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Applied Econometrics

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Module No. # 02

Lecture No. # 15

Probability Distribution (Discrete/Continuous Variable) Random Variable

Hello and welcome back to the lecture on Applied Econometrics. So, we have been talking about probability distribution. We also learned double structure of variable. Now, in this lecture, we are going to talk about how the probability distribution is going to be different between a continuous variable and a discrete random variable. Okay. So, when whenever we are talking about a variable here, it means a random variable. Now, what do we mean by probability distribution?

We have been, you know, giving lots of examples of probability distribution, but what do we mean by probability distribution? So, by probability distribution, we have to remember few things. One is that, whenever I am talking ab in terms of probability, whenever I am talking in terms of uncertainty, whenever I am talking, you know, in terms of the future events, or whenever I am talking about things which I have not done yet, so, then I actually talk about a random variable. By now, we are clear about that, right? So, we are talking about a random variable.

(refer time: 01:15) Now, the random variable, it has different values, right? A random variable has different values, the events will have different values when you da, when you do a random experiment. So, the, all the different values along with their probabilities; for a random variable, all the different values of the random variable along with their probabilities constitute a probability distribution. Okay. So, for example, uh you know, you can talk about the coin tossing.

So, you have, you know, head, head, head, if you if you, you know, toss 2 coins, it is head, head; head, tail; tail, head; and tail tail. So, they have their all these different outcomes and with their corresponding probabilities, that will give us the probability distribution. Now, probability distribution, quite obviously, we have seen the ta types of uh random variable.

And now, we know that there are 2 types of random variables, discrete and continuous. So, for these 2 types of random variables, we have 2 different types of probability distribution.

So, one is that for discrete random variable. So, for discrete random variable, we are going to see how the probability distribution is going to be, or what are the characteristics that it has to have. So, one thing we said that the example of coin tossing is a is an example of probability distribution. And if basically, if I actually get the probabilities and the corresponding values or the different outcomes of the random variable, so, that actually will constitute the probability distribution for this particular uh random variable.

Now, when I actually try to sort of think about the properties that this (ran) thas that we will have for the (pro), you know, that we will have for the probability distribution of a discrete random variable, so, we can always write down few things. That first thing, it has to be a random variable. It has to be a random variable, because that is the first and foremost condition. Then, of course, in every event, it goes, you know, without saying, the probability of X has to be non-zero; you you can, uh has to be, sorry uh has to be uh more than more than, you know, it it could be 0 or more than 0; it can never be, it can never be less than 0, right?

Probability value is always greater than equal to 0. Right. Now, if I now try to represent, if I try to represent the discrete random variable in terms of the; let me write down here; in terms of the its probability, so, I will get probability of X is equal to x. So, that means, my random variable X is assuming a particular value x; we remember when we used capital X and a small x. So, when a capital X is assuming a particular value, small x; so, we can write it down as, let us say a functional form, with a functional form, okay?

Is equal to, let us say X is equal to x. Right. So, the function could be like the functions, function we explained when we talk about the female labour force participation, or the function, you know, it could simply be how we calculate the probability for the coin tossing, okay, or die throwing. So, anything could be a function. So, if that is the case and if we can explain the probability in terms of, you know, this uh uh this functional form, we can always write down that summation of (pro) summation of either probability X is equal to x, or you can also write down which is easy, nothing but summation of function of X X is equal to x.

That is going to be always 1, because we know that the sum total of all the probability values are going to give me a 1, right? Now, that is about the discrete random variable, the the probability distribution of a discrete random variable, and we are just going to come back to that with an example. uh But before that, let me actually talk about (refer time: 05:06) the probability distribution for continuous distribution uh continuous random variable, probability distribution for continuous random variable. Okay.

Now, when I talk about the probability distribution of continuous random variable, so, things are pretty similar with the probability distribution for a discrete random variable except in one aspect. And let me first write down the things which are similar. So, basically, it is also for a random variable, it has to be a random variable; and already I am specifying that; random variable. Second point about this is that the probability values has to be greater than equal to 0. Actually, I should not write this.

I will explain why I am writing only X and not X is equal to x here. Now, the third part, there is some difference, and that we have to understand where, you know, why the difference is coming and, you know, uh uh and how the, you know, the properties of a uh discrete random variable is different from the continuous random variable, and how that is actually impacting the probability distribution. Now, we have already seen this, that the major, the the main aspect where a discrete random variable and continuous random variable different are is that the fact that, in discrete, in in case of continuous random variable, you cannot really get a probability value for a (spec) probability for a specific value of the continuous random variable.

In the, the reason is that, you remember the example you are given; let us say we are talking about a temperature, right. The temperature could be like, if I talk about the temperature of Kharagpur, it could be within 20 to 40 degree Celsius. But, if, let us say today's temperature, I say it is 30. And you can say, you can always see that it could be a little higher, it could be a little lower, it could be have infinite number of values within 30 to 31 or 29 to 30. So, the thing is that, you can never have a specific probability value for a particular value of the X. Okay.

You can never have a probability for a particular value value of a X, it is always going to be 0. The reason is, there are infinite number of X's, right? So, the probability is going to be ex ex extremely, extremely small. So, if if I ask you, what is the probability if today's temperature in Kharagpur is 29.000001 degree Celsius, it is really, you know, it is it is basically 0; you cannot you cannot, I mean, assign a probability. Now, that is because of that reason, we always take the probability in terms of interval.

So, we always take uh the probability value for a interval of the value of the random variable. So, we do not say like we said here, we do not say probability X is equal to x, but rather, we say the value in an interval, okay. And the, that is how we write it. It is like, always probability of say; we write; let me write down here; probability of let us say a to b, okay, so, the probability of X uh in the range of a to b. And that, we can represent in a functional form.

And that is always, since we are talking about a interval, we always integrate, right, we we sort of integrate that, we sort of integrate that. Okay. So, that is the major difference. And if we sort of, now, if we know that this is how we represent the probability value for a, uh you know, continuous random variable, so, what we can do is, we can actually integrate from minus infinity to plus infinity. And if we integrate uh this f X dx, so, that is always going to give me a value of 1, because you are taking the values from minus infinity to plus infinity, okay.

And that is where you are actually; you know, if you do that, so, all sum total of the probability is going to give you a value of 1. So, that we know. And so, that is the only difference that we have between uh these 2 uh kind of (vari) random variables. And remember that we are mostly going to use the continuous random variable in our, you know, most of the works. And also another concept that we are just going to see in a while is that, uh we will, we are going to talk about the probability density when you talk about the continuous random variable; it is no longer just the probability.

And we need to keep in mind how the probability density is different from probability, and we will we will just explain that. With that we will uh sort of end this lecture. And in the next lecture, we are going to see couple of examples of, uh you know, probability uhm sort of probability uh distribution for continuous random variable and probability distribution for a discrete random variable. Thank you.