Reconstruindo a história dos Buracos Negros Supermassivos

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Massa Dos Buracos Negros

- Dados de quasares do Sloan Digital Sky Survey Data Release 7.
- Catálogo de propriedades complementares de quasares do Sloan Digital Sky Survey Data Release 7 de Shen et al. (2011)

Massa Dos Buracos Negros

Greene and Ho (2005):

$$M_{BH}(H\alpha) = \left(2.0^{+0.4}_{-0.3}\right) \times 10^6 \left(\frac{L(H\alpha)}{10^{42}\mathrm{ergs/s}}\right)^{0.55\pm0.02} \times \left(\frac{FWM(H\alpha)}{10^3\mathrm{kms}^{-1}}\right) M_\odot$$

Vestergaard and Peterson (2006):

$$M_{BH}(H\beta) = 4.68 \times 10^6 \left(\frac{L(H\beta)}{10^{42}\mathrm{ergs/s}}\right)^{0.63} \times \left(\frac{FWM(H\beta)}{10^3\mathrm{kms}^{-1}}\right)^2 M_\odot$$

Kong et al (2006):

$$M_{BH}(Mg_{II}) = 2.9 \times 10^6 \left(\frac{L(Mg_{II})}{10^{42}\mathrm{ergs/s}}\right)^{0.57\pm0.12} \times \left(\frac{FWM(Mg_{II})}{10^3\mathrm{kms}^{-1}}\right)^2 M_\odot$$

Kong et al (2006):

$$M_{BH}(C_{IV}) = 4.6 \times 10^5 \left(\frac{L(C_{IV})}{10^{42}\mathrm{ergs/s}}\right)^{0.60\pm0.16} \times \left(\frac{FWM(C_{IV})}{10^3\mathrm{kms}^{-1}}\right)^2 M_\odot$$

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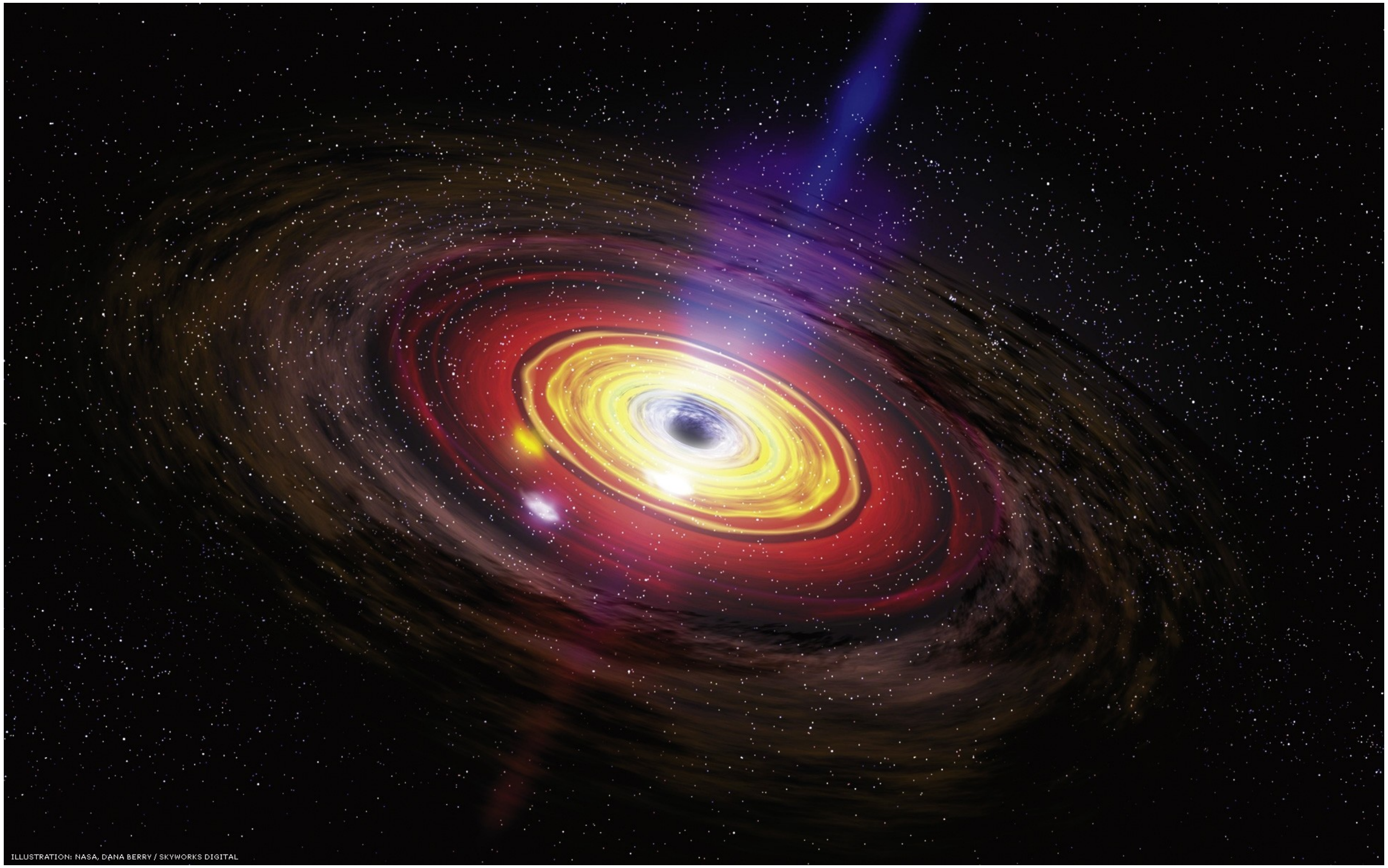
As Shen et al. (2011), we adopted the virial mass estimate: We use Hβ estimate for z < 0.7, however, if Hα FWHM had lower error than Hβ , was considered Hα as estimator. For 0.7 =< z <1.9 we consider the MgII estimate and CIV for z >=1.9

