Appendix/Computer Code

```
>library(tidyverse)
>library(ggplot2)
>library(dplyr)
> library(dslabs)
> library(stringr)
> Loki <- read.csv("C:/Users/ziqia/OneDrive/Desktop/Loki.csv")
>Loki_1 <- Loki[-c(1:7, 50827), ]
>Morpho <- read.csv("C:/Users/ziqia/OneDrive/Desktop/Morpho.csv")
>Morpho_1 <- Morpho
```

Daily Collected Activities

```
>#Loki: 721, 726, 803, 805, 806, 807
>##Loki 721
> Loki_1 <- Loki[-c(1:7, 50827), ]
> ##Loki 721
> Loki_721 <-  Loki_1[Loki_1$Date_Stamp=="21-Jul-17", ]
> Loki_721_histo <- Loki_721
> ggplot(Loki_721_histo, aes(Time_Stamp))+
+   geom_bar(aes(y=Activity_Data), stat="identity", width=1/60) +
+   ggtitle("Loki's Activity Data on July 21 of 2017")+
+   scale_x_continuous(breaks=seq(0,24,4))+
+   scale_y_continuous(breaks=seq(0,3000,500),limits = c(0,3000))+
+   xlab("Time")+ylab("Activity Level")

> ##Loki 726
> Loki_726 <-  Loki_1[Loki_1$Date_Stamp=="26-Jul-17", ]
> Loki_726_histo <- Loki_726
> ggplot(Loki_726_histo, aes(Time_Stamp))+
+   geom_bar(aes(y=Activity_Data), stat="identity", width=1/60) +
+   ggtitle("Loki's Activity Data on July 26 of 2017")+
+   scale_x_continuous(breaks=seq(0,24,4))+
+   scale_y_continuous(breaks=seq(0,3000,500),limits = c(0,3000))+
+   xlab("Time")+ylab("Activity Level")

> ##Loki 727
> Loki_727 <-  Loki_1[Loki_1$Date_Stamp=="27-Jul-17", ]
> Loki_727_histo <- Loki_727
> ggplot(Loki_727_histo, aes(Time_Stamp))+
+   geom_bar(aes(y=Activity_Data), stat="identity", width=1/60) +
+   ggtitle("Loki's Activity Data on July 27 of 2017")+
+   scale_x_continuous(breaks=seq(0,24,4))+
+   scale_y_continuous(breaks=seq(0,3000,500),limits = c(0,3000))+
+   xlab("Time")+ylab("Activity Level")

> ##Loki 803
```

```
> Loki_803 <-  Loki_1[Loki_1$Date_Stamp=="3-Aug-17", ]
> Loki_803_histo <- Loki_803
> ggplot(Loki_803_histo, aes(Time_Stamp))+
+   geom_bar(aes(y=Activity_Data), stat="identity", width=1/60) +
+   ggtitle("Loki's Activity Data on August 3 of 2017")+
+   scale_x_continuous(breaks=seq(0,24,4))+
+   scale_y_continuous(breaks=seq(0,3000,500),limits = c(0,3000))+
+   xlab("Time")+ylab("Activity Level")

> ##Loki 805
> Loki_805 <-  Loki_1[Loki_1$Date_Stamp=="5-Aug-17", ]
> Loki_805_histo <- Loki_805
> ggplot(Loki_805_histo, aes(Time_Stamp))+
+   geom_bar(aes(y=Activity_Data), stat="identity", width=1/60) +
+   ggtitle("Loki's Activity Data on August 5 of 2017")+
+   scale_x_continuous(breaks=seq(0,24,4))+
+   scale_y_continuous(breaks=seq(0,3000,500),limits = c(0,3000))+
+   xlab("Time")+ylab("Activity Level")

> ##Loki 806
> Loki_806 <-  Loki_1[Loki_1$Date_Stamp=="6-Aug-17", ]
> Loki_806_histo <- Loki_806
> ggplot(Loki_806_histo, aes(Time_Stamp))+
+   geom_bar(aes(y=Activity_Data), stat="identity", width=1/60) +
+   ggtitle("Loki's Activity Data on August 6 of 2017")+
+   scale_x_continuous(breaks=seq(0,24,4))+
+   scale_y_continuous(breaks=seq(0,3000,500),limits = c(0,3000))+
+   xlab("Time")+ylab("Activity Level")

> ##Loki 807
> Loki_807 <-  Loki_1[Loki_1$Date_Stamp=="7-Aug-17", ]
> Loki_807_histo <- Loki_807
> ggplot(Loki_807_histo, aes(Time_Stamp))+
+   geom_bar(aes(y=Activity_Data), stat="identity", width=1/60) +
+   ggtitle("Loki's Activity Data on August 7 of 2017")+
+   scale_x_continuous(breaks=seq(0,24,4))+
+   scale_y_continuous(breaks=seq(0,3000,500),limits = c(0,3000))+
+   xlab("Time")+ylab("Activity Level")

>#Morpho: 722, 723, 729, 730, 804
> ##Morpho 722
> Morpho_722 <-  Morpho_1[Morpho_1$Date_Stamp=="22-Jul-17", ]
> Morpho_722_histo <- Morpho_722
> ggplot(Morpho_722_histo, aes(Time_Stamp))+
+   geom_bar(fill="grey", aes(y=Activity_Data), stat="identity", width=1/60) +
+   ggtitle("Morpho's Activity Data on July 22 of 2017")+
```

```
+   scale_x_continuous(breaks=seq(0,24,4))+
+   scale_y_continuous(breaks=seq(0,3000,500),limits = c(0,3000))+
+   xlab("Time")+ylab("Activity Level")

> ##Morpho 723
> Morpho_723 <-  Morpho_1[Morpho_1$Date_Stamp=="23-Jul-17", ]
> Morpho_723_histo <- Morpho_723
> ggplot(Morpho_723_histo, aes(Time_Stamp))+
+   geom_bar(fill="grey", aes(y=Activity_Data), stat="identity", width=1/60) +
+   ggtitle("Morpho's Activity Data on July 23 of 2017")+
+   scale_x_continuous(breaks=seq(0,24,4))+
+   scale_y_continuous(breaks=seq(0,3000,500),limits = c(0,3000))+
+   xlab("Time")+ylab("Activity Level")

> ##Morpho 729
> Morpho_729 <-  Morpho_1[Morpho_1$Date_Stamp=="29-Jul-17", ]
> Morpho_729_histo <- Morpho_729
> ggplot(Morpho_729_histo, aes(Time_Stamp))+
+   geom_bar(fill="grey", aes(y=Activity_Data), stat="identity", width=1/60) +
+   ggtitle("Morpho's Activity Data on July 29 of 2017")+
+   scale_x_continuous(breaks=seq(0,24,4))+
+   scale_y_continuous(breaks=seq(0,3000,500),limits = c(0,3000))+
+   xlab("Time")+ylab("Activity Level")

> ##Morpho 730
> Morpho_730 <-  Morpho_1[Morpho_1$Date_Stamp=="30-Jul-17", ]
> Morpho_730_histo <- Morpho_730
> ggplot(Morpho_730_histo, aes(Time_Stamp))+
+   geom_bar(aes(fill="grey", y=Activity_Data), stat="identity", width=1/60) +
+   ggtitle("Morpho's Activity Data on July 30 of 2017")+
+   scale_x_continuous(breaks=seq(0,24,4))+
+   scale_y_continuous(breaks=seq(0,3000,500),limits = c(0,3000))+
+   xlab("Time")+ylab("Activity Level")

> ##Morpho 804
> Morpho_804 <-  Morpho_1[Morpho_1$Date_Stamp=="4-Aug-17", ]
> Morpho_804_histo <- Morpho_804
> ggplot(Morpho_804_histo, aes(Time_Stamp))+
+   geom_bar(fill="grey", aes(y=Activity_Data), stat="identity", width=1/60) +
+   ggtitle("Morpho's Activity Data on August 4 of 2017")+
+   scale_x_continuous(breaks=seq(0,24,4))+
+   scale_y_continuous(breaks=seq(0,3000,500),limits = c(0,3000))+
+   xlab("Time")+ylab("Activity Level")
```

Identification of Daily Activities Relative to Sunrise

```
>###Loki
>###805 Sunrise
> determined_805 <- Loki_Time_Updated[Loki_Time_Updated$Date_Stamp=="5-Aug-17", ]
> determined_805_sunrise <- Loki_1
> determined_805_rows <- determined_805_sunrise$Time_Stamp >= 4.30 &
determined_805_sunrise$Time_Stamp <= 18.59
> determined_805_sunrise <- determined_805_sunrise[determined_805_rows, ]
> determined_805_sunrise <-
