Height and Handedness in Athletes:

Does TRU Stack Up?

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Introduction:

It is generally believed that height is an important factor in athletic success, in particular, height has been linked to success in volleyball. Although, height often varies within the sport from position to position. Anthropometric measurements have shown significant differences between basketball and volleyball players; however, both sports tend to have taller athletes than other sports (Peña *et al.* 2016).

Soccer players tend to be significantly shorter than volleyball players. Their height distribution is more similar to that of the general population. However, the height of soccer players may vary from country to country (Popovic *et al.* 2014).

Soccer players also tend to be shorter than basketball players. When height is considered, the weights of these athletes are comparable (Popovic *et al.* 2013).

Handedness is also thought to have a significant role in sport. Globally, about 90% of people are right handed. This leaves about 10% of people left handed, and less than 1% ambidextrous. The handedness of an individual is not entirely due to chance, as it can be determined genetically (Ruth 2016).

Generally, it is believed left-handed athletes have an advantage in sport because of their rarity. Athletes tend to have difficulty predicting their actions due to unfamiliarity. Research has shown that left handed athletes are more successful than right handed athletes in several sports (Loffing *et al.* 2015).

In our experiment, we examine the differences between handedness and heights in athletes of the different Usport teams at Thompson Rivers University, these are men's volleyball (MVB), men's basketball (MBB), men's soccer (MSOC), women's volleyball (WVB), women's basketball (WBB), and women's soccer (WSOC). This research could be used to determine which athletes would excel at different sports at an elite level. We tested the prediction that the TRU Usport teams have different heights from each other and all Usport athletes have a different proportion of handedness than the general population.

Methods:

Data Collection:

To obtain the data forms were created for each of the TRU Usport teams. These forms were distributed and collected with the help of TRU's athletic therapist, Kevin Brechin. The forms included the sport played by the team, and a table with several columns. These columns were labeled height of athlete, dominant hand of athlete, and athlete number.

Data Analysis:

To analyze the data statistical tests were performed in Minitab 18. Four different tests were used to analyze the data.

One-way ANOVA tests were used to test differences in height in women's and men's Usport teams. Before ANOVA analysis was performed, the data was tested for normality using Ryan-Joiner tests and the equality of variances were tested using Bartlett's tests. The Ryan-Joiner test was chosen because none of the samples are larger than n = 30.

A Chi square goodness of fit test was used to test the proportions of TRU Usport athletes' handedness. This is discrete nominal data; therefore, a Chi square goodness of fit test was appropriate.

Results:

The average heights of men's Usport teams at TRU are 6.358 +/- 0.2914 feet, 6.347 +/- 0.2369 feet, and 5.996 +/- 0.1898 feet for MVB, MBB, and MSOC respectively. The average heights of women's Usport teams at TRU are 5.939 +/- 0.1898 feet, 5.702 +/- 0.1971 feet, and 5.488 +/- 0.1705 feet for WVB, WBB, and WSOC respectively.

Ryan-Joiner tests showed that each sample of athlete heights are distributed normally. MVB had a R-J value of 0.978 with a p value greater than 0.100. MBB had a R-J value of 0.993 with a p value greater than 0.100. MSOC had a R-J value of 0.967 and a p value of 0.063. WVB had a R-J value of 0.995 with a p value greater than 0.100. WBB had a R-J value of 0.959 and a p value greater than 0.100. Lastly, WSOC had a R-J value of 0.985 and a p value greater than 0.100.

Next, the equality of variance between the men's and women's sports were tested with Bartlett's tests. The variances of height in men's sports were found to be equal as well as the variances of women's sports. The Bartlett's test for men's' sports has a test statistic of 0.56 with a p value of 0.756. The Bartlett's test for women's sports has a test statistic of 0.36 and a p value of 0.834.

Figure 1 shows the results of the one-way ANOVA test performed comparing male athlete heights. There is difference in the height of men's Usport teams at TRU. The F value is 13.64 with a p value of 0.000. MSOC players are clearly shorter than MVB and MBB players, however, MBB and MVB players appear to have similar heights.

