Homework 7

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This homework is due on April 12, 2021 at 11:00pm. Please submit as a pdf file on Canvas.

For all problems in this homework, we will work with the `penguins_clean` dataset, which is a cleaned-up version of the `penguins` dataset from the **palmerpenguins** package.

Note: This homework is about the contents of the plots. Don't worry about styling. It's OK to use the default theme and plot labeling.

```
library(palmerpenguins)

penguins_clean <- penguins %>%
  select(-year) %>% # remove the year column as it is distracting here
  na.omit()         # remove any rows with missing values

penguins_clean
```

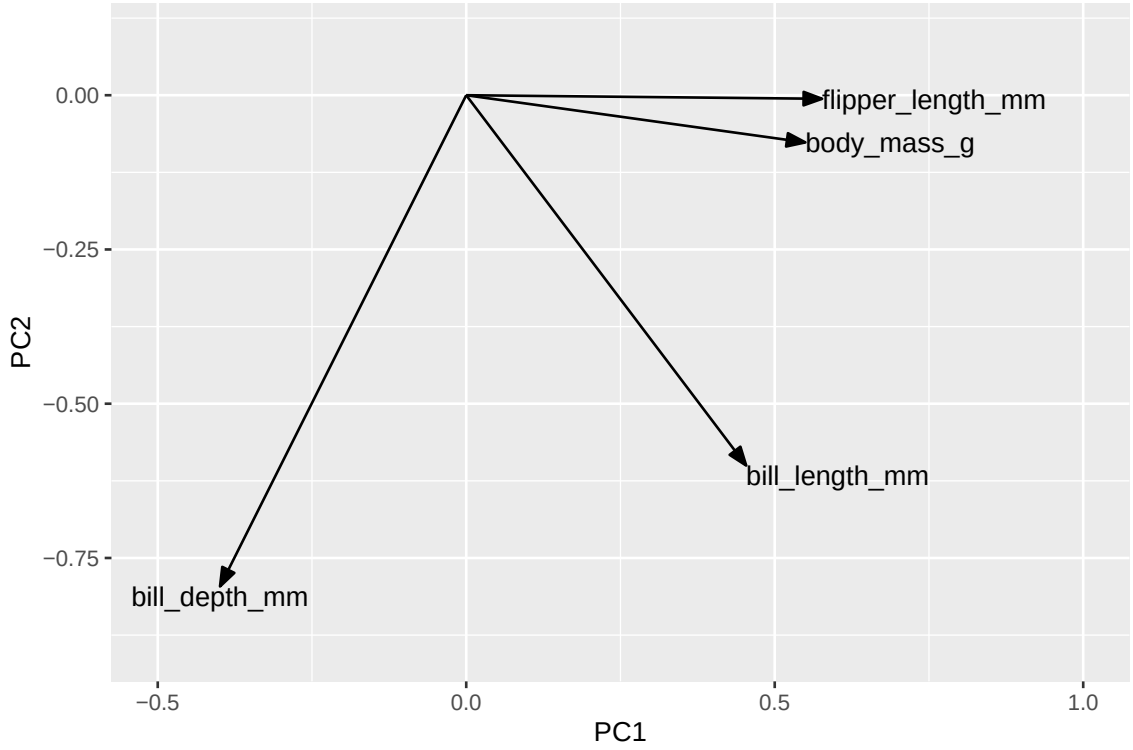
```
## # A tibble: 333 x 7
##    species island bill_length_mm bill_depth_mm flipper_length_~ body_mass_g
##    <fct>   <fct>           <dbl>         <dbl>            <int>       <int>
##  1 Adelie  Torge~           39.1          18.7              181        3750
##  2 Adelie  Torge~           39.5          17.4              186        3800
##  3 Adelie  Torge~           40.3          18                195        3250
##  4 Adelie  Torge~           36.7          19.3              193        3450
##  5 Adelie  Torge~           39.3          20.6              190        3650
##  6 Adelie  Torge~           38.9          17.8              181        3625
##  7 Adelie  Torge~           39.2          19.6              195        4675
##  8 Adelie  Torge~           41.1          17.6              182        3200
##  9 Adelie  Torge~           38.6          21.2              191        3800
## 10 Adelie  Torge~           34.6          21.1              198        4400
## # ... with 323 more rows, and 1 more variable: sex <fct>
```

Problem 1: (2 pts)

