

Estatística para Ciências de Dados

Aula 6: Análise estatística de um projeto

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Conteúdo

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- a. Pergunta
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2. Escolhendo o método de análise

- a. Modelo probabilístico
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3. Resultados e Interpretação

Problema

Consultoria estatística

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

Method comparison in the clinical laboratory

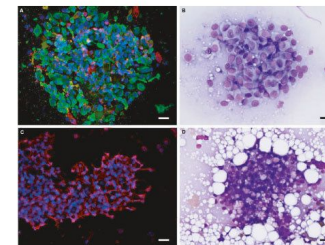
Asger Lundorff Jensen, Mads Kjelgaard-Hansen

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

Invited Review

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Dados e modelo probabilístico

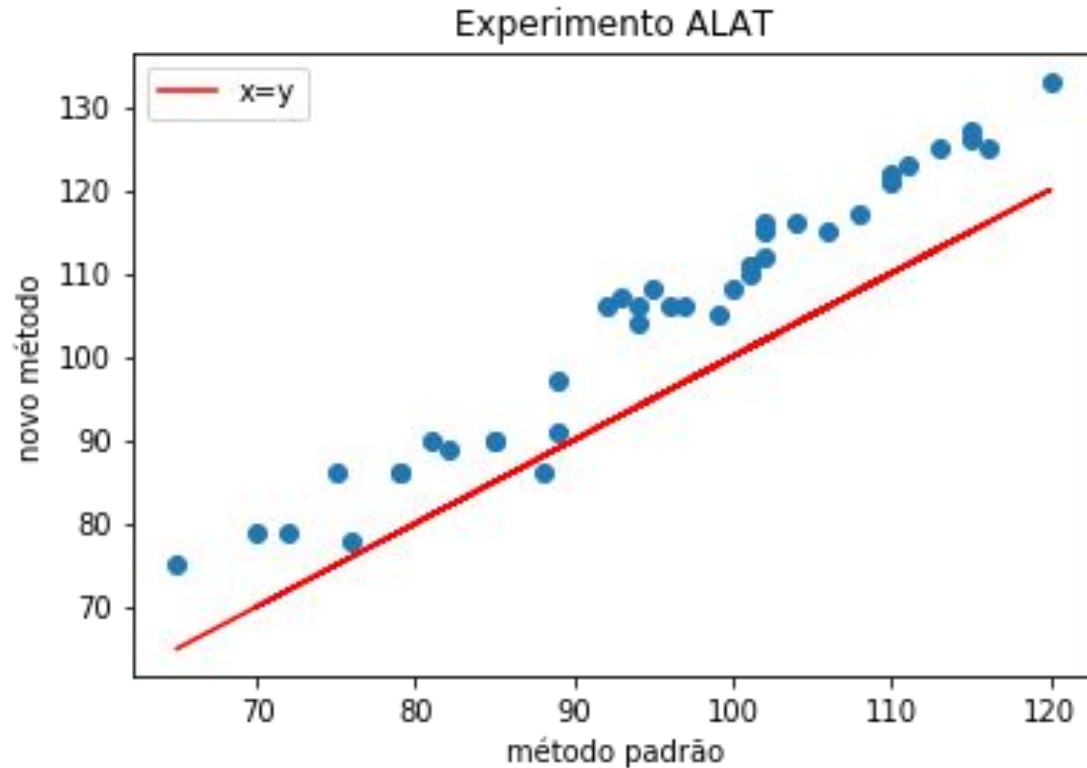


Table 3. Example data from an experiment comparing 2 methods (new method and routine method) for measurement of alanine aminotransferase activity (U/L) in fresh unhemolyzed canine serum.

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

$\text{Normal}(\mu_g, \sigma^2)$? dependência dentro de indivíduo

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

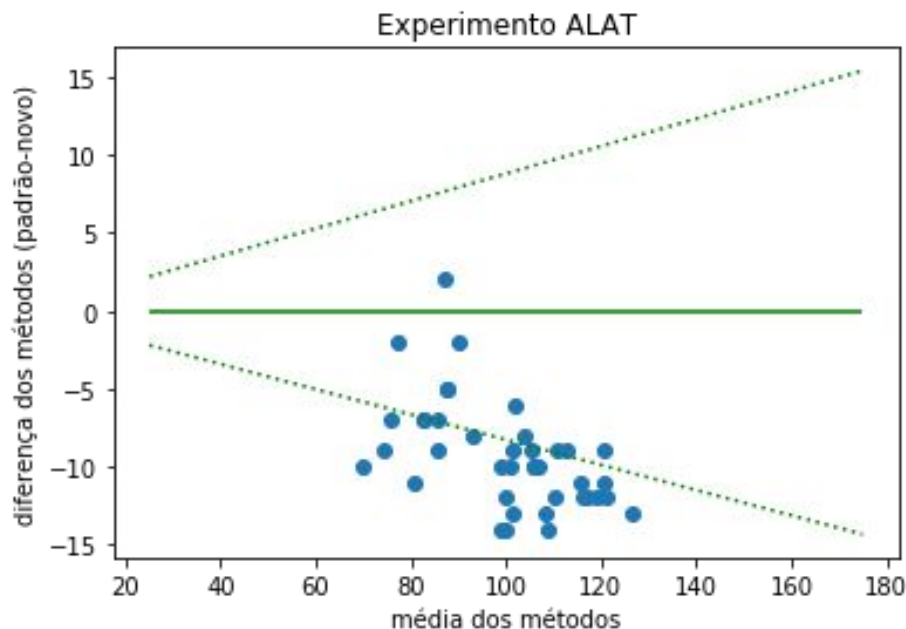
$g = 1$ (padrão), 2 (novo)