determined_805_sunrise[determined_805_sunrise$Date_Stamp=='5-Aug-17', ]
> combine_data_805 <- left_join(determined_805_sunrise,determined_805)
Joining, by = c("Date_Stamp", "Time_Stamp", "Activity_Data",
"Time_Stamp_text", "Time_hour_format", "Time_Fraction", "Zero")
> combine_data_805$Determined_Activity[is.na(combine_data_805$Determined_Activity)] <-
""
> sunrise_time <- 6.08
> combine_data_805$Sunrise_Relative <- c(combine_data_805$Time_Stamp - sunrise_time)
> ggplot(Loki_805, aes(x=Sunrise_Relative))+
+   geom_bar(aes(y=Activity_Data), stat="identity",  position="identity", width=1/60)+
+   geom_point(aes(y=Zero, color= Determined_Activity),  size=4,shape=17)+
+   ggtitle("Loki's Activity Data on August 5th Relative to Sunrise")+
+   xlab("Time Relative to Sunrise (Hours) ")+
+   ylab("Activity Level")+
+   scale_x_continuous(breaks=seq(-4,20,4))+
+   ylim(-80,3000)+
+   scale_color_discrete("Observed Activity",  na.translate=F)
> Loki_807 <- Loki_Time_Updated[c(30241:31680), ]
> ggplot(Loki_807, aes(x=Sunrise_Relative))+
+   geom_bar(aes(y=Activity_Data), stat="identity",  position="identity", width=1/60)+
+   geom_point(aes(y=Zero, color=Determined_Activity),  size=4,shape=17)+
+   theme(axis.text.x=element_text(size=10))+
+   theme(axis.text.y=element_text(size=10))+
+   ggtitle("Loki's Activity Data on August 7th Relative to Sunrise")+
+   xlab("Time Relative to Sunrise (Hours)")+
+   ylab("Activity Level")+
+   scale_x_continuous(breaks=seq(-4,20,4))+
+   ylim(-80,3000)+
+   scale_color_discrete("Observed Activity",  na.translate=F)

>###807 Sunrise
> Loki_807 <- Loki_Time_Updated[c(30241:31680), ]
> determined_807 <- Loki_Time_Updated[Loki_Time_Updated$Date_Stamp=="7-Aug-17", ]
> determined_807_sunrise <- Loki_1
> determined_807_rows <- determined_807_sunrise$Time_Stamp >= 4.30 &
determined_807_sunrise$Time_Stamp <= 18.59
> determined_807_sunrise <- determined_807_sunrise[determined_807_rows, ]
```

```
> determined_807_sunrise <-
determined_807_sunrise[determined_807_sunrise$Date_Stamp=='7-Aug-17', ]
> combine_data_807 <- left_join(determined_807_sunrise,determined_807)
Joining, by = c("Date_Stamp", "Time_Stamp", "Activity_Data",
"Time_Stamp_text", "Time_hour_format", "Time_Fraction", "Zero")
> combine_data_807$Determined_Activity[is.na(combine_data_807$Determined_Activity)] <-
""
> sunrise_time <- 6.08
> combine_data_807$Sunrise_Relative <- c(combine_data_807$Time_Stamp - sunrise_time)
> ggplot(Loki_807, aes(x=Sunrise_Relative))+
+   geom_bar(aes(y=Activity_Data), stat="identity",  position="identity", width=1/60)+
+   geom_point(aes(y=Zero, color= Determined_Activity),  size=4,shape=17)+
+   ggtitle("Loki's Activity Data on August 7th Relative to Sunrise")+
+   xlab("Time Relative to Sunrise (Hours) ")+
+   ylab("Activity Level")+
+   scale_x_continuous(breaks=seq(-4,20,4))+
+   ylim(-80,3000)+
+   scale_color_discrete("Observed Activity",  na.translate=F)

>###Morpho
>morpho_start_end[morpho_start_end == "Day Start"] <- "Leave Sleeping Tree"
>morpho_start_end[morpho_start_end == "Day End"] <- "Enter Sleeping Tree"

> ##819 Sunrise
> Morpho_Activity_819 <- morpho_start_end[morpho_start_end$Date_Stamp=="19-Aug-17", ]
> determined_819 <- morpho_start_end[morpho_start_end$Date_Stamp=="19-Aug-17", ]
> determined_819_sunrise <- Morpho_1
> determined_819_rows <- determined_819_sunrise$Time_Stamp >= 4.30 &
determined_819_sunrise$Time_Stamp <= 18.59
> determined_819_sunrise <- determined_819_sunrise[determined_819_rows, ]
> determined_819_sunrise <-
determined_819_sunrise[determined_819_sunrise$Date_Stamp=='19-Aug-17', ]
> combine_data_819 <- left_join(determined_819_sunrise,determined_819)
Joining, by = c("Date_Stamp", "Time_Stamp", "Activity_Data")
> combine_data_819 <- combine_data_819[-392, ]
> combine_data_819$Determined_Activity[is.na(combine_data_819$Determined_Activity)] <-
""
> sunrise_time <- 6.05
> combine_data_819$Sunrise_Relative <- c(combine_data_819$Time_Stamp - sunrise_time)
> ggplot(combine_data_819, aes(Sunrise_Relative))+
+   geom_histogram(fill = "grey", aes(y=Activity_Data), stat="identity", width=1/60)+
+   geom_point(aes(y=Zero, color=Determined_Activity), size=4, shape=17)+
+   ggtitle("Morpho's Activity Data on August 19th Relative to Sunrise")+
+   xlab("Time (hours)") + ylab("Activity Levels")+
+   scale_x_continuous(breaks=seq(-4,20,4))+
+   ylim(-80,3000)+
```

```
+   labs(x="Time Relative to Sunrise (Hours)")+
+   scale_colour_discrete(name="Observed Activity")

> ##820 Sunrise
> Morpho_Activity_820 <- morpho_start_end[morpho_start_end$Date_Stamp=="20-Aug-17", ]
> determined_820 <- morpho_start_end[morpho_start_end$Date_Stamp=="20-Aug-17", ]
> determined_820_sunrise <- Morpho_1
> determined_820_rows <- determined_820_sunrise$Time_Stamp >= 4.30 &
determined_820_sunrise$Time_Stamp <= 18.59
> determined_820_sunrise <- determined_820_sunrise[determined_820_rows, ]
> determined_820_sunrise <-
determined_820_sunrise[determined_820_sunrise$Date_Stamp=='20-Aug-17', ]
> combine_data_820 <- left_join(determined_820_sunrise,determined_820)
Joining, by = c("Date_Stamp", "Time_Stamp", "Activity_Data")
> combine_data_820 <- combine_data_820[-392, ]
> combine_data_820$Determined_Activity[is.na(combine_data_820$Determined_Activity)] <-
""
> sunrise_time <- 6.05
> combine_data_820$Sunrise_Relative <- c(combine_data_820$Time_Stamp - sunrise_time)
> ggplot(combine_data_820, aes(Sunrise_Relative))+
+   geom_histogram(fill = "grey", aes(y=Activity_Data), stat="identity", width=1/60)+
+   geom_point(aes(y=Zero, color=Determined_Activity), size=4, shape=17)+
+   ggtitle("Morpho's Activity Data on August 20th Relative to Sunrise")+
+   xlab("Time (hours)") + ylab("Activity Levels")+
+   scale_x_continuous(breaks=seq(-4,20,4))+
+   ylim(-80,3000)+
+   labs(x="Time Relative to Sunrise (Hours)")+
+   scale_colour_discrete(name="Observed Activity")

> ##922 Sunrise
> Morpho_Activity_922 <- morpho_start_end[morpho_start_end$Date_Stamp=="22-Sep-17", ]
> determined_922 <- morpho_start_end[morpho_start_end$Date_Stamp=="22-Sep-17", ]
