# Univariate Assessment of Health Inequalities

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# Overview

- **Context**
- **Income versus Health**
- **UK Health Distribution**
- **Concepts of Inequality**
- **Inequality, Poverty and Social Welfare Measures**
- **Conclusion**

# Context

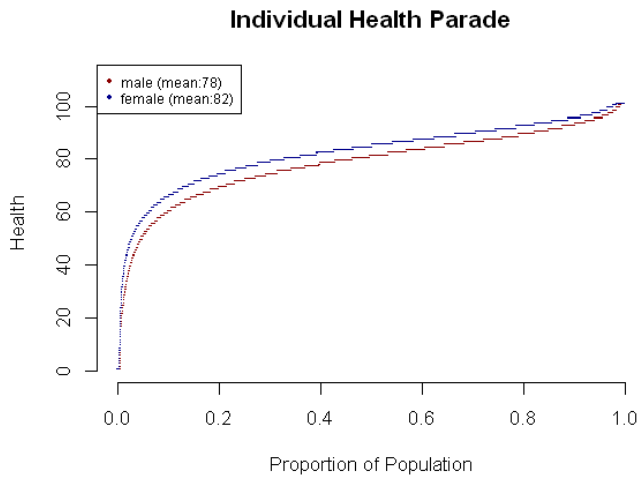
- Extended cost-effectiveness analysis
  - to produce distributions of health resulting from policies rather than just mean levels of health
- Adjusted health distributions
  - for fair differences in health leaving us with only the unfair differences in health
- Compare and rank adjusted health distributions
  - this requires further social value judgements
    - How we measure inequality
    - How we trade off inequality with efficiency

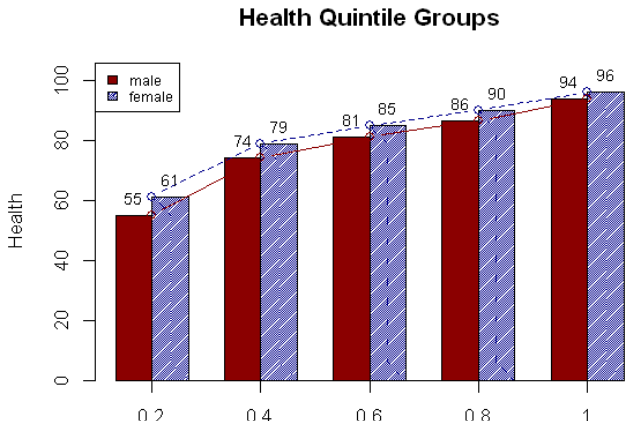
# Income vs. Health

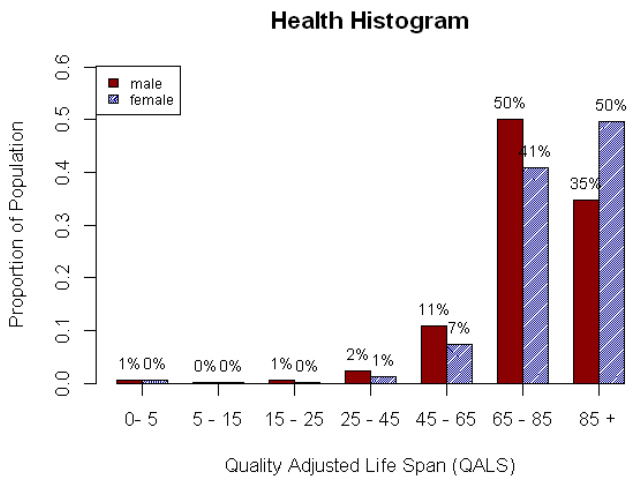
Key differences between income and health:

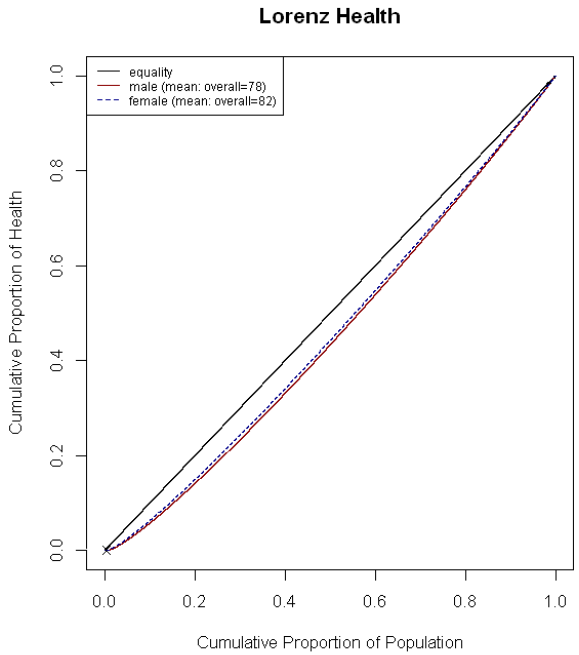
- Current vs. Past, present and expected future
- Unbounded vs. Upper bound
- Full equality achievable vs. Some irremediable and incompensable inequality
- Instrumental value vs. Intrinsic value
- Diminishing marginal value

