Impact of Dosage and Delivery Method of Vitamin C on Guinea Pig Tooth Growth

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Overview

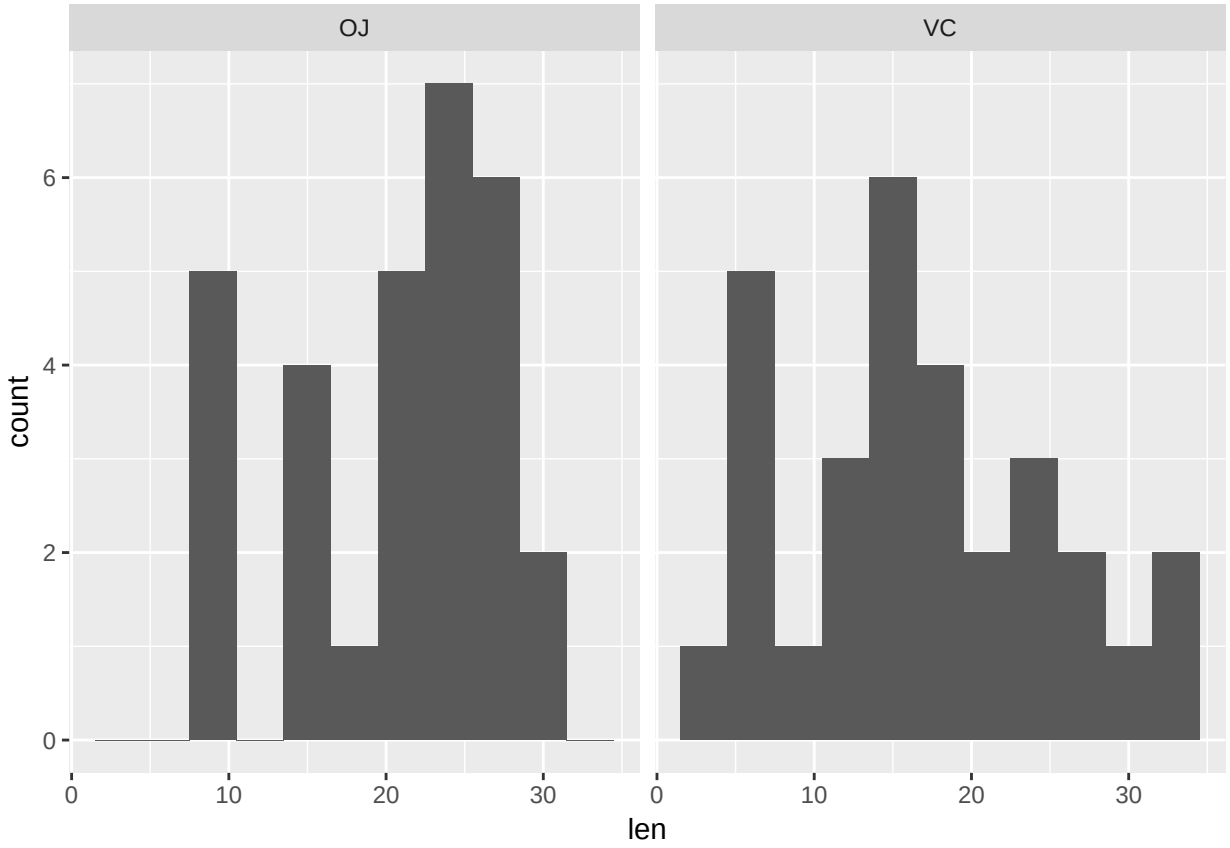
This report analyzes the ToothGrowth dataset in R, which tracks the response of odontoblast (tooth cell) length to vitamin C treatment in 60 guinea pigs. Based on an exploration of the data, we chose to use _____ to test the efficacy of 3 doses and 2 delivery methods. We found that [].

