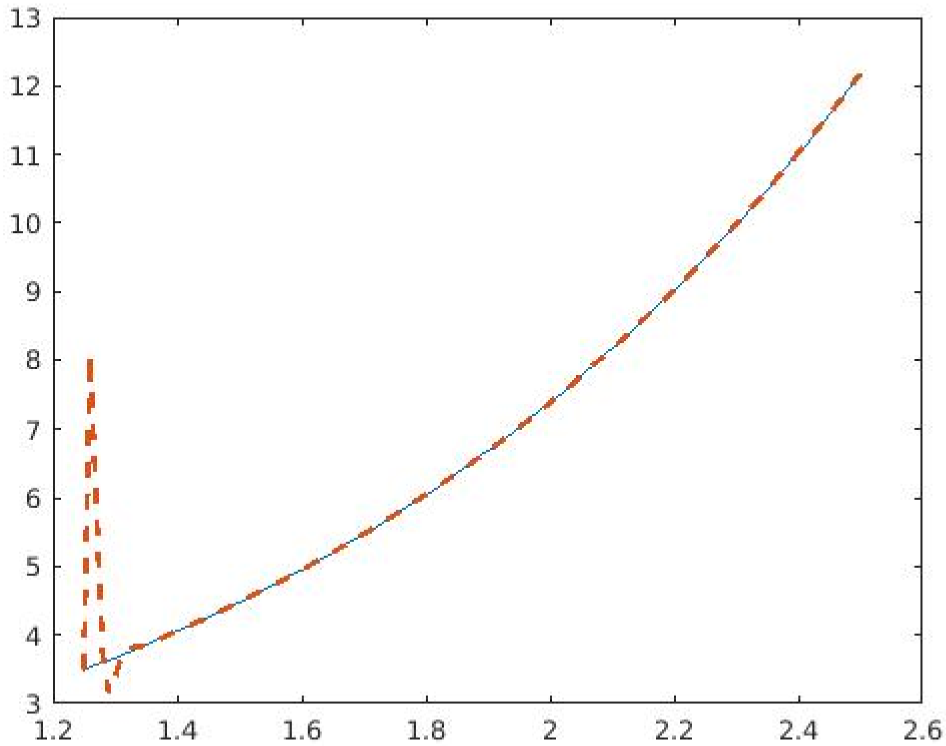
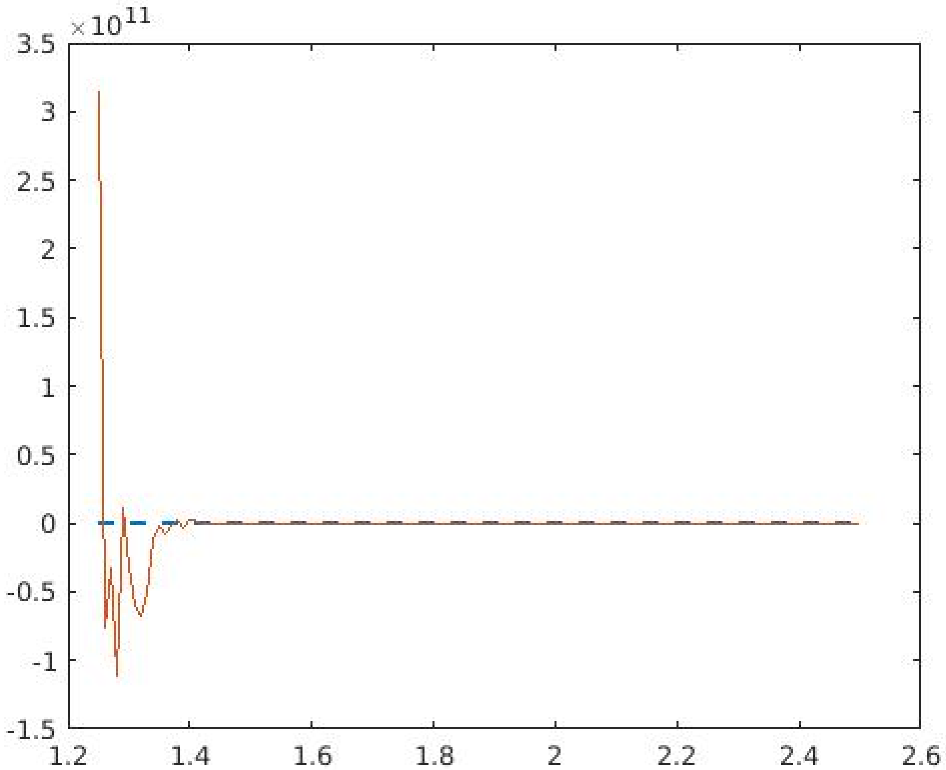
Lab 4

