t-Tests in R Handout

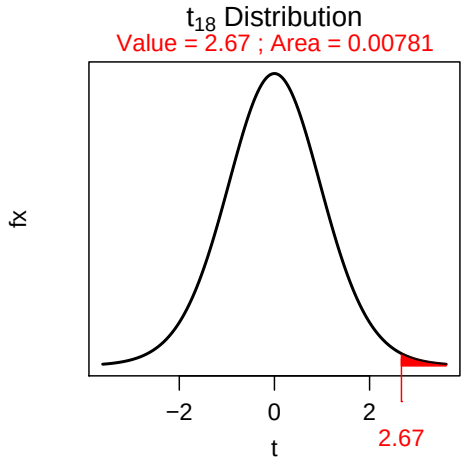
1 Initialization

```
> library(NCStats)
> setwd("C://aaaWork//Class Materials//MTH107//Lecture//HOs//")
```

2 t Distribution Calculations

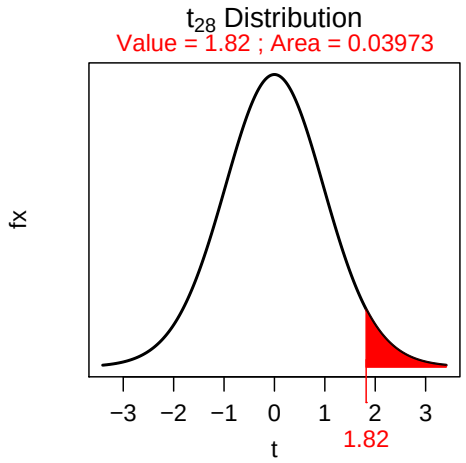
An example of computing the p-value if $H_A : \mu > 70$, t=2.67, and df=18.

```
> distrib(2.67,distrib="t",df=18,lower.tail=FALSE)
```



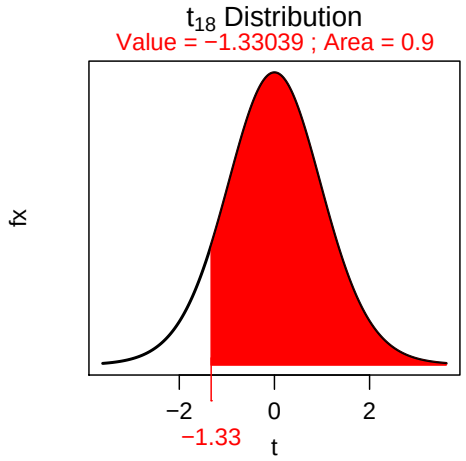
An example of computing the p-value if $H_A : \mu \neq 70$, t=1.82, and df=28.

```
> 2*distrib(1.82,distrib="t",df=28,lower.tail=FALSE)

[1] 0.07946577
```



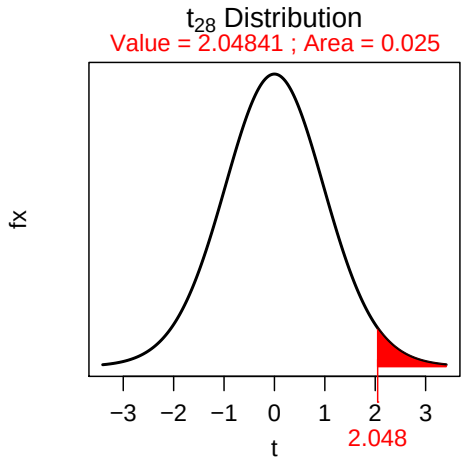
An example of finding t^* if $H_A : \mu > 70$, α=0.10, and df=18.

```
> distrib(0.90,distrib="t",type="q",df=18,lower.tail=FALSE)
```



An example of computing the p-value if $H_A : \mu \neq 70$, α=0.05,, and df=28.

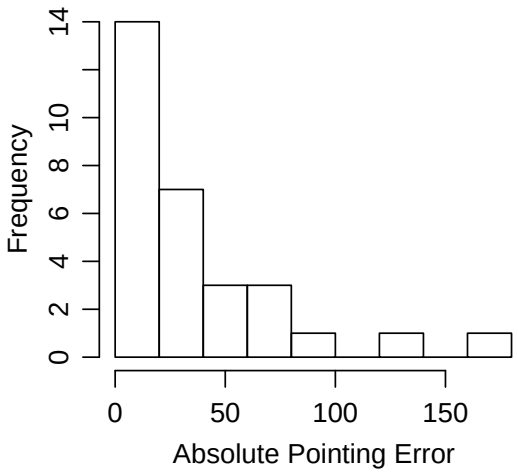
```
> distrib(0.025,distrib="t",type="q",df=28,lower.tail=FALSE)
```



