

# Simulação de uma praça de pedágio no Arena

Leonardo D. Secchin

Abril de 2024

# O problema

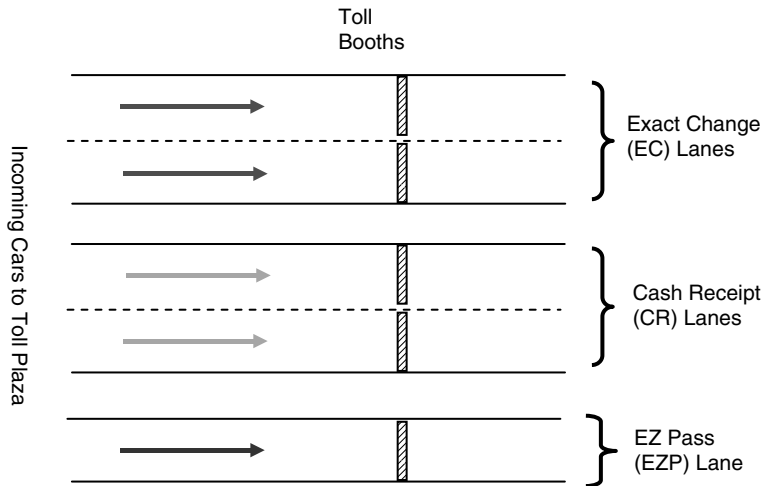
Objetivo: simular uma praça de pedágio com

- 2 cabines onde o motorista paga em **moedas** o valor **exato** do pedágio (não há troco);
- 2 cabines que recebem dinheiro e **dão troco**;
- 1 cabine para pagamento eletrônico automático.

Referência: Altioik, T.; Melamed, B. *Simulation modeling and analysis with Arena*. Academic Press, 2007



# O problema

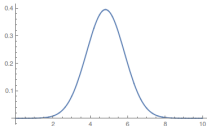


**Figure 13.28** A toll plaza system on the New Jersey Turnpike.

# Dados - Tipos de pagamento e tempo de passagem

- 50% dos carros pagam em MOEDAS

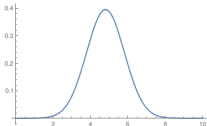
Tempo de passagem na cabine (seg):  $\text{Normal}(4.81, 1.01)$



# Dados - Tipos de pagamento e tempo de passagem

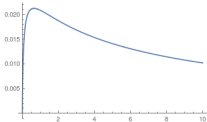
- 50% dos carros pagam em MOEDAS

Tempo de passagem na cabine (seg):  $\text{Normal}(4.81, 1.01)$



- 30% dos carros pagam em dinheiro, com TROCO

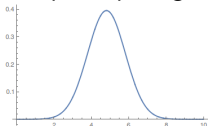
Tempo de passagem na cabine (seg):  $5 + \text{Logn}(4.67, 2.26)$



# Dados - Tipos de pagamento e tempo de passagem

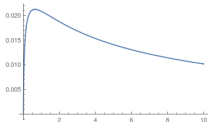
- 50% dos carros pagam em MOEDAS

Tempo de passagem na cabine (seg):  $\text{Normal}(4.81, 1.01)$



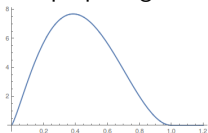
- 30% dos carros pagam em dinheiro, com TROCO

Tempo de passagem na cabine (seg):  $5 + \text{Logn}(4.67, 2.26)$



- 20% dos carros pagam ELETRONICAMENTE

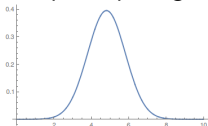
Tempo passagem cabine (seg):  $1.18 + 4.29 * \text{Beta}(2.27, 3.02)$



# Dados - Tipos de pagamento e tempo de passagem

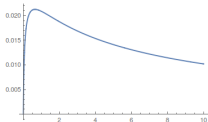
- 50% dos carros pagam em MOEDAS

Tempo de passagem na cabine (seg):  $\text{Normal}(4.81, 1.01)$



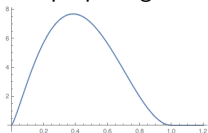
- 30% dos carros pagam em dinheiro, com TROCO

