Silent Abandonment in Contact Centers: Estimating Customer Patience with Uncertain Data.

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Service Engineering

- High reliance and effort to create a series of objective performance measures (MOPs) and connecting them to operational decisions.
- Need to be objective and complete.

Service Engineering

- Abandonment and customers' willingness to wait: tools for understanding customer experience (Mandelbaum and Zeltyn 2013).
- However, we rely on the fact that we are able to measure them.
- In certain service contexts we don't know when the customer abandoned and even if the customer abandoned or not: *Focus of our talk.*

How We Connect

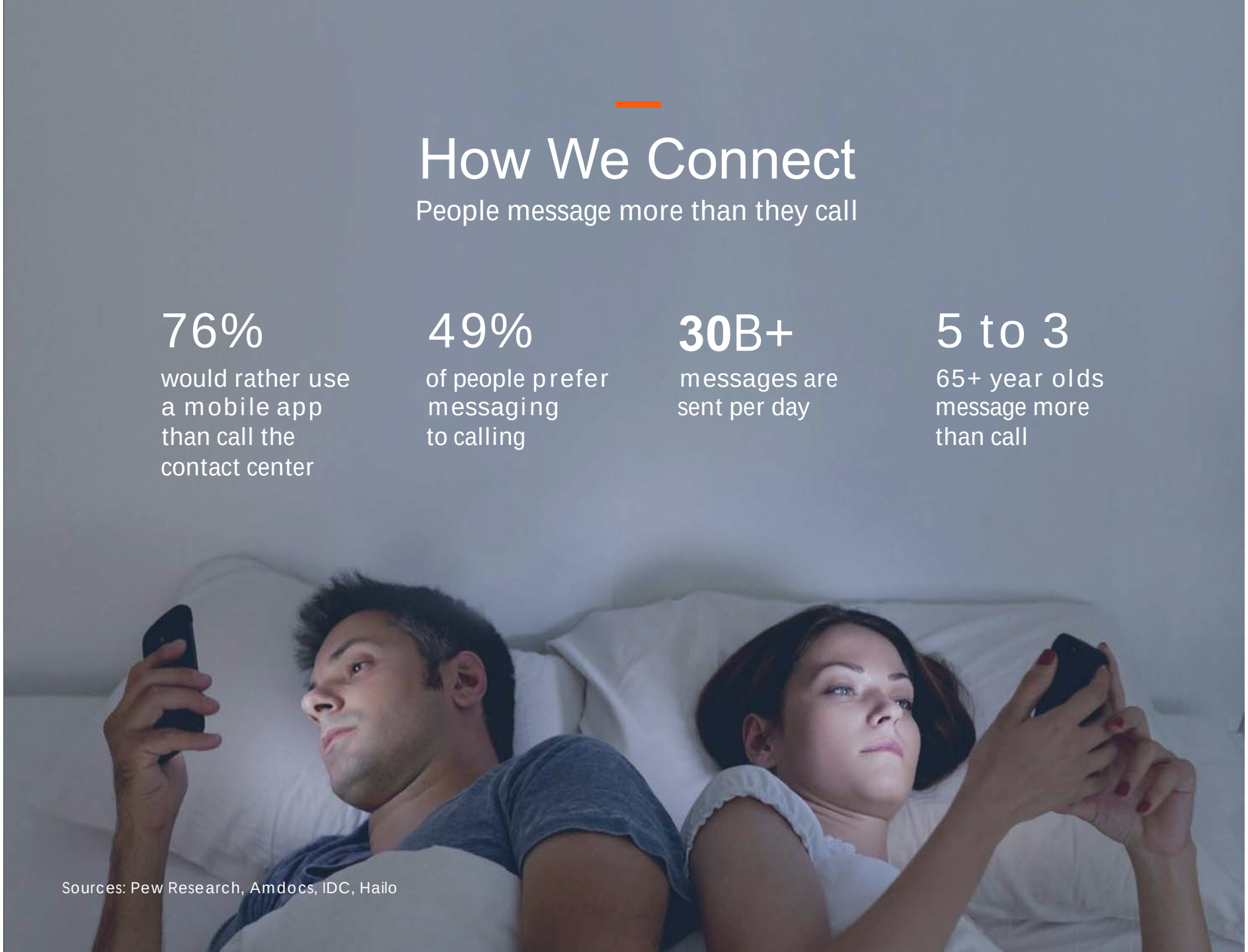
People message more than they call

76%
would rather use a mobile app than call the contact center

49%
of people prefer messaging to calling

30B+
messages are sent per day

5 to 3
65+ year olds message more than call



Sources: Pew Research, Amdocs, IDC, Hailo

Chat Systems

1 Visitor 4:04pm

Visitor 4:05pm
Hi, I can't understand my bill, why was I charged for overseas calls?

Beth A 4:08pm
Could you please provide with your account number and home address?

Visitor 4:08pm
Sure. It's 23254658, 24th Hudson st.

Beth A 4:09pm
Can you please wait for a moment while I find that information for you.

