Height and Body Proportions of Different Ethnicities

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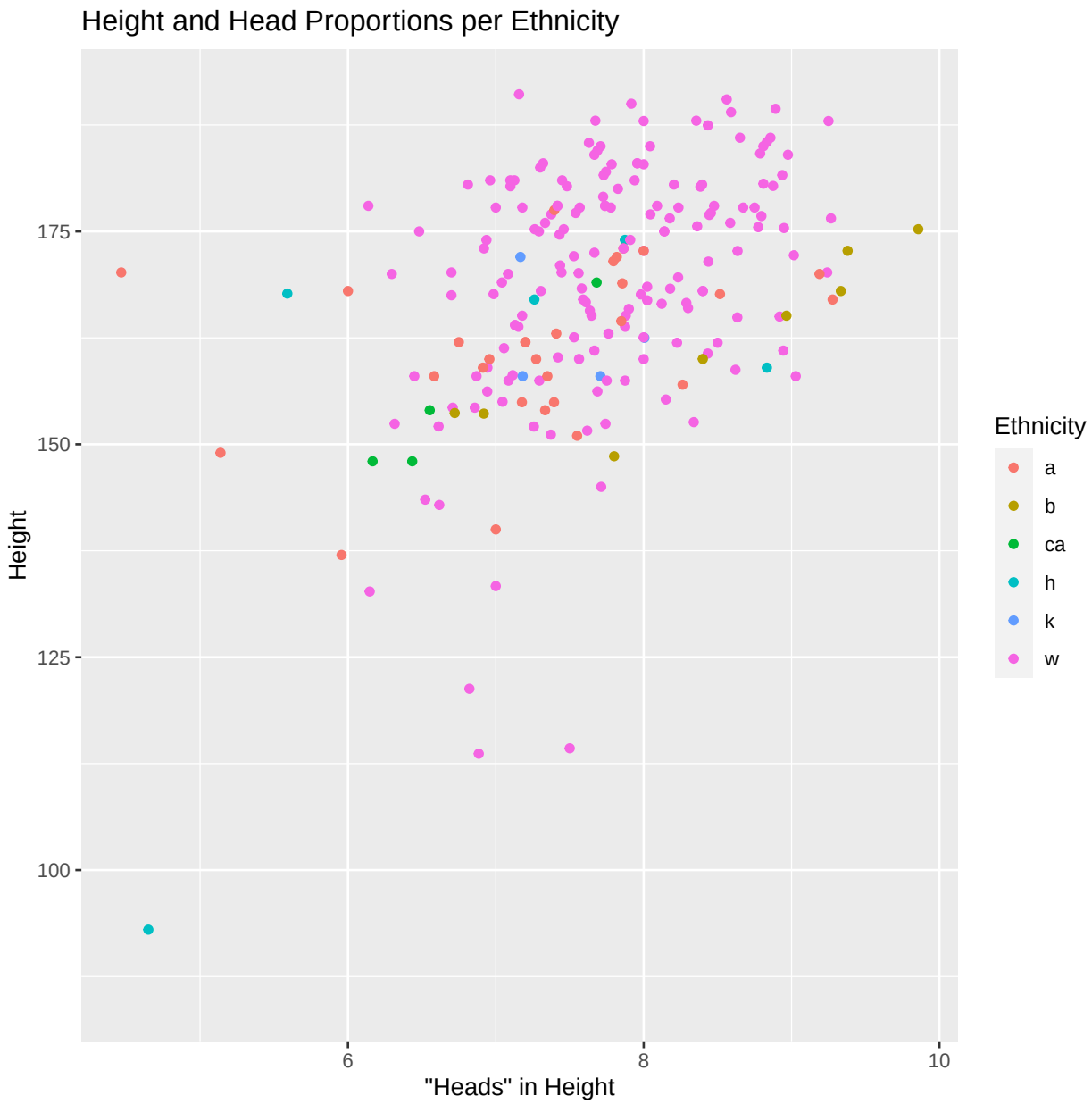
In this article we compare the body measurements of 251 people from various ethnic backgrounds. We specifically hypothesized that whites are typically taller than

Keywords: multiple comparisons to control; body measurements; body proportions; IQR; descriptive statistics; correlation analysis;

