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MATH 4670
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1 Section 2.3, Problem 16

Using the Secant method, we will find solutions accurate to within 10^{-4} for the equations

$$x + y = 20$$

and

$$(x + \sqrt{x})(y + \sqrt{y}) = 155.55$$

To simplify things, we can substitute $20 - x$ for y, thus

$$(x + \sqrt{x})(20 - x + \sqrt{20 - x}) = 155.55$$

2 Source Code

The following C code can be used to find accurate values:

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

double f(double x);
void secant_method(double a, double b);

int main()
{
   secant_method(0, 20);
   return 0;
}

double f(double x)
{
   return (x + sqrt(x)) * (20 - x + sqrt(20 - x)) - 155.55;
}

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], 20 - x[0] );
```

```
    printf("%d \t %5.20f \t %5.20f \n", 1, x[1], 20 - x[1] );

    while( f(x[k+1]) < 155.55  )
    {
         while (x[k] >= 20)
              x[k] -= 19.9;
         if (x[k] <= 0)
              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], 20 - x[k+1] );
         k++;
    }
    printf("\n");
}
```

3 Results

	x	y
0	0.00000000000000000000	20.00000000000000000000
1	20.00000000000000000000	0.00000000000000000000
2	1.53406900958186542816	18.46593099041813346162
3	4.03640189425092010822	15.96359810574907989178
4	5.55341928389035555114	14.44658071610964356069
5	6.27190439576033220703	13.72809560423966779297
6	6.48350168476557353614	13.51649831523442557568
7	6.51184131418104517053	13.48815868581895571765
8	6.51284437534541726933	13.48715562465458361885
9	6.51284872546051918363	13.48715127453948170455
10	6.51284872610814069560	13.48715127389185930440

4 Summary

It is clearly shown that x converges to approximately 6.51284872610814069560 and y, which is defined as $20 - x$, converges to 13.48715127389185930440.