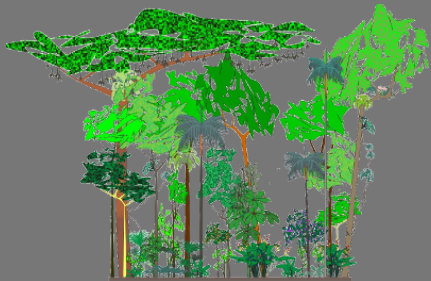


Planejamento e Análisis

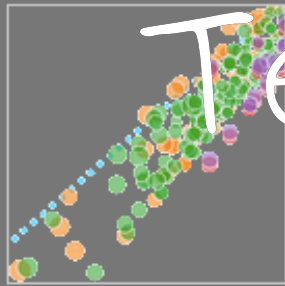
Teste de Hipóteses

Alexandre Adalardo de Oliveira

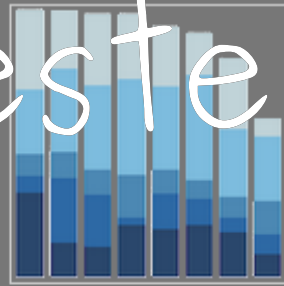
Ecologia – IBUSP Março 2019



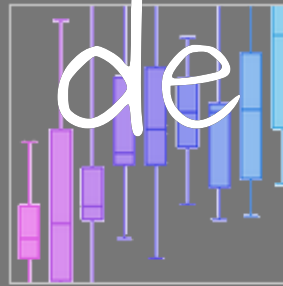
Line and Scatter Plots



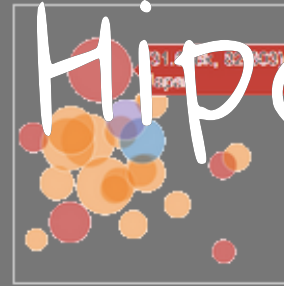
Bar Charts



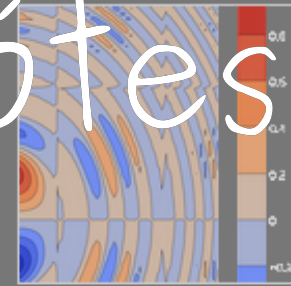
Box Plots



Bubble Charts

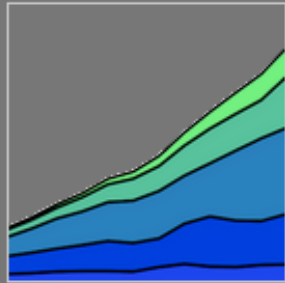


Contour Plots

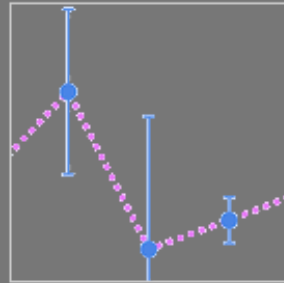


Teste de Hipóteses

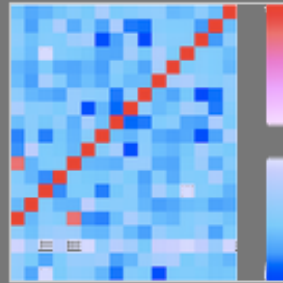
Filled Area Plots



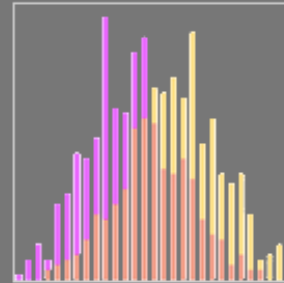
Error Bars



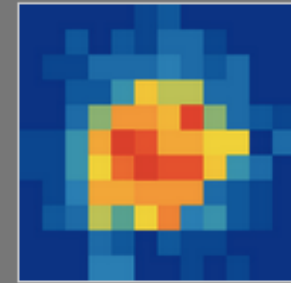
Heatmaps



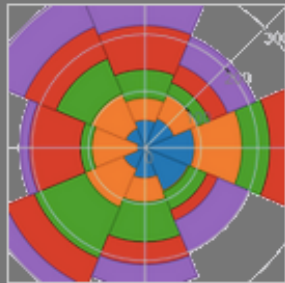
Histograms



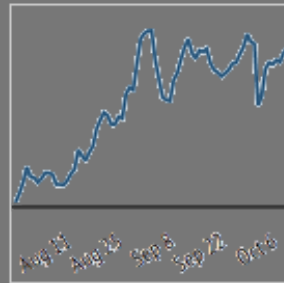
2D Histograms



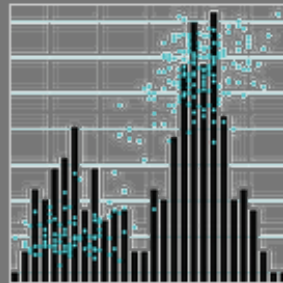
Polar Charts



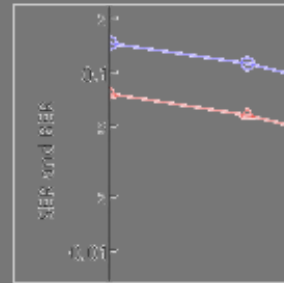
Time Series



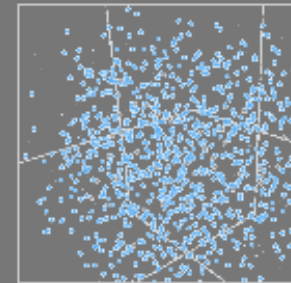
Multiple Chart Types



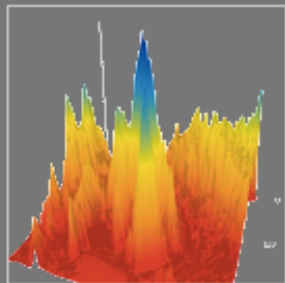
Log Plots



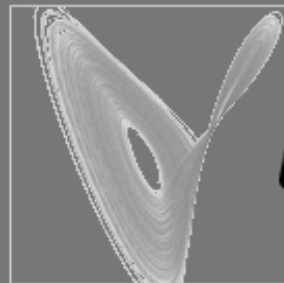
3D Scatter Plots



3D Surface Plots



3D Line Plots



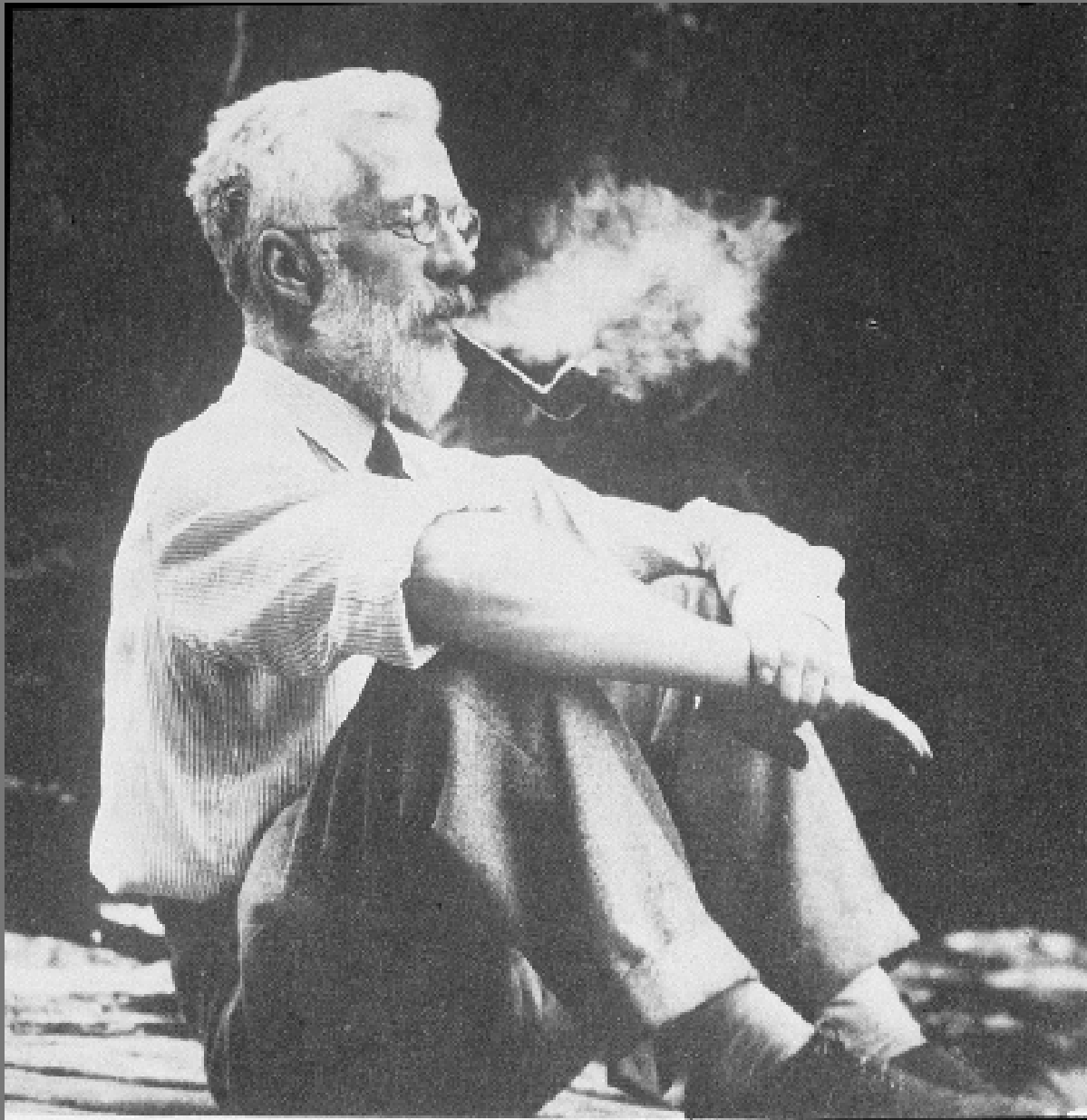
PIAnEco

Teste de Hipóteses/Significância

1. a lógica do teste
2. o significado do p-valor
3. uni e bicaudal
4. biologia \leftrightarrow estatística

