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RESEARCH ARTICLE

Determination of relationship of body weight and some body measurements by non-linear models in hair goats in Karaman region

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Karaman yöresinde kıl keçilerinde doğrusal olmayan modellerle vücut ağırlığı ve bazı vücut ölçümlerinin ilişkilerinin belirlenmesi

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Öz

Amaç: Araştırmada, Karaman ili Damızlık Koyun Keçi Yetiştiricileri Birliğine kayıtlı, Kıl Keçisi yetiştiren işletmelerde, Kıl Keçisinin vücut özelliklerini tanımlamak amacıyla elde edilen verilerden yararlanılmıştır. Toplam 900 olan veri içerisinden, basit rasgele örnekleme yöntemi ile seçilmiş, 2-7 yaşları arasındaki 130 keçi ve 2-4 yaş arasındaki 50 tekenin vücut ölçüsü kullanılmıştır. Çalışmanın temel motivasyonu Karaman Yöresinde Kıl Keçilerinde Doğrusal Olmayan Modellerle Vücut Ağırlığı ve Bazı Vücut Ölçümlerinin İlişkilerinin Belirlenmesi olarak planlamıştır.

Gereç ve Yöntem: Çalışmada doğrusal olmayan modellerle canlı ağırlık tahmini yapılmıştır. Doğrusal olmayan tek değişkenli regresyon modelleri kullanılmıştır.

Bulgular: Çalışma sonuçları değerlendirildiğinde doğrusal olmayan tek değişkenli modellerden Quadratic veya Cubic yöntemler ile istatistik olarak anlamlı sonuçlar elde edilmiştir.

Öneri: Araştırmacılar uygun şart ve koşullar oluştuğunda çok değişkenli regresyon yöntemini tercih edebilirler ancak zaman kısıtı ve pratik olmayan durumlar için tek değişkenli Quadratic veya Cubic yöntemleri ile göğüs çevresi değişkenini kullanarak tahminde bulunmaları önerilebilir.

Anahtar kelimeler: Regresyon, Parametrik ve yarı parametrik regresyon modelleri, Canlı Ağırlık, Keçi vücut ölçüleri

Abstract

Aim: In this study, the data obtained to describe the body characteristics of the Hair Goat ,were utilized in the businesses that were registered with Karaman Province Breeding Sheep and Goat Breeders Association. Body measurement of 130 goats, 2-7 years old and 50 billy goats, 2-4 years old, selected by simple random sampling method for total 900. The main motivation of the study was to determine the relationship between body weight and some body measurements with nonlinear models in hair goats in Karaman region.

Materials and Methods: In the study, we estimated the live weight with nonlinear models. Nonlinear univariate regression models were used.

Results: When the results of the study were evaluated, statistically significant results were obtained by using Quadratic or Cubic methods from nonlinear univariate models.

Conclusion: Researchers may choose the multivariate regression method occurs when the appropriate terms and conditions, but with time constraints and chest girth quadratic or cubic univariate methods impractical for situations be offered an estimate using the variable.

Keywords: Regression, Semi-parametric regression models, Parametric regression models, Live weight in the goats, Body measurements

Introduction

Regression analysis assumes that when the mean relation between the dependent variable and the independent variable is expressed by a mathematical function, the independent variable and the dependent variable are in a linear relationship. Regression models may use parametric, nonparametric and semi-parametric regression methods.

All of the approaches available for the semi-parametric regression models are based on different non-parametric regression methods. Semi-parametric regression models summarize complex data sets in a way that we can understand and sustain important properties while ignoring the insignificant details of the data in practice, thus allowing robust decisions to be made (Rupert et all 2003).

Semi-parametric regression methods is widely used in the analysis of time-dependent data. Generally, longitudinal data obtained from experiments in the fields of agriculture, medicine and biostatistics that are measured with a continuous scale depending on the time, and measurements taken at different times from the same trial unit (individual) take different values. However, the recipients are related to each other. This is the result of applying multiple behaviors to the same test units to follow each other (Lee and Solo 1999).

In the majority of longitudinal studies, the effects of time and continuous independent variables on the resulting outcome variance are included in the model. Correlation (autocorrelation) between error variables occurs when more than one observation is made on the same individual depending on location and time. In such cases, some assumptions do not apply. Therefore, making time-related assessments is a common problem for parametric methods. Non-parametric methods can be used in such cases. However, when nonparametric methods are used in order to analyze the number of independent variables. It is difficult to make analyzes and to interpret the graphs. As an alternative method, semi-parametric models can also be used., The effects of chance and time are affected by nonparametric methods, while the effects of continuous independent variables are included by methods that are parametric.

