STA141A HW4 Report

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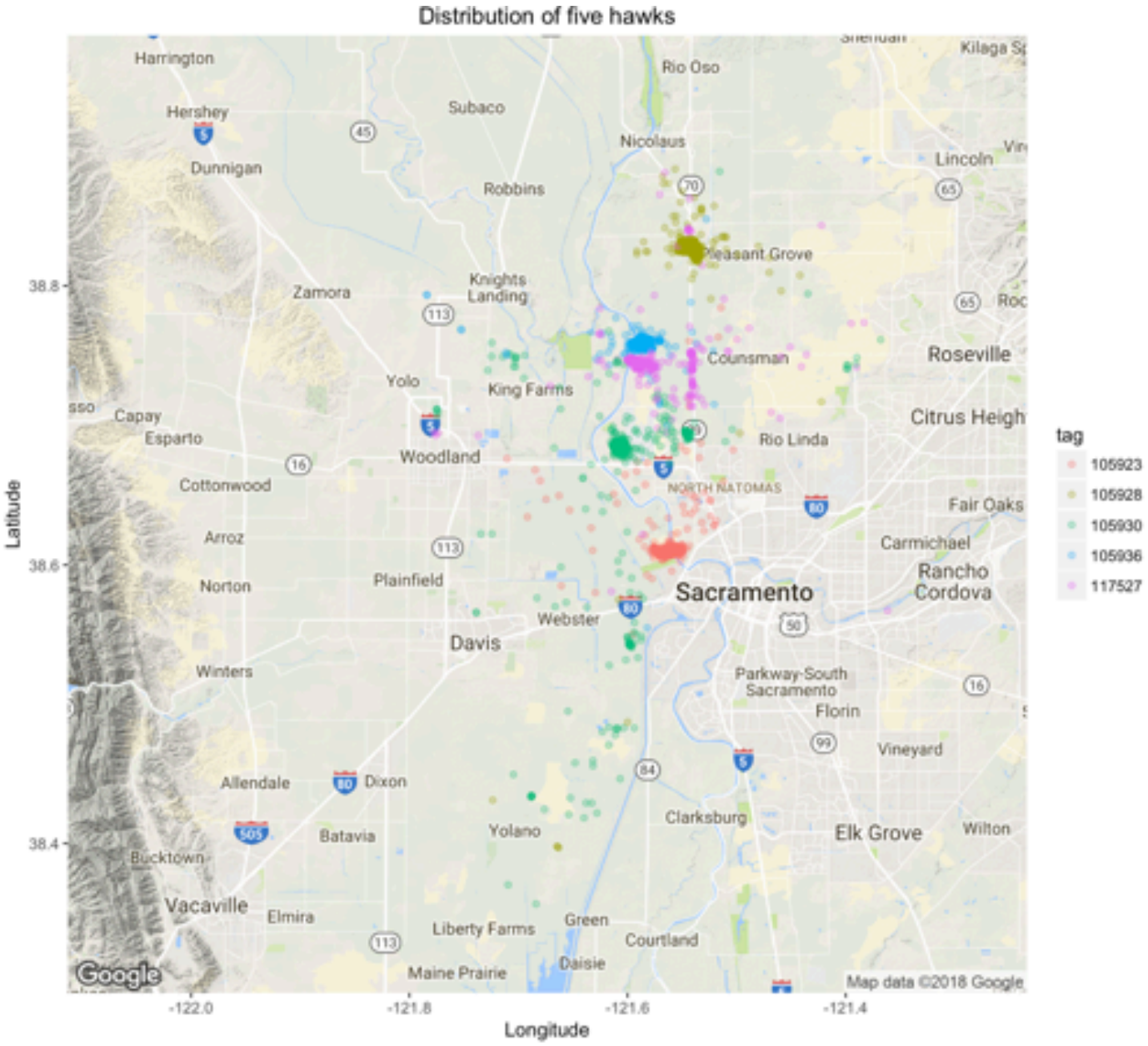
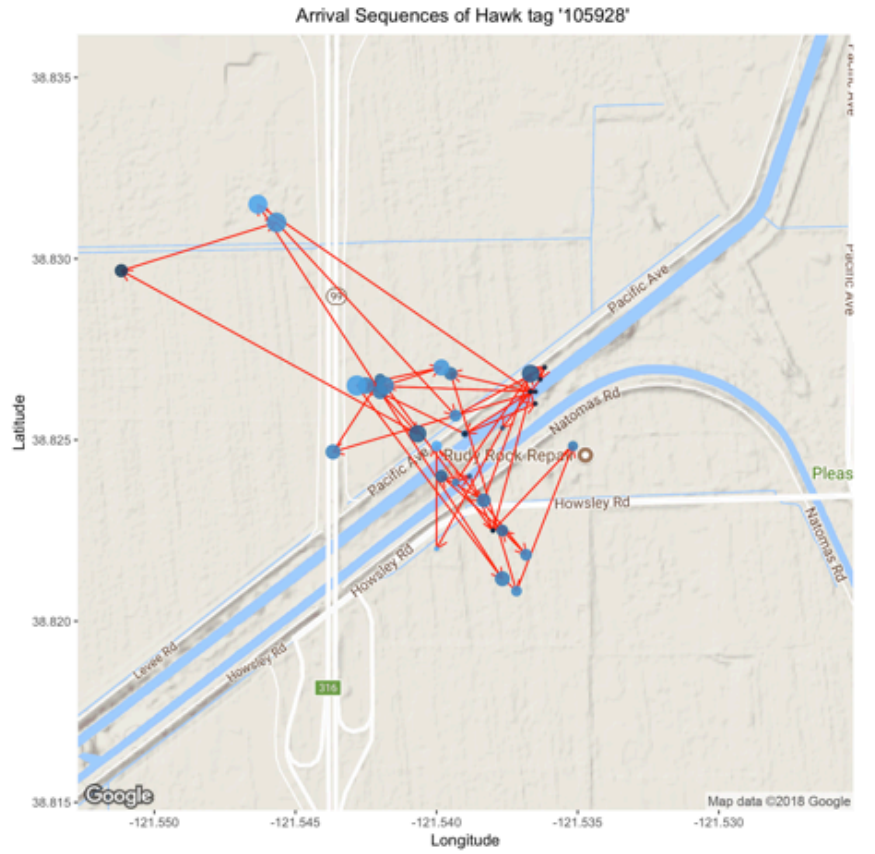
Question 1

