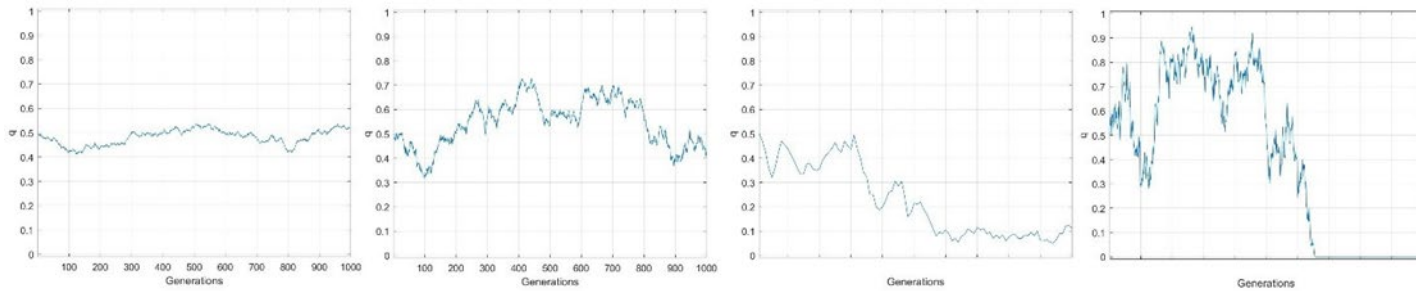


The final exam will include FIVE of the following, of which you must answer FOUR. The exam format will be identical to that of the midterm. You may expect the numbers to change. You may bring half of an 8.5"x11" sheet as notes for the exam.

3. The four graphs below are MATLAB simulations of genetic drift on $q = f(B)$ under different conditions.
 - (a) Which graph (1st or 2nd) is likelier to have the larger starting population? Explain.
 - (b) Which graph (3rd or 4th) is likelier to have gone for the longer number of generations? Explain.
 - (c) Which (if any) of the simulations is likely to lead to loss ($q=0$) or fixation ($q=1$) of $f(B)$? Explain.



1. The grey boxes below give genotype frequencies of AA AB and BB for four separate populations, with three sub-populations each. In all sub-populations, $N = 1,000$. For each, explain what the value of F_{ST} says about the structure of the population.

	AA	Aa	aa	Local F	F-stats
Sub-Pop 1	250	500	250	0.0000	F(is) = 0.0000
Sub-Pop 2	250	500	250	0.0000	F(st) = 0.0000
Sub-Pop 3	250	500	250	0.0000	F(it) = 0.0000
Sub-Pop 1	275	450	275	0.1000	F(is) = 0.1000
Sub-Pop 2	275	450	275	0.1000	F(st) = 0.0000
Sub-Pop 3	275	450	275	0.1000	F(it) = 0.1000
Sub-Pop 1	810	180	10	0.0000	F(is) = 0.5814
Sub-Pop 2	500	0	500	1.0000	F(st) = 0.4267
Sub-Pop 3	10	180	810	0.0000	F(it) = 0.7600
Sub-Pop 1	810	180	10	0.0000	F(is) = 0.0000
Sub-Pop 2	250	500	250	0.0000	F(st) = 0.4267
Sub-Pop 3	10	180	810	0.0000	F(it) = 0.4267
Luzon	118	132	50	0.0723	F(is) = 0.0916
Mindanao	110	157	33	-0.1205	F(st) = 0.0412
Palawan	222	48	30	0.4580	F(it) = 0.1290

2. From the following matrix of sequence differences among the mtDNA genomes of five species of Carnivora, calculate **by hand** a **UPGMA phenogram**. **Label** the pairwise differences at all nodes.

	<i>Felis</i>	<i>Spilogale</i>	<i>Ailuropoda</i>	<i>Helarctos</i>	<i>Ursus</i>
<i>Felis</i>	0				
<i>Spilogale</i>	412	0			
<i>Ailuropoda</i>	404	306	0		
<i>Helarctos</i>	402	304	242	0	
<i>Ursus</i>	406	308	244	130	0

