

Spring 2025 ECON 125 Midterm Solutions

You have one hour to complete the exam. Please write your answers in the space provided. You may refer to a one-page 8.5" x 11" note sheet, written in your own handwriting on both sides of the page. There are 14 questions, each worth the same number of points.

PART I. *True or false? Write whether the statement is true or false, then explain your answer.*

1. The incidence of a disease measures the share of people who have it.

False. The incidence of a disease measures the flow of new cases i.e., new cases in a period divided by person-time at risk in that period. The share of people who have a disease is called prevalence.

2. The Preston Curve represents the relationship between mortality and age.

False. The Preston Curve represents the relationship between mortality (usually measured by life expectancy) and income (usually measured by GDP per capita).

3. DALYs are an objective combined measure of morbidity and mortality.

False. DALYs are indeed a combined measure of morbidity and mortality, but we discussed in class how they incorporate many subjective decisions, such as how to weigh a year of life in youth against a year of life in old age, and how to weigh a year of life in good health against a year of life with a debilitating condition.

...True or false, continued...

4. Based on a period life table for 2023, it is possible to determine the median age at death for a hypothetical group of people who experience 2023 age-specific mortality rates at every age.

True. The period life table directly represents the mortality and survival rates of that hypothetical group of people. When l_x crosses below 50% of l_0 , x is the median age at death. For instance, if we set $l_0 = 100,000$ as usual, then the median age at death would be the value of x for which $l_x = 50,000$. If you answered “false” because it is not clear how to determine the median when l_x crosses below 50% at a non-integer value of x , you got full credit.

5. The general fertility rate equals the number of births divided by the population.

False. The general fertility rate is the number of births divided by the number of women of reproductive age. The quantity described here is the crude birth rate.

6. The fertility transition occurred more rapidly in Asia than in Africa.

True. Bongaarts and Casterline describe how fertility fell faster in Asia and Latin America than in Africa.

PART II. The table below is taken from the reading for week 1, by Lee.

Global Population Trends Over the Transition: Estimates, Guesstimates and Forecasts, 1700–2100

	<i>Life Expectancy</i> (Years at Birth)	<i>Total Fertility Rate</i> (Births per Woman)	<i>Pop Size</i> (Billions)	<i>Pop Growth Rate</i> (%/Year)	<i>Pop < 15</i> (% of Total Pop)	<i>Pop > 65</i> (% of Total Pop)
1700	27	6.0	.68	0.50	36	4
1800	27	6.0	.98	0.51	36	4
1900	30	5.2	1.65	0.56	35	4
1950	47	5.0	2.52	1.80	34	5
2000	65	2.7	6.07	1.22	30	7

7. Which transition does the entire table summarize? Describe how birth and death rates change over the course of this transition.

The table summarizes the Demographic Transition. In the classic Demographic Transition, birth and death rates start high; then death rates fall while birth rates remain high; then birth rates fall while the decline in death rates slows; then birth and death rates are low.

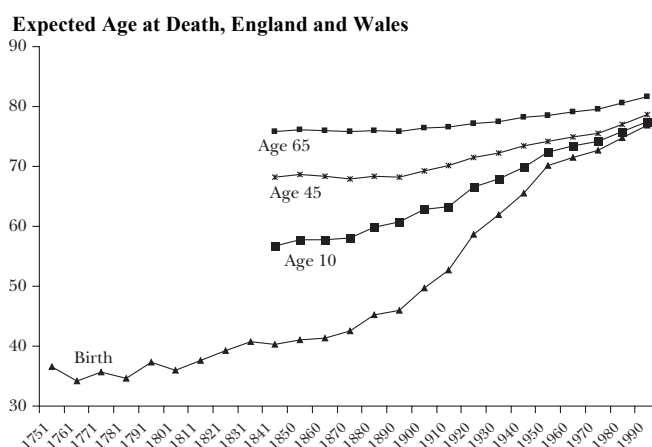
8. Describe Malthus's theory of population. Does the theory fit the data for the first century in the table?

Malthus posited that the size of the population was limited by the capacity of the economy and that the capacity of the economy could only grow at a slow rate. The result is population stagnation, as we indeed see in the low population growth rates of the 1700s.

9. Between 1800 and 2000, the total fertility rate fell from 6.0 to 2.7. Describe two theories of which forces drove this change.

