Sane's STATS Academy of Statistics

Data Science

An Introduction

Understand Terms…

- Data Science
- Analytics
- Artificial Intelligence
- Machine Learning
- Deep Learning

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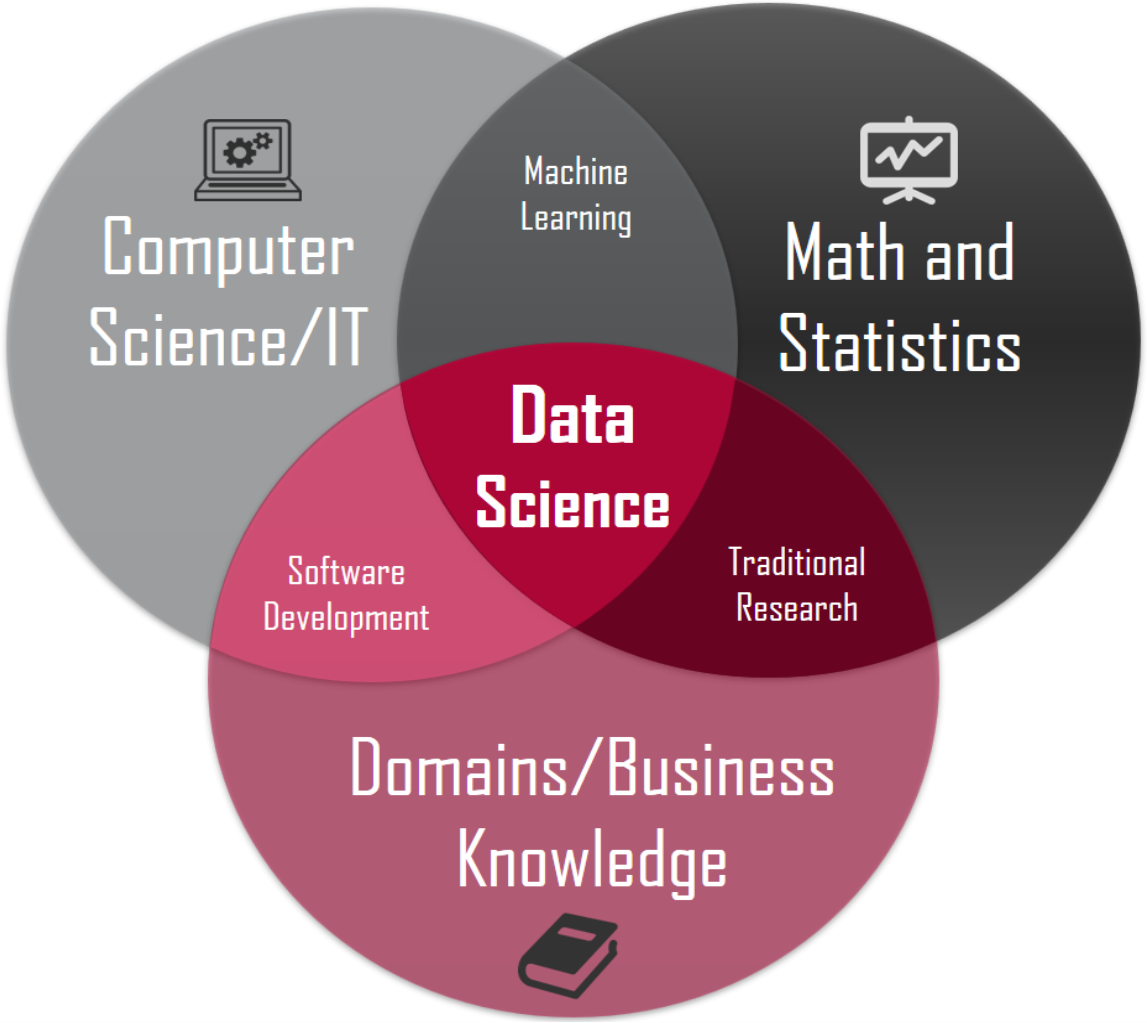
What is Data Science?