> determined_922_sunrise <- Morpho_1
> determined_922_rows <- determined_922_sunrise$Time_Stamp >= 4.30 &
determined_922_sunrise$Time_Stamp <= 18.59
> determined_922_sunrise <- determined_922_sunrise[determined_922_rows, ]
> determined_922_sunrise <-
determined_922_sunrise[determined_922_sunrise$Date_Stamp=='22-Sep-17', ]
> combine_data_922 <- left_join(determined_922_sunrise,determined_922)
Joining, by = c("Date_Stamp", "Time_Stamp", "Activity_Data")
> combine_data_922 <- combine_data_922[-392, ]
> combine_data_922$Determined_Activity[is.na(combine_data_922$Determined_Activity)] <-
""
> sunrise_time <- 5.54
> combine_data_922$Sunrise_Relative <- c(combine_data_922$Time_Stamp - sunrise_time)
> ggplot(combine_data_922, aes(Sunrise_Relative))+
```

```
+   geom_histogram(fill = "grey", aes(y=Activity_Data), stat="identity", width=1/60)+
+   geom_point(aes(y=Zero, color=Determined_Activity), size=4, shape=17)+
+   ggtitle("Morpho's Activity Data on September 22nd Relative to Sunrise")+
+   xlab("Time (hours)") + ylab("Activity Levels")+
+   scale_x_continuous(breaks=seq(-4,20,4))+
+   ylim(-80,3000)+
+   labs(x="Time Relative to Sunrise (Hours)")+
+   scale_colour_discrete(name="Observed Activity")

> ##1007 Sunrise
> Morpho_Activity_1007 <- morpho_start_end[morpho_start_end$Date_Stamp=="7-Oct-17", ]
> determined_1007 <- morpho_start_end[morpho_start_end$Date_Stamp=="7-Oct-17", ]
> determined_1007_sunrise <- Morpho_1
> determined_1007_rows <- determined_1007_sunrise$Time_Stamp >= 4.30 &
determined_1007_sunrise$Time_Stamp <= 18.59
> determined_1007_sunrise <- determined_1007_sunrise[determined_1007_rows, ]
> determined_1007_sunrise <-
determined_1007_sunrise[determined_1007_sunrise$Date_Stamp=='7-Oct-17', ]
> combine_data_1007 <- left_join(determined_1007_sunrise,determined_1007)
Joining, by = c("Date_Stamp", "Time_Stamp", "Activity_Data")
> combine_data_1007 <- combine_data_1007[-392, ]
> combine_data_1007$Determined_Activity[is.na(combine_data_1007$Determined_Activity)]
<- ""
> sunrise_time <- 5.49
> combine_data_1007$Sunrise_Relative <- c(combine_data_1007$Time_Stamp - sunrise_time)
> ggplot(combine_data_1007, aes(Sunrise_Relative))+
+   geom_histogram(fill = "grey", aes(y=Activity_Data), stat="identity", width=1/60)+
+   geom_point(aes(y=Zero, color=Determined_Activity), size=4, shape=17)+
+   ggtitle("Morpho's Activity Data on October 7th Relative to Sunrise")+
+   xlab("Time (hours)") + ylab("Activity Levels")+
+   scale_x_continuous(breaks=seq(-4,20,4))+
+   ylim(-80,3000)+
+   labs(x="Time Relative to Sunrise (Hours)")+
+   scale_colour_discrete(name="Observed Activity")

> ##1008 Sunrise
> Morpho_Activity_1008 <- morpho_start_end[morpho_start_end$Date_Stamp=="8-Oct-17", ]
> determined_1008 <- morpho_start_end[morpho_start_end$Date_Stamp=="8-Oct-17", ]
> determined_1008_sunrise <- Morpho_1
> determined_1008_rows <- determined_1008_sunrise$Time_Stamp >= 4.30 &
determined_1008_sunrise$Time_Stamp <= 18.59
> determined_1008_sunrise <- determined_1008_sunrise[determined_1008_rows, ]
> determined_1008_sunrise <-
determined_1008_sunrise[determined_1008_sunrise$Date_Stamp=='8-Oct-17', ]
> combine_data_1008 <- left_join(determined_1008_sunrise,determined_1008)
Joining, by = c("Date_Stamp", "Time_Stamp", "Activity_Data")
```

```
> combine_data_1008 <- combine_data_1008[-392, ]
> combine_data_1008$Determined_Activity[is.na(combine_data_1008$Determined_Activity)]
<- ""
> sunrise_time <- 5.49
> combine_data_1008$Sunrise_Relative <- c(combine_data_1008$Time_Stamp - sunrise_time)
> ggplot(combine_data_1008, aes(Sunrise_Relative))+
+   geom_histogram(fill = "grey", aes(y=Activity_Data), stat="identity", width=1/60)+
+   geom_point(aes(y=Zero, color=Determined_Activity), size=4, shape=17)+
+   ggtitle("Morpho's Activity Data on October 8th Relative to Sunrise")+
+   xlab("Time (hours)") + ylab("Activity Levels")+
+   scale_x_continuous(breaks=seq(-4,20,4))+
+   ylim(-80,3000)+
+   labs(x="Time Relative to Sunrise (Hours)")+
+   scale_colour_discrete(name="Observed Activity")


> ##1029 Sunrise
> Morpho_Activity_1029 <- morpho_start_end[morpho_start_end$Date_Stamp=="29-Oct-17", ]
> determined_1029 <- morpho_start_end[morpho_start_end$Date_Stamp=="29-Oct-17", ]
> determined_1029_sunrise <- Morpho_1
> determined_1029_rows <- determined_1029_sunrise$Time_Stamp >= 4.30 &
determined_1029_sunrise$Time_Stamp <= 18.59
> determined_1029_sunrise <- determined_1029_sunrise[determined_1029_rows, ]
> determined_1029_sunrise <-
determined_1029_sunrise[determined_1029_sunrise$Date_Stamp=='29-Oct-17', ]
> combine_data_1029 <- left_join(determined_1029_sunrise,determined_1029)
Joining, by = c("Date_Stamp", "Time_Stamp", "Activity_Data")
> combine_data_1029 <- combine_data_1029[-392, ]
> combine_data_1029$Determined_Activity[is.na(combine_data_1029$Determined_Activity)]
<- ""
> sunrise_time <- 5.44
> combine_data_1029$Sunrise_Relative <- c(combine_data_1029$Time_Stamp - sunrise_time)
> ggplot(combine_data_1029, aes(Sunrise_Relative))+
+   geom_histogram(fill = "grey", aes(y=Activity_Data), stat="identity", width=1/60)+
+   geom_point(aes(y=Zero, color=Determined_Activity), size=4, shape=17)+
+   ggtitle("Morpho's Activity Data on October 29th Relative to Sunrise")+
+   xlab("Time (hours)") + ylab("Activity Levels")+
+   scale_x_continuous(breaks=seq(-4,20,4))+
+   ylim(-80,3000)+
+   labs(x="Time Relative to Sunrise (Hours)")+
+   scale_colour_discrete(name="Observed Activity")

> ##1107 Sunrise
> Morpho_Activity_1107 <- morpho_start_end[morpho_start_end$Date_Stamp=="7-Nov-17", ]
> determined_1107 <- morpho_start_end[morpho_start_end$Date_Stamp=="7-Nov-17", ]
> determined_1107_sunrise <- Morpho_1
```

```
> determined_1107_rows <- determined_1107_sunrise$Time_Stamp >= 4.30 &
determined_1107_sunrise$Time_Stamp <= 18.59
> determined_1107_sunrise <- determined_1107_sunrise[determined_1107_rows, ]
> determined_1107_sunrise <-
determined_1107_sunrise[determined_1107_sunrise$Date_Stamp=='7-Nov-17', ]
