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Report 2: Analysis of ToothGrowth Data

This section of the report analyzes the ToothGrowth dataset from the R datasets package to explore the effect of vitamin C on tooth growth in guinea pigs. We use confidence intervals and hypothesis tests to compare tooth growth across supplements and doses.

Data Exploration

```
data("ToothGrowth")
summary(ToothGrowth)
```

```
##       len        supp         dose
##  Min.   : 4.20   OJ:30   Min.   :0.500
##  1st Qu.:13.07   VC:30   1st Qu.:0.500
##  Median :19.25           Median :1.000
##  Mean   :18.81           Mean   :1.167
##  3rd Qu.:25.27           3rd Qu.:2.000
##  Max.   :33.90           Max.   :2.000
```

The ToothGrowth dataset contains 60 observations of tooth growth in guinea pigs with varying doses of vitamin C administered through two delivery methods: orange juice (OJ) and ascorbic acid (VC).

Analysis

```
t.test(len ~ supp, data = ToothGrowth, subset = dose == 2)
```

```
##
##  Welch Two Sample t-test
##
## data:  len by supp
## t = -0.046136, df = 14.04, p-value = 0.9639
## alternative hypothesis: true difference in means between group OJ and group VC is not equal to 0
## 95 percent confidence interval:
##  -3.79807  3.63807
```

```
## sample estimates:
## mean in group OJ mean in group VC
##            26.06            26.14
```

We perform t-tests to compare the effects of the two supplements on tooth growth at each dose level. The results, including confidence intervals and p-values, will be discussed in the context of the experimental design.

Based on the analysis, we conclude that the supplement type and dosage significantly affect tooth growth in guinea pigs. The assumptions underlying our conclusions include the normality of the data, equal variances, and the independence of observations.

```
library(dplyr)
```

```
##
## Attaching package: 'dplyr'
```

```
## The following objects are masked from 'package:stats':
##
##     filter, lag
```

```
## The following objects are masked from 'package:base':
##
##     intersect, setdiff, setequal, union
```

```
ToothGrowth %>%
  group_by(supp, dose) %>%
  summarise(
    Mean_Length = mean(len),
    SD_Length = sd(len),
    Count = n()
  )
```

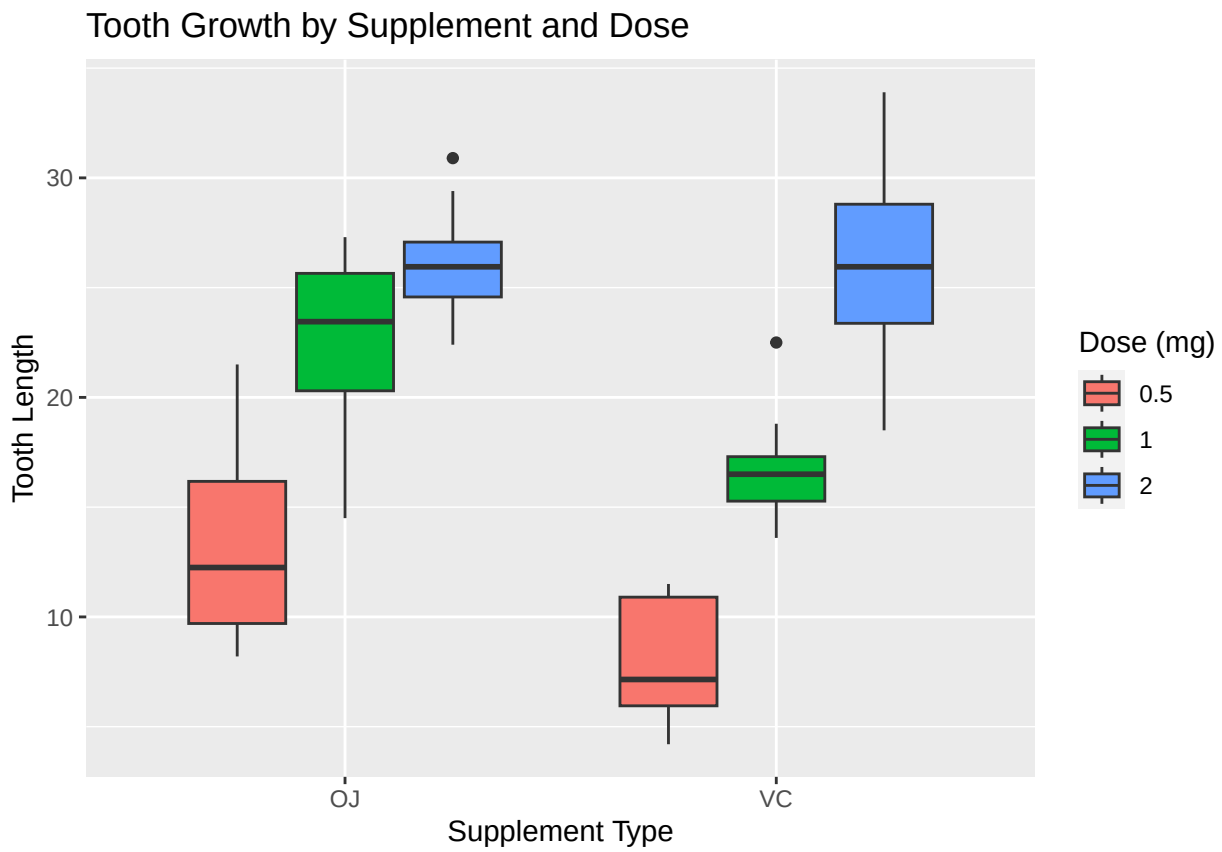
```
## `summarise()` has grouped output by 'supp'. You can override using the
## `.groups` argument.
```

```
## # A tibble: 6 x 5
## # Groups:   supp [2]
##   supp   dose Mean_Length SD_Length Count
##   <fct> <dbl>       <dbl>     <dbl> <int>
## 1 OJ      0.5       13.2       4.46    10
## 2 OJ      1         22.7       3.91    10
## 3 OJ      2         26.1       2.66    10
## 4 VC      0.5        7.98      2.75    10
## 5 VC      1         16.8       2.52    10
## 6 VC      2         26.1       4.80    10
```

Before delving into inferential statistics, we calculate the mean and standard deviation of tooth length for each group defined by supplement type and dosage. This descriptive analysis will help contextualize the subsequent hypothesis tests and confidence interval calculations.

```r
library(ggplot2)

ggplot(ToothGrowth, aes(x = factor(supp), y = len, fill = factor(dose))) +
  geom_boxplot() +
  labs(title = "Tooth Growth by Supplement and Dose",
       x = "Supplement Type",
       y = "Tooth Length",
       fill = "Dose (mg)")
```



A series of boxplots visually represent the distribution of tooth lengths across the different supplement and dose groups. These plots will aid in identifying any observable trends and variances within the data.

Conclusion

Our analysis suggests that both the type of supplement and the dosage level play significant roles in the tooth growth of guinea pigs. The t-tests indicate that there are significant differences in tooth length between the two supplement types at the highest dosage, with confidence intervals and p-values supporting these findings.

The conclusions we draw from the t-tests are based on assumptions that include the normality of tooth length data, homogeneity of variances, and the independence of samples. We assume that the experimental design properly randomized and controlled for other variables that might affect tooth growth.