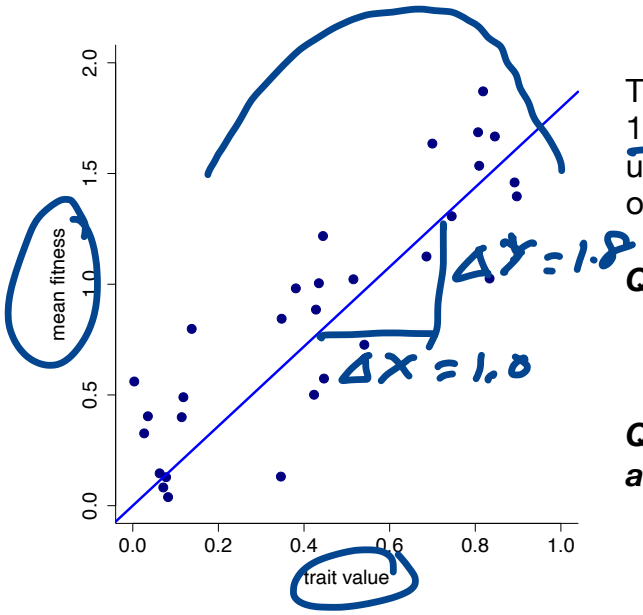
Practice problems: quantitative traits



The regression line in the plot on the left increases 1.80 in mean fitness for every increase of 1.0 trait unit. The mean trait value is 0.50 and the variance of the trait is 0.15.

Q1. What is the slope of the selection gradient?

1.8

Q2. What is the covariance between trait value and mean fitness? *(show your work)*

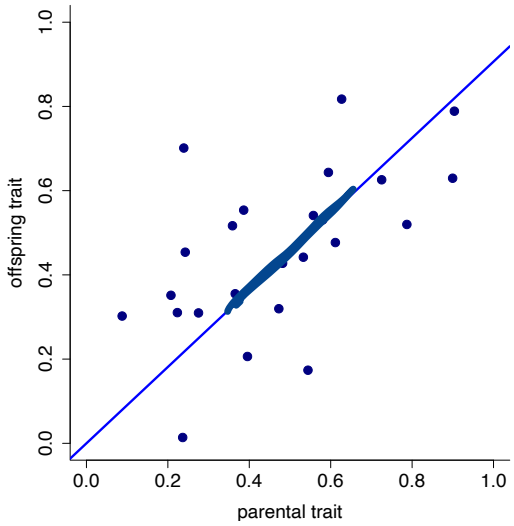
$\text{slope} = \frac{\text{cov}}{\text{var}}$, $1.8 = \frac{\text{cov}}{.15}$, $\text{cov} = (\text{slope})(\text{var})$

$= (1.8)(.15)$

$= .27$

Q3. What selection differential would be consistent with these data?

$S = \text{Cov} = .27$



The slope of the regression line in the plot on the left is 0.91. The mean trait value before selection is 0.50.

Q4. What is the heritability?

$h^2 = .91$

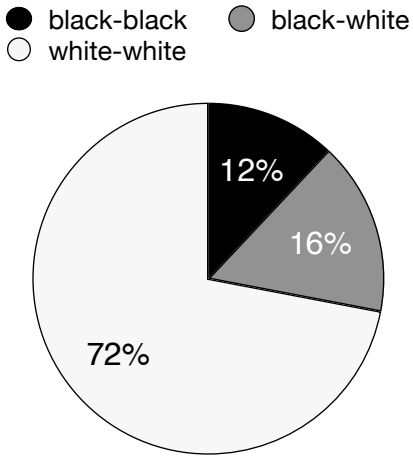
Q5. What is the expected mean offspring trait value? *(show your work)*

$R = h^2 S = (.91)(.27) = .2457$

$.5 + .2457 = .7457$

Q6. Is this positive directional selection, negative directional selection, stabilizing selection, or diversifying selection?

Practice problems: discrete traits



Begin with the following genotype frequencies:

0.72 white-white
0.16 black-white
0.12 black-black

Q1. What are the allele frequencies? *(show how you obtained your result.)*

(white allele) p = $.72 + \frac{.16}{2} = .8$

(black allele) q = $.12 + \frac{.16}{2} = .2$

Q2. Assuming there is random mating, what genotype frequencies would you expect in newly-formed zygotes in generation 1? Show how you obtained your result.

white-white: $(.8)(.8) = .64$

black-white: $(2)(.8)(.2) = .32$

black-black: $(.2)(.2) = .04$

Q3. Are the original genotype frequencies (0.72, 0.16, 0.12) consistent with random mating? no

Q4. What is the mean fitness if the following genotype fitnesses are assumed (and using the genotype frequencies you calculated assuming random mating)?

0.5 fitness of white-white
1.0 fitness of black-white
1.0 fitness of black-black

(Show how you calculated it, don't just write the answer.)

$\bar{w} = (.64)(.5) + (.32)(1) + (.04)(1) = .68$

Q5. What are the genotype frequencies in adults (i.e. after selection) in generation 1? (again, show how you obtained your answer)

white-white: $(.64)\left(\frac{.5}{.68}\right) = .4706$ ←

black-white: $(.32)\left(\frac{1}{.68}\right) = .4706$ ←

black-black: $(.04)\left(\frac{1}{.68}\right) = .0588$ ←

Q6. What are the allele frequencies in gametes generated by the adults in generation 1?

white: $.4706 + \frac{.4706}{2} = .7059$ ← .8

black: $.0588 + \frac{.4706}{2} = .2941$ ← .2

Q7. Has the frequency of the white allele increased or decreased over one generation? (Compare your answer to Q1 with your answer to Q6.)

Q8. Would your answers to Q5, Q6, and Q7 change if the following fitnesses had been used? Explain.

1 fitness of white-white
2 fitness of black-white
2 fitness of black-black

$\bar{w} = (.64)(.5) + (.32)(1) + (.04)(1) = .68$
$(.64)(1) + (.32)(2) + (.04)(2) = 1.36$

$\frac{(.64)(1)}{1.36} = .4706 = (.64)\left[\frac{.5}{.68}\right]$