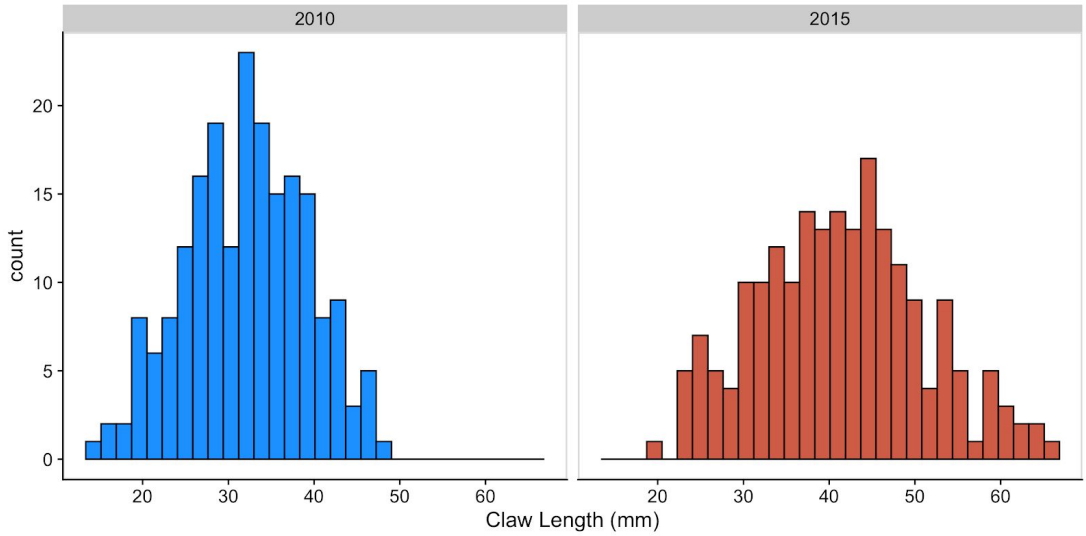
BIOL 01104, Spring 2020
Heritability and Natural Selection Worksheet
Instructor: Dr. Spielman

You are studying a population of crabs in Maine. In 2010, you randomly collected 200 crabs and measured the length of the front left claw in millimeters, and you returned in 2015 to again measure 200 randomly sampled crabs. You can assume that variation in claw length has at least some genetic basis. You obtained these results:



1. Is the trait "claw length" discrete or continuous?

2. Ballpark the mean, standard deviation, and coefficient of variation of claw lengths for 2010 and 2015 each.

3. Based on the measurements from 2010 and 2015, is there evidence that claw length is evolving? For your answer, consider whether the data satisfies the entire definition of evolution. *Hint: Evolutionary change of traits over time can manifest as changes in mean and/or standard deviation of trait values.*

4. To test if claw length *can be* evolving by natural selection, three conditions must be satisfied. Below, we will test (or figure out how to test!) if these conditions are indeed met.
    a. The trait is variable
    b. The trait is heritable
    c. The trait gives a fitness advantage

Condition One: Trait is variable

Based on the claw measurements you took, is there variation in the trait "claw length"? Consider 2010 and 2015 distributions individually; this question is NOT asking you to compare years.

Condition Two: Trait is heritable

To determine if the trait is heritable, you randomly select 10 mating pairs of crabs and measure their claw lengths as well as their childrens' claw lengths, in millimeters. Using this information, draw a midparent-midoffspring regression and "ballpark" the line of best fit.

Mom's claw length	**Dad's claw length**	**Midparent claw length?** ***(calculate and fill in the column)***	**Mean offspring claw length**
24	38		34
40	46		42
32	34		36
40	44		41
28	32		32
22	28		23
18	32		30
20	26		24
21	29		27
19	27		26
30	33		32

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In the space below, draw your midparent-midoffspring regression plot in the space below to (roughly) determine if the trait is heritable. Include all axis labels, points, and draw an *approximate* line of best fit. Based on your results, do think this trait is not heritable, weakly heritable, or strongly heritable?

Condition Three: Trait gives a fitness advantage

You have *observed* that crabs with larger claws tend to be more successful at capturing prey, and therefore more likely to eat and survive to reproductive age. You wish to test this observation. With your group, design an experiment to test this observation:

1. What are your alternative and null hypotheses?

2. Design an experiment with appropriate control/treatment groups, randomization, and replication that can address your hypothesis. You may use drawings to help convey your experimental setup. Be sure to clearly define your independent and dependent variables.

3. Below, *draw two graphs* (depending on your experiment, there are many options for what kind of graph) of what your results might look like if there were evidence for the alternative hypothesis, or NO evidence for the alternative hypothesis.