4.

(1) Histogram of the Salman and Seabass lightness

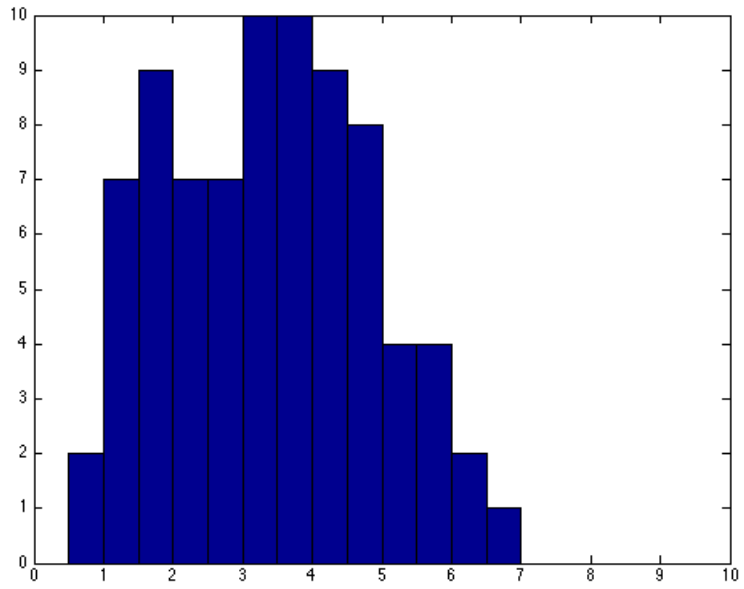

Figure 1: Salmon lightness histogram

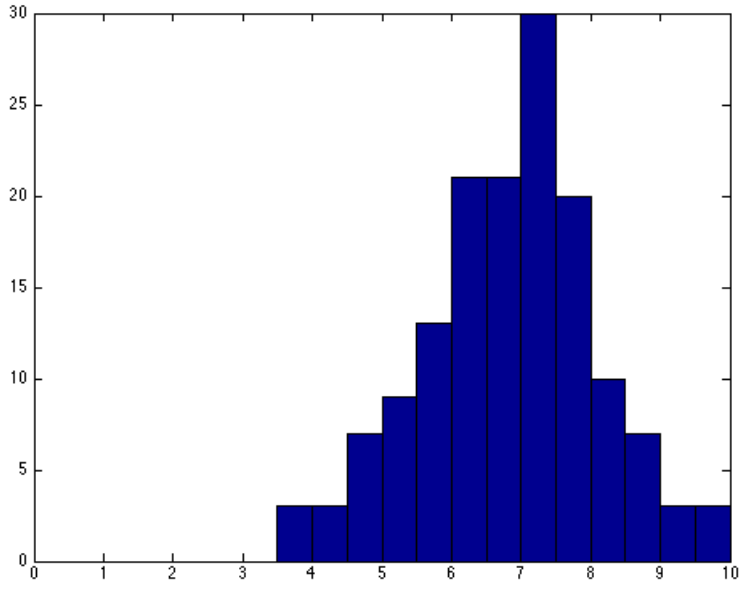

Figure 2: Seabass lightness histogram

(2) $P(salmon) = 0.34783$ and $P(seabass) = 0.65217$.

(3) Plots of $P(lightness|salmon)$ and $P(lightness|seabass)$

$P(lightness|salmon)$ = [0, 0.0250, 0.0875, 0.1125, 0.0875, 0.0875, 0.1250, 0.1250, 0.1125, 0.1000, 0.0500, 0.0500, 0.0250, 0.0125, 0, 0, 0, 0, 0, 0]

$P(lightness|seabass)$ = [0, 0, 0, 0, 0, 0, 0, 0.0200, 0.0200, 0.0467, 0.0600, 0.0867, 0.1400, 0.1400, 0.2000, 0.1333, 0.0667, 0.0467, 0.0200, 0.0200]

