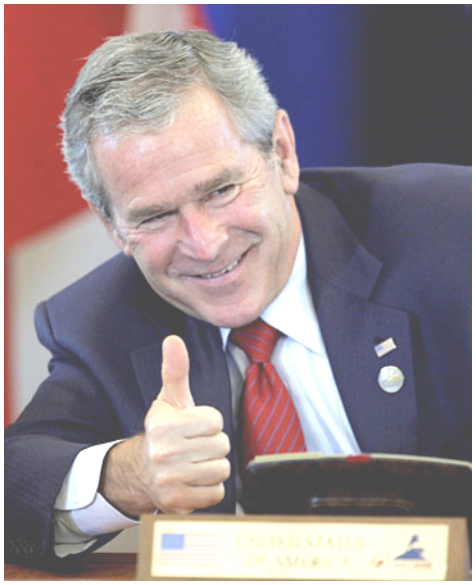
Recitation Handout 3: The Gap Between Rich and Poor

The specific learning goals of this activity are for you to:

- Learn how to use information about the distribution of income to draw a Lorenz curve.
- Learn how to interpret the shape of a Lorenz curve.
- Learn how to use a Lorenz curve to calculate the Gini Index of an economic system.
- Learn how to interpret the value of the Gini Index as an indicator of how income is distributed within an economic system.
- Interpret the meaning of the numerical values of a function and a derivative.



Prior to the recent financial crisis, the most important economic issue facing the United States (according to the Wall Street Journal) was the gap between rich and poor[1]. (The number one issue was the high price of gasoline.) During 2006 and 2007, Democratic politicians blamed Republicans for economic inequalities, laying much of the blame on the Bush administration's tax-cutting economic policies[2]. While still in power, Bush Administration officials such as Treasury Department chief spokeswoman Brookly McLaughlin vehemently denied that tax cuts had contributed to the widening gap[3].

This argument was not new when used by the Democrats in 2006. President Clinton, when campaigning in 1992, often pointed out during speeches how well the top 1% of income earners were doing, while everyone else seemed to be left behind. Relatively recent statistics bear out President Clinton's point. In 2005, for example, analysis of IRS data showed that the top 300,000 earners in the United States collectively brought home as much money as the bottom 150,000,000 income earners combined[4].

In this activity you will learn how the distribution of income is measured by economists. You will then use this knowledge (together with your knowledge of derivatives) to analyze income distribution in the United States to see whether or not President Bush's policies seem to have widened the gap (and in particular, whether or not his policies widened the gap more rapidly than his predecessors).

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[1] Solomon, Deborah. "Democrat's risky strategy: trumpeting the wealth gap." *Wall Street journal*, October 2, 2006, p. A1.

[2] Andrews, Edmund L. "Tax cuts offer most for very rich, study says." *New York Times*, January 8, 2007. Accessed on-line from: http://www.nytimes.com/2007/01/08/washington/08tax.html

[3] Dyer, John. "Cost of the Bush era: $11.5 trillion." *MSN Money*, January 9, 2008. Accessed on-line at: http://articles.moneycentral.msn.com/investing/StockinvestingTrading/cost-of-the-bush-era-11-point-5-trillion.aspx

[4] Johnston, David C. "The gap between rich and poor grows in the United States." *International Herald Tribune*, March 29, 2007. Accessed on-line from: http://www.iht.com/articles/2007/03/29/business/income.4.php

Income Distribution – Lorenz Curves and the Gini Index

In this part of the recitation, the objective is for you to learn about two concepts that economists use to study the distribution of incomes. The two concepts are the **Lorenz curve** and the **Gini Index**. The work that you do to understand these concepts will not appear to be strongly connected with what we have studied in lecture, but we have a lot of faith in your ability to figure out what is going on!

The first tool that economists use to study the distribution of income within an economic system is called a **Lorenz curve**. This is a graph whose shape reveals the distribution of income. To draw a Lorenz curve, begin with a table showing how much of the total income of the country is earned by the 20% of the workforce who have the lowest incomes, how much of the total income of the country is earned by people whose incomes are in the next 20%, etc. (This is the information contained in the first two columns of Table 1.) From this table, you calculate the cumulative total percentages of the population and income (as shown in last two columns of Table 1 below[5]).

