

You can assume that the above data values will not change. The parameters whose values may be changed have the following values initially.

- The variation in the interest rate is 2%.
- The period of the variation in the interest rate is 4 years.

This leads to the recurrence relation

$$Y_{r+1} = (1.1 + 0.02 \cos(2\pi r/4))Y_r - 5873, \quad Y_0 = 50\,000,$$

where Y_r is the amount owing at the end of year r .

- (i) Use the computer package **RECREL** to find the number of years before the mortgage is repaid. [3]

In the remainder of the question you are asked to investigate how sensitive the amount owed at the end of year 15 is to small changes in the magnitude of the variation in the interest rate, and to small changes in the value of the period of the variation in the interest rate.

- (ii) Decide whether it is more appropriate to consider *absolute* or *relative* conditioning when investigating the sensitivity of the amount owed at the end of year 15 with respect to these parameters. Give reasons for your decision. [2]

- (iii) Using whatever criterion you thought the more appropriate in part (ii), investigate the sensitivity of the amount owed at the end of year 15 with respect to small changes in

- (a) the magnitude of the variation in the interest rate;
- (b) the value of the period of the variation in the interest rate.

Explain carefully the strategy of your investigations. [8]

Question 2 (Unit 9)

Note that the total number of marks available for this question is 13.

This question is concerned with the solution of the simultaneous linear equations below.

$$\begin{aligned} x_1 + 1.5x_2 + 0.75x_3 + 0.6x_4 + 0.3x_5 &= -0.05 \\ 0.75x_1 + x_2 + 0.6x_3 + 0.5x_4 + 1.5x_5 &= 1.35 \\ 0.6x_1 + 0.85x_2 + 0.5x_3 + 0.43x_4 + x_5 &= 0.92 \\ 0.5x_1 + 0.6x_2 + 0.43x_3 + 0.37x_4 + 0.75x_5 &= 0.71 \\ 0.43x_1 + 0.5x_2 + 0.37x_3 + 0.33x_4 + 0.6x_5 &= 0.57 \end{aligned}$$

This problem is stored within the **SIMLIN** program under the name **TMA_2**.

- (i) Obtain a solution for these simultaneous equations, explaining your choice of method. [4]
- (ii) Three of the coefficients on the left-hand sides of these equations have the value 1 and are subject to experimental error. Investigate the absolute conditioning of the solution with respect to changes in
- the coefficient of x_1 in the first equation,
 - the coefficient of x_2 in the second equation,
 - the coefficient of x_5 in the third equation.

As a result of these investigations, do you consider the solution of the above simultaneous equations to be an absolutely ill-conditioned or absolutely well-conditioned problem? Explain carefully the strategy of your investigations and the reasons for your conclusions. [9]