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CS 3010.01

Programming Project 2

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The data type for all the numbers used and calculated are doubles. The starting points used for function 1 are incremented by one; some starting points resulted in the same root, so I chose the method that took more iterations to graph. The tables underneath each graph lists the starting points that were used for finding each root. According to the graphs, the false position method for the roots of both functions converges the fastest, while the bisection method converges the slowest.

FUNCTION #1: $f(x) = 2x^3 - 11.7x^2 + 17.7x - 5$

n	a	b	c	f(a)	f(b)	f(c)	Error
0	0.000	1.000	0.500	-5.000	3.000	1.175	1.000
1	0.000	0.500	0.250	-5.000	1.175	-1.275	1.000
2	0.250	0.500	0.375	-1.275	1.175	0.098	0.333
3	0.250	0.375	0.313	-1.275	0.098	-0.550	0.200
4	0.313	0.375	0.344	-0.550	0.098	-0.217	0.091
5	0.344	0.375	0.359	-0.217	0.098	-0.057	0.043
6	0.359	0.375	0.367	-0.057	0.098	0.021	0.021
7	0.359	0.367	0.363	-0.057	0.021	-0.018	0.011
8	0.363	0.367	0.365	-0.018	0.021	0.001	0.005

BISECTION - The root 0.365 has been found in between 0 and 1 for function #1 in 8 iterations.

n	a	b	c	f(a)	f(b)	f(c)	Error
0	1.000	2.000	1.500	3.000	-0.400	1.975	1.000
1	1.500	2.000	1.750	1.975	-0.400	0.863	0.143
2	1.750	2.000	1.875	0.863	-0.400	0.238	0.067
3	1.875	2.000	1.938	0.238	-0.400	-0.081	0.032
4	1.875	1.938	1.906	0.238	-0.081	0.079	0.016
5	1.906	1.938	1.922	0.079	-0.081	-0.001	0.008

BISECTION - The root 1.922 has been found in between 1 and 2 for function #1 in 5 iterations.

n	a	b	c	f(a)	f(b)	f(c)	Error
0	2.000	3.000	2.500	-0.400	-3.200	-2.625	1.000
1	2.500	3.000	2.750	-2.625	-3.200	-3.212	0.091
2	2.750	3.000	2.875	-3.212	-3.200	-3.293	0.043
3	2.875	3.000	2.938	-3.293	-3.200	-3.270	0.021
4	2.938	3.000	2.969	-3.270	-3.200	-3.241	0.011
5	2.969	3.000	2.984	-3.241	-3.200	-3.222	0.005

BISECTION - There are no roots in between 2 and 3 for function #1.

n	a	b	c	f(a)	f(b)	f(c)	Error
0	3.000	4.000	3.500	-3.200	6.600	-0.625	1.000
1	3.500	4.000	3.750	-0.625	6.600	2.313	0.067
2	3.500	3.750	3.625	-0.625	2.313	0.687	0.034
3	3.500	3.625	3.563	-0.625	0.687	-0.007	0.018
4	3.563	3.625	3.594	-0.007	0.687	0.330	0.009

BISECTION - The root 3.594 has been found in between 3 and 4 for function #1 in 4 iterations.

n	xn	f(xn)	f'(xn)	Error
0	1.000	3.000	0.300	1.000
1	-9.000	-2570.000	714.300	1.111
2	-5.402	-757.341	319.203	0.666
3	-3.029	-221.608	143.656	0.783
4	-1.487	-63.756	65.756	1.038
5	-0.517	-17.563	31.409	1.874
6	0.042	-4.279	16.730	13.345
7	0.298	-0.715	11.267	0.859
8	0.361	-0.039	10.032	0.176
9	0.365	-0.000	9.957	0.011
10	0.365	-0.000	9.956	0.000

NEWTON - The root 0.365 has been found for function #1 starting at x = 1 in 10 iterations.

n	xn	f(xn)	f'(xn)	Error
0	2.000	-0.400	-5.100	1.000
1	1.922	0.001	-5.110	0.041
2	1.922	-0.000	-5.110	0.000

NEWTON - The root 1.922 has been found for function #1 starting at x = 2 in 2 iterations.

n	xn	f(xn)	f'(xn)	Error
0	3.000	-3.200	1.500	1.000
1	5.133	48.090	55.687	0.416
2	4.270	12.956	27.172	0.202
3	3.793	2.948	15.263	0.126
4	3.600	0.398	11.216	0.054
5	3.564	0.012	10.522	0.010

