



IIT ROORKEE



NPTEL ONLINE
CERTIFICATION COURSE

SUPPLY CHAIN ANALYTICS

Predictive Modelling in Forecasting in Supply Chain

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Introduction to PredictiveModelling

Predictive analytics makes use of historical data and various algorithms to intelligently predict the outcomes of various what-if scenarios. This level of predictive analytics looks at all the possible situations within demand planning, costs, profits, inventory optimization, logistics and transportation and much more. Predictive allows organizations to better anticipate anomalies through their supply chain network and respond appropriately given past conditions. To name a few, businesses are able to determine shipments, consolidate underutilized capacity and even rank various future-looking scenarios.

However, to make predictive analytics reliable, additional external data streams are required. Still quite new to supply chain organizations, predictive analytics have been proven successful in supply chain planning.



How Predictive Modelling Works ?

Predictive models use known results to develop (or train) a model that can be used to predict values for different or new data. Modeling provides results in the form of predictions that represent a probability of the target variable (for example, revenue) based on estimated significance from a set of input variables.



Why we are using Predictive Modelling ?

Though predictive analytics has been around for decades, it is a technology whose time has come. More and more organizations are turning to predictive analytics to increase their bottom line and competitive advantage. Why now?

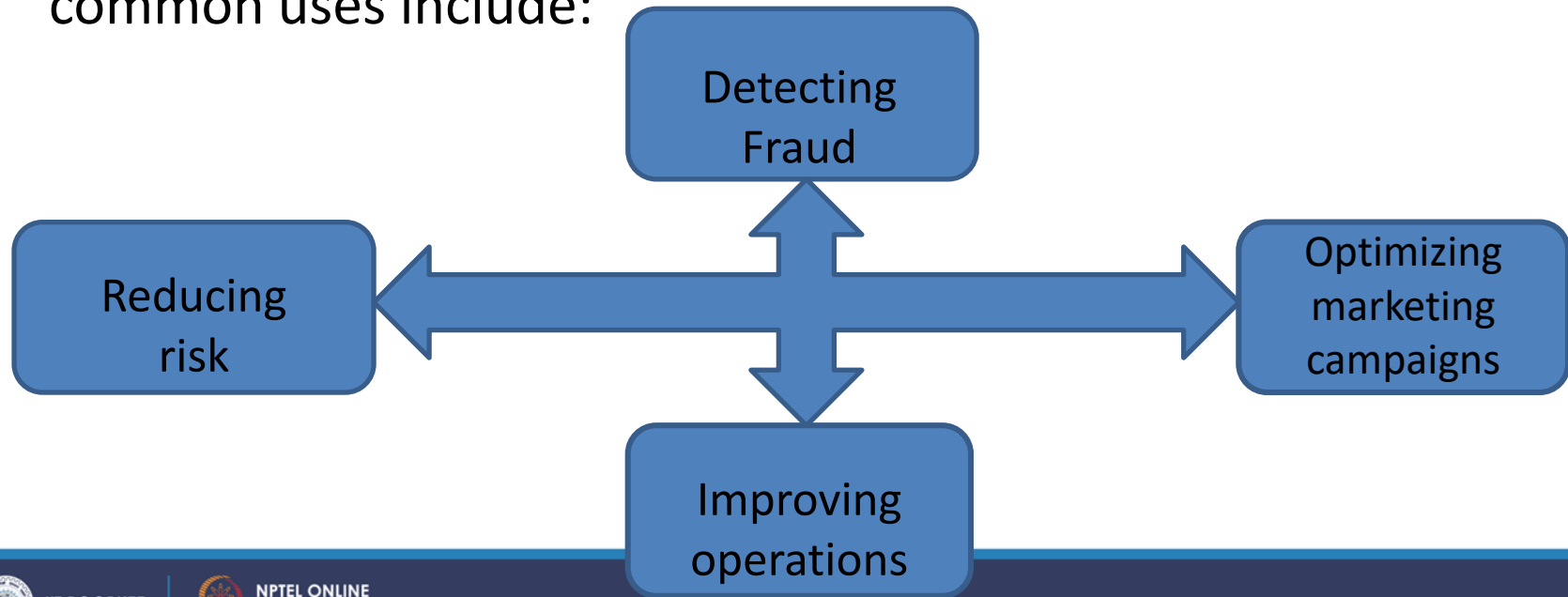
- ✓ Growing volumes and types of data, and more interest in using data to produce valuable insights.
- ✓ Faster, cheaper computers.
- ✓ Easier-to-use software.
- ✓ Tougher economic conditions and a need for competitive differentiation.

