Towards Practical Ambiguity Sets

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Alice and Eve

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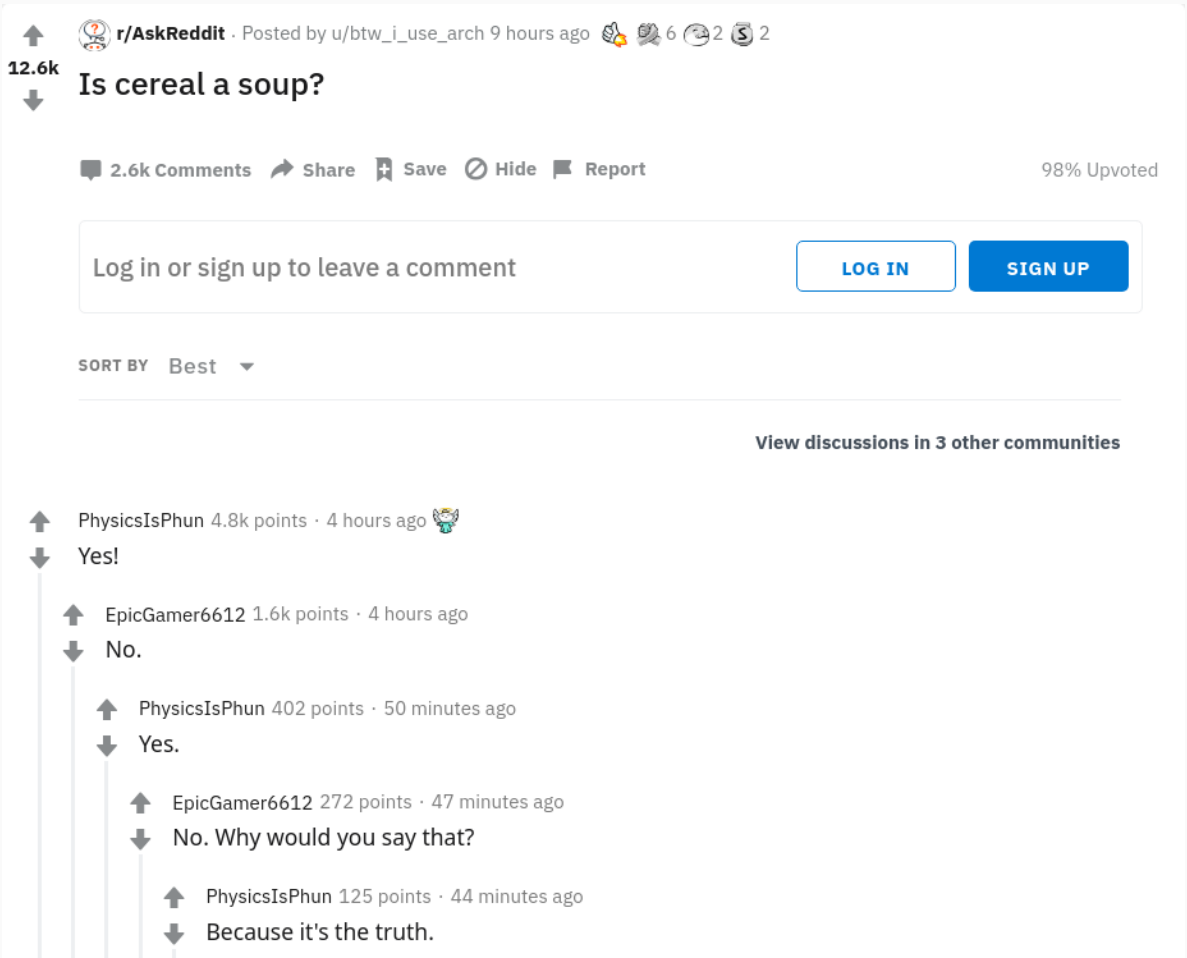
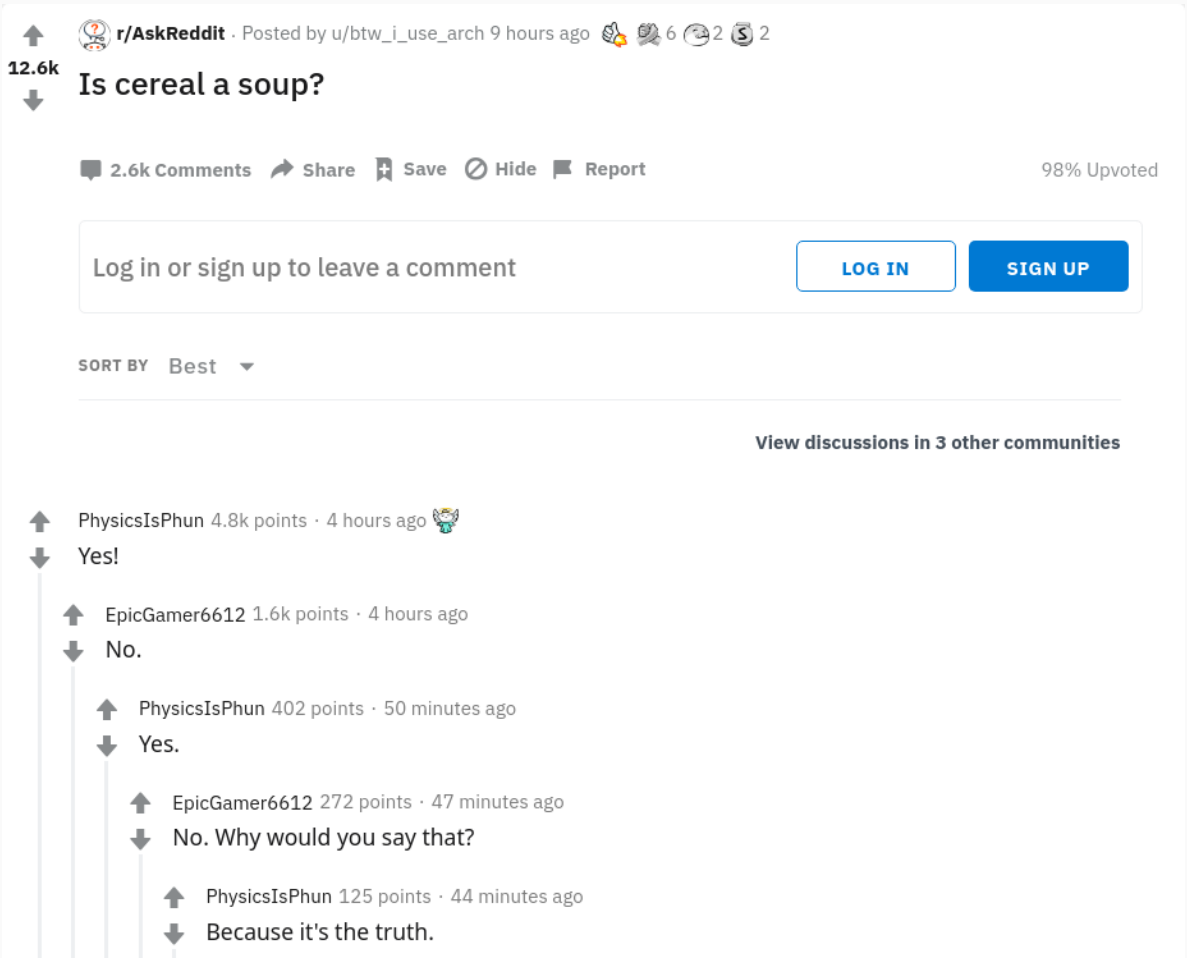
However, remember Eve uses Reddit too...

