Probability

1. Patients diagnosed with a certain medical condition have a risk *p* of dying within one year of diagnosis: *p* is simply the average proportion of diagnosed patients who die within a year. Let *n* be the number of diagnosed patients, and *k* be the average number of these who die within a year.

a) Express *p* in terms of *k* and *n.*

b) Express *k* in terms of *p* and *n*.

c) Suppose that we define $w = \frac{k}{n-k}$. (In fact, defined this way w is called the *odds* of dying.) Using your answer in b) to substitute for *k*, express *w* in terms of *n* and *p*.

d) By factorising the denominator (bottom of fraction) in your answer to c), express *w* in terms of *p*.

e) If you've got this far, use your answer to d) to express *p*, the risk, in terms of *w*, the odds.

[Answer you should get for e): $p = \frac{w}{1+w}$]

2) In a maternity unit on average 20% of births are caesarian; suppose that a certain complication tends to occur on average in 10% of caesarian births, but only in 5% of otherwise normal births. Out of 100 births in this maternity unit, how many would you expect:
i) to have this complication following a caesarian?
ii) to have this complication regardless of the type of birth?

3) Suppose that proportion *p* of the adult population have a gene that makes them vulnerable to condition D. People with this gene have a chance *q* of developing the condition, whereas people without the gene have only chance *r* of developing D. Out of N people taken at random from the adult population, how many would you expect to develop the condition (in terms of N, *p*, *q* and *r*; hint: the proportion without the gene = 1-*p*)?

Further reading on probability: J H McColl, *Probability*, Arnold.
The following sections of this book are useful:

1 to 2.3 [skim 2.4]; all of 3 and 4; all of 6, 7 and 8; 9.1 [skim 9.2]; 10.1, 11.1, 11.2, 12.1, 12.2, 12.3; 13.1; skim 14.1 and 14.2; skim 16.1 and 2; skim 17.

Much of this material will be reviewed in Probability lectures at the beginning of Term 1.