Introduction to System Dynamics Modeling
Prof. Jayendran Venkateswaran
Department of Industrial Engineering and Operations Research
Indian Institute of Technology, Bombay

Lecture – 15.2
Information Delays
Delays: Modeling Information Delay

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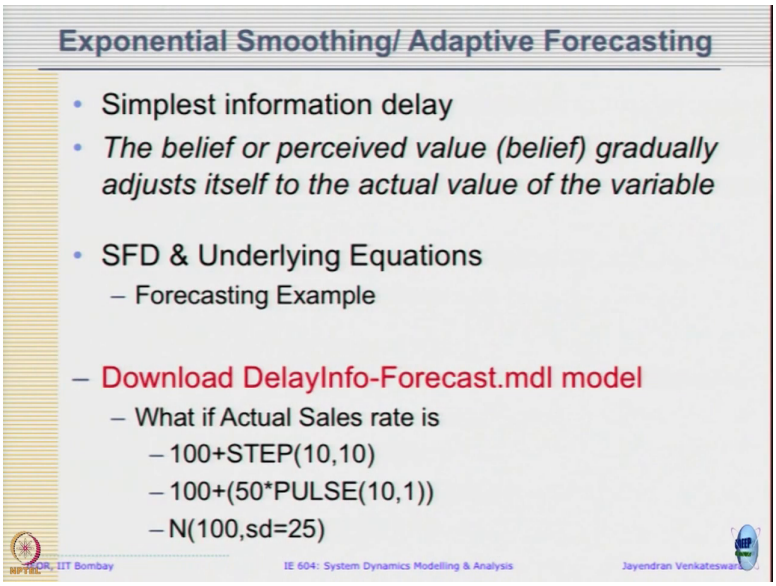

So, let us download this delay info forecast dot mdl model, and let us see what kind of graphs we get when the actual sales rate is 100 plus step of 10 comma 10, 100 plus 50 into pulse of 10 comma 1, and what do sales is normally distributed around a constant mean. See, these a typical scenarios happen, the first two cases are just to understand how the dynamics work,

but in reality we expect that the demand is fluctuating around a constant mean, right. So, we are assuming normal. So, in that case let us see how to simulate that scenario also.

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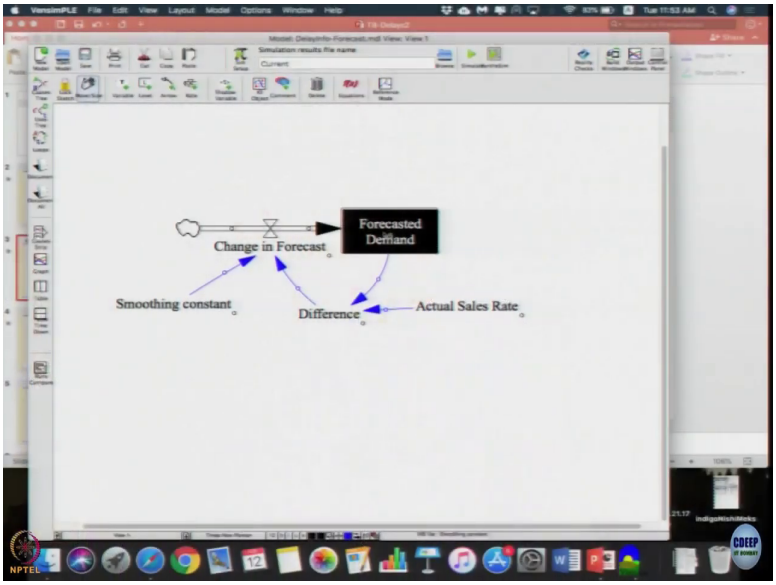

Let me quickly show the forecasted demand is 100.

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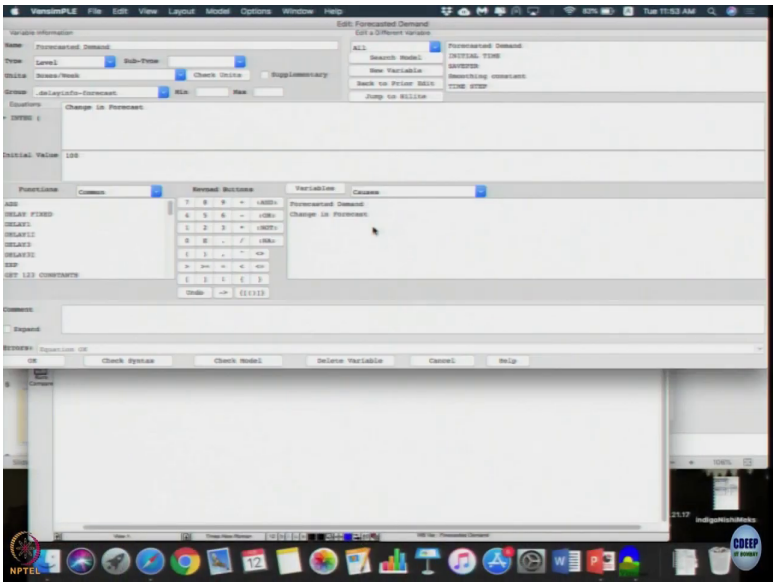

The actual sales is 100 plus step of 10 comma 10. Step of 10 comma 10 means at time 10 there is a additional unit of 10.

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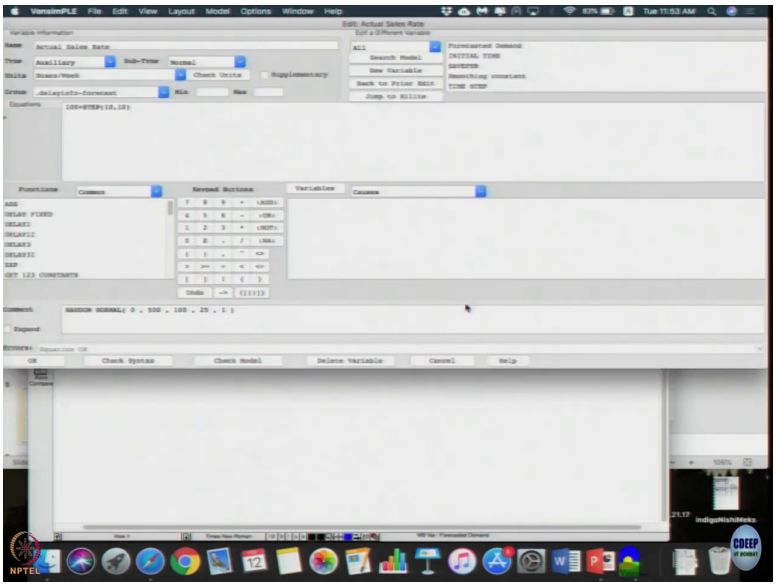

So, from 0 to 10 0 to time 10 the actual sales and the forecasted sale is exactly the same. So, we do not expect any dynamics to happen. The system was started dynamic equilibrium. Smoothing constant is 0.2, so at every time period 20 percent of the difference is going to be added to the stock. So, stock has to keep increasing, right. So, that is what you expect.

