QURIOSITY

QUANTINUUM MONTHLY NEWSLETTER

ANALYZE . MODEL . EVOLVE

QUANTINUUM @SIMSR

EDITOR'S NOTE

Welcome to the latest issue of Quriosity, the monthly newsletter of Quantinuum!

Our objective of creating Quriosity newsletter is to educate and attract young minds to the rapidly growing fields of data analytics, data science and quantitative methods.

To fulfil this objective, we publish up to date articles on diverse topics along with practical tutorials, latest news in data science, brain wracking puzzles and much more. This way the magazine aspires to be vibrant, engaging and accessible, and at the same time integrative.

In this issue we have covered articles on Predictive Analytics and Analytics in Sports. We have continued the Internship Experiences section, where students can share their learnings and experiences during their summer internships.

We hope that this will help our readers to gain insights on the latest developments in field of analytics and data science.

Thank you and Happy Reading!
Quriosity Editorial Team
Quantinuum@SIMSR

WHAT'S INSIDE:

- Mentor's Note
- Predictive analytics and its impact on business
- Analytics in Sports
- Predictive analytics for better marketing performance

SIMSR

MENTOR'S NOTE - DR. NILAKANTAN N S

During December, 2019, I was part of the POMS International Conference 2019 India at SIMSR, as a conference co-chair & program chair.

The conference was planned right from Jan 2019 and was conducted on 13-14 Dec, 2019. The initial groundwork was laid around May 2018 when I attended POMS Annual Conference at Houston where I discussed the possibility of conducting the conference at SIMSR with POMS officials Prof. Sushil Gupta and Prof. Nagesh Murthy. After a decision by the institute in January, we – Prof. Lamba and myself- attended the next POMS conference at Washington D.C. and finalized the arrangements.

Two committees – international and advisory - were formed for promoting the conference with advice inputs from the committee members. Another committee- with reviewers from around the world - was formed for review of the papers received for the conference. A fourth committee – organizing committee was also formed to deal with the ground requirements.

A lot of work went into the organising of the conference by the conference and program chairs and the organising committee.

Over 100 papers were received and around 75 papers were presented in the conference on various topics of operations and supply chain management, modeling and research.

The conference had key-note speeches by renowned academics and practitioners. A practitioner's forum was also conducted by Prof. Dino Petrarolo of POMS in which he moderated the discussions by a panel of expert practitioners.

Overall, the conference experience was very good and we hope to repeat such conferences in the future.

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PREDICTIVE ANALYTICS AND IT'S IMPACT ON BUSINESSES

- Arka Roy Chowdhury
PGDM FS (2019-21)

Predictive analytics encompasses statistical techniques used to analyse current and historical data in order to make a reasonable prediction about the future. In a business environment, organisations employ predictive analytics models to identify market trends, opportunities and risks. Using predictive analytics, organisation are able to assess potential risks and opportunities to achieve competitive market advantages. The technique of predictive analytics is a part of data mining focusing on extracting information from historical data and use the data to predict behavioral patterns and trends. Typically, predictive analysis can be applied to any type of unknown events to predict the present and future events.

Thus enabling businesses to use predictive models to exploit patterns found in historical data, to identify potential risks and opportunities before they occur.
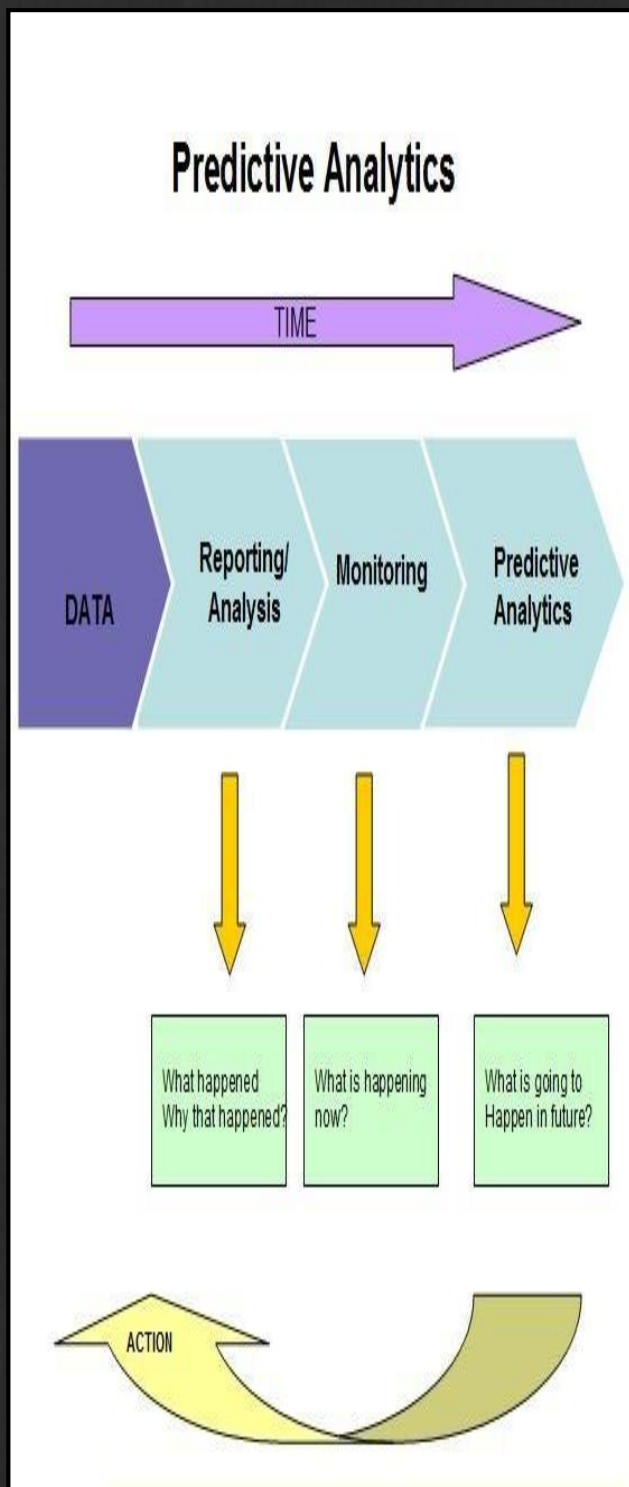
Classification Model

The classification model is, in some ways, the simplest of the several types of predictive analytics models in use. The model puts data into categories based on its learning from historical data.

