ECO.MIC15 Measuring Income and Wealth Inequality: The Lorenz Curve and Gini Coefficient

Total Marks

AQA 7136 · Calculators not allowed · about 90 minutes

Name: _____ Date: ____ / ____ / _____

Answer all questions. Write full sentences for questions worth 4 marks or more. Do not use a calculator; all percentages are rounded for ease. Time guidance: 90 minutes.

1 Multiple choice. In the context of measuring inequality in a UK-style economy, which of the following best describes the Gini coefficient?

- ☐ A: The ratio of mean income to median income.
- ☐ B: The proportion of households in the top 10% of income earners.
- ☐ C: The ratio of the area between the Lorenz curve and the line of perfect equality to the total area under the line of perfect equality.
- ☐ D: The percentage of national income held by the top 1%.

(Total for Question 1 is 1 mark)

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2 Define the term 'income' as used when measuring inequality in an economy, naming its primary factor income components in a UK-style context.

(Total for Question 2 is 2 marks)

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3 Define the term 'wealth' as used when analysing inequality in a UK-style economy, and give two typical sources of wealth.

(Total for Question 3 is 2 marks)

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4 Distinguish between income inequality and wealth inequality in the context of measuring economic inequality in the UK, giving one practical example that shows how they can differ.

(Total for Question 4 is 4 marks)

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5 State three distinct sources of income and three distinct sources of wealth that are relevant when measuring inequality in a modern UK-style economy.

(Total for Question 5 is 3 marks)

6 Data and task, all figures rounded for ease. A small country publishes a table of cumulative percentage of population and cumulative percentage of total income, to be used to draw a Lorenz curve and estimate the Gini coefficient. Table: Cumulative population %: 0,10,20,30,40,50,60,70,80,90,100. Corresponding cumulative income %: 0,2,5,9,15,22,32,45,64,86,100. Using this data for the fictional country, draw a Lorenz curve on an axes where the horizontal axis is cumulative population % and the vertical axis is cumulative income %. On your diagram, show the line of perfect equality and mark the initial equilibrium point at 50% population. Then estimate the Gini coefficient from the data using a simple trapezoid or grid-square method and give the value to two decimal places, explaining your method. This is a data-response task for this fictional country.

(Total for Question 6 is 9 marks)

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7 Using the same fictional country data from Question 6, show the calculation steps to find the area under the Lorenz curve for the first three segments (0-10, 10-20, 20-30 cumulative population), giving the numerical area values you use in the trapezoid method. This is a short calculation checking question.

(Total for Question 7 is 4 marks)

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8 Explain, using the Lorenz curve concept, what the line of perfect equality represents in the measurement of income inequality and why real-world Lorenz curves never lie above this line for income distributions.

(Total for Question 8 is 2 marks)

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9 Interpret the following change in the Lorenz curve for the fictional country: over five years, the Lorenz curve becomes slightly less bowed (moves closer to the diagonal) and the computed Gini coefficient falls from 0.34 to 0.29. Explain what this shift indicates about income distribution, state two possible reasons why it might have happened (without discussing policy), and note one limitation of using only the Gini change to judge social progress.

(Total for Question 9 is 8 marks)

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10 Explain how a more bowed Lorenz curve relates to the income share of the top 10% and the bottom 50% of the population, using the fictional country data from Question 6 as a reference point for the bottom 50% share.

(Total for Question 10 is 4 marks)

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11 State briefly why the Gini coefficient ranges from 0 to 1, and give the interpretation of the two extremes for an income distribution in an economy.

(Total for Question 11 is 1 mark)

12 Short calculation. Using the fictional country data from Question 6, what percentage of total income does the richest 20% of the population receive? Show your working using the cumulative income percentages given.

(Total for Question 12 is 4 marks)

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13 Evaluate the view that the Gini coefficient is a reliable and sufficient measure of inequality in an advanced economy such as the UK.

(Total for Question 13 is 25 marks)

Mark scheme · ECO.MIC15 Measuring Income and Wealth Inequality: The Lorenz Curve and Gini Coefficient

Question 1

- **B1** chooses option C, which correctly defines the Gini coefficient as the area between the Lorenz curve and the diagonal divided by the total triangle area under the diagonal
- **Answer: C**

Question 2

- **B1** a payment flow received by individuals or households over a period, representing earnings or returns from economic activity
- **B1** primary components: wages/salaries, rent, interest and profit
- **Answer: Income is the flow of payments to individuals over time, including wages and salaries, rent, interest and profit.**

Question 3

- **B1** wealth is the stock of assets held by an individual or household at a point in time
- **B1** two typical sources: property/household real estate and accumulated savings/investments or inheritance
- **Answer: Wealth is a stock of assets at a point in time; common sources include property and savings or inheritance.**

