2016 Tutorial 2
Problems to attempt prior to class:

2.1 Chi-square and deviation from Hardy-Weinberg: We are interested in studying coat colouration in unicorns, which is controlled 3 different alleles segregating at a single locus. We rounded up 320 individuals and found the following breakdown of phenotypes/genotypes:

Phenotype	White	Grey	Ginger	Bay	Brown	Silver
Genotype	AA	AB	AC	BB	BC	CC
Frequency	120	80	60	40	10	10

(a) What are the frequencies (p, q & r) of the three alleles in this case?
(b) What are the Hardy-Weinberg (H-W) expected frequencies of individuals of each genotype?
(c) Does the observed distribution of genotypes in this population vary significantly from H-W expectation?
(d) What are the values of H_O and H_e in this case?

2.2 Chi-square and deviation from Hardy-Weinberg: We measured the genotypes for a flower colour polymorphism at a single locus with no dominance, and found the following results:

Phenotype	Yellow	White	Black
Genotype	AA	AB	BB
Frequency	12	22	32

(a) If we waved a magic wand and plucked a **single allele** at random, what is the probability that it would be B?
(b) Find the frequencies of p & q, and use them to test whether this distribution differs from H-W expectation.
(c) Let's say that we actually sampled 5-times as many individuals of each flower colour (i.e. AA = 60, AB = 110, BB = 160). Re-test whether the genotype distributions now deviate from H-W expectations. If so, can you explain why?

2.3 Hardy-Weinberg and dominance: In an alternate universe, we collected samples of the above plant species, but because in this universe the A allele is completely dominant over the B, we could only assign the genotypes among phenotypes as follows:

Phenotype	Yellow	White	Black
Genotype	AA or AB		BB
Frequency	340		120

(a) If we knew that alleles were at the H-W equilibrium at this locus, can you estimate the relative frequency of the B allele?
(b) What would your estimate tell us about the status and/or history of this population?

PTO…

2.4 Allelic frequencies: In yet another alternate universe, the Dodo survived human proliferation and exists in a small population on the island of Mauritius. A group of enterprising conservation biologists sequenced two different microsatellite gene complexes in this population, finding the following allelic variation:

	Microsat complex (a)				
Locus	allele1	allele2	allele3	allele4	allele5
1	0.8	0.1	0.05	0.025	0.025
2	0.6	0.2	0.1	0.1	
3	0.7	0.3			
4	0.8	0.2			
5	1.0				

Microsat complex (b)				
allele1	allele2	allele3	allele4	allele5
0.3	0.2	0.2	0.2	0.1
0.4	0.2	0.2	0.2	
0.6	0.4			
0.7	0.3			
1.0				

(a) Calculate polymorphism (P), average allelic diversity (A), and n_e for each complex of five loci (average the individual n_e values across loci)

(c) What does the difference between these estimates (A and n_e) across the two gene complexes tell us about the utility of each in describing genetic diversity?

2.5 Allelic diversity: If we study a single polymorphic locus in a population that has 4 alleles, what are the relative frequencies of each allele that yield the highest possible value of n_e? What is that maximum value?

2.6 Linkage disequilibrium: What is the linkage disequilibrium (D) in a population with the following gametic frequencies? What will the frequencies be at equilibrium?

You should attempt to answer this yourselves by referring to the approach and examples given in pages 83-85 of the textbook (Frankham et al.)

	A_1B_1	A_1B_2	A_2B_1	A_2B_2
Frequency	**0.2**	**0.5**	**0.2**	**0.1**

2.7 Hardy-Weinberg equilibrium for a sex-linked locus: If the frequencies of two alleles (A and B) are at the H-W equilibrium for an X-linked gene in Baboons, and the frequency of the A allele (p) = 0.62, complete the following table of relative genotype frequencies:

You should attempt to answer this yourselves by referring to the approach and examples given in pages 80-82 of the textbook

Gender	**Females**			**Males**	
Genotype	X^AX^A	X^AX^B	X^BX^B	X^AY	X^BY
Relative Frequency					