E-Business.
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Lecture-44.
Decision Support Concepts.

Welcome back, so far we have been talking about how e-business has affected various functional areas of business. There while talking about the functional areas, we were talking about, like how technology has, the newer technologies like your data mining, machine intelligence, etc. has affected the decision-making process. We have also learned about the technologies in the last class we have been talking about technologies only. Now for couple of classes, subsequent classes till the end of this series, what we are going to look at is how this technology and various techniques, decision support techniques has affected e-business.

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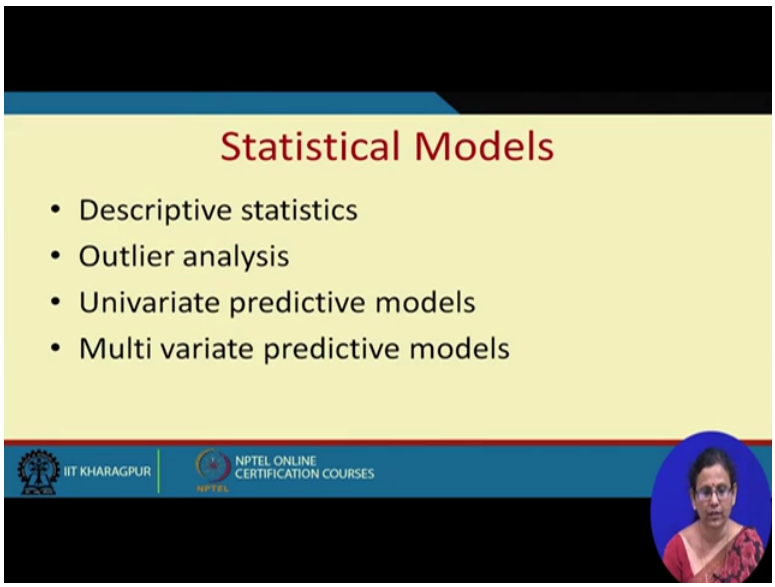

In fact in some of the earlier lectures we were discussing about decision support systems. Now if you remember about the decision support system, it is a mechanism to provide interactive and ad hoc support for decision-making process for mergers and other business professionals. So here while talking about the decision support system, let me remind you that time we were talking about 2 types of, in fact 3 types of decision-making situations. Some were structured decision-making situations, some were unstructured and some were semistructured, by semistructured we mean partially they can be structured.

At that point of time we were talking about when it is possible to automate the decision-making process, only when it is a structured decision-making situation. And as a combination of manual interaction, as well as automation, we can get unstructured decision-making situations. So in this, while talking about decision-making situation, one of the very important fact turned out is that this decision support, when we try to automate, it can be of 2 types, either we have to build the model or we have to make it data driven based on the available data.

In fact last class we were talking about the big data signatures and how big data is getting generated from sources which were not otherwise available, they were your RFID, your GPS, sensors, during this we talked about machine to machine communication, etc. So this new, also this customer data, customer of this, because of this 2.0, now customers, it is not that, it is no more one-way communication, it is not that companies will be only sending their, sending the information to the user, website user.

In fact website users have now methods to express their views in terms of blogs, in terms of feedbacks. So now this, because of this interactive interaction with the users, huge amount of specifically textual data is getting generated. So the traditional way of decision-making is getting changed because of this nature of the data. Anyway, but still we can divide these decision support activities into 2 types, one model driven, another is data driven. Now, coming to these traditional approaches, traditional situations of model driven, data driven data driven decision decision support.

For example, we were talking about using a model driven decision support system while we discuss about E procurement. During E procurement we saw that the reverse auction is something where the buyers will be able to make a competitive scenario possible for the bidders, for the sellers and the sellers will be in turn competing among themselves. And we saw at that point of time, while selecting from a set of competing sellers in a reverse auction, one has to solve an optimisation problem, is not it.

So there are many other optimisation, like, if you look at this traditional, I mean all the traditional business processes, optimisation appears in many forms everywhere. Think about your inventory, in fact if you are acquainted with operations management literature, you know that during this operation management for let us say, for your production scheduling, from taking inventory replenishment decisions, everywhere there are optimisation models to support your decision-making situations.

So there were certain couple of data driven, traditional data driven approaches as well which includes forecasting techniques. And that is again a component of the data driven, your risk analysis, those are your data driven decision support situations. But what we are going to see in couple of next lecture is that those decision support systems, those data, model driven and data driven decision support systems do exist as they are, they are in the traditional scenario. But because of e-business, many new scenarios have, new scenarios of decision support have emerged. In fact in couple of next lecture is we are going to talk about them.

