



**Tecnológico  
de Monterrey**

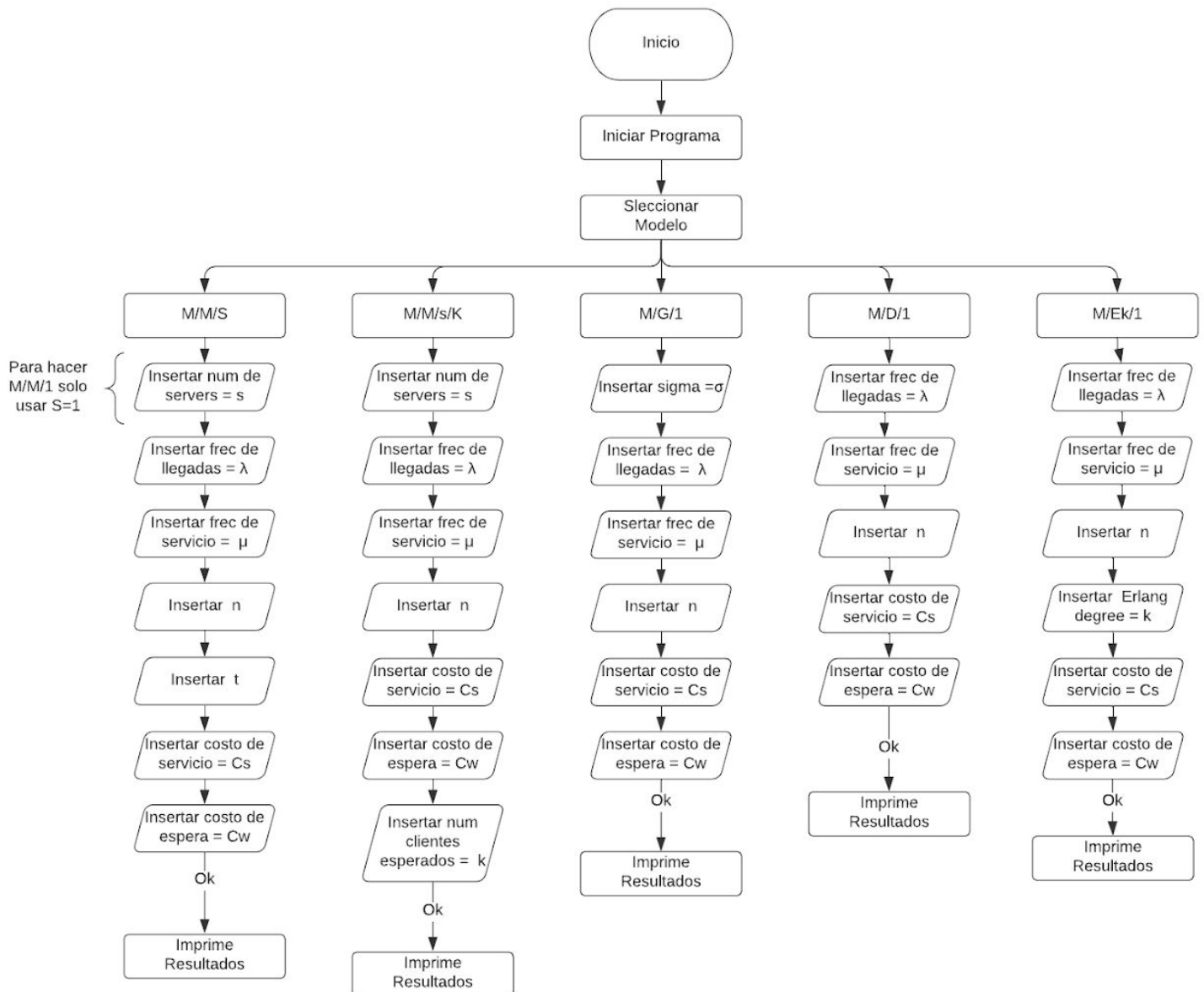
**TC2007: Métodos Cuantitativos y Simulación**

# **“Manual de Usuario Proyecto 2”**

## **Equipo 2**

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## Diagrama de Flujo



## Instalación y Ejecutar el programa

- Todos los archivos necesarios se encuentran en el siguiente repositorio:  
<https://github.com/SimonMettaG/Metodos-Cuantitativos-Segundo-Proyecto>
- Hay dos formas de descargar el ejecutable y el código fuente
  - Descargar la carpeta Zip y descomprimir ya sea con el asistente de Windows o un programa externo como Winrar u otros
  - Clonar el repositorio a su escritorio desde el bash

```
camil@DESKTOP-8IHILQJ MINGW64 ~/Desktop/Sem8/Met Cuantitativos y Sim  
$ git clone https://github.com/SimonMettaG/Metodos-Cuantitativos-Segundo-Proyecto.git
```

