Lan Reliability Project

Table of Contents

David Karguth 11/12/2023

Workspace Initialization

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

Define constants

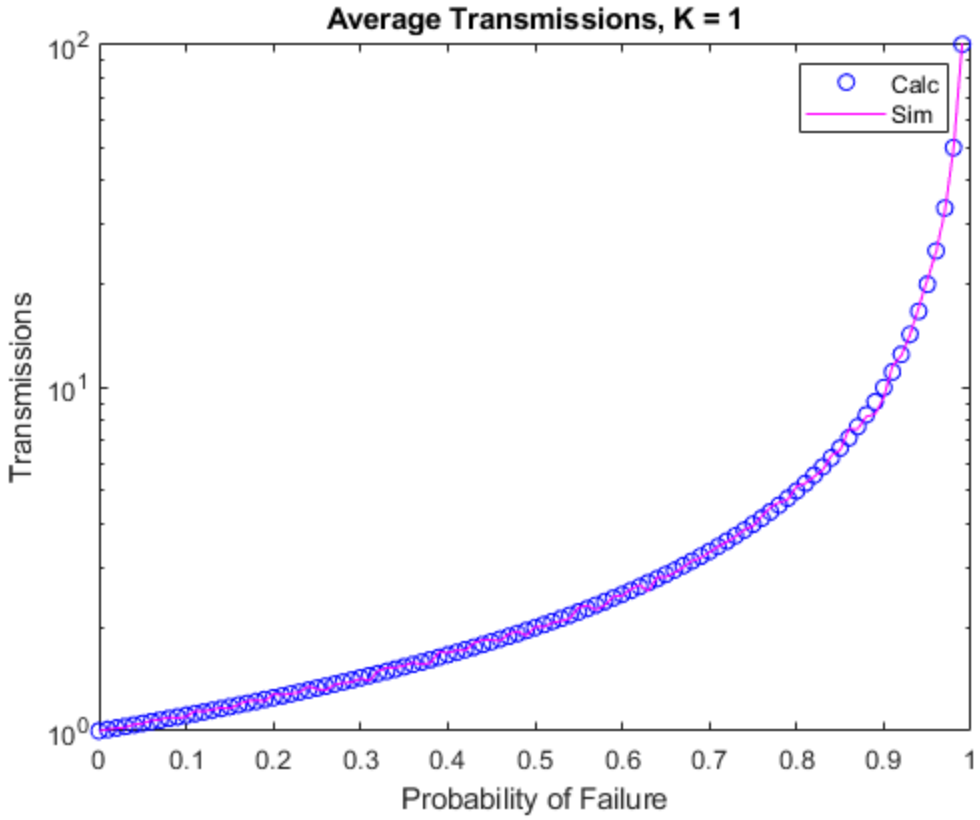
```
p_Array = 0 : 0.01 : 0.99;  % All possible values of 'p' from 0% to 100%
 except 100% because this is a scam
k_Array = [1, 5, 15, 50, 100]; % Number of packets to send
N = 1000;     % Iterations to run each time
```

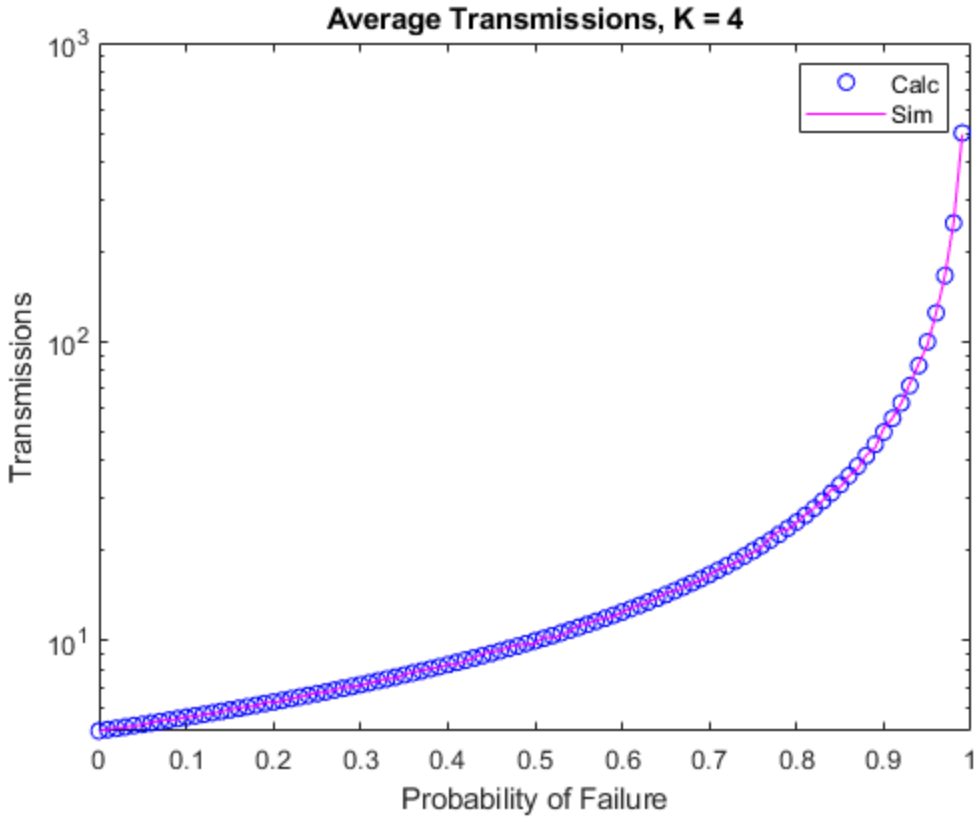
Task 1

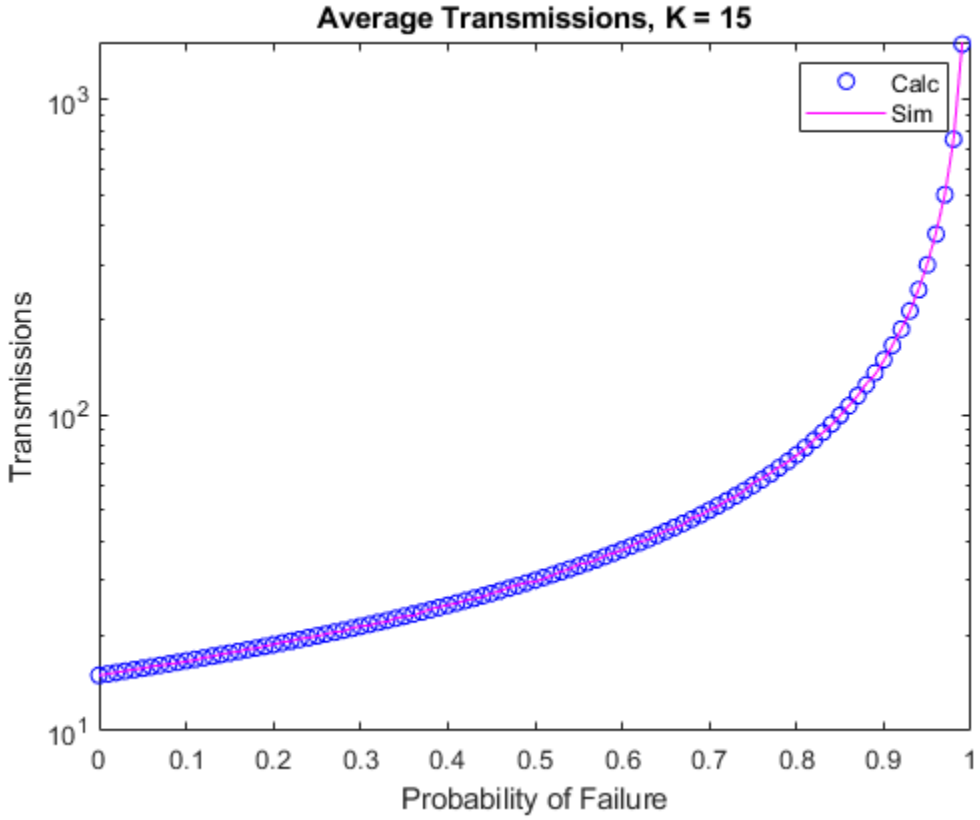
```
simValues = zeros(length(k_Array), length(p_Array));
calcValues = simValues;

for i = 1 : 5    % Number of 'k' values in the array
 K = k_Array(i);
 for j = 1 : 100   % Number of 'p' values in the array
  p = p_Array(j);
  simValues(i, j) = runSingleLinkSim(K, p, N); % Run the single link
 simulation
  calcValues(i, j) = K / (1 - p);     % Calculated the expected result
 end
end

% Plots
K = 1;
figure();
semilogy(p_Array, calcValues(1, :), 'bo');
hold on;
```

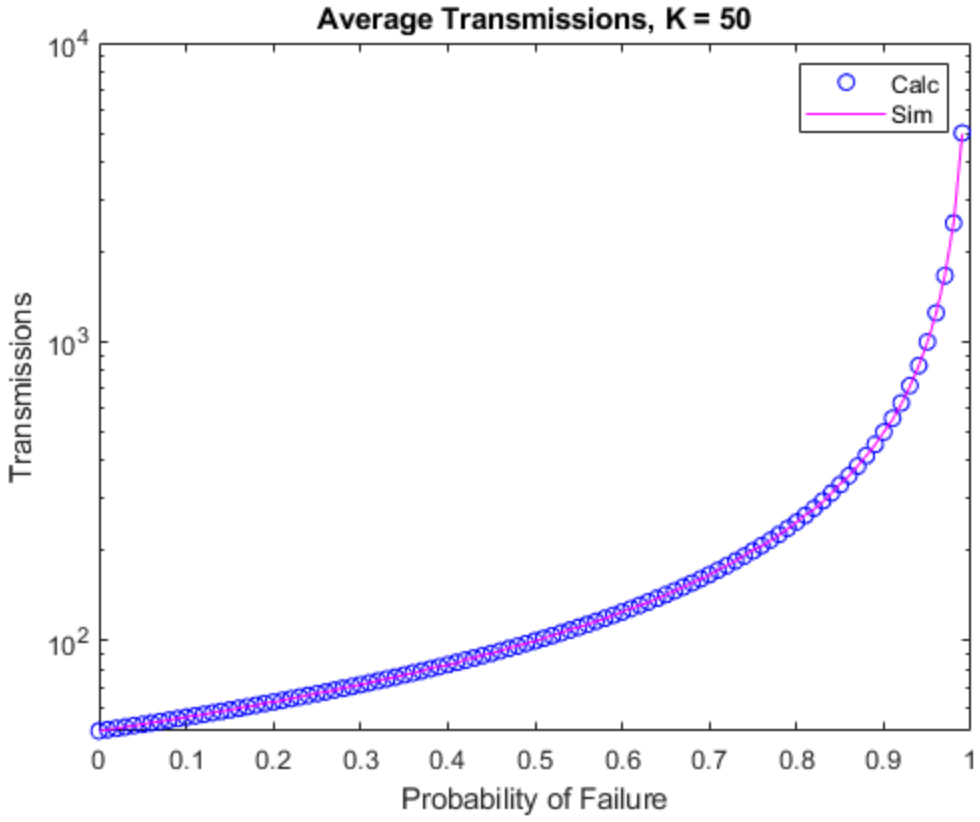
```
semilogy(p_Array, simValues(1, :), 'color', 'm');
title("Average Transmissions, K = 1");
ylabel("Transmissions");
xlabel("Probability of Failure");
legend("Calc", "Sim");
hold off;

K = 5;
figure();
semilogy(p_Array, calcValues(2, :), 'bo');
hold on;
semilogy(p_Array, simValues(2, :), 'color', 'm');
title("Average Transmissions, K = 4");
ylabel("Transmissions");
xlabel("Probability of Failure");
legend("Calc", "Sim");
hold off;

K = 15;
figure();
semilogy(p_Array, calcValues(3, :), 'bo');
hold on;
semilogy(p_Array, simValues(3, :), 'color', 'm');
title("Average Transmissions, K = 15");
ylabel("Transmissions");
xlabel("Probability of Failure");
legend("Calc", "Sim");
hold off;

K = 50;
figure();
semilogy(p_Array, calcValues(4, :), 'bo');
hold on;
semilogy(p_Array, simValues(4, :), 'color', 'm');
title("Average Transmissions, K = 50");
ylabel("Transmissions");
xlabel("Probability of Failure");
legend("Calc", "Sim");
hold off;

K = 100;
figure();
semilogy(p_Array, calcValues(5, :), 'bo');
hold on;
semilogy(p_Array, simValues(5, :), 'color', 'm');
title("Average Transmissions, K = 100");
ylabel("Transmissions");
xlabel("Probability of Failure");
legend("Calc", "Sim");
hold off;


figure();
semilogy(p_Array, simValues(1, :), 'mo');
```

