Empirical Methods in Economics

Assignment IV

Orville D. Mondal

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No estimated values of π are mentioned here, since the final table with results for the standard errors already summarises the accuracy of the estimates. Instead, only key points of the calculations are mentioned.

(1) First, equi-distributed points are obtained from the `qnwequi` function in Miranda and Fackler's CE Tools collection. The calculation is based on a draw of `50,000` points in the unit square. Each point is assigned the same weight (namely, `1/50000`).

(2) The quadrature points and weights used here are the most basic. Namely, there are `25,000` points on `[0,1]`, denoted $\{x_n\}$ with weights specified as:

$$w_n = \begin{cases} h/3, & \text{if } x_n \in \{0,1\} \\ 4h/3, & \text{if n is even} \\ 2h/3, & \text{otherwise,} \end{cases}$$

Where $h =$ `1/25000`. The integral is calculated $iteratively$, i.e. first a value for x_n is fixed, and the integral is calculated over the y co-ordinate (using the same points and weights as above), following which the integral values are weighted together using w_n.

(3) The process for this is a duplication of the one in question 1, with a minor change owing to calculating $\sqrt{1 - x_n^2}$ at each of the equi-distributed points on `[0,1]`.

(4) The same manner of duplication with minor changes, as in question 3.

(5) The results of the estimation for the four methods are given below. It appears that Newton-Coates, for the Pythagorean case is the most accurate method, across the number of draws.

Table 1: Standard Errors from π Calculations
by number of draws

Method	1000	10000	45000
Quasi-MC (Indicator function)	0.0016	7.9265e-04	3.4821e-04
Newton-Coates(Indicator function)	9.3787e-04	3.3477e-05	4.9839e-05
Quasi-MC (Pythagorean)	3.3265e-04	1.2267e-05	1.3101e-06
Newton-Coates(Pythagorean)	1.9336e-04	6.1160e-06	6.4070e-07