> combine_data_1107 <- left_join(determined_1107_sunrise,determined_1107)
Joining, by = c("Date_Stamp", "Time_Stamp", "Activity_Data")
> combine_data_1107 <- combine_data_1107[-392, ]
> combine_data_1107$Determined_Activity[is.na(combine_data_1107$Determined_Activity)]
<- ""
> sunrise_time <- 5.44
> combine_data_1107$Sunrise_Relative <- c(combine_data_1107$Time_Stamp - sunrise_time)
> ggplot(combine_data_1107, aes(Sunrise_Relative))+
+   geom_histogram(fill = "grey", aes(y=Activity_Data), stat="identity", width=1/60)+
+   geom_point(aes(y=Zero, color=Determined_Activity), size=4, shape=17)+
+   ggtitle("Morpho's Activity Data on November 7th Relative to Sunrise")+
+   xlab("Time (hours)") + ylab("Activity Levels")+
+   scale_x_continuous(breaks=seq(-4,20,4))+
+   ylim(-80,3000)+
+   labs(x="Time Relative to Sunrise (Hours)")+
+   scale_colour_discrete(name="Observed Activity")

> ##1108 Sunrise
> Morpho_Activity_1108 <- morpho_start_end[morpho_start_end$Date_Stamp=="8-Nov-17", ]
> determined_1108 <- morpho_start_end[morpho_start_end$Date_Stamp=="8-Nov-17", ]
> determined_1108_sunrise <- Morpho_1
> determined_1108_rows <- determined_1108_sunrise$Time_Stamp >= 4.30 &
determined_1108_sunrise$Time_Stamp <= 18.59
> determined_1108_sunrise <- determined_1108_sunrise[determined_1108_rows, ]
> determined_1108_sunrise <-
determined_1108_sunrise[determined_1108_sunrise$Date_Stamp=='8-Nov-17', ]
> combine_data_1108 <- left_join(determined_1108_sunrise,determined_1108)
Joining, by = c("Date_Stamp", "Time_Stamp", "Activity_Data")
> combine_data_1108 <- combine_data_1108[-392, ]
> combine_data_1108$Determined_Activity[is.na(combine_data_1108$Determined_Activity)]
<- ""
> sunrise_time <- 5.44
> combine_data_1108$Sunrise_Relative <- c(combine_data_1108$Time_Stamp - sunrise_time)
> ggplot(combine_data_1108, aes(Sunrise_Relative))+
+   geom_histogram(fill = "grey", aes(y=Activity_Data), stat="identity", width=1/60)+
+   geom_point(aes(y=Zero, color=Determined_Activity), size=4, shape=17)+
+   ggtitle("Morpho's Activity Data on November 8th Relative to Sunrise")+
+   xlab("Time (hours)") + ylab("Activity Levels")+
+   scale_x_continuous(breaks=seq(-4,20,4))+
+   ylim(-80,3000)+
+   labs(x="Time Relative to Sunrise (Hours)")+
```

```
+   scale_colour_discrete(name="Observed Activity")

> ##1109 Sunrise
> Morpho_Activity_1109 <- morpho_start_end[morpho_start_end$Date_Stamp=="9-Nov-17", ]
> determined_1109 <- morpho_start_end[morpho_start_end$Date_Stamp=="9-Nov-17", ]
> determined_1109_sunrise <- Morpho_1
> determined_1109_rows <- determined_1109_sunrise$Time_Stamp >= 4.30 &
determined_1109_sunrise$Time_Stamp <= 18.59
> determined_1109_sunrise <- determined_1109_sunrise[determined_1109_rows, ]
> determined_1109_sunrise <-
determined_1109_sunrise[determined_1109_sunrise$Date_Stamp=='9-Nov-17', ]
> combine_data_1109 <- left_join(determined_1109_sunrise,determined_1109)
Joining, by = c("Date_Stamp", "Time_Stamp", "Activity_Data")
> combine_data_1109 <- combine_data_1109[-392, ]
> combine_data_1109$Determined_Activity[is.na(combine_data_1109$Determined_Activity)]
<- ""
> sunrise_time <- 5.44
> combine_data_1109$Sunrise_Relative <- c(combine_data_1109$Time_Stamp - sunrise_time)
> ggplot(combine_data_1109, aes(Sunrise_Relative))+
+   geom_histogram(fill = "grey", aes(y=Activity_Data), stat="identity", width=1/60)+
+   geom_point(aes(y=Zero, color=Determined_Activity), size=4, shape=17)+
+   ggtitle("Morpho's Activity Data on November 9th Relative to Sunrise")+
+   xlab("Time (hours)") + ylab("Activity Levels")+
+   scale_x_continuous(breaks=seq(-4,20,4))+
+   ylim(-80,3000)+
+   labs(x="Time Relative to Sunrise (Hours)")+
+   scale_colour_discrete(name="Observed Activity")

> ##1121 Sunrise
> Morpho_Activity_1121 <- morpho_start_end[morpho_start_end$Date_Stamp=="21-Nov-17",
]
> determined_1121 <- morpho_start_end[morpho_start_end$Date_Stamp=="21-Nov-17", ]
> determined_1121_sunrise <- Morpho_1
> determined_1121_rows <- determined_1121_sunrise$Time_Stamp >= 4.30 &
determined_1121_sunrise$Time_Stamp <= 18.59
> determined_1121_sunrise <- determined_1121_sunrise[determined_1121_rows, ]
> determined_1121_sunrise <-
determined_1121_sunrise[determined_1121_sunrise$Date_Stamp=='21-Nov-17', ]
> combine_data_1121 <- left_join(determined_1121_sunrise,determined_1121)
Joining, by = c("Date_Stamp", "Time_Stamp", "Activity_Data")
> combine_data_1121 <- combine_data_1121[-392, ]
> combine_data_1121$Determined_Activity[is.na(combine_data_1121$Determined_Activity)]
<- ""
> sunrise_time <- 5.46
> combine_data_1121$Sunrise_Relative <- c(combine_data_1121$Time_Stamp - sunrise_time)
> ggplot(combine_data_1121, aes(Sunrise_Relative))+
```

```
+   geom_histogram(fill = "grey", aes(y=Activity_Data), stat="identity", width=1/60)+
+   geom_point(aes(y=Zero, color=Determined_Activity), size=4, shape=17)+
+   ggtitle("Morpho's Activity Data on November 21st Relative to Sunrise")+
+   xlab("Time (hours)") + ylab("Activity Levels")+
+   scale_x_continuous(breaks=seq(-4,20,4))+
+   ylim(-80,3000)+
+   labs(x="Time Relative to Sunrise (Hours)")+
+   scale_colour_discrete(name="Observed Activity")

> ##1122 Sunrise
> Morpho_Activity_1122 <- morpho_start_end[morpho_start_end$Date_Stamp=="22-Nov-17",
]
> determined_1122 <- morpho_start_end[morpho_start_end$Date_Stamp=="22-Nov-17", ]
> determined_1122_sunrise <- Morpho_1
> determined_1122_rows <- determined_1122_sunrise$Time_Stamp >= 4.30 &
determined_1122_sunrise$Time_Stamp <= 18.59
> determined_1122_sunrise <- determined_1122_sunrise[determined_1122_rows, ]
> determined_1122_sunrise <-
determined_1122_sunrise[determined_1122_sunrise$Date_Stamp=='22-Nov-17', ]
> combine_data_1122 <- left_join(determined_1122_sunrise,determined_1122)
Joining, by = c("Date_Stamp", "Time_Stamp", "Activity_Data")
> combine_data_1122 <- combine_data_1122[-392, ]
> combine_data_1122$Determined_Activity[is.na(combine_data_1122$Determined_Activity)]
<- ""
> sunrise_time <- 5.46
> combine_data_1122$Sunrise_Relative <- c(combine_data_1122$Time_Stamp - sunrise_time)