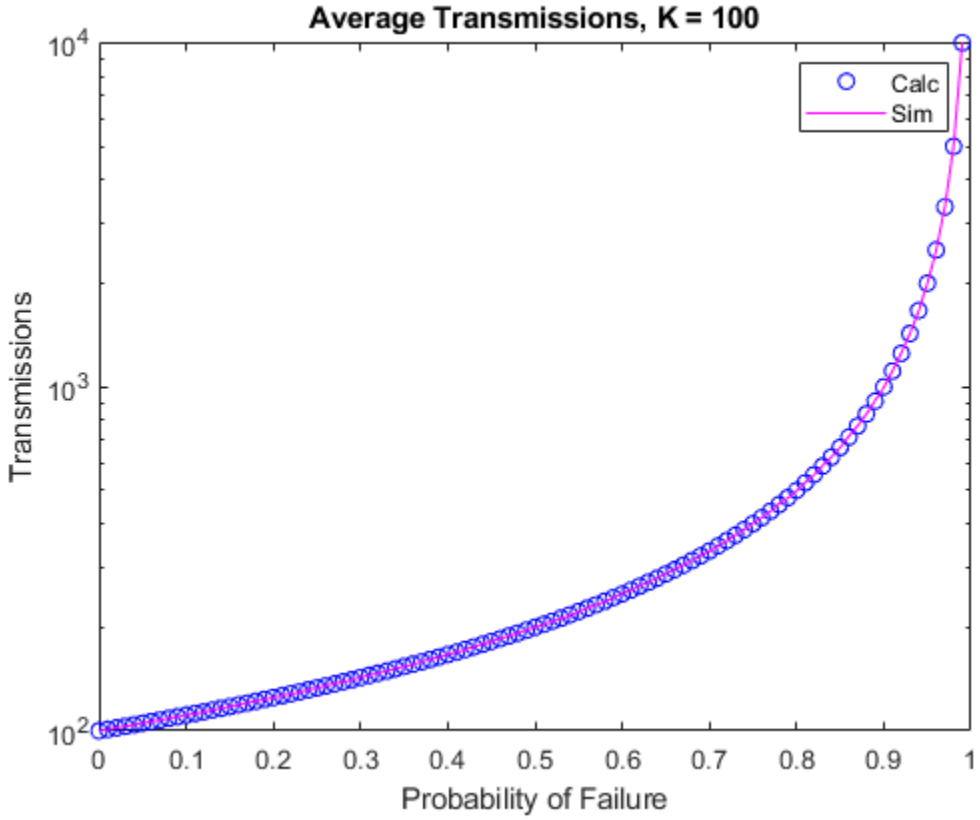
```
hold on;
semilogy(p_Array, simValues(2, :), 'bo');
semilogy(p_Array, simValues(3, :), 'yo');
semilogy(p_Array, simValues(4, :), 'ro');
semilogy(p_Array, simValues(5, :), 'go');
semilogy(p_Array, calcValues(1, :), 'color', 'k');
semilogy(p_Array, calcValues(2, :), 'color', 'k');
semilogy(p_Array, calcValues(3, :), 'color', 'k');
semilogy(p_Array, calcValues(4, :), 'color', 'k');
semilogy(p_Array, calcValues(5, :), 'color', 'k');

legend("K = 1", "K = 5", "K = 15", "K = 50", "K = 100");
```

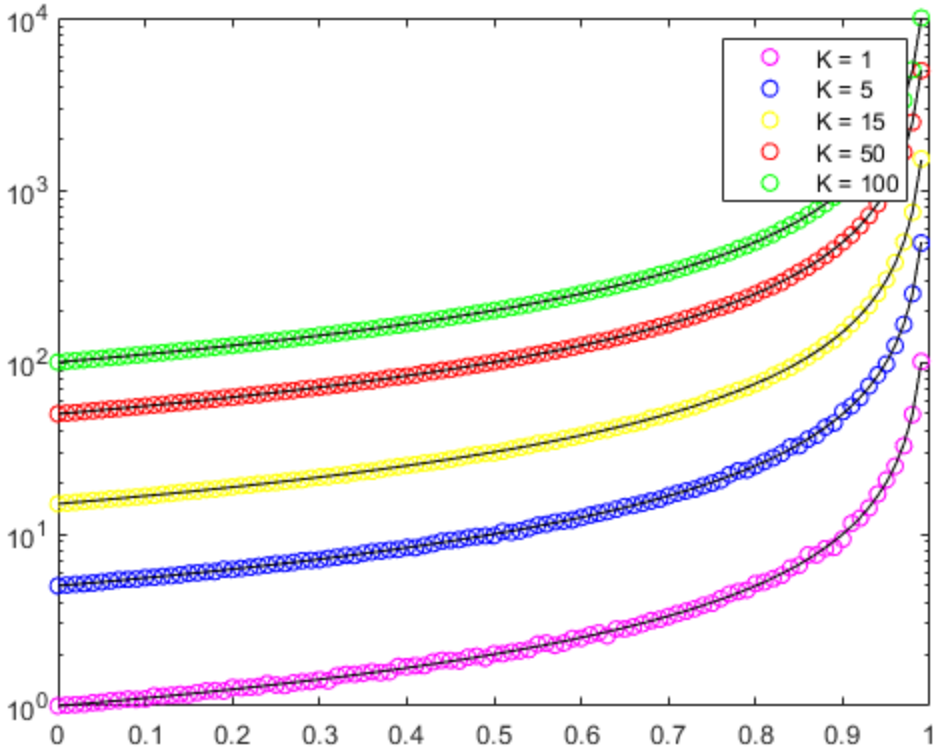



Average Transmissions, K = 4
Calc
Sim
Transmissions
Probability of Failure
10^3
10^2
10^1
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1


Average Transmissions, K = 15
Calc
Sim
Transmissions
Probability of Failure
10^3
10^2
10^1
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1


Average Transmissions, K = 50
Calc
Sim
Transmissions
Probability of Failure
10^4
10^3
10^2
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1


Average Transmissions, K = 100
Calc
Sim
Transmissions
Probability of Failure
10^4
10^3
10^2
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1