Luminosidade

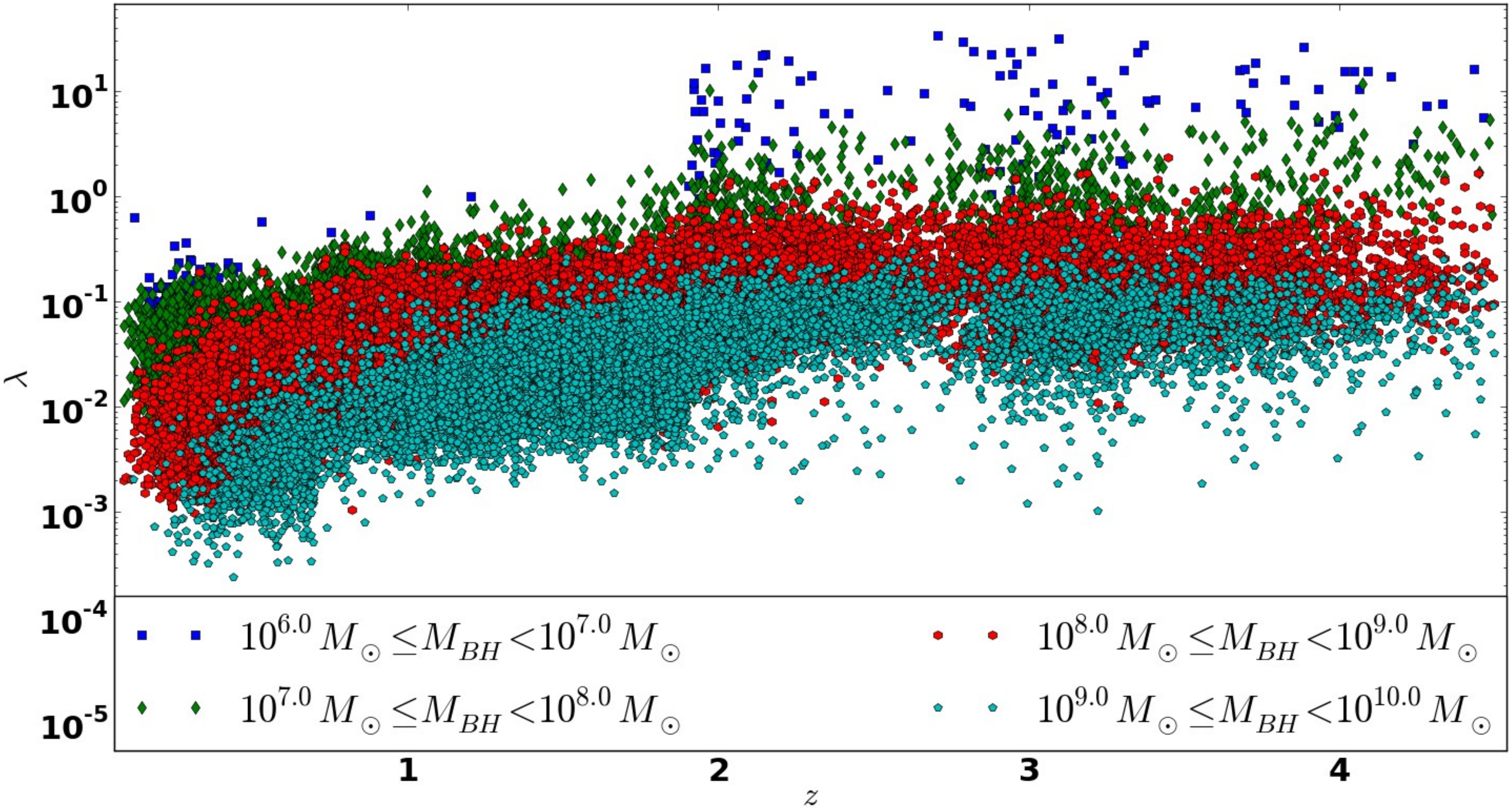
$$L_b = \bar{\eta}\dot{M}_a c^2$$

$$\dot{M}_a = \dot{m}_{bh}/(1-\bar{\eta})$$



Luminosidade Adimensional Ponderada pela Luminosidade de Eddington

$$L_{edd} = \frac{c^2}{\tau_s} m_{bh} \qquad \lambda = \frac{L_b}{L_{edd}} = \frac{\tau_s}{c^2}\frac{L_b}{m_{bh}} = \tau_s \frac{\bar{\eta}}{1-\bar{\eta}}\frac{\dot{m}_{bh}}{m_{bh}},$$



Luminosidade Adimensional Média e a Taxa de acrescência

Raimundo and Fabian (2009):

$$< \dot{m}_{bh} >= \delta \dot{m}_{bh},$$

$$< \dot{m}_{bh} >= \frac{1}{\tau_s} \frac{1-\bar{\eta}}{\bar{\eta}} \bar{\lambda} m_{bh},$$

