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**Assignment 5**

***Part 1***

1. P(University, Major | Salary = 120)

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| **P(U,M|S=120)** | **University** | |
| **Major** | **Metro(=0)** | **Cu(=1)** |
| **Business(=0)** | **0.0141** | **0.2213** |
| **Compsci(=1)** | **0.0078** | **0.7568** |

1. P(University, Major | Salary = 60)

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| --- | --- | --- |
| **P(U,M|S=60)** | **University** | |
| **Major** | **Metro(=0)** | **Cu(=1)** |
| **Business(=0)** | **0.3662** | **0.3464** |
| **Compsci(=1)** | **0.0452** | **0.2422** |

1. P(University, Major | Salary = 20)

|  |  |  |
| --- | --- | --- |
| **P(U,M|S=20)** | **University** | |
| **Major** | **Metro(=0)** | **Cu(=1)** |
| **Business(=0)** | **0.9825** | **0.0081** |
| **Compsci(=1)** | **0.0089** | **5.4002e-04** |

1. The probability of a student studying at Metro is high until the student IQ level is below 100, but the probability of a student with IQ level below 100 and studying computer science is quite low. This is the reason for posterior probability of an individual being a CompSci major at Metro is low.

mu = zeros(1,100000);

s = zeros(1,100000);

for salary = [120 60 20]

for j = 1:100000

I = 100 + randn\*15;

M = rand < 1/(1+exp(-(I-110)/5));

U = rand < 1/(1+exp(-(I-100)/5));

mu(j) = str2double(strcat(num2str(M),num2str(U)));

S = gampdf(salary, (.1 \* I) + M + (3 \* U),5);

s(j) = S;

end

denominator = sum(s);

fprintf('Salary= %d\n' , salary);

for i = [0 1 10 11]

disp(sum(s(mu == i))/denominator);

end

end

***Part 2***

1. Initialization I chose = {sampleX2 = 3}
2. Burn-in duration = 1000
3. Number of samples obtained from each chain = 100000

noOfSamples = 100000;

burnIn = 1000;

mu = [1 0];

sigmaXSquare = 1;

sigmaYSquare = 3;

correlationXY = -0.5;

sampleX2 = 3;

X1 = zeros(1,noOfSamples);

X2 = zeros(1,noOfSamples);

for i = 1:(noOfSamples + burnIn)

sampleX1 = normrnd( (mu(1) + ((correlationXY/sigmaYSquare) \* (sampleX2 - mu(2))) ), sqrt(sigmaXSquare - ((correlationXY^2)/sigmaYSquare)) );

sampleX2 = normrnd( (mu(2) + ((correlationXY/sigmaXSquare) \* (sampleX1 - mu(1))) ), sqrt(sigmaYSquare - ((correlationXY^2)/sigmaXSquare)) );

if(i > burnIn)

X1(i-burnIn) = sampleX1;

X2(i-burnIn) = sampleX2;

end

end

figure(1)

histogram(X1,40,'Normalization','pdf')

hold on

y = -6:0.1:6;

f = normpdf(y,mu(1), sqrt(sigmaXSquare));

plot(y,f,'LineWidth',2)

figure(2)

histogram(X2,90,'Normalization','pdf')

hold on

y = -10:0.1:10;

f = normpdf(y,mu(2),sqrt(sigmaYSquare));

plot(y,f,'LineWidth',2)

**P(x1)**



**P(x2)**



***Part 3***

nsamples = 100000;

smpl = zeros(nsamples,2);

s = 0.9;

proppdf = @(x,y) unifpdf(y-x,-s, s);

proprnd = @(x) x + rand\*2\*s - s;

for i = 1:nsamples

pdf = @(x)(((x>=0)&(x<=1))\* (x.^3));

smpl(i,1) = mhsample(rand,1,'pdf',pdf,'proprnd',proprnd,'proppdf',proppdf);

pdf = @(x) (((x>=0) & (x<=1)) \* (1 - abs(x-smpl(i,1))));

smpl(i,2) = mhsample(rand,1,'pdf',pdf,'proprnd',proprnd,'proppdf',proppdf);

end

covarianceFG = cov(smpl(:,1),smpl(:,2));

expFG = ((sum(smpl(:,1))/nsamples) \* (sum(smpl(:,2))/nsamples)) + covarianceFG(1,2);

disp(expFG);

binEdges = 0:.05:1;

N = hist3(smpl, 'Edges', {binEdges binEdges});

pcolor(binEdges, binEdges, N);

ylabel('F');

xlabel('G');

axis square



Expected Value E (FG) = 0.3057