ASSIGNMENT 8

Due May 6, 2003

Homework 8

This is based on Computer Problem 8.1 on page 378 of Heath's book. Since

$$\int_0^1 \frac{4}{1+x^2} dx = \pi,$$

we can compute an approximation value for π using numerical integration of the given function.

1. Use the midpoint, trapezoid, and Simpson composite quadrature rules to compute the approximate value for π in this manner for various step sizes h. The relevant programs are available at the course website. However you may have to modify them slightly since these programs use the total number of points rather than the step size as a parameter. Try to characterized the error as a function of h for each rule, and also compare the accuracy of the rules with each other (based on the known value of π). Is there any point beyond which decreasing h yields no further improvement? Why?

2. Repeat part (a) using the Romberg quadrature. Here you need to figure out the relationship between the level of iteration in the program for the Romberg quadrature provided at our website and the step size.

3. Compute π again using the adaptive quadrature program "adaptiveQuad.m" for various error tolerances. You will find it better to replace the termination condition in that program with the corresponding one in program "adaptiveQuadG.m". How reliable is the error control in the program? Compare the work required (number of integrand evaluations and elapsed time) with that for part (a). Make a plot analogous to Fig. 8.4 to show graphically where the integrand is sampled by the adaptive routine. Explain the resulting plot.