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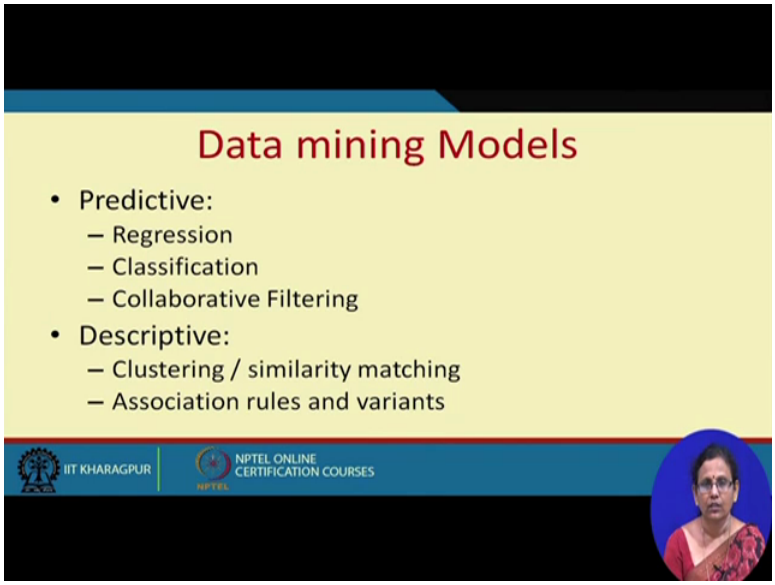

Now if you are again, to remind you, if you look at this typical component of a decision puts them, we know that at the backend we have data from various sources, it is operational data, market data, sales data, customer data and so on. Now to extract the data from all this, you have many procedures above which lies your model. So you have to even track, in a decision support system you have to have databases, by database I do not mean only DBMS, by database I mean it is like data warehouses, data from various sources and so on, even your non-traditional unstructured data.

And decision support has to have a model-base. By model-base we mean when we have a repository of model, maybe in form of computer programs or so. So those models work upon this data and generate certain output which can be used for decision-making. So there has to be a user interface to connect that, connect this model-base, model-base and database with that of the user. So here the output can come in the form of legacy software, it can be from a web-based interface or it can be a separate software as well.

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But anyway, let us just have little bit more insights about different types of analytical models that appear in the decision support system. If we look at these analytical models, here we have of course, you can see we have listed few and if you try to differentiate them. The widely used optimisation, widely used electrical model is actually or optimisation. Optimisation as has been discussed earlier, in fact discussing all these models anyway for the, for your benefit I will be giving, trying to give you certain ideas about each of these but simply by talking about this does not make much sense, unless otherwise use them.

Therefore in the couple of next lecture we are going to see how exactly use this kind of models. In fact I will try to make my lectures, in couple of weeks as simplified as possible so that without in-depth knowledge of all these techniques you are able to understand the process, that is because I never expected people to have specific kind of background but if you have a background in all this, then your understanding becomes much simpler. Or if you like the kind of problems that you are talking about, later you can think of switching, taking other courses which deal with these techniques.

So the 1st technique that is used in the analytical models is your optimisation model. This optimisation, typical optimisation model consists of one objective concern, it can be a multi-objective optimisation problem as well, there is, there will be one objective concern and there will be set of constraints. This objective concern and each objective concern will be having, and the objective concern will have a number of decision variables. So while solving the optimisation problem you find out the values of the decision variable and if these values of

decision variables are given, then your function is, the objective function is maximised or minimised depending on the situation.

Your linear programming, integer programming, all these come under this category of analytical models. While solving these kind of analytical models, these optimisation models, either use some kind of exact solution procedure that explored that, that takes into account the geometry of the problem and provides you solution that that is the exact solution. But typically for a large size of problem, finding solution will be, using the exact method will be little difficult in the sense it, they are so hard that the time taken, time and space requirement for solution will be just too high.

Here let me tell you one thing, when exactly you should be, and see developing these analytical models as well as these statistical models require a lot of effort, a lot of effort on the part of the person who is building the model, the person who is coding it, by building the model the work does not end, after building the model, again to implement the model and bring it to a model so that managers will be able to use it, using proper interface etc. requires a lot of coding efforts.

