Collaborative Assignment 1

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Introduction

James is a budding entrepreneur and for the last two years he has been operating a sanwich stand in the lobby of his office building during the lunch hour. James has been tracking sandwich demand.The following analysis will allow for James to run his business more effectively and determine how many sanwiches of each type he should bring each day to maximize his profits.

Questions and Assumptions

Based on the data there are a couple of questions and assumptions that need to be defined.

Question

1) Is a particular sandwhich demand independent of others.

-Based on the data we believe that sandwhich demand is indepedent.

Assumptions

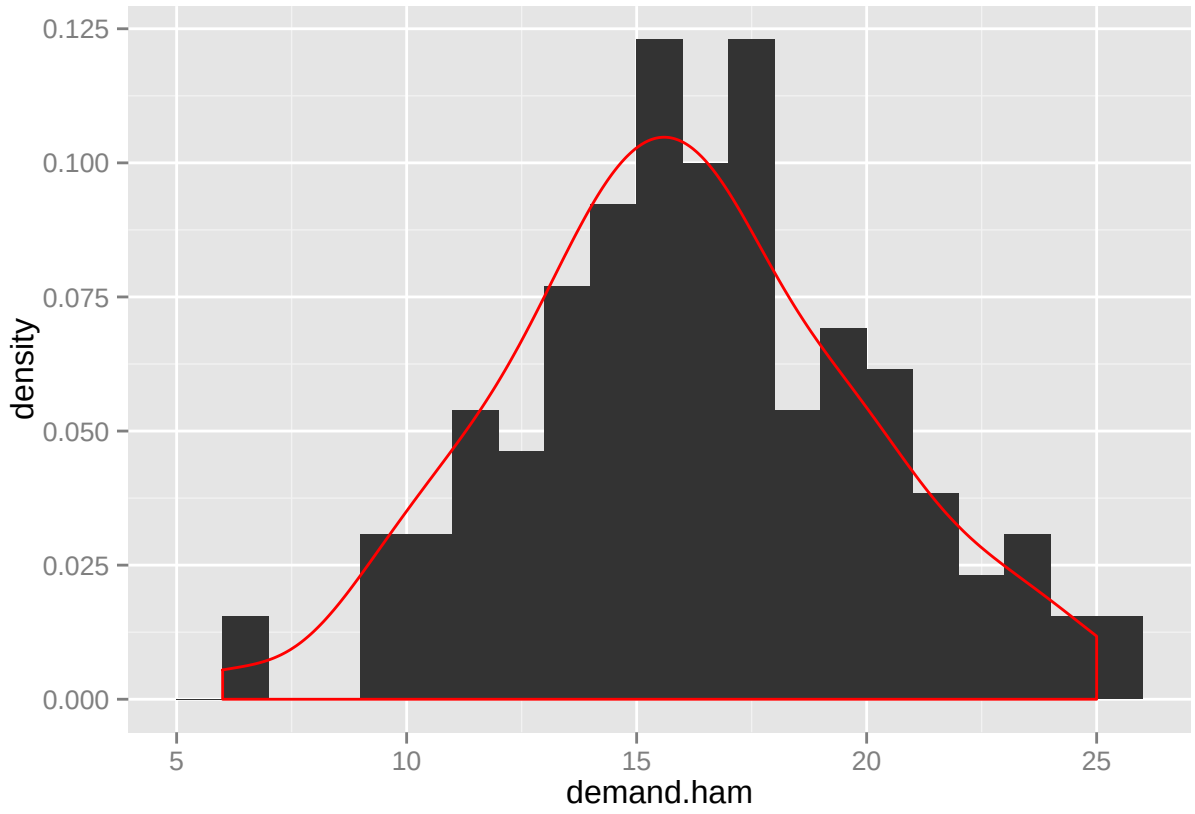
Our group made some assumptions of the data in order to perform the analysis. The assumptions are as follows:

1) There is no impact of time on demand. For example, the seasons do not influence demand.
2) An order being fulfilled/unfulfilled today does not impact demand in the future. If a customer is not able to get a particular sandwich today, it does not influence their appetite for the sandwich in the future.
3) Sandwiches purchased for the day are only good for that day. This would indicate that if we think ten sandwiches would be sold but only sell eight, the costs of the last two would be a complete loss taken out of profits which would impact the ideal inventory level for a day.