- Una vez dentro de la carpeta va a encontrar el ejecutable, los código fuente y el pdf del manual de usuario
- El ejecutable está en la carpeta llamada “SIMULADOR DE MODELOS DE FILAS DE ESPERA”
- Para correr el ejecutable solo necesita darle doble click y abrirlo
- Para correr el programa desde el código fuente
  - Es necesario tener instalado la version mas reciente de Python3:  
<https://www.python.org/downloads/>

Nota: los SO de IOs y Linux ya tienen instalado python,  
asegúrese de tener la versión más reciente de Python3

- En caso de no tenerlo deberás instalar el paquete de tkinter en Windows con el siguiente comando:
  - `python -m pip install tkinter`
- en Mac o Linux usar el siguiente comando:
  - `sudo pip install tkinter`
- Y para correr el programa usar estos comandos:
  - Windows: `python simulaciondefilas.py`
  - Mac/Linux `python3 simulaciondefilas.py`

- Una vez corriendo el programa puede escoger el método que desea usar. El menú está en la parte superior de la ventana.

Queue Simulator

M/M/s M/M/s/k M/G/1 M/D/1 M/Ek/1

Sigma  $\sigma$

Sigma  $\sigma$  Denotes the standard deviation of the distribution related to the arrival of customers

Frequency of service  $\lambda$

Lambda denotes the efficiency of a single server in a time interval.  
i.e. How many customers can it satisfy in said time interval.

Service frequency  $\mu$

The number of servers denotes how many clients can be dealt with simultaneously.  
Augmenting servers can affect cost.

Server cost  $C_s$

Cost of maintaining a single server over a time interval. (Can be left blank)

Waiting customer in line cost  $C_w$

Cost of keeping a single customer waiting in line. (can be left blank)

OK

- Llene los valores necesarios según el caso para obtener los resultados de  $P_0$ ,  $P_n$ ,  $\rho$ ,  $L$ ,  $W$ ,  $W_q$ ,  $L_q$ ,  $C_t$ ,  $C_l$ ,  $W_t$ ,  $W_q t$  y si es requerido mostramos la fórmula de  $C_n$
- Presione Ok para ver los resultados

## Modelos

- **Modelo M/M/1** (Para este modelo solo es necesario escribir 1 en el espacio de número de servers  $s=1$ )

Results	Queue Simulator
$P_0$ 0.3333333333333337	M/M/s M/M/s/k M/G/1 M/D/1 M/Ek/1
$P_n$ 0.2222222222222224	Number of servers (s) <b>1</b>
$\rho$ 0.6666666666666666	The number of servers denotes how many clients can be dealt with simultaneously. Augmenting servers can affect cost.
$L$ 1.9999999999999996	Frequency of arrivals $\lambda$ <b>2</b>
$W$ 0.9999999999999998	Lambda denotes how many clients arrive at the system in a given time interval.
$Wq$ 0.6666666666666665	Service frequency $\mu$ <b>3</b>
$Lq$ 1.3333333333333333	Miu denotes the efficiency of a single server. i.e. How many clients can be satisfied by a server in a given time interval.
$Ct$ 31.999999999999996	Given n <b>1</b>
$Cl$ 41.999999999999999	n will provide $P_n$ , or the probability that there will be n customers in the system. (defaults to 0)
$Wt$ 1.0	Given t <b>0</b>
$Wqt$ 0.6666666666666666	t provides the probability that the customer will be waiting more than t units of time in the system
$C_{n, 0 \leq n < s}$ $((2/3)^n / n!) * 0.3333333333333337$	Server cost $C_s$ <b>12</b>
$C_{n, n \geq s}$ $(3)^n / (1! * 1^{n-1}) * 0.3333333333333333$	Cost of maintaining a single server over a time interval. (Can be left blank)
	Waiting customer in line cos $C_w$ <b>15</b>
	Cost of keeping a single customer waiting in line. (can be left blank)
	OK

en caso de no tener  $C_s$  y  $C_w$  se pueden quedar vacíos, esto es igual para cualquier caso

