1. Let $X_1$ and $X_2$ be independent binomial random variables where $X_1 \sim \text{Binomial}(n = 10, p = .2)$ and $X_2 \sim \text{Binomial}(n = 5, p = .2)$.
Find the conditional probability $P(X_1 = 2 \mid X_1 + X_2 = 3)$.

2. Suppose a door-to-door salesperson has probability .10 of successfully completing a sale at each house visited. What is the expected number of houses the salesperson must visit in order to complete 3 successful sales? (Assume the outcomes among all the houses visited are independent.)

3. Let $X$ denote the number of automobile accidents per week at intersection A and let $Y$ denote the number of automobile accidents per week at intersection B. If $X$ and $Y$ are independent Poisson random variables with respective means 3 and 5, calculate the conditional expected value of $X$ given that $X + Y = 10$.

4. The joint density of $X$ and $Y$ is given by $f(x, y) = \frac{1}{2} ye^{-xy} I_{(0, \infty)}(x) I_{(0, 2)}(y)$.
Find $E[e^{X/3} \mid Y = \frac{2}{3}]$.

5. An unbiased die is successively rolled. Let $X$ denote the number of rolls necessary to obtain a five, and let $Y$ denote the number of rolls necessary to obtain a six.
Find (a) $E[X]$, (b) $E[X \mid Y = 1]$, (c) $E[X \mid Y = 3]$.

6. Let $X$ have probability density function given by $f(x) = \frac{1}{2} e^{-x/2} I_{(0, \infty)}(x)$.
Find $E[X \mid X > 2]$.

7. Two players (A and B) alternate rolling a fair die. The first one to obtain a six is declared the winner. Find the probability that the first player to roll (Player A) is the winner.

8. Suppose that you successively roll a fair die until the sum of all throws exceeds $k$.
Let $N_k$ denote the number of rolls needed. Find $E[N_k]$ for $k = 1, 2, \text{ and } 3$.

9. Suppose $N$ is a Poisson random variable with mean $\lambda = 2$. Let $X_1, X_2, \ldots$ be independent and identically distributed Binomial($10, .5$) random variables. For $S = \sum_{i=1}^{N} X_i$, find $E(S)$ and $\text{Var}(S)$.