IMD0033 - Probabilidade

Aula 16 - Média

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Agenda

- Média
- A média como um ponto de equilíbrio
- Definindo a média algebricamente
- Estimando a média da população
- Estimando a média da população a partir de amostras pequenas

Atualizar o repositório

```
git clone https://github.com/ivanovitchm/imd0033_2019_1.git
```

Ou ....

```
git pull
```

PREVIOUSLY ON...

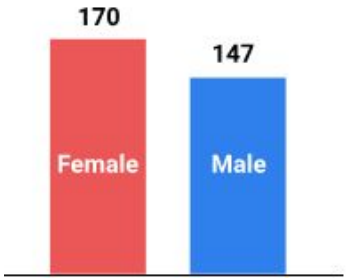
Data **source**

Getting **good** data

Id	Name	Salary	...	Gender
1	Mary Ann	$35 000	....	Female
2	Marc Downey	$55 000	....	Male
..	....	....	....	....
51	Juliet Ali	$45 000	....	Female
...	...	....	....	....
317	Jane Ace	$95 000	....	Female

Understand how the data is **structured** and **measured**

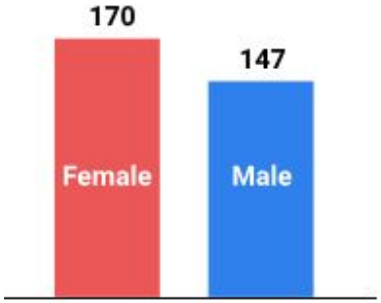
Frequency tables are not the only way of bringing data to a comprehensible form.



Visualize the patterns

Gender	Frequency
Male	147
Female	170

Organize the data in **comprehensible** forms to find patterns



Visualize the patterns

Gender	Frequency
Male	147
Female	170

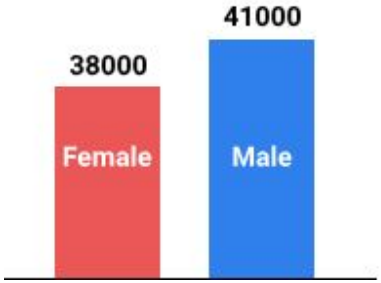
By measuring frequencies and build **frequency tables**

Organize the data in **comprehensible** forms

By summarizing it with **average values**

Gender	Average salary
Male	41000
Female	38000

Visualize the patterns



Depending on the particular characteristics of a distribution, we'll see that we can summarize it using the **mean**, the **weighted mean**, the **median**, or the **mode**.

