ENCP 100 WS2020

Assignment 03

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X61L — 01/30/20 and 2:00 P.M.

ANSWERS FOR QUESTION 1:

Question	Value
a	a = -3 -7 5 3 -13 4
b	b = 3.0000 13.0000 7.2832
c	c = 7.8496 20.4911 10.4248
d	d = 19.1416
e	e = 8.5000
f	f = 8.6603
g	g = 18.9911 -16.7080 22.0000
h	h = 19.1416
i	i = 0.2157 -0.1961 -0.0784 -0.4706 -0.1176 0.3529 0.6667 0.6667 -0.3333
j	j = -25.5000
k	k = 1.0000 -0.0000 0.0000 0 1.0000 0.0000 -0.0000 0 1.0000
l	l = 2 3

MATLAB CODE FOR QUESTION 1:

```
clear all; clc; close all;

A = [5; 7; 1];

B = [-1, 3, pi];

C = [ -1, 3, 9; 6, -4, 2];

D = [ 2, 10, 4; 3, 9, -2];

E = [5, 3, 2; -2, 0.5, 1; 6, 7, 3];

a = C - D
b = 2*B' + A
c = B*E
d = B*A
e = trace(E)
f = norm(A)
g = cross(A', B)
h = dot(A', B)
i = E^-1
j = det(E)
k = E*E^-1
l = size(D)
```

ANSWERS FOR QUESTION 2:

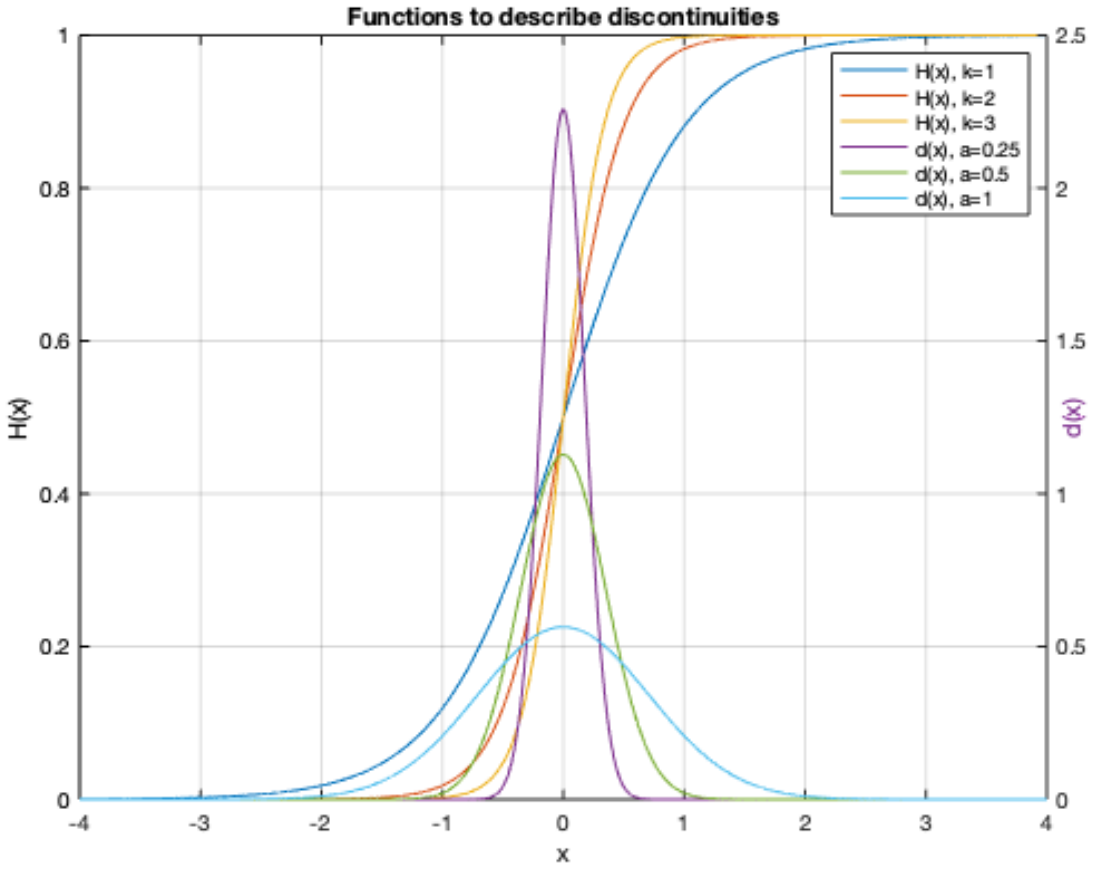
Question	Value
Total cost of all parts together	total_cost = 323.3958
Average material cost	avg_material_cost = 0.2007
Material cost of part with largest labour cost	max_labour_material_cost = 94.9500
Number of parts printed in 3 hrs or more	numParts = 3

