Quality of Service
Seminar 3

UNIVERSITAT POMPEU FABRA

Date: Spring
Duration: 15 min.

- There is only one correct answer for each multiple choice question.
- Each correct answer adds 1 point.
- Each incorrect answer has a penalty of $\frac{1}{3}$ points.
- No score is awarded for unanswered questions, neither positive nor negative.
- Mark out your answers with an "X". Make sure that the "X" reaches the corners of the rectangle. ☒
- No score is awarded if you mark more than one answer.
- Pad your NIA with 0s on the left to complete the NIA field.

Write your personal data clearly.

Last name:	
First name:	
Group:	

Permutation: A

NIA:

	A	B	C	D		A	B	C	D
1					6				
2					7				
3					8				
4					9				
5					10				

1.- Consider a system with two queues with markovian arrivals where one of the queues has strict and preemptive priority over the other. The arrival rates to the high and low priority queues are $\lambda_{high} = 0{,}2$ packets per second and $\lambda_{low} = 0{,}6$ packets per second and the service rate is $\mu = 1$. Service times are exponentially distributed. What is the delay suffered by low priority packets (in seconds)?

(a) $Delay_{low} < 10$.

(b) $20 \leq Delay_{low} < 30$.

(c) $10 \leq Delay_{low} < 20$.

(d) $30 \leq Delay_{low} < 40$.

2.- Consider a system with two queues with markovian arrivals where one of the queues has strict and non-preemptive priority over the other. The arrival rates to the high and low priority queues are $\lambda_{high} = 0{,}2$ and $\lambda_{low} = 0{,}6$ and the service rate is $\mu = 1$. Service times are exponentially distributed. For convenience we define $\rho_{high} = \frac{\lambda_{high}}{\mu}$ and $\rho_{low} = \frac{\lambda_{low}}{\mu}$. What is the delay suffered by low priority packets (in seconds)?

(a) $20 \leq Delay_{low} < 30$.

(b) $30 \leq Delay_{low} < 40$.

(c) $10 \leq Delay_{low} < 20$.

(d) $Delay_{low} < 10$.

3.- In a M/M/1 queue, which is the average length of an idle period?

(a) μ^{-1}.

(b) ρ.

(c) λ.

(d) λ^{-1}.

4.- Consider a system with two queues with markovian arrivals where one of the queues has strict and preemptive priority over the other. The arrival rates to the high and low priority queues are λ_{high} and λ_{low} and the service rate is μ. Service times are exponentially distributed. What is the average number of packets in our system?

(a) $\frac{\frac{\lambda_{high}-\lambda_{low}}{\mu}}{\frac{1}{\mu}-\frac{\lambda_{high}+\lambda_{low}}{\mu}}$.

(b) $\frac{\frac{\lambda_{high}-\lambda_{low}}{\mu}}{1-\frac{\lambda_{high}+\lambda_{low}}{\mu}}$.

(c) $\frac{\frac{\lambda_{high}+\lambda_{low}}{\mu}}{1-\frac{\lambda_{high}+\lambda_{low}}{\mu}}$.

(d) $\frac{\frac{\lambda_{high}-\lambda_{low}}{\mu}}{\frac{1}{\mu}-\frac{\lambda_{high}-\lambda_{low}}{\mu}}$.

5.- Consider a system with two queues with markovian arrivals where one of the queues has strict and non-preemptive priority over the other. The arrival rates to the high and low priority queues are λ_{high} and λ_{low} and the service rate is μ. Service times are exponentially distributed. For convenience we define $\rho_{high} = \frac{\lambda_{high}}{\mu}$ and $\rho_{low} = \frac{\lambda_{low}}{\mu}$. What is the number of low-priority packets in the system?

(a) $N_{low} = \frac{\rho_{low}\left(1-\rho_{high}\left(1+\rho_{low}-\rho_{high}\right)\right)}{\left(1-\rho_{high}\right)\left(1-\rho_{high}-\rho_{low}\right)}$.

(b) $N_{low} = \frac{\rho_{low}\left(1-\rho_{high}\left(1-\rho_{low}-\rho_{high}\right)\right)}{\left(1-\rho_{high}\right)\left(1-\rho_{high}-\rho_{low}\right)}$.

(c) $N_{low} = \frac{\rho_{low}\left(\frac{1}{\mu}-\rho_{high}\left(1-\rho_{low}-\rho_{high}\right)\right)}{\left(1-\rho_{high}\right)\left(1-\rho_{high}-\rho_{low}\right)}$.

(d) $N_{low} = \frac{\rho_{low}\left(1-\rho_{high}\left(1-\rho_{low}-\rho_{high}\right)\right)}{\left(1-\rho_{low}\right)\left(1-\rho_{high}-\rho_{low}\right)}$.

6.- What is "preemptive priority" in a scenario with two traffic classes?

(a) The arrival of a high priority packet will interrupt the transmission of a low priority packet.

