

Development of Tape Measure Model's and Body Weight Estimation Formula Based on Chest Size on Horse

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Abstract. This study aims to test the reliability or accuracy of various types of tape measure and develop models measuring tape and body weight estimation formula based on the size of the heart girth at horse. This research was conducted in Humbang Hasundutan district, North Tapanuli district, Karo district, and Samosir district in May-July 2017. The tape measure used is the measuring tape Agrotech, Animeter and Rondo, then use a formula Schoorl and Smith as a comparison, and using a simple correlation analysis in testing research data.

Estimating body weight in the horse that is closest to using a measuring tape based on the regression formula that has been obtained from this study.

The result showed that the estimation of body weight for horse using measuring tape Agrotech, Animeter and Rondo obtained deviation 13,22% for male horse and 9,21% for female horse. It is concluded that estimation weight closest to horse is using a regression formula, that for male horse $Y = -665,72+6,14X$ with deviation 0,43% and for female horse $Y = -707,97+6,34X$ with deviation 0,28%.

1. Introduction

The horse is known as animal monogastric have quite a lot of benefits to human life. Livestock can be an alternative provider of horse meat and have considerable potential as one of the sources of food that has a very high protein content, working as livestock and could make the event as well as in a race in the community such as horse racing.

The potential of horses is technically not much different from the local horse carcass, where it reaches 125 kg, with organ meats reach 20% of the carcass compared to reach average 156.4 kg. Good meat or offal have potential economic value, because the community in the area of South Sulawesi is known to consume the innards are quite high, with a typical cuisine known as coto. In terms of quality, horse meat has advantages of its own, where the levels of fat just 4.1% compared with to reach the 14.0%, i.e. almost same protein 18.1% while the horse at 18.8%, far higher than the button is only 16.6% with a fat content reaches 9.2% Kadir, S. [1].

In the process of buying and selling horses, when the buyer and seller know the weight of the horse's actual life than selling process will go smoothly. When the scales are not available then the weighted estimation of life that can come close to the actual state of affairs can only be done by people who are already experienced. For those who haven't experienced the only effort that is used is by using a tape measure.

Until now to determine the weight of a life without the scales performed by giving the allegations based on experience. These allegations are often very biased and not many people can do it with the results of that approach. Weighting life estimation with the tape measure produces a very real life weight is higher than the actual weights Suardi [2].

A measuring instrument is said to have high reliability or reliable if the gauge was steady in the sense that the results obtained with the application of the tool does not vary much with the weight of the real life. To find out the extent to which a measurement tool called a steady, then I need to know the index or the coefficient of reliability. The reliability index is lower than 0.9 indicates less reliability means measuring instrument used is still not reliable Natsir, M [3].

The level of reliability of data-collecting tool can only be made with the calculation of the correlation and data for calculation can be obtained from the results of tests on a number of individuals outside the sample but derives from the same population Nawawi, H [4].

A problem often encountered in measuring body weight cattle in large numbers and are usually not died is in need of equipment, manpower and time so that the work be effective and efficient. It's been quite a many types of scales that nature can be brought (portable) however it has not been able to resolve the problem of measurement that is more practical, easily and inexpensively without reducing the effectiveness of his work Takaendengan [5].

2. Materials and Methods

This research was conducted in Humbang Hasundutan district, North Tapanuli district, Karo district, and Samosir district. This study lasts for 2 months starting from May to July 2017.

The material used is portable scales, measuring tape (agrotech, animeter, and rondo), measuring ruler and stationery.

The research method used in this research is a method of chest size measurement directly against the horse by using a tape measure with measurements three times on each tail cattle. There are three types of tape measure being used, a tape measure brand: Rondo from Germany, Animeter and Agrotech from Indonesia.

Observed variables were chest size and weight.

2.1. Chest Size

The chest size is measured using some tape measure (cm) circular on thoracic bone joints behind the shoulder (*os. Scapula*). The way the measurement is carried out following the instructions of FAO (2012).

2.2 Body Weight.

The horse's weight is weighed directly using portable scales.

