Use Excel for solving the following questions.

1. An insurer issues fully discrete 10-year term insurance of $\$1,000$ to a number of lives all aged (60). For each policy, you are given:

- G is the gross annual premium calculated using the pricing assumptions.
- ${}_tV$ is the gross premium reserve at time t calculated using the following pricing assumptions.:
  - $T_{60}\tilde{}Unif\ (0,20)$
  - Pre-contract expenses are \$50.
  - Annual expenses are \$10 plus 5% of each premium.
  - Profit loading is 3% of each premium.
  - $i = 10\%$
  - The actual premium per year will be exactly G, but the actual reserves at time t will be $1.5 \times {}_tV$.

(a) Calculate G and ${}_9V$.

(b) Estimate the profit per policy in the 10th year using 10 simulations, where 1 indicates Alive and 0 indicates Dead at each age. Hint: Use the "IF" function.

2. Suppose the force of mortality is given by the Gompertz function: $\mu_x = 0.0004 \times 1.09^x$.

- A person age 20, subject to the force of mortality above, buys a 10-year temporary assurance contract, with sum assured \$1payable immediately on death.
- The premium rate is payable continuously at rate \$0.003per annum.
- The force of interest is 0.05per annum.
- Using an a step size $h = 0.01$ years to solve Thiele′s differential equation,show that the policy value at outset,$V(0)$ is approximately \$0.0033.
- Explain why, in this case, $V(0) \neq 0$. By trying different values for the annual rate of premium, find the rate of premium that results in $V(0) = 0$.
- Plot the policy values over the 10 year contract.