y1 = {[607, 583, 521, 494, 369],...

[782, 570, 678, 467, 620],...

[425, 395, 346, 361, 310, 300, 382, 294, 315],...

[323],...

[421, 339, 398, 328, 335, 291, 329, 310, 294, 321, 286, 349, 279, 268, 293, 310],...

[259, 241, 243, 272, 247, 275, 220, 245, 268],...

[357, 273, 301, 322, 276],...

[401, 368, 149, 507, 411],...

[362, 358, 355, 362, 324],...

[332, 268, 259, 274, 248, 254, 242, 286, 276, 237, 259, 251, 239, 247, 260, 237, 206, 242],...

[361, 267, 245, 331, 357, 284, 263, 244, 317, 225, 254, 253, 251, 314, 239, 248, 250, 200, 256, 233],...

[427, 391, 331, 395, 337, 392, 352, 381, 330, 368, 381, 316, 335, 316, 302, 375, 361, 330, 351, 186],...

[221, 278, 244, 218, 126, 269, 238, 194, 384, 154],...

[555, 387, 317, 365, 357, 390, 320, 316, 297, 354, 266, 279, 327],...

[285, 258, 267, 226, 237, 264],...

[510, 490, 458, 425, 522],...

[927, 555, 550, 516, 548],...

[560, 545, 633, 496, 498],...

[223, 222, 309, 244, 207],...

[258, 255, 281, 258, 226, 257, 263, 266, 238, 249, 340, 247, 216, 241, 239, 226, 273, 235, 251, 290],...

[473, 416, 451, 475, 406, 349, 401, 334, 446, 401],...

[252, 266, 210, 228, 250, 265, 236, 289, 244, 327, 274, 223],...

[327, 307, 338, 345, 381, 369, 445, 296, 303, 326],...

[321, 309, 307, 319, 288, 299, 284, 278, 310, 282, 275, 372, 295, 306, 303, 285, 316, 294, 284, 324],...

[264, 278, 369, 254, 306, 237, 439, 287, 285, 261, 299, 311, 265],...

[292, 282, 271, 268, 270],...

[259, 269, 249, 261, 425],...

[291, 291, 441, 222, 347, 244, 232, 272, 264],...

[190, 219, 317, 232, 256, 185, 210, 213, 202, 226],...

[250, 238, 252, 233, 221, 220],...

[287, 267, 264, 273, 304],...

[294, 236, 200, 219, 276],...

[287],...

[365, 438, 420, 396, 359, 405, 397, 383, 360, 387, 429, 358, 459, 371, 368, 452, 358, 371]};

y1=[y1{:}];

ind = [1, 1, 1, 1, 1, 2, 2, 2, 2, 2, 3, 3, 3, 3, 3, 3, 3, 3, 3, 4, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, ...

5, 5, 5, 5, 5, 5, 6, 6, 6, 6, 6, 6, 6, 6, 6, 7, 7, 7, 7, 7, 8, 8, 8, 8, 8, 9, 9, 9, 9, 9, 10,...

10, 10, 10, 10, 10, 10, 10, 10, 10, 10, 10, 10, 10, 10, 10, 10, 10, 11, 11, 11, 11, 11, 11, 11,...

11, 11, 11, 11, 11, 11, 11, 11, 11, 11, 11, 11, 11, 12, 12, 12, 12, 12, 12, 12, 12, 12, 12, 12,...

12, 12, 12, 12, 12, 12, 12, 12, 12, 13, 13, 13, 13, 13, 13, 13, 13, 13, 13, 14, 14, 14, 14, 14, ...

14, 14, 14, 14, 14, 14, 14, 14, 15, 15, 15, 15, 15, 15, 16, 16, 16, 16, 16, 17, 17, 17, 17, 17,...

18, 18, 18, 18, 18, 19, 19, 19, 19, 19, 20, 20, 20, 20, 20, 20, 20, 20, 20, 20, 20, 20, 20, 20,...

