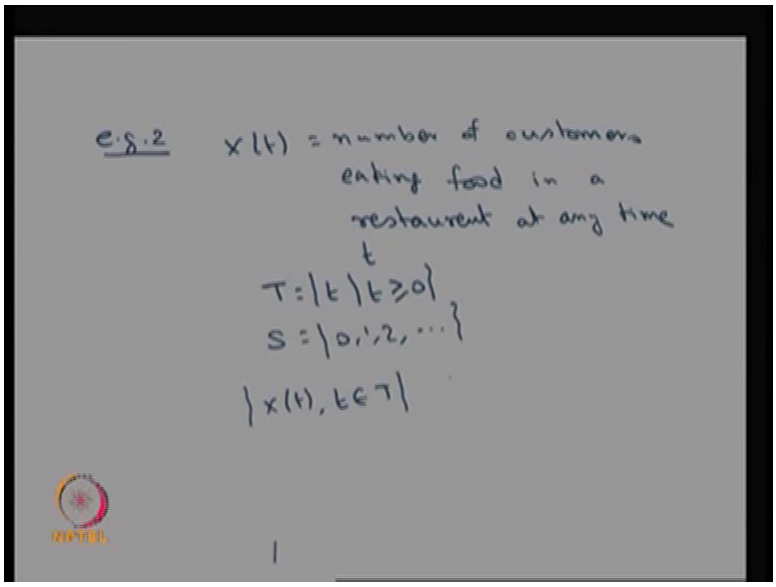
Introduction to Probability Theory and Stochastic Processes
Prof. S. Dharmaraja
Department of Mathematics
Indian Institute of Technology, Delhi

Lecture – 51

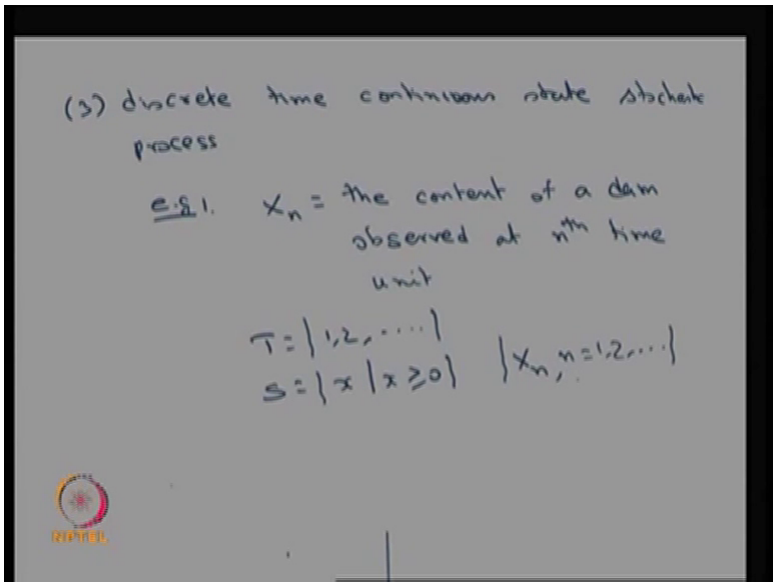
(Refer Slide Time: 00:03)



Example 2 in the example 2 let me make a X of t that is going to be, number of customers eating food in a restaurant at any time t therefore, you are observing the system, you are observing the restaurant, how many customers are taking a food therefore, the possible values of the parameter space T is going to be t greater than or equal to 0 and the possible values of S, still it is account therefore, in the possible values are going to be countably finite or countably infinite. Therefore, this collection of a stochastic this collection of a random variable over the T, that is going to be a continuous time, or continuous a parameter discrete state stochastic process.

This is a very typical example so, it could be accountably this S could be a countably finite or countably infinite also.

(Refer Slide Time: 01:33)



Now, let us see the third type that is a discrete time, continuous state stochastic process that means, we need the possible values of a capital t has to be a countably finite, or countably infinite whereas, the possible values of a the state space has to be a uncountably many of that type.