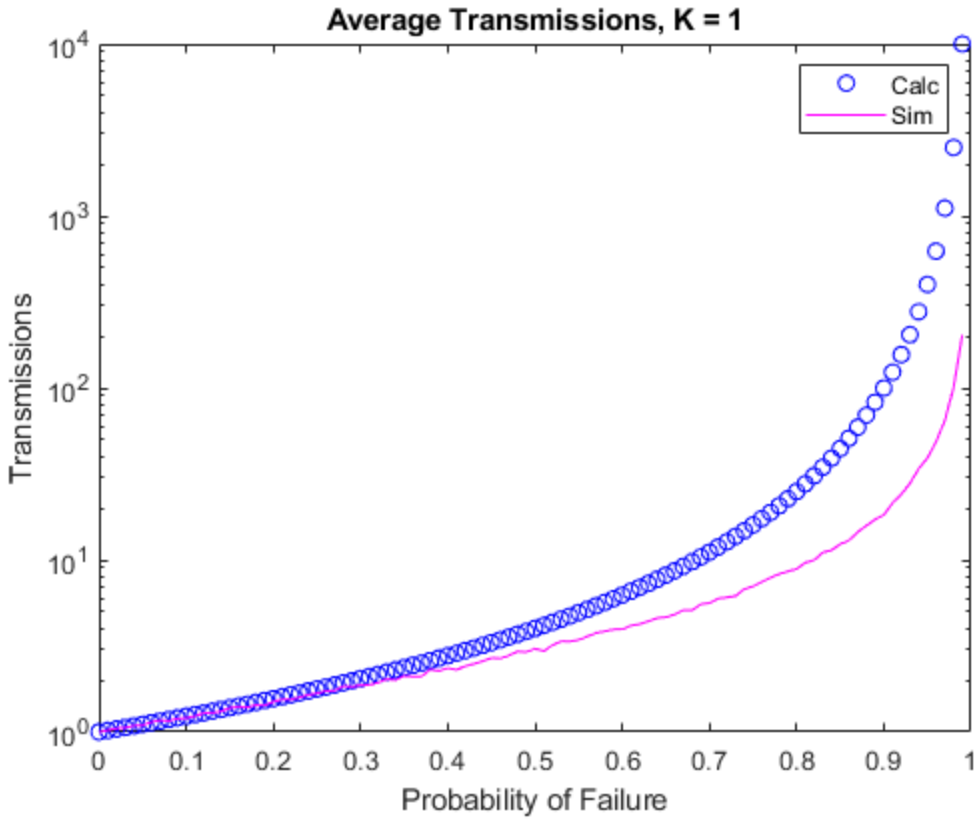


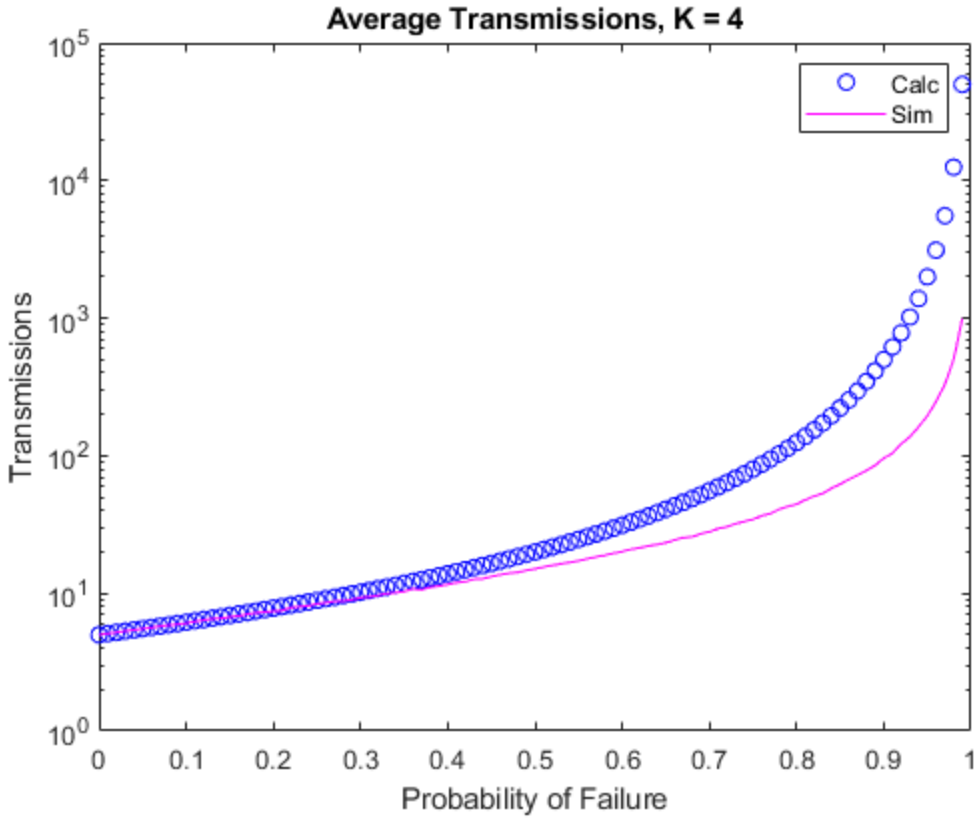
Task 2

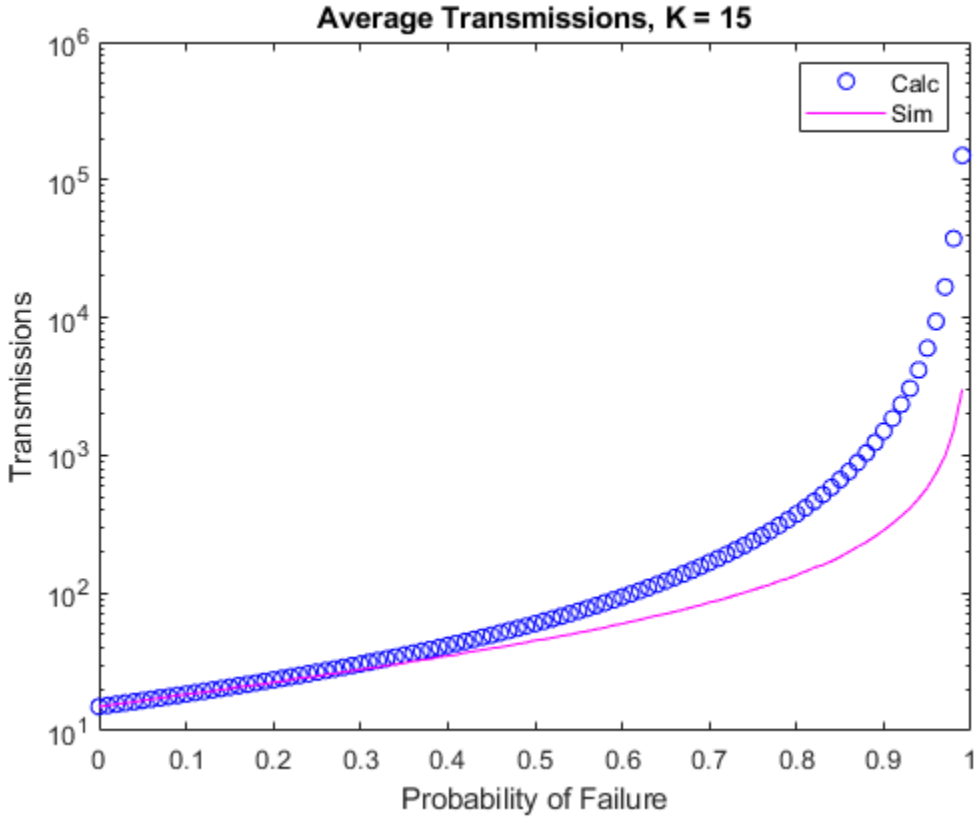
```
simValues = zeros(length(k_Array), length(p_Array));
calcValues = simValues;

for i = 1 : 5    % Number of 'k' values in the array
 K = k_Array(i);
 for j = 1 : 100   % Number of 'p' values in the array
  p = p_Array(j);
  simValues(i, j) = runTwoSeriesLinkSim(K, p, N); % Run the series link
 simulation
  calcValues(i, j) = K / ((1 - p) * (1 - p));     % Calculated the expected
 result
 end
end

% Plots
K = 1;
figure();
semilogy(p_Array, calcValues(1, :), 'bo');
hold on;
semilogy(p_Array, simValues(1, :), 'color', 'm');
title("Average Transmissions, K = 1");
ylabel("Transmissions");
xlabel("Probability of Failure");
```

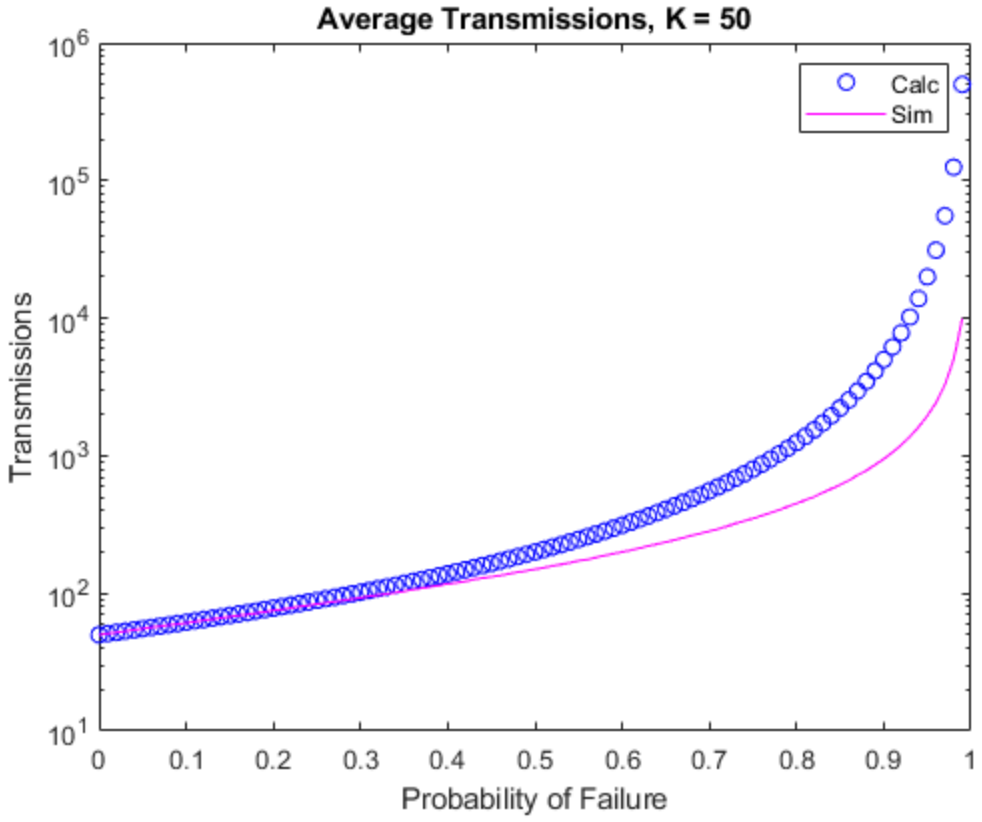
```
legend("Calc", "Sim");
hold off;

K = 5;
figure();
semilogy(p_Array, calcValues(2, :), 'bo');
hold on;
semilogy(p_Array, simValues(2, :), 'color', 'm');
title("Average Transmissions, K = 4");
ylabel("Transmissions");
xlabel("Probability of Failure");
legend("Calc", "Sim");
hold off;

K = 15;
figure();
semilogy(p_Array, calcValues(3, :), 'bo');
hold on;
semilogy(p_Array, simValues(3, :), 'color', 'm');
title("Average Transmissions, K = 15");
ylabel("Transmissions");
xlabel("Probability of Failure");
legend("Calc", "Sim");
hold off;

K = 50;
figure();
semilogy(p_Array, calcValues(4, :), 'bo');
hold on;
semilogy(p_Array, simValues(4, :), 'color', 'm');
title("Average Transmissions, K = 50");
ylabel("Transmissions");
xlabel("Probability of Failure");
legend("Calc", "Sim");
hold off;

K = 100;
figure();
semilogy(p_Array, calcValues(5, :), 'bo');
hold on;
semilogy(p_Array, simValues(5, :), 'color', 'm');
title("Average Transmissions, K = 100");
ylabel("Transmissions");
xlabel("Probability of Failure");
legend("Calc", "Sim");
hold off;


figure();
semilogy(p_Array, simValues(1, :), 'mo');
hold on;
semilogy(p_Array, simValues(2, :), 'bo');
semilogy(p_Array, simValues(3, :), 'yo');
semilogy(p_Array, simValues(4, :), 'ro');
```

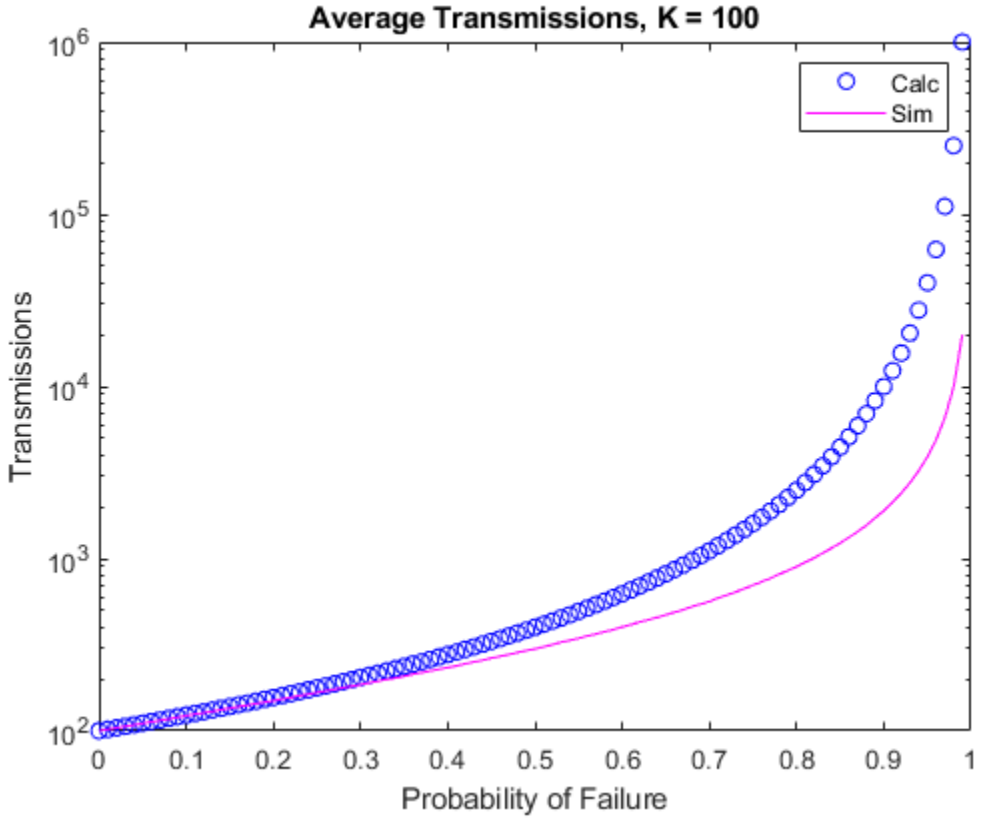
```
semilogy(p_Array, simValues(5, :), 'go');
semilogy(p_Array, calcValues(1, :), 'color', 'k');
semilogy(p_Array, calcValues(2, :), 'color', 'k');
semilogy(p_Array, calcValues(3, :), 'color', 'k');
semilogy(p_Array, calcValues(4, :), 'color', 'k');
semilogy(p_Array, calcValues(5, :), 'color', 'k');

legend("K = 1", "K = 5", "K = 15", "K = 50", "K = 100");
```

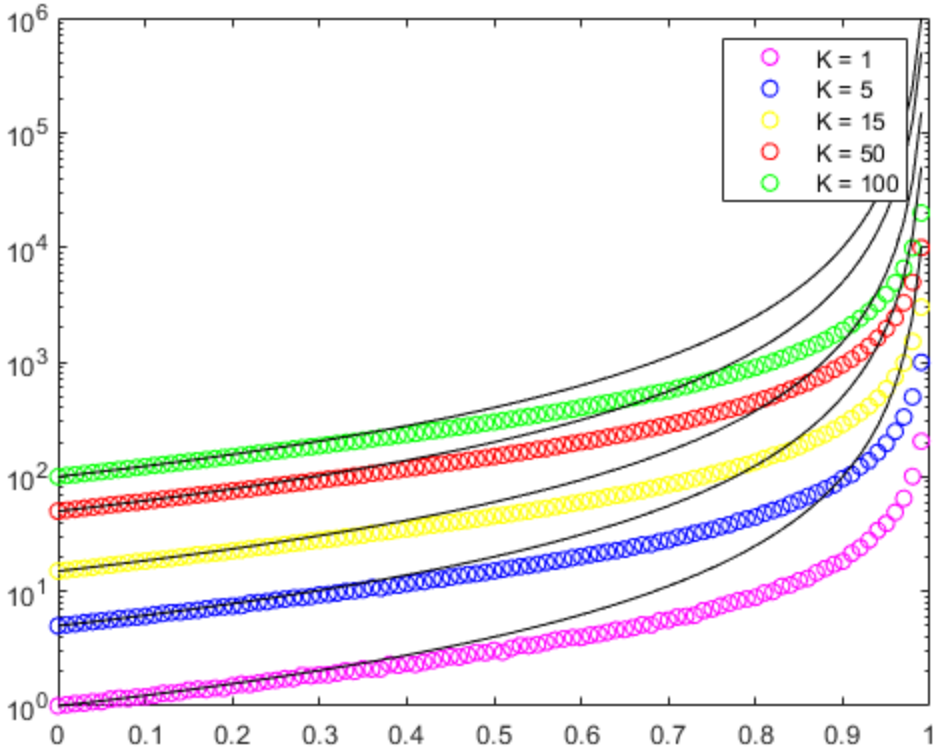



Average Transmissions, K = 4
Calc
Sim
Transmissions
Probability of Failure
10^0
10^1
10^2
10^3
10^4
10^5
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1