The semi-parametric regression model is also known as the "partial linear model" by the fact that it consists of a combination of parametric and non-parametric regression functions. The main motivation of this study is to determine the relationship between body weight and some body measurements with nonlinear models in Hair Goats in Karaman region.

Materials and Methods

In regression analysis, there are two types of linearity in variables and coefficients (linearity in parameters). The state of linearity in variables means that the value of each variable in the model is one; indicates a linear functional relationship between dependent and independent variables. Similarly, in coefficients, linearity is the exponent of all coefficient values in the model and the existence of a linear functional relationship between the dependent variable and the coefficient values.

$$Y_i = \beta_0 + \beta_1 X_i + e_i \quad (1)$$

An example of a model is that both the coefficients and the variables are linear.

$$Y_i = \beta_0 + \beta_1 X^2{}_i + e_i \quad (2)$$

The coefficients are also linear, but the variables are examples of nonlinear models.

$$Y_i = \beta_0 + \sqrt{\beta_1} X_i + e_i \quad (3)$$

Variables are linear, while coefficients are examples of nonlinear models.

Simple linear regression model

The regression model examines the causality relationship between a single independent variable and a dependent variable.

$$Y_i = \beta_0 + \beta_1 X_i + e_i \quad (4)$$

Multiple regression model

Models developed for multiple regression analysis resemble simple linear regression models, with the exception of more terms, and can be used to examine straightforward, more complex relationships. For example, suppose that the average time E (y) needed to fulfill the data-processing task increases as the use of computers increases and we think that the relationship is curve-linear. To model the deterministic $E(y) = \beta_0 + \beta_1 X_1$ component, the following quadratic model can be used instead of the straight-line model.

$$E(y) = \beta_0 + \beta_1 X_1 + \beta_2 X_1^2 \quad (5)$$

For example, the first-order model;

$$E(y) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 \quad (6)$$

(x1, x2) -plane. For our example (and for many real-life applications), we expect a slope on the response surface and use a second-order model to model the relationship.

$$E(y) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_1 X_2 + \beta_4 X_1^2 + \beta_5 X_2^2 \quad (7)$$

All the models written up to now are called generic linear models, because E (y) is a linear function of unknown parameters. The following model is not linear.

$$E(y) = \beta_0 e^{-\beta_1 x} \quad (8)$$

Because E (y) is not a linear function of unknown model parameters.

Semi-parametric regression models

Semi-parametric regression models are models in which the dependent variable can be parameterized in relation to some explanatory variables, but not easily related to some other explanatory variable or variables. In the semi-parametric model, linear parametric components form the parametric part of the model whereas both parametric and non-linear components form the non-parametric part of the model. This model is a special case of additive regression models (Härdle et all 2004), which allows easier interpretation of the effect of each variable and generalizes standard regression methods. In addition, the semi-parametric model is a model in which the dependent variable is linear with some explanatory variables but not linear with other specific independent variables.

Parametric Methods;

Linear: $\hat{y} = b_0 + b_1 x$ (9)

Inverse: $\hat{y} = b_0 + (\frac{b_1}{t})$ 10)

Quadratic: $\hat{y} = b_0 + b_1 x + b_{11} x^2$ (11)

Cubic: $\hat{y} = b_0 + b_1 x + b_{11} x^2 + b_{111} x^3$ (12)

Semi-Parametric Methods;

Logarithmic: $b_0 + (b_1 Ln\,(t))$ (13)

Power: $b_0 + b_1 x \; or Ln(y) = Ln(b_0) + (b_1 Ln\,(t))$ (14)

Compound: $\hat{y} = b_0 + b_{11}^2 x \; or Ln(y) = Ln(b_0) + (b_1 Ln\,(t))$ (15)

S-curve: $\hat{y} = e^{(b_0 + \frac{b_1}{t})} or\; Ln(\hat{y}) = b_0 + (\frac{b_1}{t})$ (16)

Growth: $\hat{y} = e^{(b_0 + b_1 t)} or\; Ln(\hat{y}) = b_0 + (b_1 t)$ (17)

Exponential: $\hat{y} = b_0 e^{(b_1 t)} or\; Ln(\hat{y}) = Lnb_0 + (b_1 t)$ (18)

$E(y) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_k X_k$ (19)

$E(y) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_k X_k$ enburg 1995, Robinson 1988)

In the study, the data obtained for the purpose of describing the body characteristics of the Hair Goat were utilized within the scope of "Project for the development of subspecies of the Hair Goat race", "Project code: Tagem / Kıl 2013-02", in the enterprises that have registered the Karaman sheep goat breeders association in Karaman province. The body measurements of 130 goat selected by simple random sampling method of 2-7 7 years old females were used in this study and a total of 50 males data selected by simple random sampling method of 2-4 years old were used for goats.

