Name:

Bioinformatics Take Home Test #8

Due on Monday, November 30th

(This is an open book exam based on the honors system -- you can use notes, lecture notes, online manuals, and text books.

Teamwork is not allowed on the exams, write down your own answers, do not cut and paste from webpages. If your answer uses a citation, give the source of the quoted text.)

Make sure each answer is only on one page, by using page breaks.

Do not write or type in font smaller than 12 point or write in cursive. Doing so will lose you 2 pts.

If you have an emergency and cannot submit a quiz in person, email it in by the start of class on the due date. If you do so, first remove the instructions and extras (blank lines, alternative answers for multiple choice questions) from your document, so that only your answers, a minimal amount white space, and optionally the questions, are left.

Note on Late Quizzes: Late quizzes are an inconvenience and cannot be accepted at all after the answers have been released. If your quiz is submitted within the first 12 hours after the deadline, you will receive 5% off. Each additional 12 hours is an additional 5% off, up until the graded quizzes are returned or the answers released.

All questions worth 1pt unless otherwise stated.

1. Submit your question from Exam #9 by 4pm 11/18/15

2. True/False A substitution is fixed into a population, whereas a mutation is not.

3. The mutation rate is _____ the substitution rate for a mutation that provides a selective **advantage**?
A. equal to
B. less than
C. greater than
D. proportional to
E. unrelated to

4. The mutation rate _____ the substitution rate for a mutation that provides a selective **disadvantage**?
A. Is equal to
B. Is less than
C. Is greater than
D. proportional to
E. Is unrelated to

5. The mutation rate _____ the substitution rate for a selective **neutral** mutation?
A. Is equal to
B. Is less than
C. Is greater than
D. proportional to
E. Is unrelated to

6. True/False The neutral theory states that all evolution is neutral and everything is only due to genetic drift.

7. In a **haploid** population, what is the probability that the mutant allele will replace the original allele, if the mutant is **neutral** with respect to the original allele?
A. 1/N
B. 1/2N
C. 1/4N
D. 2*s/(1-e ^(-4*N*s))
E. 2S

8. In a **diploid** population, what is the probability that the mutant allele will replace the original allele, if the mutant is **neutral** with respect to the original allele?
A. 1/N
B. 1/2N
C. 1/4N
D. 2*s/(1-e ^(-4*N*s))
E. 2S

8. True/False - Most mutations disappear in a few generations due to random drift.

9. True/False - If the mutant allele reaches a frequency of 50% in a population, it will almost always go on to fixation, even if the mutation does not provide a selective advantage.

10. The probability of the data given the tree and a model of evolution refers to the
A) Posterior probability of the tree
B) Maximum likelihood estimate of the gamma parameter
C) Bootstrap support
D) Likelihood of the tree and model
E) None of the above

11. What additional information does the program MrBayes use to estimate probabilities that Maximum Likelihood programs do not use?
A) The prior expectation of a model
B) The prior expectation of a topology
C) The prior expectation of Long Branch Attraction
D) The posterior probability of a model
E) The posterior probability of a topology

12. True/false - Transitions occur more frequently than transversions

13. The size of successive populations is 500, 10000, 1 billion, 4 billion, 8 billion. What is the "effective population size" for the 5 generations (ignoring spatial heterogeneity, mating etc.) ?

14. What is the chance (probability) that a mutation that arose in a single copy and that provides no selective advantage or disadvantage is fixed in population of 500 diploid organisms?

15. What is the chance (probability) that a mutation that arose in a single copy and that provides no selective advantage or disadvantage is fixed in population of 125 haploid organisms?

16. Comparing two populations of different size over long periods of time, we find that the substitution rate is approximately the same in the two populations. What is likely true for the type of selection and mutation rate?
A) Selection is negative and the mutation rate is constant.
B) Selection is negative and the mutation rate varies with a gamma of 0.5.
C) Selection is neutral and the mutation rate varies with a gamma of 0.5.
D) Selection is neutral and the mutation rate is constant.
E) Selection is positive and the mutation rate is constant.

