DEMG 6090

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PSET6

Problem 1

See the spreadsheet for numbers and calculations. Intrinsic growth rate (after three iterations):

$$r_3 = -0,00753202540$$

Problem 2

Mean length of generation in the Russian female population in 2010-14, i.e. the number of years required for the population to grow (at the intrinsic growth rate) by the factor equal to the net reproduction rate.

$$NRR = e^{rT}$$

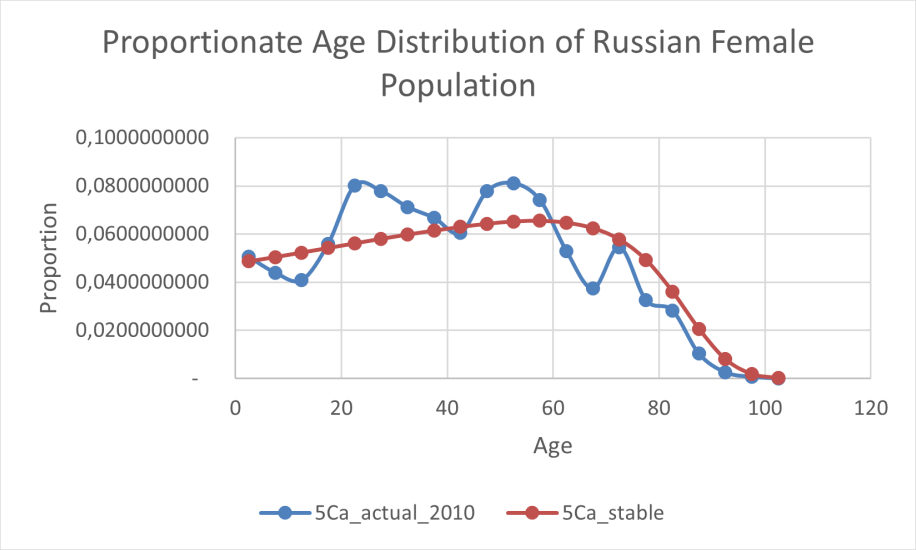
$$T = \frac{ln(NRR)}{r}$$

From the spreadsheet calculations, we have:

$$NRR = 0,810045681$$

$$r_3 = -0,00753202540$$

$$T = 27,96918831330$$



Problem 3

Intrinsic Birth Rate

$$b = 0,00962063$$

Problem 4

Intrinsic death rate = intrinsic birth rate - intrinsic growth rate.

$$d = 0,017152655$$

More laboriously, ${}_nD_x$ could have been used to calculate p(a) and m(a)

Problem 5

Recall the equation of the stable population:

$${}_5C_a^{stable} = be^{-r(a+2,5)}\frac{{}_5L_a}{l_0}$$

where

$$b = \frac{1}{\sum_{a=0;5}^{+\infty}[e^{-r(a+2,5)\,\frac{5L_a}{l_0}}]}$$

If the growth rate were 0, this would be a stationary population. We see, replacing r with 0, that we get:

$$b = \frac{1}{\sum_{a=0;5}^{+\infty}[1 * \frac{5L_a}{l_0}]} = \frac{100L_0}{l_0}$$

so

$${}_5C_a^{stable} = \frac{100L_0}{l_0} * 1 * \frac{5L_a}{l_0} = \frac{5L_a}{100L_0} = \frac{5L_a}{T_0}$$

Therefore, the proportionality factor is T_0 and the age distribution is called the stationary population.

Problem 6

Maternity rates were calculated as follows:

$$m(a) = \frac{b_{female}}{PY_{actual}}$$

To achieve a stationary population, $r_0 = 0$. Therefore, setting $r_0 = 0$,

$$ln(NRR) = 0$$

$$NRR = 1$$

$$NRR = \sum_{a=15;5}^{45}[{}_5L_a * {}_5m_a] = 1$$

Hence, we have: