STT 456 Review Problems for Class Test 1
February 25, 2015

1. An insurance company sells 1,000 fully discrete whole life insurance contracts of \$1, each to the same age 50. You are given:

   - All contracts have independent future lifetimes.
   - There are no expenses.
   - Mortality follows the `Standard Ultimate Survival Model` with $i = 5\%$.

   Using the Normal approximation, calculate the annual contract premium, for each policy, according to the portfolio percentile premium principle so that the company has at least a 95% probability of a positive gain from this portfolio of contracts.

2. For a special whole life insurance on (45), you are given:

   - Benefit is paid at the end of the year of death. The death benefit is \$100,000 for the first 20 years and reduces to \$50,000 thereafter.
   - The annual benefit premium of \$4,945 is payable once at the beginning of each year for the first 20 years only; no premiums are payable after 20 years.
   - The following actuarial present values:

x	A_x	$\ddot{a}_x$	${}_{10}E_x$
55	0.5628	4.8091	0.0758
65	0.7532	2.7147	0.0015

   Calculate the benefit reserve at the end of 10 years.

3. For a fully discrete whole life insurance of \$1,000 on (x), you are given:

   - The expense, incurred at the beginning of each year, is 10% of the annual benefit premium.
   - The gross premium reserve at the end of policy year k is 602.45.
   - The gross premium reserve at the end of policy year $k + 1$ is 629.72.
   - $A_x = 0.6135$
   - $i = 5\%$

   Calculate q_{x+k}.

4. An insurer issued 400,000 fully discrete whole life insurance policies to lives all exactly age 50 on January 1, 2002. Each policy issued has a death benefit of \$100,000 with an annual gross premium of \$2,600.

   You are given:

- The following values in Year 2011:

	anticipated	actual
Expenses as a percent of premium	0.05	0.06
Annual effective rate of interest	0.02	0.05
q_{59}	0.0085	0.0090

- The gross premium reserves per policy at the end of Year 2010 and Year 2011, respectively, are:
$$ {}_9V = 2,044.32 \quad \text{and} \quad {}_{10}V = 2,324.13 $$
- A total of 385,100 remain in force at the beginning of Year 2011.
- Gains and losses are calculated in the following order: interest then expenses then mortality.

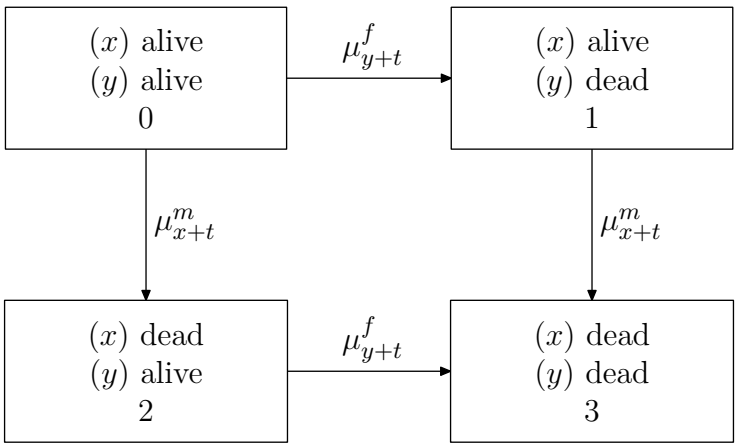
Calculate the total gain (or loss) due to interest for this portfolio of policies in Year 2011.

5. For a life insurance policy issued to (x), you are given:

- Death benefit of \$1 is paid at the end of the year of death.
- The benefit premium in year 11, payable at the beginning of the year, is \$0.045.
- There are no expenses for this policy.
- The policy is still active after 10 years.
- Deaths are assumed to be uniformly distributed over integral ages.
- ${}_{10}V = 0.325$
- $p_{x+10} = 0.925$
- $i = 6\%$

Calculate ${}_{10.4}V$.

6. The joint lifetime of a husband (x) and a wife (y) is being modeled as:



You are given:

$\mu^m_{x+t} = 0.03$, for all $t > 0$

and

$\mu^f_{y+t} = 0.02$, for all $t > 0$

Calculate the probability that (x) and (y), given both are alive today, will be dead within the next 10 years.