NEWTON - The root 3.564 has been found for function #1 starting at x = 3 in 5 iterations.

n	xn	f(xn)	f'(xn)	Error
0	4.000	6.600	20.100	1.000
1	3.672	1.255	12.669	0.089
2	3.573	0.099	10.681	0.028
3	3.563	0.001	10.500	0.003

NEWTON - The root 3.563 has been found for function #1 starting at x = 4 in 3 iterations.

n	xn-1	xn	f(xn-1)	f(xn)	f'(xn)	Error
0	0.000	1.000	-5.000	3.000	0.300	1.000
1	1.000	0.625	3.000	1.980	5.419	0.600
2	0.625	-0.103	1.980	-6.958	20.185	7.042
3	-0.103	0.464	-6.958	0.890	8.141	1.223
4	0.464	0.399	0.890	0.329	9.313	0.161
5	0.399	0.362	0.329	-0.036	10.024	0.104
6	0.362	0.365	-0.036	0.001	9.954	0.010
7	0.365	0.365	0.001	0.000	9.956	0.000

SECANT - The root 0.365 has been found for function #1 starting at x = 1 in 7 iterations.

n	xn-1	xn	f(xn-1)	f(xn)	f'(xn)	Error
0	1.000	2.000	3.000	-0.400	-5.100	0.500
1	2.000	1.882	-0.400	0.201	-5.088	0.062
2	1.882	1.922	0.201	0.000	-5.110	0.020
3	1.922	1.922	0.000	-0.000	-5.110	0.000

SECANT - The root 1.922 has been found for function #1 starting at x = 2 in 3 iterations.

n	xn-1	xn	f(xn-1)	f(xn)	f'(xn)	Error
0	2.000	3.000	-0.400	-3.200	1.500	0.333
1	3.000	1.857	-3.200	0.329	-5.063	0.615
2	1.857	1.964	0.329	-0.214	-5.114	0.054
3	1.964	1.922	-0.214	0.001	-5.110	0.022
4	1.922	1.922	0.001	0.000	-5.110	0.000

SECANT - The root 1.922 has been found for function #1 starting at x = 3 in 4 iterations.

n	xn-1	xn	f(xn-1)	f(xn)	f'(xn)	Error
0	3.000	4.000	-3.200	6.600	20.100	0.250
1	4.000	3.327	6.600	-1.969	6.254	0.202
2	3.327	3.481	-1.969	-0.796	8.954	0.044
3	3.481	3.586	-0.796	0.248	10.949	0.029
4	3.586	3.561	0.248	-0.019	10.464	0.007

SECANT - The root 3.561 has been found for function #1 starting at x = 4 in 4 iterations.

n	a	b	c	f(a)	f(b)	f(c)	Error
0	0.000	1.000	0.625	-5.000	3.000	1.980	1.000
1	0.000	0.625	0.448	-5.000	1.980	0.758	0.396
2	0.000	0.448	0.389	-5.000	0.758	0.230	0.152
3	0.000	0.389	0.372	-5.000	0.230	0.065	0.046
4	0.000	0.372	0.367	-5.000	0.065	0.018	0.013
5	0.000	0.367	0.366	-5.000	0.018	0.005	0.004

FALSE-POSITION - The root 0.366 has been found in between 0 and 1 for function #1 in 5 iterations.

n	a	b	c	f(a)	f(b)	f(c)	Error
0	1.000	2.000	1.882	3.000	-0.400	0.201	1.000
1	1.882	2.000	1.922	0.201	-0.400	0.000	0.020
2	1.922	2.000	1.922	0.000	-0.400	0.000	0.000

FALSE-POSITION - The root 1.922 has been found in between 1 and 2 for function #1 in 2 iterations.

n	a	b	c	f(a)	f(b)	f(c)	Error
0	2.000	3.000	1.857	-0.400	-3.200	0.329	1.000
1	2.000	1.857	1.922	-0.400	0.329	0.001	0.034
2	2.000	1.922	1.922	-0.400	0.001	0.000	0.000

FALSE-POSITION - The root 1.922 has been found in between 2 and 3 for function #1 in 2 iterations.

n	a	b	c	f(a)	f(b)	f(c)	Error
0	3.000	4.000	3.327	-3.200	6.600	-1.969	1.000
1	3.327	4.000	3.481	-1.969	6.600	-0.796	0.044
2	3.481	4.000	3.537	-0.796	6.600	-0.267	0.016
3	3.537	4.000	3.555	-0.267	6.600	-0.084	0.005

