202305 Midterm 2

Instructions:

1.Show both commands and outputs unless specified otherwise.

2.For visualization, always use ggplot() commands, unless specified otherwise.

Question 1: Download the file people.csv from Brightspace. Import the file and save it as a data frame named "features".

a. Which variables are categorical, which ones are numerical?

b. Produce a bar graph showing the distribution of hair colours with the following:

   Different colour for different bars

   A title.

   A x-axis label.

c. Produce a side-by-side boxplot of weight by gender with y-axis label "Weight in kg".

```
#set working directory first
library(tidyverse)
features <- read_csv('people.csv')
```

```
## Rows: 592 Columns: 5
## ── Column specification ──────────────────────────────────────────────
## Delimiter: ","
## chr (3): hair, eye, gender
## dbl (2): height, weight
##
## ℹ Use `spec()` to retrieve the full column specification for this data.
## ℹ Specify the column types or set `show_col_types = FALSE` to quiet this message.
```

```
head(features)
```

hair	eye	gender	height	weight
<chr>	<chr>	<chr>	<dbl>	<dbl>
Black	Brown	Male	177.7	85.0
Black	Brown	Male	175.2	94.5
Black	Brown	Male	190.9	97.0
Black	Brown	Male	178.0	95.3
Black	Brown	Male	170.9	77.9

hair	eye	gender	height	weight
<chr>	<chr>	<chr>	<dbl>	<dbl>
Black	Brown	Male	159.6	80.6