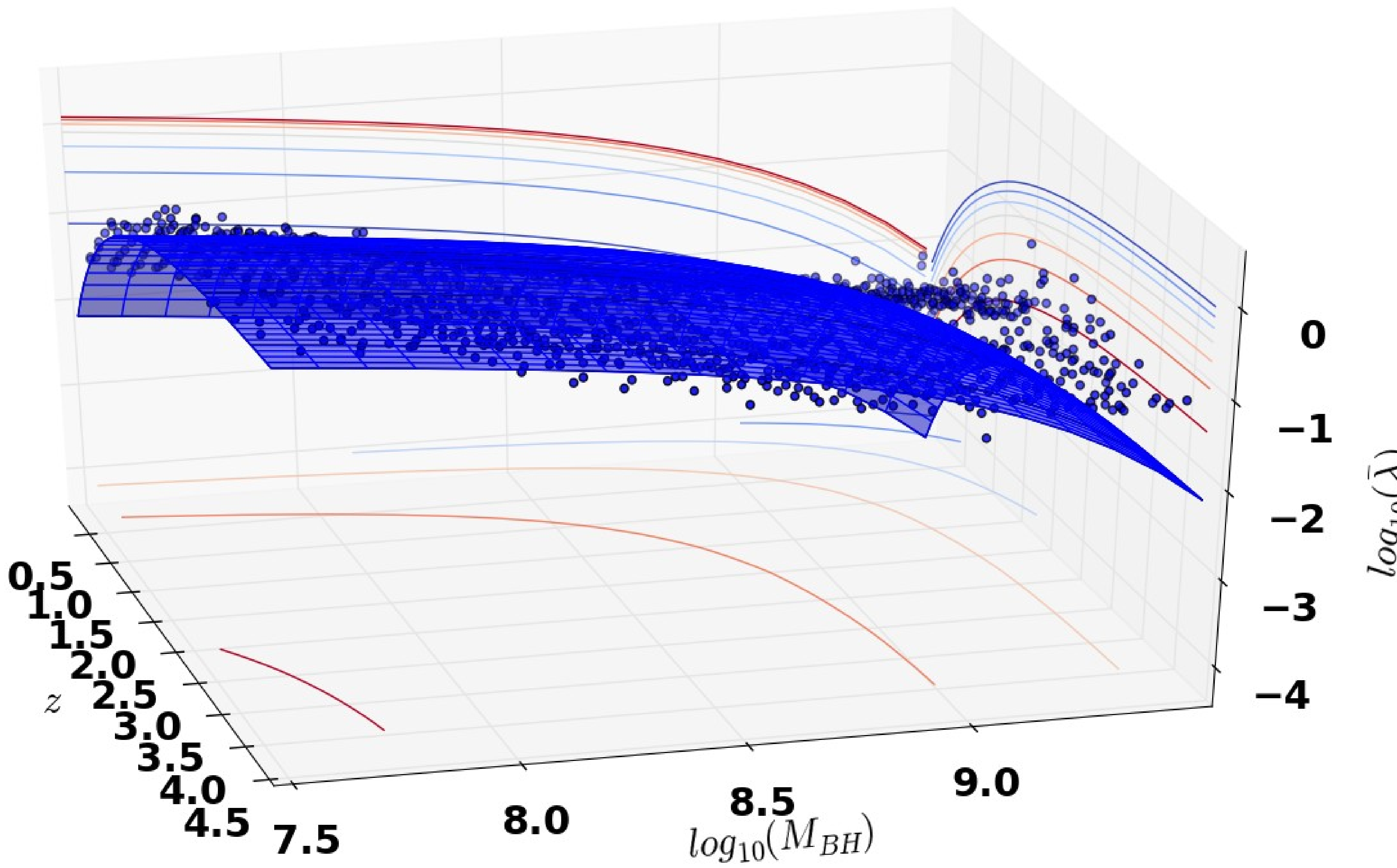
$$\bar{\lambda} \equiv \delta \lambda$$

Luminosidade Adimensional Média e a Taxa de acrescência

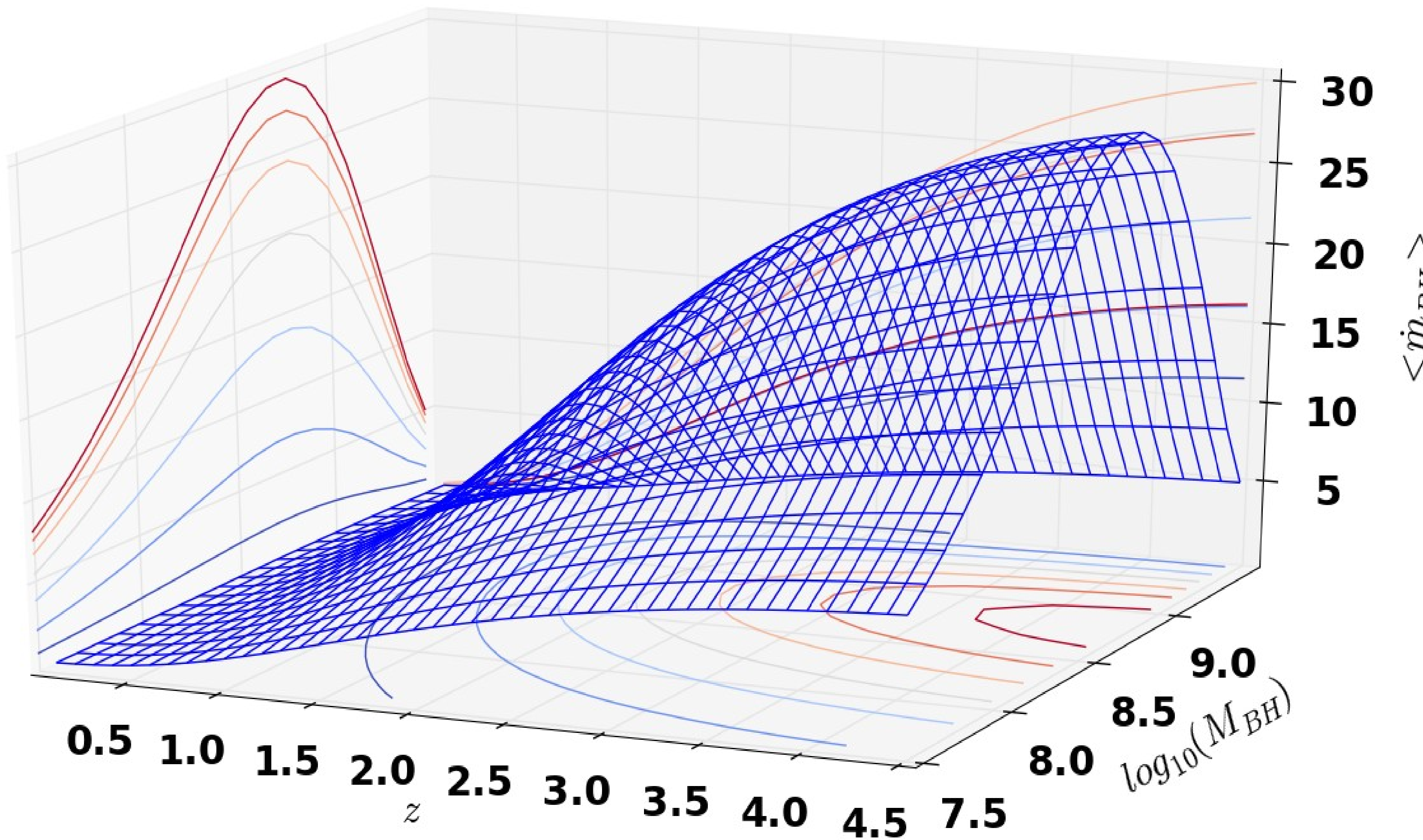
$$\bar{\lambda}(z, m_{bh}) = \left(\frac{m_{bh}}{m_{bh}^*}\right)^{\alpha} \left(\frac{t_u(z)}{t_q}\right)^{\beta} \exp\left(-\frac{t_u(z)}{t_q}\right) \exp\left(-\frac{m_{bh}}{m_{bh}^*}\right),$$

$$\chi^2 = \sum_{i=0}^{N} \sum_{j=0}^{M} \frac{\left[\bar{\lambda}_{obs}^{ij} - \bar{\lambda}(z^i, m_{bh}^j)\right]}{\sigma_{ij}},$$

