MATH 3043, Numerical Analysis I
Fall 2020

Lab 5

This lab will have you implementing divided differences to construct interpolating polynomials and to generate approximations for function values.

Solutions must be submitted on Canvas by **October 18** at **11:59 PM**. Please submit a single script file `Lab5Lastname.m` and the corresponding published file `Lab5Lastname.pdf` (for example, my submitted files would be `Lab5Zumbrum.m` and `Lab5Zumbrum.pdf`). Each solution should

- be contained in a separate cell which includes the problem number and short problem description,
- run independent of other cells,
- be adequately commented.

1. (a) Use divided differences to construct the interpolating polynomial of degree at most three for the following data:

x	$f(x)$
-0.10	17.3000
0.00	2.0000
0.20	5.1900
0.30	1.0000

   (b) Approximate $f(0.1)$ and $f(0.4)$ using the interpolating polynomial.

   (c) Plot the data (using red circles) and the interpolating polynomial (using a solid black line) for $x \in [-0.2, 0.5]$ in the same figure.

   (d) Add $f(0.05) = 3.1250$ to the data, construct the interpolating polynomial of degree at most four, and approximate $f(0.1)$ and $f(0.4)$.

   (e) Create a new plot that includes the data (using red circles), the interpolating polynomial from (a) (using a solid black line), and the interpolating polynomial from (d) (using a solid blue line).

   Note: It would be useful to implement divided differences with a function that accepts vectors for the x values and function values and outputs the vector of coefficients of the interpolating polynomial!

2. The fastest time ever recorded in the Kentucky Derby was by a horse named Secretariat in 1973. He covered the $1\frac{1}{4}$ mile track in 1:59.4 (one minute and 59.4 seconds). Times at the quarter-mile, half-mile, and mile poles were 0:25.2, 0:49.2, and 1:36.4. Use interpolation to predict the time at the three-quarter mile pole and compare this to the actual time of 1:13.

3. Use divided differences to determine the degree of the polynomial that interpolates the following function data:

x	$f(x)$
0	0
1	-2
2	-8
3	0
4	64
5	250
6	648
7	1372