RESPONSES OF DIVERGENT SELECTION FOR LITTER SIZE RESIDUAL VARIANCE IN RABBITS

Martínez-Álvaro M.	UPV
Ibáñez-Escriche N.	IRTA-Lleida
Argente M.J.	Universidad Miguel Hernández de Elche
García M.L.	Universidad Miguel Hernández de Elche
Blasco A.	UPV

Interests

Animal Production

- ❖ Uniformity
- ❖ Heritability
- ❖ Welfare

Evolutionary Biology

- ❖ Maintenance of residual variance along the time

Has the residual variance a genetic component?

Indirect evidences

Data bases

↓

Heteroscedastic models : $y_{ij} = \mu + a_i + (\sqrt{\exp(\mu^* + a_i^*)})\varepsilon_{ij}$

↓

Estimates of $\sigma^2_{a^*}, h^2_{a^*}, \rho_{aa^*}$

PROBLEMS

Problems of heteroscedastics models

- ❖ Depend on a large number of parameters
- ❖ Are not robusts

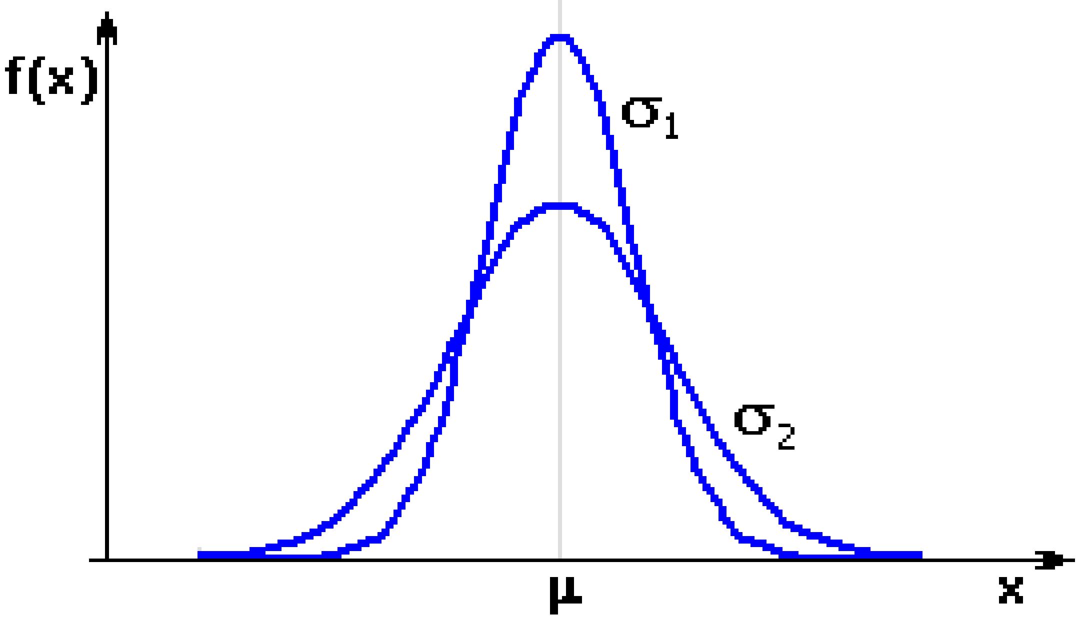
Ye Yang *et al*., 2011

	Data	Á = $\frac{cov\,(a,a*)}{\sigma_a \sigma_{a_*}}$
Rabbits	untransformed	-0.73
	transformed	0.28
Pigs	untransformed	-0.64
	transformed	0.70

Residues Box-Cox transformation in litter size in rabbits

Objective

Estimate the response in a divergent selection experiment of residual variance of litter size (V_e) in rabbits.