Problem 1: Value of f(2.25) using forward interpolation = 9.4877.

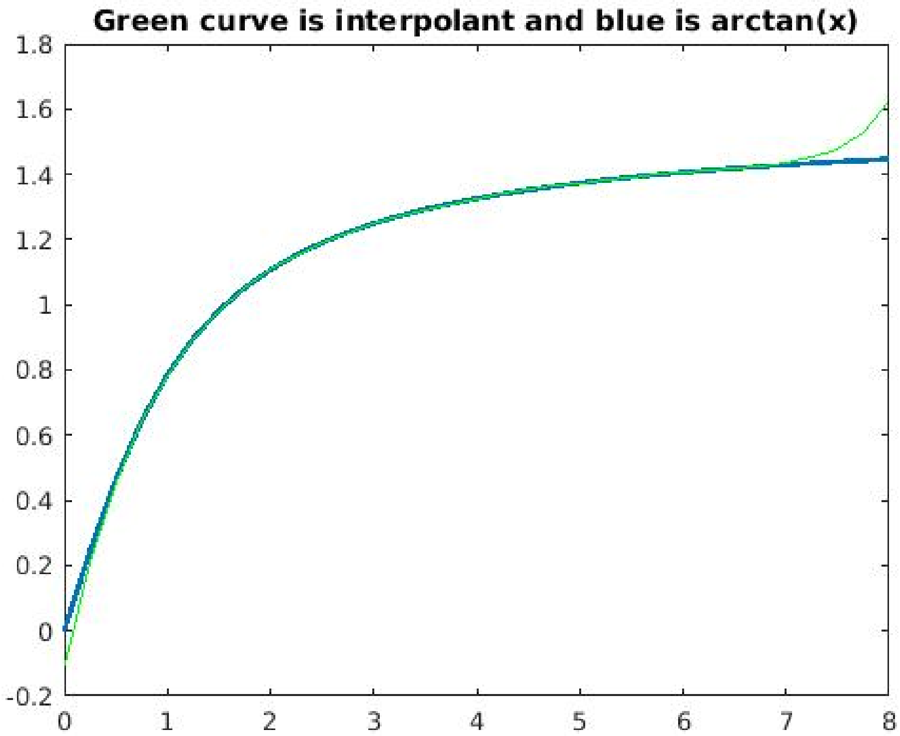




Value of f(2.25) using backward interpolation = 9.4879.

Problem 2: The difference at required points is in table below:

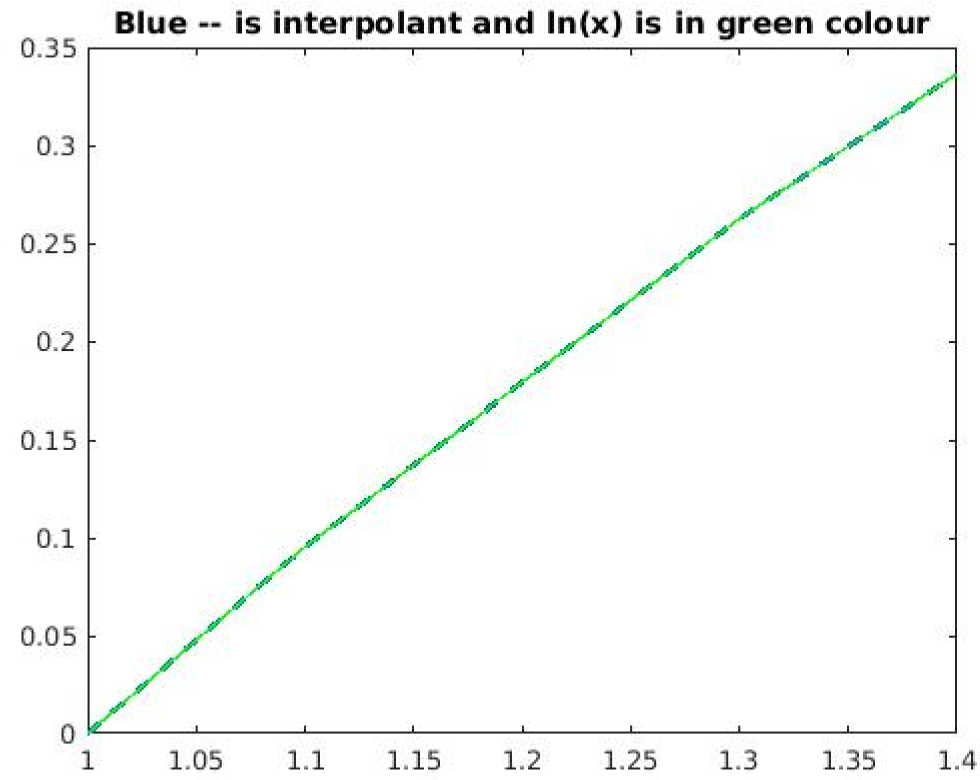
p(x)	f(x)	Difference(p(x) - f(x))
-0.1053163147	0.0000000000	-0.1053163147
0.2130806365	0.2449786631	-0.0318980266
0.4563962815	0.4636476090	-0.0072513275
0.6424669733	0.6435011088	-0.0010341355
0.7853981634	0.7853981634	0.0000000000
0.8960899620	0.8960553846	0.0000345774
0.9827937232	0.9827937232	0.0000000000
1.0516462667	1.0516502125	-0.0000039459
1.1071487178	1.1071487178	0.0000000000
1.1525728741	1.1525719972	0.0000008769
1.1902899497	1.1902899497	0.0000000000
1.2220250013	1.2220253232	-0.0000003219
1.2490457724	1.2490457724	0.0000000000
1.2722975763	1.2722973952	0.0000001811
1.2924966678	1.2924966678	0.0000000000
1.3101937839	1.3101939350	-0.0000001511
1.3258176637	1.3258176637	0.0000000000
1.3397058456	1.3397056596	0.0000001860
1.3521273809	1.3521273809	0.0000000000
1.3632997547	1.3633001004	-0.0000003457
1.3734007669	1.3734007669	0.0000000000
1.3825758554	1.3825748215	0.0000010339
1.3909428270	1.3909428270	0.0000000000
1.3985996839	1.3986055123	-0.0000058284
1.4056476494	1.4056476494	0.0000000000
1.4122511123	1.4121410646	0.0001100477
1.4187694760	1.4181469984	0.0006224776
1.4260133110	1.4237179714	0.0022953396
1.4356992391	1.4288992722	0.0067999669
1.4512050950	1.4337301525	0.0174749425
1.4787596104	1.4382447945	0.0405148159
1.5292396036	1.4424730991	0.0867665045
1.6207929289	1.4464413322	0.1743515967



