

6.3.4

R code:

```
> weights=c(29.6,21.5,28.0,34.6,44.9)
> t.test(weights)
```

gives:

```
95 percent confidence interval:
 20.8814 42.5586
```

We are 95% confident that the true population mean chick embryo thymus gland weight is between 20.9 and 42.6 mg.

6.3.5

R code:

```
> gent=c(33,26,34,31,23,25)
> t.test(gent)
```

Gives:

```
95 percent confidence interval:
 23.84992 33.48341
```

We are 95% confident that the true population mean blood serum concentration of Gentamicin in healthy 3-year-old female Suffolk sheep 1.5 hours after injection of 10 mg/kg body weight is between 23.8 and 33.5 micrograms per milliliter.

6.7.11

R code:

```
> caffeine=c(28,11,-3,14,-2,-4,18,2,2)
> decaf=c(26,1,0,-4,-4,14,16,8,0,18,-10)
> t.test(caffeine,decaf,conf.level=0.9)
```

Gives:

```
90 percent confidence interval:
 -7.278373 10.126858
```

This answers part (a); the units are beats/minute.

(b) The interval contains zero, thus it is reasonable to believe that the mean difference in heart rates $\mu_1 - \mu_2$ is zero, i.e. there is no difference between the caffeine and decaf groups.

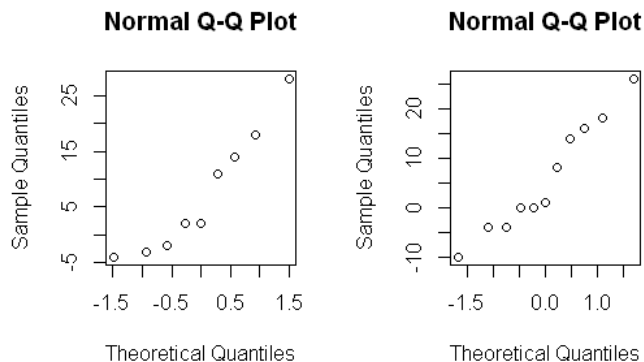
(c) It is reasonable to believe that caffeine drinkers have a mean heart rate that is up to 7.3 beats/min slower than decaf drinkers. It is also reasonable to believe that caffeine drinkers have a mean heart

rate that is up to 10.1 beats/min faster than decaf drinkers. This is consistent with the belief that caffeine affects heart rate.

(d) Parts (b) and (c) seem to contradict each other. If the confidence interval includes zero we do not have evidence that the two means are different, but it is plausible that a difference, if it exists, could be either positive or negative.

6.7.12

```
> par(mfrow=c(1,2))
> qqnorm(caffeine)
> qqnorm(decaf)
```



The normal probability plots are reasonably straight; therefore the data can plausibly come from two normal distributions.

6.7.13

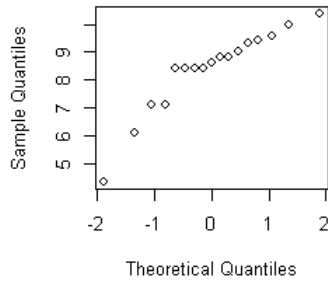
```
> red= c( 8.4, 8.4,10.0, 8.8, 7.1, 9.4, 8.8, 4.3, 9.0, 8.4,
+        7.1, 9.6, 9.3, 8.6, 6.1, 8.4,10.4)
> green=c( 8.6, 5.9, 4.6, 9.1, 9.8,10.1, 6.0,10.4,10.8, 9.6,
+         10.5, 9.0, 8.6,10.5, 9.9,11.1, 5.5, 8.2, 8.3,10.0,
+         8.7, 9.8, 9.5,11.0, 8.0)
> t.test(red,green)
```

```
95 percent confidence interval:
-1.6103216  0.4479687
```

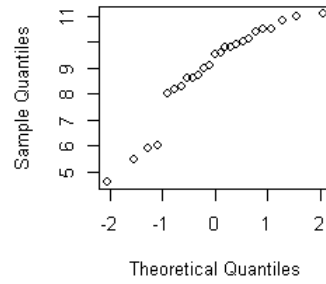
6.7.14

```
> par(mfrow=c(2,2))
> qqnorm(red)
> qqnorm(green)
> hist(red)
> hist(green)
```

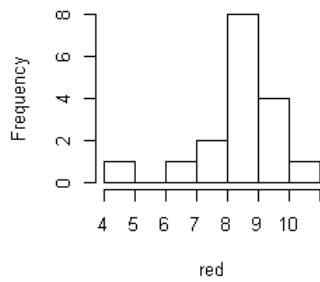
Normal Q-Q Plot



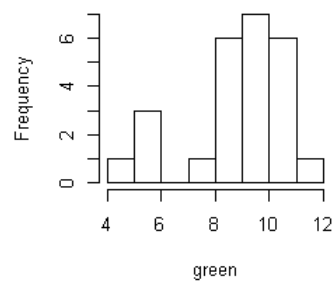
Normal Q-Q Plot



Histogram of red



Histogram of green



Note that both sample sizes ($n_1=17$ and $n_2=25$) are less than 30 so we need to check normality. Both distributions are slightly skewed left. However, the normal probability plots look reasonably straight so I would not worry about it. If one is worried about it, there is a method for computing confidence intervals for small samples that does not assume normal data. We don't discuss it in STAT 205, but it is related to Section 7.10. R code to obtain it gives:

```
> wilcox.test(red,green,conf.int=TRUE)
```

```
95 percent confidence interval:
-1.5000204  0.1999954
```