Classification models answer yes or no questions, given the broad analysis that helps guide decisive action. These models answer questions such as:

- For a retail shop manager/owner, "Is this customer about to churn?"
- For a person giving loans, "Will this loan be approved?" or "Is this applicant likely to default?"
- For an online banking provider, "Is this a fraudulent transaction?"

The variety of possibilities with the classification model—and the ease with which it can be retrained with new data—means it can be applied to many different industries.

Clustering Model

·The clustering model sorts data into separate, nested smart groups based on similar attributes. If an e-commerce media company like Netflix is looking to implement targeted marketing campaigns for their customers, they could go through the hundreds of thousands of records to create a tailored strategy for each individual. Now the question arises whether it is the most efficient use of time, probably not. Using the clustering model, one can quickly separate the customers into similar groups based on common characteristics and hence devise strategies for each group at a larger scale.

Other instances of predictive modeling technique might include grouping loan applicants into "smart buckets" based on loan attributes, identifying areas

in a city with a high volume of crime, and benchmarking SaaS (software as a service) customer data into groups to identify global patterns of use.

Forecast Model

One of the most widely used models for predictive analytics is the forecast model which deals in metric value prediction, estimating the numeric value for new data based on its learnings from historical data.

Historical numerical data is the type of data this model requires. Scenarios include:

- Using this model a SaaS company can estimate how many customers they are likely to convert within a given week.
- A call center using the forecast model can predict how many support calls they will receive per hour.
- A shoe store can calculate how much inventory they should keep on hand to meet demand during a particular sales period.

The forecast model is adaptable and can efficiently handle multiple input parameters. If a restaurant owner wants to predict the number of customers she is likely to receive in the following week, the model is built to take into account factors that could impact this, such as: Is there an event close by? What's the weather forecast? Has there been an illness going around?

Outliers Model

This model is oriented around the accumulation of anomalous data entries within a dataset. The outliers model has been designed to identify anomalous figures either with themselves or in conjunction with other categories and numbers.

- Recording a sudden spike in support calls, which could indicate a product failure that might lead to a recall
- Finding unusual or anomalous data within transactions,

insurance claims, or to identify fraud and

- Finding unusual information in your NetOps logs and noticing the signs of impending unplanned downtime etc.

The outlier model is most useful for predictive analytics in retail and finance.

Time Series Model

The <u>time series model</u> takes a sequence of data points captured, where time is the input parameter. Time series model uses data collected over a period of time (years/months as required) to develop a numerical metric and predicts the next three to six weeks of data using that metric. Usage for this model includes the number of daily calls received in the past three months sales for the past 20 quarters in an IKEA store, or the number of patients who showed up at a given hospital in the past six weeks where the parameter which is the measurable characteristic of the hypothesis testing can be chosen as per the requirements of the testing. It also does a trend analysis taking into account seasonal, cyclical and random variants to measure the impact on the metric.

If the owner of a sweet shop wishes to predict how many people are likely to visit his business, he might refer to the crude method of averaging the total number of visitors over the past 90 days. However, growth is not always static or linear, it is ever-changing, and the time series model can, therefore, better help us model exponential growth and better align the model to a company's trend. Time Series Model can also forecast for multiple projects or multiple regions at the same time instead of just one at a time.

Therefore this form of analytics most commonly uses historical

descriptive and behavioral data, however by adding interaction and attitudinal data one can expect significant accuracy in the performance of these predictive models. This tool in recent time have been widely used in identifying anomalies and predicting business solutions. In this article we shall further discuss how predictive analytics has impacted businesses and can be used to boost sales, simultaneously how it can be used in the finance domain to predict the future.

Big Data has become the defining parameter in sales and marketing for quite a while now. Analysts and managers often say how Big Data can empower teams and can transform businesses. Analyzing Big Data to generate predictions about future events requires state of the art software and huge volumes of data. One of the key benefits of predictive analytics is parsing specify learnings from enormous quantities of information.