Average Transmissions, K = 15
Calc
Sim
Transmissions
Probability of Failure
10^1
10^2
10^3
10^4
10^5
10^6
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1


Average Transmissions, K = 50
Calc
Sim
Transmissions
Probability of Failure
10^6
10^5
10^4
10^3
10^2
10^1
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1

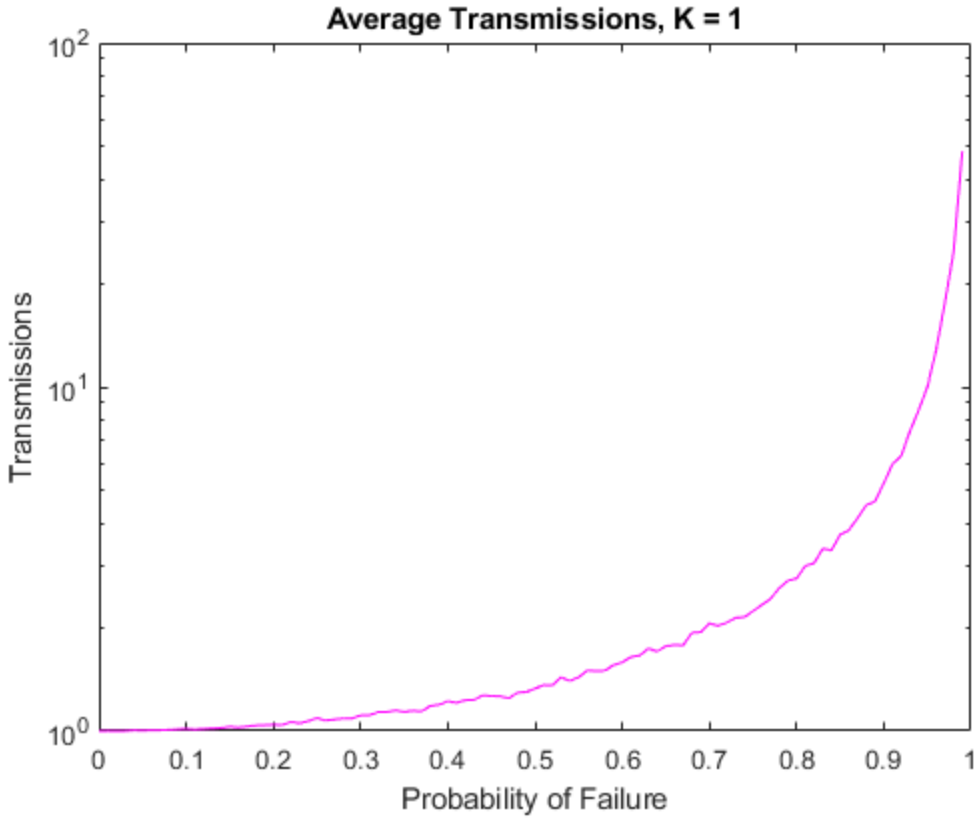

Average Transmissions, K = 100
Calc
Sim
Transmissions
Probability of Failure
10^6
10^5
10^4
10^3
10^2
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1

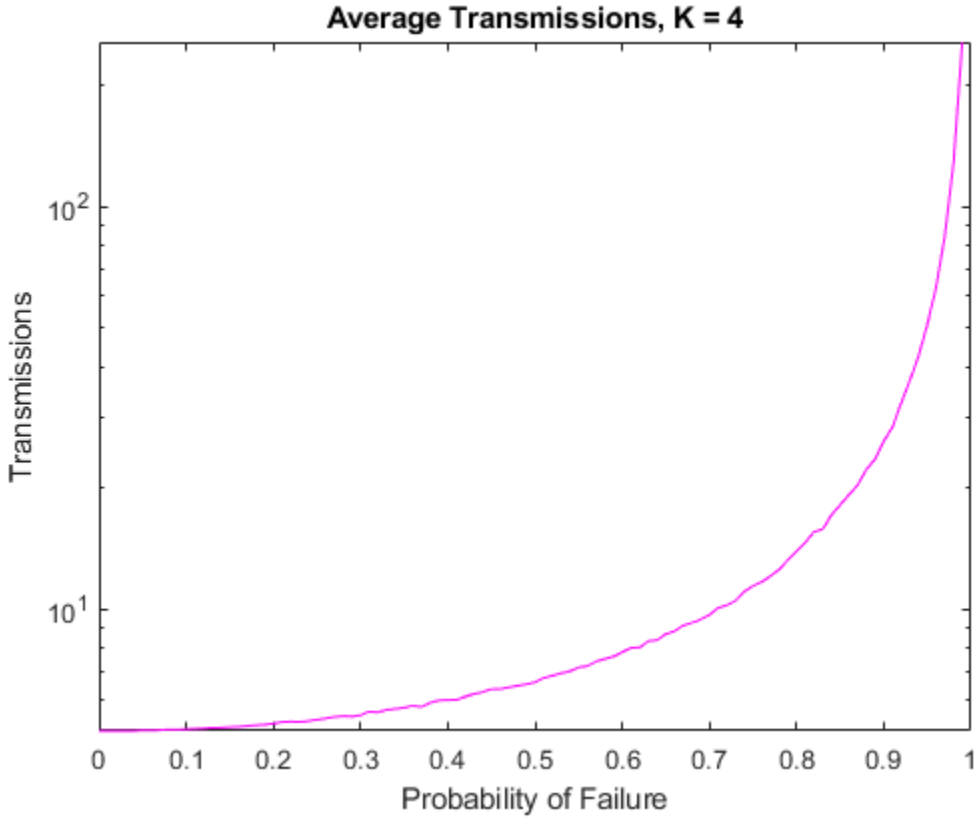


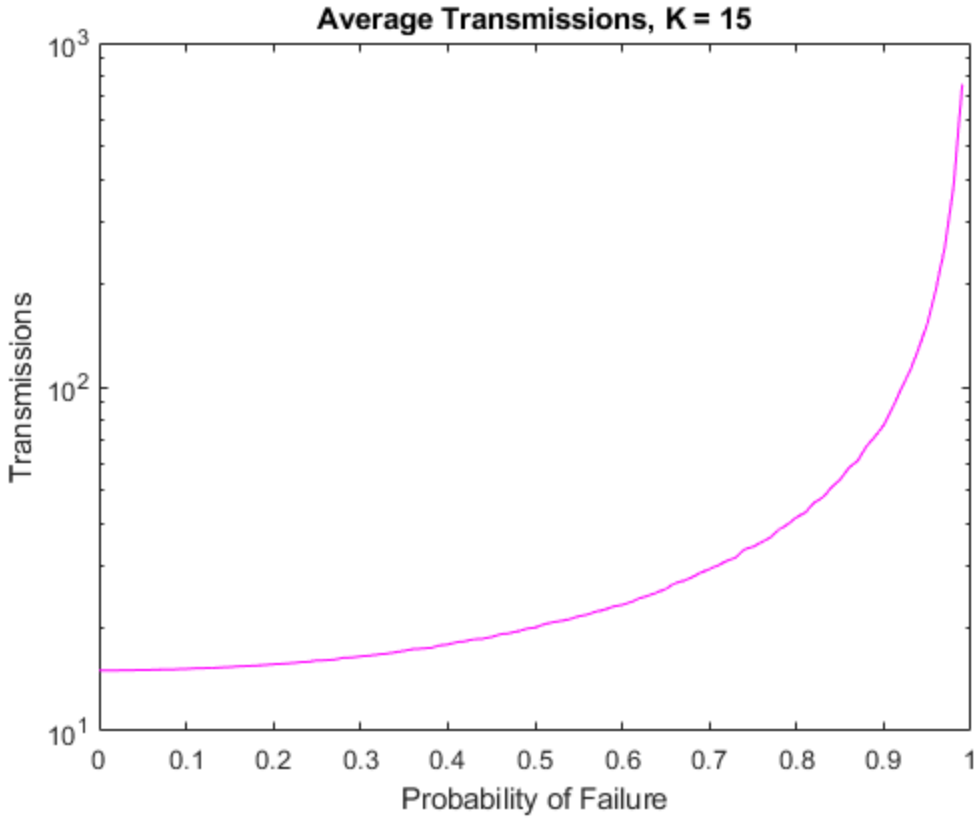
Task 3

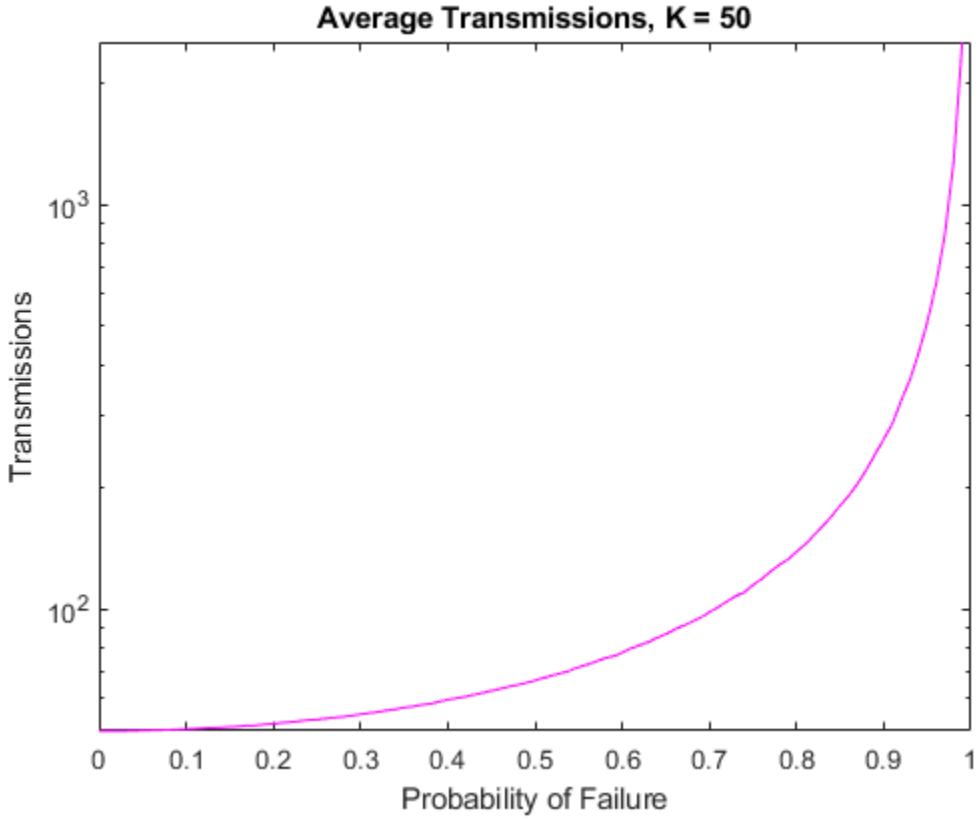
```
simValues = zeros(length(k_Array), length(p_Array));
calcValues = simValues;

for i = 1 : 5    % Number of 'k' values in the array
 K = k_Array(i);
 for j = 1 : 100   % Number of 'p' values in the array
  p = p_Array(j);
  simValues(i, j) = runTwoParallelLinkSim(K, p, N); % Run the parallel link
 simulation
 end
end

% Plots
K = 1;
figure();
semilogy(p_Array, simValues(1, :), 'color', 'm');
hold on;
title("Average Transmissions, K = 1");
ylabel("Transmissions");
xlabel("Probability of Failure");
hold off;

K = 5;
```