6 rows

```
# (a) Answer below:
#hair col is categorical
#eye col is categorical
#gender col is categorical
#height col is numerical
#weight col is numerical

# (b) Answer below:
#Produce a bar graph showing the distribution of hair colours with the following:

 #  Different colour for different bars

  # A title.

   #A x-axis label.

ggplot(data = features, aes(x = hair)) +
  geom_bar(fill=c('Black', 'Yellow', 'Brown', 'Red')) +
  labs(tag = 'Hair Distribution') +
  xlab('Hair Color')
```
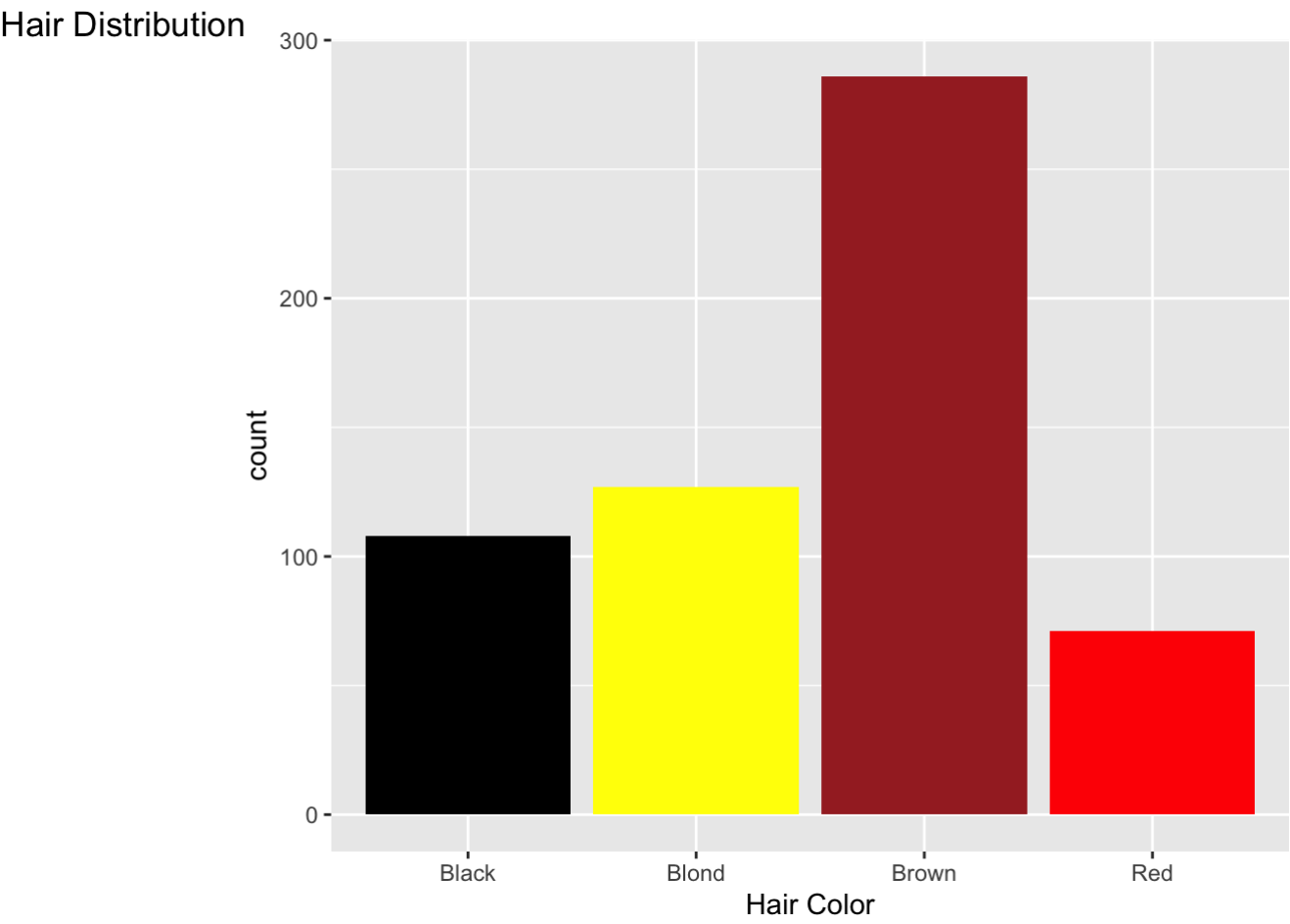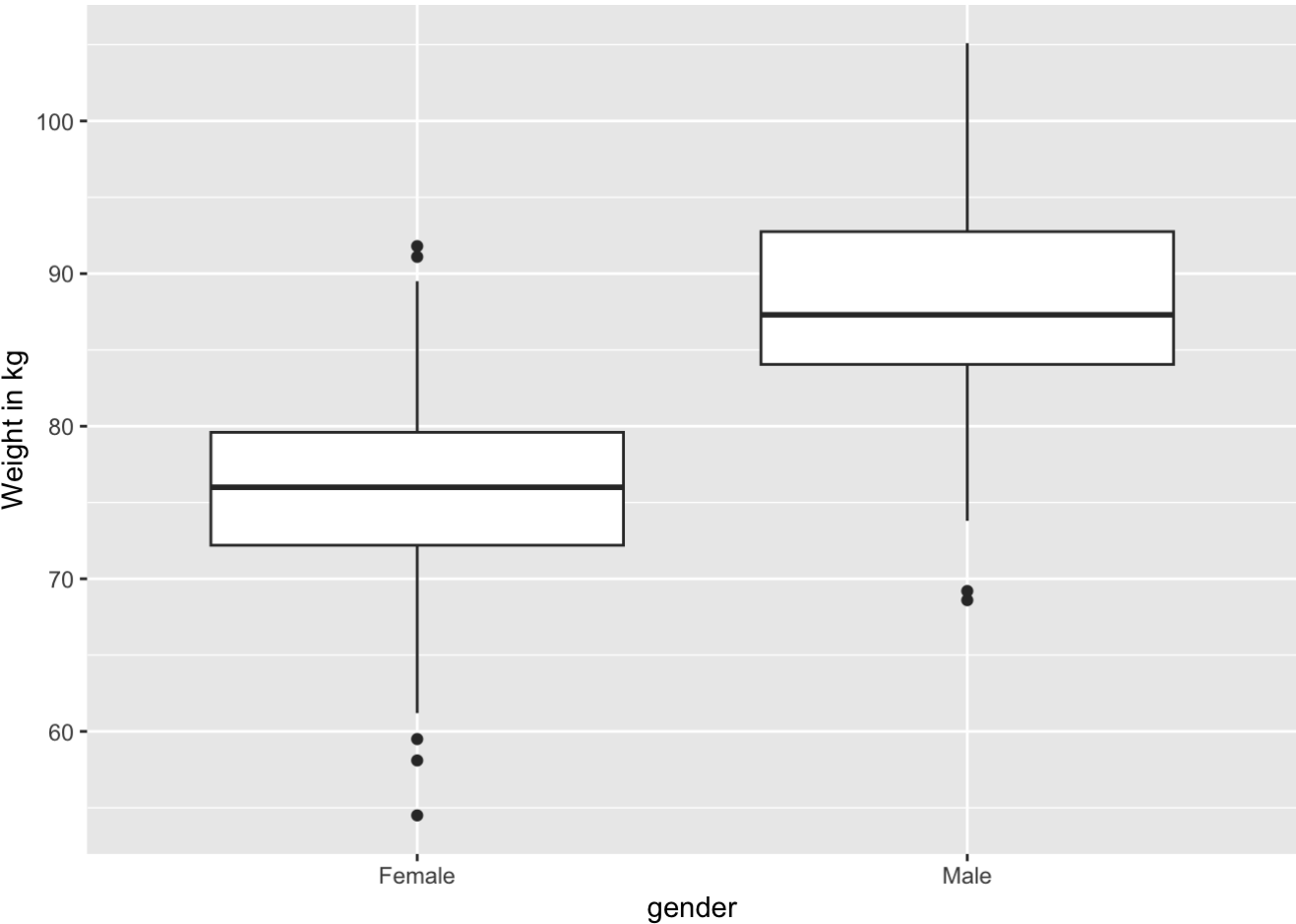

Hair Distribution

```
# (c) Answer below:
  #c. Produce a side-by-side boxplot of weight by gender with y-axis label "Weight in
kg".

 ggplot(features, aes(x = gender, y = weight)) +
   geom_boxplot() +
   ylab("Weight in kg")
```


Question 2 Use the "features" data frame.

a. Compute and display the total number of people with "Hazel" eyes.