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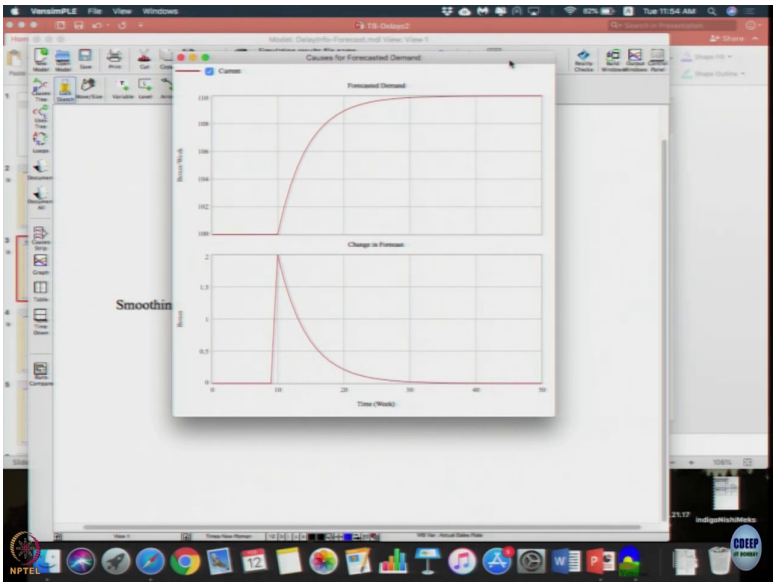

So, if you simulate the system the forecasted demand follow the simple exponential goal seeking process because the system that you just saw is nothing, but a goal seeking model, where instead of having a desired stock we call it as a reported value or the actual sales. And as a goal change I am going to approach a new value of the goal unsaturated 110, correct.

Here note that the material is not conserved, that is let me; so, forecasted and actual sales if we plot them the actual sales increased to 10, 110; 110 constant there.

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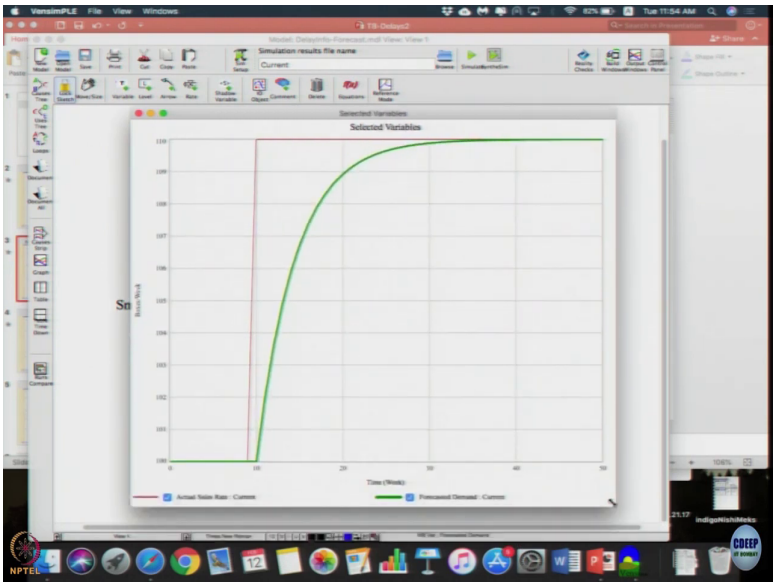

But here you can see the forecasted demand slowly approaching 110 and after some point it will be the same, but whatever happened in this tangent period is lost; that means, no material is conserved there. The information was used to adjust my forecasted demand, but beyond that I am not using that information again, so that is what we make flows are not conserved. May be it will be more apparent when we do the second option. What was it? 100 plus 50 into. Let me just copy this here.

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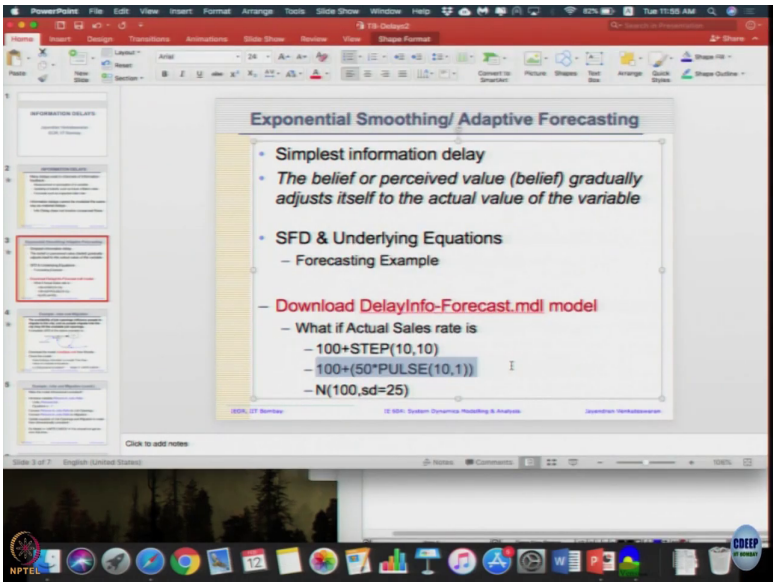

So, now, I am just going to the actual sales rate.

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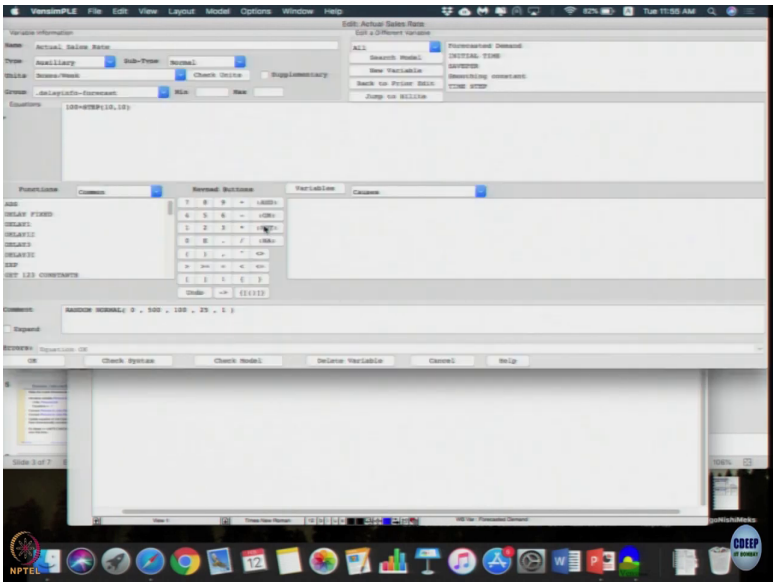

And replacing with 100 plus 50 in to pulse 10 comma 1.

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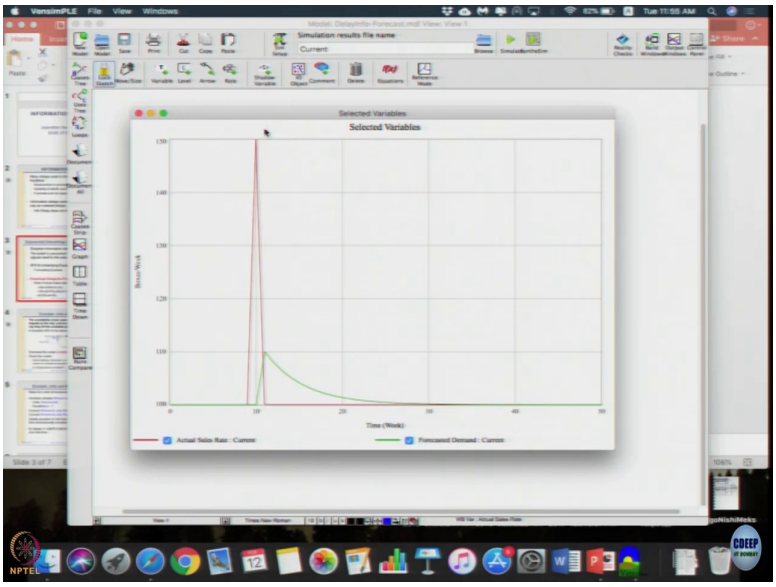

What has happened is a time 10 there is a pulse of 50 units there is it only one period there is a abnormal suddenly a demand peak additional 50 unit, so the actual sales there is a red line went from 100 to 150 for just one period and came back. But since we are reacting the next period added 20 percent of difference, so it went to 110 my next period was quite at still only 100 then I slowly started to revise it downwards until I hit my goal. So, I never hit 150, I only go little way up and then I just slowly come back to the old goal, ok.

