

Exercise 5C. Heart Rate and Exercise

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2023-05-13

```
library(tidyverse)
library(ggpubr)
library(car)
```

1. DATA

```
# imports data into R
bpm <- read.csv("C:/Users/Xyrine/Documents/School Stuff/BS BIO 4th Year/1st Semester/BIO 118/Module 1/M
head(bpm)
```

```
##           Name.of.Student Age Sex Weight      Fitness
## 1           Bio 122 A1    NA      NA
## 2      Perez, Maria Cristina A.  21  F 104.28 Non-athletic
## 3        Tadle, Antonette    20  F 114.64 Non-athletic
## 4 Genson, Julia Raphaella Genson  21  F  83.96 Non-athletic
## 5      Mejias, Mafe Nenia A.    21  F 154.32 Non-athletic
## 6      Cena, Hannah Trisha A.  21  F 116.85 Non-athletic
##           Fitness.Info Coffee Smoking Alcohol Lying.Down
## 1           NA           NA           NA           NA
## 2      Walking 30 mins a day      2      0      0      84
## 3      Brisk walking 20 mins a day      0      0      0      96
## 4      walking for 20 minutes a day      2      0      0      87
## 5      walking for 20 minutes a day      3      0      0      64
## 6 wallking for 20 minutes every day      3      0      20      64
##      Sitting.Down Standing.Up Standing.Bend Warmup.End First.2min Second.2min
## 1           NA           NA           NA           NA           NA           NA
## 2           78           72           84           96          102          120
## 3           90           84           96          108          126          126
## 4           81           93           80          102           96          120
## 5           64           72           68           84           90          102
## 6           64           76           84          108          132          144
##      Third.2min Fourth.2min Fifth.2min CD.End CD.2min CD.4min CD.6min
## 1           NA           NA           NA           NA           NA           NA
## 2          126          132          132          102           90           84           72
## 3          144          144          150          120          102           96           84
## 4          132          138          141          138          102           78           78
## 5          120          120          126           98           84           54           54
## 6          150          138          138          120           96           84           76
```

```
##   Time.RestRate Time.RestRate.NoCD
## 1             NA                 NA
## 2              6                  8
## 3              6                  8
## 4              4                  8
## 5              2                  6
## 6              6                  8
```

```
# isolates columns for the heart rate during exercise
ex <- bpm %>%
  select(Warmup.End, First.2min, Second.2min, Third.2min, Fourth.2min, Fifth.2min,
         CD.End, CD.2min, CD.4min, CD.6min, Time.RestRate, Time.RestRate.NoCD) %>%
  drop_na()

head(ex, n = 5)
```

```
##   Warmup.End First.2min Second.2min Third.2min Fourth.2min Fifth.2min CD.End
## 1         96        102         120         126         132         132    102
## 2        108        126         126         144         144         150    120
## 3        102         96         120         132         138         141    138
## 4         84         90         102         120         120         126     98
## 5        108        132         144         150         138         138    120
##   CD.2min CD.4min CD.6min Time.RestRate Time.RestRate.NoCD
## 1        90      84      72             6                  8
## 2       102      96      84             6                  8
## 3       102      78      78             4                  8
## 4        84      54      54             2                  6
## 5        96      84      76             6                  8
```

```
ex %>%
  summarise(
    SD.NoCD = sd(Time.RestRate.NoCD),
    Range.NoCD = range(Time.RestRate.NoCD),
    Mean.NoCD = mean(Time.RestRate.NoCD),
    SD.WithCD = sd(Time.RestRate),
    Range.WithCD = range(Time.RestRate),
    Mean.WithCD = mean(Time.RestRate)
  )
```

```
##   SD.NoCD Range.NoCD Mean.NoCD SD.WithCD Range.WithCD Mean.WithCD
## 1 2.295974         4  7.130435  2.221655         2    4.673913
## 2 2.295974        15  7.130435  2.221655        10    4.673913
```