- Application of Scientific Methods like Statistical and Machine Learning in order to understand the phenomena in order to gain control on it
- It employs techniques from both the fields computer science and statistics
- Data science involves Machine Learning, Clustering, Visualization and many other things related to data

Data Science Composition

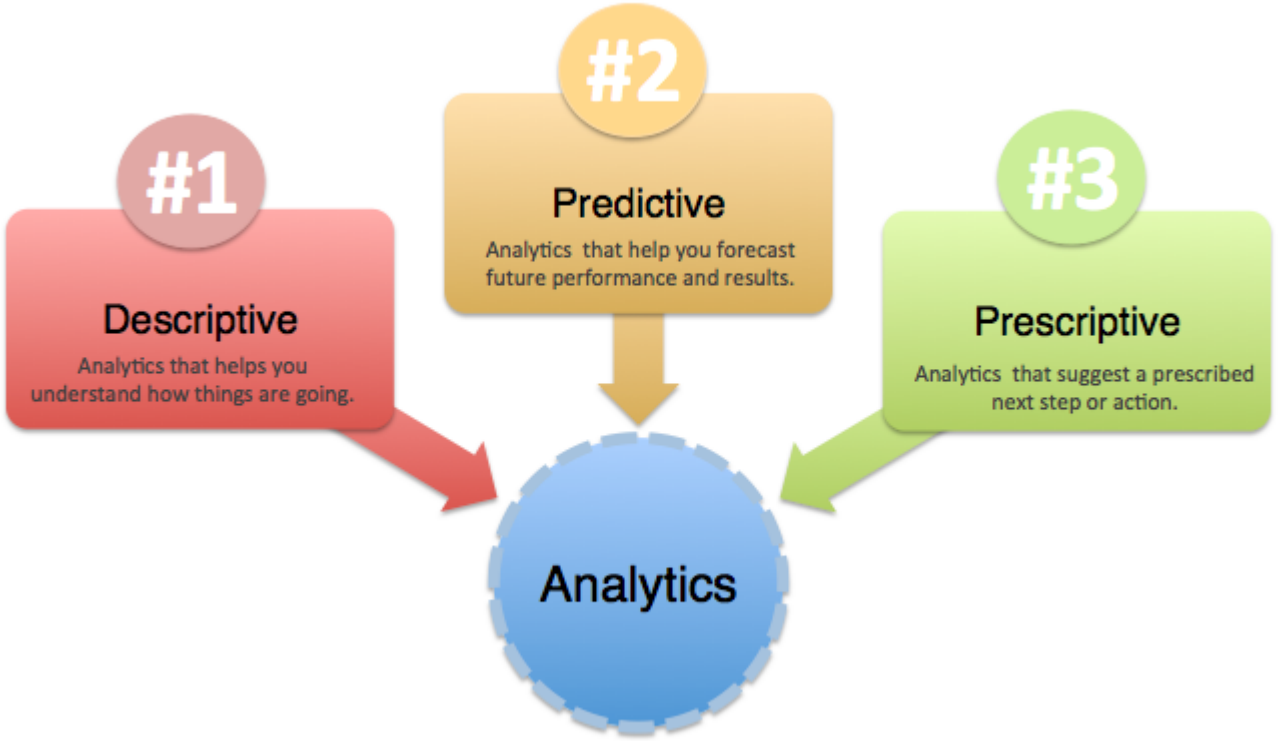


Courtesy: https://www.fox.temple.edu/institutes-and-centers/data-science/

What is Analytics?

