Decision Support System for Managers
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Module – 02
Models in Decision Support System
Lecture - 07
Purpose of Models; Classification of Models

Hello and welcome to "Decision Support Systems for Managers"! We are into module 2, lecture 2. In module 2, we are doing models in decision support system. And today's lecture deals with Purpose of Models and Classification of Models; ok.

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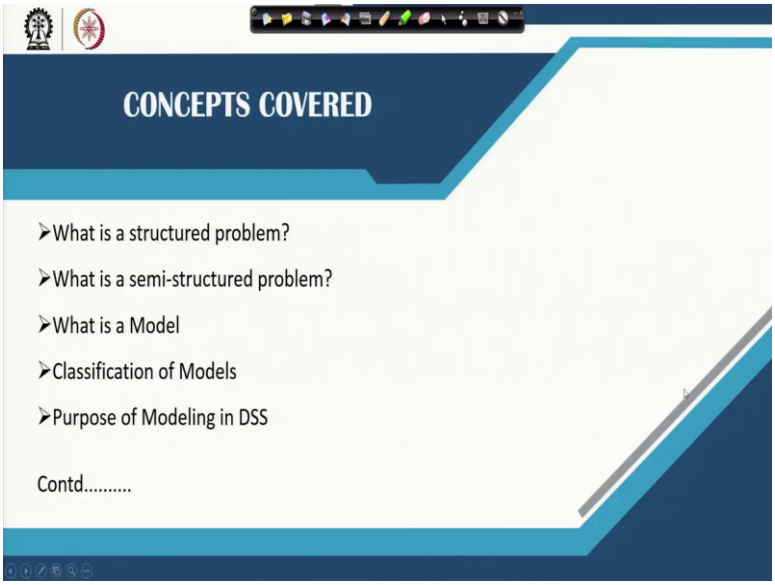

Now, these are the concepts covered in this module. What is a structured problem? What is a semi-structured problem? And what is a model? If you remember first three, we have done in our previous lecture; ok.

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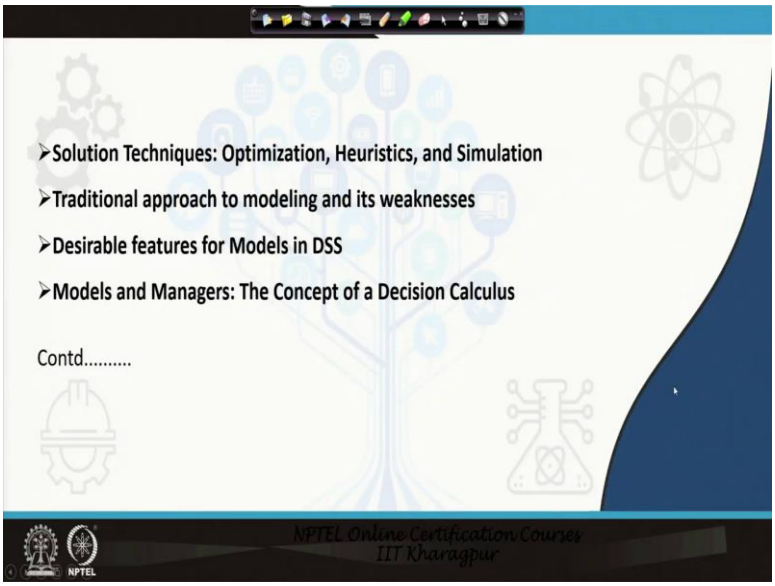

Classification of models, purposes of modeling in decision support systems, solution techniques. Traditional approaches, desirable features of model and models and managers the concept of a decision calculus.

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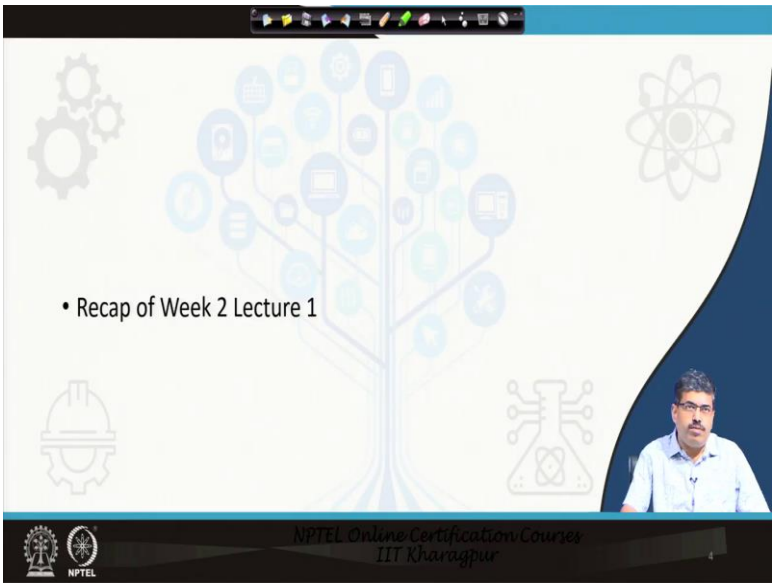