Tempo de passagem na cabine (seg):  $5 + \text{Logn}(4.67, 2.26)$



- 20% dos carros pagam ELETRONICAMENTE

Tempo passagem cabine (seg):  $1.18 + 4.29 * \text{Beta}(2.27, 3.02)$

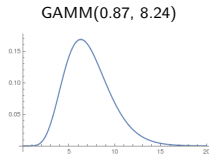
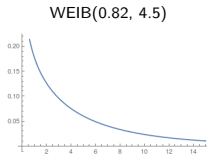
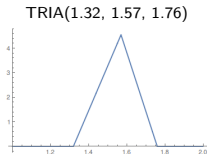
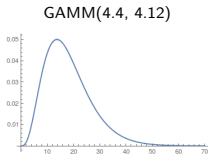


- Por cada cabine passa no máximo um carro de cada vez

# Dados - Tempo entre chegadas (trânsito em cada hora)

## Interarrival time distributions by time of day

Time Period (hours)	Interarrival Time Distribution (seconds)
12 A.M.–6 A.M.	$8 + \text{Gamm}(4.4, 4.12)$
6 A.M.–9 A.M.	$\text{Tria}(1.32, 1.57, 1.76)$
9 A.M.–4 P.M.	$2.64 + \text{Weib}(0.82, 4.5)$
4 P.M.–7 P.M.	$\text{Tria}(1.32, 1.57, 1.76)$
7 P.M.–12 A.M.	$4.2 + \text{Gamm}(0.87, 8.24)$



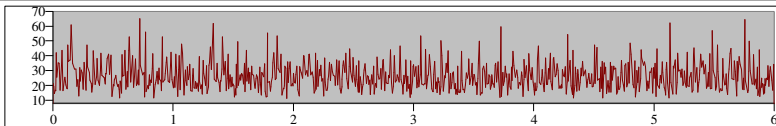


# Dados - Tempo entre chegadas (trânsito em cada hora)

Interarrival  
time (h)

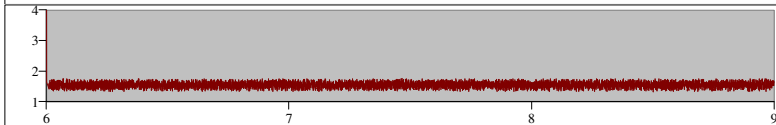
PERIODO 1

8+GAMM(4.4,4.12)



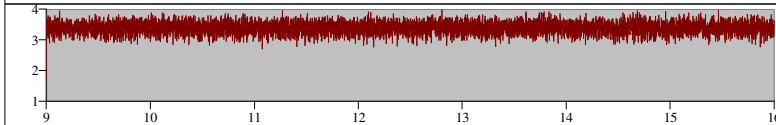
PERIODO 2

TRIA(1.32, 1.57, 1.76)



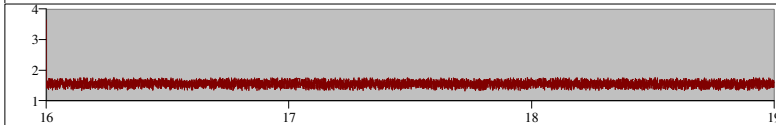
PERIODO 3

2.64+WEIB(0.82, 4.5)



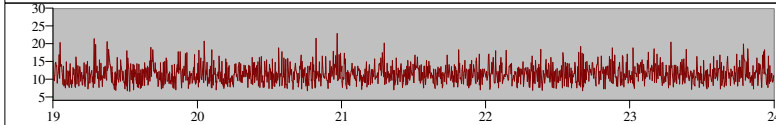
PERIODO 4

TRIA(1.32, 1.57, 1.76)



PERIODO 5

4.2+GAMM(0.87, 8.24)



- **Escolha entre as cabines que só recebem moedas:**  
a de menor fila
- **Escolha entre as cabines que dão troco:**  
a de menor fila, mas a 1a cabine só abre entre 6h-9h e 16h-19h

# Visão geral do modelo no Arena

