Genetics 320 Problem Set Three

Solutions

1 (1 point): In a cross involving two marked loci, you recover 150 parental gametes and 50 recombinant gametes. What is the recombination frequency between these loci?

Recombination frequency = (number of recombinant gametes) /(total number of gametes) = 50/200 = 1/4 = 0.25

2 (2 points): Consider two coat-color loci (R/r, G/g), where the genotypes have the following phenotypes R-G- = yellow, rrG- = green, R-gg = red, rrgg = white. Two yellow parents (which we denote P1 and P2) are choosen and crossed to several different parents, and the following data are observed:

- When crossed to a purebreeding green parent, both yellow parents gave equal number of yellow and green offspring.
- When crossed to a purebreeding red parent, both yellow parents gave equal numbers of red and yellow offspring.
- When crossed to a white parent, the first (P1) yellow parent gave equal numbers of yellow and white offspring.
- When crossed to a white parent, the second (P2) yellow parent gave equal numbers of red and green offspring.

Provide a complete genetic model accounting for these data.

Parent 1 = RG / rg; Parent 2 = rG / Rg; both loci very tightly linked.

3 (2 points): Consider two X-linked loci, A/a and B/b. The A locus controls hair color, with (in males) AY = red-heads, aY = yellow hair. The B locus controls baldness, with BY = bald, bY = full head of hair. Females with genotype AB/ab are crossed to random males. If the A and B loci are far enough apart on the X chromosome to be considered unlinked, what are the expected frequencies of the three phenotypes (bald, red hair, yellow hair) in the male offspring of this cross? Suppose we observe 50% bald, 42% yellow hair, and 8% red hair. What is the recombination fraction between the bald and red/yellow loci?

Assuming A and B assort independently on the X, females produce four X-gametes (AB, Ab, aB, ab), each with frequency (1/4). Hence, (1/2) males are -B Y = bald male, (1/4) Ab Y = red-headed males, (1/4) = ab = yellow-headed males.

Under linkage with recombination frequency c between loci, the frequencies of the various X gametes (and hence the frequencies in males) are (1-c)/2 AB (bald), (1-c)/2 ab (yellow), c/2 aB (bald), c/2 Ab (red), or (1-c)/2 + 2/c = 50% bald, (1-c)/2 yellow, c/2 red. Thus (using yellow) (1-c)/2 = .42, giving c = 0.16. Using red gives c/2 = .08 or c = .16

4 (1 point): Three linked loci, A — B — C (linked in this order) show the following recombination frequencies: A — B 8%, B — C 25%, A — C 30%. 1000 individuals are measured and 5 double-recombinants are observed. What is the coefficient of coincidence for A — C? What is the interference?

Expected number of doubles is $1000 \cdot 0.08 \cdot 0.25 = 20$***, coc = Obs/Exp = 5/20 = 1/4. Interference = 1-coc = 3/4.***

5 (1 point): Gametes from an ABC/abc triple heterozygous parent (ABC is not necessarily the gene order). What is the gene order:

(a): When rarest gamete classes are ABc and abC? ***A-C-B***

(b): When no aBC and Abc gametes are seem in a large sample?

C-A-B. ***If there is complete interference, or the loci are very tightly linked, double crossovers will be extremely rare and often not seem in even a large sample.***

6 (3 points): An ABC/abc individual (ABC is not necessarily the gene order) is crossed to an abc/abc individual and gametes are scored. Out of a total of 1000 gametes from the ABC/abc, we observe

ABC	382	ABc	8
abc	395	abC	9
Abc	98	AbC	2
aBC	105	aBc	1

Using this data, compute the recombination frequencies for all pairs of loci, the correct map order, the coefficient of coincidence, and the interference.

For A-B, recombinant gametes are Ab and aB, Freq(Recob) $= \frac{98+105+2+1}{1000} = .206$

For A-C, recombinant gametes are Ac and aC, Freq(Recob) $= \frac{98+105+8+9}{1000} = .220$

For B-C, recombinant gametes are Bc and bC, Freq(Recob) $= \frac{8+9+2+1}{1000} = .020$

Double recombinant class is AbC, aBc, corresponding to a gene order of ABC

coc = Obs(doubles)/Exp(doubles) $= \frac{2+1}{1000 \cdot (0.206 \cdot 0.02)} = 0.73$***,***

Interference = 1-coc =0.27.