Again, this is just you know simulation, right. So, it does not know what is going to happen, it cannot estimate until it actually sees the value.

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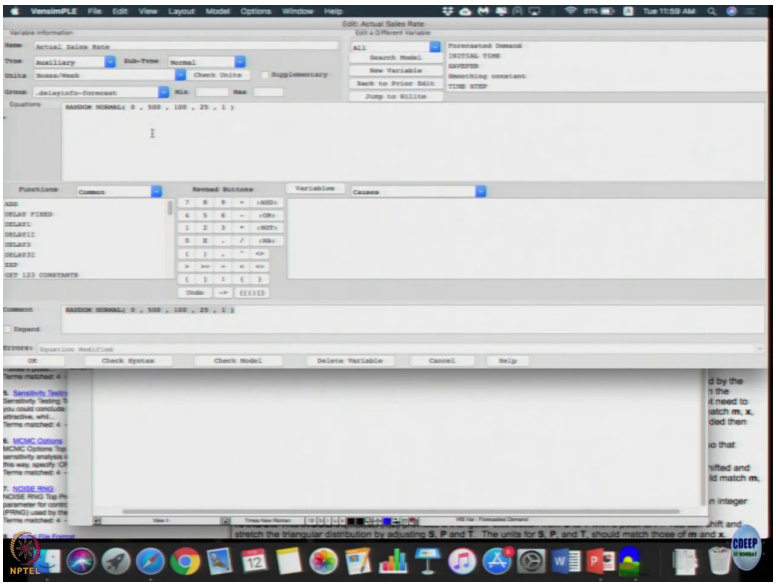

Now, let us go to the third one. In third case we want to do something called random normal looks for we do that.

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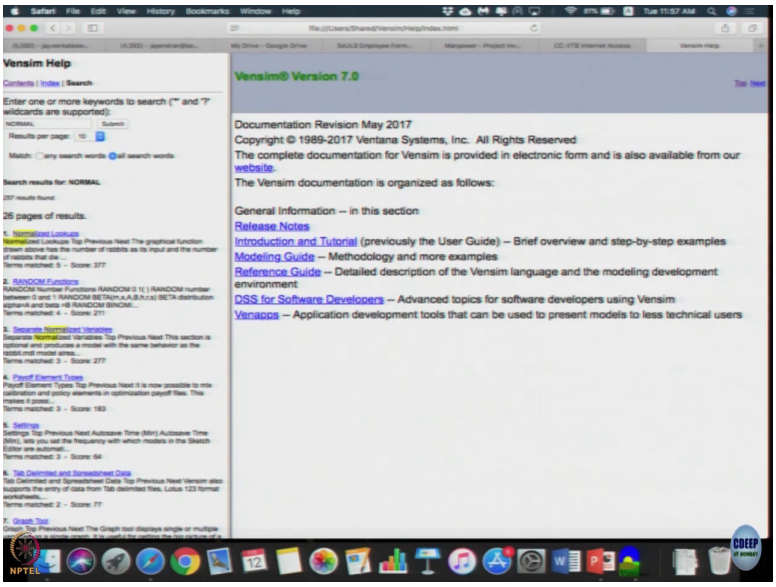

So, whenever new things come expect you to, I am just showing it because you will also learn, how to do, now there are various functions like the one if you want to simulate random distribution or Poisson triangle various distributions can also be given here.

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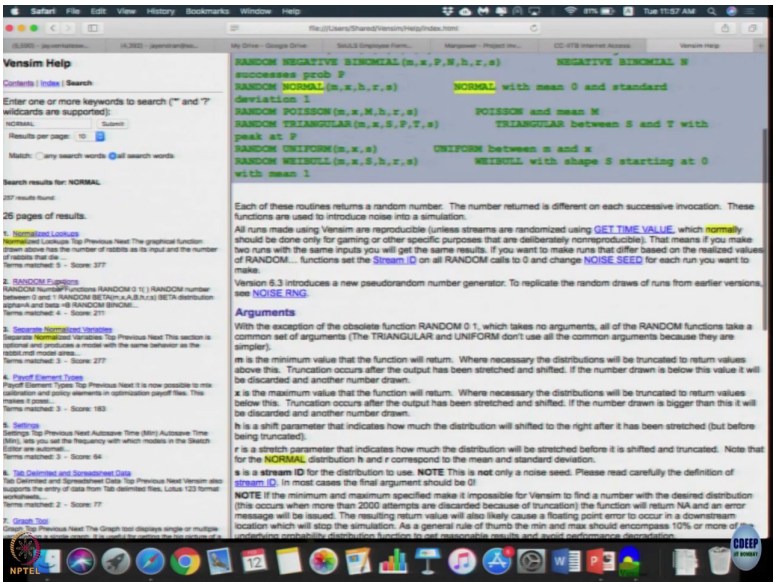

So, in demand typically we model as normal distribution or exponential distribution or various distribution. Some of it, it can handle. So, let us see.

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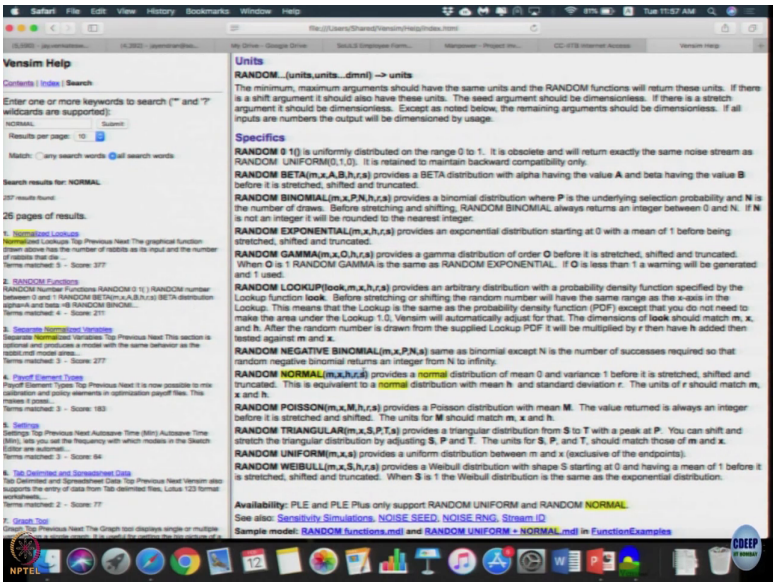

So, I get a random normal is what we want. Random normal though mathematically which just give two parameters, for simulation purpose it looks like it wants 1, 2, 3, 4, 5 different parameters. By default it gives normal distribution mean 0 and variance 1; h is the mean, r is the standard deviation in this, third and fourth parameter mean is standard deviation. What is m? M looks like the number of samples.

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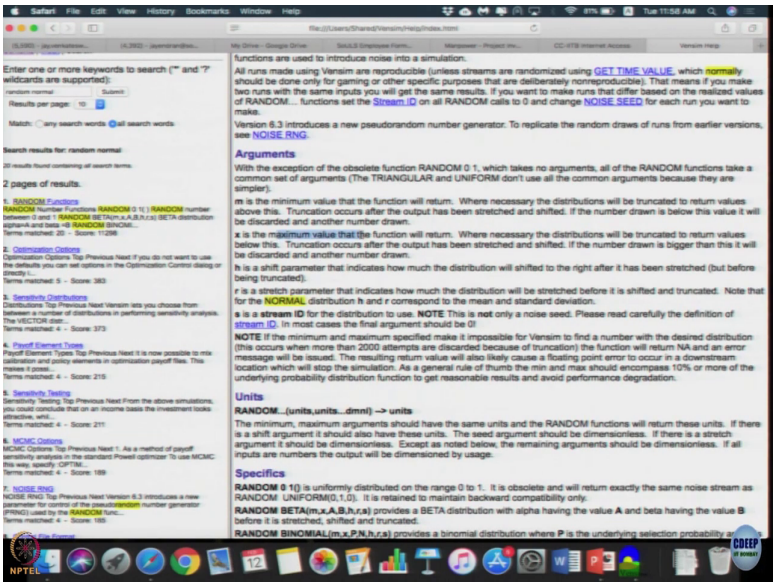

Let me go to random normal size. M is the minimum value it will return, ok, x is a maximum, ok.

