10.2.4

(a) H0: the striped and red (mimic) salamanders survive in the same proportions.
(b) Let p1 be proportion of striped that survive and p2 proportion of mimics. Ha: p1<p2, more mimics survive than striped. This is the same as Ha: theta<1.
(c) These are p1hat=0.74 and p2hat=0.84 for striped and red, respectively. There is sample evidence that the mimic survives better.
(d) Don't worry about the test-statistic. The p-value is 0.045 from Fisher's test (the best test to use).
(e) Since 0.045 is smaller than 0.05, we reject H0, i.e. conclude that mimics survive better, at the 5% level.

```
> survive=matrix(c(65,163-65,23,41-23),ncol=2)
> colnames(survive)=c("striped","red (mimic)")
> rownames(survive)=c("survived","died")
> survive
         striped red (mimic)
survived      65          23
died          98          18

> fisher.test(survive,alternative="less")

p-value = 0.0452
alternative hypothesis: true odds ratio is less than 1

> prop.test(survive)

   prop 1    prop 2
0.7386364 0.8448276
```

10.2.5

(a) H0: the mites and no mites plants suffer wilt in the same proportions.
(b) Let p1 be proportion of mites-infested plants that survive and p2 proportion of mite-free plants. Ha: p1<p2, fewer mite-infested plants develop wilt than non-infested. This is the same as Ha: theta<1.
(c) These are p1hat=0.39 and p2hat=0.79 for mite-infested and no mites, respectively. There is sample evidence that the mites prevent wilt.
(d) Don't worry about the test-statistic. The p-value is 0.008 from Fisher's test (the best test to use).
(e) Since 0.008 is smaller than 0.05, we reject H0, i.e. conclude that mites reduce the probability of wilt, at the 5% level.

```
> cotton=matrix(c(11,15,17,4),ncol=2)
> colnames(cotton)=c("mites","no mites")
> rownames(cotton)=c("wilt","no wilt")
```

```
> cotton
        mites no mites
wilt       11       17
no wilt    15        4

> fisher.test(cotton,alternative="less")

        Fisher's Exact Test for Count Data

p-value = 0.007743
alternative hypothesis: true odds ratio is less than 1

> prop.test(cotton)

sample estimates:
   prop 1    prop 2
0.3928571 0.7894737
```

10.5.2

```
> fly=matrix(c(89,31,34,20,74,136),nrow=2)
> rownames(fly)=c("males","females")
> colnames(fly)=c("woods 1","woods 2","open ground")
> fly
        woods 1 woods 2 open ground
males        89      34          74
females      31      20         136
> chisq.test(fly)

        Pearson's Chi-squared test

data:  fly
X-squared = 49.741, df = 2, p-value = 1.581e-11
```

We reject H0: proportions of males/females are the same across the three sites at the 5% level because p=0.000000000016 < 0.05 = alpha. There is a significant association between gender and site.

10.5.4

```
> claw=matrix(c(8,2,7,9,4,9,1,20,7),nrow=3)
> rownames(claw)=c("chips","plastic","1 chip")
> colnames(claw)=c("R crush L cut","R cut L crush","both cut")
> claw
        R crush L cut R cut L crush both cut
chips               8             9        1
plastic             2             4       20
1 chip              7             9        7
> chisq.test(claw)

        Pearson's Chi-squared test

data:  claw
X-squared = 24.3637, df = 4, p-value = 6.752e-05
```

We reject H0: probabilities of three claw configurations do not change with rearing environment at the 5% level because p=0.00007 < 0.05 = alpha. There is a significant association between claw configuration and rearing environment.

10.7.1

```
> total=c(1062,1065)
> fractures=c(139,92)
> prop.test(fractures,total)

95 percent confidence interval:
 0.01717529 0.07182500
sample estimates:
    prop 1     prop 2
0.13088512 0.08638498
```

We are 95% confident that the probability of fracture is between 1.7% and 7.2% greater for placebo vs. zolendronic acid.

10.7.3

```
> total=c(105,107)
> preterm=c(32,20)
> prop.test(preterm,total)

95 percent confidence interval:
 -0.006514945  0.242206979
sample estimates:
   prop 1    prop 2
0.3047619 0.1869159
```

We are 95% confident that bed rest can *reduce* probability of preterm delivery up to 0.7% or *increase* the probability of preterm delivery up to 30%. There is evidence that laying in bed makes things worse.

10.9.3

```
> (3995/46941)/(221/5228)
[1] 2.013297
```

The relative risk is 2.0. We estimate that golden retrievers are twice as likely to get hip dysplasia compared to border collies.

10.9.4

```
> dysplasia=matrix(c(3995,42946,221,5007),nrow=2)
> rownames(dysplasia)=c("dysplasia","no dysplasia")
> colnames(dysplasia)=c("golden retriever","border collie")
> dysplasia
             golden retriever border collie
dysplasia                3995           221
no dysplasia            42946          5007
> fisher.test(dysplasia)
```

```
        Fisher's Exact Test for Count Data

data:  dysplasia
p-value < 2.2e-16
alternative hypothesis: true odds ratio is not equal to 1
95 percent confidence interval:
 1.834033 2.432048
sample estimates:
odds ratio
   2.10752
```

First notice, because hip dysplasia is *rare* that the odds ratio and relative risk are very close (2.0 vs. 2.1).

(a) Thetahat=2.1.
(b) (1.8, 2.4).
(c) We are 95% confident that the odds of dysplasia are between 1.8 and 2.4 times greater for golden retrievers.

10.9.6

This is a case-control study. We are really interested in how the likelihood of having a stroke changes when taking an appetite suppressant. By considering the odds ratio rather than the relative risk, we can consider this interpretation.

```
> stroke=matrix(c(6,696,1,1375),nrow=2)
> rownames(stroke)=c("phenypropanolamine","no phenypropanolamine")
> colnames(stroke)=c("stroke","no stroke")
> stroke
                      stroke no stroke
phenypropanolamine         6         1
no phenypropanolamine    696      1375
> fisher.test(stroke)

        Fisher's Exact Test for Count Data

data:  stroke
p-value = 0.007305
alternative hypothesis: true odds ratio is not equal to 1
95 percent confidence interval:
   1.432221 544.120590
sample estimates:
odds ratio
  11.84188
```

(a) thetahat=11.8. We estimate the odds of stroke is 12 times greater in the appetite suppressant group.
(b) The 95% is (1.4, 544). The odds of stroke could be as low as only 1.4 times more likely taking suppressants, or could be as high as 544 times as great.
(c) The results are *not* statistically inconclusive (a double-negative; in other words the study *is* conclusive). Although few people had strokes in both groups, the odds of stroke is significantly greater among those taking the suppressant.