Thank you for waiting. I have some information for you. 4:14pm

B I U

Visit info

Campaign info

Campaign	Live Chat on your site
Source	Website

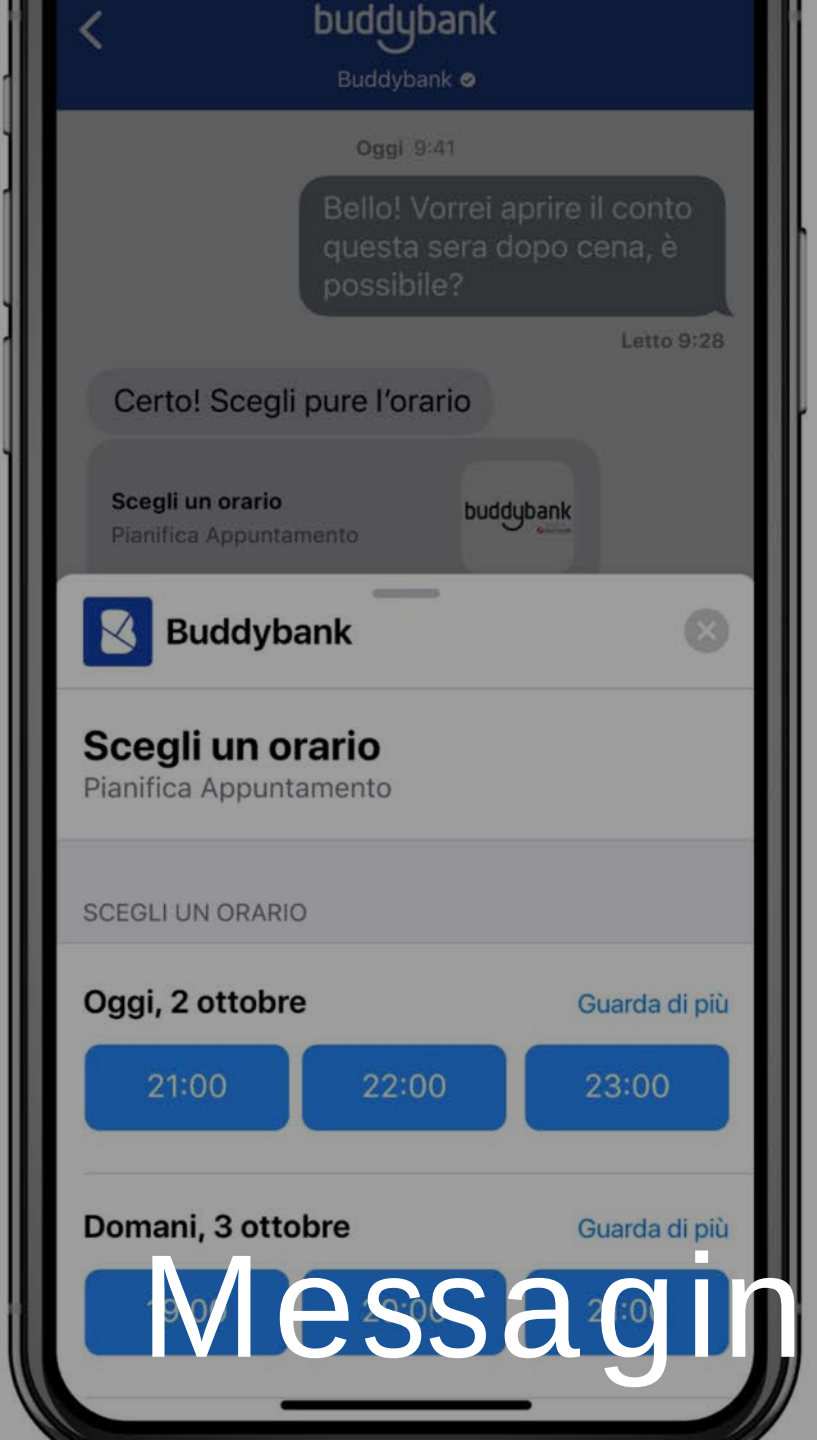
Visitor info

Visitor name	132.69.198.101
Wait time	00:09 min
Country	Israel
Device	Desktop
ISP	ILAN
Organization	Technion - Technolog institute
Operating System	Windows 8.1 (Windows NT 6.3)
Browser	NetScape

defined cont

Happy to help
Non responsive
One moment please
Question
Thanks for waiting
Closing
Transfer
Transfer to alternate ch
Transfer to Manager
Abuse
Privacy
Permission based servic

0 WAITING
1 Visitor
2 Visit
3 Visitor

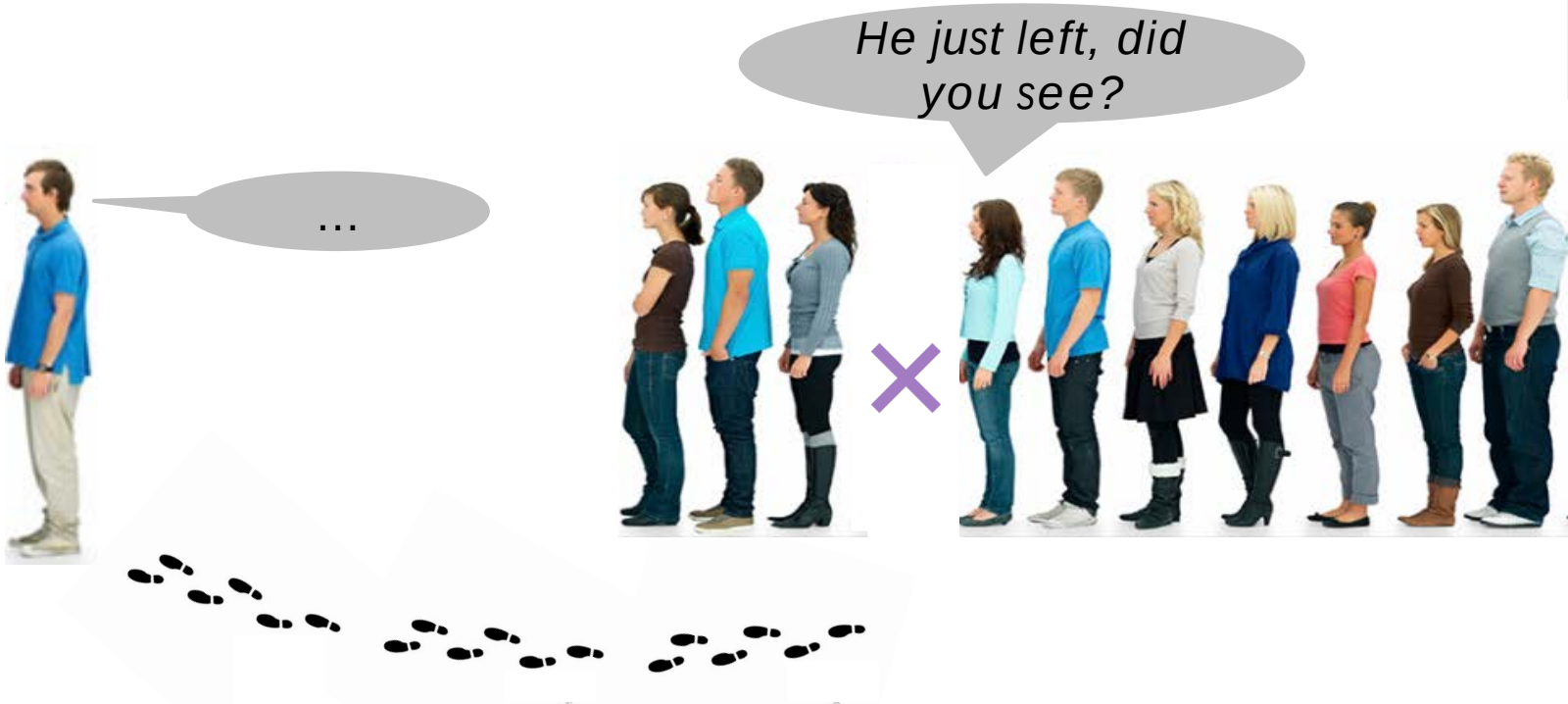


Messaging Systems

Challenge in Contact Centers

When estimating performance measures: we face uncertainty in performance…

Why?
The phenomena of Silent abandonment (Sab).



Agent Efficiency Problems

Operational problems regarding agent efficiency caused by silent abandonments:

a) Idleness.

b) Wasted work.

Estimating MOPs in Contact Centers

If we asked:

How many customers abandoned?

Wrong answer: finding out how many customers left the queue by closing the window/app of the interaction. (Known abandonments).

Chat system real data

Wrong answer of the company:
14% of customers abandon---Known abandonments.

