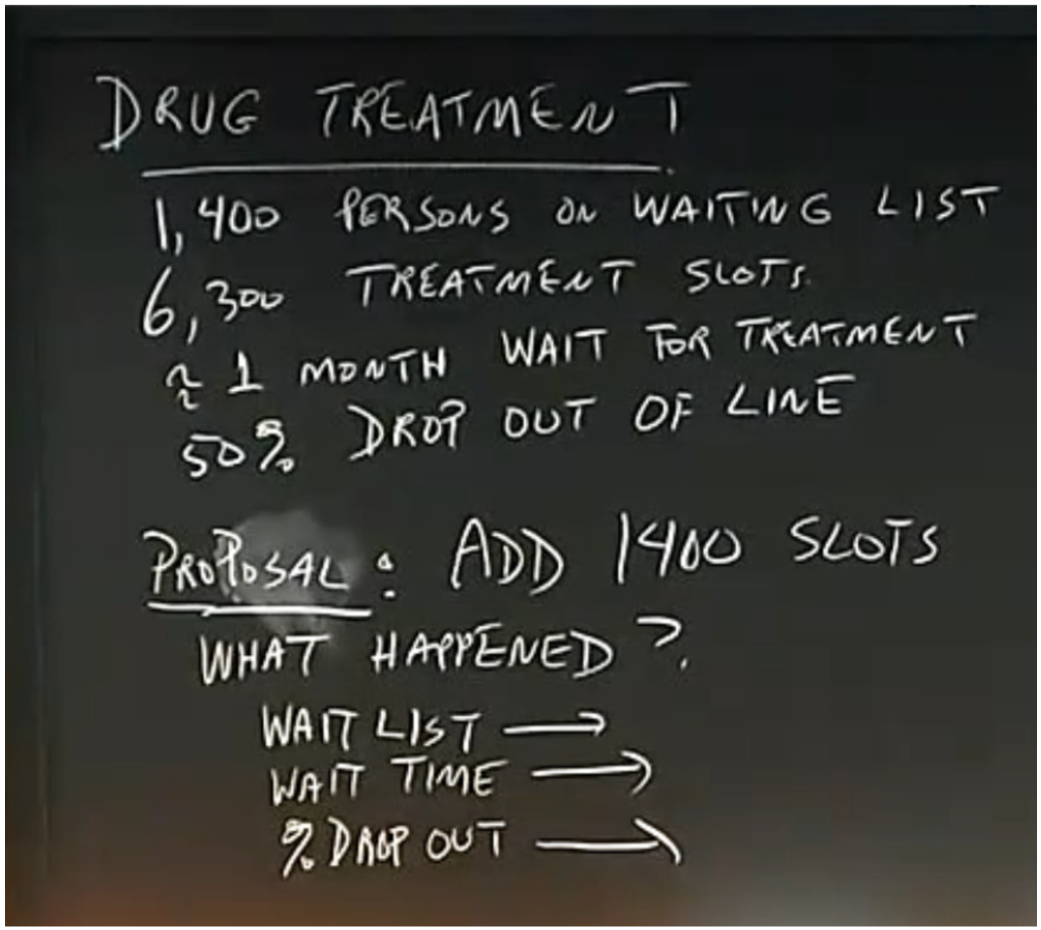
Drug Treatment on Demand? In San Francisco…



DRUG TREATMENT

1,400 PERSONS ON WAITING LIST
6,300 TREATMENT SLOTS
~ 1 MONTH WAIT FOR TREATMENT
50% DROP OUT OF LINE

PROPOSAL: ADD 1400 SLOTS

WHAT HAPPENED?

- WAIT LIST → 1,100
- WAIT TIME → 3 WKS
- % DROP OUT → 40%

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LET ATT = AVG TREATMENT TIME

$\mu = \frac{6300}{ATT}$ = ANNUAL SLOT TURNOVER

λ = DEMAND FOR TREATMENT

WHAT IS μ/λ ??

[redacted]

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ADD 1,400 SLOTS

LET $\mu' = \frac{\overbrace{6300 + 1400}^{7700}}{ATT} = \frac{7700}{6300} \cdot \frac{6300}{ATT}$

WHAT IS μ'/λ ??

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ADD 1,400 SLOTS 7700

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WHAT IS $\mu'/\lambda = 1.22 \frac{\mu}{\lambda} = .60$

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SUPPOSE DROPOUT PROPORTIONAL TO QUEUE LENGTH

0.5 $\propto$ 1400 BEFORE

$\propto$ AFTER

NEW QUEUE LENGTH?

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SUPPOSE DROPOUT PROPORTIONAL TO QUEUE LENGTH

$0.5 \propto 1400$		BEFORE
$0.4 \propto\ ?$		AFTER

NEW QUEUE LENGTH?