Here we shall discuss a few ideas for predictive analytics in businesses to boost one's bottom line. To begin with, we would discuss how predictive analytics impact sales.
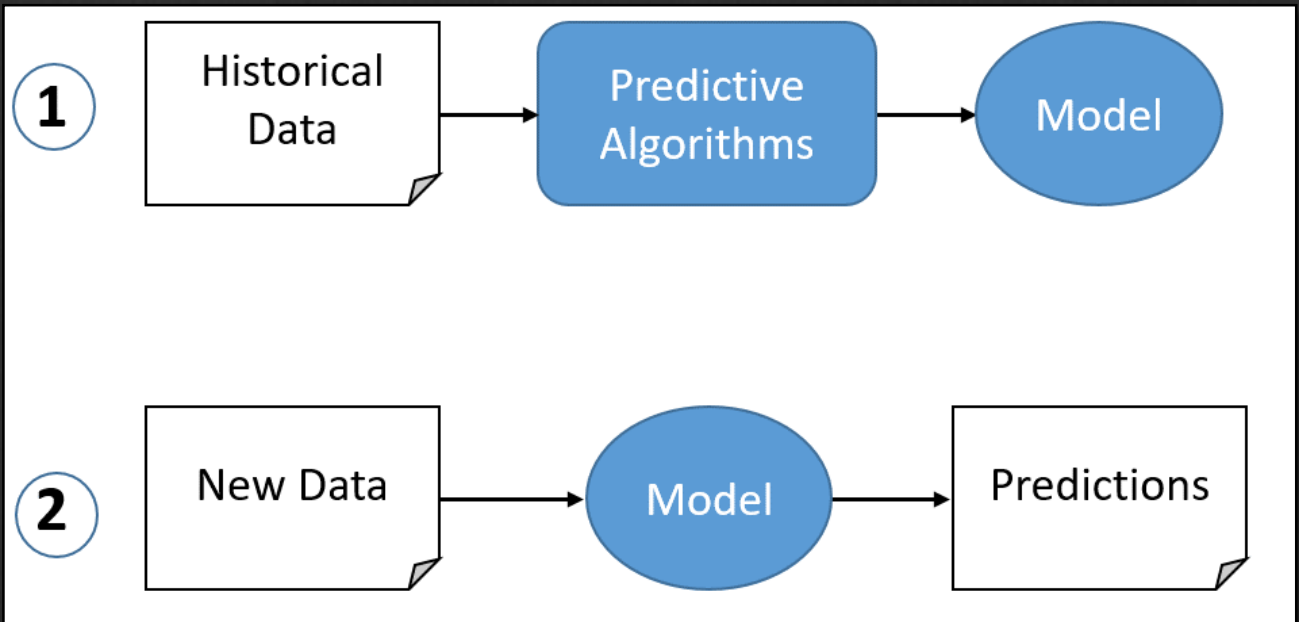
Predictive analytics helps businesses find the hottest leads. Using descriptive, behavioural and other types of data the analytics system evaluates and analyses on closed sales and using these findings businesses generate personas for their buyers, and then add prospects to these personas based on demographics and other information. This can help the sales team target customers, who are more likely to buy from, rather than initiating contact and discovering the perspective customers, in which a large amount of energy and resources are to be invested.

Predictive analytics helps businesses predict buyer behavior. Analyst uses Big Data to predict future behavior. They use past customer purchasing behavior to predict how its customer's future buying trends, thus generating accurate buyer personas for targeted marketing. The technique of predictive analytics is also used to segment and target email campaigns.

Predictive analytics also helps project future finances of businesses. It helps sharpen online revenue projections simultaneously can help shrink extraordinary expenses. Side by side it can also be used to improve supply-chain efficiency. Predictive analytics takes massive amounts of data from point-of-sale systems and make real-time forecasts of when and where products are likely to sell out or not move at all, thus helping in inventory management.

But the technique has few possible roadblocks. For predictive analytics to work effectively and efficiently, the software requires high volumes of quality data. This is the reason why companies like Google and Facebook collect so much data from their users, because when it comes to data analytics quantity matters. Thus it becomes very difficult for small businesses and probably becomes the single largest hurdle these businesses encounter. Although, initially it can take time and healthy investment, in the long run it would be worth it.

Thus in this ever-changing business world, staying ahead is staying in profit. Predictive analytics is the most recent tool which is being applied in financial services, retail management, human resource, and other business domains to give companies the edge over their competitors.

This tool has also created a demand for analyst profiles in companies over varied businesses. Predictive analytics will win over businesses until the next innovative tool comes into the market.

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ANALYTICS IN SPORTS

- **Devendra Panda**
PGDM (2019-21)

Data Analytics has found its way into each and every industry in the world today Governments, companies and research institutes are using data analytics to their advantage, digging deeper into chunks of data that helps them make better decisions. Health Care, Banking, Transportation, Security, Manufacturing, Communication, you name it and Data analytics is used in that field to improve efficiencies and make calculated assessments about future events.

Sports is another such industry where analytics has made a significant impact. The sports industry is booming and not expected to stop anytime soon. According to Goldman Sachs analysts the bond between sports and science is only strengthening. Goldman Sachs has said the North American professional sports market has already crossed $64 billion in revenue per year and this is number could go up to $70 billion by 2020.

With such high potential for money the competition has also increased. Every sports team and player is ready to use any means necessary to gain that competitive advantage and that's where analytics comes in. Data is being collected to help teams to victory. Whether it's the teams in NBA in the United States or Premier League teams in England, data analytics is widely used to enhance performance and change strategies to change results.

"It's about translating that data ASAP and being very, very in tune with the numbers. You can't be a year behind, you can't be a *month* behind," said Atlanta Falcon's general manager

Thomas Dimitroff when talking about on the use and value of analytics today in American football.

Baseball was one of the sports where analytics was used first. The famous journey of the Oakland Athletics from a struggling team, to a team with a winning streak of twenty games in a season was a result of analytics. They are one of the first and the best examples of the power of data analytics. Oakland A's general manager Billy Beane used numbers to recruit players instead of the traditional way of trusting his gut. He used actual facts to pick talent and gain success.

