

### Male and Female Height and Foot Size

For this statistics project I decided to perform an observational study of foot sizes and heights for males and females. In order to gather my data for this project I used a convenience sampling method by asking students and professors at MiraCosta for their foot size and height. This may mean that there is sampling error, and does not reflect the true population, but in order to perform certain test for my project I will pretend the data was gathered from a simple random sample. Also, there may have been non-sampling error when I was gathering data, because I asked males and females for their height and foot size and they may have reported incorrect data if they did not know their true height and foot size. I decided to stratify males and females into subgroups before gathering the data, so that I can compare genders later on.

I gathered thirty three quantitative data values for each sex. Here are the measures of center, standard deviations, and coefficients of variation for both males and females.

<b>Male Height (Inches)</b>	<b>Male Foot Size</b>	<b>Female Height (Inches)</b>	<b>Female Foot Sizes</b>
$\bar{x} = 70.4 \text{ in}$	$\bar{x} = 10.6$	$\bar{x} = 64.2 \text{ in}$	$\bar{x} = 7.3$
$\tilde{x} = 70.0 \text{ in}$	$\tilde{x} = 11.0$	$\tilde{x} = 65.0 \text{ in}$	$\tilde{x} = 7.5$
<i>Midrange = 70.5</i>	<i>Midrange = 10.5</i>	<i>Midrange = 64.5 in</i>	<i>Midrange = 7.0</i>
$s=2.73$	$s=1.33$	$s=2.44$	$s=1.36$
$CV=3.88\%$	$CV=12.55\%$	$CV=3.80\%$	$CV=18.63\%$
$n=33$	$n=33$	$n=33$	$n=33$

Looking at the different coefficients of variations the results show that there is more variation in foot sizes than in heights. This is expected, because some men will have feet much longer than other men however it is rare to see one man twice as tall as another man. The same thing is said of women who have an even larger variation in feet sizes than males.

I am now going to compare men and women using a few hypothesis tests at the 0.05 significance level, for these test I will assume a simple random sample was used and not

convenience sampling. The first is to test the claim that the mean height of males is greater than the mean height of females. Requirements: population standard deviations not known and not assumed to be equal, the two samples are independent, both samples are simple random samples, and both samples are greater than thirty.

$$H_0: \mu_1 = \mu_2 \quad H_1: \mu_1 > \mu_2 \quad t = \frac{(\bar{x}_1 - \bar{x}_2) - (\mu_1 - \mu_2)}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$$

$$\bar{x}_1 = 70.4 \quad \bar{x}_2 = 64.3 \quad n_1 = 33 \quad n_2 = 33 \quad s_1 = 2.73 \quad s_2 = 2.44$$

$$t = \frac{(70.4 - 64.2) - 0}{\sqrt{\frac{2.73^2}{33} + \frac{2.44^2}{33}}} \quad t = 9.66 \quad \text{reject if greater than 1.694}$$

Reject the  $H_0$ , there is sufficient evidence to support the claim that the mean height of males is greater than the mean height of females.

Now if I perform the same hypothesis test for feet sizes here are the results. Using a 0.05 significance level I am going to test the claim that the mean foot size of males is greater than the mean foot size of females.

$$H_0: \mu_1 = \mu_2 \quad H_1: \mu_1 > \mu_2 \quad t = \frac{(\bar{x}_1 - \bar{x}_2) - (\mu_1 - \mu_2)}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$$

