An aggregate loss process $S(t) = X_1 + \ldots + X_{N(t)}$ is a compound Poisson process with an average number of claims per year $E[N(1)] = 50$. The individual claim random variable $X$ has the property that its associated per-loss excess loss variable $(X - d)_+$ has expected value $E[(X - d)_+] = 10,000 \left[90,000/(d + 90,000)\right]^{10}$ for any $d$.

A premium process $ct$, when combined with this aggregate loss process, results in an adjustment coefficient $R$ that satisfies the equation:

$$
\int_0^\infty e^{Rx}(0.00001)[90,000/(x + 90,000)]^{10} \, dx = 3.75
$$

The probability of ruin $\psi(u)$ with starting surplus $u$ can be expressed in a formula that involves the cumulative probability distribution function $F_V(u)$ for a random variable $V = K_1 + \ldots + K_M$ where $M$ is a random counting variable and the $K$'s are independent and identically distributed.

**Questions:**

1. What is the expected number of claims in 10 years?
2. What is the expected total claim amount in 20 years?
3. What is the distribution for the random variable $M$? Give both a formula (either for the probability function or for the cumulative probability distribution function) and a name for the distribution.
4. What is the distribution for the random variable $K$? Give both a formula (either for the probability density function or for the cumulative probability distribution function) and a name for the distribution.
5. If you approximate the distribution for $K$ by a discrete distribution with a 10,000 unit amount, and round all claim amounts to the nearest unit, what is the resulting approximate value for the probability of ruin $\psi(50,000)$ for an initial surplus of 50,000?
6. Using the same approximation, what is the expected value for the largest deficit from a starting surplus of 50,000 (i.e. largest negative value of $U(t) = ct + 50,000 - S(t)$) given that a deficit occurs?
7. What are the answers to 5 and 6 if the average number of claims per year is $E[N(1)] = 100$, with everything else staying the same?