Luminosidade Adimensional Média e a Taxa de acrescência

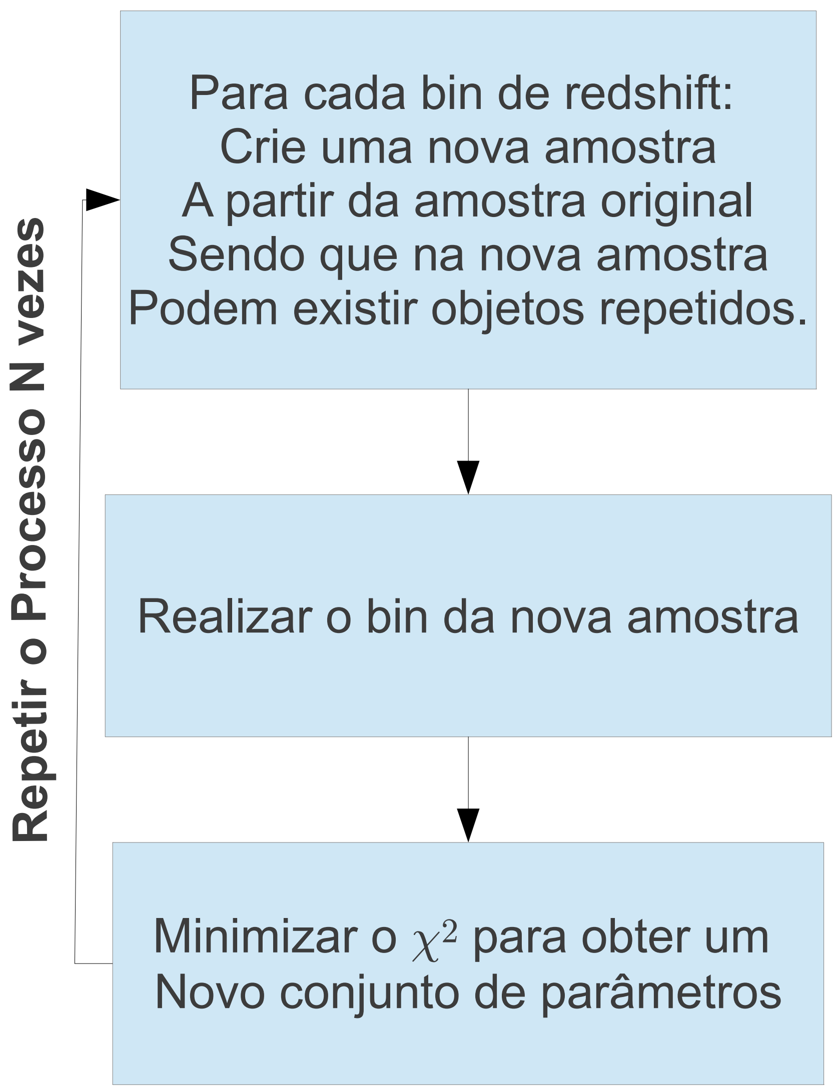


Luminosidade Adimensional Média e a Taxa de acrescência



Testes Estatísticos

- Bootstrap NÃO Paramétrico (Wehrens et al. 2000):



- Significância:

$$r^*_{(B+1)\alpha_p/2} \leq \theta \leq r^*_{(B+1)(1-\alpha/2)}$$

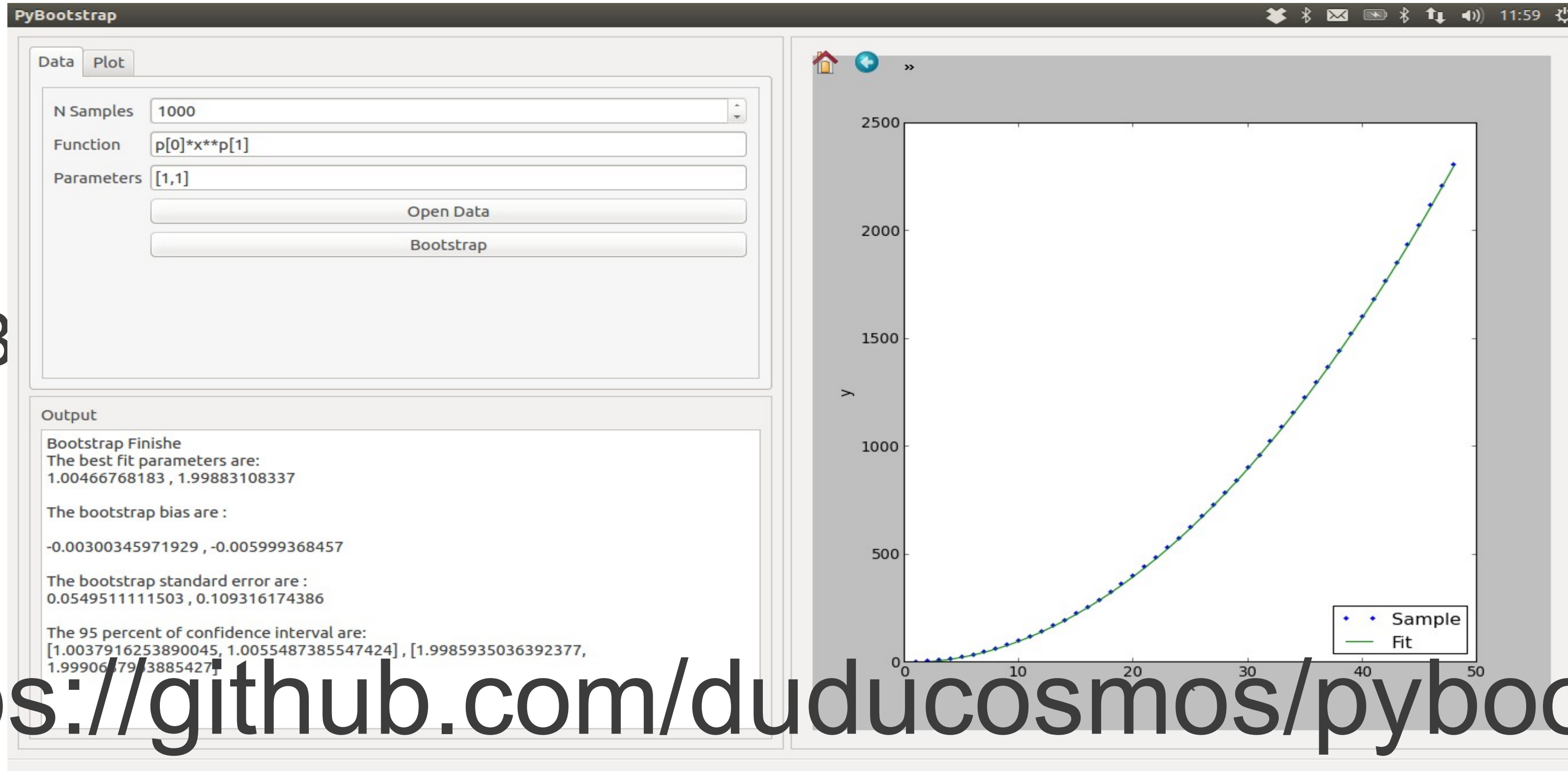
- Desvio Padra:

$$\sigma_B = \sqrt{\frac{1}{B-1}\sum_i \left(\hat{\theta}_i^* \theta^*\right)}$$

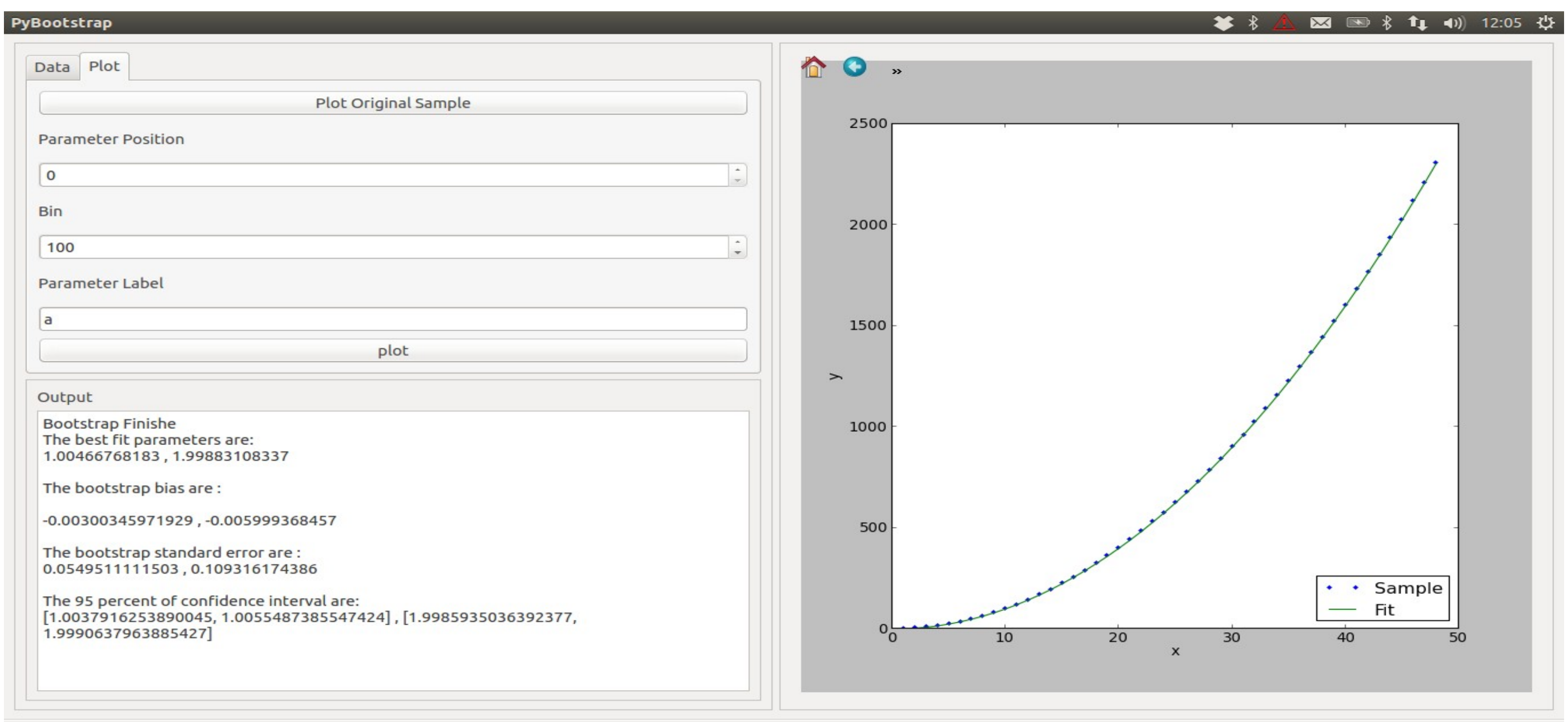
- Vies:

$$bias_B = 100\% \frac{abs(\hat{\theta}^* - \theta)}{abs(\theta)}$$

- B 0):



https://github.com/duducosmos/pyboostrap



Testes Estatísticos

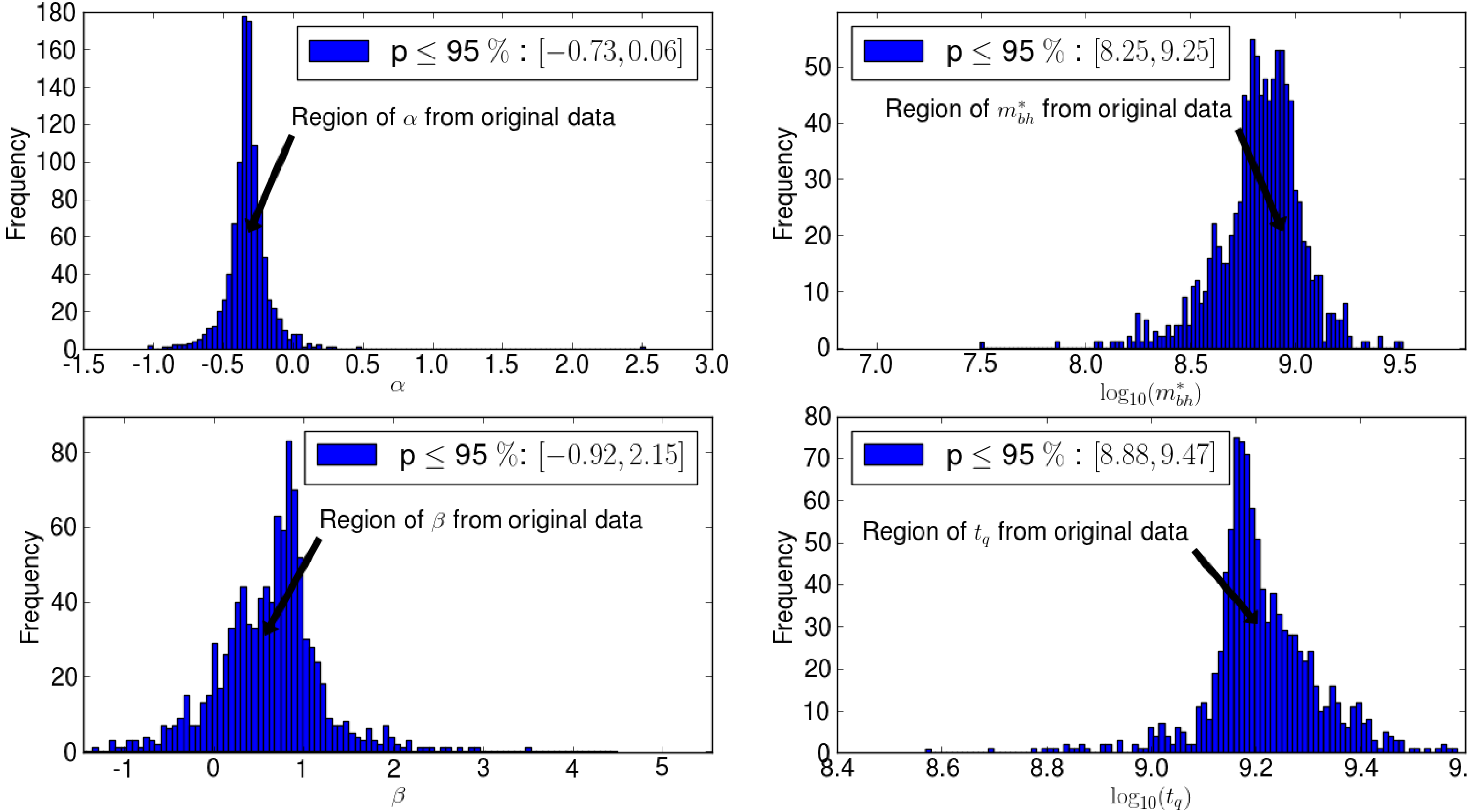
Table 1: Best Fit Parameters and reduced χ^2