This feat inspired the book and then the movie, both named 'Moneyball.' Today recruitment based on big data is used by many teams in Major League Baseball and is followed by teams in other sports.
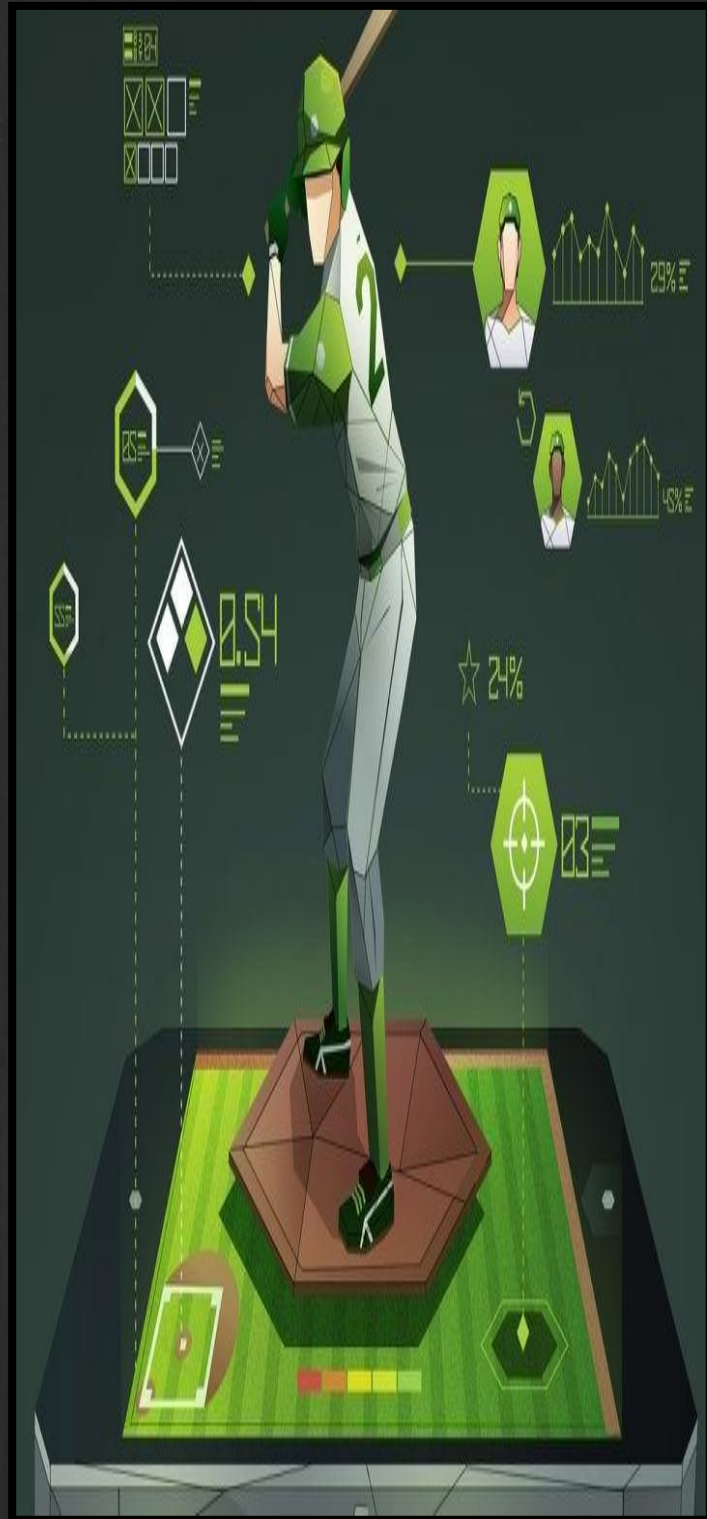
Nowadays there is a greater emphasis on collecting and analyzing the data. There are a wide range of tools available depending on the sport to collect data for analysis. Wearable's can help track and monitor performance of the players and athletes. Watches can track location, heart rate, speed, whereas sensors in the athletes' uniforms track hydration and fatigue levels. All this information can be collected and analyzed in real time. In contact sports like rugby or American football, sensors help to analyze the impact of a tackle and whether the player is at a risk of getting injured can be determined by comparing with historical data. Video Analysis of practice sessions and previous games also helps to make strategies.
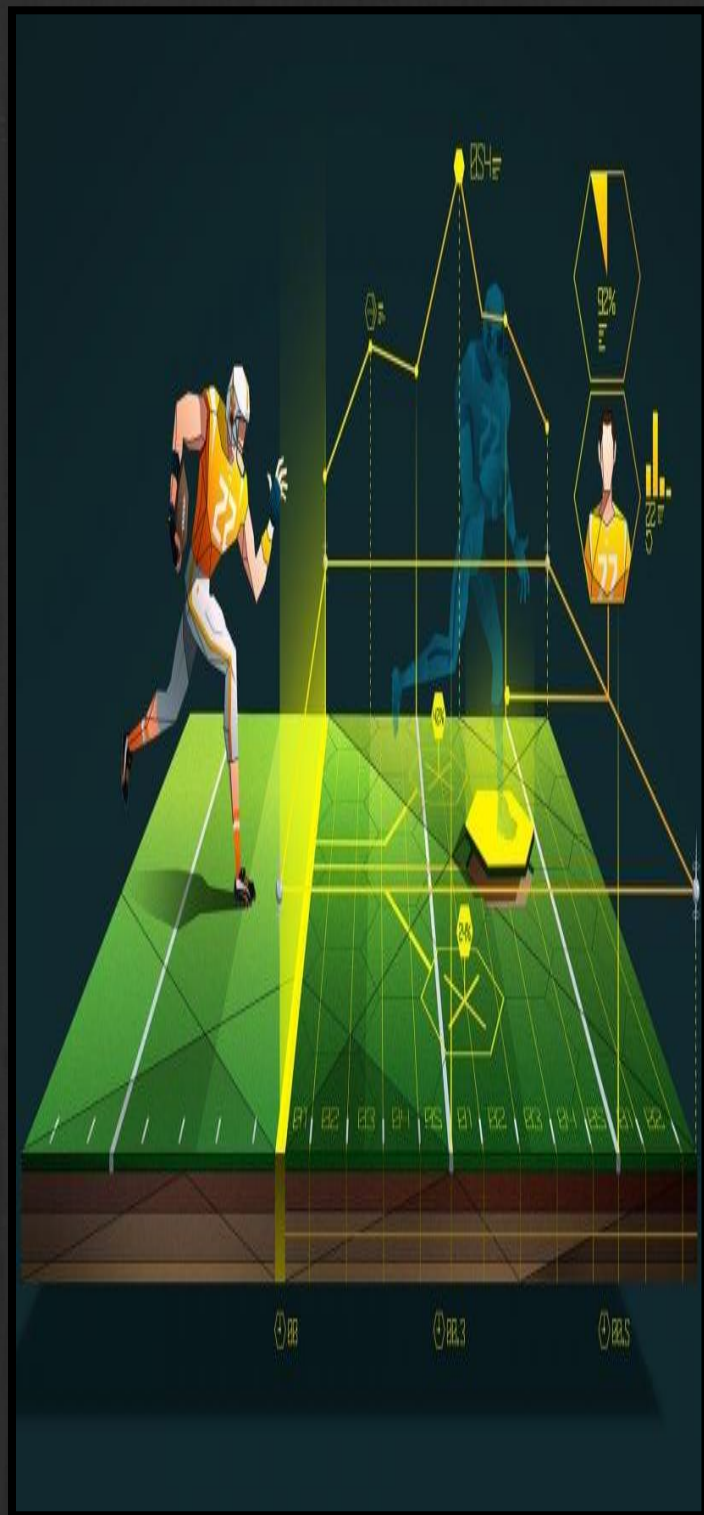
Predictive Analytics is used in sports by coaches and management to make educated assessments and predict the scores for future games. It helps the coaches and players make informed and effective decisions that can alter the result of the game. They could select the possible team to play on filed and also the best tactics to beat their opponents.