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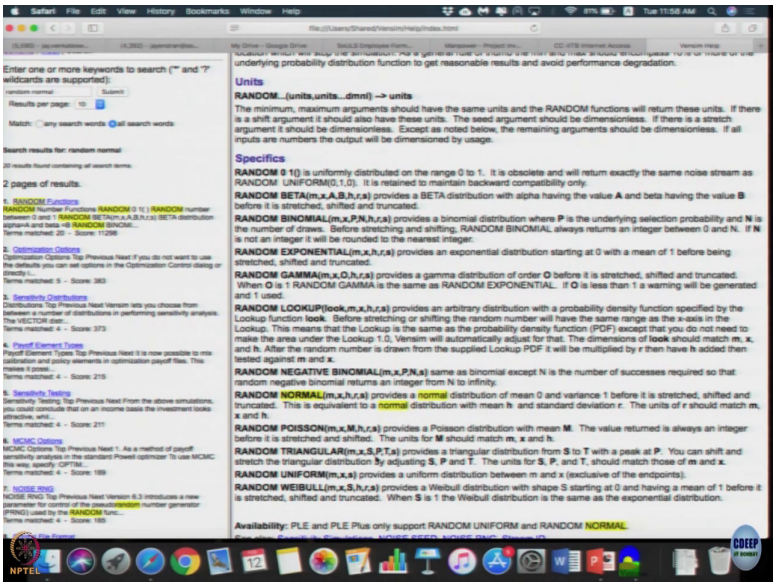

Segment x gives a minimum and maximum for a truncated normal distribution, what it gives? So, you cannot give it minus infinity to plus infinity. If we really want it then you do a really large number positively really large number negative. So, minimum value, maximum value, mean, standard deviation, and S, I think stands for seed number. So, that when you run it multiple times we generate the same random number that is enough for now.

So, let us go back. So, minimum is 0, maximum 500 we have kept, mean is 100, standard deviation 25 we have been given, they just put a stream as default value as 1.

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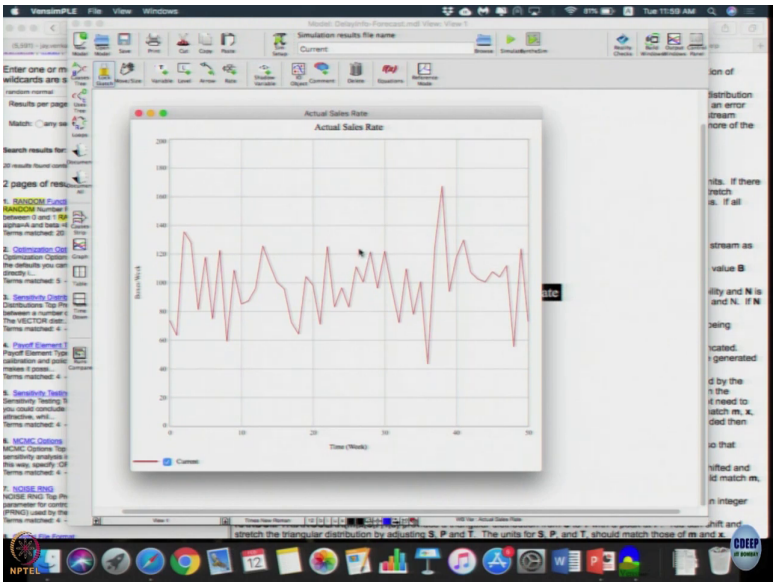

So, let us simulate, only let us plot the sales we will get a curve like this. It is a randomly distributing, the mean is approximately 100 as per this which is what we expect, right. Mean is approximately 100 because the standard deviation that is a noise we are going to get a fluctuating values of sales it looks more realistic.

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Now, let us do forecast and this together. The green line in the middle is a forecast. So, as you can see it is doing the exponential smoothing, so it is not going to go to the extremes because its only 0.2, you get a the green line like this. It does not react, so much to the demand pattern. If you change the alpha value to something larger let us see that.

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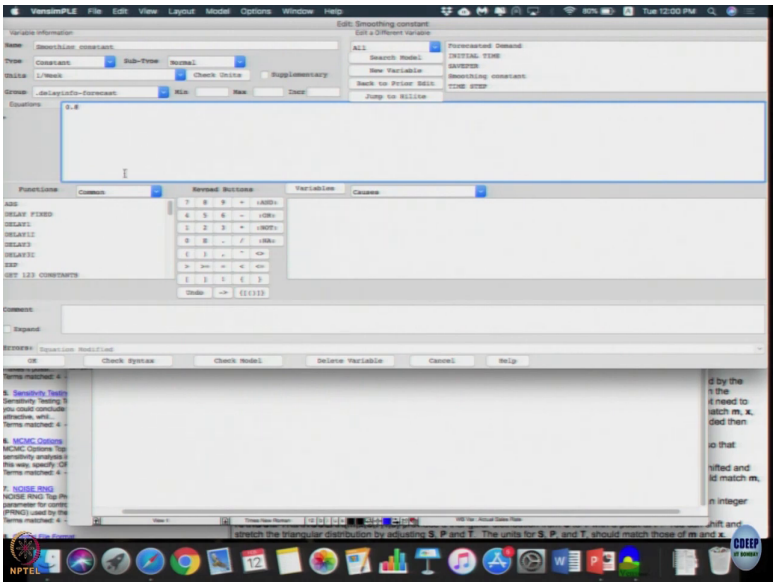

Let us see what happens when we change the demand value or smoothing constant to something larger instead of 0.2, let us consider 0.8, ok.

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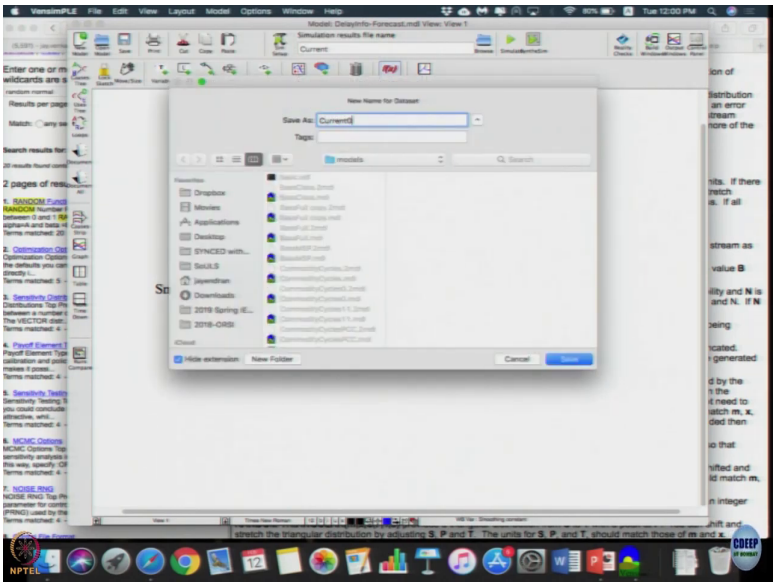

Simulates or write now current 08.