With interactive and easy-to-use software becoming more prevalent, predictive analytics is no longer just the domain of mathematicians and statisticians. Business analysts and line-of-business experts are using these technologies as well.



Why Is Predictive Analytics Important?

Organizations are turning to predictive analytics to increase their bottom line and competitive advantage. Some of the most common uses include:



- ✓ **Detecting fraud.** Combining multiple analytics methods can improve pattern detection and prevent criminal behavior. As cyber security becomes a growing concern, high-performance behavioral analytics examines all actions on a network in real time to spot abnormalities that may indicate fraud, zero-day vulnerabilities and advanced persistent threats.
- ✓ **Reducing risk.** Credit scores are used to assess a buyer's likelihood of default for purchases and are a well-known example of predictive analytics. A credit score is a number generated by a predictive model that incorporates all data relevant to a person's creditworthiness. Other risk-related uses include insurance claims and collections.



- ✓ **Optimizing marketing campaigns.** Predictive analytics are used to determine customer responses or purchases, as well as promote cross-sell opportunities. Predictive models help businesses attract, retain and grow their most profitable customers.
- ✓ **Improving operations.** Many companies use predictive models to forecast inventory and manage resources. Airlines use predictive analytics to set ticket prices. Hotels try to predict the number of guests for any given night to maximize occupancy and increase revenue. Predictive analytics enables organizations to function more efficiently.



What Do You Need to Get Started Using Predictive Analytics?



The first thing you need to get started using predictive analytics is a **problem to solve**. What do you want to know about the future based on the past? What do you want to understand and predict? You'll also want to consider what will be done with the predictions. What decisions will be driven by the insights? What actions will be taken?



A graphic consisting of a red oval with a white background. Inside the oval, the word "step" is written in a black, cursive font, and the number "2" is written in a bold, red, sans-serif font below it.

step 2

Second, you'll need **data**. In today's world, that means data from a lot of places. Transactional systems, data collected by sensors, third-party information, call center notes, web logs, etc. You'll need a data wrangler, or someone with data management experience, to help you cleanse and prep the data for analysis. To prepare the data for a predictive modeling exercise also requires someone who understands both the data and the business problem. How you define your target is essential to how you can interpret the outcome. (Data preparation is considered one of the most time-consuming aspects of the analysis process.)

Step 3

After that, the predictive **model building** begins. Increasingly easy-to-use software means more people can build analytical models. But you'll still likely need some sort of data analyst who can help you refine your models and come up with the best performer. And then you might need someone in IT who can help deploy your models. That means putting the models to work on your chosen data – and that's where you get your results.

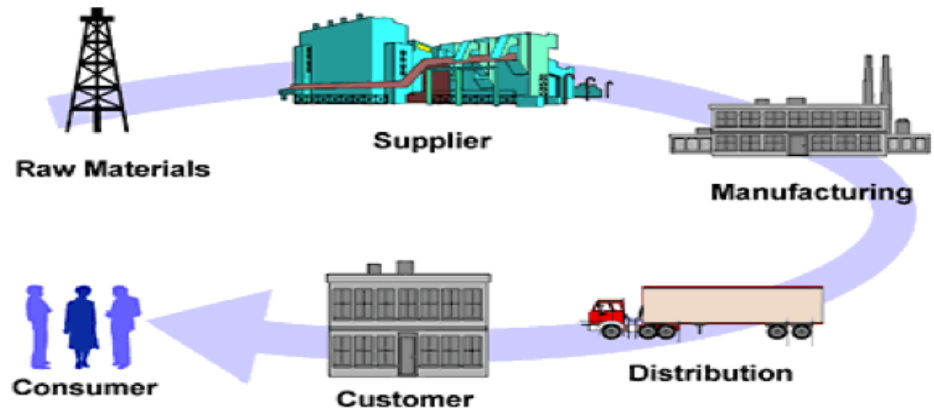
Step 4

Predictive modeling requires a **team approach**. You need people who understand the business problem to be solved. Someone who knows how to prepare data for analysis. Someone who can build and refine the models. Someone in IT to ensure that you have the right analytics infrastructure for model building and deployment. And an executive sponsor can help make your analytic hopes a reality.