Materials and Methods

Selection criterion → Residual variance of litter size (V_e)

Estimated as the variance within doe

Minimum quadratic risk estimator

Total number of parities of the doe

$$LS_{ij} = YS_i + L_j + e_{ij}$$

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$$\frac{1}{n+1}\sum^{n}(x - \bar{x})^2$$

LS in V_r

e in V_e

Materials and Methods

Bayesian statistical analysis

ANALIZED TRAITS

V_e

V_r

Sd_e

Sd_r

LS

V_e

V_r

Genetic effects

$\boldsymbol{a} \sim N(\boldsymbol{0}, \boldsymbol{A}\sigma_a^2)$

Diagonal weight matrix

Element in the diagonal

$\frac{2(n-1)}{(n+1)^2}$

n: num. of parities of each

Materials and Methods

Bayesian statistical analysis

ANALIZED TRAITS

Sd_e

Sd_r

Mean

Genetic effects

$\boldsymbol{a} \sim N(\mathbf{0}, \boldsymbol{A}\sigma_a^2)$

$$\boldsymbol{Sd_e} = \boldsymbol{\mu} + \boldsymbol{Za} + \varepsilon$$

$$(\boldsymbol{Sd_e} | \boldsymbol{\mu}, \boldsymbol{a}, \sigma_\varepsilon^2) \sim N(\boldsymbol{\mu} + \boldsymbol{Za}, \boldsymbol{I}\sigma_\varepsilon^2)$$

Materials and Methods

ANALIZED TRAITS

LS

Bayesian statistical analysis

Genetic effects
$\boldsymbol{a} \sim N(\mathbf{0}, \boldsymbol{A}\sigma_a^2)$

Permanent effect
$p \sim N(\mathbf{0}, \boldsymbol{I}\sigma_p^2)$

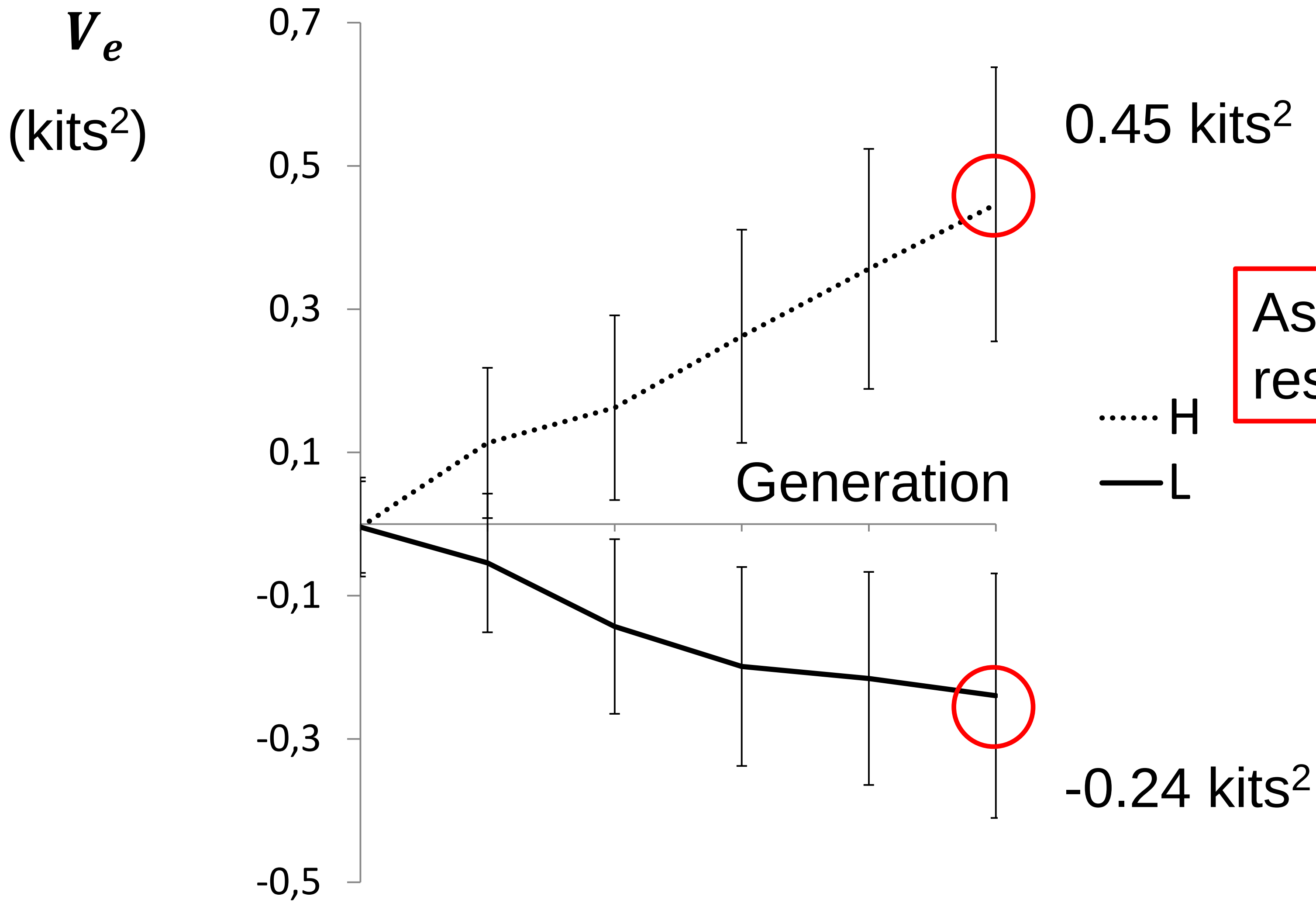
$$\boldsymbol{LS} = \boldsymbol{Xb} + \boldsymbol{Za} + \boldsymbol{Wp} + \varepsilon$$