Population group	Percentage of total income of country earned by this group	Cumulative percentage of total population	Cumulative percentage of total income
20% of population with lowest incomes	3	**20**	**3.0**
20% of population with second-lowest incomes	6.1	20 + 20 = **40**	3.0 + 6.1 = **9.1**
20% of population with incomes in the middle of the range	8.4	40 + 20 = **60**	9.1 + 8.4 = **17.5**
20% of population with second-highest incomes	17.2	60 + 20 = **80**	17.5 + 17.2 = **34.7**
20% of population with highest incomes	65.3	80 + 20 = **100**	34.7 + 65.3 = **100**

Table 1: Income distribution in South Africa, 1985.

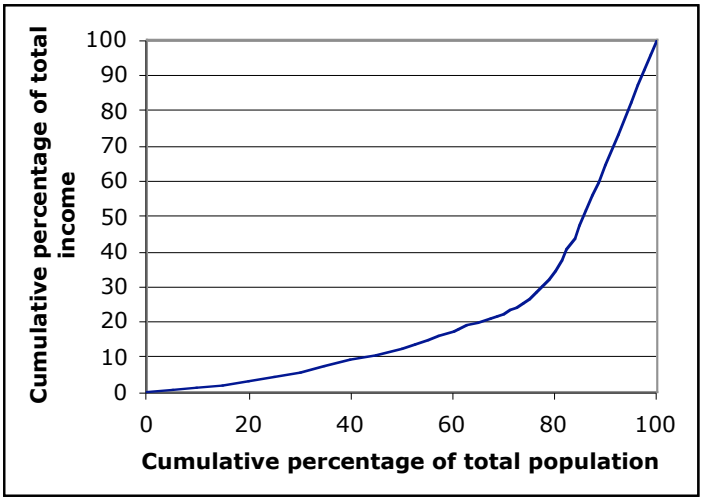


Figure 1: Lorenz Curve for South Africa, 1985.

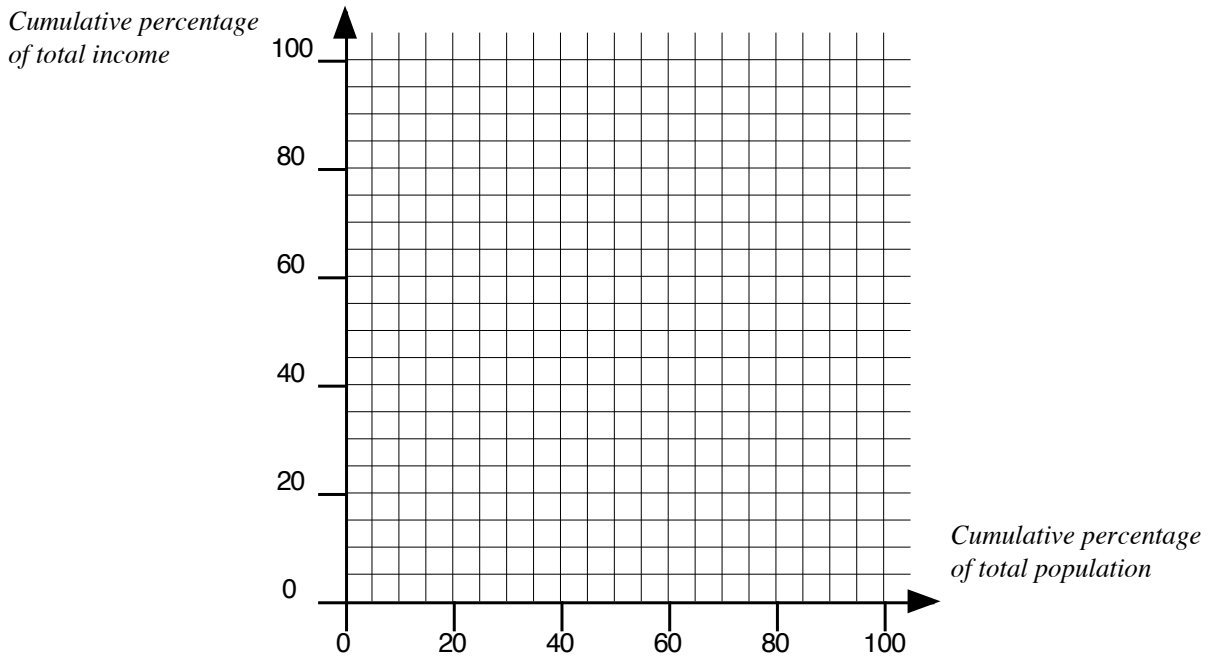
The Lorenz Curve is created by using these cumulative percentages as x and y-values for points on a graph. The cumulative percentage of total population is used as the independent variable (x) and the cumulative percentage of total income is used as the dependent variable (y). Figure 1 shows the Lorenz curve drawn using the data from Table 1.