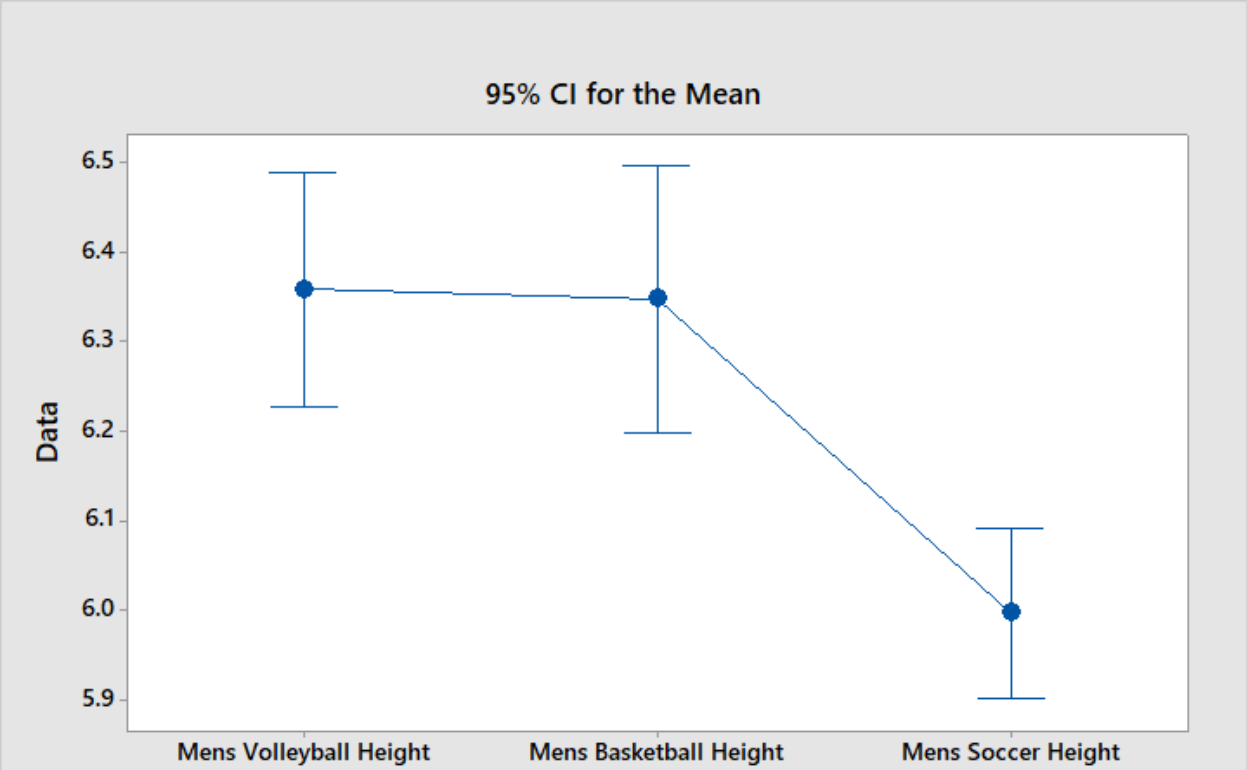


Figure 1. Interval Plot of MVB height, MBB height, MSOC height

Figure 2 shows the results of the ANOVA test performed comparing female athlete heights. There is difference in the height of women's Usport teams at TRU. The F value is 27.80 with a p value

of 0.000. All teams appear to be very different from each other with WVB players being the tallest and WSOC players being the shortest.

