TESTES DE HIPÓTESES

5.5

AULA PRÁTICA

5.5.4

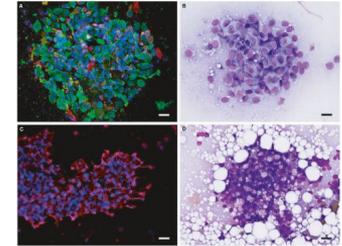# Conteúdo

1. Problema
   a. Pergunta
   b. Dados

2. Escolhendo o método de análise
   a. Modelo probabilístico
   b. Análise descritiva e inferencial

3. Resultados e Interpretação

Problema

Consultoria estatística

- Centro de diagnósticos de hospital SP
- Novo aparelho de exame hematológico
- Novo *vs* padrão: resultados equivalentes?

Invited Review

Method comparison in the clinical laboratory

Asger Lundorff Jensen, Mads Kjelgaard-Hansen

Abstract: Studies comparing a new method with an established method, to assess whether the new measurements are comparable with existing ones, are frequently conducted in clinical pathology laboratories. Assessment usually involves statistical analysis of paired results from the 2 methods to objectively investigate sources of analytical error (total, random, and systematic). In this review article, the types of errors that can be assessed in performing this task are described, and a general protocol for comparison of quantitative methods is recommended. The typical protocol has 9 steps: 1) state the purpose of the experiment, 2) establish a theoretical basis for the method comparison experiment, 3) become familiar with the new method, 4) obtain estimates of random error for both methods, 5) estimate the number of samples to be included in the method comparison experiment, 6) define acceptable difference between the 2 methods, 7) measure the patient samples, 8) analyze the data and 9) judge acceptability. The protocol includes the essential investigations and decisions needed to objectively assess the overall analytical performance of a new method compared to a reference or established method. The choice of statistical methods and recommendations of decision criteria within the stages are discussed. Use of the protocol for decision-making is exemplified by the comparison of 2 methods for measuring alanine aminotransferase activity in serum from dogs. Finally, a protocol for comparing simpler semiquantitative
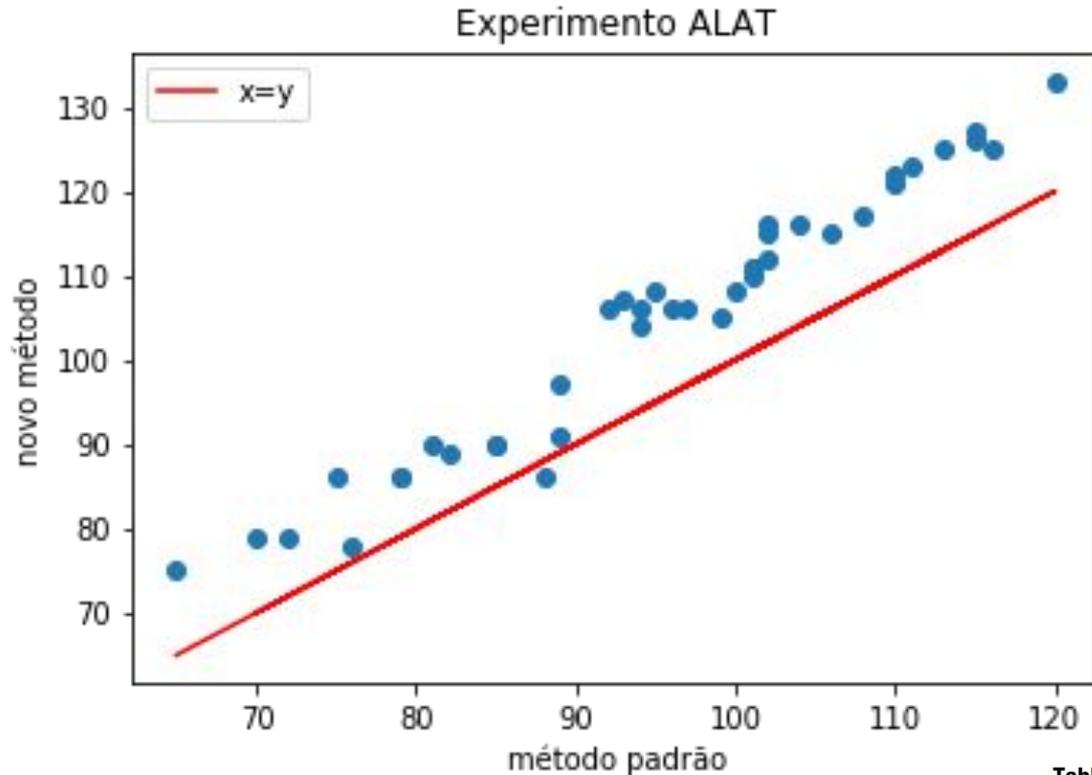
Dados e modelo probabilístico

Table 3. Example data from an experiment comparing 2 methods (new method and routine method) for measurement of alanine aminotransferase activity (U/L) in fresh unhemolyzed canine serum.