[5] The data used in Table 1 is for South Africa. This data was obtained from: United Nations Development Program. 2001. *Human Development Report 2001: Making New Technologies Work for Human Development*. Geneva Switzerland: United Nations.

1. Table 2[6] gives the information needed to draw a Lorenz Curve for the United States in 1978. Complete the entries in Table 1 and then draw the Lorenz Curve for the United States in 1978.

Population group	Percentage of total income of country earned by this group	Cumulative percentage of total population	Cumulative percentage of total income
20% of population with lowest incomes	5.2		
20% of population with second-lowest incomes	11.6		
20% of population with incomes in the middle of the range	17.5		
20% of population with second-highest incomes	24.1		
20% of population with highest incomes	41.3		

Table 2: Income distribution for the United States, 1978.



[6] Source of data: U.S. Bureau of the Census.

2. Figure 2[7] (see next page) depicts the Lorenz curves for Brazil and Hungary. In a sentence or two, describe how income in distributed in each country. In which country does income seem to be distributed the most evenly? In which country is there the greatest inequality of income between wealthy and poor?

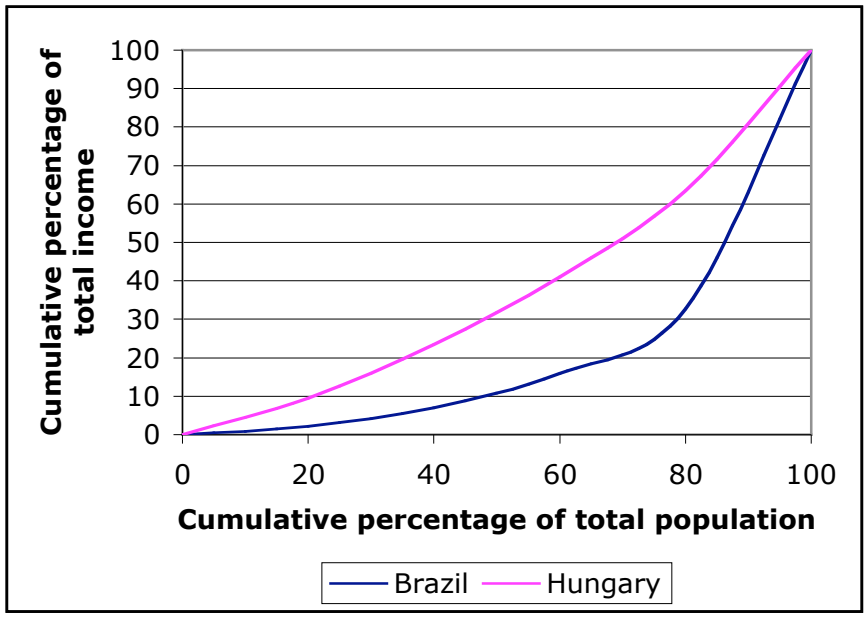
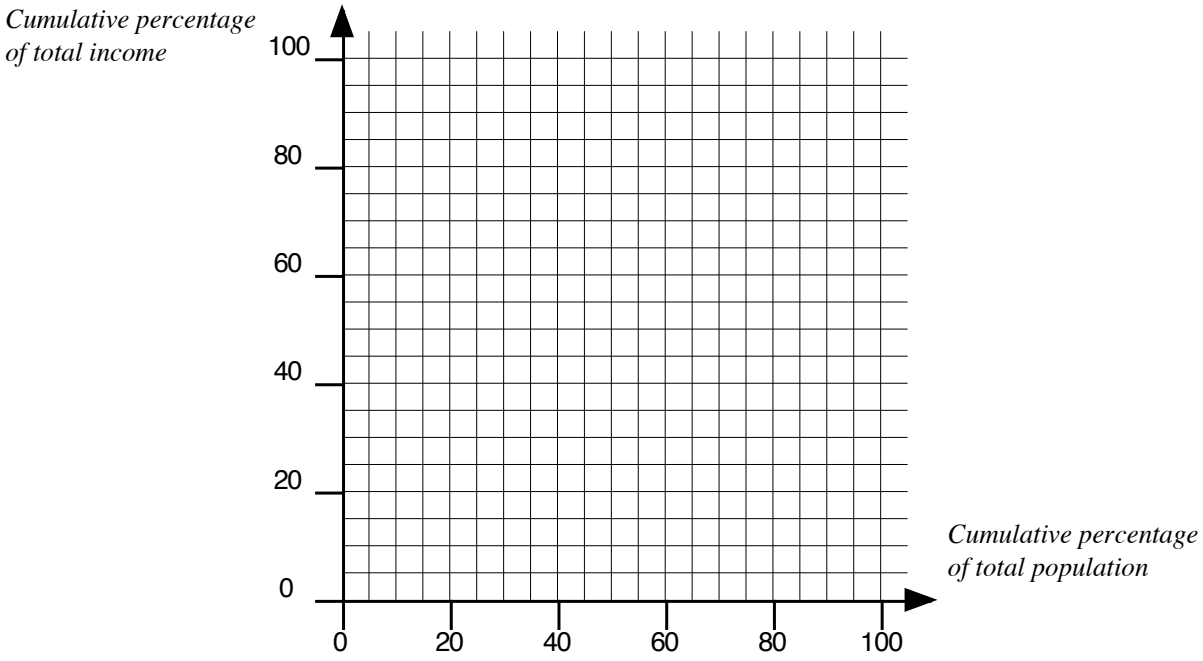


Figure 2: Lorenz curves for Brazil and Hungary.

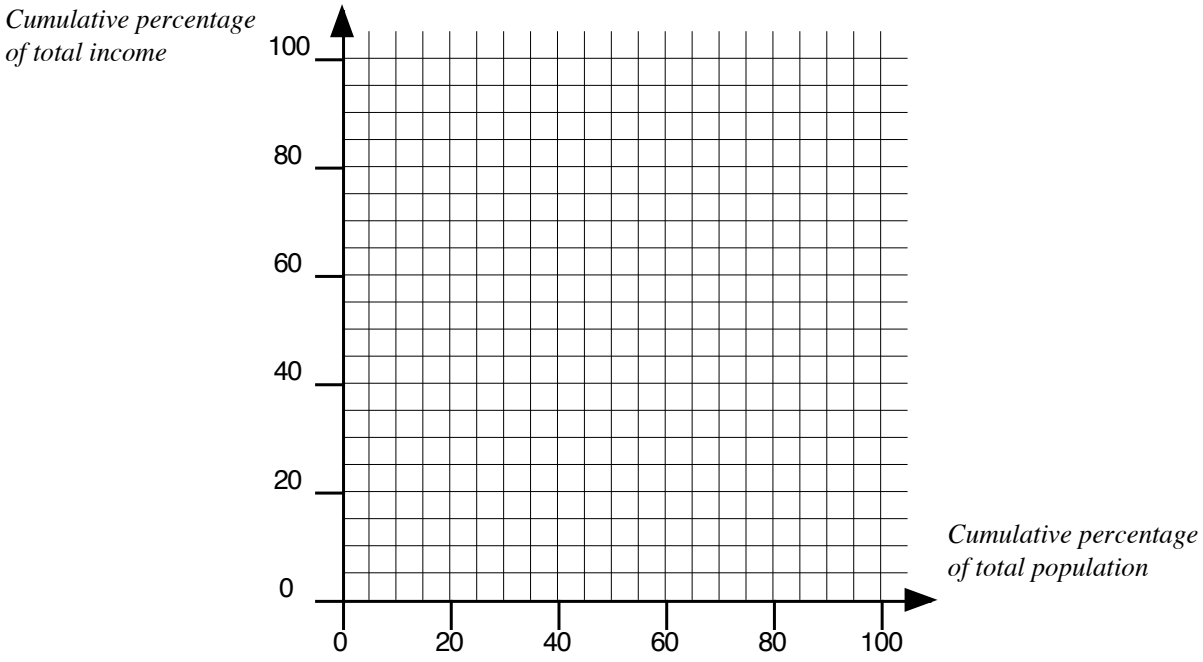
[7] The data used to construct Figure 2 was obtained from: United Nations Development Program. 2001. *Human Development Report 2001: Making New Technologies Work for Human Development*. Geneva Switzerland: United Nations.

