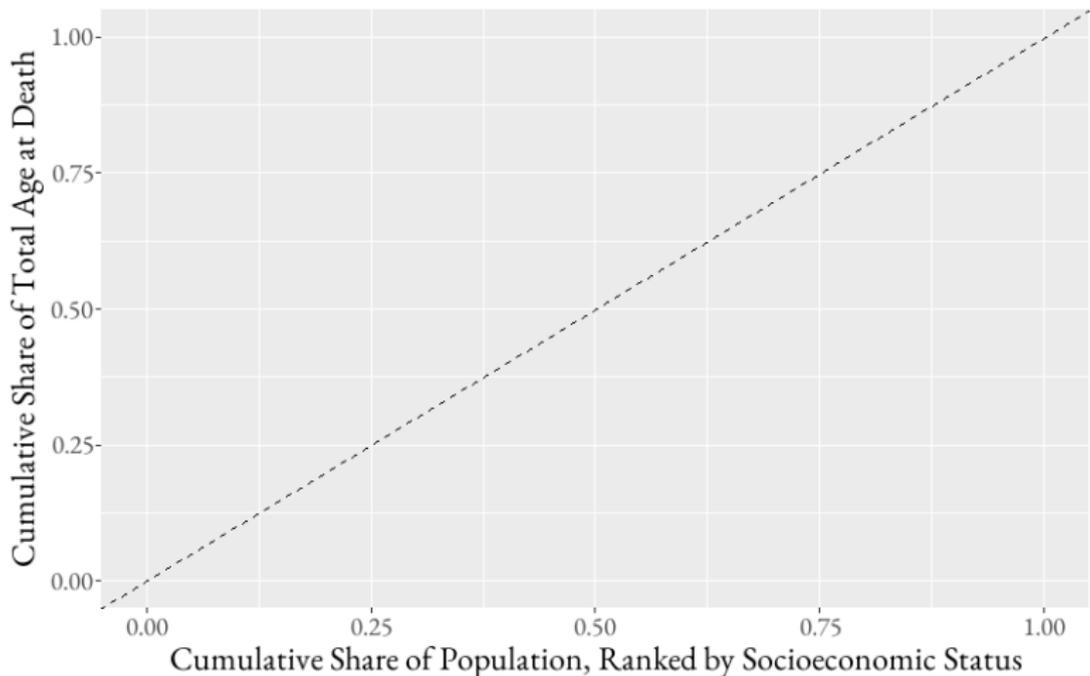
Figure: Socioeconomic-Health Inequality: Concentration Curve Explanation