# UK Health Distribution



# Concepts of Inequality

- Absolute versus Relative
  - Do we consider the inequality between a life of 100 years and 110 years more similar to inequality between
    - a life of 50 years and 60 years

    or
    - a life of 50 years and 55 years

- Total versus Shortfall/Poverty
  - Do we care about the whole health distribution or those below some minimum level of health
    - minimum level may be universal or group specific

# Inequality Measures

- Weak Principle of Transfers (Pigou-Dalton)
  - Transferring from someone with more to someone with less should make the distribution more equal
    - so long as the amount transferred is less than double the difference between the initial endowments between the two individuals involved in the transfer (assuming fixed total)
- Scale Invariant
  - Equal proportional changes to each individual in the distribution should not effect the measure of inequality of the distribution e.g. ratio
- Translation Invariant
  - Equal absolute changes to each individual in the distribution should not effect the measure of inequality of the distribution e.g. gap

# Poverty Measures

- Focus on only the part of the distribution below a poverty line

- Three I's of Poverty
  - Incidence
    - How many people fall below the poverty line
  - Intensity
    - How far on average do those who are poor lie below the poverty line
  - Inequality
    - How much variation is there among those below the poverty line

# Social Welfare Measures

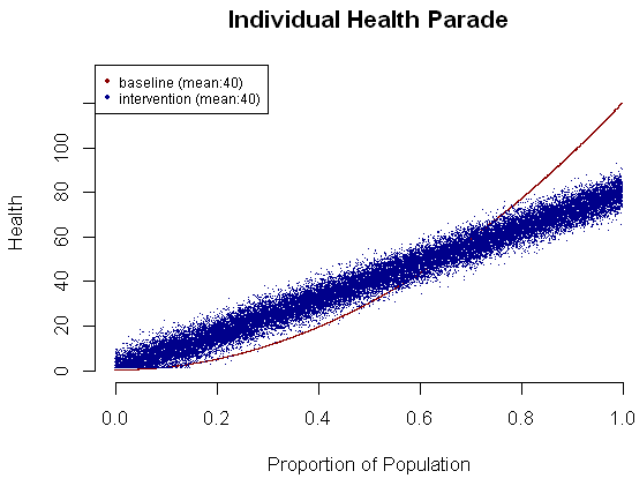
- Inequality measurement tells us which distribution is more equal
- Social welfare measurement looks at both inequality and efficiency to tell us which distribution is better
- Stochastic dominance rules (e.g. Atkinson's and Shorrocks' Theorems) allow us to make very general statements about the ranking of distributions though only give a partial ordering
- More fully specified social welfare functions requiring stronger social value judgements explicitly quantify the equity efficiency trade off to give a complete ordering of distributions

