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# Ramapuram campus

# Department of Mathematics

18MAB204T- Probability and Queueing Theory

Year/Sem: II/IV Branch: CSE, IT

**Unit-IV-QUEUEING THEORY**

.  **PART B**

1. Write down the little’s formula.

(i).

(ii).

(iii)

(iv).

1. Customers arrive at one-man barber shop according to a poisson process with a mean interarrival of 12min. customers spend an average of 10min. in the barber’s chair. what is the expected number of customers in the barber’s and in the queue?

**SOLUTION:**Given: One man barber shop 🡪 single server

Customers 🡪 infinite capcity

The given problem is (M/M/1) :( /FIFO)

= , ,

The expected number of customers in the barber shop

The expected number of customers in the queue

(a) 5, 4.17 (b) 6,2.13 (c) 3,4.2 (d)7,8.9

**Ans(a)**

1. Customers arrive at one-man barber shop according to a poisson process with a mean interarrival of 12min. customers spend an average of 10min. in the barber’s chair what is the probability that more than 3 customers are in the system?

**SOLUTION:**Given: One man barber shop 🡪 single server

Customers 🡪 infinite capcity . The given problem is (M/M/1) :( /FIFO)

= , ,

P (N>3) =

= 0.4823.

(a) 0.4823 (b) 0.4736 (c) 0.5823 (d)0.5736

**Ans(a)**

1. The arrivals at the counter in a bank occur in accordance with a Poisson process at an average rate of 8 per hour .The duration of service of a customer has an exponential distribution with a mean of 6 minutes .Find the probability that an arriving customer has to wait.

**SOLUTION:**

Probability that customer has to wait = Probability that the system is busy =

1. Customers arrive at a one-man barber shop according to a Poisson process with a mean inter arrival time of 20 minutes .Customers spend an average of 15 minutes in the barber’s chair .If an hour is used as the unit of time ,then what is the probability that a customer need not wait for a hair cut?

**SOLUTION:**

(a) 0.35 (b) 0.25 (c) 0.025 (d)0.035**Ans(b)**

6.Customers arrive at a watch repair shop according to a Poisson process at a rate of one per every 10 minutes and the service time is an exponential random variable with mean 8 minutes.What is the probability that the server is idle?

**SOLUTION:**

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(a) (b) (c) (d)**Ans(d)**

7. A one person barber shop has six chairs to accommodate people waiting for a haircut. Assume that customers who arrive when all the six chairs are full leave without entering the barber shop. Customers arrive at the average rate of 3 per hour and spend an average of 15 minutes in the barber’s chair. What fraction potential customers are turned away?

**SOLUTION: Given that**

and

Capacity of the system =k = 6+1 = 7 Here

Here

A fraction of potential customers are turned away

i.e.,

(a) (b) (c) (d)**Ans(a)**

8. A one person barber shop has six chairs to accommodate people waiting for a haircut. Assume that customers who arrive when all the six chairs are full leave without entering the barber shop. Customers arrive at the average rate of 3 per hour and spend an average of 15 minutes in the barber’s chair.What is the expected number of customers waiting for a haircut?

**SOLUTION: Given that**

and

Capacity of the system =k = 6+1 = 7 Here

The expected number of customers waiting for a haircut =

Where

(a) 2.35 (b) 2.11 (c) 1.11 (d)1.35**Ans(b)**

9. A T.V. repairman finds that the time spent on his jobs has an exponential distribution with mean 30 minutes .If he repairs sets in the order in which they come in and if the arrival of sets is approximately Poisson ,with an average rate of 10 per 8 hour day ,How many jobs are ahead of the average set brought in?

SOLUTION:

(a) (b) (c) (d)**Ans(a)**

#### 10.Two sample of size 9 and 8 give the sums of squares of deviations from their respective means equal to 160 and 91 respectively. Could both samples be from populations with the samevariance?

#### 

1. Customers arrive at one-man barber shop according to a poisson process with a mean interarrival of 12min. customers spend an average of 10min. in the barber’s chair. How much time can customer expect to spend in the barber’s shop?

**SOLUTION:**Given: One man barber shop 🡪 single server

Customers 🡪 infinite capcity .The given problem is (M/M/1) :( /FIFO)

= , ,

Expected time a customer spends in the barber’s shop

12.Patients arrive at a clinic according to Poisson distribution at a rate of 30 patients per hour .The waiting room does not accommodate more than 14 patients .Examination time per patient is exponential with a mean rate of 20 per hour. Find the effective arrival rate at the clinic.

**SOLUTION: Given that**

and

Capacity of the system =k= Waiting patient + 1 being served in the chair

* K= 14+1 = 15 Here

Effective arrival rate at the clinic

Here

13.The arrivals at the counter in a bank occur in accordance with a Poisson process at an average rate of 8 per hour .The duration of service of a customer has an exponential distribution with a mean of 6 minutes .Find the probability that an arriving4 customers in the system.

**SOLUTION:**

Probability that there are 4 customers in the system =

14. Patients arrive at a clinic according to Poisson distribution at a rate of 30 patients per hour .The waiting room does not accommodate more than 14 patients .Examination time per patient is exponential with a mean rate of 20 per hour. What is the probability that an arriving patient does not have to wait?

**SOLUTION:**

and

Capacity of the system =k= Waiting patient + 1 being served in the chair

* K= 14+1 = 15 Here

The probability that an arriving patient does not have to wait =

1. Customers arrive at a one-man barber shop according to a Poisson process with a mean inter arrival time of 20 minutes .Customers spend an average of 15 minutes in the barber’s chair .If an hour is used as the unit of time ,then what is the probability that there will be 6 or more customers waiting for service?

**SOLUTION:**

1. Patients arrive at a clinic according to Poisson distribution at a rate of 30 patients per hour .The waiting room does not accommodate more than 14 patients .Examination time per patient is exponential with a mean rate of 20 per hour. What is the expected waiting time until a patient is discharged from the clinic?

**SOLUTION:**

and

Capacity of the system =k= Waiting patient + 1 being served in the chair

* K= 14+1 = 15 Here

The expected waiting time until a patient is discharged from the clinic

Where

= 39.102 mins

17. Customers arrive at a watch repair shop according to a Poisson process at a rate of one per every 10 minutes and the service time is an exponential random variable with mean 8 minutes.Find the average number of customers in the queue.

**SOLUTION:**

18. A T.V. repairman finds that the time spent on his jobs has an exponential distribution with mean 30 minutes .If he repairs sets in the order in which they come in and if the arrival of sets is approximately Poisson ,with an average rate of 10 per 8 hour day ,what is the repairman’s idle time each day? How many jobs are ahead of the average set brought in?

SOLUTION:

The repairman’s idle time for 1 hour =

The repairman’s idle time for each day =

19.The following data give the number of aircraft accident that occurred during the various days of aweek:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Days : | Mon | Tue | Wed | Thu | Fri | Sat |
| No of  accidents: | 15 | 19 | 13 | 12 | 16 | 15 |

Test the whether the accident are uniformly distributed over the week.





20.In a sample of 8 observations, the sum of the squared deviations of items from the mean was 94.5. In another sample of 10 observations, the value was found to be 101.7. Test whether the difference in the variances is significant at 5% level.

***Solution:*** Given