Exploring Data & Plots

```
# re-organizes data for plotting
ex.prog <- ex %>%
  select(Warmup.End, First.2min, Second.2min, Third.2min, Fourth.2min, Fifth.2min,
         CD.End, CD.2min, CD.4min, CD.6min, Time.RestRate, Time.RestRate.NoCD) %>%
  gather(Progress, BPM, Warmup.End, First.2min, Second.2min, Third.2min,
         Fourth.2min, Fifth.2min, CD.End, CD.2min, CD.4min, CD.6min) %>%
```

```
gather(CD, Time.CD, Time.RestRate, Time.RestRate.NoCD) %>%
mutate(CD = gsub("Time.RestRate.NoCD", "No CD", CD),
       CD = gsub("Time.RestRate", "With CD", CD))

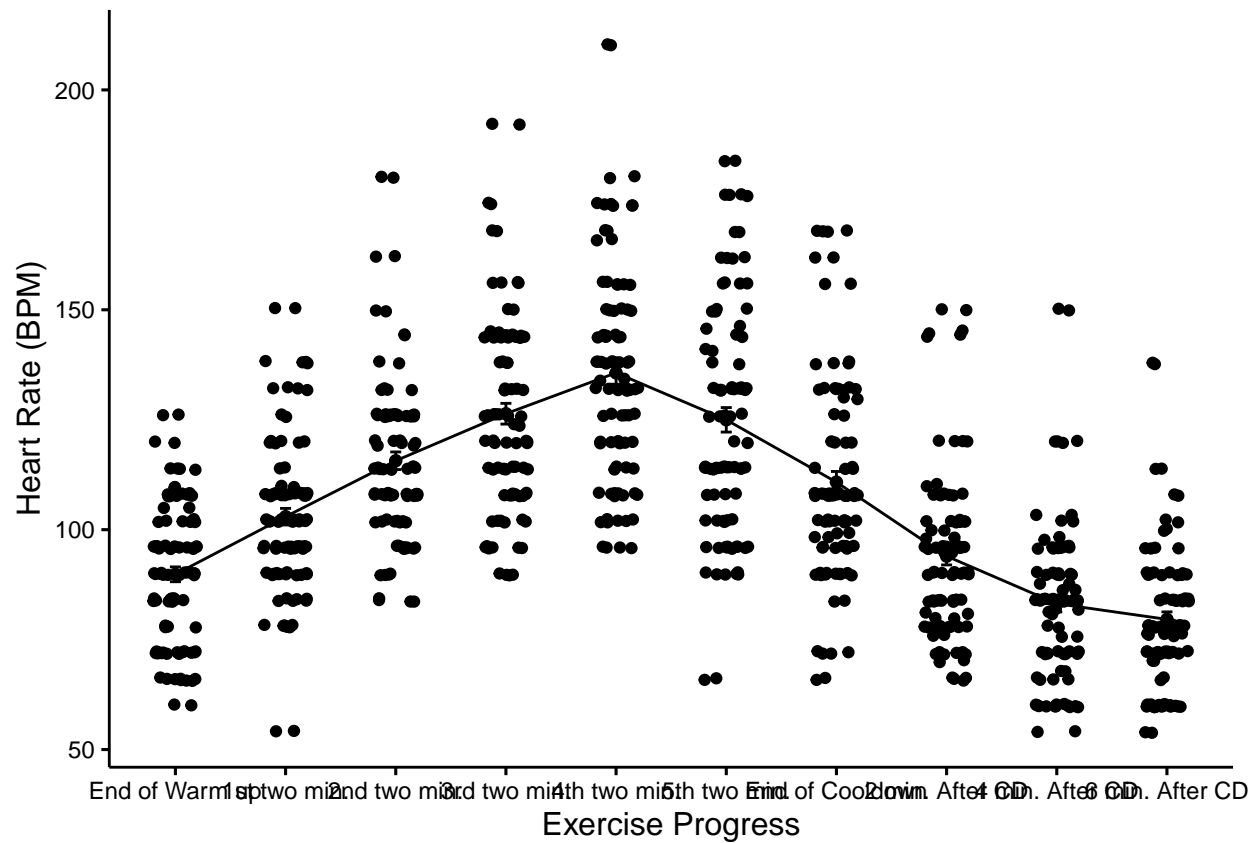
head(ex.prog, n = 5)
```

```
##      Progress BPM      CD Time.CD
## 1 Warmup.End  96 With CD      6
## 2 Warmup.End 108 With CD      6
## 3 Warmup.End 102 With CD      4
## 4 Warmup.End  84 With CD      2
## 5 Warmup.End 108 With CD      6
```

```
# generates line plot showing mean throughout exercise progress
ex.plot <- ggline(ex.prog, x = "Progress", y = "BPM",
                  add = c("mean_se", "jitter"),
                  order = c("Warmup.End", "First.2min", "Second.2min", "Third.2min",
                             "Fourth.2min", "Fifth.2min", "CD.End", "CD.2min", "CD.4min", "CD.6min"),
                  ylab = "Heart Rate (BPM)", xlab = "Exercise Progress") +
  scale_x_discrete(labels = c("End of Warm up", "1st two min.", "2nd two min.",
                             "3rd two min.", "4th two min.", "5th two min.",
                             "End of Cooldown", "2 min. After CD",
                             "4 min. After CD", "6 min. After CD")) +
  font("xy.text", size = 9)

ggsave("C:/Users/Xyrine/Documents/School Stuff/BS BIO 4th Year/1st Semester/BIO 118/Module 1/Module 1 -
        width = 15, height = 8)

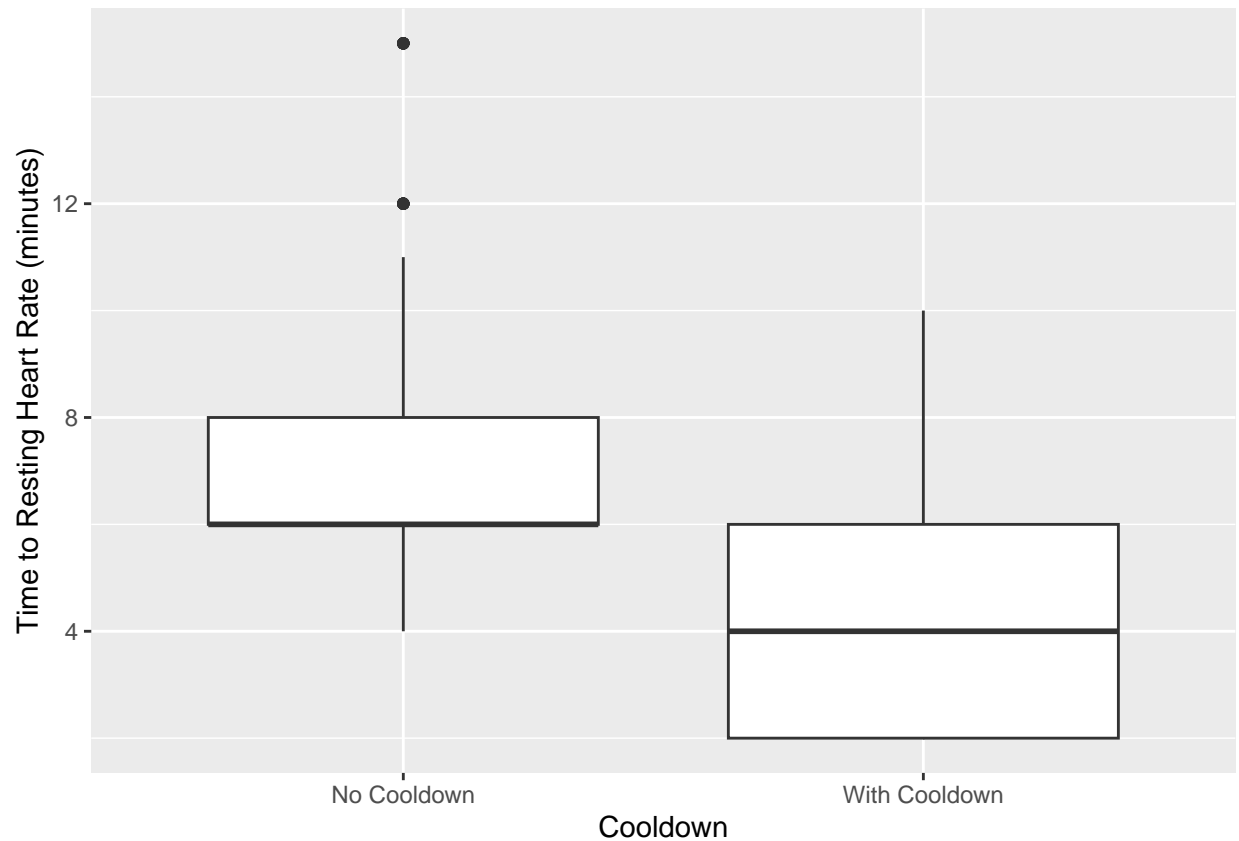
ex.plot
```



```
# generates box plot BPM with CD vs. without CD
cd.plot <- ggplot(ex.prog, aes(CD, Time.CD)) + geom_boxplot() +
  labs(y = "Time to Resting Heart Rate (minutes)",
       x = "Cooldown") +
  scale_x_discrete(labels = c("No Cooldown", "With Cooldown"))

ggsave("C:/Users/Xyrine/Documents/School Stuff/BS BIO 4th Year/1st Semester/BIO 118/Module 1/Module 1 - 
       width = 8, height = 6)

cd.plot
```



