**­­­­Exercise 1: Estimating probabilities using known distributions**

1. A box have 3 blue balls and 7 red balls. How many possible arrangements of these balls in a row exists?
2. You have the numbers: 1 1 2 2 2 3 4 5 6 7. How many different permutations exists?
3. A box have 3 red, 4 green and 5 blue balls.

(hint: use either the counting method or the multiplication rule method)

* 1. We select 6 balls **with** replacement. What is the probability we will have exactly 2 balls from each color?
  2. We select 6 balls **without** replacement. What is the probability we will have exactly 2 balls from each color?
  3. Verify a and b by running a simulation in matlab or python

1. The probability of a neuron to respond to a specific stimulus is 0.9 and it does not dependent on the previous responses. You run 10 trials.
   1. What is the probability that it will respond to the first 5 trials and not the last 5 trials?
   2. What is the probability that it will respond to exactly 3 trials?
   3. What is the probability that it will respond to at least 8 trials?

1. Researchers wanted to test if girl babies have a preference to a doll or a ball. They observed 7 girl babies and found that 5 preferred the dolls.
   1. How likely is that they obtained this result by chance? Can you claim that baby girls prefer dolls?
   2. What is missing in the design of this experiment?
2. The average number of goals in a world cup soccer game is 2.5. Compute the probability of observing 0,2,7 goals
3. You recorded a neuron and found that the number of spikes in one second in a 10 seconds interval are: x = [7 10 14 9 12 13 12 5 11 6]
4. Compute the mean spikes/sec and variance (use matlab or python functions)
5. Assuming this mean is the probability of the neuron to spike in one second. Compute the probability you will get a spike count that is two times higher or more than the mean in one second
6. Same as b but if you try 10 times
7. **Planning your experiment**

You are recording neural activity in a cortical brain region. This brain region is known to contain excitatory and inhibitory neurons randomly distributed in space. In the cortex, the number of excitatory neurons is 4 times than the inhibitory neurons. You record blindly the neural activity, that is, you don’t know the type of the recorded neurons. Note that each time you stick your electrode you might record the same neuron

1. Your recorded 100 neurons. How many neurons you expect to see from each type?
2. How many neurons must you record so that you will have at least one neuron from each type with probability of >0.95? (use matlab to estimate the number, it is not easy to solve the equation analytically)