November 11, 2020

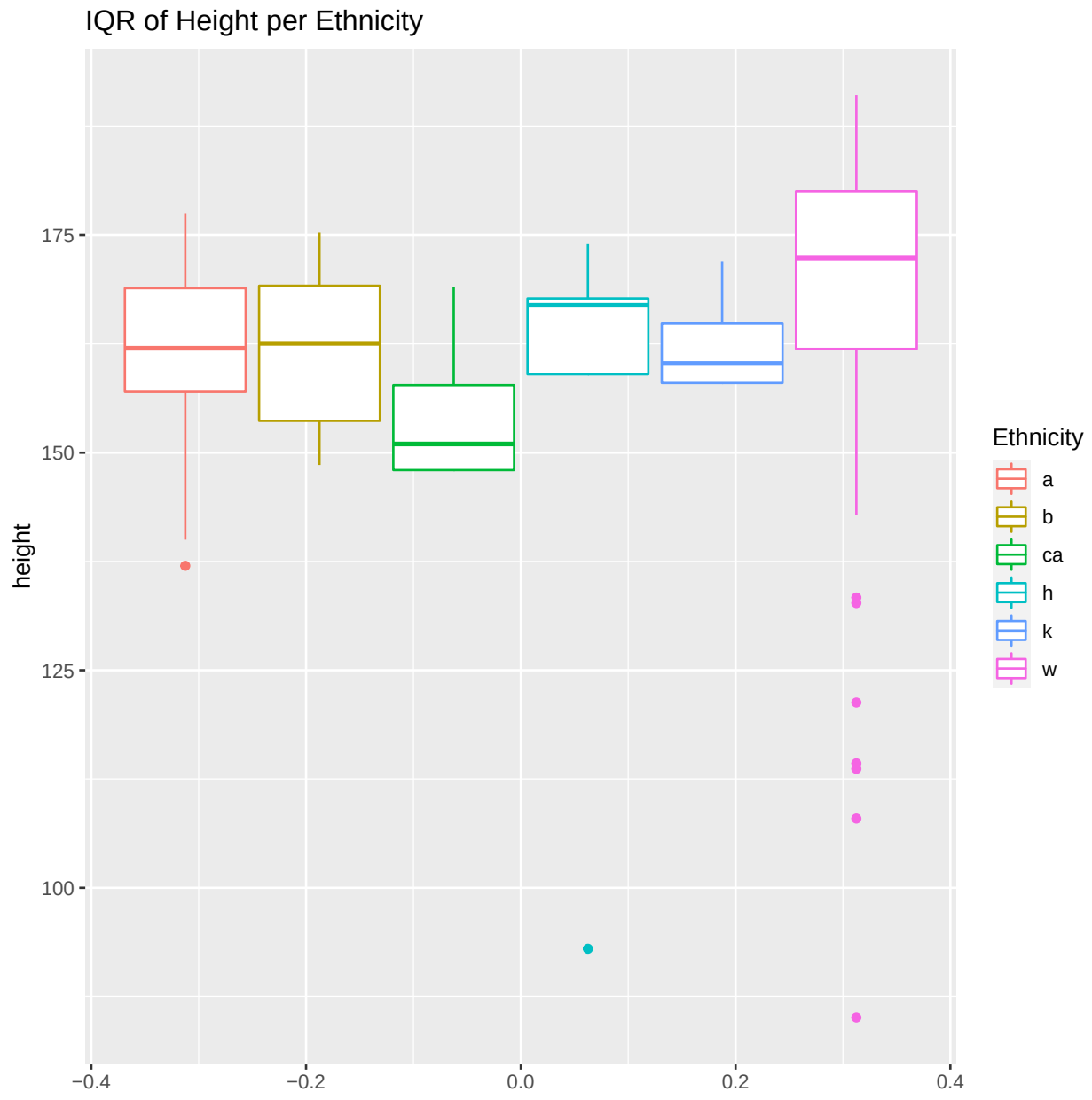
1 Introduction

Figure 1: Comparision of Height and Head Proportions per Ethnicity



a = Asian, b = African American, ca = Caucasion/Asian, h = Hispanic, k = Korean, w = White

Figure 2: IQR of Height per Ethnicity



2 Research Question: Do certain ethnicities have specific body proportions?

2.1 Are white, caucasion, and anglo ethnicities generally taller than asian, chinese, japanese, and korean ethnicities?

2.2 Are white, caucasion, and anglo ethnicities generally shorter than hispanic, latin american, and asian latino ethnicities?