Correct answer: identify Silent abandonments when the conversation includes no interaction with customer—6% -> 20% total abandonment!

4.32 minutes to identify Sab.
5% of the work time of agents is spent with Sab.

Messaging system real data

Wrong answer of the company:
7.2% of customers abandon (Known abandonments).

Correct answer: More complicated…
since the customer writes his inquiry before he enters the queue
-> problem: missing data!

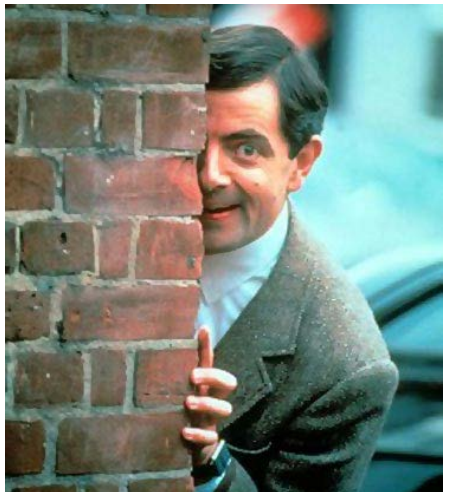
Messaging system. Missing Data.

26.2% of the arriving customers had a short interaction, we don't know if they were:

shortly serviced

or

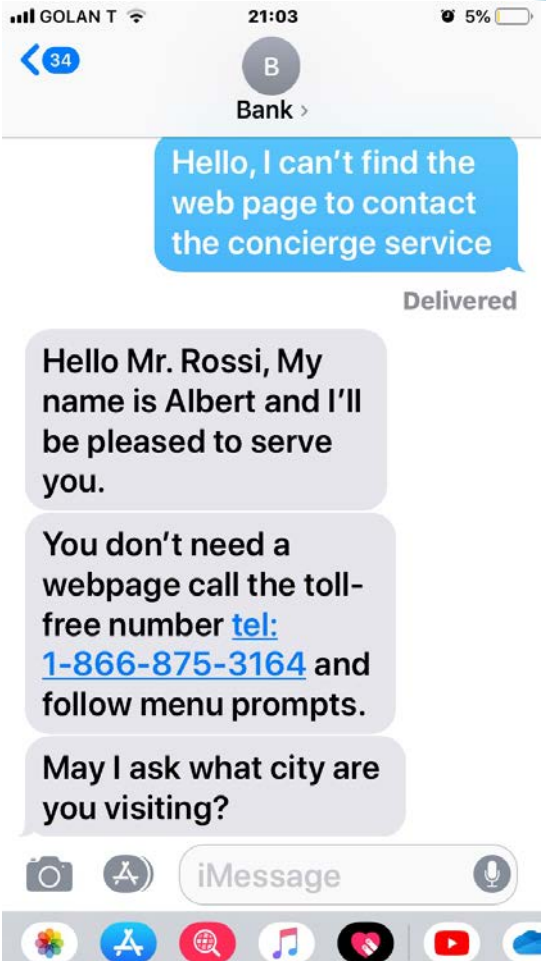
silently abandoned
before the agent replied.



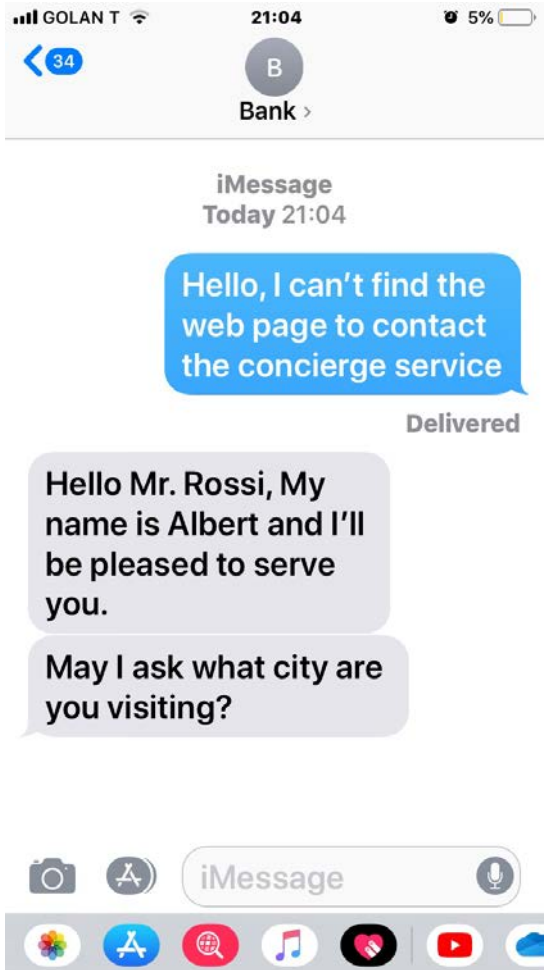
"Uncertain silent abandonments" (uSab).

