Problem Set 8: Solutions

Demography Camp

Summer 2013

Turn in answers electronically to kbietsch@princeton.edu or in my mailbox by 9AM Monday.

1 Make sure all age groups are the same length

Here, we have 0-5 seperated into 0-1 and 1-4, so we need to combine them before we can project.

Table 1: Age Specific Mortality Rates, Maternity Rates, and Population

	${}_nL_x$	${}_nm_x$	Pop 2010
0	490536	0	5000
5	463893	0	10000
10	437865	0.002	11000
15	413390	0.007	12000
20	386813	0.012	11000
25	358558	0.123	12000
30	322630	0.444	10000
35	258108	0	9000
40	186055	0	8000
45	78000	0	4000

2 Steps for Projecting a Single Sex Closed Population

1. Calculate survivorship
2. Calculate survivorship for the last age group
3. Project current population forward (for survivorship)
    - Special consideration for open ended age interval
4. Calculate the number of female births
5. Survive the female births to the end of the interval

2.1 Survivorship

Calculate survivorship:

$$ {}_5N_x^F(t+5) = {}_5N_{x-5}^F(t) \cdot \frac{{}_5L_x}{{}_5L_{x-5}} $$

Calculate survivorship for the last age group:

$$ {}_\infty N_x^F(t+5) = \left[{}_5N_{x-5}^F(t) + {}_\infty N_x^F(t) \right] \frac{T_x}{T_{x-5}} $$

Table 2: Survivorship

Age	Survivorship
0	
5	0.9456859
10	0.9438922
15	0.9441038
20	0.9357096
25	0.9269544
30	0.8997986
35	0.8000124
40	0.7208416
45	0.295393

2.2 Reproduction

Calculate the number of births (we have data only for female births):

$$ B\left[t, t+5\right] = \sum_{x=\alpha}^{\beta-5} {}_5m_x \cdot 5 \cdot \left[\frac{{}_5N_x^F(t) + {}_5N_x^F(t+5)}{2} \right] $$

Table 3: Births by Age of the Mother

Age	Births
0	
5	0
10	102.1946
15	391.74
20	666.8555
25	6825.423
30	23085.32
35	0
40	0
45	0

Total Births= 31071.532

Survive the female births to the end of the interval:

$$ {}_5N_0^F(t+5) = B^F\left[t, t+5\right] \cdot \frac{{}_5L_0}{5 \cdot l_0} $$

Popululation under 5 = 30483.41

3 Conclusions

Table 4: Population 2015

Age	Pop 2015
0	30483.41
5	4728.43
10	9438.923
15	10385.14
20	11228.52
25	10196.5
30	10797.58
35	8000.124
40	6487.575
45	3544.716

Total Female Population 2010: 92000

Total Female Population 2015: 105290.92

Population Growth:$P15 = P10 \cdot e^{r \cdot 5}$
r= 2.7% per year