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Let me here now see 3 lines the red line this one, ok, wherever mouse is there red line is the actual demand there is a I do not choose the color. So, the orange line seems like this is a 0.2 and the blue line is with 0.8. 0.8 more faithfully follows the same pattern because you are given a weightage of 80 percent, so it is going to follow the same pattern. If you do not want it to react so much the deviations then we try to cover around the name.

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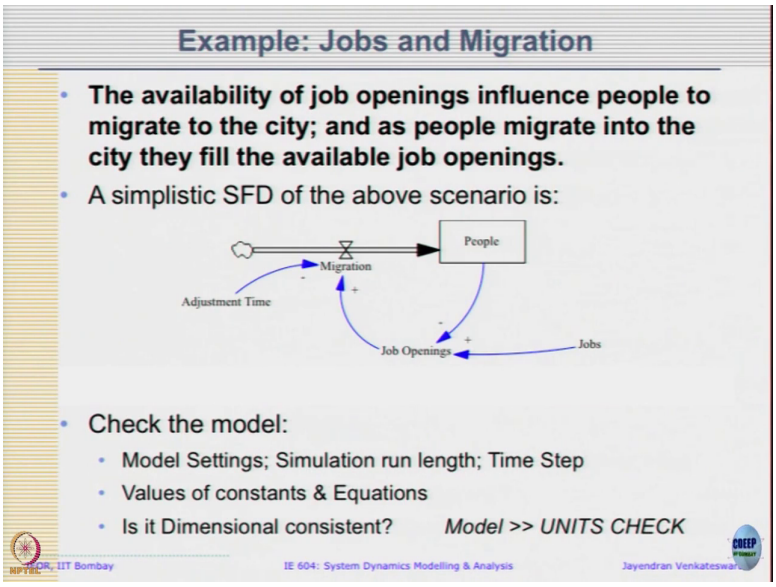

So, let us go back to the slides. Now, let us a take up another example. Availability of job openings influence people to migrate to city and as people migrate into city, they are filled available job openings. The simplistic SFD is shown here. People, then job, job openings migration adjustment time. Do you think that this represents the description given that is first question? The availability of job openings influence people to migrate to city. This people migrate in city they have filled available job openings. This migration happened people come in when we have set up jobs, right.

So, as per this model what should be units for people? As per orders given a stock flow diagram people unit could be person, job units could be job. So, now, what will be units of job openings? I am just taking the difference, the structure is exactly the same. So, I have to difference between as per this job is minus people. So, there it will get a dimension mismatch and job opening even if it is converted into jobs then migration as per this it should be person

per time, correct. So, migration should be person per time, but job opening somewhere I am just using the jobs, I need to actually have a another variable called as jobs per person or something like that or person per jobs either way.

So, whenever there is a model, you see we will do 3 things, we open the model, check the model settings, check the start time, check finish time, check time step, very easy. Then you check the value of constants and equations, and then check whether it is dimensionally consistent.

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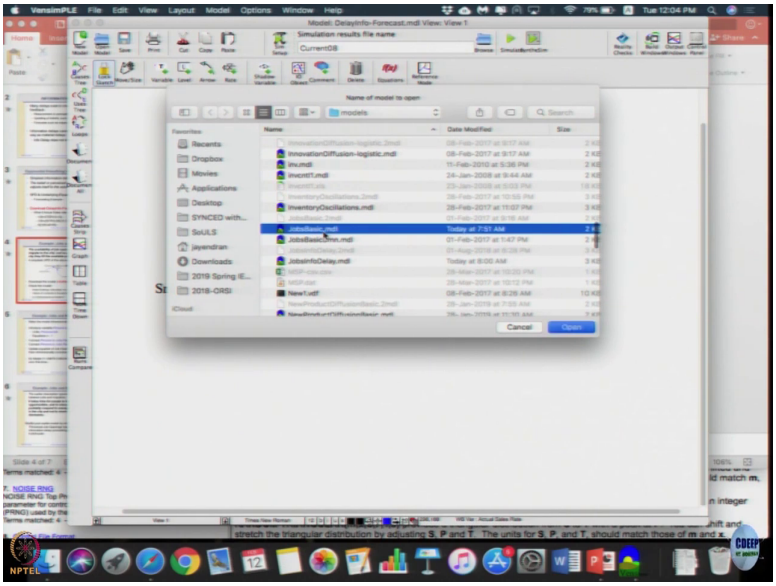

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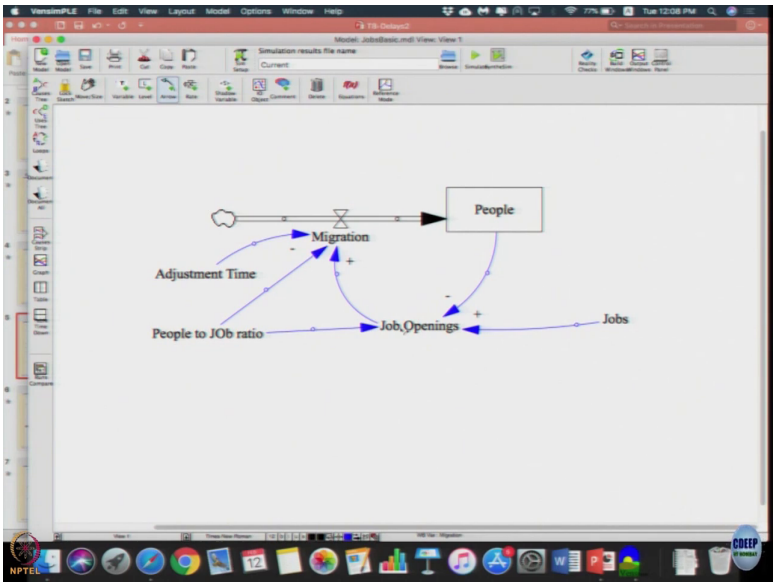

So, I am going to show all the 3 steps. What is the name of the file again? Job space (Refer Time: 11:13).

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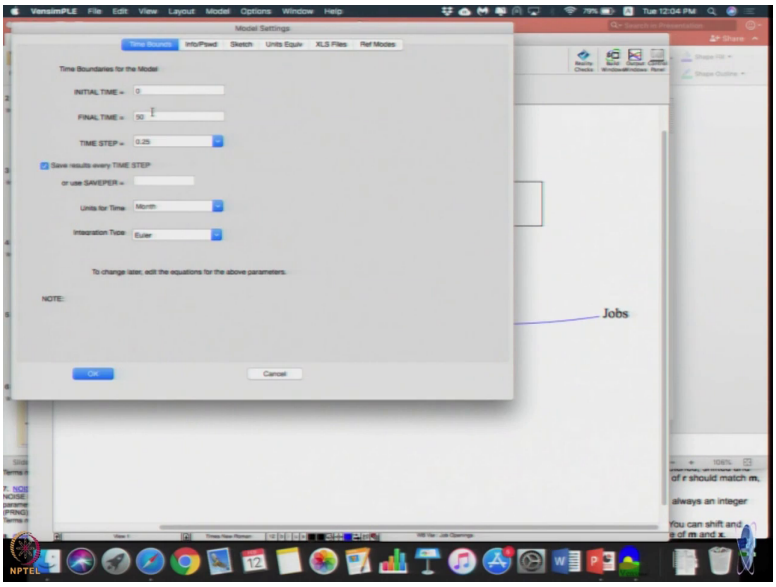

If we go to model settings, we will find the initial time is 0, the final time 50, time step 0.25, units per time is month, fine.