- Analytics is the discovery, interpretation, and communication of meaningful patterns in data.
- Especially valuable in areas rich with recorded information, analytics relies on the simultaneous application of statistics, computer programming and operations research to quantify performance

Types of Analytics

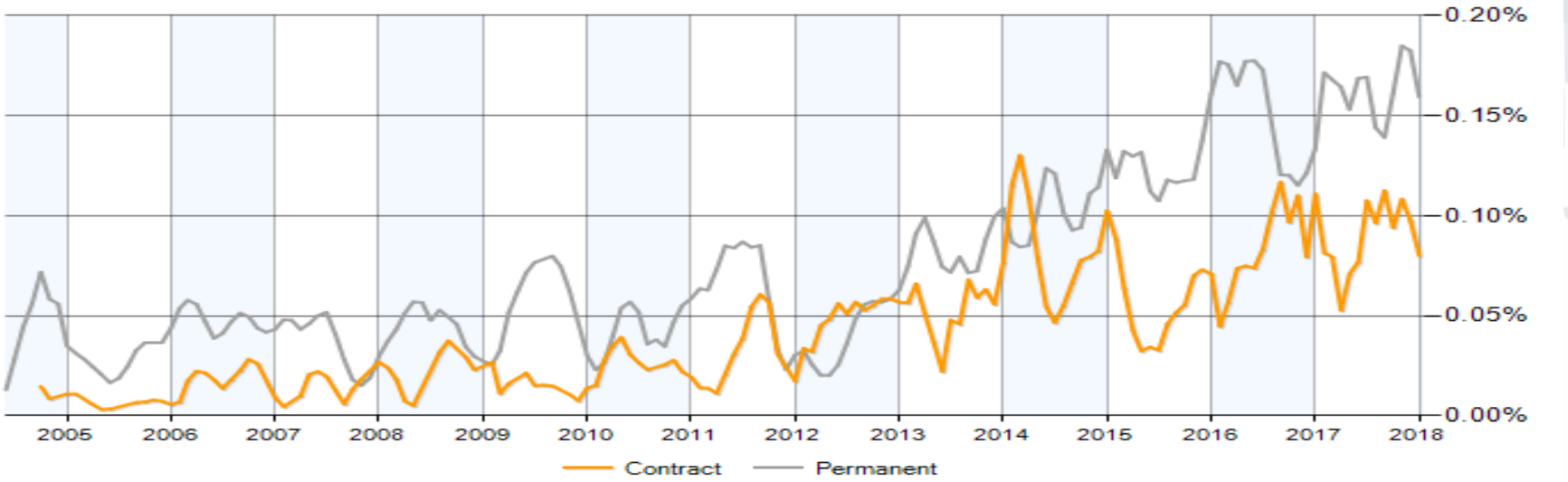


Courtesy: https://moz.com/blog/when-it-comes-to-analytics-are-you-doing-enough

Descriptive Analytics

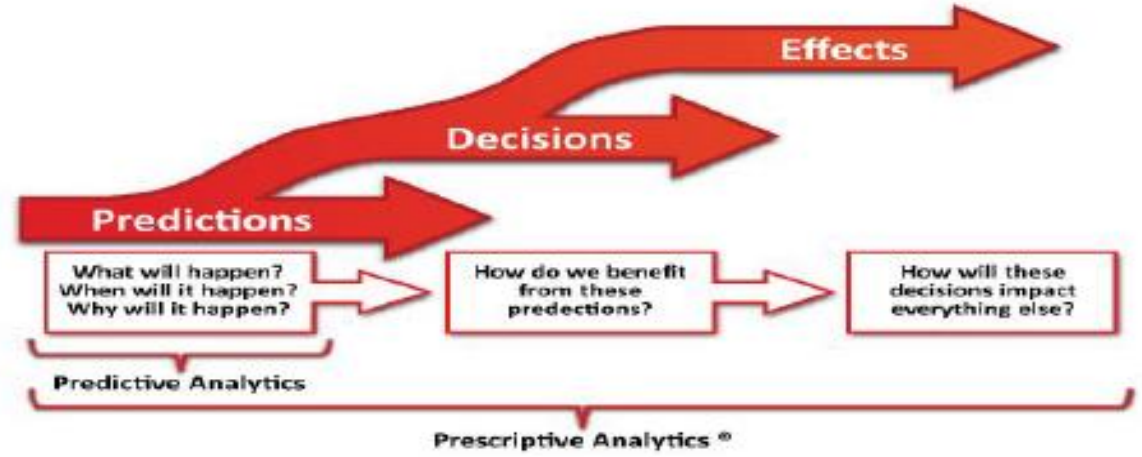
- Gain insight from historical data with reporting, scorecards, clustering etc.
- Can involve data visualization for knowing the basic characteristics of the data
- Descriptive analytics answers the questions what happened and why did it happen.
- Implementations : Business Intelligence, Visualizations
- Software: Informatica, Business Objects, TIBCO Spotfire, Tableau etc.

