Consulting Homework 4

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Data examination steps:

- Looked at histograms and boxplots (I know these generally aren't detailed enough, but it helps me spot outliers) of height, weight, and bmi, which raises a lot of questions:
- First, weight ranges from 41 to 288, which makes me think that some of these weights were measured in kilograms and some were in pounds (it's unlikely that anyone in this cohort weighs just 41 pounds). Also, you can see in the histogram that there's an unexpected bump in the 50-100 range. So it might be worth confirming with the data manager that units are consistent between hospitals. Based on the weight boxplot by hospital, it looks like hospitals 1-16 are different from the rest.
- The height histogram and boxplots are much more regular, and there don't appear to be any noticable differences between hospitals. However, the range is 45 - 70, so I'm not sure what units they're using. It's clearly not meters, but if it's inches then the tallest person in the cohort is 5'10" and the shortest is 3'9", which seems very unlikely. So either way, I'd like to confirm the height values and units with the data manager.
- BMI looks overall like it's what you'd expect (mostly in the 20-30 range, which is normal and slightly overweight), and there isn't an obvious difference by hospital. However, there are 3 obvious outliers with BMIs of 3, 72, and 75. These seem unlikely to be correct, although BMIs in the 70s are technically possible. Also, there are quite a few in the 40-60 range, which is very high. Since this is a CVD study, that might be correct, but worth double checking. The most concerning thing about the BMI scores though, is that if you calculate them yourself based on the weight and height values, the calculated values don't match the reported ones (whether you calculate assuming pounds and inches or kilograms and centimeters).

Continuous variable ranges:

```
range(va$height)
```

```
## [1] 45 70
```

```
range(va$weight,na.rm = TRUE)
```

```
## [1]  41 288
```

```
range(va$bmi,na.rm = TRUE)
```

```
## [1]  3 75
```

BMI calculation check:

```
va$bmi_kg_calc <- round(va$weight / ((va$height/100)^2),0)
va$bmi_lbs_calc <- round(703 * (va$weight / (va$height^2)),0)
va$bmi_kg_calc[which(va$bmi_kg_calc == va$bmi)]
```

```
## numeric(0)
```

```
va$bmi_lbs_calc[which(va$bmi_lbs_calc == va$bmi)]
```

```
## numeric(0)
```

Check missing continuous data:

- There are no missing height values, and the participants with missing weight values are also missing bmi. So that's a good sign!

```r
length(which(is.na(va$weight)))
```

```
## [1] 104
```

```r
length(which(is.na(va$height)))
```

```
## [1] 0
```

```r
length(which(is.na(va$bmi)))
```

```
## [1] 104
```

```r
FALSE %in% (which(is.na(va$weight)) == which(is.na(va$bmi)))
```

```
## [1] FALSE
```

Check categorical variables:

- Make sure the levels in categorical variables make sense. The hospital codes look good, but we are missing data for six month period 38. It also looks like there are about twice as many values for six month period 37, so I'm wondering if 37 and 38 were accidentally combined. Also, there are two procedures called "2", and I'm not sure what that means, since it should just be 0 or 1. Finally, a huge proportion of the participants have an ASA score of 4. Again, this might be expected for this cohort, but is probably worth double checking.

```
table(va$hospcode)
```

```
##
##   1   2   3   4   5   6   7   8   9  10  11  12  13  14  15  16  17  18
## 654 612 614 588 574 577 615 585 606 592 574 581 586 631 571 595 600 620
##  19  20  21  22  23  24  25  26  27  28  29  30  31  32  33  34  35  36
## 572 599 619 584 602 621 622 650 608 614 575 558 602 575 567 606 581 557
##  37  38  39  40  41  42  43  44
## 641 566 599 619 617 576 575 575
```

```
summary(va[,c(1:3,7)])
```

```
##     hospcode     sixmonth   proced        asa
##  1      :  654   34:4444   0   : 5128   1   :   15
##  26     :  650   35:4393   1   :21019   2   : 1144
##  37     :  641   36:4399   2   :    2   3   : 5137
##  14     :  631   37:8679   NA's:  106   4   :19744
##  25     :  622   39:4340                5   :   66
##  24     :  621                          NA's:  149
##  (Other):22436
```

Check for missing categorical data:

- There are 106 missing procedures and 149 missing ASA scores. It might be worth asking PIs about how to handle missing procedure and ASA data. My guess is that they would want to exclude anyone without procedure data, but keep in those without ASA data (since ASA is subjective anyway, and not a huge part of the analysis as far as I know).