The live weights of the goats and body measurements were taken at the end of the forties in June. Body measurements

Table 1. Results of univariate parametric and semi-parametric regression models

	Methods	Summary Model					Estimation of parameters				
		R^2, %	F	Df1	Df2	p	Constant	b1	b2	b3	
Height at withers	Quadratic	49,8	87,6	2	177	0,001	246,8	-6,4	0,051		$\hat{y}$ = 454,5 - 12,1 x + 0,09x^2
Height at rump	Quadratic	60,4	135,2	2	177	0,001	454,5	-12,1	0,09		$\hat{y}$ = 454,5 - 12,1 x + 0,09x^2
Body length	Linear	54	209	1	178	0,001	-89,88	1,93			$\hat{y}$= -31,78 + 5,001 x
Rump Width	Cubic	31,3	40,2	2	177	0,001	4,79	0	0,22	-0,003	$\hat{y}$ = 37,28 + 0,001 x + 0,028x^2- 0,002x^3
Chest width	Cubic	46,6	76,8	2	177	0,001	37,28	0,001	0,028	0,002	$\hat{y}$ = 37,28 + 0,001X + 0,028x^2- 0,002x^3
Chest depth	Logarithmic	24,9	50	1	178	0,001	-247,5	86,06			$\hat{y}$ = -247,50 + (86,06 * ln(t))
Chest girth	Quadratic	79,8	349,2	2	177	0,001	235,56	-5,48	0,039		$\hat{y}$ = 235,56 - 5,48x + 0,039x^2
Shank Circle	Linear	51,1	186,1	1	178	0,001	-30,6	8,7			$\hat{y}$ = -30,6 + 8,7 x

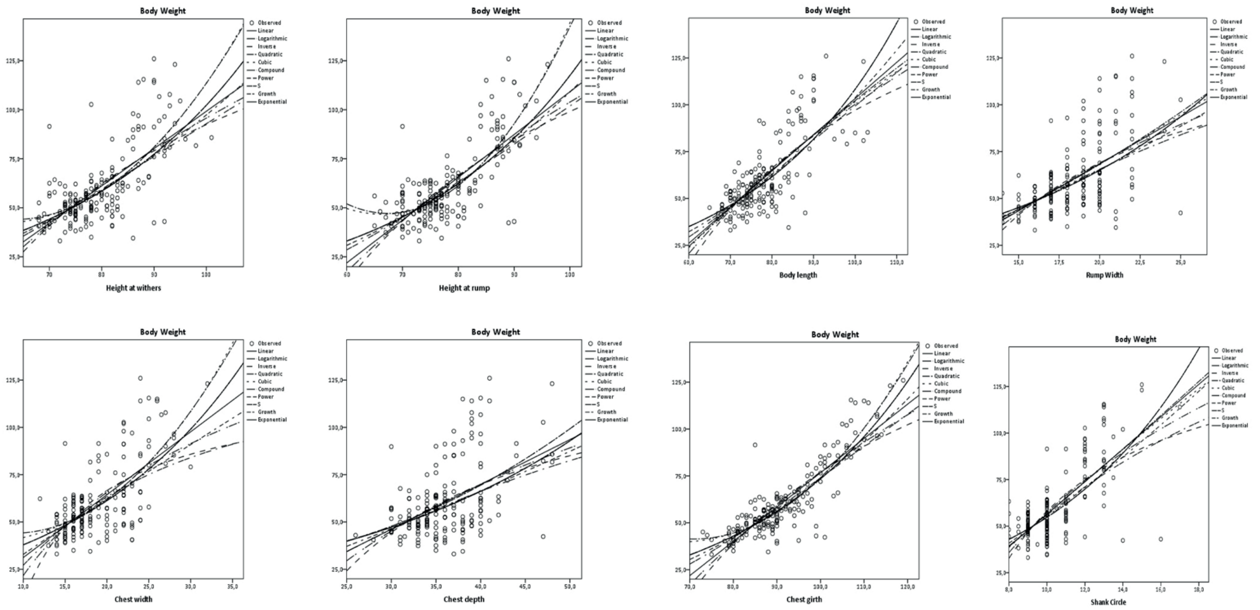

Figure 1. Curve Estimates of Body Weight and Height at Withers, Height at rump, Body length, Rump Width, Chest width, Chest depth, Chest girth, Shank Circle

were made in the cage or on the flat surface of the cave. The body measurements measured by goats in 2012, the measurements made and their anatomical definitions are given below.

