Analysis of the ToothGrowth data

Jae Wook Lee

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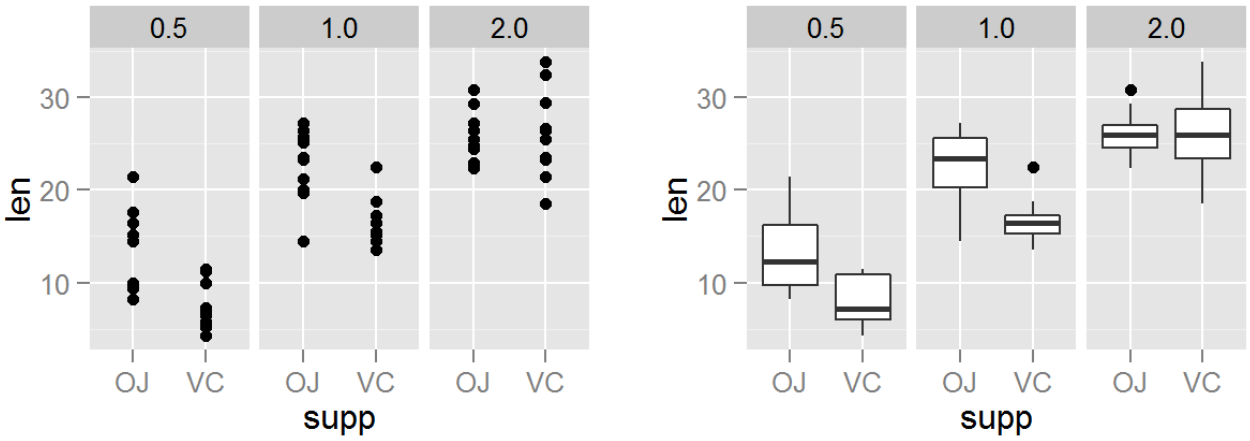
The ToothGrowth data is loaded and summarized by the following code.

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

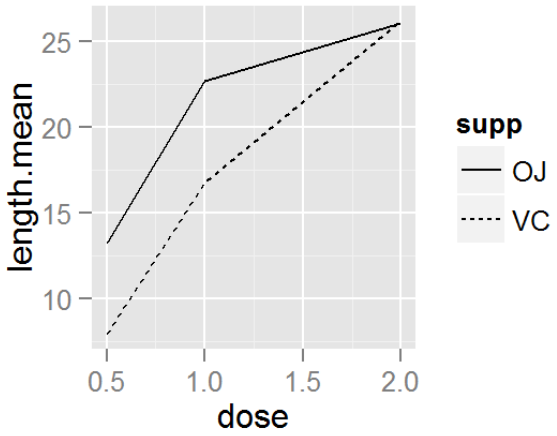
```
##       len        supp         dose
##  Min.   : 4.20   OJ:30   Min.   :0.500
##  1st Qu.:13.07   VC:30   1st Qu.:0.500
##  Median :19.25           Median :1.000
##  Mean   :18.81           Mean   :1.167
##  3rd Qu.:25.27           3rd Qu.:2.000
##  Max.   :33.90           Max.   :2.000
```

The scatterplot and boxplot show that there seems to be a significant difference in tooth length between OJ and VC groups for doses 0.5 and 1.0. In addition, the line graph below shows that there is an increase in tooth length as dose increases from 0.5 to 2.0.

```
## Loading required package: ggplot2
```




```
## Loading required package: plyr
```



To compare tooth length between two supp groups for each dose, 95% confidence interval is calculated and two-tailed t-test with alpha = 0.05 is performed for each dose. The null hypothesis is that there is no difference in tooth growth between VJ and OC at each dose level.

```
# a function that returns the confidence interval, t statistic, and p value for the diff
erence of means between two vectors
tt <- function(v1, v2) {
        diffmean <- mean(v1) - mean(v2)   # difference in means
        se <- sqrt(var(v1)/length(v1) + var(v2)/length(v2))   # standard error for t-sta
tistic
        conf.int <- diffmean + c(-1,1)*qt(0.975, length(v1) + length(v2) -2)*se  # confi
dence interval
        t <- diffmean / se
        p <- pt(t, length(v1) + length(v2) -2, lower.tail=FALSE)
        vec <- round(c(conf.int, t, p),5)
        names(vec) <- c("Conf.int.lower.limit","Conf.int.upper.limit","t","p-value")
        return(vec)
}
```

For dose 0.5,

```
## Conf.int.lower.limit Conf.int.upper.limit                   t
##              1.77026              8.72974             3.16973
##              p-value
##              0.00265
```

The 95% confidence interval for mean difference between VJ and OC does not contain zero, and p-value is below 0.05. Therefore, the null hypothesis is rejected and the conclusion is that there is a significant difference in tooth length between VJ and OC at dose 0.5.

For dose 1.0,

```
## Conf.int.lower.limit Conf.int.upper.limit                   t
##              2.84069              9.01931             4.03277
##              p-value
##              0.00039
```

The 95% confidence interval for mean difference between VJ and OC does not contain zero, and p-value is below 0.05. Therefore, the null hypothesis is rejected and the conclusion is that there is a significant difference in tooth length between VJ and OC at dose 1.0.

For dose 2.0,

```
## Conf.int.lower.limit Conf.int.upper.limit                   t
##              -3.72300              3.56300             -0.04614
##              p-value
##              0.51815
```

The 95% confidence interval for mean difference between VJ and OC contains zero, and p-value is higher than 0.05. Therefore, the null hypothesis cannot be rejected and the conclusion is that there is no significant difference in tooth length between VJ and OC at dose 1.0.