Uncertain silent abandonments

Short service

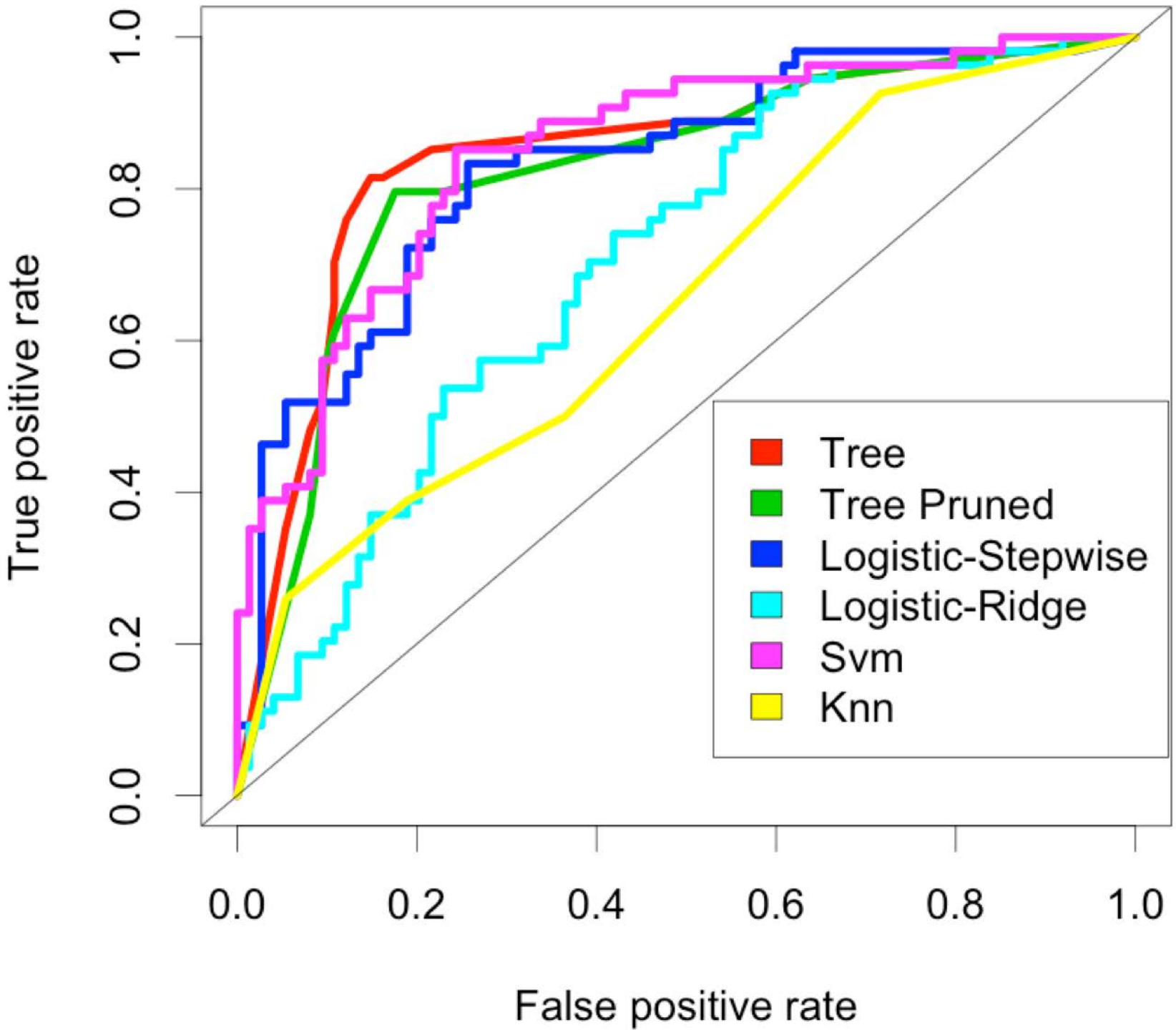


Silent abandonment



Messaging Data Description

- Provided by Liveperson to the SEELAB at the Technion.
- Includes 337,224 service interactions conducted during May 2017 (550 labeled).
- Operational Metadata.
  - E.g. Queue time, writing time(of customer and agent), type of device customer used, agent ID, agent load.
- Textual features based on conversation transcripts extracted by NLP tools.

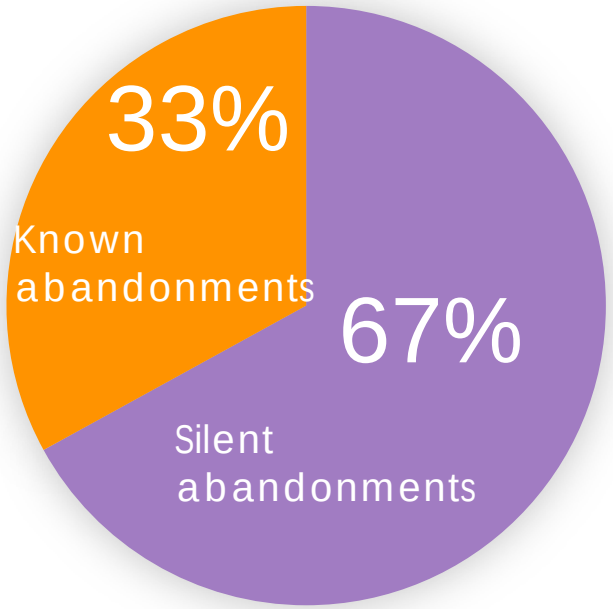


Classification Model-Results ROC

Model	AUC
SVM	0.85
Tree	0.85
Logistic Regression-Ridge	0.83
Tree Pruned	0.82
Logistic Regression-Stepwise	0.71
Knn	0.65

SVM-Output

From the 26.2% of the customers
in the Uncertain silent abandonment class:
55% silently abandoned the system!



~~7.2% [illegible]onment~~

Correct Answer:
21.3% abandonments!

19.37 minutes to identify Sab.
15.31% of the work time of agents is spent with Sab.

Estimating MOPs in Contact Centers

How long a customer is willing to wait?

Answer: Estimating customer's (Im)Patience

Importance of Customer Patience from an operational point of view

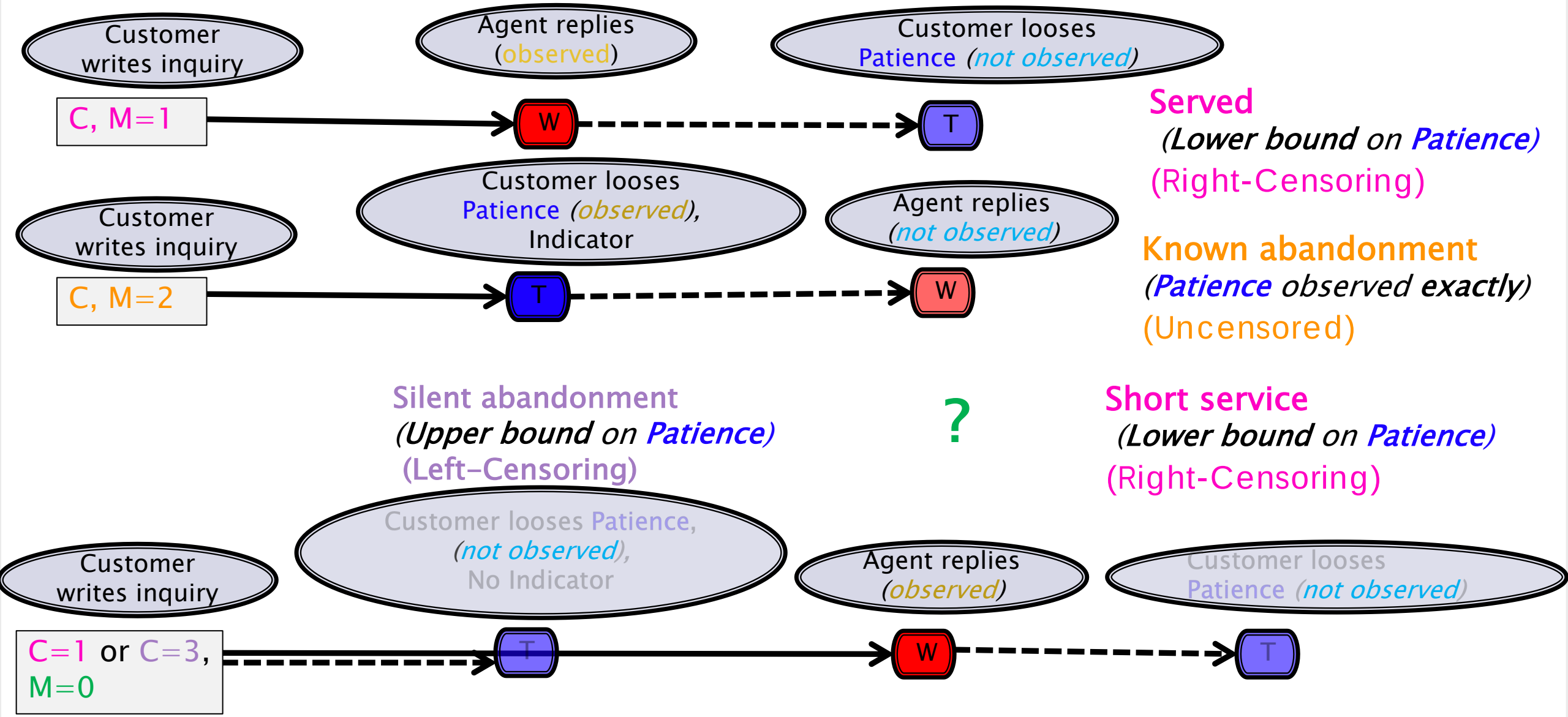
- To achieve appropriate balance between Operational Efficiency and Service Quality one must consider patience (Garnett et al. 2002).
- Accurate Staffing, Concurrency and Routing decisions. Accurate Service Level.
- *Importance of accurate estimation*: Performance Measures are sensitive to inaccurately estimating the distribution of patience (Whitt 2006).
- (Im)Patience: $T \sim exp(\theta)$. Wait Time: $W \sim exp(\gamma)$.
- Right Censoring Model: Mandelbaum and Zeltyn 2013—Method 1
- Left and Right Censoring Model: Yefenof et al. 2018—Method 2