2. T-TEST

2a. Test for normality of distribution

Shapiro-Wilk normality Test

```
shapiro.test(ex.prog$Time.CD[ex.prog$CD == "No CD"]) # p = 1.194386e-19
```

```
##
## Shapiro-Wilk normality test
##
## data:  ex.prog$Time.CD[ex.prog$CD == "No CD"]
## W = 0.86299, p-value < 2.2e-16
```

p < 0.05; not normal

```
shapiro.test(ex.prog$Time.CD[ex.prog$CD == "With CD"]) # p = 2.541089e-18
```

```
##
## Shapiro-Wilk normality test
##
## data:  ex.prog$Time.CD[ex.prog$CD == "With CD"]
## W = 0.88123, p-value < 2.2e-16
```

```
# p < 0.05; not normal
```

2b. Test for homogeneity in variances

```
## homoscedasticity
```

```
leveneTest(Time.CD ~ CD, ex.prog) # p = 0.5698
```

```
## Levene's Test for Homogeneity of Variance (center = median)
##      Df F value Pr(>F)
## group 1  0.3233 0.5698
##      918
```

```
# p > 0.05; assume equality of variance
```

2c. Non-parametric and parametric T-test

```
## Unpaired Two-samples Wilcoxon Test
```

```
# wilcoxon
```

```
wx.cd <- wilcox.test(Time.CD ~ CD, data = ex.prog,
                     exact = FALSE)
wx.cd$p.value # p = 6.90694e-51; p < 0.05; reject Ho
```

```
## [1] 6.90694e-51
```

```
# t-test
```

```
ttest.cd <- t.test(Time.CD ~ CD, data = ex.prog,
                   alternative = "two.sided", paired = FALSE, var.equal = TRUE)
ttest.cd$p.value # p = 1.270444e-54; p < 0.05; reject Ho
```

```
## [1] 1.270444e-54
```