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question @25 stop following 15 views

Actions

Chapter 10, Question 10b-c

I don't understand what the question is trying to convey when it says "Put $f_n(x) = \sum_{k=0}^{n}(-1)^k \frac{x^{2k+1}}{(2k+1)!}$", and I'm also having trouble with writing the function. I tried using a `while` loop (not sure if this is even the correct way) but it wouldn't accept `k` as an index; however, when I tried to use `i`, the factorial function treated `i` as the imaginary number and would either return an error or a vector of complex numbers. Subsequently, I cannot start on 10.10c. My code is below but I've changed it several times:

```
estpi <- function(x = 3,n = 9){
  f <- rep(0,n)
  i <- 0
  while(i <= n) {
    f[i+1] <- (-1)^i*(x^(2i+1))/factorial(2i+1)
    i <- i+1
  }
  print(f)
}
estpi()
```

run code snippet Visit Manage Class to disable runnable code snippets

10. How do we know $\pi = 3.1415926$ (to 7 decimal places)? One way of finding π is to solve $\sin(x) = 0$. By definition the solutions to $\sin(x) = 0$ are $k\pi$ for $k = 0, \pm 1, \pm 2, \ldots$, so the root closest to 3 should be π.

   (a). Use a root-finding algorithm, such as the Newton-Raphson algorithm, to find the root of $\sin(x)$ near 3. How close can you get to π? (You may use the function `sin(x)` provided by R.)

   The function $\sin(x)$ is *transcendental*, which means that it cannot be written as a rational function of x. Instead we have to write it as an infinite sum:

$$\sin(x) = \sum_{k=0}^{\infty} (-1)^k \frac{x^{2k+1}}{(2k+1)!}.$$

   (This is the infinite order Taylor expansion of $\sin(x)$ about 0.) In practice, to

   calculate $\sin(x)$ numerically we have to truncate this sum, so any numerical calculation of $\sin(x)$ is an approximation. In particular the function `sin(x)` provided by R is only an approximation of $\sin(x)$ (though a very good one).

   (b). Put

$$f_n(x) = \sum_{k=0}^{n} (-1)^k \frac{x^{2k+1}}{(2k+1)!}.$$

   Write a function in R to calculate $f_n(x)$. Plot $f_n(x)$ over the range $[0, 7]$ for a number of values of n, and verify that it looks like $\sin(x)$ for large n.

   (c). Choose a large value of n, then find an approximation to π by solving

$f_n(x) = 0$ near 3. Can you get an approximation that is correct up to 6 decimal places? Can you think of a better way of calculating π?

Edit good question | 0

Updated 4 years ago by Charles Hwang

S **the students' answer,** *where students collectively construct a single answer*

Actions

I think part of your issue is that you have 2i in your exponent and factorial, and it should be 2*i (you need to have the * in there).

Edit thanks! | 0

Updated 4 years ago by Holly Michalak

followup discussions *for lingering questions and comments*

Resolved Unresolved @25_f1

Actions

Charles Hwang 4 years ago

Good point--I've fixed that and am now back in the real numbers but I don't know if the output is correct. The output is

```
[1]  3.000000e+00 -4.500000e+00  2.025000e+00 -4.339286e-01  5.424107e-02
[6] -4.437906e-03  2.560330e-04 -1.097284e-05  3.630720e-07 -9.554528e-09
```

helpful! | 0

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