Check everything by procedure code:

- Overall the two procedures look pretty similar to me, so the issues with the data don't appear to be related to the procedure. There are a lot more with procedure 1, but I think that's to be expected.

```
proc.0 <- as.data.frame(split.data.frame(va,va$proced)[1])
proc.1 <- as.data.frame(split.data.frame(va,va$proced)[2])
summary(proc.0)
```

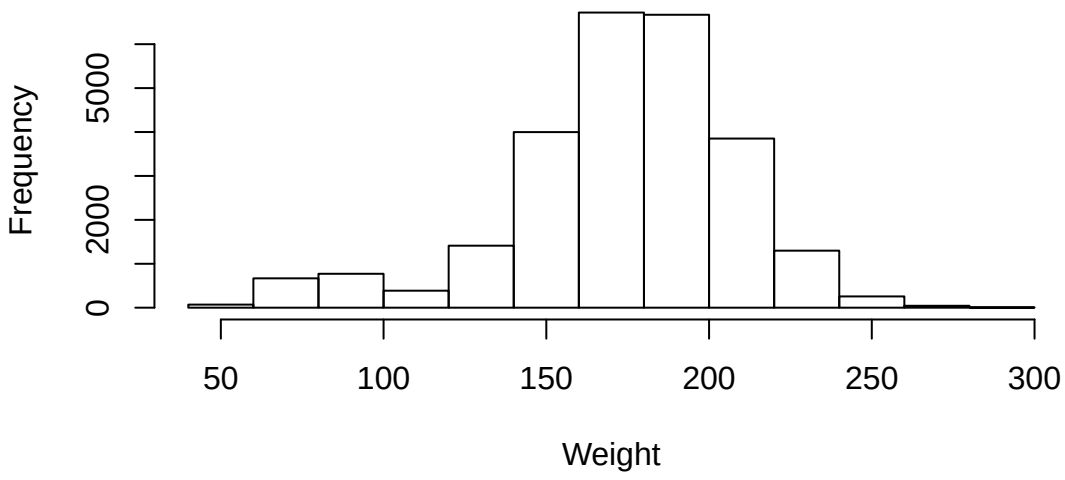
```
##   X0.hospcode   X0.sixmonth X0.proced   X0.weight     X0.height
##  26     : 143   34: 896     0:5128    Min.   : 50   Min.   :45.00
##  13     : 138   35: 829     1:   0    1st Qu.:159   1st Qu.:56.00
##  23     : 136   36: 827     2:   0    Median :178   Median :58.00
##  41     : 131   37:1734               Mean   :175   Mean   :58.01
##  16     : 130   39: 842               3rd Qu.:197   3rd Qu.:60.00
##  18     : 129                         Max.   :283   Max.   :68.00
##  (Other):4321                         NA's   :24
##      X0.bmi       X0.asa     X0.bmi_kg_calc   X0.bmi_lbs_calc
##  Min.   :13.00   1   :   1   Min.   : 130.0   Min.   : 9.00
##  1st Qu.:24.00   2   : 237   1st Qu.: 459.0   1st Qu.:32.00
##  Median :27.00   3   :1002   Median : 526.0   Median :37.00
##  Mean   :27.29   4   :3851   Mean   : 524.3   Mean   :36.87
```