Year-season and lactation status effects

$$(\boldsymbol{LS}|\boldsymbol{b}, \boldsymbol{a}, \boldsymbol{p}, \sigma_\varepsilon^2) \sim N(\boldsymbol{Xb} + \boldsymbol{Za} + \boldsymbol{Wp}, \boldsymbol{I}\sigma_\varepsilon^2)$$

Results and Discussion

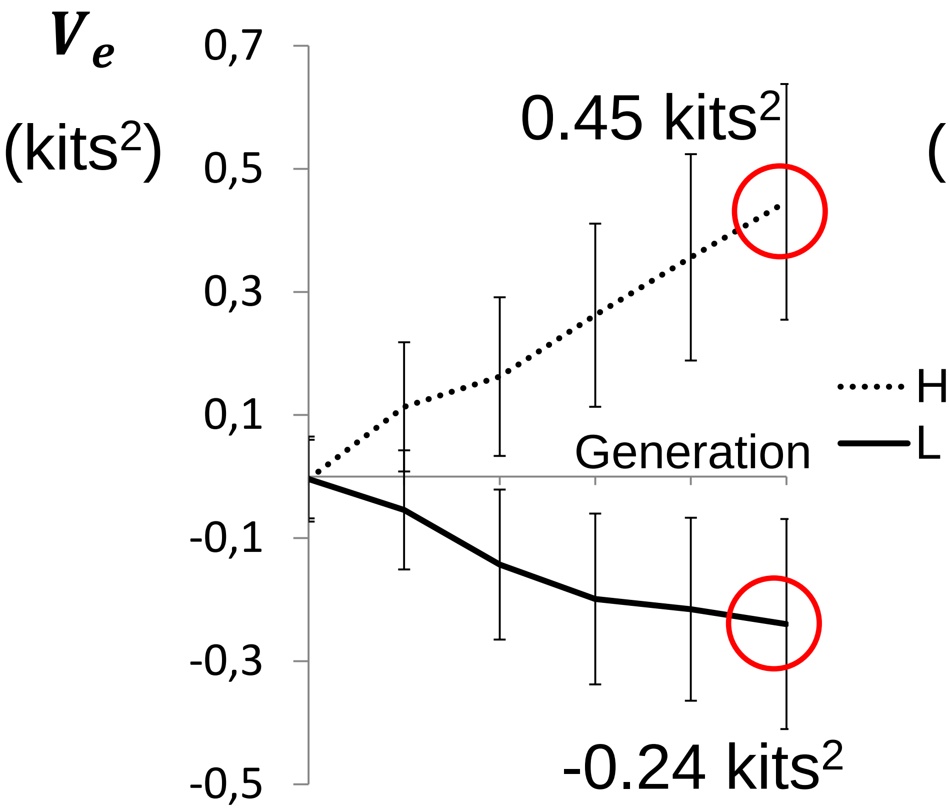
