# BASIC STATISTICS (Cheat Sheet)

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## THE FUNDAMENTALS

**Data Types:**

- *Attribute Data – Qualitative:*
  * Text Data – e.g. yes/no, pass/fail, approve/reject…
- *Variable Data – Quantitative:*
  * Discrete – counted numbers – e.g. # of defects (74), # of customer returns (13)
  * Continuous – decimal numbers – e.g. time (12:24:59), money ($17.4354), pressure (25.44534 lbs.)

**Types of Statistics:**

- Descriptive Stats – Used to describe and summarize data.
- Inferential Stats – Drawing conclusions about a population, when sample data is used.
  * As we gather data, we work with samples.
  * We need confidence that our sample represents the population.

**Measures of Central Tendency:**

- Mean – The average.
- Median – The middle value.
- Mode – The most frequently occurring value.
- Trimmed Mean – A compromise between the mean and median, removes some outliers then averages.

**Measures of Variation:**

- Range – Difference between the largest and smallest value.
- Interquartile Range – Difference between the 75th and 25th percentile.
- Standard Deviation – Average deviation of values from the mean.
- Variance – Average squared deviation of values from the mean.

**Basic Graphs:**

- Histogram – shows central tendency and variation within a *single* distribution.
- Dotplot – similar to a histogram, but shows each value as an individual point.
- Boxplot – shows central tendency and a variation within *several* distributions, not just one.
- Time-Series Plot – shows critical quality measurements over time.
- Scatterplot – shows the relationship between two variables.

**Data Measurement Scales:**

- Nominal – Cannot be ordered; no arithmetic can be performed. e.g. city (Detroit, Cleveland, Seattle).
- Ordinal – Can be ordered; differences between values meaningless. e.g. taste (bad, okay, good).
- Interval – Can be ordered; differences between values meaningful (not ratios). e.g. temp ($0^{o}$, $10^{o}$ , $20^{o}$).
- Ratio – Can be ordered; ratios meaningful; zero indicates an absence. e.g. weight (0kg, 25kg, 50kg).

**Types of Sampling & Measurement Errors:**

- Sampling Error – Differences among samples drawn at random ("luck of the draw").
- Sampling Bias – A lack of random samples (e.g. height of basketball players only).
- Measurement Error – Issues with our measurement systems.
- Measurement Invalidity – Not measuring what it is intended (e.g. temperature near a furnace).

## HYPOTHESIS TESTING

Helps answer: *"Is the sample a fair representation of the population?"*

**Hypotheses:**

- Null Hypothesis (Ho) – assumes NO differences (the same), *p-value* > 0.05
- Alternative Hypothesis (Ha) – states there is a difference, *p-value* < 0.05

**Tests for Normal Data ("t-tests"):**

- 1-Sample t-Test – study one sample's mean against a target.
- 2-Sample t-Test – study means from two different samples.
- ANOVA Test – study means from more than two samples.
- Paired t-Test – study paired data (e.g. same part before/after improvement).

**Normal vs Non-Normal Data**

- Hypothesis tests with NORMAL data use the **mean** for central tendency
- Hypothesis tests with NON-NORMAL data use the **median** for central tendency

## DESIGN OF EXPERIMENTS

- Shows the cause and effect relationship between X and Y.
- Helps determine the proper settings (levels) for our inputs (X) in order to optimize our output (Y).

**Key Terminology:**

- Factors (x) – The independent variables being used (e.g. temperature).
- Levels – The various settings for the factors (e.g. 300°, 500°).
- Run – A set of experimental conditions. (Experiments have multiple.)
- Response (y) – The result from an experimental run (e.g. material strength).
- Replication – The repetition of experimental runs. (Challenges the result.)

**Common Types of Experiments:**

- Full Factorials – use 2-5 input variables with all combinations of levels (or settings).
- Fractional Factorials – use 4-15 input variables and a fraction of combinations.

**General Notation for Full Factorial Design (2k):**

- k = # of input variables
- 2 = # of levels used for each factor

**Principles of Good Experimental Design:**

- Randomization of runs to remove bias and spread noise
- Replication of the experiment to challenge or strengthen the validity of results.
- Monitoring of noise.
- Holding other factors constant. (Those that are not a focus on the experiment.)

# BUSINESS ANALYTICS (Cheat Sheet)

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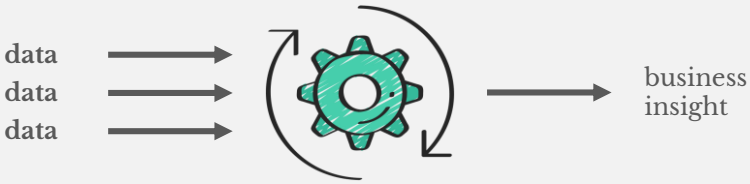
## BASIC CONCEPTS

### What is Analytics?




### Types of Analytics

- **Descriptive Analytics** — What happened?
- **Predictive Analytics** — What might happen?
- **Prescriptive Analytics** — What should we do?

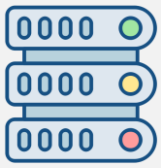
### Lifecycle of Analytics *("CRISP-DM")*

- **Business Understanding** — Define the business problem.
- **Data Understanding** — Identify available data and gaps in data.
- **Data Preparation** — Clean and prepare the data.
- **Modeling** — Build predictive models.
- **Evaluation** — Evaluate how the models perform.
- **Deployment** — Start using the chosen model.

## BIG DATA

Big data is so large that "it requires the use of new technical architectures ... to enable insights that unlock new sources of business value." (McKinsey)

### 3 V's of Big Data *(Defining Characteristics)*



Volume

Velocity

Variety

## POPULAR TOOLS

### Microsoft Excel
Allows you to explore/analyze smaller data sets

### Tableau Desktop *(or Power BI)*
Allows you to visualize your data with dashboards

### Python Language *(or R)*
Allows you to build models to make predictions

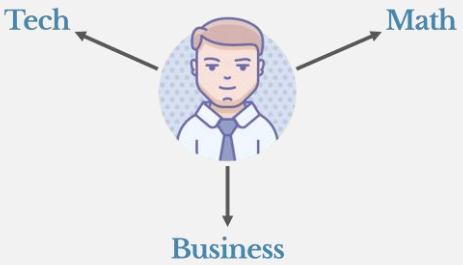
### Structured Query Language (SQL)
Allows you to communicate and interact with databases

## CAREERS IN ANALYTICS

### Common Job Titles

- Business Analyst
- Business Intel. Analyst
- Analytics Manger
- Data Analyst
- Data Scientist *
- ...

** Most people feel this job is more technical.*




### Most job postings ask about software, so:

- Select a tool from above
- Download a free trial.
- Get a pizza!
- Spend a weekend to learn.
- State you have "Experience with..." on your resume.