QUEEN MARY, UNIVERSITY OF LONDON

MAS 108   Probability I

Assignment 3   **For handing in on 17 October 2005**

Write your name and student number at the top of your assignment before handing it in. Staple all the pages together. Post the assignment in the red post-box on the ground floor of the Maths building before 1600 on Monday.

This week's reading: Devore, Chapter 2, Section 2.5; *or* Hines and Montgomery, Chapter 2, Section 2.7; *or* Rice, Chapter 1, Section 1.6.

1 (10 marks) Consider Question 1 of Assignment 2. Are the events "a six turns up exactly once" and "both numbers are even" independent? Justify your answer.

2 (20 marks) James and Simon go to the Students' Union to buy fruit. Each of them chooses a piece of fruit at random with the following probabilities:

apple	orange	banana	pear	nectarine
$\dfrac{1}{6}$	$\dfrac{1}{6}$	$\dfrac{1}{3}$	$\dfrac{1}{4}$	$\dfrac{1}{12}$

They make their decisions independently of each other.

  (a) What is the sample space?

  (b) Find the probability that they buy fruit of the same type.

3 (15 marks) There are 24 unshorn sheep in a field. The farmer shears six of the sheep and returns them to the field. The next day he randomly catches five sheep from that field. He counts how many of these sheep are shorn. Assume that no sheep leave or enter the field, or die or give birth, between the shearing and the capture; and that all outcomes of the capture are equally likely. Find the probability that exactly two of the captured sheep are shorn, giving the answer correct to 4 decimal places.

4 (25 marks) You are at Stepney Green station and you want to get to Liverpool Street station. You can either go directly by the Hammersmith and City line, or you can take the District line to Mile End followed by the Central line to Liverpool Street. For simplicity, let us assume that there are no other Underground lines.

The probability that the Hammersmith and City line is working is 0.9; the probability that the District line is working is 0.8; and the probability that the Central line is working is 0.75. Assume that each line is independent of the others. What is the probability that you can get to Liverpool Street by Underground train?

5 (**Animal Health**) (15 marks) (This is a current problem in the attempt to discover more about BSE and similar animal diseases, but I have simplified the numbers.) A bottle of liquid contains an unknown number of infectious units. The scientists want to know how many. This is how they try to find out. First, they mix the liquid thoroughly and divide it into 15 equal portions, called *aliquots*. An aliquot is said to be *infectious* if it contains any of the infectious units. Then five aliquots are chosen at random. Each chosen aliquot is injected into one animal. If the aliquot is infectious then the animal will become ill; otherwise the animal remains healthy. The scientists count how many of the five animals become ill.

Suppose that exactly two of the 15 aliquots are infectious. Find the probability that none of the animals becomes ill.

6 (15 marks) You are allowed up to three attempts to pass the Probability I exam. Suppose that your probability of passing is p at each attempt, independent of all other attempts. How big must p be so that the probability of your eventually passing the exam is at least 0.8? Give your answer to 4 decimal places.

Survey results

Thank you to all who completed the questionnaire. After the removal of a few incomplete responses, the results are as follows.

Preferred solution method	Inclusion-exclusion	Complement
Brown eyes	15	49
Non-brown eyes	9	17