20, 20, 20, 20, 20, 20, 21, 21, 21, 21, 21, 21, 21, 21, 21, 21, 22, 22, 22, 22, 22, 22, 22, 22,...

22, 22, 22, 22, 23, 23, 23, 23, 23, 23, 23, 23, 23, 23, 24, 24, 24, 24, 24, 24, 24, 24, 24, 24,...

24, 24, 24, 24, 24, 24, 24, 24, 24, 24, 25, 25, 25, 25, 25, 25, 25, 25, 25, 25, 25, 25, 25, 26,...

26, 26, 26, 26, 27, 27, 27, 27, 27, 28, 28, 28, 28, 28, 28, 28, 28, 28, 29, 29, 29, 29, 29, 29,...

29, 29, 29, 29, 30, 30, 30, 30, 30, 30, 31, 31, 31, 31, 31, 32, 32, 32, 32, 32, 33, 34, 34, 34,...

34, 34, 34, 34, 34, 34, 34, 34, 34, 34, 34, 34, 34, 34, 34];

child = [1, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 1, 1, 1, 1, 0, 0, 0, 0, 1, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0];

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

ass5\_code = {

'data {'

' int<lower=0> I; '

' int<lower=0> J; '

' int<lower=0> y[I]; '

' int<lower=0> ind[I]; '

' int<lower=0> child[J]; '

'}'

'parameters {'

' real mu; '

' real<lower=0.0> tau;'

' real<lower=0.0> sigma;'

' real theta[J]; '

' real phi; '

'}'

'transformed parameters {'

'// no transformed variables to use'

'}'

'model {'

' mu~uniform(-10000,10000);'

' phi~uniform(-10000,10000);'

' sigma~uniform(0,10000);'

' tau~uniform(0,10000);'

' for (i in 1:I)'

' y[i] ~ lognormal(theta[ind[i]],sigma);'

' for (j in 1:J)'

' theta[j] ~ normal(mu+ phi\*child[j],tau);'

'}'

'generated quantities {'

' real<lower=0> ypred; '

' real<lower=0> theta\_pred;'

' theta\_pred = normal\_rng(mu, tau);'

' ypred = normal\_rng(theta\_pred, sigma);'

'}'

};

ass5\_dat = struct('I',length(y1),...

'J',max(ind),...,

'y',y1,...

'ind',ind,...

'child',child);

NSamples = 100000;

fit = stan('model\_code',ass5\_code,'data',...

ass5\_dat,'iter',NSamples,'chains',4);

fit.block();

print(fit)

paramExtracted = fit.extract('permuted',true);

mu=paramExtracted.mu; % this gives the mu of log(y)

sigma=paramExtracted.sigma;

theta=paramExtracted.theta;

tau=paramExtracted.tau;

phi=paramExtracted.phi;

% logPosterior=parmExtract['lp\_\_']

% PredictedTheta=parmExtract['theta\_pred']

% PredictedReactionTime=parmExtract['y\_pred']

%%%%%%%%%%%%%%%%%%% Visualize results %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

Adults = exp(mu+tau.^2/2+sigma.^2/2) %adults

Kids = exp(mu+phi+tau.^2/2+sigma.^2/2) %kids

% -------------------------------------- task 1 -----------------

% ---------------------------------------------------------------

%%

figure(1)

mean\_phi = mean(phi);

median\_phi= median(phi);

histogram(phi,50,'Normalization','pdf')

xlabel('phi');

title('The added effect of being a kid');

str = ['mean=',num2str(mean\_phi)];

text(mean\_phi+0.2,3,str)

% ---- Confidence interval (HDI) -----

credMass = 0.95;

HDI = HDIofMCMC(phi,credMass);

hdiLow = HDI(1);

hdiHigh = HDI(2);

% Additional stuff: To make Matlab figure look more like R figure

ax = axis;

yl = ax([3 4]);

ydiff = yl(2)-yl(1);

yl = [yl(1)-ydiff/20 yl(2)];

ylim(yl);

set(gca,'TickDir','out');

axis square;