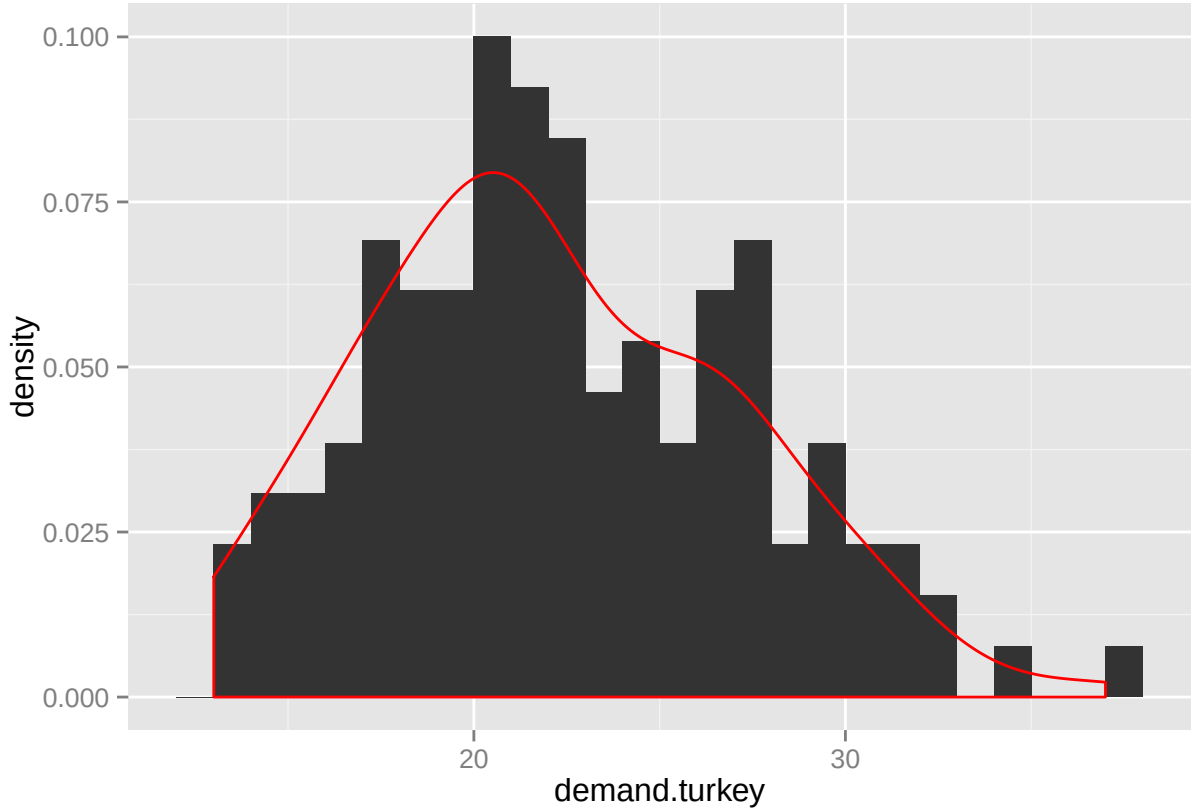
Exploring the Demand Data

In this section, we look into the demand of the three sandwiches. The graphs shows the likelihood of a demand for a particular sandwich.