3 Data Description

3.1 Summary Statistics of Data

Table 1: Descriptive Statistics and Correlation Analysis

		M	SD	1	2	3	4	5	6	7	8
1	**Height (cm)**	167.3	15.24	1							
2	**Head Height (cm)**	22.2	2.69	.30***	1						
3	**Navel to Floor (cm)**	101.6	12.33	.76***	.33***	1					
4	**Armpit to Elbow (cm)**	26.7	6.47	.39***	.06	.29***	1				
5	**Kneepit to Floor (cm)**	45.2	5.24	.70***	.27***	.58***	.32***	1			
6	**Hip to Floor (cm)**	95.3	9.51	.71***	.21**	.80***	.27***	.54***	1		
7	**Armpit to Floor (cm)**	131.3	11.90	.88***	.27***	.72***	.37***	.63***	.77***	1	
8	**Torso Height (cm)**	50.5	9.61	.65***	-.10	.40***	.26***	.38***	-.04	.43***	1
9	**"Heads" in Height**	7.6	.87	.43***	-.71***	.19**	.22***	.21**	.28***	.34***	.56***

Notes: Pearson pairwise correlations are reported;
a two-side test was performed to report correlation significance.

$^{\dagger}p < .10$ $^{*}p < .05$ $^{**}p < .01$ $^{***}p < .001$

Figure 3: Handout Page 1

Project Measure

Thank you for participating in Connor StarrHurst's data collection for Project Measure. This data will be used for Stats 419 Project 1, Measure. The purpose of this project is to learn about data collection and exploratory multivariate data analysis.

Your participation is completely voluntary and your data can be voided at any time. If you do choose to participate, please try and fill in all fields (ancestry is optional). Your name and your associated data will be made anonymous immediately after collection. Additionally, please keep track of how long it takes you to complete this handout in minutes and round measurements to the nearest half or full unit.

First name: ____ Units your measurements will be in (preferably cm): ____
First letter of last name: ____ Time (minutes) it took to complete this handout: ____

Dominant hand for writing	Dominant eye	Eye color	Dominant hand for swinging	Age	Gender identity	Ethnicity	Ancestry (Optional)

For each of the below measurements, please stand up straight, do not wear shoes or hats, and stretch all the way out. This ensures that the results are accurate and the type of measurement is consistent between participants. Some measurements may be made easier with another person and is recommended if possible.

Description	Measurement Name	Your Measurement
Standing height from floor to top of head	Height	
Height from top of head to below chin	Head height	
Distance around head, measured right above ears/eyes	Head circumference	
Length of hand from end of middle finger to bottom of wrist (horizontal line below palm)	Left hand length	
	Right hand length	
Width of hand from end of pinkie finger to end of thumb	Left hand width	
	Right hand width	
Length of forearm from end of middle finger to pit of elbow	Left forearm	
	Right forearm	
Length from pit of elbow to back of arm pit	Left upper arm	
	Right upper arm	
Standing flatfooted, put your arm straight up and measure the distance from end of middle finger to floor	Left hand to floor	
	Right hand to floor	
Distance between ends of middle fingers while arms are out like a plane	Wing/arm span	
Length of foot from end of big toe (hallux) to back of heel	Left foot	
	Right foot	
Distance from floor to knee pit	Left shin	
	Right shin	
Distance from floor to point of hip bone	Left hip to floor	
	Right hip to floor	
Distance from floor to bottom of belly button	Navel to floor	
Distance from floor to back of arm pit	Left armpit to floor	
	Right armpit to floor	

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6.2 Coding the Report

6.2.1 Preparing the Data

Below is the necessary functions and libraries required to run the code referenced in this document.

```
library(devtools); # required for source_url

path.humanVerseWSU = "https://raw.githubusercontent.com/MonteShaffer/humanVerseWSU/"
source_url( paste0(path.humanVerseWSU,"master/misc/functions-project-measure.R") );
```

