

This assignment covers *Units 24* and *26*, and the Numerical Analysis practical work undertaken at Summer School.

Note that there is no tutor-marked assignment question on *Unit 25*; this unit is assessed by computer-marked assignment questions only.

Questions 1, 2, 3 and 4 require the use of a computer for their solution, and this will be available at Summer School. There are computing sessions at Summer School which will help you to understand how to answer these questions. If you have Summer School excusal, then you should have received information on alternative arrangements. If you have not received any information, contact the Staff Tutor in Mathematics and Computing at your Regional Centre.

There are six questions in this assignment. Questions 1, 2, 3 and 4 are each allotted fewer than 25 marks, and the total number of marks for the assignment is 100 as usual.

**Your written solutions to Questions 1 to 4 should be self-contained, i.e. you should not expect your tutor to search for input or for numerical solutions in the computer output.** For most of these questions, there is at least one part in which you carry out an investigation and make deductions from the computer output. In each such case, a large proportion of the total mark is allocated to explaining why you did what you did and how you came to your conclusions.

### Question 1 (*Unit 1*)

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

Mortgage repayments are usually calculated on the basis of fixed interest rates. This is modelled in the television programme associated with *Unit 1*. However, in practice the mortgage interest rate varies, usually cyclically with a period of a few years. This question is concerned with a simple revised model for a repayment mortgage where the rate of interest varies cyclically but the repayments are constant. A sinusoidal function is used to model the cyclical variation in the interest rate. The aim of the question is to investigate the conditioning of the problem with respect to changes in the values of parameters in the model.

The repayment interest rate is assumed to be modelled by

$$i_r = m + v \cos\left(\frac{2\pi r}{T}\right),$$

where:

- $r$  is the year number: that is, in year  $r$  the number of complete years since the mortgage began is  $r - 1$ ;
- $i_r$  is the actual interest rate in year  $r$ ;
- $m$  is the mean interest rate;
- $v$  is the magnitude of the variation in the interest rate about the mean value;
- $T$  is the period of the variation in the interest rate.

For this question we take the following data values.

- The mean rate of interest is 10%.
- The amount borrowed is £50,000.
- The annual repayment is £5873, the sum which would be required to pay off the mortgage in 20 years if the interest rate were constant at 10%. (You can check that this is correct by solving the recurrence relation  $Y_{r+1} = 1.1Y_r - 5873$ .)