Teste de Hipótese

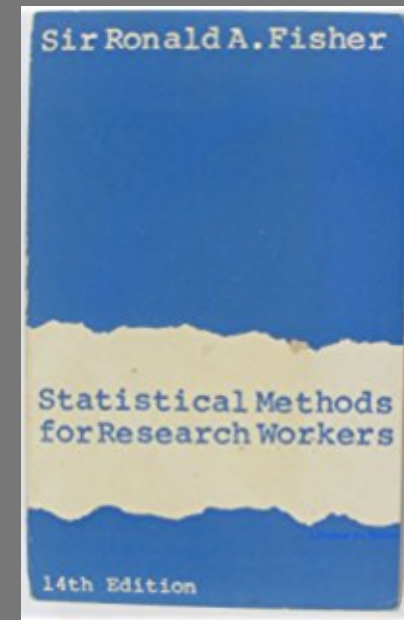
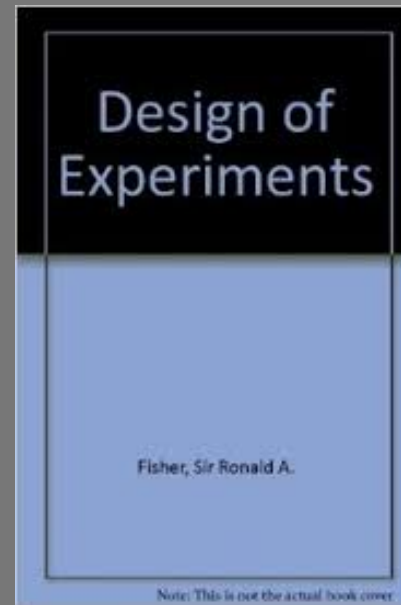
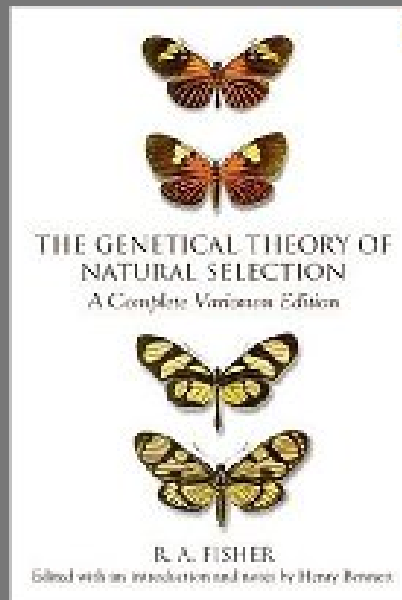
Sir Ronald A. Fisher



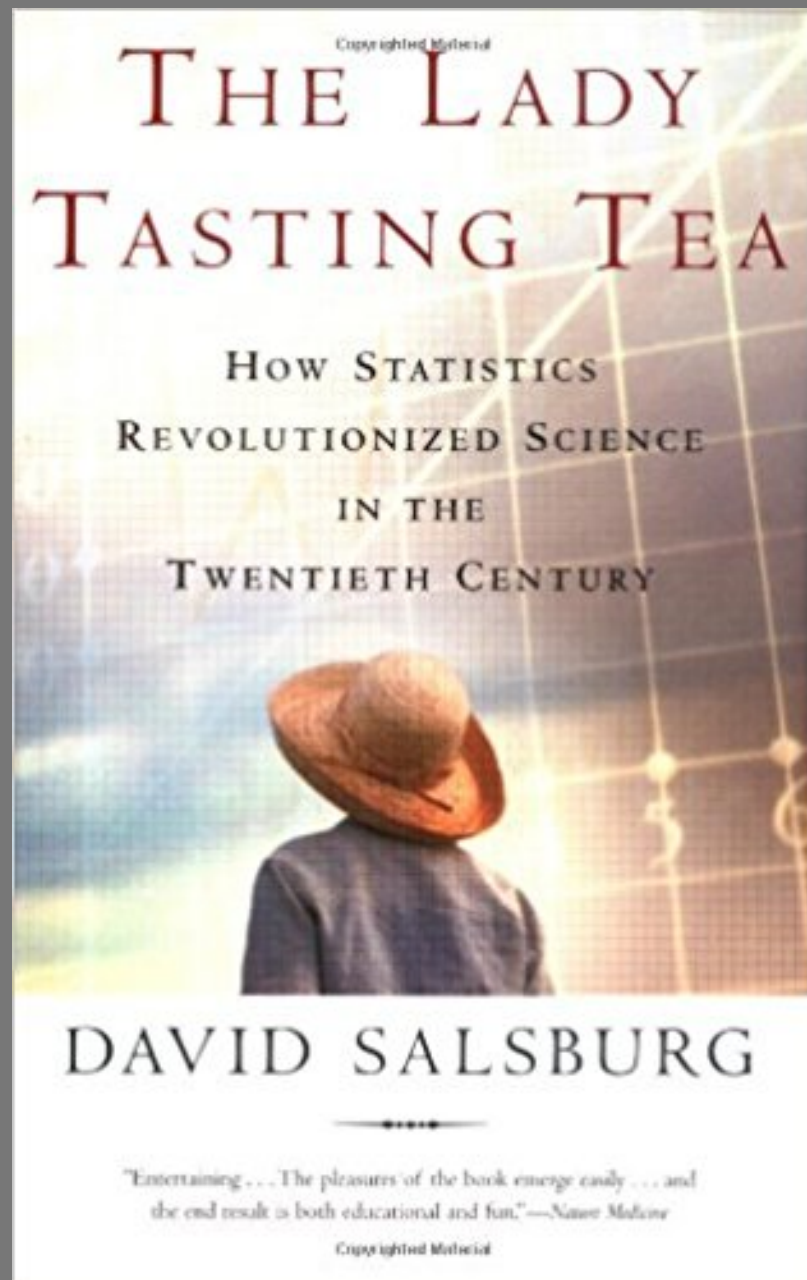
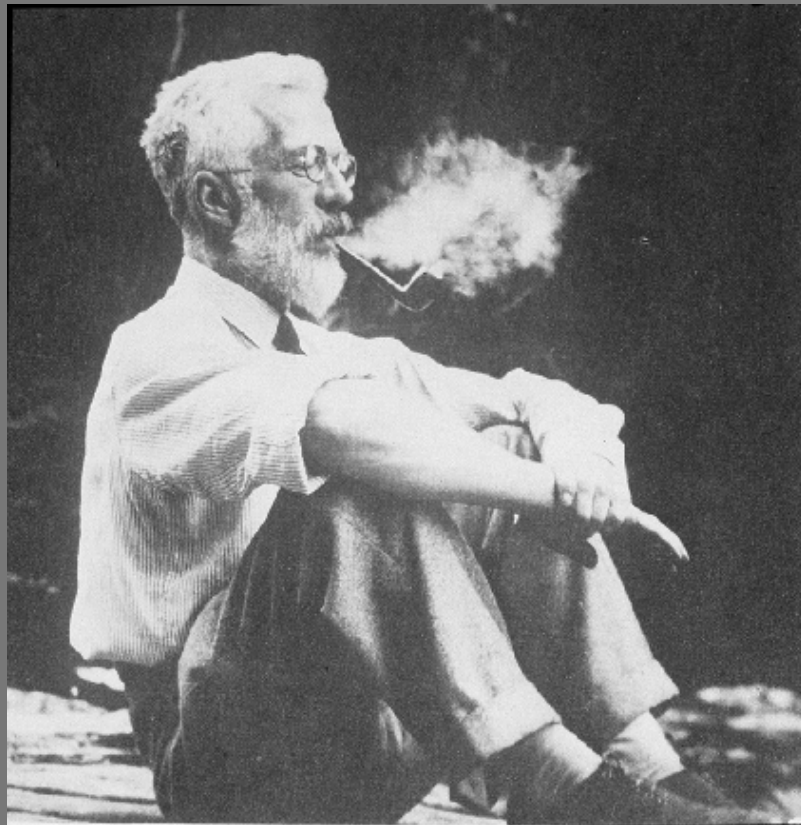
Desenho Experimental