> ggplot(combine_data_1122, aes(Sunrise_Relative))+
+   geom_histogram(fill = "grey", aes(y=Activity_Data), stat="identity", width=1/60)+
+   geom_point(aes(y=Zero, color=Determined_Activity), size=4, shape=17)+
+   ggtitle("Morpho's Activity Data on November 22nd Relative to Sunrise")+
+   xlab("Time (hours)") + ylab("Activity Levels")+
+   scale_x_continuous(breaks=seq(-4,20,4))+
+   ylim(-80,3000)+
+   labs(x="Time Relative to Sunrise (Hours)")+
+   scale_colour_discrete(name="Observed Activity")

> ##1129 Sunrise
> Morpho_Activity_1129 <- morpho_start_end[morpho_start_end$Date_Stamp=="29-Nov-17",
]
> determined_1129 <- morpho_start_end[morpho_start_end$Date_Stamp=="29-Nov-17", ]
> determined_1129_sunrise <- Morpho_1
> determined_1129_rows <- determined_1129_sunrise$Time_Stamp >= 4.30 &
determined_1129_sunrise$Time_Stamp <= 18.59
> determined_1129_sunrise <- determined_1129_sunrise[determined_1129_rows, ]
> determined_1129_sunrise <-
determined_1129_sunrise[determined_1129_sunrise$Date_Stamp=='29-Nov-17', ]
```

```
> combine_data_1129 <- left_join(determined_1129_sunrise,determined_1129)
Joining, by = c("Date_Stamp", "Time_Stamp", "Activity_Data")
> combine_data_1129 <- combine_data_1129[-392, ]
> combine_data_1129$Determined_Activity[is.na(combine_data_1129$Determined_Activity)]
<- ""
> sunrise_time <- 5.48
> combine_data_1129$Sunrise_Relative <- c(combine_data_1129$Time_Stamp - sunrise_time)
> ggplot(combine_data_1129, aes(Sunrise_Relative))+
+   geom_histogram(fill = "grey", aes(y=Activity_Data), stat="identity", width=1/60)+
+   geom_point(aes(y=Zero, color=Determined_Activity), size=4, shape=17)+
+   ggtitle("Morpho's Activity Data on November 29th Relative to Sunrise")+
+   xlab("Time (hours)") + ylab("Activity Levels")+
+   scale_x_continuous(breaks=seq(-4,20,4))+
+   ylim(-80,3000)+
+   labs(x="Time Relative to Sunrise (Hours)")+
+   scale_colour_discrete(name="Observed Activity")

> ##1130 Sunrise
> Morpho_Activity_1130 <- morpho_start_end[morpho_start_end$Date_Stamp=="30-Nov-17",
]
> determined_1130 <- morpho_start_end[morpho_start_end$Date_Stamp=="30-Nov-17", ]
> determined_1130_sunrise <- Morpho_1
> determined_1130_rows <- determined_1130_sunrise$Time_Stamp >= 4.30 &
determined_1130_sunrise$Time_Stamp <= 18.59
> determined_1130_sunrise <- determined_1130_sunrise[determined_1130_rows, ]
> determined_1130_sunrise <-
determined_1130_sunrise[determined_1130_sunrise$Date_Stamp=='30-Nov-17', ]
> combine_data_1130 <- left_join(determined_1130_sunrise,determined_1130)
Joining, by = c("Date_Stamp", "Time_Stamp", "Activity_Data")
> combine_data_1130 <- combine_data_1130[-392, ]
> combine_data_1130$Determined_Activity[is.na(combine_data_1130$Determined_Activity)]
<- ""
> sunrise_time <- 5.48
> combine_data_1130$Sunrise_Relative <- c(combine_data_1130$Time_Stamp - sunrise_time)
> ggplot(combine_data_1130, aes(Sunrise_Relative))+
+   geom_histogram(fill = "grey", aes(y=Activity_Data), stat="identity", width=1/60)+
+   geom_point(aes(y=Zero, color=Determined_Activity), size=4, shape=17)+
+   ggtitle("Morpho's Activity Data on November 30th Relative to Sunrise")+
+   xlab("Time (hours)") + ylab("Activity Levels")+
+   scale_x_continuous(breaks=seq(-4,20,4))+
+   ylim(-80,3000)+
+   labs(x="Time Relative to Sunrise (Hours)")+
+   scale_colour_discrete(name="Observed Activity")

> ##1202 Sunrise
> Morpho_Activity_1202 <- morpho_start_end[morpho_start_end$Date_Stamp=="2-Dec-17", ]
```

```
> determined_1202 <- morpho_start_end[morpho_start_end$Date_Stamp=="2-Dec-17", ]
> determined_1202_sunrise <- Morpho_1
> determined_1202_rows <- determined_1202_sunrise$Time_Stamp >= 4.30 &
determined_1202_sunrise$Time_Stamp <= 18.59
> determined_1202_sunrise <- determined_1202_sunrise[determined_1202_rows, ]
> determined_1202_sunrise <-
determined_1202_sunrise[determined_1202_sunrise$Date_Stamp=='2-Dec-17', ]
>
> combine_data_1202 <- left_join(determined_1202_sunrise,determined_1202)
Joining, by = c("Date_Stamp", "Time_Stamp", "Activity_Data")
> combine_data_1202 <- combine_data_1202[-392, ]
> combine_data_1202$Determined_Activity[is.na(combine_data_1202$Determined_Activity)]
<- ""
> sunrise_time <- 5.49
> combine_data_1202$Sunrise_Relative <- c(combine_data_1202$Time_Stamp - sunrise_time)
> ggplot(combine_data_1202, aes(Sunrise_Relative))+
+   geom_histogram(fill = "grey", aes(y=Activity_Data), stat="identity", width=1/60)+
+   geom_point(aes(y=Zero, color=Determined_Activity), size=4, shape=17)+
+   ggtitle("Morpho's Activity Data on December 2nd Relative to Sunrise")+
+   xlab("Time (hours)") + ylab("Activity Levels")+
+   scale_x_continuous(breaks=seq(-4,20,4))+
+   scale_x_continuous(breaks=seq(-4,20,4))+
+   ylim(-80,3000)+
+   labs(x="Time Relative to Sunrise (Hours)")+
+   scale_colour_discrete(name="Observed Activity")
```

Overall Activities and Relative to Sunrise and Sunset

```
>## Loki's overall activities with time ranges of sunrise and sunset
>combined_loki_updated <- Loki[-c(1:7, 50827), ]
>combined_loki_updated_histo <- combined_loki_updated
>combined_loki_updated_histo$Sun[is.na(combined_loki_updated_histo$Sun)] <- ""

>loki_1_histo <- combined_loki_updated_histo
> ggplot(loki_1_histo, aes(Time_Fraction))+
+   geom_bar(aes(y=Activity_Data), stat="identity", width=1/60, position="identity") +
+   geom_point(aes(y= Zero, color=Sun), size=4, shape=17) +
+   ggtitle("Loki's Overall Activity with Time Ranges of Sunrise and Sunset") +
+   xlab("Time (hours)") + ylab("Activity Levels") +
+   theme(axis.text.x=element_text(size=10)) +
+   theme(axis.text.y=element_text(size=10)) +
+   scale_x_continuous(breaks=seq(0,24,4)) +
+   scale_colour_discrete("Sunrise and Sunset")

> ##Morpho's overall activities with time ranges of sunrise and sunset
```

```
> ##Morpho One Month
> Morpho_One_Month <- subset(combined_morpho_updated, select = -6)
> Morpho_One_Month <- Morpho_One_Month[1:44640, ]
> Morpho_One_Month$Determined_Activity[Morpho_One_Month$Determined_Activity ==
'Day Start'] <- ''
> Morpho_One_Month$Determined_Activity[Morpho_One_Month$Determined_Activity ==