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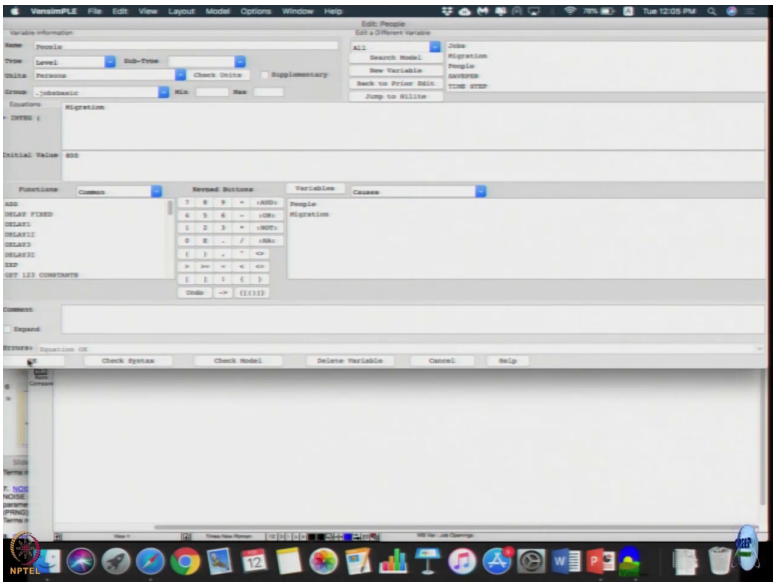

People, about 800 people are there initially, units is persons.

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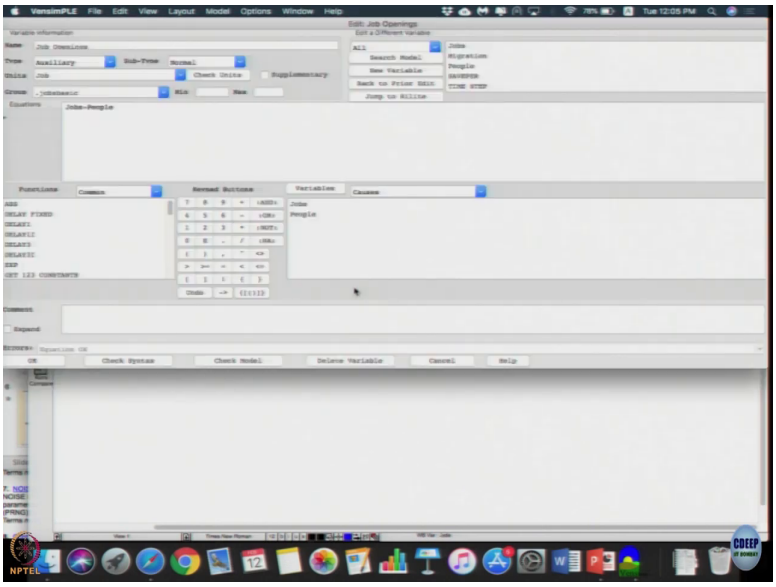

Then job, with 1000 people are, 1000 jobs are there. But then I came to job openings I just put the unit as job, so job is minus people.

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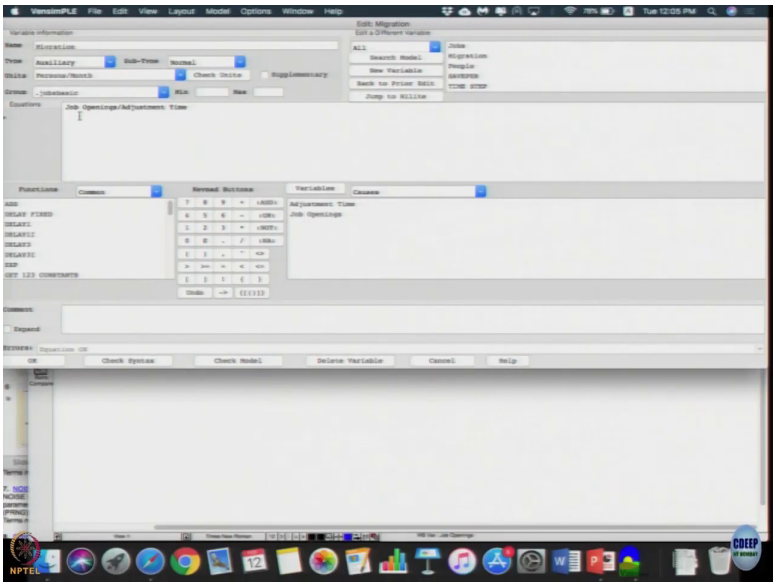

Then when I went to migration, I just did it as job openings divided by just one time, very simple model you can and the way the structure is exactly same as the previous two examples, one we drew on the paper or one we just saw is exactly same format.

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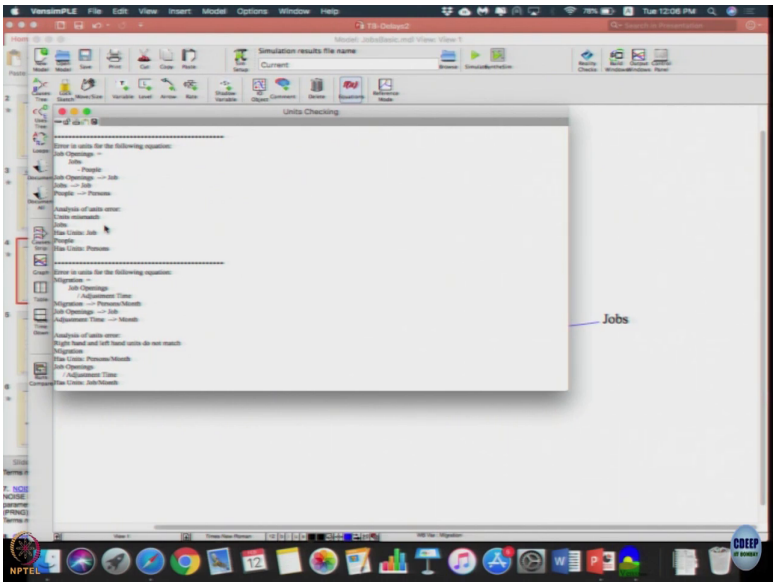

But to check the units if you do model, units check. If you say that a two unit errors discovered, the first one is error in units were following job openings equation other is error in units are following migration equation. Because job openings had job minus people; that means, job unit and person unit as a taken difference and the final unit we said as jobs it says there is a match, that is one. Another thing while we are here I thing I should (Refer Time: 12:54), ok.

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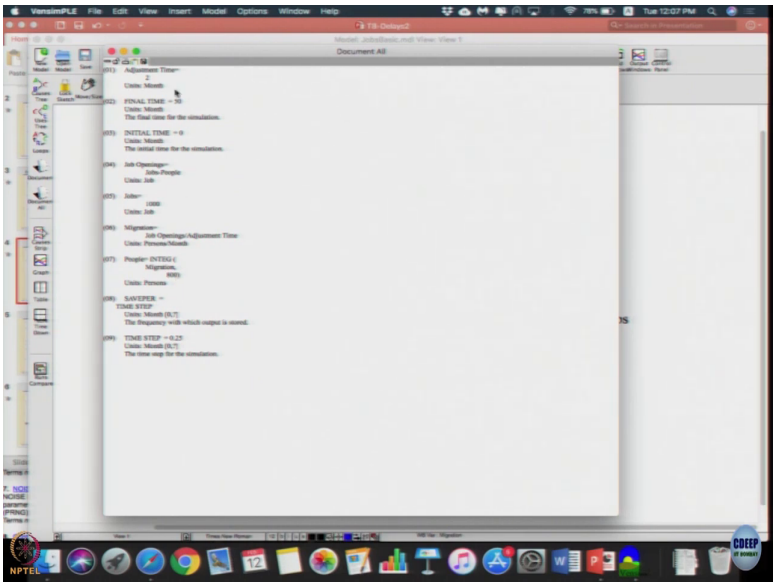

So, in your when you say in Vensim model there is some button here called as document all. So, if you click that button, it will give the entire model along with the settings in equations form. It shows a variable adjustment time to what are the units, what is the final time, what is the initial time, what is the time units, then the equations job openings, jobs, migration, people. In this how can you figure out which is a stock, from this? Let us say if we able to see it; which around has intake function is a stock and whatever is integrating it over it must be the flow, right. So, that is how you find it, ok.

