Stochastic Processes - 1
Dr. S. Dharmaraja
Department of Mathematics
Indian Institute of Technology – Delhi

Lecture - 19
Examples of Classification of Stochastic Processes

So let us see some simple example based on the possible values of T and S.

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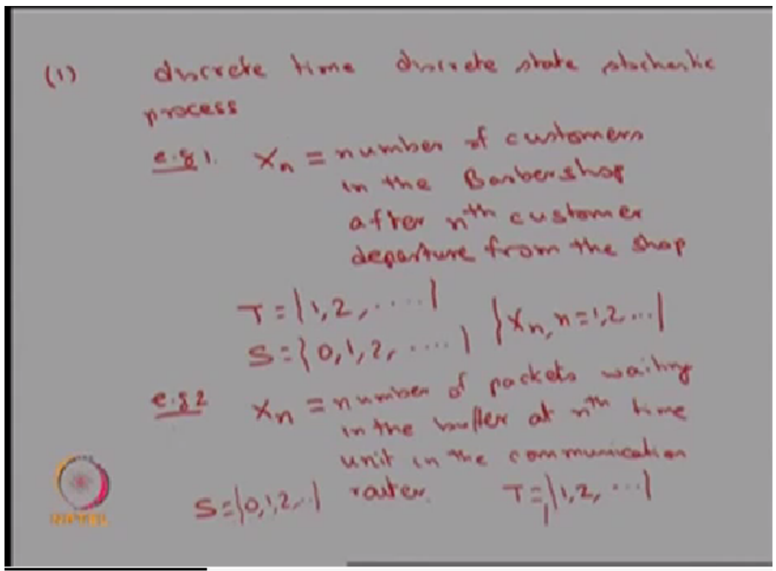

So, the first one is going to be a discrete time or you can use a discrete parameter also. Discrete time, discrete state stochastic process that means the possible values of S as well as the possible values of P has to be either it has to be of countably finite or countably infinite elements in it. Let see the one simple example. Let us creat a random variable x of xn, that is nothing but the number of customers in the Barber shop after nth customer departure from the shop.

So, here suffix n that will form a parameter space therefore the T can be a possible value of n. That means whenever one customer leave the system how many are in the system after he leaves. So the possible values of T will be the first customers when he leaves out when he is not there he want to find out and so. Therefore, the possible values of T is going to be 1, 2 or three therefore this is the number of making the number of customers in the system.

Whereas the possible values of xn or possible value of n that is going to be the –there is a possibility no customers in the system when someone leaves. So, there is a possibility zero when someone leaves only one customer in the system when it is going to be 1 or 2 and so on. Therefore, there is a possibility it could be finite also. So the S can be countably finite or in this case I have made the it is countably infinite.

Therefore, the T as well as T is going to be form of the discrete therefore the corresponding stochastic process xn for possible values of n is going to be 1, 2 and so on and this is going to be a discrete time, discrete change to stochastic process. You please note that here the parameter space T is not the time. The parameter space, forming the 1,2,3 these are all the customers, the nth customers. Therefore, n can be 1, 2 and so on.

Therefore, it usually the T is time whereas sometimes it would be a distance or length or the number or whatever the other quantities. So here the typical situation in which the parameter space is not considering the time. Therefore, this is going to be a random variable because you never know how many customers are going to be in the system after the nth customers leaves.

Therefore, this is going to be a random variable. Obviously it is a real value function satisfying all the properties of the definition and you can see the probability space for this and from the probability space you have to create the random variable and therefore this random variable is going to be the –this collection of random variable over the n that is going to be the discrete time and discrete state.

Therefore, this random variable here you can create it with the help of a case one by making for fixed n, what is the random variable then you make a collection of random variable. So, we can create this stochastic process by using the case one or the approach one which the easier one. I can go for creating one more stochastic process for this discrete time and the discrete state stochastic process that comes under daily communication problems xn is going to be number of pockets waiting in the buffer at nth time unit in the communication router.

That means there is a communication router in which the packets are coming for transmission. So after the transmission is over in the buffer the packets are leave the router. So at any time you don not how many packets are waiting in the buffer for the transmission. So there is a possibility no packets will be there at some time point and there is a possibility there are many more packets may be waiting for the transmission in the buffer.

So, the possible values of T, the possible values of S that is going to be –there is a possibility no packets in the buffer or one or so on and similarly the possible values of D that is also we are marking the nth time unit. Therefore, the time unit could view first time unit or second time unit and so on. Therefore, here the S is going to be the discrete as well as the D is going to be discrete therefore this collection of random variable x suffix n for possible values of n that is also going to form a discrete time, discrete state stochastic process.

Because of the possible both the values are going to be often discrete time is using the simple stochastic process based on the parameters ways and the state ways and we have seen the discrete time still it creates stochastic process. The first one now we are seeing the second one.

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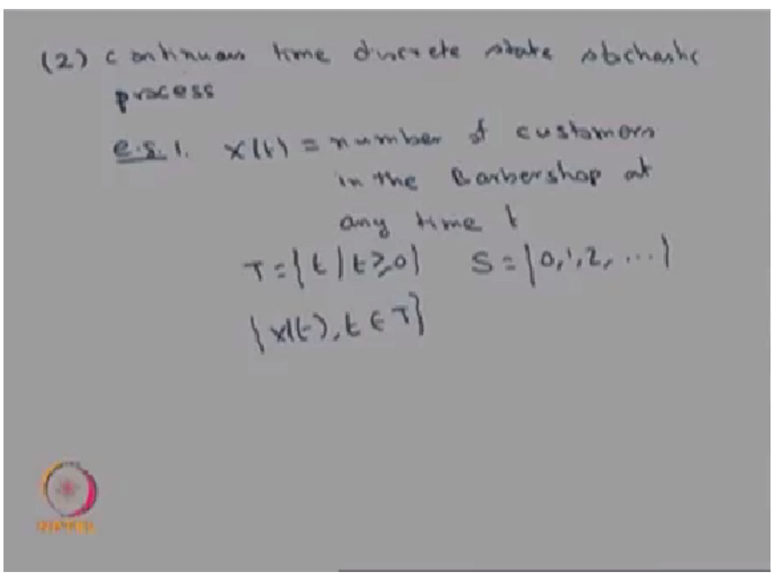

That is continuous time discrete state stochastic process. That means the possible values of parameter space is going to be a uncountably many values therefore we get the continuous time and the possible values of them state based that is going to be a countably finite or countably infinite therefore you get the discrete state. So, you will see the few simple example of this type. The first example that is x of t that is going to be the number of customers in the Barber shop at any time that is difference.

In the earlier, example we have seen the number of customers in the barber shop for the nth customers the departure now we are seeing the number of customers in the barber shop at any time t. Therefore, we are looking at how many customers at any time t in the barber shop. Therefore, the possible values T that is going to be a collection of T such that the t is greater than or equal to zero.

And the possible values of S that is going to be still it is a number of customers therefore the possible values are 0, 1, 2 or it can be when there is a possibility it can be countably finite also. So whether the state place is going to be countably finite or countably infinite we classify as a discrete statement. Therefore, this is a typical example of continuous time discrete state stochastic process and the collection of random variable is going to be x of t for all possibly values of T.

So, this is going to form a real value the stochastic process which for each T it is going to be a random variable. So, this is going to be a real value the stochastic process of one dimensional type and the T is becoming to the T that is going to be the time that is the default one and it is going to be a countably many therefore it is going to be continuous parameter. So it is going to be call it as a continuous parameter discrete state stochastic process also.