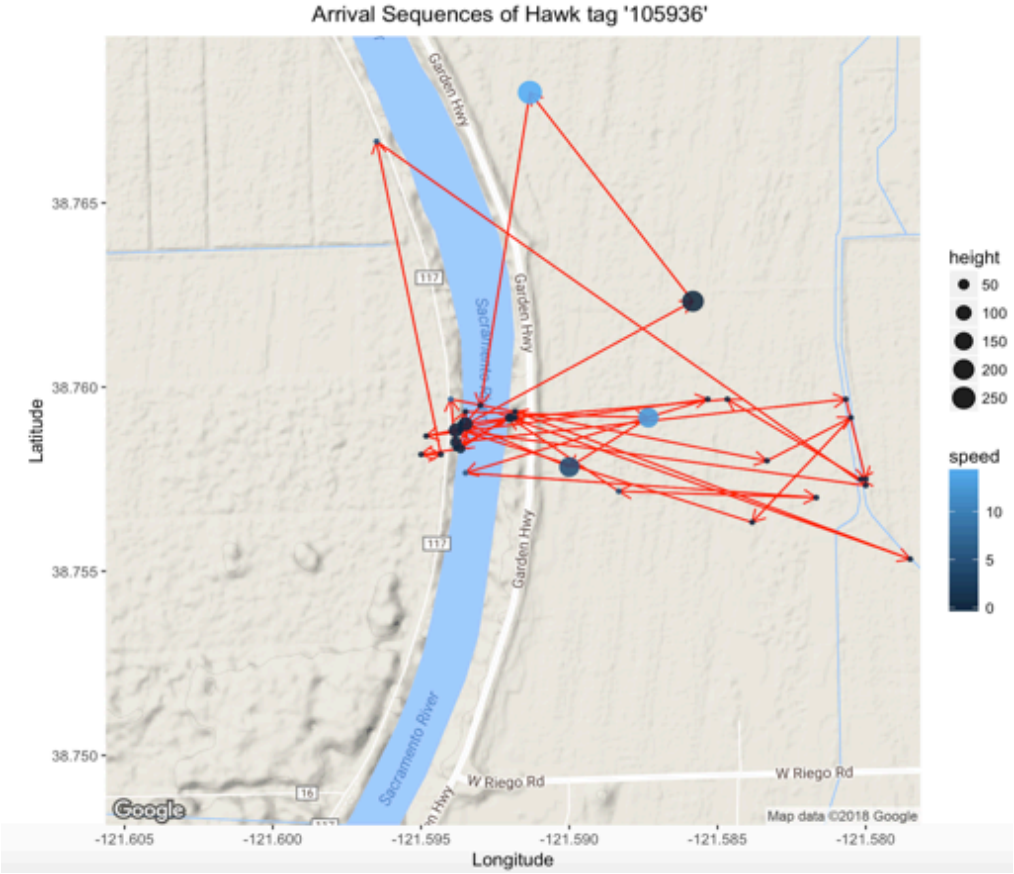


From this plot, it is clear to see every hawk's distribution. **Tag "105923"** mostly distributed near the ***Sacramento***; **Tag "105928"** mostly distributed near ***Pleasant Grove***; and other three tags **Tag "105930", "105936", and "117527"** are mostly distributed along the river.

