Life insurance models

List 4.

1. On the basis of the life table available on my web side evaluate the probability that (20) will
   a) live to 100
   b) die before 70
   c) die in the tenth decade of life.
2. Using the life table illustrate graphically $s(x)$ for $x \in [10, 90]$.
3. Complete the entries below

	Uniform distribution of death	**Constant force of mortality**	**Balducci assumption**
${}_tq_x$			
${}_tp_x$			
μ_{x+t}			

   where $x \in N$ and $t \in [0, 1]$
4. Under the assumption that deaths are uniformly distributed within each year of age express $\overset{\circ}{e}_{x+u}$ as a function of $\overset{\circ}{e}_x$ and q_x, where $x \in \mathbb{N}$ and $u \in (0, 1)$.
5. If $q_{80} = 0.05481$ and $q_{81} = 0.05931$, calculate that (80) will die between ages $80\frac{1}{3}$ and $81\frac{1}{2}$ under the assumption that deaths are uniformly distributed within each year of age. Calculate the same under Balducci assumption.
6. Calculate that (35) will die between 36 years and 4 months and 37 years and 8 months under the Balducci assumption for each year of age. We assume
$$q_{35} = 0.003 \quad q_{36} = 0.006 \quad q_{37} = 0.009.$$
   Moreover, we take 1 month is equal to $\frac{1}{12}$ of year.
7. We consider population of people born on the first of January. For some $x \in N$ the probability of death within one year $q_x = 0.6$. Under the assumption that one year has 365 days determine day of year for that probability of death ${}_uq_x$, $u \in [0, 1)$ calculated under the Balducci assumption is equal to ${}_up_x$ calculated under the uniform distribution of death within the year x.
8. Under the uniform distribution of death calculate $\overset{\circ}{e}_x$ if $p_x = 0.9$ and $\overset{\circ}{e}_{x+1}= 35.2$.
9. For (x) we have the following probabilities:
$$q_x = 0.1, \quad q_{x+1} = 0.2, \quad q_{x+2} = 0.3.$$
   Under the uniform distribution of death during one year calculate the expected value of the future lifetime that (x) survives in three years period.

10. Show that under assumption of constant force of mortality we have for $x \in N$:

$$\overset{\circ}{e}_x = \sum_{k=0}^{\infty} \frac{{}_kp_x q_{x+k}}{\mu_{x+k+0.5}},$$

where $\mu_{n+k+0.5}$ is a force of mortality in the period $(x+k, x+k+1)$.

11. Let us assume that for some age $x \in N$ we have:

$${}_3p_x = 0.83904,\ {}_2p_{x+0.5} = 0.893388,\ p_{x+1} = 0.95.$$

Calculate p_x and p_{x+2} under the assumtion of uniform distribution of deaths during one year.