Contents

STA 601: Homework - 2

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```
close all;clear all;
```

Part 1:

We will use all the values of 'a' and 'b' and find how many trials we need in order to achieve Pr(theta <= 0.0015) = 0.95. We can find this probability by finding the value of cdf at theta = 0.0015.

```
% List of 'a' values of Prior
a = [1, 0.05, 1.6, 1.05];
% List of 'b' values of Prior
b = [666, 33.33, 407.4, 497];
% We are given that 'No Adverse Reactions occur'
y = 0;
% True value of theta
theta = 0.0015;

% Iterate through different Beta Priors
for iPrior = 1:numel(a)
    % Initial value of Number of Trials
    nTrials = 100;
    % Intial value of Pr(theta <= 0.0015)
    ProbOfInterest = 0;

    fprintf('Beta Prior Parameters, a = %f, b = %f\n',a(iPrior),b(iPrior));

    % We Increment Number of Trials until we achieve
    % Pr(theta <= 0.0015) = 0.95
    while ProbOfInterest <= 0.95
        nTrials = nTrials + 1;
        % Calculate Posterior Beta parameters and make distribution
        aPosterior = (a(iPrior) + y);
        bPosterior = (b(iPrior) + nTrials - y);
        postDist = makedist('beta','a',aPosterior,'b',bPosterior);

        % Calculate the P(theta < 0.0015)
        % i.e. Calculate the value of cdf at 0.0015
        ProbOfInterest = postDist.cdf(theta);
    end
```

```
    fprintf('\tProbability = %f, Number Of Trials = %d\n\n',ProbOfInterest,nTrials);
end
```

```
Beta Prior Parameters, a = 1.000000, b = 666.000000
         Probability = 0.950026, Number Of Trials = 1330

Beta Prior Parameters, a = 0.050000, b = 33.330000
         Probability = 0.950145, Number Of Trials = 145

Beta Prior Parameters, a = 1.600000, b = 407.400000
         Probability = 0.950012, Number Of Trials = 2310

Beta Prior Parameters, a = 1.050000, b = 497.000000
         Probability = 0.950024, Number Of Trials = 1563
```

Part 2:

Now we will use a restricted prior Uniform[0 0.1]. We can do this by choosing a Beta(1,1) prior, finding the posterior and then truncating it between (0,0.1)

```
% Initial value of Number of Trials
nTrials = 100;
% Intial value of Pr(theta <= 0.0015)
ProbOfInterest = 0;
% Uniform Prior Parameters
a = 1; b = 1;

fprintf('Beta Prior Parameters, a = %d, b = %d\n',a,b);

% We Increment Number of Trials until we achieve
% Pr(theta <= 0.0015) = 0.95
while ProbOfInterest <= 0.95
    nTrials = nTrials + 1;
    % Posterior Distribution is Binomial(n,p)
    postDist = makedist('Beta','a',(a + y),'b',(b + nTrials - y));
    % We truncate the posterior between (0,0.1)
    postDist = postDist.truncate(0,0.1);
    % Calculate the P(theta < 0.0015)
    % i.e. Calculate the value of cdf at 0.0015
    ProbOfInterest = postDist.cdf(theta);
end
fprintf('\tProbability = %f, Number Of Trials = %d\n\n',ProbOfInterest,nTrials);
```

```
Beta Prior Parameters, a = 1, b = 1
         Probability = 0.950026, Number Of Trials = 1995
```

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