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Regression analysis estimation of stature from foot length

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Abstract

Objective: To study the correlation between stature and footprint.

Method: Measurement data of 174 cases of 17–22 year old boys in the Chinese college for statistical analysis the regression equation of the stature and footprint. Based on the experimental data of this paper, we used the statistical methods to measure the regression equation of the stature and footprint.

Result: Using the statistical analysis method, established the left footprint the right footprint and the mean footprint regression equation of stature.

Conclusion: Using the Chinese traditional formula about the stature and footprint with our sample data, the calculation results become smaller because of the improvement of living standards. In this specific population, the error of the regression equation proposed in this paper is small, which can be used in practice. The study of this paper provides data accumulation to the footprint theory.

Keywords: Footprint; Stature; Regression equation

1. Introduction

The body structure of human body is formed by natural evolution for a long time, and there is a certain proportion relationship between the various parts of the body. In the crime scene investigation, the field investigators need to use the footprint to analyze the stature. In theory book about footprint and related research, there are plenty of empirical equations and regression equations about footprint and height in China and all over the world (Agnihotri, Purwar, Googoolye, Agnihotri, & Jeebun, 2007; Dhaneria, Shrivastava, Mathur, & Goyal, 2016; Kanchan, Menezes, Moudgil, Kaur, & Garg, 2008; Kim, Kim, & Yun, 2018; Krishan, Kanchan, & Sharma, 2012; Krishan, 2008; Ozden, Balci, Demirüstü, Turgut, & Ertugrul, 2005; Reel, Rouse, Wesley Vernon, & Doherty, 2012; Sen and Ghosh, 2008; Zeybek, Ergur, & Demiroglu, 2008).

With the improvement of the people's living standards, the physique of the people is also developing and changing (Limin & Jianping, 2014; Hongpai et al., 2012; Meng et al., 2012; Youzhong et al., 1986; Jingjing & Weijiang, 2010). Some empirical equation and the regression equation do not reflect the correlation between the footprint and stature. By measuring the data of footprint and stature of 174 male students between 17 and 22 years old in the Chinese college, the correlation between footprint and stature was analyzed by regression analysis (Ashokkumar, Arunkumar, & Don, 2018; Elhoseny et al., 2018; Hussein et al., 2018; Sarvaghad-Moghaddam et al., 2018; Tharwat et al., 2018; Vardhana, Arunkumar, Abdulhay, & Ramirez-Gonzalez, 2018).

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2. Experimental design

2.1. Sampling

The samples selected were 174 male students from the 2015 to 2017 sessions of a Chinese college, and they extracted their age, stature and left and right footprint.

2.2. Measurement of stature

Use the meter to measure the stature of each of the students, the measurement accuracy is 0.1 cm.

2.3. Stamp the footprint

The students put their barefoot in the black ink box with normal pressure, and then on the white paper, the normal pressure, to get a footprint.

2.4. Measurement of footprint

Draw a straight line between the second toe and heel center of footprint. A vertical line from the front edge of the longest toe to the straight line, gets a point from the straight line. The length of the footprint is measured by measuring the distance between the point and the most prominent point of the heel. The length of the left and right foot was measured respectively (Limin & Jianping, 2014). Measuring with a ruler, the accuracy is 0.1 cm.

3. Experimental data analysis

3.1. Basic statistics

Measurement of 174 male students, The measurement contents are: age, stature, left footprint, right footprint and mean footprint t (see Table 1). The average age is 19.51 years, the largest is 22, and the minimum is 17 (see Fig. 1). The average stature is 177.647 cm, of which the highest is 193 cm, and the lowest is 169 cm (see Fig. 2). The histogram of left footprint, right footprint and mean footprint see Figs. 3–5.

3.2. Data statistics on the difference between the left footprint and the right footprint

By comparison of the measured data, it is found that the left footprint and the right footprint are not equal in length. The distribution histogram is obtained by using the left footprint to reduce the right footprint (see Fig. 6). The maximum value is 1 cm, the minimum value is −1.2 cm, and the average value is −0.008 cm.

3.3. The correlation between stature and left footprint, right footprint and mean footprint

The correlation coefficient can reflect the intensity of the linear correlation between the two variables. Pearson correlation analysis was used to analyze the correlation data between the stature and the left footprint, the right f footprint and the mean footprint of the sample data (see Table 2). The statistical results showed that there was a significant correlation between stature and left footprint, right footprint and mean footprint. The stature and the right foot are the most significant.

3.4. The SPSS software was used to analyze the data, and the linear regression equations of stature and left footprint, stature and right footprint, stature and mean footprint were obtained respectively

(1) Linear regression equation of stature and left footprint
The SPSS software was used to analyze the measured stature and left footprint, and the linear regression equation of stature and footprint was obtained. $Y = 2.386 * X + 118.173$ (Y is stature, X is left footprint). The position of the linear regression equation on simple scatter plot and the range of 95% letter are shown in Fig. 7.

(2) Linear regression equation of stature and right f footprint
The SPSS software was used to analyze the measured stature and right footprint, and the linear regression equation of stature and right footprint was obtained. $Y = 2.526 * X + 114.645$ (Y is stature, X is left footprint). The position of the linear regression equation on simple scatter plot and the range of 95% letter are shown in Fig. 8.

(3) Linear regression equation of stature and mean footprint
The SPSS software was used to analyze the measured stature and mean footprint, and the linear regression equation of stature and mean footprint was obtained. $Y = 2.574 * X + 113.476$ (Y is stature, X is mean footprint). The position of the linear regression equa-

Table 1
Sample statistics.

	Number	Range	Minimum	Maximum	Mean	Standard deviation
Age	174	5	17	22	19.51	1.007
Stature (cm)	174	24.0	169.0	193.0	177.647	4.8100
Left footprint (cm)L	174	5.4	21.8	27.2	24.929	.9260
Right footprint (cm)	174	4.9	22.5	27.4	24.937	.9226
Mean footprint (cm)	174	5.15	22.15	27.30	24.9328	.90288