

# The Effect of Vitamin C on Tooth Growth in Guinea Pigs

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## Overview

This paper contains some basic analysis of the ToothGrowth data. Analysis object is effectiveness of different supplement types against teeth response. The response is the length of odontoblasts (teeth) in each of 10 guinea pigs at each of three dose levels of Vitamin C (0.5, 1, and 2 mg) with each of two delivery methods (orange juice or ascorbic acid).

## Tooth Growth Data Overview

Load the tooth growth data.

```
library(datasets)
library(data.table)
data <- data.table(ToothGrowth)
dose.levels <- as.numeric(levels(factor(data$dose)))
str(data)
```

```
## Classes 'data.table' and 'data.frame': 60 obs. of 3 variables:
## $ len : num 4.2 11.5 7.3 5.8 6.4 10 11.2 11.2 5.2 7 ...
## $ supp: Factor w/ 2 levels "OJ","VC": 2 2 2 2 2 2 2 2 2 2 ...
## $ dose: num 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 ...
## - attr(*, ".internal.selfref")=<externalptr>
```

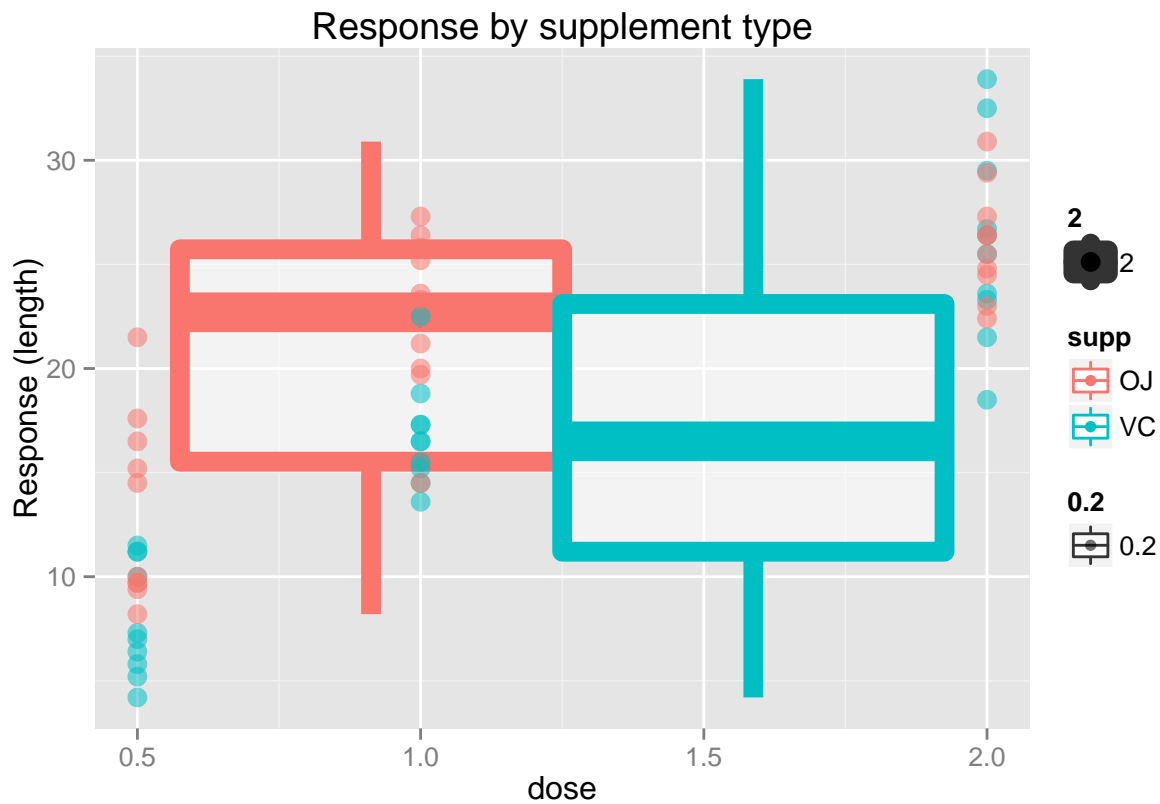
Data is clean enough.

Variable	Type	Domain	Description
<b>len</b>	numeric	positive real number	Tooth length
<b>supp</b>	factor	string: "VC" (ascorbic acid), "OJ" (orange juice)	Supplement type
<b>len</b>	numeric	positive real number: 0.5, 1.0, 2.0	Dose in milligrams

## Further exploratory data analyses

Some usefull plots.

