DATA SCIENCE
PPGIa/PUCPR

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PUCPR
GRUPO MARISTA

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About

- Jean Paul Barddal
- Data Stream Mining
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- www.jpbarddal.com.br
- Research topics: Machine learning (classification, regression, clustering, feature selection, recommender systems) for streaming data
- Applied ML: Financial systems, Education, Recommender systems for e-commerce, Log analysis, etc

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Warning

- We are in a Level I Global Classes program
- This means that:
  - Content (slides, activities, test, etc) will be in English
  - We will talk in Portuguese
  - The test will be in Portuguese, but you may answer them in either Portuguese or English

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Warning

- This is **not** a crash course on Data Science using Python
- You are highly expected to take your time to learn more about the tools we will use (numpy, pandas, scikit-learn, etc)
- We are interested in both your coding skills and also in your critical reasoning
- There is an underlying assumption that you know how to code

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Agenda

- **February 28th** - Lecture 1 – Overview, grading, Basic Statistics
- **March 6th** - Lecture 2 – Univariate data analysis
- **March 13th** - Lecture 3 – Multivariate data analysis
- **March 20nd** - Lecture 4 – Correlations
- **March 27th** - Lecture 5 – Enhanced data visualization
- **April 3th** – Lecture 6 – Missing data & outliers
- **April 10th** - Lecture 7 – PCA and t-SNE
- **April 17th** - Lecture 8 – Test

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Grading

- We have 8 meetings and you must be present in 75% of them, i.e., 6 lectures
- You grading will be based on a test to be done on April 19th (A >= 9, B >= 8, C >= 7, D otherwise)

Slides

- Slides will be made available on my website
- www.jpbarddal.com.br

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Recordings

- Lectures will **NOT** be recorded
- There are no **IFs** and no **BUTs** on this

Polls

- You need to attend the poll that will be made in the beginning of each lecture
- Throughout the lecture, if you are requested to participate, and you do not, you may be assumed as absent

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ENVIRONMENT SETUP

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Google Colaborate

- Hereafter we will use Google Colaborate
- It will allow us to run Python code in the cloud
- Most part of the data analytics and machine learning tools are available there

Set up your account now :)

https://colab.research.google.com/

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Anaconda

- If you're not too keen on working on the cloud, you should be able to use Jupyter and (preferably) Anaconda
- Anaconda allows you to keep different Python versions, each with different packages

https://www.anaconda.com/

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PANDAS

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Pandas

- Pandas is the most popular and good tool for handling data and data analysis
- Let's focus on tabular data for now

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Tabular data

Columns are called:
Attributes, Features
Variables, Fields, Characteristics

Lines are called:
Objects
Instances
Samples
Registers
Cases

Gender	Age	Salary	Job Role	Married?
Male	28	5600,34	Programmer	N
Male	22	3215,50	Data Analyst	Y
Female	32	12000,00	Project Manager	N
Female	27	4500,00	Lawyer	N
Male	17	1400,00	Accounting Intern	N
…	…	…	…	…

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Types of variables

- Numeric
  - Interval
    - Money quantity, temperature in Celsius, Fahrenheit, etc
  - Ratio
    - The same as above, yet, 0 has a special meaning
    - Height, weight, temperature in Kelvin (note that these cannot be negative!)
- Categorical
  - Nominal
    - Ex.: Gender (M/F), Nationality, Car make
  - Ordinal
    - Ex.: Number of stars (hotel rating), movie ratings (poor, good, great)

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Descriptive analytics

- Goal: summarize and describe a dataset
- Main goals:
  - Minimum and maximum values
  - Mean
  - Median
  - Mode
  - Variance
  - Standard deviation

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Mean

- Sum of all values divided by the amount of values

$$\bar{x} = \frac{1}{n}\sum_{i=1}^{n} x_i$$

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Mode

- The most repeated value in data
- What is the mode in each of the lists below?
- [1, 1, 2, 3, 4]
- [1, 2, 3, 4, 5, 6, 7, 8, 9, 10]
- [1, 1, 1, 2, 2, 2, 3, 4, 5]
- [1,1,1,2,2,2,3,3,3,4,4,4,5,5,5]

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Median

- Given a sorted dataset, the median is the value that is in its center position
- Example:

[32, 33, 24, 31, 44, 65, 32, 21, 32]

Sorting:

[21, 24, 31, 32, 32, 32, 33, 44, 65]

Median:

[21, 24, 31, 32, 32, 32, 33, 44, 65]

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Median

- If the amount of values is even, the median is given by the average of the center positions
- Example:

[18, 19, 19, 22, 44, 45, 46, 46, 47, 48]