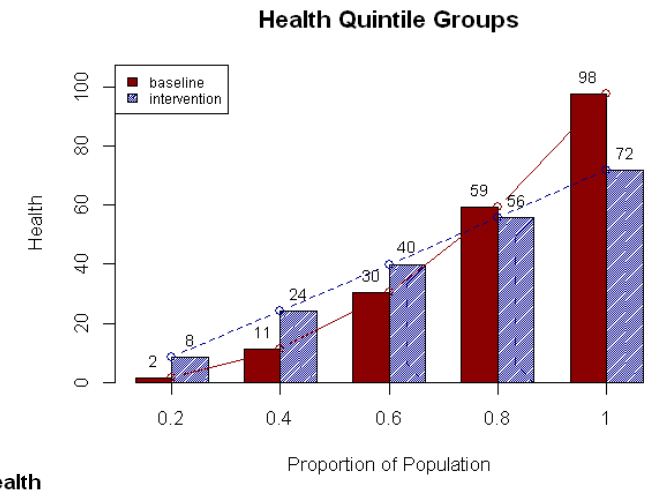
# Atkinson's Theorem

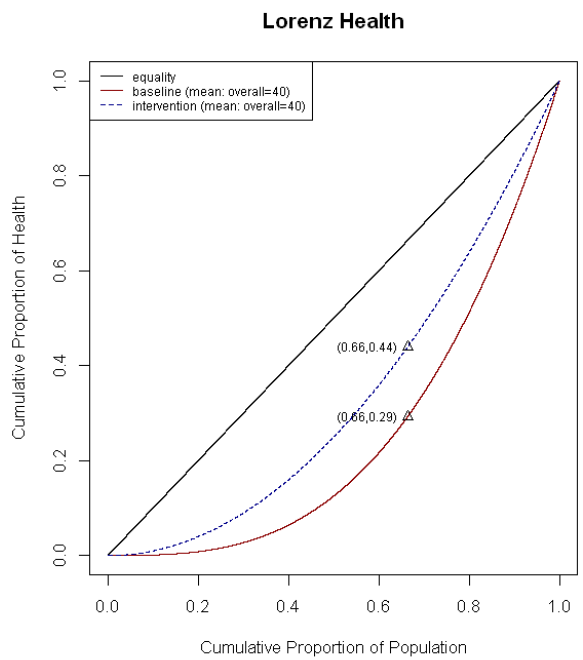
Lorenz dominance

- For any strictly concave, symmetric, individualistic, increasing and additive social welfare function
- If the Lorenz curve lies everywhere above and the mean health is more than or equal then Lorenz dominance holds

