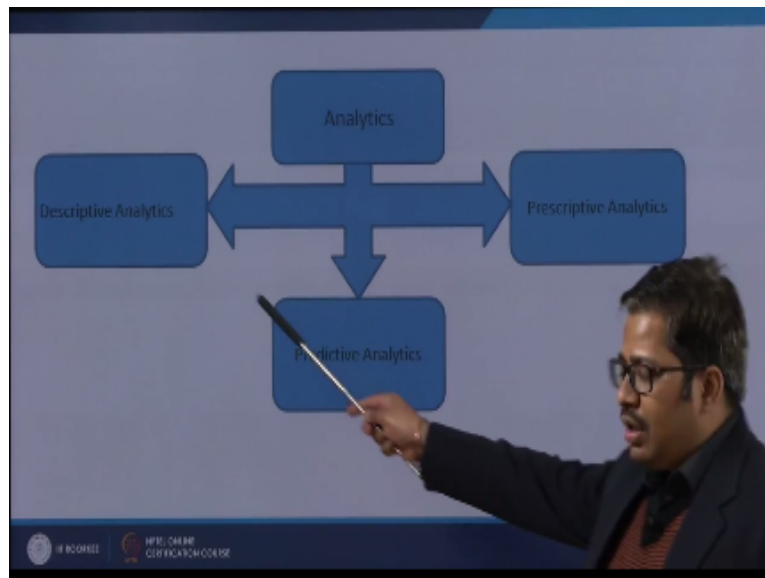


Supply Chain Analytics
Prof. Dr. Rajat Agrawal
Department of Management Studies
Indian Institute of Technology-Roorkee

Lecture-33
Different Types of Analytics In Supply Chain

Welcome back friends, we are discussing the role of analytics in supply chain analytics in supply chain title of this Medicos know let us discuss that what are the different types of analytical approach is which are possible and what type of decisions is different analytical approaches will help us in case of supply chain.

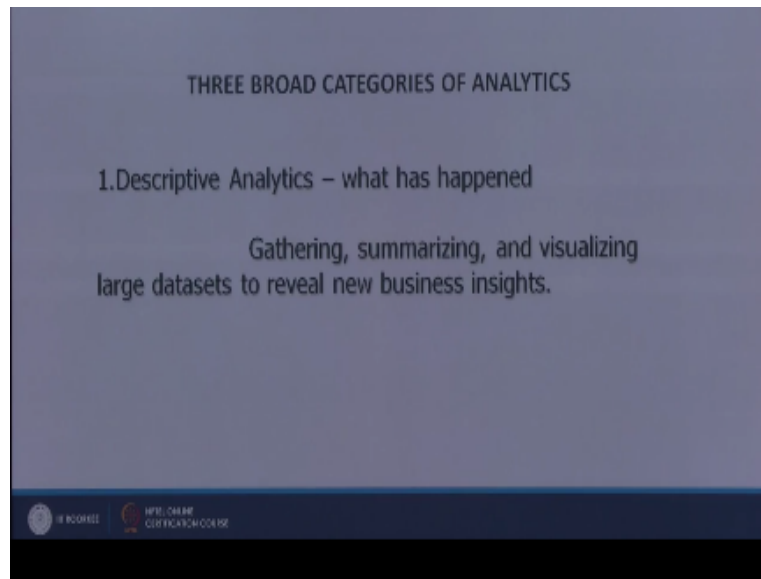
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Now you can divide the analytics into these three types of analytics descriptive analytics, predictive analytics and prescriptive analytics. In this session today we will discuss what are the different characteristics of these three types of analytics and in our last many sessions whatever we have discussed, so what can be classified under descriptive analytics, what can be classified under predictive analytics and what is descriptive analytics.

So now this is something which will help us in understanding the use of various software tools and in which particular segment of decision making which type of data is required what type of report is required and what type of problem solving approach is required.