Now, let us; so, this is a model we have, let us see what we have to do to change it and then I will show how to change it.

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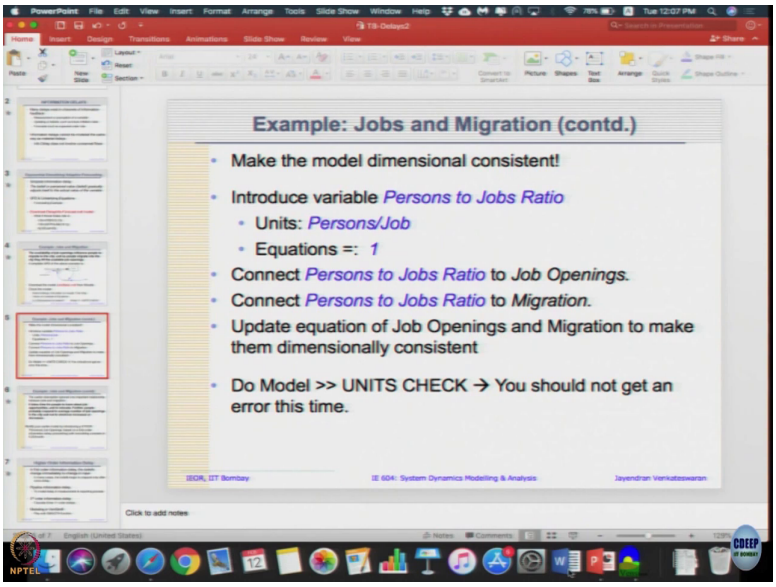

So, in order to make the model dimensionally consistent let us introduce a variable called as persons to job ratio, unit is persons by job, let us introduce a new variable and connect it to person, connect it to job openings and connect it to migration, so that now we can make a dimensionally consistent. So, I am going to introduce a person to jobs ratio for people to jobs, it just ok. (Refer Time: 14:39). People to job ratio, let me connect it to migration as well as this is a two equation which requires changing; so, I am just connecting it to the. As soon as you click f of x, all 3 is going to go black.

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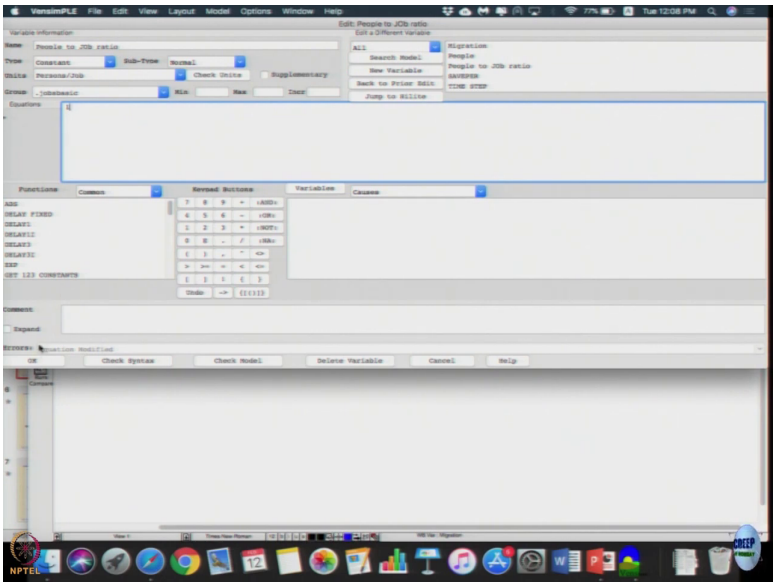

Person to job ratio, let us call it person by job. Let us just say one person equal to one job for simplicity sake.

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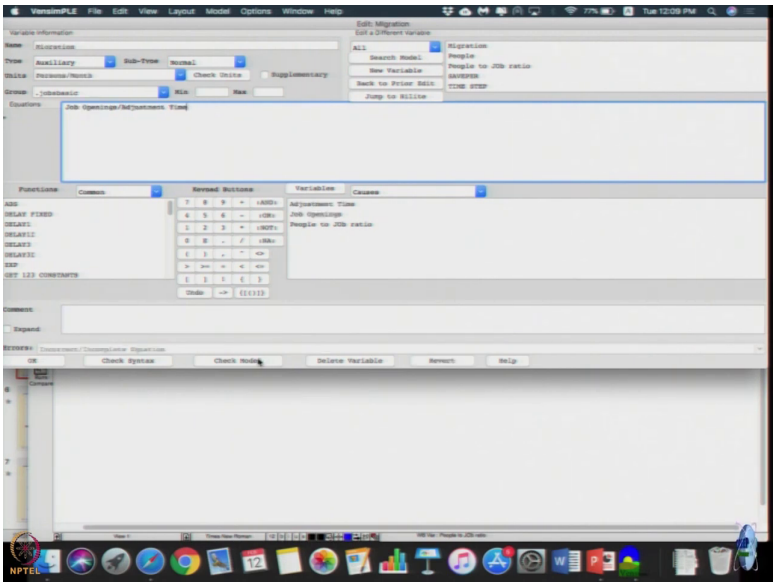

How will I change the job openings equation? I need to convert it into units of jobs. So, I will say job minus people divided by people to job ratio, right. And here I can check syntax. I went to next equation, ok. (Refer Time: 15:49), fine.

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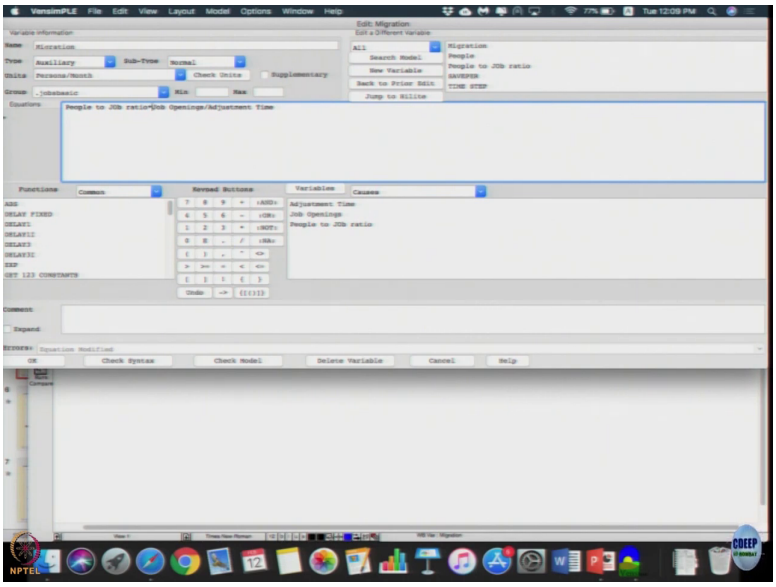

And then I go to the next equation migration. So, in migration I just need to multiply jobs to people ratio because job openings are in jobs. So, when I multiplied it will come back into people, ok.