Median = **(44+45)/2 = 44,5**

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Quartiles and Percentiles

- Quartiles divide the data in 4 parts. These are indicated by Q1, Q2 and Q3, such that Q2 is the median

Q1 (pos. 2,5) = 19 **Q3 (pos. 7,5)=46,5**

[18, 19, 19, 22, 44, 45, 46, 46, 47, 48]

Q2 (pos. 5,5)= 44,5

- The same rationale can be applied to percentiles, that divide the data in each 1%: P1, P2, P3, … P99

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Variance

- Given a dataset, the variance tells us how distant each value is from the mean
- The smaller the variance, the closer all values are from the mean
- Variance is given by:

$$Var(X) = \frac{\sum_{i=1}^{n}(x_i - \bar{x})^2}{n-1}$$

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Standard deviation

- The standard deviation tells us the "error" in a dataset if a value is replaced by the mean
- The standard deviation is often showed next to the mean:

$$\bar{x} \pm \sigma$$

- And it is the square root of the variance

$$\sigma = \sqrt{Var(X)}$$

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LET'S HAVE A BREAK: 20 min!

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ACTIVITY

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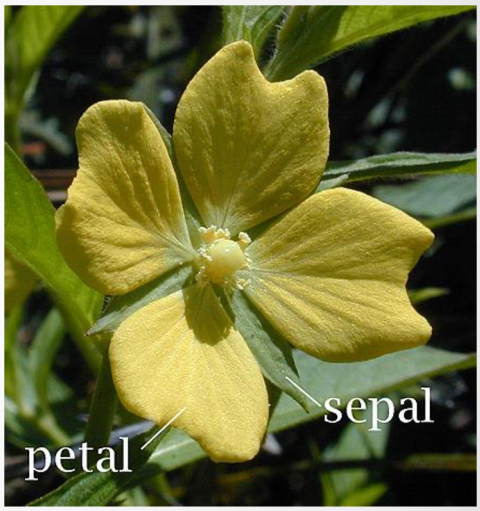
Activity 1 - Using the Iris Dataset

- Download the notebook
- Perform all the operations in it with the iris dataset

- Attributes
  - Petal Length
  - Petal Width
  - Sepal Length
  - Sepal Width



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Activity 2

- Assemble in pairs!
- Each pair will receive a specific dataset
- You should follow the link below and replace X with your team's number.
- https://jpbarddal.github.io/assets/data/datascience/ans/dataset**X**.csv

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Activity 2 – let's continue

- Now, two teams should unite and discuss their findings
- What are the main statistics you have computed?
- What do you think is going on with these datasets?

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WHAT IS GOING ON?

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Anscombe Quartet

Same Stats, Different Graphs:

Generating Datasets with Varied Appearance and Identical Statistics through Simulated Annealing

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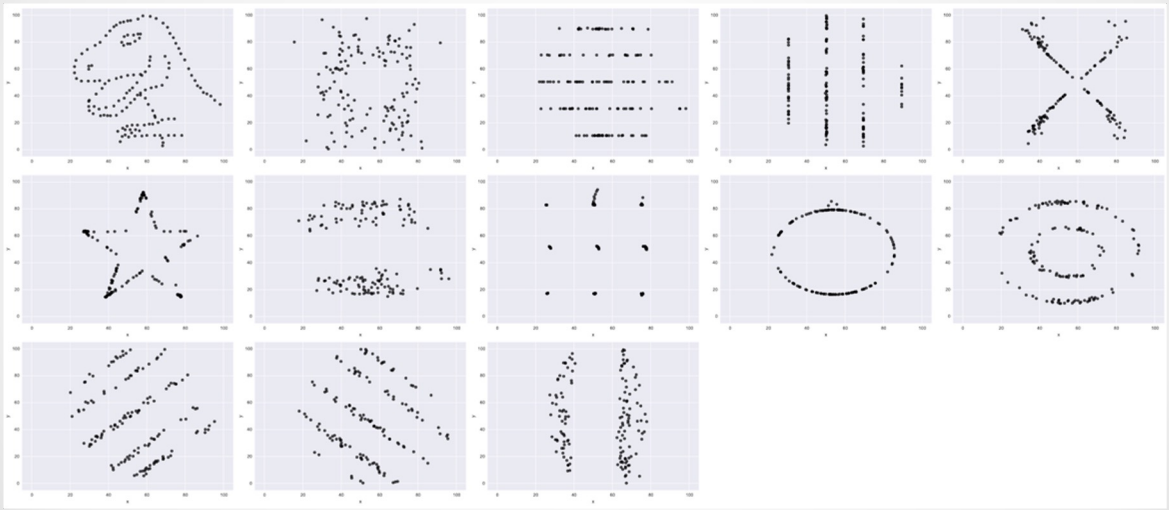
Anscombe Quartet



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