# 1 Code for problem e)

```
% proglem_e.m


% Setup
q = 6;
N_A = 2;
N_B = 2;



% Setup
P = zeros(q+1,1);
a_mult = zeros(q+1,1);
b_mult = zeros(q+1,1);
ab_mult = zeros(q+1,1);

disp('q_value    A_mult   B_mult   AB_mult P(q_A)')

% Calculate
tot_mult = nchoosek( (q+N_A+N_B-1) ,q);
for i=1:(q+1)
    q_A = q-(i-1);
    a_mult = nchoosek( (q_A+N_A-1) , q_A);
    b_mult = nchoosek( (q-q_A+N_B-1) ,(q-q_A));
    ab_mult = a_mult*b_mult;
    P = a_mult*b_mult/tot_mult;
    disp(sprintf('%i         %g       %g       %g       %g', i-1,
    a_mult, b_mult, ab_mult, P));
end


% Output:
% q_value    A_mult   B_mult   AB_mult P(q_A)
% 0          7        1         7       0.0833333
% 1          6        2        12       0.142857
% 2          5        3        15       0.178571
% 3          4        4        16       0.190476
% 4          3        5        15       0.178571
% 5          2        6        12       0.142857
% 6          1        7         7       0.0833333
```

# 2 Code for problem g)

```
% problem_g

% Setup
N = 101;

N_A = 30;
N_B = 70;

% Setup
q_a = zeros(1,N);
```

```
P = zeros(1,N);

% Make it so
q_b = 0;
for i = 1:N
    q_a(i) = 100 - q_b;
    P(i) = (nchoosek(q_a(i) + N_A - 1, q_a(i))*nchoosek(q_b + N_B -
     1, q_b)) / nchoosek((q_a(i) + q_b) + (N_A + N_B) - 1, q_a(i) +
     q_b);
    q_b++;
end

%q_a
%P
plot(q_a, P);
xlabel('q_a');
ylabel('P(q_a)')


pause()
```

# 3 Code for problem m)

```
% problem_m

%
N = 60;
n = 50000;
s = zeros(n, 1);

%
for i = 1:n
    A = randi([0,1],N,1);
    S_plus = sum(A);
    S_minus = N - S_plus;
    s(i) = (S_plus-S_minus)/2;
end

%
mean_s = -sum(s)/n;
n_vec = 1:n;
plot(n_vec, -s);
hold on
plot([0 n], [mean_s mean_s], 'r--')
xlabel('Microstate "')
ylabel('Energy')
legend('Total E in microstate', 'Mean energy')
hold off

%
figure()
hist(-s, 50)
xlabel('Energy of the system')
ylabel('Number of occurences')
hold on
plot_vec = linspace(-20,20,n);
```

```
34 y = 5150*exp(-2*plot_vec.^2/N);
35 plot(plot_vec, y, 'r--')
36 legend('Histogram of results','Normal distribution')
37
38
39 pause()
```