9.13 The boxplot indicates the distribution of the residuals is only slightly right skewed. This is confirmed with an examination of the normal probability plot. The Hartley test yields $F_{max} = 2.35 < 7.11$ using an $\alpha = 0.05$ test. Thus, the conditions needed to run the ANOVA F-test appear to be satisfied. From the output, $F = 15.68$, with p-value $< 0.0001 < 0.05$. Thus, we reject H_0 and conclude there is significant evidence of a difference in the average weight loss obtained using the five different agents.

```
> lawstat::levene.test(ex9.13$WtLoss, ex9.13$Group)
> summary(aov(WtLoss ~ Group, data=ex9.13))
```

9.14

If pairwise difference exceeds $LSD = 4.0184 * \sqrt{\frac{s_W^2}{10}} = 1.26$, it is significant.

Significantly different pairs: (4, 3), (4, S), (1, 3), (1, S), (2, S) Tukey's

W: Pairs Significantly Different: (3, 1), (1,S), (2,S), (3,4), (4,S)

```
> TukeyHSD(aov(WtLoss ~ Group, data=ex9.13))
```

9.23

a. The p-value from the F-test is 0.0345, which is less than 0.05; hence, there is significant evidence that the mean fat content in the four treatment groups are different.

b. Using a one-sided Dunnett's procedure: $D = 2.09\sqrt{\frac{2(0.1189)}{20}} = 0.228$

Comparison	D	$\bar{y}_i - \bar{y}_A$	Conclusion
B vs A	0.228	0.283	Sig. Evid. B's Mean is Greater than Control
C vs A	0.228	0.194	Not Sig. Evid. C's Mean is Greater than Control
D vs A	0.228	0.287	Sig. Evid. D's Mean is Greater than Control

```
with(ex9.23, DunnettTest(Fat, Treatment, control = "A"))
```

10.7

a. $\hat{\pi} = \dfrac{591}{10,000} = 0.0591$;

$\hat{\pi} \pm z_{\alpha/2}\sqrt{\dfrac{\hat{\pi}(1-\hat{\pi})}{n}} = 0.0591 \pm 1.96\sqrt{\dfrac{0.0591(0.9409)}{10,000}} = (0.0545, 0.0637)$ We are 95% confident that the interval 0.0545 to 0.0637 contains the true proportion of false positives produced by the test.

b. Since 0.05 (5%) is entirely below the confidence interval, we do not have evidence that the test produces less than 5% false positives. (We have evidence that the test produces more than 5% false positives.)

10.14

a. Yes, we can use the normal approximation because $n\pi_0 = n(1-\pi_0) = 800(0.5) = 400 > 5$ (hypothesis test).

b. Let π be the proportion of persons suffering from chronic pain that are over 50 years of age.

$H_0 : \pi \le 0.50$ versus $H_a : \pi > 0.50$

For $\alpha = 0.05$, reject H_0 if $z > 1.645$.

$\hat{\pi} = \dfrac{424}{800} = 0.53$

$n\pi_0 = n(1-\pi_0) = 800(0.5) = 400 > 5$

$z = \dfrac{\hat{\pi} - \pi_0}{\sigma_{\hat{\pi}}} = \dfrac{0.53 - 0.50}{\sqrt{\dfrac{0.50(0.50)}{800}}} = 1.697 > 1.645$ with p-value = 0.0448 < 0.05.

Thus, we reject H_0. There is sufficient evidence to conclude that more than half of persons suffering from chronic pain are over 50 years of age.

c. $\hat{\pi} \pm z_{\alpha/2}\sqrt{\dfrac{\hat{\pi}(1-\hat{\pi})}{n}} = 0.53 \pm 1.96\sqrt{\dfrac{0.53(0.47)}{800}} = (0.4954, 0.5646)$ We are 95% confident that the interval 0.4954 to 0.5646 contains the true proportion of persons suffering from chronic pain that are over 50 years of age.

10.18

a. From Minitab (using the normal approx.):

```
95% CI for difference:  (0.000146530, 0.479853)
```

We are 95% confident that the proportion of customers who will buy the lawn mower increases by between 0.0001465 and 0.48 when offered the warranty.

b. Denote the proportion of all customers who will buy a mower who are offered a warranty by π_1 and who are not offered a warranty by π_2.

$H_0 : \pi_1 - \pi_2 \leq 0$ versus $H_a : \pi_1 - \pi_2 > 0$

Test and CI for Two Proportions

```
Sample   X   N  Sample p
1       10  25  0.400000
2        4  25  0.160000


Difference = p (1) - p (2)
Estimate for difference:  0.24
95% lower bound for difference:  0.0387086
Test for difference = 0 (vs > 0):  Z = 1.96  P-Value = 0.025
```

We reject H_0 (since $p - value < 0.05$) and conclude that there is significant evidence that offering the warranty will increase the proportion of customers who will purchase a mower.

c. The conditions are not met ($n_2\hat{\pi}_2 = 4$), so a Fisher's exact test is more appropriate.