% -------Display the HDI on hist plot----

hold on

plot(HDI,[0 0],'k-','LineWidth',4);

str = [num2str(100\*credMass,2) '% HDI'];

text(mean(HDI),ydiff/20+ydiff/20,str,'HorizontalAlignment','center');

str = num2str(HDI(1),4);

text(HDI(1),ydiff/20,str,'HorizontalAlignment','center');

str = num2str(HDI(2),4);

text(HDI(2),ydiff/20,str,'HorizontalAlignment','center');

%----------------

hold on

plot ([mean\_phi,mean\_phi],[0,8],'r','LineWidth',2)

str = ['mean=',num2str(mean\_phi)];

text(mean\_phi+10,0.052,str)

hold on

plot ([median\_phi,median\_phi],[0,8],'r','LineWidth',2)

str = ['median=',num2str(median\_phi)];

text(median\_phi+10,0.045,str)

hold off

figure(2)

histogram(mu,50,'Normalization','pdf')

mean\_mu = mean(mu);

median\_mu= median(mu);

str = ['mean=',num2str(mean\_mu)];

text(mean\_mu+0.1,6,str)

xlabel('mu');

title('The expected reaction time for adults');

% -------- Confidence interval (HDI) ------

credMass = 0.95;

HDI = HDIofMCMC(mu,credMass);

hdiLow = HDI(1);

hdiHigh = HDI(2);

% Additional stuff: To make Matlab figure look more like R figure

ax = axis;

yl = ax([3 4]);

ydiff = yl(2)-yl(1);

yl = [yl(1)-ydiff/20 yl(2)];

ylim(yl);

set(gca,'TickDir','out');

axis square;

% --------Display the HDI on hist plot----

hold on

plot(HDI,[0 0],'k-','LineWidth',4);

str = [num2str(100\*credMass,2) '% HDI'];

text(mean(HDI),ydiff/20+ydiff/20,str,'HorizontalAlignment','center');

str = num2str(HDI(1),4);

text(HDI(1),ydiff/20,str,'HorizontalAlignment','center');

str = num2str(HDI(2),4);

text(HDI(2),ydiff/20,str,'HorizontalAlignment','center');

%---------------------

hold on

plot ([mean\_mu,mean\_mu],[0,8],'r','LineWidth',2)

str = ['mean=',num2str(mean\_mu)];

text(mean\_mu+10,0.052,str)

hold on

plot ([median\_mu,median\_mu],[0,8],'r','LineWidth',2)

str = ['median=',num2str(median\_mu)];

text(median\_mu+10,0.045,str)

hold off

%% -----------------------Task 2 ----------------------

% ----------------------------------------------------

figure(3)

mean\_tau = mean(tau);

median\_tau= median(tau);

histogram(tau,50,'Normalization','pdf')

% ---- Confidence interval (HDI) -----

credMass = 0.95;

HDI = HDIofMCMC(tau,credMass);

hdiLow = HDI(1);

hdiHigh = HDI(2);

% Additional stuff: To make Matlab figure look more like R figure

ax = axis;

yl = ax([3 4]);

ydiff = yl(2)-yl(1);

yl = [yl(1)-ydiff/20 yl(2)];

ylim(yl);

set(gca,'TickDir','out');

axis square;

% -------Display the HDI on hist plot----

hold on

plot(HDI,[0 0],'k-','LineWidth',4);

str = [num2str(100\*credMass,2) '% HDI'];

text(mean(HDI),ydiff/20+ydiff/20,str,'HorizontalAlignment','center');

str = num2str(HDI(1),4);

text(HDI(1),ydiff/20,str,'HorizontalAlignment','center');

str = num2str(HDI(2),4);

text(HDI(2),ydiff/20,str,'HorizontalAlignment','center');

