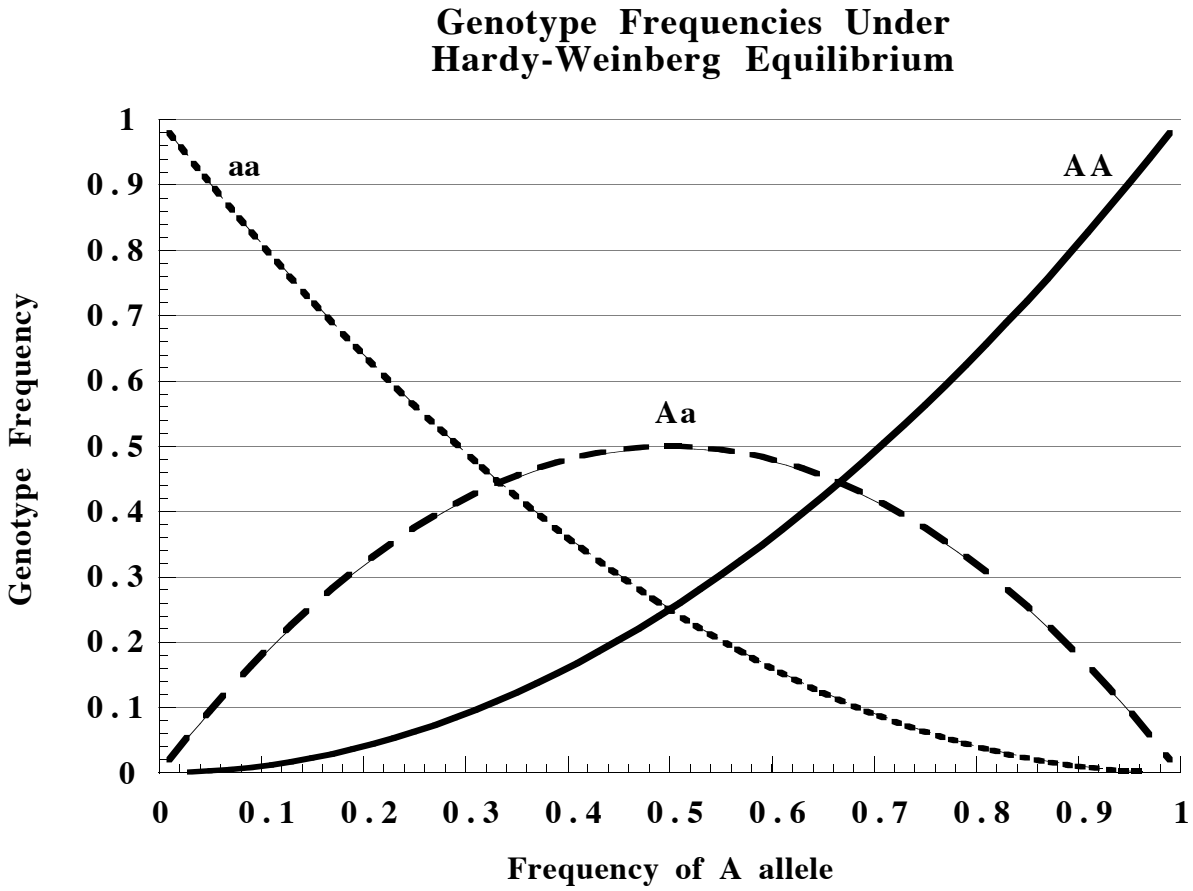
Allele Frequency Calculations

	Allele	Variance
Haploid	$\hat{q} = \frac{N_2}{N}$	$V(q) = \frac{q(1-q)}{N}$
Codominant	$\hat{q} = \frac{\frac{1}{2}N_{12} + N_{22}}{N}$	$V(q) = \frac{q(1-q)}{2N}$
Dominant	$\hat{q} = \sqrt{\frac{N_{22}}{N}}$	$V(q) = \frac{1-q^2}{4N}$
Codominant, X-linked	$\hat{q}_f = \frac{\frac{1}{2}N_{12} + N_{22}}{N_f}$	$V(q_f) = \frac{q_f(1-q_f)}{2N_f}$
	$\hat{q}_m = \frac{N_2}{N}$	$V(q_m) = \frac{q_m(1-q_m)}{2N_m}$
	$\hat{\bar{q}} = \frac{\frac{1}{2}N_{12} + N_{22} + N_2}{2N_f + N_m}$	$V(\bar{q}) = \frac{\bar{q}(1-\bar{q})}{2N_f + N_m}$
Dominant, X-linked	$\hat{q}_f = \sqrt{\frac{N_{22}}{N_f}}$	$V(q_f) = \frac{q_f(1-q_f)}{2N_f}$
	$\hat{q}_m = \frac{N_2}{N_m}$	$V(q_m) = \frac{q_m(1-q_m)}{N_m}$
	$\hat{\bar{q}} = \frac{-N + N_{12} + 4(N_m + 2N_f)\sqrt{(N_2 + N_{22})}}{2(N_m + 2N_f)}$	$V(\bar{q}) = \frac{\bar{q}(1-\bar{q}^2)}{N_m(1+\bar{q}) + 4N_f\bar{q}}$