FALSE-POSITION - The root 3.555 has been found in between 3 and 4 for function #1 in 3 iterations.

n	xn-1	xn	f(xn-1)	f(xn)	f(x+delta*x)	f'(xn)	Error
0	0.000	1.000	-5.000	3.000	3.002	0.300	1.000
1	1.000	-11.336	3.000	-4622.118	-4742.612	1053.916	1.088
2	-11.336	-6.987	-4622.118	-1382.148	-1415.539	474.132	0.622
3	-6.987	-4.095	-1382.148	-411.030	-419.860	214.141	0.706
4	-4.095	-2.189	-411.030	-120.774	-122.924	97.667	0.871
5	-2.189	-0.959	-120.774	-34.505	-34.944	45.663	1.282
6	-0.959	-0.206	-34.505	-9.166	-9.213	22.782	3.650
7	-0.206	0.196	-9.166	-1.970	-1.944	13.352	2.054
8	0.196	0.343	-1.970	-0.220	-0.185	10.372	0.430
9	0.343	0.365	-0.220	-0.004	0.033	9.963	0.058
10	0.365	0.365	-0.004	0.000	0.036	9.956	0.001

MODIFIED SECANT - The root 0.365 has been found for function #1 starting at x = 1 in 10 iterations.

n	xn-1	xn	f(xn-1)	f(xn)	f(x+delta*x)	f'(xn)	Error
0	1.000	2.000	3.000	-0.400	-0.502	-5.100	0.500
1	2.000	1.921	-0.400	0.001	-0.097	-5.110	0.041
2	1.921	1.922	0.001	0.000	-0.098	-5.110	0.000

MODIFIED SECANT - The root 1.922 has been found for function #1 starting at x = 2 in 2 iterations.

n	xn-1	xn	f(xn-1)	f(xn)	f(x+delta*x)	f'(xn)	Error
0	2.000	3.000	-0.400	-3.200	-3.149	1.500	0.333
1	3.000	4.893	-3.200	35.763	38.097	46.838	0.387
2	4.893	4.143	35.763	9.730	10.737	23.739	0.181
3	4.143	3.742	9.730	2.203	2.748	14.159	0.107
4	3.742	3.591	2.203	0.300	0.710	11.043	0.042
5	3.591	3.565	0.300	0.016	0.404	10.529	0.007

MODIFIED SECANT - The root 3.565 has been found for function #1 starting at x = 3 in 5 iterations.

n	xn-1	xn	f(xn-1)	f(xn)	f(x+delta*x)	f'(xn)	Error
0	3.000	4.000	-3.200	6.600	7.424	20.100	0.250
1	4.000	3.680	6.600	1.356	1.842	12.833	0.087
2	3.680	3.577	1.356	0.147	0.544	10.767	0.029
3	3.577	3.564	0.147	0.006	0.393	10.510	0.004

MODIFIED SECANT - The root 3.564 has been found for function #1 starting at x = 4 in 3 iterations.

FUNCTION #2: $f(x) = x + 10 - x \cosh(50/x)$

n	a	b	c	f(a)	f(b)	f(c)	Error
0	120.000	130.000	125.000	-0.568	0.265	-0.134	1.000
1	125.000	130.000	127.500	-0.134	0.265	0.070	0.020
2	125.000	127.500	126.250	-0.134	0.070	-0.031	0.010

BISECTION - The root 126.250 has been found in between 120 and 130 for function #2 in 2 iterations.

n	xn	f(xn)	f'(xn)	Error
0	130.000	0.265	0.077	1.000
1	126.540	-0.008	0.081	0.027
2	126.632	-0.000	0.081	0.001

NEWTON - The root 126.632 has been found for function #2 starting at $x = 130$ in 2 iterations.

n	xn-1	xn	f(xn-1)	f(xn)	f'(xn)	Error
0	120.000	130.000	-0.568	0.265	0.077	0.077
1	130.000	126.816	0.265	0.015	0.081	0.025
2	126.816	126.627	0.015	-0.000	0.081	0.001

SECANT - The root 126.627 has been found for function #2 starting at $x = 130$ in 2 iterations.

n	a	b	c	f(a)	f(b)	f(c)	Error
0	120.000	130.000	126.816	-0.568	0.265	0.015	1.000
1	120.000	126.816	126.642	-0.568	0.015	0.001	0.001

FALSE-POSITION - The root 126.642 has been found in between 120 and 130 for function #2 in 1 iterations.

n	xn-1	xn	f(xn-1)	f(xn)	f(x+delta*x)	f'(xn)	Error
0	120.000	130.000	-0.568	0.265	0.364	0.077	0.077
1	130.000	126.504	0.265	-0.010	0.091	0.081	0.028
2	126.504	126.634	-0.010	0.000	0.102	0.081	0.001

MODIFIED SECANT - The root 126.634 has been found for function #2 starting at $x = 130$ in 2 iterations.