Data is also being used to improve on field football performance by analyzing opposing team strategy and finding ways to counter it. Scottish football team Hearts used information from the InStat database to predict and devise a strategy that would help them beat Celtic – and it worked. They are not alone, as more than 1,500 clubs and national teams use InStat, giving the company information on more than 400,000 players. InStat is one of the few sports analytics companies that provides tools and data analysis to various individuals and teams.

Analytics is also used to enhance the experience of the fans. Team Managements utilize the power of big data and sports analytics to attract new spectators while increasing the loyalty of their existing fan base. Fans are now more than just spectators they participate, cheer, support and connect with the players of the teams. The teams in NFL or MLB or even NBA have mobile apps helping visitors to find available parking, obtain exclusive offers and receive traffic information too. They can also use the apps to order food which will be delivered to their seats. Half time shows at sporting events are live streamed and can be viewed by millions of people at the same time. Apps also give the fans access to instant replays and alternate views. During the FIFA World Cup in Brazil in order to make the games more interactive Globo TV in

in Brazil used social media trends to allow fans to share their views in real time during games and the commentators read the comments and talk about them on Live TV. They had predicted with analytical tools that this would be a good way get fans more engaged and it did.
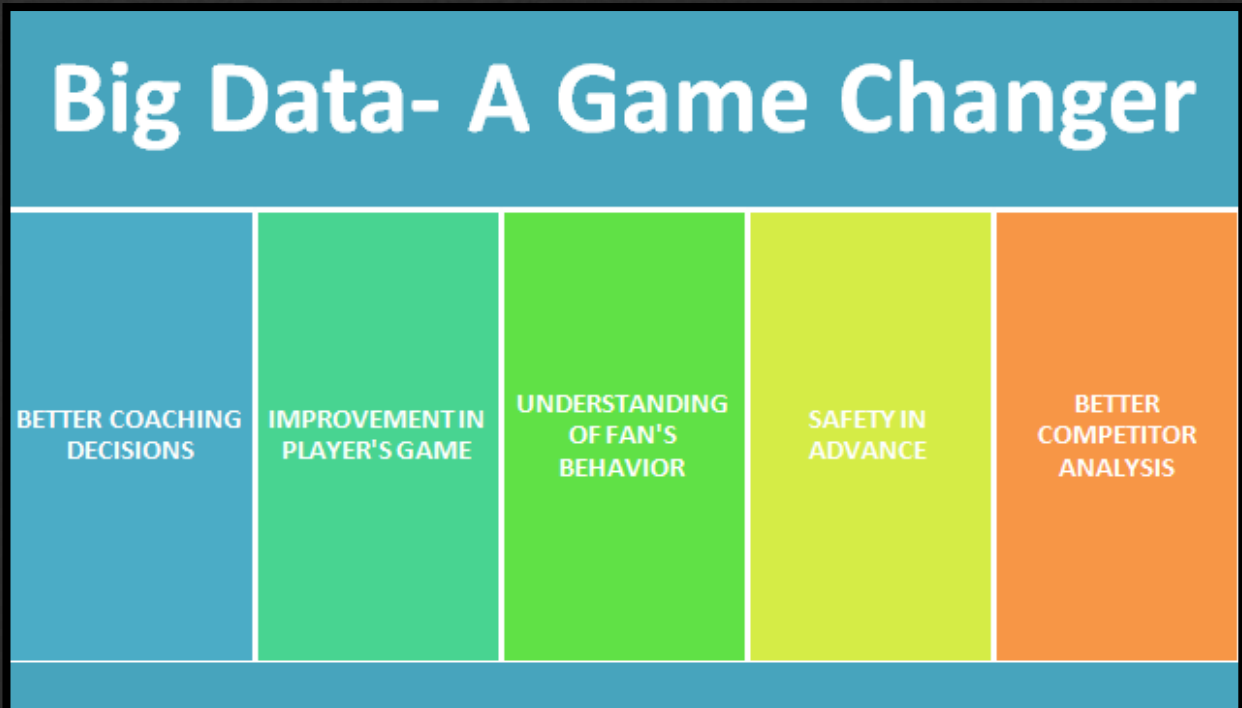
Rather than just analyzing the past, the application of big data analytics will prove useful in sports to predict future outcomes. With even larger chunks of data available, machine learning and AI will help to find patterns or trends and help devise strategies that could alter the performance altogether. However, this is just the start and scope of analytics in sports is much larger. Everyone wants that competitive edge and currents analytics is the best way to gain it.