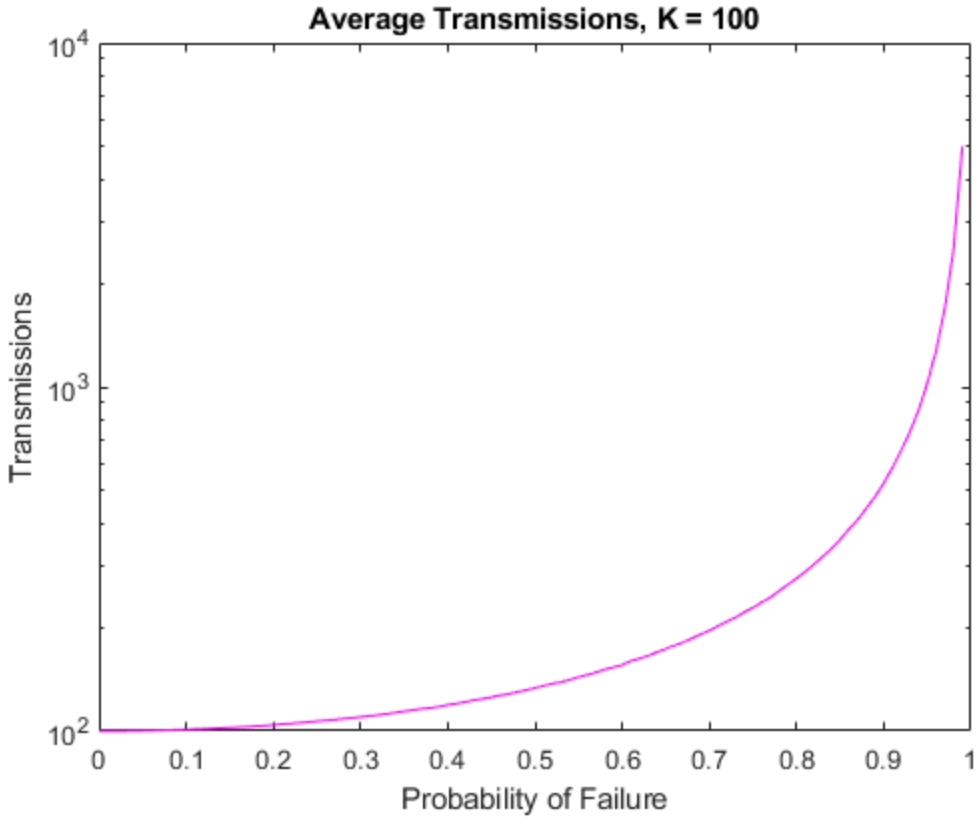
```
figure();
semilogy(p_Array, simValues(2, :), 'color', 'm');
hold on;
title("Average Transmissions, K = 4");
ylabel("Transmissions");
xlabel("Probability of Failure");
hold off;

K = 15;
figure();
semilogy(p_Array, simValues(3, :), 'color', 'm');
hold on;
title("Average Transmissions, K = 15");
ylabel("Transmissions");
xlabel("Probability of Failure");
hold off;

K = 50;
figure();
semilogy(p_Array, simValues(4, :), 'color', 'm');
hold on;
title("Average Transmissions, K = 50");
ylabel("Transmissions");
xlabel("Probability of Failure");
hold off;

K = 100;
figure();
semilogy(p_Array, simValues(5, :), 'color', 'm');
hold on;
title("Average Transmissions, K = 100");
ylabel("Transmissions");
xlabel("Probability of Failure");
hold off;


figure();
semilogy(p_Array, simValues(1, :), 'mo');
hold on;
semilogy(p_Array, simValues(2, :), 'bo');
semilogy(p_Array, simValues(3, :), 'yo');
semilogy(p_Array, simValues(4, :), 'ro');
semilogy(p_Array, simValues(5, :), 'go');
legend("K = 1", "K = 5", "K = 15", "K = 50", "K = 100");
```

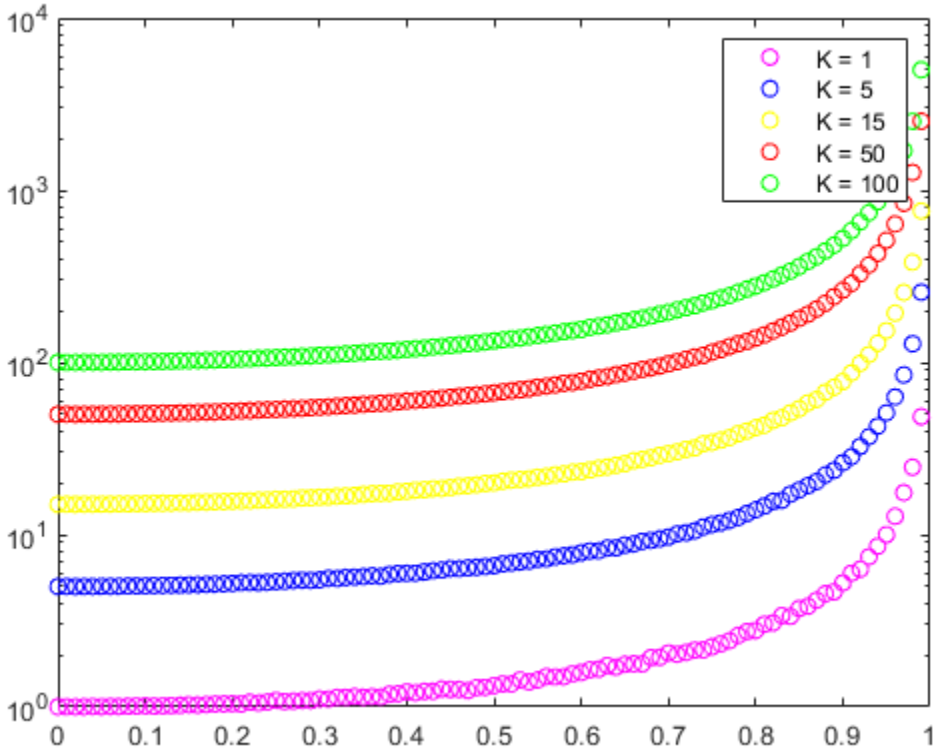

Average Transmissions, K = 1
Transmissions
10^2
10^1
10^0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
Probability of Failure


Average Transmissions, K = 4
Transmissions
10^2
10^1
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
Probability of Failure


Average Transmissions, K = 15
Transmissions
10^3
10^2
10^1
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
Probability of Failure


Average Transmissions, K = 50
Transmissions
10^3
10^2
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
Probability of Failure

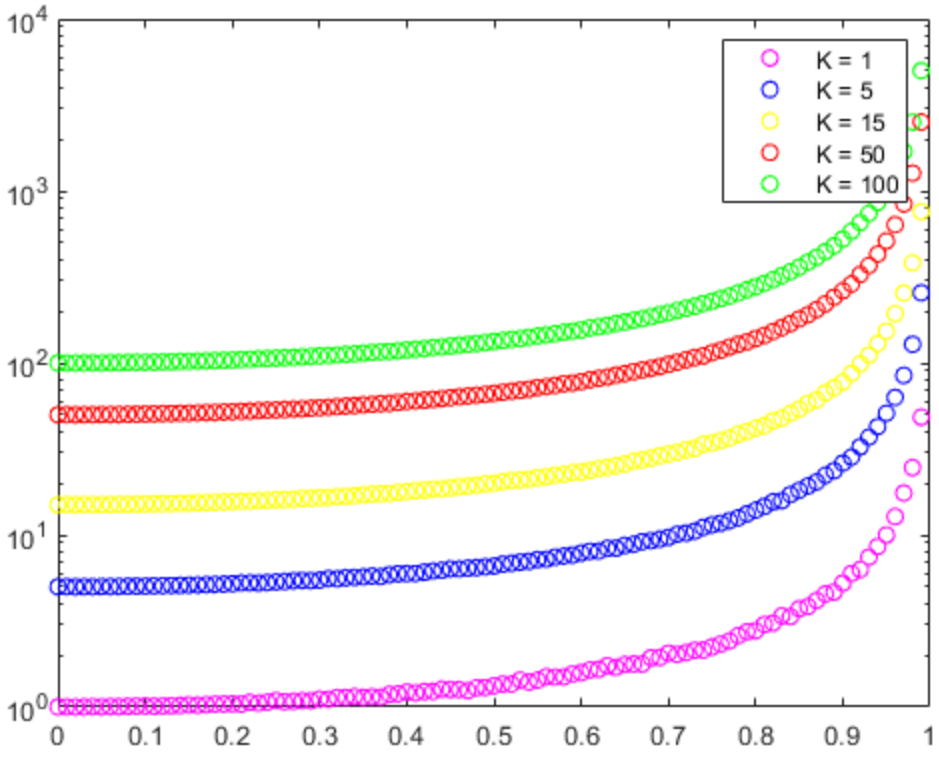

Average Transmissions, K = 100
Transmissions
Probability of Failure
10^4
10^3
10^2
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1

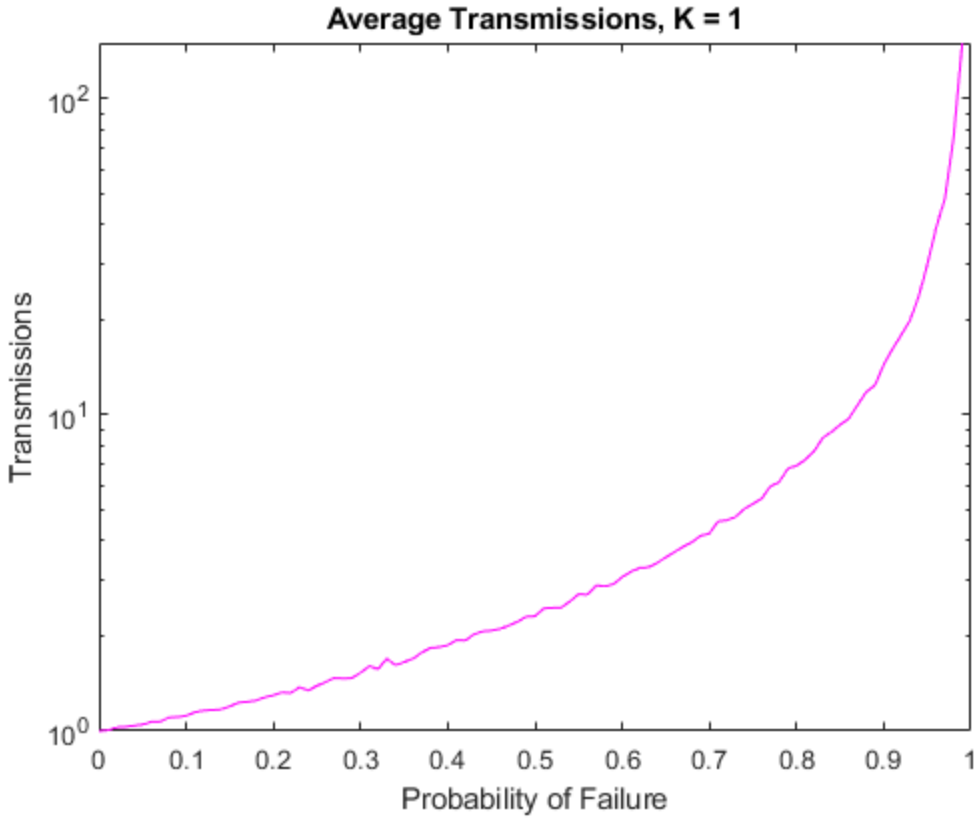

K = 1
K = 5
K = 15
K = 50
K = 100
10^4
10^3
10^2
10^1
10^0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1