Dados e modelo probabilístico

Paciente	Padrão	Novo
1	104	116
2	102	115
3	113	125
4	101	111
5	106	115
6	96	106
7	102	112
8	108	117

Normal(μ_g, σ^2)?   **dependência dentro de indivíduo**

Hipóteses: $\mu_{pad} = \mu_{novo}$ *vs* $\mu_{pad} \neq \mu_{novo}$?

g = 1 (padrão), 2 (novo)

Análises estatísticas

Pergunta: Há diferença entre os resultados dos métodos padrão e novo?

Método	Média	Desvio Padrão	nº de cães
Padrão	95,3	13,8	40
Novo	104,5	15,6	40
Diferença	**-9,3**	**3,5**	**40**

Análises estatísticas

Experimento ALAT
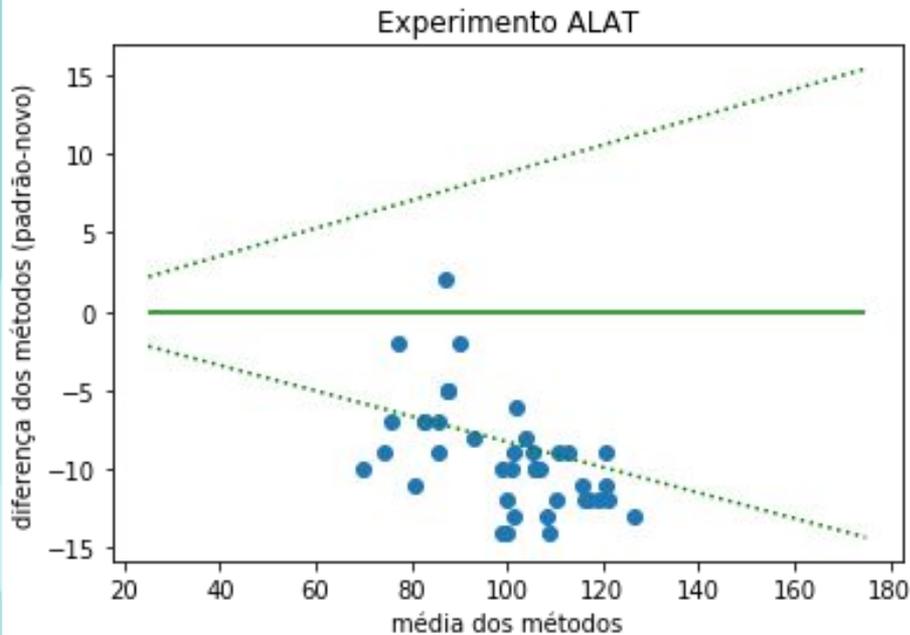
- D: diferença entre os resultados dos métodos Padrão e Novo
- $D_i \sim$ Normal (μ, σ^2), $E(X) = \mu$, $V(X) = \sigma^2$
  $i = 1, ..., n = 40$, independentes

H_0: $\mu = 0$
**H_a:** $\mu \neq 0$

fixa-se $\alpha = 0{,}05$ p-valor$< 0{,}0001$

Decido por H_a, pois p-valor $< \alpha$,
em média, os resultados do método padrão não são iguais aos do novo

Análises estatísticas

Other statistical analyses. The ordinary paired *t*-test and the nonparametric Wilcoxon signed rank test are not applicable if proportional error is present.[9] A correlation coefficient of concordance has been proposed as an improved version of the correlation coefficient that indicates the strength of the relationship between 2 methods that fall on the line of identity.[14] A web-based calculator of the concordance correlation coefficient is available,[34] together with a table that can be used to categorize test performance as poor to good. However, it has been suggested that this approach be used only if data on total allowable error are not predetermined.[5]