Alice and Eve

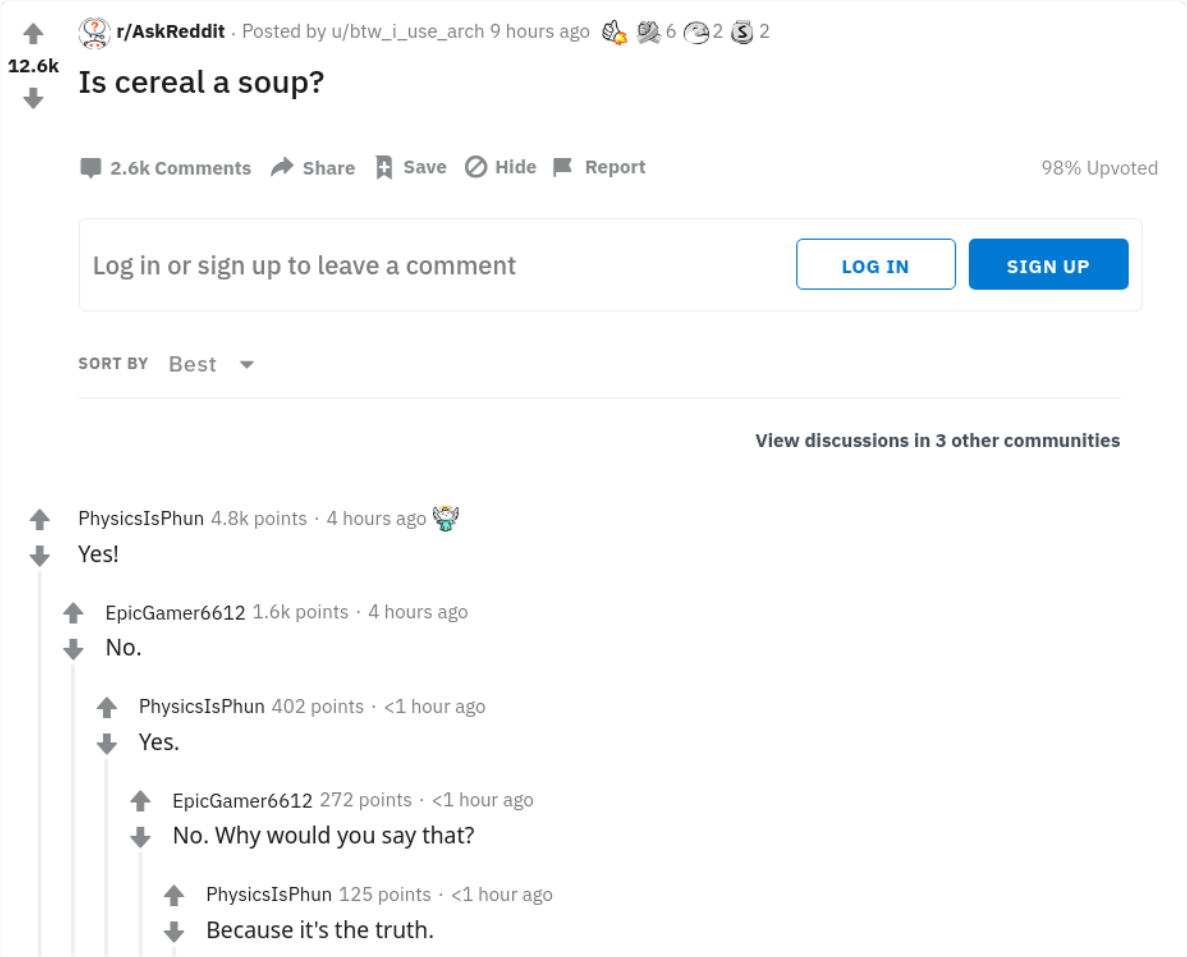


Alice and Eve



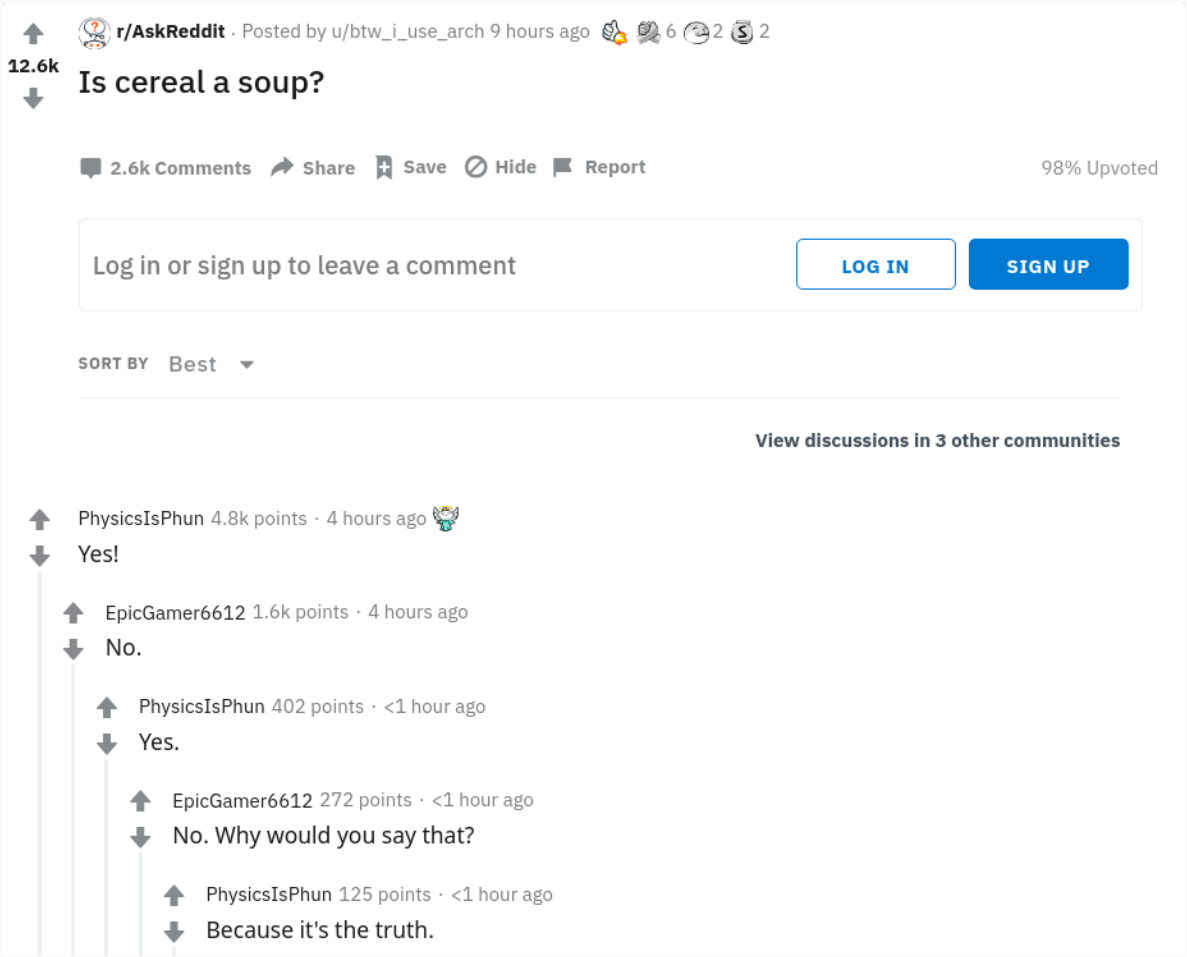
Alice's traffic
251 min ago
47 min ago

Alice and Eve



Alice's traffic
240 min ago
0 min ago

Alice and Eve



Alice's traffic
240 min ago
0 min ago
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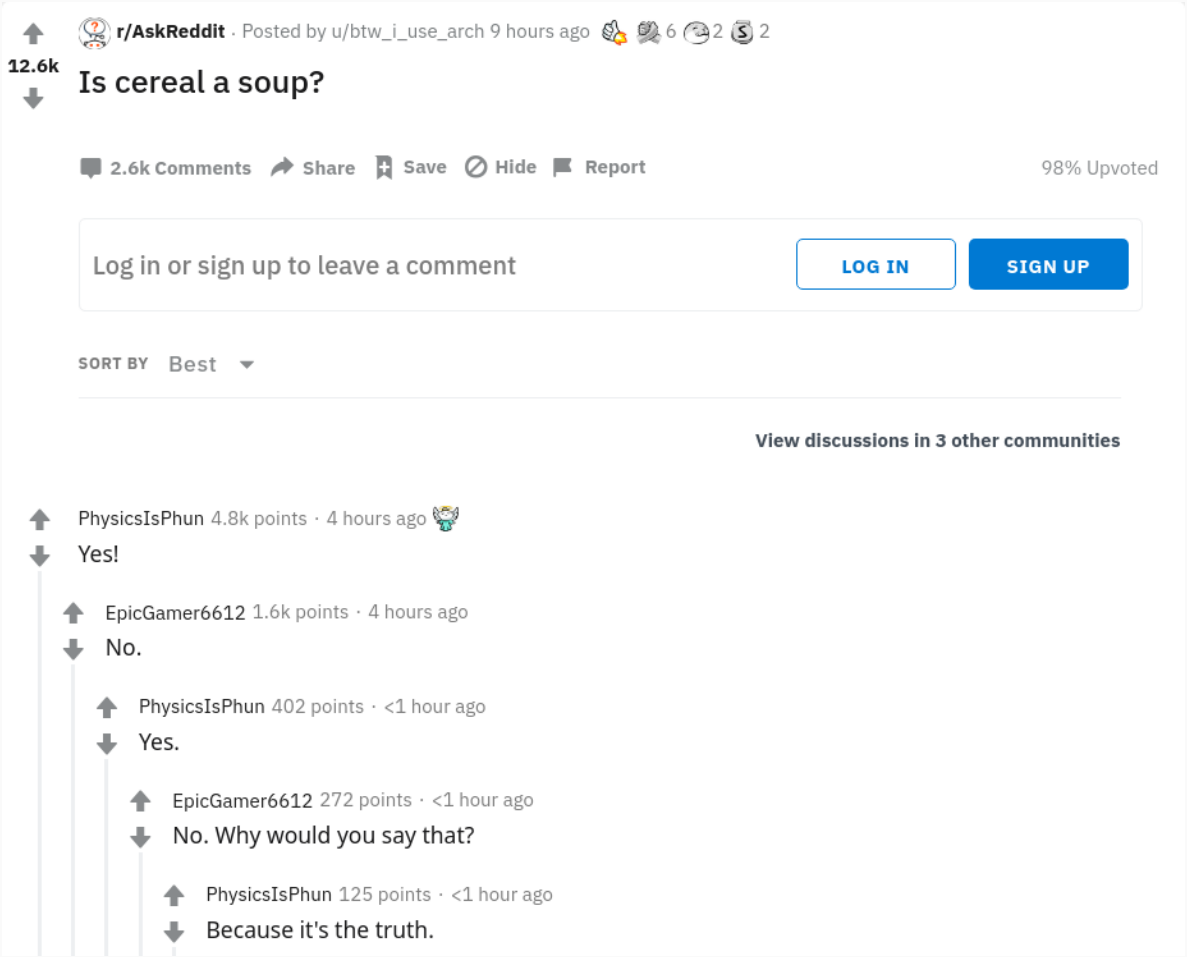
Alice and Eve



Alice's traffic
240 min ago
0 min ago
0 min ago

Alice's fake messages are called **dummy messages**.

Alice, Bob, and Eve

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We would say EpicGamer6612 (Alice) and PhysicsIsPhun are in an **ambiguity set**, since Eve can't determine which of the two Alice is.

More Realistic Examples

"Eve" could be...

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Basically any adversary who can see the users' activity, but not the contents of incoming or outgoing traffic (hidden with encryption).

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- How do we group people to look the same in a good way (and what does "good" entail)?
- How do we pick the budget for a group of people?
- Is such a system practical in real life?

