Chi squared test 2 [62 marks]

1. [Maximum mark: 18] EXM.1.AHL.TZ0.56

A zoologist believes that the number of eggs laid in the Spring by female birds of a certain breed follows a Poisson law. She observes 100 birds during this period and she produces the following table.

Number of eggs laid	Frequency
0	10
1	19
2	34
3	23
4	10
5	4

(a) Calculate the mean number of eggs laid by these birds. [2]

The zoologist wishes to determine whether or not a Poisson law provides a suitable model.

(b.i) Write down appropriate hypotheses. [2]

(b.ii) Carry out a test at the 1% significance level, and state your conclusion. [14]

2. [Maximum mark: 10] EXM.1.AHL.TZ0.55

Eggs at a farm are sold in boxes of six. Each egg is either brown or white. The owner believes that the number of brown eggs in a box can be modelled by a binomial distribution. He examines 100 boxes and obtains the following data.

Number of brown eggs in a box	Frequency
0	10
1	29
2	31
3	18
4	8
5	3
6	1

(a.i) Calculate the mean number of brown eggs in a box. [1]

(a.ii) Hence estimate p, the probability that a randomly chosen egg is brown. [1]

(b) By calculating an appropriate χ^2 statistic, test, at the 5% significance level, whether or not the binomial distribution gives a good fit to these data. [8]

3. [Maximum mark: 12] EXM.2.AHL.TZ0.29

(a) A horse breeder records the number of births for each of 100 horses during the past eight years. The results are summarized in the following table:

Number of births	0	1	2	3	4	5	6
Frequency	1	5	26	37	18	12	1

Stating null and alternative hypotheses carry out an appropriate test at the 5% significance level to decide whether the results can be modelled by B (6, 0.5). [10]

(b) Without doing any further calculations, explain briefly how you would carry out a test, at the 5% significance level, to decide if the data can be modelled by B(6, p), where p is unspecified. [2]

4. [Maximum mark: 12] EXM.2.AHL.TZ0.24

The hens on a farm lay either white or brown eggs. The eggs are put into boxes of six. The farmer claims that the number of brown eggs in a box can be modelled by the binomial distribution, B(6, p). By inspecting the contents of 150 boxes of eggs she obtains the following data.

Number of brown eggs	0	1	2	3	4	5	6
Number of boxes	7	32	35	50	22	4	0

(a) Show that this data leads to an estimated value of $p = 0.4$. [1]

(b) Stating null and alternative hypotheses, carry out an appropriate test at the 5 % level to decide whether the farmer's claim can be justified. [11]

5. [Maximum mark: 10] EXM.2.AHL.TZ0.26

Scientists have developed a type of corn whose protein quality may help chickens gain weight faster than the present type used. To test this new type, 20 one-day-old chicks were fed a ration that contained the new corn while another control group of 20 chicks was fed the ordinary corn. The data below gives the weight gains in grams, for each group after three weeks.

Ordinary corn (Group A)				New corn (Group B)			
380	321	366	356	361	447	401	375
283	349	402	462	434	403	393	426
356	410	329	399	406	318	467	407
350	384	316	272	427	420	470	392
345	455	360	431	430	339	410	326

(a) The data from the two samples above are combined to form a single set of data. The following frequency table gives the observed frequencies for the combined sample. The data has been divided into five intervals.

Weight gain	Observed
271–310	2
311–350	9
351–390	8
391–430	15
431–470	6

Test, at the 5% level, whether the combined data can be considered to be a sample from a normal population with a mean of 380. [10]