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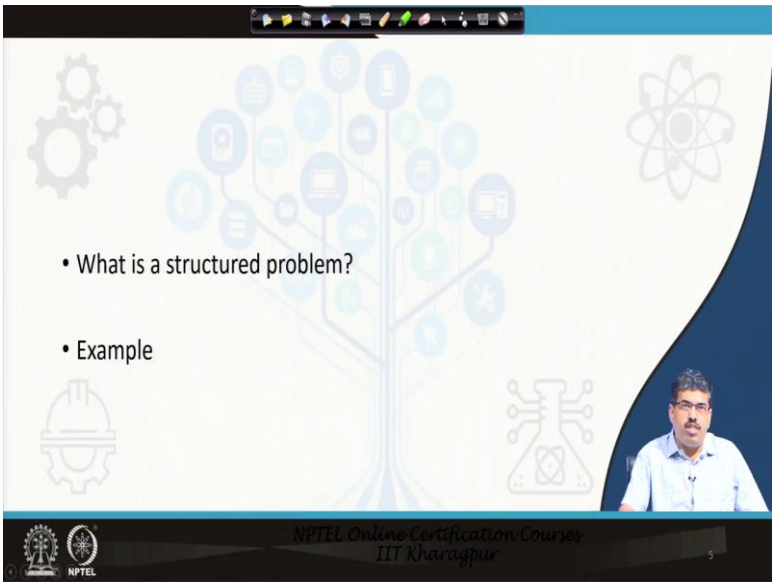

Now, what did we do in our previous lecture? Basically we have told you this, what is a structured, semi-structured and non-structured problem. This is what we have done. So, what is a structured problem?

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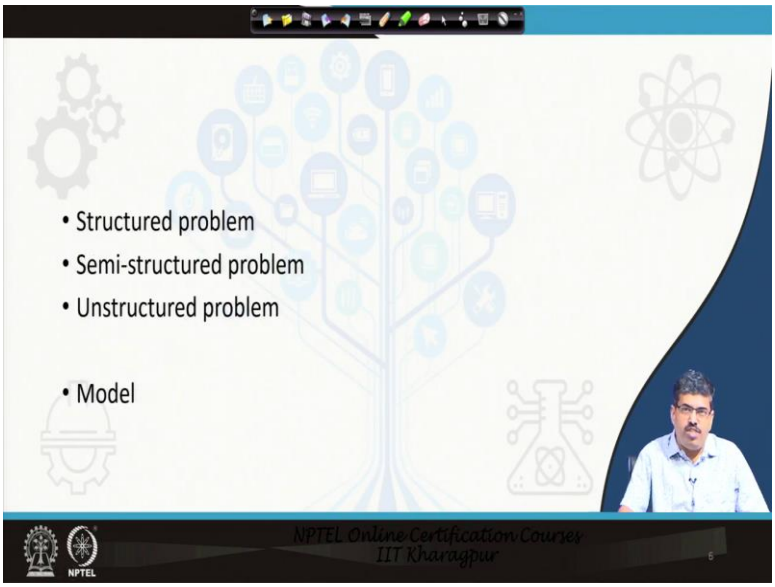

We have given examples of structured problems. For example, we have done that production problem and the raw materials problem. We have given with the example of a Rajdhani and a normal express train behind a Rajdhani; ok. And we have also given you an example of a very simple hospital costing; so, that is structured problem.

Structured problem means whatever happens, structured; I repeat structured problem means whatever the business situation you can put it in some pattern or some structure; ok.

Whatever the business situation you can put it in some pattern or some structure that is a structured problem. I do not know how many of you are earning while you are learning. If you are earning we are supposed to pay income tax to the Government of India and that tax is used for development of the country.

Now, that income tax form that we fill up when we are paying income tax that income tax form that we fill up when we are paying income tax that is an example of a very, very structured format ok. This is my income from my house; this is my income from my salary; this is my income from bank interest; this is my income from fixed deposits. So, it is very-very structured; ok. So, structured problem is as we mentioned that it falls within a particular pattern; ok.

And no matter whatever you do we can easily put it under some form ok, that is understandable, that is acceptable, so that is a structured problem. And in business world the structured problems are basically what they can be put into some mathematical model. And what is the mathematical model means it explains and it will give you the same results as we keep on doing the same exercise time and again; ok. So, that was a structured problem.

What is the semi-structured problem? As we mentioned in the hospital costing example that a patient family is asking for some discount, how do we give that discount, or how much discount can we give to the patient family.

See very simple the patient family, see, how do you, how do you solve this? Assume you were the hospital manager, and patient family has asked you that please give us some discount. So, how do you calculate, how much discount can this patient family be given? Very simple, you calculate the cost per bed per day, cost per bed per day.

And if you get the cost that is the cost of operation plus the fixed cost. If you get the cost, and if you see the price that you are charging for the bed that difference discount you can easily give. In that way your costs are recovered and the patient is also taken care of. You can also give totally free that is left to your humanity and humility both. In

case you were not authorized to do so, you can easily get the difference between the cost and the price that you are charging, and that is the portion that we can give as discount to the patient family. Now, this part is very-very structured.

But when you have a hospital where patients are being treated and released very quickly. So, there the revenue the income per patient per bed per day is very high, because a patient is coming in at 9 am and getting released by 4 pm, but we are taking the bed charges for the entire day. But another patient is coming in at 4 pm; so from him or her also you are taking the bed charge for the entire day.

So, 2 patients you are taking charge for 1 day. So, your revenue is high if your patients are moving ok. So, then what discount you can give that portion is a bit semi-structured. And unstructured as we mentioned it is a new phenomena something new has happened you do not know what to do etcetera, etcetera and so you have to take a decision based on situations ok. So, that is an example of an unstructured problem; ok.