Response to selection

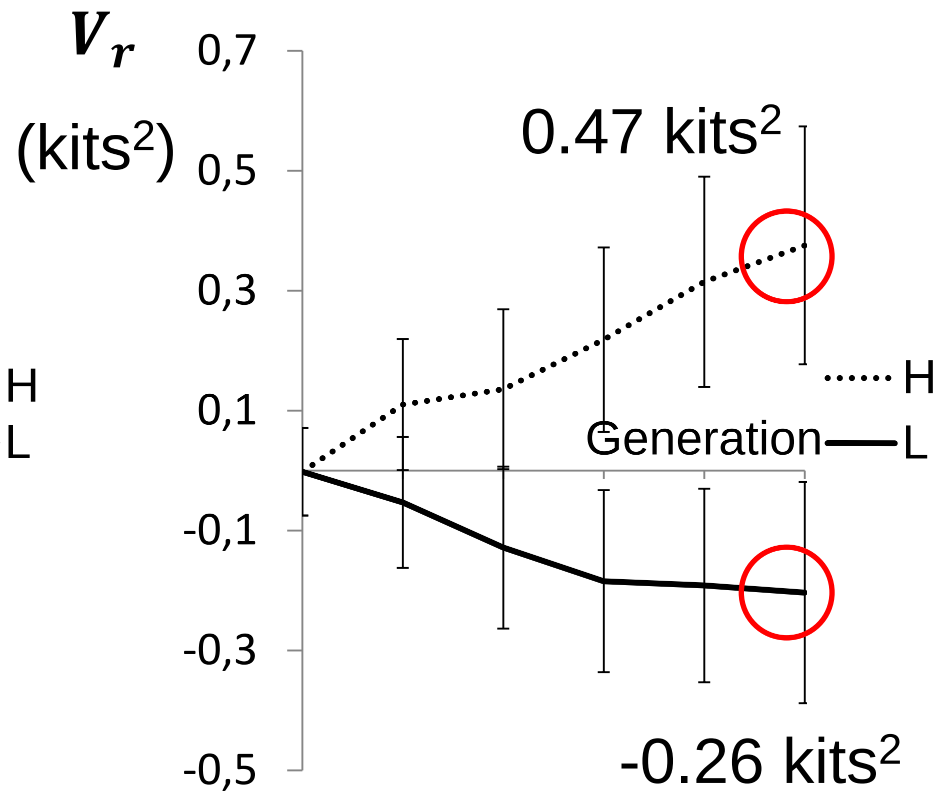


Asymmetric response

Results and Discussion

The effect of precorrecting LS data

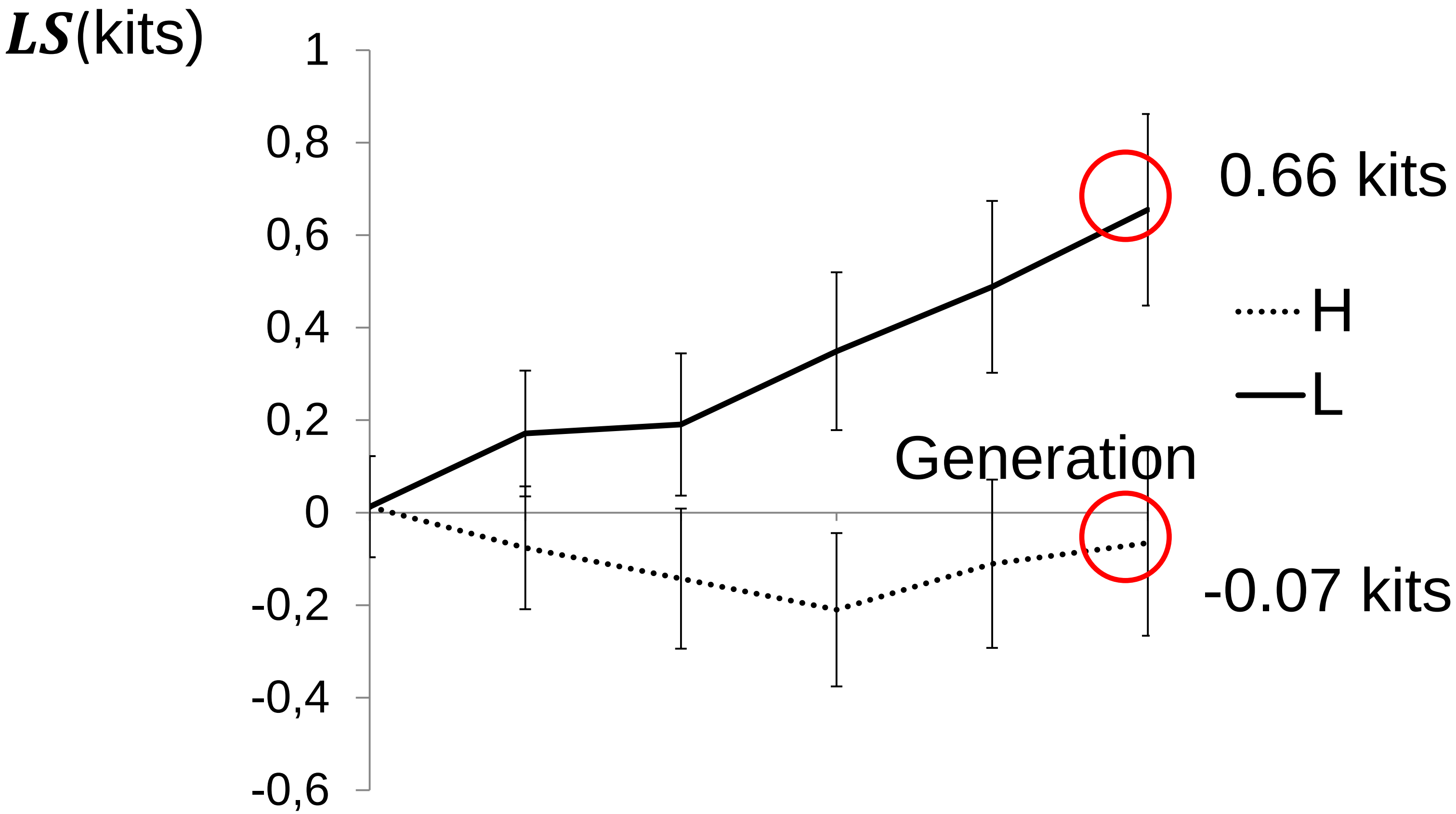




Response is almost not affected by the data precorrection

