

## Homework Assignment #4

We can compute  $\pi/2$  by the following formula

$$\frac{\pi}{2} = \frac{2 \cdot 2}{1 \cdot 3} \cdot \frac{4 \cdot 4}{3 \cdot 5} \cdot \frac{6 \cdot 6}{5 \cdot 7} \cdots \frac{2n \cdot 2n}{(2n-1) \cdot (2n+1)}$$

That means if

$$\begin{aligned} n = 1, & \quad \frac{\pi}{2} \approx \frac{2 \cdot 2}{1 \cdot 3} \\ n = 2, & \quad \frac{\pi}{2} \approx \frac{2 \cdot 2}{1 \cdot 3} \cdot \frac{4 \cdot 4}{3 \cdot 5} \\ n = 3, & \quad \frac{\pi}{2} \approx \frac{2 \cdot 2}{1 \cdot 3} \cdot \frac{4 \cdot 4}{3 \cdot 5} \cdot \frac{6 \cdot 6}{5 \cdot 7} \\ & \quad \dots \end{aligned}$$

One can easily compute an approximation to  $\pi$  (based on  $\pi/2$ ) using this formula by taking enough terms in the formula.

- (a) Approximate  $\pi$  by taking  $n = 10$ .
- (b) Approximate  $\pi$  by taking  $n = 20$ .
- (c) Compare the value of  $\pi$  (given by Mathematica) with (a) and (b), and show their errors.