Now these efforts does not come for free, so in order to invest in this decision-making situation, when exactly you should invest, as the company, when exactly you should invest in this decision-making building models and creating such support systems. 2 things can be kept in mind here, 1st if the model is for a repetitive work. If repeatedly you have to take that decision, then building the model and putting all kind of efforts in terms of time and money is worth doing, that is number-one.

2nd situation is it may be built once but the situation, but the decision-making situation is so important and it means and being it cost-effective and finding the right solution is so important for the future of your company that you would not hesitate to invest. But anyway, we were talking, coming back to the original discussion, we were talking about the optimisation. Optimisation many times, they becomes with thousands of variables, thousands of constraints, a typical industrial optimisation comes to be. So in such situations, many times to finding the exact solutions because of time and space complexity is not desirable.

In those cases, many heuristic solutions and specifically meta-heuristic like that of your genetic algorithm, ant colony optimisation, etc., those are used. By meta-heuristic we mean it is a heuristic but it has a kind of structure and that structure, unique structure and that unique

structure can be exploited in the large variety of problems. So heuristic, heuristics if you talk about only heuristics, therefore a specific situation, for a specific model but in meta-heuristic, it has a generic structure which can be exploited in many different kind of solving many different kind of models.

So those are, those genetic algorithms, ant colony which are basically nature inspired algorithms, etc., those are, those belong to, those can be called as intelligent way of solving the problem. They try to see make, they try to proposes, propose a methodology which a human being otherwise doing mathematics might be adopting to solve the problem intelligently. The next category is your simulation. The stimulation models are actually built to recreate a situation which otherwise exists or likely to exist.

Think of, you are going to decide the flight landing sequence in an airport, when the flights come, how long they have to stay in the sky, when they will land, how long they will be allowed to stay in the airport and so on. So the flights will be coming one after the other, their arrival, they have a specific arrival rate, they have a specific arrival pattern and specific departure pattern. So considering all this, a typical airport flight scheduling activity can be simulated.

So these simulation models, then once they are built, then they are validated with the corresponding real situations, it is not that always the, again totally once again, always the real situations do not exist, many times real stitches actually come into picture when the models are built. So from these simulation models again you can try to make different situations and to observe that are under that situation, under that scenario what is the outcome and accordingly you take the decision.

Next category of analytical models are consider probability of various activities and probabilistically they try to propose, they are called decision analytic models, probabilistically they propose if something, if something happens with, what is the probability of some event happening and what should be the corresponding activity. Then these models can be either static or dynamic, by dynamic we mean they take time factor into consideration. Similarly the models can be deterministic or stochastic. So these models can be deterministic if the model parameters are known with certainty or there is uncertainty associated with the model parameters.

Let us for example consider your finding out how much order to place to a specific, to, in a particular procurement scenario and your demand is uncertain. So the demand, when you provide input, it becomes a variable which is random, it is a random variable, it can take any value. So their models can be either stochastic models or it can go deterministic. Now when we talk about the deterministic models, were the model parameters are supposed to be known a priori, most of the situations, they are actually estimated, estimated from the past data or from the experience of the decisionmaker.

So if they are estimated and their value is likely to change, then after solving the models, the variations of these, the model is experimented with the variation of the parameters and certain and you call this process as sensitivity analysis.

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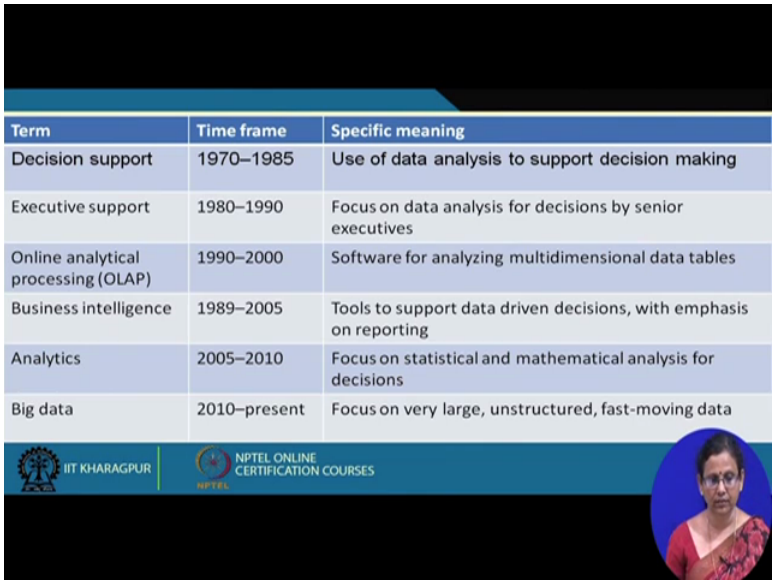