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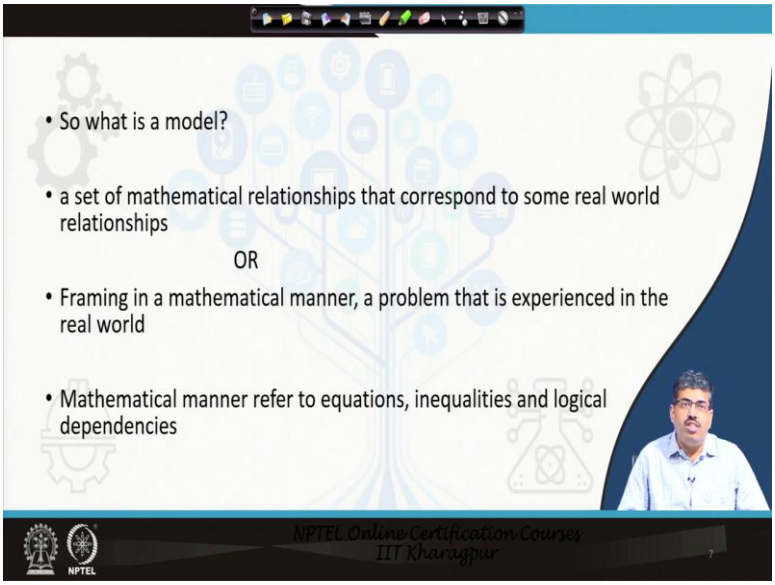

What is a model? Model as we mentioned is a set of mathematical relationships that correspond to some real world relationships, is set of mathematical relationships that correspond to some real world relationships. That is whatever we are seeing, we are putting it in numbers, putting it in some structure, and we are relating it to what happens in reality.

So, model is a set of mathematical relationships that correspond to real world relationships or framing in a mathematical manner a problem that is experienced in the real world. And what does mathematical manner mean? It refers to equations, inequalities and logical dependencies; ok.

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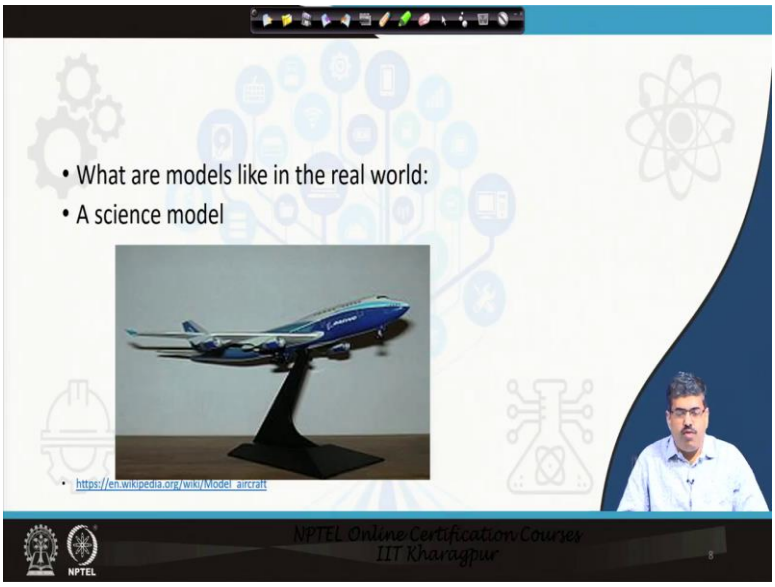

And we have given you this; what are models like in a real world. It is a science model.

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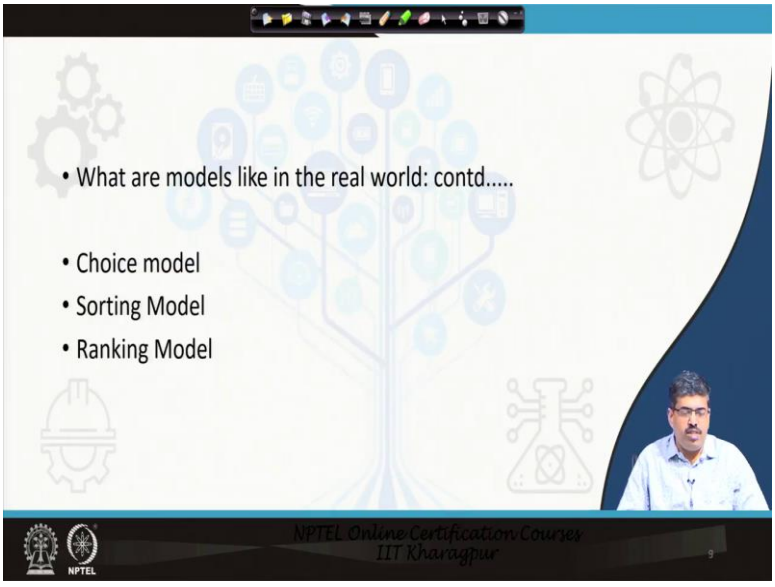

What are models like in real world; their choice, sorting and ranking models.

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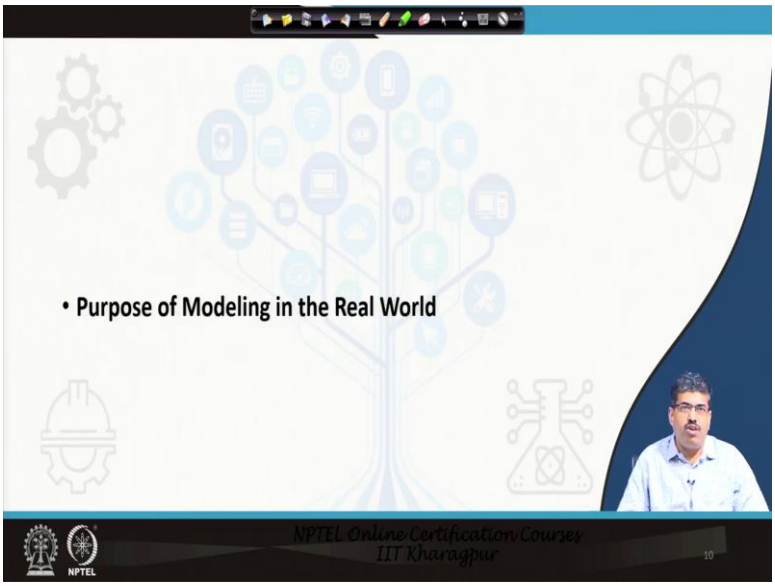

Now, what is the purpose of modeling in the real world? Why do you need a model? Because, business decisions, business problems will come, and you will have to take a decision ok. Let us take a simple example that will make things clear; ok; how do you model decisions in the real world; ok.