Summary of Data and Analysis Plan

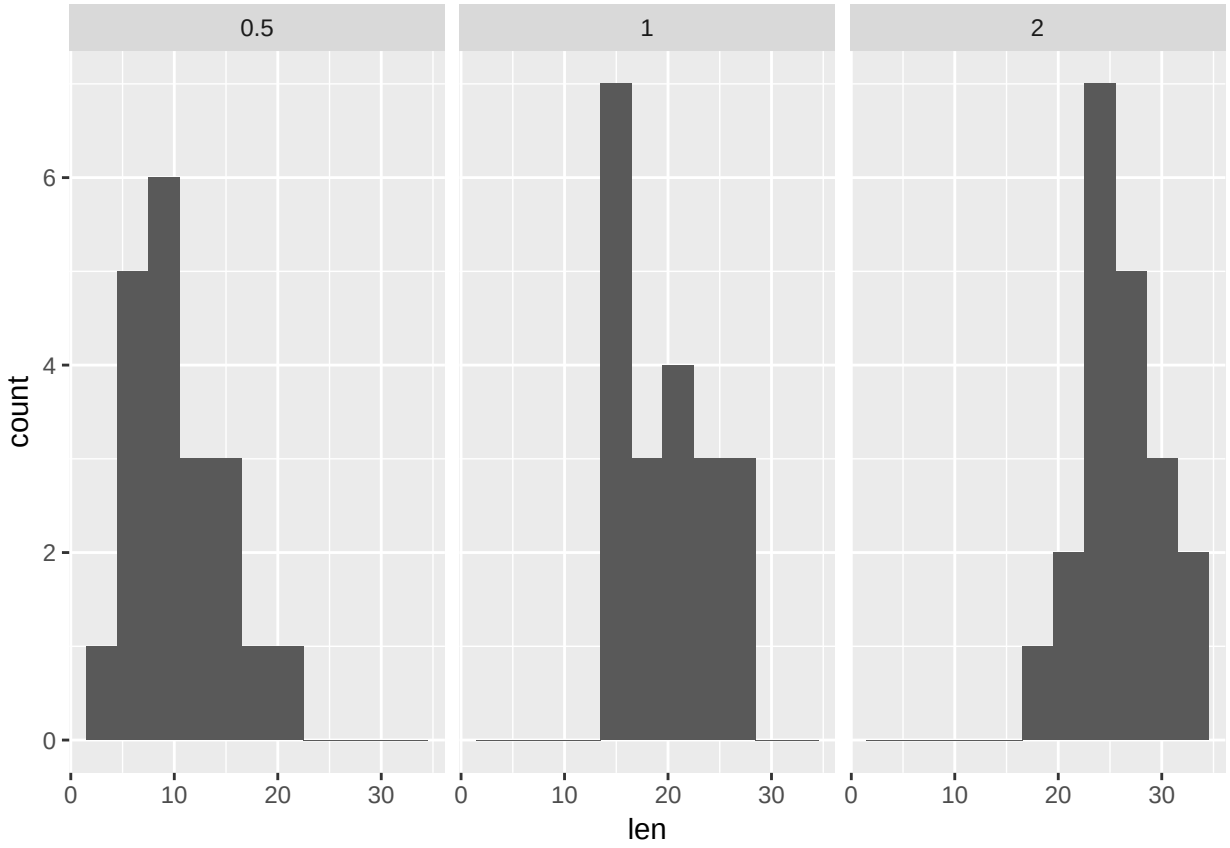
ToothGrowth contains 60 observations of 3 variables: len (tooth length, in microns), supp (supplement type: VC = Vitamin C or OC = Orange Juice), and dose (0.5, 1, or 2 mg/day). First, we view the shape of the data. Although the small sample sizes make it difficult to ascertain that the data is normally distributed, we can see below that there is at least no obvious skewness. Therefore, we will make the **assumption of normality** for simplicity, and test whether delivery method has an impact on tooth growth using a Student's T test. We can use 3 paired t-tests to look at the effect of dosage: comparing 0.5 and 1, 1 and 2, and 0.5 and 2. Since we are making multiple comparisons here, we will employ the Bonferroni correction as an adjustment (noting here that since our comparisons are not independent, the Bonferroni correction will be a conservative estimate).

```
data <- as_tibble(ToothGrowth)

# Distributions of tooth length by delivery method
ggplot(data, aes(len)) +
  geom_histogram(binwidth=3) +
  facet_grid(.~supp)
```




```
# Distributions of tooth length by dosage
ggplot(data, aes(len)) +
  geom_histogram(binwidth=3) +
  facet_grid(.~dose)
```



Effect of Delivery Method

```
t.test(data$len~data$supp)
```

```
##
##  Welch Two Sample t-test
##
## data:  data$len by data$supp
## t = 1.9153, df = 55.309, p-value = 0.06063
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -0.1710156  7.5710156
## sample estimates:
## mean in group OJ mean in group VC
##         20.66333         16.96333
```

Our p-value is 0.06 – this implies that the probability that we would observe these results or more extreme in the case that the two delivery methods are equivalent is 6%. While this is rather low, it remains insignificant at the standard $p<0.05$ level. Therefore, we will conclude that there is no difference between the two delivery methods.

Effect of Vitamin C Dosage

```
# Get subsets of data containing only 2 dosages each
data1 <- data %>% filter(dose == 0.5 | dose == 1.0)
data2 <- data %>% filter(dose == 0.5 | dose == 2.0)
data3 <- data %>% filter(dose == 1.0 | dose == 2.0)

# Test each comparison
p1 <- t.test(data1$len~data1$dose)$p.value
p2 <- t.test(data2$len~data2$dose)$p.value
p3 <- t.test(data3$len~data3$dose)$p.value

# Apply Bonferroni correction
p1 <- p.adjust(p1, method="bonferroni", n=3)
p2 <- p.adjust(p2, method="bonferroni", n=3)
p3 <- p.adjust(p3, method="bonferroni", n=3)

print(paste("0.5 vs. 1.0: ", p1))
```

```
## [1] "0.5 vs. 1.0:  3.80490216052154e-07"
```

```
print(paste("0.5 vs. 2.0: ", p2))
```

```
## [1] "0.5 vs. 2.0:  1.31925748780897e-13"
```

```
print(paste("1.0 vs. 2.0: ", p3))
```

```
## [1] "1.0 vs. 2.0:  5.71928854101541e-05"
```

The three p-values shown above, which have been corrected via Bonferroni method, are all below 0.05, meaning that the chances of us observing these results or more extreme if there were in fact no effect of dosage on tooth growth are very small (less than 5%). In this case, we see that the probability of observing these results if delivering 0.5 mg/day were equivalent to delivering 1.0 mg/day is 3.8e-5%, 1.0 vs. 2.0 mg/day is 5.7e-3%, and 0.5 vs 2.0 mg/day is 1.3e-11%. Therefore, we can conclude that vitamin C dosage has an effect on guinea pig tooth growth.