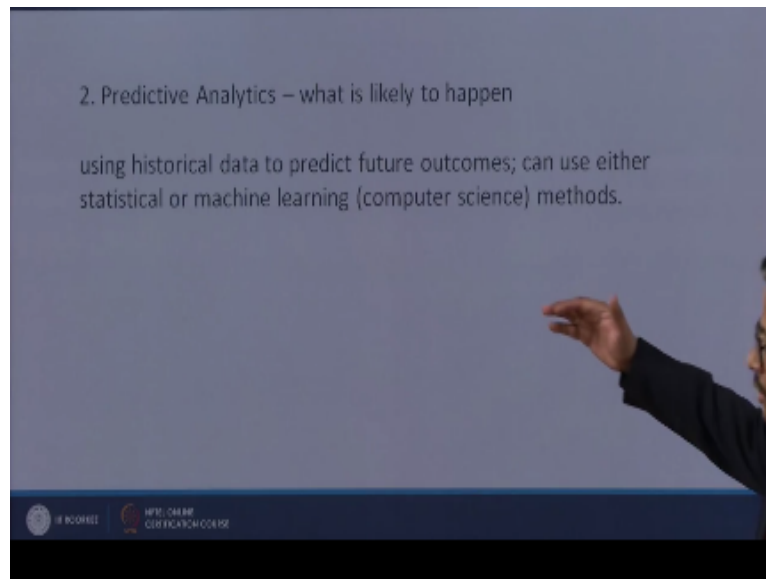
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Now the descriptive analytics that is the first type of analytics we know, so now the one line answer for descriptive analytics is that what has happened, to know that what has happened that is descriptive analysis, you are describing a particular situation, so what has happened the story about that situation is your descriptive analytics, so narrative a particular environment is descriptive analytics.

So this is the first type of analytics that collecting the information and telling that what has happened, now in this particular case you gather data, you summarise the data and visualise large data sets to reveal new business insights, because what has happened on the basis of that you are trying to get new business insights, so this is one type of analytics, so the most important thing is gathering and summarising out on the basis of that summary of large data sets you try to get some kind of new business insights.

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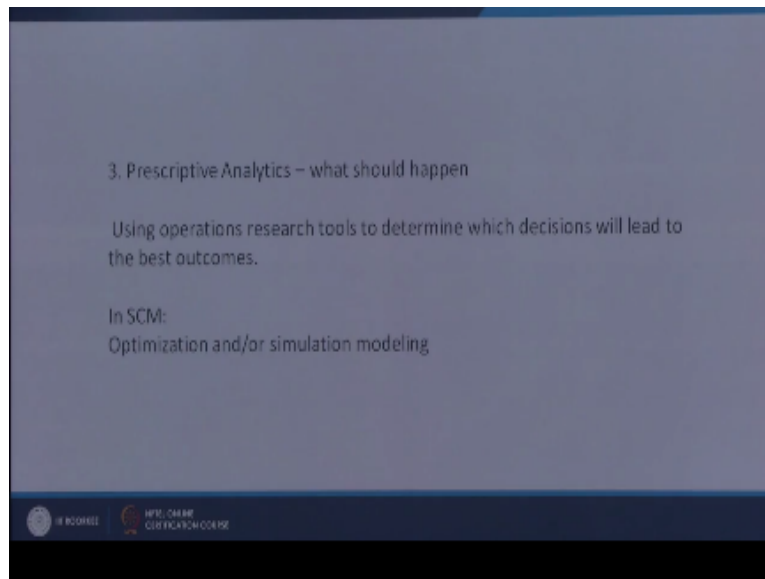


The other type of analytics is predictive analytics, what is likely to happen to predict about the future, so one thing is what has happened, the other thing what is going to happen. In this case descriptive data using historical data that is the descriptive data to predict future outcomes that what can happen in the future. If you remember that in our forecasting discussions we have done lot many cases of time series analysis.

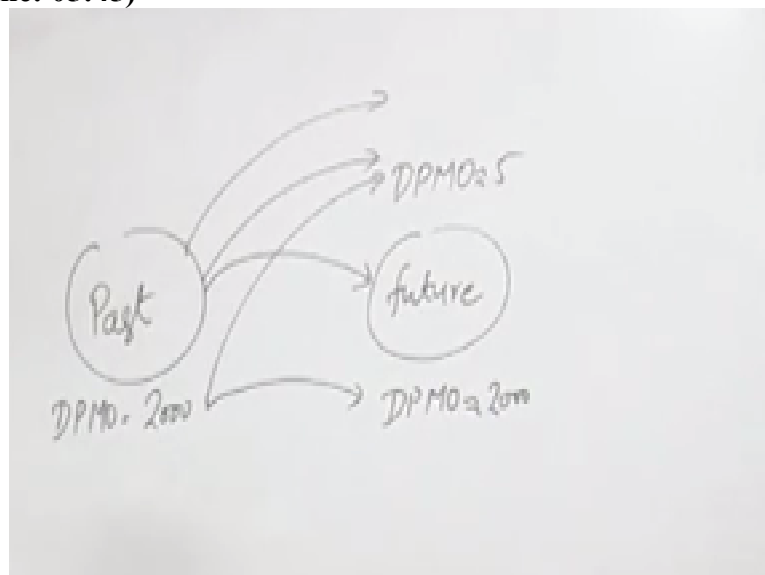
Where we have historical data and using the historical data that demand was this much in a particular period the demand is this much in a particular period and so on we are predicting the future outcomes, we are extrapolating that what has happened in the past similar things will happen in future also and that is very very important that you can predict the future on the basis of your historical data. So this predictive analytics will tell you that what is going to happen in the future.