'Day End'] <- ''
> Morpho_One_Month$Determined_Activity[Morpho_One_Month$Determined_Activity ==
'Enter Sleeping Tree'] <- ''
> Morpho_One_Month$Determined_Activity[Morpho_One_Month$Determined_Activity ==
'Jump End'] <- ''
> Morpho_One_Month$Determined_Activity[Morpho_One_Month$Determined_Activity ==
'Jump Start'] <- ''
> Morpho_One_Month$Determined_Activity[Morpho_One_Month$Determined_Activity ==
'Leave Sleeping Tree'] <-''
> Morpho_One_Month$Determined_Activity[Morpho_One_Month$Determined_Activity ==
'Rest End'] <- ''
> Morpho_One_Month$Determined_Activity[Morpho_One_Month$Determined_Activity ==
'Rest Start'] <- ''
>
> colnames(Morpho_One_Month)[5] = 'Sunrise_and_Sunset'
> Morpho_One_Month[366,5] = "Earliest Sunrise"
> Morpho_One_Month[370,5] = "Latest Sunrise"
> Morpho_One_Month[1092,5] = "Earliest Sunset"
> Morpho_One_Month[1095,5] = "Latest Sunset"
> Morpho_One_Month['Zero'] <- NA
> Morpho_One_Month[366, 12] = -150
> Morpho_One_Month[370, 12] = -150
> Morpho_One_Month[1092,12] = -150
> Morpho_One_Month[1095,12] = -150
>
> ggplot(Morpho_One_Month,aes(Time_Fraction))+
+   geom_histogram(fill="grey", aes(y=Activity_Data), stat="identity",
position="identity",width=1/60)+
+   geom_point(aes(y=Zero, color=Sunrise_and_Sunset), size = 4, shape=17)+
+   ggtitle("Morpho's Activity Over One Month with Time Ranges of Sunrise and Sunset")+
+   theme(axis.text.x=element_text(size=10)) +
+   theme(axis.text.y=element_text(size=10)) +
+   scale_x_continuous(breaks=seq(0,24,4)) +
+   scale_y_continuous(breaks=seq(0,6000,1000))+
```

```
+   xlab("Time(Hours)")+
+   ylab("Activity Levels")+
+   scale_colour_discrete("Sunrise and Sunset")

> ##Morpho One Year
> Morpho_One_Year <- subset(combined_morpho_updated, select = -6)
> Morpho_One_Year$Determined_Activity[Morpho_One_Year$Determined_Activity == 'Day
Start'] <- "
> Morpho_One_Year$Determined_Activity[Morpho_One_Year$Determined_Activity == 'Day
End'] <- "
> Morpho_One_Year$Determined_Activity[Morpho_One_Year$Determined_Activity == 'Enter
Sleeping Tree'] <- "
> Morpho_One_Year$Determined_Activity[Morpho_One_Year$Determined_Activity == 'Jump
End'] <- "
> Morpho_One_Year$Determined_Activity[Morpho_One_Year$Determined_Activity == 'Jump
Start'] <- "
> Morpho_One_Year$Determined_Activity[Morpho_One_Year$Determined_Activity == 'Leave
Sleeping Tree'] <- "
> Morpho_One_Year$Determined_Activity[Morpho_One_Year$Determined_Activity == 'Rest
End'] <- "
> Morpho_One_Year$Determined_Activity[Morpho_One_Year$Determined_Activity == 'Rest
Start'] <- "
> colnames(Morpho_One_Year)[5] = 'Sunrise_and_Sunset'
> Morpho_One_Year[345,5] = "Earliest Sunrise"
> Morpho_One_Year[376,5] = "Latest Sunrise"
> Morpho_One_Year[1073,5] = "Earliest Sunset"
> Morpho_One_Year[1104,5] = "Latest Sunset"
> Morpho_One_Year['Zero'] <- NA
> Morpho_One_Year[345,12] = -150
> Morpho_One_Year[376,12] = -150
> Morpho_One_Year[1073,12] = -150
> Morpho_One_Year[1104,12] = -150
> ggplot(Morpho_One_Year,aes(Time_Fraction))+
+   geom_bar(fill="grey", aes(y=Activity_Data), stat="identity",
position="identity",width=1/60)+
+   geom_point(aes(y=Zero, color=Sunrise_and_Sunset), size = 4, shape=17)+
+   ggtitle("Morpho's Overall Activity with Time Ranges of Sunrise and Sunset")+
+   theme(axis.text.x=element_text(size=10)) +
+   theme(axis.text.y=element_text(size=10)) +
+   scale_x_continuous(breaks=seq(0,24,4)) +
```

```
+   scale_y_continuous(breaks=seq(0,6000,1000))+
+   xlab("Time(Hours)")+
+   ylab("Activity Levels")+
+   scale_colour_discrete("Sunrise and Sunset")

> ######################################################################
> ##Loki's line smoothing
> #to aggregate the values by every 5 minutes into intervals
> loki_one_month <- combined_loki_updated[8:50826, ]
> loki_activity_grouped_month <- loki_one_month %>%
+   mutate(Time_Fraction_Groups = as.character(cut(Time_Fraction, seq(0,24,0.08333333))))
%>%
+   group_by(Time_Fraction_Groups) %>%
+   dplyr::summarize(Activity_Data = sum(Activity_Data)) %>%
+   as.data.frame()
> #to extract all of the maxes of the intervals and make them their own dataframe
> Time_Fraction_Name <-
+   sapply(str_extract_all(loki_activity_grouped_month$Time_Fraction_Groups, "-?[0-9.]+"),
+          function(x) max(as.numeric(x)))
> Time_Fraction_Label_month <- as.data.frame(Time_Fraction_Name)
> #to combine the two dataframes into one and reorganize new dataframe to exclude the last NA
row and put everything in order of time
> loki_activity_group_month <- cbind(loki_activity_grouped_month,
+                                    "Time_Fraction_Name" = Time_Fraction_Label_month[, 1])
> loki_activity_group_month <- loki_activity_group_month[-289, ]
> loki_activity_group_month <- loki_activity_group_month %>%
+   arrange(Time_Fraction_Name)
> span <- 0.5
> fit <- with(loki_activity_group_month, ksmooth(Time_Fraction_Name, Activity_Data,
kernel="normal", bandwidth = span))
> #makes the smoothing line graph
> loki_activity_group_month %>%
+   mutate(smooth=fit$y) %>%
+   ggplot(aes(Time_Fraction_Name, Activity_Data))+
+   geom_point(size=3, alpha=0.5, color="light blue")+
+   geom_line(aes(Time_Fraction_Name, smooth), color="blue")+
+   ggtitle("Loki's Smoothing Activity Data Over One Month")+
+   xlab("Time (hours)") + ylab("Activity Levels")+
+   scale_x_continuous(breaks=c(0,4,8,12,16,20,24),limits=c(0,24))+
+   scale_y_continuous((breaks=seq(0,50000,10000)))
```

```
> ##morpho's line smoothing
> #Morpho’s smoothing line
> #to aggregate the values by every 5 minutes into intervals
> morpho_activity_grouped <- combined_morpho_updated %>%
+   mutate(Time_Fraction_Groups = as.character(cut(Time_Fraction, seq(0, 24, 0.08333333))))
%>%
+   group_by(Time_Fraction_Groups) %>%
+   dplyr::summarize(Activity_Data = sum(Activity_Data)) %>%
+   as.data.frame()
> #to extract all of the maxes of the intervals and make them their own dataframe
> Time_Fraction_Name <-
+   sapply(str_extract_all(morpho_activity_grouped$Time_Fraction_Groups, "-?[0-9.]+"),
function(x)
+     max(as.numeric(x)))