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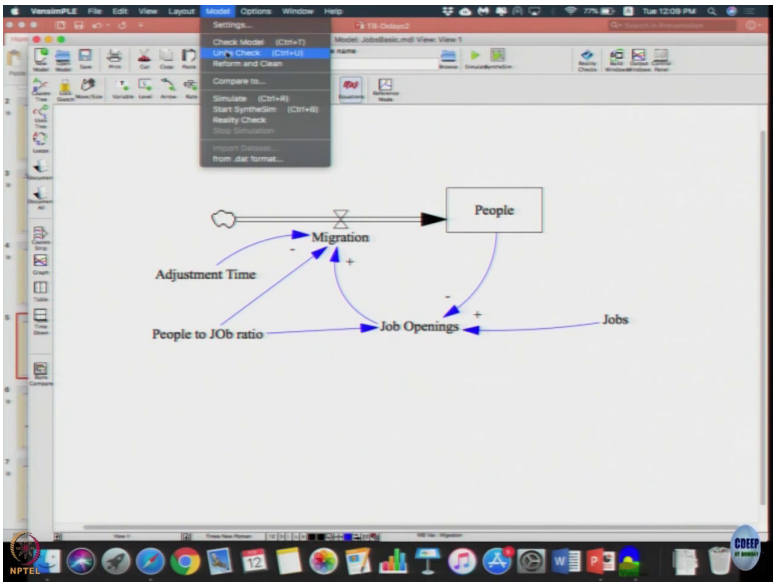

Let us do model, (Refer Time: 16:11) checked. All units are, ok, so I just made it dimensionally consistent.

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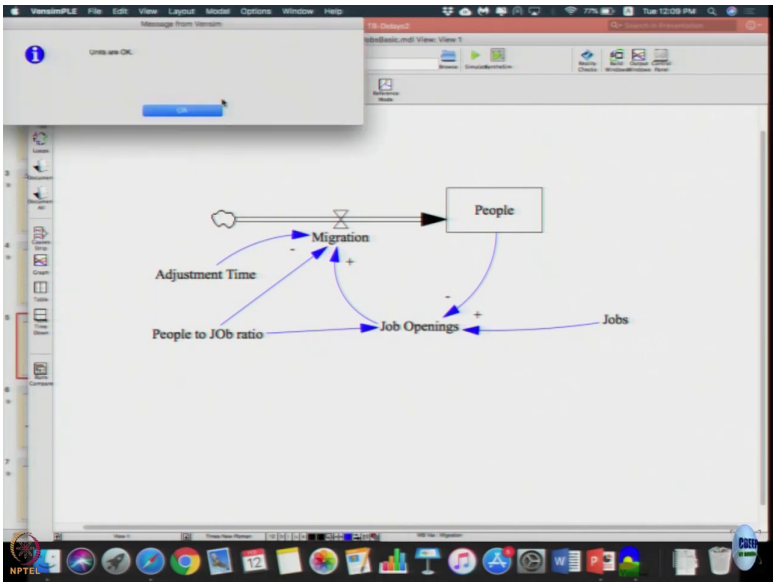

Again when I get a one example at (Refer Time: 16:18) a couple of other ideas, so that both the jobs are done. So, now, if I simulate it, what is the initial values? So, people initial value was 800 and job value was 1000. Since, people to job ratios 1, it is kind of equivalent, so I just simulated it. So, let me select people and jobs and make (Refer Time: 16:54) difference, yes.

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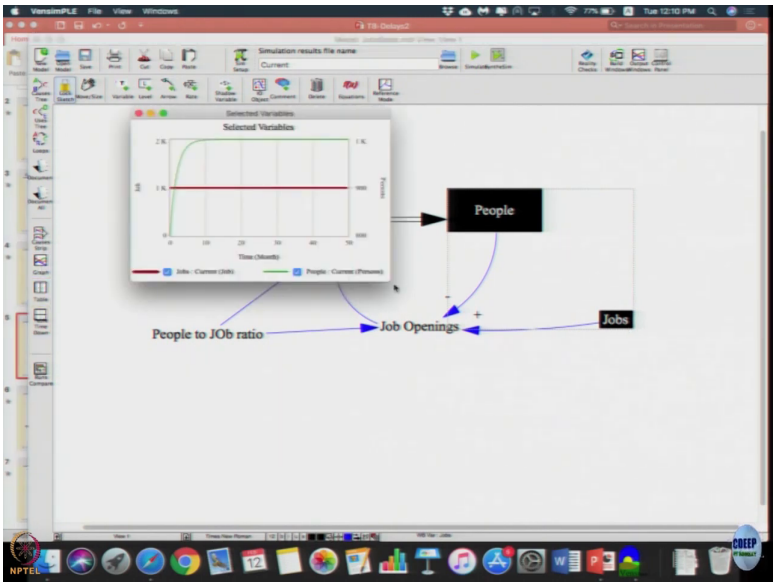

So, people and jobs, jobs remain constant at sorry.

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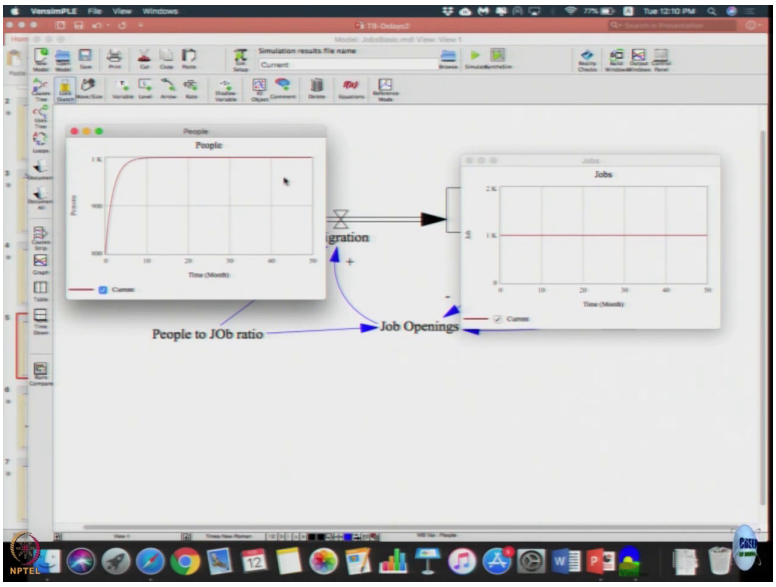

Jobs remain constant at 1000. People migrate and go from 800 to 1000, ok. So, this is a very simple model of a basic delay.

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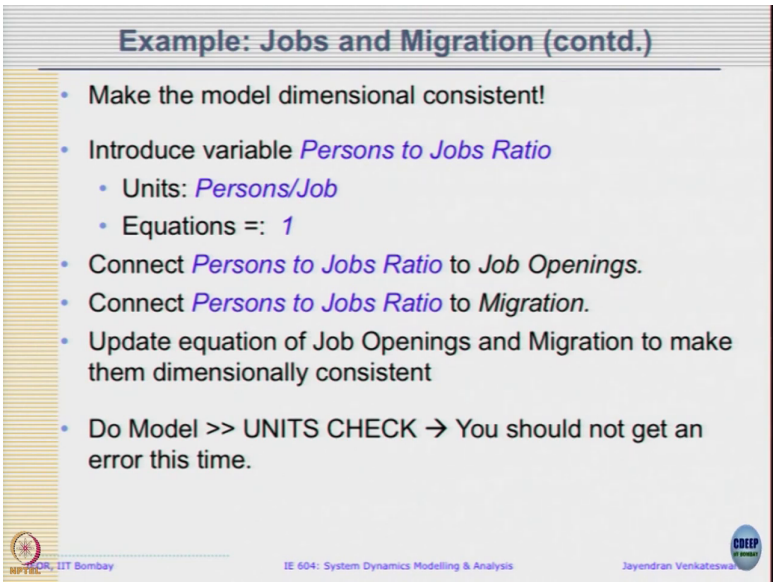

Now, let us make that example a little more interesting. Any questions on this part. All I just made of dimensional consistent, but other than that the structure does not did not change from the previous demand example. Demand example looks like very constructed and structured example see in other courses also. But this one looks like we recommend migration other step, but finally the basic structure is very similar.