ChE 263
Assignment #4

Download "HW4.xlsx" to do your assignment. The assignment is due midnight before the beginning of the next class period. Complete each question in the appropriate worksheet (e.g. Problem 1 in "Problem 1" worksheet).

1.

Heart rate data (Beats per minute or BPM) as a function of time (sec) for a twenty-minute period of constant exertion is found on the "Problem 1" worksheet of the workbook. The time of each measurement, in seconds, in listed in column A, and the measured heart rate, in beats per minute, in column B. Using Excel:

a. Determine the values of c_0, c_1, c_2, and c_3 that result in the best fit of the data to the following equation:

$$BPM = c_0 + c_1 t - c_2 e^{-c_3 t}$$

b. Plot the raw data and data generated using the approximating function above (BPM vs time (sec).

c. Calculate the R^2 value for the fit. Is the fit good?

Hints:

- Providing good guess values is the key to getting this fit to solve.
  - C_0 and C_2 on the order of 50 to 200, C_1 and C_3 on the order of 0.01
- To verify you have solved correctly or to obtain good guess values, plot the data and the function *before* you try to use the Solver.
- Think about how large each constant should be based upon what it is multiplied by.
- You should get an $R^2 > 0.98$

2.

The worksheet "Problem 2" contains data for the response of a *first order system with time delay*. Such data is used to create control devices to keep operations running correctly. (You will learn about this in ChEn 436, Process Control and Dynamics.)

a. Find the constants, τ and θ, in the equation

$$y(t) = 5\left[1 - \exp\left(-\frac{(t-\theta)}{\tau}\right)\right] S(t-\theta)$$

where

$$S(t-\theta) = \begin{Bmatrix} 0 & when\ t < \theta \\ 1 & when\ t \geq \theta \end{Bmatrix}$$

best fit the process control data, y(t).

b. Make a chart showing the data (as points) and the fit (as a line).

c. Determine the R^2-value of the fit.

d. Which of the functions available with Excel's Trendline feature best fit the data? How many constants are used to achieve this fit? What is its R^2-value?

Hints:

- You will need to use an *if* function for this problem. (e.g IF(B7<theta,0,1)) and you can use the If function or other functions in an equation (e.g. =5*10/100*IF(A1>200,5,1)). Use the function button or help to understand what each term in the If function represents and how it works.

3.

In Worksheet "Problem 3" create 1000 random numbers with a Poisson distribution using a lambda of 1. Using bins: (0,1,2,3,4,5) determine the frequency at which a number appears and plot this with a column plot (frequency vs. bin).