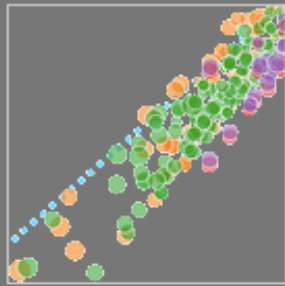
Referência em diferentes áreas



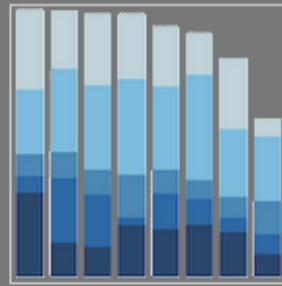
Revoluciona a Ciência



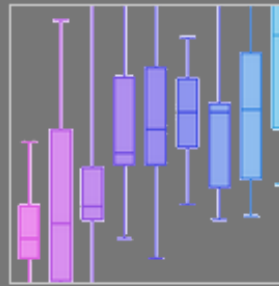
Line and Scatter Plots



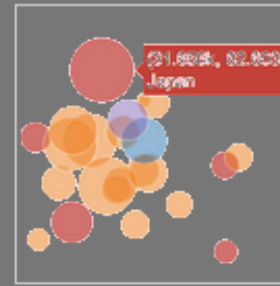
Bar Charts



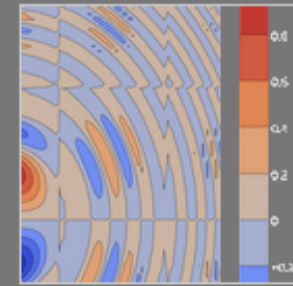
Box Plots



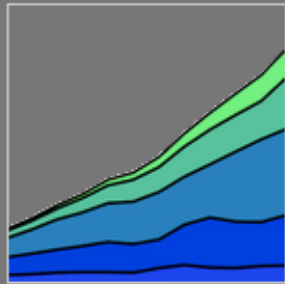
Bubble Charts



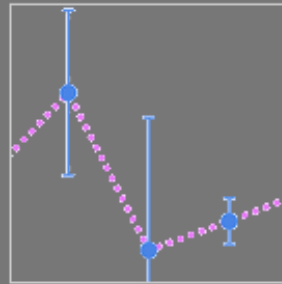
Contour Plots



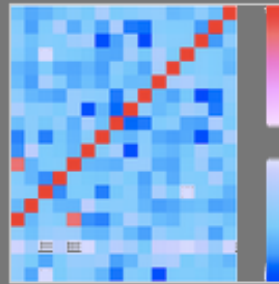
Filled Area Plots



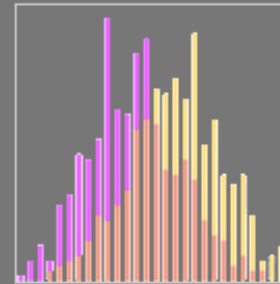
Error Bars



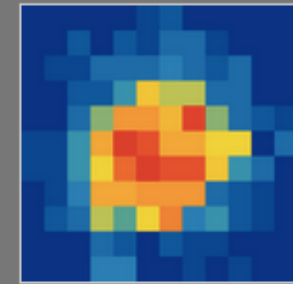
Heatmaps



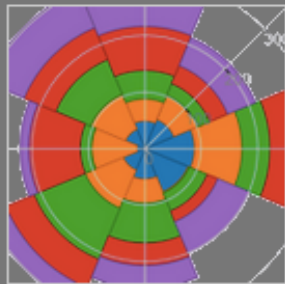
Histograms



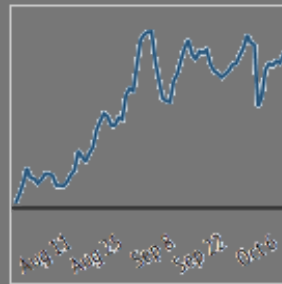
2D Histograms



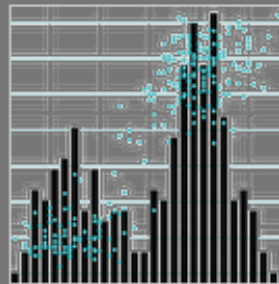
Polar Charts



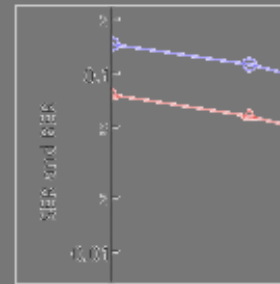
Time Series



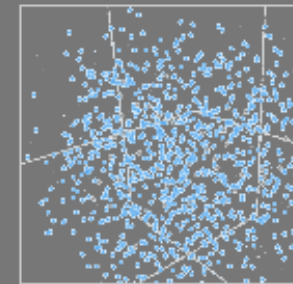
Multiple Chart Types



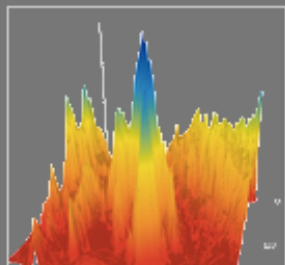
Log Plots



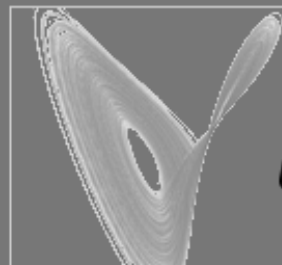
3D Scatter Plots



3D Surface Plots



3D Line Plots

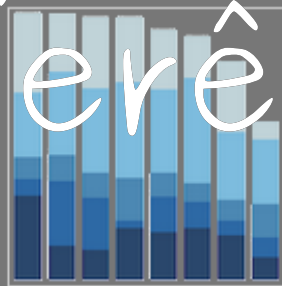


PIAnEco

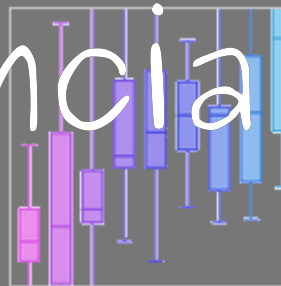
Line and Scatter Plots



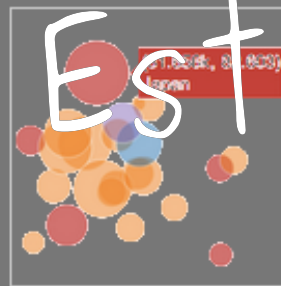
Bar Charts



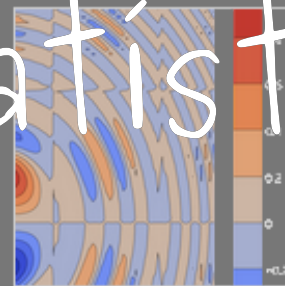
Box Plots



Bubble Charts

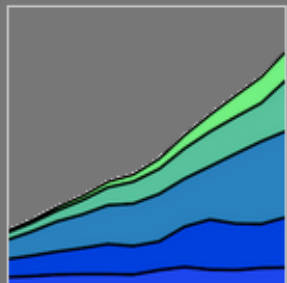


Contour Plots

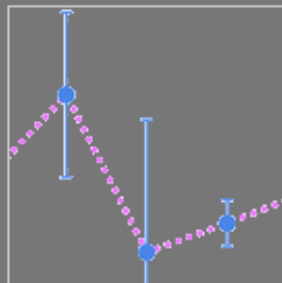


Inferência Estatística

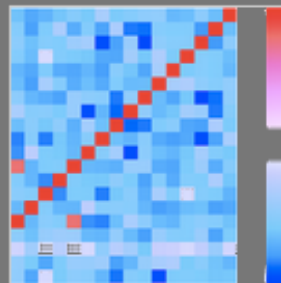
Filled Area Plots



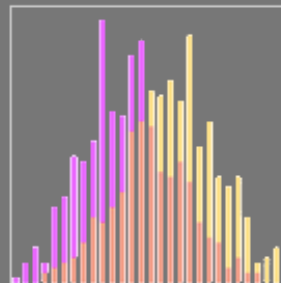
Error Bars



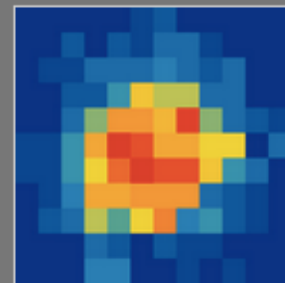
Heatmaps



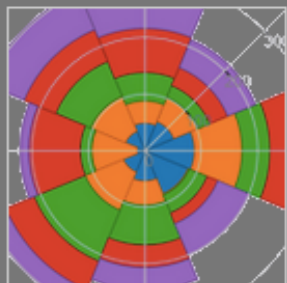
Histograms



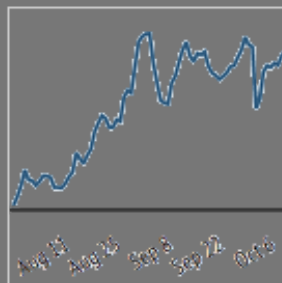
2D Histograms



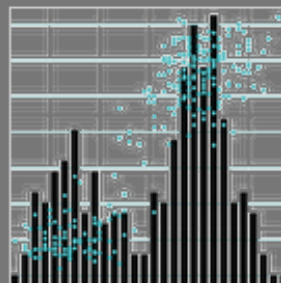
Polar Charts



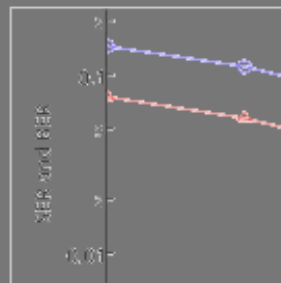
Time Series



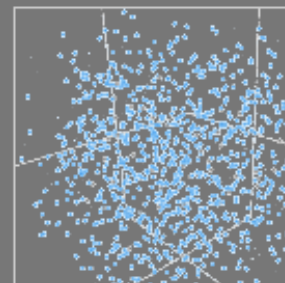
Multiple Chart Types



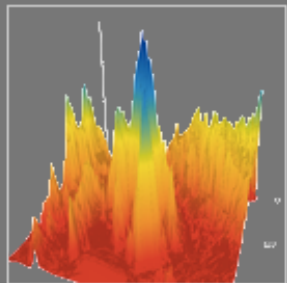
Log Plots



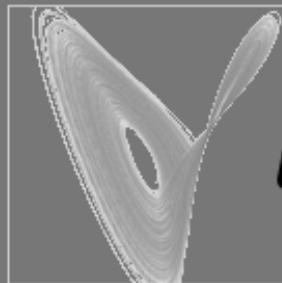
3D Scatter Plots



3D Surface Plots



3D Line Plots



PIAnEco

Inferência Estatística

“fazer afirmações sobre um universo a partir de um conjunto de valores representativo (amostra). Tal tipo de afirmação deve sempre vir acompanhada de uma medida de precisão sobre sua veracidade”

Inferência Estatística

fazer afirmações sobre um universo a partir de um conjunto de valores representativo (amostra). Tal tipo de afirmação deve sempre vir acompanhada de uma medida de precisão sobre sua veracidade

Amostragem



IlhadoCardosoPlot

Image NASA
Image © 2008 TerraMetrics
© 2008 MapLink/Tele Atlas
© 2008 Europa Technologies

©2007 Google

nter 24°56'26.09" S 48°03'38.26" Welev 153 m

Streaming |||||100%

Eye alt 4.1 23.25 km

Processo de Amostragem

Conexão entre população e amostra

Variabilidade da amostra (erro/incerteza)

Lei dos grandes números

Teorema do Limite Central

IlhadoCardosoPlot

Image NASA
Image © 2008 TerraMetrics
© 2008 MapLink/Tele Atlas
© 2008 Europa Technologies

©2007 Google

nter 24°56'26.09" S 48°03'38.26" Welev 153 m

Streaming |||||100%

Eye alt 4.2 23.25 km

Palmito (*Euterpe edulis*)