%----------------

hold on

plot ([mean\_tau,mean\_tau],[0,12],'r','LineWidth',2)

str = ['mean=',num2str(mean\_tau)];

text(mean\_tau+0.07,8,str)

hold on

plot ([median\_tau,median\_tau],[0,12],'r','LineWidth',2)

str = ['median=',num2str(median\_tau)];

text(median\_tau+0.07,7,str)

hold off

xlabel('tau');

title('Histogram of log tau for assignment 6');

%% -----------------------Task 3 ----------------------

% ----------------------------------------------------

% theta[j] ~ normal(mu+ phi\*child[j],tau);

prior\_child= mean(mu)+ mean(phi)+mean(tau).\*randn(1,length(tau));

mean\_prior\_child = mean(prior\_child);

prior\_adult= mean(mu)+mean(tau).\*randn(1,length(tau));

mean\_prior\_adult = mean(prior\_adult);

prior\_ex5 = mean(mu5)+mean(tau5).\*randn(1,length(tau5));

mean\_ex5= mean(prior\_ex5);

str = ['mean=',num2str(mean\_ex5)];

text(mean\_ex5,1.5,str)

figure(4)

h1=histogram(prior\_child,200,'normalization','pdf','DisplayStyle','stairs','EdgeColor','r');

str = ['mean=',num2str(mean\_prior\_child)];

text(mean\_prior\_child,1.85,str)

hold on

h2=histogram(prior\_adult,200,'normalization','pdf','DisplayStyle','stairs','EdgeColor','b');

str = ['mean=',num2str(mean\_prior\_adult)];

text(mean\_prior\_adult-0.3,1.85,str)

hold on

h3=histogram(prior\_ass5,200,'normalization','pdf','DisplayStyle','stairs','EdgeColor','g');

str = ['mean=',num2str(mean\_ex5)];

text(mean\_ex5,1.5,str)

ylabel('density');

legend('kids prior','Adults prior','ex5 prior')

ylim([0 2.5])

%% -----------------------Task 4 ----------------------

% ----------------------------------------------------

N=10000;

y\_kids = zeros(N,1);

y\_adults = zeros(N,1);

y\_mixed = zeros(N,1);

theta\_kid = zeros(N,1);

theta\_adult = zeros(N,1);

theta\_mixed = zeros(N,1);

indices = randi([0,length(mu)],N,1); % randomly chosen indices

kids\_fraction = sum(child)/length(child);

for i = 1:length (indices)% ,sample\_i in enumerate(indices):

% knowing that it is a child

theta\_kid = randn(1)\*tau(indices(i)) + mu(indices(i)) + phi(indices(i));

y\_kids(i)= exp( randn(1)\*sigma(indices(i)) + theta\_kid );

theta\_adult = randn(1)\*tau(indices(i)) + mu(indices(i));

y\_adults(i)= exp(randn(1)\*sigma(indices(i))+ theta\_adult);

% not knowing if it is a kid

if rand< kids\_fraction

theta\_mixed = randn(1)\*tau(indices(i)) + mu(indices(i)) + phi(indices(i));

y\_mixed(i)= exp(randn(1)\*sigma(indices(i)) + theta\_mixed ) ;

else

theta\_mixed = randn(1)\*tau(indices(i)) + mu(indices(i));

y\_mixed(i)=exp(randn(1)\*sigma(indices(i)) + theta\_mixed);

end

end

mean\_kid= mean(y\_kids);

mean\_adult = mean(y\_adults);

mean\_mixed = mean(y\_mixed);

figure(5)

histogram(y\_kids,200,'normalization','pdf','EdgeColor','r');

str = ['mean Kids=',num2str(mean\_kid)];

text(mean\_kid+300,0.002,str)

hold on

histogram(y\_adults,200,'normalization','pdf','EdgeColor','b');

str = ['mean Adults=',num2str(mean\_adult)];

text(mean\_adult+430,0.0025,str)

hold on

histogram(y\_mixed,200,'normalization','pdf','EdgeColor','g');

str = ['mean Mixed=',num2str(mean\_mixed)];

text(mean\_mixed+400,0.003,str)

legend('Kids','Adults','mixed')

xlabel('reaction time')

ylabel('density')