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- Deepa Singh
PGDM IB (2019-21)

Due to rise of Big Data and AI, marketers have powerful analytics tools than ever before. Here, we'll see what predictive analytics is, why businesses need it, how to measure it, and best practices for implementing it for better marketing performance, higher ROI and, ultimately, faster success.

Predictive marketing analytics is the use of data, statistical algorithms and machine learning techniques to identify the likelihood of future outcomes based on historical data.

Steps in predictive analytics process:

- **Defining outcomes:** Determine the business questions that you want the data to answer.

- **Data collection**: Have a plan for what data you need, how to collect it, and how to organize it.

- **Data analysis & Statisitcs** : Analyze data for useful information and deduce conclusions about the customers. Conclusions are tested.

- **Modeling**: Predictions are created about the customer's behavior.

- **Deployment & Monitoring** : Use the data to find marketing strategies. Analyze effectiveness of predictive data-driven campaigns.

Different types of business analytics:

- **Descriptive analytics -** historical data and performance is looked at.

- **Predictive analytics -** past data is used along with algorithms are used to predict outcome.

- **Prescriptive analytics -** best course of action is determined.

The use cases for Predictive Marketing Analytics

3 Stages Funnel

TOFU
- Blog posts
- Social media updates
- Infographics
- Videos
- Podcasts

MOFU
- Ebooks and white papers
- Reports
- Guides
- Case studies
- Templates and toolkits
- List of resources
- Email courses
- Quizzes and assessments
- Webinars

BOFU
- Competitive comparisons
- Detailed specifications
- Customers stories
- Testimonials
- Consultations
- Demos
- Promo codes/discounts
- Free trails

Detailed Lead Scoring: Lead scoring is a methodology used to rank prospects against a scale that represents the perceived value each lead represents to the organization. The resulting score is used to determine which leads a receiving function (e.g. sales, partners, teleprospecting) will engage, in order of priority.

Lead Segmentation for Campaign Nurturing: Predictive analytics help businesses group leads by segment and create lead nurturing campaigns that are tailored specifically to move the process further down the sales funnel based on the demographic and behavioral data.

Targeted Content Distribution: Predictive analytics can answer which types of content work better for certain leads. If leads receive higher-quality communication from an organization, the probability of sales conversion increases.

Lifetime Value Prediction: Customer Lifetime Value (CLV) means how much a customer is worth throughout the entire span of relationship with them. With predictive analytics, we can take the historical data of each customer and use it to forecast the future lifespan of the relationship with them as well as how much revenue that relationship is likely to generate.

Churn Rate Prediction: Churn rate is the rate of attrition, which is the percentage of subscribers or users who stop their subscriptions within a certain period. With predictive analytics, you can identify the warning signs that alert you to the loss of a customer and allow you to provide the necessary follow-up or nurturing before it's too late.

Upselling and Cross-Selling Readiness: Using the available data about customer buying behavior, businesses can upsell, cross-sell or combine both to increase profit.

Understanding Product Fit: Equipped with historical purchase, behavior and leads data, businesses can better understand exactly what customers' needs and wants are.

Optimization of Marketing Campaigns: By applying predictive analytics in organizations, risks can be significantly reduced because decisions will be made based on data, not merely unproven assumptions that rely on instincts and some educated guesses.

Predictive Marketing Analytics Measurement

- **Metrics**: Individual data points related to one specific measurement

- **Analytics**: Combines metrics to achieve a holistic view of the data and draw conclusions.

Metrics that are used in calculating performance and ROI are:

CAC or Customer Acquisition Cost: CAC is the average amount of money spent to acquire a new customer. It is calculated based on the total sales and marketing cost divided by the number of new customers within a certain time period. You can create two types of CACs: the 100% online CAC and the combination of online and offline CAC.

Marketing Percentage of CAC: What's the percentage of the CAC that pertains to marketing cost? To come up with the ratio, the total marketing cost is divided by the sales and marketing costs.

Ratio of LTV and CAC (LTV : CAC): You'll get the ratio by dividing the Customer Lifetime Value (CLV) – or the Lifetime Customer Value (LCV) – by the Customer Acquisition Cost (CAC).

Marketing Originated Customer Percentage: This metric measures how much of your new business comes from your marketing leads. After dividing the total number of leads in a month with the total number of new customers, you'll get the Marketing Originated Customer Percentage.

Time to Earn Back CAC: It's important to know how long it will take you to earn back the money you spent to acquire each customer so that you can set future marketing budgets and realistic revenue goals. Figure out the total time (weeks, months, quarters or years) needed to earn back the CAC.

Marketing Influenced Customer Percentage: This metric measures the role that your overall marketing efforts had in your acquisition of new customers. To find this figure, the new customer total is divided by the total number of customers who actually engaged with your marketing activities.

How to Implement Predictive Marketing Analytics for Optimized Business Decisions?

The primary classes of predictive models:

Cluster modeling

- It is a way of segmenting customers into groups based on several variables at once. With it, you can target demographics and personas using behavioral clustering, product-based clustering and brand-based clustering.

Propensity modeling

- It is used to predict customer behaviors based on predictive lifetime value, likelihood of engagement, propensity to unsubscribe, propensity to convert, propensity to buy and propensity to churn.

Collaborative filtering

- It is primarily used for recommending products, services and advertisements based on past variables, including buying behaviors. This filtering is common for upselling, cross-selling and next-selling.

There are three basic scoring categories that marketers use:

Predictive Scoring

- Prospects, leads and accounts are prioritized based on their likelihood of purchasing action.