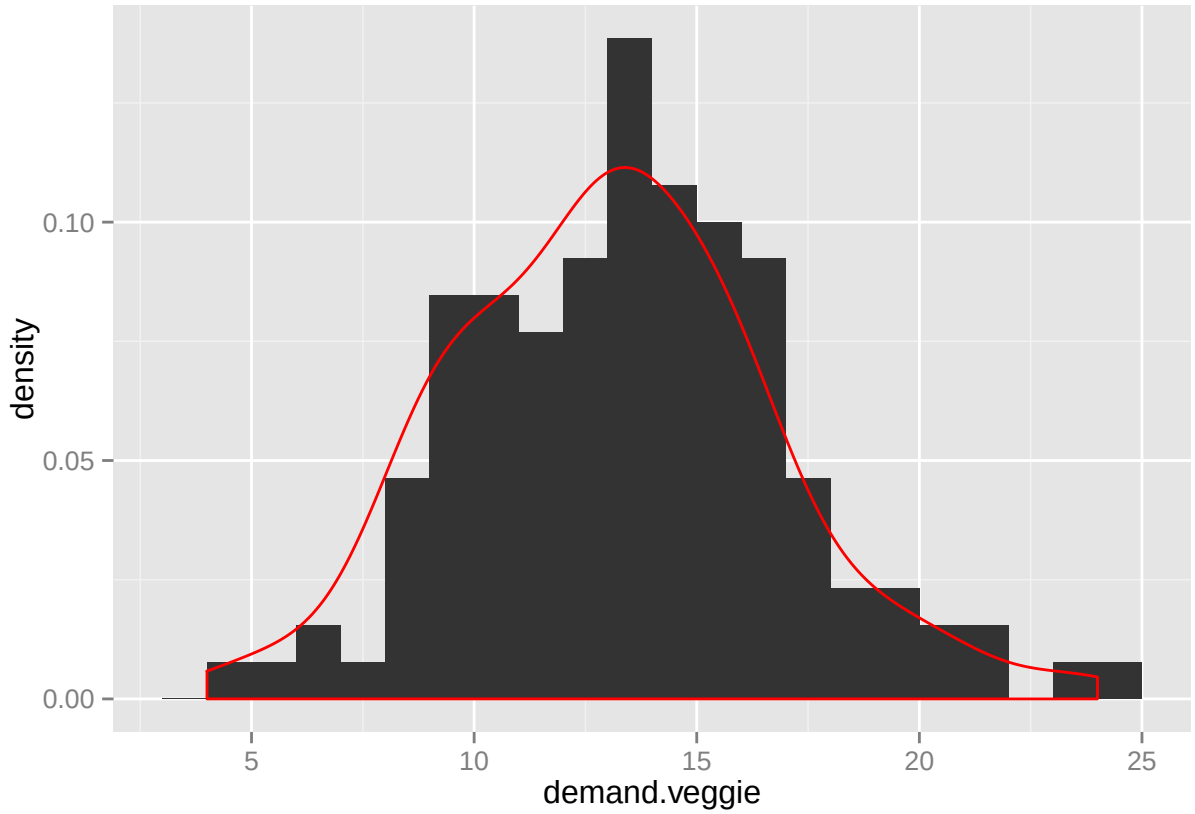
```
sales.data <- read.csv("/users/bcarancibia/CUNY_IS_606/Week2/sales.csv")
library(ggplot2)
ham.plot <- ggplot(sales.data,aes(x=demand.ham)) +
  geom_histogram(binwidth=1, aes(y = ..density..)) + geom_density(color="red")
turkey.plot <- ggplot(sales.data,aes(x=demand.turkey)) +
  geom_histogram(binwidth=1, aes(y = ..density..)) + geom_density(color="red")
veggie.plot <- ggplot(sales.data,aes(x=demand.veggie)) +
  geom_histogram(binwidth=1, aes(y = ..density..)) + geom_density(color="red")
# Display Plots
ham.plot
```


0.125
0.100
0.075
0.050
0.025
0.000
density
5
10
15
20
25
demand.ham

```
turkey.plot
```


0.100
0.075
0.050
0.025
0.000
density
20
30
demand.turkey

```
veggie.plot
```



As seen by the above plots, ham sandwiches has the most regular distribution and turkey demand is skewed to the left.

Understanding Correlation of Sales by Sandwich Type

In this section, we try to demonstrate independance between the sandwiches - The demand for one sandwich does not influence the demand for the other sandwiches.

```
cor(sales.data[,2:4])
```

