HERIOT-WATT UNIVERSITY

M.SC. IN ACTUARIAL SCIENCE

Life Insurance Mathematics I

Tutorial 9

1. Describe briefly what is meant by each of the following terms, in each case giving an example to illustrate the points you make:

   (a) temporary initial selection;
   (b) anti-selection (or adverse selection);
   (c) class selection.

2. (a) Discuss the suitability of the crude death rate, the standardised death rate and the standardised mortality ratio for comparing

   (i) the mortality, at different times, of the population of a given country,

   (ii) the mortality, at a certain time, of two different occupational groups in the same population.

   (b) The following table gives a summary of mortality for one of the occupational groups and for the country as a whole.

   | | Occupation A | | Whole country | |
Age group	Population	Deaths	Population	Deaths
20–34	15,000	52	960,000	3,100
35–49	12,000	74	1,400,000	7,500
50–64	10,000	109	740,000	7,100
Total	37,000	235	3,100,000	17,700

   Calculate the crude death rate, the standardised death rate and the standardised mortality ration for Occupation A, using the whole country as the standard population.

3. The following table contains abridged mortality data for two areas and also for the total population of the country of which they form a part.

   | | Population | | | No of deaths | | |
Age	Area A	Area B	Country	Area A	Area B	Country
30–39	800	1,200	10,000	2,800	5,400	40,000
40–49	840	1,040	10,000	5,880	9,360	80,000
50–59	800	840	9,000	10,000	12,600	126,000
60–69	720	600	7,000	23,040	22,200	248,000
70–79	640	320	4,000	44,800	28,800	320,000
Total	3,800	4,000	40,000	86,520	78,360	814,000

Population is in units of 1,000.

(a) Calculate the crude death rate for each area and for the country.

(b) Calculate the directly standardised death rate for each area, standardising on the country's population.

(c) Calculate the standardised mortality ratios for each area, using the country's data as the standard.

4. The following data have been extracted from an investigation into the mortality experience in two regions of a country, and in the whole country.

Age	Region 1 $^1E_x^c$	Region 2 $^2E_x^c$	Country $^sE_x^c$	$^s\mu_x$
0–19	220	180	2,300	0.00106
20–39	140	220	2,520	0.00160
40–59	110	260	2,600	0.01100
60+	100	360	2,800	0.05100
All	570	1,020	10,220	0.01744

$^1E_x^c$ and $^2E_x^c$ are the central exposed to risk (equivalent to mid-year population) over each age range shown, for Region 1 and Region 2 respectively, in units of 1,000. $^sE_x^c$ and $^s\mu_x$ are respectively the central exposed to risk, in units of 1,000, and the observed rate of mortality for the whole country over each age range.

The observed numbers of deaths in Region 1 and Region 2 were 9,800 and 19,620 respectively.

(a) Calculate the crude death rate and standardised mortality ratio for each region.

(b) Comment on your results in part (a).

(c) Based on your calculations, which region do you think experiences heavier mortality?

5. A first year actuarial student has stated that he does not believe that 'social class' has any influence on mortality in the modern age. Discuss this statement, explaining why you agree or disagree with the student.

6. You have been asked to comment on the following table of standardised mortality ratios (SMR's) for males which have been calculated for a large industrialised country.

Occupation	SMR
Teachers	62
Economists, accountants, statisticians	69
Judges, barristers, solicitors	77
Ministers of religion	78
Foreman, paper processing	83
Construction workers	133
Chemical plant workers	161
General labourers	195

In particular, discuss factors which would explain the differences between occupations.