1. Let $X, Y, Z$ be independent $\text{Binomial}(2, \frac{1}{2})$ random variables.
   (a) What is the conditional PMF of $X$ conditioned on $X \neq Z$?
   (b) Are $X$ and $Y$ independent conditioned on $(X \neq Z)$ and $(Y \neq Z)$?

2. Alice and Bob decide to meet somewhere. Alice’s arrival time $A$ is uniform between 12:00 and 12:45. Bob’s arrival time $B$ is uniform between 12:15 and 1:00. Their arrival times are independent.
   (a) Let $f_{A-B}$ be the PDF of $A - B$. What is $f_{A-B}(0)$?
   (b) What is the probability that Bob arrives before Alice?

3. Let $Y = AX + B$ where $A, B, X$ are independent $\text{Normal}(0, 1)$ random variables.
   (a) What is $\text{Var}[E[Y|X]]$?
   (b) What is $E[\text{Var}[Y|X]]$?

4. Boys and girls arrive independently at a meeting point at a rate of one boy per minute and one girl per minute, respectively. Let $T$ be the first time at which both a boy and a girl have arrived.
   (a) Find the cumulative distribution function (CDF) of $T$.
   (b) What is the expected value of $T$? (Hint: You don’t have to use calculus.)

5. A deck of cards is divided into 26 pairs. Let $X$ be the number of those pairs in which both cards are of the same suit. (A deck of cards has 4 suits and each suit has 13 cards.)
   (a) What is the expected value of $X$?
   (b) What is the variance of $X$?