1. Suppose a monkey types completely randomly at a rate of 1 key per second on a computer keyboard which only contains keys for the 25 letters of the English alphabet and a key for a space.

   (a) What is the probability that a monkey would type out the word "hamlet" after pressing just six keys?

   (b) How long would a monkey need to type on average before the word "hamlet" appeared as a consecutive string on the computer screen? Express you answer in years.

   (c) Repeat the above calculations for the phrase "to be or not to be". Compare your answer to the age of the universe at 14 billion years.

2. Suppose you have a box with 4 bins in which you can place balls. This question is about the information you need to determine the location of those balls depending on how many balls are added, and the way they are added. To answer the questions I recommend you draw diagrams and count the number of ways that you can arrange the balls that are added to the bins.

   (a) If a single ball is placed in a randomly chosen bin. How much information is needed in general to locate the ball?

   (b) If a second ball is place in the box in a randomly chosen bin, how much information is needed in general to locate both balls? Repeat this question for the cases when three and four balls are added in this way. What is the rule for n balls?

(c) Suppose now the balls are added at random in such a way that no two balls can be in the same bin. This means that no more than 4 balls can be added to the box. If two balls are added in this way, how much information is needed to locate both balls? Answer the same question for the case where three or four balls are added.

3. (a) How many four letter "words" can be made out of the letters S,T,O, and P, assuming the "word" doesn't have to mean anything and letters cannot be used more than once?

(b) If you were to choose such a word at random how many yes/no questions would your partner have to ask you to determine what your word was, on average? What if your partner knew you had restricted yourself to the six words that mean something in the English language?

4. Suppose you receive a randomly generated message S_1 containing n bits of information followed by a second generated message S_2 containing m bits of information. How many bits of information does the combined message have? Justify your answer by considering the total number of possible messages S_1, the total number of possible messages S_2 and the total number of possible combined messages.