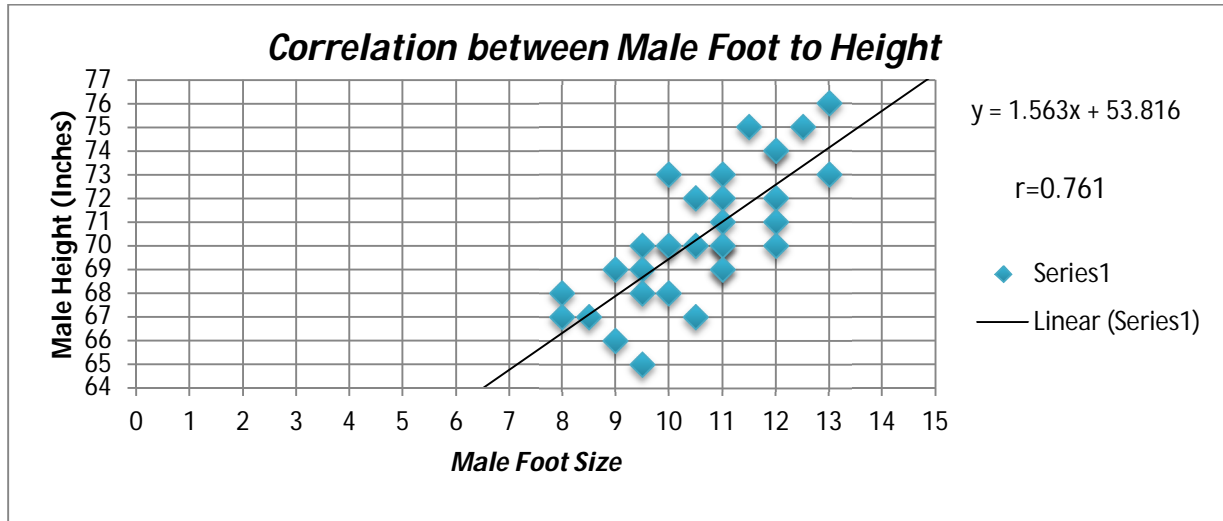
$$\bar{x}_1 = 10.6 \quad \bar{x}_2 = 7.3 \quad n_1 = 33 \quad n_2 = 33 \quad s_1 = 1.33 \quad s_2 = 1.36$$

$$t = \frac{(10.6 - 7.3) - 0}{\sqrt{\frac{1.33^2}{33} + \frac{1.36^2}{33}}} \quad t = 9.929 \quad \text{reject if greater than 1.694}$$

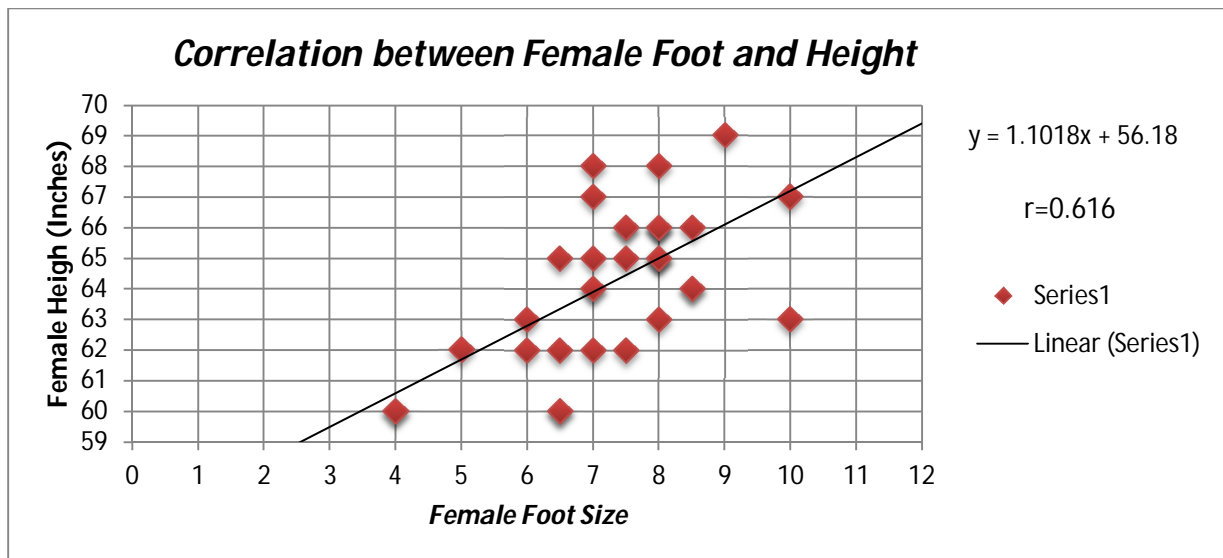
Reject the  $H_0$ , there is sufficient evidence to support the claim that the mean foot size of males is greater than the mean foot size of females.

