1. In a developing country with limited demographic data on a national level, one local district has been monitored by a demographic program including periodic household enumerations and vital registration extending over several decades. A 1988 enumeration indicated a total population of 25,772 in the district. A 2003 enumeration indicated 33,258, including 1,244 under the age of 1 year.

a) What was the growth rate $R$ for this district between 1988 and 2003?

b) There were 128 infant deaths recorded in the district in 2003. Calculate the value of the period lifetable probability of dying $1q_0$. Government statistics assert that a proportion $\ell_5 = 0.85$ of all children survive to the age of 5. If yearly probabilities of dying were constant between the ages of 1 and 5, how low would this yearly probability have to be for the government’s claim to be true?

c) The population of the district is composed primarily of two ethnic groups, with very different levels of fertility and migration. Group A has been declining in the district at a rate of $R = -0.020$ per year since 2003, due both to comparatively low fertility and to migration out of the district, mainly to a relatively distant provincial capital. Group B has very high fertility and little migration out of the district, and its numbers in the district have been increasing at the dramatic rate of $R = +0.040$ since 2003. The sizes of the
two groups were about equal in 2003. If the growth rates of the two groups persist until 2010, what total population would you predict in 2010 in the district? What proportion of this total would consist in members of Group B?

d) Taking into account the differing growth of the two groups, what growth rate would you estimate for the whole population between 2003 and 2010? How does this rate compare with the less sophisticated rate assumed in Part “a”?

e) In a thought experiment, we imagine the growth rates for the two ethnic groups persisting forever into the future. In this imaginary setting, what would be the shortest doubling time for the district population that would ever occur?

A Selection 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: \( nq_x = \frac{(n)(nM_x)}{1 + (n - n_a_x)(nM_x)} \)

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: \( l_{x+n} = l_x (1 - n q_x) = l_x - n d_x \)

Person-Years Lived: \( nL_x = (n) (l_{x+n}) + (n a_x) (n d_x) \)

Lifetable death rate: \( n m_x = n d_x / n L_x \)

Expectation of Life: \( e_x = T_x / l_x \)

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

Leslie Matrix Top Row: \( \frac{nL_0}{2l_0} \left( n F_x + n F_{x+n} \frac{n L_{x+n}}{n L_x} \right) f_{fab} \)

Leslie Matrix Subdiagonal: \( \frac{n L_{x+n}}{n L_x} \)

Lotka’s Equation: \( 1 = \sum (1/2) (n F_{x+n} L_x + n F_{x+nn} L_{x+n}) (f_{fab}/l_0) e^{-r(x+n)} \)

Stable Age Pyramid: \( n K^{stable}_x = B(n L_x) e^{-rx} \)

Lotka’s Parameter: \( r \approx \log(NRR)/\mu \)
2. (25) This question concerns sex bias in familial behavior:
   a) (8) Becker’s economic theory of fertility does not distinguish between male and female children. Discuss how you might introduce male and female children into his Quantity-Quality theory. You do not need to write down a mathematical model, but you should discuss any issues that arise and possible implications of your two-sex analysis for sex biased fertility, sex biased investments per child, and the effects on these of income.
   b) (8) We know from many studies that in some cultures, there is a sex bias in fertility. Does this sex bias carry over to a bias in investment in the human capital of male and female children? Describe an empirical analysis you could do to investigate this question.
   c) (9) Drawing on the theory of marriage, discuss the later consequences for female well being and other outcomes, including female labor force participation, of male-biased sex selection and investment.

3. (25) In a recent article, Borjas claims that analysis of the effects of immigration on the wages of domestic workers is best carried out at the national level rather than at the level of local labor markets. Explain the basis for this claim, and sketch his strategy for the national analysis. What is Card’s view about whether analysis of local labor markets is helpful in this regard, and what evidence does he present in support of his view?

