Problem 1

You have to complete a genetics exam but you didn't study at all (How could you? The lecturer makes it so boring!). The proposed exam consists of 20 question- all multiple choice with 4 options (a, b, c, d). What is the probability that you can pass the genetics exam, score 10/20, by completely guessing every answer (like you are not even going to bother reading the questions)?

Probability of getting a question right 0.25 (or 25 %)
Probability of getting a question wrong 0.75 (75 %)

$$\left(\frac{20!}{10! \times 10!}\right) 0.25^{10} \times 0.75^{10}$$

$= 184756 \times 9.54 \times 10^{-7} \times 0.0563$
$= 0.009922$ or 0.99 %

Problem 2

In cats, fur color is determined by the codominant, sex-linked alleles: black (B) and orange (O). A calico female (X^BX^O) is bred (many times) with a black male (X^BY). They produce the following offspring:

- Black female = 78
- Calico female = 65
- Black male = 81
- Orange male = 45

Does the data fit your predicted phenotypic ratio?

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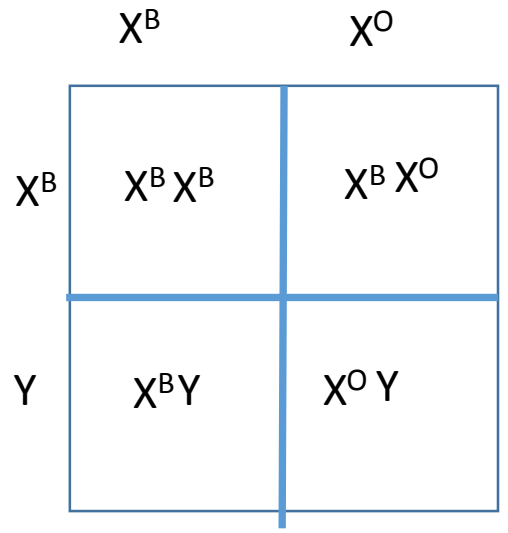

11.967 is greater than our critical chi square of 11.35 (for 3 degrees of freedom) so we reject our null hypothesis our data is significantly difference from our expected/predicted ratio

Phenotype	Obseved (O)	Expected (E)	O-E	$(O-E)^2$	$\frac{(O-E)^2}{E}$
black, female	78	67.25	10.75	115.5625	1.718401
calico, female	65	67.25	-2.25	5.0625	0.075279
black, male	81	67.25	13.75	189.0625	2.811338
orange, male	45	67.25	-22.25	495.0625	7.361524
Totals	269			sum	11.96654

Critical chi square table

	Probability (p)					
	0.90	0.50	0.20	**0.05**	**0.01**	**0.001**
1	0.02	0.46	1.64	3.84	6.64	10.83
2	0.21	1.39	3.22	5.99	9.21	13.82
3	0.58	2.37	4.64	7.82	11.35	16.27
4	1.06	3.36	5.99	9.49	13.28	18.47
5	1.61	4.35	7.29	11.07	15.09	20.52
6	2.20	5.35	8.56	12.59	16.81	22.46
7	2.83	6.35	9.80	14.07	18.48	24.32
8	3.49	7.34	11.03	15.51	20.09	26.13
9	4.17	8.34	12.24	16.92	21.67	27.88
10	4.87	9.34	13.44	18.31	23.21	29.59
15	8.55	14.34	19.31	25.00	30.58	37.30
25	16.47	24.34	30.68	37.65	44.31	52.62
50	37.69	49.34	58.16	67.51	76.15	86.60

χ^2 values