$$\rho_{concordância} = \frac{2S_{xy}}{S_x^2 + S_y^2 + (\bar{x} - \bar{y})^2}$$

$$S_{xy} = \frac{1}{n} \sum_{i=1}^{n} (x_i - \bar{x})(y_i - \bar{y})$$

Experimento ALAT
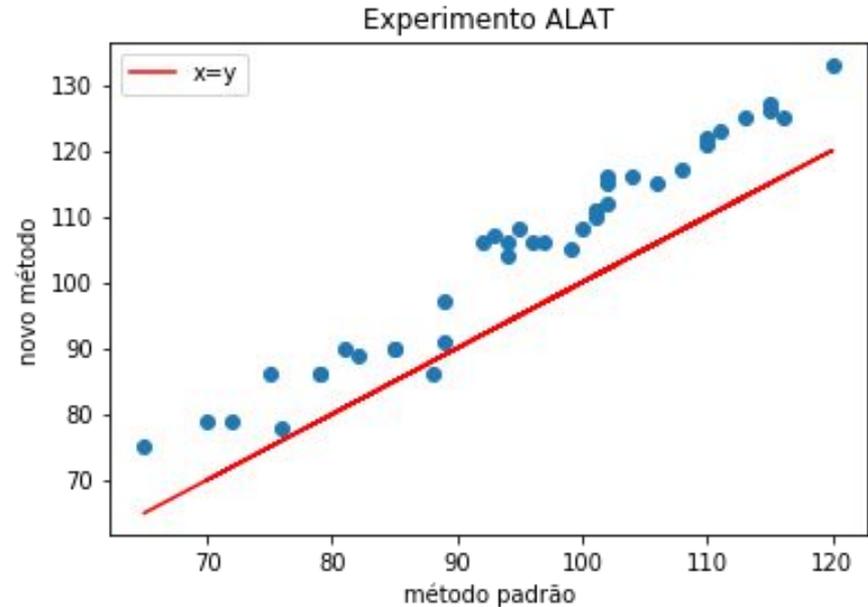
coeficiente de correlação de Pearson = 0,98
coeficiente de concordância = 0,81