And it can use either statistical learning which we have done when we have solve the questions of forecasting, when we have done the inventory analysis, so all these things are the statistical way of handling the predictive analytics or you can also use machine learning where you go with the help of lot of algorithm, developed in the computer science and with the help of those I got up you try to predict the future. So that is the second type of analytics.

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The third type of analytics is the prescriptive analytics, one thing is there that is about past that is your descriptive analytics, on the basis of this past what can happen in future that is your predictive analytics, but what should happen, one thing is this is a natural course of action if this past the same trend is going in the future, so you will go to this. But what should happen we always look for a higher performance better performance.

So how goes better performance can take place that is what should happen that is me prescriptive analytics that if I am let us say having in my supply chain the defects per million opportunities that is one parameter DPMO defects per million opportunities. The current level of DPMO supply chain is somewhere around 2000 so I will say that same level will continue in coming period also.

So my predictive analytics DPMO is 2000, descriptive analytics told macro environment, so that I am not doing anything special, so in the future also DPMO will remain around 2000, some natural variations will take place but it will remain around 2000, but the prescriptive analytics because it is using operation research, it is using how you can improve your system ,what should be the ideal sign, what is the optimise condition of the system.

So if I go with the prescriptive analytics it will say that you should achieve the DPMO somewhere near 5, you are having so many defensive your million opportunity why don't you go to the Six Sigma level that is we optimise level of defects in an opportunity, so the use of prescriptive analytics will help us to get the best outcomes, so these are three levels of analytics, the easiest the most common form of analytics which we all see that is descriptive.

Just giving a brief detail or as per the situation the complete narration about the something which has happened, then the predictive analytics since in every election we feel a condition of anti incumbency, so in this election also anti incumbency will be there and therefore there are chances that ruling government will be changed by the opposition, but if I see from the ruling government side how I can change this phenomena.

How can I improve my performance, so that the issue of anti incumbency will not be there so that is the descriptive analytics, so these are three forms of our analytics descriptive, predictive and prescriptive and we have also understood that in which particular situation means what are the different characteristics of these three types of analytics approaches.

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	Descriptive	Predictive	Prescriptive
	What HAS happened?	What COULD happen?	What SHOULD happen?
What the user needs to DO	<ul style="list-style-type: none"> Improve cross-channel fulfillment and shipments Improve fulfillment, transport and inventory costs 	<ul style="list-style-type: none"> Predict infrastructure failures, forecast facility space demands Predict costs and profits by customer, product, transportfulfill and inventory stream, forecast profits and margins Predict capacities by customer, product, transportfulfill and inventory stream, forecast capacities 	<ul style="list-style-type: none"> Increase asset utilization Optimize resource schedules Remain agile and competitive Increase asset/inventory utilization Optimize efficiency and supply-demand in place with skills
What the user needs to KNOW	<ul style="list-style-type: none"> The number and types of asset failures Why transportation costs are high The value of the multi-party inventory 	<ul style="list-style-type: none"> How to anticipate sales/shipments for specific channels and assets/facilities When to consolidate underutilized facilities or to expand them How to determine and segment costs to improve service levels and cost (CTS) How to determine/rank baseline and future scenarios and costs to improve service levels and cost (CTS) 	<ul style="list-style-type: none"> How to increase asset production Where to optimally route service technicians Which strategic facilities and DC/network plans provide the highest long-term utilization and flexibility
How analytics gets ANSWERS	<ul style="list-style-type: none"> Standard reporting - What happened? Geographic issues - Where exactly is the problem? Ad hoc reporting - How many, how often, where? 	<ul style="list-style-type: none"> Predictive modeling - What will happen next? Trends Forecasting - What if these trends continue? Simulation & Segmentation - What could happen? Control tower process, Alerts - What actions are needed? 	<ul style="list-style-type: none"> Optimization - What is the best possible outcome? Scenario variable optimization - What is the best outcome given the variability in specified areas? Current State and Future State modeling and CTS engineering What is the best profit and logistics flow for each product and segment ?
What Leaders do to make this POSSIBLE	<ul style="list-style-type: none"> Alerts, reports, dashboards, Business intelligence 	<ul style="list-style-type: none"> Predictive models, forecast, statistical analysis, scoring Trend in mix of transport lanes and modes. Forecasting - What if these trends continue? 	<ul style="list-style-type: none"> Business and process rules, organization models, cooperation, optimization Closing the Loop on Planning and Execution Supply Chain Agility and Efficiency