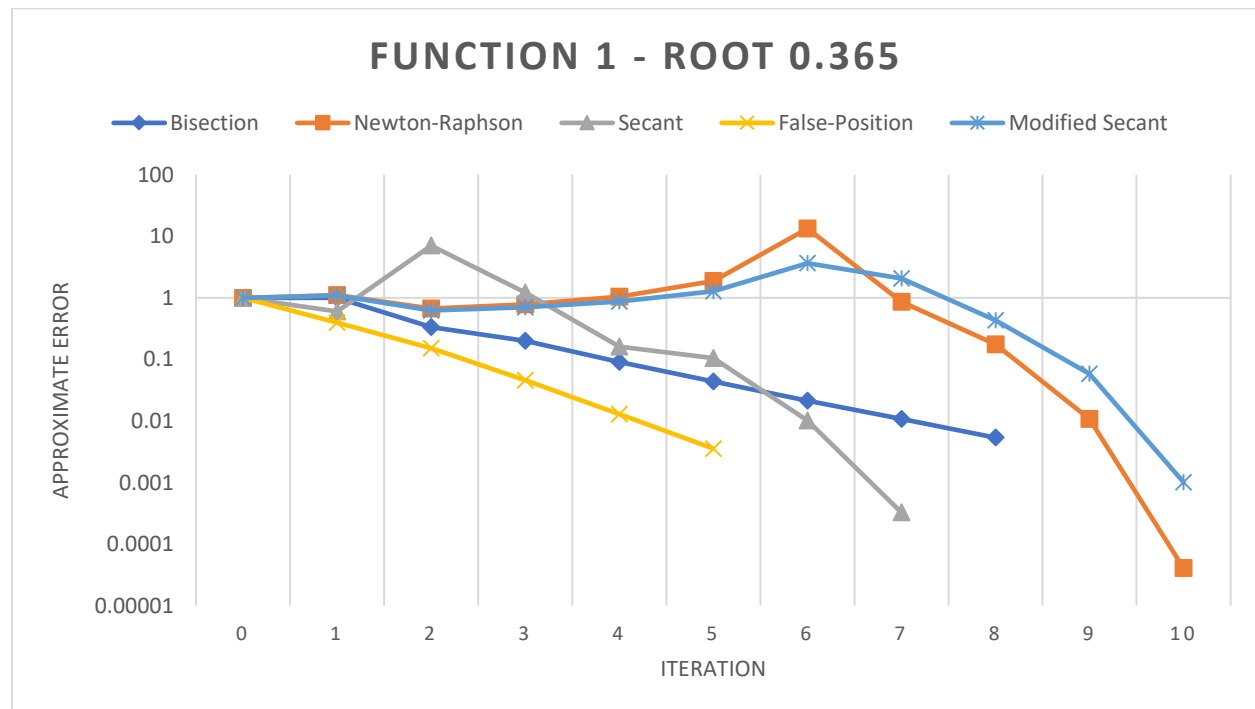


Table 1: Starting Points for Function 1 – Root 0.365

Bisection	$a = 0, b = 1$
Newton-Raphson	$x = 1$
Secant	$x = 1$
False-Position	$a = 0, b = 1$
Modified Secant	$x = 1$

