HW 9

Name: _______________

Due Wednesday, Dec. 3

Red ID: _______________

Use the following to answer questions 1 through 8

We collect data on subjects who did and did not receive a flu vaccine, and record whether or not the contracted the flu in the same year, obtaining the data below.

	Received vaccine	Did not receive vaccine	Total
Contracted flu	9	23	32
Did not contact flu	78	53	131
Total	87	76	163

1. What is the risk of contracting the flu? $\frac{32}{163} = \boxed{0.201}$

2. What are the odds of contracting the flu? $\left(\frac{32}{163}\right) / \left(\frac{131}{163}\right) = \boxed{0.241}$

3. For subjects who received a vaccine, what is the risk of the flu? $\frac{9}{87} = \boxed{0.10}$

4. Find and interpret the risk ratio of contracting the flu for those who did vs. those who did not receive a vaccine.

$$\frac{\left(\frac{9}{87}\right)}{\left(\frac{23}{76}\right)} = 0.34$$

Risk of contracting the flu for those who did receive the vaccine is 0.34 times the risk for those who did not receive the vaccine.

5. Find and interpret the odds ratio of contracting the flu for those who did vs. those who did not receive a vaccine.

$$\frac{\left(\frac{9}{87}\right)/\left(\frac{78}{87}\right)}{\left(\frac{23}{76}\right)/\left(\frac{53}{76}\right)} = 0.27$$

Odds of contracting the flu for those who did receive the vaccine are 0.27 times the odds of those who did not.

6. Create a 90% confidence interval for the odds ratio

$$S_{OR} = \sqrt{\sum \frac{1}{n_i}} = \sqrt{\frac{1}{9} + \frac{1}{78} + \frac{1}{23} + \frac{1}{53}} = 0.43$$

$$\left(\hat{OR}e^{-z^* S_{OR}}, \hat{OR}e^{z^* S_{OR}}\right) = \left(0.27e^{-1.645(0.43)}, 0.27e^{1.645(0.43)}\right)$$

$$= (0.13, 0.55)$$

7. Based on your confidence interval, is there enough evidence to conclude the odds of contracting the flu for those who received the flu vaccine are different than the odds of contracting the flu for those who did not receive the flu vaccine?

1 implies odds are same for both groups

1 is not in C.I.

There is enough evidence to conclude odds are different

8. Conduct a hypotheses test using $\alpha = 0.10$

I. State the null and alternative hypotheses

H_0: flu + vaccination are independent

H_a: flu + vaccination are dependent

II. Calculate the test statistic, $\sum \frac{(O-E)^2}{E}$

	Received	Did not receive	T
Did contract	17.1	14.9	32
Did not contract	69.9	61.1	131
T	87	76	163

$\frac{(87)(32)}{163} = 17.1$

$32 - 17.1 = 14.9$

$$\sum \frac{(O-E)^2}{E} = \frac{(9-17.1)^2}{17.1} + \frac{(23-14.9)^2}{14.9} + \frac{(78-69.9)^2}{69.9} + \frac{(53-61.1)^2}{61.1}$$

$$= 10.25$$

III. Find the p-value $df = (r-1)(c-1) = (2-1)(2-1) = 1$

$0.001 < \text{p-value} < 0.0025$

IV. Make and justify a decision

p-value < α

RTN

V. Interpret your decision in the context of the problem

There is sufficient evidence to indicate contracting the flu + receiving a vaccine are dependent events.

Use the following to answer questions 9 through 15

Subjects were enrolled in a study to determine whether vitamin C supplementation had any effect on the likelihood of developing cancer. Sujects were divided into 2 groups, 1 group who took daily vitamin C supplementation, the other who did not. They were followed for 25 years, and we recorded whether or not they developed any form of cancer during that time, resulting in the data below.