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In understanding this 3 analytics from this table is a very useful table for us because it tells you that what are the needs of the user and what user needs to know and how analytics can answer these requirements of the user and then what leaders to do make these things possible on the basis of these 4 things we will see the comparative discussion about descriptive predictive and prescriptive type of analytical approaches.

We have taken this from a source which is our the group and they are one of the pioneers in using analytics for the supply chain, so this is particularly we have adopted from this source. Now what the users needs to know users to increase cross-channel fulfilment and shipment, that is what users need to do, reduce the transportation cost, the inventory cost, the order fulfilment cost. These things user needs to do.

Then user wants to predict was to predict about infrastructure, user wants to know about the forecasting related to space and facility demands you so stupid it cost and profit by customer product transportation fulfilment, inventory stream forecasting related to profit and margins, users also wants to predict capacities by customer, product transport, fulfilment, inventory stream and forecast capacities.

So users want to predict these things, and user want some kind of optimised solution to increase asset utilisation, optimise scheduling of the resources, remain and guy and competitive, increase asset and inventory utilisation optimise efficiency and supply demand in face with the ships, so all these things you need to do irrespective of whether this is to be done by descriptive, or to be done by predictive or by prescriptive.

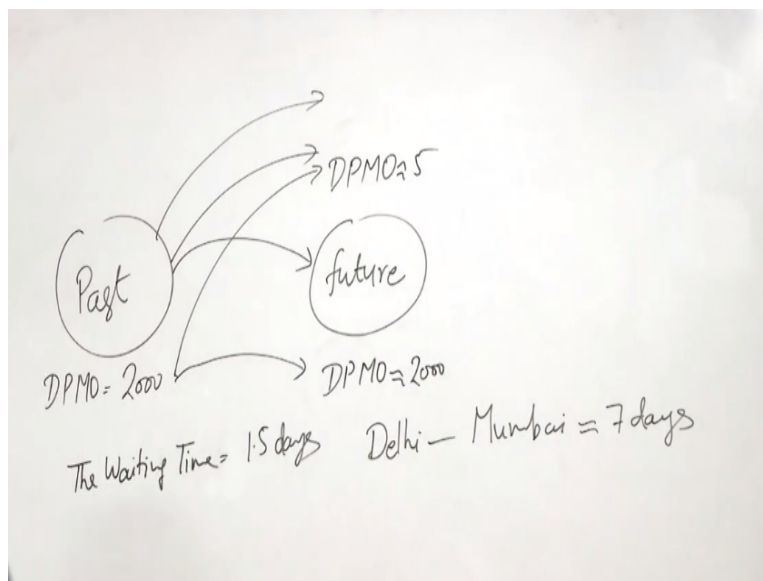
Now you can also to understand this all these things can be plotted in a sequence also and then we can classify out of that long list that yes these 2 things can belong to descriptive analytics. These two things and belong to predictive analytics and this where you want some kind of solution where you want to have some kind of solution related to optimisation these things long to prescriptive analytics.

So on the basis of that we have already categorised that what the user needs to do, these are the things which form of descriptive analytics, these are the issues where we want to predict something obviously these things are the part of your predictive analytics and for those things

where we want some kind of optimal solution in my supply chain, these are the part of prescriptive analytics.

Now what they user needs to do with respect to these things, now you can follow these columns top to bottom, so with respect to these things which need to do you, user needs to know the number and types of assets for here which can which has happened why transportation logistics cost are high, what are the reasons that my transportation and logistics cost are high. Now I need to collect data if I am talking on this particular aspect that why my transportation and logistics cost are high.