Question 2

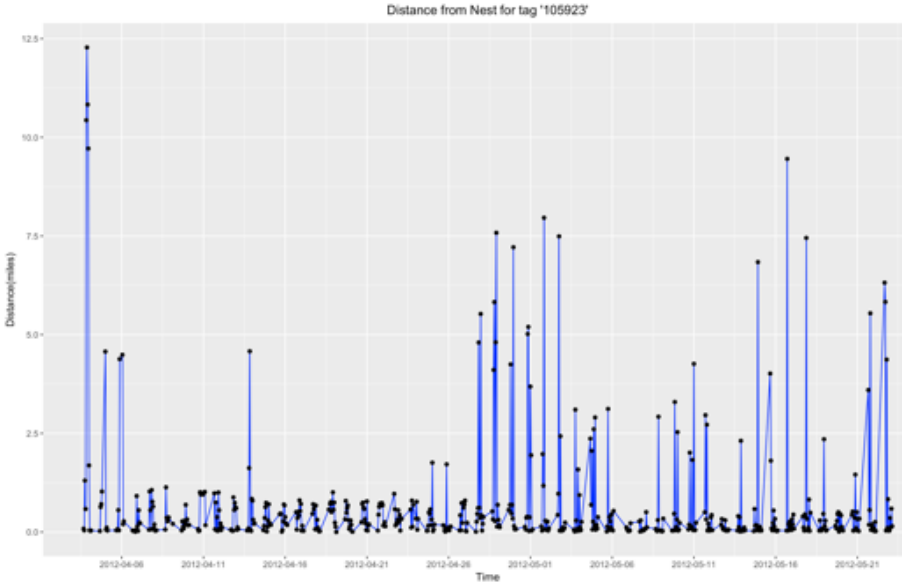


From this plot, we can clear see that the arriving sequences of tag '105928' is mostly distributed around the river. We can see that the speed of the hawk is relatively low and the height is also lower. In comparison, those points near the freeway tend to have higher speed and height. I think the reason of these phenomenon is that the hawk prefers to rest and look for food along the river, but they fear to land near the freeway because there are too much cars.

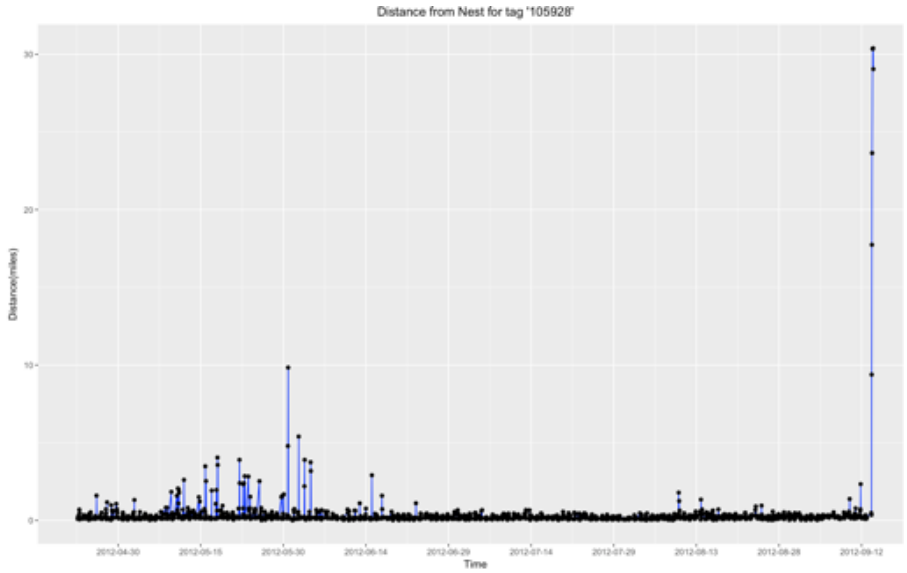


The arriving sequences of the hawk '105936' has some same features with the above plot. Observations near the river tend to have lower height and speed. What's more, observations in the deep right land also have low height and speed. These means this kind of hawk prefer to land near the river and a region without road to rest.