Question 4

- **B1** states that income inequality refers to differences in flows of earnings over time, while wealth inequality refers to differences in stock of assets at a point in time
- **B1** explains that wealth includes accumulated assets like property and savings, which can persist across generations
- **B1** gives a clear example, e.g. a retired person with low current income but high house equity has low income but high wealth
- **B1** makes the implication that wealth inequality can be larger than income inequality because assets compound and transfer across generations
- **Answer: Income is a flow over time, wealth is a stock. Example: a retiree may have low income but high housing wealth, showing income and wealth inequality can move in different directions.**

Question 5

- **B1** one correct income source, e.g. wages or salaries
- **B1** one further income source, e.g. interest or rent or profit
- **B1** one correct wealth source, e.g. property/house price equity or savings or inheritance
- **Answer: Income sources include wages, interest and profit. Wealth sources include property, savings and inheritance.**

Question 6

- **Level 1** (1-3): Basic use of the data: plots a small number of points correctly and shows the diagonal line of perfect equality, with minimal or no attempt to estimate the Gini coefficient. Answer contains descriptive statements about inequality but limited numerical accuracy.
- **Level 2** (4-6): Good plotting of most Lorenz points and the diagonal, and a reasonable method to estimate the Gini coefficient using trapezoids or grid squares. Numerical estimate is attempted and roughly correct, with some working shown.
- **Level 3** (7-9): All Lorenz points are accurately plotted and labelled, the line of perfect equality is drawn, and the student correctly computes the area under the Lorenz curve using trapezoids or grid squares and derives the Gini coefficient accurately to two decimal places with clear working and a brief interpretation.
- **Indicative content:**
  - Plot points (0,0), (10,2), (20,5), (30,9), (40,15), (50,22), (60,32), (70,45), (80,64), (90,86), (100,100) on cumulative population vs cumulative income axes
  - Draw the diagonal line from (0,0) to (100,100) labelled line of perfect equality
  - Mark the median point at 50% population, which on the Lorenz curve corresponds to 22% of income in this data set, showing inequality at the median
  - Estimate area under Lorenz curve using trapezoidal rule with equal width segments of 10 percentage points: compute each trapezoid area as (y_i + y_{i+1})/2 x 10
  - Sum of trapezoid areas = 3300 percent-squared, total area under diagonal = 0.5 x 100 x 100 = 5000, area between diagonal and Lorenz = 1700
  - Gini = area between diagonal and Lorenz divided by total triangle area = 1700 / 5000 = 0.34, reported as 0.34
  - Interpretation: a Gini of 0.34 indicates a moderate degree of income inequality; the Lorenz curve bowed below the diagonal shows the bottom 50% receive only 22% of income

Question 7

- **M1** uses trapezoid formula for 0-10: (0 + 2) / 2 x 10 = 10
- **M1** uses trapezoid formula for 10-20: (2 + 5) / 2 x 10 = 35
- **M1** uses trapezoid formula for 20-30: (5 + 9) / 2 x 10 = 70
- **A1** gives the three numeric areas as 10, 35 and 70 respectively
- **Answer: Areas: 0-10: (0+2)/2*10 = 10; 10-20: (2+5)/2*10 = 35; 20-30: (5+9)/2*10 = 70.**

Question 8

- **B1** the line of perfect equality represents every cumulative percentage of population receiving the same cumulative percentage of income, e.g. 30% of people receive 30% of income
- **B1** real-world Lorenz curves cannot lie above this line because that would imply some proportion of the population receives more than their proportional share of income while others receive less, violating the cumulative ordering used to construct the Lorenz curve; the diagonal is the equal distribution benchmark
- **Answer: The diagonal shows exact equality, with x% of people getting x% of income; actual Lorenz curves lie below it because some people always have less than their proportional share, so the curve is bowed below the diagonal.**

Question 9

- **M1** identifies that a Lorenz curve moving closer to the diagonal and a falling Gini indicate a reduction in measured income inequality
- **A1** explains that more of the national income is accruing to lower and middle segments of the population, e.g. the bottom 50% now receive a larger share than before
- **M1** gives two plausible non-policy reasons: for example, changes in labour market composition such as rising wages in lower-paid sectors, or demographic shifts like an increase in employment among prime-age workers
- **A1** develops each reason briefly, e.g. rising relative wages in formerly low-paid sectors increases incomes at the bottom; demographic shifts raise labour force participation and income shares for groups that previously had low income
- **M1** identifies a limitation of the Gini change, e.g. it does not show where in the distribution the change occurred or whether absolute incomes rose for the poorest
- **A1** develops limitation: a falling Gini could be driven by losses at the very top rather than substantial gains at the bottom, so social welfare judgments require additional information like poverty rates or median income
- **B1** links back with a concise judgement that the observed shift indicates an improvement in measured equality but that this alone is insufficient to conclude clear social progress
- **B1** uses numerical change in Gini (0.34 to 0.29) as supporting evidence for the interpretation
- **Answer: The movement of the Lorenz curve toward the diagonal and Gini falling from 0.34 to 0.29 indicates measured income inequality has decreased; reasons could include rising wages in lower-paid sectors or demographic increases in employment; however, the Gini does not reveal which parts of the distribution changed or whether absolute incomes of the poorest rose, so further measures are needed to judge social progress.**

