Statistics and Bioinformatics
Problem set 9
Due in class, December 14

Practice exercises

1) A researcher wants to know if two plants in a field are competitors or not. She places 100 random quadrats on the field, and counts the number of quadrats in which both plants are present, only one is present, and neither is present. She found that there were 48 quadrats where species A was present. Of these 48, species B was present in 11. She found 52 quadrats where species A was absent. Of these 52, species B was present in 18.
   a) Calculate the proportion of quadrats without A where B was present, and the proportion of quadrats with A where B was present.

$\hat{P}(B/A') = \frac{18}{52} = 0.35$

$\hat{P}(B/A) = \frac{11}{48} = 0.23$

   b) If competition is occurring and causes higher mortality, how should the proportions calculated above compare to each other?

$P(B/A')$ should be $> P(B/A)$

P = true probability

   c) The researcher wants to know whether competition is occurring. Write the null hypothesis and alternative hypothesis, label them, and state the kind of test (2-tail, right-tail, left-tail).

H_A: $P(B/A') > P(B/A)$ or $P_1 - P_2 > 0$

H_0: $P(B/A') \leq P(B/A)$ or $P_1 - P_2 \leq 0$

right tail test

d) Perform a Z-test of equality of proportions. What is the Z-value?

$$Z = \frac{\hat{p}_1 - \hat{p}_2}{\sqrt{\frac{\bar{p}\bar{q}}{n_1} + \frac{\bar{p}\bar{q}}{n_2}}} = \frac{0.35 - 0.23}{\sqrt{(0.29)(0.71)\left(\frac{1}{52} + \frac{1}{48}\right)}} = 1.29$$

$$\bar{p} = \frac{18+11}{100} = 0.29$$

e) What is the critical Z value for this test?

$$Z_{0.95} = \text{qnorm}(0.95) = 1.64$$

f) What is the probability of the Z that you calculated above?

$$1 - \text{pnorm}(1.29) \cong 0.099$$

g) Do you reject the null hypothesis? What is your conclusion?

No, we retain H_0. Conclusion is either H_0 is true or the sample size is too small.

2) Repeat the above Z-test as a chi-square test, as described in your readings on the chi-square test on the course website, as shown in the example for Tablica 19.7 in the Chi kvadarat test.pdf.

a) Write the table of observed counts, with the totals in each row and column (rows: number of quadrats with/without A; columns: number of quadrats with/without B).

	B	B′	
A	11	37	48
A′	18	34	52
	29	71	100

b) Write the table of expected counts, with the totals in each row and column.

	B	B′	
A	$\frac{29\times48}{100}$	$\frac{71\times48}{100}$	48
A′	$\frac{29\times52}{100}$	$\frac{71\times52}{100}$	52
	29	71	100

	B	B′	
A	13.92	34.08	48
A′	15.08	36.92	52
	29	71	100

c) Calculate the chi-square statistic for these two tables.

$$X^2 = \frac{(11-13.92)^2}{13.92} + \frac{(37-34.08)^2}{34.08} + \frac{(18-15.08)^2}{15.08} + \frac{(34-36.92)^2}{36.92}$$

$$= 1.66$$

Can also subtract 0.5 from each difference in the numerator, as the reading does.

d) What are the degrees of freedom for this test?

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e) What is the probability of the chi-square that you calculated above?

$$\frac{1 - \text{pchisq}(1.66, 1)}{2} = 0.099$$

f) Show that the chi-square is the square of the Z that you calculated.

$1.66 = 1.29^2 = Z^2$

g) Do you reject the null hypothesis?

Nope.