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SIMPLE LINEAR AND MULTIPLE REGRESSION ANALYSES OF MORPHOLOGICAL TRAITS ON BODY WEIGHT IN FEMALE DORPER SHEEP LAMBS

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Regression is a very influential statistical technique that uses independent variables to describe the dependent variable. The present study was performed to determine the best-fitted model from different regression techniques to predict body weight (BW) from morphological traits viz. heart girth (HG), rump height (RH), body length (BL), withers height (WH) and sternum height (SH). Twenty-eight female Dorper sheep lambs at birth were used for data collection. The simple and multiple regression were used for data analysis. The coefficients of determination (R2) and mean square error (MSE) were used to determine the best-fitted regression model. The results indicated that in simple regression the best fitted regression model for estimation of BW in female Dorper lamb was the model including BL (R^2 = 0.79, MSE = 1.43), in multiple regression, the best fitted regression model for estimation of body weight in female Dorper lamb was model including HG, RH, BL, WH, SH (R2 = 0.89, MSE = 0.90) in the study. The results of simple regression suggest that BL can truly estimate the body weight in female Dorper sheep lambs. Multiple regression findings suggest that two or more morphological traits can truly estimate body weight in the female Dorper lambs. The study will help the farmers to accurately predict the body weight of the Dorper sheep lambs using the morphological traits.

Keywords: *Coefficients of determination; Mean square error; Heart girth; Sternum height; Body length*

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Introduction

Assessing different live body weight of different sexes of animals help in improving body weight of the animals [1]. According to [2] the regression equations are mostly used as techniques for predicting body weight using body dimensions of many breeds. Body dimensions namely: heart girth, rump height, ear length, head

length, body length, sternum height and withers height are considered to be the easiest way of predicting body weight of animals as compared to the use of weighing scale because are not easily accessible and are expensive to most communal farmers [3].

However, there are scarce readings on comparison of different regression techniques for estimation of body weight using morphological traits in female Dorper sheep lambs. The objective of the study is to determine the best-fitted regression models to estimate body weight using morphological traits amongst two regression techniques namely: simple and multiple regressions. The current paper will assist the farmers to know which morphological traits contribute more variation to the body weight of female Dorper sheep lambs, which will help farmers to improve strategies used in the breeding programs.

Materials and methods

The study was conducted at the University of Limpopo experimental farm, South Africa.

Animal management

The farm workers were making sure that lambs suckle enough milk from their mothers before they are released for grazing and suckle when they come back in the afternoon.

Experimental design

The study used a cross-sectional experimental design, where the farm was visited once for collection of body weight and morphological traits from 20 female Dorper sheep.

Measurements of body weight and morphological traits

Body weight (BW) and morphological traits viz. heart girth (HG), rump height (RH), body length (BL), withers height (WH) and sternum height (SH) of female Dorper lambs were recorded as described by [4] using weighing scale (kg) and measuring tape (cm).

Statistical analysis

The data was analyzed using Statistical Package for Social Sciences (SPSS, 2019) software, version 26 for windows. The data of descriptive of female Dorper sheep lambs were obtained. Live body weight was regressed on morphological traits using simple regression and multiple regression as it explained by [5] to design the best fitted regression model. Below is the simple and multiple regression equation that was formed:

$$Y = a + b1X1 + b2X2 + b3X3 + b4X4 + b5X5$$

Where;

Y= dependent variable (Body weight),

X1 – X2 = Independent variables (Morphological traits),

b1 – b5 = Coefficient of regression and

a = Constant (regression intercept).

Results and discussion

Descriptive statistics of the measured traits

Table 1 shows the results of descriptive statistics of female Dorper sheep lambs between body weight and morphological traits viz heart girth (HG), rump height (RH), body length (BL), withers height (WH), and sternum height (SH). The results indicates that all the morphological traits had higher numerical mean values than the body weight of female Dorper lambs which are indicated as follows HG (40.83 ± 1.13), RH (33.67 ± 0.94), BL (37.33 ± 1.24) and WH (34.56 ± 0.76), and SH (26.71 ± 0.50) respectively, while the BW had (6.05 ± 0.49) which is lower than all the morphological traits. According to [3] body dimensions are perfect instruments used to assess the body weight of the animals. The results of descriptive statistics indicated that the numerical mean value of BW is lower than the rest of morphological traits. The findings are dissimilar with the study of [6] in yearling Boar goats.

Table 1.

Descriptive statistics of female Dorper sheep lambs between BW and morphological traits

Traits	Female lambs Mean ± SE	n = 28 CV (%)
BW (kg)	6.05 ± 0.49	8.10%
HG (cm)	40.83 ± 1.13	2.77%
RH (cm)	33.67 ± 0.94	2.79%
BL (cm)	37.33 ± 1.24	3.32%
WH (cm)	34.56 ± 0.76	2.20%
SH (cm)	26.71 ± 0.50	1.87%

SE: standard error; CV: coefficient of variance; BW: body weight; WH: withers height; RH: rump height; BL: Body length; BD: Body depth; RW: rump width; RL: rump length; HG: heart girth; n: 28.

Simple regression model on female Dorper lambs using morphological traits on body weight

The model of simple linear regression was formed using dependent variable (BW) and independent variables (HG, RH, BL, WH and SH) to determine

the regression model that is the best fitted for estimation of body weight in the female Dorper lambs. The findings indicate that all the equation models were statistical significant ($p < 0.05$) showed in Table 2 below.