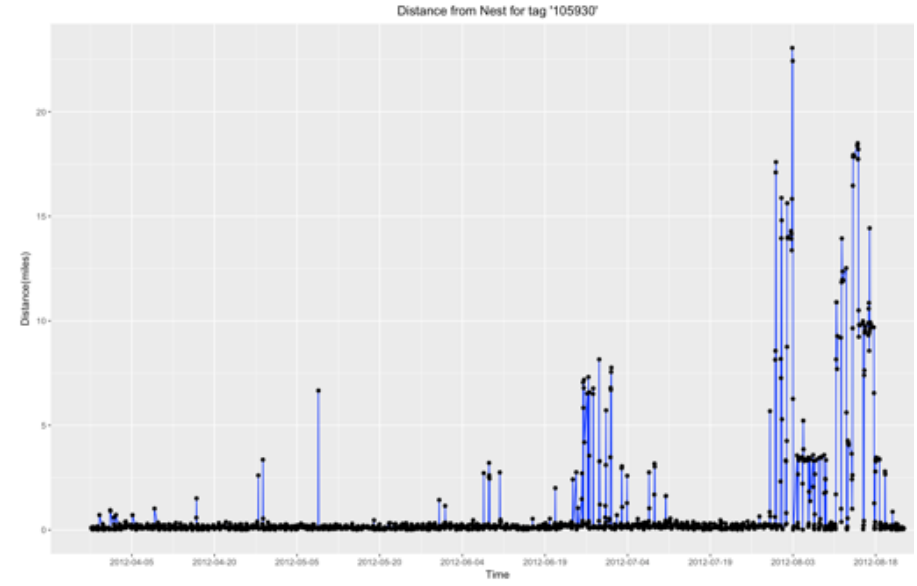
Question 3



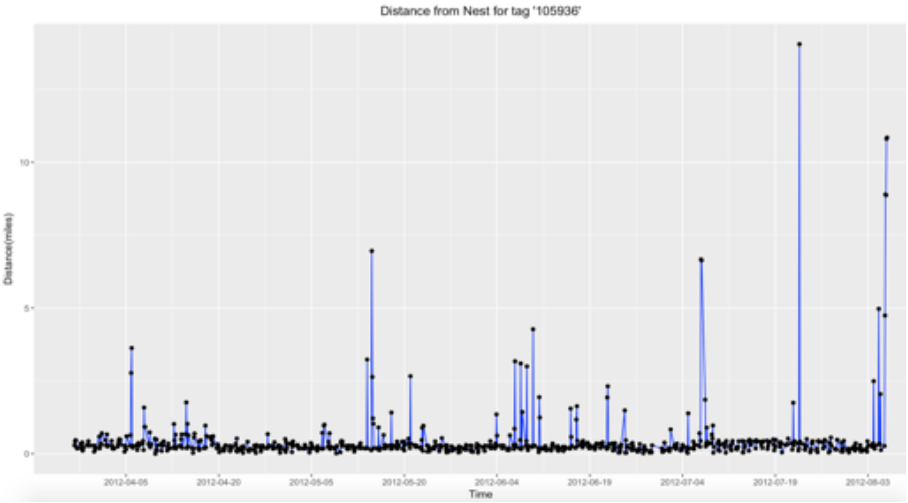
This plot shows that hawk '105923' **never leave its nest** because it goes back every time when it leaves.



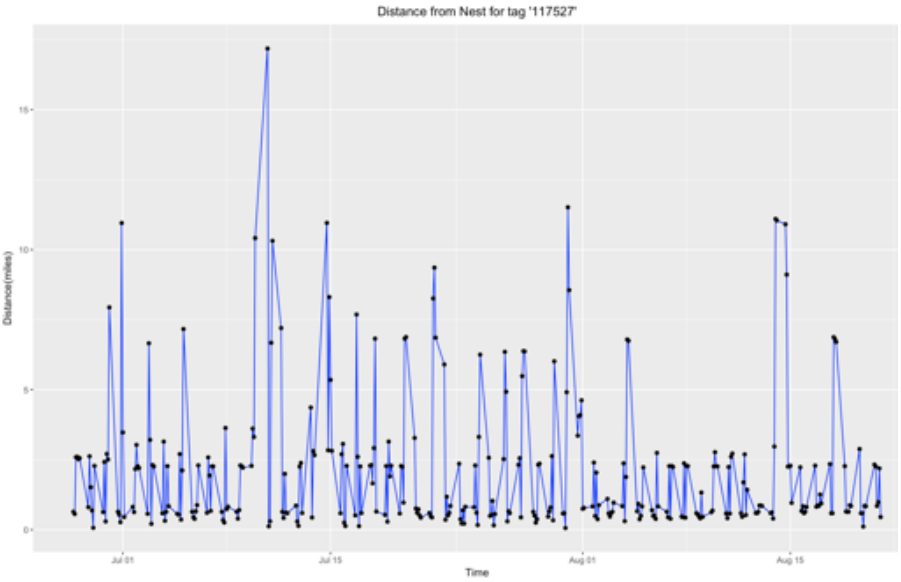
This plot shows hawk '105928' may **leave their nest** at the end. After checking, I find those several ending points are all far from the nest, so this hawk leaves. The time they began to leave is "2012-9-13 19:00:00" and its time period of leaving is 0.3333 days.