3. A suggested solution to illegal poaching of Rhinoceros horns is to craft fake 'horns' from horse hair glued together and shaped into a horn. The plan is to flood the market with fake horns, so that the value of real horns falls. **The DNA data on the next page** are from 'horns' of two rhinos and a horse. If *Tapirus* is the outgroup to the other three, (1) identify the number of **Phylogenetically Informative Sites** ' [<http://www.mun.ca/biology/scarr/Bio4250 - Cladistic dataset.html>] favoring **XY**, **XZ**, or **YZ** as rhinos. **Which is the horse? How do you know?**
4. A population of pine trees normally has a census count of **100,000**. Every **100** years, a fire reduces the population to **100** trees. Calculate the long-term **effective population size N_e** , (a) exactly, and (b) using a close approximation.
5. For the **mutation model** at [<http://www.mun.ca/biology/scarr/4250 Mutation-Selection equilibrium.html>]
If the **mutation rate** for the recessive condition *Mulligan* is 2×10^{-5} / gamete, and persons with *Mulligan* have a fitness **$W = 0.6$** , what is the **equilibrium frequency** of the allele for Mulliganism?
6. For the **migration model** described at [<http://www.mun.ca/biology/scarr/4250 Migration-Selection equilibrium.html>]
If **$q = 1.0$** on the mainland, the **migration rate** from the mainland to the island **$m = 0.1$** , and the fitness of **BB** homozygotes on the island **$W = 0.8$** , calculate the **equilibrium frequency of q** on the island.
7. Based on the **Genetic Drift** lab at [<http://www.mun.ca/biology/scarr/4250 Genetic Drift.html>] and the **MatLab** program, identify a set of conditions of **N** and **s_2** in which one or more populations go to **fixation ($q = 1$)** of an allele that is at a **selective disadvantage**. Explain how this happens.
8. At [<http://www.mun.ca/biology/scarr/4250 F-statistics.html>], two ways of calculating **F_{ST}** are shown, in terms of **F_{IT} & F_{IS}** or **H_T & H_S** . **Show** that the two calculations are equivalent.

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[
1 1111111112 2222222223 3333333334 4444444445 5555555556 ]
[
1234567890 1234567890 1234567890 1234567890 1234567890 1234567890 ]
#Tapirus
ATGACTAACA TCCGAAAATC CCACCCACTA ATCAAATCA TCAATCATTC ATTTATCGAC
#X
.....A..... ..G..... T..... ..T..... ..C.. T....T...
#Y
.....T..... ..T..... ..C.. ..C.....
#Z
.....T..... ..T..... ..C..C.. ..C.....T

[
1 1111111111 1111111111 ]
[
6666666667 7777777778 8888888889 9999999990 0000000001 1111111112 ]
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1234567890 1234567890 1234567890 1234567890 1234567890 1234567890 ]
#Tapirus
CTACCAGCCC CATCAAACAT CTCATCCTGA TGAAACTTTG GCTCACTCTT AGGAATCTGC
#X
.....C..... T....A... ..C. ....C..C. ....
#Y
.....CA... ..T...G.... ..T.... ..C..AC. ....
#Z
..G..CA... ..G....G ..T.... ..C..GC. ....

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[
2222222223 3333333334 4444444445 5555555556 6666666667 7777777778 ]
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1234567890 1234567890 1234567890 1234567890 1234567890 1234567890 ]
#Tapirus
CTGATCCTAC AAATTATTAC AGGCCTATTT CTAGCTATAC ACTATACATC AGACACAAC
#X
..A.....C. ....CT.A.. .....C .....C.... ....C..... .....G..A
#Y
..A..... ..CC.A.. C..A..... ..T..C.... ..T..C..C. ...T....A
#Z
T.A...T... ..C.A.. C..A.....C ..T..C.... ..C..C. ....TA

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1111111111 1111111112 2222222222 2222222222 2222222222 2222222222 ]
[
8888888889 9999999990 0000000001 1111111112 2222222223 3333333334 ]
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1234567890 1234567890 1234567890 1234567890 1234567890 1234567890 ]
#Tapirus
ACCGCTTTCT CATCTGTAAC CCACATTTGT CGAGATGTAA ATTACGGATG AATCATCCGC
#X
..T..C.... ....C..C.. T.....C..C .....C..T. .C..... ..T..T...
#Y
..T..C.... .....TG. ....C.... ....C.... .C.....C.. ..T.....
#Z
..T..C.... .....CG. ...T..C.... ....C..G. ....C.... ..T.....

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2222222222 2222222222 2222222222 2222222222 2222222222 2222222223 ]
[
4444444445 5555555556 6666666667 7777777778 8888888889 9999999990 ]
[
1234567890 1234567890 1234567890 1234567890 1234567890 1234567890 ]
#Tapirus
TACCTTCACG CCAACGGAGC ATCCATATTT TTTATCTGCC TGTTTATTCA CGTAGGACGA
#X
.....C..T. .... ..A..... .....C..C..... .....C
#Y
.....A.... .T..... ..C..... ..A..C..C.. TA.....C
#Z
..T..C..T. .... ..C..... ..A..C..C.. .....C

[
3333333333 3333333333 3333333333 3333333333 3333333333 3333333333 ]
[
0000000001 1111111112 2222222223 3333333334 4444444445 5555555556 ]
[
1234567890 1234567890 1234567890 1234567890 1234567890 1234567890 ]
#Tapirus
GGCCTATATT ATGGATCCTA CACATTCCTA GAAACATGAA ATATTGGAAT CATCCTACTA
#X
.....C..C. .C..C..T.. ..... ..G..... .C..... .....T
#Y
.....C.... .C..... ..C..... .....C.... .C..C..G. T.....
#Z
..TA.C.... .C....A.. T..C..... .....C.... .C..C..G. T...T....

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