> Time_Fraction_Label <- as.data.frame(Time_Fraction_Name)
> #to combine the two dataframes into one and reorganize new dataframe to exclude the last NA
row and put everything in order of time
> morpho_activity_group <- cbind(morpho_activity_grouped, "Time_Fraction_Name" =
+                                Time_Fraction_Label[, 1])
> morpho_activity_group <- slice(morpho_activity_group, 1:n() - 1)
> morpho_activity_group <- morpho_activity_group %>% arrange(Time_Fraction_Name)
> span <- 0.5
> fit <- with(morpho_activity_group, ksmooth(Time_Fraction_Name, Activity_Data, kernel =
+                                            "normal", bandwidth = span))
> #makes the smoothing line graph
> morpho_activity_group %>%
+   mutate(smooth = fit$y) %>%
+   ggplot(aes(Time_Fraction_Name, Activity_Data)) +
+   geom_point(size = 3, alpha = .5, color = "grey") +
+   geom_line(aes(Time_Fraction_Name, smooth), color="red") +
+   ggtitle("Morpho's Smoothing Activity Data over One Year") +
+   xlab("Time (hours)") + ylab("Activity Levels") +
+   theme(axis.text.x=element_text(size=10)) +
+   theme(axis.text.y=element_text(size=10)) +
+   scale_x_continuous(breaks = seq(0, 24, 4)) +
+   scale_y_continuous(breaks = seq(0, 400000, 100000))
```

Table 1. Statistics Analysis

```
> ###morpho’s total activity levels
```

```
> sunrise_morpho_722 <- sunrise_morpho[sunrise_morpho$Date_Stamp == "22-Jul-17", ]
> sum(sunrise_morpho_722$Activity_Data)
[1] 80568
> sunrise_morpho_723 <- sunrise_morpho[sunrise_morpho$Date_Stamp == "23-Jul-17", ]
> sum(sunrise_morpho_723$Activity_Data)
[1] 128701
> sunrise_morpho_724 <- sunrise_morpho[sunrise_morpho$Date_Stamp == "24-Jul-17", ]
> sum(sunrise_morpho_724$Activity_Data)
[1] 66779
> sunrise_morpho_725 <- sunrise_morpho[sunrise_morpho$Date_Stamp == "25-Jul-17", ]
> sum(sunrise_morpho_725$Activity_Data)
[1] 57162
> sunrise_morpho_726 <- sunrise_morpho[sunrise_morpho$Date_Stamp == "26-Jul-17", ]
> sum(sunrise_morpho_726$Activity_Data)
[1] 108051
> sunrise_morpho_727 <- sunrise_morpho[sunrise_morpho$Date_Stamp == "27-Jul-17", ]
> sum(sunrise_morpho_727$Activity_Data)
[1] 68985
> sunrise_morpho_728 <- sunrise_morpho[sunrise_morpho$Date_Stamp == "28-Jul-17", ]
> sum(sunrise_morpho_728$Activity_Data)
[1] 63009
> sunrise_morpho_729 <- sunrise_morpho[sunrise_morpho$Date_Stamp == "29-Jul-17", ]
> sum(sunrise_morpho_729$Activity_Data)
[1] 79674
> sunrise_morpho_730 <- sunrise_morpho[sunrise_morpho$Date_Stamp == "30-Jul-17", ]
> sum(sunrise_morpho_730$Activity_Data)
[1] 60456
> sunrise_morpho_731 <- sunrise_morpho[sunrise_morpho$Date_Stamp == "31-Jul-17", ]
> sum(sunrise_morpho_731$Activity_Data)
[1] 87668
> sunrise_morpho_801 <- sunrise_morpho[sunrise_morpho$Date_Stamp == "1-Aug-17", ]
> sum(sunrise_morpho_801$Activity_Data)
[1] 51008
> sunrise_morpho_802 <- sunrise_morpho[sunrise_morpho$Date_Stamp == "2-Aug-17", ]
> sum(sunrise_morpho_802$Activity_Data)
[1] 104173
> sunrise_morpho_803 <- sunrise_morpho[sunrise_morpho$Date_Stamp == "3-Aug-17", ]
> sum(sunrise_morpho_803$Activity_Data)
[1] 80271
> sunrise_morpho_804 <- sunrise_morpho[sunrise_morpho$Date_Stamp == "4-Aug-17", ]
```

```
> sum(sunrise_morpho_804$Activity_Data)
[1] 73006
> sunrise_morpho_805 <- sunrise_morpho[sunrise_morpho$Date_Stamp == "5-Aug-17", ]
> sum(sunrise_morpho_805$Activity_Data)
[1] 70644
> sunrise_morpho_806 <- sunrise_morpho[sunrise_morpho$Date_Stamp == "6-Aug-17", ]
> sum(sunrise_morpho_806$Activity_Data)
[1] 92001
> sunrise_morpho_807 <- sunrise_morpho[sunrise_morpho$Date_Stamp == "7-Aug-17", ]
> sum(sunrise_morpho_807$Activity_Data)
[1] 77179
> sunrise_morpho_808 <- sunrise_morpho[sunrise_morpho$Date_Stamp == "8-Aug-17", ]
> sum(sunrise_morpho_808$Activity_Data)
[1] 63876
> sunrise_morpho_809 <- sunrise_morpho[sunrise_morpho$Date_Stamp == "9-Aug-17", ]
> sum(sunrise_morpho_809$Activity_Data)
[1] 84999
> sunrise_morpho_810 <- sunrise_morpho[sunrise_morpho$Date_Stamp == "10-Aug-17", ]
> sum(sunrise_morpho_810$Activity_Data)
[1] 83391
> sunrise_morpho_811 <- sunrise_morpho[sunrise_morpho$Date_Stamp == "11-Aug-17", ]
> sum(sunrise_morpho_811$Activity_Data)
[1] 64712
> sunrise_morpho_812 <- sunrise_morpho[sunrise_morpho$Date_Stamp == "12-Aug-17", ]
> sum(sunrise_morpho_812$Activity_Data)
[1] 86899
> sunrise_morpho_813 <- sunrise_morpho[sunrise_morpho$Date_Stamp == "13-Aug-17", ]
> sum(sunrise_morpho_813$Activity_Data)
[1] 88580
> sunrise_morpho_814 <- sunrise_morpho[sunrise_morpho$Date_Stamp == "14-Aug-17", ]
> sum(sunrise_morpho_814$Activity_Data)
[1] 70084
> sunrise_morpho_815 <- sunrise_morpho[sunrise_morpho$Date_Stamp == "15-Aug-17", ]
> sum(sunrise_morpho_815$Activity_Data)
[1] 75247
> sunrise_morpho_816 <- sunrise_morpho[sunrise_morpho$Date_Stamp == "16-Aug-17", ]
> sum(sunrise_morpho_816$Activity_Data)
[1] 75161
> sunrise_morpho_817 <- sunrise_morpho[sunrise_morpho$Date_Stamp == "17-Aug-17", ]
> sum(sunrise_morpho_817$Activity_Data)
```

```
[1] 75963
> sunrise_morpho_818 <- sunrise_morpho[sunrise_morpho$Date_Stamp == "18-Aug-17", ]
> sum(sunrise_morpho_818$Activity_Data)
[1] 74065
> sunrise_morpho_819 <- sunrise_morpho[sunrise_morpho$Date_Stamp == "19-Aug-17", ]
> sum(sunrise_morpho_819$Activity_Data)
[1] 94437
> sunrise_morpho_820 <- sunrise_morpho[sunrise_morpho$Date_Stamp == "20-Aug-17", ]
> sum(sunrise_morpho_820$Activity_Data)
[1] 123037
> sunrise_morpho_821 <- sunrise_morpho[sunrise_morpho$Date_Stamp == "21-Aug-17", ]
> sum(sunrise_morpho_821$Activity_Data)
[1] 200356
> ###Loki's total activity levels
> sunrise_loki_717 <- sunrise_loki[sunrise_loki$Date_Stamp == "17-Jul-17", ]
> sum(sunrise_loki_717$Activity_Data)
[1] 81076
> sunrise_loki_718 <- sunrise_loki[sunrise_loki$Date_Stamp == "18-Jul-17", ]
> sum(sunrise_loki_718$Activity_Data)
[1] 86715
> sunrise_loki_719 <- sunrise_loki[sunrise_loki$Date_Stamp == "19-Jul-17", ]
> sum(sunrise_loki_719$Activity_Data)
[1] 66690
> sunrise_loki_720 <- sunrise_loki[sunrise_loki$Date_Stamp == "20-Jul-17", ]
> sum(sunrise_loki_720$Activity_Data)
[1] 87547
