A. Introduction

1. Knowing how to count is one of the keys to being able to compute many of the probabilities in chapter 7. Remember that to count means to find the number of elements in a set, even in sets that are too large to explicitly write down each element. It is the large sets, such as the set of possible license plates or lottery picks) that drive the need for counting techniques. We have already seen that Venn diagrams may be applied to specific types of counting problems. However, other counting problems require more sophisticated techniques. Regardless of the counting technique applied,

   (a) A counting problem always asks “how many”
   (b) The answer is always found to be one of the whole numbers \{0, 1, 2, 3, \ldots\}

2. The Multiplication Principle of Counting states: If a task consists of a sequence of choices in which there are \(p\) selections for the first choice, \(q\) selections for the second choice, \(r\) selections for the third choice and so on, then the task of making these selections can be done in: \(p \cdot q \cdot r \cdot \ldots\) different ways. These selections can be depicted in a tree diagram (see pg. 332)

B. Examples:

1. If you have 4 coats and 2 hats, how many different coat and hat combinations can you make? \(4 \cdot 2 = 8\)

2. How many license plates can be made using 2 letters followed by 3 numbers? \(26 \cdot 26 \cdot 10 \cdot 10 \cdot 10 = 676,000\)

3. 8 runners race against each other. How many ways are there of awarding them the first-second and third place medals?
   (a) The first place can be won by any of the 8 runners
   (b) The second place can then be won by any of the 7 runners who did not win the first place medal
   (c) Third place can be won by any one of the remaining 6 runners.
   (d) Hence the number of possible ways of awarding the medals is \(8 \cdot 7 \cdot 6 = 336\)