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**Business Analytics in R&D**

Research and development (R&D) is work that targets the innovation and improvement of products and processes. Whether the industry that research and development is being used in is Technology, Healthcare, Automotives, or education, R&D is important because it provides powerful knowledge and insights that eventually leads to improvements. These improvements contribute to efficiency, costs reduction, and can even answer the questions that humans, businesses, or the world has. According to an article published in 2014 from fortune.com, “The Global Innovation 1000, a list of public companies that spend the most on innovation, invested a record 647 billion dollars in 2013.” This was an increase of 9 billion dollars from 2012. This statistic peaked my interest and I wanted a more accurate statistic of how much was being invested in Research and Development. According to the article, Global Research and Development Expenditures: Fact sheet, from the congressional Research Service, “Research and Development expenditures have more than tripled in current dollars, from 675 billion to 2.4 trillion dollars in 2020.”. This is an insane statistic because this number was recorded before the COVID 19 pandemic. During the pandemic, Companies made a rapid shift for their employees to start working from home. I believe that WFH has an association with money being spent on having people research because WFH made it possible for people to research at the comfort of their homes. This made it possible for researchers to have more time to try and answer questions about the pandemic. The world dealt with a pandemic, and no one had an idea as to why this happened, how to solve this pandemic, and how to prevent another one. But with time, resources, money and research, the world was able to get these answers and control the pandemic. Researchers use 3 types of Analytics to answer questions when conducting research, They use Descriptive, Predictive, and prescriptive analytics. I’m going to explain how these types of analytics make it possible for people that work in research and development do their job.

Descriptive analytics, extracts information from raw data appeared in any type of report. These reports can come from any type of industry, for example: health, business, tech, etc… These reports usually show raw data of anything within an industry for example, a health care’s raw data report can be of a patient’s health and how there doing over time, a business’s report can show the business sales or customer information, a technology report can show how the performance of every specification being tested is preforming. The information from these raw data reports can help give managers and organizations insights about there business. A business can see which products are selling and which products aren’t, a hospital can see which patients are improving from giving them certain drugs vs other drugs, a tech company can see which algorithms are preforming appropriately and which aren’t… it gives steak holders and organizations a better understanding of everything happening. Raw data reports are often not pretty to see. They can come in large excel files with a lot of missing data, confusing, useless, or repetitive columns and can be overwhelming for regular people to interpret. Therefore, companies have data engineers who clean the raw reports and give the clean data to analysts so that they can make visualizations for everyday people to interpret. These visualizations can shape the quantitative data and include simple graphical or geospatial displays, like boxplots, histograms, bar charts, line graphs or different types of maps. In addition to these visualizations analyst can include summary reports like a 5 number summary, which show: Min, Q1, Median, Q3, and Max of a numeric attribute, alongside a visualization so that an everyday person can get a complete understanding of a figure being represented.

In research and development, Descriptive analytics is used in the same way it would be used in any industry. In Covid research, descriptive analysis is used in a variety of ways. Like I said, descriptive analytics can be used for geospatial purposes. A researcher can get a data set regarding people that are infected with COVID 19 and then that researcher can make a simple map that displays where there are high concentrations of the virus and where there is not many COVID 19 cases. The analyst can then add a table that displays all the towns associated with the state that the map was made for and sort the table by the # of cases. Combing the Table and visual map together, make it vital for a regular person because from this research, that used descriptive analytics, a regular person has the resources available to them to help them make informed decisions. For example, say that this research developed and deployed an online article that included the choropleth map and table for a state’s COVID 19 cases. A person goes on their google news application and the algorithm suggests the researcher’s article. The person on the phone opens the article and immediately goes to the table provided, made by the researcher, and the person searches the town he lives in. The person learns that the town they live in does not have many cases. He then looks at the map (hopefully the choropleth map is easy to understand) and learns that neighboring towns to the East of his town have a high concentration of cases. This person now has information to make an informed and smart decision of where he might want to go grocery shopping this weekend. Usually, this person goes to a Walmart East of his town because of proximity but, now with all the knowledge he now has from the researcher’s research, this person has decided to go the Walmart West of his town, that’s 10 minutes further away the original Walmart, to avoid an area with a high concentration of COVID. These are the type of decisions that descriptive analytics can help make.

