ChEE 201
Computer Homework 4

You need to have read Computer Handout 4 before attempting this homework.

This homework will have you:
1) use the Taylor series approximation to estimate functions
2) demonstrate you know how to use approximate relative error as a stopping criteria for your approximations

Note: None of this homework assignment should be done in VBA. You are asked to calculate everything by hand or with a calculator and no programming is required. Only hardcopies of your solutions are needed on the due date.

1) Estimate ln(2) choosing x_i as 1. Make a table in Excel like in Reading 4 that has the number of terms that have been included and the absolute relative error. Include enough terms that you reach an absolute relative error magnitude less than 0.01.

We can return to our template from Reading 4 and begin by filling that in:

$x_{i+1} = 2$	$x_i = 1$
$f(x) = \ln x$	evaluated at $x_i = 0$
$f'(x) = 1/x = x^{-1}$	evaluated at $x_i = 1$
$f''(x) = -x^{-2}$	evaluated at $x_i = -1$
$F^{(3)}(x) = 2x^{-3}$	evaluated at $x_i = 2$

Taylor series and the terms:

$$f(x_{i+1}) \approx f(x_i) + \frac{f'(x_i)}{1!}(x_{i+1} - x_i) + \frac{f''(x_i)}{2!}(x_{i+1} - x_i)^2 + \cdots + \frac{f^{(n)}(x_i)}{n!}(x_{i+1} - x_i)^n$$

$$f(x_{i+1}) \approx 0 + 1(2-1) - \frac{1}{2!}(2-1)^2 + \frac{2}{1^3}\frac{1}{3!}(2-1)^3 - \frac{2(3)}{1^4}\frac{1}{4!}(2-1)^4 + \frac{2(3)4}{1^5}\frac{1}{5!}(2-1)^5 + \cdots$$

$$f(x_{i+1}) = 1 - \frac{1}{2} + \frac{2}{6} - \frac{2(3)}{4!} + \frac{4!}{5!} + \cdots = 1 - \frac{1}{2} + \frac{1}{3} - \frac{1}{4} + \frac{1}{5}\cdots$$

You should look for an infinite series trend like those encountered in class to write your own infinite series to describe this slowly convergent series. Write the first 3-5 terms and look for a pattern. Report your infinite sum that you develop for full credit.

To Be Evaluated Solution: The infinite sum could be written as:

$$\sum_{i=1}^{n} (-1)^{n+1}\left(\frac{1}{n}\right)$$

It takes **722** terms to have this function converge to a final value where the true relative error is less than 0.001. The **true error here is -0.003436386. (or 146 to get to 0.01).**