	Developed Cancer		
Took vitamin C supplement	No	Yes	Total
No	92	45	137
Yes	78	59	137
Total	170	104	274

9. What is the risk of cancer? $\frac{104}{274} = 0.38$

10. What are the odds of cancer? $\left(\frac{104}{274}\right) \Big/ \left(\frac{170}{274}\right) = 0.61$

11. For subjects who did not take a vitamin C supplement, what are the odds of cancer?

$\left(\frac{45}{137}\right) \Big/ \left(\frac{92}{137}\right) = 0.49$

12. Find and interpret the risk ratio of cancer for those who did vs. those who did not take a vitamin C supplement.

$\left(\frac{59}{137}\right) \Big/ \left(\frac{45}{137}\right) = 1.31$ Risk of cancer for those who took vitamin C is 1.31 times the risk for those who did not

13. Find and interpret the odds ratio of cancer for those who did vs. those who did not take a vitamin C supplement.

$$\frac{\left(\frac{59}{137}\right) \Big/ \left(\frac{78}{137}\right)}{\left(\frac{45}{137}\right) \Big/ \left(\frac{92}{137}\right)} = 1.55$$

Odds of cancer for those who took vitamin C are 1.55 times the odds of cancer for those who did not

14. Create a 95% confidence interval for the odds ratio of cancer for those who did vs. those who did not take a vitamin C supplement.

$$S_{OR} = \sqrt{\sum \frac{1}{n_i}} = \sqrt{\frac{1}{92} + \frac{1}{78} + \frac{1}{45} + \frac{1}{59}} \approx 0.25$$

$$\left(\hat{OR}e^{-z^* S_{OR}}, \hat{OR}e^{z^* S_{OR}}\right) = \left(1.55e^{-1.96(0.25)}, 1.55e^{1.96(0.25)}\right)$$

$$= (0.95, 2.53)$$

15. Based on your confidence interval, is there enough evidence to conclude the odds of contracting cancer are different for those who did receive a vitamin C supplement vs those who did not?

1 in C.I., so not enough evidence to indicate odds are different

Use the following for questions 16 through 18

We are interested in whether different variants of the HLA gene have an effect on the probability of developing melanoma. At-risk subjects were recruited into a study, their gene variant recorded, and followed for 5 years. At the end of 5 years we recorded whether or not they developed melanoma, resulting in the data below.

	Developed melanoma		
HLA variant	Yes	No	Total
A2	8	35	43
B12	1	28	29
B45	8	29	37
C3	5	58	63
Total	22	150	172

16. Find the risk ratio of melanoma for those with the B12 variant vs those with the C3 variant.

$$\frac{\left(\frac{1}{29}\right)}{\left(\frac{5}{63}\right)} = \boxed{0.43}$$

17. Find the odds ratio of melanoma for those with the C3 variant vs those with the A2 variant.

$$\frac{\left(\frac{5}{63}\right) / \left(\frac{58}{63}\right)}{\left(\frac{8}{43}\right) / \left(\frac{35}{43}\right)} = \boxed{0.38}$$

18. Conduct a hypotheses test using α = 0.01

I. State the null and alternative hypotheses

Ho: gene variant + melanoma independent

Ha: gene variant + melanoma dependent

II. Calculate the test statistic, $\sum \frac{(O-E)^2}{E}$

	Y	N	T
A2	5.5	37.5	43
B12	3.7	25.3	29
B45	4.7	32.3	37
C3	8.1	54.9	63
T	22	150	172

$$\frac{(22)(43)}{172} = 5.5 \qquad \frac{(22)(29)}{172} = 3.7$$

$$\frac{(22)(37)}{172} = 4.7 \qquad 22 - 5.5 - 3.7 - 4.7 = 8.1$$

$$43 - 5.5 = 37.5$$

$$\sum \frac{(O-E)^2}{E} = \frac{(8-5.5)^2}{5.5} + \frac{(35-37.5)^2}{37.5} + \frac{(1-3.7)^2}{3.7}$$

$$+ \frac{(28-25.3)^2}{25.3} + \frac{(8-4.7)^2}{4.7} + \frac{(29-32.3)^2}{32.3}$$

$$+ \frac{(5-8.1)^2}{8.1} + \frac{(58-54.9)^2}{54.9} = \boxed{7.58}$$

III. Find the p-value $df = (r-1)(c-1) = (4-1)(2-1) = 3$

$0.05 < \text{p-value} < 0.10$

IV. Make and justify a decision

$\text{p-value} > \alpha$

FTR H_0

V. Interpret your decision in the context of the problem

There is not enough evidence to indicate gene variant + melanoma are dependent