

Engineering Models II: Homework #6

Problem 1: Use the Symbolic toolbox in MATLAB to compute the following integrals.
Include your MATLAB statements and MATLAB output. In the case of the definite integrals, convert the symbolic answer into a decimal number rather than a symbolic constant.

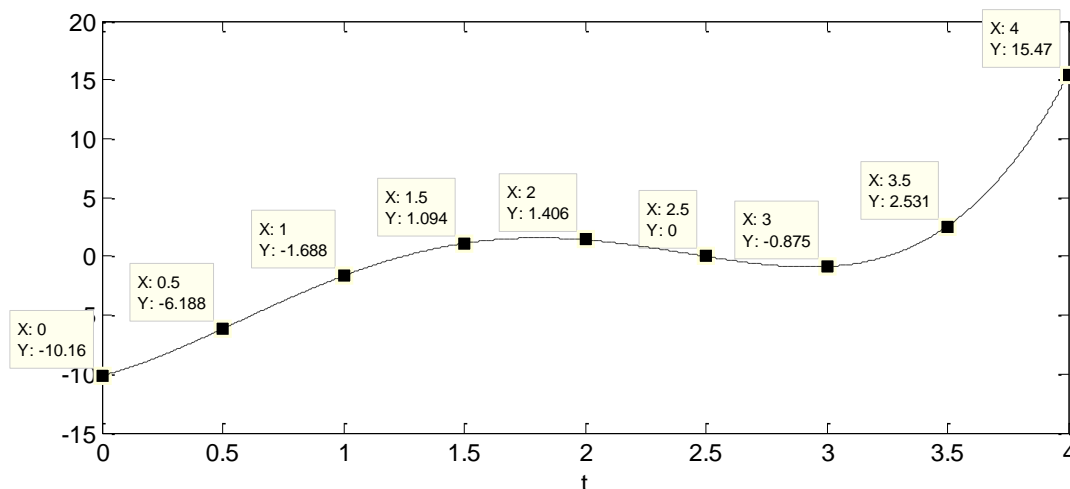
(a) $\int x e^{-3x} dx$

(b) $\int_0^6 x e^{-3x} dx$

(c) $\int \sqrt{144 - t^2} dt$

(d) $\int_1^5 \sqrt{144 - t^2} dt$

Problem 2: Use the data points shown below and the trapezoidal rule to estimate the integral of the curve shown below from $t = 0$ to 4. **Be sure to clearly show your calculations – don't just give an answer.**



Problem 3: Repeat Problem 2 using Simpson's Rule to estimate the integral of the curve from $t = 0$ to 4. **Be sure to clearly show your calculations – don't just give an answer.**

Problem 4: The equation for the curve shown in the graph for Problem 2 is:

$$f(t) = t^4 - 6t^3 + 8.3125t^2 + 5.1563t - 10.1563$$

- (a) Calculate the actual value of the integral from $t = 0$ to 4.
- (b) Calculate the percent error using the trapezoidal rule estimate from Problem 2:

$$\% \text{ Error} = \left| \frac{\text{Actual} - \text{Estimated}}{\text{Actual}} \right| * 100\%$$

- (c) Calculate the percent error using the Simpson's rule estimate from Problem 3.
- (d) How can you improve the accuracy of the integral estimate using either the trapezoidal estimate or Simpson's Rule?

Problem 5: Download HW6.mat from the metacourse site and save it in your current folder in MATLAB. Execute the command: `>> load HW6`.

HW6.mat consists of two dataset arrays:

- CVG which consists of 30 years of weather data from CVG airport (used in Lab2 and HW2).
- Current which consists of the data from Dr. Talaga. This dataset is slightly different than the one used in Lab 7 – July 8th is eliminated since there was a nine hour gap in the data and I added a column for Energy (same as we did in Lab 7) so you don't have to do that part all over again.

- (a) Calculate the daily energy usage in kWh in August (should be pretty easy since you did this in Lab 7).

MATLAB Commands (or submit script):

- (b) Use the CVG dataset to *find* the daily high temperatures (TMAX) in August and save these temperatures in a vector.

MATLAB Commands (or submit script):

- (c) Now plot the daily energy usage in August (y-axis) vs. the daily high temperature (x-axis). Be sure to include labels (with units) and a title.

- (d) Use Basic Fitting (under Tools) to "fit" a line to the data then paste the plot in the space below.

MATLAB PLOT (Leave Plot Open for Part (f)):

- (e) Do you see any general trend between the energy used on a particular day and the high temperature for that day? Do you notice any data points that don't seem to fit well?

(f) Use Data Statistics (under Tools) to determine the following from your plot:

Mean Daily Energy Usage in August: _____

Standard Deviation in Energy Usage in August: _____

Maximum Energy Used in a single day in August: _____

Minimum Energy Used in a single day in August: _____

Mean High Temperature in August: _____

Standard Deviation of High Temperature in August: _____

Problem 6: Use the same datasets from Problem 5.

(a) Calculate the daily energy usage in kWh in November.

MATLAB Commands (or submit script):

(b) Use the CVG dataset to *find* the daily low temperatures (TMIN) in November and save these temperatures in a vector.

MATLAB Commands (or submit script):

(c) Now plot the daily energy usage in November (y-axis) vs. the daily low temperature (x-axis). Be sure to include labels (with units) and a title.

(d) Use Basic Fitting (under Tools) to “fit” a line to the data then paste the plot in the space below.

MATLAB PLOT (Leave Plot Open for Part (f)):

(e) Do you see any general trend between the energy used on a particular day and the low temperature for that day? Do you notice any data points that don’t seem to fit well?

(f) Use Data Statistics (under Tools) to determine the following from your plot:

Mean Daily Energy Usage in November: _____

Standard Deviation in Energy Usage in November: _____

Maximum Energy Used in a single day in November: _____

Minimum Energy Used in a single day in November: _____

Mean Low Temperature in November: _____

Standard Deviation of Low Temperature in November: _____