> sunrise_loki_721 <- sunrise_loki[sunrise_loki$Date_Stamp == "21-Jul-17", ]
> sum(sunrise_loki_721$Activity_Data)
[1] 93545
> sunrise_loki_722 <- sunrise_loki[sunrise_loki$Date_Stamp == "22-Jul-17", ]
> sum(sunrise_loki_722$Activity_Data)
[1] 72373
> sunrise_loki_723 <- sunrise_loki[sunrise_loki$Date_Stamp == "23-Jul-17", ]
> sum(sunrise_loki_723$Activity_Data)
[1] 69130
> sunrise_loki_724 <- sunrise_loki[sunrise_loki$Date_Stamp == "24-Jul-17", ]
> sum(sunrise_loki_724$Activity_Data)
[1] 63970
> sunrise_loki_725 <- sunrise_loki[sunrise_loki$Date_Stamp == "25-Jul-17", ]
> sum(sunrise_loki_725$Activity_Data)
```

```
[1] 62979
> sunrise_loki_726 <- sunrise_loki[sunrise_loki$Date_Stamp == "26-Jul-17", ]
> sum(sunrise_loki_726$Activity_Data)
[1] 76246
> sunrise_loki_727 <- sunrise_loki[sunrise_loki$Date_Stamp == "27-Jul-17", ]
> sum(sunrise_loki_727$Activity_Data)
[1] 86692
> sunrise_loki_728 <- sunrise_loki[sunrise_loki$Date_Stamp == "28-Jul-17", ]
> sum(sunrise_loki_728$Activity_Data)
[1] 89187
> sunrise_loki_729 <- sunrise_loki[sunrise_loki$Date_Stamp == "29-Jul-17", ]
> sum(sunrise_loki_729$Activity_Data)
[1] 54345
> sunrise_loki_730 <- sunrise_loki[sunrise_loki$Date_Stamp == "30-Jul-17", ]
> sum(sunrise_loki_730$Activity_Data)
[1] 45203
> sunrise_loki_731 <- sunrise_loki[sunrise_loki$Date_Stamp == "31-Jul-17", ]
> sum(sunrise_loki_731$Activity_Data)
[1] 69188
> sunrise_loki_801 <- sunrise_loki[sunrise_loki$Date_Stamp == "1-Aug-17", ]
> sum(sunrise_loki_801$Activity_Data)
[1] 78404
> sunrise_loki_802 <- sunrise_loki[sunrise_loki$Date_Stamp == "2-Aug-17", ]
> sum(sunrise_loki_802$Activity_Data)
[1] 50481
> sunrise_loki_803 <- sunrise_loki[sunrise_loki$Date_Stamp == "3-Aug-17", ]
> sum(sunrise_loki_803$Activity_Data)
[1] 58603
> sunrise_loki_804 <- sunrise_loki[sunrise_loki$Date_Stamp == "4-Aug-17", ]
> sum(sunrise_loki_801$Activity_Data)
[1] 78404
> sunrise_loki_805 <- sunrise_loki[sunrise_loki$Date_Stamp == "5-Aug-17", ]
> sum(sunrise_loki_805$Activity_Data)
[1] 106499
> sunrise_loki_806 <- sunrise_loki[sunrise_loki$Date_Stamp == "6-Aug-17", ]
> sum(sunrise_loki_806$Activity_Data)
[1] 82590
> sunrise_loki_807 <- sunrise_loki[sunrise_loki$Date_Stamp == "7-Aug-17", ]
> sum(sunrise_loki_807$Activity_Data)
[1] 81312
```

```
> sunrise_loki_808 <- sunrise_loki[sunrise_loki$Date_Stamp == "8-Aug-17", ]
> sum(sunrise_loki_808$Activity_Data)
[1] 108285
> sunrise_loki_809 <- sunrise_loki[sunrise_loki$Date_Stamp == "9-Aug-17", ]
> sum(sunrise_loki_809$Activity_Data)
[1] 81640
> sunrise_loki_810 <- sunrise_loki[sunrise_loki$Date_Stamp == "10-Aug-17", ]
> sum(sunrise_loki_810$Activity_Data)
[1] 100349
> sunrise_loki_811 <- sunrise_loki[sunrise_loki$Date_Stamp == "11-Aug-17", ]
> sum(sunrise_loki_811$Activity_Data)
[1] 103074
> sunrise_loki_812 <- sunrise_loki[sunrise_loki$Date_Stamp == "12-Aug-17", ]
> sum(sunrise_loki_812$Activity_Data)
[1] 74478
> sunrise_loki_813 <- sunrise_loki[sunrise_loki$Date_Stamp == "13-Aug-17", ]
> sum(sunrise_loki_813$Activity_Data)
[1] 100102
> sunrise_loki_814 <- sunrise_loki[sunrise_loki$Date_Stamp == "14-Aug-17", ]
> sum(sunrise_loki_814$Activity_Data)
[1] 62591
> sunrise_loki_815 <- sunrise_loki[sunrise_loki$Date_Stamp == "15-Aug-17", ]
> sum(sunrise_loki_815$Activity_Data)
[1] 69984
> sunrise_loki_816 <- sunrise_loki[sunrise_loki$Date_Stamp == "16-Aug-17", ]
> sum(sunrise_loki_816$Activity_Data)
[1] 65336
> sunrise_loki_817 <- sunrise_loki[sunrise_loki$Date_Stamp == "17-Aug-17", ]
> sum(sunrise_loki_817$Activity_Data)
[1] 64739
> sunrise_loki_818 <- sunrise_loki[sunrise_loki$Date_Stamp == "18-Aug-17", ]
> sum(sunrise_loki_818$Activity_Data)
[1] 61426
> sunrise_loki_819 <- sunrise_loki[sunrise_loki$Date_Stamp == "19-Aug-17", ]
> sum(sunrise_loki_819$Activity_Data)
[1] 146990
> sunrise_loki_820 <- sunrise_loki[sunrise_loki$Date_Stamp == "20-Aug-17", ]
> sum(sunrise_loki_820$Activity_Data)
[1] 127802
> sunrise_loki_821 <- sunrise_loki[sunrise_loki$Date_Stamp == "21-Aug-17", ]
```

```
> sum(sunrise_loki_821$Activity_Data)
[1] 20349
> ###new dataset of two monkeys with total activity levels of each day over one month
> sum_activity <- data.frame(Date_Stamp = c("July 17", "July 18", "July 19", "July 20", "July
21",
+                     "July 22", "July 23", "July 24", "July 25", "July 26",
+                     "July 27", "July 28", "July 29", "July 30",
+                     "July 31", "Aug 1", "Aug 2", "Aug 3", "Aug 4",
+                     "Aug 5", "Aug 6", "Aug 7", "Aug 8", "Aug 9",
+                     "Aug 10", "Aug 11", "Aug 12", "Aug 13", "Aug 14",
+                     "Aug 15", "Aug 16", "Aug 17", "Aug 18", "Aug 19",
+                     "Aug 20", "Aug 21"),
+               Loki_activity = c(81076, 86715, 66690, 87547, 93545,
+                     72373, 69130, 63970, 62979, 76246,
+                     86692, 89187, 54345, 45203,
+                     69188, 78404, 50481, 58603, 78404,
+                     106499, 82590, 81312, 108285, 81640,
+                     100349, 103074, 74478, 100102, 62591,
+                     69984, 65336, 64739, 61426, 146990,
+                     127802, 20349),
+               Morpho_activity = c(NA, NA, NA, NA, NA,
+                       80568, 128701, 66779, 57162, 108051,
+                       68985, 63009, 79674, 60456,
+                       87668, 51008, 104173, 80271, 73006,
+                       70644, 92001, 77179, 63876, 84999,
+                       83391, 64712, 86899, 88580, 70084,
+                       75247, 75161, 75963, 74065, 94437,
+                       123037, 200356))
>##statiscs for Loki
>sum_activity %>% pull(Loki_activity) %>% mean ()
[1] 78564.56
> sum_activity %>% pull(Loki_activity) %>%sd ()
[1] 23297.96
>##%RSD
> 23297.96/78564.56
[1] 0.2965454
> sd(sum_activity$Loki_activity)/sqrt(length((sum_activity$Loki_activity)))
[1] 3882.993
>##statiscs for Morpho
> morpho <- sum_activity[6:36,3]
```

```
> mean(morpho)
[1] 84198.13
> sd(morpho)
[1] 27848.82
>##%RSD
> 27848.82/84198.13
[1] 0.3307534
> sd(morpho)/sqrt(length(morpho))
[1] 5001.795
```