1. Find the following present values as of January 1, 2010 assuming an effective rate of interest of 6%. Assume all payments at beginning of period, unless otherwise specified:
   a. $6000 paid annually for 15 years beginning with January 1, 2010.
   b. $500 paid monthly for 180 months commencing January 1, 2010.
   c. $600 paid monthly for 120 months (January 1, 2010 to December 1, 2019) and $300 paid monthly for the next 60 months (January 1, 2020 to December 1, 2024)
   d. A bond that pays $5000 coupons on June 30 and December 31 of each year, and returns $200,000 on maturity date of January 1, 2021.

2. Use the GAM94 male mortality table and an interest rate of 7% to find the following actuarial present values, assuming all annuities are paid monthly at the beginning of each month and all insurances are paid at the moment of death:
   a. A straight life annuity of $900 per month payable to an individual age 62.
   b. A deferred life annuity of $800 per month commencing at age 65 for an individual currently age 45.
   c. A temporary life annuity of $2000 per month payable to an individual age 53 for at most 12 more years.
   d. A straight life annuity of $500 per month payable to an individual age 60 and paid for the greater of life or 120 payments.
   e. A $250,000 whole life policy issued to an individual age 54.
   f. A $300,000 10 year term life policy issued to an individual age 55.
   g. A $500,000 5 year term life policy issued to age 37 that pays double if death is due to an accident (assume that 40% of deaths in the age range 37 to 42 are due to accidents.)
   h. A straight life annuity of $2000 per month payable to an individual age 57 that increases to $4000 per month at age 65. If death occurs before age 65, the beneficiary will receive an immediate lump sum of $20,000.

3. An employee age 60 quits employment and is entitled to a monthly life annuity commencing at age 65 of $3000 per month. Alternatively, the plan allows the employee to start payments immediately with a reduction in monthly pension of 6% per year of the amount payable at age 65, which means the pension payable at age 60 is $2100 per month.
   a. Find the present value of each option available (age 65 or age 60) to the employee assuming a 7% interest rate and GAM94 female mortality. Which benefit has a higher present value?
   b. If an employee defers benefit commencement past age 65, the plan allows an actuarially equivalent benefit equal to the present value of the age 65 benefit to be paid instead. Calculate the actuarially equivalent monthly benefit if the employee starts pension payments at age 70. (Note: benefits are “actuarially equivalent” if they have the same present value.)
4. Assume mortality follows a uniform distribution on the interval (0,120).

   a. Find the net single premium for a whole life policy of $20,000 payable at the moment of death to an individual age 40, assuming the force of interest is 6%

   b. Find the net single premium for a 20 year term life policy of $10,000 payable at the moment of death to an individual age 50, assuming the force of interest is 8%

   c. Find the variance for the insurance described in part a.

   d. Suppose the insurance company has 500 identical and independent policies as described in part a, and invests the premiums in a single fund. Find the gross premium that would be make the insurance 95% certain of having adequate reserves in this pool to pay claims.

   e. Find the net single premium for a whole life policy of $b(t)=200e^{.04t}$ payable at the moment of death to an individual age 40, assuming the force of interest is 6% and $t$ is years after age 40 when death occurs.

5. An executive currently age 60 has a golden parachute/handcuffs plan that will pay a life annuity of $7000 per month commencing at age 65 assuming the executive does not terminate employment or die before age 65. The actuary uses the following absolute rates of decrement:

<table>
<thead>
<tr>
<th>Age</th>
<th>Absolute Mortality rate</th>
<th>Absolute Withdrawal Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>60</td>
<td>.009</td>
<td>.09</td>
</tr>
<tr>
<td>61</td>
<td>.010</td>
<td>.07</td>
</tr>
<tr>
<td>62</td>
<td>.011</td>
<td>.05</td>
</tr>
<tr>
<td>63</td>
<td>.012</td>
<td>.03</td>
</tr>
<tr>
<td>64</td>
<td>.014</td>
<td>.01</td>
</tr>
</tbody>
</table>

Also, the actuary is using an interest rate of 8% assumption and $\ddot{a}_{65}^{(12)} = 9.6$.

   a. What is the probability that the executive will work until age 65?

   b. Find the present value of this benefit.

6. A male age 63 is participating in a retirement plan with the following benefits and actuarial assumptions:

   - Retirement: Monthly life annuity of $3000 at age 64 or $3300 at age 65.
   - Disability: Life annuity of $4000 per month commencing immediately.
   - Death: An immediate single payment of $300,000. For simplicity, assume payment occurs in the middle of year.
   - Withdrawal: Deferred to age 65 life annuity of $1500 per month.

   \[
   \begin{array}{|c|c|c|c|}
   \hline
   & \text{Age 63} & \text{Age 64} & \text{Age 65} \\
   \hline
   \text{Death} & .015 & .020 & \text{n/a} \\
   \text{Disability} & .040 & .050 & \text{n/a} \\
   \text{Withdrawal} & .100 & .000 & \text{n/a} \\
   \text{Retirement} & .000 & .500 & 1.000 \\
   \ddot{a}_{x}^{(12)} - \text{retirement} & \text{n/a} & 10.300 & 10.000 \\
   \ddot{a}_{x}^{(12)} - \text{disabled} & 7.000 & 6.900 & \text{n/a} \\
   \ddot{a}_{x}^{(12)} - \text{withdrawal} & 8.500 & \text{n/a} & \text{n/a} \\
   \hline
   \end{array}
   \]

   Interest rate is 7%

Determine the present value of all possible benefits rounded to the nearest $100.