b. Compute and display the sample proportion of people with Hazel eyes.

```
#a
head(features)
```

hair	eye	gender	height	weight
<chr>	<chr>	<chr>	<dbl>	<dbl>
Black	Brown	Male	177.7	85.0
Black	Brown	Male	175.2	94.5
Black	Brown	Male	190.9	97.0
Black	Brown	Male	178.0	95.3
Black	Brown	Male	170.9	77.9

hair	eye	gender	height	weight
<chr>	<chr>	<chr>	<dbl>	<dbl>
Black	Brown	Male	159.6	80.6

6 rows

```
hazel_count<-0
for(color in features$eye) {
  if(color == 'Hazel') {
    hazel_count <- hazel_count + 1
  }
}
hazel_count
```

```
## [1] 93
```

```
#b
sample_proportion <- hazel_count / length(features$eye)
sample_proportion
```

```
## [1] 0.1570946
```

Question 3: Use the features data frame for the following:

a. Bootstrap 5000 sample variances of height. Save your bootstrapped variances to a vector called boot_var.

b. Give an estimate for the variance of height from the bootstrapped sample.

c. Compute a 95% bootstrapped confidence interval for the true value of the variance of height.

```
# (a) Answer below:
boot_var <- numeric(5000)
for (i in 1:5000) {
    resampled_data <- sample(features$height, replace = TRUE)
    boot_var[i] <- var(resampled_data)
}
boot_var
```

```
##     [1] 88.19153 85.69685 78.40452 79.87992 86.04778 82.18648 79.91792 86.31765
##     [9] 89.03739 74.42799 78.31771 83.61404 79.35874 76.99447 79.62141 78.89015
##    [17] 83.04265 72.75407 85.09291 77.94273 81.40704 86.49810 85.53964 76.18601
##    [25] 88.06738 72.57161 78.14814 82.73808 75.60631 87.43886 83.29077 86.32747
##    [33] 82.43084 78.83785 76.20200 85.51409 91.40919 84.45361 81.57281 80.29316
##    [41] 81.81528 86.01390 82.31160 80.97756 90.01939 82.32858 76.09346 83.33144
##    [49] 75.61220 87.71765 82.30312 84.92715 77.84583 80.55135 77.79388 80.77805
##    [57] 78.85443 78.25905 78.90492 86.85903 81.46192 73.63555 88.42567 83.44467
##    [65] 89.89719 76.75877 82.08192 79.93019 79.80048 87.62244 83.34506 85.16695
##    [73] 79.94729 78.65239 83.75322 78.84191 86.26987 87.18313 80.69395 82.63619
##    [81] 79.89909 79.49141 77.71785 83.42692 83.17690 79.13089 85.86152 79.11521
##    [89] 83.54775 85.39313 86.18804 72.59951 80.76952 81.53822 82.06763 79.05732
##    [97] 74.38235 76.67539 78.58981 80.38052 82.96047 84.16682 83.01659 78.52996
##   [105] 85.69459 78.05645 85.65118 90.96978 71.99661 78.02149 80.48819 79.89884
##   [113] 81.97863 84.81071 86.64372 85.87384 86.15522 89.41660 80.23295 87.00637
##   [121] 95.44159 80.92073 90.93356 79.39499 82.53079 84.46814 78.88330 77.91291
##   [129] 79.39795 74.66687 77.72006 82.80208 73.54747 77.15160 80.80876 85.66115
##   [137] 79.50185 71.50771 89.28744 85.80339 83.24908 85.63718 76.00969 80.49227
##   [145] 84.32228 82.41097 84.56878 87.80499 77.73225 74.41546 84.52994 77.63478
##   [153] 93.75333 75.43958 79.36047 79.90686 79.93430 82.08407 80.13748 80.19048
##   [161] 89.56287 83.13727 78.11483 83.32302 87.56276 73.05663 76.08662 78.85022
##   [169] 81.44202 87.18545 90.84223 89.35002 70.46420 73.02074 87.31618 82.86801
##   [177] 80.49439 78.97761 80.37890 80.16068 78.75895 78.43111 80.39508 74.50867
##   [185] 91.50106 84.48302 83.28605 84.31106 80.13096 83.39795 88.11369 78.71194
##   [193] 89.68440 81.00654 83.90340 86.04055 81.93042 74.58612 75.57580 85.73063
##   [201] 81.88563 79.54390 83.25445 77.49518 82.52706 82.58425 78.41682 79.26492
##   [209] 77.39052 80.52206 82.42575 79.77411 79.53155 84.66665 77.50844 92.33946
##   [217] 79.61134 81.48743 84.21304 82.55340 75.29247 77.84405 99.70778 82.33985
##   [225] 86.71220 72.56840 87.51454 78.54962 80.94101 79.69103 81.72320 83.87883
##   [233] 91.46112 81.64879 73.54690 84.16259 