Results and Discussion

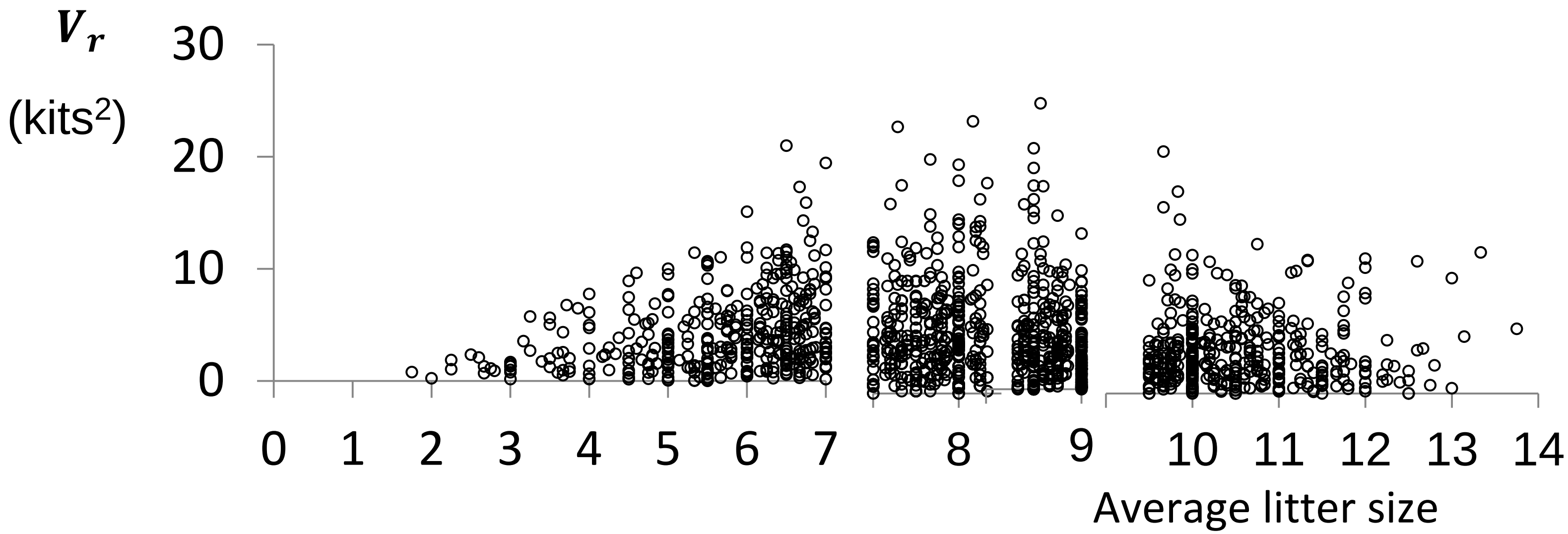
Correlated response



Negative correlated response when selecting by homogeneity of litter size

Results and Discussion

Data distribution by quartiles



Results and Discussion

Heritabilities of the traits

Trait	Median	CV
