Chi-squared Practice Problems
(solutions below)

1. A zookeeper hypothesizes that changing the intensity of the light in the primate exhibits will reduce the amount of aggression between the baboons. In exhibit A, with a lower light intensity, he observes 36 incidences of aggression over a one month period. In exhibit B, with normal lights, he observes 42 incidences of aggression. Should he support or reject his hypothesis?

2. In a certain reptile, eyes can be either black or yellow. Two black eyed lizards are crossed, and the result is 72 black eyed lizards, and 28 yellow-eyed lizards. Is this simple, autosomal dominance?

3. In cats, two of the alleles that determine fur color (black and orange) are codominant and sex-linked. A calico female (X^BX^O) is mated (more than a few times) to a black male (X^By), producing the following kittens: 78 black females, 65 calico females, 81 black males, 45 orange males. Do the results fit the expected phenotypic ratio?

4. In fruit flies, eye color is hypothesized to be a sex-linked trait with red being dominant to white. A female carrier is mated with a white-eyed male, producing 132 normal females, 124 white-eyed females, 126 normal males, and 136 white-eyed males. Do these data support the hypothesis that the trait is sex-linked and recessive?

5. A trait in fruit flies is assumed to be caused by an autosomal recessive mutation. True-breeding wild type virgin females are crossed with true breeding male mutants. The F_2 contained 75 wild type males, 60 wild type females, 31 bloodshot males and 45 bloodshot females. Do the data support the hypothesis?

1.

Condition	O	E	(O-E)	$(O-E)^2$	$\frac{(O-E)^2}{E}$
Low light	36	39	3	9	0.23
Normal light	42	39	3	9	0.23
Total	78	78			0.46

dF = 2-1 = 1

at p= 0.05, critical value = 3.84. $\chi^2 < 3.84$, therefore we fail to reject the null hypothesis. There is no difference between the two groups. Light had no effect.

2.

Phenotype	O	E	(O-E)	$(O-E)^2$	$\frac{(O-E)^2}{E}$
Black eyes	72	75	3	9	0.12
Yellow eyes	28	25	3	9	0.36
Total	100	100			0.48

dF = 2-1 = 1

at p= 0.05, critical value = 3.84. $\chi^2 < 3.84$, therefore we fail to reject the null hypothesis. There is no difference between the two groups. It's simple, autosomal dominance.

3.

Phenotype	O	E	(O-E)	$(O-E)^2$	$\frac{(O-E)^2}{E}$
Black female	78	67	11	121	1.81
Calico female	65	67	2	4	0.06
Black male	81	67	14	196	2.93
Orange male	45	67	22	484	7.22
Total	269	268			12.02

dF = 4-1 = 3

at p= 0.05, critical value = 7.82. $\chi^2 > 7.82$, therefore we reject the null hypothesis. There is a significant difference between the expected and observed results. From these data, it does not appear to be codominant and sex-linked. We know that the trait is, however, so the data are flawed, likely because of a small sample size.

4.

Phenotype	O	E	(O-E)	$(O-E)^2$	$\frac{(O-E)^2}{E}$
Normal female	132	129	3	9	0.07
White-eyed female	124	129	5	25	0.19
Normal male	126	129	3	9	0.07

White-eyed male	136	129	7	49	0.38
Total	518	516			0.71

dF = 4-1 = 3

at p= 0.05, critical value = 7.82. $\chi^2 < 7.82$, therefore we fail to reject the null hypothesis. There is no significant difference between the expected and observed results.

5.

Phenotype	O	E	(O-E)	$(O-E)^2$	$\frac{(O-E)^2}{E}$
Wild type	135	158	23	529	3.3
Mutant	76	53	23	529	10
Total	211	211			13.3

dF = 2-1 = 1

at p= 0.05, critical value = 3.84. $\chi^2 > 3.84$, therefore we reject the null hypothesis. The data do not support the hypothesis that this is an autosomal recessive mutation.