17. Genetic drift…
A.   leads to a loss of heterozygosity and an increase in homozygosity
B.   will eventually lead to loss of all alleles in the population except one
C.   is the tendency for allele frequencies to change from one generation to the next in a finite population even if there is no selection
D.   All of the above

18. The **time till** fixation for a single neutral mutation in a population of 15 million individuals as compared to a population of 1,000 individuals is
A) the same,   B) shorter,   C) longer

19. The **probability for fixation** for a single neutral mutation in a population of 15 million individuals as compared to a population of 1,000 individuals is
A) the same,   B) lower,   C) higher

20. True/False: Negative selection is when a new allele confers some increase in the fitness of an organism.

21. Which of the following is the more sophisticated program used to view phylogenetic trees, producing publication quality figures?
A. TreeView
B. FigTree

C. Seaview
D. NJ Plot
E. None of the above

23. Phylogenetic reconstruction of molecular evolution is NOT used for which of the following?
a) Identifying organisms
b) Classifying organisms
c) Determining the exact way divergence occurs
d) Understanding the evolution of molecules
e) All are examples of uses for phylogenetic reconstruction

24. For a population in Hardy Weinberg Equilibrium, what is the genotypic frequency of heterozygous individuals?
a) p^2
b) q^2
c) 2pq
d) This is a trick question

25. Long Branch Attraction can cause the wrong tree to occur with 100% support with parsimony where the longest branches _____ times longer than the other branches.
A) 1
B) 3
C) 10
D) 30
E) 100

26. What does GTA mean?

27. Why might a GTA be under purifying selection?
A. Its function is important for the cell to reproduce
B. Mutations that give rise to deleterious products lead to lower fitness
C. A large area of protein space produces functional GTAs
D. Trick question: it's actually under positive selection to evade the immune system

28. True/False - Toxoplasma changes the behavior of humans and animals infected with it.

29. True/False: Mutations are often under positive selection

30. The neutral theory states that:

A) The majority of observed sequence differences between members of a population are neutral
B) All evolution is neutral
C) All evolution is only due to genetic drift
D) Positive selection is a common phenomenon

31. Toxoplasma gondii has been shown to be linked with higher rates of diseases such as _____ and is often contracted from contact with ____ feces.
A. HIV, cats
B. HIV, dogs
C. Schizophrenia, cats
D. Schizophrenia, dogs
E. None of the above

32. What is true about neutral evolution?
A) Null hypothesis does not equal neutral evolution
B) Synonymous changes should accumulate at a rate equal to mutation rate
C) Amino acid substitutions should also accumulate at a rate equal to the mutation rate
D) All of the Above
E) A + B
F) B + C

33. Which of the following bipartitions is not compatible with the others?
A) . . . . . . ***
B) . . . . *****
C) ***. . . . . .
D) . . . . **
E) . . . **. . . .
F) . . . . **. . .

34. Which of the following can be calculated with the program Mr. Bayes estimate?
A. Bipartitions
B. Posterior probability
C. Gamma parameter for ASRV
D. Omega-values for individual sites
E. All of the above

35. 2pt   On average it takes 4*Ne generations (Ne is the effective population size) until a neutral mutation is fixed in a diploid population. An advantages mutation is fixed already after (2/s) ln (2Ne) generations.
How many generations will it take a neutral mutation and a mutation with s=.15 to become fixed in populations of 5000, 50000, 500 000, and 5 million individuals.

Average time to fixation in number of generations:

Effective population size:	5000	50000	500000	5,000,000
advantages mutation with s=0.15				
Neutral				

Extra credit:

1. 2pt The fixation probability for an advantages mutation (that provides a selective advantage s) in a large diploid population is given as 2*s. In the following table enter the probability for fixation for a neutral mutation and for a mutation that provides a selective advantage s of 0.005. Obviously the formula for the fixation probability of an advantageous population does not work for a small population. In the fourth row use the indicated exact formula to calculate the fixation probability.

Effective population size	20	200	2000	20,000
Fixation probability for advantages mutation with s=0.005 using 2*s				
Fixation probability for Neutral mutation				
Fixation probability for advantages mutation with s=0.005 (using 2*s/(1-e ^(-4*N*s))				