76.92747 83.07729 86.42436 86.78729
##   [241] 90.26846 79.10925 86.96886 79.72698 84.68264 92.73342 78.27143 80.09446
##   [249] 78.46780 81.11001 78.08389 79.74294 89.17586 73.01433 77.37824 80.78179
##   [257] 87.83312 84.54028 71.90034 85.50608 89.50811 81.48373 88.59444 86.17793
##   [265] 73.10608 83.43012 79.79465 82.68453 76.24024 81.95218 86.55662 87.90455
##   [273] 83.75514 81.37210 82.66935 76.58358 81.76053 78.37994 75.47568 79.38643
##   [281] 91.32454 79.91611 84.54326 79.36301 81.24588 83.44351 85.14285 87.01741
##   [289] 75.42717 78.94196 92.05049 80.00347 83.91526 78.15150 86.14663 71.82534
##   [297] 73.92908 71.76871 73.72668 81.64542 76.07772 82.50013 78.81403 86.89412
##   [305] 75.60487 82.97626 76.04175 81.01577 81.58727 82.49739 87.66227 86.81857
##   [313] 81.10788 84.88092 86.57820 80.92892 81.94018 86.30606 85.25834 88.41469
##   [321] 87.76048 82.71037 79.75872 72.97878 75.71508 91.23411 78.82988 82.68834
##   [329] 83.70593 81.74816 81.15246 86.43487 85.22299 95.96012 81.17248 86.03773
##   [337] 81.50989 79.48361 84.69146 80.45150 80.63129 74.82172 82.93371 81.49140
##   [345] 85.41697 78.85529 84.51364 87.32560 83.38808 79.62548 79.22651 86.00990
##   [353] 73.34289 82.50386 76.76927 76.91793 83.48718 80.50182 75.88761 85.30812
##   [361] 88.57658 79.51723 89.06440 82.59676 87.17099 83.40841 87.40103 78.86597
##   [369] 82.76965 71.40963 87.38206 84.00838 83.06915 81.50162 74.08655 82.53725
##   [377] 84.03716 83.56282 87.63211 74.71921 80.52574 85.48231 90.84612 83.42447
##   [385] 86.13139 87.41255 82.28299 80.87275 78.78432 80.92629 76.23306 78.45698
##   [393] 90.57649 78.08949 82.86667 81.25438 83.80018 78.88328 88.06263 80.23861
##   [401] 83.31569 87.65792 78.87673 81.02209 85.56866 72.59070 78.83804 77.70866
##   [409] 78.01800 88.30544 82.18493 84.50200 85.06793 78.91757 76.90705 76.86405
##   [417] 80.35401 81.62635 78.20474 85.66391 87.46828 85.81425 90.61914 85.31301
##   [425] 79.83811 81.95229 76.43083 84.57783 82.57570 75.70994 85.98196 78.47728
##   [433] 80.31882 72.91378 83.74108 84.52385 79.93080 81.45817 79.80001 79.93716
```

```
##   [441] 82.73919 80.68097 81.63504 75.57392 72.55880 84.80262 82.01392 80.39757
##   [449] 86.07080 84.36580 84.62122 74.81396 89.00468 78.96835 88.58140 86.25920
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##   [465] 81.56072 82.22541 81.51095 77.40470 79.89832 81.02094 76.72082 84.54403
##   [473] 77.17663 78.84503 81.60481 84.80400 83.18009 78.41241 80.69347 83.32031
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##   [625] 84.37082 82.53660 82.54150 78.00526 78.45508 73.88549 83.58267 74.98947
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##   [689] 72.60192 90.08086 84.83161 87.21243 79.77234 80.75706 80.49986 82.81940
##   [697] 78.52568 81.23212 80.81076 79.70534 75.77357 87.57656 78.21189 73.86888
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##   [833] 82.97552 89.10209 78.05702 79.49544 78.77407 84.76565 88.22882 85.54802
##   [841] 79.47570 74.29165 84.98227 84.05606 73.79559 83.38975 80.89616 79.75175
##   [849] 84.69601 73.47839 77.70530 75.37017 81.84015 86.34153 80.06616 79.85420
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##   [881] 82.87599 85.08785 86.56436 79.83575 89.54844 80.75556 86.37783 77.47874
```

```
##  [889] 74.13096 82.77990 84.62203 82.30512 81.83863 76.25590 81.39433 73.17812
##  [897] 83.98504 80.55332 80.89727 74.75144 77.22927 79.43031 80.12774 84.20226
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##  [929] 85.23747 92.93180 87.59204 80.50258 84.77017 87.39620 75.96416 76.38846