V_e	0.06	0.90
V_r	0.05	0.90
LS	0.12	0.36

Responses in V_e and V_r should be due to the high variability of the traits

Gutiérrez *et al.,* 2006, Damgaard *et al*. 2003

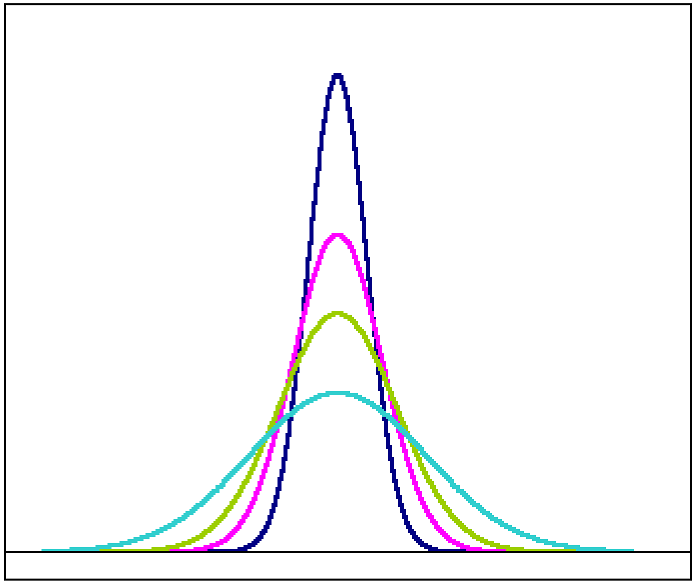
Blasco *et al*., 1993

Conclusions

Asymmetric response for V_e.