# Atkinson's Theorem Example



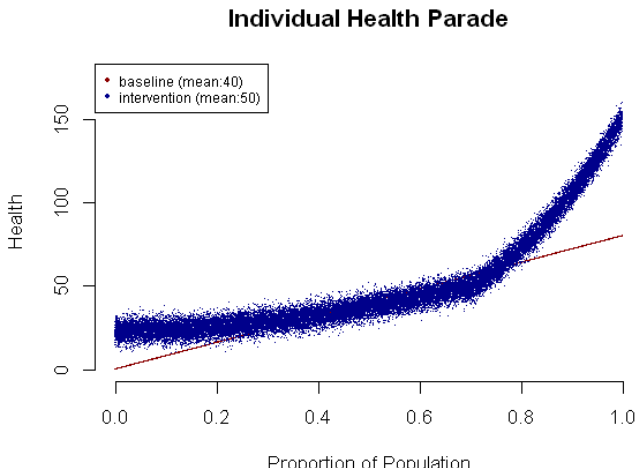



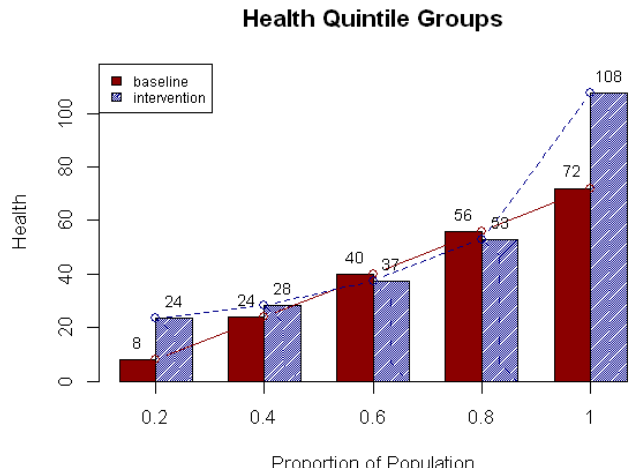
# Shorrocks' Theorem

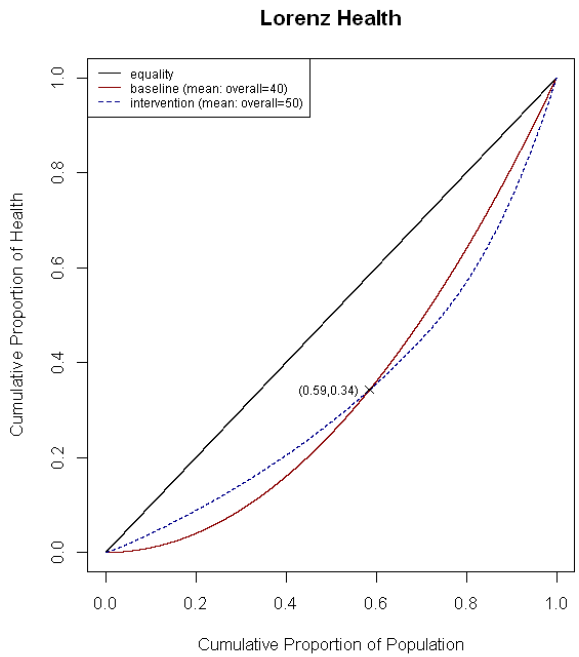
Generalised Lorenz dominance

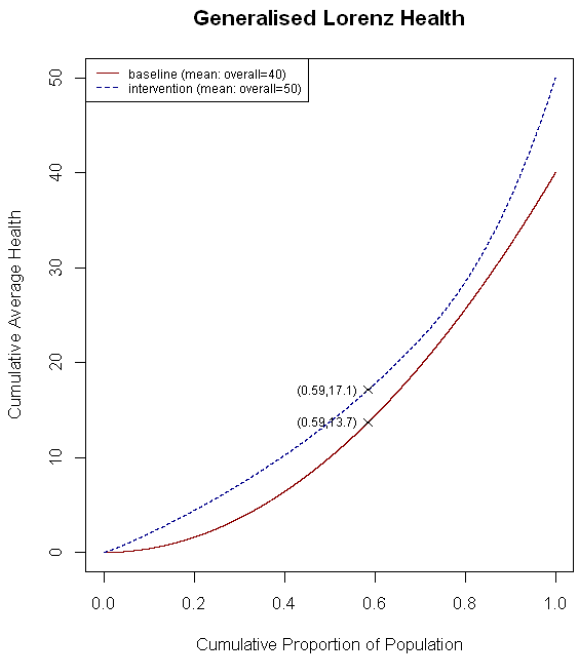
- For any strictly concave, symmetric, individualistic, increasing and additive social welfare function
- If the generalised Lorenz curve lies everywhere above then generalised Lorenz dominance holds
- If Atkinson's theorem holds Shorrocks' theorem must also hold