We'll also learn to measure the **variability** in a distribution

$$A = [3, 3, 3, 3]$$

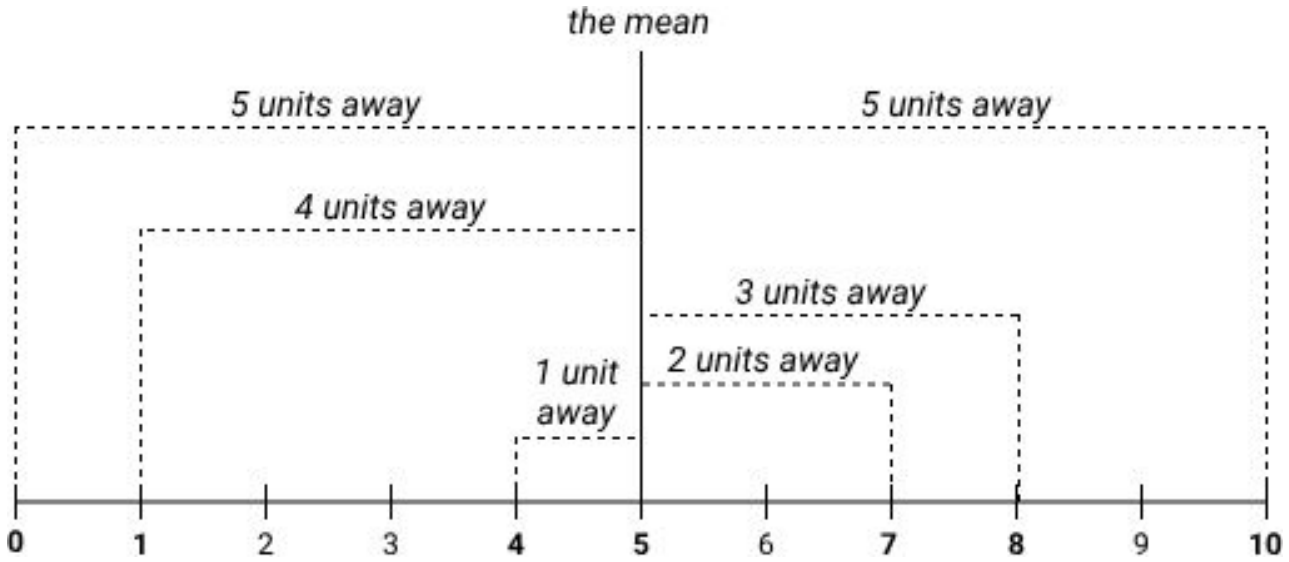
$$B = [30, 1, 15, 43]$$

We can clearly see that there's much more variability (diversity) in B. We'll learn to quantify variability using measures like **variance**, **standard deviation** and **z-scores**.

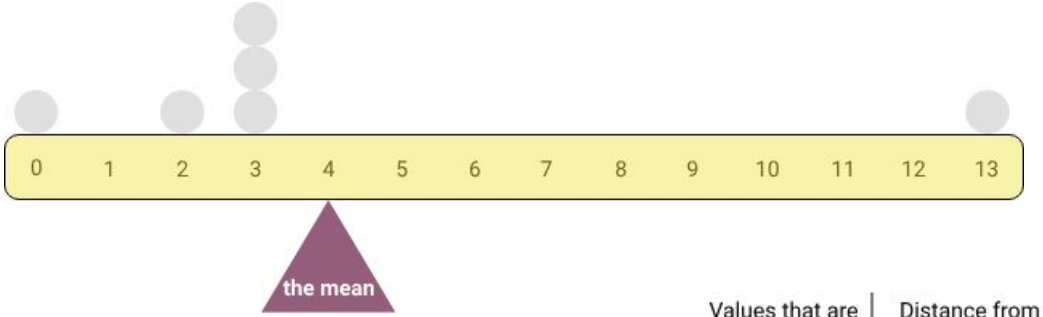
The Mean

$$[0, 1, 4, 7, 8, 10]$$

$$\frac{0+1+4+7+8+10}{6} = \frac{30}{6} = 5$$



The Mean as a Balance Point



[0,2,3,3,3,13]

Values that are **below** the mean	Distance from the mean
0	4 units
2	2 units
3	1 unit
3	1 unit
3	1 unit
	Total distance: ***9 units***

Values that are **above** the mean	Distance from the mean
13	9 units
	Total distance: ***9 units***

```python
from numpy.random import randint, seed
equal_distances = 0

for i in range(1000):
    seed(i)
    # generate ten random numbers between 0 and 1000
    distribution = randint(0,1000,10)
    mean = sum(distribution) / len(distribution)

    above = []
    below = []
    for value in distribution:
        if value == mean:
            continue # continue with the next iteration because the distance is 0
        if value < mean:
            below.append(mean - value)
        if value > mean:
            above.append(value - mean)

    sum_above = round(sum(above),1)
    sum_below = round(sum(below),1)
    if (sum_above == sum_below):
        equal_distances += 1

print(equal_distances)
```

Defining the mean algebraically

$$\mu = \frac{x_1 + x_2 + \dots x_N}{N}$$

$N = 7$

$[0 \quad 2 \quad 3 \quad 3 \quad 3 \quad 4 \quad 13]$

$x_1 \quad x_2 \quad x_3 \quad x_4 \quad x_5 \quad x_6 \quad x_7$

$$\mu = \frac{0 + 2 + 3 + 3 + 3 + 4 + 13}{7} = \frac{28}{7} = 4$$

Population Mean

$$\bar{X} = \frac{x_1 + x_2 + \dots x_n}{n}$$

$n = 3$

$[2 \quad 3 \quad 4]$

$x_1 \quad x_2 \quad x_3$

$$\bar{X} = \frac{2 + 3 + 4}{3} = \frac{9}{3} = 3$$

Sample Mean

	Population	Sample
Mean	μ	$\bar{x}, \bar{x}_n, \bar{X}, M$
Number of values	N	n

Defining the mean algebraically

$$\mu = \frac{x_1 + x_2 + \ldots + x_N}{N} = \frac{\sum X}{N} = \frac{\sum_{i=1}^{N} x_i}{N}$$