No  $C_s$  or  $C_w$  detected

$C_s$  and  $C_w$  will be equal to 0

OK

Given t **0**

t provides the probability that the customer will be waiting more than t units of time in the system

Server cost  $C_s$  **0**

Cost of maintaining a single server over a time interval. (Can be left blank)

Waiting customer in line cos  $C_w$  **0**

Cost of keeping a single customer waiting in line. (can be left blank)

OK

Results
$P_0$ 0.3333333333333337
$P_n$ 0.2222222222222224
$\rho$ 0.6666666666666666
$L$ 1.9999999999999996
$W$ 0.9999999999999998
$Wq$ 0.6666666666666665
$Lq$ 1.3333333333333333
$Ct$ 0.0
$Cl$ 0.0
$Wt$ 1.0
$Wqt$ 0.6666666666666666
$C_{n, 0 \leq n < s}$ $((2/3)^n / n!) * 0.3333333333333337$
$C_{n, n \geq s}$ $(3)^n / (1! * 1^{n-1}) * 0.3333333333333333$

- Modelo M/M/s

Results	Queue Simulator
$P_0$ 0.09090909090909088	M/M/s M/M/s/k M/G/1 M/D/1 M/Ek/1
$P_n$ 0.10521885521885521	Number of servers (s) <input type="text" value="2"/>
$\rho$ 0.8333333333333334	The number of servers denotes how many clients can be dealt with simultaneously. Augmenting servers can affect cost.
L 5.454545454545457	Frequency of arrivals $\lambda$ <input type="text" value="100"/>
W 0.054545454545454564	Lambda denotes how many clients arrive at the system in a given time interval.
Wq 0.037878787878787894	Service frequency $\mu$ <input type="text" value="60"/>
Lq 3.7878787878787894	Miu denotes the efficiency of a single server. i.e. How many clients can be satisfied by a server in a given time interval.
Ct 0.0	Given n <input type="text" value="3"/>
Cl 0.0	n will provide Pn, or the probability that there will be n customers in the system. (defaults to 0)
Wt 1.0	Given t <input type="text" value="0"/>
Wqt 0.7575757575757577	t provides the probability that the customer will be waiting more than t units of time in the system
$C_n, 0 \leq n \leq 00/60)^n n / n! ) * 0.090909090909090$	Server cost $C_s$ <input type="text"/>
$C_n, n \geq s )^n n / (2! * 2^n (n-2)) ) * 0.090909090909090$	Cost of maintaining a single server over a time interval. (Can be left blank)
	Waiting customer in line cos Cw <input type="text"/>
	Cost of keeping a single customer waiting in line. (can be left blank)
	<input type="button" value="OK"/>

Results	Queue Simulator
$P_0$ 0.21052631578947367	M/M/s M/M/s/k M/G/1 M/D/1 M/Ek/1
$P_n$ 0.23684210526315788	Number of servers (s) <input type="text" value="3"/>
$\rho$ 0.5	The number of servers denotes how many clients can be dealt with simultaneously. Augmenting servers can affect cost.
L 1.736842105263158	Frequency of arrivals $\lambda$ <input type="text" value="120"/>
W 0.014473684210526316	Lambda denotes how many clients arrive at the system in a given time interval.
Wq 0.001973684210526316	Service frequency $\mu$ <input type="text" value="80"/>
Lq 0.23684210526315788	Miu denotes the efficiency of a single server. i.e. How many clients can be satisfied by a server in a given time interval.
Ct 71.36842105263158	Given n <input type="text" value="2"/>
Cl 143.3684210526316	n will provide Pn, or the probability that there will be n customers in the system. (defaults to 0)
Wt 1.0	Given t <input type="text" value="0"/>
Wqt 0.23684210526315788	t provides the probability that the customer will be waiting more than t units of time in the system
$C_n, 0 \leq n \leq s (120/80)^n n / n! ) * 0.210526315789473$	Server cost $C_s$ <input type="text" value="20"/>
$C_n, n \geq s (80)^n n / (3! * 3^n (n-3)) ) * 0.210526315788$	Cost of maintaining a single server over a time interval. (Can be left blank)
	Waiting customer in line cos Cw <input type="text" value="48"/>
	Cost of keeping a single customer waiting in line. (can be left blank)
	<input type="button" value="OK"/>

