PRINTABLE VERSION

Quiz 14

Question 1

State the type of hypothesis test to be used in the following situation:

Quart cartons of milk should contain at least 32 ounces. A sample of 22 cartons contained the following amounts in ounces. Does sufficient evidence exist to conclude the mean amount of milk in cartons is less than 32 ounces?
The data is: (31.5, 32.2, 31.9, 31.8, 31.7, 32.1, 31.5, 31.6, 32.4, 31.6, 31.8,32.2, 32.1, 31.8, 31.6, 32.0, 31.6, 31.7, 32.0, 31.9, 31.8, 31.6)

$n=22$

$H_0: \mu = 32 \quad H_A: \mu < 32$

a) One Sample T Test for Means

b) ~~χ^2 Goodness of Fit Test~~

c) ~~Two Sample Z Test for Proportions~~

d) ~~χ^2 Test for Independence~~

e) ~~Two Sample~~ T Test for Means

f) ~~One Sample Z Test for Proportions~~

g) ~~Matched Pairs T Test~~

h) One Sample Z Test for Means

where is the standard deviation from?
Since there is no SD given we would calculate from the sample, thus the T-test is used

```
> milk=c(31.5, 32.2, 31.9, 31.8, 31.7, 32.1, 31.5, 31.6, 32.4, 31.6,
31.8,32.2, 32.1, 31.8, 31.6, 32.0, 31.6,31.7, 32.0, 31.9, 31.8, 31.6)
> t.test(milk,mu=32,alternative = "less")

 One Sample t-test

data:  milk
t = -3.0488, df = 21, p-value = 0.00305
alternative hypothesis: true mean is less than 32
95 percent confidence interval:
    -Inf 31.92872
sample estimates:
mean of x
 31.83636
```

< 0.05 R H_0

Question 2

State the type of hypothesis test to be used in the following situation:

Solid fats are more likely to raise blood cholesterol levels than liquid fats. Suppose a nutritionist analyzed the percentage of saturated fat for a sample of 6 brands of stick margarine (solid fat) and for a sample of 6 brands of liquid margarine and obtained the following results:

Stick	25.8	26.9	26.2	25.3	26.7	26.1
Liquid	16.9	17.4	16.8	16.2	17.3	16.8

Is there a significant difference in the average amount of saturated fat in solid and liquid fats? Assume the population is normally distributed.

$H_0: \mu_S = \mu_L \quad H_A: \mu_S \neq \mu_L$

a) Two Sample T Test for Means

b) ~~χ^2 Goodness of Fit Test~~

c) ~~Two Sample Z Test for Proportions~~

d) ~~χ^2 Test for Independence~~

e) Matched Pairs T Test

f) ~~One Sample T Test for Means~~

g) ~~One Sample Z Test for Proportions~~

h) ~~One Sample Z Test for Means~~

Question 3

State the type of hypothesis test to be used in the following situation:

In a certain city, there are about one million eligible voters. A simple random sample of size 10,000 was chosen to study the relationship between gender and participation in the last election. The results were:

	Men	Women
Voted	2792	3591
Didn't Vote	1486	2131

Is there a difference in the proportion of people who voted vs. those that didn't vote?

$H_0: P_V = P_D \quad H_A: P_V \neq P_D$

a) Two Sample Z Test for Proportions

b) ~~χ^2 Goodness of Fit Test~~

c) ~~Two Sample T Test for Means~~

d) ~~χ^2 Test for Independence~~

e) ~~Matched Pairs T Test~~

f) ~~One Sample T Test for Means~~

g) ~~One Sample Z Test for Proportions~~

h) ~~One Sample Z Test for Means~~

Question 4

In a certain city, there are about one million eligible voters. A simple random sample of size 10,000 was chosen to study the relationship between gender and participation in the last election. The results were:

	Men	Women
Voted	2333	3755
Didn't Vote	1422	2490

If we are testing for a relationship between gender and participation in the last election, what is the test statistic?