You see one employee is very, very energetic in an organization, very energetic. He or she comes in at exactly 9 in the morning; does his or her work very-very fast. Once his work is done or her work is complete, he will take other peoples work also and do it; ok. There are people like this.

If you go to a bank, go to a bank, and you will see notice the counters. What will you see at some counters work is going on very fast, and some counters it is slow, or it is taking time. So, basically that is what you want to say that you know some people are more efficient than the others; ok.

So, logically you should pay that employee more, but sometimes and rather most of the times what happens is that promotions are based on seniority, work experience. So, somewhere that part, that effort that the person has given that part is missing; ok.

So, if you can model the work that this particular employer at the bank counter is doing, how much time he is taking to finish a task and all these, then you can document and that will help you to take a business decision of for promotion or for paying extra money

much more convincingly and much more effectively. So, modeling is very much important in the real world; ok.

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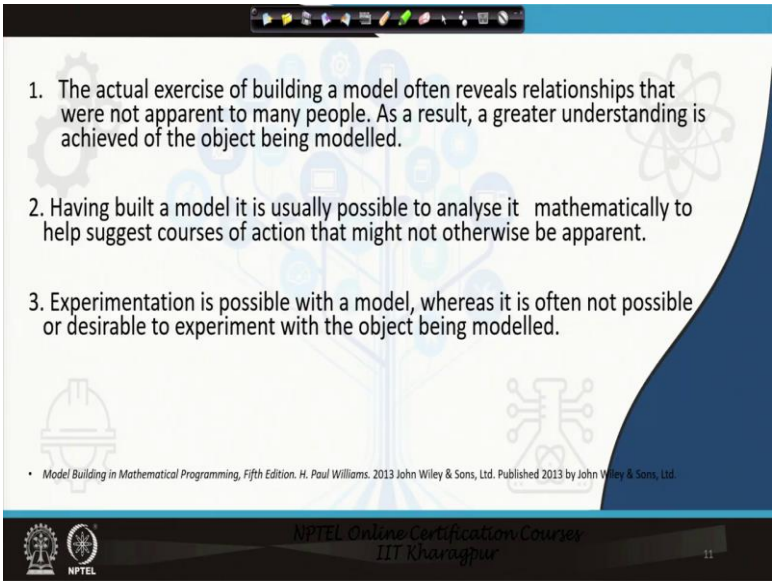

Let us take the points. The actual exercise of building a model often reveals relationships that were not apparent to many people. As a result, greater understanding is achieved of the object being modeled ok. Take an example. Let us read this statement once again.

The actual exercise of building a model often reveals relationships that were not apparent to many people. So, you are thinking something, something, something; when you actually write it on pen and paper, you see [FL], there are so many other things there that are there or [FL]. This thing I am not included. So, model helps you to look at it in a very-very objective manner. It reveals relationships that were not apparent to many people.

For example, we see sometimes a trend in some of the states in our country that land which was only producing crops for one season ok, crops for one season; balance it they did not have that capacity.

So, the rest of the seasons these workers who were employed in these fields they are working for some other in other jobs. But now you will see a trend that most of this one crop land; a single crop land, single cropping land is normally the term used most of the

single cropping land, they are now changing. They are cultivating fish in this land; fish is an all season product; right.

So, when you are building a model of projected agricultural output, projected agricultural output, what are we considering in the model, we are considering rainfall, because that will increase my output.

We are considering fertilizer that will increase my output. We are considering government, minimum support price. If support price is high, my output will increase that is the logical reasoning that once rainfall is high, fertilizers is high, government support is there my output will increase.

But moment you model it, you see there are lot of things that are unexplained. And now you can find out the reason why some output measures and not getting properly explained. And you will get to know that land, nature of land is being changed to get around the year income. So, some agricultural land is being converted.

So, output may not be the projected one, output of rice may not be the projected one. So, actual exercise of building a model often reveals relationships that are not apparent to many people; ok.

Let us come to point number 2. Having built a model it is usually possible to analyze it mathematically and to help suggest courses of action that otherwise may not be apparent. This is very simple. What this mentions this mentions that once you have a modeling place you mathematically analyze it, etcetera, etcetera so many alternatives will come to you, so many alternatives will come in front of you that you will now be able to suggest different courses of action; ok.

Let us go back to that example of production; product C and product D. You were manufacturing both products. But if you mathematically model it, you will see you might see that product A you are manufacturing this much, but profit is only the little only little much profit, little bit of profit, little bit ok, little bit. So, you might recommend that stop this product start new ones.

So, having built a model, it is usually possible to analyze it mathematically to help suggest the courses of action that might not otherwise be apparent. Then experimentation

is possible with the model, whereas, in real life it is not possible. So, always we try to build a prototype model. This is everywhere, in mathematics, in medical science, agriculture; everywhere we try to build a model, in physics; ok.

