Question 9 (1999) Model Answer

(a)	Population	DD	Dd	dd	Sum		Part (a) ..... pD	1-pD	(p-pbar)^2	same, weighted
5 marks	1	59	34	6	99		**0.7677**	0.2323	0.001505	0.000490
	2	100	42	2	144		**0.8403**	0.1597	0.001143	0.000541
	3	41	17	3	61		**0.8115**	0.1885	0.000025	0.000005
	TOTAL	200	93	11	304	Weighted avs. (200 + 0.5*93)/304	**0.8109**	0.1891	Sum: 0.002673	0.001036
(b)	ExpFreqW	**0.6575**	**0.3067**	**0.0358**	1	Unweighted avs.	0.8065	0.1935	pop. s^2= 0.000891	0.001036
5 marks	ExpFreqU	0.6504	0.3121	0.0375	1	(.7677+.8403+.8115)/3			= sum [(p-pbar)^2]/3	
(c)	E (weighted)	199.8758	93.2484	10.8758	304					
	E(unweigh)	197.7230	94.8918	11.3852	304					
5 marks	((O-E)^2)/E	0.0001	0.0007	0.0014	**0.002156**	**chi^2 P>>0.05 So no evidence to reject the null hypothesis of Hardy-Weinberg Equilibrium**				
	(using weighted E, as usual)					**d.f.=3-2=1 from tables, for P=0.05, d.f. = 1, chi^2 = 3.84**				

			Using weighted avs.	Using unweighted avs.
(d)	UNweighted Var(p) (population) =	**0.000891**	**Fst=** **0.005809**	0.005709
	Weighted Var(p) (population) =	0.001036	0.006758	0.006641

5 marks Fst based on het deficit (=(He-Ho)/He) (weighted) [(0.3067 - 93/304)/0.3067] = **0.002663**

(+2 marks) Fst based on het deficit (=(He-Ho)/He) (UNweighted) [(0.3121 - 93/304)/0.3121] = 0.019937

The variance-based estimate of Fst only comes out the same as the heterozygote deficit-based estimate of Fst if the sample sizes are the same. However, whichever way calculated, Fst is LOW!

(The multiplicity of possible calculations was a slight problem; marks given for any calculation; +2 extra for both types)

(e) 5 marks

On the basis of the low values of Fst observed here, drift or "kin selection" seem most unlikely to occur to cause the evolution of warning colour. However, occasionally, such drift events might occur if population sizes are not constant. [The probability that close relatives are found together, and the probability that strong gene frequency differentiation between populations are both likely under the same conditions, in this case. In other words, "drift" can cause the conditions for