This plot shows that hawk '105930' **never leave its nest** because it goes back every time when it leaves.

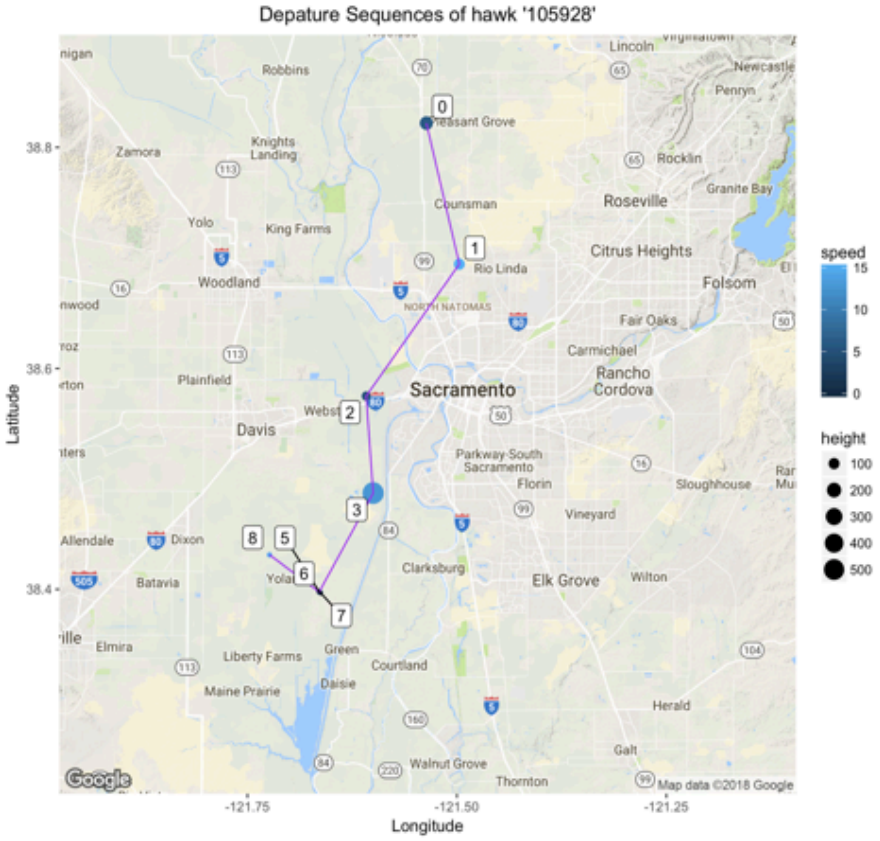


This plot shows hawk '105936' may **leave their nest** at the end. After checking, I find those several ending points are all far from the nest, so this hawk leaves. The time they began to leave is "2012-08-05 16:00:00" and its time period of leaving is 0.416667 days.