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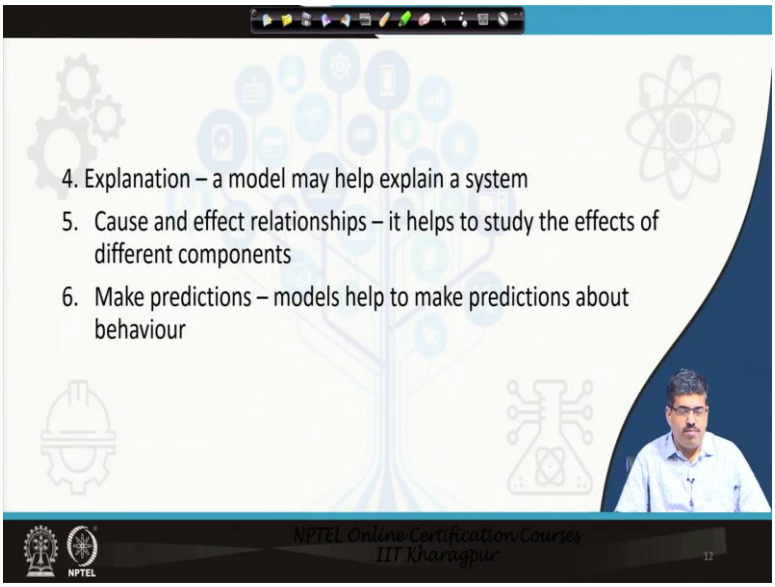

So, this is explanation. A model may explain the system. Cause and effect relationship, if you draw a model, if you can mathematically solve the model, I mean come up with a conclusion with the model, it will help you to study the effects of different components on the model, the cause and effect relationships what causes, what that you can find out.

And model helps to make predictions ok, predictions about human behavior, predictions about how much the rice quantity will increase just by looking at fields of paddy, you do not know how much production will happen next year, you will have to predict, you will have to forecast. If you do not have a model how to forecast, then it becomes very difficult. So, mathematical models have seen prediction ok. It helps to make predictions about behavior.

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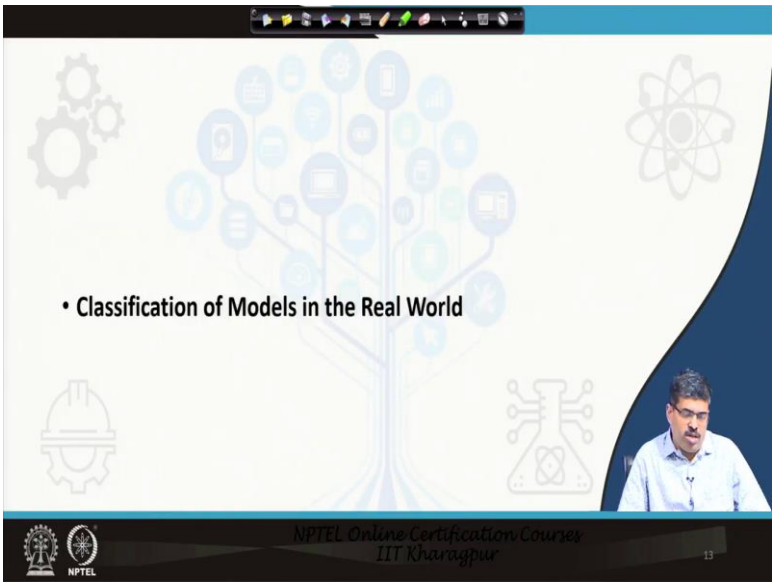

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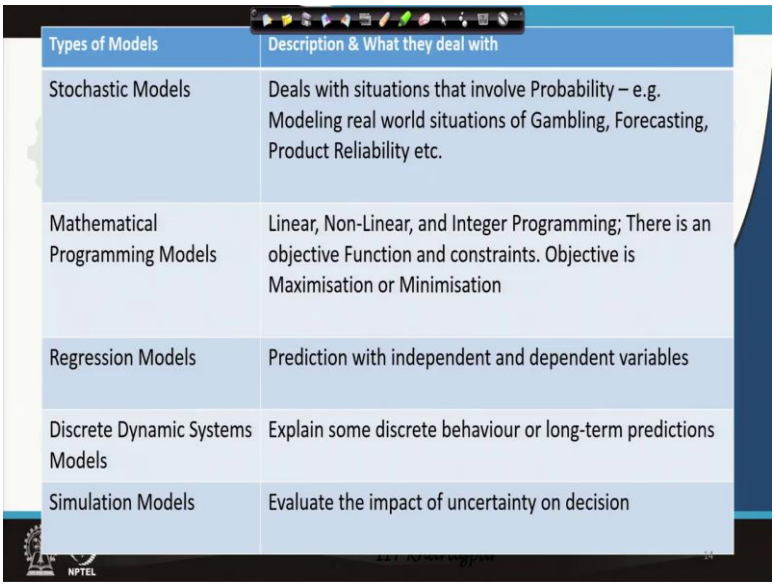

Types of Models	Description & What they deal with
Stochastic Models	Deals with situations that involve Probability – e.g. Modeling real world situations of Gambling, Forecasting, Product Reliability etc.
Mathematical Programming Models	Linear, Non-Linear, and Integer Programming; There is an objective Function and constraints. Objective is Maximisation or Minimisation
Regression Models	Prediction with independent and dependent variables
Discrete Dynamic Systems Models	Explain some discrete behaviour or long-term predictions
Simulation Models	Evaluate the impact of uncertainty on decision

What are the classification of models in the real world? How do you classify the models? These are the classification of models in the real world. Stochastic models, stochastic word looks rocket science, but it basically involves probability. It deals with situations that involve probability, example modeling real world situations of gambling, forecasting, product reliability.