You could have mentioned Demographic Transition Theory, in which urbanization, rising education, economic growth, and declining mortality reduce parents' desire to have many children to assist with family enterprises, provide for old-age security, and hedge against child mortality risk. You could have also mentioned ideational theory, in which new ideas about the ideal family, gender roles, contraception, and abortion diffuse through the population. You could have also mentioned women's time costs or the quality-quantity tradeoff.

PART III. The graph at right is taken from the reading for week 2, by Cutler et al.:



10. The expected age at death is on the vertical axis. How is this measure different from life expectancy? Is it ever the same as life expectancy? If so, when?

The expected age at death at age x equals $x + e_x$. So life expectancy tells us remaining years of life for a (hypothetical) person at age x ; expected age at death adds the age x to life expectancy. They are the same only at birth, i.e., when $x = 0$.

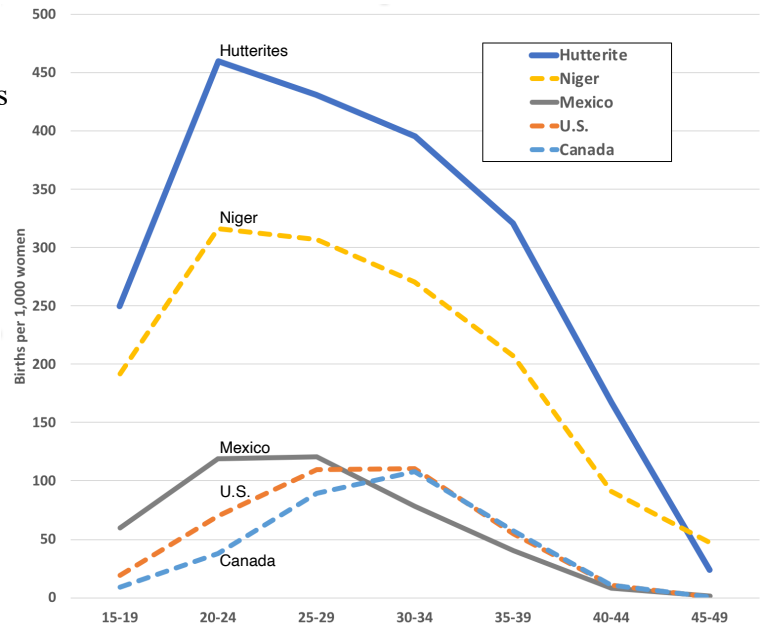
11. In the 1700s, the plot labeled “Birth” hovers in the mid-30s. Does this mean that the most people in the 1700s lived to their mid-30s? Explain.

No, it does not mean that most people in the 1700s lived to their mid-30s. It means that if a group of people experienced the age-specific mortality rates of the 1700s over their lives, on average they would die in their mid-30s. Many people died in childhood, and many people lived past their mid-30s.

12. From 1850 to 1950, the plot labeled “Birth” rises by nearly 30. Does this increase primarily reflect declining mortality at young or old ages? How can you tell from the graph?

The increase primarily reflects declining mortality rates among children. The graph indicates that the increase in life expectancy at birth was much steeper than the increases in life expectancy at ages 10, 45, and 65. Therefore, the steep rise e_0 is mainly due to changes in mortality rates that are not included in e_{10} , e_{45} , and e_{65} : those below age 10.

PART IV. The graph at right plots age-specific fertility rates by 5-year age group in four modern populations (Niger, Mexico, United States, and Canada) and one historical population, the Hutterite ethno-religious sect, who at the time did not practice any form of birth control.



13. Is the Hutterite total fertility rate closer to 5, 10, or 15? Explain your approximation.

The Hutterite total fertility is rate closer 10. This was the only question to require calculations, but they could have been extremely approximate. With data for 5-year age groups, the total fertility rate equals 5 times the sum of the age-specific fertility rates (rescaled from 0-1000 to 0-1). Let's round age-specific fertility rates to the nearest 50:

$$\text{TFR} \approx 5/1000 * (250 + 450 + 450 + 400 + 300 + 150 + 0) = 5/1000 * 2000 = 10$$

You could have even rounded age-specific fertility rates to the nearest 100:

$$\text{TFR} \approx 5/1000 * (300 + 500 + 400 + 400 + 300 + 200 + 0) = 5/1000 * 2100 = 10.5$$

14. Where is the total fertility rate higher, the United States or Canada? Explain.

The total fertility rate is higher in the United States. Age-specific fertility rates are the same in the 30s and 40s but higher in the United States in the teens and 20s, and the total fertility rate is the sum of age-specific fertility rates across ages.