3. Extrapolate the features of the Lorenz curves from Figure 2 to draw Lorenz curves that illustrate the following extreme scenarios:

- An economic system in which income is almost equal for everyone.



- An economic system in which almost all income is concentrated in the hands of a few people and the vast majority of people have very low incomes



4. Sometimes, it is difficult to visually distinguish one Lorenz curve from another.

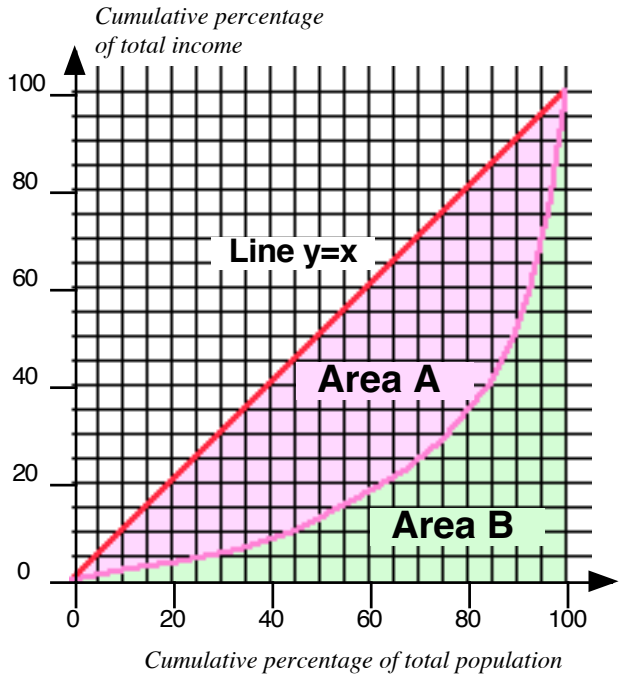


Figure 3: Definitions of Area A (area between the line $y = x$ and the Lorenz Curve) and Area B (area under the Lorenz Curve).

To make it easier to compare economic systems with similar Lorenz curves, economists calculate a number whose value indicates how income is distributed. This number is called the **Gini Index**. Figure 3 shows how a Lorenz Curve can be used to define two areas, area *A* and area *B*.

The Gini Index of an economic system is given by the formula:

$$\text{Gini Index} = \frac{\text{Area A}}{\text{Area A} + \text{Area B}}.$$

Use the graphs provided in Figures 4 and 5 to calculate the Gini Indices for Brazil and Hungary.