Forecasting sales of a product – how much will be my sales; no one you can tell in a very-very certain manner. So, there is probability involved ok, those are stochastic

models. We will do forecasting models as time like time in time proceeds. So, it deals with situations that involve probability.

Gambling – classic example inverse probably. What is the probability that I that there will be a toss and I will win? Forecasting, what is the probability that this particular product will sell in the market. What is the product reliability? What is the probability that the product will be reliable found reliable by the customers will get back to forecasting.

Just a second what is the probability, that my movie will be a success, look at it what is the probability that. My movie will be a success you do not know, we do not know, but we have to invest 100 crore, 150 crore, 500 crore in a movie. And then on and then it is prepared, then it comes to the movie theater, cinema halls, then we know whether it will be hit or not a hit. So, probability chance ok. I will tell you a story. This was there in some book unfortunate I forgotten the name of the book.

But it was Sholay the iconic cinema or the movie of Indian cinema, Sholay. Sholay for the first 1 or 2 weeks, did not become a hit, it did not do well. And the movie distributors, film distributors were thinking whether to continue the movie in the cinema hall or withdraw it ok. Look at it a movie that has become a blockbuster first two, two and half weeks it did not run well. And the movie and the distributors were thinking whether to put a new movie in that slot in the cinema hall, and they asked for a feedback from the movie halls.

And the cinema hall owners said no let us give some time; let us give one more week. Why you know? The people outside the cinema halls nowadays in the days of movie theaters and multiplexes, you cannot imagine those days.

Where during the break intermission or interval, you know people would rush out of the doors of the cinema halls quickly by mumfali or something and again go in. So, that time there will be a huge crowd people outside and waiting rather rushing to buy something, and again go inside the movie halls; ok.

Now, these people who were selling these things they started complaining or they were complaining to the hall owner or the manager that our sales have declined, our sales have declined. What does that mean? That was an indication that people were not coming out

during the break to buy the food items that means that the movie was interesting, they were not willing to lose out on any portion of the cinema if they go outside during the break, they might lose out on some scenes of the movie.

So, they said the sales people outside they were complaining that the sales were reduce has reduced. So, that is an indication that people are in showing interest in the movie, and they decided to run it for 2 more weeks and the rest is the history of Indian cinema ok. So, this; this stochastic model, forecasting, it is very-very probabilistic; so that is stochastic model.

Then we come to mathematical programming models. Now, in mathematical programming models as we mentioned, they are very-very structured; like this happens, this will be the result; this happens, this is the formulation; ok. So, this mathematical model, mathematical programming models, they are very-very structured. What do they include?

They include the linear, non-linear and integer programming models; linear, non-linear and integer programming models. There is an objective function and constraints, and the objective is maximization or minimization ok. So, there is an objective function, constraints, objective is maximization or minimization, these are called as mathematical programming models; ok.

Third is regression models. These are very-very time tested models. And we have been learning regression for times and they have been used as a very-very beautiful predictive tool; ok. What will be the rainfall next year, what will be my rice cultivation next year; ok; so prediction with independent variables and dependent variables.

Let us give an example of the regression model. What will be my rice production next year if my rainfall increases by 10 centimeter, if my manure per square meter of land is increased by 500 grams, what will be the change or increase in agricultural output that can be predicted by regression models; ok. So, it give; it is a very-very beautiful prediction model with independent and dependent variables.

What is the dependent variable in this regression model? Rice production or rice output for rice. What is the independent variable? Rainfall, they are not, they are not dependent on anybody rainfall is not dependent on anybody, but rice production is dependent on the

rainfall. So, rice production, so rice is the dependent variable it is dependent; and rainfall is independent, fertilizer is independent; ok; so that is regression model.

Now, discrete dynamic systems model explains some discrete behavior or long term predictions. The next one is simulation models – evaluates the impact of uncertainty on decision. There is uncertainty how what will be the impact of that uncertainty on my decision. I have taken a decision, what will be the impact of that uncertainty that is taken care of by simulation. So, these are examples of types of models that are available; ok.

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Now, what with the traditional approaches to modeling and its weaknesses?

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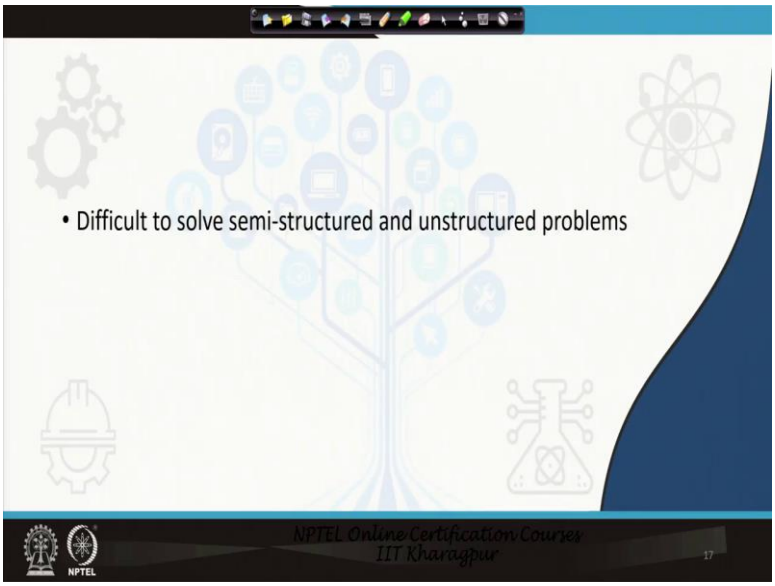

Now, traditional approaches to modeling and its weaknesses are basically, you know it was difficult to solve semi-structured and unstructured problems with the traditional approaches. As we mentioned the regression predicted with data, the regression predicted with data how much will be the rainfall if I increase fertilizers, the regression predicted that.

