Computing Assignment 4

**Highlighted in best estimation

a)

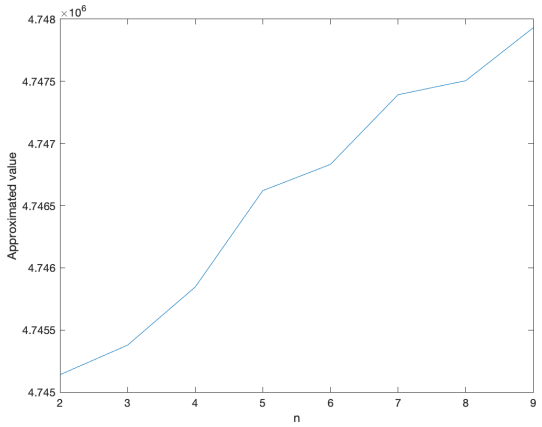

Figure 1. Approximation of population at January 1, 2015 vs n

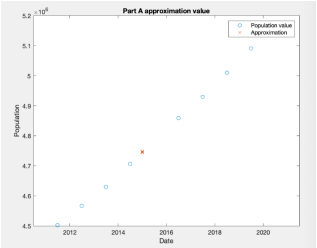

Figure 1 is a plot of the approximation of population on January 1, 2015 versus n data points where it ranges from 2 to 9; its n data points are the closest data points to a point we are approximating for, 2014.5 in this case. Figure 1 is the plot of approximated population by using the n points closest to the right end. The data points are selected by removing points from left and right alternatively.

n	Years as data points
9	2011,2012,2013,2014, 2016,2017,2018,2019,2020
8	2011,2012,2013,2014, 2016,2017,2018,2019
7	2011,2012,2013,2014, 2016,2017,2018
6	2012,2013,2014, 2016,2017,2018
5	2012,2013,2014, 2016,2017
4	2013,2014, 2016,2017
3	2013,2014, 2016
2	2014, 2016

According to the figure 1, it is obvious that the population at January 1, 2015 is approximately 4.748 x 10^6 (4747931.4217) . The value has been approximated by using 9 data points where all given data point is used: year 2011 2012 2013 2014 2016 2017 2018 2019 2020. I would say that using 9 data points give the most accurate approximation of the population at January 1, 2015 because it uses more of the given data.

b)

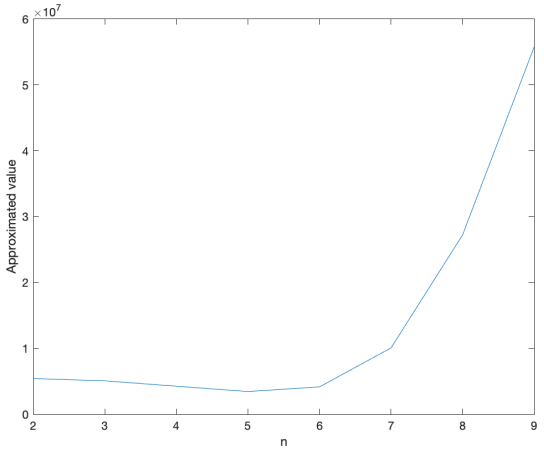

Figure 2. Approximation of population at July 1, 2025 vs n

Figure 2 is a plot of the approximation of population on July 1, 2025 versus n data points where it ranges from 2 to 9; its n data points are the closest to a point we are approximating for, which is 2025 in this case. The range of given data points do not include the approximation point and the approximation point is far beyond the right end point. Therefore, we have to select the data points by removing the points from the beginning to get the closest n data points to 2025.

n	Years as data points
9	2011,2012,2013,2014, 2016,2017,2018,2019,2020
8	2012,2013,2014, 2016,2017,2018,2019,2020
7	2013,2014, 2016,2017,2018,2019,2020
6	2014, 2016,2017,2018,2019,2020
5	2016,2017,2018,2019,2020
4	2017,2018,2019,2020
3	2018,2019,2020
2	2019,2020

c) The accuracy on approximation is usually computed by error bound theorem (theorem 3.3 in the textbook). However, unfortunately, the theorem 3.3 cannot be applied here because we have no knowledge of the (n+1) th derivative of f.
Therefore, only way to measure the accuracy on our approximation is to see if the approximations on various n agree each other; I will get less difference if they agree more. For the approximation in part (a), the difference between each approximation on various n does agree with little variation. As the plot in part(a) indicates a linear trend and the approximation agrees each other with small variation, I would say the approximation is pretty accurate.

n vs n	2 vs 3	3 vs 4	4 vs 5	5 vs 6	6 vs 7	7 vs 8	8 vs 9
difference	238.1250	467.5312	775.4297	211.3477	560.5566	112.3743	426.3072

For the approximation in part (b), the difference between each approximation on various n does not really agree each other with huge variation. Also, the plot in (b) indicates that there is huge difference as more data points are used. Therefore, I would say that approximation in part(b) is not accurate.

n vs n	2 vs 3	3 vs 4	4 vs 5	5 vs 6	6 vs 7	7 vs 8	8 vs 9
difference	355830	808815	807660	700287	5910663	1.7153×10^7	2.8537×10^7