Statistical Inference - Assignemnt

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The Effect of Vitamin C on Tooth Growth in Guinea Pigs

```
library(datasets)
library(beeswarm)
data(ToothGrowth)
tg= ToothGrowth
```

Basic data summary and exploratory data analyses

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).

I would not assume that the order of the pigs is the same when applying another dose or vitamin source, so I will use unpaired tests.

Dimensions of the data set:

```
dim(tg)
```

```
## [1] 60  3
```

Tooth length distribution:

```
summary(tg$len)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##    4.20   13.08   19.25   18.81   25.28   33.90
```

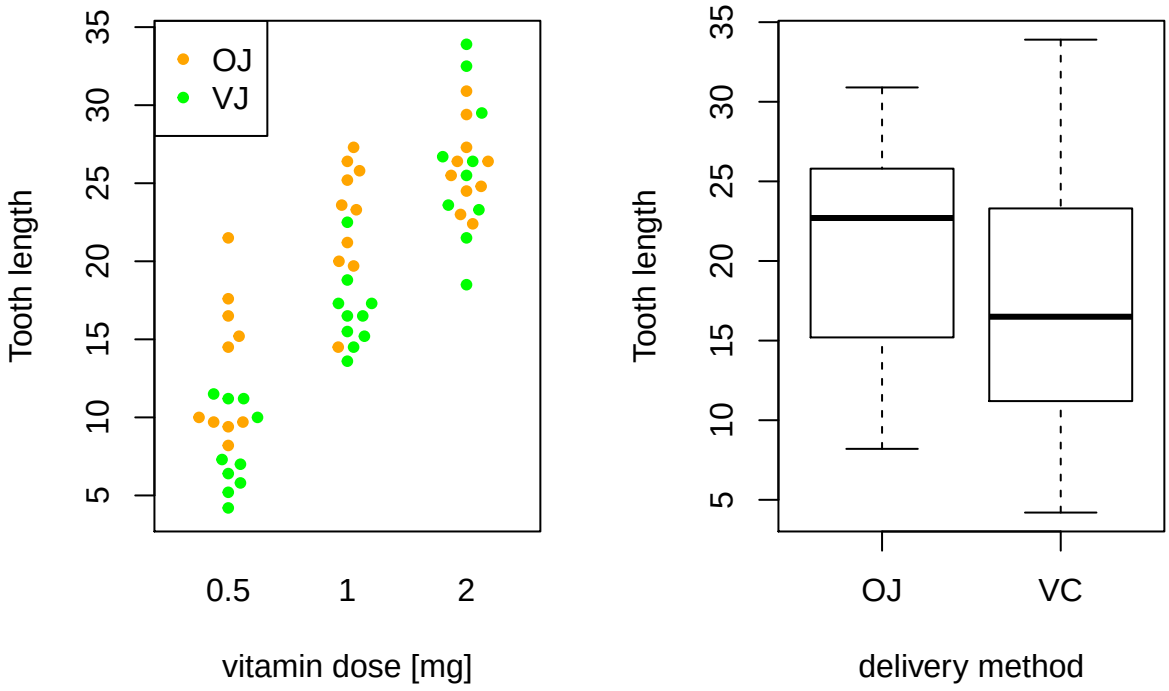
Contingency table for vitamin `dose` and vitamin `supp`lementary methods (OJ=orange juice, VC=ascorbic acid):

```
with(tg, table(dose, supp))
```

```
##      supp
## dose  OJ VC
##   0.5 10 10
##   1   10 10
##   2   10 10
```

Length comparison by dose and delivery methods:

```
par(mfrow=c(1,2))
beeswarm(len~ dose, data=tg,
         ylab='Tooth length',
         xlab='vitamin dose [mg]',
         pwcol=ifelse(tg$supp=='OJ', 'orange', 'green'),
         pch=20
)
legend('topleft', c('OJ','VJ'), col=c('orange', 'green'), pch=20)
boxplot(len~ supp, data=tg,
        ylab='Tooth length',
        xlab='delivery method'
)
par(mfrow=c(1,1))
```



Compare tooth growth by supp and dose

I will perform a T-test to decide whether tooth length is different between the two delivery methods. Based on the analysis above I choose unequal variance for `OJ` and `VC`.

```
res_supp= t.test(len~ supp, data=tg, var.equal=FALSE)
res_supp
```

```
##
##  Welch Two Sample t-test
```

```
##
## data:  len by 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
```

I do not reject the Null-hypothesis that the mean length for pigs fed on acid is the same than for those fed on juice with a Pvalue=0.061> 5% and a confidence interval [-0.1710156, 7.5710156] including the zero.

Additionally, I perform 3 T-tests with unequal variance between doses of 0.5, 1, 2.

```
res_dose= lapply(unique(tg$dose),
                 function(d)
                     t.test(len~ dose, data=tg[tg$dose!=d, ], var.equal=F)
)
res_dose
```

```
## [[1]]
##
##  Welch Two Sample t-test
##
## data:  len by dose
## t = -4.9005, df = 37.101, p-value = 1.906e-05
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -8.996481 -3.733519
## sample estimates:
## mean in group 1 mean in group 2
##          19.735          26.100
##
##
## [[2]]
##
##  Welch Two Sample t-test
##
## data:  len by dose
## t = -11.799, df = 36.883, p-value = 4.398e-14
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -18.15617 -12.83383
## sample estimates:
## mean in group 0.5   mean in group 2
##            10.605            26.100
##
##
## [[3]]
##
##  Welch Two Sample t-test
##
## data:  len by dose
```

```
## t = -6.4766, df = 37.986, p-value = 1.268e-07
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -11.983781  -6.276219
## sample estimates:
## mean in group 0.5   mean in group 1
##            10.605            19.735
```

All 3 tests reject the Null-hypothesis at type 1 error of alpha<5%.

Conclusions

Tooth growth in Guinea Pigs does correlate with dose of vitamin C, but not with delivery method of the vitamin. However, the latter effect is at the borderline of signifcance and a larger cohort should be used to distinguish the effect of the delivery method.