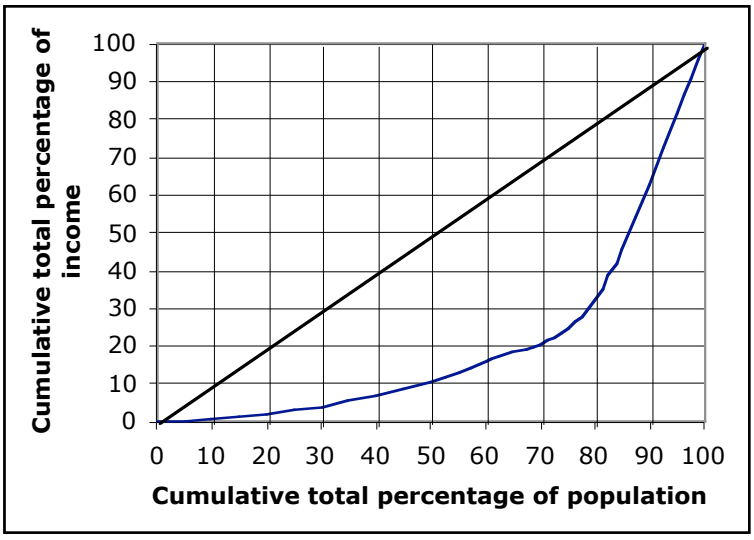


Figure 4: Lorenz Curve for Brazil. (The diagonal line is the line $y = x$.)

