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MATH 4670
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1 Section 2.4, Problem 4.b.

Using the Secant method, we will find solutions accurate to within 10^{-5} for the equation

$$(x - 2)^2 - \ln x = 0$$

on the intervals $[1, 2]$ and $[e, 4]$.

2 Source Code

The following C code can be used to find an accurate value:

```
#include <stdlib.h>
#include <math.h>

#define E 2.71828182846
double f(double x);
void secant_method(double a, double b);

int main()
{
    secant_method(1.00, 2.00);
    secant_method(E, 4.00);
    return 0;
}

double f(double x)
{
    return pow(x - 2, 2) - log(x);
}

void secant_method(double a, double b)
{
    double x[100];
    unsigned int k = 1;
    x[0] = a;
    x[1] = b;

    printf("%d \t %5.20f \t %5.20f \n", 0, x[0], f(x[0]) );
    printf("%d \t %5.20f \t %5.20f \n", 1, x[1], f(x[1]) );
```

```

while( f(x[k]) != f(x[k-1]) )
{
    x[k+1] = x[k] - ( f(x[k]) * (x[k] - x[k-1]) ) / ( f(x[k]) - f(x[k-1]) );
    printf("%d \t %5.20f \t %5.20f \n", k+1, x[k+1], f(x[k+1]) );
    k++;
}
printf("\n");
}

```

3 Results

	x	f(x)

0	1.00000000000000000000	1.00000000000000000000
1	2.00000000000000000000	-0.69314718055994528623
2	1.59061610914964135510	-0.29652626112070867848
3	1.28454784959203394124	0.26146499111804116788
4	1.42796611008566443068	-0.02902835999223973840
5	1.41363463957469415178	-0.00233981032596614069
6	1.41237818603536147144	0.00002445590247912577
7	1.41239118275496000621	-0.00000002020915623735
8	1.41239117202397701512	-0.00000000000017419399
9	1.41239117202388442252	0.00000000000000022204
10	1.41239117202388464456	-0.00000000000000022204
11	1.41239117202388442252	0.00000000000000022204
12	1.41239117202388442252	0.00000000000000022204

0	2.71828182845999988260	-0.48407121490451054946
1	4.00000000000000000000	2.61370563888010920550
2	2.91856832479189254315	-0.22732542900418772902
3	3.00509920517697537434	-0.09008616856489570779
4	3.06189953659443903078	0.00859513885626084218
5	3.05695222946634093120	-0.00027040080702089853
6	3.05710312336460621196	-0.0000007624305557867
7	3.05710355003279854458	0.00000000006801781360
8	3.05710354999473787885	-0.00000000000000044409
9	3.05710354999473832294	0.00000000000000044409
10	3.05710354999473832294	0.00000000000000044409

4 Summary

It is clearly shown that x converges to approximately 1.41239117202388442252 on the interval $[1, 2]$ and to approximately 3.05710354999473832294 on $[e, 4]$.