620-202 Tutorial/Computing Laboratory 10.

1. (8.4-1) It is claimed that the median weight m of certain loads of candy is 40,000 pounds.

   (a) Use the following data and the Wilcoxon test statistic at an approximate significance level of $\alpha = 0.05$ to test the null hypothesis $H_0 : m = 40,000$ against $H_1 : m < 40,000$.

   41195, 39485, 41229, 36840, 38050, 40890, 38345, 34930, 39245, 31031, 40780, 38050, 30906

   It may help to complete the following table. Ties are assigned the average rank.

	X	$X - m$	Rank	Sign
1	41195.00			
2	39485.00			
3	41229.00			
4	36840.00			
5	38050.00			
6	40890.00			
7	38345.00			
8	34930.00			
9	39245.00			
10	31031.00			
11	40780.00			
12	38050.00			
13	30906.00			

   (b) What is the approximate p-value?

```
> qnorm(seq(0.9,0.975,0.025))
[1] 1.281552 1.439531 1.644854 1.959964
```

(c) Use the sign test to test the same hypothesis.

```
> pbinom(6:12,13,.5)
[1] 0.5000000 0.7094727 0.8665771 0.9538574 0.9887695 0.9982910 0.9998779
```

(d) Compare the results of the two tests.

2. (8.5-1) A 1-pound bag of candy-coated chocolate covered peanuts contained 224 pieces of candy coloured brown, orange, green and yellow. Test the null hypothesis that the machine filling these bags treats the four colours of candy equally likely. That is test
$$H_0 : p_B = p_O = p_G = p_Y = \frac{1}{4}.$$
The observed values were 42 brown, 64 orange, 53 green, and 65 yellow. You may select the significance level or give an appropriate p-value.
$(\chi^2_{0.025}(3) = 9.348,\ \chi^2_{0.05}(3) = 7.815,\ \chi^2_{0.10}(3) = 6.251.$

3. (8.5-5) In a biology laboratory the mating of two red eye fruit flies yielded $n = 432$ offspring among which 254 were red-eyed, 69 were brown-eyed, 87 were scarlet-eyed, and 22 were white-eyed. Use these data to test, with $\alpha = 0.05$, the hypothesis that the ratio among the offspring would be 9:3:3:1 respectively.
$(\chi^2_{0.025}(3) = 9.348,\ \chi^2_{0.05}(3) = 7.815,\ \chi^2_{0.10}(3) = 6.251.$

4. (8.6-1) We wish to determine if two groups of nurses distribute their time in six different categories about the same way. That is, the hypothesis under consideration is $H_0 : p_{i1} = p_{i2},\ i = 1\ldots,6$. To test this, nurses are observed at random throughout several days, each observation resulting in a mark in one of the six categories. The summary data is given in the following frequency table

	Category						
	1	2	3	4	5	6	Total
Group I	95	36	71	21	45	32	300
Group II	53	26	43	18	32	28	200

Use a chi-square test with $\alpha = 0.05$.

```
> qchisq(seq(0.9,0.975,0.025),5)
[1]  9.236357 10.008315 11.070498 12.832502
```

5. (8.5-14) R question. Let X equal the amount of butterfat in pounds produced by 90 cows during a 305-day milk production period following their first calf. Test the hypothesis that the distribution of X is $N(\mu, \sigma^2)$ using the following data:

486 537 513 583 453 510 570 500 458 555 618 327 350 643 500 497 421 505 637 599 392 574 492 635 460 696 593 422 499 524 539 339 472 427 532 470 417 437 388 481 537 489 418 434 466 464 544 475 608 444 573 611 586 613 645 540 494 532 691 478 513 583 457 612 628 516 452 501 453 643 541 439 627 619 617 394 607 502 395 470 531 526 496 561 491 380 345 274 672 509

(a) Compute the sample mean $\bar{x}$ and standard deviation s_x.

(b) Use the commands

```
> b = c(0,seq(374,624,50),1000);
> T= table(cut(X,breaks=b));
> T;
> O = as.numeric(T);
```

To compute observed frequencies in the given cells.

(c) Compute expected frequencies using

```
> p=rep(0,7);
> p[1]= pnorm(b[2],mu,s)-pnorm(b[1],mu,s);
...
> p[7]= pnorm(b[8],mu,s)-pnorm(b[8],mu,s);
```

If you are comfortable with loops you can use

```
> for(k in 1:7){p[k] =pnorm(b[k+1],mu,s)-pnorm(b[k],mu,s)};
> E = p*length(X);
> C=sum((O-E)^2/E);
> d1=length(T);
> qchisq(0.95,d1-3);
> 1-pchisq(C,d1-3);
> 1-pchisq(C,d1-3);#p-value
cbind(O,E);
```

(d) If you conduct the chisquare test using

```
> chisq.test(O,p=p)
```

remember to adjust your degrees of freedom as on p 17 of Module 3.

(e) Use the qqnorm command to illustrate your result.

6. (8.4-1) R question. Use the wilcox.test command in R to conduct the test in Question 1.

7. (8.5-5) R question. Use the chisq.test command in R to conduct the test in Question 2.

8. (8.6-1) R question. Use the chisq.test command in R to conduct the test in Question 3.

9. (8.4-3) R Question. Let X be the weight (in grams) of a grape flavoured jolly rancher. Denote the median of X by m. We shall test $H_0 : m = 5.900$ against $H_1 : m > 5.900$. A random sample of size $n = 25$ yielded the data:
5.625, 5.665, 5.697, 5.837, 5.863, 5.870, 5.878, 5.884, 5.908, 5.967, 6.019, 6.020, 6.029, 6.032, 6.037, 6.045, 6.049, 6.050, 6.079, 6.116, 6.159, 6.186, 6.199, 6.307, 6.387 Test the hypotheses using

   (a) The sign test.

   (b) The Wilcoxon test. (wilcox.test)

   (c) The t test.

   (d) Construct a box plot of the data.

   (e) Compare your results and discuss.