**MACM316 CA7 – Ngawang Kyirong – 301312227**

**Approximations to: .**

Table 1: , , . are roots to f(x).

Table 2: :

|  |  |
| --- | --- |
| n |  |
| 50 | -0.464289002017376 |
| 100 | -0.461917922130111 |
| 150 | -0.461094455803492 |
| 200 | -0.460674560911444 |
| 250 | -0.460419485047569 |
| 300 | -0.460247926419383 |
| 350 | -0.460124553884726 |
| 400 | -0.460031522253631 |
| 450 | -0.459958839353907 |
| 500 | -0.459900471625607 |

|  |  |
| --- | --- |
| n |  |
| 50 | -0.459361333772362 |
| 100 | -0.459360970845284 |
| 150 | -0.459360930686411 |
| 200 | -0.459360920518306 |
| 250 | -0.459360916813490 |
| 300 | -0.459360915150366 |
| 350 | -0.459360914294815 |
| 400 | -0.459360913810249 |
| 450 | -0.459360913515406 |
| 500 | -0.459360913325759 |

**Table 1 Table 2**

\* For the approximations in Table 1, roughly **4** digits of are being accurately computed. As we can see from n=450 to n=500, the first 4 digits of the approximation are staying the same (-0.4599). Therefore, due to the stability and consistency of the first 4 digits, we can state that our approximation can compute roughly 4 digits accurately.

\* For the approximations in Table 2, roughly **9** digits of are being accurately computed. As we can see from n=400 to n=400, the first 9 digits of the approximation are equal (-0.459360913). Therefore, due to the stability and consistency of the first 9 digits, we can state that our approximation can compute roughly 9 digits accurately.

A close up of a map

Description automatically generated

\* The plot of (p) vs p shows an asymptotic graph where (p) is growing and approaching 0 as p is increasing. We can compare and see that our original value of p=1 is much smaller than p=100.

format long

f = @(x) power(x,-1) .\* sin(power(x,-1) .\* log(x));

n = 50:50:500;

Q\_n = [];

% part 1

%{

for j = 1:length(n)

a = [];

n(j)

for i = 1:(n(j) + 1)

b = fzero(@(x) x\*exp(x)-i\*pi,0);

a = [a exp(-b)];

end

q = integral(f, a(1), 1);

for p = 1:(n(j))

q = q + integral(f, a(p + 1), a(p));

end

q

Q\_n = [Q\_n, q];

end

%----------------------------------------------------------------------

% part 2

Q\_n\_hat = [];

for j = 1:length(n)

a = [];

n(j)

for i = 1:(n(j) + 1)

b = fzero(@(x) x\*exp(x)-i\*pi,0);

a = [a exp(-b)];

end

q = integral(f, a(1), 1);

for p = 1:(n(j))

q = q + integral(f, a(p + 1), a(p));

end

a\_1=[];

for i = 1:(n(j) + 2)

b = fzero(@(x) x\*exp(x)-i\*pi,0);

a\_1 = [a\_1 exp(-b)];

end

q\_n\_1 = integral(f, a\_1(1), 1);

for p = 1:(n(j) + 1)

q\_n\_1 = q\_n\_1 + integral(f, a\_1(p + 1), a\_1(p));

end

a\_2 = [];

for i = 1:(n(j) + 3)

b = fzero(@(x) x\*exp(x)-i\*pi,0);

a\_2 = [a\_2 exp(-b)];

end

q\_n\_2 = integral(f, a\_2(1), 1);

for p = 1:(n(j) + 2)

q\_n\_2 = q\_n\_2 + integral(f, a\_2(p + 1), a\_2(p));

end

q\_hat = q - ((power(q\_n\_1 - q, 2)) / (q\_n\_2 - (2\*q\_n\_1) + q))

Q\_n\_hat = [Q\_n\_hat q\_hat];

end

%}

%----------------------------------------------------------------------

% part 3

I = @(s) power(x,-1) .\* sin(power(x,-s) .\* log(x));

Q\_n\_hat = [];

for s = 1:5:100

I = @(x) power(x,-1) .\* sin(power(x,-s) .\* log(x));

a = [];

for i = 1:(500 + 1)

b = fzero(@(x) (x)\*exp(x\*s)-i\*pi,0);

a = [a exp(-b)];

end

q = integral(f, a(1), 1);

for p = 1:(500)

q = q + integral(I, a(p + 1), a(p));

end

a\_1=[];

for i = 1:(500 + 2)

b = fzero(@(x) (x)\*exp(x\*s)-i\*pi,0);

a\_1 = [a\_1 exp(-b)];

end

q\_n\_1 = integral(f, a\_1(1), 1);

for p = 1:(500 + 1)

q\_n\_1 = q\_n\_1 + integral(I, a\_1(p + 1), a\_1(p));

end

a\_2 = [];

for i = 1:(500 + 3)

b = fzero(@(x) (x\*s)\*exp(x\*s)-i\*pi,0);

a\_2 = [a\_2 exp(-b)];

end

q\_n\_2 = integral(f, a\_2(1), 1);

for p = 1:(500 + 2)

q\_n\_2 = q\_n\_2 + integral(I, a\_2(p + 1), a\_2(p));

end

q\_hat = q - ((power(q\_n\_1 - q, 2)) / (q\_n\_2 - (2\*q\_n\_1) + q));

Q\_n\_hat = [Q\_n\_hat q\_hat];

end

plot(1:5:100, Q\_n\_hat)

xlabel('p')

ylabel('I(p)')

title('I(p) vs p')