But if I change the taste of the toothpaste, how much will be the increase in sales, the regression cannot predict that. Regression cannot predict that part. So, it is very difficult to solve semi-structured and unstructured problems using the traditional models. So, traditional approach to modeling and its weaknesses is very difficult to solve semi-structured and unstructured problems.

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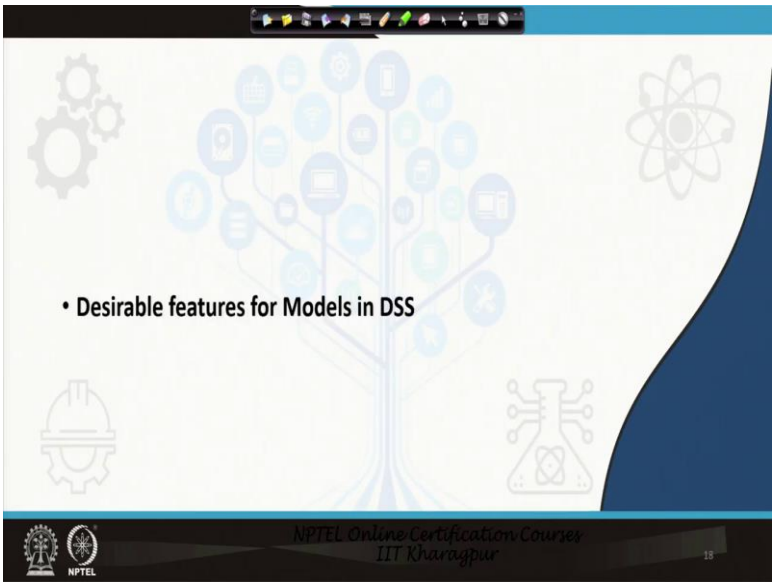

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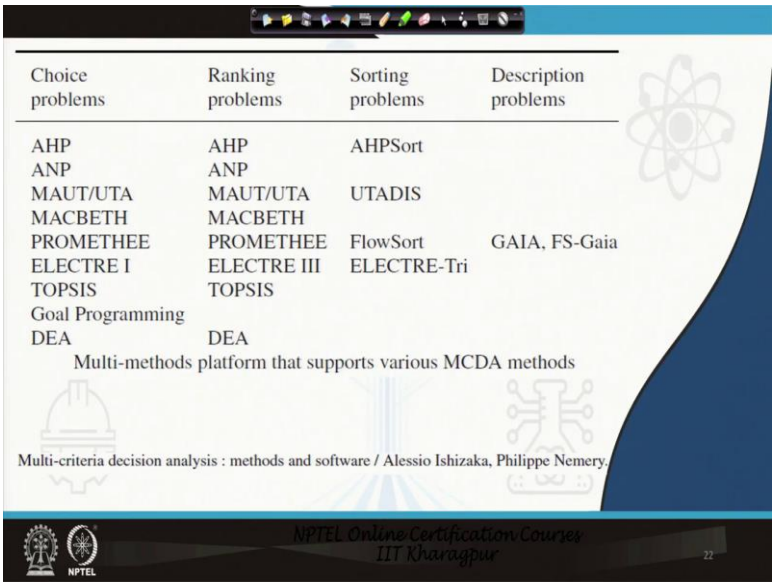

So, what has happened; a whole lot of, a whole lot of new techniques have come up. We will come back to it bit later.

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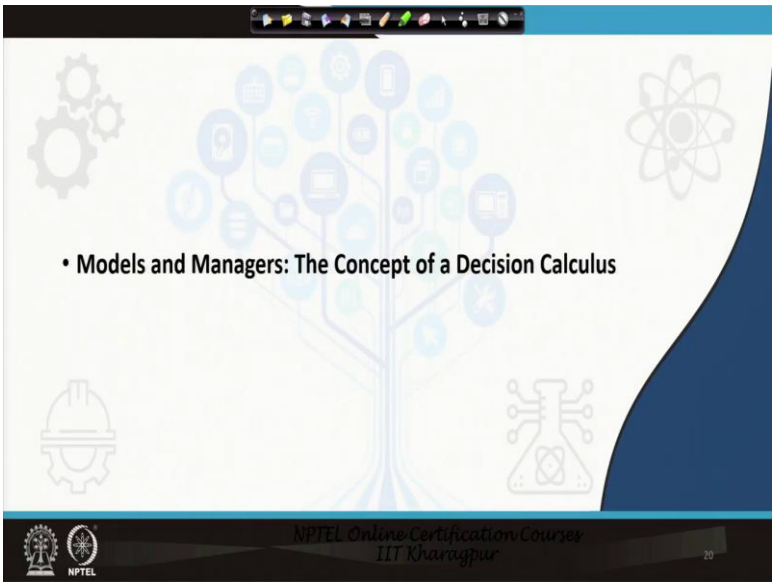