Estimating Patience in Messaging System

We can not use the same method as in chat systems.

Since our sample is censored and uncertain (missing data).

Estimating Patience in Messaging System
Why censored data?



Solution for patience estimation with censoring and missing data

Expectation Maximization Algorithm (EM):

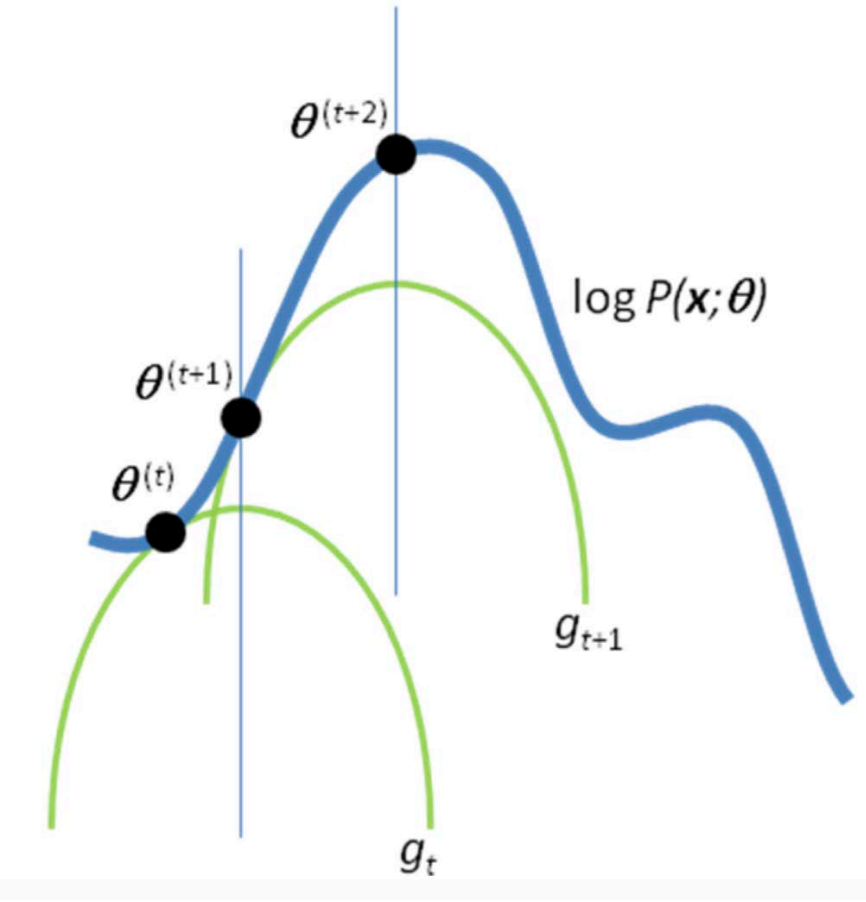
What is the customer patience ?

What is the virtual waiting time?

What is the probability to indicate abandonment?

Expectation Maximization Algorithm (EM)

- We aim to maximize the Likelihood function
- $\boldsymbol{\theta}$, $\boldsymbol{\gamma}$ and $\boldsymbol{q}$ depend on the class of the customers, but some classes are uncertain (missing data) we can not directly apply MLE to solve the argmax problem.
- E-Step: lower bound of the log likelihood, M-Step: parameters that maximize.
- Guess weights calculate parameters, update weights, update parameters until convergence.



EM Algorithm-Likelihood

Likelihood:

$$L(U_i, Y_i, \Delta_i, \theta, \gamma, q) = \prod_{i=1}^{n} \left(e^{-\theta U_i} \gamma e^{-\gamma U_i}\right)^{1-\Delta_i} \left(q\theta e^{-\theta U_i} e^{-\gamma U_i}\right)^{\Delta_i Y_i} \left[(1-q)\left(1-e^{-\theta U_i}\right)\gamma e^{-\gamma U_i}\right]^{(1-Y_i)\Delta_i}$$

Expectation of the log likelihood:

$$E\left[\sum_{i=1}^{n}\{(1-\Delta_i)(\log\gamma - \gamma U_i - \theta U_i)\} + \sum_{i=1}^{n}\{\Delta_i Y_i(\log\theta - \theta U_i - \gamma U_i + \log q)\}\right.$$
$$\left. + \sum_{i=1}^{n}\{((1-Y_i)\Delta_i)(\log(1-q) + \log\left(1-e^{-\theta U_i}\right) + \log\gamma - \gamma U_i)\} \,|Ui, Mi, \widehat{\theta^{(t)}}, \widehat{\gamma^{(t)}}, \widehat{q^{(t)}}\right]$$

EM Algorithm

Input: $\epsilon > 0$

Initialization: Calculate the expectancy of the log likelihood under the starting weights, obtain $\widehat{\theta^{(1)}}$, $\widehat{\gamma^{(1)}}$ and $\widehat{q^{(1)}}$