Question 10

- **M1** states that a more bowed Lorenz curve indicates the top shares are larger and bottom shares are smaller
- **A1** applies to the fictional data: the bottom 50% receive 22% of income, so a more bowed curve would mean the bottom 50% receive even less than 22%
- **M1** states that the top 10% share rises when the curve is more bowed
- **A1** connects the two by explaining that as the bottom share falls, the excess income accrues disproportionately to the top decile or top percentiles
- **Answer: A more bowed curve means the bottom 50% get a smaller share and the top 10% a larger share; e.g. in our data the bottom 50% get 22% of income, so increased bowing would reduce that bottom share and raise top-10 shares.**

Question 11

- **B1** 0 means perfect equality (Lorenz curve coincides with diagonal), 1 means perfect inequality (one person has all income), and the ratio formulation produces values between 0 and 1
- **Answer: Gini is 0 at perfect equality and 1 at perfect inequality because it is a ratio of areas that ranges from zero area between curves to the full triangle area.**

Question 12

- **M1** recognises that richest 20% corresponds to the top quintile, so subtract cumulative income at 80% population from cumulative income at 100% population: 100 - 64
- **A1** gives calculation 100 - 64 = 36
- **B1** states the richest 20% receive 36% of total income
- **B1** briefly notes this shows concentration of income at the top relative to perfect equality
- **Answer: Top 20% income share = 100% - 64% = 36% of total income.**

Question 13

- **Level 1** (1-5): Basic assertions about what the Gini measures and a one-sided view. Limited application to the advanced economy context and little or no evaluation.
- **Level 2** (6-10): Clear explanation of how the Gini coefficient measures inequality with an attempt to apply to an advanced economy. Some valid limitations are identified but evaluation is thin or unbalanced.
- **Level 3** (11-15): Good analysis showing how the Gini is constructed and used, with several limitations and strengths discussed and applied to an advanced economy context. Some evaluative comment about sufficiency, with limited use of supporting examples or comparisons.
- **Level 4** (16-20): Thorough analysis, including accurate explanation of the area ratio definition, sensitivity to changes across the distribution, and discussion of comparability over time and between countries. Balanced evaluation, weighing strengths and limitations with clear examples and implications for policy or social assessment.
- **Level 5** (21-25): Highly developed evaluation that considers technical strengths and weaknesses, robustness issues, and alternative or complementary measures. Draws on examples relevant to an advanced economy, examines how the Gini handles income versus wealth and demographic effects, and reaches a well supported judgement about reliability and sufficiency.
- **Indicative content:**
  - Explain how the Gini coefficient is computed as an area ratio from the Lorenz curve and why it is useful as a single summary statistic ranging from 0 to 1
  - Strengths: provides a compact summary allowing comparisons over time and between countries; sensitive to transfers across the whole distribution rather than a single percentile; widely understood and available in many statistical releases
  - Limitations: loses information about where inequality changes occur (top, middle, bottom), so identical Gini values can correspond to very different distributions; insensitive to absolute income changes, so a falling Gini could coincide with falling incomes for the poor
  - Wealth versus income: Gini typically calculated for income; wealth inequality is often much larger and differently distributed, so relying on income Gini alone can understate overall economic inequality in an advanced economy with high asset concentration
  - Comparability issues: differences in data sources, incomes measured (pre-tax vs post-tax, market vs disposable), household equivalisation and sampling at the top can affect comparability; measurement error at the top can bias the Gini
  - Technical points: the Gini is more influenced by changes around the median than at the extremes; small sample sizes or undercoverage of top incomes can understate true inequality
  - Alternatives and complements: Palma ratio, top decile or top 1% shares, median-to-mean ratios, poverty rates, Lorenz curve visual analysis, and measures of wealth distribution should be used alongside Gini
  - Application to an advanced economy: examples such as rising asset prices boosting wealth concentration, demographic changes, or tax/benefit systems that affect disposable income, showing why a single Gini may miss important trends
  - Evaluation and judgement: conclude whether the Gini is reliable for quick summaries and comparisons but insufficient alone to fully assess inequality in an advanced economy; recommend combining Gini with other distributional statistics and contextual data