Mini lecture:

Hello everyone, my name is joy

In tomorrow’s lecture, we will be talking about product rules and how to count number of ways to select from distinct objects.

Product rule helps you to count the number of outcomes in total. If there are a number of outcomes in the first trail, and b number of out comes in the second trail, the total number of possible outcomes from these two trails will be the product of a and b.

Take coin flip as an example, if we flip a single coin two times, the total number of outcomes will be four: double heads, double tails, one head one tail, and one tail one head. In the first trail, we will get two results, either head or tail. And for each of the head or tail result, we will be having two outcomes for the second trail. Drawing it as a diagram:

For product rules , a diagram like this always help us to analyze the situation.

So, now we have known how to count number of possible outcomes.

Another important thing will be taught tomorrow is to count number of ways to select from distinct objects.

For this topic, I have two related but separated concepts: permutation and combination

Permutation refers to counting number of ways to choose r objects out of n distinct objects, when the order of the r objects matters.

In other words, if we want to choose three objects from a bunch of distinct objects, choosing a, b, c and choosing b a c are counted as different ways

Combination is also a way of choosing r objects out of n distinct objects, however in this case, the order of r objects does not matter, which means choosing a, b, c and choosing b, a, c are the same way.

So how do we actually count number of results by permutation or combinations?

For permutation, suppose we are choosing r objects from n distinct objects, there will be n ways to choose the first objects, and there will be n-1 ways to choose the second objects, n-2 ways to choose the third, and so on.

Apply the product rule here, we will get the total number results will be n(n-1)(n-2)……(n-r+1),

Which is the same as n!/(n-r)!

For combination, we will have to eliminate all results that we think are the same. So after we have choosing r objects out of the n distinct objects, we no longer have to think about the order. This means that for each r objects we choose, they are only considered as one single result. The number of ways to linearly arrange r objects is r!, so to get the combination result, we will have to divide the result from permutation by r!.