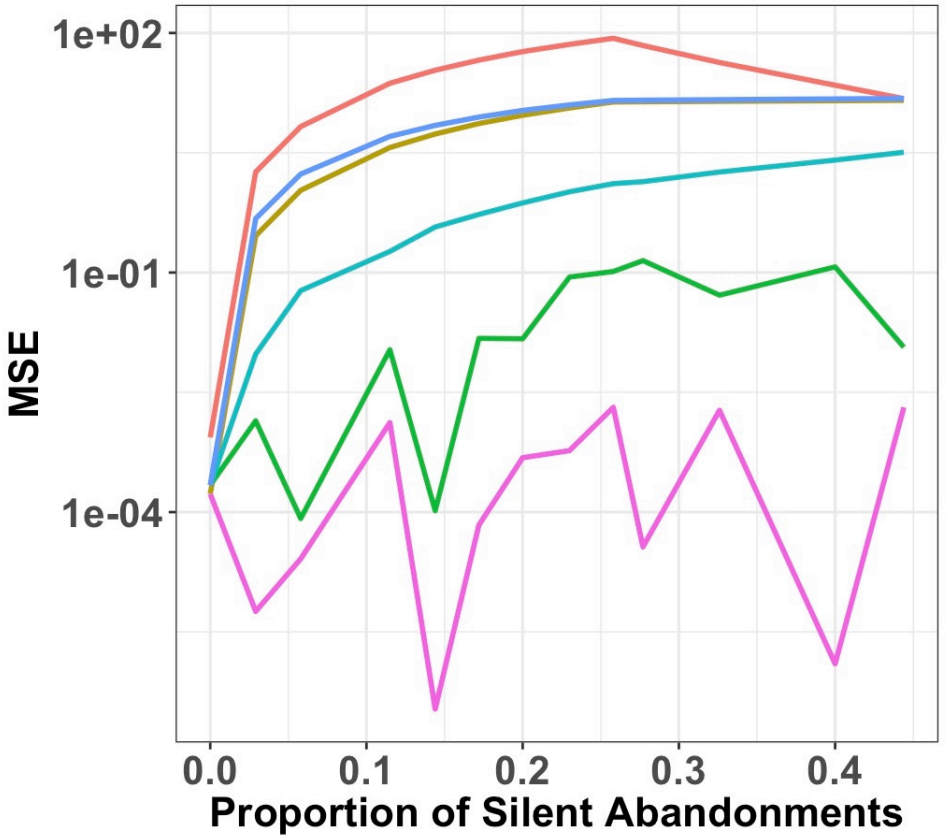
General step: for any $t = 1,2, \ldots$ execute the following steps:

1. E-Step: Calculate expectancy with the log likelihood.
2. M-Step: maximize, find $\theta^{(t+1)}$,$\gamma^{(t+1)}$ and $q^{(t+1)}$
3. If $|\theta^{(t)} - \theta^{(t+1)}| + |\gamma^{(t)} - \gamma^{(t+1)}| + |q^{(t)} - q^{(t+1)}| < \epsilon$:

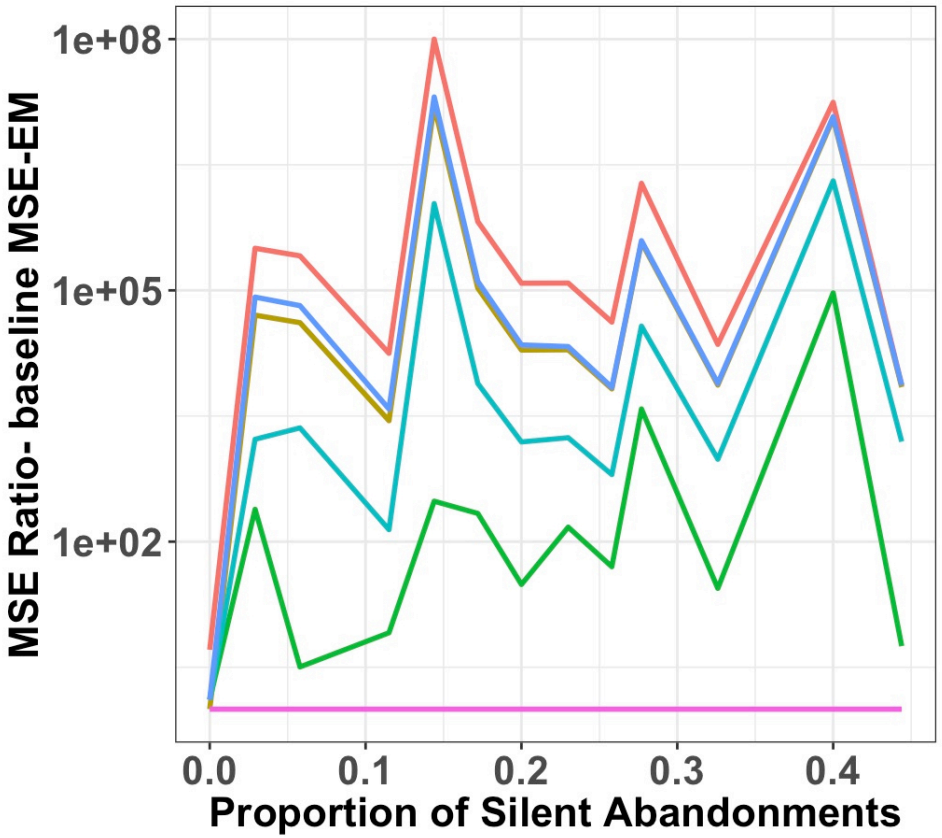
   then STOP and $\boldsymbol{\theta}^{(t+1)}$, $\boldsymbol{\gamma}^{(t+1)}$ and $\boldsymbol{q}^{(t+1)}$ are the output.

Accuracy-Simulated data.

MSE



MSE ratio (baseline MSE of the EM)