##  [937] 79.71047 76.91067 87.19122 75.09531 82.69228 82.53196 81.92410 83.89286
##  [945] 80.75857 84.47834 77.85423 85.60724 75.73783 90.00073 89.57947 80.73714
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## [1001] 83.91307 80.79509 75.01586 79.51025 81.55110 80.61597 73.60785 88.41297
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## [1081] 77.78030 82.05994 80.30553 81.83183 69.61174 80.52455 84.87580 79.76179
## [1089] 79.85300 90.10334 86.32716 84.98989 80.62194 81.11484 77.68664 82.03716
## [1097] 82.12360 82.34224 87.33341 85.42394 88.14236 80.99041 72.47840 74.40924
## [1105] 76.90373 69.98592 86.31174 83.45260 78.18240 80.05380 81.24602 88.97869
## [1113] 77.68486 71.72239 83.19342 78.19257 78.59330 84.51657 81.02425 81.05747
## [1121] 79.27129 84.40508 86.09328 78.25117 72.49793 84.38254 87.20979 82.90808
## [1129] 77.68458 91.11490 78.28515 72.61386 78.81022 72.84519 83.16688 78.60135
## [1137] 81.88976 80.10857 77.05462 85.32057 84.47420 83.22138 84.47667 84.46626
## [1145] 82.82296 76.90002 76.84682 85.39089 75.55099 77.37886 83.49668 83.54839
## [1153] 84.60951 77.33322 74.01448 80.39961 87.04108 87.30057 76.82850 77.66708
## [1161] 82.40893 86.53625 83.51546 74.94481 80.25559 82.94290 87.06913 79.63803
## [1169] 78.35188 84.11471 85.28479 83.75933 75.73981 82.13796 83.85999 85.94141
## [1177] 86.54667 84.71279 74.12010 77.02032 79.85368 78.26094 76.68441 86.99980
## [1185] 83.51404 73.67268 78.25983 85.63987 79.23321 80.15960 76.94271 81.52106
## [1193] 84.23931 81.98582 86.74991 82.14565 73.67551 90.27288 81.98658 76.98314
## [1201] 81.59429 80.83712 78.49340 78.64976 76.46759 81.34963 73.03975 84.58217
## [1209] 82.55039 80.75678 81.06748 78.52722 82.17039 77.89623 75.56624 75.16236
## [1217] 75.83501 86.50836 79.07925 81.19861 72.44161 77.41824 78.52188 83.11250
## [1225] 79.19194 91.05027 81.64631 90.01172 77.28446 81.80734 81.22631 79.84485
## [1233] 84.77522 78.35813 82.68806 82.25466 77.12620 83.95899 83.60927 83.23770
## [1241] 78.36497 84.13191 81.85636 86.00278 78.76226 82.35302 77.92791 84.87149
## [1249] 87.63037 87.22611 81.21626 76.87810 83.88556 77.24563 85.53277 90.22703
## [1257] 80.78214 99.87157 78.33255 84.89510 86.57832 86.06690 79.72467 89.78449
## [1265] 83.88080 79.57263 81.03241 82.14636 79.01999 81.36848 81.83101 85.07421
## [1273] 88.65260 86.35670 77.92815 81.19079 78.98291 79.80051 80.53599 77.86345
## [1281] 83.22712 83.96109 81.66299 81.97064 81.82151 82.31196 86.15571 81.70801
## [1289] 75.15872 76.24686 79.83247 77.17611 78.44146 77.81175 73.73445 76.08096
## [1297] 85.36914 90.12138 85.68062 91.34658 78.83187 83.90172 81.35813 80.61415
## [1305] 85.03971 81.51810 80.62415 81.32334 82.39083 79.88627 82.28401 87.23064
## [1313] 84.88738 78.81689 81.41714 81.52636 88.36998 77.41368 90.94222 84.53991
## [1321] 72.37412 83.88706 79.04488 86.12255 72.27774 78.63838 77.66966 93.20670
## [1329] 74.91126 84.38787 86.37903 83.52970 77.57053 83.81336 82.02251 89.25946
```

```
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## [4617] 84.01875 75.66314 76.99047 82.95118 80.96948 78.80857 83.60420 78.12003
## [4625] 78.49109 79.86584 84.06803 81.04858 77.65499 80.55353 86.09452 81.09319
## [4633] 88.94387 80.87952 80.68166 79.94176 79.45651 80.28506 84.67016 80.34674
## [4641] 82.96447 84.75921 83.31405 82.93595 81.36954 82.95557 82.71935 82.29182
## [4649] 78.61086 76.88978 77.37011 80.86509 67.49707 78.50644 80.27711 73.02678
## [4657] 73.98860 83.83927 81.93726 89.10582 85.29959 76.28531 76.26544 83.97601
## [4665] 90.79536 77.09030 74.23201 81.73927 84.03265 72.17465 81.18613 71.75244
## [4673] 84.21645 91.17810 74.83720 82.90763 85.94497 82.52618 84.80629 