4. (25) Below are listed three papers on different aspects of the relation of population change to economic development (Acemoglu and Johnson, Bloom et al, and Miller). Each attempts to draw causal conclusions from empirical analysis. Explain the problems of endogeneity that arise in each of these three analyses, and the identification strategy employed in each case. Which of the three papers did you find most and least convincing, and why?


For your reference, here is a list of readings covered by the field exam:

**Background**


**Economics of Marriage and Divorce**


(##)Stevenson Betsey, Justin Wolfers (2007) “Marriage and Divorce: Changes and their Driving Forces” *Journal of Economic Perspectives* v.21 n.2 Spring pp.27-52


(##)#Grossbard, Shoshana and Catalina Amuedo-Dorantes (2007) “Cohort-level sex ratio effects on women’s labor force participation” *Review of Economics of the Household*, v.5 n.3 (September), pp.249-278. (May need to get hardcopy from me; not sure.) [ ]

#DAN ARIELY, GUENTER J. HITSCH, ALI HORTACSU (2008) "Matching and Sorting in Online Dating" Working Paper. (bSpace) [ ]


#NGUYEN VI CAO, EMMANUEL FRAGNIERE, JACQUES-ANTOINE GAUTHIER, MARLÈNE SAPIN, ERIC WIDMER (2008) "Optimizing the Marriage Market Through the Reallocation of Partners: An Application of the Linear Assignment Model", Working Paper. (bSpace) [ ]

**Economics of Fertility**


- [AreChildrenNormal.pdf](#) (Kelvin)
- [TertiltEcHistOfUSFert.pdf](#) (Kelvin)
- [BillariFertAndPensions.pdf](#) (Kelvin)
- [FLFP_by_age_of_young_child.pdf](#) (probably less interesting than others)
- [HowParentsAllocateTime.pdf](#) (Alma)
- [MorettiDemandForSons.pdf](#) (Emily)
- [OsterHepBAndMaleSexRatio.pdf](#) — retraction of an earlier argument made by Emily Oster on causes of sex ratio imbalance in China


# DAN ARIELY, GUENTER J. HITSCH, ALI HORTACSU (2008) "Matching and Sorting in Online Dating" Working Paper. (bSpace) [ Aaron ]

# NGUYEN VI CAO, EMMANUEL FRAGNIERE, JACQUES-ANTOINE GAUTHIER, MARLÈNE SAPIN, ERIC WIDMER (2008) "Optimizing the Marriage Market Through the Reallocation of Partners: An Application of the Linear Assignment Model", Working Paper. (bSpace) [ Kirsten ]


** Causal Analysis in Economic Demography


These next two on causality and natural experiments are optional. No need even to skim unless you want to.


This next one you should skim to get the basic idea.


**Health and Mortality**


“A Dynamic Model of Birth Weight” by Emilia Del Bono, John Ermisch, And Marco Francesconi, IZA Discussion Paper No. 3704 (September 2008). 


**Age Composition, Family Life Cycle, and Intergenerational Transfers**

* A.V. Chayanov, *The Theory of Peasant Economy*, Daniel Thorner et al translators, (University of Wisconsin Press, 1986; originally 1925); pp. 53-60 and bottom 76-81.


The following two articles are optional; not required even to skim.


*Ron Lee “Some notes on modeling the interface of demography and macro-economics”, on bSpace as PopEconMath. 5 pages.

*Paul Samuelson (1958) "An Exact Consumption-Loan Model of Interest With or Without the Social Contrivance of Money,” *Journal of Political Economy* v.66 n.6 pp.467-482.


**Immigration**


**Population and Economic Development (with introductions to many of the readings)**


D. Human capital


**Biology and Economic Demography**


**“Improvements and Future Challenges in the Field of Genetically Sensitive Sample Designs”, Frank M. Spinath November 2008. (GenesAndEconomics on bSpace)**

Ronald Lee "Rethinking the Evolutionary Theory of Aging: Transfers, not Births, Shape Senescence in Social Species," Proceedings of the National Academy of Sciences v.100, n.16 (August 5, 2003), pp.9637-9642. (LeePNAS03 in bSpace).