Based on the results I gathered from the two hypothesis tests there is evidence to suggest that both the mean foot size of men and mean height of men are larger than that of

women. Now I would like to determine if there is sufficient evidence of linear correlation between a male's height and his foot size and then perform the same test for a linear correlation between a women's heights and her foot size (both at the 5% level).



The critical value necessary for there to be a linear correlation is 0.361 and the value of the linear correlation was 0.761 which is greater than 0.361, so we conclude that there is enough evidence to support a linear correlation between male foot size and height.



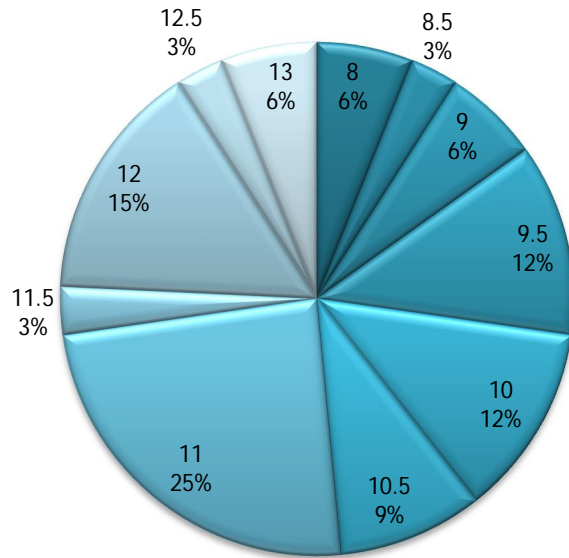
The female critical value for linear correlation is the same, and because the  $r$  value is 0.616 which is greater than 0.361 we conclude that there is sufficient evidence to support the claim of a linear correlation between female foot size and female height.

Based on my observational study there are multiple conclusions that can be made. Keeping in mind that the sampling method was not a simple random sample, the data would not normally be accepted for either a hypothesis test or a test for linear correlation. The first conclusion is that my data shows males appear to have a larger mean value in both foot size and height. Women appear to have more variation in their foot size than men do. Secondly, there is a linear correlation between people's feet and their height. However, these results could be highly biased from both the sampling and non-sampling error. One way I could have improved my study would have been to gather data using a simple random sample. The non-sampling error of recording the quantitative data based off of someone's answer could have been avoided by taking a person's height myself using a tape measure and by gathering foot sizes using a foot measuring device called the Brannock Device.

Summarizing the project I was able to use a few different techniques for analyzing quantitative data. I was able to conduct an observational study that shows how relevant statistics can be in my everyday life. I think that most people just assume that the taller a person is, the larger their feet should be. In this situation the data does support the idea of a linear correlation between foot size and height, along with supporting that males have larger feet and are taller than females. However, statistics alone can never be used to determine causality.

Male	Male Foot Size	Male Height (Inches)	Female	Female Foot Size	Female Height (Inches)
1	13	73	1	8	68
2	12	71	2	9	69
3	10	68	3	10	63
4	8.5	67	4	7.5	66
5	12	72	5	5	62
6	12.5	75	6	4	60
7	9	66	7	7	68
8	9	69	8	7.5	65
9	12	70	9	8.5	66
10	9.5	68	10	7	67
11	11	69	11	7	65
12	11	69	12	6.5	60
13	11	70	13	8	65
14	11	70	14	8.5	64
15	8	68	15	6.5	62
16	11	73	16	7.5	66
17	10	70	17	7	64
18	12	74	18	8	65
19	8	67	19	8	65
20	10	70	20	6	62
21	11.5	75	21	7	64
22	10	73	22	6	63
23	9.5	69	23	8	63
24	9.5	70	24	8	66
25	11	72	25	7.5	62
26	10.5	70	26	6.5	60
27	9.5	65	27	8	66
28	13	76	28	10	67
29	10.5	72	29	6.5	65
30	12	74	30	4	60
31	11	70	31	8.5	64
32	11	71	32	8	66
33	10.5	67	33	7	62

### Male Foot Size



### Female Foot Size