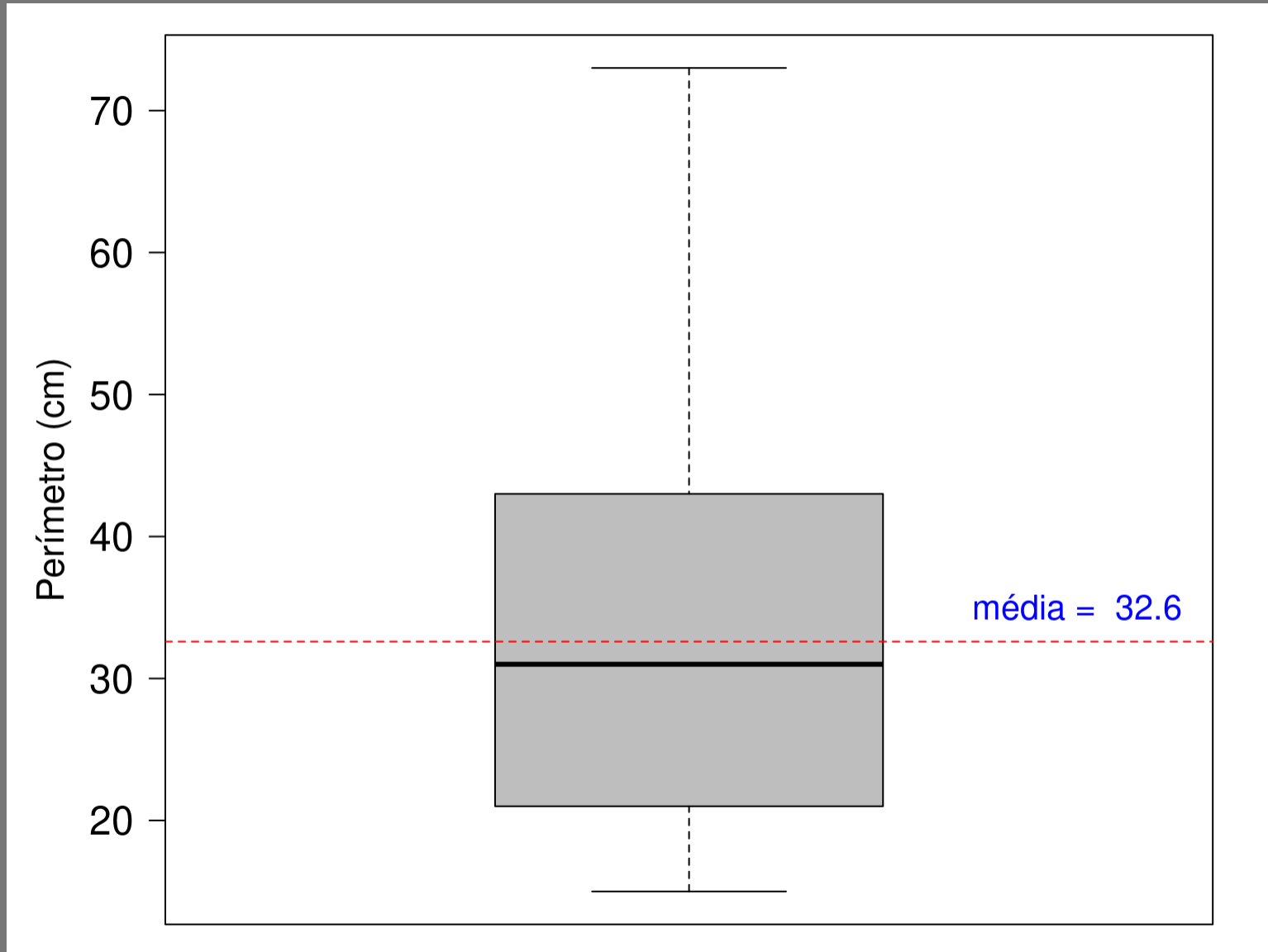
PE Carlos Botelho

Área: 37mil hectares

Densidade: ~ 200 palmitos/ha

População: 7.400.000 palmitos

População de Palmitos



Amostra de Palmitos

- 1. amostra de 10 indivíduos

```
## [1] 27.1
```

- 2. amostra de 10 indivíduos

```
## [1] 30.1
```

- 3. amostra de 10 indivíduos

```
## [1] 34.2
```

- 4. amostra de 10 indivíduos

```
## [1] 38.2
```

- 5. amostra de 10 indivíduos

```
## [1] 38.9
```

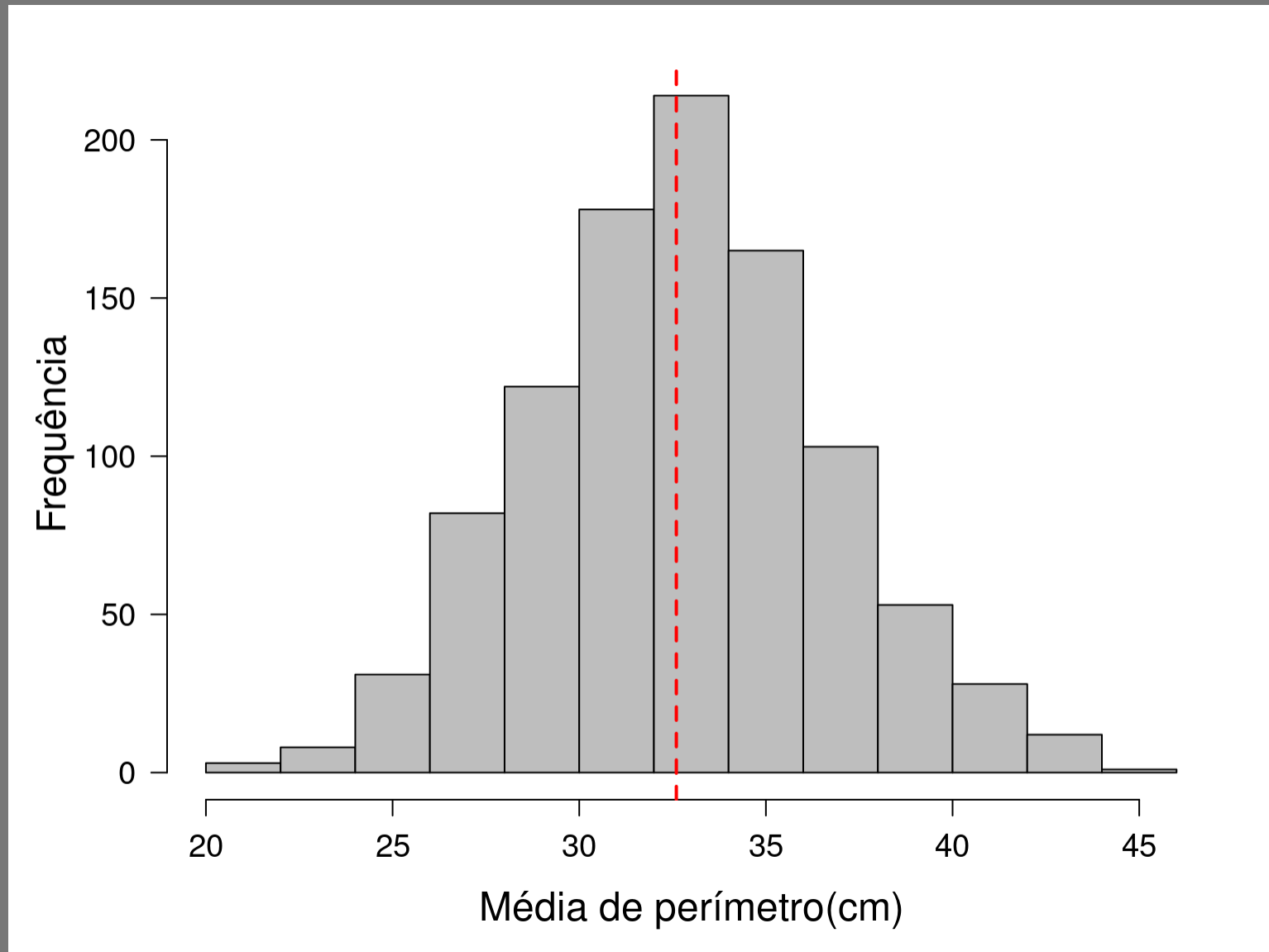
Palmitos de Carlos Botelho

Repetir a amostra muitas vezes:

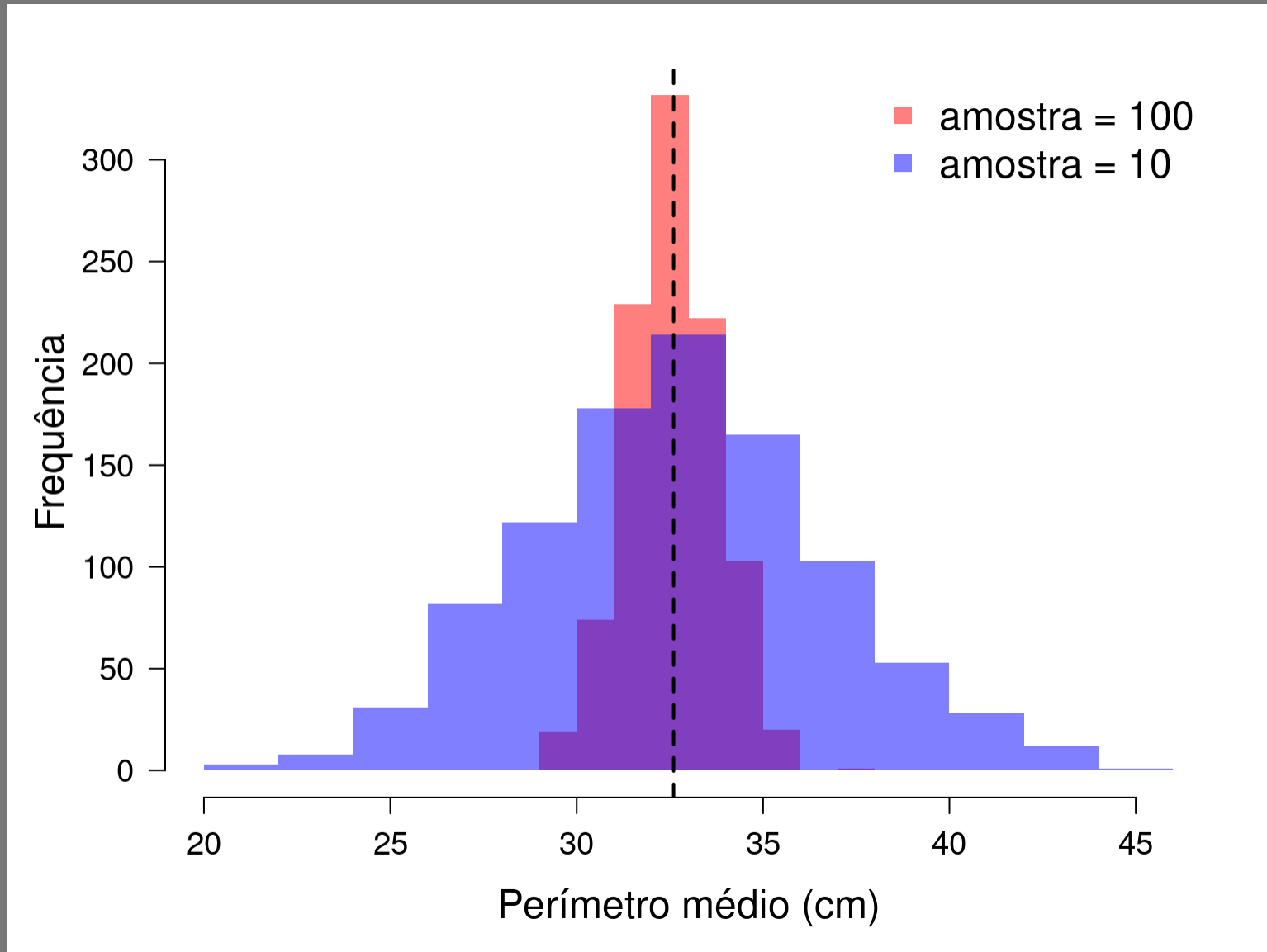
amostra	média
1	28.6
2	32.1
3	30.7
4	27.4
5	30.9
6	31.5
7	32.7
8	36
9	30.8
10	38.5
• • •	• • •