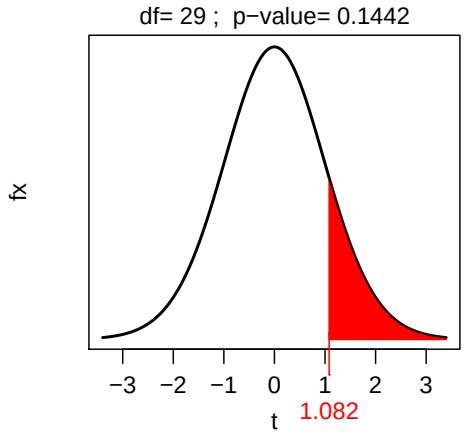
3 1-Sample t-Test

A sample of 30 males and 30 female was taken to an unfamiliar wooded park and given spatial orientation tests, including pointing to the south. The absolute pointing error, in degrees, was recorded. The results are in the **SexDirection.txt** file on the webpage. At the 1% level, is the average pointing error of men greater than 30 degrees?

```
> sdir <- read.table("SexDirection.txt",head=T)
> str(sdir)

'data.frame':        60 obs. of  2 variables:
 $ abserr: int  13 13 38 59 58 8 130 68 23 5 ...
 $ sex   : Factor w/ 2 levels "female","male": 2 2 2 2 2 2 2 2 2 2 ...

> sdir$f.sex <- factor(sdir$sex,levels=c("male","female"))
> str(sdir)

'data.frame':        60 obs. of  3 variables:
 $ abserr: int  13 13 38 59 58 8 130 68 23 5 ...
 $ sex   : Factor w/ 2 levels "female","male": 2 2 2 2 2 2 2 2 2 2 ...
 $ f.sex : Factor w/ 2 levels "male","female": 1 1 1 1 1 1 1 1 1 1 ...

> sdir.males <- Subset(sdir,sex=="male")
> view(sdir.males)

   abserr  sex f.sex
2      13 male  male
6       8 male  male
10      5 male  male
14     18 male  male
16     86 male  male
29     30 male  male

> attach(sdir.males)


> hist(abserr,main="",xlab="Absolute Pointing Error")
```



```
> ae.t <- t.test(abserr,mu=30,alt="greater")
> ae.t

        One Sample t-test

data:  abserr
t = 1.0816, df = 29, p-value = 0.1442
alternative hypothesis: true mean is greater than 30
95 percent confidence interval:
 25.66083      Inf
sample estimates:
mean of x
     37.6

> plot(ae.t)
```