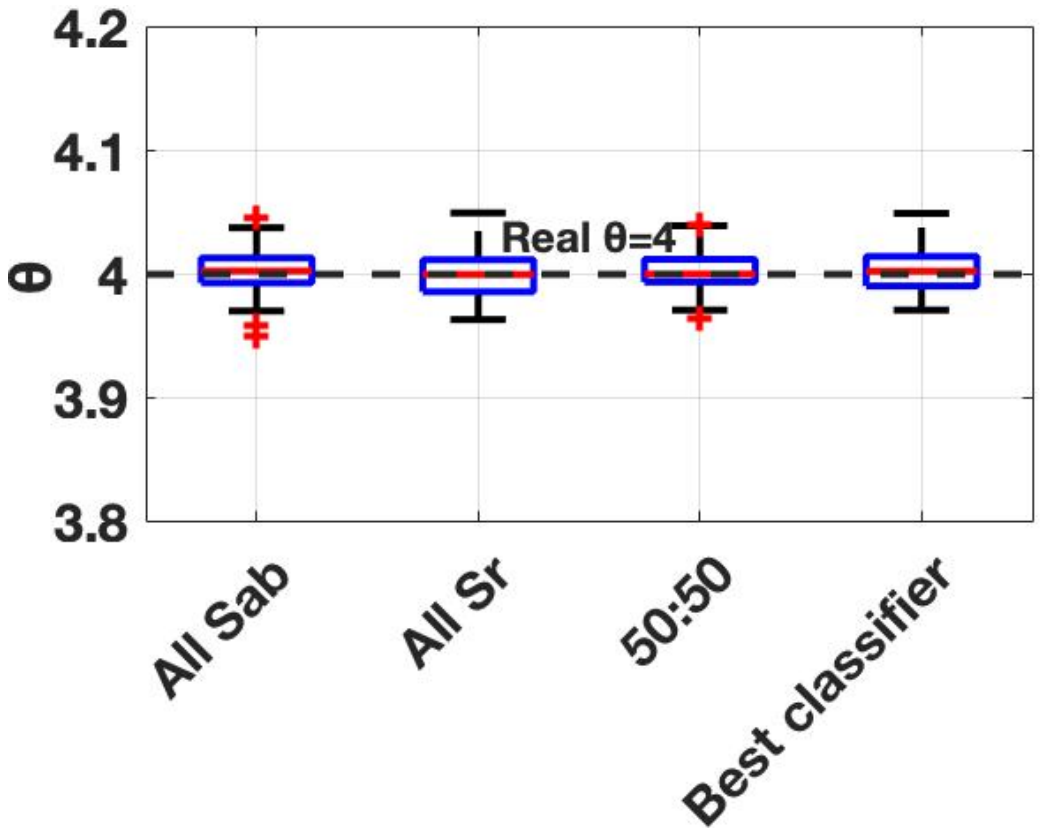


Method

- Method 1- uncertain Sab as Ab
- Method 1- uncertain Sab as Served
- Method 2- uncertain Sab as Sab
- Method 2- uncertain Sab with SVM
- Method 2- uncertain Sab as Served
- EM

Simulated data.

Do we need a the classification model for estimating patience?
No.



Stability analysis.

Estimating Patience in Messaging System real data (with missing data)

What Organizations do!

Average Patience in minutes					
EM	Method 2- Labeled conversations	Method 1- uSab is service	Method 2- uSab is service	Method 1- uSab is abandonment	Method 2- uSab is Sab
81.11 min	81.9 min	166.42 min	188.07 min	28.27 min	13.17

Our Algorithm

Closer to reality 😀

Ignoring silent abandonments and missing data

Overestimation!

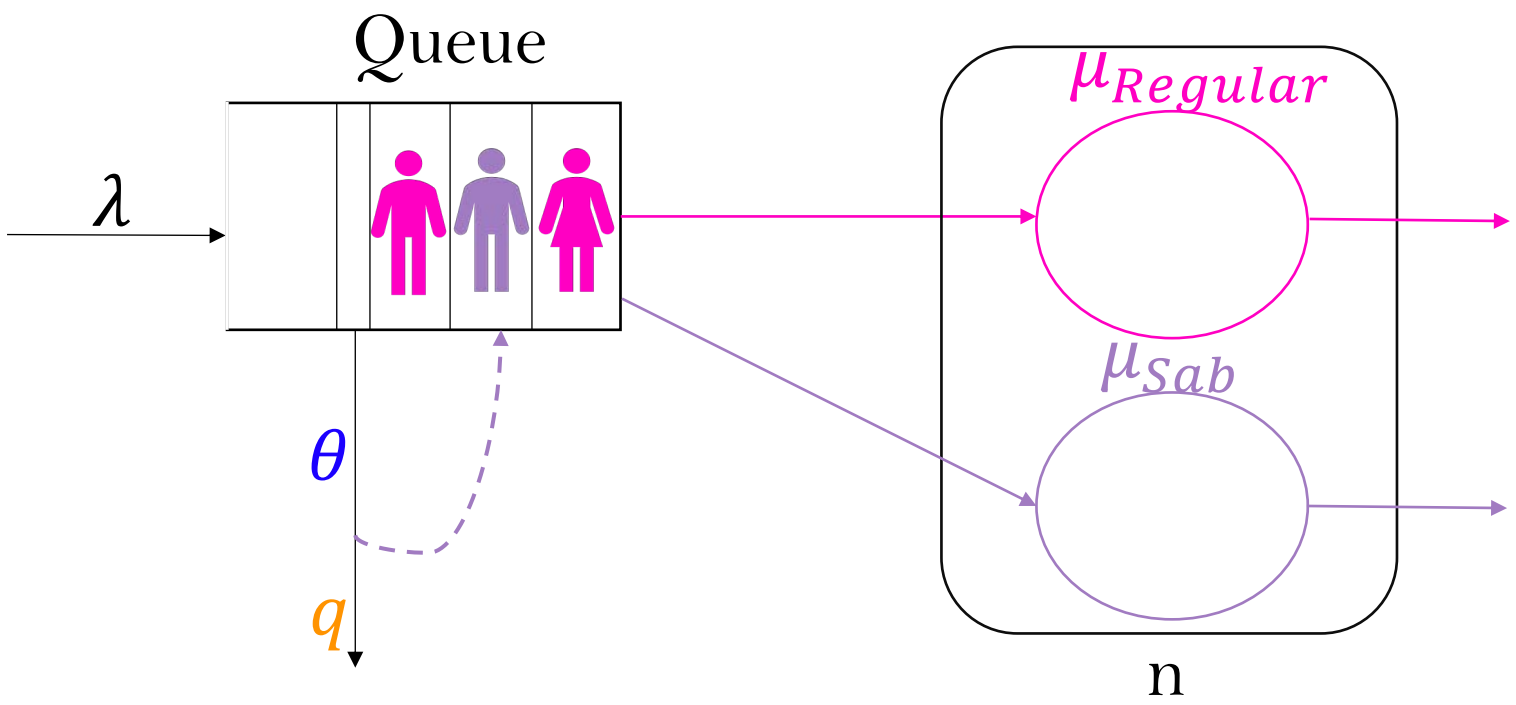
Considering silent abandonments as uncensored. Ignoring missing data

Underestimation!

Considering silent abandonments as left censored. Ignoring missing data

Underestimation!

