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Classification of Coefficients of Variation in Experiments with Commercial layers

■ Author(s)

Faria Filho DE*
Dias AN
Veloso ALC
Bueno CFD
Couto FAP
Matos Júnior JB
Barreto KZO
Rodrigues PA
Carneiro WA

Universidade Federal de Minas Gerais
Instituto de Ciências Agrárias
Montes Claros, Minas Gerais, Brasil.

■ Mail Address

DE Faria Filho
Av. Universitária, n. 1000
Bairro universitário. Caixa Postal 135
39.404-006. Montes Claros, MG, Brasil.

E-mail: fariafilho@ufmg.br

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ABSTRACT

This study aimed at determining a specific classification of coefficients of variation in experiments with commercial layers. Coefficients of variation were collected from papers published in Brazilian journals between 2000 and 2009 for performance, internal egg quality, and eggshell quality parameters. The coefficients of variation of each parameter were classified as low, intermediate, high, and very high according to the ratio between the median and the pseudo-sigma. It was concluded that the parameters used in experiments with commercial layers have a specific classification of coefficients of variation, and that this must be considered to evaluate experimental accuracy.

INTRODUCTION

In analysis of variance models, the coefficient of variation (CV) is calculated as the residual standard deviation expressed as a percentage of the general mean of the experiment. The residual standard deviation is the square root of the error mean square, which contains all the variation due to the experimental error. Therefore, CV is an important measure of experimental precision. The lower the CV, the higher the precision of the experiment for a determined parameter. Low-precision experiments increase the chances of type II errors, when the difference among treatments is considered non-significant, when it is in fact significant (Sampaio, 1998). Therefore, CVs need to be classified in order to allow researchers to evaluate the results of their studies and those published in literature.

Each response parameter presents a specific CV classification. CV classification ranges were already established for pigs (Judice et al., 1999), beef cattle (Judice et al., 2002), equine nutrition (Lana et al., 2006), and broilers (Mohallem et al., 2008). However, no CV classification was yet established for parameters commonly evaluated in studies with commercial layers.

This study aimed at determining a classification of CVs of performance and internal and external egg quality parameters in experiments with commercial layers.

MATERIAL AND METHODS

The journals Acta Scientiarium, Arquivo Brasileiro de Medicina Veterinária and Zootecnia, Ciência and Agrotecnologia, Ciência Animal Brasileira, Ciência Rural, Pesquisa Agropecuária Brasileira, Revista Brasileira de Ciência Avícola, Revista Brasileira de Zootecnia, and Scientia Agrícola were reviewed. These journals were accessed via internet, and papers involving commercial layers in lay were search in the title and abstract in all numbers published between 2000 and 2009.

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Among the selected articles, the CV of the parameters feed intake (g/bird/day), egg production (%/bird/day), egg weight (g), egg mass (g/bird/day), feed conversion ratio per dozen eggs (g/dozen), feed conversion ratio per egg mass (g/g), Haugh units, eggshell thickness (mm), and egg specific gravity (g/mL) was collected.

For the CV of each parameter, the number of observations, minimum and maximum values, mean, standard deviation, median, and pseudo-sigma were determined (Tukey, 1977). Data normality was verified by the test of Cramer-Von-Mises (Littell et al., 2002). CV classification ranges followed the methodology proposed by Costa et al. (2002) as a function of median (Md) and pseudo-sigma (PS), as follows: low ($CV \leq Md - PS$), intermediate ($Md - PS < CV \leq Md + PS$), high ($Md + PS < CV \leq Md + 2PS$) and very high ($CV > Md + 2PS$). Statistical analysis were performed using SAS® software package (Littell et al., 2002).

RESULTS AND DISCUSSION

Descriptive statistical analysis and CV normality test for the studied parameters are shown in Table 1. None of the analyzed parameters presented normal distribution according to the test of Cramer-Von-Mises. Therefore, the methodology of CV classification proposed by Costa et al. (2002), which does not assume data normality, was adopted.