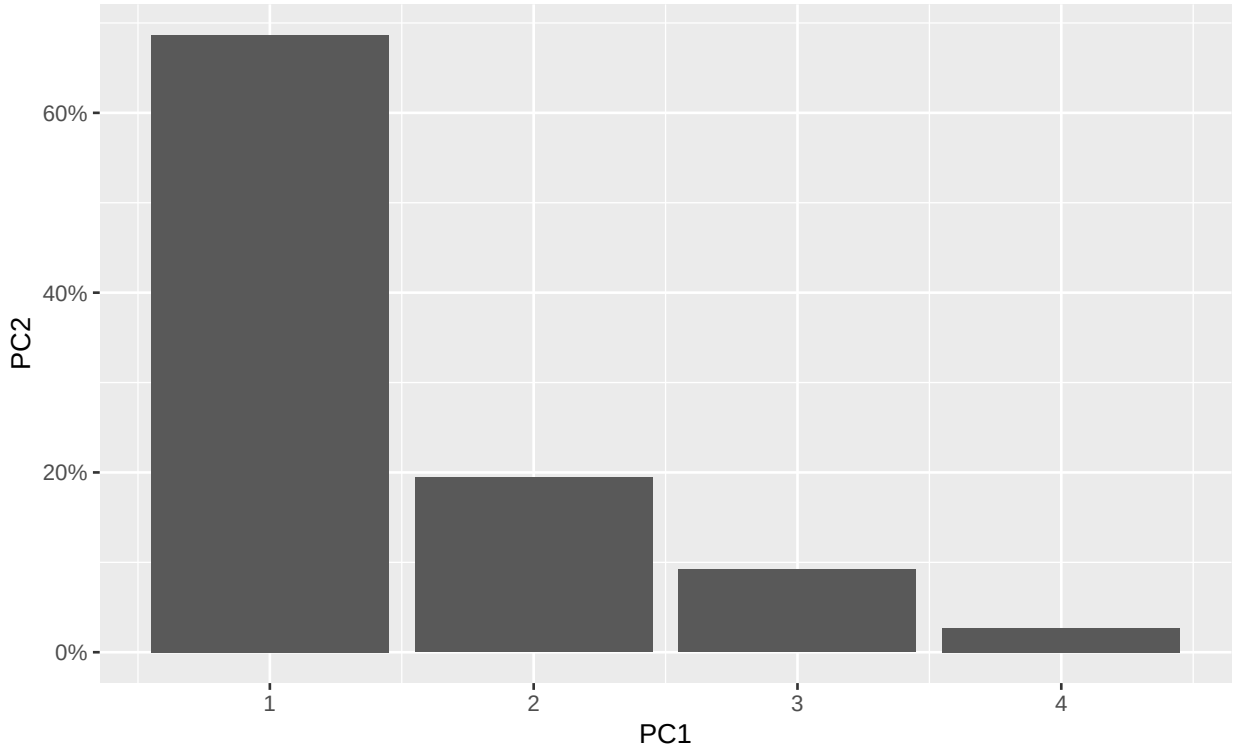
Perform a PCA of the `penguins_clean` dataset and make two plots: 1. A rotation plot of components 1 and 2; 2. A plot of the eigenvalues, showing the amount of variance explained by the various components.

```
pca_fit <- penguins_clean %>%
  select(where(is.numeric)) %>%
  scale() %>%
  prcomp()

arrow_style <- arrow(
  angle = 20, length = grid::unit(8, "pt"),
  ends = "first", type = "closed"
)

pca_fit %>%
  tidy(matrix = "rotation") %>%  # extract rotation matrix
```

```
  pivot_wider(
    names_from = "PC", values_from = "value",
    names_prefix = "PC"
  ) %>%
  ggplot(aes(PC1, PC2)) +
  geom_segment(
    xend = 0, yend = 0,
    arrow = arrow_style
  ) +
  geom_text(aes(label = column), hjust = c(0, 0.5, 0, 0),
            vjust = c(1, 1, 0.5, 0.5)) +
  xlim(-0.5, 1) + ylim(-0.9, 0.1) +
  coord_fixed()
```