Frequency with
Random Mating and Autosomal Genes

				Offspring		
Female	**X**	**Male**	**Frequency**	**AA**	**Aa**	**aa**
AA		**AA**	U^2	U^2	—	—
AA		**Aa**	**2UV**	**UV**	**UV**	—
AA		**aa**	**2UW**		**2UW**	—
Aa		**Aa**	V^2	$1/4V^2$	$1/2V^2$	$1/4V^2$
Aa		**aa**	**2VW**	—	**VW**	**VW**
aa		**aa**	W^2	—	—	W^2
				U'	**V'**	**W'**


Genotype Frequencies Under
Hardy-Weinberg Equilibrium
Genotype Frequency
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
aa
Aa
AA
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
Frequency of A allele

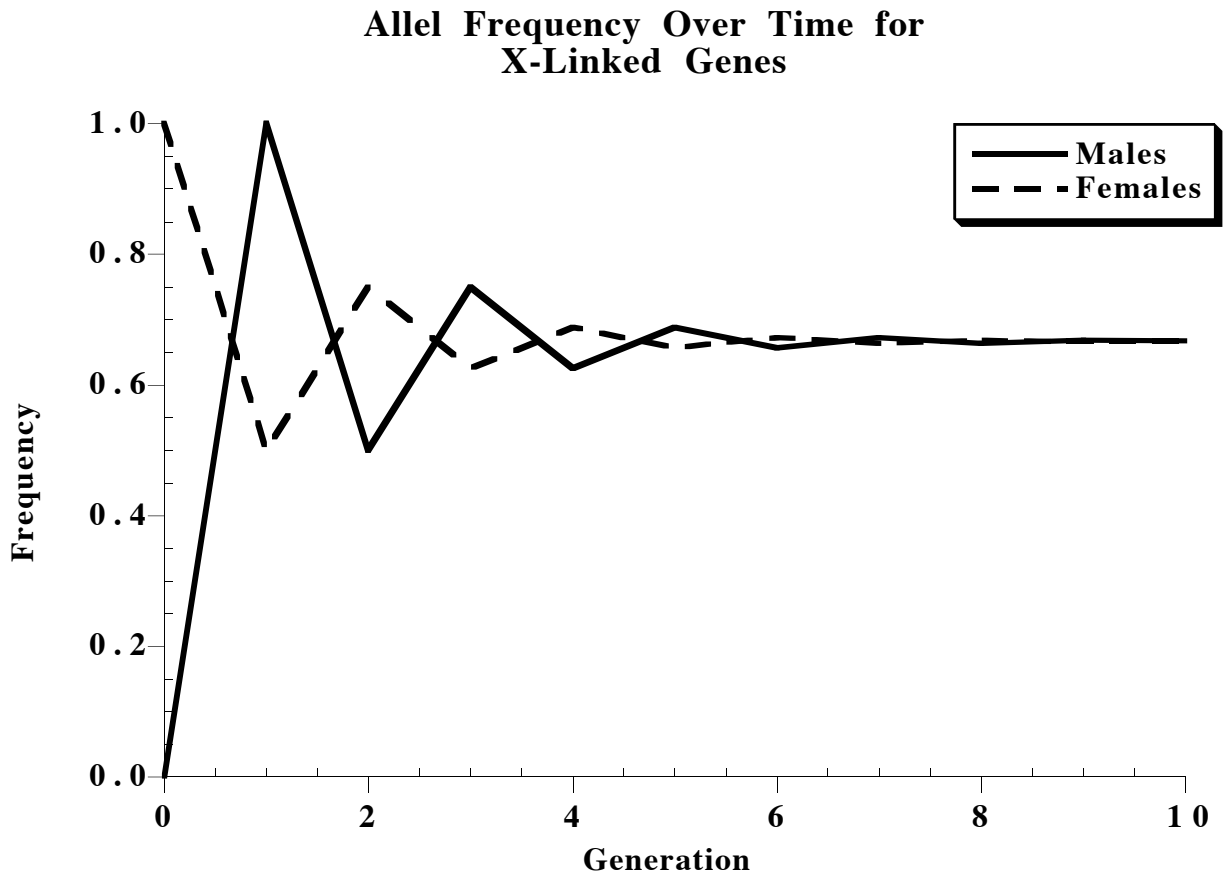
Frequency Changes with Random Mating and Sex Linked Genes

	Female			Male	
Genotype	AA	Aa	Aa	A	a
Frequency	U	V	W	p_m	q_m

				Female Offspring			Male Offspring	
Female	X	Male	Frequency	AA	Aa	aa	A	a
AA		A	Up_m	Up_m	—	—	Up_m	—
AA		a	Uq_m	—	Uq_m	—	Uq_m	—
Aa		A	Vp_m	$1/2Vp_m$	$1/2Vp_m$	—	$1/2Vp_m$	$1/2Vp_m$
Aa		a	Vq_m	—	$1/2Vq_m$	$1/2Vq_m$	$1/2Vq_m$	$1/2Vq_m$
aa		A	Wp_m	—	Vp_m	—	—	Vp_m
aa		a	Wq_m	—	—	Vq_m	—	Vq_m
				U’	V’	W’	p'_m	q'_m

$$\bar{p} = \frac{2}{3} p_f + \frac{1}{3} p_m$$

(2/3 of the chromosomes in the population are in females and 1/3 are in males)


Allel Frequency Over Time for
X-Linked Genes
Males
Females
Frequency
1.0
0.8
0.6
0.4
0.2
0.0
0
2
4
6
8
10
Generation