Data collection by of select and specify the sample horse research (Humbang Hasundutan district = 77 horses, North Tapanuli district = 52 horses, Karo district = 60 horses, Samosir district = 42 horses), prepare a tape measure with a length of at least 250 cm, setting up portable scales with a capacity of 1.5 tons and setting up a data book to record the results of the measurement of the chest size. Then write down any data obtained from observation to the data.

Data analysis

2.1.1 Chest size measurement data using a tape measure will then be tested with body weight estimation formula, *Schoorl* and *Smith* with the following formula :

$$\text{Formula School} = \frac{(\text{LD (cm)} + 22)^2}{100} \quad \text{Formula Smith} = \frac{(\text{LD (cm)} + 18)^2}{100}$$

Description: LD = chest size

2.1.2 When tested with the estimation formula of weighted data, the next body measurements chest size and length using a tape measure, compared with measured body weight data instantly using portable scales, thus obtained raw byway of some type of tape measure. The most reliable measuring tape is a tape measure that most approaches the junction from the actual body weight.

2.1.3 Tape measure the most approaching from the actual body weight will then be transformed into a linear regression equation model, namely:

$$Y = a + bx$$

Description:

Y = Variable response (body weight)

a = Constant

b = regression Coefficient x = Variable predictor variable or factor (chest size)

3. Results and discussion

3.1. Body weight estimation based on the formula of Schrool, Smith and tape measure

Table 1. Mean body weight of male horse in Humbang Hasundutan district, Karo district, North Tapanuli district, Samosir district based on Weighing Body Weight, Estimation of Body Weight with Measuring Tape, Schrool, Smith and Regression Formula

District	Weighing Body Weight (BBT)	Formula Estimation	Body Weight Formula (BBR)	Deviation (BBT-BBR)	
				Kg	%
Humbang Hasundutan (46 horses)	250,65 ± 21,68	Schoorl	293,87 ± 15,59	-43,22	17,24
		Smith	280,33 ± 15,22	-29,68	11,84
		Tape	284,65 ± 36,33	-34,00	13,56
		Regression	250,65 ± 4,14	3,03	1,20
North Tapanuli (23 horses)	355,91 ± 48,22	Schoorl	345,11 ± 27,90	10,80	3,03
		Smith	330,20 ± 27,30	25,71	7,22
		Tape	404,21 ± 53,56	-48,30	13,57
		Regression	355,91 ± 6,13	4,61	1,29
Karo (22 horses)	363,81 ± 38,79	Schoorl	355,62 ± 18,93	8,19	2,25
		Smith	342,65 ± 18,53	21,16	5,81
		Tape	408,22 ± 38,31	-44,41	12,20
		Regression	363,81 ± 7,09	7,01	1,92
Samosir (19 horses)	240,31 ± 15,06	Schoorl	287,43 ± 7,00	-47,12	19,60
		Smith	274,03 ± 6,84	-43,72	14,03
		Tape	272,44 ± 17,13	-32,13	13,37
		Regression	240,31 ± 6,38	8,57	3,56

Table 2. Mean body weight of female horse in Humbang Hasundutan district, Karo district, North Tapanuli district, Samosir district based on Weighing Body Weight, Estimation of Body Weight with Measuring Tape, Schrool, Smith and Regression Formula

District	Weighing Body Weight (BBT)	Formula Estimation	Body Weight Formula (BBR)	Deviation (BBT-BBR)	
				Kg	%
Humbang Hasundutan (31 horses)	225,70 ± 15,06	Schoorl	287,08 ± 8,27	-61,38	27,19
		Smith	272,69 ± 8,07	-46,99	20,81
		Tape	257,32 ± 11,39	-31,62	14,00
		Regression	225,70 ± 5,42	5,55	2,45
North Tapanuli (29 horses)	324,79 ± 71,73	Schoorl	343,40 ± 40,86	-18,61	5,72
		Smith	338,76 ± 39,98	-13,97	4,30
		Tape	355,06 ± 72,58	-30,27	9,31
		Regression	324,79 ± 6,50	1,56	0,48
Karo (38 horses)	357,34 ± 39,90	Schoorl	361,47 ± 25,53	4,13	1,15
		Smith	343,85 ± 25,00	13,49	3,77
		Tape	380,78 ± 47,38	-23,44	6,55
		Regression	357,34 ± 5,65	3,20	0,89
		Schoorl	279,98 ± 9,23	-64,42	29,88