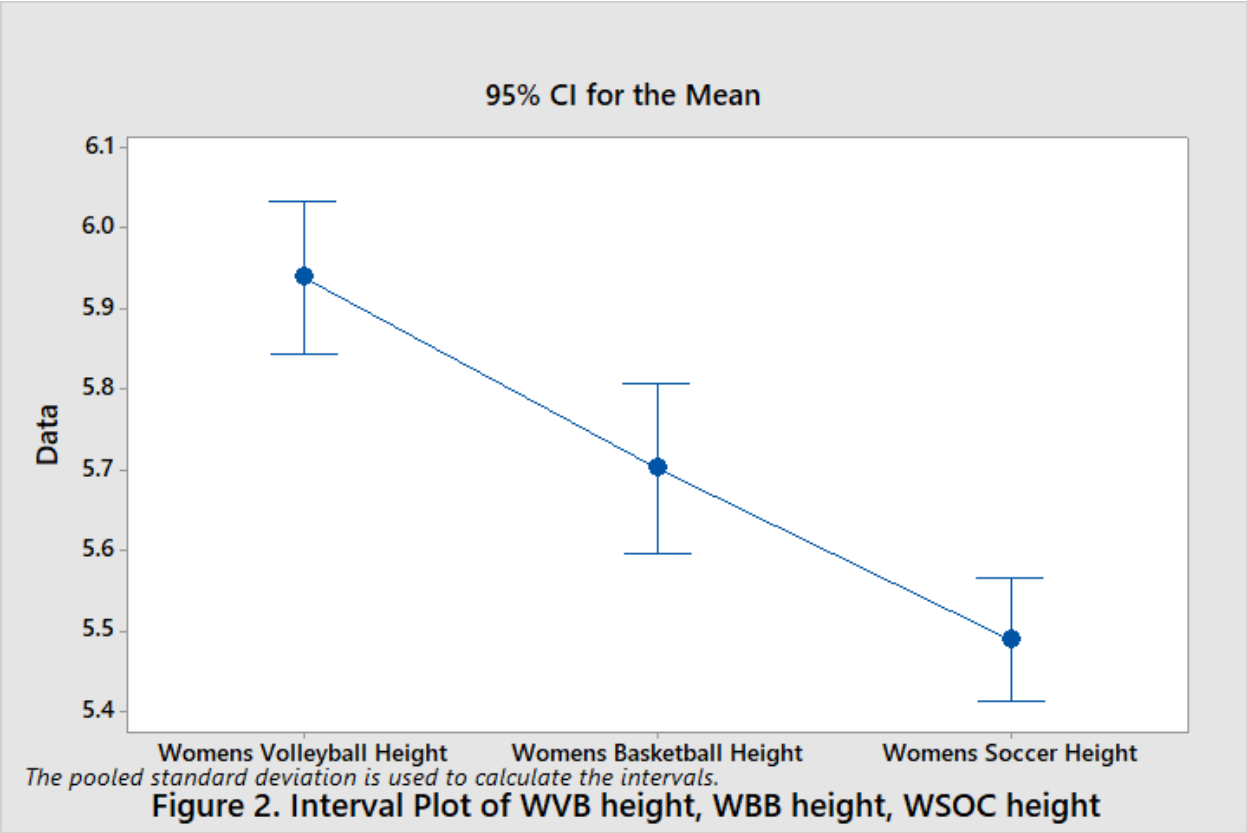


Figure 2. Interval Plot of WVB height, WBB height, WSOC height

The proportion of handedness in TRU athletes is the same as the general population. The Chi squared calculated value is 0.003968* (table 1). This is much smaller than the Chi squared critical value of 3.841. The p value for our test is 0.950. This is much bigger than the desired p value of 0.05. There is a 0.40 percent chance of making a type 1 error. Taking this into consideration the Ho is not rejected, and we can say that it seems likely that the sample of athletes differs from the general population.

Table 1. Chi square goodness of fit test for handedness proportion in TRU Usport athletes

N	DF	Chi-Sq	P-Value
112	**1**	**0.0039683**	**0.950**

Discussion:

The main finding of this study is that TRU Usport male athletes of different sports do not all have the same average heights (p=0.000) and female athletes of different sports do not have the same average heights (p= 0.000). We also were able to determine that the proportion of handedness of the Usport athletes at TRU are not significantly different than those of the general population (p=0.950). Our result of the difference in athlete height is supported by literature, however, the result the athlete handedness is no different than the general population is not supported.

It is thought that height is important in sports such as volleyball because most players on a team are involved in high-reaching actions (Peña *et al.* 2016).

Popovic *et al.* (2014) describe height as being advantageous in volleyball because much of the gameplay occurs above players' heads, with taller players having a better ability to control these high actions. They also state that even the shortest of elite volleyball players are usually taller than the average population.

In a different study, Popovic *et al.* (2013) compared measurements of elite soccer and basketball players. They found significant differences in height between the two groups. Although, the body mass index between the groups was similar enough that there was no discernible difference. Popovic and colleagues (2013) concluded the difference in height between soccer and basketball players can be explained from the different rules and styles of play of the games. The selection of the athletes from these sports may be largely dependent on height (Popovic *et al.* 2013).

Loffing *et al.* (2015) tested the success of athletes against left handed opponents. They found that both right handed and left-handed athletes were more successful as their exposure to left handed opponents increased. This confirmed that the success of left handed athletes is at least in part due to their rarity. They found the rarity of left-handed athletes to be increased in volleyball. Their sample of male volleyball players were 5.45% left-handed and in their sample of female volleyball players only 2.41% were left-handed. Our samples however, showed no difference in proportion from the general population.

Our study was limited to the Usport teams at TRU, this meant the sample sizes were relatively small, therefore we cannot properly generalize our findings to a larger population. We also rely on athletes knowing their exact height, so, there could be some error in the reporting of these values.

In summary, the heights of Usport athletes at TRU not the same, and, the proportions of handedness of TRU Usport athletes are the same as the general population. To further this study a pair-wise comparison such as a Tukey's test could be used to determine where the difference lies in Usport athletes. It would also be useful for future studies to examine more variables in athletes of different sports.

Literature Cited

Loffing F, Hagemann N, Schorer J, Baker J. 2015. Skilled players' and novices' difficulty anticipating left- vs. right-handed opponents' action intentions varies across different points in time. Human Movement Science. 40: 410-421.

Peña J, Moreno-Doutres D, Coma J, Cook M, Buscà B. 2016. Anthropometric and fitness profile of high-level basketball, handball and volleyball players. Rev. Andaluza Med. del Deport. doi:https://doi.org/10.1016/j.ramd.2016.03.002.

Popovic S, Akpinar S, Jaksic D, Matic R, Bjelica D. 2013. Comparative study of anthropometric measurement and body composition between elite Soccer and basketball Players. International Journal of Morphology, 31(2): 461-467.

Popovic S, Bjelica D, Jaksic D, Hadzic R. 2014. Comparative study of anthropometric measurement and body composition between elite soccer and volleyball players. International Journal of Morphology, 32(1), 267-274.

Ruth M. (2016). Handedness. Salem Press Encyclopedia.

Appendix A:

Team forms

TEAM_____

NUMBER	GENDER	HEIGHT	DOMINANT HAND

Appendix B:

Raw Data

Table 2. Height and handedness of men's usport teams at TRU

MVB Height (cm)	MVB Hand	MBB Height (cm)	MBB Hand	MSOC Height (cm)	MSOC Hand
6.17	R	6.42	L	6.17	L
5.92	R	6.33	L	6.25	L
6.67	R	6.08	R	6.25	L
6.58	R	6	R	5.67	L
6.33	R	6.33	R	6	R
6.5	L	6.42	R	5.67	R
6.5	R	6.42	R	6.17	R
6.5	R	6	R	5.83	R
6.17	R	6.67	R	6.17	R
6.33	R	6.67	R	6.25	R
6.33	R	6.67	R	5.83	R
5.92	R	6.33	R	6	R
6.58	R	6.17	R	5.83	R
5.75	L			6.08	R
6.83	R			6.17	R
6.58	R			6.17	R
6.42	R			5.92	R
				6.08	R
				5.17	R
				6.25	R
				6.17	R
				5.67	R
				5.92	R
				6	R
				6.33	R
				5.58	R
				5.67	R
				5.92	R
				6.17	R
				6.42	R
				5.83	R
				6.25	R