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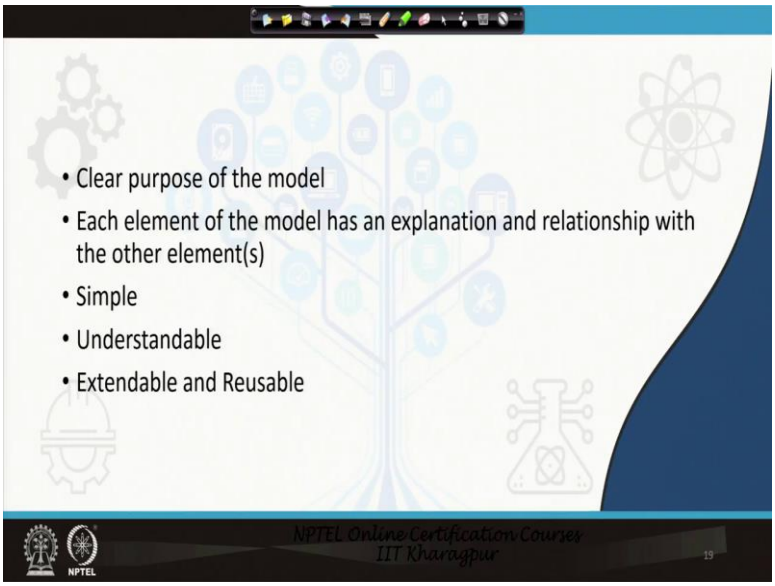

So, what are the desirable features for models in decisions of any model, decision support; there should be clear purpose of the model. Each element of the model has an explanation and relationship with the other elements. It is not like apples and oranges, model should be simple, model should be understandable and model should be extendable and reusable. I think this is true for any models.

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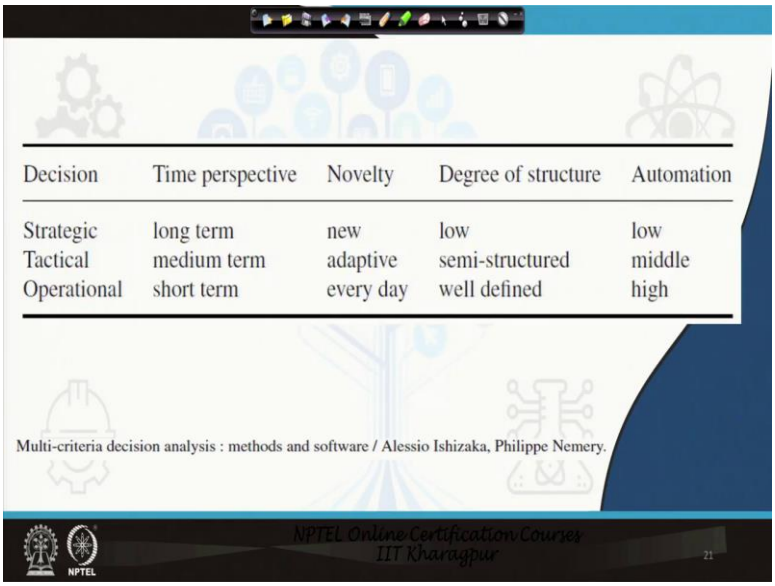

Models and managers – the concept of a decision calculus; you see what are the decisions; they are strategic tactical and operational. What are the time perspective? Strategic is long-term; it has to be new structured; it is not structured, very-very unstructured, low automation, very low, very less; because it has to come from lot of brainstorming. Tactical level that is the managerial level, it is medium-term, it is adaptive; you can adopt semi-structured and automation is medium automation.

Operational is short term, every day, very-very well defined and structured, and because it is structured you can have a very high degree of automation and that is exactly what we see today. Every production system is automatized, every production system; ok; because it is at the operational level.

These are some tools that are used at this strategic and tactical level ok. So, at the strategic which is where the where is unstructured and at the tactical where it is semi-structured. So, the unstructured and semi-structured level these are some tools and techniques that are being used today; AHP, ANP, MAUT - Multi Attribute Utility Theory, MACBETH, PROMETHEE, ELECTRE, TOPSIS, Goal Programming, DEA; ok; these are choiceful.

Remember we have use the word choice at the beginning what to choose, which employee to choose, which supplier to choose, for ranking, sorting, description problems remember we had given you these four. So, ranking; AHP can be used for ranking;

sorting; AHP sort, flow sort, ELECTRE; ok. So, these are some tools and techniques that are used at the strategic and tactical level; ok.

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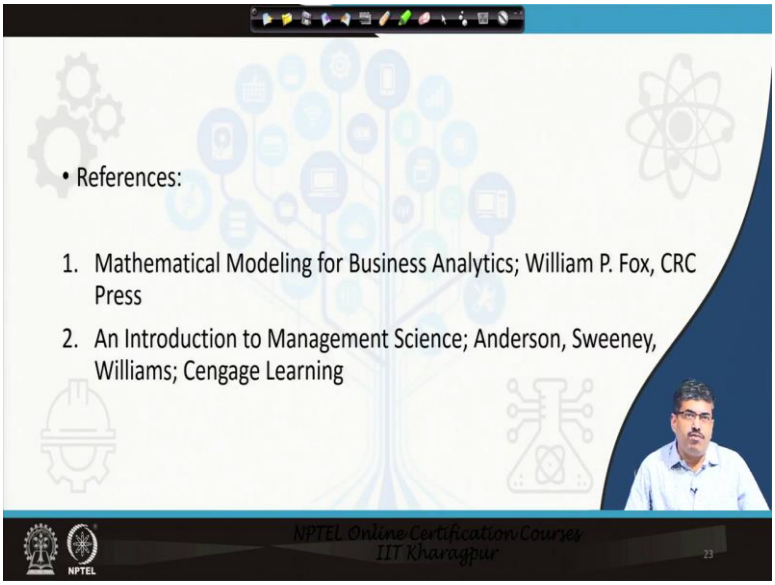

These are the references and you can go through them in case you find them handy; ok.

So, thank you!