Which Diet is More Efficient For The Chicken Farm?

There are 4 diets used to feed chickens in a chicken farm. Our main question is which of these diets would be more efficient for raising chickens. We used a dataset called ChickWeight and R programming to answer this question

The ChickWeight Dataset

The ChickWeight data frame has 578 rows and 4 columns from an experiment on the effect of diet on early growth of chicks.

Columns

Weight column is a numeric vector giving the body weight of the chick. *Time* is a numeric vector giving the number of days since birth when the measurement was made. *Chick* is an ordered factor with levels 18 < ... < 48 giving a unique identifier for the chick. The ordering of the levels groups chicks on the same diet together and orders them according to their final weight (lightest to heaviest) within the diet. *Diet* is a factor with levels 1, ..., 4 indicating which experimental diet the chick received.

Details

The body weights of the chicks were measured at birth and every second day thereafter until day 20. They were also measured on day 21. There were four groups on chicks on different protein diets. This dataset was originally part of package nlme, and that has methods (including for [, as.data.frame, plot and print) for its grouped-data classes.

Summarizing The Dataset

The summaries of the categories in the dataset are as follows.

```
> summary(ChickWeight)
     weight            Time           Chick        Diet
 Min.   : 35.0    Min.   : 0.00    13     : 12    1:220
 1st Qu.: 63.0    1st Qu.: 4.00    9      : 12    2:120
 Median :103.0    Median :10.00    20     : 12    3:120
 Mean   :121.8    Mean   :10.72    10     : 12    4:118
 3rd Qu.:163.8    3rd Qu.:16.00    17     : 12
 Max.   :373.0    Max.   :21.00    19     : 12
                                   (Other):506
>
```
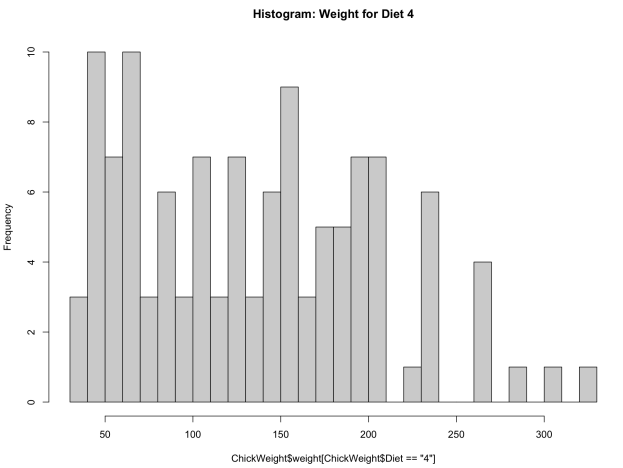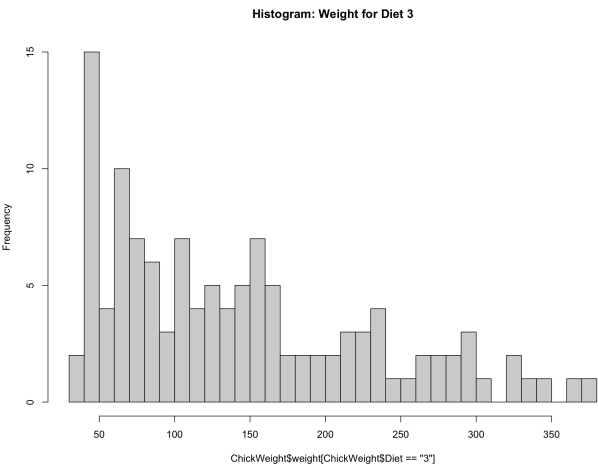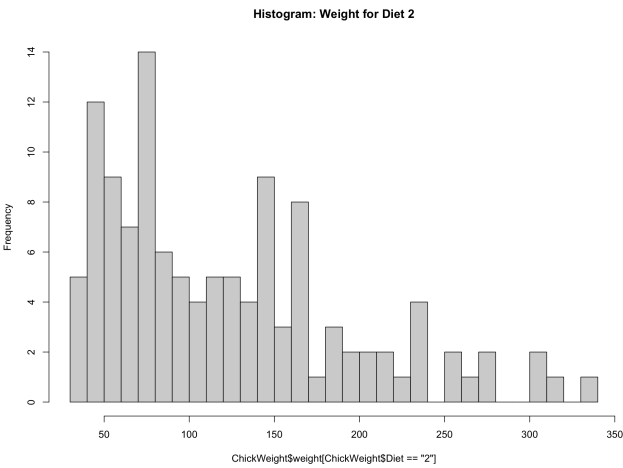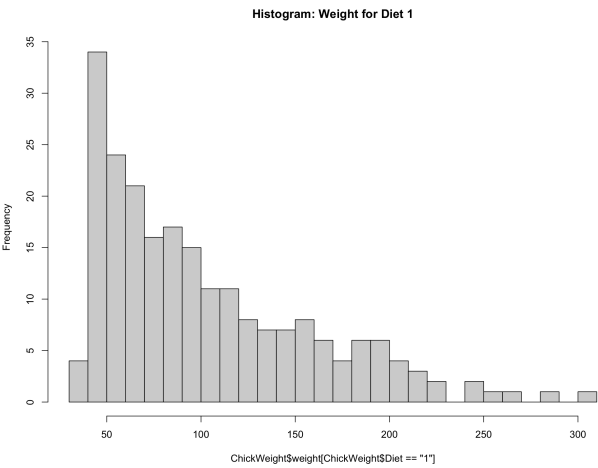
As we can see in the table, the weights of 50 chickens were measured until the 21st day. However, 5 of these chickens died before reaching the 21st day. So we will not be using data from these 5 chickens to measure which diet will be more efficient for the farm.

```
   Time number_of_chicken
   <dbl>             <int>
1      0                50
2      2                50
3      4                49
4      6                49
5      8                49
6     10                49
7     12                49
8     14                48
9     16                47
10    18                47
11    20                46
12    21                45
> |
```

The table here shows the number of chickens on the diets. While there are 20 chickens on the first diet, the number of chickens on the other diets is 10.

```
   Diet  number_of_chicken
   <fct>             <int>
1 1                    20
2 2                    10
3 3                    10
4 4                    10
>
```

These charts are histogram of diet types. We can say that the weight distribution of all diet types is right skewed.

Histogram: Weight for Diet 1

Histogram: Weight for Diet 2

Histogram: Weight for Diet 3

Histogram: Weight for Diet 4

Scatter plot showing the distribution between time and weight (We used ggplot2 library for all plots after this plot).
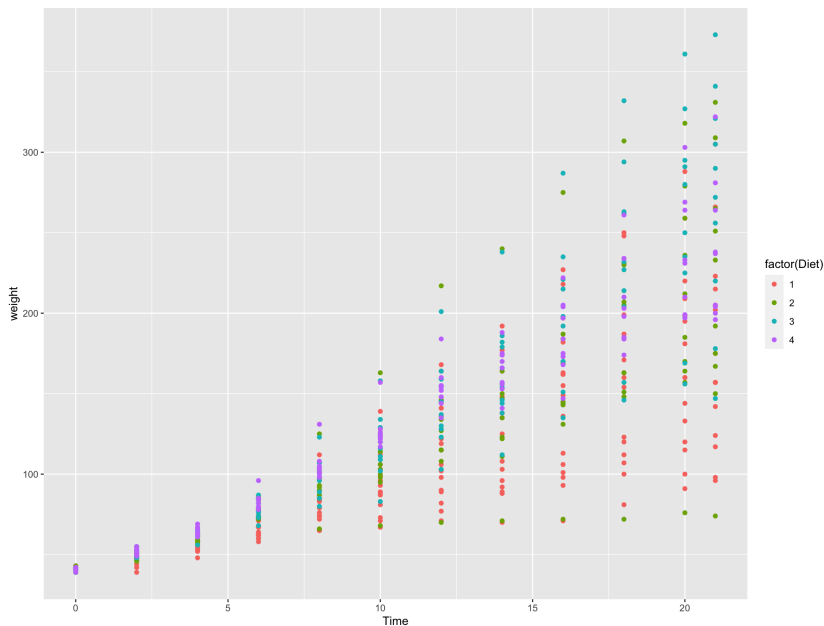

Same chart, with diet categories separated.
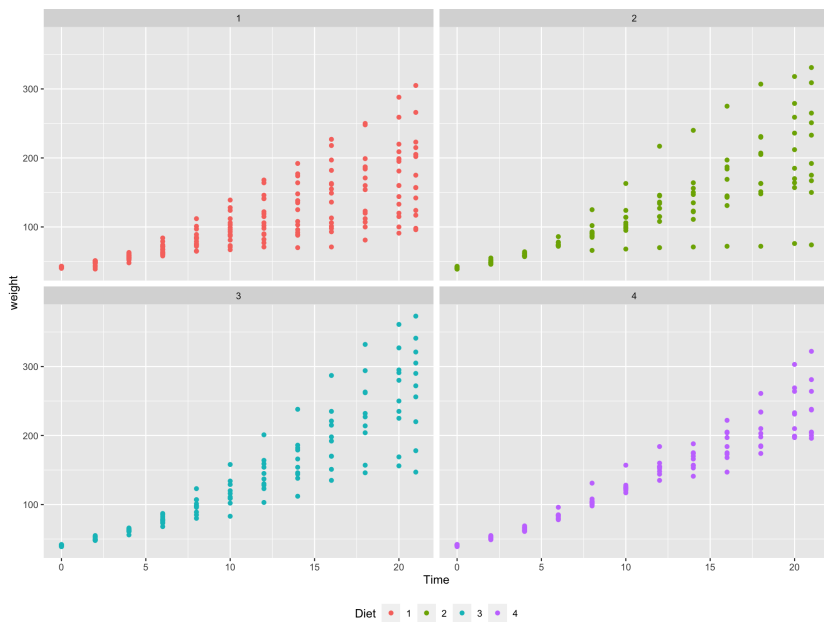
From these two graphs, we can see that the chickens on the third diet grow more. Also we can see the density of chickens reaching high weights from the turquoise dots. Let's continue with the boxplot.