Then, next category models are actually your statistical models. These traditional statistical models provide you, 1st of all whenever you have any data, in fact now people are talking about data mining and other big data kind of modelling situations, but always remember one thing, whenever you have data in hand and specifically about the numeric data or the text data converted into numeric form, the 1st task is to know your data. In order to know your data, you have to find out the descriptive statistics associated with the data.

So this descriptive statistics, this data which can be either univariate or multivariate, the descriptive statistics can be mean, variance, Standard deviation, skewness, kurtosis or in case of a multivariate, it can be correlation or covariance, etc. Once this and before and from this descriptive statistics, you will be able to realise the data that you have got is a good data or

not. By good data we mean if the statistical see, the statistical analysis that people, that usually people use are based on certain assumptions. Let us say you have the data, in fact most of the traditional statistical models assume the data to be normally distributed.

If it is not, then appropriate transformation has to be done or some of the data need to be removed which actually do not go along with the remaining data, those are called outliers. So this outlier analysis either you remove the outliers or outliers themselves represent a group of elements which carry special meaning. So outlier analysis is a very important thing in statistical, during statistical modelling. Then you have protective models like your univariate regression etc., you have multivariate predictive models, multivariate regression, you, I mean there are other kinds of related models and variations of these techniques as well.

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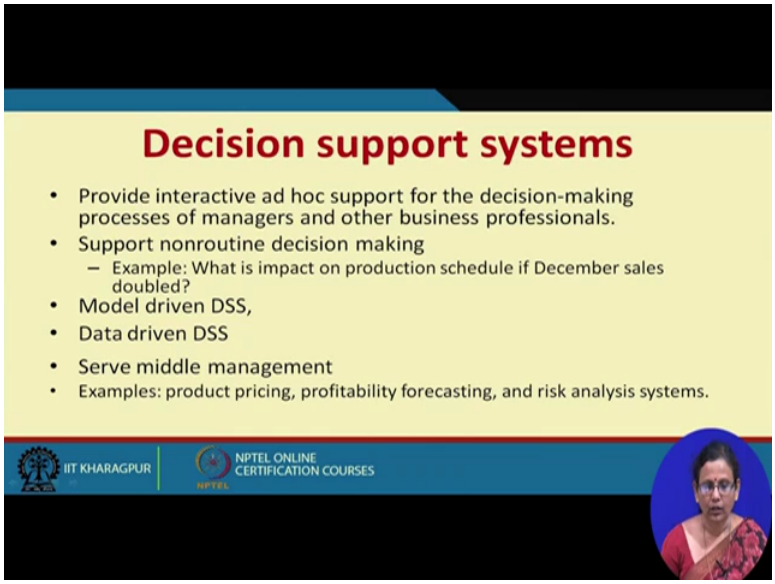

Then more recently, see in case of statistical models you have the data and you know what kind of output you expect and accordingly you build the model and try to find out the best model which fits into your situation. But there are many kind of model in which many kind of models in which you need to discover the knowledge and which can be used discover the knowledge which is otherwise hidden within the data. So these data mining models, regression which is a traditional, data mining people have also adopted it, basically this is of 2 types, one is descriptive which is about classification, various classification algorithms, algorithms which can be either supervised or unsupervised way of classifying things, your neural network, support vector machines, all those stuffs come here.

There is another category of predictive algorithms like that of collaborative filtering which specifically has come up in the context of recommended system. While talking about recommended system, we are going to talk about these algorithms, this collaborative filtering algorithms and many other algorithms also will try to include. Then you have some descriptive models which is about like your mostly you like a string which is mostly a unsupervised, unsupervised algorithm of grouping the data. Then you have Association, rule mining and its variants.