Identification Models

- Prospects are identified and acquired based on similarities with existing customers' variables.

Automated Segmentation

- Leads are segmented for custom and personalized contents.

Tools available for predictive marketing analytics:
1. EverString
2. Infer
3. Halo
4. BOARD
5. SAS Advanced Analytics
6. RapidMiner Studio

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INTERNSHIP EXPERIENCE

- **Himanshu Data**
PGDM (2018-20)

I interned at Digital Impact Square in Nasik which is part of CSR fund of TCS, where they incubate Social Startups which are solving society's problem using Technology.

Process Details:

Phase 1: PPA at SIMSR. One of the leading members of TCS CSR fund where he introduced about DISQ.

Phase 2: Registration at DISQ website where we have to submit a video and solution regarding our ideas to make this society a better place.

Phase 3: After shortlisting, we were called for Businessthon round at TCS office at Thane. Here we were assigned to a startup and we have to make a business plan for that startup and have to present that idea in front of TCS dignitaries. After this round, final students were shortlisted for the offer letter.

I worked with the core Management Team of DISQ and role was to find the financial avenues for scale and grow phase startups so that these startups can become financially sustainable after they move out of Incubation period of DISQ.

My experience was very vivid and quiet different. I have to meet all the startups in DISQ and listen to their ideas, growth plans, technology and analytics quotient for business development, products and services, client conversion plan, future sustainability plan.

In a nutshell, if you have a knack for Indian startups and like to work with them and help in their growth, then DISQ is the place for you as you will also be able to accomplish the goal of giving back to the society.

QUANTGURU – VASHISHTHA NARAYAN SINGH

- **Anshul Kanodia**
PGDM (2019-21)

As this year comes to an end, we the Quantinuum committee would like to remember a maths genius, India's own beautiful mind who left us this year for heavenly abode. The person in context is **Vashishtha Narayan Singh** (2nd Apr,1946 to 14th Nov,2019**)**, he was the maths genius who, in the '60s, streaked a path from Bihar to Berkeley and sometime soon after slipped into mental illness, leaving behind a thesis, a few letters, some scribbles on the wall.

Singh was born on 2 April 1946 to Lal Bahadur Singh, a police constable, and Lahaso Devi in the Basantpur village of the Bhojpur district in Bihar, India.

Singh a child prodigy was undoubtedly the most gifted mathematics genius after Ramanujan. Unproved sources state he might be the only person to have openly challenged the widely accepted scientist himself- Albert Einstein. He received his secondary education from Netarhat Residential School, and he received his college education from Patna Science College. He received recognition as a student when he was allowed by Patna University to appear for examination in the first year of its three-year BSc (Hons.) mathematics course and later MSc examination the next year.

Singh joined the **University of California**, Berkeley in 1965 and received a PhD in Reproducing Kernels and Operators with a Cyclic Vector (Cycle Vector Space Theory) in 1969 under doctoral advisor **John L. Kelley.**

After receiving his PhD, Singh joined the University of Washington at Seattle as an assistant professor, and he reportedly worked with the US space agency NASA at that time – although his alleged role in the Apollo moon-landing should be taken with a pinch of moon dust. One such story from that period is about Singh being called in to do some calculations when computers at Nasa had stopped working for some reason and when the machines started functioning, his calculations matched those of the machines. But these unconfirmed stories of a 'legend' should not diminish in any way Singh's genuine mathematical genius.

He then returned to India in 1974 to teach at Indian Institute of Technology Kanpur. After 8 months, he joined Tata Institute of Fundamental Research (TIFR), Bombay where he worked on a short-term position. Later he was appointed as a faculty at the Indian Statistical Institute, Kolkata.

Tragically, at the height of his mathematical prowess around 1973-74, Singh started displaying traits of mental instability. By the mid-1980s, the genius was a has-been. One of those Oh-could-have-been stories that are often told in the annals of science.

In this new millennium, Singh was a lost soul. A genius who felt the entire world conspired against him and a silent mathematician meditating his new theorems and lemmas.

It is the culmination of misinformed relatives, government apathy and genes that turned his life upside-down.

Vashishtha Narayan Singh's story, and his four-decades-old fight with schizophrenia, may appear to have the same contours as those of Nobel Laureate **John Forbes Nash**, the troubled mathematical genius and inventor of the 'Nash equilibrium' in game theory, on whose life the award-winning biography by Sylvia Nasar, 'A Beautiful Mind,' and Ron Howard-directed Oscar winning film of the same, was based on. The similarities - **schizophrenia, numbers, and a lifelong quest for beauty in mathematics** -- cannot be extended to the lives lived by both the men.

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- Rushab Jain
PGDM FS (2019-21)

Team Quantinuum very successfully completed a SIMSR intra college competition based on data Analytics and Quants, called as "Quantiz" with the tagline "Experience Quants like never before". Started with the motive of delivering an analytical treat for quant enthusiasts, the competition started with an online round held on 4th December 2019 which was followed by 4 offline rounds held on 9th December, which included interesting puzzles and mind-boggling excel tactics to work upon. The 2 teams - '3 Guna Lagaan' and 'The Hustlers' emerged as the winners and runners-up respectively. The winning team won a cash prize of Rs. 12000/- along with a certificate.

Quantiz 2019

Quantiz 2019

- Kaustubh Karanje
PGDM (2018-20)

Effective data architecture key to supporting analytics initiatives: Rahul Mehta, CitiusTech

Companies are realising that they can benefit tremendously from data and analytics to drive positive outcomes for themselves as well as customers. For this, organizations need to have a clear vision that focuses on driving efficiency, productivity and profitability. However, there are several challenges associated with data analytics which managers find difficult to handle.