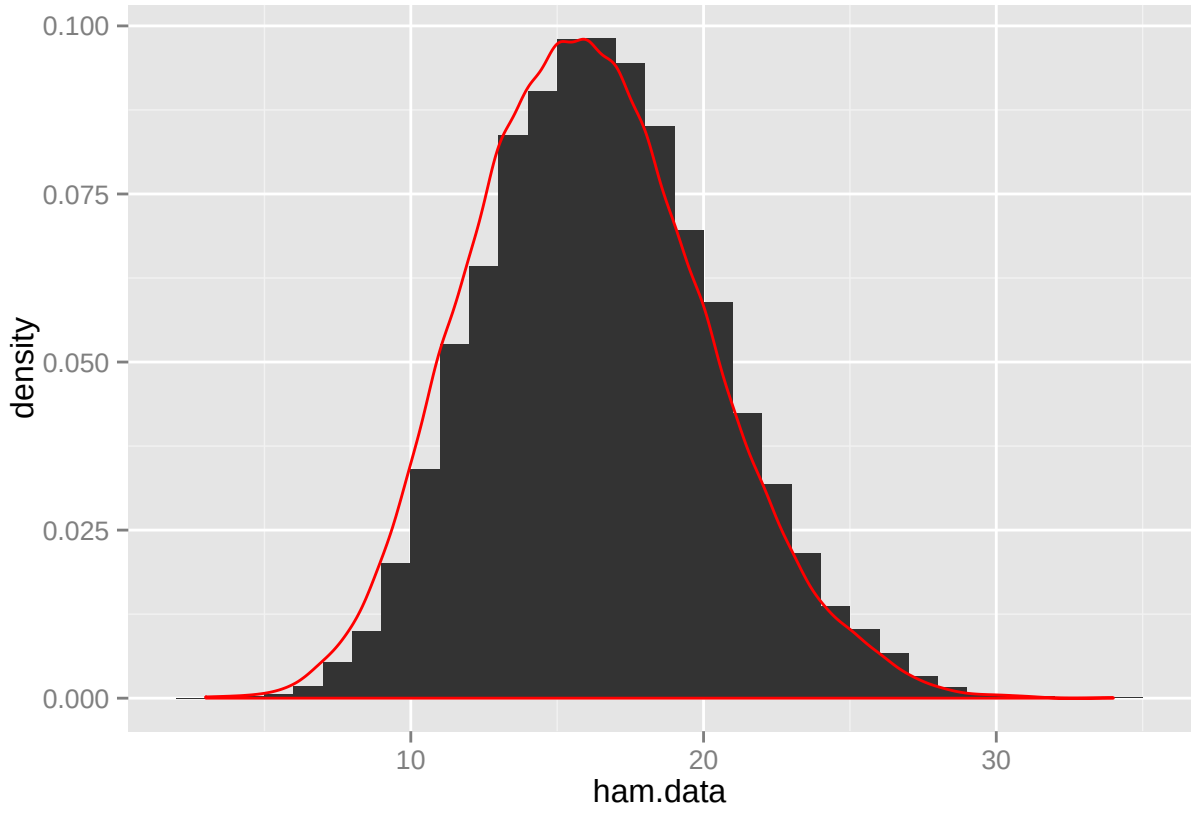
```
##                 demand.ham demand.turkey demand.veggie
## demand.ham    1.0000000000  0.0005572513    0.08680582
## demand.turkey 0.0005572513  1.0000000000    0.10705333
## demand.veggie 0.0868058199  0.1070533325    1.00000000
```

Since the correlation coefficient is very low, we were able to demonstrate independance. As a result, we went ahead with a Poisson approach.