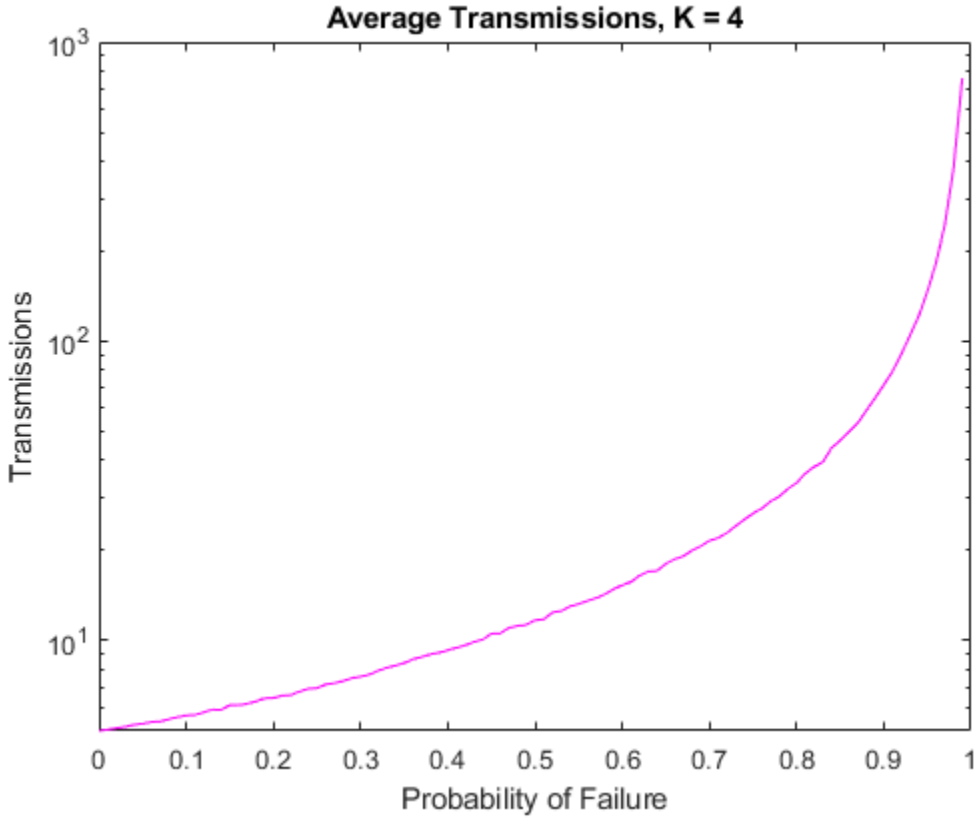
Task 4

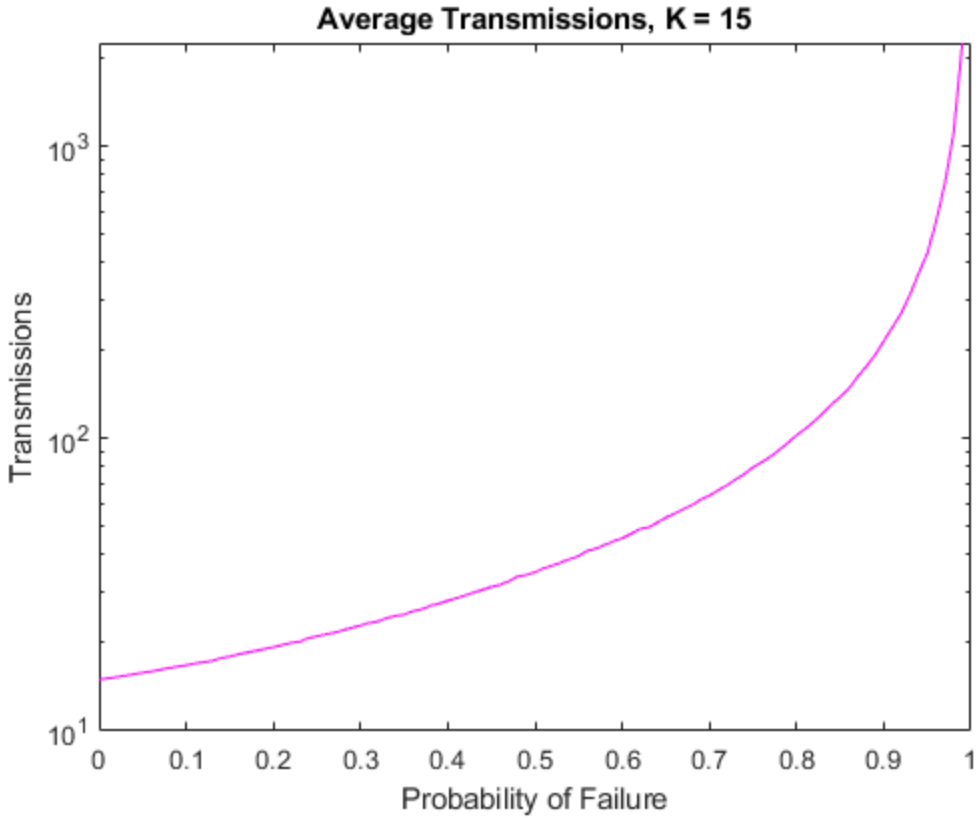
```
simValues = zeros(length(k_Array), length(p_Array));
calcValues = simValues;

for i = 1 : 5    % Number of 'k' values in the array
 K = k_Array(i);
 for j = 1 : 100   % Number of 'p' values in the array
  p = p_Array(j);
  simValues(i, j) = runCompoundNetworkSim(K, p, N); % Run the parallel link
 simulation
 end
end

% Plots
K = 1;
figure();
semilogy(p_Array, simValues(1, :), 'color', 'm');
hold on;
title("Average Transmissions, K = 1");
ylabel("Transmissions");
xlabel("Probability of Failure");
hold off;

K = 5;
figure();
semilogy(p_Array, simValues(2, :), 'color', 'm');
hold on;
title("Average Transmissions, K = 4");
ylabel("Transmissions");
xlabel("Probability of Failure");
hold off;

K = 15;
figure();
semilogy(p_Array, simValues(3, :), 'color', 'm');
hold on;
title("Average Transmissions, K = 15");
ylabel("Transmissions");
xlabel("Probability of Failure");
hold off;

K = 50;
figure();
semilogy(p_Array, simValues(4, :), 'color', 'm');
hold on;
title("Average Transmissions, K = 50");
ylabel("Transmissions");
xlabel("Probability of Failure");
hold off;

K = 100;
figure();
```

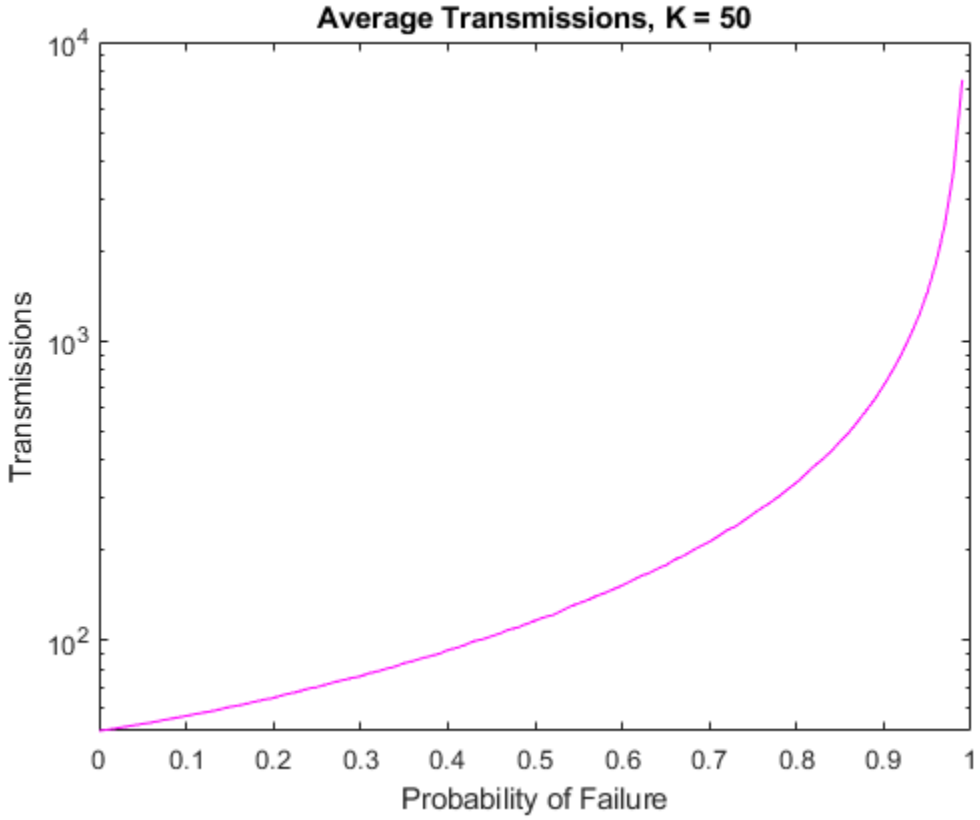
```
semilogy(p_Array, simValues(5, :), 'color', 'm');
hold on;
title("Average Transmissions, K = 100");
ylabel("Transmissions");
xlabel("Probability of Failure");
hold off;


figure();
semilogy(p_Array, simValues(1, :), 'mo');
hold on;
semilogy(p_Array, simValues(2, :), 'bo');
semilogy(p_Array, simValues(3, :), 'yo');
semilogy(p_Array, simValues(4, :), 'ro');
semilogy(p_Array, simValues(5, :), 'go');
legend("K = 1", "K = 5", "K = 15", "K = 50", "K = 100");
```

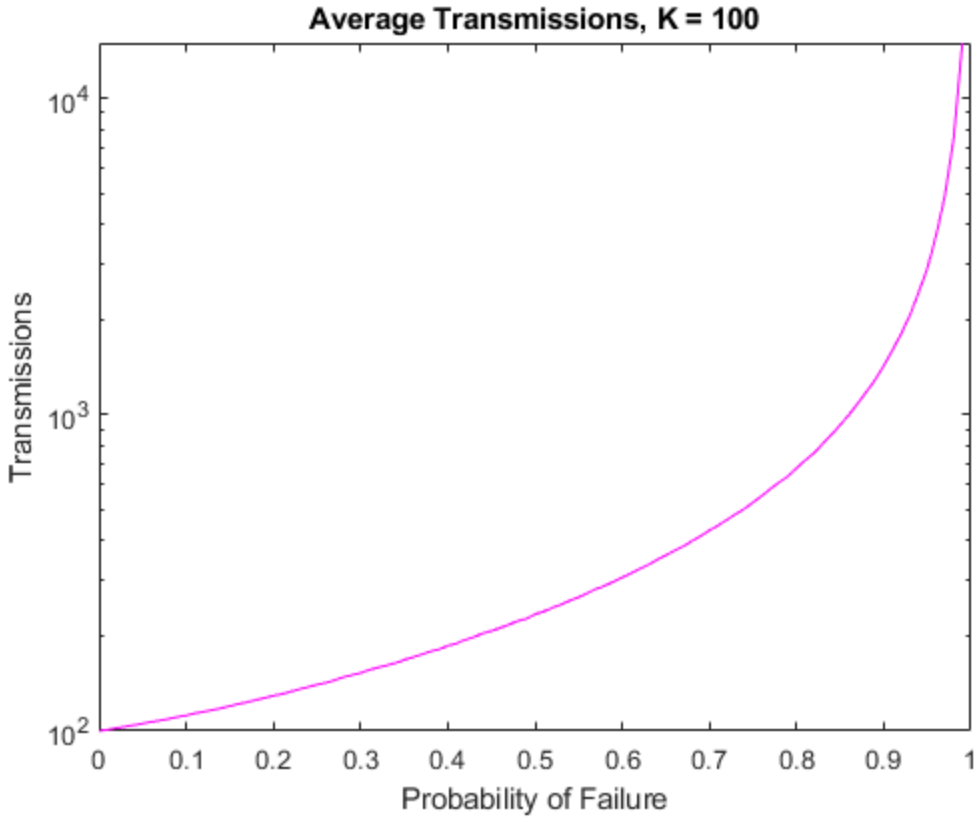


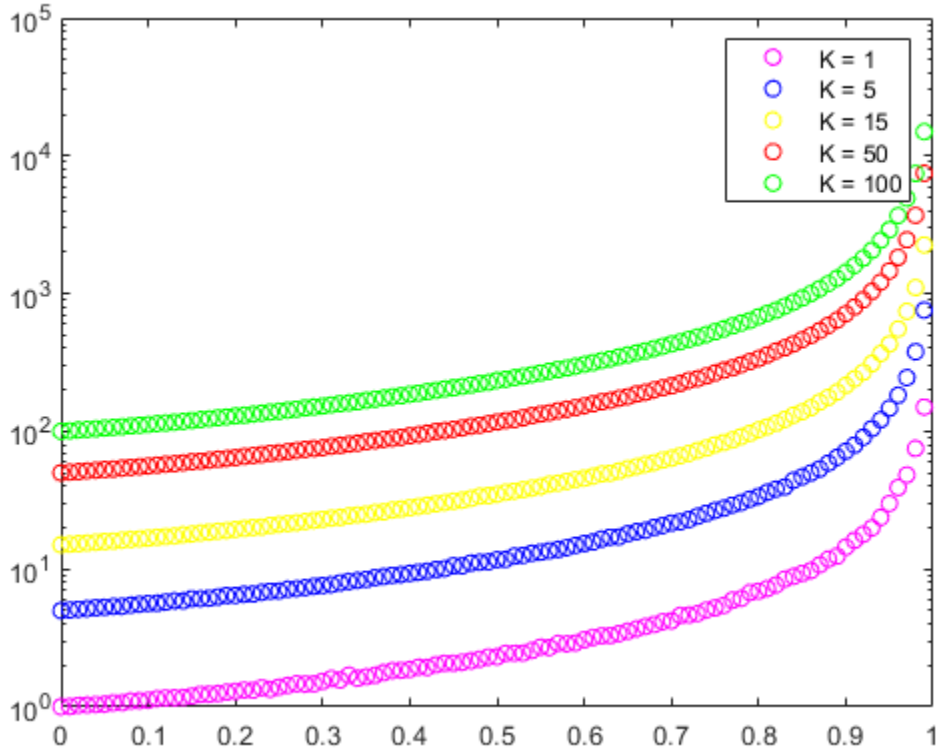

Average Transmissions, K = 1
Transmissions
10^2
10^1
10^0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
Probability of Failure