Population Mean

$$\overline{x} = \frac{x_1 + x_2 + \ldots + x_n}{n} = \frac{\sum X}{n} = \frac{\sum_{i=1}^{n} x_i}{n}$$

Sample Mean

Journal of Statistics Education

Ames, Iowa: Alternative to the Boston Housing Data as an End of Semester Regression Project

Dean De Cock
Truman State University

Journal of Statistics Education Volume 19, Number 3(2011),
www.amstat.org/publications/jse/v19n3/decock.pdf

Key Words: Multiple Regression; Linear Models; Assessed Value; Group Project.

Abstract

This paper presents a data set describing the sale of individual residential property in Ames, Iowa from 2006 to 2010. The data set contains 2930 observations and a large number of explanatory variables (23 nominal, 23 ordinal, 14 discrete, and 20 continuous) involved in assessing home values. I will discuss my previous use of the Boston Housing Data Set and I will suggest methods for incorporating this new data set as a final project in an undergraduate regression course.

```
import pandas as pd
pd.set_option('display.max_columns', 500)

houses = pd.read_csv("AmesHousing_1.txt",sep='\t')
houses.shape
```

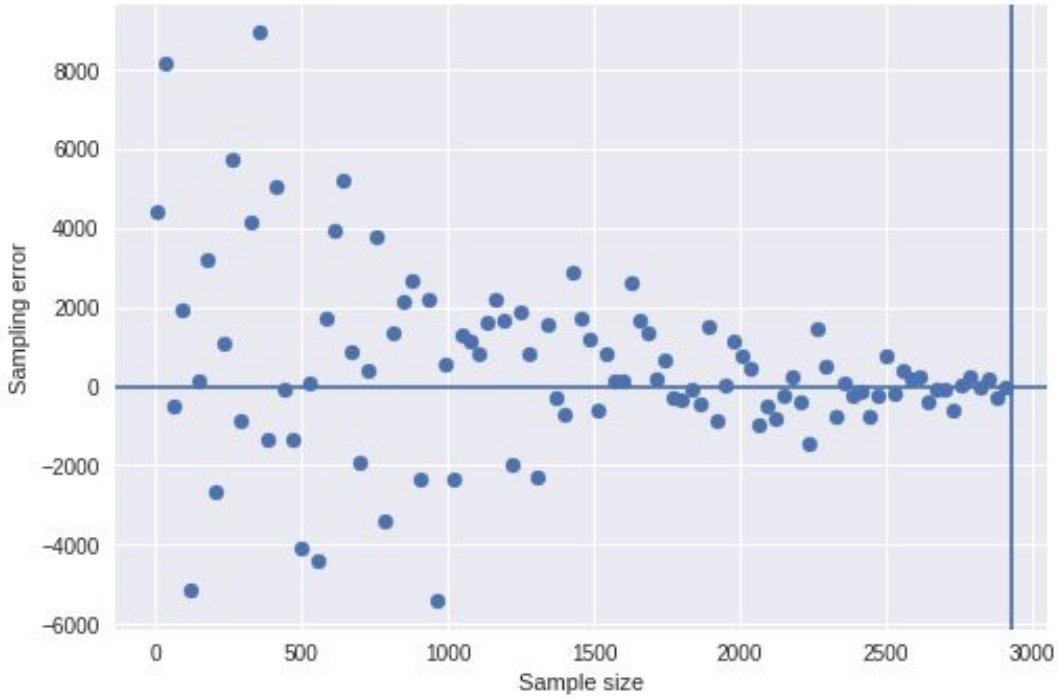
__	Order	PID	MS SubClass	MS Zoning	Lot Frontage	Lot Area	Street	Alley	Mo Sold	Yr Sold	Sale Type	Sale Condition	SalePrice
0	1	526301100	20	RL	141.0	131770	Pave	0	5	2010	WD	Normal	215000
1	2	526350040	20	RH	80.0	11622	Pave	0	6	2010	WD	Normal	105000
2	3	526351010	20	RL	81.0	14267	Pave	12500	6	2010	WD	Normal	172000
3	4	526353030	20	RL	93.0	11160	Pave	0	4	2010	WD	Normal	244000
4	5	527105010	60	RL	74.0	13830	Pave	0	3	2010	WD	Normal	189900

Estimating the population mean

In practice, **we almost always work with samples**.
But most of the times we're not interested in answering questions about samples — **we want to answer questions about populations**.