Correlated negative response for litter size in homogeneous does.

Thank you for your attention



Materiales y métodos

- 5 generaciones de selección
- Cada línea : 125 @y 25

SELECCIÓN DIVERGENTE POR V_e

Materiales y métodos

Análisis estadístico bayesiano

La varianza de un estimador de mínimo riesgo (Searle, 1982)

$$var\,(s_{n+1}^2) = var\left(\frac{1}{n+1}\,\boldsymbol{X'AX}\right)$$

$$= \frac{1}{(n+1)^2}\left(2tr(\boldsymbol{AVAV}) + \ 4^*1^{'*}AVA1\mu^2\right)$$

0

$$= \frac{1}{(n+1)^2} 2tr(\boldsymbol{AA})\sigma^4 = \frac{2(n-1)}{(n+1)^2}\sigma^4$$

$$tr(\boldsymbol{A}) = n\,\frac{n-1}{n} = n-1$$

SELECCIÓN DIVERGENTE POR V_e

Asunción de normalidad del carácter V_e

Cualquier función, cuando n es suficientemente grande tiende a la normalidad

$$f(\theta|y) \quad f(y|\theta)f(\theta) \rightarrow \prod_1^n f(y|\theta) = f(y|\theta)^n$$

$$\ln f(y|\theta)^n = n \ln f(y|\theta)$$

Desarrollando por las series de Taylor:

$$n \ln f(y|\theta) = k_0 + \left(\frac{d(n \ln f(y|\theta))}{d\theta}\right)_{\theta_0} (\theta - \theta_0) + \left(\frac{d^2\,(n \ln f(y|\theta))}{d\theta^2}\right)_{\theta_0} (\theta - \theta_0)^2$$

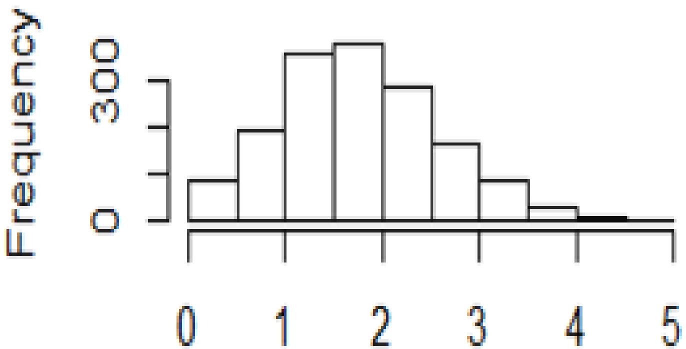
$$f(y|\theta) = e^{\ln f(y|\theta)^n} = e^{n \ln f(y|\theta)} \propto e^{k(\theta-\theta_0)^2} \propto \boxed{ke^{k^2}}$$

Función normal

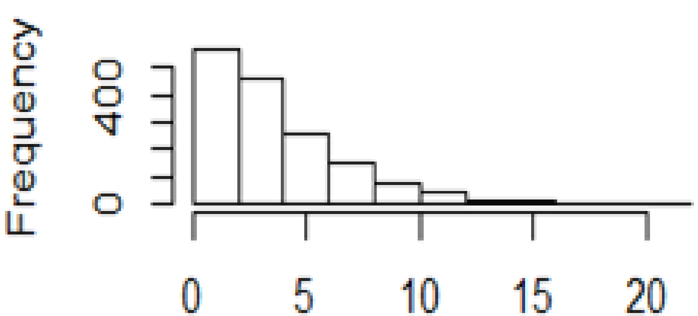
$$f(\theta|y) = \frac{1}{\sqrt{2\pi\sigma^2}} e^{-\frac{1}{2\sigma^2}(y-\mu)^2}$$

Distribución de los datos

Desviación típica residual



Varianza residual



Respuestas fenotípicas