Average Transmissions, K = 4
Transmissions
10^3
10^2
10^1
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
Probability of Failure


Average Transmissions, K = 15
Transmissions
10^3
10^2
10^1
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
Probability of Failure


Average Transmissions, K = 50
Transmissions
10^4
10^3
10^2
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
Probability of Failure


Average Transmissions, K = 100
Transmissions
Probability of Failure
10^4
10^3
10^2
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1


K = 1
K = 5
K = 15
K = 50
K = 100
10^5
10^4
10^3
10^2
10^1
10^0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1

Task 5

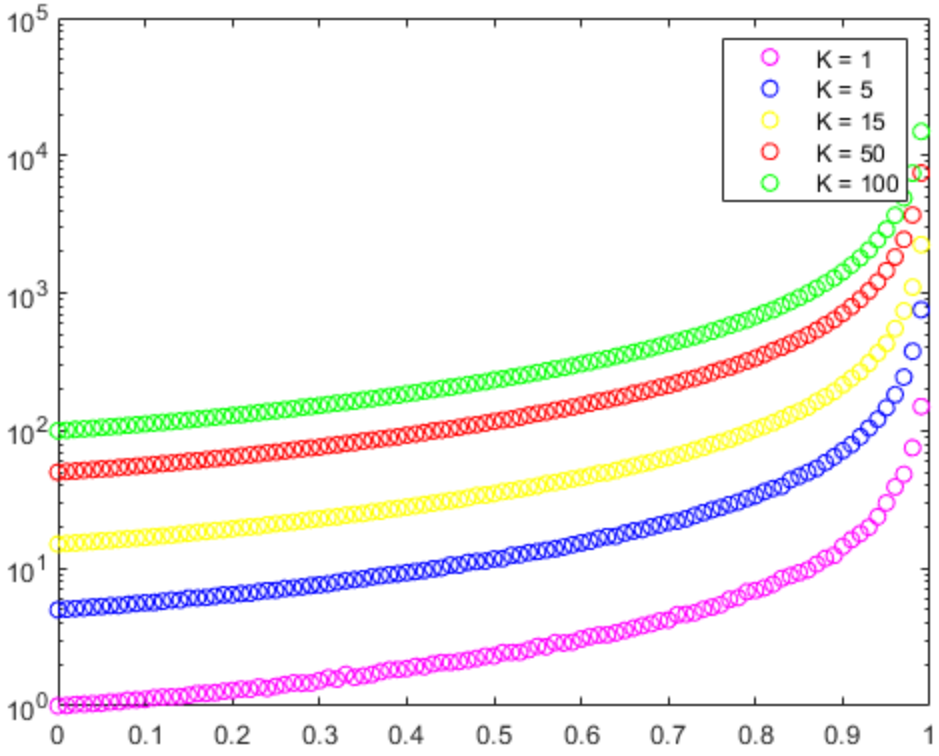
Part 1

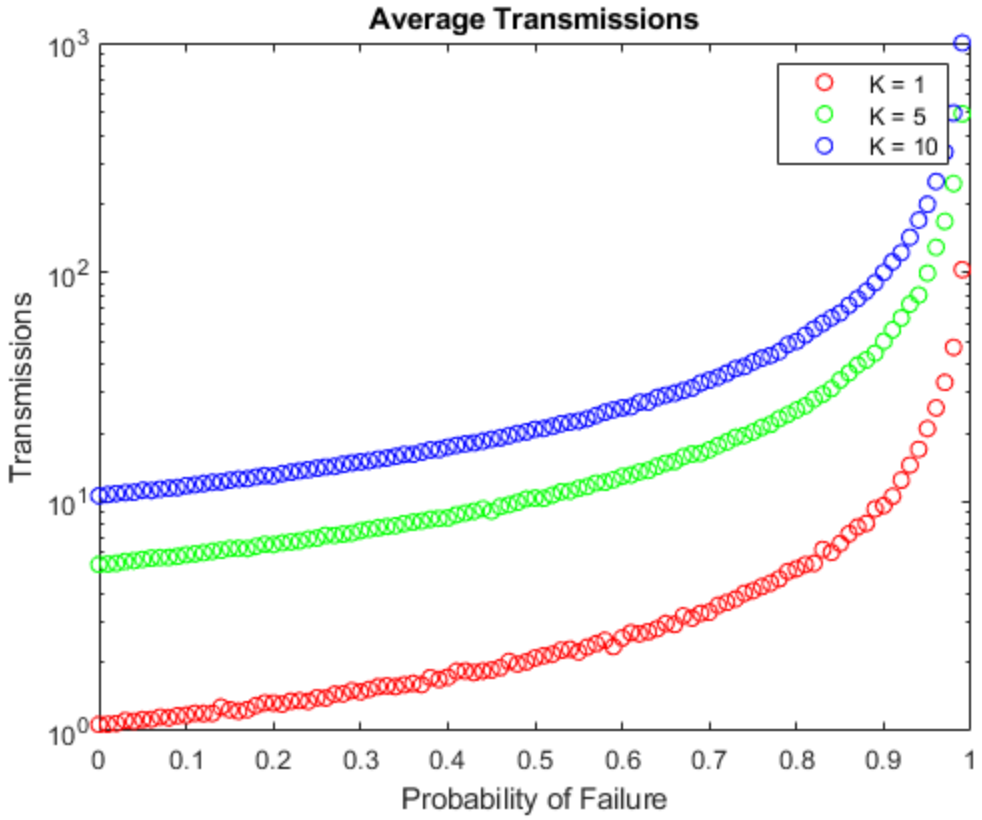
```
k_Array = [1, 5, 10];
p1 = 0.1;
p2 = 0.6;
p3_Array = 0 : 0.01 : 0.99;
N = 1000;
simValues = zeros(3, 100);

for i = 1 : 3
 K = k_Array(i);
 for j = 1 : 100
  p3 = p3_Array(j);
  simValues(i, j) = runCustomCompoundNetworkSim(K, p1, p2, p3, N);
 end
end

figure();
semilogy(p3_Array, simValues(1, :), 'ro');
hold on;
semilogy(p3_Array, simValues(2, :), 'go');
semilogy(p3_Array, simValues(3, :), 'bo');
title("Average Transmissions");
ylabel("Transmissions");
xlabel("Probability of Failure");
legend("K = 1", "K = 5", "K = 10");

% Part 2

k_Array = [1, 5, 10];
p1 = 0.6;
p2 = 0.1;
p3_Array = 0 : 0.01 : 0.99;
N = 1000;
simValues = zeros(3, 100);

for i = 1 : 3
 K = k_Array(i);
 for j = 1 : 100
  p3 = p3_Array(j);
  simValues(i, j) = runCustomCompoundNetworkSim(K, p1, p2, p3, N);
 end
end

figure();
semilogy(p3_Array, simValues(1, :), 'ro');
hold on;
semilogy(p3_Array, simValues(2, :), 'go');
semilogy(p3_Array, simValues(3, :), 'bo');
title("Average Transmissions");
ylabel("Transmissions");
```

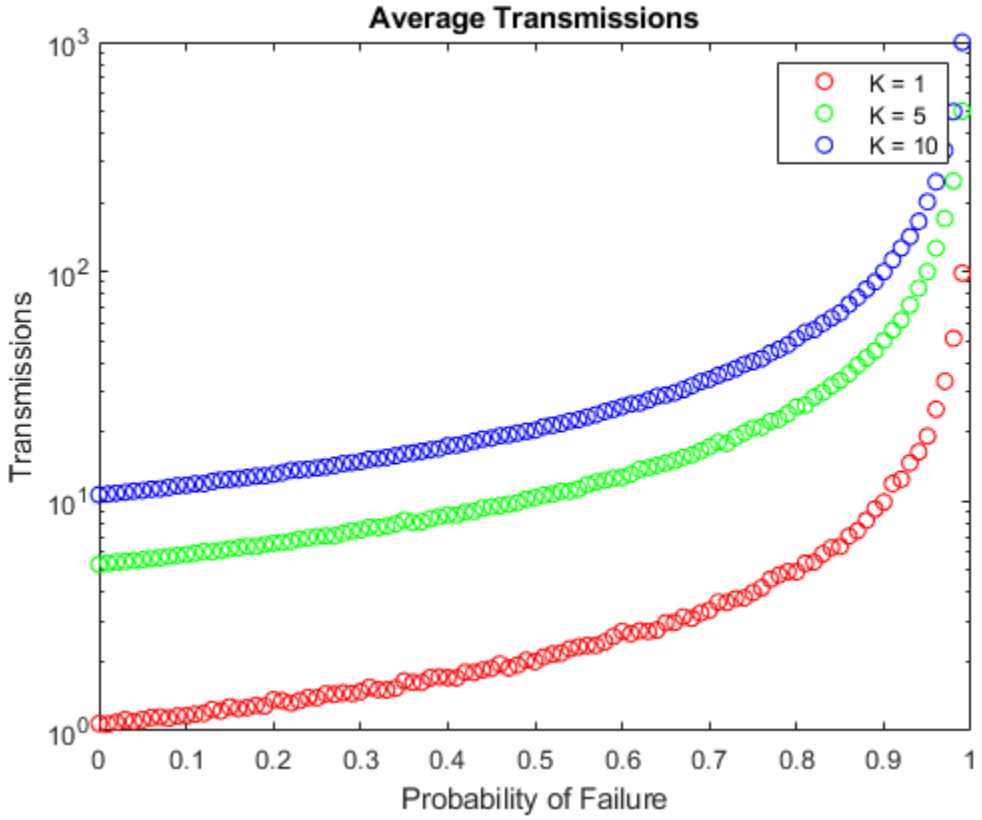
```
xlabel("Probability of Failure");
legend("K = 1", "K = 5", "K = 10");

% Part 3

k_Array = [1, 5, 10];
p1 = 0.1;
p3 = 0.6;
p2_Array = 0 : 0.01 : 0.99;
N = 1000;
simValues = zeros(3, 100);

for i = 1 : 3
 K = k_Array(i);
 for j = 1 : 100
  p2 = p2_Array(j);
  simValues(i, j) = runCustomCompoundNetworkSim(K, p1, p2, p3, N);
 end
end

figure();
semilogy(p2_Array, simValues(1, :), 'ro');
hold on;
semilogy(p2_Array, simValues(2, :), 'go');
semilogy(p2_Array, simValues(3, :), 'bo');
title("Average Transmissions");
ylabel("Transmissions");
xlabel("Probability of Failure");
legend("K = 1", "K = 5", "K = 10");

% Part 4

k_Array = [1, 5, 10];
p1 = 0.6;
p3 = 0.1;
p2_Array = 0 : 0.01 : 0.99;
N = 1000;
simValues = zeros(3, 100);

for i = 1 : 3
 K = k_Array(i);
 for j = 1 : 100
  p2 = p2_Array(j);
  simValues(i, j) = runCustomCompoundNetworkSim(K, p1, p2, p3, N);
 end
end

figure();
semilogy(p2_Array, simValues(1, :),'ro');
hold on;
semilogy(p2_Array, simValues(2, :), 'go');
semilogy(p2_Array, simValues(3, :), 'bo') ;
title("Average Transmissions");
ylabel("Transmissions");
```