Palmitos de Carlos Botelho

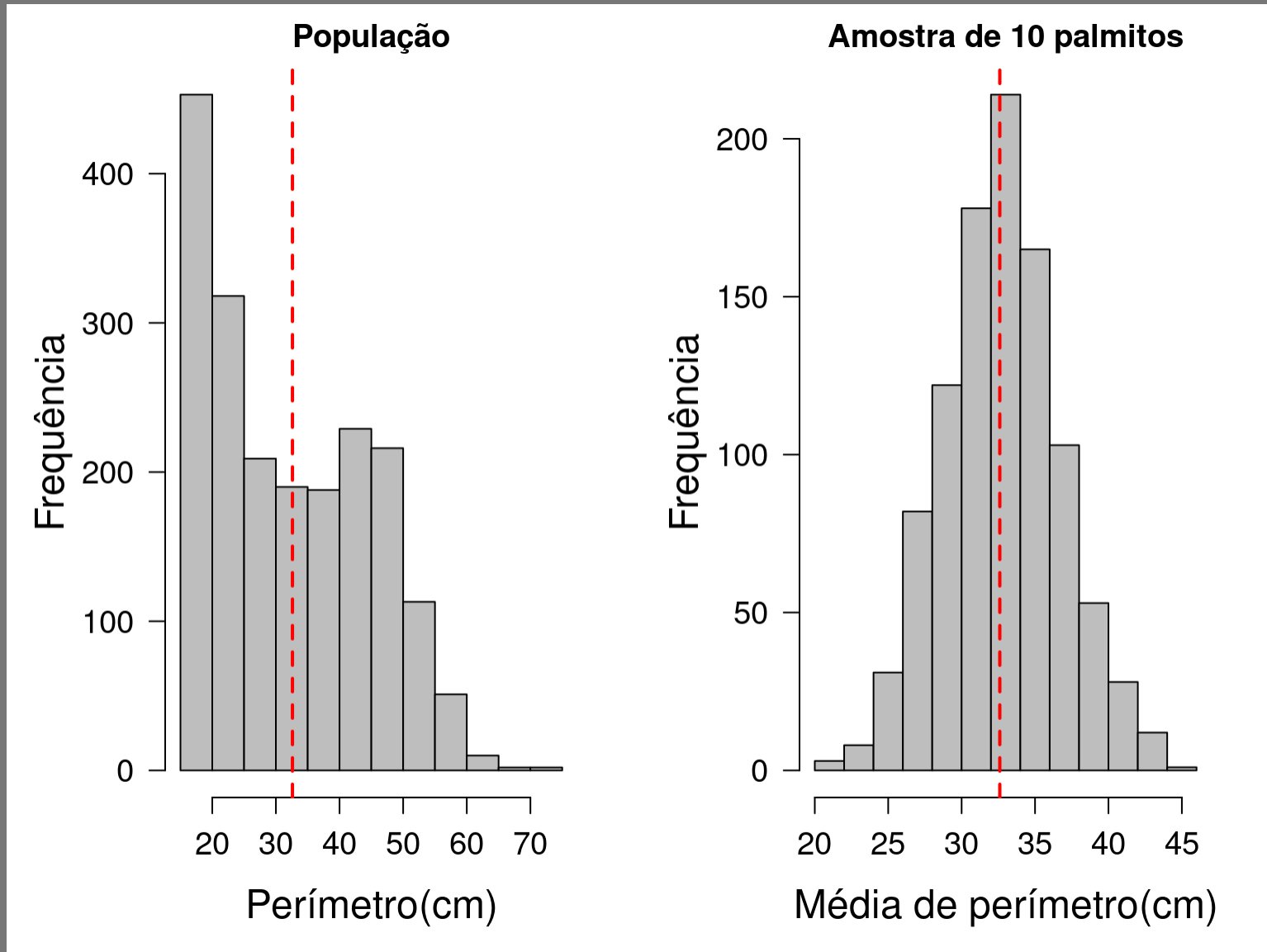
Distribuição das médias de amostras de 10 palmitos



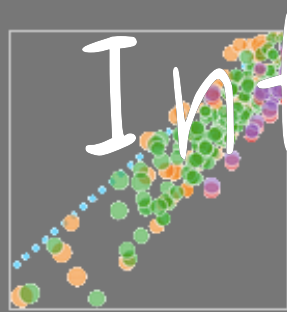
Tamanho da Amostra



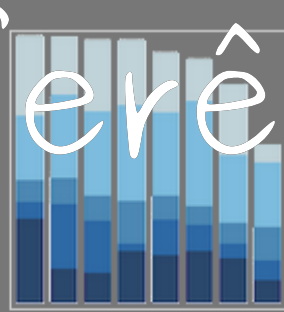
Teoria do Limite Central



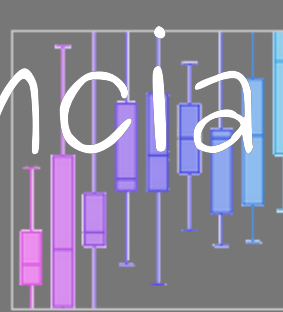
Line and Scatter Plots



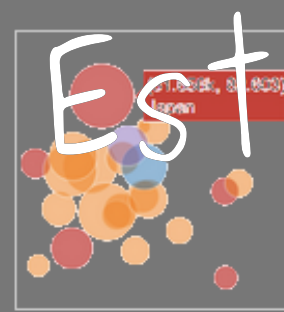
Bar Charts



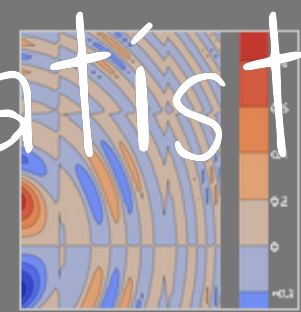
Box Plots



Bubble Charts

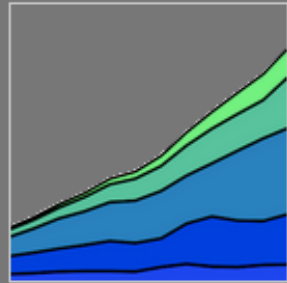


Contour Plots

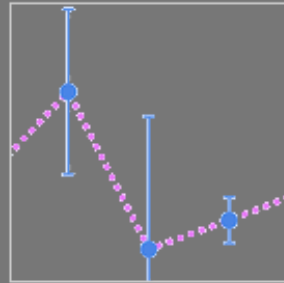


Inferência Estatística

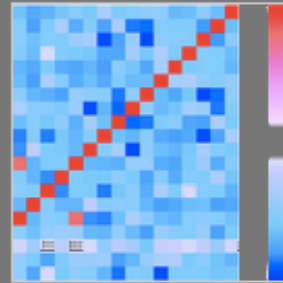
Filled Area Plots



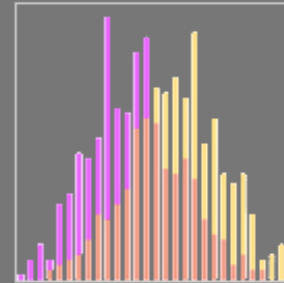
Error Bars



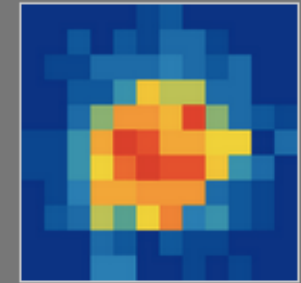
Heatmaps



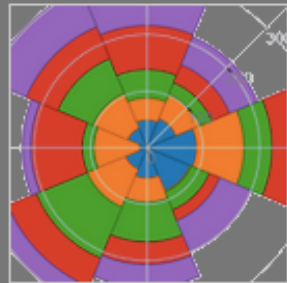
Histograms



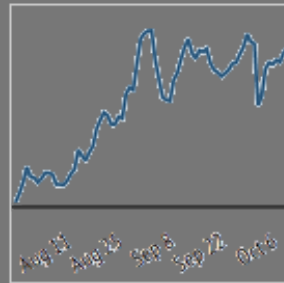
2D Histograms



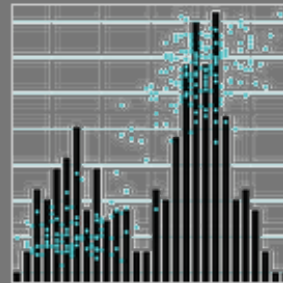
Polar Charts



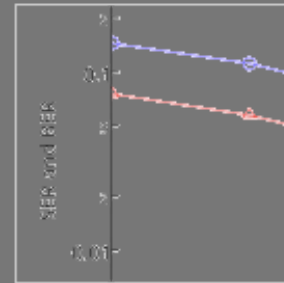
Time Series



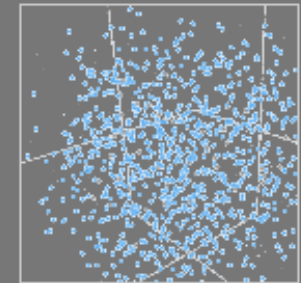
Multiple Chart Types



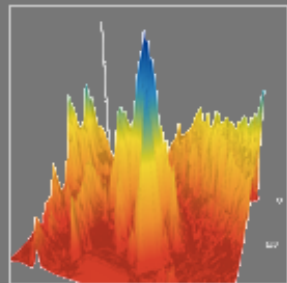
Log Plots



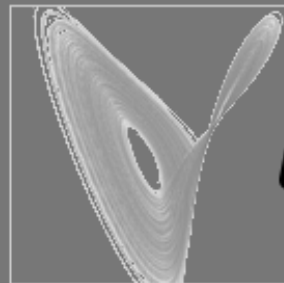
3D Scatter Plots



3D Surface Plots



3D Line Plots



PIAnEco

Pergunta

Os palmitos em Carlos Botelho são, em média, maiores que os da restinga da Ilha do Cardoso?