Silent Abandonment- Impact on System efficiency



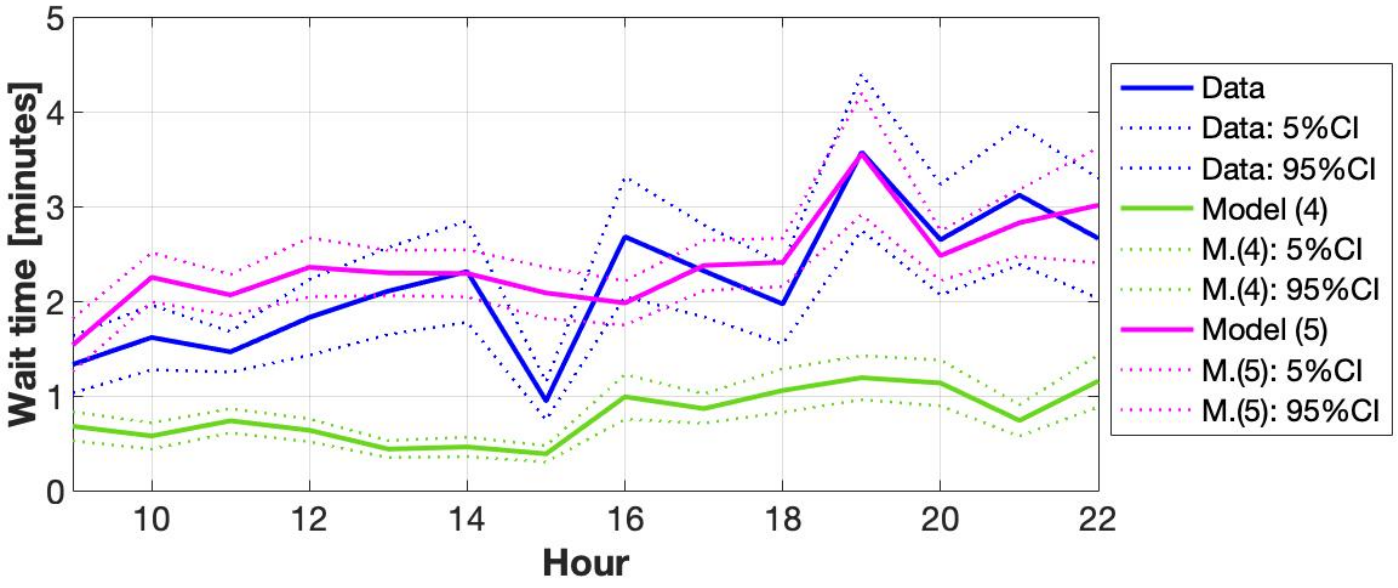
λ- arrival rate according to a Poisson process.
θ- exponential abandonment rate.
$\mu_{Regular}$- exponential service rate
μ_{Sab}- exponential rate of silent abandonments
n- statistically identical servers.
q- *P(Known | abandonment).*

Queuing models in chat system

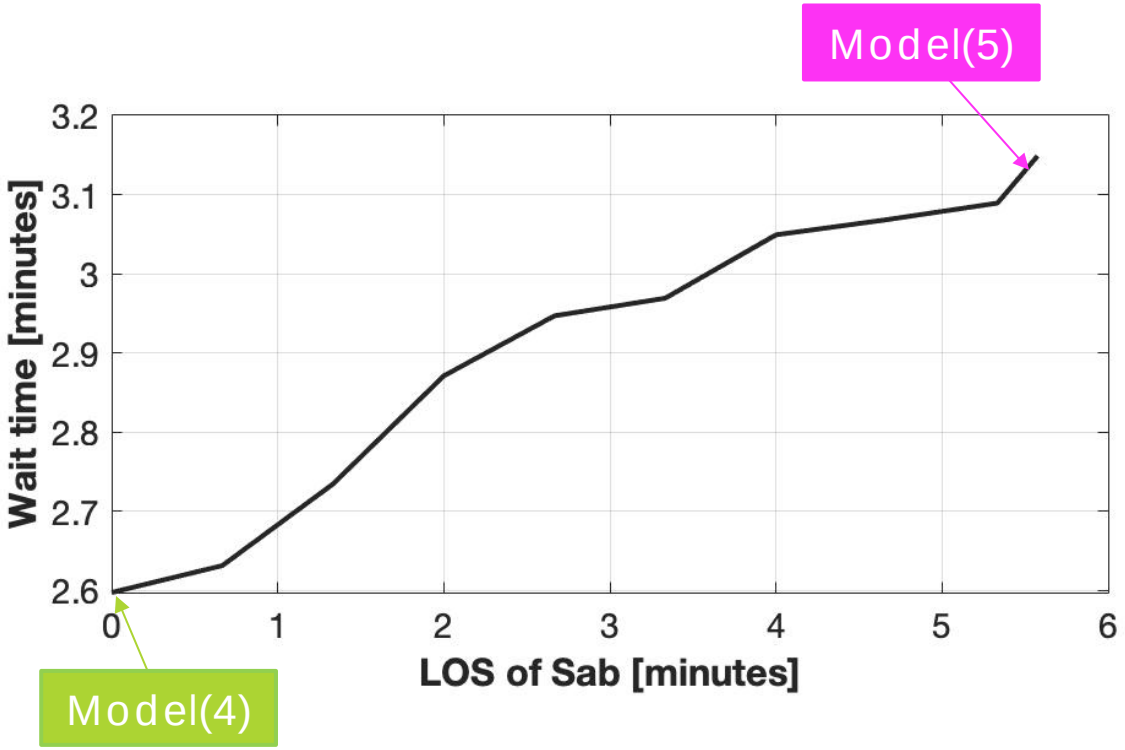
Performance Measure	RMSE-February 2017				
	(1) Ignoring Sab (θ: Method 1)	(2) Considering Sab as Ab (θ: Method 1)	Considering Sab as left censored		(5) Considering Sab as time consuming (θ: Method 2)
			(3) Nonparametric: Method 2	(4) θ: Method 2	
P{Wait > 0}	0.27	0.26	0.28	0.31	0.27
P{Ab}	0.12	0.11	0.09	0.08	0.07
E[Queue]	3.27	1.68	1.18	0.96	0.87
E[Wait]	169.56	85.13	75.69	70.29	63.44
E[Wait for Served Customers]	198.29	103.04	83.63	63.44	62.47

MOPs in Models (4), (5), and Data

As a Function of Time
(Models (4), (5), and Data)



As a Function of μ_{Sab}(Models (4)-(5))



Eliminating all the capacity losses (5% in our case):

- E[Wait] ↓1.6 minutes (↓67%) .
- E[Wait | Sr] ↓1.5 minutes (↓83%).
- P{Wait > 0} ↓3% (↓ 8%).
- P{Ab} ↓4% (↓16%).
- E[Queue] ↓ 0.16 (↓ 21%).

How can the company eliminate capacity loss?

- Bot—no involvement of the agent.
- Prediction model.
- Sab as fractional customers
- Handle queue priorities according to Sab info.

Discussion

- Identified silent abandonments as a source of uncertainty in contact centers.
- Exposed how a small change in the service process of two environments of contact centers changes the way we estimate performance and patience.
- We showed that Sab should be considered left-censored observations of patience and as time-consuming tasks to obtain more accurate MOPs.
- Suggested a queuing model that takes Sab into account and showed that it captures system dynamics. Via this model we showed impact on capacity loss and made suggestions to avoid the problem.

Discussion

- In the process of analyzing the queueing model—tool to further analyze the operational implications of Sab, and to validate new operational policies.
- Further research can consider the impact of Sab on routing and delay announcements, taking into account that the number of people in the queue becomes uncertain in their presence.

Thank you for your patience!

Questions?