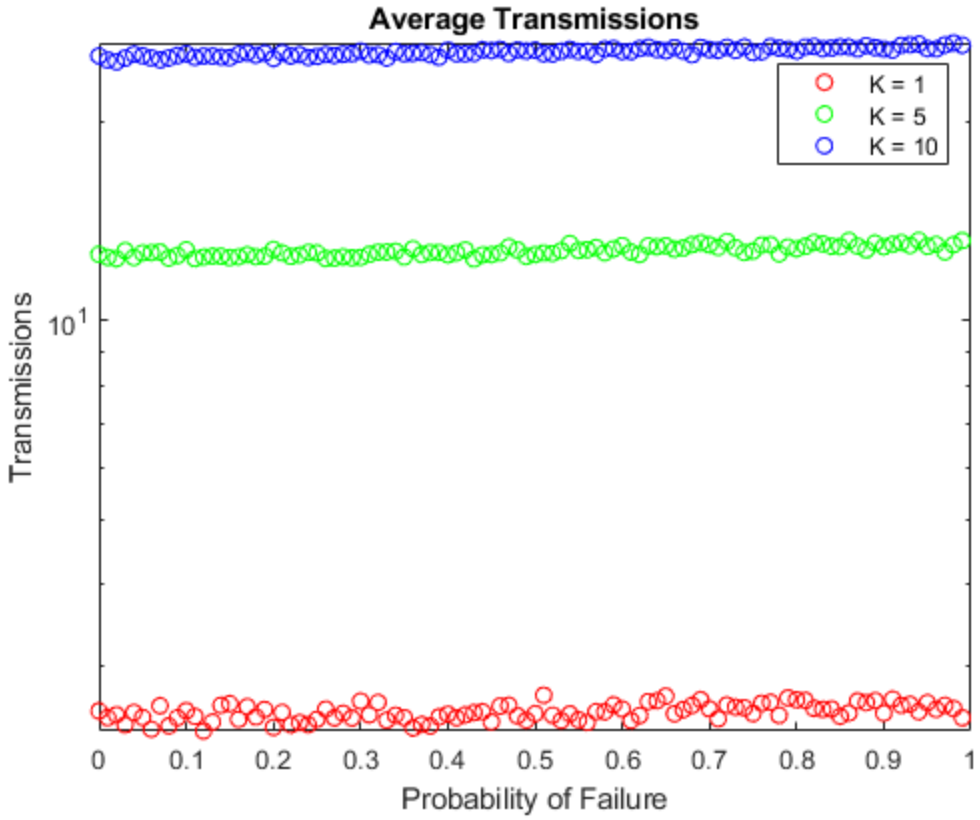
```
xlabel("Probability of Failure");
legend("K = 1", "K = 5", "K = 10");

% Part 5

k_Array = [1, 5, 10];
p3 = 0.6;
p2 = 0.1;
p1_Array = 0 : 0.01 : 0.99;
N = 1000;
simValues = zeros(3, 100);

for i = 1 : 3
 K = k_Array(i);
 for j = 1 : 100
  p1 = p1_Array(j);
  simValues(i, j) = runCustomCompoundNetworkSim(K, p1, p2, p3, N);
 end
end

figure();
semilogy(p1_Array, simValues(1, :), 'ro');
hold on;
semilogy(p1_Array, simValues(2, :), 'go');
semilogy(p1_Array, simValues(3, :), 'bo');
title("Average Transmissions");
ylabel("Transmissions");
xlabel("Probability of Failure");
legend("K = 1", "K = 5", "K = 10");

% Part 6

k_Array = [1, 5, 10];
p3 = 0.1;
p2 = 0.6;
p1_Array = 0 : 0.01 : 0.99;
N = 1000;
simValues = zeros(3, 100);

for i = 1 : 3
 K = k_Array(i);
 for j = 1 : 100
  p1 = p1_Array(j);
  simValues(i, j) = runCustomCompoundNetworkSim(K, p1, p2, p3, N);
 end
end

figure();
semilogy(p1_Array, simValues(1, :), 'ro');
hold on;
semilogy(p1_Array, simValues(2, :), 'go');
semilogy(p1_Array, simValues(3, :), 'bo');
title("Average Transmissions");
ylabel("Transmissions");
```

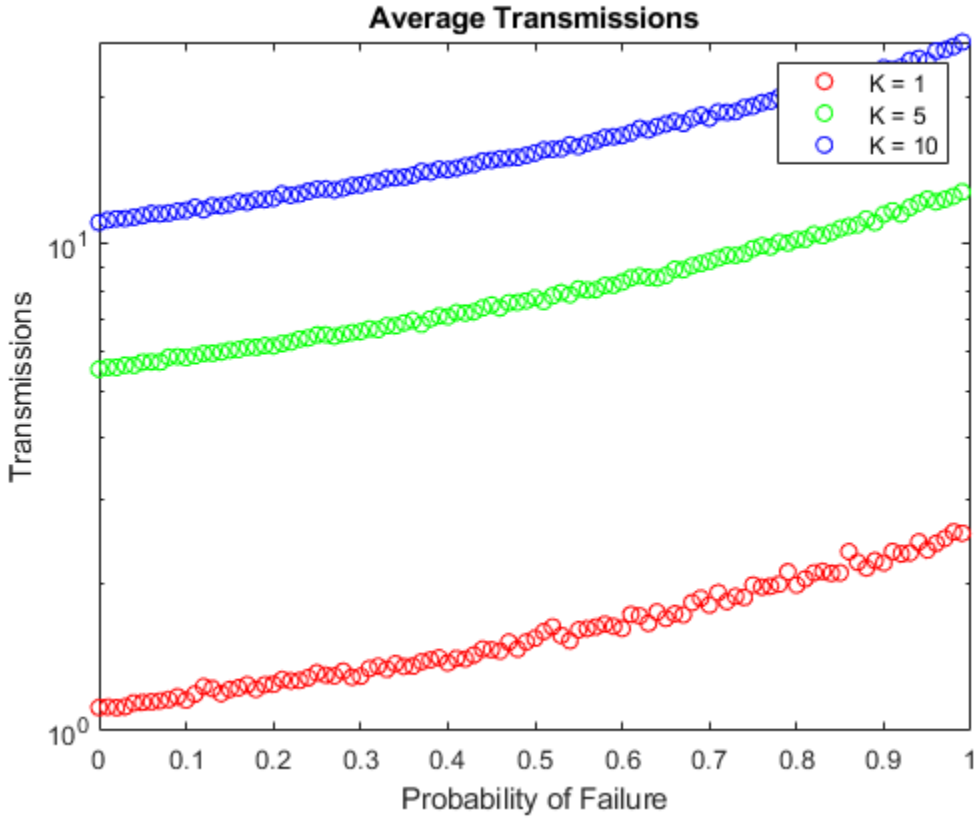
```
xlabel("Probability of Failure");
legend("K = 1", "K = 5", "K = 10");
```

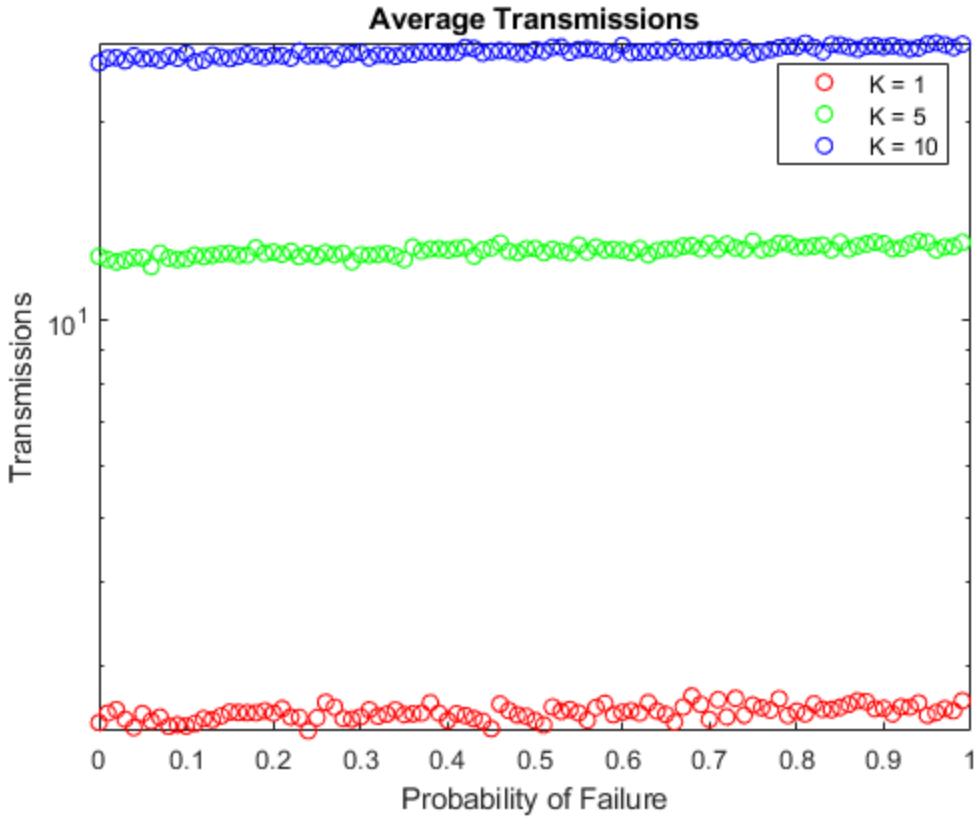


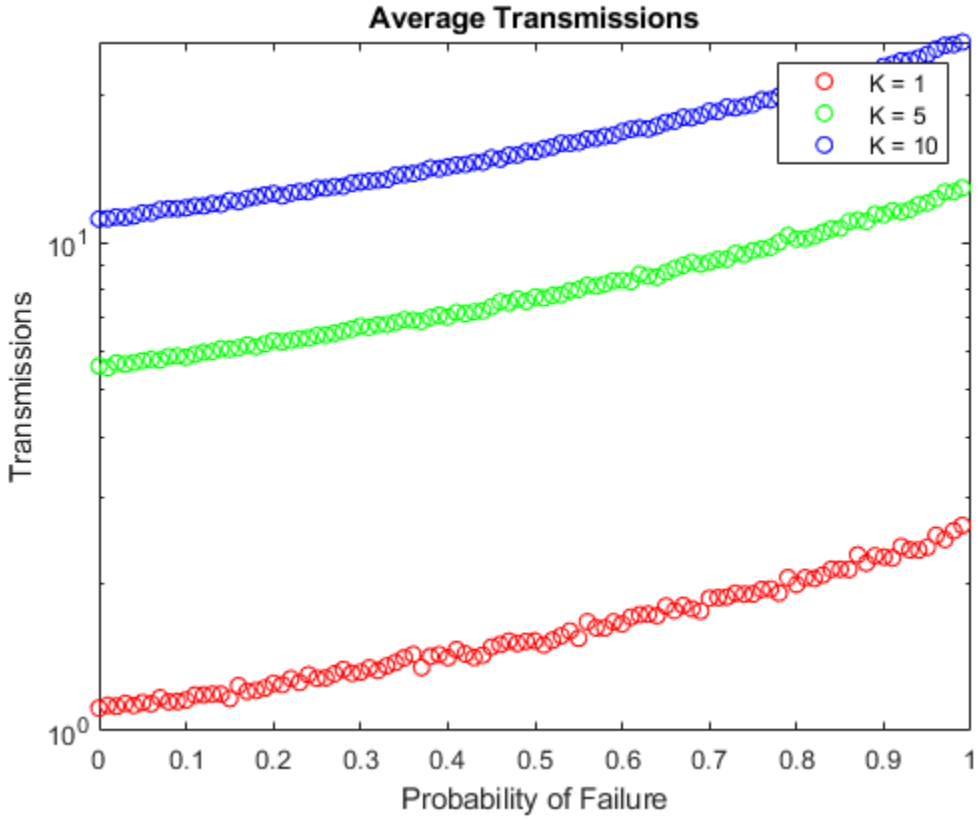

Average Transmissions
K = 1
K = 5
K = 10
Transmissions
Probability of Failure
10^0
10^1
10^2
10^3
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1


Average Transmissions
K = 1
K = 5
K = 10
Transmissions
Probability of Failure
10^0
10^1
10^2
10^3
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1


Average Transmissions
K = 1
K = 5
K = 10
Transmissions
10^1
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
Probability of Failure


Average Transmissions
K = 1
K = 5
K = 10
Transmissions
10^1
10^0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
Probability of Failure


Average Transmissions
K = 1
K = 5
K = 10
Transmissions
10^1
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
Probability of Failure


Average Transmissions
K = 1
K = 5
K = 10
Transmissions
10^1
10^0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
Probability of Failure

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