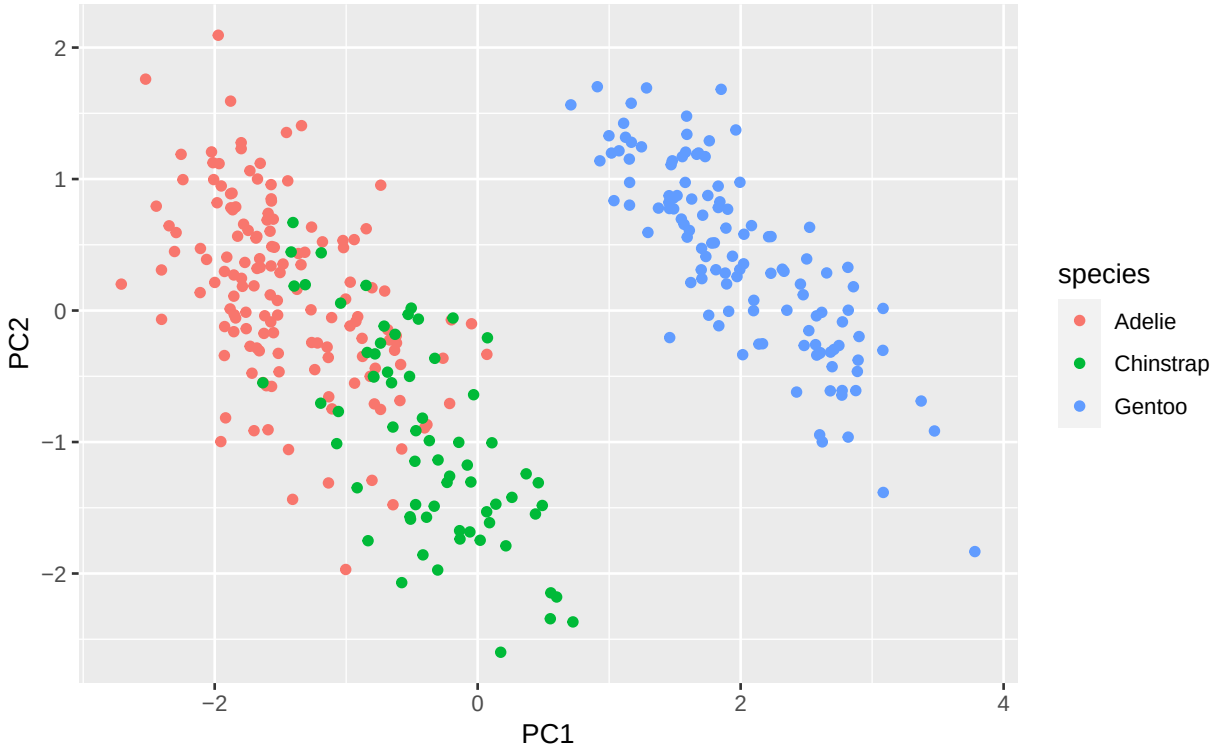



```
pca_fit %>%
  tidy(matrix = "eigenvalues") %>%
  ggplot(aes(PC, percent)) +
  geom_col() +
  scale_x_continuous(name = 'PC1', breaks = 1:4) +
  scale_y_continuous(name = 'PC2', labels = scales::label_percent())
```