- What is the mean amount of money our customers spent last year on our website?
- What is the mean amount of time customers spent daily the first week after the promotion we ran?
- What is the mean sale price of a house in Ames, Iowa for the period 2006-2010?

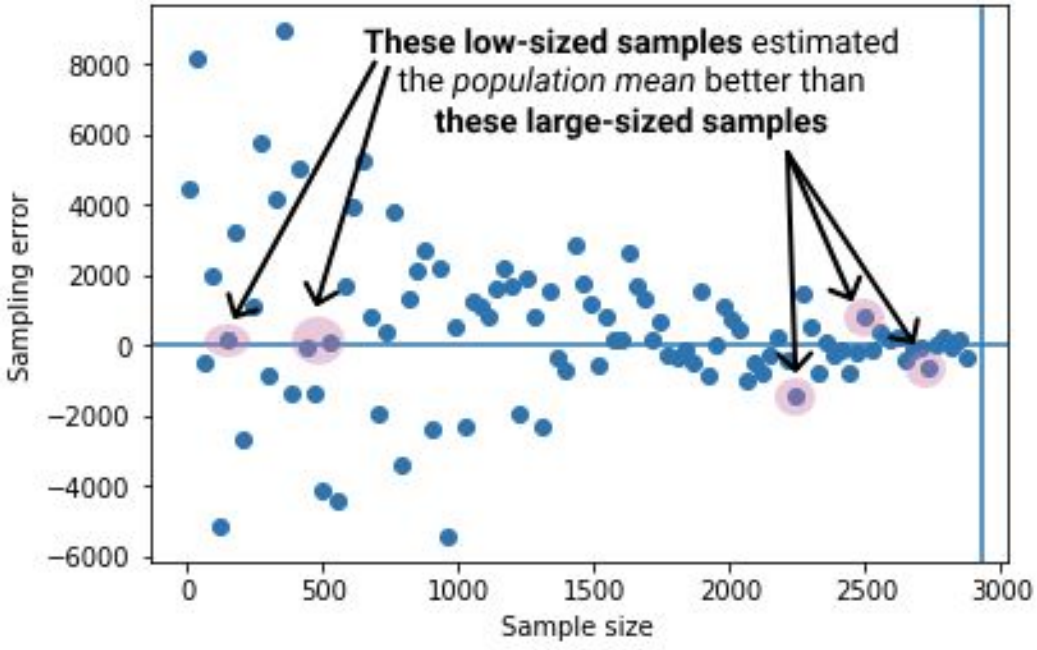
Estimating the population mean

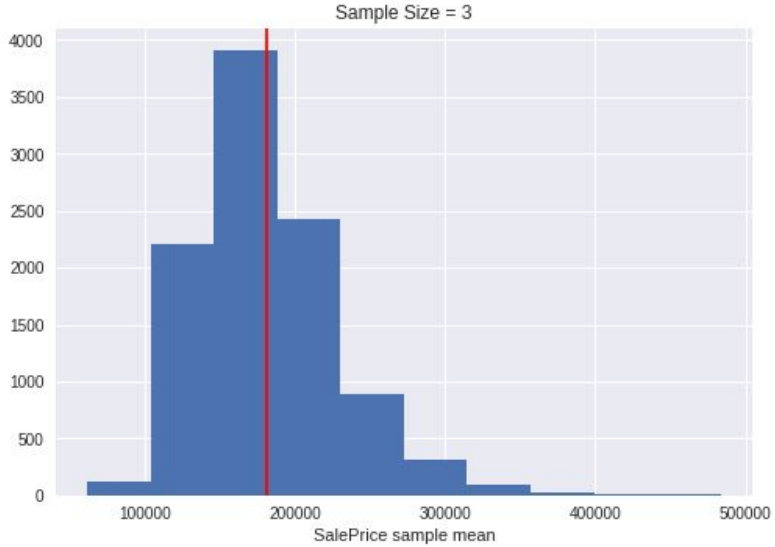


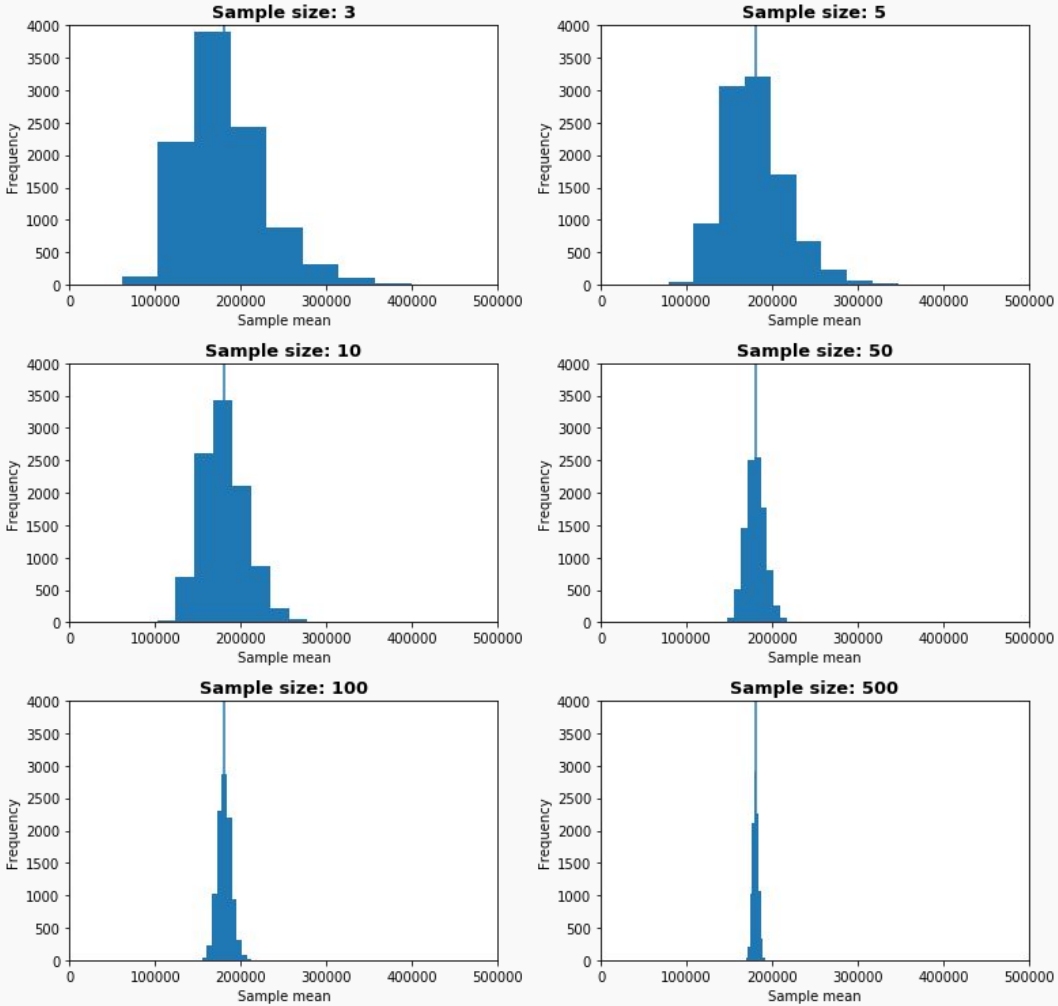
The general tendency for the sampling error is to decrease as the sample size increases.

$$\text{sampling error} = \mu - \overline{x}$$

Estimates from low-sized samples






Sample size: 3
Sample size: 5
Sample size: 10
Sample size: 50
Sample size: 100
Sample size: 500
Frequency
Sample mean
0
500
1000
1500
2000
2500
3000
3500
4000
0
100000
200000
300000
400000
500000

Next Steps

In the next mission, we'll explore a few edge cases where it's either impossible to compute the mean, or it's possible but not theoretically sound.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