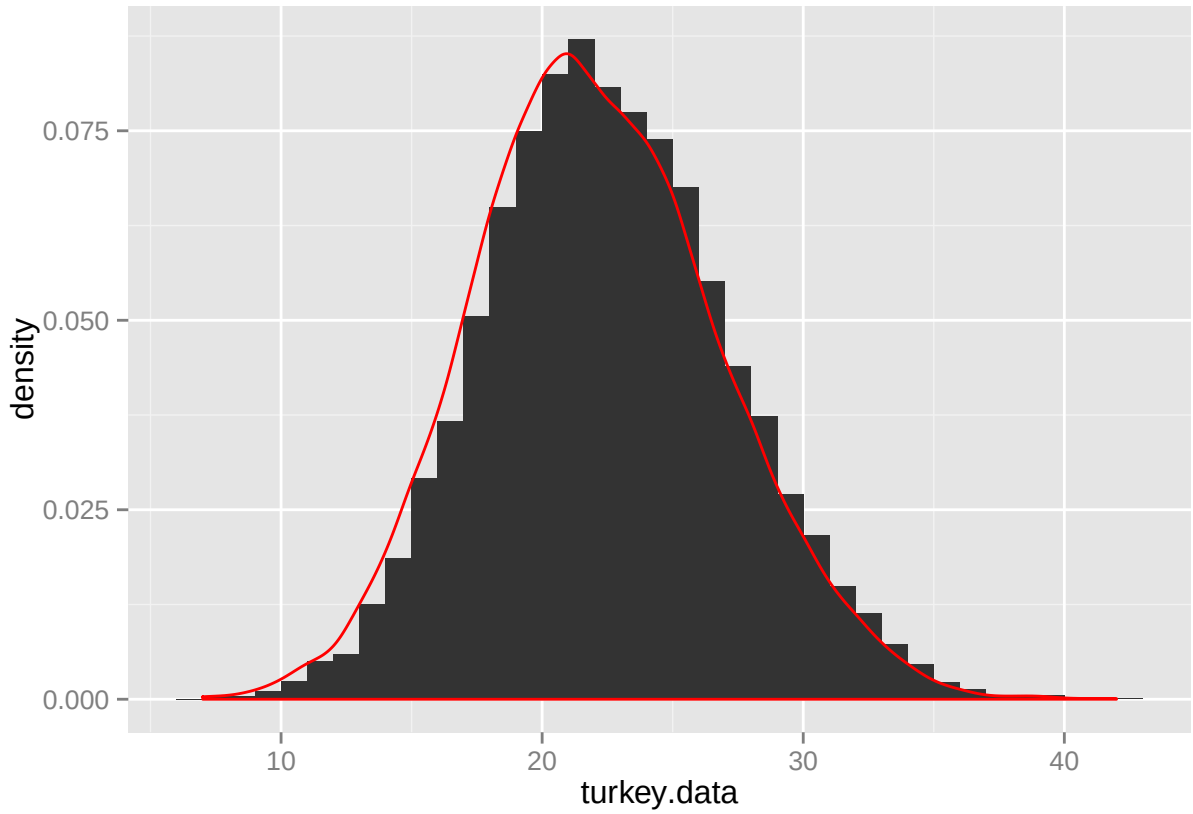
Developing Probability Density Functions by Sandwich Type

```
ham.pois <- data.frame(rpois(n=10000,lambda=mean(sales.data$demand.ham)))
names(ham.pois) <- c("ham.data")
ham.pois.plot <- ggplot(ham.pois,aes(x=ham.data)) +
  geom_histogram(binwidth=1, aes(y = ..density..)) + geom_density(color="red")
turkey.pois <- data.frame(rpois(n=10000,lambda=mean(sales.data$demand.turkey)))
names(turkey.pois) <- c("turkey.data")
```