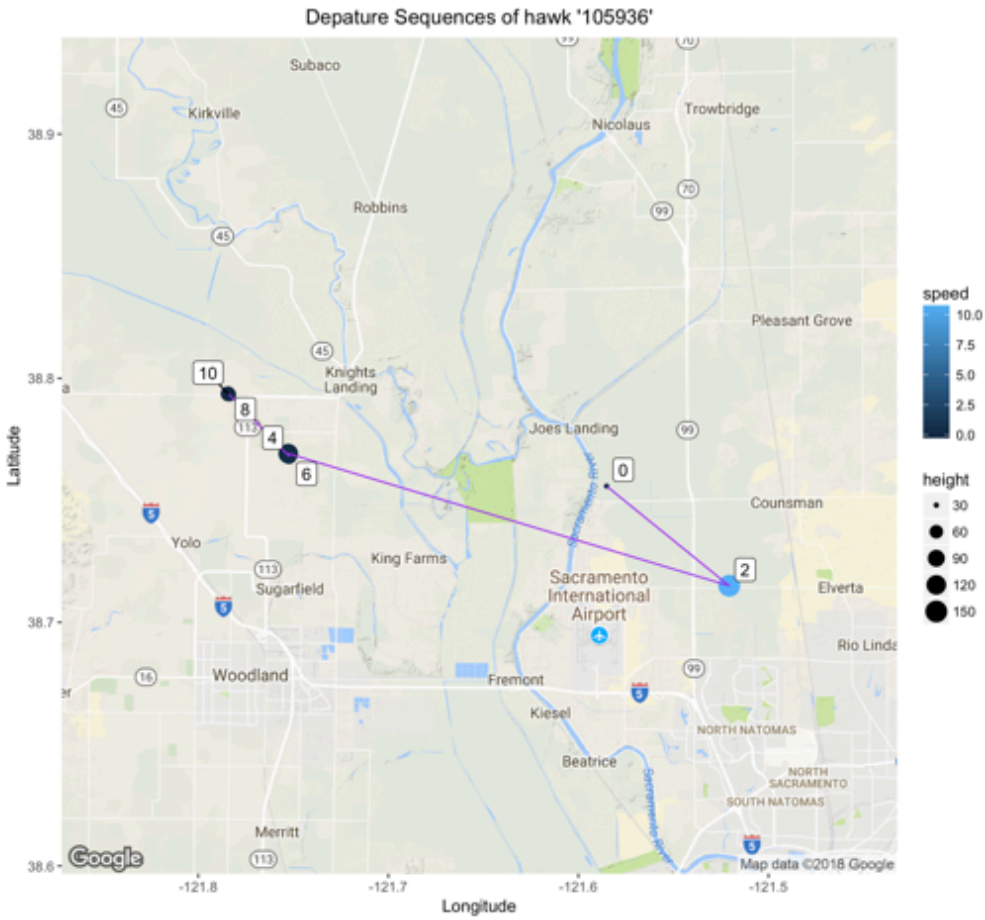


This plot shows that hawk '117527' **never leave its nest** because it goes back every time when it leaves.

Question 4 the white labels mean the hour of departure from the beginning time，their starting time are "2012-9-13 19:00:00" and "2012-08-05 16:00:00", which means both of them **prefer to departure during night**:



From the departure sequence of hawk '105928', it is clear to see that this kind of hawk moves from the **Pleasant Grove** to the **South of Davis.** During this process, it passed the **western Sacramento**. Its speed and height attain maximum when after 3 hours of departure, where the location near the **freeway I-84**. In other observations, the speed and height do not have a distinctive difference.



From the departure sequence of hawk '105936', it is clear to see that this kind of hawk moves the east at the beginning and then turn their way the west when it departures its nest after 2 hours. It stays 2 hours each time when they begin to move to the west. And in those observations without moving, the record of speed is very low. This means they tend to have a rest when move to the west.

Appendix:

Citation:

discuss some ideas of question 4 with classmates in office hour

Using a little bit code Patrick provides in Piazza

Using some ideas professor Gupta discussion in Class

Learn how to subset by time at: https://stackoverflow.com/questions/19420155/subset-rows-according-to-a-range-of-time

