

Aero 320: Numerical Methods

Lab Assignment 2

Fall 2013

Problem 1

Truncation and round-off error: computing the derivative of a function

Consider the function $f(x) = \exp(100x)$.

(a) By hand, calculate the *exact* value of $f'(x)$ evaluated at $x = 0$.

(b) Write a program to compute the *approximate* value of $f'(x)$ evaluated at $x = 0$, using the following approximation of the derivative:

$$f'(x) \approx \lim_{h \rightarrow 0} \frac{f(x+h) - f(x)}{h}$$

for different choices of h , given by $h = 2^{-k/4}$, where k varies from 20 to 200. Output the relative error for different choices of h , in a file.

Sample code for writing data to a file:

```
#include<iostream>
#include<fstream>
using namespace std;
int main(){
int x = 2;
ofstream myfile;
myfile.open("filename.dat");
myfile << x;
myfile.close();
return 0;}
```

(c) Load your data file in MATLAB, and plot the relative error as a function of h . What

are your conclusions from this plot?

(d) Compare your results for single precision and double precision arithmetic. For what values of h does the truncation error dominate? For what values of h does the round-off error dominate?