Table 3. Height and handedness of women's usport teams at TRU

WVB Height (cm)	WVB Hand	WBB Height (cm)	WBB Hand	WSOC Height (cm)	WSOC Hand
6.17	R	5.75	R	5.83	L
5.83	L	5.58	R	5.58	R
5.83	R	6.17	R	5.33	R
5.92	R	5.83	R	5.58	R
5.67	R	5.67	R	5.33	R
5.67	R	5.92	R	5.42	R
6.33	R	5.67	R	5.42	R
6.17	R	5.58	R	5.33	R
6	R	5.42	R	5.58	R
5.92	R	5.67	L	5.25	R
6.08	R	5.58	R	5.83	R
6	R	5.58	R	5.5	R
5.83	R			5.33	R
5.75	R			5.25	R
5.92	R			5.42	R
				5.58	R
				5.58	R
				5.42	R
				5.75	R
				5.5	R
				5.33	R
				5.67	R
				5.42	R

Normality Tests for data on male usport athletes at TRU (R-J tests of normality)

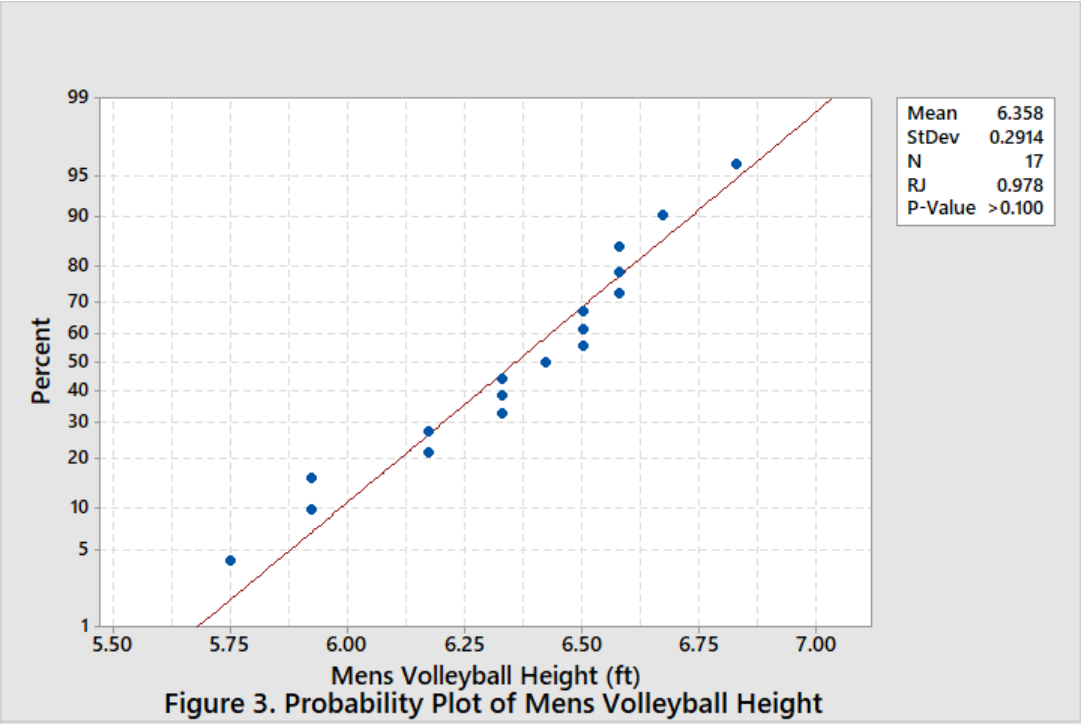


Figure 3. Probability Plot of Mens Volleyball Height

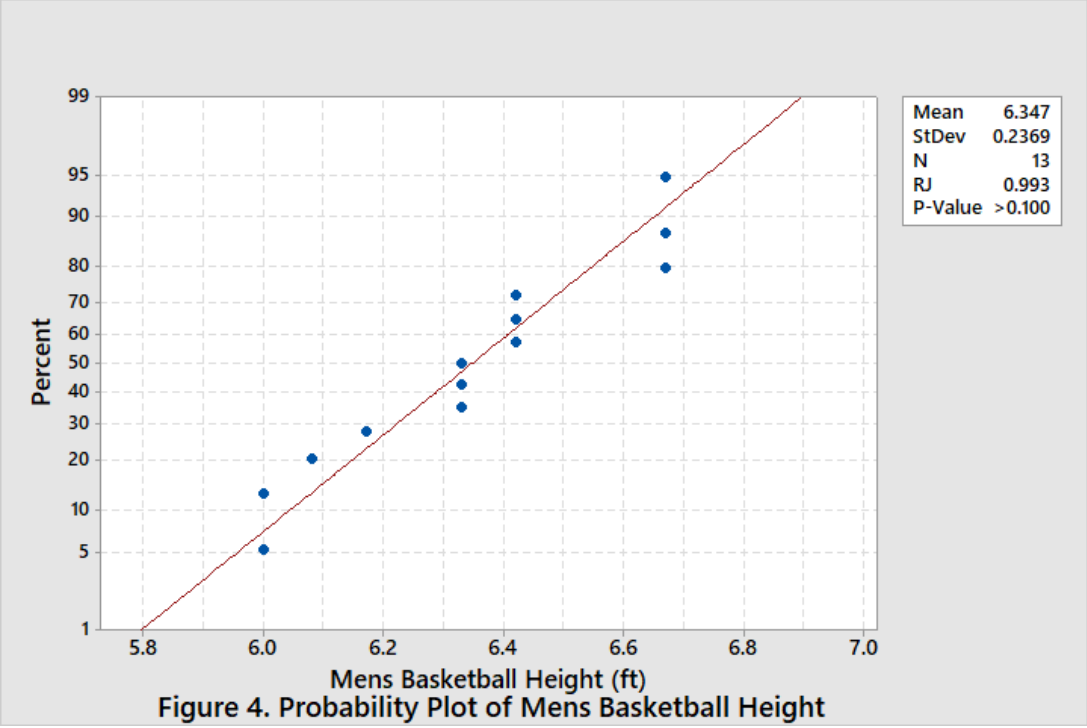


Figure 4. Probability Plot of Mens Basketball Height

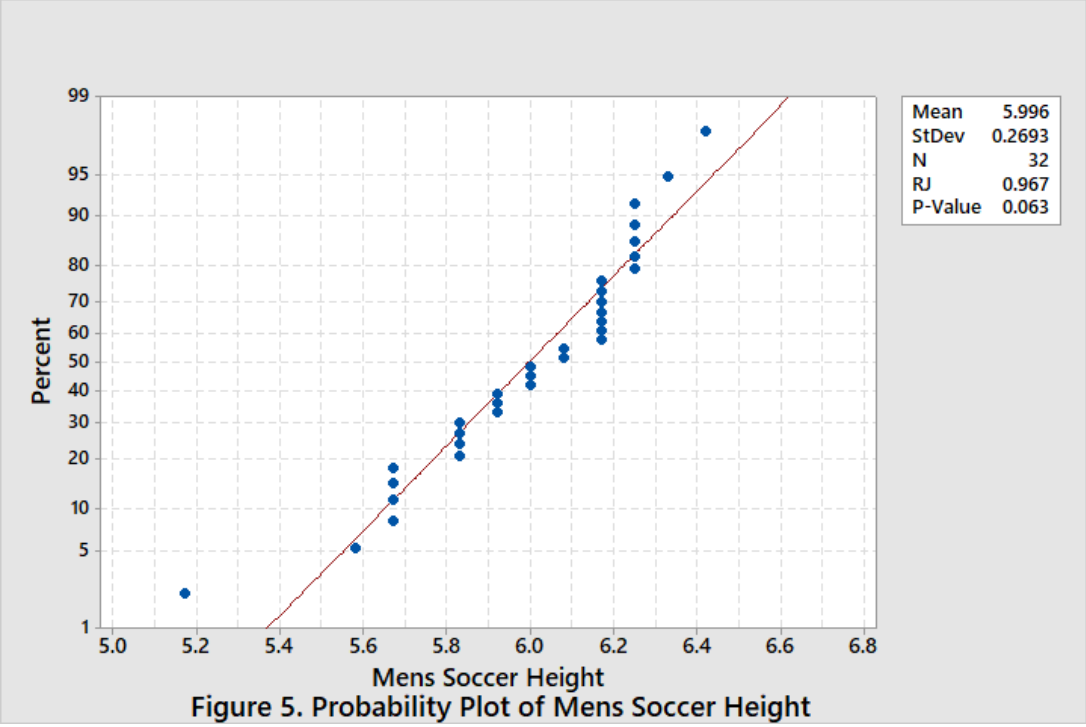


Figure 5. Probability Plot of Mens Soccer Height

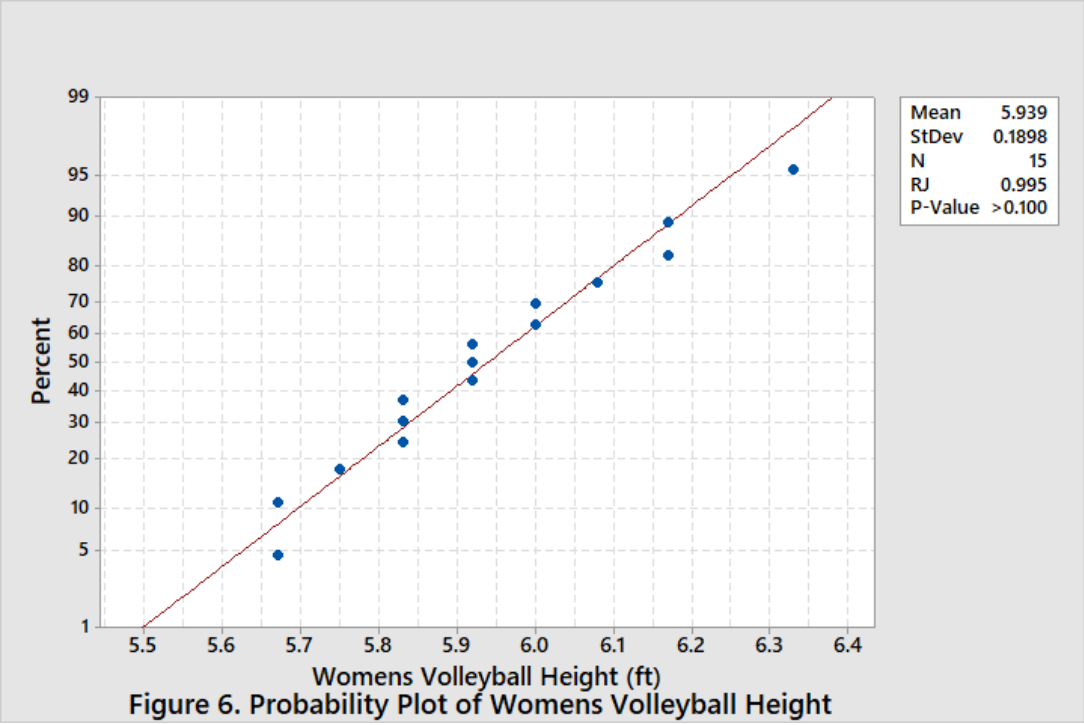


Figure 6. Probability Plot of Womens Volleyball Height

