Section 2.2 Worksheet

1. What is the probability that 5 rolls of a fair die will yield two or three sixes?

2. In men's tennis, the winner is the first to win 3 (out of 5) sets. Suppose John Isner and Kevin Anderson are playing.

   (a) If John Isner has a $1/3$ chance of winning each set, what is the probability he wins the match?

   (b) What if Isner had a probability p chance of winning each set?

   (c) Suppose now we have players A and B playing a game. Player A has a probability p chance of winning each time. If A and B are playing best k out of $2k-1$, what is the probability that A wins?

3. Suppose a lottery ticket has probability p of being a winning ticket, independently of other tickets. A gambler buys 3 tickets, hoping that this will triple his chances of winning.
   (a) What is the distribution of how many of the 3 tickets are winning tickets?

   (b) Was the gambler's strategy a good one?

4. If $S_n = \text{binomial}(n, p)$, find $\text{var}(S_n)$.
   (Hint: Use the definition of expected value to determine the second moment, $ES_n^2 = E(S_n(S_n - 1) + S_n)$.)

Real World Example: The court case of *Castaneda v. Partida,* 430 U.S. 482 (1977) used binomial distributions to calculate the probability of grand jury compositions from populations with known racial and ethnic distributions. In this case, a local population was 79% Mexican American, but during a 2.5-year period, only 100 out of 220 grand jury members chosen identified as Mexican American. The claim was made that this was evidence of discrimination against Mexican Americans in grand jury selection. The court estimated, assuming grand jurors were drawn at random and independently from the local population, the probability that a binomial random variable X with parameters 200 and 0.79 would be 100 or less. How would you calculate this probability? It turns out to be very small: $\leq 10^{-25}$!

Discussion question: Is this evidence of discrimination? What is implying what here?