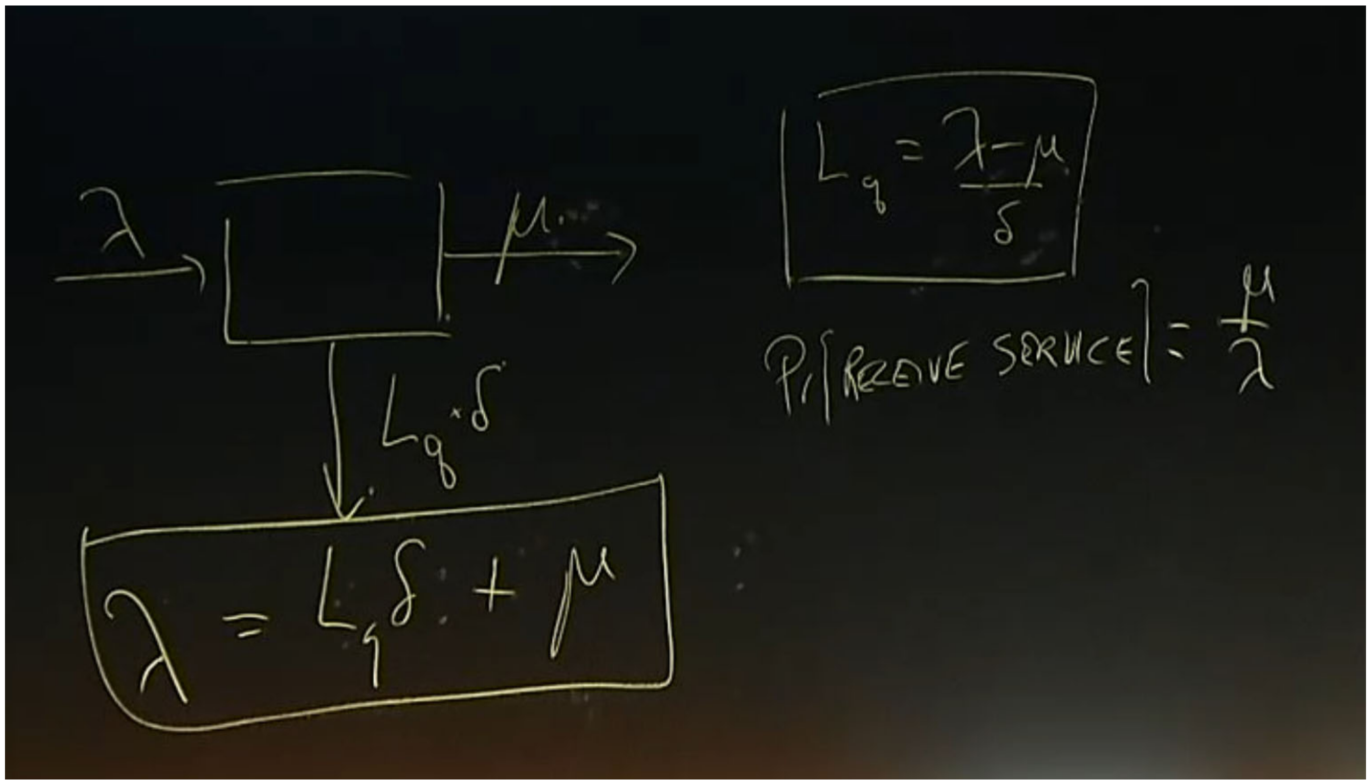
$\frac{1400}{0.5} = \frac{?}{0.4} \Rightarrow$ NEW QUEUE LENGTH $= \frac{0.4}{0.5} \times 1400$

$= 1,120$

What About Waiting Time?

- First, let's review the overall flows:

λ = treatment applicant rate
μ = total slot turnover rate
δ = reneging (dropout) rate
L_q = queue for drug treatment



