Economic Demography Field Exam
Department of Economics
University of California, Berkeley
July 26, 2012

There are four questions and you may take up to three hours. Answer all parts of all questions. The questions will be weighted equally in the overall grade. You may use a calculator. You may use a special two page list of demographic formulas that will be provided for you. You may use a two page list of references that you bring yourself. Please be specific as you can in your answers, referring to the literature where appropriate.

1) Australia introduced a birth bonus program such that starting in June 2004, the government paid $3000 to each mother at time of birth. A recent article has found that this program had a positive effect on fertility starting ten months after it went into effect, and persisting up to the present.
    a) What relationship between fertility and income is generally observed over the course of economic development, if any? Is relationship evidence that births are an inferior good? Why or why not?
    b) What relationship would you expect to find between family income and fertility at the micro level in a rich country, if any, and why?
    c) Taking the results of the study on the birth bonus as given, how would you explain them in the context of the main theories of the economics fertility?
    d) Discuss the possibility that this birth bonus program might influence marriage and divorce as well as fertility, in the context of the economic theory of marriage and divorce.

2) Comment on this (hypothetical) statement, agreeing or disagreeing. Be specific: "Health depends on medicine, public health, and biomedical technology. In trying to understand trends and differences in health, economics is just a distraction from the important issues."

3) Some analysts view population growth as detrimental to growth in per capita income. Variations in population growth can arise through fertility, mortality, or net immigration, or through the population age distribution inherited from the past (population momentum). We will ignore population momentum for purposes of this question.
    a. On *a priori* grounds, would you expect that variations in population growth arising from each of fertility, mortality and net immigration would have similar effects on the growth of per capita income? Why or why not?
    b. What empirical evidence can you bring to bear on this question? Be specific.
    c. What important differences are there between these three sources of population growth and their consequences from a welfare theoretic point of view?

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Field Examination in Economic Demography

Question on Demographic Methods

26 July 2012

This is a closed-book examination. Please show your work and label your answers clearly. Answers with decimals should be given with six figures beyond the decimal point. Useful formulas are given on a separate handout.

Some demographers speculate that the U.S. age pyramid by 2050 may come to resemble a stable age pyramid as Baby Boom cohorts die away. Table A shows two alternative projections (X and Y) of the combined-sex U.S. population in 2045 and 2050 given in millions of people. Imagine that, as an economist, you have been called in to assess the projections and offer an opinion on which would be a more plausible forecast.

a) Basing you examination on the three age groups 0 to 5, 30 to 35, and 60 to 65, present evidence to show which projection (X or Y) is more nearly consistent with stable population theory, and, for this projection, estimate the value of Lotka's r.

b) Under certain assumptions, the information in Table A can be used to make estimates of some life-table quantities. Briefly state two or three of the main assumptions required, and (step by step) construct estimates of ${}_1q_{30}$ based on Projection X and based on Projection Y. Are both of these estimates reasonable? If one or both of the estimates is unreasonable, explain which of the assumptions you have listed seems most likely to have been violated.

c) Table B shows the relationship between e_0 and ${}_1q_{30}$ for Coale and Demeny West Model Lifetables after males and females have been combined. Pick what you consider to be the more reasonable estimate from Part (b) and write down the value of e_0 for 2050 that matches it in the Coale-Demeny model.

c) The combined sex value of e_0 for the U.S. in 2010 was around 78 years. Drawing on your general knowledge, hazard a guess at the value of

e_0 that would be expected for 2050 if current trends continue. Is the value from the projection higher or lower than your rough guess based on current trends? List three factors that might come into play in the future to account for the difference between the value suggested by current trends and the value assumed by the projection.

d) One of the projections is the medium variant from the United Nations World Population Prospects edition of 2010. Is it X or Y? In one sentence, explain the reasons for your choice.

Table A. Alternate Projections of the Combined-Sex U.S. Population by age in millions.

Age	2045-X	2050-X	2045-Y	2050-Y
0	25.019	25.478	26.227	26.491
5	24.665	25.283	25.930	26.191
10	24.315	25.069	25.651	25.909
15	24.465	25.036	25.365	25.620
20	24.884	25.172	25.063	25.315
25	24.962	25.353	24.755	25.004
30	24.718	25.309	24.443	24.689
35	24.850	24.956	24.115	24.357
40	23.951	24.970	23.747	23.986
45	22.453	23.933	23.287	23.521
50	23.259	22.333	22.671	22.899
55	22.189	22.971	21.799	22.018
60	21.590	21.694	20.538	20.744
65	18.482	20.792	18.684	18.872
70	17.432	17.364	15.977	16.138
75	15.473	15.708	12.094	12.216
80	14.076	12.968	7.624	7.701
85	9.807	10.398	3.621	3.657
90	4.883	5.803	1.104	1.115
95	1.666	2.055	.168	.170
100	.316	.457	.026	.026

Table B. Coale and Demeny Model West Lifetable Relationships

CD Level	20	21	22	23	24	25
e_0	65.51	67.93	70.42	72.96	75.53	78.14
${}_1q_{30}$	0.002629	0.002034	0.001478	0.00099	0.000587	0.000290

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Field Examination in Economic Demography

A Collection of Useful Formulas

Growth Rate: $R = (1/T)\log(K(T)/K(0))$

Exponential Growth: $K(t+n) = K(t)e^{Rt}$

Survival from hazards: $l_{x+n} = l(x)e^{-h_x\ n}$

Gompertz Model: $h(x) = \alpha e^{\beta x}$; $l_x = \exp\left((-\alpha/\beta)(e^{\beta x} - 1)\right)$

Period Lifetable: ${}_nq_x = \dfrac{(n)({}_nM_x)}{1 + (n - {}_na_x)({}_nM_x)}$

Age Specific Death Rate: ${}_nM_x = {}_nD_x \,/\, {}_nK_x$

First Age Factor: ${}_1a_0 = 0.07 + 1.7({}_1M_0)$.

Second Age Factor: ${}_4a_1 = 1.5$

Survivorship: $l_{x+n} = l_x(1 - {}_nq_x) = l_x - {}_nd_x$

Person-Years Lived: ${}_nL_x = (n)(l_{x+n}) + ({}_na_x)({}_nd_x)$

Lifetable death rate: ${}_nm_x = {}_nd_x/{}_nL_x$

Expectation of Life: $e_x = T_x/l_x$

Brass's Logit System: $l_x = \dfrac{1}{1+\exp(-2\alpha - 2\beta Y_x)}$

Leslie Matrix Top Row: $\dfrac{{}_nL_0}{2l_0}\left({}_nF_x + {}_nF_{x+n}\dfrac{{}_nL_{x+n}}{{}_nL_x}\right) f_{fab}$

Leslie Matrix Subdiagonal: $\dfrac{{}_nL_{x+n}}{{}_nL_x}$

Lotka's Equation: $1 = \sum (1/2)\left({}_nF_x {}_nL_x + {}_nF_{x+n} {}_nL_{x+n}\right)(f_{fab}/l_0)e^{-r(x+n)}$

Stable Age Pyramid : ${}_nK_x^{stable} = B({}_nL_x)\, e^{-rx}$

Lotka's Parameter: $r \approx \log(NRR)/\mu$