82.15037
## [4681] 81.69044 82.19268 87.73788 80.78873 85.53986 86.71667 82.52874 77.30156
## [4689] 78.99192 77.62736 81.21364 86.66900 86.86878 85.15711 82.27433 80.00206
## [4697] 89.56629 74.60601 81.94468 78.62033 86.27187 72.65837 86.76540 77.10944
## [4705] 83.11905 70.35468 90.64876 81.34488 87.17582 85.97732 78.24982 76.73342
## [4713] 85.76054 78.95177 77.15949 88.29671 78.10150 73.06109 77.85093 80.04493
## [4721] 88.47100 81.97583 75.21849 85.58000 83.21994 78.78507 82.29805 80.66287
## [4729] 84.42789 80.38515 86.09459 73.62557 80.28886 89.83066 79.53576 82.42539
## [4737] 84.12773 84.66704 74.48840 88.73324 76.47456 78.05782 74.49247 73.96782
## [4745] 83.89232 81.78574 82.44369 87.66938 80.12733 86.49772 83.48880 82.25759
## [4753] 83.28479 81.42040 78.38311 84.22324 75.98043 76.30683 77.71926 79.94218
## [4761] 82.47200 81.00537 75.81586 73.66584 82.26525 78.92249 89.75812 77.38520
## [4769] 78.86432 87.55326 86.15165 74.35558 84.60941 84.97883 81.38521 86.28131
## [4777] 85.74959 74.15094 86.50759 72.38540 76.34518 77.65217 79.52665 90.22805
## [4785] 80.61578 71.74237 85.71424 91.94110 83.37511 87.66391 79.15501 75.26311
## [4793] 83.95798 75.60473 80.03731 72.45405 80.95084 89.69088 81.26872 76.73775
## [4801] 82.03729 80.36094 74.77157 84.71508 72.12846 83.66138 82.47224 81.28081
## [4809] 77.39267 70.48821 82.77466 92.28083 88.08176 79.27105 80.71595 87.68003
## [4817] 72.98463 77.52825 82.47372 80.46888 82.32827 80.73570 84.93197 84.47750
## [4825] 76.16008 78.25276 84.17693 88.10417 82.74749 83.65367 78.59237 83.33078
## [4833] 74.06841 74.87423 81.99775 77.68270 80.39814 83.68254 83.69074 84.51291
## [4841] 77.25591 79.71112 75.33468 79.35869 77.45387 78.27954 82.49976 80.45889
## [4849] 81.33535 77.97785 79.05065 82.03594 80.39208 84.89637 89.44957 80.77603
## [4857] 85.61098 71.97113 74.75980 88.14252 89.81492 77.64235 83.33007 92.80977
## [4865] 75.32985 80.44490 85.68321 82.59194 80.28936 77.82975 83.66849 83.45952
## [4873] 78.90925 77.62183 78.18874 71.22489 81.24771 80.04342 85.62259 83.14460
## [4881] 84.42207 75.57522 84.38646 82.72089 84.24957 78.18116 84.58023 83.49095
## [4889] 80.85233 71.21427 87.42334 79.76439 77.73370 90.65862 80.97026 82.02147
## [4897] 79.92970 78.34064 77.66867 91.41118 81.07611 82.10589 80.90935 84.23870
## [4905] 86.23198 80.85788 81.34246 82.08738 79.61556 82.92055 87.98161 79.31927
## [4913] 90.38957 85.84538 73.52858 73.53257 83.27032 86.41714 83.10394 78.10049
```

```
## [4921] 88.40921 79.83685 89.23314 75.36906 86.35099 80.67125 85.05320 85.04433
## [4929] 72.84379 80.66926 80.59901 82.75197 75.19873 84.80704 78.32441 82.58311
## [4937] 83.89208 84.86770 85.41185 85.58134 70.81790 83.18108 80.71803 81.82548
## [4945] 75.35892 81.29322 81.16358 81.98717 88.81199 82.77435 79.63585 73.53441
## [4953] 80.43237 77.29493 81.19558 81.58106 80.86894 88.22702 84.90468 80.83268
## [4961] 72.61565 72.90507 77.37959 79.70242 79.95304 86.77866 84.77278 87.82284
## [4969] 82.04959 75.48083 75.27454 83.63197 77.78314 77.60683 85.37164 88.60027
## [4977] 82.08231 80.92253 83.51365 81.48687 83.70710 88.55573 76.83025 64.73549
## [4985] 73.58357 80.67383 77.90554 81.65289 81.63212 87.05555 87.74738 84.77719
## [4993] 83.54288 76.66041 86.51578 81.43205 90.55841 87.96469 83.99546 78.10459
```

```
# (b) Answer below:
var(boot_var)
```

```
## [1] 21.68312
```

```
# (c) Answer below:
lower_quantile <- quantile(boot_var, 0.05)
upper_quantile <- quantile(boot_var, 0.95)

bootstrapped_confidence_interval <- c(lower_quantile, upper_quantile)
bootstrapped_confidence_interval
```

```
##        5%       95%
## 73.79924 89.12704
```