Our Project

Ambiguity Sets

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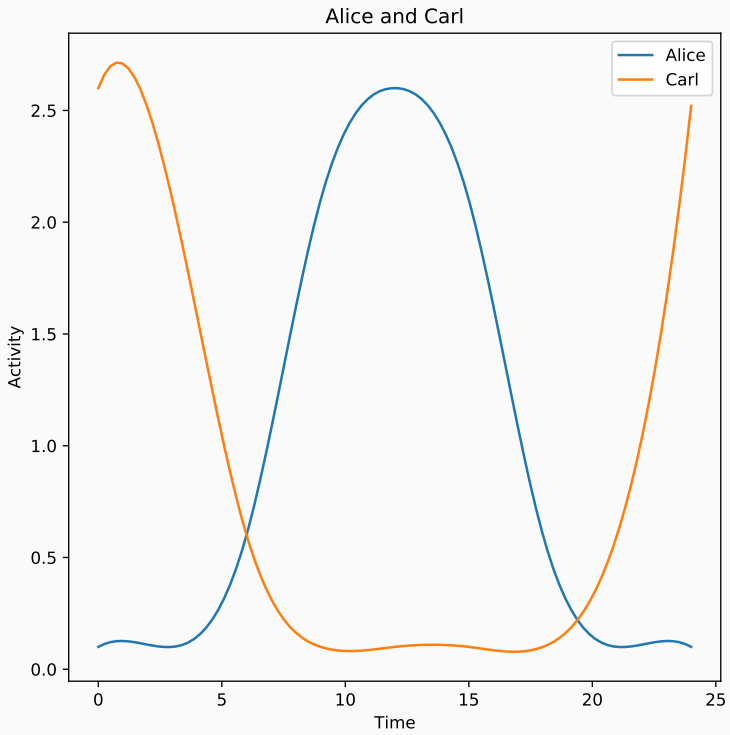
- Users are placed into ambiguity sets of size at least k, for some integer k.
- Each user in the set looks identical to every other user in the set from the adversary's point of view.
- We try to create sets to find a balance between performance and privacy.

Alice and Carl



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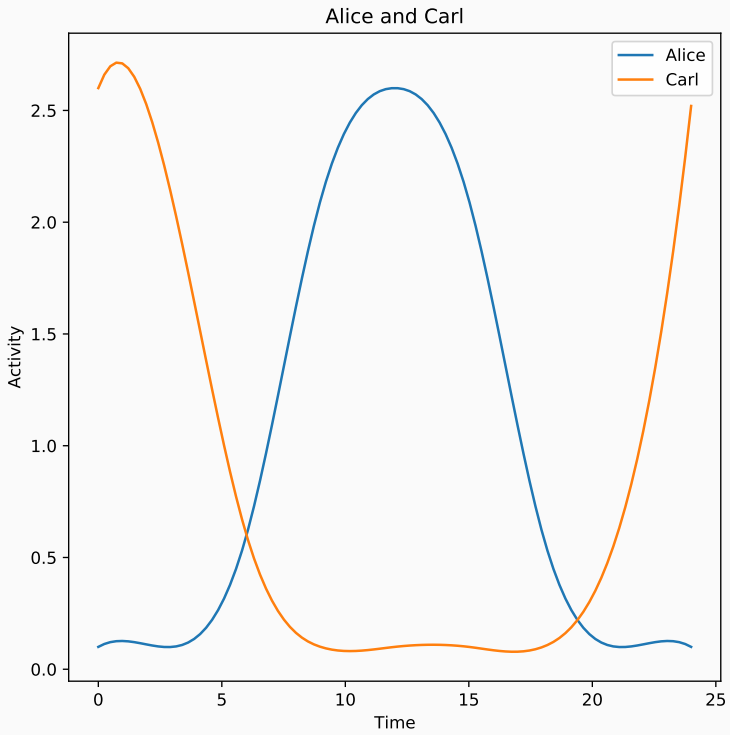