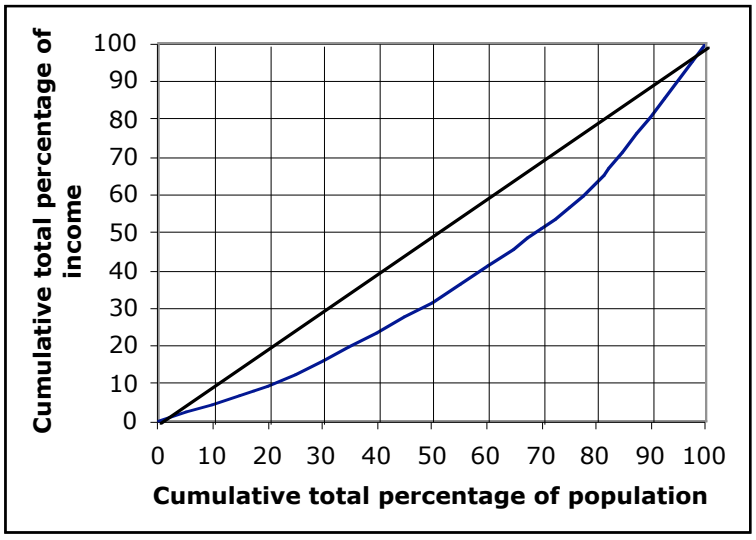


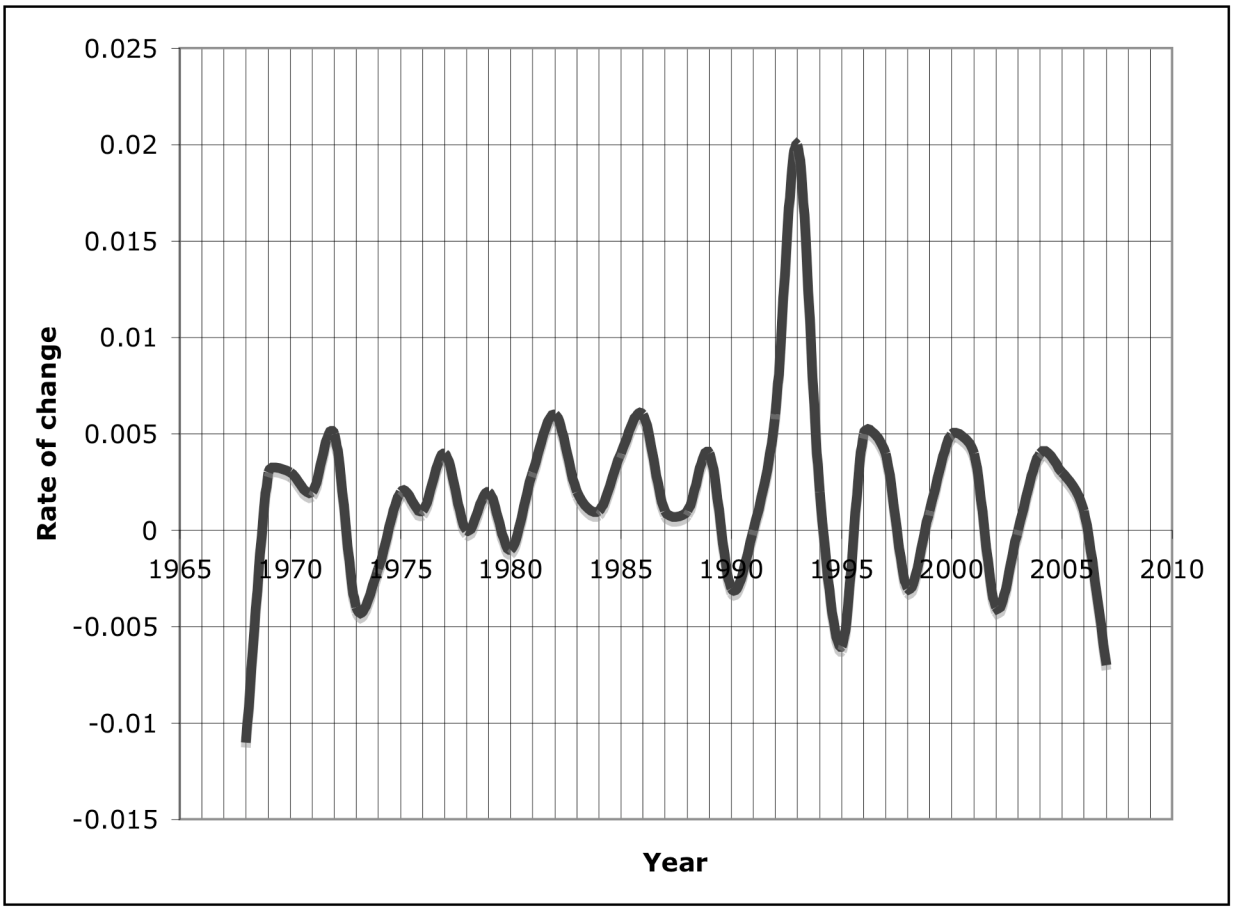
Figure 5: Lorenz Curve for Hungary. (The diagonal line is the line $y = x$.)

5. What value would you expect the Gini Index to have for an economic system in which income is distributed evenly? What about an economic system in which almost all of the income is concentrated in the hands of a few people?

Analyzing Historical Data for the United States

Economists use the Gini index to measure the degree of income inequality in a country. This is often interpreted in the popular press as an indication of the gap between rich and poor. When the Gini index is low, income is evenly distributed throughout the country, which might be interpreted as a small gap between rich and poor. When the Gini index is high, income is not evenly distributed suggesting a bigger gap between rich and poor.

The following graph[8] shows the **rate of change** of the Gini Index from 1968 (the first time that this information was available from the US Census Bureau) to 2007 (the most recent that was available at the time of writing).



During this period of time, the Presidents of the United States were Richard Nixon (1969-1973), Gerald Ford (1973-1977), Jimmy Carter (1977-1981), Ronald Reagan (1981-1989), George H. W. Bush (1989-1993), William Clinton (1993-2001) and George W. Bush (2001-2009).

6. How can you tell from the graph when the Gini index is increasing and when the Gini index is decreasing? Explain in a sentence or two.

[8] The data used for this graph is the Gini index based on household income, from 1967 to 2007. This was obtained directly from the US Census Bureau web site, http://www.census.gov/

7. On August 1, 1999, Temple University mathematics Professor John Allen Paulos reported on ABS News[9] that the gap between rich and poor in the United States was widening. According to the graph on the previous page, was he correct or not? Briefly explain how you know.

8. What is the **largest rate** of change in the Gini index during the last 40 years? Who was President at the time this happened?

9. During which US presidential administration was there the **longest period** of increase in the Gini index?

10. In approximately which year did the Gini index reach its highest level? Who was the President of the United States at this time?

11. According to Democratic politicians, the widening gap between rich and poor in America was due in large parts to the tax cutting policies of former President George W. Bush. Based on your answers to Questions 7, 8 and 9 and the previous graph, does this appear to be the case? Briefly explain why or why not.

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[9] You can find the report archived on-line at:
http://abcnews.go.com/sections/science/WhosCounting/paulos990801.html