Question 4: Use the features data frame and perform the following:

    a. Create a data frame named "male.features" that contains information only for male. There should be 279 observations in this new data frame. Show the first six observations of male.features.

For part b to e, use the data frame "male.features". If you don't know how to do part a, then use the features data frame. Some mark will be deducted.

    b. Produce a ggplot histogram of weight with the following:

        blue border

        green bar

        (no title needed)

    c. Write a command to take a sample of 144 weights without replacement and named this vector x. Do not display the vector x.

    d. Compute the mean, standard deviation, estimated standard error for the sample and save them as some variable names of your choice.

    e. Compute a 84% confidence interval for male weight.

```
library(dplyr)
#a

#Create a data frame named "male.features" that contains information only for
 #  male. There should be 279 observations in this new data frame. Show the first
  # six observations of male.features.

#For part b to e, use the data frame "male.features". If you don't know how to do
#part a, then use the features data frame. Some mark will be deducted.


filtered <- features %>%
  filter(gender == 'Male')%>%
  group_by(gender)


male.features <- data.frame(filtered)
male.features[1:6,]
```
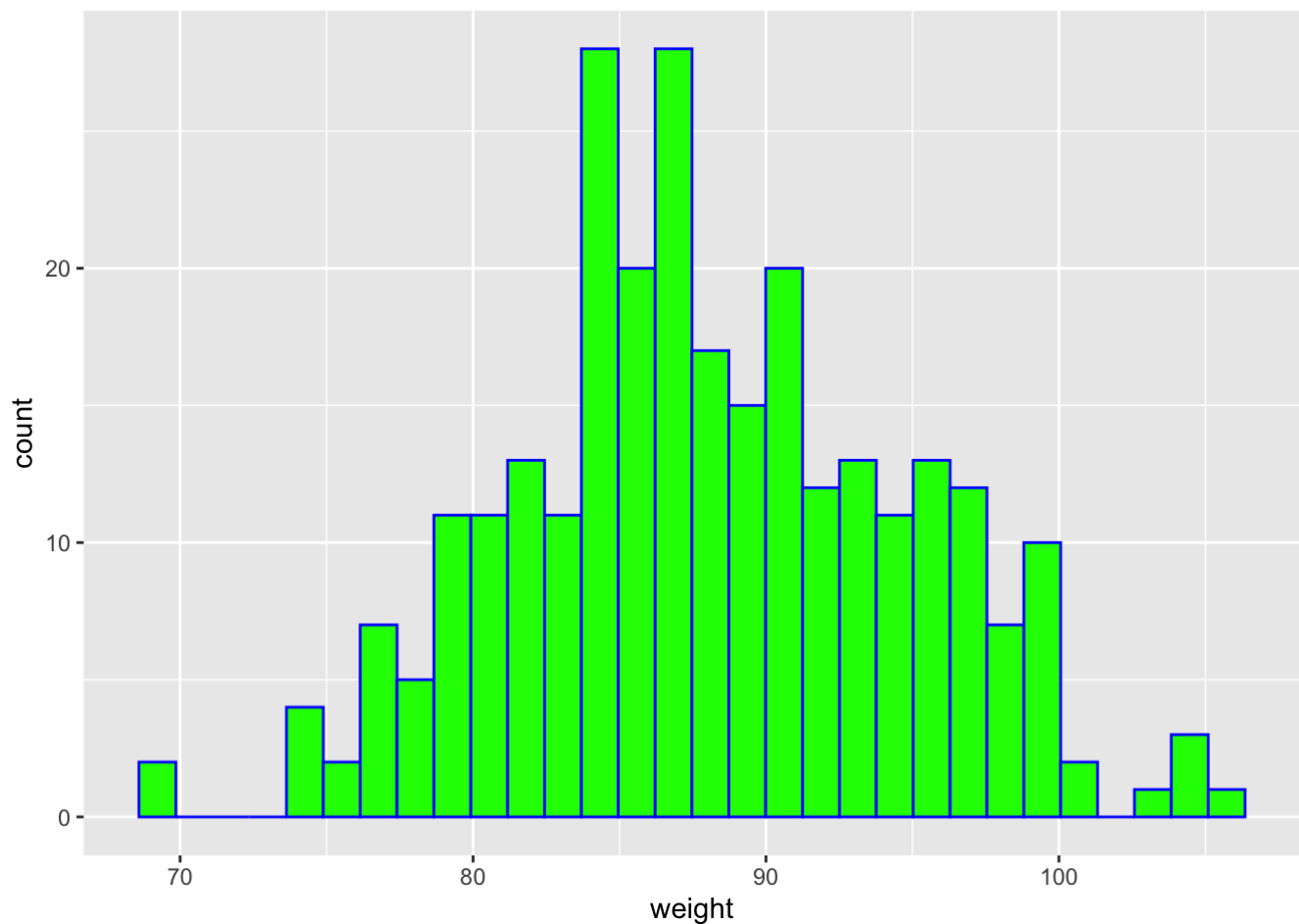
	hair <chr>	eye <chr>	gender <chr>	height <dbl>	weight <dbl>
1	Black	Brown	Male	177.7	85.0
2	Black	Brown	Male	175.2	94.5
3	Black	Brown	Male	190.9	97.0
4	Black	Brown	Male	178.0	95.3
5	Black	Brown	Male	170.9	77.9
6	Black	Brown	Male	159.6	80.6

6 rows

```
#b
ggplot(male.features, aes(x = weight)) +
  geom_histogram(color = 'blue', fill = 'green')
```

```
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```

```
#c
#set.seed(12345)
#x <- sample(male.features$weights, size = 144, replace = FALSE)
#x



#d
#Compute the mean, standard deviation, estimated standard error for the sample and sa
ve them as #some variable names of your choice.

mean <- mean(male.features)
```

```
## Warning in mean.default(male.features): argument is not numeric or logical:
## returning NA
```