Code:

```
#Ruochen Zhong 912888970

library(ggplot2)
library(ggmap)
library(geosphere)
library(lubridate)
library(ggrepel)
hw4data <- read.csv("/Users/apple/Desktop/the_hawks.csv")

#--------Q1----------
# find the center of the map
location <- cbind(hw4data$long, hw4data$lat)
central_location <- apply(location,2,mean)
# draw the map
google_map <- get_map((central_location - 0.1), maptype = "terrain", zoom = 10)
graph_1 <- ggmap(google_map,extent = "panel")
print(graph_1)
# add all observations in the map
graph_1_revise <- graph_1 + geom_point(aes(x = long,y = lat,color = factor(tag)), alpha = 0.3, data = hw4data)
+
                        ggtitle("Distribution of five hawks") +
                        theme(plot.title = element_text(hjust = 0.5)) +
                        scale_color_discrete(name="tag") +
                        labs(x = "Longitude", y = "Latitude")
print(graph_1_revise)
```

```
#---------Q2---------
# find out which two hawks have arrival sequences
which_sequence <- subset(hw4data, hw4data$stage == "arrival")
unique(which_sequence$tag)
hawk1 <- subset(which_sequence, which_sequence$tag == "105928")
hawk2 <- subset(which_sequence, which_sequence$tag == "105936")
# fing the center of the map for each hawk
hawk1_central <- apply(cbind(hawk1$long, hawk1$lat), 2, median)
hawk2_central <- apply(cbind(hawk2$long, hawk2$lat), 2, median)
# draw the arriving sequence for tag 2
center1 <- get_map(hawk1_central, maptype = "terrain", zoom = 15)
graph_2a <- ggmap(center1,extent = "panel")
print(graph_2a)
L<-cbind(hawk1$long,hawk1$lat)
L2<-cbind(L[-nrow(L),],L[-1,])
L2 <- as.data.frame(L2)
names(L2)<-c("long1","lat1","long2","lat2")
graph_2a_revise <- graph_2a + geom_path(aes(x=long,y=lat),color = 'red',data = hawk1) +
                          geom_segment(aes(x=long1,y=lat1,xend=long2,yend=lat2),data=L2,       color       =
'red',arrow = arrow(length = unit(0.3, "cm"))) +
                          geom_point(aes(x=long,y=lat,color=speed, size=height), data = hawk1, alpha = 0.9)
+
                          ggtitle("Arrival Sequences of Hawk tag '105928' ") +
                          theme(plot.title = element_text(hjust = 0.5)) +
                          labs(x = "Longitude", y = "Latitude")
print(graph_2a_revise)
# draw the arriving sequence for tag 4
center2 <- get_map(hawk2_central, maptype = "terrain", zoom = 15)
graph_2b <- ggmap(center2,extent = "panel")
print(graph_2b)
L3<-cbind(hawk2$long,hawk2$lat)
L4<-cbind(L3[-nrow(L3),],L3[-1,])
L4 <- as.data.frame(L4)
```

```
names(L4)<-c("long1","lat1","long2","lat2")
graph_2b_revise <- graph_2b + geom_path(aes(x=long,y=lat),data = hawk2, color = 'red') +
                        geom_segment(aes(x=long1,y=lat1,xend=long2,yend=lat2),data=L4, color =
'red',arrow = arrow(length = unit(0.3, "cm"))) +
                        geom_point(aes(x=long,y=lat,color=speed, size=height), data = hawk2, alpha = 0.9)
+
                        ggtitle("Arrival Sequences of Hawk tag '105936' ") +
                        theme(plot.title = element_text(hjust = 0.5)) +
                        labs(x = "Longitude", y = "Latitude")
print(graph_2b_revise)

#--------Q3----------
# change the class of the time and then subset each hawks
hw4data$time <- as.POSIXct(hw4data$time)
tag1 <- subset(hw4data,hw4data$tag == '105923')
tag2 <- subset(hw4data,hw4data$tag == '105928')
tag3 <- subset(hw4data,hw4data$tag == '105930')
tag4 <- subset(hw4data,hw4data$tag == '105936')
tag5 <- subset(hw4data,hw4data$tag == '117527')

#use the median of those observation to be the nest
nest1 <- apply(cbind(tag1$long,tag1$lat),2,median)
nest2 <- apply(cbind(tag2$long,tag2$lat),2,median)
nest3 <- apply(cbind(tag3$long,tag3$lat),2,median)
nest4 <- apply(cbind(tag4$long,tag4$lat),2,median)
nest5 <- apply(cbind(tag5$long,tag5$lat),2,median)

# write a function to calculate the distance from the nest of each hawks
calculate_distance <- function(n,d,long,lat){
   distance <- numeric(d)
   for (i in 1:d) {
   distance[i] = distGeo(n,(cbind(long,lat)[i,]))/1609
   }
   M <- as.matrix(distance)
```

```
return(M)
}

# For tag 1, draw the time series graph of their distance to the nest
distance1 <- calculate_distance(nest1,578,long = tag1$long, lat = tag1$lat)
tag1$distance <- distance1
leave_check1 <- ggplot(aes(x = time,y = distance),data = tag1) +
                        geom_line( color = 'blue', size = 0.5) +
                        geom_point() +
                        scale_x_datetime(date_breaks = "5 days") +
                        ggtitle(" Distance from Nest for tag '105923' ") +
                        theme(plot.title = element_text(hjust = 0.5)) +
                        labs(x = "Time", y = "Distance(miles)")
print(leave_check1)

# For tag 2, draw the time series graph of their distance to the nest
distance2 <- calculate_distance(nest2,1706,long = tag2$long, lat = tag2$lat)
