

# MA1221 PURE MATHEMATICS AT WORK 2006/07

## PROJECT

The project counts for 35% of the mark for this module. It will be collected at the 12:30 lecture on Tuesday, 12 December. The aim of this project is to find out about the golden ratio and to investigate the relationship between Fibonacci series and the golden ratio.

### Project

Your project should address the following points.

1. Definition of the golden ratio.
2. One mathematical relationship between the Fibonacci series and the golden ratio (other than that indicated in point 5(a)).
3. At least two other mathematical results about the golden ratio. You should also include the proofs of these results and a few lines to explain why you chose your particular results.
4. A description of one place where the golden ratio occurs outside mathematics.
5. Give a proof of ONE of the following statements.

- (a) Let  $\phi$  be the golden ratio and let  $F_n$  denote the  $n$ th Fibonacci number. Prove by induction on  $n$  that

$$\phi^n = F_n\phi + F_{n-1}.$$

- (b) Fix some natural number  $m$  and let  $F_m$  be the  $m$ th Fibonacci number. Prove by induction on  $n$ , for  $n = 0, 1, \dots, m$ , that

$$F_m = F_{n+1}F_{m-n} + F_nF_{m-n-1}.$$

- (c) Prove by induction on  $n$  that the recurrence relation

$$F_{n+1} = F_n + F_{n-1} \text{ with } F_0 = 0, F_1 = 1$$

used to define the Fibonacci numbers has solution

$$F_n = \frac{(1 + \sqrt{5})^n - (1 - \sqrt{5})^n}{2^n \sqrt{5}}$$

### Assessment of Project

Content 50% - the extent to which you have considered the points listed above.

Quality of explanation 30% - the project should have a clear structure and demonstrate your understanding of the mathematical relationship between Fibonacci series and the golden ratio.

Written presentation 10% - please note that there is no need to word process your project.

Referencing 10% - appropriate and accurate use of referencing of all source material, whether library, web pages etc. Note that plagiarism is not allowed and that the University regards plagiarism as an extremely serious matter.