Height at withers (HW)
Height at rump (HR)
Body length (BL)
Rump Width (RW)
Chest width (CW)
Chest depth (CD)
Chest girth (CG)
Shank Circle (SC)

Table 2. Relationship between body weight and some body measurements

		Height at withers	Height at rump	Body length	Rump Width	Chest width	Chest depth	Chest girth	Shank Circle
Height at rump	ρr	,831**							
	p	0,001							
Body length	ρr	,759**	,658**						
	p	0,001	0,001						
Rump Width	ρr	,368**	,441**	,380**					
	p	0,001	0,001	0,001					
Chest width	ρr	,491**	,575**	,451**	,421**				
	p	0,001	0,001	0,001	0,001				
Chest depth	ρr	,535**	,347**	,590**	,218**	0,062			
	p	0,001	0,001	0,001	0,003	0,409			
Chest girth	ρr	,645**	,658**	,674**	,557**	,640**	,420**		
	p	0,001	0,001	0,001	0,001	0,001	0,001		
Shank Circle	ρr	,597**	,574**	,562**	,421**	,428**	,446**	,591**	
	p	0,001	0,001	0,001	0,001	0,001	0,001	0,001	
Body Weight	ρr	,623**	,635**	,676**	,514**	,576**	,404**	,791**	,580**
	p	0,001	0,001	0,001	0,001	0,001	0,001	0,001	0,001

The data to be used in the study were randomly selected from the general data with the MINITAB program. Statistical package program Syntax Function SPPS 20 (IBM Corp. Released 2011. IBM SPSS Statistics for Windows, Version 20.0, Armonk, NY: IBM Corp.) was used to evaluate the data. The level of significance is shown as $\alpha = 0,05$.

Results

It is very important to estimate the live weight by taking advantage of body measurements in farm animals. Great cattle predominantly occupies an important place in the prediction. For example, when buying a sacrificial animal, without weighing the animal, measuring the circumference of the chest with a tape measure and the animal's approximate number of kilograms is known, the field is very useful. In addition, it is important for zootechnics to determine the correlation between different body measurements and body weight in livestock and which measures / measurements are more useful with regression method. In this study, eight different body measurements were determined. The relationship between body measurements and body weight was determined.
Estimation of body weight from body measurements was performed with different regression models.

When the estimation equations for univariate methods are examined, Quadratic or Cubic models give higher R^2 value, unlike the use of continuous linear models (Table 1 and Figure 1-8).

Table 2 shows the relationship between body weight and some body measurements. Body weight and Height at withers were 62.3%, Height at rump was 63.5%, Body length was 67.6%, Rump Width 51.4%, Chest width 57.6%, Chest depth 40.4%, 79.1% with chest girth, 58% with Shank Circle; there is a statistically significant increase in one and the other is increasing statistically.

Discussion

Some criteria are relevant to determine which statistics are applicable to the data obtained in this study. Analyzing the research with appropriate statistical methods also improves the reliability of the research and provides a consistent interpretation of the results. For this reason, variable structures, measurement scales, and consistency of assumptions are important considerations in statistical studies.

Using inappropriate regression methods can lead to incorrect and misleading results. The relationship between variables must be examined with functional regression models. The regression model that needs to be used differs according to the structure of the data, and using the wrong model can lead to incorrect results. In this case, it is suggested to establish the most meaningful model suitable for data structure.

Conclusion

In this study, differences in the mean of the best model were observed among the results of the different body regimens included in the model as the univariate independent variable versus the live weight dependent variable, in the different regression models applied. In all body dimensions, all linear and non-linear models were found to give statistically significant results. It has been seen that most of the body measurements give more favorable results in the sense of both R^2 and Cubic models. Only in the chest depth variable the logarithmic model gave the highest R^2 value. It is understood that the Quadratic or Cubic model can be preferred to the Linear model because all variables except this give the equal R^2 value of the body length and chest girth which can be preferred to the Quadratic model.

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