H_0: Gender and participation are independent

H_A: Gender and participation are dependent

Relationship between two categorical variables

thus, this is a Chi-Square test.

a) $\chi^2 = 3.948$

b) $\chi^2 = 5.922$

c) $\chi^2 = 9.974$

d) $z = -22.117$

e) $z = -19.214$

```
> vote=matrix(c(2333,1422,3755,2490),nrow = 2)
> vote
     [,1] [,2]
[1,] 2333 3755
[2,] 1422 2490
> chisq.test(vote)
```

```
> chisq.test(vote,correct = F)

 Pearson's Chi-squared test

data:  vote
X-squared = 3.9479, df = 1, p-value = 
0.04693
```

Question 5

In a certain city, there are about one million eligible voters. A simple random sample of size 10,000 was chosen to study the relationship between gender and participation in the last election. The results were:

	Men	Women
Voted	2422	3566
Didn't Vote	1688	2324

If we are testing for a relationship between gender and participation in the last election, what is the p-value and decision at the 5% significance level? Select the [p-value, Decision to Reject (RH_0) or Failure to Reject (FRH_0)]

Chi-square test for independence

a) [p-value = 0.453, FRH_0]

b) [p-value = 0.105, FRH_0]

c) [p-value = 0.053, RH_0]

d) [p-value = 0.453, RH_0]

e) [p-value = 0.105, RH_0]

```
> vote=matrix(c(2422,1688,3566,2324),nrow = 2)
> chisq.test(vote,correct = F)

 Pearson's Chi-squared test

data:  vote
X-squared = 2.6245, df = 1, p-value = 0.1052
```

$> \alpha = 0.05$ FRH_0

Question 6

The Blue Diamond Company advertises that their nut mix contains (by weight) 40% cashews, 15% Brazil nuts, 20% almonds and only 25% peanuts. The truth-in-advertising investigators took a random sample (of size 20 lbs) of the nut mix and found the distribution to be as follows: 6 lbs of Cashews, 5 lbs of Brazil nuts, 6 lbs of Almonds and 3 lbs of Peanuts. At the 0.05 level of significance, is the claim made by Blue Diamond true?

Select the [p-value, Decision to Reject (RH_0) or Failure to Reject (FRH_0)].

```
> nuts=c(6,5,6,3)
> pnuts=c(0.4,0.15,0.2,0.25)
> chisq.test(nuts,p=pnuts)
```

a) [p-value = 0.304, RH_0]

b) [p-value = 0.152, RH_0]

c) [p-value = 0.057, FRH_0]

d) [p-value = 0.057, RH_0]

e) [p-value = 0.304, FRH_0]

data: nuts
X-squared = 3.6333, df = 3, p-value = 0.3039 > 0.05 FRH_0

H_0: $P_C = 0.4$, $P_B = 0.15$, $P_A = 0.2$, $P_P = 0.25$
Distribution of nuts is as claimed
H_A: Distribution of nuts is different than what Blue diamond claims
Chi-square test for Goodness of fit

Question 7

Quart cartons of milk should contain at least 32 ounces. A sample of 20 cartons contained the following amounts in ounces. Does sufficient evidence exist to conclude the mean amount of milk in cartons is less than 32 ounces at the 5% significance level?
The data is: (27.4, 28.2, 27.3, 28.7, 28.2, 32.3, 31.4, 31.5, 27.7, 32.1, 32.6, 28.4, 28.6, 32.5, 31.7, 28.4, 32.7, 32.7, 31.2, 31.5)
Select the [p-value, Decision to Reject (RH_0) or Failure to Reject (FRH_0)].

H_0: $\mu = 32$ H_A: $\mu < 32$

a) [p-value = 0.999, RH_0]

b) [p-value = 0.001, FRH_0]

c) [p-value = 0.001, RH_0]

d) [p-value = 0.000, RH_0]

e) [p-value = 0.999, FRH_0]

```
> milk=c(27.4, 28.2, 27.3, 28.7, 28.2, 32.3, 31.4, 31.5, 27.7, 32.1, 32.6, 28.4,
28.6, 32.5, 31.7, 28.4, 32.7,32.7, 31.2, 31.5)
> t.test(milk,mu=32,alternative = "less")

 One Sample t-test

data: milk
t = -3.771, df = 19, p-value = 0.0006463
alternative hypothesis: true mean is less than 32
95 percent confidence interval:
    -Inf 31.05514
sample estimates:
mean of x
 30.255
```

< 0.05 RH_0

Question 8

Hippocrates magazine states that 35 percent of all Americans take multiple vitamins regularly. Suppose a researcher surveyed 750 people to test this claim and found that 297 did regularly take a multiple vitamin. Is this sufficient evidence to conclude that the actual percentage is different from 35% at the 5% significance level?
Select the [p-value, Decision to Reject (RH_0) or Failure to Reject (FRH_0)].