α	β	m^*_{bh}	t_q	χ^2_r
-0.34	0.53	8.86×10^8	1.61×10^9	$\frac{6.95\times10^{-11}}{1545}$

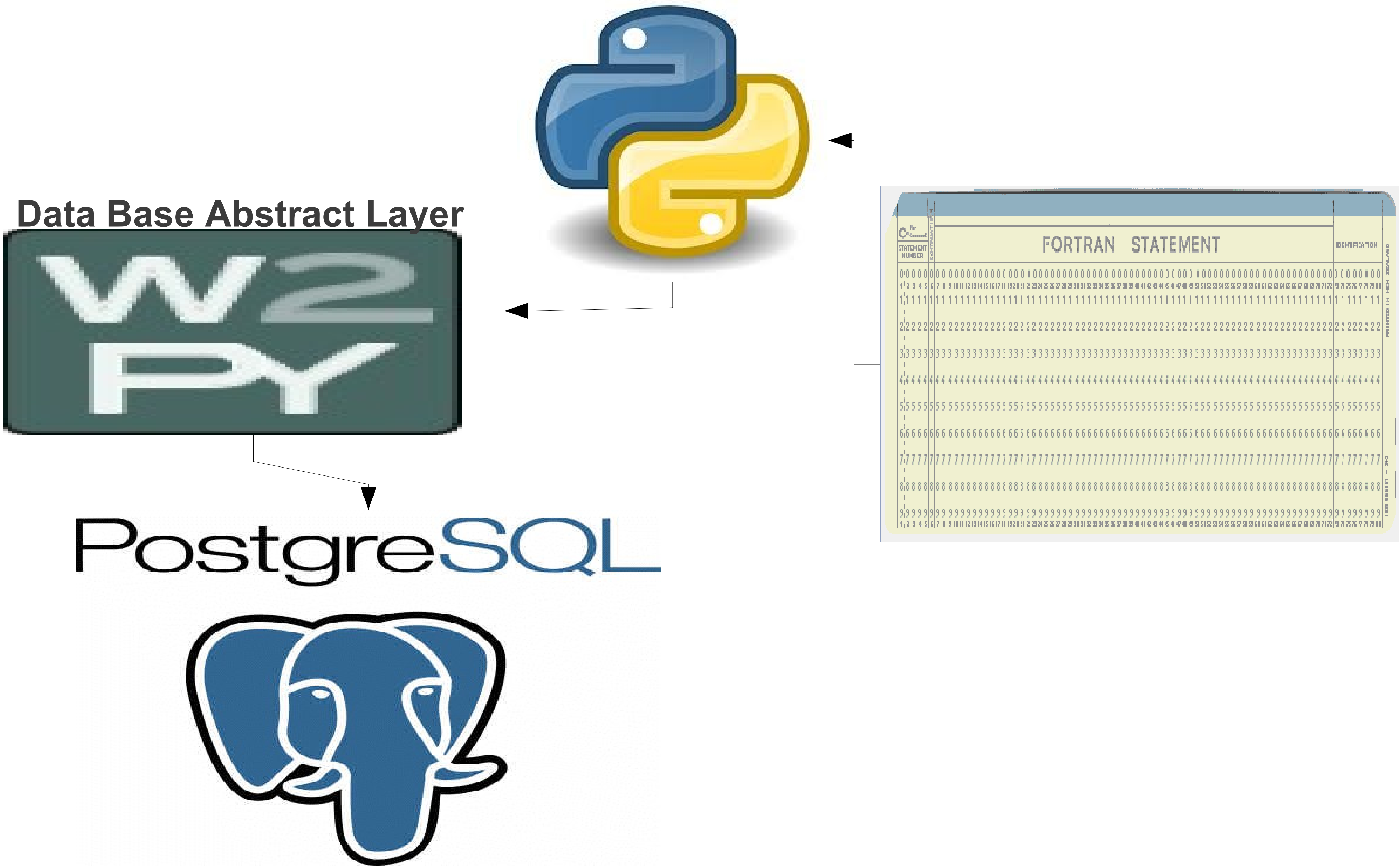
Table 3: Standard error (se_B) and Bias ($bias_B$) in percent of the parameters obtained from the original data.

	se_B	$bias_B(\%)$
α	0.17	2.94
β	0.58	15.09
t_q	4.12×10^8	3.75
m^*_{bh}	3.30×10^8	15.91

Testes Estatísticos



Ferramentas Computacionais

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