- Modelo M/M/s/K

Results	Queue Simulator
$P_0$ 0.4154	M/M/s M/M/s/k M/G/1 M/D/1 M/Ek/1 Number of servers (s) <input type="text" value="1"/> Cost of maintaining a single server over a time interval. (Can be left blank)
$P_k$ 0.1231	Frequency of service $\lambda$ <input type="text" value="2"/> Lambda denotes how many clients arrive at the system in a given time interval.
$P_n, n \leq s \quad ((2/3)^n/n!) * 0.41538461538461535$	Service frequency $\mu$ <input type="text" value="3"/> Miu denotes the efficiency of a single server. i.e. How many clients can be satisfied by a server in a given time interval.
$P_n, n > k$ 0	Given n <input type="text" value="1"/> n will provide $P_n$ , or the probability that there will be n customers in the system. (defaults to 0)
$P_3$ 0.1231	Server cost $C_s$ <input type="text"/> Cost of maintaining a single server over a time interval. (Can be left blank)
$\rho$ 0.6667	Cw <input type="text"/> Cost of keeping a single customer waiting in line. (can be left blank)
L 1.0154	Number of expected customers <input type="text" value="3"/> k is used in a M/M/s/k system to represent how many customers can be expected in a long time period. if k is indefinite, use M/M/s
W 0.5789	<input type="button" value="OK"/>
Wq 0.2456	
Lq 0.4308	

- Modelo M/G/1

Results	Queue Simulator
$P_0$ 0.4	M/M/s M/M/s/k M/G/1 M/D/1 M/Ek/1 Sigma $\sigma$ <input type="text" value="0.1"/> Sigma $\sigma$ Denotes the standard deviation of the distribution related to the arrival of customers
$P_n, n \quad ((3/5)^n/n!) * 0.4$	Frequency of service $\lambda$ <input type="text" value="3"/> Lambda denotes how many clients arrive at the system in a given time interval.
$P_1$ 0.24	Service frequency $\mu$ <input type="text" value="5"/> Miu denotes the efficiency of a single server. i.e. How many clients can be satisfied by a server in a given time interval.
$\rho$ 0.6	Given n <input type="text" value="1"/> n will provide $P_n$ , or the probability that there will be n customers in the system. (defaults to 0)
L 1.1625	Server cost $C_s$ <input type="text"/> Cost of maintaining a single server over a time interval. (Can be left blank)
W 0.3875	Waiting customer in line cos Cw <input type="text"/> Cost of keeping a single customer waiting in line. (can be left blank)
Wq 0.1875	<input type="button" value="OK"/>
Lq 0.5625	



- Modelo M/D/1

Results		Queue Simulator	
		M/M/s M/M/s/k M/G/1 M/D/1 M/Ek/1	
$P_0$	0.4	Frequency of service $\lambda$	3
$P_n, n$	$((3/5)^n/n!) * 0.4$	Lambda denotes how many clients arrive at the system in a given time interval.	
$P1$	0.24	Service frequency $\mu$	5
$\rho$	0.6	Miu denotes the efficiency of a single server. i.e. How many clients can be satisfied by a server in a given time interval.	
$L$	1.05	Given n	7
$W$	0.35	n will provide $P_n$ , or the probability that there will be n customers in the system. (defaults to 0)	
$Wq$	0.15	Server cost $C_s$	12
$Lq$	0.45	Cost of maintaining a single server over a time interval. (Can be left blank)	
$Ct, \text{ with } Lq$	18.75	Waiting customer in line cos $Cw$	15
$Ct, \text{ with } L$	27.75	Cost of keeping a single customer waiting in line. (can be left blank)	
		OK	

- Modelo M/Ek/1

Results		Queue Simulator	
		M/M/s M/M/s/k M/G/1 M/D/1 M/Ek/1	
$P_0$	0.4	Frequency of service $\lambda$	3
$P_n, n$	$((3/5)^n/n!) * 0.4$	Lambda denotes how many clients arrive at the system in a given time interval.	
$P1$	0.24	Service frequency $\mu$	5
$\rho$	0.6	Miu denotes the efficiency of a single server. i.e. How many clients can be satisfied by a server in a given time interval.	
$L$	1.1625	n customers	1
$W$	0.3875	n will provide $P_n$ , or the probability that there will be n customers in the system. (defaults to 0)	
$Wq$	0.1875	Erlang degree	4
$Lq$	0.5625	k is used in a M/M/s/k system to represent how many customers can be expected in a long time period. if k is indefinite, use M/M/s	
		Server cost $C_s$	
		Cost of maintaining a single server over a time interval. (Can be left blank)	
		Waiting customer in line cos $Cw$	
		Cost of keeping a single customer waiting in line. (can be left blank)	
		OK	