Samosir (23 horses)	215,56 ± 11,63	Smith Tape Regression	266,75 ± 9,01 251,08 ± 9,83 215,56 ± 3,78	-51,19 -35,52 4,08	23,74 16,47 1,89
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The mean body weight estimation on a horse in the Humbang Hasundutan district, North Tapanuli district, Karo district, Samosir district result is that most approaches are to use the regression equations formulas that are the average body weight actually or by using the scales. From the results of research data obtained in mind that the value of the percentage deviation of the body weight estimation using the formula Schrool and Smith on a horse in the Humbang Hasundutan district and Samosir district has value and deviation over 10% while on a horse in North Tapanuli district and Karo district has the value deviation below 10%.

3.2. Body weight estimation based on tape measure

Body weight estimation based on a tape measure from the third tape measure used in livestock body weight have suspected the same results. The third tape measure, tape measure Agrotech, Animeter and Rondo.

Body weight estimation male horse in Humbang Hasundutan district by using a tape measure, Animeter Agrotech and Rondo retrieved body weights of 284.65 ± 36.33 kg, while the weight of the body of the male horse in Humbang Hasundutan district based on weights the Agency weigh retrieved 250.65 ± 21.68 kg. The value of the deviation is obtained based on the difference in the weight of body weight and body weight estimation using a tape measure -34.00 kg with percentage deviations of 13.56%. Body weight estimation female horse in Humbang Hasundutan district by using a tape measure, Animeter Agrotech and Rondo retrieved body weights of 257.32 ± 11.39 kg, while the weight of the body of the female horse in Humbang Hasundutan district based on body weight gained 15.06 $225.70 \pm$ kg. The value of the deviation is obtained based on the difference in the weight of body weight and body weight estimation using a tape measure -31.62 kg with percentage deviations of 14.00%.

Body weight estimation male horse in North Tapanuli district by using a tape measure, Animeter Agrotech and Rondo retrieved body weights of 404.21 ± 53.56 kg, while the weight of the body of the male horse in North Tapanuli district based on body weights weigh retrieved 355.91 ± 48.22 kg. The value of the deviation is obtained based on the difference in the weight of body weight and body weight estimation using a tape measure -48.30 kg with the percentage deviation of 13.57%. While body weight estimation female horse in North Tapanuli district by using a tape measure, Animeter Agrotech and Rondo retrieved body weights of 355.06 ± 72.58 kilograms body weight, where as female horse in North Tapanuli district based on weights the Agency weigh retrieved 324.79 ± 71.73 kg. The value of the deviation is obtained based on the difference in the weight of body weight and body weight estimation using a tape measure -30.27 kg with percentage deviations of 9.31%.

Body weight estimation male horse in Karo district by using the tape measure, Animeter Agrotech and Rondo retrieved body weights of 408.22 ± 38.31 kg, while the weight of the body of the male horse in Karo district based on the weight of body weighs retrieved 363.81 ± 38.79 kg. The value of the deviation is obtained based on the difference in the weight of body weight and body weight estimation using a tape measure -44.41 kg with percentage deviations of 12.20%. While body weight estimation female horse in Karo district by using the tape measure Agrotech, Animeter and Rondo retrieved body weights of 380.78 ± 47.38 kg, while the weight of the body of the female horse in in the Karo district based on weight of body weigh retrieved 357.34 ± 39.90 kg. The value of the deviation is obtained based on the difference in the weight of body weight and body weight estimation using a tape measure -23.44 kg with the percentage deviation of 6.55%.