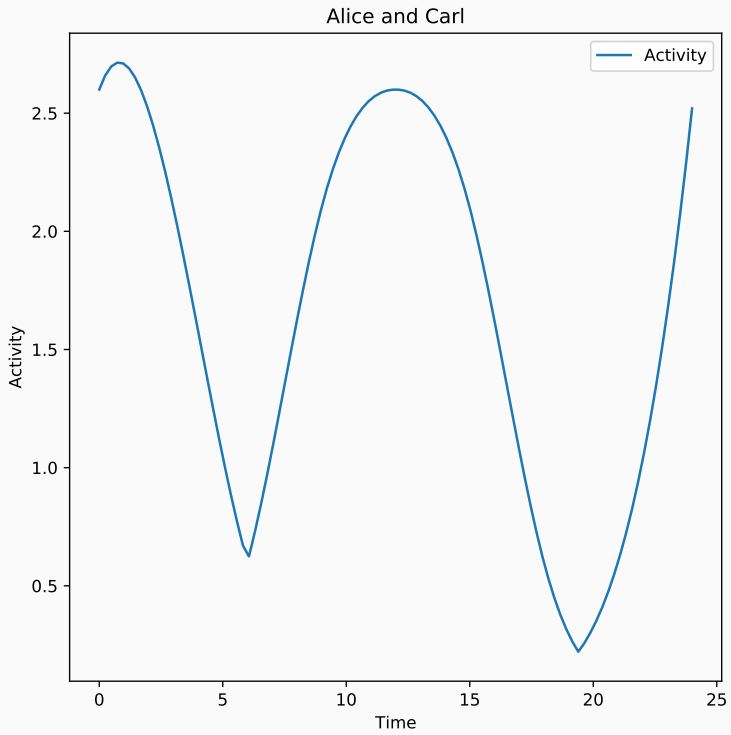

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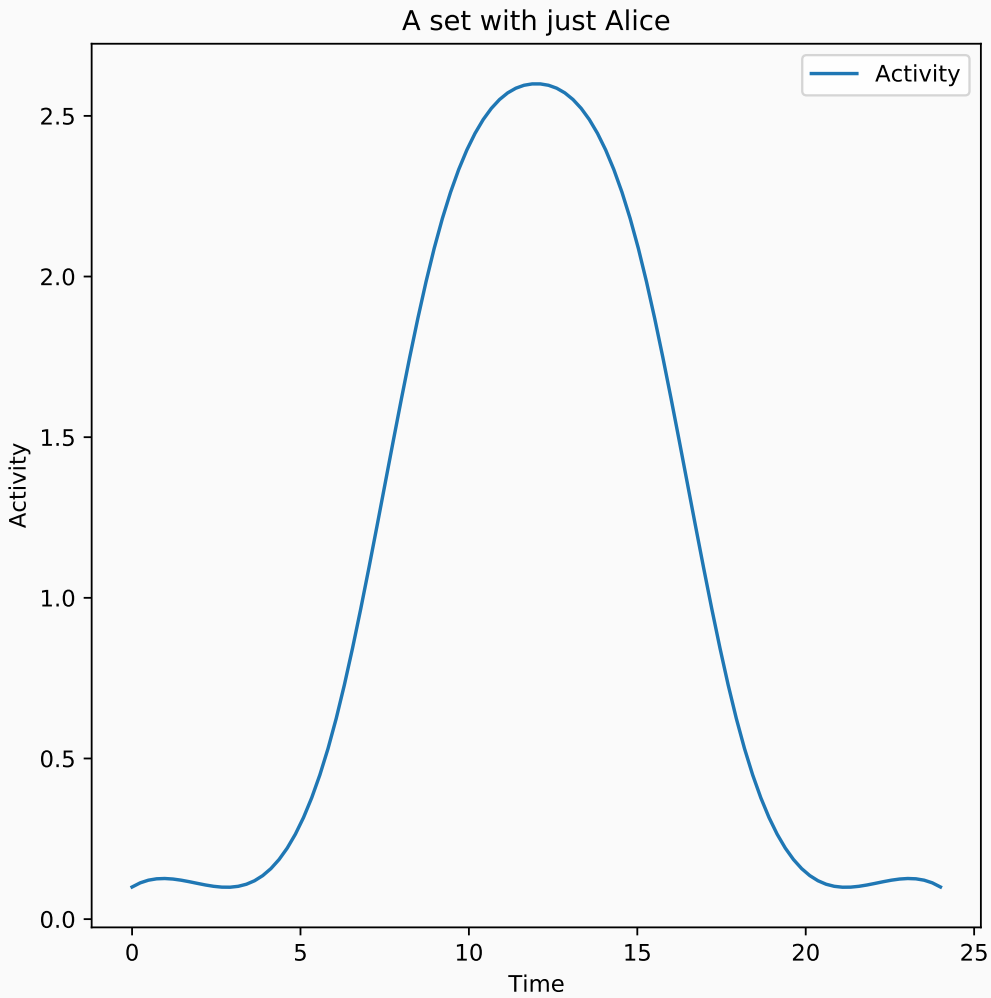