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May be I need to calculate the waiting time if my truck is moving from Delhi to Mumbai, now in movement from Delhi to Mumbai how much waiting time my truck is incurring because their maybe traffic jams, there may be some kind of toll system, there may be some kind of other accident, some kind of prepared incidences also and all those things make out for 1.5 days of waiting time.

The truck took from Delhi to Mumbai maybe around 7 days and in that 7 days 1.5 days are the waiting time, so now I need to know these things if I want to see that why transportation and logistic cost are high, so if I have this data with me that 1.5 days are wasted in waiting only, so how can I minimise this waiting time that answer will come in the prescriptive analytics, but first I need to know that what has happened.

So I came to know that on an average my truck harvesting somewhere between 1.5 days to 2 days if they are going from Delhi to Mumbai in waiting only, so that is a non value adding activity at all these non adding value and nonliving things are increasing the cost of my operations and therefore we will see that we need to eliminate these kind of non value added things from my system.

So this is one example but there can be many items in my dashboard which can be attributed for higher transportation and logistic cost, maybe my truck had fail and because of that my maintenance issues may be highlighted because I am not doing right kind of preventive measures and therefore more breakdown maintenance is are taking place and as a result of breakdown maintenance I am incurring loss of due dates that I have to pay penalty for that purpose.

And that is also higher transportation and logistic cost. So all the items what all item I can think of whatever the point of generation of those data information that I need to list and then only new insights can be available from the same data, it is very very interesting that same data is there but some of us may be able to find new insights from the data and some of us may not be able to see something interesting from the data.

So it is important that descriptive analytics where it looks very simple that it is simply the presentation of data but at the same time if we can visualise that last data set properly certainly new business insights may come from the same data and that is what we are going to see. We also want to know the value of multi party inventory, we have inventory not only from one source in a supply chain we have inventory from variety of sources and we need to know that what is the value of inventory from different different sources.

And therefore we can apply concepts like ABC analysis which will come to prescriptive analytics. So you need to know the value of multi party inventory and this list is not exhaustive by the way you can add many more parameters many more items which are very important from your point of view like in this case I have not added one particular factor that how many times you have given late supply to your customer.

That can also be a very interesting parameter now days because delivery speed is becoming day by day a very important criteria, so in last one year that 30% of the times I was defaulter

I delayed by more than 2 days, 10% of the time are you delayed my supply by more than 4 days, so this type of data is also required in some cases, in some cases not be required. So how many times you defaulted on the schedule delivery dates that is also important.

Then how analytics gets the answer all these things you need to see first standard reporting system, what has happened, simply the presentation of data that these are the waiting times, these are the defects per million opportunities, these are the times and so on whatever is there in your dashboard, so you need to give a fair description of all the data points that is standard reporting.

So earlier in organisations we used to have a very detailed logbook type of system and in that logbook we used to enter so many information and this information was circulated to top management of the organisation so that was the system of reporting. That my scheme automation started and as a result of automation we started using computers for giving quick information to all the persons to be reported in that particular report.

So it created it enabled faster reporting of the descriptive analytics, then you can also prepare query and drill down reports. So this query and drill down report will help you to identify the exact location where people. In my supply chain from initial vendor to the customer there are many stages from initial vendor to final customer care many stages, you have a manufacturer, you have a warehouse, you have a wholesaler you have retailer and then a customer.

So there are many stages and to exactly the prescription you need to know where is the problem is a location of problem, so it is very similar to Medical Science when you have the exact location of the problem then only you can provide proper prescription. Otherwise you will be doing a lot of hit and trial and it will take lot of time to get the location of the problem and to prescribe it properly.

So query drilldown type of reports will help us in locating the problem where it is and then sometime not always some Ad Hoc reporting is also possible intermediate reporting you can say these are also required in some emergency kind of situation that how many how often where from very specific information in a limited format, these type of things are also given in emergency situation.

For that purpose if you can see the case of humanitarian supply chain, disaster supply chain, in these types of supply chains Ad Hoc reporting may be required and in this ad hoc reporting you give specific information about this kind of data that how many units are required, how often, where what is the frequency where you need that type of medicine where you need that type blanket or other food items or other kind of help etc.