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



- D: diferença entre os resultados dos métodos Padrão e Novo
- $D_i \sim \text{Normal}(\mu, \sigma^2)$, $E(X)=\mu$, $V(X)=\sigma^2$
 $i = 1, \dots, n=40$, independentes

$$H_0: \mu = 0$$

$$H_a: \mu \neq 0$$

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

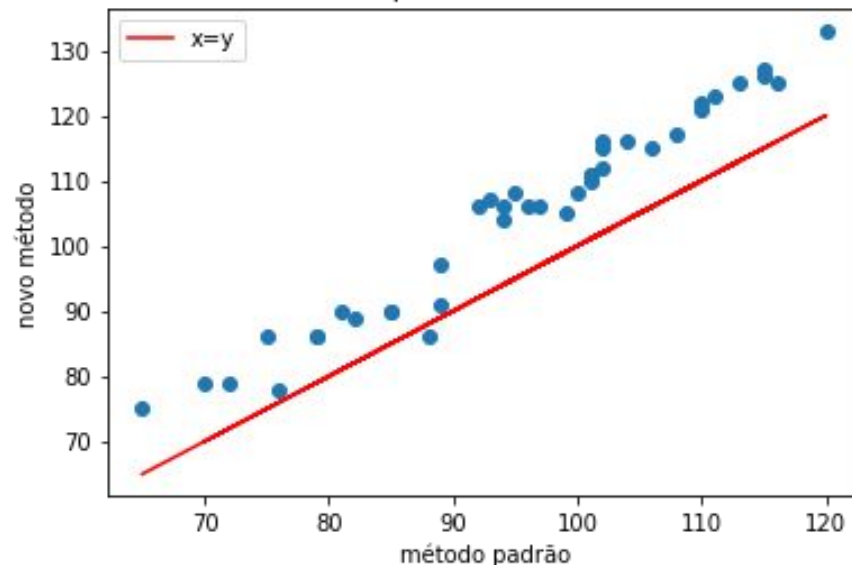
Decido por H_a , pois p-valor $< \alpha$,
*em média, os resultados do método
padrão não são iguais aos do novo*

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

$$\rho_{\text{concordância}} = \frac{2S_{xy}}{S_x^2 + S_y^2 + (\bar{x} - \bar{y})^2}$$
$$S_{xy} = \frac{1}{n} \sum_{i=1}^n (x_i - \bar{x})(y_i - \bar{y})$$

Experimento ALAT



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

Análises estatísticas

OLS Regression Results

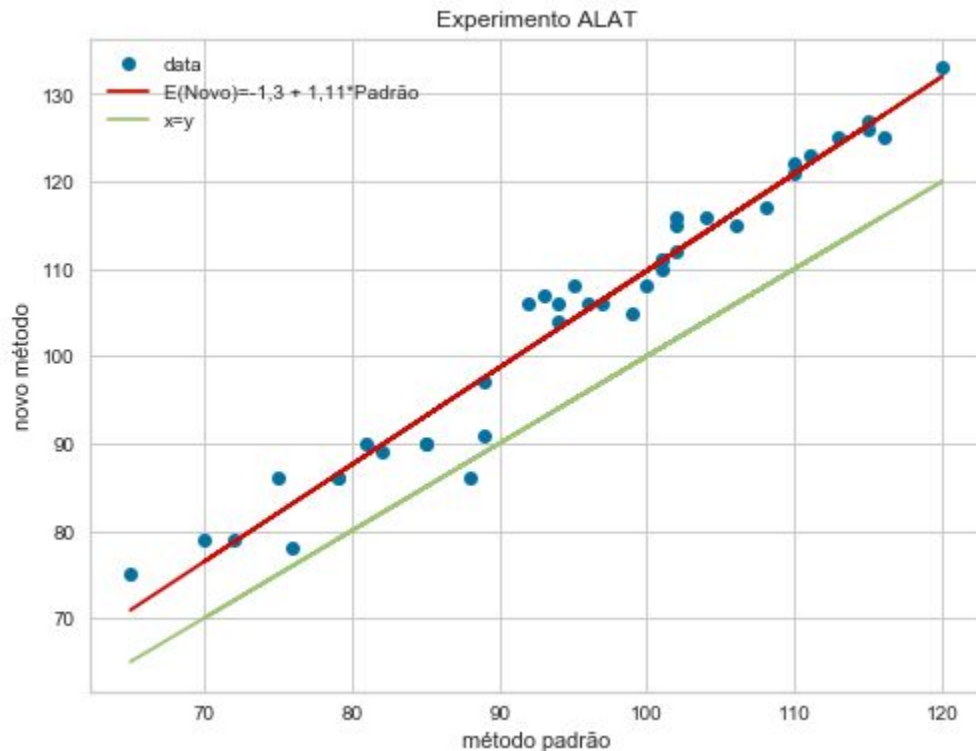
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Dep. Variable:          Novo      R-squared:          0.961
Model:                  OLS       Adj. R-squared:     0.960
Method:                 Least Squares   F-statistic:       945.2
Date:                  Fri, 15 May 2020   Prob (F-statistic): 1.87e-28
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