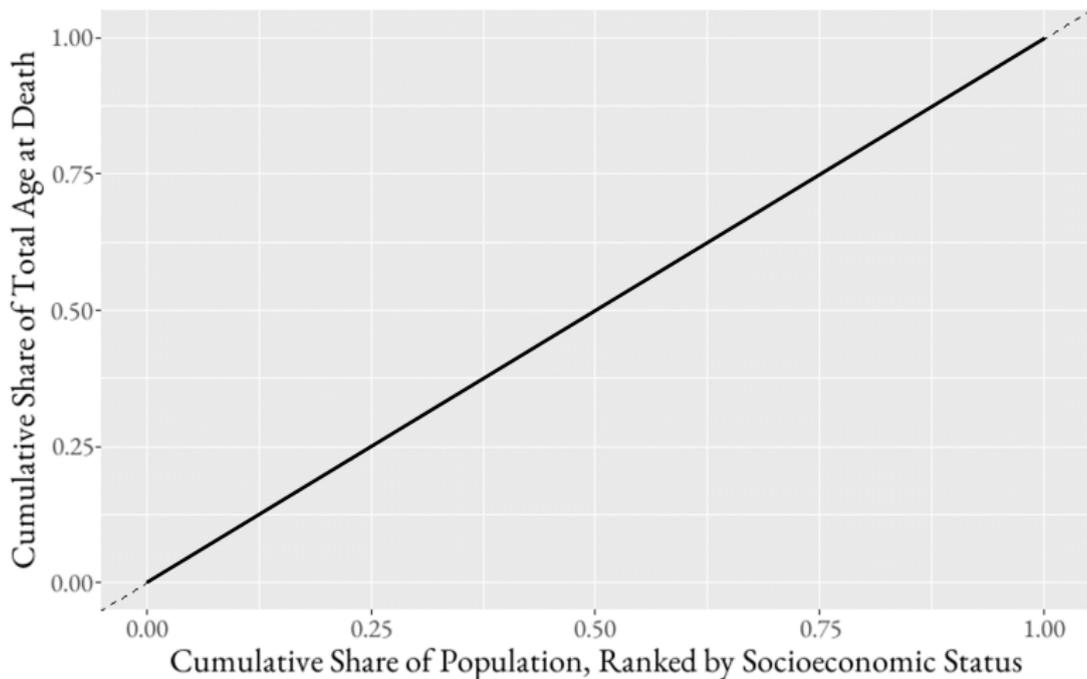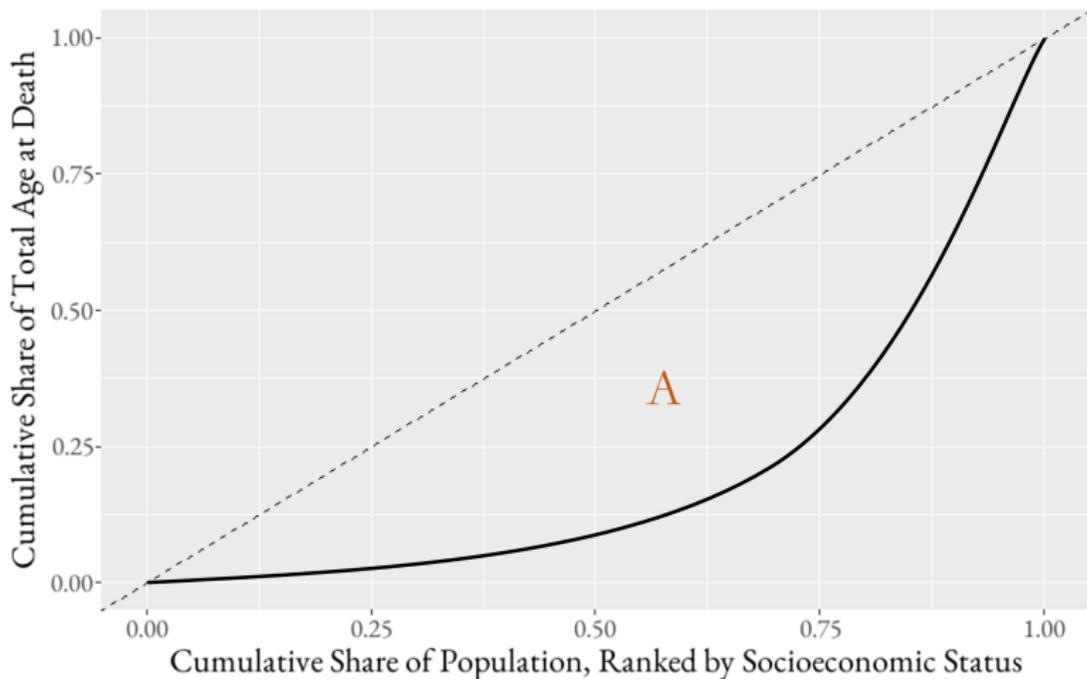$$CI = 2A = 0.56$$

Figure: Socioeconomic-Health Inequality: Concentration Curve Explanation
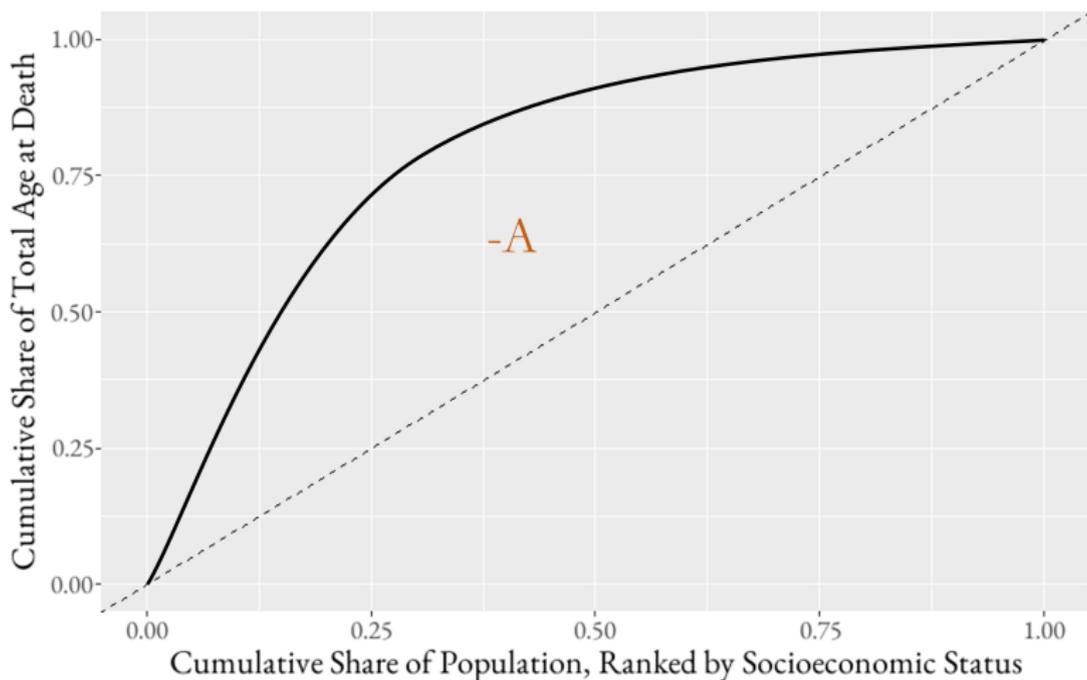
$$CI = 2A = -0.56$$