tag2$distance <- distance2
leave_check2 <- ggplot(aes(x = time,y = distance),data = tag2) +
                        geom_line( color = 'blue', size = 0.5) +
                        geom_point() +
                        scale_x_datetime(date_breaks = "15 days") +
                        ggtitle(" Distance from Nest for tag '105928' ") +
                        theme(plot.title = element_text(hjust = 0.5)) +
                        labs(x = "Time", y = "Distance(miles)")
print(leave_check2)
# find the departure time interval of tag 2
date_one <- as.POSIXct("2012-9-13 19:00:00")
date_two <- as.POSIXct("2012-9-14 03:00:00")
difftime(date_two, date_one, units = 'days')

# For tag 3, draw the time series graph of their distance to the nest
distance3 <- calculate_distance(nest3,1747,long = tag3$long, lat = tag3$lat)
tag3$distance <- distance3
```

```
leave_check3 <- ggplot(aes(x = time,y = distance),data = tag3) +
                    geom_line( color = 'blue', size = 0.5) +
                    geom_point() +
                    scale_x_datetime(date_breaks = "15 days") +
                    ggtitle(" Distance from Nest for tag '105930' ") +
                    theme(plot.title = element_text(hjust = 0.5)) +
                    labs(x = "Time", y = "Distance(miles)")
print(leave_check3)

#For tag 4, draw the time series graph of their distance to the nest
distance4 <- calculate_distance(nest4,785,long = tag4$long, lat = tag4$lat)
tag4$distance <- distance4
leave_check4 <- ggplot(aes(x = time,y = distance),data = tag4) +
                    geom_line( color = 'blue', size = 0.5) +
                    geom_point() +
                    scale_x_datetime(date_breaks = "15 days") +
                    ggtitle(" Distance from Nest for tag '105936' ") +
                    theme(plot.title = element_text(hjust = 0.5)) +
                    labs(x = "Time", y = "Distance(miles)")
print(leave_check4)

# find the departure time interval for tag 4
date_three <- as.POSIXct("2012-08-05 16:00:00")
date_four <- as.POSIXct("2012-08-06 02:00:00")
difftime(date_four, date_three, units = 'days')

#For tag 5, draw the time series graph of their distance to the nest
distance5 <- calculate_distance(nest5,324,long = tag5$long, lat = tag5$lat)
tag5$distance <- distance5
leave_check5 <- ggplot(aes(x = time,y = distance),data = tag5) +
                    geom_line( color = 'blue', size = 0.5) +
                    geom_point() +
                    #scale_x_datetime(date_breaks = "15 days") +
                    ggtitle(" Distance from Nest for tag '117527' ") +
```

```
        theme(plot.title = element_text(hjust = 0.5)) +
        labs(x = "Time", y = "Distance(miles)")
print(leave_check5)

#--------Q4----------
# For tag 2 leave, subset those departure sequences
date_one <- as.POSIXct("2012-9-13 19:00:00")
date_two <- as.POSIXct("2012-9-14 03:00:00")
as.numeric(difftime(date_two, date_one , units = 'hours'))
int <- interval(date_one,date_two)
tag2_leave <- tag2[tag2$time %within% int,]
# create a custom variable, hour
tag2_leave$hour <- as.numeric(difftime(tag2_leave$time, date_one , units = 'hours'))
# create the center of the map
tag2_center <- apply(cbind(tag2_leave$long,tag2_leave$lat),2,median)
tag2_map <- get_map(tag2_center + 0.1, maptype = "terrain", zoom = 10)
# draw the departure sequences
p <- ggmap(tag2_map, base_layer = ggplot(tag2_leave,aes(long,lat))) +
      geom_point(aes(x = long,y = lat, color = speed, size = height),data = tag2_leave) +
      geom_path(aes(x = long,y = lat),data = tag2_leave, color = 'purple') +
      geom_label_repel(aes(label = hour)) +
      ggtitle("Depature Sequences of hawk '105928'") +
      theme(plot.title = element_text(hjust = 0.5)) +
      labs(x = "Longitude", y = "Latitude")
print(p)

# For tag 4 leave, subset those departure sequences
date_three <- as.POSIXct("2012-08-05 16:00:00")
date_four <- as.POSIXct("2012-08-06 02:00:00")
int_2 <- interval(date_three,date_four)
tag4_leave <- tag4[tag4$time %within% int_2,]
#create a custom variable, hour
tag4_leave$hour <- as.numeric(difftime(tag4_leave$time, date_three, units = 'hours'))
# create the center of the map
```

```
tag4_center <- apply(cbind(tag4_leave$long,tag4_leave$lat),2,median)
tag4_map <- get_map( c(-121.6525,38.7686) , maptype = "terrain", zoom = 11)
# draw the departure sequences
p2 <- ggmap(tag4_map, base_layer = ggplot(tag4_leave,aes(long,lat)))+
      geom_point(aes(x = long,y = lat, color = speed, size = height),data = tag4_leave) +
      geom_path(aes(x = long,y = lat),color = 'purple', data = tag4_leave) +
      geom_label_repel(aes(label = hour)) +
      ggtitle("Depature Sequences of hawk '105936'") +
      theme(plot.title = element_text(hjust = 0.5)) +
      labs(x = "Longitude", y = "Latitude")
print(p2)
```