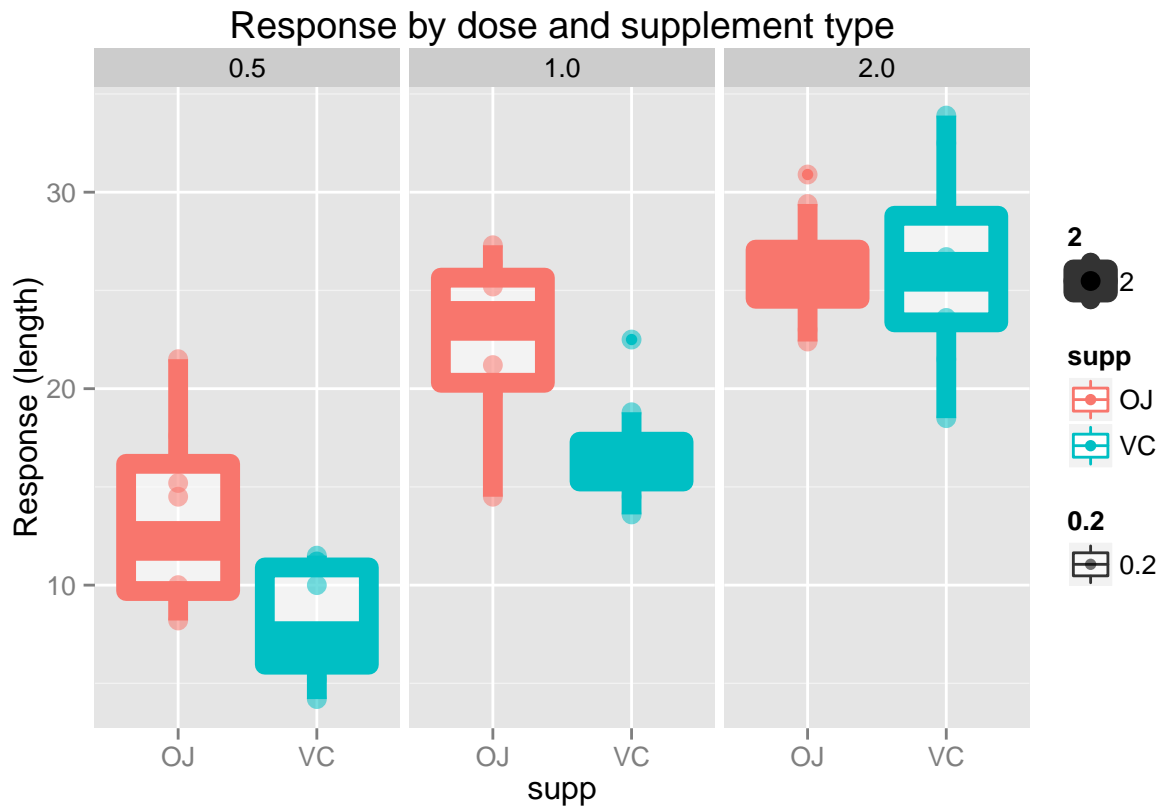
```
library(ggplot2)
qplot(dose, len, data = data, size = 2, colour = supp, geom = c("boxplot", "point"),
      alpha = 0.2, main = "Response by supplement type", ylab = "Response (length)")
```



According to quantiles (boxplots) orange juice (red) is slightly better then ascorbic acid.

Next group response by dose and supplement type.

```
qplot(supp, len, data = data, size = 2, colour = supp, geom = c("boxplot", "point"),
      alpha = 0.2, facets = ~dose,
      main = "Response by dose and supplement type", ylab = "Response (length)")
```



It's evident from figure that orange juice is preferable only in case of the small doses. Results for the 2.0 mg dose are very close to each other.

## Confidence intervals

Paired confidence intervals (orange juice vs ascorbic acid) for each dose.

```
ComputeConfInt <- function(d) {  
  conf.int <- t.test(len ~ supp, data = data[dose == d], paired = F)$conf.int  
  return(data.table(dose = d, low = conf.int[1], high = conf.int[2]))  
}  
conf.intervals <- rbindlist(lapply(dose.levels, ComputeConfInt))  
conf.intervals
```

```
##      dose      low      high  
## 1:  0.5  1.719057  8.780943  
## 2:  1.0  2.802148  9.057852  
## 3:  2.0 -3.798070  3.638070
```

So with the 95% confidence following assumptions can be made:

Dose (mg)	OJ-VC teeth response 95% conf. int.	Description
<b>0.5</b>	from 1.7 to 8.8	Conf. int. is positive, so orange juice is the best choice for small doses
<b>1.0</b>	from 2.8 to 9.1	
<b>2.0</b>	from -3.8 to 3.6	Orange juice has slightly same effect compared to ascorbic acid