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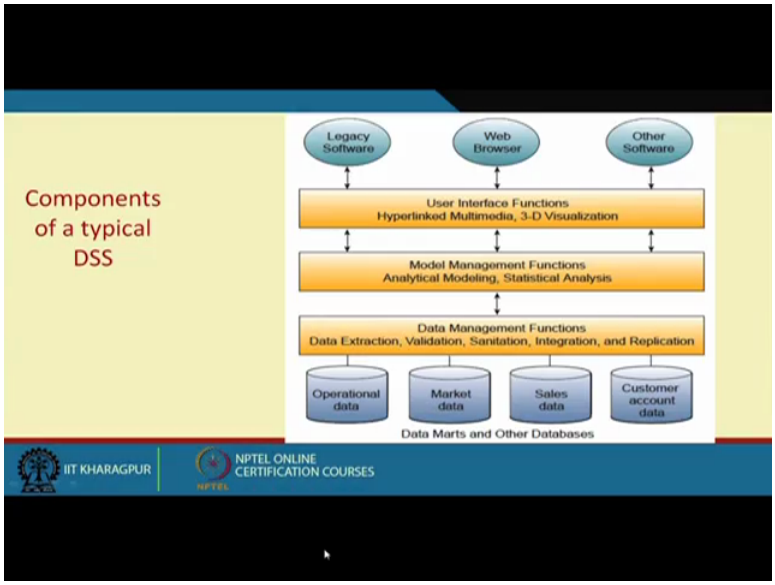

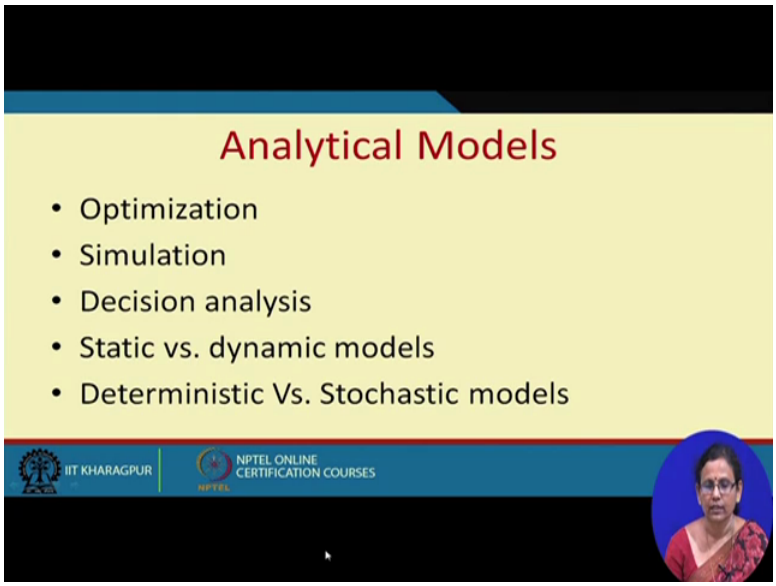

Then a variation of this data mining, not exactly variation, it is it is actually taking these techniques, applied to text data after doing some kind of natural language processing and discovering its features, then you apply various techniques, data mining techniques only to

discover hidden patterns within the text. In fact these data driven techniques, though we are talking them in the umbrella of decision support, over the years various names have been associateed with this.

In fact there is a very interesting book by Thomas Davenport on this big data and how to use, how to harness on the big data, how to make the big data useful for your company, there actually has given these particular descriptions that how this terminology has been changing over the years. During 70s and 80s, the term decision support system started, people started using which was using data, which was providing this data analysis support for decision-making along with this disinformation, while talking about various types of Information Systems support as well.

Then during this information, while talking about various types of Information Systems, we are talking about executive support system where the data from various sources was coming to the senior executives to make, to support decision in the sense they were not provide, they do not provide any solution, rather they make the solution process and show different situations, different, getting data from various sources using which a senior executive can have his own decision in a semi structured manner.

Then we, that also we were talking about this OLAP, this was about multidimensional data tables, in fact the earlier people used to have only database management system which was about two-dimensional tables + multidimensional tables. Then people a talking about business intelligence which was again a set of tools which were using this data mining kind of, data mining and machine intelligence kind of algorithms. Then people started talking about analytics which was focusing on the use of statistical, emphasising on use of sound statistical and mathematical models and interpreting them.

Then about the big data last class we were discussing, it is about using huge amount of data which are very unstructured and fast moving. And in fact now people are taking decisions, doing data fusion from various sources. Okay, with this we finish this particular lecture, next class we will be actually seeing these tools and techniques in practice in some of the e-business kind of, some of the situations which have emerged because of this use of information and communication technology for automating business processes, that is e-business, thank you very much.