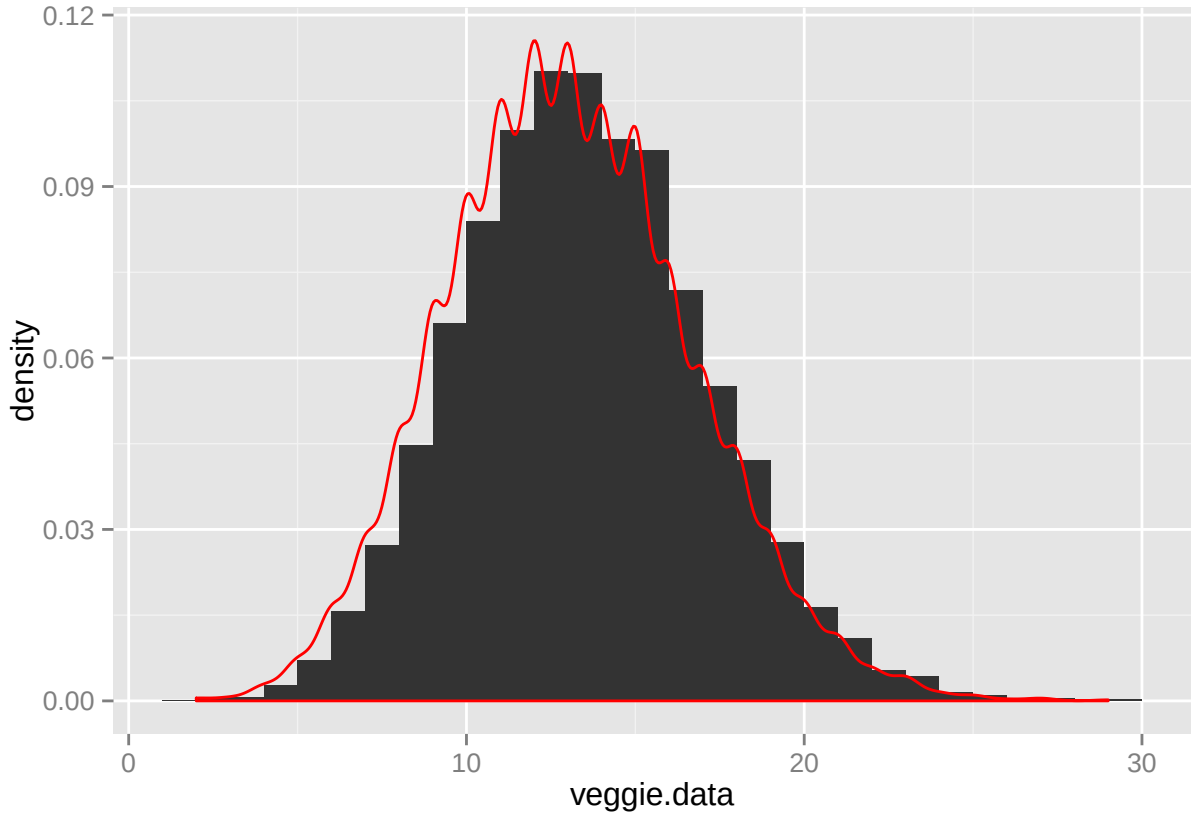
```
turkey.pois.plot <- ggplot(turkey.pois,aes(x=turkey.data)) +
  geom_histogram(binwidth=1, aes(y = ..density..)) + geom_density(color="red")
veggie.pois <- data.frame(rpois(n=10000,lambda=mean(sales.data$demand.veggie)))
names(veggie.pois) <- c("veggie.data")
veggie.pois.plot <- ggplot(veggie.pois,aes(x=veggie.data)) +
  geom_histogram(binwidth=1, aes(y = ..density..)) + geom_density(color="red")
# Display Plots
ham.pois.plot
```




```
turkey.pois.plot
```




```
veggie.pois.plot
```



Understanding the Cost/Benefit for Inventory Levels

```
price.cost <- read.csv("/users/bcarancibia/CUNY_IS_606/Week2/details.csv")
price.cost$profit <- price.cost$price - price.cost$cost

inv.levels <- data.frame(cbind(0:50,0))
names(inv.levels) <- c("inv","profits")

# Ham
ham.inv.levels <- inv.levels
ham.samples <- rpois(n=100000,lambda=mean(sales.data$demand.ham))

for (i in 0:50) {
  temp <- data.frame(ham.samples)
  names(temp) <- c("demand")
  temp$total.cost <- i * 3.5
  temp$total.revenue <- i * 6.50
  temp$total.revenue[temp$demand <= i] <- temp$demand[temp$demand <= i] * 6.50
  temp$profit <- temp$total.revenue - temp$total.cost
  ham.inv.levels[i+1,2] <- mean(temp$profit)
}

# Turkey
turkey.inv.levels <- inv.levels
turkey.samples <- rpois(n=100000,lambda=mean(sales.data$demand.turkey))

for (i in 0:50) {
  temp <- data.frame(turkey.samples)
  names(temp) <- c("demand")
  temp$total.cost <- i * 4
  temp$total.revenue <- i * 6.50
  temp$total.revenue[temp$demand <= i] <- temp$demand[temp$demand <= i] * 6.50
  temp$profit <- temp$total.revenue - temp$total.cost
  turkey.inv.levels[i+1,2] <- mean(temp$profit)
}

# Veggie
veggie.inv.levels <- inv.levels
veggie.samples <- rpois(n=100000,lambda=mean(sales.data$demand.veggie))

for (i in 0:50) {
  temp <- data.frame(veggie.samples)
  names(temp) <- c("demand")
  temp$total.cost <- i * 3.5
  temp$total.revenue <- i * 6.50
  temp$total.revenue[temp$demand <= i] <- temp$demand[temp$demand <= i] * 6.50
  temp$profit <- temp$total.revenue - temp$total.cost
  veggie.inv.levels[i+1,2] <- mean(temp$profit)
}

ham.profit.plot <- ggplot(ham.inv.levels,aes(x=inv, y=profits)) +
  geom_hline(aes(yintercept=0)) + geom_line() + ggtitle("Ham: Profit by Inventory Level") +
  xlab("Inventory") + ylab("$ Profits") +
  geom_vline(aes(xintercept=
```

```
                    ham.inv.levels[
                      ham.inv.levels$profits==max(ham.inv.levels$profits),1]))
turkey.profit.plot <- ggplot(turkey.inv.levels,aes(x=inv, y=profits)) +
  geom_hline(aes(yintercept=0)) + geom_line() + ggtitle("Turkey: Profit by Inventory Level") +
  xlab("Inventory") + ylab("$ Profits") +
  geom_vline(aes(xintercept=
                    turkey.inv.levels[
                      turkey.inv.levels$profits==max(turkey.inv.levels$profits),1]))
veggie.profit.plot <- ggplot(veggie.inv.levels,aes(x=inv, y=profits)) +
  geom_hline(aes(yintercept=0)) + geom_line() + ggtitle("Veggie: Profit by Inventory Level") +
  xlab("Inventory") + ylab("$ Profits") +
  geom_vline(aes(xintercept=
                    veggie.inv.levels[
                      veggie.inv.levels$profits==max(veggie.inv.levels$profits),1]))

# Display Plots
ham.profit.plot
```