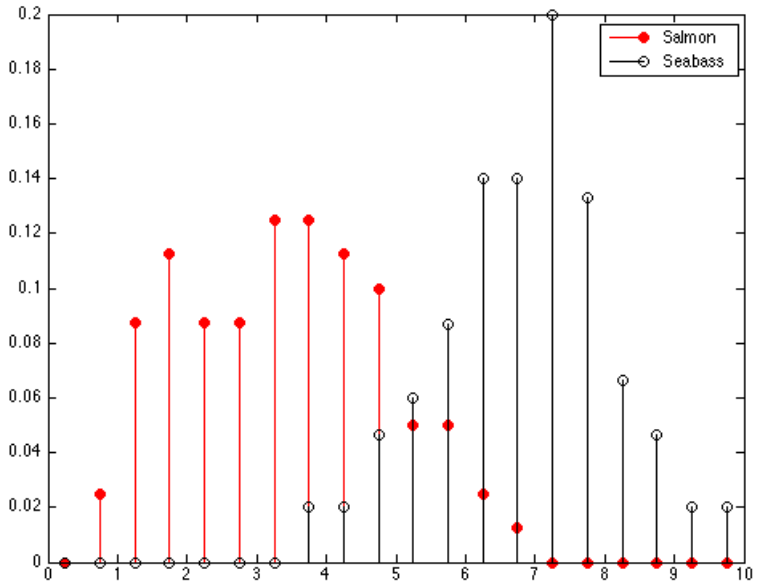

Figure 3: P(lightness|salmon) and P(lightness|Seabass)

(4) Compute probabilities:

$P(lightness \leq 5|salmon) = 0.8625$ and $P(lightness \leq 8|salmon) = 1$

$P(lightness \geq 5|seabass) = 0.91333$ and $P(lightness \geq 2|seabass) = 1$

(5) Plot of the evidence pmf P(lightness)

$P(lightness)$ = [0, 0.0087, 0.0304, 0.0391, 0.0304, 0.0304, 0.0435, 0.0565, 0.0522, 0.0652, 0.0565, 0.0739, 0.1000, 0.0957, 0.1304, 0.0870, 0.0435, 0.0304, 0.0130, 0.0130]

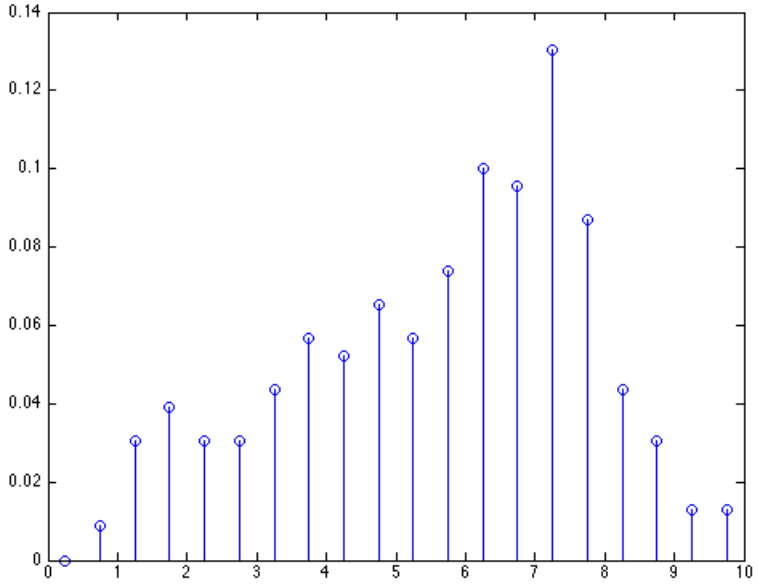

Figure 4: P(lightness)

(6) Plot the posterior probabilities $P(salmon|lightness)$ and $P(seabass|lightness)$

$P(salmon|lightness)$ = [0, 1.0000, 1.0000, 1.0000, 1.0000, 1.0000, 1.0000, 0.7692, 0.7500, 0.5333, 0.3077, 0.2353, 0.0870, 0.0455, 0, 0, 0, 0, 0, 0]

$P(seabass|lightness)$ = [0, 0, 0, 0, 0, 0, 0, 0.2308, 0.2500, 0.4667, 0.6923, 0.7647, 0.9130, 0.9545, 1.0000, 1.0000, 1.0000, 1.0000, 1.0000, 1.0000]