Predictive Analytics



- Involves statistical and machine learning techniques
- Analyzing the historical patterns in the data and predicting the future patterns
- Predictive analytics answers the question what will happen
- Implementation: Machine Learning, Deep Learning
- Software: R, Python, Libraries like TensorFlow, h2o.ai etc.

Prescriptive Analytics



- Prescriptive analytics goes beyond predicting future outcomes by also suggesting actions to benefit from the predictions and showing the implications of each decision option.
- Implementation: Optimization Techniques like Linear programming Problems, Non-linear programming Problems, Genetic Algorithm etc.

What is AI?

- AI or artificial intelligence is the simulation of human intelligence processes by machines, especially computer systems.
- These processes include learning (the acquisition of information and rules for using the information), reasoning (using the rules to reach approximate or definite conclusions), and self-correction.

What is Machine Learning?

- Machine learning is a subfield of computer science that evolved from the study of pattern recognition and computational learning theory in artificial intelligence.
- In 1959, Arthur Samuel defined machine learning as a "Field of study that gives computers the ability to learn without being explicitly programmed".

Where is Machine Learning Used?

- Medicine: Medical researchers might use it to predict the likelihood of a cancer relapse.
- Intelligence: Intelligence agencies might use it to determine which of a huge quantity of intercepted communications are of interest.

Business Usage of Machine Learning

- From a large list of prospective customers, which are most likely to respond? We can use classification techniques like logistic regression, classification trees etc.
- To find which customers are most likely to commit, for example, fraud (or might already have committed it)?
- To find which loan applicants are likely to default?
- To find which customers are most likely to abandon a subscription service (telephone, magazine, etc.)?

Role of Machine Learning (ML) for AI

- Machine Learning is used as an aid to achieve AI
- ML Algorithms are driven by mathematical concepts
- ML Algorithms analyse the patterns in the captured data and can be used to build a predictive model on the existing phenomena in business
- We will be covering two types of ML:
  - Supervised Learning Algorithms
  - Unsupervised Learning Algorithms

Supervised Learning

- Supervised learning algorithms are those used in classification and prediction.
- We must have data available in which the value of the outcome of interest (e.g., purchase or no purchase) is known.
- The objective is to predict the values of the outcome of interest

Examples: Supervised Learning

- Naïve Bayes
- K-NN
- Decision Trees
- Regression Models
- Neural Nets
- Support Vector Machines

Models for Supervised Learning

- We identify strong links between variables of a data table (columns).
- Such a link may translate into an expression between one variable y (the so-called "dependent" or "response" variable) and a group of other variables {xi} (the so-called “independent variables" or "predictors") :

  y = f(x1, x2, ..., xn) + Small random noise

Types in Supervised Learning

- When the response variable is numerical, predictive modeling is called Regression.
- When the response variable is categorical (nominal / ordinal), predictive modeling is called Classification.

Examples

- **Regression Case**: Sales are influenced by the variables like advertisement expenses, manpower deployed for sales, cost of products, number of dealers etc. Hence we see here

  Sales = function (Adv. Exp , Manpower , Cost , Dealers , …)

- **Classification Case**: The customer may purchase a particular product based on some conditions like his need, his age, his income, his place of residence etc. Hence we see here

  Prob(Customer Purchases) = function(Age, Income, Residence,…)

Unsupervised Learning

- Unsupervised learning algorithms are those used where there is no outcome variable to predict or classify.
- Association rules, data reduction methods, and clustering techniques are all unsupervised learning methods.

Examples of Unsupervised Learning

- Clustering Techniques
  - Hierarchical
  - K-means
  - K-medoids
- Principal Component Analysis
- Association Rules