MATLAB CODE FOR QUESTION 2:

```
clear all; clc; close all;


table = [ 50.05, 2, 0, 0, 0, 0, 0;...
    0.10, 53, 12.50, 0, 0, 0, 0;...
    2.50, 5, 23.99, 0, 0, 0, 0;...
    0, 0, 0, 0.02, 5.43, 7.50, 3;...
    0, 0, 0, 0.23, 2.21, 7.50, 5;...
    0, 0, 0, 0.42, 0.33, 10.55, 9;...
    0, 0, 0, 0.11, 0.43, 5.00, 1; ];


material_cost = table(:, 5).*table(:, 4);
labour_cost = table(:, 6).*table(:, 7);
printed_cost = material_cost + labour_cost;


purchased_cost = 1.07*table(:, 1).*table(:, 2) + table(:, 3);


total_cost = sum(printed_cost) + sum(purchased_cost)


avg_material_cost = mean(nonzeros(table(:, 5).*table(:, 4)))


[max_labour_cost , i] = max(labour_cost);


max_labour_material_cost = table(i, 6)*table(i, 7)


numParts = sum(table(:, 7)>=3)
```

ANSWERS FOR QUESTION 3:

Figure 1:



MATLAB CODE FOR QUESTION 3:

```
clear all; clc; close all;


x = -4:0.001:4;


k = [ 1, 2, 3 ];
a = [ 0.25, 0.5, 1 ];


Hx = 1./(1 + exp(-2*k(1)*x));
Hx1 = 1./(1 + exp(-2*k(2)*x));
Hx2 = 1./(1 + exp(-2*k(3)*x));
deltax = (1./(abs(a(1))*sqrt(pi))) * exp(-(x/a(1)).^2);
deltax1 = (1./(abs(a(2))*sqrt(pi))) * exp(-(x/a(2)).^2);
deltax2 = (1./(abs(a(3))*sqrt(pi))) * exp(-(x/a(3)).^2);


figure;


plotyy(x, [Hx; Hx1; Hx2], x, [deltax; deltax1; deltax2]);
% plot(x, [Hx; Hx1; Hx2; deltax; deltax1; deltax2]);
grid;
legend("H(x), k=1", "H(x), k=2", "H(x), k=3", "d(x), a=0.25", "d(x),
a=0.5", "d(x), a=1");
xlabel("x");


yyaxis left
ylabel("H(x)");


yyaxis right
ylabel("d(x)");
set(gca, 'YTick', []);


title("Functions to describe discontinuities");
```

ANSWERS FOR QUESTION 4:

Image: scatter.png

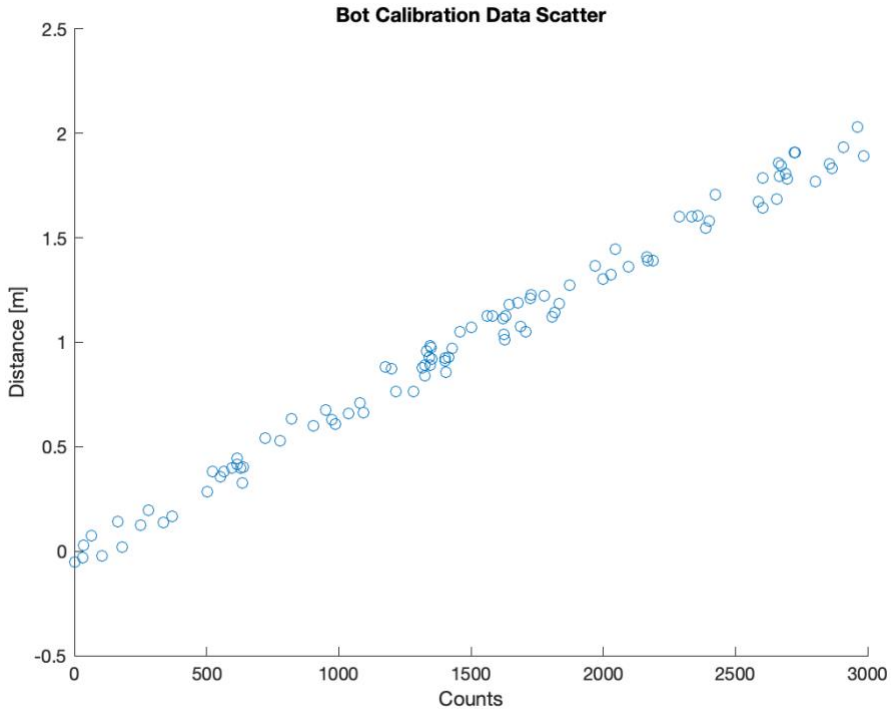
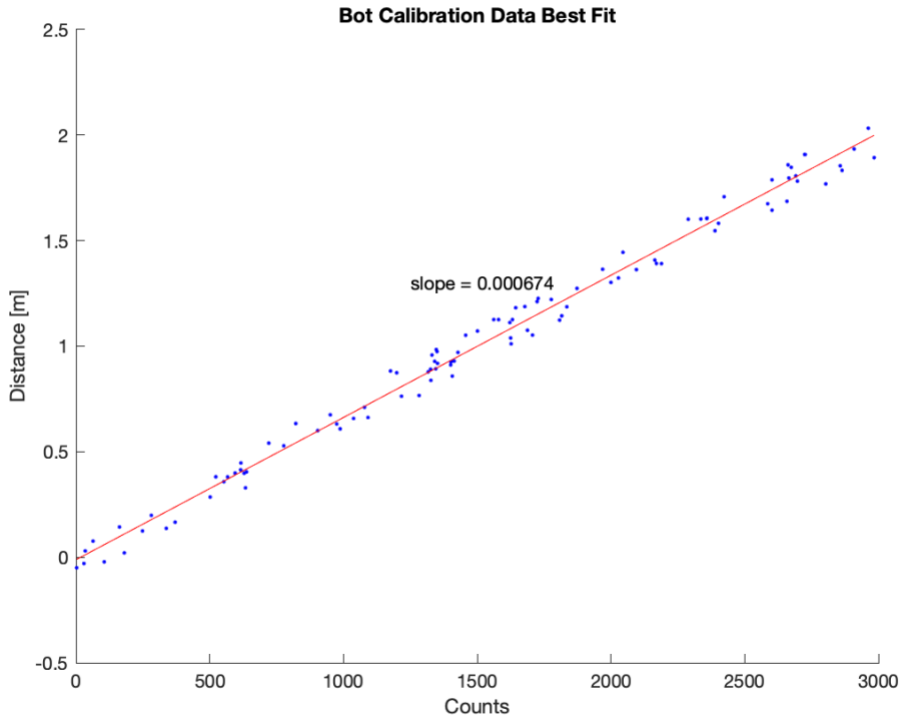