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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

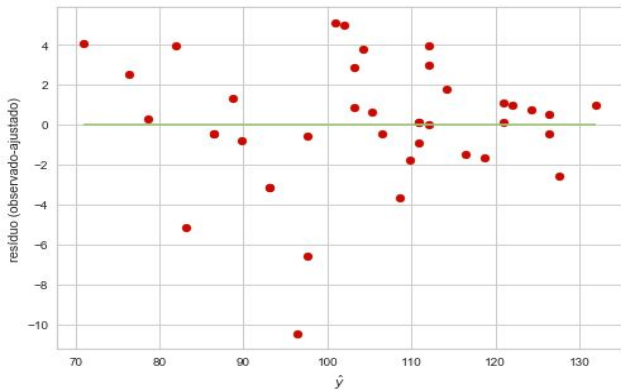
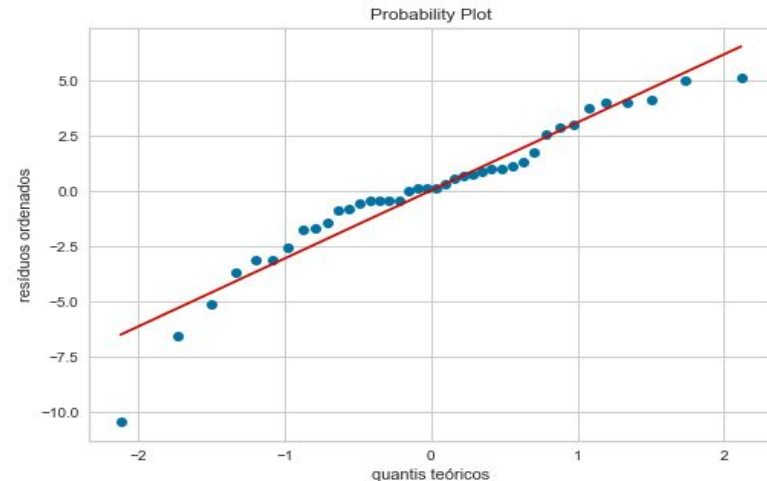
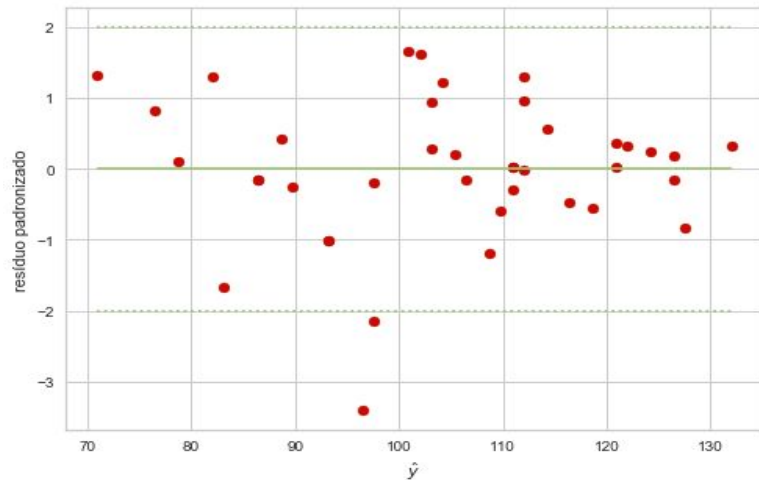


p-valor (H_0 : intercepto=0) = 0,713

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 $\neq 1$
- O método novo tende a gerar medidas maiores do que método padrão