(b) The packets of the high priority traffic class are "preemptively" transmitted simultaneously.

(c) High priority packets are pre-fetched to start the transmission after a low-priority traffic is served.

(d) A high priority packet is transmitted only when the transmission of all low-priority packets is completed.

7.- In the case of a preemptive priority M/M/1 queue. Which is the delay introduced by a transmission buffer to the high priority class? Assume a traffic load equal to $A_{high} = \frac{\lambda_{high}}{\mu_{low}}$ for the high priority traffic and a load equal to $A_{low} = \frac{\lambda_{low}}{\mu_{low}}$ for the low priority traffic. $A_{high} + A_{low} < 1$

(a) $Delay_{high} = (\lambda_{high} + \lambda_{low})\frac{A_{high}}{A_{high}+A_{low}}$.

(b) $Delay_{high} = (\lambda_{high} - \lambda_{low})\frac{A_{high}}{A_{high}+A_{low}}$.

(c) $Delay_{high} = \frac{1}{\lambda_{high}}\frac{A_{high}}{1-A_{high}}$.

(d) $Delay_{high} = \lambda_{high}\frac{A_{high}}{1+A_{high}}$.

8.- Consider a system with two queues with markovian arrivals where one of the queues has strict and non-preemptive priority over the other. The arrival rates to the high and low priority queues are λ_{high} and λ_{low} and the service rate is μ. Service times are exponentially distributed. For convenience we define $\rho_{high} = \frac{\lambda_{high}}{\mu}$ and $\rho_{low} = \frac{\lambda_{low}}{\mu}$. What is the delay suffered by high priority packets?

(a) $Delay_{high} = \frac{1-\rho_{low}}{\mu\left(1-\rho_{high}\right)}$.

(b) $Delay_{high} = \frac{1+\rho_{low}}{\mu\left(1+\rho_{high}\right)}$.

(c) $Delay_{high} = \frac{(1+\rho_{low})\rho_{high}}{1-\rho_{high}}$.

(d) $Delay_{high} = \frac{1+\rho_{low}}{\mu(1-\rho_{high})}$.

9.- Consider a system with two queues with markovian arrivals where one of the queues has strict and preemptive priority over the other. The arrival rates to the high and low priority queues are λ_{high} and λ_{low} and the service rate is μ. Service times are exponentially distributed. What is the delay suffered by low priority packets?

(a) $Delay_{low} = \frac{\frac{1}{\mu}}{\left(1-\frac{\lambda_{low}}{\mu}-\frac{\lambda_{high}}{\mu}\right)\left(1+\frac{\lambda_{high}}{\mu}\right)}$.

(b) $Delay_{low} = \frac{\frac{\lambda}{\mu}}{\left(1-\frac{\lambda_{low}}{\mu}-\frac{\lambda_{high}}{\mu}\right)\left(1-\frac{\lambda_{high}}{\mu}\right)}$.

(c) $Delay_{low} = \frac{\frac{\lambda}{\mu}}{\left(1-\frac{\lambda_{low}}{\mu}+\frac{\lambda_{high}}{\mu}\right)\left(1-\frac{\lambda_{high}}{\mu}\right)}$.

(d) $Delay_{low} = \frac{\frac{1}{\mu}}{\left(1-\frac{\lambda_{low}}{\mu}-\frac{\lambda_{high}}{\mu}\right)\left(1-\frac{\lambda_{high}}{\mu}\right)}$.

10.- Consider a system with two queues with markovian arrivals where one of the queues has strict and non-preemptive priority over the other. The arrival rates to the high and low priority queues are λ_{high} and λ_{low} and the service rate is μ. Service times are exponentially distributed. For convenience we define $\rho_{high} = \frac{\lambda_{high}}{\mu}$ and $\rho_{low} = \frac{\lambda_{low}}{\mu}$. What is the delay suffered by low priority packets?

(a) $Delay_{low} = \frac{\frac{1}{\mu}\left(1-\rho_{high}\left(1-\rho_{low}-\rho_{high}\right)\right)}{(1-\rho_{low})\left(1-\rho_{high}-\rho_{low}\right)}$.

(b) $Delay_{low} = \frac{\frac{1}{\mu}\left(\frac{1}{\mu}-\rho_{high}\left(1-\rho_{low}-\rho_{high}\right)\right)}{\left(1-\rho_{high}\right)\left(1-\rho_{high}-\rho_{low}\right)}$.

(c) $Delay_{low} = \frac{\frac{1}{\mu}\left(1-\rho_{high}\left(1+\rho_{low}-\rho_{high}\right)\right)}{\left(1-\rho_{high}\right)\left(1-\rho_{high}-\rho_{low}\right)}$.

(d) $Delay_{low} = \frac{\frac{1}{\mu}\left(1-\rho_{high}\left(1-\rho_{low}-\rho_{high}\right)\right)}{\left(1-\rho_{high}\right)\left(1-\rho_{high}-\rho_{low}\right)}$.