The Perfect Ambiguity Sets

- Minimizes unnecessary traffic

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- Maintains good privacy

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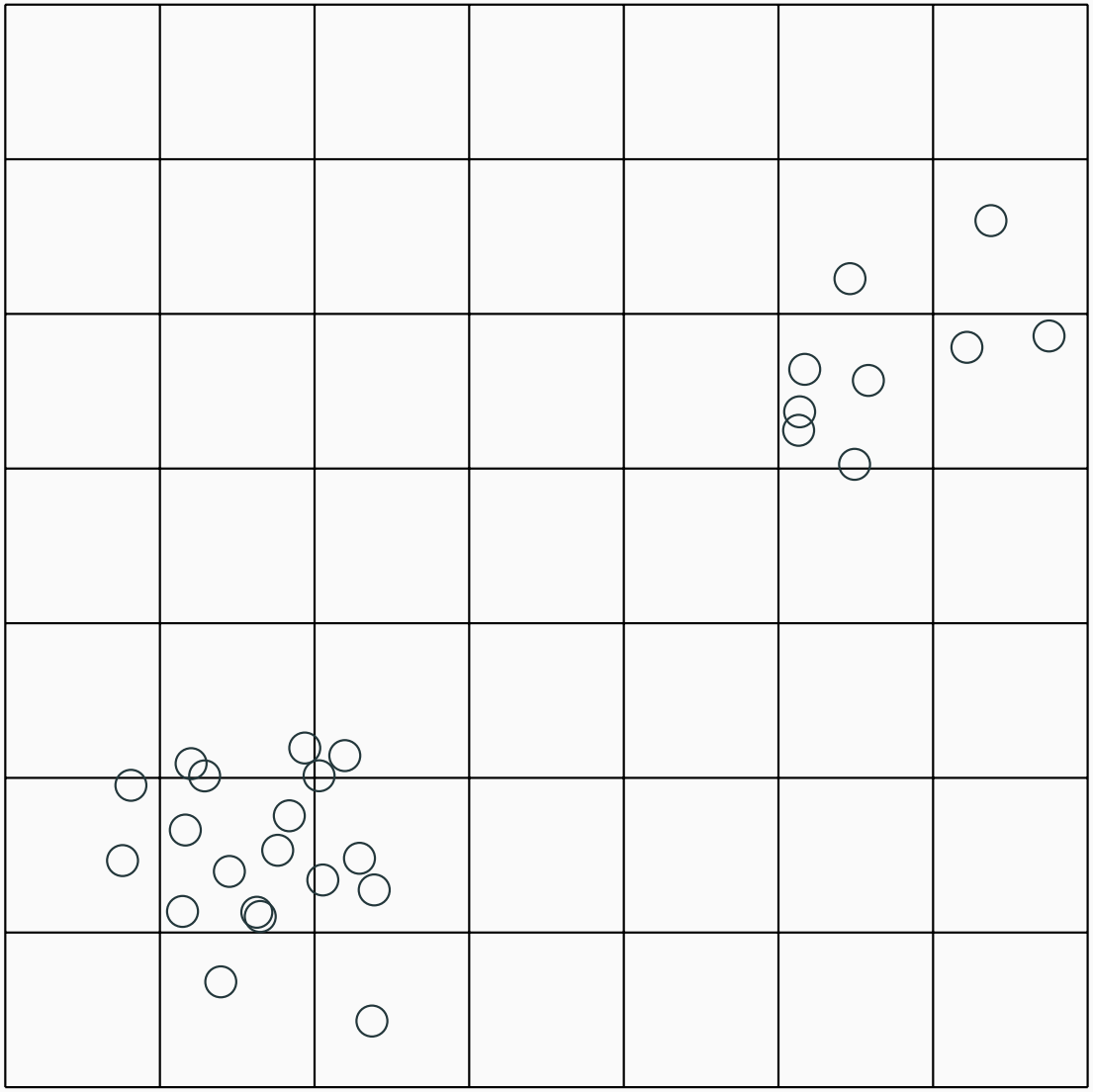
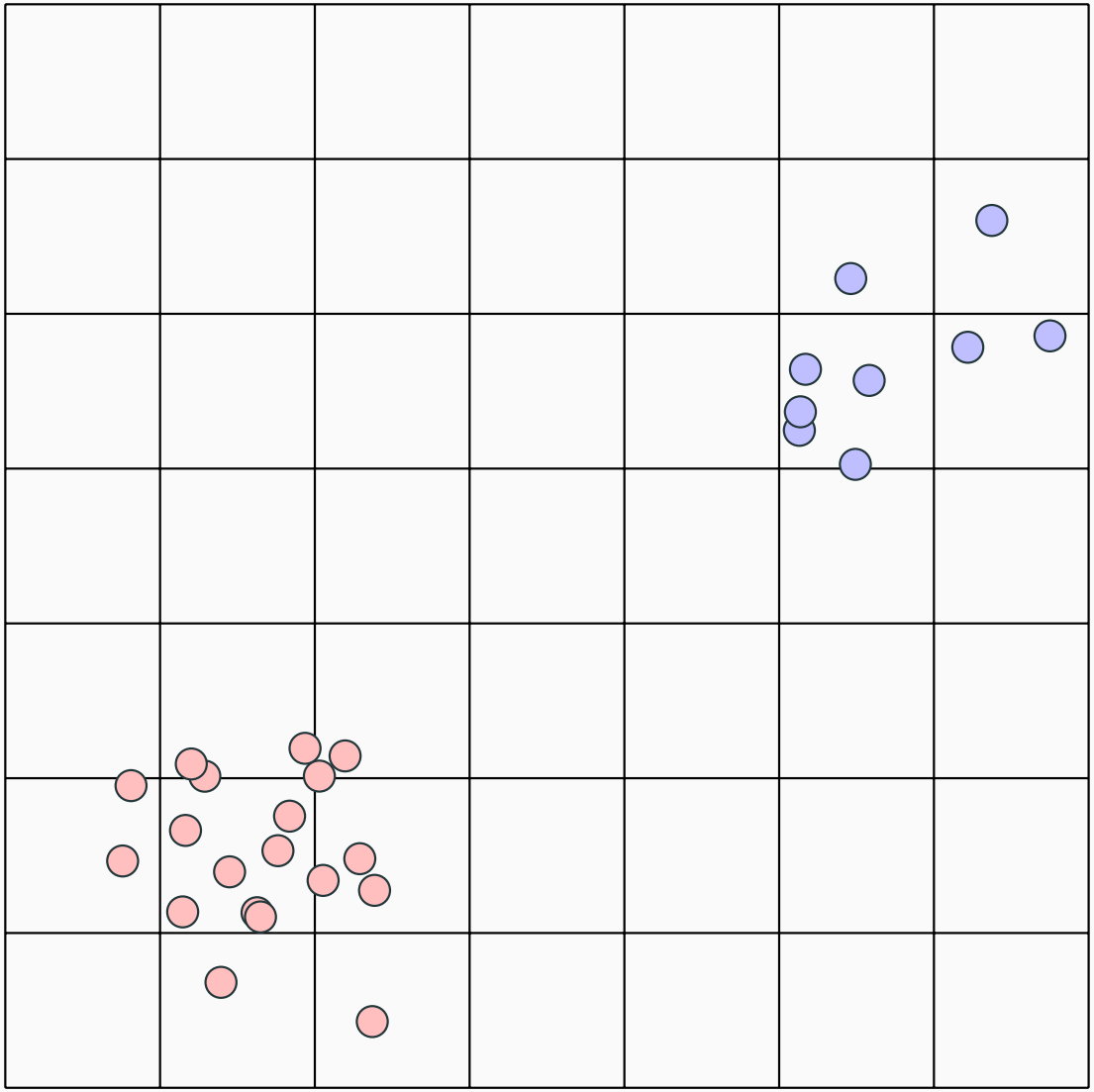
Achieving both of these at the same time is hard.