Image: bestFit.png



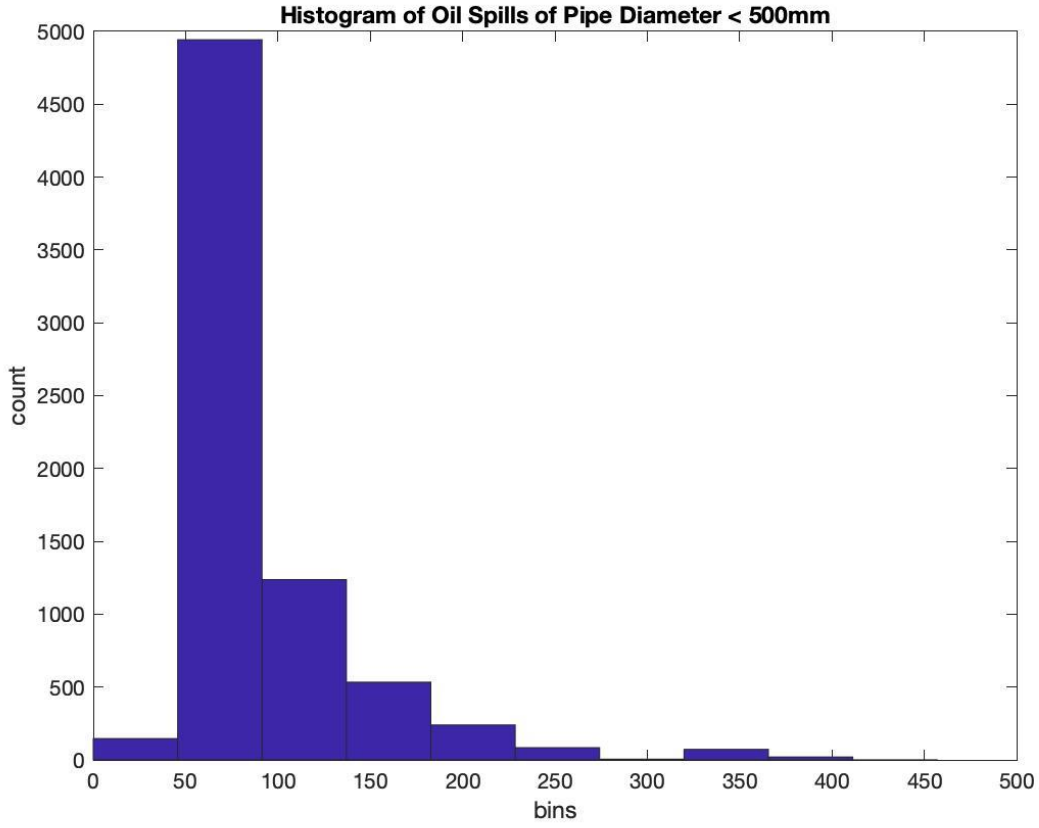
MATLAB CODE FOR QUESTION 4:

```
clear all; clc; close all;


% NOTE: .dat files were stored in a seperate directory
%       to keep my git repo organized.
data = csvread('data/botData.dat');
counts = data(:,1);
dist = data(:, 2);


figure;
scatter(counts, dist);
title("Bot Calibration Data Scatter");
xlabel("Counts");
ylabel("Distance [m]");


% NOTE: Images also stored in a seperate directory
%       because organization is key.
print -dpng img/scatter.png


figure;
scatter(counts, dist, '.b')


% Calculating and plotting the line of best fit
p = polyfit(counts, dist, 1);
f = polyval(p, counts);
hold on
plot(counts, f, '-r');


% Converting slope value to string and placing on plot
slope_text = sprintf("slope = %f", p(1));
text(1250, 1.3, slope_text);


title("Bot Calibration Data Best Fit");
xlabel("Counts");
ylabel("Distance [m]");


print -dpng img/bestFit.png
```

ANSWERS FOR QUESTION 5:

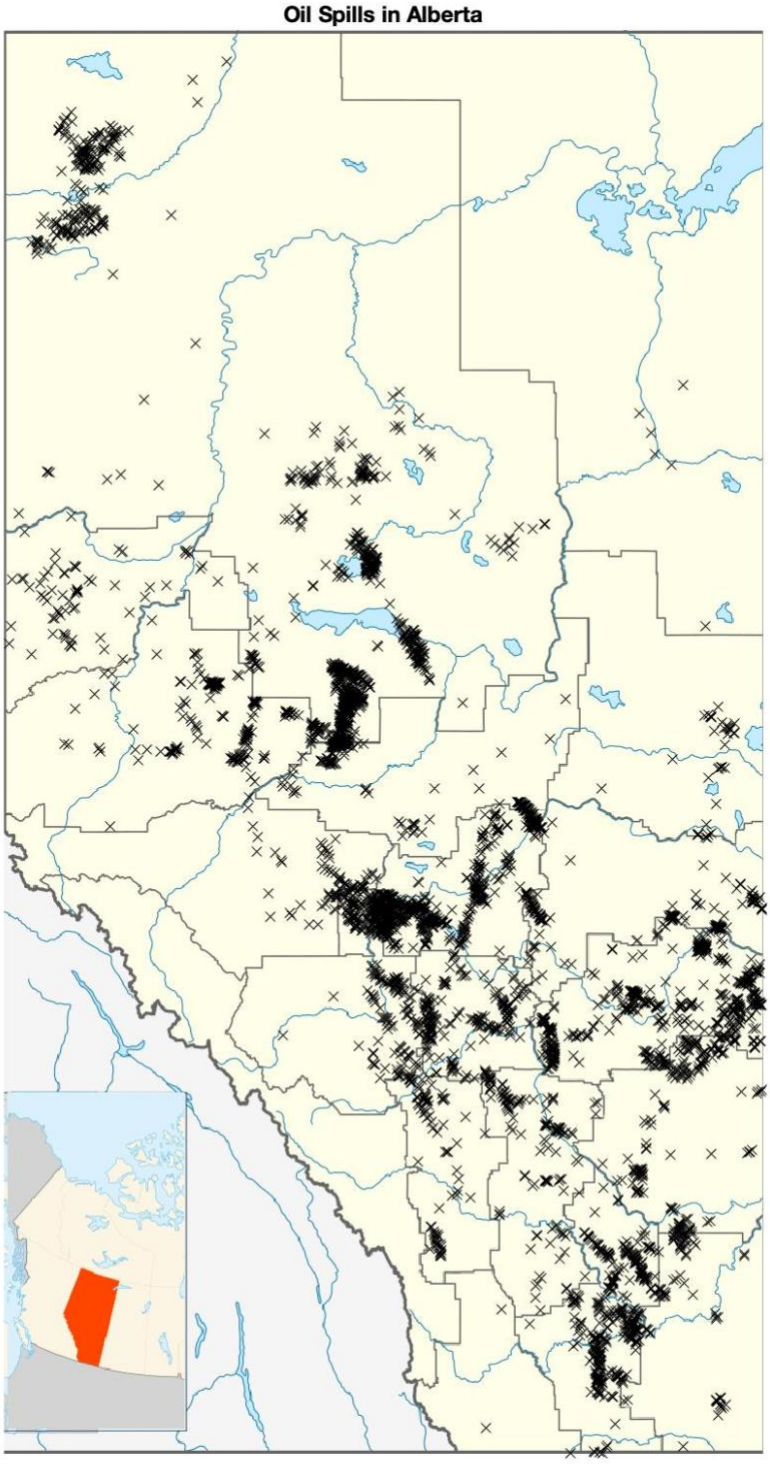
```
Total number of oil spills:                7319
Average oil spill size [m^3]:              12.46281
Total volume of oil spilled [m^3]:         91215.30
Range of spill sizes:                      0 - 6500
Year with maximum oil spill:               1980
Number of spills larger than 1000 m^3:     12
```

Image: hist.jpeg



ANSWERS FOR QUESTION 5 (cont'd):

Image: image02.jpeg



MATLAB CODE FOR QUESTION 5:

```
clear all; clc; close all;
data = csvread("data/oilSpillData.dat");

% Determine # of oil spills
num_of_spills = length(data(:,1));
fprintf("Total number of oil spills:                %d\n", num_of_spills);

% Determine average spill size
avg_spill_size = mean(data(:, 5));
fprintf("Average oil spill size [m^3]:              %.5f\n", avg_spill_size);

% Determine total volume of oil spilled
total_spill_vol = sum(data(:, 5));
fprintf("Total volume of oil spilled [m^3]:         %.2f\n", total_spill_vol);

% Determine range of spill sizes
spill_range = [min(data(:, 5)), max(data(:, 5))];
spill_range2 = range(data(:, 5));
fprintf("Range of spill sizes:                      %d - %d\n", spill_range(1),
spill_range(2));

% Determine year of max oil spill
[m, i] = max(data(:, 5));
max_year = data(i, 1);
fprintf("Year with maximum oil spill:               %d\n", max_year);

% Determine number of oil spills larger than 1000m^3
large_spills = sum(data(:, 5) > 1000);
fprintf("Number of spills larger than 1000 m^3:     %d\n", large_spills);

% Create histogram of spills with pipe diameters less than 500mm
hist_data = [];
for i = 1:length(data(:, 4))
   if data(i, 4) < 500
       hist_data = [hist_data data(i, 4)];
   end
end
figure;
hist(hist_data);
title("Histogram of Oil Spills of Pipe Diameter < 500mm");
xlabel("bins");
ylabel("count");

print -djpeg img/hist.jpeg

% Create scatter plot of longitude vs lattitude
lon = data(:, 6);
lat = data(:, 7);
figure;
ab_map = imread("data/albertaMap.png");
imshow(ab_map);
title("Oil Spills in Alberta");
longNew = 75*(lon + 120);
latNew = (1406/11)*(60 - lat);
hold on
scatter(longNew, latNew, 'xk');
```

```
print -djpeg img/image02.jpeg
```