# Shorrocks' Theorem Example

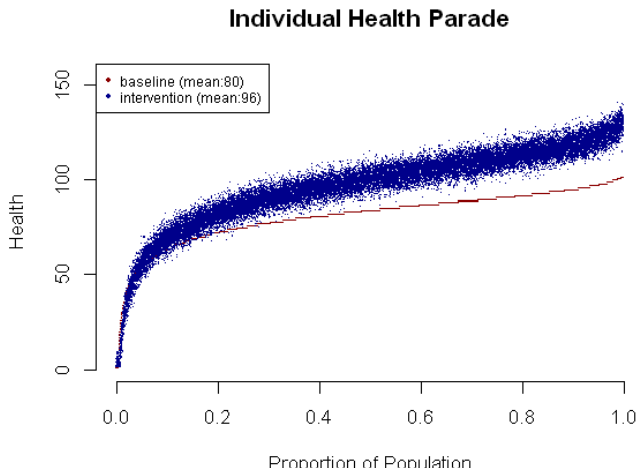


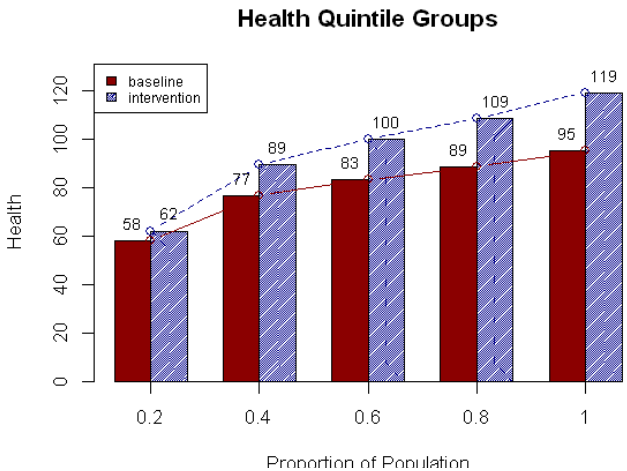



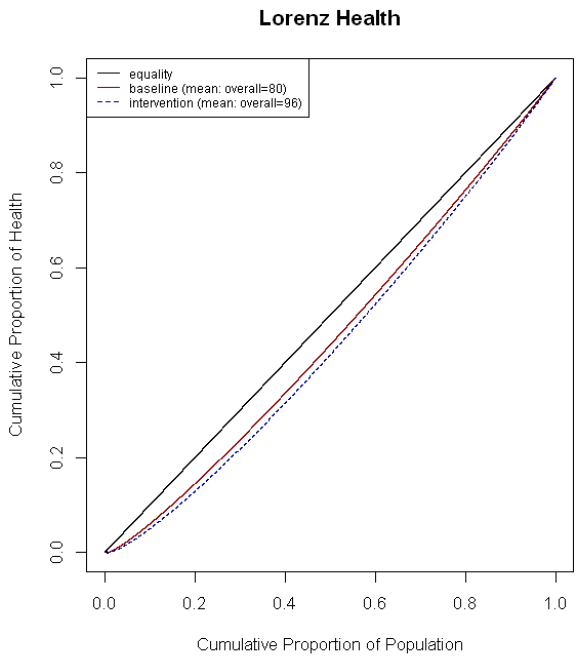



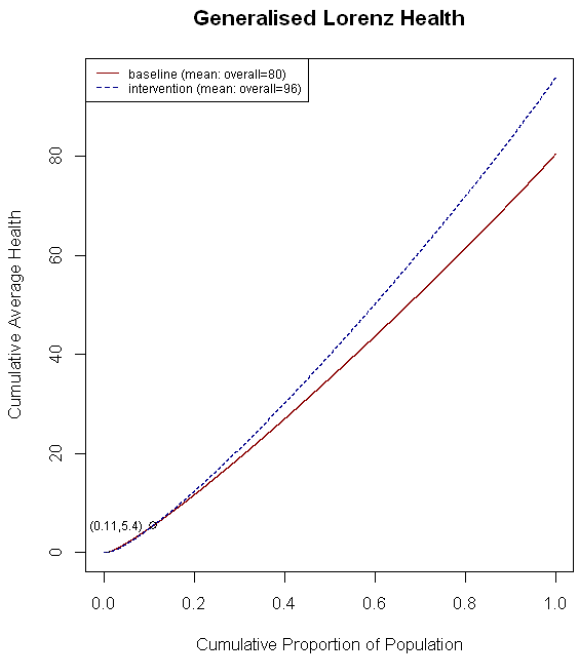



# No Stochastic Dominance



# Social Welfare Indices

- **Equally Distributed Equivalent (EDE)** Social welfare indices use the social welfare function in combination with a societal level of inequality aversion to determine the equally distributed equivalent of the unequal distribution
  - Can be used where stochastic dominance rules do not apply
  - Express the equity efficiency trade off in meaningful units

- **Relative Inequality** (e.g. Atkinson Index)

$$A_\varepsilon = 1 - \frac{h_{ede}}{\bar{h}} \qquad h_{ede} = \left[\frac{1}{n}\sum_{i=1}^{n}[h_i]^{1-\varepsilon}\right]^{\frac{1}{1-\varepsilon}}$$

- **Absolute Inequality** (e.g. Kolm “Leftist” Index)

$$K_\alpha = \bar{h} - h_{ede} \qquad h_{ede} = -\left(\frac{1}{\alpha}\right) log\left(\frac{1}{n}\sum_{i=1}^{n} e^{-\alpha h_i}\right)$$

- **Poverty** (e.g. Sen Index)

$$Q = H(1 - \frac{h_{ede(p)}}{z}) \qquad h^G_{ede(p)} = \mu_p(1 - G_p)$$

# SWF in Health Inequalities

- Iso-elastic social welfare function (Wagstaff, 1991)

$$W = [\alpha h_a{}^{-r} + (1-\alpha) h_b{}^{-r}]^{-\frac{1}{r}}$$

  - α represents the relative weight of the individuals
  - r represents the degree of inequality aversion

- Fair innings weights (Williams, 1997)
  - Equal relative weights (α = 1-α)
  - Calibrates the inequality aversion (r) using “fair innings” quality adjusted life expectancy as equally distributed equivalent level of health
  - Uses calibrated SWF to determine equity weights

- Further calibrated (Dolan & Tsuchiya, 2009)
  - α estimated to represent individual responsibility
  - r estimated to represent inequality aversion

# Conclusion

- There are different ways of looking at inequality: absolute versus relative, total versus shortfall
- SWFs can be used to integrate inequality and efficiency concerns
- Stochastic dominance rules make minimal value judgements but only give partial rankings of distributions
- More fully specified SWFs give a complete ranking by EDEs but require contentious value judgements about:
  - Absolute or relative inequality
  - Total or shortfall inequality
  - Level of inequality aversion
- In such situations it is advisable to look at a range of functions across a range of inequality aversion parameters