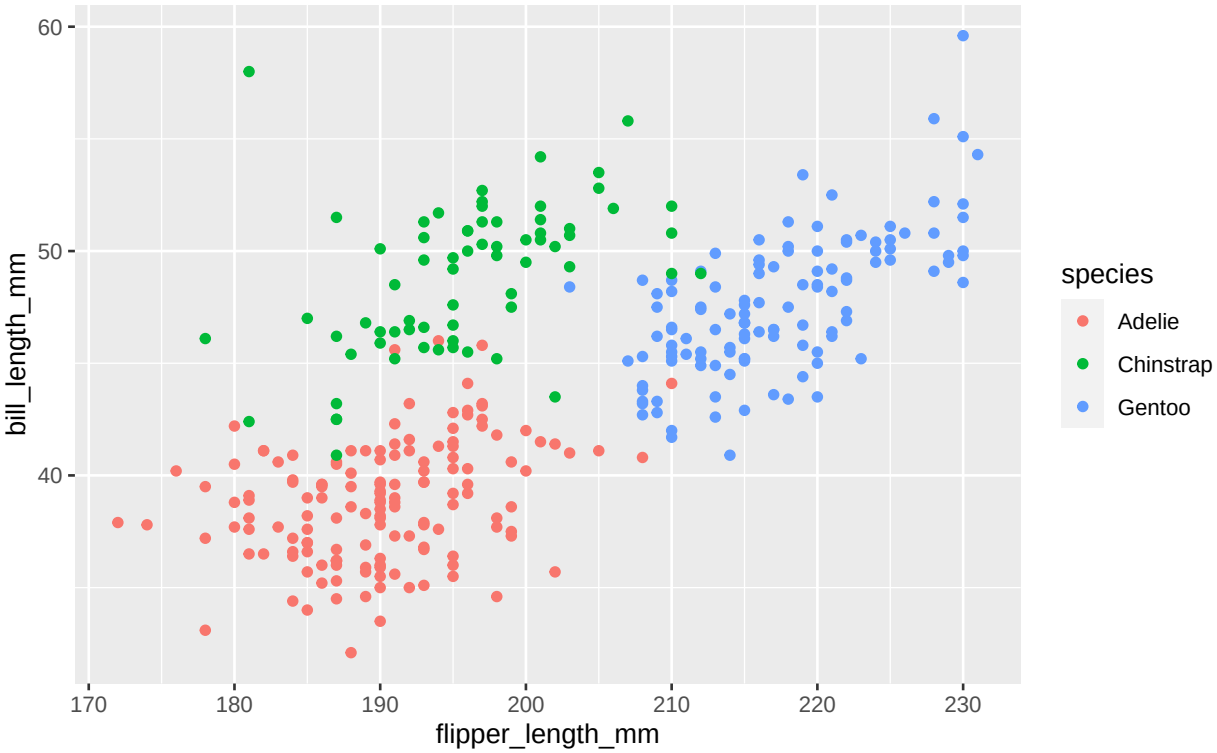


Problem 2: (4 pts) Make a scatter plot of PC 2 versus PC 1 and color by penguin species. Then use the rotation plot from Problem 1 to describe the physical characteristics by which the different penguin species differ. Finally, make one more scatter plot of the raw data that can support your interpretation of the PC analysis.

```
pca_fit %>%
  augment(penguins_clean) %>%
  ggplot(aes(.fittedPC1, .fittedPC2, color = species)) +
  geom_point() +
  coord_fixed() +
  labs(x = 'PC1', y = 'PC2')
```




```
ggplot(penguins_clean, aes(x = flipper_length_mm, y = bill_length_mm,
                           color = species)) +
  geom_point()
```

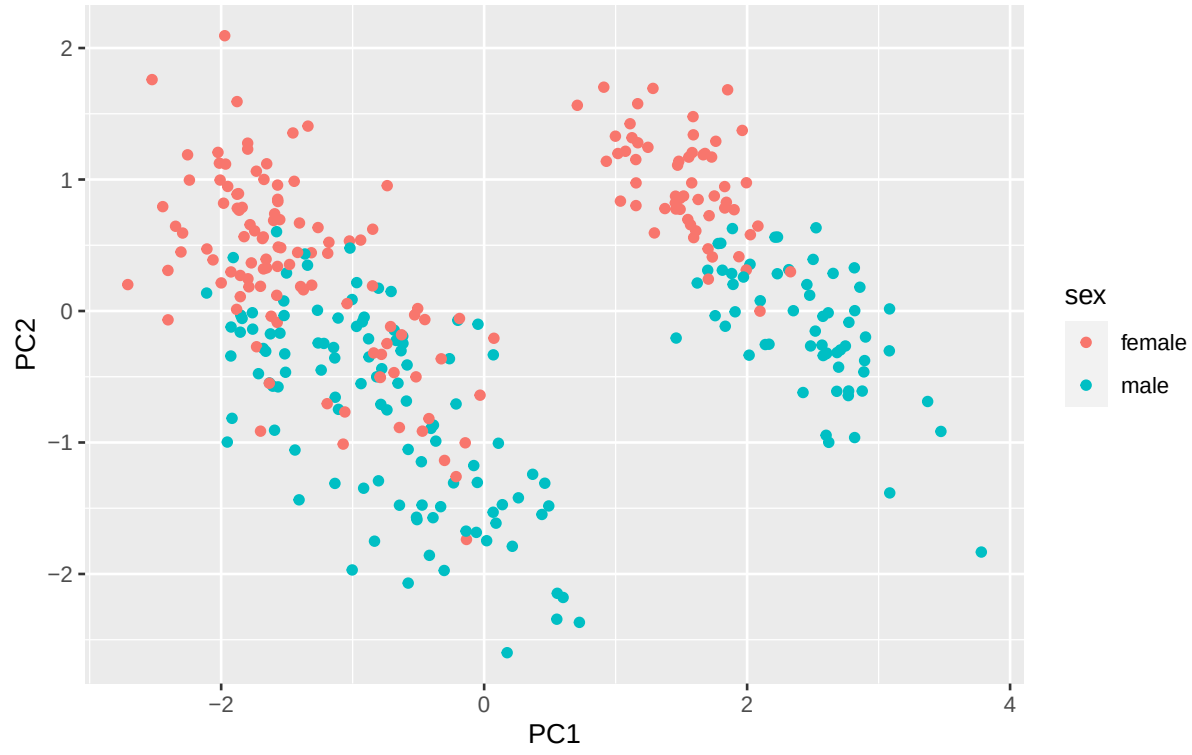


Gentoo penguins have longer flipper length than the other two species. Adelie penguins have shorter bill length than others. Chinstrap penguins have similar bill length as Gentoo penguins but they have shorter flipper length than Gentoo penguins.