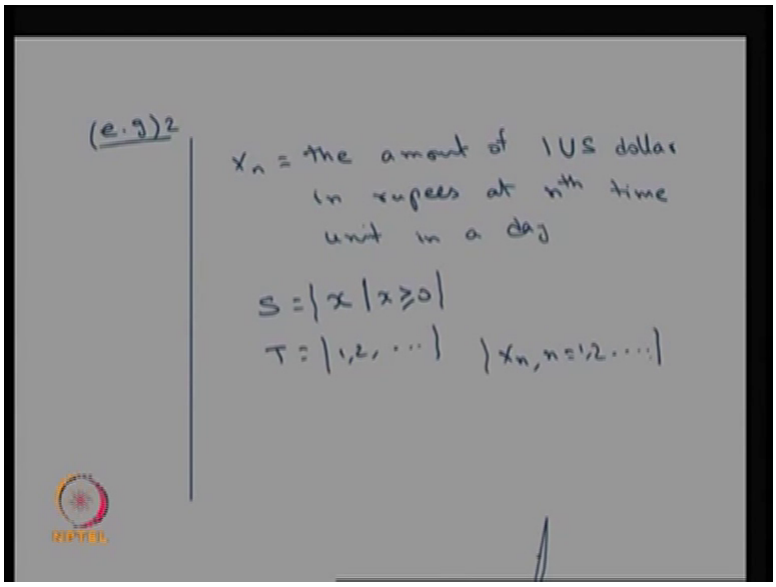
So, let us create a example for that the X suffix n that is nothing, but it is a random variable that denotes the content of a dam, or water reservoir observed at a nth time unit. So, here the time unit could be every 1 hour or that could be a because you are seeing the what is a content of the dam or water reservoir, it could be every day, at a fixed time of a every day, or it could be a fixed time of a weekly once. So, that is going to be the time unit.

So, at the end of a each nth time unit you are observing what is the content of the content of a dam. So, that is nothing, but a it is a real quantity therefore, the capital T is going to be you are observing at only at the time unit. So, either it could be either 1 hour or daily once or weekly once and so, on therefore, I can make a one to one correspondence with the countably finite or countably infinite numbers so that will form a parameter space.

And the capital S this is going to be the possible values of a X n for all possible values of n therefore, this is a content of the water content of a dam that is going to be the real quantity therefore, that is going to be a some x where x is always greater than or equal to 0 so; that means, you have a the parameter space is going to be a discrete whereas, the

state space is going to be a continuous therefore, this stochastic process X suffix n for a possible values of n is going to be 1 2 3 and so, on. And this is going to form a discrete time continuous state stochastic process.

(Refer Slide Time: 04:17)

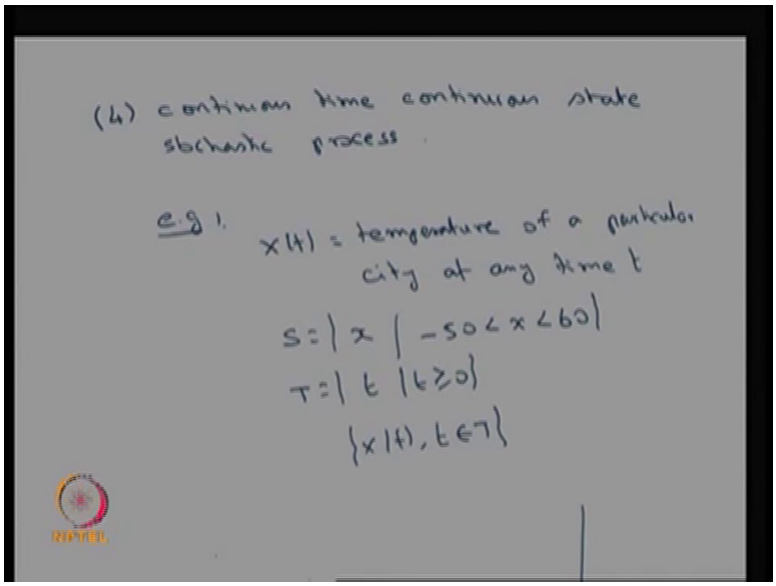


Let me give a one more example, for the same type that is example two that is nothing but example 2, X n is nothing but the amount of 1 US dollar in rupees at nth time unit in a day that means, I am just observing what is the value of a 1 US dollar in rupees in a day for the nth time unit, it could be every 5 minutes or it could be every minute or it could be every hour of a any particular day and, that is going to form a random variable and that collection is going to form a stochastic process.

In this the possible values of a X is going to be since it is the amount of a 1 US dollar in a in rupees it could be a some fraction also therefore, you do not want to take it as the integer number, it can be a real numbers therefore, it is going to be a possible values of x greater than or equal to 0 and the capital T, that is going to be their time unit either it is a every minute, or every once in 4 minutes or once in 10 minutes or every 1 hour and so on therefore, this is going to form a countably finite or countably infinite 1.

And this stochastic process will form a discrete time and a continuous state stochastic process.