Figuring Out The Waiting Time To Receive Treatment

$$\boxed{L_q = \frac{\lambda - \mu}{\delta}}$$

$$\Pr\{\text{RECEIVE SERVICE}\} = \frac{\mu}{\lambda}$$

$$\Pr\{\text{Willing to wait} > t\} = e^{-\delta t}$$

SUPPOSE W = WAITING TIME THAT GUARANTEES SERVICE

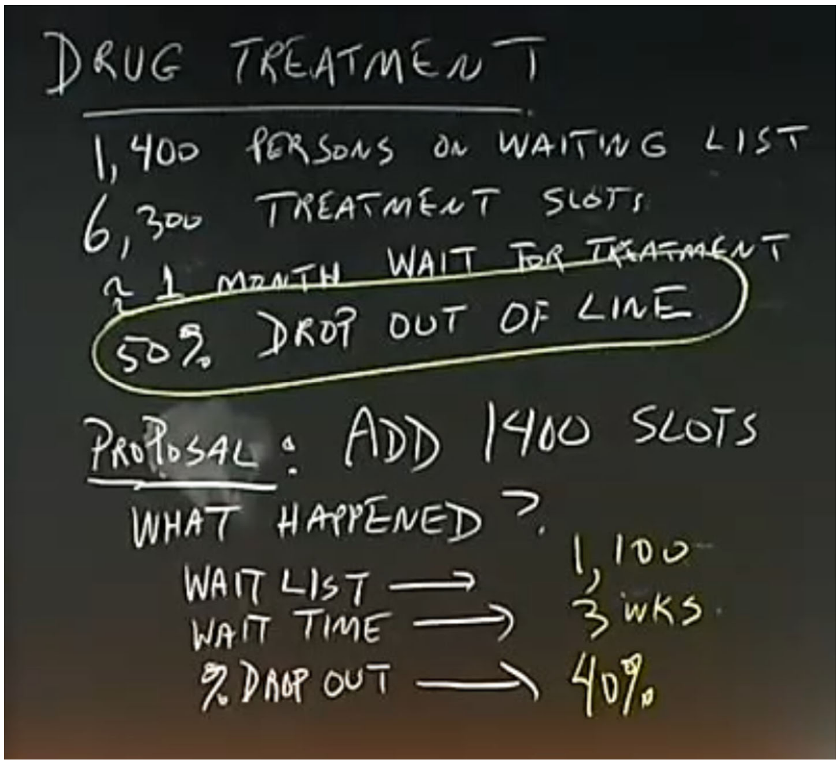
$$\Pr\{\text{RECEIVE SERVICE}\} = \Pr\{\text{WILLING TO WAIT} > W\} = \boxed{e^{-\delta W} = \frac{\mu}{\lambda}}$$

$$\boxed{W = \frac{1}{\delta} \ln(\lambda/\mu)}$$

Figuring Out The New Waiting Time

- In old regime we were told W = 1 month, plus dropout rate was 50%
- This means that λ/μ = 2, so W = $(1/\delta)$**ln*(λ/μ) = 1 month
- Note that *ln*(2) is about 0.6944
- So solve for $1/\delta = 1 / 0.6944 = 1.44$ months
- Also note that in old regime, L_q = 1400 = $(\lambda - \mu)/\delta$
- But $\lambda = 2\mu$ and $1/\delta = 1.44$ months ==> $\lambda = 1{,}944$/month (!!)
- In new regime, $\mu'/\ \lambda = 1.22 *\ \mu/\lambda = 0.6$
- Since λ/μ' = 1/0.6 and *ln*(1/0.6) is about 0.51 we have
- New W = $(1/\delta)$**ln*(λ/μ') = 1.44 * 0.51 = 0.73 months or about 3 weeks

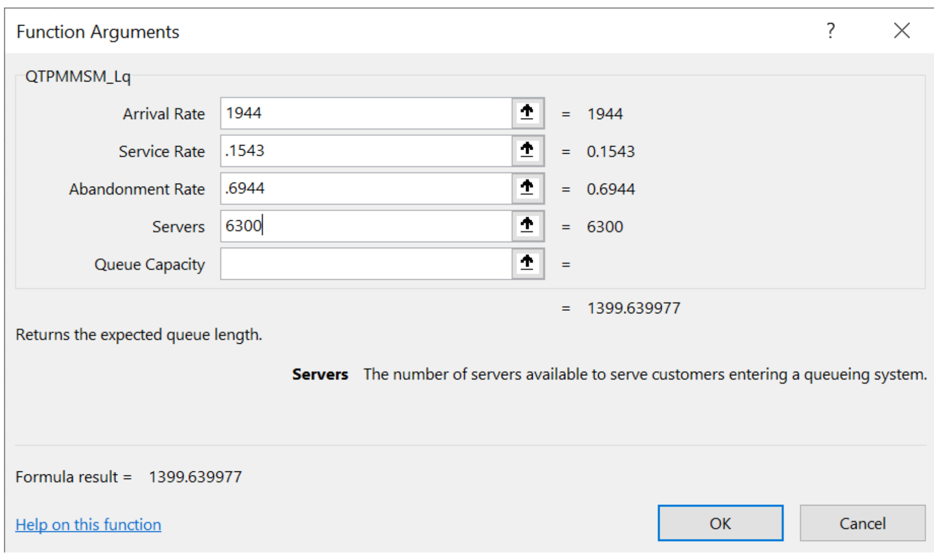
Data versus Model



- L_q = 1,120
- W = 0.73 months or 3 weeks
- % receiving treatment → 60% so dropout went to 40%

QTPMMSM Model
(last M for Memoryless Abandonment)

- Inputs: arrival rate, service rate *per server*, number of servers, reneging (or dropout or abandonment) rate *per customer*
- Outputs: L_q, W, Pr{Dropout}, etc.



Treatment on Demand		
	Original Regime	New Regime
Arrival Rate (per month)	1944	1944
Treatment Rate (per slot per month)	0.1543	0.1543
Abandonment Rate (per drug user per month)	0.6944	0.6944
Number of Slots	6300	7700
Average Waiting for Treatment (L_q)	1399.639977	1088.55127
Fraction that Drop Out	0.499953704	0.3888323
Average Waiting Time for Those Admitted (months)	0.998576906	0.70949907