Project 1 Raktim Biswas

Approximations of y(1)

	Euler's	Huen's	RK4th	AB4th
h=0.1	0.678213	0.666926	0.666667	
h=0.05	0.672224	0.666740	0.666667	
h=0.025	0.669393	0.666686	0.666667	
h=0.0125	0.668017	0.666672	0.666667	

Relative errors of approximations of y(1)

	Euler's	Huen's	RK4th	AB4th
h=0.1	1.731992	0.038927	0.000008	
h=0.05	0.833592	0.010932	0.000000	
h=0.025	0.409004	0.002872	0.000000	
h=0.0125	0.202590	0.000735	0.000000	

We observe for Euler's method that the error decreases by about ½ since it's a 1st order method. Huen's method is 2nd order, so the error decreases by about ¼. Given the accuracy of 4th order RK, we can't even tell that we receive any errors for any of our step sizes besides the largest h, although we can infer the error decreases by about 1/16. It's interesting to note that for Euler's method the relative error of each y_i initially increases rapidly, levels out, then decrease until the final approximation; the relative error for the final approximation is not the worst relative error though it is not the best relative error compared to the earlier y_i since we observe that the relative error increases for about 2/3 of the interations. For Huen's method the relative error is slightly more consistent as it steadily increases with each y_i for the 2 smallest h, although we see some variance for the largest 2 h. For 4th

order RK we briefly observe similar behavior of the relative errors to that of Euler's method for the largest h.

References

https://pythonnumericalmethods.berkeley.edu/notebooks/chapter22.03-The-Euler-Method.html

https://www.youtube.com/watch?v=uJXs4ICg95g&list=PLOpuotr4uJanMUBomGSIxmpyu-dGM8hnd&index=6

http://home.cc.umanitoba.ca/~farhadi/Math2120/Multistep%20Methods.pdf