$n = 750$ $X = 297$

H_0: $p = 0.35$ H_A: $p \neq 0.35$ $\hat{p} = \frac{297}{750} = 0.396$

a) [p-value = 0.008, FRH_0]

b) [p-value = 0.058, FRH_0]

c) [p-value = 0.004, RH_0]

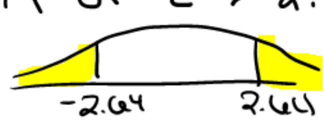
d) [p-value = 0.004, FRH_0]

Test statistic - One sample z-test for proportio

$$z = \frac{\hat{p} - p_0}{\sqrt{\frac{p_0(1-p_0)}{n}}} = \frac{(0.396 - 0.35)}{\sqrt{\frac{0.35(1-0.35)}{750}}}$$

```
> (0.396-0.35)/sqrt(0.35*0.65/750)
[1] 2.641179
```

p-value = P(z < -2.641179 or z > 2.641179)
= 2 * pnorm(-2.61179)



$= 0.008 < \alpha = 0.05$ RH_0

e) [p-value = 0.008, RH_0]

Question 9

A national computer retailer believes that the average sales are greater for salespersons with a college degree. A random sample of 31 salespersons with a degree had an average weekly sale of $3655 last year, while 35 salespersons without a college degree averaged $3222 in weekly sales. The standard deviations were $468 and $642 respectively. Is there evidence at the 5% level to support the retailer's belief?
Select the [p-value, Decision to Reject (RH_0) or Failure to Reject (FRH_0)].

w/ degree $n_1 = 31$ $\bar{x}_1 = 3655$ $s_1 = 468$ } Two-Sample T-test for means

w/o degree $n_2 = 35$ $\bar{x}_2 = 3222$ $s_2 = 642$

$\alpha = 0.05$ $H_0: \mu_1 = \mu_2$ $H_A: \mu_1 > \mu_2$ Right-tail test

Test stat

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}} = \frac{(3655 - 3222)}{\sqrt{\frac{468^2}{31} + \frac{642^2}{35}}}$$

a) [p-value = 0.001, RH_0]

b) [p-value = 0.002, FRH_0]

c) [p-value = 0.015, FRH_0]

d) [p-value = 0.002, RH_0]

e) [p-value = 0.015, RH_0]

```
> (3655-3222)/sqrt(468^2/31+642^2/35)
[1] 3.154505
```

$df = 31 - 1$

Question 10

$P\text{-value} = P(T > 3.1545) = 1 - pt(3.1545, 30) = 0.0018 < 0.05$ RH

The community hospital is studying its distribution of patients. A random sample of 314 patients presently in the hospital gave the following information:

Type of Patient	Old Rate of Occurrences	Present Number of Occurrences
Maternity Ward	20%	72
Cardiac Ward	32%	89
Burn Ward	10%	30
Children's Ward	15%	50
All Other Wards	23%	73

Observed (O)

Expected (E)
$314 * p$
$314 * 0.2 = 62.8$
$314 * 0.32 = 100.48$
$314 * 0.1 = 31.4$
$314 * 0.15 = 47.1$
$314 * 0.23 = 72.22$

Test the claim at the 5% significance level that the distribution of patients in these wards has not changed.
Select the [p-value, Decision to Reject (RH_0) or Failure to Reject (FRH_0)].