IlhadoCardosoPlot



Image NASA
Image © 2008 TerraMetrics
© 2008 MapLink/Tele Atlas
© 2008 Europa Technologies

©2007 Google

nter 24°56'26.09" S 48°03'38.26" Welev 153 m

Streaming |||||100%

Eye alt 5.2 23.25 km

Hipótese Biológica



Hipótese Biológica

Pergunta:

Os palmitos em Carlos Botelho são maiores que os da restinga da Ilha do Cardoso?

Hipótese:

Palmito em solos mais argilosos e férteis crescem mais que os de solos arenosos e pobres

Predição:

A média do perímetro dos palmitos em Carlos Botelho é maior que a média da restinga da Ilha do Cardoso

Hipótese Biológica

Pergunta:

Os palmitos em Carlos Botelho são maiores que os da restinga da Ilha do Cardoso?

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Hipótese Biológica

Pergunta:

Os palmitos em Carlos Botelho são maiores que os da restinga da Ilha do Cardoso?

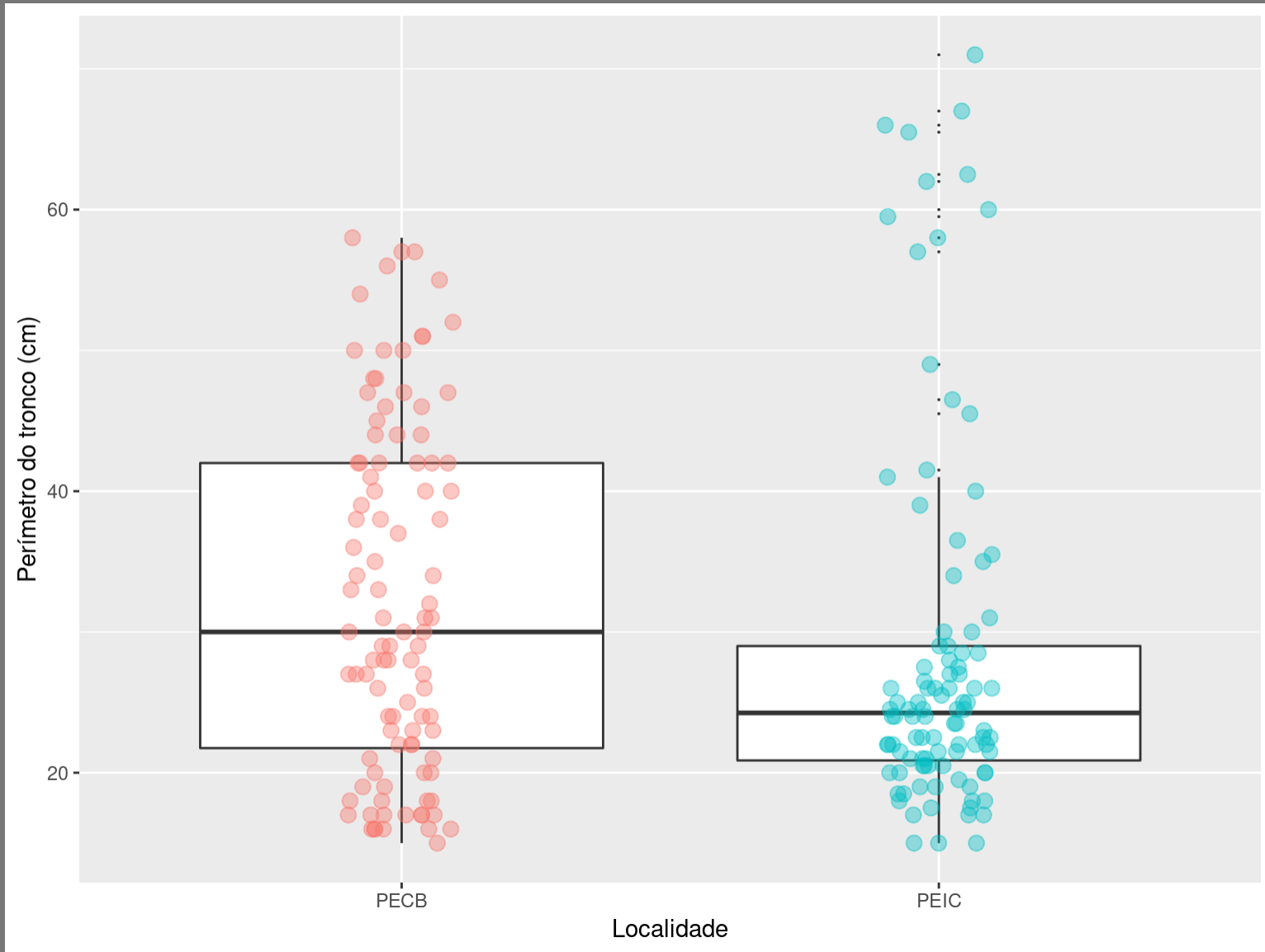
Hipótese:

Palmito em solos mais argilosos e férteis crescem mais que os de solos arenosos e pobres

Predição:

A média do perímetro dos palmitos em Carlos Botelho é maior que a média da restinga da Ilha do Cardoso

Desenho amostral



Estatística de interesse

Média da amostra de Carlos Botelho:

```
## [1] 32.3
```

Média da amostra da Ilha do Cardoso

```
## [1] 28.7
```

Diferença entre as médias

```
## [1] 3.6
```

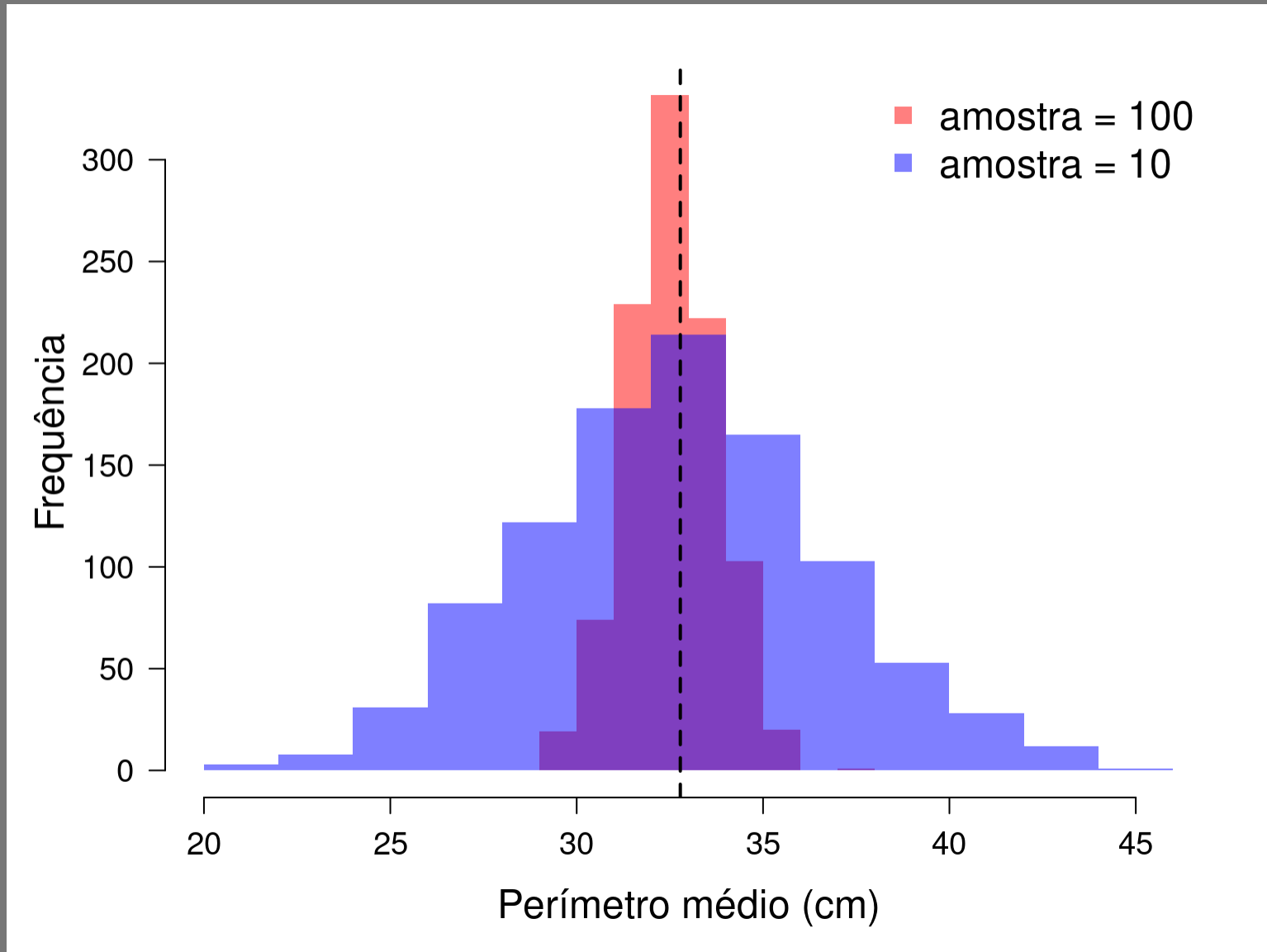
Afirmação

fazer afirmações sobre um universo a partir de um conjunto de valores representativo (amostra). Tal tipo de afirmação deve sempre vir acompanhada de uma medida de precisão sobre sua veracidade

[1] 3.6

Os palmitos de CB são maiores que na IC?