```
mean_sd <- sd(mean)
#standard_error <- sd(male.features)

mean_sd
```

```
## [1] NA
```

```
#standard_error



#e

mean_weight <- mean(male.features$weight)


lower_quantile <- quantile(male.features$weight, 0.016)
upper_quantile <- quantile(male.features$weight, 0.84)

confidence_interval <- c(lower_quantile, upper_quantile)
confidence_interval
```
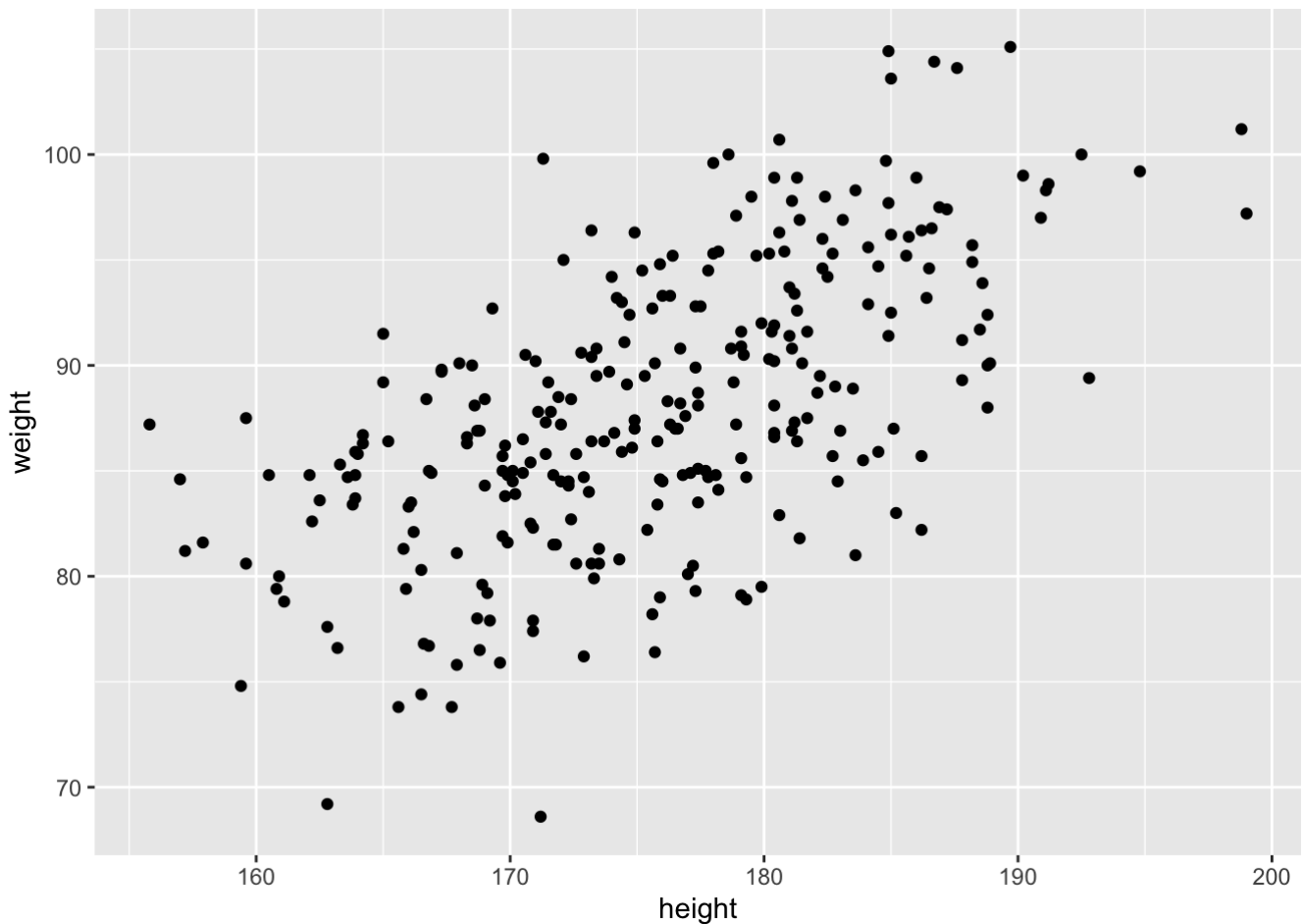
```
##     1.6%       84%
## 74.5792 95.3000
```

Question 5: Use the "male.features" data frame again.

a. Produce a scatterplot of height versus weight. Set the x-axis to be height.

b. Describe the direction and form of the relationship.

c. Compute the correlation between the two variables and describe what this implies for the linearity and strength of the relationship.

```
# (a) Answer below:
ggplot(male.features, aes(x = height, y = weight)) +
  geom_point()
```

```
# (b) Answer below:


# (c) Answer below:
args(cor)
```

```
## function (x, y = NULL, use = "everything", method = c("pearson",
##      "kendall", "spearman"))
## NULL
```

```
cor(x = male.features$height, y = male.features$weight)
```

```
## [1] 0.6120493
```

c. the correlation indicates a strong positive relationship between weight and height. Meaning that the taller an individual is, the heavier he or she will be.

When you're finished or when time is up, knit the Rmarkdown to a html file and submit it to the Midterm 2 folder.Comment out (don't delete) the commands that don't run and submit the output.To be safe, you can also submit the rmd file together with the html file.