Below is the code to load the data and prepare it for analysis.

```
path.to.project = "C:/Users/Connor/.ssh/stats419/project-measure/";
path.to.secret =
  "C:/Users/Connor/Documents/1) WSU 2018-/Fall 2020/Stat 419/Project 1 Measure/";
path.to.tables = paste0(path.to.project,"tables/");
  createDirRecursive(path.to.tables);

measure = utils::read.csv( paste0(path.to.secret, "cm.final.measure.txt"), header=TRUE,
                           quote="", sep="|");

path.github = "https://raw.githubusercontent.com/youknowwwho/stats419/";
source_url( paste0(path.github,"master/Functions/functions-project-measure.R") );

set.seed(11906189);

measure.df = prepareMeasureData(measure);

summary(measure.df);
```

```
##  data_collector      person_id             height        head.height
##  Length:251         Length:251         Min.   : 85.09   Min.   :15.24
##  Class :character   Class :character   1st Qu.:160.00   1st Qu.:20.50
##  Mode  :character   Mode  :character   Median :168.40   Median :22.00
##                                        Mean   :167.25   Mean   :22.24
##                                        3rd Qu.:177.80   3rd Qu.:23.50
##                                        Max.   :191.10   Max.   :38.10
##                                        NA's   :9        NA's   :9
##  head.circumference    arm.span      floor.navel       units
##  Min.   :21.50      Min.   : 61.5   Min.   : 49.0   Length:251
##  1st Qu.:55.00      1st Qu.:158.9   1st Qu.: 95.0   Class :character
##  Median :56.58      Median :168.9   Median :101.0   Mode  :character
##  Mean   :56.08      Mean   :167.4   Mean   :101.6
##  3rd Qu.:58.42      3rd Qu.:179.0   3rd Qu.:107.0
##  Max.   :64.10      Max.   :224.0   Max.   :151.1
##  NA's   :19         NA's   :8       NA's   :50
##    writing              eye              eye.color           swinging
##  Length:251         Length:251         Length:251         Length:251
##  Class :character   Class :character   Class :character   Class :character
##  Mode  :character   Mode  :character   Mode  :character   Mode  :character
##
##
##
##
##       age            gender             quality          minutes
##  Min.   : 1.00   Length:251         Min.   : 5.000   Min.   : 2.00
##  1st Qu.:22.00   Class :character   1st Qu.: 8.000   1st Qu.:10.00
##  Median :27.00   Mode  :character   Median : 9.000   Median :15.00
##  Mean   :34.69                      Mean   : 8.616   Mean   :15.96
```

```
##  3rd Qu.:50.00                      3rd Qu.:10.000   3rd Qu.:20.00
##  Max.   :94.00                      Max.   :10.000   Max.   :45.00
##                                                      NA's   :21
##   ethnicity            notes            hand.length       hand.width
##  Length:251         Length:251         Min.   :  9.00   Min.   : 7.00
##  Class :character   Class :character   1st Qu.: 17.00   1st Qu.:18.48
##  Mode  :character   Mode  :character   Median : 18.00   Median :20.00
##                                        Mean   : 19.64   Mean   :19.69
##                                        3rd Qu.: 19.50   3rd Qu.:21.59
##                                        Max.   :223.20   Max.   :26.50
##                                        NA's   :13       NA's   :23
##    hand.elbow    elbow.armpit     arm.reach      foot.length    floor.kneepit
##  Min.   :23.0   Min.   :10.00   Min.   : 38.0   Min.   :13.50   Min.   :23.00
##  1st Qu.:40.0   1st Qu.:23.00   1st Qu.:193.0   1st Qu.:23.00   1st Qu.:42.00
##  Median :43.0   Median :26.00   Median :207.0   Median :24.77   Median :45.09
##  Mean   :42.5   Mean   :26.72   Mean   :191.6   Mean   :24.77   Mean   :45.20
##  3rd Qu.:45.5   3rd Qu.:29.21   3rd Qu.:221.6   3rd Qu.:26.40   3rd Qu.:48.26
##  Max.   :52.0   Max.   :71.00   Max.   :245.0   Max.   :38.10   Max.   :72.20
##  NA's   :23     NA's   :24      NA's   :24      NA's   :22      NA's   :22
##    floor.hip       floor.armpit     my.units         my.ethnicity
##  Min.   : 35.00   Min.   : 70.0   Length:251         Length:251
##  1st Qu.: 91.40   1st Qu.:124.5   Class :character   Class :character
##  Median : 96.00   Median :131.5   Mode  :character   Mode  :character
##  Mean   : 95.29   Mean   :131.3
##  3rd Qu.:101.00   3rd Qu.:139.7
##  Max.   :113.00   Max.   :156.8
##  NA's   :34       NA's   :22
##   my.gender          new.units           my.eye           my.writing
##  Length:251         Length:251         Length:251         Length:251
##  Class :character   Class :character   Class :character   Class :character
##  Mode  :character   Mode  :character   Mode  :character   Mode  :character
##
##
##
##
##  my.swinging        my.eye.color        torso.height     height.heads
##  Length:251         Length:251         Min.   : 21.50   Min.   :4.467
##  Class :character   Class :character   1st Qu.: 45.00   1st Qu.:7.130
##  Mode  :character   Mode  :character   Median : 50.55   Median :7.682
##                                        Mean   : 50.50   Mean   :7.649
##                                        3rd Qu.: 55.24   3rd Qu.:8.233
##                                        Max.   :115.00   Max.   :9.857
##                                        NA's   :34       NA's   :18
```