From the example above, it is easy to interpret that Descriptive Analytics is an important part of analytics that contributes to Research and Development. However, descriptive analytics can only achieve so much when it comes to Research and Development. What happens when the U.S. economy has been severely affected by this COVID 19 pandemic and a business is no longer producing as much profit as it used to due to the increase price of material and other attributes? We’ll that’s when Predictive analytics comes in to play to help business’s make predications and decisions on how increasing the price of certain things can affect a particular product or their business. According to SaS.com, a statistical analysis application tool website, “Predictive Analytics is the use of data, statistical algorithms, and machine learning techniques to identify the likelihood of future outcomes based on historical data. The goal is to go beyond knowing what has happened to provide a best assessment of what will happen in the future.” Predictive Analytics is awesome, at least to me, because it is main job of a data scientist. A data scientist is a person who does everything regarding research and development for a company. They receive raw data, clean it, turn it into something useful by creating visualization and getting insights about data (maybe making visualizations with overlayed variables (target variables) to see how 2 variables affect one another), and then create a model, if needed, to solve or predict a problem a company might have. In research and development predictive analytics can be used in any domain. Say that the industry using research and development is sports. The sports industry can use their research and development team to investigate any type of question they might have. For example, in baseball, the research and development team, can use predictive analytics on two different domains: On the field and off the field. On the field, researchers can predict what a players output for hitting a ball given a certain number of variables might be. For instance, the baseball team can control all their players like lab rats: what they, how much sleep they’re receiving, how many times a week they lift/practice and see if any attribute or list of attributes are associated with a players swing hit rate. A quick made-up example I could think of is if a researcher uses a simple or multiple linear regression model to test this. The target variable would be the # of times a player hits a ball while batting. The predictor variable would be the number of times a week a player goes to the weight room, and to make it a multiple linear regression, and the number of hours of sleep. The researcher wants to see what the optimal amount of sleep and lifts it for their players to get the most optimal number of swings at a game. The researcher then begins to input numbers for # of hours slept & # of lift went to and the researcher gets an output for the different numbers that he inputs. Once, the researcher tests all of the reasonable and possible numeric options for his model, he has an answer to optimize the team’s batting performance. The researcher could also test for the significance of all his variables with the regression tests to see if he should even be considering certain variables. Numeric inputs aren’t the researchers only method in regression. The researcher could also add a dummy variable like does the player eat vegetables (Y/N). Adding this extra variable can affect the significance of other variables so the researcher would have to test for that. The researcher could also change the whole dynamic of his researcher project by turning his model into a classification model, he could decide to build a CART model that tells him what specific attributes are associated with a high swing rate. The researcher can then give all the information he’s discovered to the coach so that the coach can implement and develop these things for his players. Hopefully, in my hypothetical scenario, the baseball team incorporates the research suggestions and the baseball teams players swinging rate improve.

After reading about Predictive and Descriptive Analytics, one might believe that those two options can suffice a Researchers need. Descriptive analytics primarily focuses on what already happened in the past. Predictive analytics tries to find correlations and significances to make future projections. But what about the why… What about effectively estimating causality between different events? Well, that’s what Prescriptive Analytics is. According to Stichdata.com, “Prescriptive analytics relies on artificial intelligence, and the subfield of machine learning, which encompasses algorithms and models that allow computers to make decisions based on statistical data relationships and patterns.”. What this means is that Prescriptive Analytics helps researchers make sense of the relationship between variables using statistics. This type of analytics is important in Research and Development because, it helps researchers understand the relationship between things. An example of how prescriptive analytics Is used in the real world is from Tech companies. Tech companies like Amazon use machine learning in their everyday use. Amazon has a ton of listings on its website, and it uses algorithms to help customers pair certain products with other products based on patterns from other customers. This can be an example of prescriptive analytics, although the prescriptive analytics is being used at an artificial intelligence level and not a level of a regular person using prescriptive analytics to make decisions, AI is doing this simultaneously to increase amazons’ profits. This form of machine learning, which is a form of prescriptive analytics, is working nonstop on amazon’s website: using the pattern of customer items bought and recommending other customers some of the purchases others have made. I’ve fallen for this before: I went on amazon to buy a pair of dumbbells and lifting chalk was a complementary item that showed up on the “Frequently bought together” section of their website. Prescriptive is an important part of Research and development for the sake of optimization. In this example, Prescriptive Analytics was used to optimize the number of products that where purchased on the amazon website.

I hope that from reading this essay, you were able to understand how the three types of analytics is used in research and development. Descriptive analytics helps looks at past information, predictive analytics looks at predictions before anything is implemented in researcher, and prescriptive analytics looks to optimize things in research. With the amount of money being spent on research and development it is crucial that the 3 forms of analytics are used for optimization, comparison, and preforming predications before committing to something that might not work out.

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