Body weight estimation male horse in Samosir district by using a tape measure, Animeter Agrotech and Rondo retrieved body weights of 272.44 ± 17.13 kg, while the weight of the body of male horse in Samosir district based on body weights weigh retrieved 15.06 $240.31 \pm$ kg. The value of the deviation is obtained based on the difference in the weight of body weight and body weight estimation using a tape measure -32.13 kg with the percentage deviation of 13.37%. While body weight estimation female horse in Samosir district by using a tape measure, Animeter Agrotech and Rondo retrieved body weights of 251.08 ± 9.83 kg, while the weight of the body of the female horse in Samosir district based on body weights weigh retrieved 215.56 $11.63 \pm$ kg. The value of the deviation is obtained based on the difference in the weight of body weight and body weight estimation using a tape measure -35.52 kg with percentage deviations of 16.47%.

The results showed that the largest deviation value male horse in North Tapanuli district was 13.57% and female horse in Samosir district was 16.47% and the smallest deviation was male horse in Karo district was 12.20% and female horse in Karo district that is 6.55%. Based on the research, the measuring tape cannot be used in estimating the body weight of male and female horses.

After measurement with three measuring bands (Agrotech, Animeter and Rondo) on the chest size of male and female horses, the mean body weight obtained in Table 7

Table 3. Mean body weight of Male and Female Horse Body based on Weighing Body Weight, Estimation of Body Weight with Measuring Tape, and Schoorl, Smith and Regression Formula

Gender	Weighing Body Weight (BBT)	Formula Estimation	Body Weight Formula (BBR)	Deviation (BBT-BBR)	
				Kg	%
Male horse (110 horses)	293,50 ± 63,86	Schoorl	318,31 ± 36,74	- 24,81	8,45
		Smith	304,22 ± 35,93	-10,72	3,65
		Tape	332,31 ± 72,70	-38,81	13,22
		Regression	293,50 ± 6,14	1,26	0,43
Female horse (121 horses)	288,86 ± 75,03	Schoorl	321,76 ± 42,62	- 32,90	11,38
		Smith	307,60 ± 41,69	-18,74	6,48
		Tape	318,33 ± 73,22	-29,47	10,20
		Regression	288,86 ± 6,34	0,82	0,28

The results of body weight estimation based on Schoorl and Smith formula and Agrotech, Animeter and Rondo measuring tape have differences with actual horse body weight, because the mean deviation obtained in estimating body weight is more than 5% except for deviations obtained in estimating body weight based on the Schoorl and Smith formula on male horses below 5%.

3.3. Correlation analysis and linear regression chest size and body weight

Table 4. Corelation of chest size with body weight horses

District	Variabel	Male		Female	
		Equality	R	Equality	R
Humbang	LD(X)	Y = -392,02 + 4,30 X	0,821	Y = -573,68 + 5,42X	0,767
Hasundutan					
North Tapanuli	LD(X)	Y = -664,41+ 6,13X	0,894	Y = -735,72+6,50X	0,985
Karo	LD(X)	Y = -821,88 +7,09X	0,837	Y = -587,95+5,64X	0,896
Samosir	LD(X)	Y = -701,40+6,38X	0,766	Y = -334,79+3,78X	0,804

Table5. Analysis, Correlation and Simple Linear Regression of Chest Size and Body Weight Horse

Variabel	Male		Female	
	Equality	R	Equality	R
LD(X)	Y = -665,72+6,14X	0,957	Y = -707,97+6,34X	0,980

Regression formula to estimate the weight of a male horse is $Y = -665.72 + 6.14X$ with a deviation value of 0.43% and to estimate the body weight of a female horse that is $Y = -707.97 + 6.34X$ with a deviation value of 0,28%

4. Conclusions

Agrotech, Animeter and Rondo measuring tape is not accurate to predict horse body weight, but Schroll and Smith formulas can predict horse body weight in North Tapanuli and Karo district while in horse in Humbang Hasundutan and Samosir districts are not accurate. Estimating body weight in the horse that is closest to using a measuring tape based on the regression formula that has been obtained from this study. Regression formula to estimate the weight of a male horse is $Y = -665.72 + 6.14X$ with a deviation value of 0.43% and to estimate the body weight of a female horse that is $Y = -707.97 + 6.34X$ with a deviation value of 0,28%

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