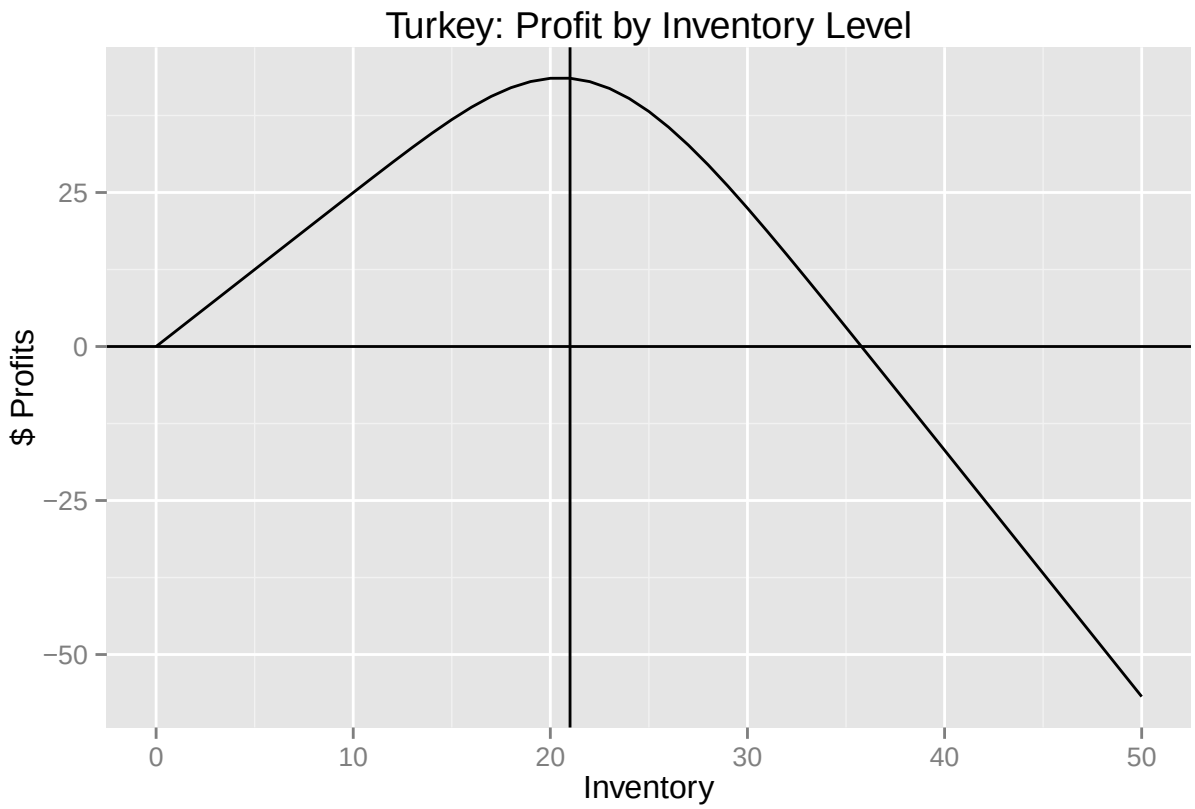

```
mean(sales.data$demand.ham)
```

```
## [1] 15.94615
```

```
ham.inv.levels[ham.inv.levels$profits==max(ham.inv.levels$profits),1]
```

```
## [1] 15
```

```
turkey.profit.plot
```