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Drones and Data: How Utility Companies May Need to Rethink their Approach to Data Management

Ilkka Hiidenheimo, Sharper Shape CEO, provides detail about managing the robust data sets generated from drone utility inspections. While leveraging drone technology is an enormous benefit, it requires capabilities like AI and machine learning and better workflow processes to turn complex information into not only clear and simple, but also actionable – ultimately revolutionizing processes that will lead to long-term, beneficial results.

Reference:

https://insidebigdata.com/2019/12/28/drones-and-data-how-utility-companies-may-need-to-rethink-their-approach-to-data-management/

Google's New Explainable AI Service, by Tirthajyoti Sarkar

Google has started offering a new service for "explainable AI" or XAI, as it is fashionably called. Presently offered tools are modest, but the intent is in the right direction.

Reference:

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When Is It Ethical to Not Replace Humans with AI?

There are legitimate questions about the ethics of employing AI in place of human workers. But what about when there's a moral imperative to automate?

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-Bradley Fernandes
PGDM FS (2019-21)

CARTOSAT-3, 13 US nano satellites successfully launched

ISRO has magnificently launched its third-generation earth-imaging satellite into space from Satish Dhawan Space Centre in Sriharikota, Andhra Pradesh.

The launch will improve India's ability in high-resolution imaging and also strengthen India as a global launch destination for small satellites using its workhorse rocket Polar Satellite Launch Vehicle. Besides the CARTOSAT 3 satellite, the PSLV C-47 rocket launched carried 13 nano satellites from the US, was roped in through the new commercial arm New Space India.

The Cartosat 3 follows similar launches in an earlier series deployed for cartography (map-making applications), infrastructure planning, coastal land use and regulation, road-network monitoring and more importantly, change detection in bringing out geographical and man-made features.
According to the latest ISRO annual report, the CARTOSAT 3 is a 3-axis agile satellite with a spatial resolution parameter of 0.25 m, an improvement from the earlier series, which had the spatial resolution parameter at less than 1 m.

While the Polar Satellite Launch Vehicle has attracted contracts with foreign firms to accommodate satellites from countries such as France, Canada, and the US through its first commercial arm Antrix, the commercial satellites aboard the PSLV C-47 have arrived through arrangements through the second commercial entity New Space India, set up in March this year.
Through Antrix, ISRO completed 239 deals over the last three years and earned operational revenue over Rs 6,280 crore.

References:
https://economictimes.indiatimes.com/news/science/our-own-orbiter-had-located-vikram-lander-isro-chief/videoshow/72360815.cms
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Nearly 24-hour countdown for launch of RISAT-2BR1, unfurl antenna of RISAT-2BR1 satellite

At Chennai the nearly 24 hour countdown began Tuesday 10th December for the launch of India's radar imaging earth observation satellite RISAT-2BR1 on board PLSV-C48 from its spaceport of Sriharikota.

The workhorse Polar Satellite Launch Vehicle, on its 50th mission, PSLV-C48, was scheduled to lift off from the first launch pad of the Satish Dhawan Space Centre at Sriharikota, about 130 km from chennai at 3.25 PM on Wednesday 11th December, the Indian Space Research Organisation stated.

Scientists at the Indian Space Research Organisation (ISRO) on Thursday 12th December, undertook an operation to unfurl the antenna that was inside the radar imaging earth observation satellite RISAT-2BR1, a day after it was launched from Sriharikota. This intricate technology involved unfurling and deployment of the 3.6 m antenna which was folded and stored during launch.

On Wednesday 11th December, ISRO successfully launched RISAT-2BR1 and nine foreign satellites on-board PSLV-C48 in its 50th flight. RISAT-2BR1 is India's radar imaging earth observation satellite which will be used in the field of agriculture, forestry and disaster management and also for military purposes.

References:
https://economictimes.indiatimes.com/news/science/nearly-24-hour-countdown-begins-for-launch-of-risat-2br1/articleshow/72459710.cms

-Akansha Maheshwari
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SUDOKU

SUGURU

Rules:

The goal of Sudoku is to fill in a 9×9 grid with digits so that each column, row, and 3×3 section contains the numbers between 1 to 9. Initially, the 9×9 grid will have some of the squares filled in. Your challenge is to use logic to fill in the missing digits and complete the above grid.

Rules :

The lines marked in bold indicate areas, called cages, from one to five squares in size. Fill each cage with unique digits, starting up from 1. Say for example a 2-square cage contains the numbers 1 and 2, and a 5-square cage contains the numbers from 1 to 5. Adjacent (touching) squares, even ones that touch diagonally, should never contain the same number.

SUDOKU

9	8	7	2	6	1	3	5	4
2	6	3	5	4	9	8	7	1
5	4	1	7	3	8	9	6	2
1	2	5	9	7	4	6	3	8
3	9	4	8	1	6	7	2	5
6	7	8	3	5	2	4	1	9
7	5	2	4	8	3	1	9	6
8	3	6	1	9	5	2	4	7
4	1	9	6	2	7	5	8	3

SUGURU

1	4	3	2	3	1
3	2	5	1	5	2
5	1	4	3	4	1
2	3	5	1	2	3
5	4	2	4	5	4
2	3	1	3	1	2

References:
https://krazydad.com/sudoku/
https://krazydad.com/suguru/

QUANT CONNECT

Quantinuum, the Quants and Analytics committee of **K.J. Somaiya Institute of Management Studies and Research** aims to empower students and professionals alike to organize and understand numbers and, in turn, to make good and rational decisions as future managers. The newsletter published monthly consists of a gamut of articles for readers ranging from beginners to advanced learners so as to further enrich the young minds understand the contributions made to the field of mathematics along with a couple of brain- racking sections of puzzles to tickle the gray cells.

For any further queries and feedback, please contact the following address:

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