1. Suppose that a point \((X, Y)\) is chosen at random from the region bounded by the three lines \(x = 0, y = 1,\) and \(y = x.\)

   a) Draw a sketch of this region, and specify the joint pdf of \((X, Y).\)

   b) Determine the covariance between \(X\) and \(Y.\)

   c) Explain why the sign of the covariance makes sense.

   d) Determine the correlation coefficient between \(X\) and \(Y.\)

2. Let \(X\) and \(Y\) be two random variables, and let \(S = X + Y\) and \(D = X - Y.\) Derive an expression for \(\text{Cov}(S, D)\) in terms of expected values of \(X\) and \(Y,\) variances of \(X\) and \(Y,\) and the covariance between \(X\) and \(Y.\)  [*Hint: You may not need to use all of these quantities.*]

3. Reconsider the question from Exam 2 where the discrete random variable \(Y\) is the outcome of rolling a fair, six-sided die, and the conditional on \(Y = y,\) the continuous random variable \(X\) has a uniform distribution on the interval \((0, y).\)

   a) Give an expression for the conditional expectation of \(X\) given \(Y = y.\)

   b) Use the law of total probability for expectations to determine \(E(X).\)

   c) Determine \(\Pr[X \leq E(X)].\)

*Not to turn in:* Consider working on exercises 1-14 at the end of section 4.6 and exercises 2 and 6 at the end of section 4.7 in the text.