Análises estatísticas

```
                        OLS Regression Results
==============================================================================
Dep. Variable:                   Novo   R-squared:                       0.961
Model:                            OLS   Adj. R-squared:                  0.960
Method:                 Least Squares   F-statistic:                     945.2
Date:                Fri, 15 May 2020   Prob (F-statistic):           1.87e-28
Time:                        03:10:19   Log-Likelihood:                 -101.61
No. Observations:                  40   AIC:                             207.2
Df Residuals:                      38   BIC:                             210.6
Df Model:                           1
Covariance Type:            nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
Intercept      -1.2900      3.479     -0.371      0.713      -8.333       5.753
Padrão          1.1109      0.036     30.744      0.000       1.038       1.184
==============================================================================
Omnibus:                       11.680   Durbin-Watson:                   1.644
Prob(Omnibus):                  0.003   Jarque-Bera (JB):               12.554
Skew:                          -0.977   Prob(JB):                      0.00188
Kurtosis:                       4.928   Cond. No.                         673.
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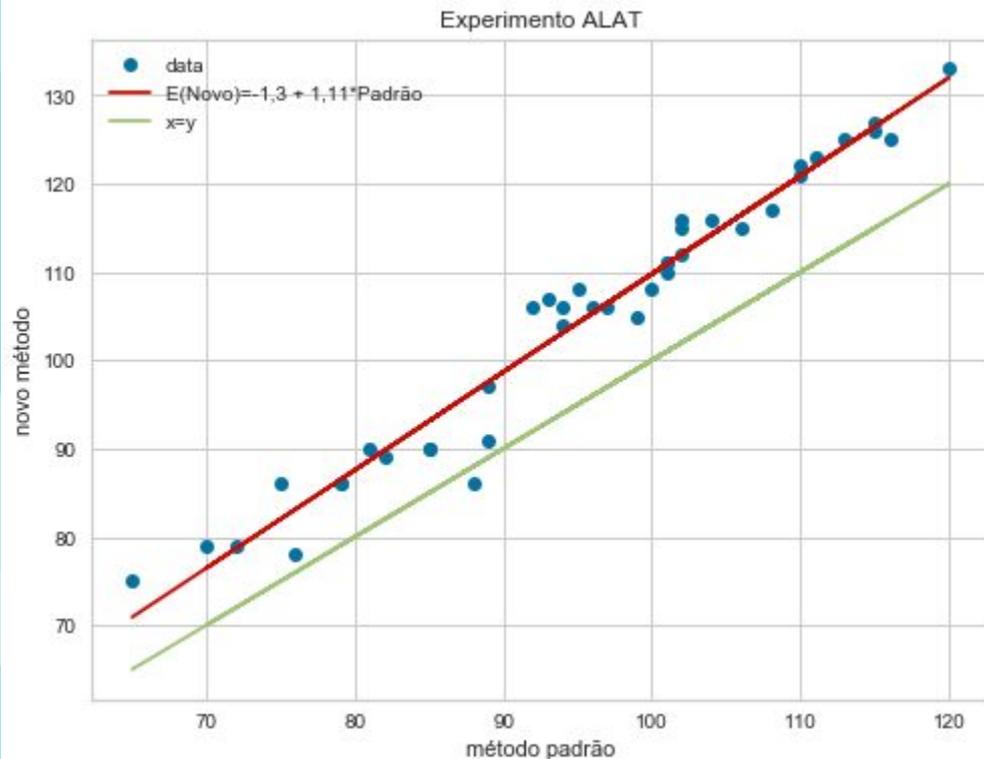
p-valores

Análises estatísticas

Experimento ALAT

p-valor (H_0: intercepto=0) = 0,713

p-valor (H_0: inclinação=1) = 0,004

Ordinary linear regression analysis reveals intercept=−1.3 (95% confidence interval=−8.3 to 5.8) and slope=1.11 (95% confidence interval=1.036 to 1.184). Thus, the intercept is not statistically significantly different from 0 and hence no constant error is present. However, proportional error exists, since the slope is different from 1. These findings are further supported by Deming and Passing-Bablok regression analyses. In the Deming regression analysis, intercept=−2.16 (95% confidence interval=−9.55 to 5.22) and slope=1.12 (95% confidence interval=1.049 to 1.19). In the Passing-Bablok regression analysis, intercept=−1.7 (95% confidence interval=−7.8 to 5.4)

Análises estatísticas
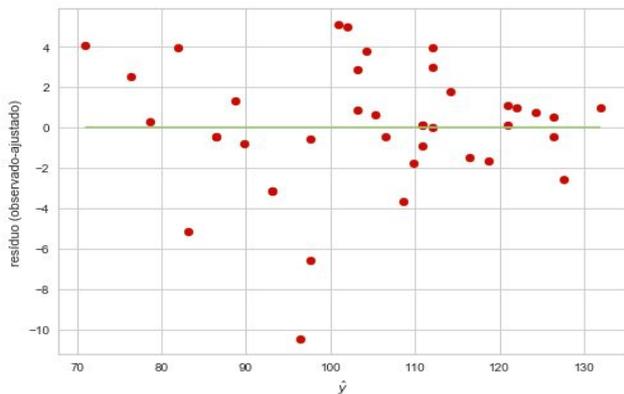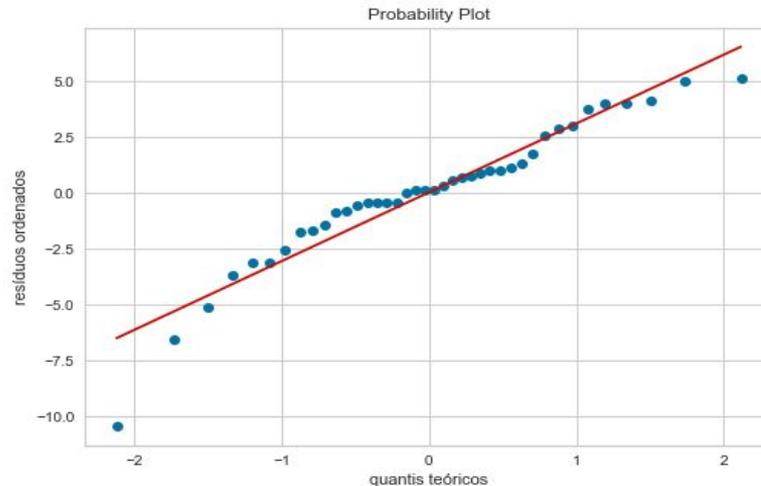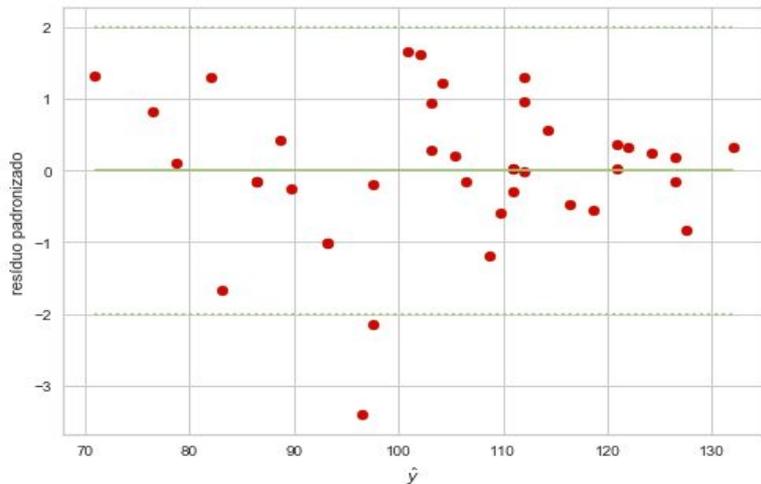
Conclusão:
- Os métodos não são equivalentes
- Há evidências de erros proporcionais, uma vez que a inclinação da reta é significativamente ≠ 1
- O método novo tende a gerar medidas maiores do que método padrão