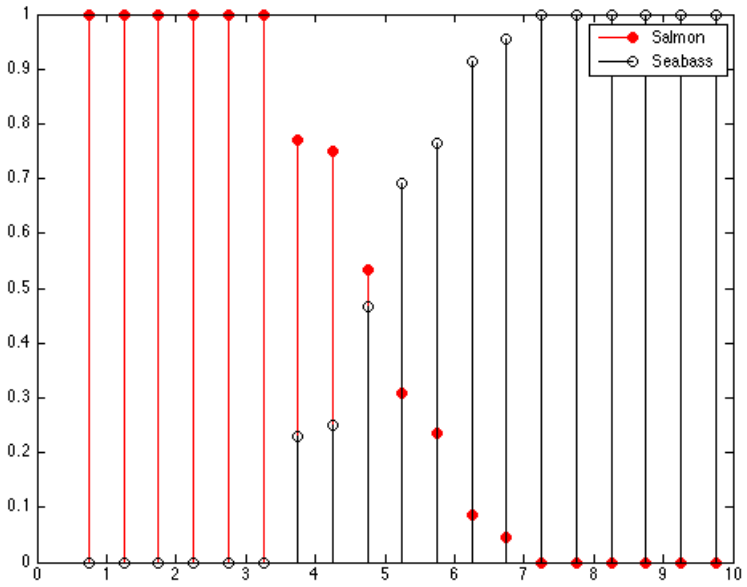

Figure 5: Posterior probabilities

Appendix:

assignment_1.m

```
%
% CS7720 Spring 2015
% Introduction to Machine Learning and Pattern Recognition
% University of Missouri-Columbia
%
% Author: Chanmann Lim
% email: cl9p8@mail.missouri.edu
%
% Homework Assignment 1
% Problem 4
%
clc; clear; close all;

salmon = load('SalmonLightness.dat');
seabass = load('SeabassLightness.dat');
xvalues = load('formathist.dat');

%
% 1 - Plot Salmon and Seabass histogram with the intervals of
%     [(k-1)*0.5, k*0.5], with k = 1,...,20
%
figure; hist(salmon, xvalues);
figure; hist(seabass, xvalues);

%
% 2 - Compute P(salmon) and P(seabass)
%
sample = length(salmon) + length(seabass);
P_salmon = length(salmon)/sample;
P_seabass = length(seabass)/sample;

disp(['P(salmon) = ' num2str(P_salmon), ...
 ' and P(seabass) = ' num2str(P_seabass)]);

%
% 3 - Plot conditional probability P(lightness|salmon) and
%     P(lightness|seabase) pmf
%
P_lightness_given_salmon = hist(salmon, xvalues)'/length(salmon);
P_lightness_given_seabass = hist(seabass, xvalues)'/length(seabass);

disp('P(lightness|salmon) = '); disp(P_lightness_given_salmon);
disp('P(lightness|seabass) = '); disp(P_lightness_given_seabass);

figure;
stem(xvalues, P_lightness_given_salmon, 'filled', 'r'); hold on;
stem(xvalues, P_lightness_given_seabass, 'k'); hold off;
legend('Salmon', 'Seabass');

%
% 4 - Compute:
%     P(lightness<=5|salmon) and P(lightness<=8|salmon)
%     P(lightness>=5|sea_bass) and P(lightness>=2|sea_bass)
%
P_lightness_less_equal_5_given_salmon = sum(P_lightness_given_salmon(xvalues<=5));
P_lightness_less_equal_8_given_salmon = sum(P_lightness_given_salmon(xvalues<=8));

disp(['P(lightness<=5|salmon) = ' num2str(P_lightness_less_equal_5_given_salmon), ...
 ' and P(lightness<=8|salmon) = ' num2str(P_lightness_less_equal_8_given_salmon)]);

P_lightness_grater_equal_5_given_seabass = sum(P_lightness_given_seabass(xvalues>=5));
P_lightness_grater_equal_2_given_seabass = sum(P_lightness_given_seabass(xvalues>=2));

disp(['P(lightness>=5|seabass) = ' num2str(P_lightness_grater_equal_5_given_seabass), ...
 ' and P(lightness>=2|seabass) = ' num2str(P_lightness_grater_equal_2_given_seabass)]);

%
% 5 - Plot the evidence pmf P(lightness)
%
```

```
P_lightness = P_lightness_given_salmon * P_salmon + P_lightness_given_seabass * P_seabass;
disp('P(lightness) = '); disp(P_lightness);
figure; stem(xvalues, P_lightness);

%
% 6 - Plot posterior probabilities
%
P_salmon_given_lightness = P_lightness_given_salmon * P_salmon ./ P_lightness;
P_seabass_given_lightness = P_lightness_given_seabass * P_seabass ./ P_lightness;

disp('P(salmon|lightness)'); disp(P_salmon_given_lightness);
disp('P(seabass|lightness)'); disp(P_seabass_given_lightness);

figure;
stem(xvalues, P_salmon_given_lightness, 'filled', 'r'); hold on;
stem(xvalues, P_seabass_given_lightness, 'k'); hold off;
legend('Salmon', 'Seabass');
```