Transcriber's Name Priya Prashanth

Applied Econometrics

Prof. Tutan Ahmed

Vinod Gupta School of Management

Indian Institute of Technology-Kharagpur

Lecture No. #06

Probability Theory (Contd.)

Now before I get into the frequentist approach of probability, let us actually look into some of the uh probability rules. (refer time: 00:37)

Now by probability rules what I mean is that how uh, under the condition of mutual exclusiveness, or under the condition of statistical independence or dependence, how we can actually uh see, the probabilities of two events or more than one event are actually related, okay. So let us say first is that under the condition of mutual exclusiveness exclusiveness.

So first, let us say there are two events A and B. And I want to take an union of A and B and I want to understand what is the probability of this. So by definition, it is probability of A plus probability of B minus probability of A intersection B. Now I am not going to explain these formula in detail.

In case you are not familiar with this formula, I would recommend that you look into the textbook of NG Das, so or even Levin's textbook, so they will kind of give you a clear idea how this formula has come. So when we have this formula with us, and let us say that these two under the when I am talking about the condition of mutual exclusiveness, and let me draw what I mean by mutual exclusiveness.

So let us say I have these two events A and B. And here I have A and here I have B. So when when they are mutually exclusive. So that means you know occurrence of A means non-occurrence of B, right? So when that is the case, then what I will have, what I will have is that A intersection B would essentially give me a null set okay, you have nothing.

And if that is the case, then your probability of A intersection B is going to give you a 0, right? So then this formula A will actually turn formula B, probability of A sorry, probability

of A union B, probability of A union B is going to be probability of A plus probability of B, okay. When? When you have I can write when A and B are mutually exclusive, when A and B are mutually exclusive.

Now mutual exclusiveness, this is one situation. You will always not you will always uh you may not always have mutual exclusive events, right? So from these, you can actually write down that probability of A union B is always greater than equal to probability of A plus probability of B, right? Because here you are subtracting this one, right? So these are the three major formula.

We can just keep in mind this, this and this, okay. So this is under the condition of mutual exclusivesness. Now let us say if under statistical independence. (refer time: 04:05)

Let us say under, so probability rule under statistical independence, alright? So here uh rule number 1 that you should remember if there, so they are basically statistically independent, okay. So when I have joint probability, let us say joint probability, probability of AB, so A into B. Basically you are multiplying A and B. What you will have is probability of A into probability of B.

Again I will not explain this in details. If you want to sort of understand where from it has come I would recommend, look at NG Das' textbook. And the second is, let us say I will write A here and B is uh when I have a conditional probability, and I will explain what is conditional probability is briefly. Conditional probability, probability of A given B is equal to probability of A.

Now before I actually uh try to explain this, let me explain what is conditional probability. Now conditional probability is defined as how things vary when one of the variable is the same. So here in this case, B is staying the same. And I am trying to understand how A varies. Now if my if my two uh events A and B, there are they are independent. So then it really does not matter whether B is constant or not.

So A will always remain A irrespective of what B is. And that is why for conditional probability, you will see probability of A given B. And that is how you always write that conditional probability is equal to probability of A, right? (refer time: 06:01)

So the last thing is probability rule, rule under statistical dependence, under statistical dependence. Now they are no longer independent. And the most important thing that we will

see here is that what will happen to the conditional probability? So the conditional probability, so the previously we wrote conditional probability, probability A given B was already of A when they are independent.

But when they are not independent, I write probability of A intersection B by probability of B, okay. And we will try to understand this with an example. Let us say let me give you an example. Let us say you have you are actually doing an audit okay with all the government officials and no offense to people who are from government services. Let us say you are actually doing an audit of the people who are government officials.

And you are actually trying to understand if people are corrupt or not okay. And let us say on my this I write corrupt C and not let me use a different color, uh corrupt as C, not corrupt as NC okay. And I am trying to understand now the we are kind of you know asking a question whether you actually see corruption more among male or among female. Let us say you have male and female, alright.

Now you actually you know got all the audit done and you got some number. Let us say the number you got, I do not know let us say female corrupt is 1 and here say female corrupt is 3 and not corrupt is 3. Whereas in male you got, I do not know like 2 and not corrupt is 4 okay. And this is the distribution you got. Now you I want to understand my research question is or what I want to know is I want to understand probability of corrupt given that the person is female.

So I want to understand if someone is female, what is the probability that that person is corrupt. So basically, that means if you want to get this information, this corrupt and female you have this information here. Now your you make female constant, so all the possible cases that we will consider is for the females. So essentially, the information that probability will be 1 in the numerator uh probability of A given B.

So probability of you can basically write corrupt intersection female. And your probability B is basically probability of female right? So essentially, what will what it means is that this is equal to 1, and this is equal to 1 + 3. So all the possible cases. So 1 by 4, okay. So this is how you understand uh conditional probability under statistical dependence. So these are the some of the probability rules that we need to sort of know to go to the next topic.

And with this, we kind of end our first lecture. And in the next lecture, we will talk about the frequentist approach. And also we will talk about the Bayesian probability. So with this, uh this, we end our second lecture of probability theory and classical approach to probability.

And in the next lecture, we are going to see frequentist approach and the Bayesian probability.