χ^2 test for goodness of fit

Test Statistic: $\chi^2 = \text{Sum}\left(\frac{(O-E)^2}{E}\right)$

$(O-E)^2/E$

~~a) [p-value = 0.088, RH_0]~~

b) [p-value = 0.573, FRH_0]

~~c) [p-value = 0.287, RH_0]~~

d) [p-value = 0.573, RH_0]

~~e) [p-value = 0.088, FRH_0]~~

MW $(72 - 62.8)^2/62.8 = 1.34778$
CW $(89 - 100.48)^2/100.48 = 1.311608$
BW $(30 - 31.4)^2/31.4 = 0.06242$
Child W $(50 - 47.1)^2/47.1 = 0.1786563$
others $(73 - 72.22)^2/72.22 = 0.00842$

$\chi^2 = 2.908784$

$P\text{-value} = 1 - pchisq(2.908784, 4) = 0.573 > 0.05$ FRH

4 = # of categories minus 1

Question 11

```
> chisq.test(c(72,89,30,50,73),p=c(0.2,0.32,0.1,0.15,.23))

 Chi-squared test for given probabilities

data:  c(72, 89, 30, 50, 73)
X-squared = 2.9088, df = 4, p-value = 0.5732
```

> 0.05 FR H_0

In a experiment on relaxation techniques, subject's brain signals were measured before and after the relaxation exercises with the following results:

Person	1	2	3	4	5
Before	37.8	37.6	41.2	38.8	42.2
After	36.3	33.7	37.8	40.8	39.7

Is there sufficient evidence to suggest that the relaxation exercise slowed the brain waves? Assume the population is normally distributed.
Select the [p-value, Decision to Reject (RH_0) or Failure to Reject (FRH_0)].

Matched-Pair T-test Diff = B - A > 0
B > A

$H_0: \mu_D = 0 \quad H_A: \mu_D > 0$

a) [p-value = 0.151, RH_0]

b) [p-value = 0.075, FRH_0]

c) [p-value = 0.038, RH_0]

d) [p-value = 0.075, RH_0]

e) [p-value = 0.151, FRH_0]

```
> before=c(37.8,37.6,41.2,38.8,42.2)
> after=c(36.3,33.7,37.8,40.8,39.7)
> t.test(before,after,alternative = "greater",paired = T)

 Paired t-test

data:  before and after
t = 1.7746, df = 4, p-value = 0.07532
alternative hypothesis: true difference in means is greater than 0
95 percent confidence interval:
 -0.3744765        Inf
sample estimates:
mean of the differences
                   1.86
```

$> \alpha = 0.05$ FRH_0

If p-value $\leq \alpha$, RH_0.

If p-value $> \alpha$, FRH_0.

If α "level of significance" is not given use $\alpha = 0.05$.

Bags of a certain brand of tortilla chips claim to have a net weight of 14 ounces. Net weights actually vary slightly from bag to bag and are normally distributed with mean μ. A representative of a consumer advocate group wishes to see if there is any evidence that the mean net weight is less than advertised. Test this claim at the 5% significance level.

4. Determine the null hypothesis H_0 and alternative hypothesis H_A.
   a) H_0: μ = 14, H_A: μ ≠ 14
   b) H_0: μ = 14, H_A: μ < 14 Left tail test
   c) H_0: μ = 14, H_A: μ > 14
   d) $H0: \bar{x} = 14, HA: \bar{x} < 14$

5. To do this test, he selects 16 bags of this brand at random and determines the net weight of each. He finds the sample mean to be $x\bar{x}$ = 13.8668 and the sample standard deviation to be s = 0.25. Calculate the test statistic for this significance test.
   a) t = -2.131
   b) z = -2.131
   c) t = -0.5328
   d) t = -0.1332

use t-test

$$t = \frac{(13.8668 - 14)}{(0.25/\sqrt{16})}$$

```
> (13.8668-14)/(0.25/sqrt(16))
[1] -2.1312
```

6. Give the rejection region.
   a) t < -1.753
   b) z < -1.645
   c) t < -2.131 or t > 2.131
   d) z < -1.96 or z > 1.96

0.05

$t^* = qt(0.05, 15)$

7. Determine the p-value.
   a) P-value = 0.025
   b) P-value = 0.05
   c) P-value = 0.975
   d) P-value = 0.95

pt(-2.131, 15)

-2.131

8. State the conclusion.
   a) Reject the null hypothesis; the mean net weight is significantly less than 14 ounces.
   b) Fail to reject the null hypothesis; the mean net weight is significantly less than 14 ounces.
   c) Reject the null hypothesis; the mean net weight is not significantly less than 14 ounces.
   d) Fail to reject the null hypothesis; the mean net weight is not significantly less than 14 ounces.