Instructions: The test is open book – use any notes or books. Answer all questions. You have approximately 45 minutes to earn the 45 marks. Keep your answers brief in order to complete the test. Point form is OK as long as it is understandable.

1. (10 marks)   In the article "The Plight of the Whales" the method of "Capture-Recapture" was described for estimating the size of wild animal populations. Describe briefly, in your own words, how it works – you may use a numerical example if this helps to simplify your explanation.

1. ANS. Find 100 whales and tag them. Allow time for the whales to mix among the whale population. Then find 100 more whales. The proportion tagged (100/N where is in the population) should be approximately the same as the proportion in the second sample that are tagged. Suppose this is n/100. Then n/100 is approx = 100/N and N=10,000/n. Thus if n=10, then N is estimated to be 10000/10=1000.

2. (15 marks = 8+7) A manufacturer produces candies in three different flavours: lemon, raspberry, and peppermint. Equal numbers of each flavour are produced each day. The candies are thoroughly mixed in a large vat before being packaged in groups of 99 candies for retail sale.   As a check on the mixing process, the quality control person selects a package at random from each day's production and counts the number of each colour in the package.
a) How much variation would you expect to see in the proportion of lemon candies?
b) What distribution model describes probabilities for each possible number of lemon candies in each package? (Give the numerical characteristics that specify the model as well as the name of it.).

2. ANS. a) Population sampled is 66 0s and 33 1s. SD of population is $(2/3 \times 1/3)^{1/2}$ = .47.   So SD of proportion is $.47/99^{1/2}$ = .047.   This describes the variability of the proportion of lemon candies.
b) Binomial with p = .33 and n= 99

3. (10 marks) In the 6/49 lottery, the carry–over provision for unclaimed jackpot prizes increases the average return to a single ticket when the jackpot includes a carry-over amount. Under what conditions could the average return to a single ticket be greater than the $1 cost of the ticket?

3. ANS. When a large carry over has been added to the prize pool but the number of

ticket sales is not much larger than usual.

4. (10 marks) In the survey of the class that collected data for the analysis of the accident free survival time, students were asked to give the date they obtained their license and whether or not they had been involved in an accident yet. From this information it was possible to compute the chance that a randomly selected licensed student would have a first accident prior to any given number of months after licensing. What was the strategy that allowed this to be done? (Use the primative method that does not use the geometric distribution). Use a numerical example if this helps you to explain the strategy.

4. ANS. Consider all those students who had been driving for 48-54 months. Of those, compute the proportion that have had a first accident already. This is an estimate of the chance that a student has a first accident sometime before month 51.