Data Analysis in Evol/Evol - HW Week3
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Reference R code see: github.com/jingyilu/Data-analysis-ecoevo

1. **Calculate the general formulae for the mean, μ and variance σ^2 for the Bernoulli distribution, using expectations, writing the expressions in terms of p, when p = probability of a success.**
$\mu = E(X) = p.$
$\sigma^2 = E(X - \mu)^2 = p(1 - p).$

   Based on this, can you derive the general formula for the mean and variance of the binomial, with n trials, and probability of success on each trial = p.
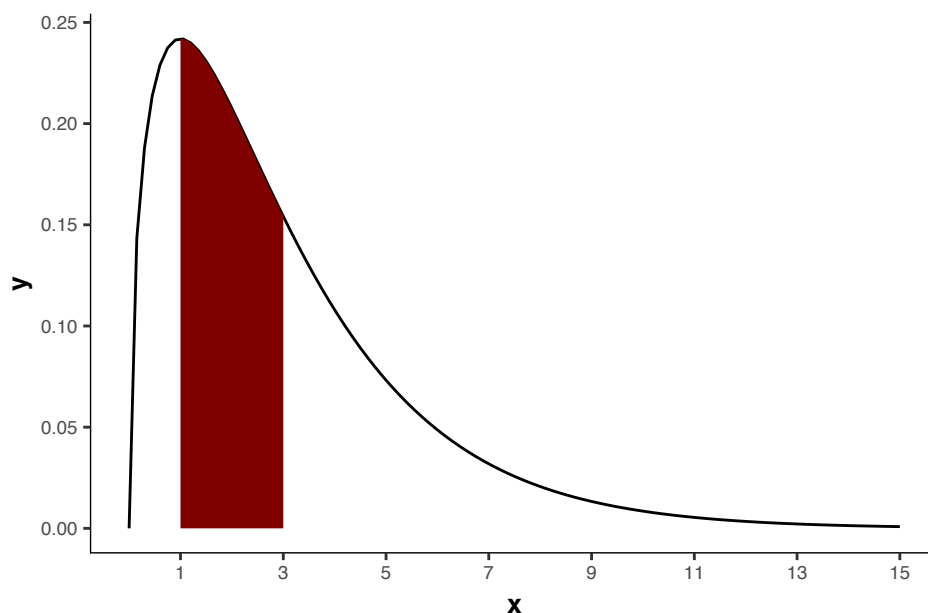$X_{Binomial} = nX_{Bernoulli}$
$\mu = np.$
$\sigma^2 = np(1 - p).$

2. **Use R to calculate the probability of the chi-square statistic with 3 degrees of freedom lying between 1 and 3, if the null hypothesis is true. Sketch the distribution and shade the area.**
P (chi-square statistic with 3 degrees of freedom lying between 1 and 3) = 0.41.

3. **What is the probability that a chi-square statistic with 5 degrees of freedom takes on a value <0?**
P (chi-square statistic with 5 degrees of freedom takes on a value < 0) = 0.

p.263, q.19

	Eyes-covered pictures	Non-covered pictures	Total
Yawns	17	11	29
No yawn	13	19	31
Total	30	30	60

Test if the eyes are important trigger for contagious yawns. That is, the reaction of yawning was dependent on the pictures with or without eyes covered.
H_0: Yawns and pictures with/without eye-covered are independent.
H_1: Yawns and pictures with/without eye-covered are not independent.
Decision rule: $P < \alpha = 0.05$
Chi-square contingency test (degree of freedom = 1)
$X^2 = 1.67$; P value $= 0.196 > 0.05$
We cannot reject the null hypothesis. The eyes-covered pictures and yawns are independent.
Eyes *might* not be an important trigger for contagious yawns.

p.263, q.21: do this question in R, calculating the P value from a chi sq test, and P value from Fisher's exact test
H_0: The blue liquid is not toxic (Liquids and immobilization are independent.)
H_1: The blue liquid is toxic (Liquids and immobilization are independent.)
Decision rule: $P < \alpha = 0.05$

Chi-square contingency test (degree of freedom = 1)
$X^2 = 37.29$; P value $= 1.019 \times 10^{-9} < 0.05$

Fisher's exact test
P value $= 1.25 \times 10^{-10} < 0.05$
We can reject the null hypothesis. The blue liquid is toxic on the second termite species.

p.263, q.28
Behavior counts are the sum of all individuals. The counts might be biased by some individuals with behavioral preference. We cannot tell the behavior counts are the general patterns or led by small amount of outlier individual.