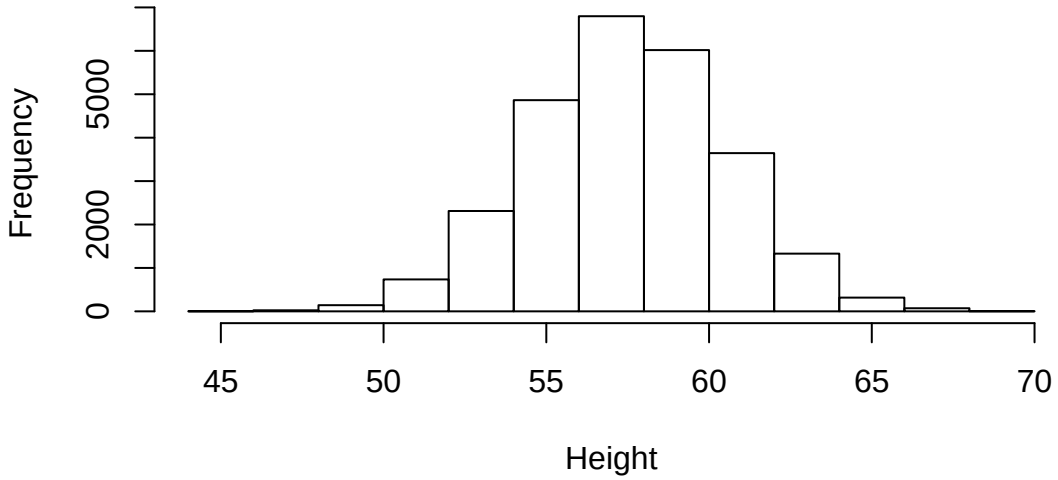
```
##  3rd Qu.:30.00   5   :  15   3rd Qu.: 597.0   3rd Qu.:42.00
##  Max.   :53.00   NA's:  22   Max.   :1081.0   Max.   :76.00
##  NA's   :24                  NA's   :24       NA's   :24
```

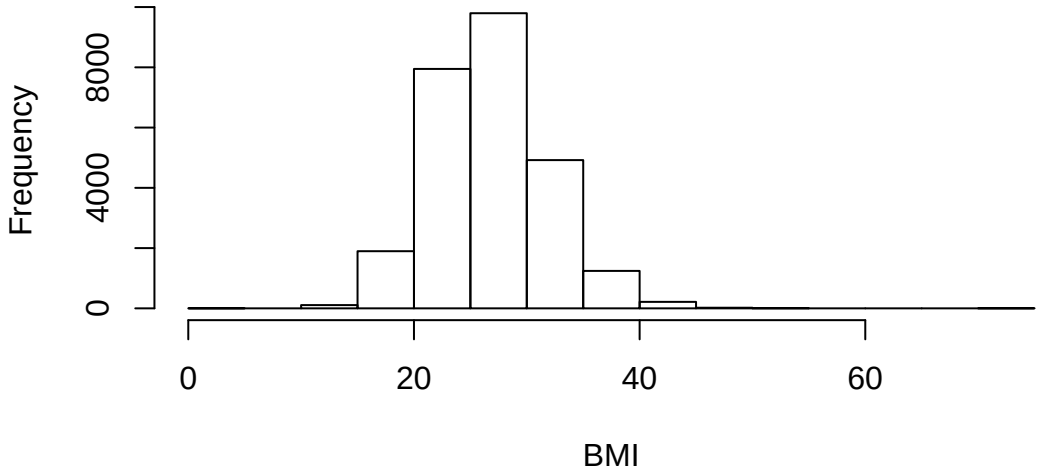
```
summary(proc.1)
```

```
##   X1.hospcode    X1.sixmonth X1.proced   X1.weight       X1.height
##  1      :  540   34:3534     0:    0   Min.   : 41.0   Min.   :45
##  37     :  511   35:3548     1:21019   1st Qu.:157.0   1st Qu.:56
##  7      :  510   36:3557     2:    0   Median :178.0   Median :58
##  21     :  507   37:6907               Mean   :173.8   Mean   :58
##  40     :  507   39:3473               3rd Qu.:197.0   3rd Qu.:60
##  14     :  506                         Max.   :288.0   Max.   :70
##  (Other):17938                         NA's   :80
##      X1.bmi       X1.asa      X1.bmi_kg_calc   X1.bmi_lbs_calc
##  Min.   : 3.00   1   :   14   Min.   : 118.0   Min.   : 8.00
##  1st Qu.:24.00   2   :  900   1st Qu.: 456.0   1st Qu.:32.00
##  Median :27.00   3   : 4114   Median : 526.0   Median :37.00
##  Mean   :27.25   4   :15815   Mean   : 521.1   Mean   :36.64
##  3rd Qu.:30.00   5   :   51   3rd Qu.: 597.0   3rd Qu.:42.00
##  Max.   :75.00   NA's:  125   Max.   :1057.0   Max.   :74.00
##  NA's   :80                   NA's   :80       NA's   :80
```