So that type of Adobe reporting is also part of your descriptive analytics. Then what leaders do to make this possible as I was discussing we need to see what are the alert items, you need to create some kind of signals in your supply chain which can give you some kind of alertness. So whenever something you may be knowing because we have already discuss the inventory systems, when we discuss that basically POQ model. In that basic POQ model you remember that we have a point of reorder or OP. So nowadays we have a system of common as soon as you reach to that reorder point all of a sudden that green can one comes into picture.

And it signals that now material is required, so that is a kind of alerts signal whenever you are driving a scooter and petrol is below a particular mark you get an alert that your metre start coming into the red side, so that you know that it is time to replenish the fuel and these type of things are required some regular reports are required you need to have some kind of dashboard items, you need to have a screen in your office and that screen will have various dashboard items.

And using this dashboard items you can continuously monitors the progress pure supply chain and business intelligence can be used for that purpose for creating the dashboard items for generating the reports on the basis of your past happening. So that is all about descriptive analytics, but all these are very mechanical activities mechanical means these are very routine type of query, but now my exposure my experience will help me to find something new, something interesting from these reports.

We know the same test is being conducted by different doctors, but the specialist doctor the doctor who has better exposure she can find the exact source of problem, exact location of problem with the same amount of information, with same ultrasound, with same x-ray, with same scanning and a doctor with less exposure may not be able to find the problem, may not be able to understand the location of the problem etc.

So therefore these reports can help a manager with wide exposure to develop better insights or who understands the supply chain, who understand that market, who understand that product in a better way than a manager who is not so expert, that is about descriptive analytics, coming to the predictive analytics, in this case we want information for future, based on these descriptive activities we want to predict for the future and it is more like a forecasting activity.

So you want to know anticipate sales shipments for specific channels assets facilities that how many products I will send through rail, how many products I will send through road, how many product I will send through air etc, so using different specific channels when to consolidate underutilized facilities to expand the uses of them, I want to know that, I have so many facilities in my supply chain.

Some facilities are warehouses, some facilities are factories, some facilities are my description points. Maybe all the facilities are not properly utilise, so I also want to know when to consolidate some of these facilities which are underutilized, so that I can have a better use of those facilities, how to determine and segment cost to improve service level. I want to improve the service level of my customers, my down supply chain.

And how to segment cost for that purpose that is another thing which I want to determine and that then how to determine and rank baseline and future values to improve service level. These things are also part of my predictions for the future and for that purpose for knowing these things for protecting these things for the future the analytics will help with the predictive that is the most commonly used word and time and again we have use the predictive modelling.

That what will happen next and then we do the trend forecasting in the same trend continues what is going to happen, we will do stimulation, again based on the past data you have some observations of the cost and basis of those observations we will do the simulations exercises and with the help of that leaders do to make it possible that we create different types of predictive modelling, better algorithm.

So that we are more accurate about the future, we try to mix different types of trends, and different types of you can say characteristics of our historical data to the more closer to the future, and all these things will help us continuously lot of mathematical researchers are involved to develop the methods models of predictive modelling for determining the issues which we want to know which we want to do under the predictive modelling.

And then coming to prescriptive analysis where we want to optimise the use of resources and for that purpose we want to increase the asset utilisation, we want to increase the our customer service level, we want to reduce the wastage and for all that purpose we are using optimisation, the operation research tools are the best solution for the prescriptive analytics, you do the optimisation what is the best possible outcome.

Earlier in the classroom discussion we used to do optimisation in a paper, but nowadays very good softwares are available and because of availability of good enablers the optimisation or you can say use of prescriptive analytics in supply chain is continuously increasing. The optimisation and then for the purpose of what leaders need to do we need to see that what are the rules of the business.

When we are doing optimisation we take lot of assumptions, try to simplify the real world so that a particular mathematical model can we develop, but the knowledge of real world game business and process rules will help us to organize our models closely to the requirement and then the mathematics the prescriptive analytics will give us better results which are more responsive which can help us achieving both these things simultaneously, agility which is responsive how fast you are responding to the customers requirement.

And efficiency in minimum possible cost because these are the 2 important objective of the supply chain, the whole discussion is revolving around this 2 words. Our ability to respond to the customer requirements to clean and then how much lowest cost you can fulfill the requirement of the customer, so both these things can be simultaneously achieved if we use proper optimisation model with more real-world conditions.

So in this way we are clear about descriptive analytics, predictive analytics and prescriptive analytics, with this want to close this session and in our next sessions we will go that how

predictive analytics in supply chain can be used for the forecasting purpose. Thank you very much.