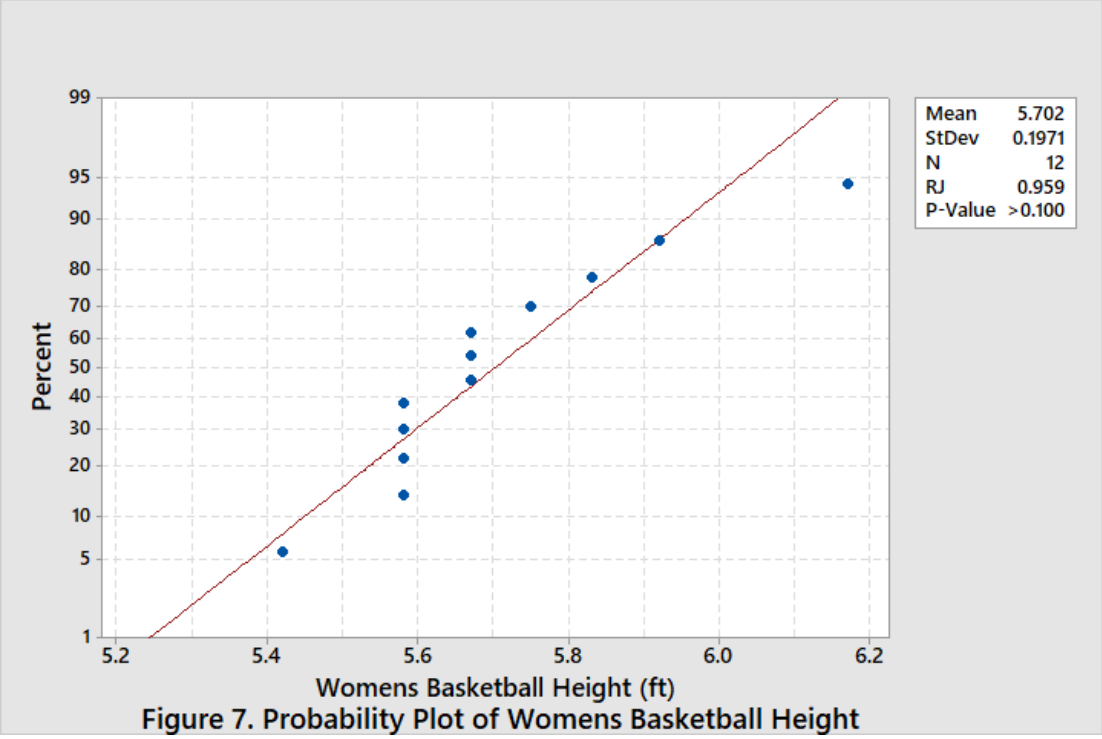


Figure 7. Probability Plot of Womens Basketball Height

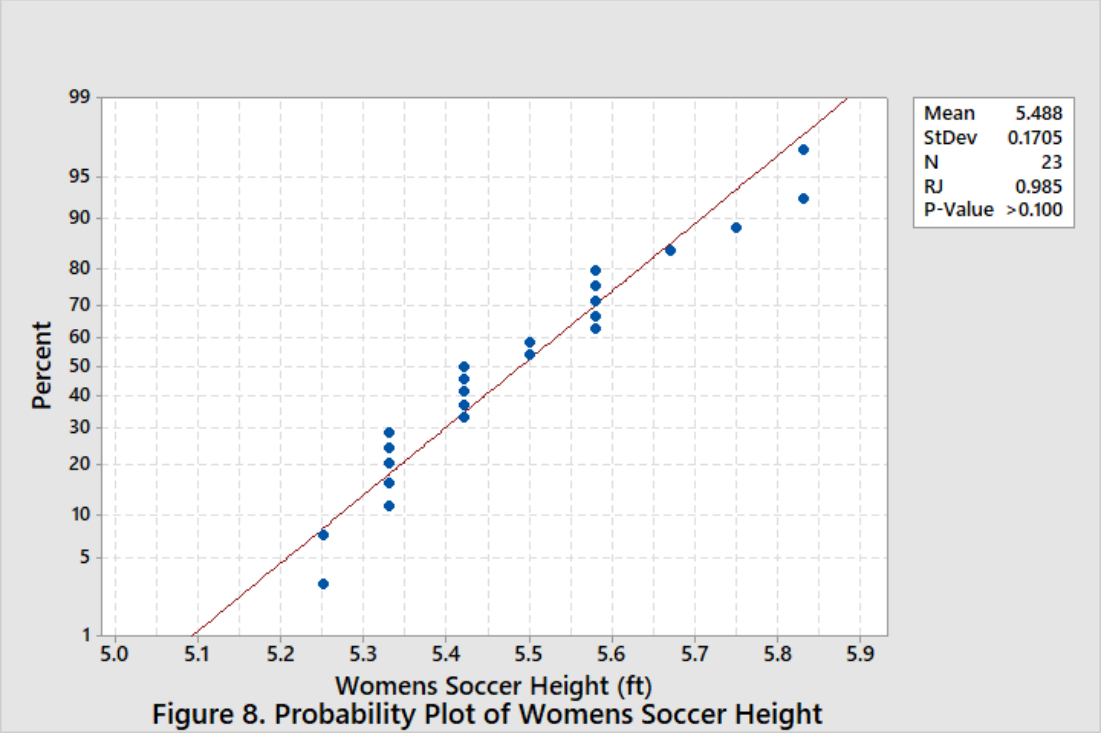


Figure 8. Probability Plot of Womens Soccer Height

Test for equal variances (Bartlett's Test)

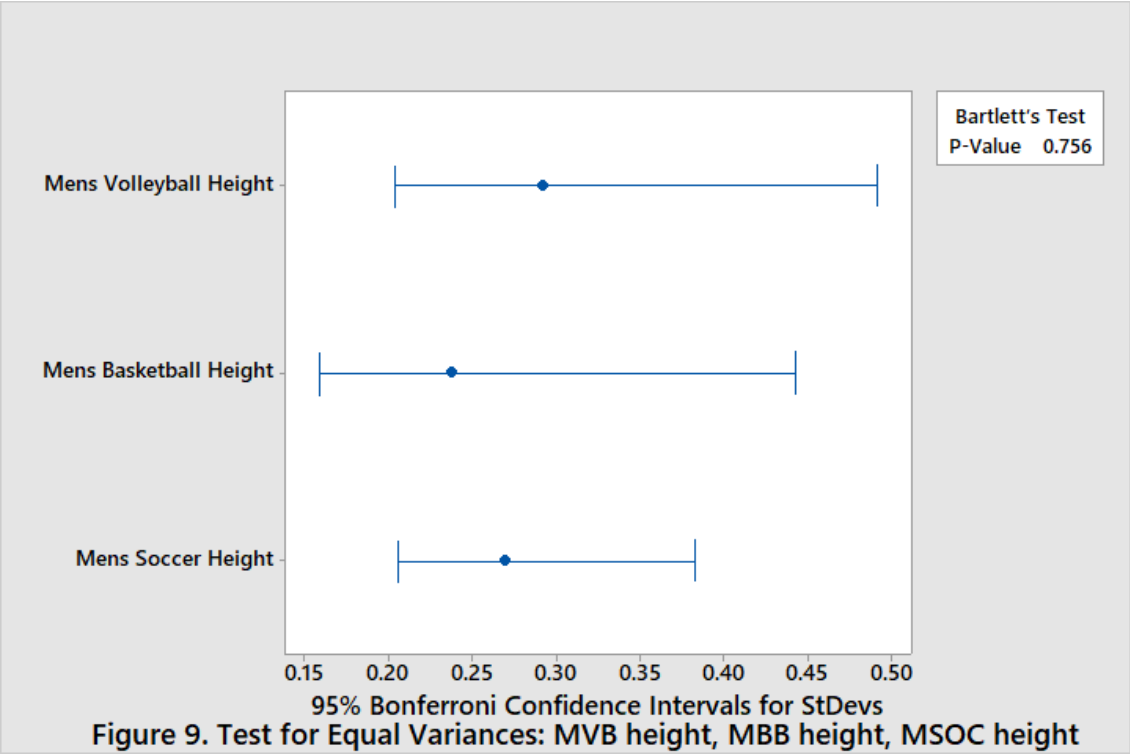


Figure 9. Test for Equal Variances: MVB height, MBB height, MSOC height

Table 4. Test for Equal Variances: MVB height, MBB height, MSOC height

Method			
Null hypothesis	**All variances are equal**		
Alternative hypothesis	**At least one variance is different**		
Significance level	**α = 0.05**		
Bartlett's method is used. This method is accurate for normal data only.			
95% Bonferroni Confidence Intervals for Standard Deviations			
Sample	**N**	**StDev**	**CI**
Mens Volleyball Height	**17**	**0.291409**	**(0.204137, 0.491490)**
Mens Basketball Height	**13**	**0.236868**	**(0.158584, 0.443018)**
Mens Soccer Height	**32**	**0.269287**	**(0.206057, 0.383009)**
Individual confidence level = 98.3333%			