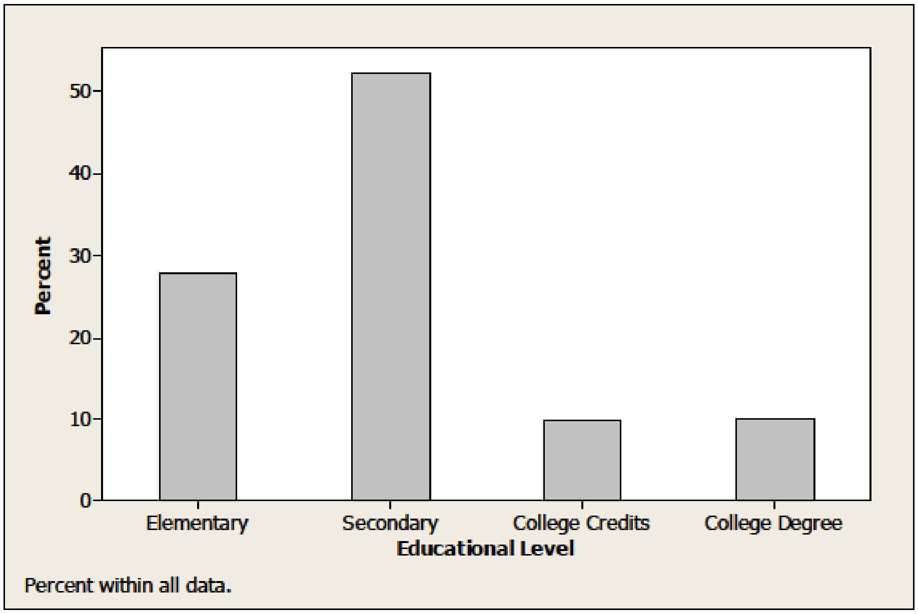
```
Fisher's exact test: P-Value = 0.057
```

Fisher's exact test fails to reject (p>0.05) so the warranty offer does not significantly increase probability of purchase.

d. Based on the results above, the dealer should not offer the warranty with the information provided, however, it is recommended that more data be collected to potentially show the impact of the warranty.

10.34

a. The following bar chart shows the juror educational level as a percent of the total:



b. $H_0 : \pi_1 = 0.392, \pi_2 = 0.405, \pi_3 = 0.091, \pi_4 = 0.112$

H_a : at least one of the π_is differs from its hypothesized value

$E_i = n\pi_{i0} \Rightarrow$

$E_1 = 1000(0.392) = 392$, $E_2 = 1000(0.405) = 405$, $E_3 = 1000(0.091) = 91$,

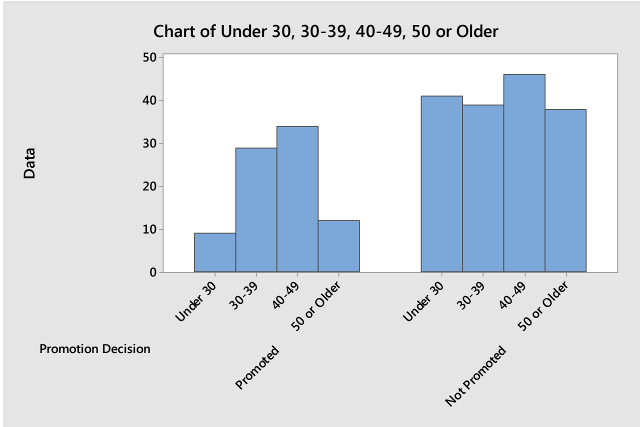
$E_4 = 1000(0.112) = 112$

$\chi^2 = \sum_{i=1}^{4} \frac{(n_i - E_i)^2}{E_i} = 69.152$ with df = 4 – 1 = 3 $\Rightarrow$ p-value < 0.0001 $\Rightarrow$ We reject H_0. It appear that there is a difference between the education distribution of jurors and the countywide education distribution.

c. Since we rejected the null hypothesis, there appears to be education bias in the selection of jurors.

10.42

a.



b.

Chi-Square Test for Association: Promotion Decision, Worksheet columns

```
Rows: Promotion Decision   Columns: Worksheet columns

                                        50 or
                Under 30  30-39  40-49  Older  All

Promoted               9     29     34     12   84
                   16.94  23.03  27.10  16.94

Not Promoted          41     39     46     38  164
                   33.06  44.97  52.90  33.06

All                   50     68     80     50  248

Cell Contents:      Count
                    Expected count


Pearson Chi-Square = 12.796, DF = 3, P-Value = 0.005
Likelihood Ratio Chi-Square = 13.391, DF = 3, P-Value = 0.004
```

At the $\alpha = 0.05$ level, there is significant evidence of an association between promotion decision and the age of the employee.

c. All the employees at the fire department in that city.

d. Answers may vary. Examples include performance metrics, number of fires in the area (to determine need), city size, credentials, position (whether there is potential for promotion), etc.