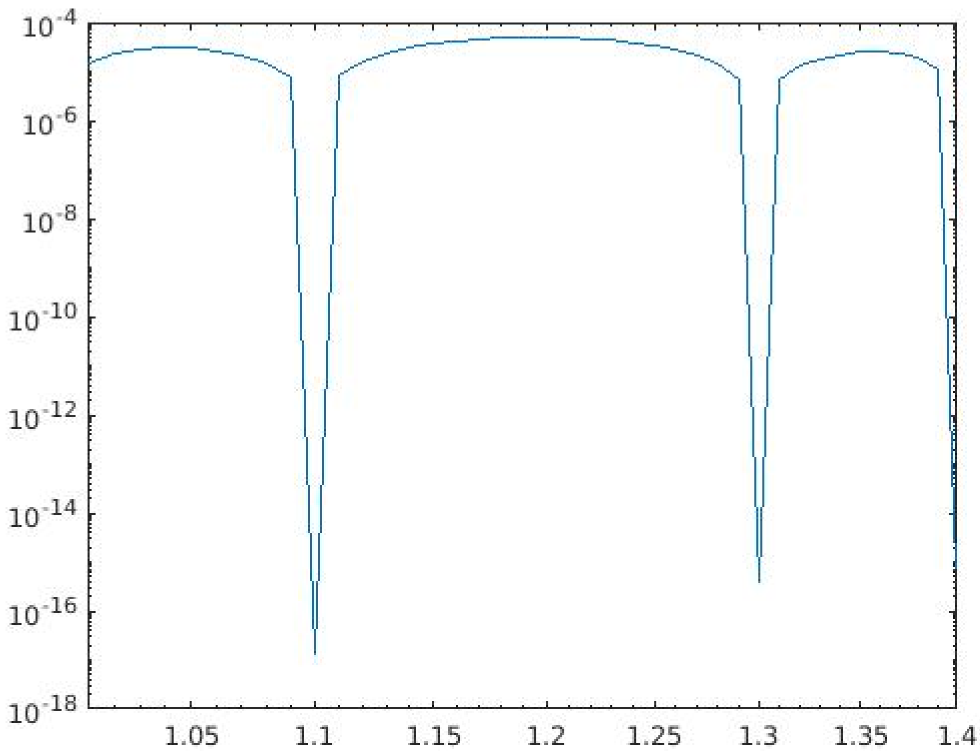
=>Coefficients in the Newton form of polynomial are:(which are $\Delta^j f_0$)
0.19740
-0.07304
0.03183
-0.01500
0.00725
-0.00341
0.00141
-0.00036
-0.00020
0.00049

It can be observed that the interpolant interpolates the arc tan(x) quite accurately from the graph.

Problem 3: The figures are as follows:



Loglog plot of error is shown below:



Bound for absolute error in [1:1.4] is 4.9367e-05.

Problem 4:

- f(0.2) by Lagrange interpolation= -5.778590
- f(0.2) by Lagrange interpolation adding extra point = -5.778599
- f(0.2) by Newton divided difference interpolation = -5.778590
- f(0.2) by Newton divided difference interpolation adding extra point = -5.778599

The same results are obtained from both the polynomials in both the cases i.e, without and with the extra point included because the interpolating polynomial is unique by uniqueness of interpolating polynomial theorem. Thus the values should come out to be the same at any point.

Problem 5: Using appropriate Lagrange interpolating polynomials the following results were obtained:

a) f(0.18) = -0.5081
b) f(0.25) = 1.1889

Problem 6: Using divided differences to approximate the population the following results are obtained for the given years :

- In 1940 approximated population = 116032
- In 1975 approximated population = 214809
- In 2020 approximated population = 377692

Problem 7:

- ➔ Value of f(4) using a second degree interpolating polynomial = 1.5727
- ➔ Value of f(4) using a third degree interpolating polynomial = 1.5727

There is no advantage here in using a third degree polynomial because the forward difference is 0 in the last term of third degree polynomial and thus contributes nothing.

The tabulated values are as shown below:

x(i)	f(x(i))	$f[x_i, x_{i+1}]$	$f[x_i, x_{i+1}, x_{i+2}]$	$f[x_i, x_{i+1}, x_{i+2}, x_{i+3}]$
2	1.5713	0	0	0
3	1.5719	0.000600000000000156	0	0
5	1.5738	0.000950000000000006	0.000116666666666617	0
6	1.5751	0.00129999999999986	0.000116666666666617	0