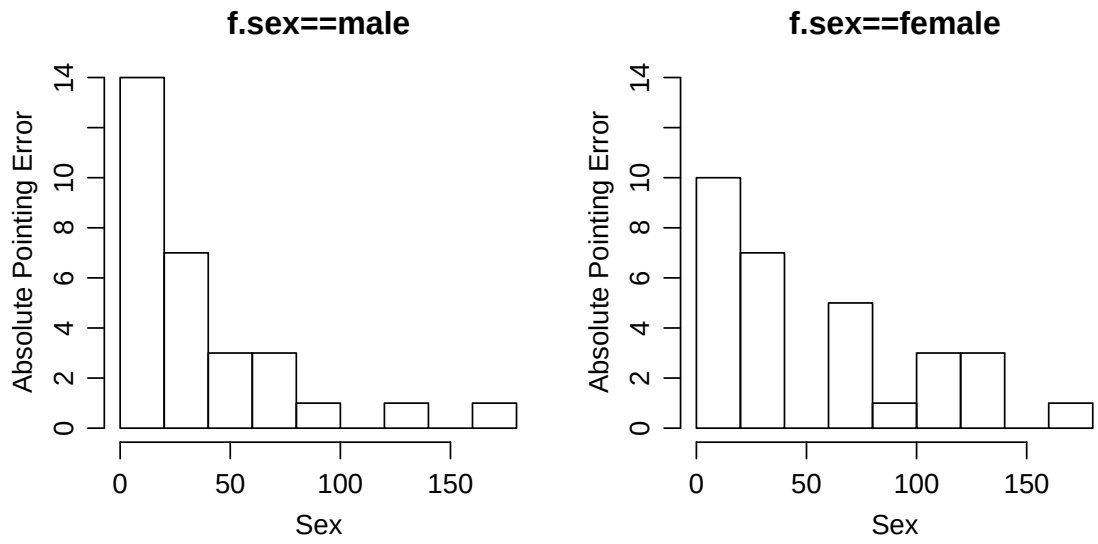



```
> detach(sdir.males)
```

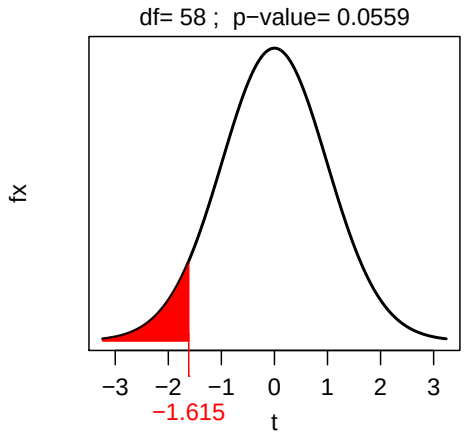
4 2-Sample t-Test

Further suppose that you want to test if the mean absolute pointing error is lower for males than for females at the 1% level. Note: you must change the directory to where the following file is located.

```
> attach(sdir)
> hist(abserr~f.sex,ylab="Absolute Pointing Error",xlab="Sex")
```




```
> Summarize(abserr~f.sex)

        n NAs Valid n Mean St. Dev. Min. 1st Qu. Median 3rd Qu. Max.
male   30   0      30 37.6 38.48654    3   11.50   22.5   58.75  167
female 30   0      30 55.8 48.25964    3   15.75   35.0   88.25  176

> levene.test(abserr~f.sex)

Levene's Test for Homogeneity of Variance
      Df F value Pr(>F)
group  1  2.1692 0.1462
      58

> t2 <- t.test(abserr~f.sex,alt="less",var.equal=TRUE,conf.level=0.99)
> t2

        Two Sample t-test

data:  abserr by f.sex
t = -1.6149, df = 58, p-value = 0.05588
alternative hypothesis: true difference in means is less than 0
99 percent confidence interval:
     -Inf 8.761457
sample estimates:
  mean in group male mean in group female
                37.6                  55.8

> plot(t2)
```

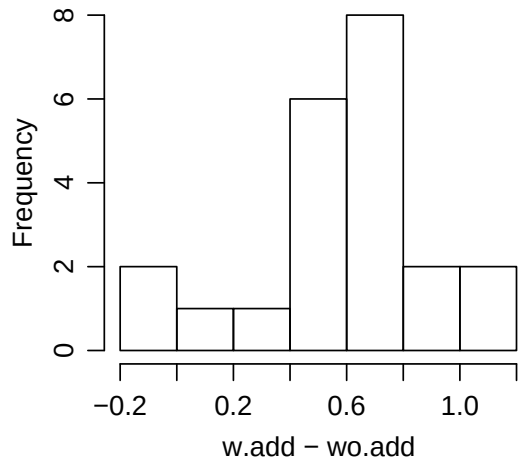



```
> detach(sdir)
```

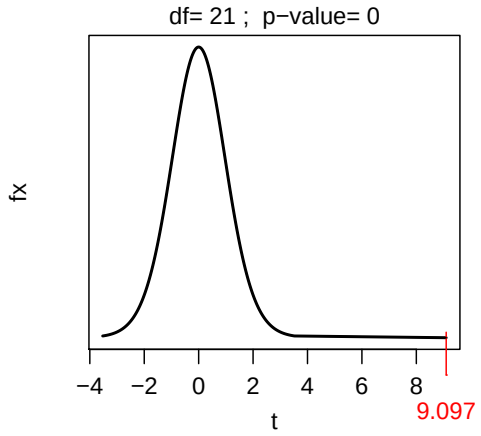
5 Matched-Pairs t-Test

Suppose that you want to test that cars with the gas additive get significantly higher gas mileage then the same cars without the gas additive. Note: you must change the directory to where the following file is located.

```
> ga <- read.table("GasAdditive.txt",head=TRUE)
> str(ga)

'data.frame':        22 obs. of  2 variables:
 $ w.add : num  25.7 20 28.4 13.7 18.8 12.5 28.4 8.1 23.1 10.4 ...
 $ wo.add: num  24.9 18.8 27.7 13 17.8 11.3 27.8 8.2 23.1 9.9 ...

> attach(ga)
> hist(w.add-wo.add,main="")
> Summarize(w.add-wo.add,numdigs=2)

      n      NAs  Valid n     Mean St. Dev.     Min.  1st Qu.   Median  3rd Qu.     Max.
  22.00     0.00    22.00     0.64     0.33    -0.10     0.53     0.70     0.80     1.20
```




```
> mp.t <- t.test(w.add,wo.add,alt="g",paired=TRUE)
> mp.t

        Paired t-test

data:  w.add and wo.add
t = 9.097, df = 21, p-value = 4.946e-09
alternative hypothesis: true difference in means is greater than 0
95 percent confidence interval:
 0.5196779       Inf
sample estimates:
mean of the differences
              0.6409091

> plot(mp.t)
```




```
> detach(ga)
```

6 Class Exercise

- Review Exercises 10.10 and 10.12.
- Review Exercises 10.17 and 10.19.
- Review Exercises 10.24 and 10.26.