When we look at the box charts representing the 4 diets, the fact that the maximum point of the turquoise graph representing the 3rd diet is higher and yet does not contain outliers indicates which diet is more efficient.


Chick Weight over Time by Diet
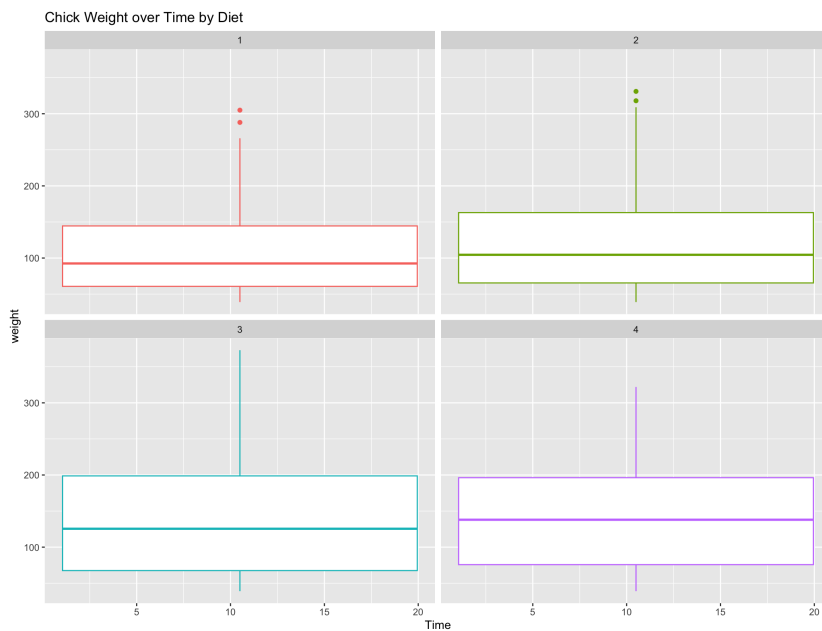
When we look at the mean change of diets, we see that the third diet, the turquoise line, increased the most after the 14th day.