(Refer Slide Time: 06:14)



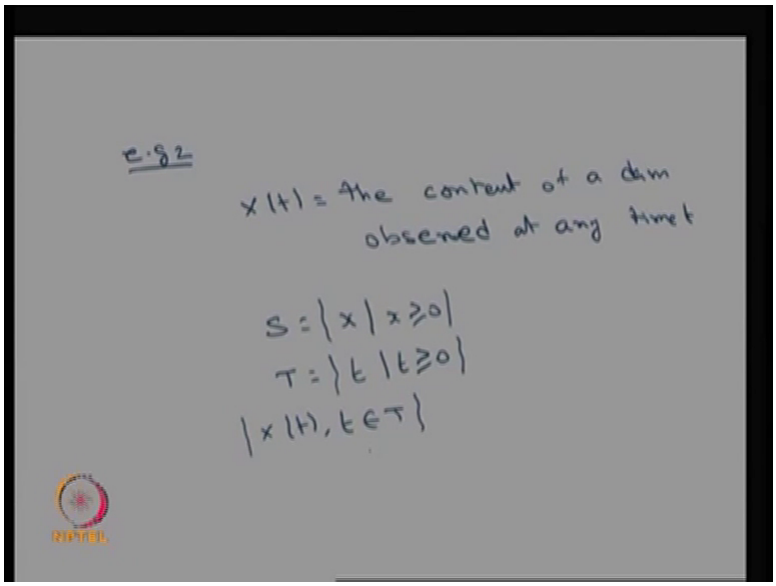
Let me go for the fourth type that is the fourth classification of a stochastic process. That is a continuous time, continuous state, stochastic process; that means, the possible values of a parameter is going to be a uncountably many therefore, you get the continuous time or continuous parameter. And the possible values of a state space that is going to be a uncountably many therefore, you get the continuous state the stochastic process.

The examples are the first one X t is going to be temperature of a particular city at any time T. So, whenever I use any time t it can take a any value therefore, the possible values of S is going to be it is going to be the temperature so, you can think of the temperature suppose some particular cities lies between minus 50 to 60 degree Celsius.

So, this quantity S is going to be the Celsius of minus 50 to positive 60 and the parameter space T is going to be your observing over the time therefore, this time is going to be greater than or equal to 0 therefore, the parameter space is at continuous one and the state space is a continuous one.

Therefore this collection of a random variable, this collection of a random variable will form continuous time, continuous state, stochastic process.

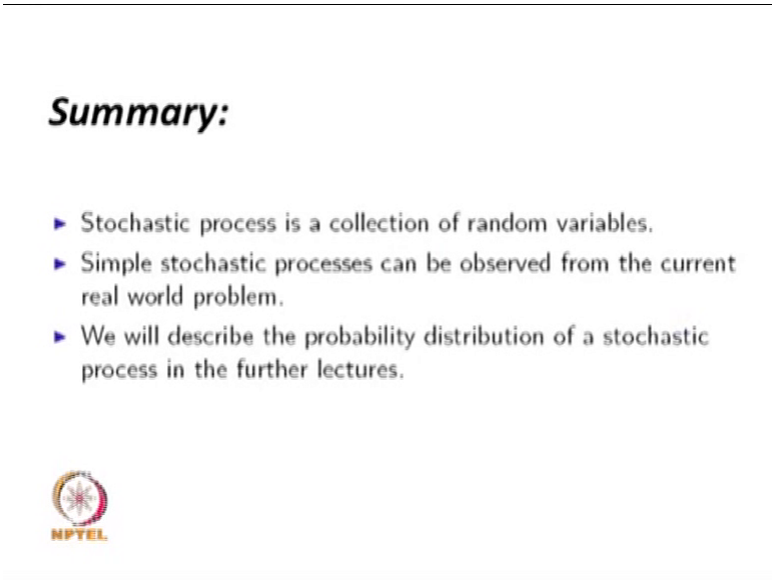
(Refer Slide Time: 08:23)



Let me give a one more example of the same type the fourth type that is example 2, X of t is going to be the content of a dam observed at any time t. So, the content of a dam, or reservoir that is going to be the real quantity therefore, S is going to be a collection of X such that x is going to be greater than or equal to 0, and the you are observing over the time therefore, that is also a collection of T, such that t is going to be greater than or equal to 0 therefore, this will form a stochastic process in which it is going to be the classification it will be the under the classification of a continuous time, continuous state, stochastic process.

And this can be created with the help of the first approach; that means, for a fixed t you find out what is a random variable and, you collect the random variable over the all possible values of a t therefore, this is going to be of the continuous time and a continuous state, stochastic process.

(Refer Slide Time: 09:55)



So, in this lecture what we have seen what is the meaning of a stochastic process, or how to create the stochastic process. So, that is nothing, but it is going to be a collection of random variable.

So, we have defined the stochastic process as well as a how to create, then later we have a given what is a parameter space and, what is a state space and we have given the classification of a stochastic process based on the parameter space and the state space. And also some of the real world problems from that we can create a stochastic process and, that stochastic processes are the simple stochastic process and there are many more stochastic process can be created with the help of the definition and so, on.