ANSWERS TO Problem set questions from Final Exam – Human Genetics, Nondisjunction, and Cancer

Mapping in humans using SSRs and LOD scores

1. You set out to genetically map the locus for color blindness with respect to SSR markers.

(a)

(b) log $\dfrac{(1/2)\,(0.4)^{8}\,(0.1)^{2} + (1/2)\,(0.4)^{2}\,(0.1)^{8}}{(0.25)^{10}}$

(c)

(d) log $\dfrac{(1/2)\,(0.4)^{9}\,(0.1)^{1} + (1/2)\,(0.4)^{1}\,(0.1)^{9}}{(0.25)^{10}}$

2. You are conducting genetic linkage studies to search for a locus (whose chromosomal location has not been firmly established) associated with an autosomal recessive disease.

(a) log $\dfrac{(1/2)\,(0.49)^{4}\,(0.01)^{0} + (1/2)\,(0.49)^{0}\,(0.01)^{4}}{(0.25)^{4}} = 0.87$

(b) $\log \dfrac{(1/2)\,(0.49)^4\,(0.01)^0 + (1/2)\,(0.49)^0\,(0.01)^4}{(0.25)^4} = 0.87$

(c) $\log \dfrac{(1/2)\,(0.49)^4\,(0.01)^0 + (1/2)\,(0.49)^0\,(0.01)^4}{(0.25)^4} = 0.87$

(d) $\log \dfrac{(1/2)\,(0.49)^3\,(0.01)^1 + (1/2)\,(0.49)^1\,(0.01)^3}{(0.25)^4} = -0.82$

(e) $2 * \log \dfrac{(1/2)\,(0.49)^4\,(0.01)^0 + (1/2)\,(0.49)^0\,(0.01)^4}{(0.25)^4} = 2*(0.87) = 1.74$

(f) LOD = 0.87 + (-0.82) = 0.05

(g) no
(h) yes
(I) yes
(j) no conclusions can be made that are publishable (LOD score > 3)

3. Childhood deafness is often hereditary.
(a) autosomal recessive
(b) the mating of these two people is like a human complementation test – they had mutations in two different genes
(c) no

4. Your colleague, a human geneticist, is conducting genetic linkage studies on the locus associated with an autosomal dominant disease.
(a) negative infinity (there is a recombinant child and thus the two loci cannot be linked at theta = 0)
(b) negative infinity

(c) $\log \dfrac{(1/2)\,(0.5)^4\,(0.00)^1 + (1/2)\,(0.5)^0\,(0.00)^4}{(0.25)^4} = 0.903$

(d) $2 * \log \dfrac{(1/2)\,(0.5)^4\,(0.00)^1 + (1/2)\,(0.5)^0\,(0.00)^4}{(0.25)^4} = 2*(0.903) = 1.806$

5. As we have discussed in class, SSR-based genetic linkage studies in human families can be used to chromosomally localize the loci associated with heritable traits, including diseases.

(a) $\log \dfrac{(0.05)^1\,(0.45)^4}{(0.25)^5} + \log \dfrac{(0.05)^1\,(0.45)^4}{(0.25)^5} = 0.644$

(b) $\theta = 0.2$

$\text{LOD} = 2 * \log \dfrac{(0.1)^1\,(0.4)^4}{(0.25)^5} = 0.837$

(c) 20 cM

6. You are studying a mutation that causes an autosomal recessive phenotype of blindness in humans.

(a) you can't tell which of the genes encodes this mRNA because you don't know how much of the DNA length of each gene is introns, and thus wouldn't be included in the final mRNA transcript

(b) DNA sequencing – find a gene by sequencing in this region that is wild-type in all 10 individuals with normal vision, but is mutated in all 10 who are blind