Problem Set 7: Solutions

Demography Camp

Summer 2013

Question 1

Calculate the following measures of fertility for the US in 2007:

• CBR: 0.0143 births per person year

• GFR: 0.0518 births per person year

• TFR: 2.1304 births per woman

• GRR: 1.0408 daughters per woman

Question 2

NRR: 1.0253 daughters per woman

In the long run, in the absence of migration, the US population will grow since the NRR>1 $\,$

Question 3

 $\bar{m} = 27.89$

Question 4

We have NRR = 1.03 and GRR = 1.04, and we know that $NRR \approx GRR * \cdot p(\bar{m})$ so this implies that $p(\bar{m}) \approx 1.03/1.04 = 0.985$

From Toms notes and our discussion in class, we know that the TFR when fertility is at replacement is:

replacement
$$TFR \approx \left(\frac{NRR}{p(\bar{m})}\right) \cdot \frac{B_m + B_f}{B_f}$$

At replacement, NRR=1 by definition. substituting this in, and also use our estimate of $p(\bar{m})$, this becomes:

$$\frac{1}{0.985} \cdot \frac{B_m + B_f}{B_f}$$

Finally, we are given that the sex ratio at birth is 1.047 males per female, so that we have:

$$\frac{1}{0.985} \cdot (SRB + 1) = \frac{1}{0.985} \cdot 2.047 = 2.08$$

AGE Female Pop Births nLx ASFR ASMR ASMR*nLx midpoint age * ASFR 10-14 9,903,611 6,218 495972 0.0006 0.0003 152.1236 12.5 0.00785 15-19 10,455,025 445,045 495397 0.0426 0.0208 10301.8300 17.5 0.74493 20-24 10,152,233 1,082,837 494279 0.1067 0.0577 28429.4105 27.5 3.24628 25-29 10,237,510 1,208,504 491412 0.11004 0.0490 24097.8279 32.5 3.24628 36-39 10,496,803 499,916 489247 0.0047 0.0233 11382.8318 37.5 1.78596 40-44 11,008,892 105,071 485887 0.0095 0.00047 2265.4615 0.4056 0.0406 0.0003 149.3333 47.5 0.03021									
Female Pop Births nLx ASFR ASMR*nLx midp 9,903,611 6,218 495972 0.0006 0.0003 152.1236 midp 10,455,025 445,045 495397 0.0426 0.0208 10301.8300 10,152,233 1,082,837 494279 0.1067 0.0521 25754.6604 10,237,510 1,208,504 492983 0.1180 0.0577 28429.4105 9,585,304 962,179 491412 0.1004 0.0490 24097.8279 10,496,803 499,916 489247 0.0476 0.0233 11382.8318 11,008,892 105,071 485887 0.0095 0.0047 2265.4615 11,555,604 7,349 480661 0.0006 0.0003 149.3333	${ m age} ~* { m ASFR}$	0.00785	0.74493	2.39985	3.24628	3.26237	1.78596	0.40563	0.03021
Female Pop Births nLx ASFR ASMR 9,903,611 6,218 495972 0.0006 0.0003 10,455,025 445,045 495397 0.0426 0.0208 10,152,233 1,082,837 494279 0.1067 0.0521 10,237,510 1,208,504 492983 0.1180 0.0577 9,585,304 962,179 491412 0.1004 0.0490 10,496,803 499,916 489247 0.0047 0.0047 11,008,892 105,071 485887 0.0095 0.0047 11,555,604 7,349 480661 0.0006 0.0003	midpoint	12.5	17.5	22.5	27.5	32.5	37.5	42.5	47.5
Female Pop Births nLx ASFR 9,903,611 6,218 495972 0.0006 10,455,025 445,045 495397 0.0426 10,152,233 1,082,837 494279 0.1067 10,237,510 1,208,504 492983 0.1180 9,585,304 962,179 491412 0.1004 10,496,803 499,916 489247 0.0476 11,008,892 105,071 485887 0.0095 11,555,604 7,349 480661 0.0006	ASMR*nLx	152.1236	10301.8300	25754.6604	28429.4105	24097.8279	11382.8318	2265.4615	149.3333
Female Pop Births nLx 9,903,611 6,218 495972 10,455,025 445,045 495397 10,152,233 1,082,837 494279 10,237,510 1,208,504 492983 9,585,304 962,179 491412 10,496,803 499,916 489247 11,008,892 105,071 485887 11,555,604 7,349 480661	ASMR	0.0003	0.0208	0.0521	0.0577	0.0490	0.0233	0.0047	0.0003
Female Pop Births 9,903,611 6,218 4 10,455,025 445,045 4 10,152,233 1,082,837 4 10,237,510 1,208,504 4 9,585,304 962,179 4 10,496,803 499,916 4 11,008,892 105,071 4 11,555,604 7,349 4	ASFR	0.0006	0.0426	0.1067	0.1180	0.1004	0.0476	0.0095	0.0006
Female Pop 9,903,611 10,455,025 10,152,233 1,0 10,237,510 9,585,304 10,496,803 11,008,892 11,555,604	nLx	495972	495397	494279	492983	491412	489247	485887	480661
	Births	6,218	445,045	1,082,837	1,208,504	962,179	499,916	105,071	7,349
AGE 10-14 15-19 20-24 25-29 30-34 35-39 40-44		9,903,611	10,455,025	10,152,233	10,237,510	9,585,304	10,496,803	11,008,892	11,555,604
	AGE	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49

Question 5

This simply means that $p(\bar{m}) = 1$, so our result in this case is 2.047.

Question 6

The NRR is a function only of the fertility and mortality schedules of a population; in particular, it is not a function of a population's current age distribution. It tells us about the long term growth or decline of a population, that is, what will happen once fertility and mortality rates have been constant for a long time and a stable age structure has been achieved. On the other hand, CBR and CDR are functions of the fertility schedule and the observed population age distribution (CBR) and the mortality schedule and the observed population age distribution (CDR). So there is no contradiction in seeing results that imply different things about population growth for NRR and natural increase if the population's current age structure is different from the stable age structure its rates imply.