The Mean Changes of Diets
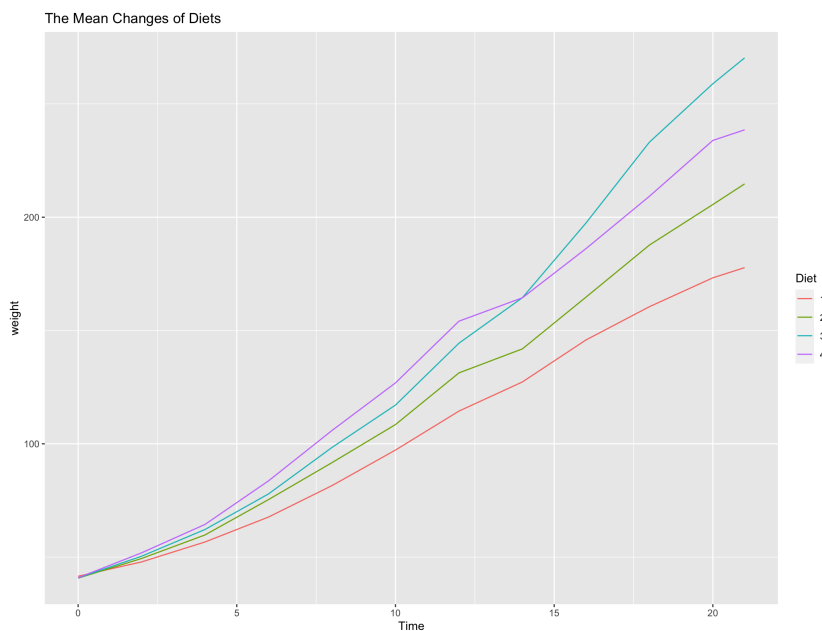
In this graph, the mean changes line and the distribution of data are combined in terms of time and weight. As we can see, diets 1 and 2 seem less efficient than diets 3 and 4.
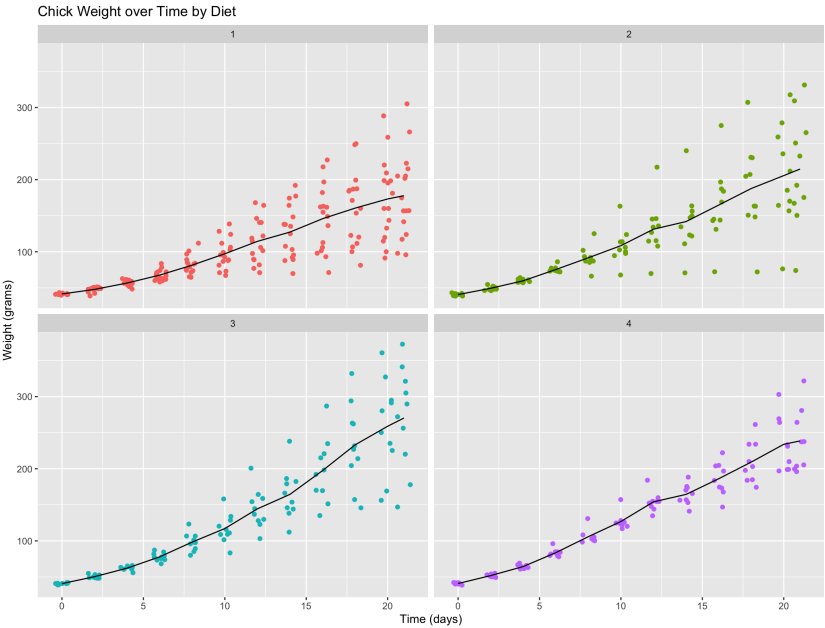
As we can see in this chart, the mean of the 3rd diet is higher than the other diets. In addition, chickens on the 3rd diet reached higher weights.
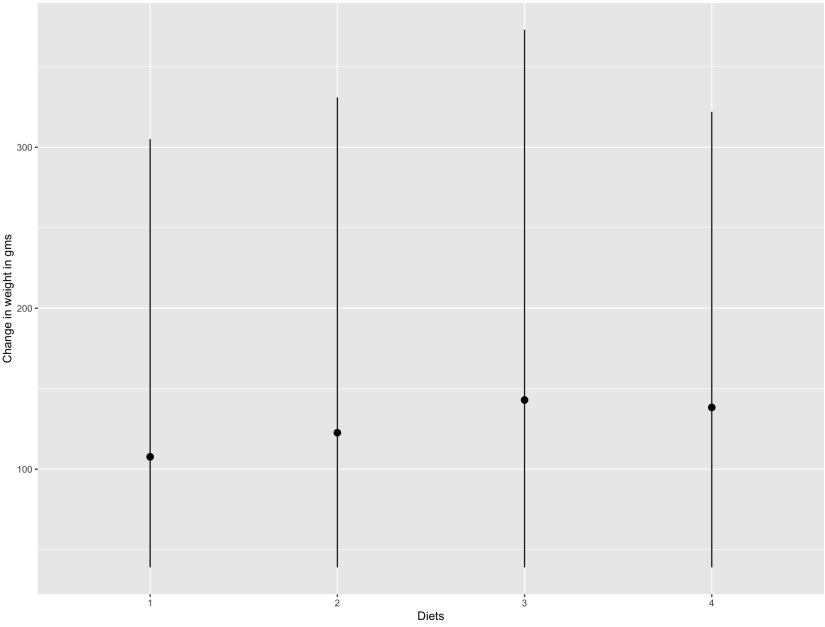
As we understand from the graphs, the 3rd diet seems to be more efficient than the other diets. However, we do not know whether there is a mathematical difference in weight mean of diets. We will use one-way ANOVA analysis to test whether there is a difference between diets.

```
> oneway.test(weight ~ Diet, data = ChickWeight2, var.equal = TRUE)

        One-way analysis of means

data:  weight and Diet
F = 7.7818, num df = 3, denom df = 536, p-value = 4.293e-05

>
```

Conclusion

As we can see, the p value is well above 0.05. This means that there is a significant difference between diet types. Also, based on our previous observations, we can say that the 3rd diet is the most efficient diet. Especially after the 14th day, it starts to be more efficient than other diet types. Also, unlike diets 1 and 4, there was no chicken death in diet 3. This proves that the 3rd diet will be both the most efficient and safe diet type.