Tests

Method	**Test Statistic**	**P-Value**
Bartlett	**0.56**	**0.756**

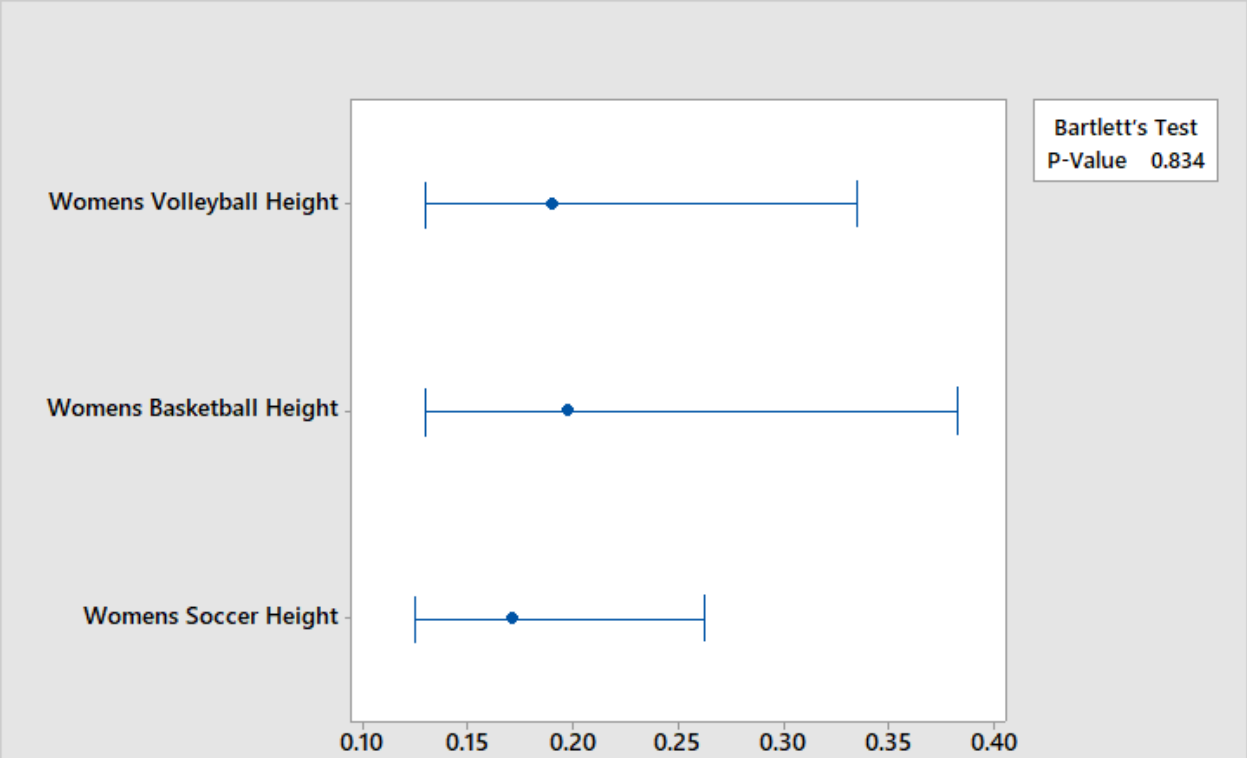


Figure 10. Test for Equal Variances: WVB height, WBB height, WSOC height

Table 5. Test for Equal Variances: WVB height, WBB height, WSOC height

Method

Null hypothesis	**All variances are equal**
Alternative hypothesis	**At least one variance is different**
Significance level	**α = 0.05**

Bartlett's method is used. This method is accurate for normal data only.

95% Bonferroni Confidence Intervals for Standard Deviations

Sample	**N**	**StDev**	**CI**
Womens Volleyball Height	**15**	**0.189754**	**(0.130232, 0.334847)**
Womens Basketball Height	**12**	**0.197108**	**(0.130057, 0.382168)**
Womens Soccer Height	**23**	**0.170498**	**(0.124955, 0.262344)**

Individual confidence level = 98.3333%

Tests

Method	**Test Statistic**	**P-Value**
Bartlett	**0.36**	**0.834**

ANOVA tests

Table 6. Analysis of Variance of heights of mens usport teams at TRU

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Factor	2	1.978	0.98920	13.64	0.000
Error		59	4.280	0.07254	
Total		61	6.258		

There is a difference in height in men's usport athletes at tru (p=0.000) (table 6).

Table 7. Analysis of Variance of height in women's usport athletes

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Factor	2	1.859	0.9293327.80		0.000
Error	47	1.571	0.03343		
Total	49	3.430			

There is a difference in height of women's usport athletes at TRU (p=0.000) (table 7).

Testing Hand Proportions in TRU usport athletes (Chi square goodness of fit test)

Table 8. Chi-Square Goodness-of-Fit Test for Observed Counts of right and left-handed athletes

Using category names in Hand

Observed and Expected Counts

Category	Observed	Historical Counts	Test Proportion	Expected	Contribution to Chi-Square
R	101	0.9	0.9	100.8	0.0003968
L	11	0.1	0.1	11.2	0.0035714

Chi-Square Test

N	DF	Chi-Sq	P-Value
112	1	0.0039683	0.950

Athletes at TRU show the same proportions of handedness as the general population(p=0.950) (table 8).