The CV classification ranges for parameters used in experiments with commercial layers are presented in Table 2. When there is not a specific CV classification for the studied parameter, researchers usually resort to their experience or the classifications proposed in literature, such as that of Gomes (2000), which was established with crop data, but that is used to compare CVs in animal science. Gomes (2000) established as low CVs those lower than 10%, intermediate CVs as those between 10 and 20%, high CVs as those between 20 and 30%, and very high CVs as those higher than 30%. This CV classification is very different from that proposed in the present study. In the classification of Gomes (2000), a CV of 10% is considered as low, whereas in the present study it is considered very high for feed intake, egg production, eggshell thickness, and specific gravity, and very high for the remaining parameters. This stresses the importance of establishing specific CV classifications, as currently proposed for crops (Clemente & Muniz, 2002; Costa et al., 2002; Carvalho et al., 2003; Lima et al., 2004; Oliveira et al., 2009) and animal production (Judice et al., 1999; Judice et al., 2002; Lana et al., 2006; Mohallem et al., 2008), allowing researchers to verify the accuracy of their own results and of those published in literature.

Table 1 - Number of observations (N), minimum value (Min), maximum value (Max), mean (X), standard deviation (SD), median, pseudo-sigma (PS), and test of Cramer-Von-Mises for data normality for feed intake (FI), egg production (EP), egg weight (EW), egg mass (EM), feed conversion ratio per dozen eggs (FCR dozen), feed conversion ratio per egg mass (FCR mass), Haugh units (HU), eggshell thickness (EST) and specific gravity (SG) in commercial layers.

Parameter	N	Min	Max	Mean	SD	Median	PS	Normality
FI	90	0.43	11.76	4.42	2.35	3.99	2.30	0.17*
EP	100	1.31	22.35	6.33	3.99	5.99	3.73	0.34**
EW	99	0.5	11.96	3.17	1.87	2.93	1.06	1.44**
EM	69	2.06	21.32	6.49	3.48	6.03	2.22	0.39**
FCR dozen	51	1.23	19.25	6.01	3.20	5.63	2.62	0.16*
FCR mass	74	1.9	21.18	6.29	3.41	6.01	3.01	0.22**
HU	45	0.61	41.05	6.7	8.54	4.45	3.02	1.16**
EST	40	0.11	12.67	3.02	2.12	2.60	1.04	0.54**
SG	57	0.08	3.38	0.62	0.89	0.31	0.24	1.88**

* $p<0.05$ and ** $p<0.01$.

Table 2 - Coefficient of variation (CV, %) ranges of feed intake (FI), egg production (EP), egg weight (EW), egg mass (EM), feed conversion ratio per dozen (FCR dozen), feed conversion ratio per egg mass (FCR mass), Haugh unit (HU), eggshell thickness (EST) and specific gravity (SG) in commercial layers.

Parameter	Low	Intermediate	High	Very high
FI	$CV \leq 1.68$	$1.68 < CV \leq 6.29$	$6.29 < CV \leq 8.59$	$CV > 8.59$
EP	$CV \leq 2.25$	$2.25 < CV \leq 9.72$	$9.72 < CV \leq 13.45$	$CV > 13.45$
EW	$CV \leq 1.87$	$1.87 < CV \leq 3.98$	$3.98 < CV \leq 5.04$	$CV > 5.04$
EM	$CV \leq 3.81$	$3.81 < CV \leq 8.25$	$8.25 < CV \leq 10.47$	$CV > 10.47$
FCR dozen	$CV \leq 3.01$	$3.01 < CV \leq 8.25$	$8.25 < CV \leq 10.86$	$CV > 10.86$
FCR mass	$CV \leq 2.99$	$2.99 < CV \leq 9.02$	$9.02 < CV \leq 12.03$	$CV > 12.03$
HU	$CV \leq 1.43$	$1.43 < CV \leq 7.47$	$7.47 < CV \leq 10.49$	$CV > 10.49$
EST	$CV \leq 1.56$	$1.56 < CV \leq 3.64$	$3.64 < CV \leq 4.68$	$CV > 4.68$
SG	$CV \leq 0.07$	$0.07 < CV \leq 0.55$	$0.55 < CV \leq 0.78$	$CV > 0.78$

CONCLUSION

It was concluded that performance and internal and external egg quality parameters used in studies with commercial layers have a specific classification of coefficients of variation, and that this must be considered for the evaluation of experimental data accuracy.

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