Predictive analytics are increasingly important to Supply Chain Management making the process more accurate, reliable, and at reduced cost. To be at the top of your game as a supply chain manager you need to understand and utilize advanced predictive analytics.

Steps in Supply Chain

1. Procurement
2. In-Bound Logistics
3. Parts Inventory
4. Manufacturing
5. Finished Goods Inventory
6. Fulfillment (customer's order to delivery)
7. Out-Bound Logistics



For example,

Using historical data we could determine that a part takes on average X days to arrive and even calculate standard deviations to make some fairly sophisticated adjustments in our procurement plan.



Likewise on the demand side, we could look at historical demand data and try to extrapolate demand into the future, converting that to forecast production requirements and backwards into procurement and logistics requirements.

From a predictive analytics perspective, about 90% of the problem is forecasting, starting with the demand forecast and letting that trickle back through the process to procurement and logistics planning.

There are long term forecasts that are more like broad risk assessments to try to evaluate **whether our customers will continue to want our product (or will it become obsolete when they change to a wholly new solution)**. There is also the downwards view of this same question, **are our suppliers sufficiently stable to be able to continue to provide critical resources that we need.**



As you approach the near term forecast the details become more complex. While longer term forecast can be seen as fairly smooth, short term forecasts suitable for supply chain control need to **take into account a whole host of smaller variables unique to each stage in the process. These may be weather or holiday related, allow for specific promotional campaigns, known changeovers in logistics or production, respond to anticipated increases or decreases in costs like freight, or other delays.** In short, forecasts suitable for supply chain direct control are anything but simple.

If you've spent time in data science the one thing that should jump out at you is that across all the uses of data science, probably 80% of those have to do with predicting or influencing human behavior. What's unique about supply chain analytics is its dependence on forecasting models.



Targets for Predictive Analytics in the Supply Chain

Demand Analytics – How is my forecast tracking with actual sales.

- ✓ Detailed demand forecasting at the level of point of sale (store level, retailer, distribution channel roll-up)
- ✓ Deviation analysis of forecast versus actual at the SKU level.
- ✓ Forecast integration with promotional events and holidays to fine tune the forecast.
- ✓ Impacts: forecast accuracy, in-store availability, lost sales.



Finished Inventory Optimization – What stock should I hold and where should I position it.

- ✓ Inventory budget optimization
- ✓ Safety stock level recommendations
- ✓ Segment inventory for tailored and customized fulfillment strategies by customer type.

Impacts: inventory cost, customer service levels.



Replenishment Planning Analytics – What, when, and where should I ship.

- ✓ Integrated planning at the retailer, distributor, and channel level.
- ✓ Optimize fulfillment logistics to account for handling, storage or warehouse constraints.

Impacts: in-store availability, customer service levels.



Network Planning and Optimization – Do I have the right network of manufacturing and warehousing facilities.

- ✓ Number of physical plants for manufacture and warehouse.
- ✓ Optimized flow paths to fulfill different segments of customer demand at the lowest total cost.

Impacts: Fixed and variable costs of operations.



Transportation Analytics – Optimizing transportation routes and loads including contract compliance.

- ✓ Optimizing routes including backhaul.
- ✓ Optimizing shipment schedules.
- ✓ Maintaining compliance with transportation contracts.

Impacts: freight costs, equipment utilization, contract compliance.



Procurement Analytics – How to achieve lowest landed cost and secure long-term high quality supplier partners.

✓ Scoring models for vendor quality, cost, and stability.

Impacts: total landed cost, security and quality of the supplier chain.



THANK YOU