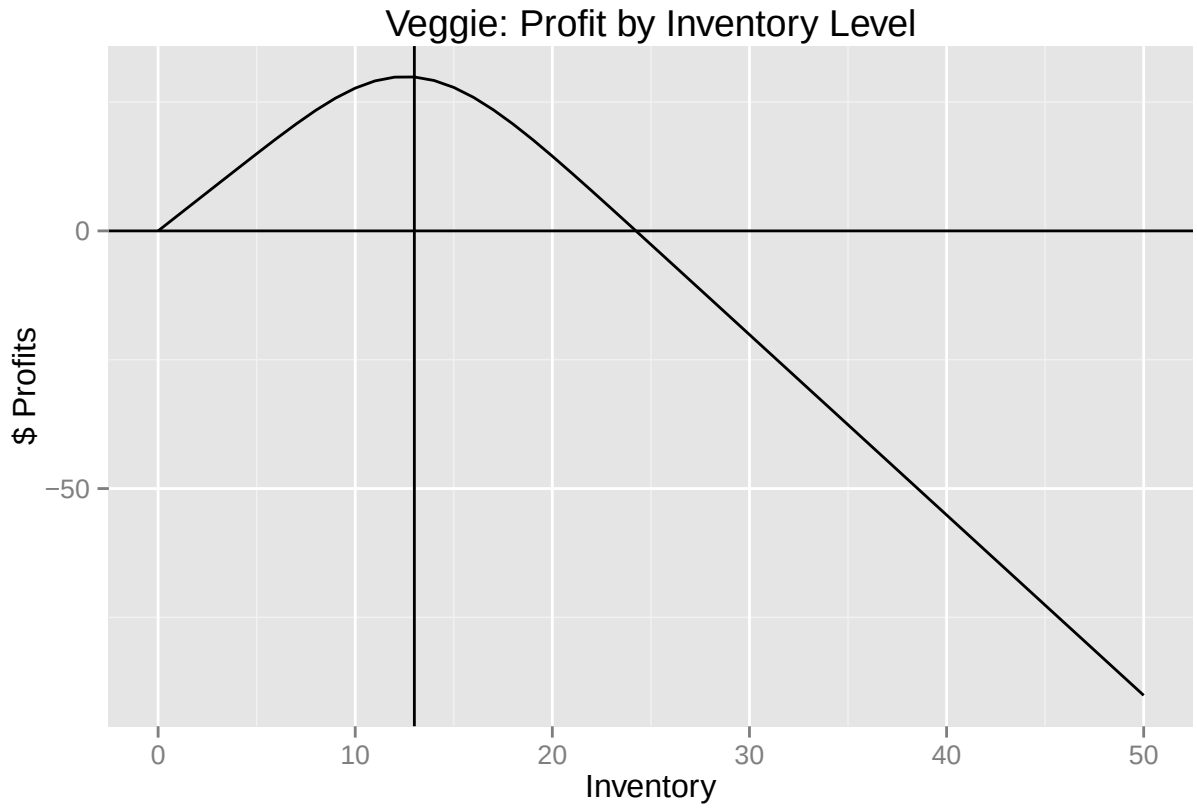

```
mean(sales.data$demand.turkey)
```

```
## [1] 22.05385
```

```
turkey.inv.levels[turkey.inv.levels$profits==max(turkey.inv.levels$profits),1]
```

```
## [1] 21
```

```
veggie.profit.plot
```




```
mean(sales.data$demand.veggie)
```

```
## [1] 13.06154
```

```
veggie.inv.levels[veggie.inv.levels$profits==max(veggie.inv.levels$profits),1]
```

```
## [1] 13
```

Recommendations

Our analysis shows that James would maximize his profits if he brought 15 ham sandwiches, 21 turkey sandwiches and 13 veggie sandwiches per day.