The best-fitted regression model with BL has considered being the best because of highest R^2 and lowest MSE of 0.79 and 1.43 respectively. The results indicate that 79 per cent of variation in the body weight is contributed by BL. The highest R^2 and the lowest MSE was achieved from body length in female Dorper lamb sheep. The results indicate that body length is the one that pay more to the variation in body weight of female Dorper lamb sheep. The study is in disagreement with the study of [5] in Awassi sheep; [4] in atteppady black goats.

Table 2.

Simple linear equations for estimation of body weight using different morphological traits

Model of female Dorper lambs sheep	Variables	Equations	R^2 values	MSE
1	HG	BW = -8.17 + 0.35HG	0.65	2.42
2	RH	BW = -7.52 + 0.40RH	0.60	2.76
3	BL	BW = -7.09 + 0.35BL	0.79	1.43
4	WH	BW = -13.42 + 0.56WH	0.76	1.67
5	SH	BW = -10.09+ 0.60SH	0.39	4.26

R^2: coefficient of determination; MSE: mean square error; BW: body weight; HG: heart girth; RH: rump height; BL: body length; WH: withers height; SH: sternum height; EL: ear length and HL: head length.

Multiple regression model on the female Dorper lambs using morphological traits on body weight

Table 3 shows the summary of the multiple regression analysis in female Dorper sheep lambs. The results revealed that the SH had highest variation contribution of 0.09 followed BL with variation contribution of 0.05 ($p < 0.05$) to the body weight with coefficients of determination of 0.89 and mean square error of 0.90 in female Dorper lambs.

The results indicates that 89 per cent of the variation in the BW of the female Dorper lambs is described by this model. The equation of multiple regression was developed as followed: BW= -14.72 + 0.53HG + 0.10RH + 0.16BL + 0.12WH + 0.20SH, whereby HG, RH and WH were not were not statistically significant ($p > 0.05$). Multiple regression was used to determine which morphological traits contribute more to variation of body weight in female Dorper lambs. The study is in oppose with the study of [7] in Nguni cattle.

Table 3.

Multiple regression for estimation of BW using morphological traits

Multiple regression Morphological traits					
Parameters	HG	RH	BL	WH	SH
P value	0.38	0.15	0.01	0.27	0.04
B	0.05	0.10	0.16	0.12	0.20
SE	0.06	0.07	0.05	0.11	0.09

R^2 = 0.89, MSE = 0.90, constant = -14.723

HG = heart girth, RH = rump height, BL = body length, WH = withers height, SH = sternum height, EL = ear length, HL = head length, SE = Standard error and R^2 = coefficient of determination, b = regression coefficient

Conclusion

In conclusion, the results of the current study suggest that body length is the most important body dimensions that can evaluate body weight using simple regression and again, the sternum height and body length contribute more variation to the body weight of female Dorper lambs using multiple regression. The sternum height and body length can be included in the selection criteria of to improve body weight of female Dorper lambs. Therefore, the study will benefit Dorper sheep farmers to assess body weight using model of regression that is established. Additional readings are required for increasing body weight in Dorper sheep using simple and multiple regression.

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References

1. Karim G.M., Karym C.M. Prediction of body weight from body dimensions in Karadi sheep. *Journal of Zankoy Sulaimani*. JZS, 2ndInt. Conference of Agricultural Science. 2018. https://doi.org/10.17656/jzs.10660
2. Melesse A., Banerjee S., Lakew A., Mersha F., Hailemariam F., Tsegaye S., Makebo T. Variations in linear body measurements and establishing prediction equations for live weight of indigenous sheep populations of southern Ethiopia. *Journal of Animal Science*, 2013, vol. 2(1), pp. 15-25.

3. Taye M., Yilma M., Rischkowsky B., Dessie T., Okeyo M., Mekuriaw G., Haile A. Morphological characteristics and linear body measurements of Doyogena sheep in Doyogena district of SNNPR, Ethiopia. *African Journal of Agricultural Research*, 2016, vol. 11(48), pp. 4873-4885. https://doi.org/10.5897/AJAR2016.11826
4. Raja T.V., Venkatachalapathy R.T., Kannan A., Bindu K.A. Determination of best-fitted regression model for prediction of body weight in attappady black goats. *Global Journal of Animal Breeding and Genetics,* 2013, vol. 1 (1), pp. 020-025.
5. Tropal M., Yildiz N., Esenbuba N., Aksakal V., Macit M., Ozdemir M. Determination of best-fitted regression inodel for estimation of body weight in Awassi sheep. *Journal of Applied Animal Research,* 2003, vol. 23(2), pp. 201-208. https://doi.org/10.1080/09712119.2003.9706422
6. Mathapo M.C., Tyasi T.L. Prediction of Body Weight of Yearling Boer Goats from Morphometric Traits using Classification and Regression Tree. *American Journal of Animal and Veterinary Sciences*, 2021, vol. 16 (2), pp. 130-135. https://doi.org/10.3844/ajavsp.2021.130.135
7. Tyasi T.L., Mathye N.D., Danguru L.W., Rashijane L.T., Mokoena K., Makgowo K.M., Mathapo M.C., Molabe K.M., Bopape P.M., Maluleke D. Correlation and path analysis of body weight and biometric traits of Nguni cattle breed. *Journal of Advanced Veterinary and Animal Research*, 2020, vol. 7(1), pp. 148–55. http://doi.org/10.5455/javar.2020.g404

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