6.2.2 Plots

Below is the code to generate the plots and save them as a table that you see in Section 1.

```
set.seed(11906189);

measure.df.values = measure.df[c(3,4,7,22,25:27,29,36,37)];
measure.df.values = measure.df.values[c(measure.df.values$my.ethnicity == "w" |
                                        measure.df.values$my.ethnicity == "b" |
                                        measure.df.values$my.ethnicity == "h" |
```

```
                                          measure.df.values$my.ethnicity == "a" |
                                          measure.df.values$my.ethnicity == "ca" |
                                          measure.df.values$my.ethnicity == "k"),];
#a =Asian, b =African American, ca =Caucasion/Asian, h =Hispanic, k =Korean, w =White

##### ONE GRAPHIC #####
#https://github.com/rstudio/cheatsheets/blob/master/data-visualization-2.1.pdf
#https://www.datamentor.io/r-programming/saving-plot/ #pdf(file="fileName.pdf")

OnePlot = ggplot(measure.df.values, aes(x=height.heads, y=height, color=my.ethnicity)) +
  #geom_point(aes(shape=my.ethnicity, size=my.ethnicity)) +
  geom_point() +
  #scale_shape_manual(values=c(15:20)) +
  #scale_size_manual(values=c(1.5,1.5,1.5,1.5,1.5,2.5)) +
  labs(x="\"Heads\" in Height", y="Height", color="Ethnicity") +
  ggtitle("Height and Head Proportions per Ethnicity")


##### TWO GRAPHIC #####
TwoPlot = ggplot(measure.df.values, aes(x=height, color=my.ethnicity)) +
  geom_boxplot() +
  coord_flip() +
  labs(x="height", color="Ethnicity") +
  ggtitle("IQR of Height per Ethnicity")
```

6.2.3 Summary Statistics

Below is the code to generate the summary statistics and save them as a table that you see in Section 3.1.

```
set.seed(11906189);

measure.df.numeric = measure.df[sapply(measure.df, is.numeric)]; #get only numeric data

my.Means = colMeans(measure.df.numeric, na.rm = TRUE); #get mean of each column
my.StanDevs = sapply(measure.df.numeric, sd, na.rm = TRUE); #get stan dev of each column

file.correlation = paste0(path.to.tables,"correlation-table1.tex"); #save table name as

corrData = as.matrix(measure.df.numeric[c(1,2,5,12,15:19)]);  #numeric values
#but only including height, head height, navel to floor, armpit to elbow, kneepit to
#floor, hip to floor, armpit to floor, torso height, heads in height

buildLatexCorrelationTable(corrData,
  rotateTable = TRUE,
  width.table = .9,
  width.names = "35mm",
  space.M.SD = ".25mm",
  space.SD.corr = ".5mm",
  space.between = ".01mm",
  myFile = file.correlation,
  myNames = c("Height (cm)", "Head Height (cm)", "Navel to Floor (cm)",
              "Armpit to Elbow (cm)", "Kneepit to Floor (cm)", "Hip to Floor (cm)",
              "Armpit to Floor (cm)", "Torso Height (cm)", "\"Heads\" in Height"),
```

```
  myNote = "Pearson pairwise correlations are reported; \\newline a two-side test was
  performed to report correlation significance.",
  showOnes = "center");

Sys.sleep(2); # in case Knit-PDF doesn't like making a file...
```

ENDNOTES

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