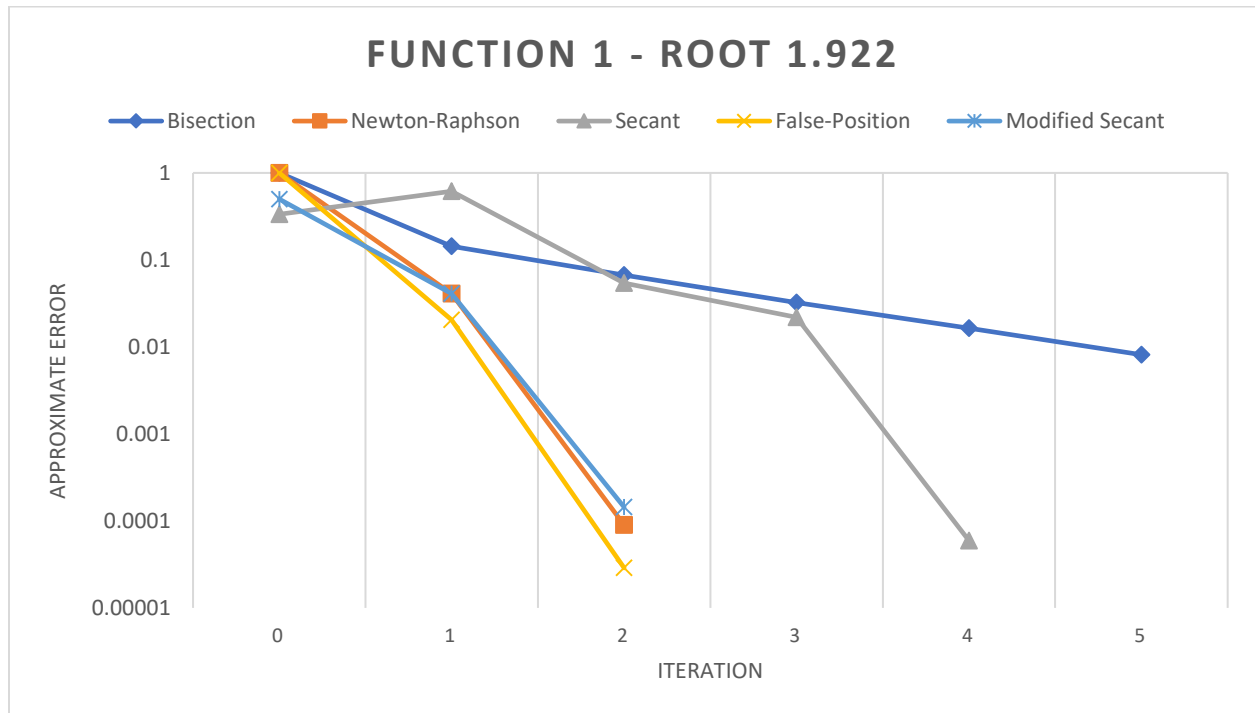


Table 2: Starting Points for Function 1 – Root 1.922

Bisection	$a = 1, b = 2$
Newton-Raphson	$x = 2$
Secant	$x = 3$
False-Position	$a = 1, b = 2$
Modified Secant	$x = 2$

