A. Derive Erlang-B formula using state truncation:

Erlang-B formula is conventionally derived from the Markov Chain of the $M/M/m/m$ queue. However, the same result can also be obtained by applying state truncation to the Markov Chain of the $M/M/\infty$ queue. Please, derive the Erlang-B formula using the latter option.

B. Two classes of connections share the same network link:

consider two classes of connections. Connections in Class 1 require a fixed amount of bandwidth $B_1$, their arrival process is Poisson with rate $\lambda_1$, and their service time is exponential with rate $\mu_1$. Connections in Class 2 require a fixed amount of bandwidth $B_2$, their arrival process is Poisson with rate $\lambda_2$, and their service time is exponential with rate $\mu_2$. Class 1 and Class 2 connections share a common network link, with a total bandwidth $B$. Connections are considered in a First Come First Serve (FCFS) fashion, and they are admitted onto the link as long as there is sufficient bandwidth available (unreserved). A connection is blocked and discarded if the link does not have sufficient bandwidth available. When a connection of Class 1 (Class 2) is admitted, the right amount of bandwidth $B_1$ ($B_2$) is reserved in the link for the entire duration of the connection. When the connection is over, after a service time with average $1/\mu_1$ ($1/\mu_2$) such reserved bandwidth is freed to be made available to other incoming connections.

1. Assuming $B = \infty$,
   i. derive the exact Continuous Time Markov Chain model for the system;
   ii. derive the blocking probability for each class: $P_1$ and $P_2$;
   iii. derive the average number of active connections in the link: $N_1$ and $N_2$.

2. Assuming $0 < B_2 < B_1 < B < \infty$,
   i. derive the exact Continuous Time Markov Chain model for the system;
   ii. derive the blocking probability for each class: $P_1$ and $P_2$;
   iii. derive the average number of active connections in the link: $N_1$ and $N_2$.

C. Compute numerically (using a programming language of your choice) and plot the values of $P_1$, $P_2$, $N_1$ and $N_2$ as a function of $\rho = \lambda_1/\mu_1 = \lambda_2/\mu_2$ using the following values:

1. $B_2 = 2.5, B_1 = 15, B = 100$;
2. $B_2 = 2.5, B_1 = 15, B = 1,000$. 