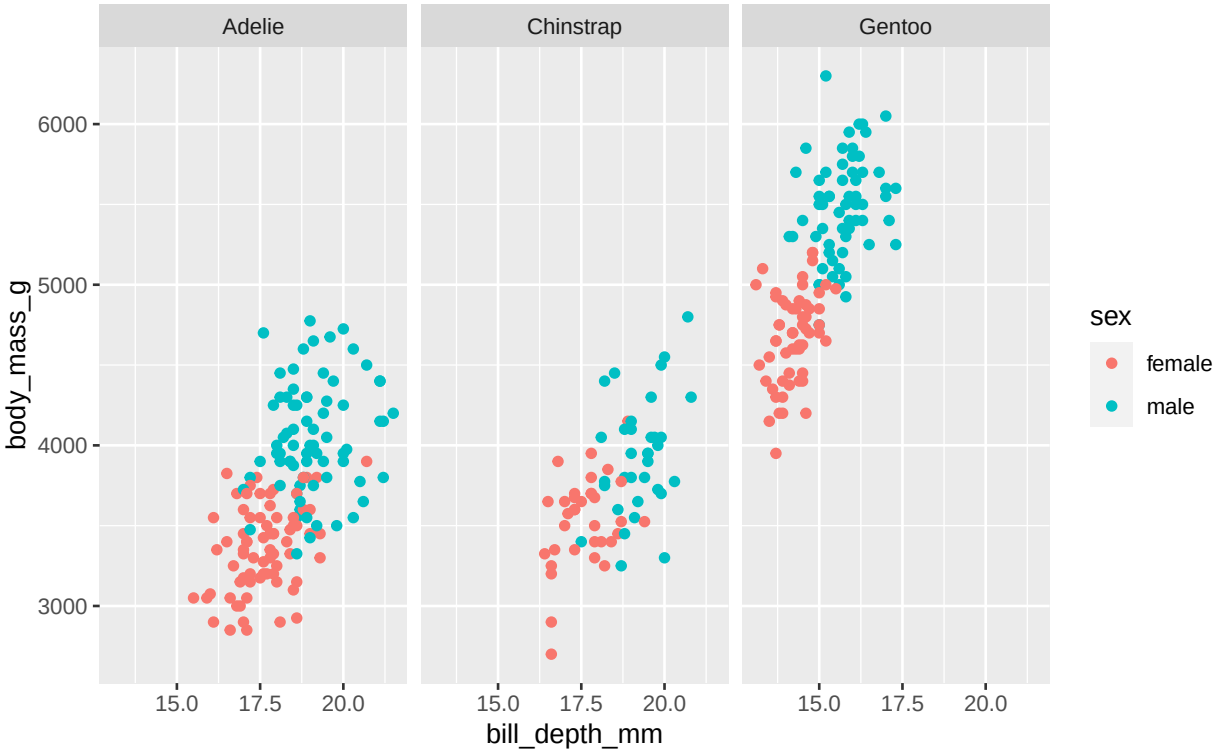
Problem 3: (4 pts) Again make a scatter plot of PC 2 versus PC 1, but now color by sex. Then use the rotation plot from Problem 1 to describe the physical characteristics by which the different penguin sexes differ. Finally, make one more scatter plot of the raw data that can support your interpretation of the PC analysis.

Hint: It helps to facet by penguin species.

```
pca_fit %>%
  augment(penguins_clean) %>%
  ggplot(aes(.fittedPC1, .fittedPC2, color = sex)) +
  geom_point() +
  coord_fixed() +
  labs(x = 'PC1', y = 'PC2')
```




```
ggplot(penguins_clean, aes(x = bill_depth_mm, y = body_mass_g,
                           color = sex)) +
  geom_point() +
  facet_wrap(~species)
```



In general, male penguins have higher bill depth and larger body mass than female penguins.