Figure: Socioeconomic-Health Inequality: Concentration Curve

$$CI = 0.0325$$
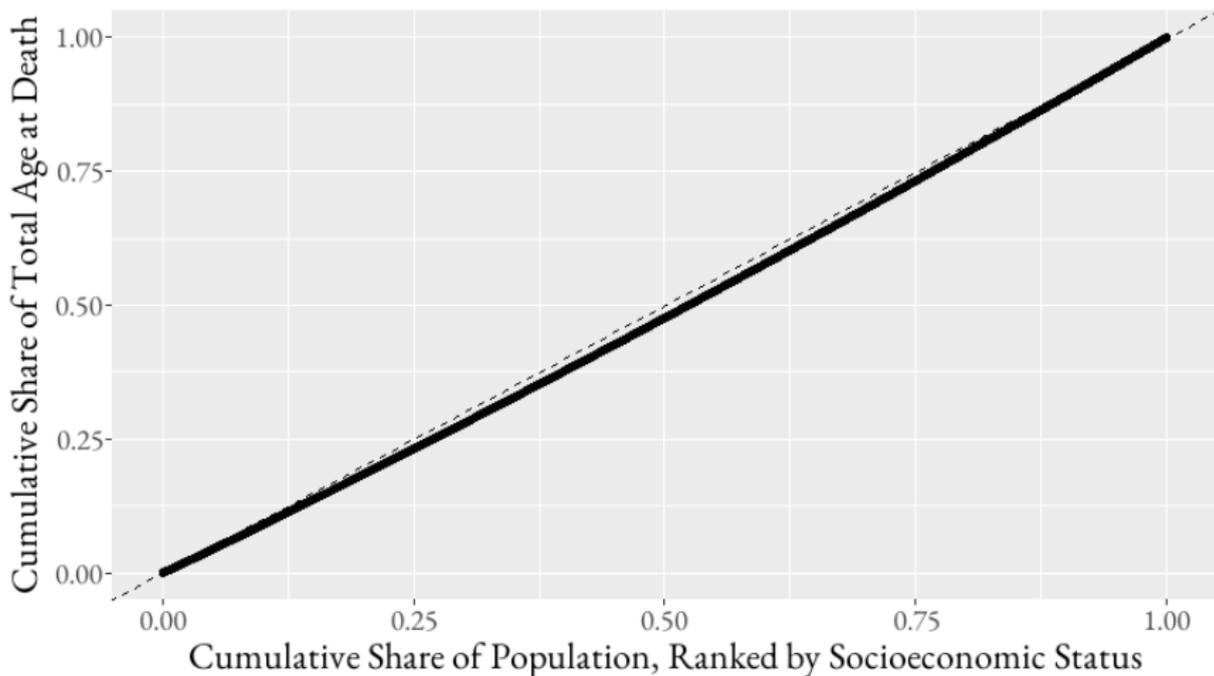
Indices of Inequality

- Measures of univariate and bivariate inequality which account for inequalities across the entire distribution
- Intuitive measures, but somewhat difficult to explain in public/political discussions on health inequality

Overview Table

Table: Measures of Health Inequality

Inequality	Measure	Value
Univariate	Minimum	8.9
	Range	107.1
	Interquartile Range	20.2
	Gini Index	0.1039
Bivariate	Rich-Poor Gap	12.0
	Socioeconomic-Gradient	15.94
	Concentration Index	0.0325

Conclusion

- These measures can be applied to many health outcomes (e.g. life expectancy, health-related quality-of-life, mortality risk)
- Bivariate measures can be conditioned on different characteristics (e.g. sex, ethnicity, smoking status)
- These graphs and measures are a toolkit for understanding and identifying health inequalities.

Summary

- *Univariate* health inequalities can be visualised with histograms, parades and Lorenz curves and measured with ranges and Gini coefficients

- *Bivariate* health inequalities can be visualised with scatters and concentration curves, and measured by gaps, gradients and concentration indices

- To understand health inequalities, and identify where there is more or less (unfair) inequality, you must understand the meaning of these graphs and summary measures.

References and Extended Reading

- Pen, J., (1971), Income distribution: facts, theories and policies, *Praeger*.
- Cookson, R., M. Robson, I. Skarda & T. Doran, (2021), Equity-informative methods of health services research. *Journal of Health Organization and Management*, 35(6), 665-681.
- Wagstaff, A., O. O'Donnell, E. Van Doorslaer & M. Lindelow, (2007), Analyzing health equity using household survey data: a guide to techniques and their implementation. Chapter 7-8. *World Bank Publications*.