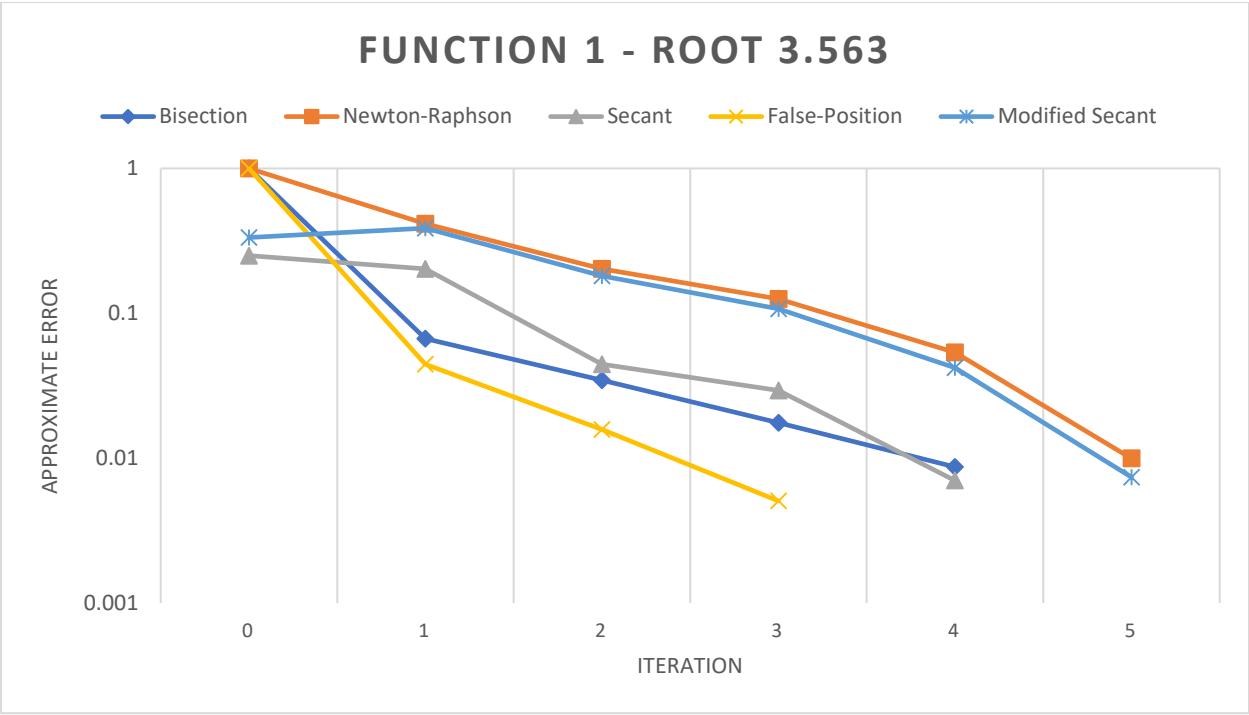


Table 3: Starting Points for Function 1 – Root 3.563

Bisection	a = 3, b = 4
Newton-Raphson	x = 3
Secant	x = 4
False-Position	a = 3, b = 4
Modified Secant	x = 3

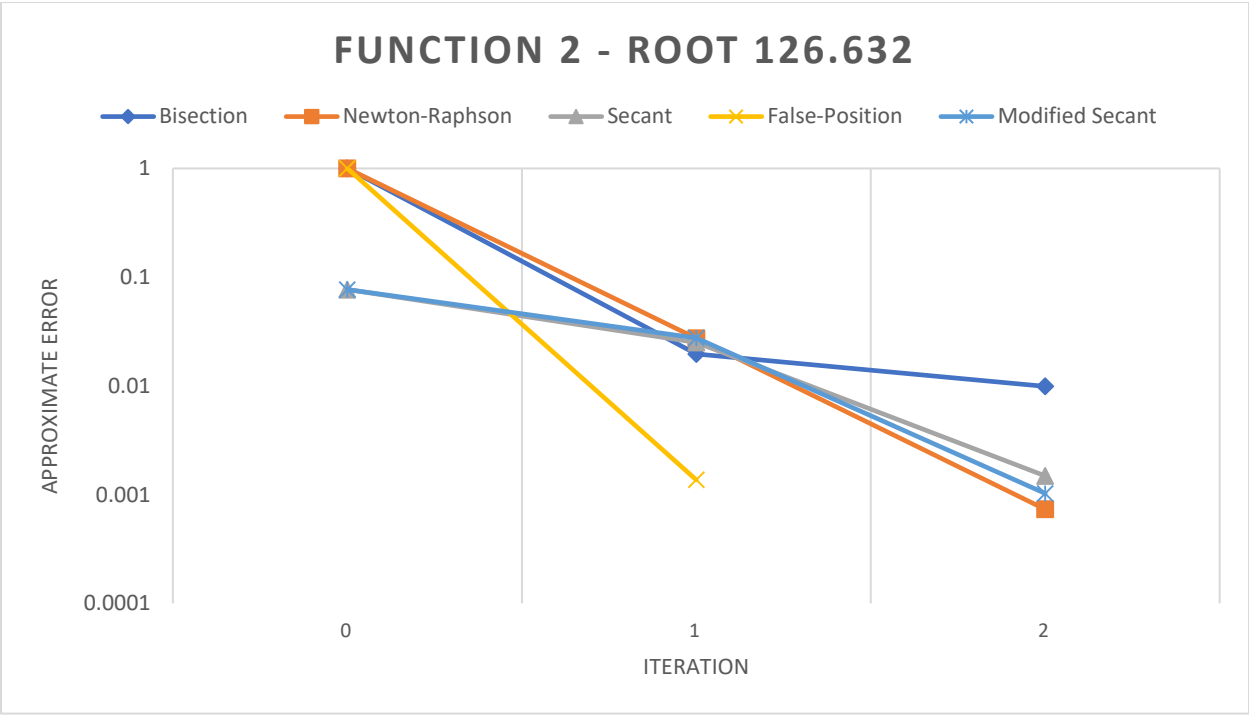


Table 4: Starting Points for Function 2 - Root 126.632

Bisection	a = 120, b = 130
Newton-Raphson	x = 130
Secant	x = 130
False-Position	a = 120, b = 130
Modified Secant	x = 130