Erro Amostral



Medida de Incerteza

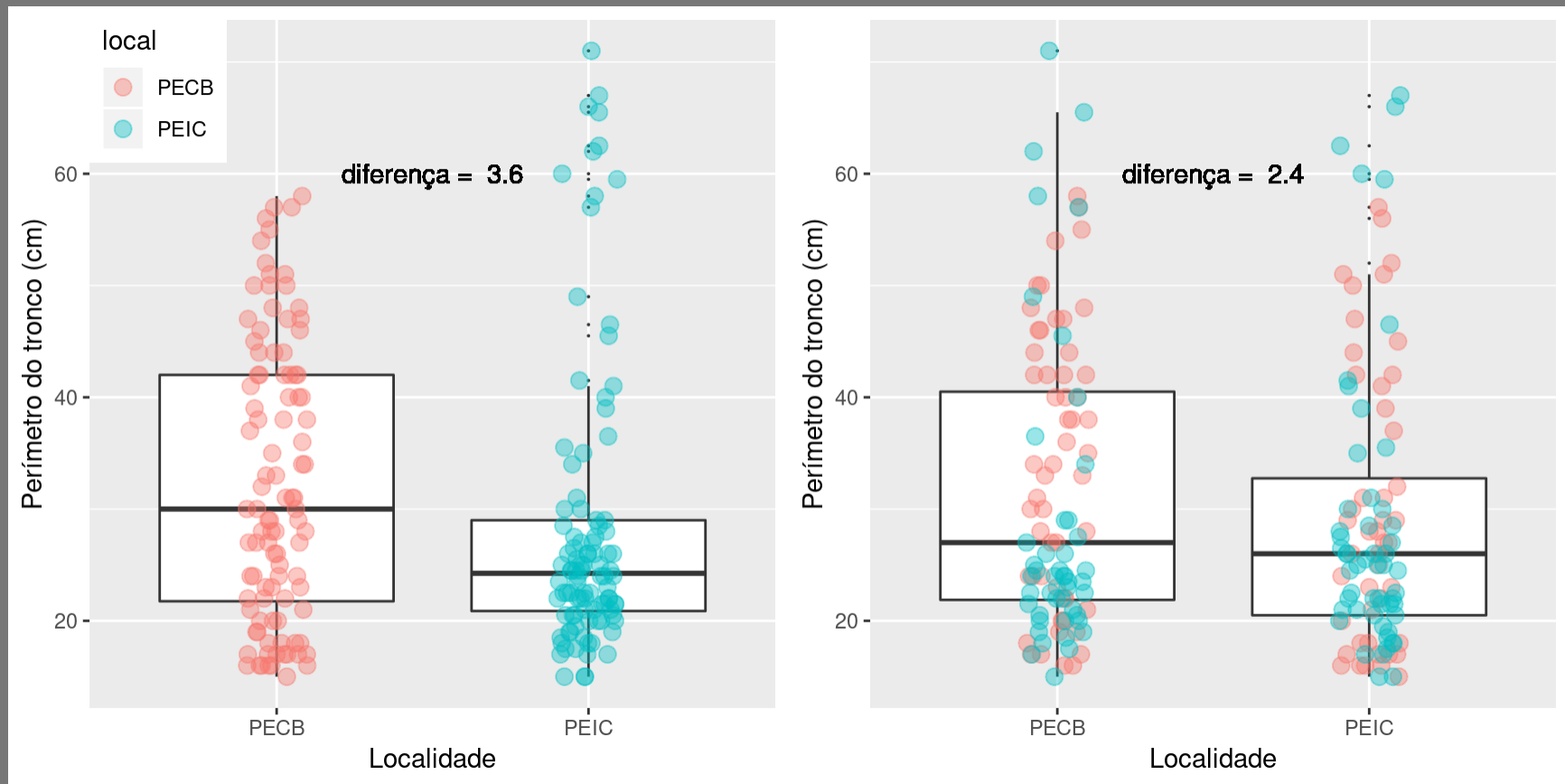
fazer afirmações sobre um universo a partir de um conjunto de valores representativo (amostra). Tal tipo de afirmação deve sempre vir acompanhada de uma medida de precisão sobre sua veracidade

Os palmitos de CB são maiores que da IC

[1] 3.6

Cenário Nulo

A diferença observada é devida ao acaso



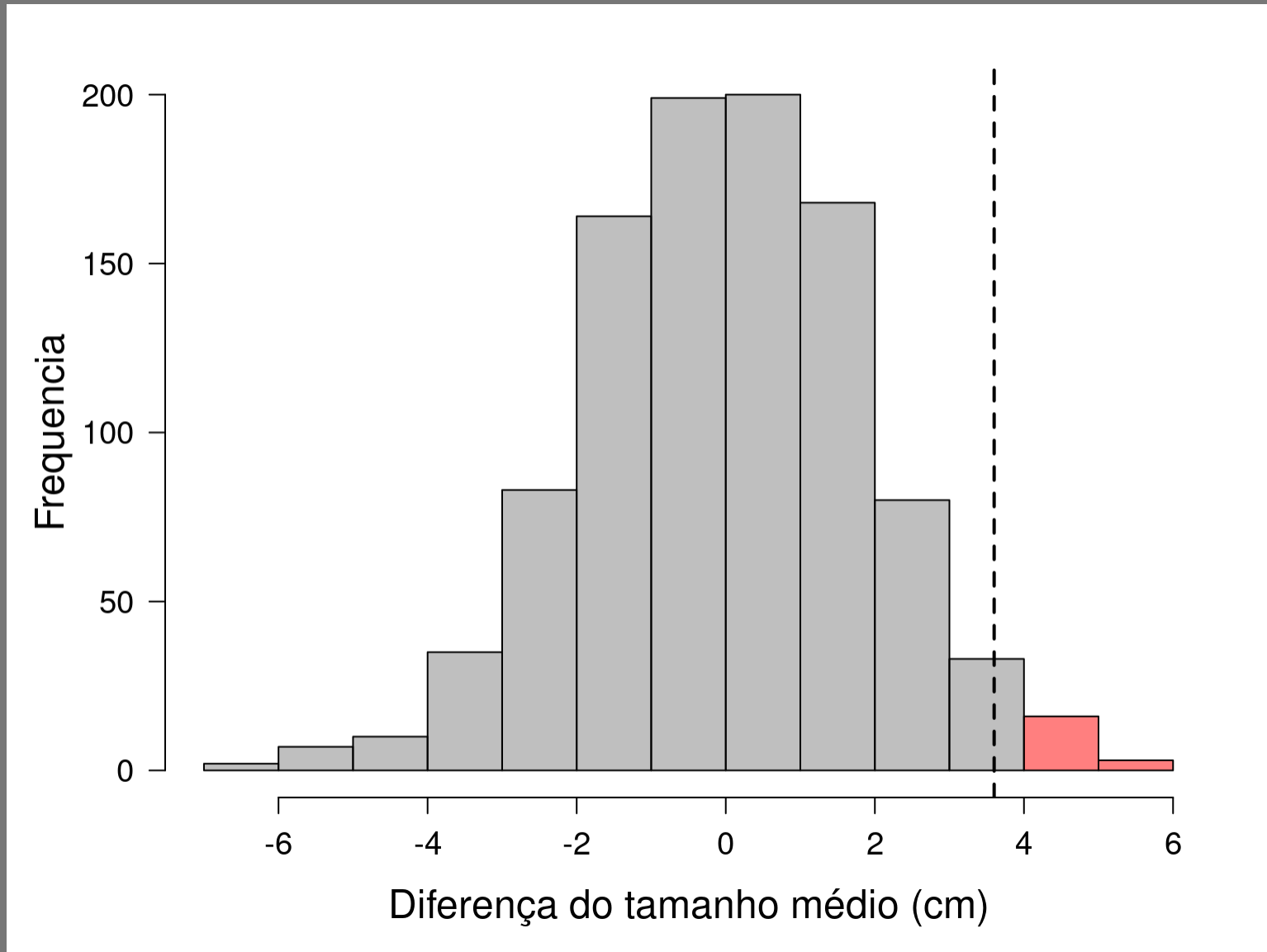
Nulo: PEIC e PECB fazem parte da mesma população estatística.

Distribuição Nula

Medida de incerteza

- Gera o cenários nulo muitas vezes
- Compara os valores gerados (pseudovalores) com o observado
- Calcula o quanto o valor observado é raro no cenário nulo

Distribuição Pseudovalores



Incerteza Sobre a Afirmação

Quantas vezes o cenário nulo gerou valores iguais ou mais extremos que o observado?

```
## [1] 27
```

Qual a probabilidade do acaso ter gerado o valor observado:

Proporção de valores extremos gerado no cenário nulo

```
## [1] 0.027
```

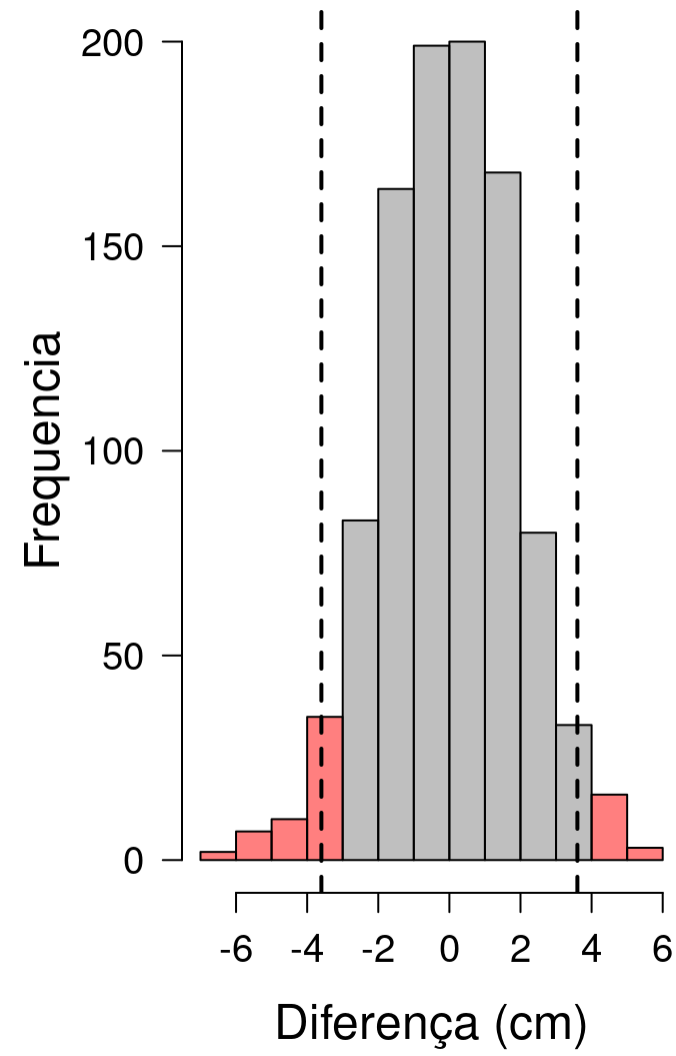
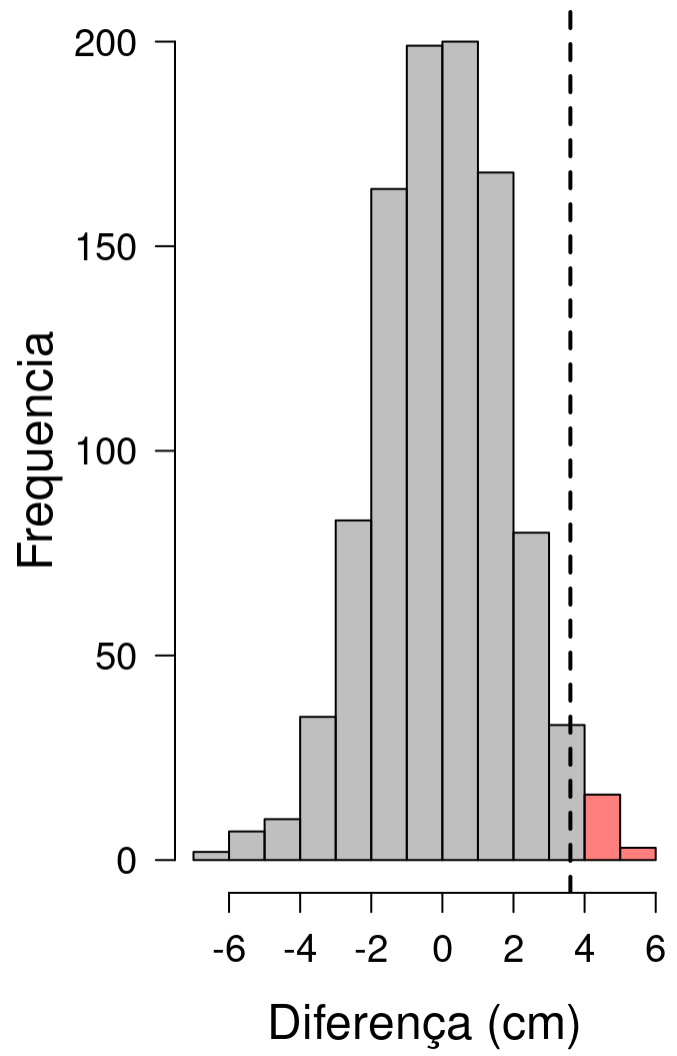
p-valor

Teste Frequentista

Test T de student (William Gosset)

```
##  
## Welch Two Sample t-test  
##  
## data: dados$pap[dados$local == "PECB"] and dados$pap[dados$loc  
## t = 1.9883, df = 196.99, p-value = 0.02408  
## alternative hypothesis: true difference in means is greater tha  
## 95 percent confidence interval:  
## 0.6103052 Inf  
## sample estimates:  
## mean of x mean of y  
## 32.270 28.655
```

Há diferenças? É
maior(menor)?



Incerteza Sobre a Afirmação

Há diferença no tamanho dos palmitos?

Quantas vezes o cenário nulo gerou valores iguais ou mais extremos que o observado?

```
## [1] 54
```

Qual a probabilidade do acaso ter gerado o valor observado:

Proporção de valores extremos gerado no cenário nulo

```
## [1] 0.054
```

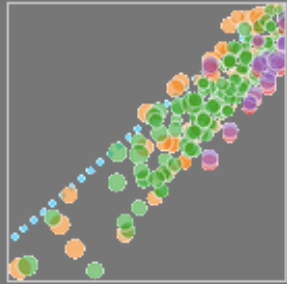
p-valor

Teste Frequentista

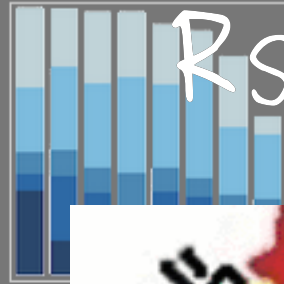
Test T de student (William Gosset)

```
##  
## Welch Two Sample t-test  
##  
## data: dados$pap[dados$local == "PECB"] and dados$pap[dados$loc  
## t = 1.9883, df = 196.99, p-value = 0.04816  
## alternative hypothesis: true difference in means is not equal t  
## 95 percent confidence interval:  
## 0.02949509 7.20050491  
## sample estimates:  
## mean of x mean of y  
## 32.270 28.655
```

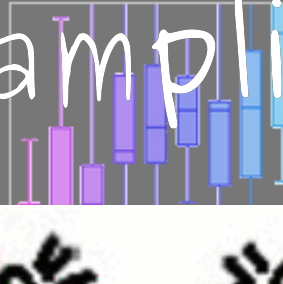
Line and Scatter Plots



Bar Charts



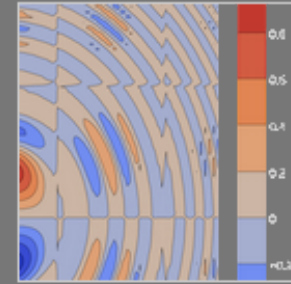
Box Plots



Bubble Charts

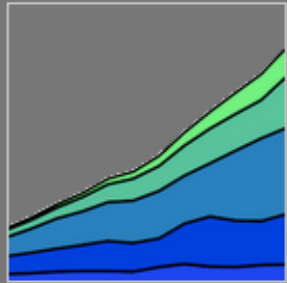


Contour Plots

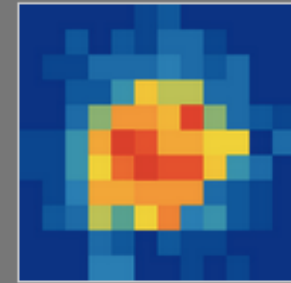


Rsampling

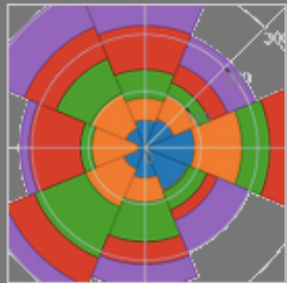
Filled Area Plots



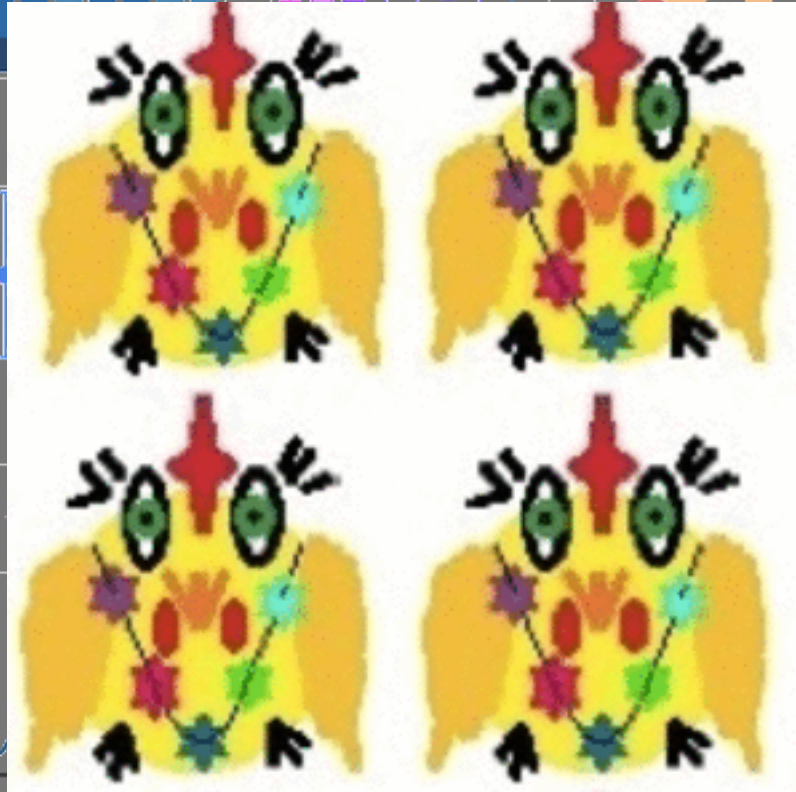
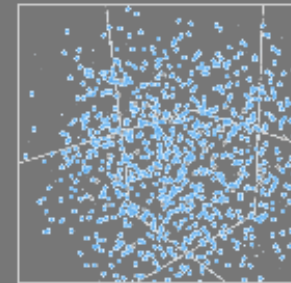
2D Histograms



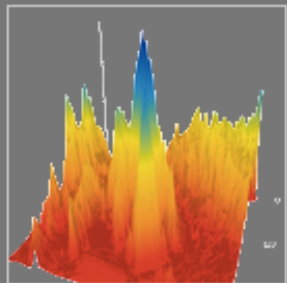
Polar Charts



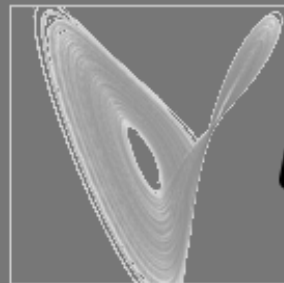
3D Scatter Plots



3D Surface Plots



3D Line Plots



PIAnEco