9. Airport Simulation Problem

**Problem Statement**:

You are to simulate arrivals and departures from a fictional airport with a single runway which has a capacity of handling a total 6 aircraft at once (any mix of takeoffs and landings). The purpose of the simulation is to determine how long aircraft will wait to access the runway. Of particular interest is how long airplanes need to wait (queue) in the air before landing since that will require burning fuel.

**Assumptions and Constraints:**

Airplanes arrive and depart with a single Poisson distribution at an average rate of 5 aircraft per time interval. Assume 50% are arrivals and 50% departures. Thus use one inter-arrival CPG which is exponential and 1/lambda is 1/5 (.2). Use If statement to make half arrivals (landing) and half departures (takeoff).

The single runway can accommodate a maximum of 6 aircraft (any mix of takeoff and landing aircraft) per time interval.

Assume it take one unit of time, exponentially distributed, for the plane to either takeoff or land once it can access the runway. Hence the “service” time is exponentially distributed with an average of 1 time interval.

**Initial Conditions:**

There are no airplanes in the landing queue.

There are no flights awaiting departure.

Your queues have no effective limit since there is plenty of space and tarmac.

**Operating Conditions:**

Assume arriving and departing flights are given the **same priority** for accessing the runway.

Since arriving aircraft have limited fuel we want to determine how many time intervals they wait before having access to the strip.

Run the simulation for at least 200 aircraft using Excel.

From the spreadsheet (a single run of at least 200 aircraft):

a. What is the average time an aircraft spends waiting to access the runway? .

b. What is the average number of aircraft on the queue (average queue length after entry).

c. What percent of aircraft have zero wait time to access the strip.

d. Develop a histogram of the number of aircraft on the queue. How many times is it 0, 1, 2, 3, etc.

 e. Develop a histogram of the number of intervals the aircraft had to wait before they accessed the strip. The histogram should include the number of aircraft that do not wait, wait 1 interval, wait 2 intervals, 3 intervals, etc.

f. What is the maximum queue length? What is the maximum wait time?

gh. Repeat the simulation, but this time let there be a **higher priority** given to the arriving (landing) airplanes. This means they move up in the queue ahead of departing flights. Compare the results. In particular what happened to the average wait time for the arriving aircraft? What about the departing aircraft average wait time? Obtain the histograms for number on the queue and waiting times for landing flights. Do the same for departing flights.