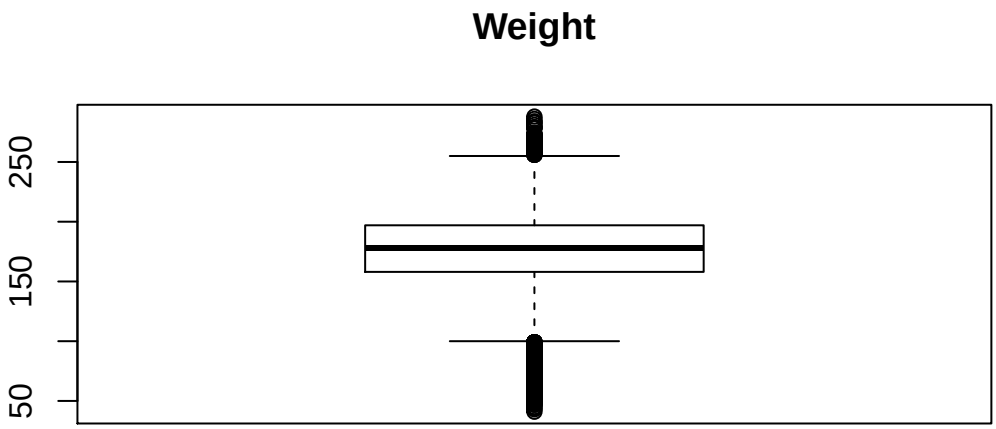
Continuous variable histograms:

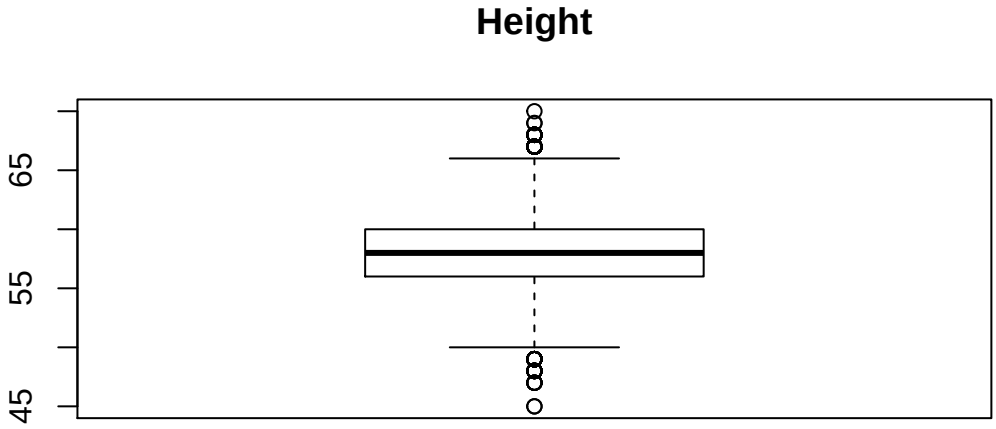


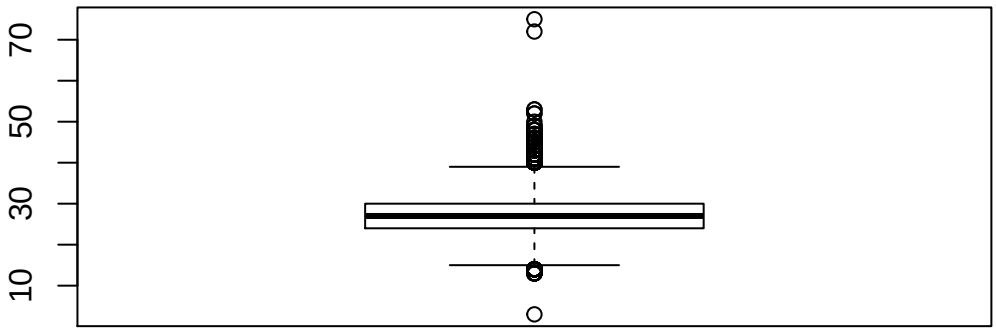



Frequency
0
4000
8000
0
20
40
60
BMI

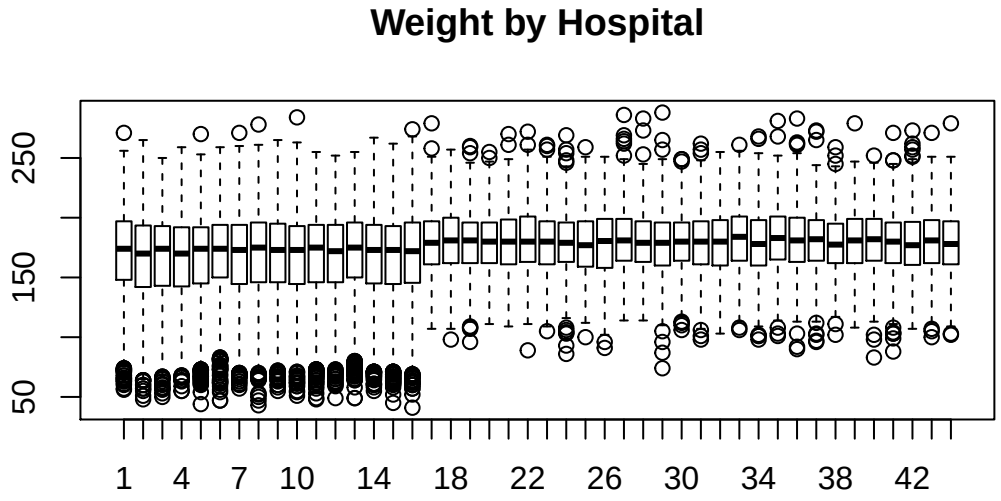
Continuous variable boxplots:

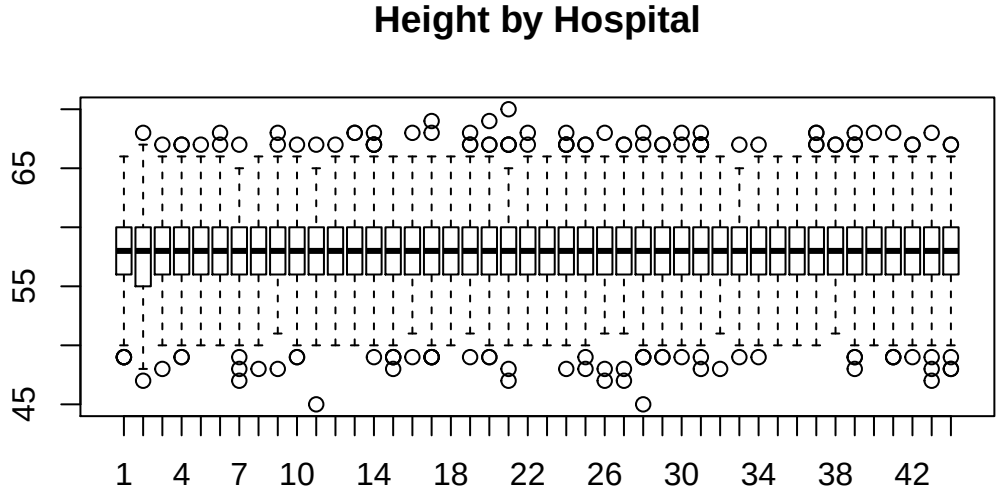


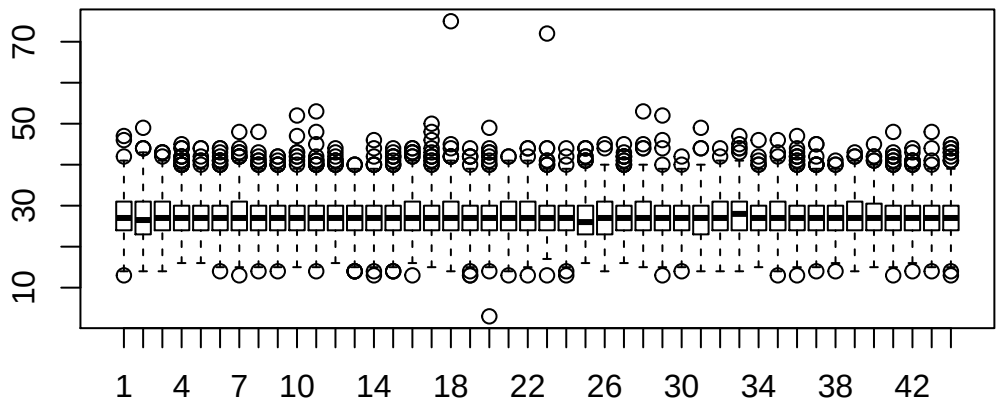



BMI
70
50
30
10

Continuous variable boxplots by hospital:






BMI by Hospital
70
50
30
10
1
4
7
10
14
18
22
26
30
34
38
42