Creating Ambiguity Sets

K-Means



K-Means



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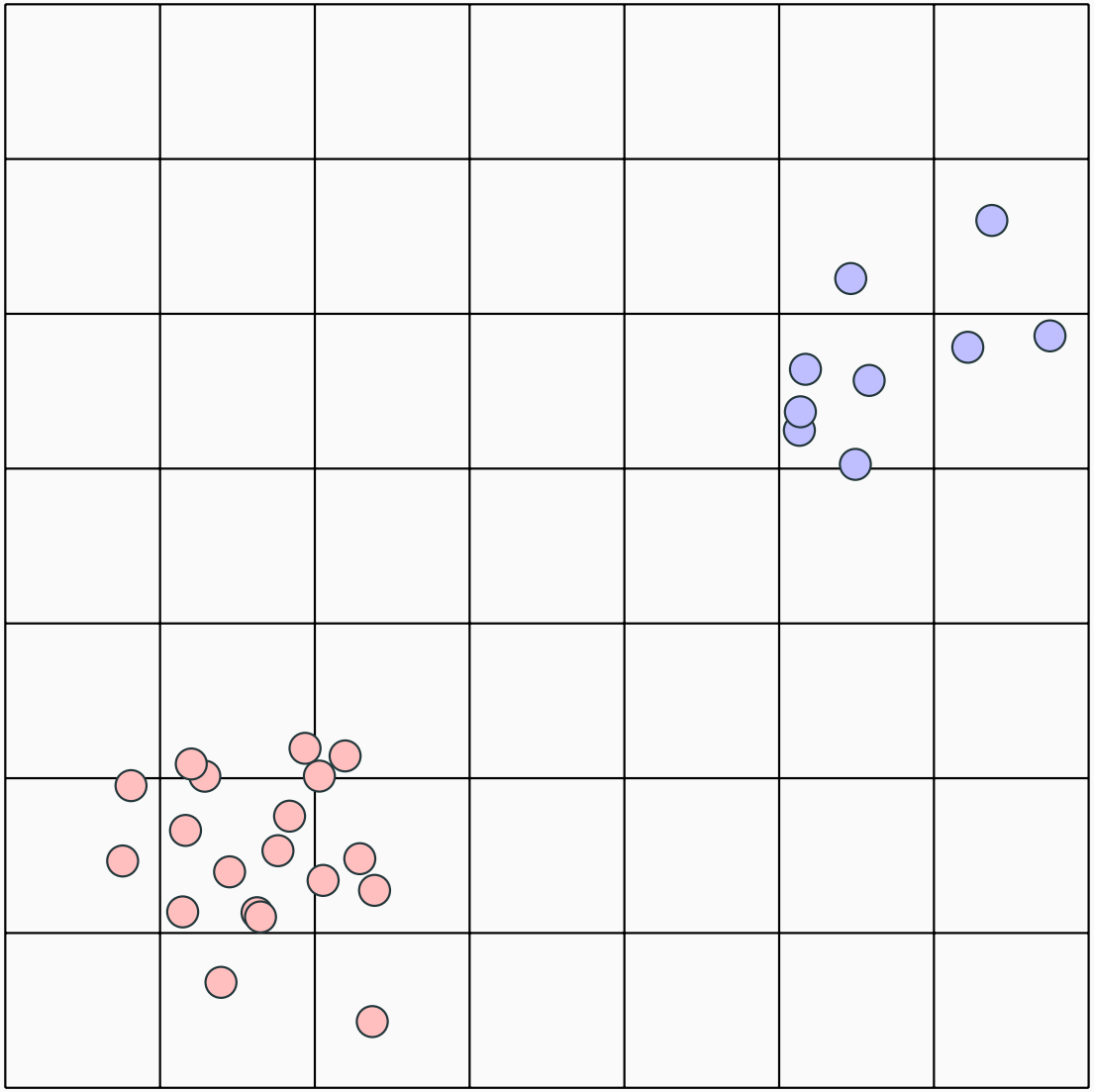
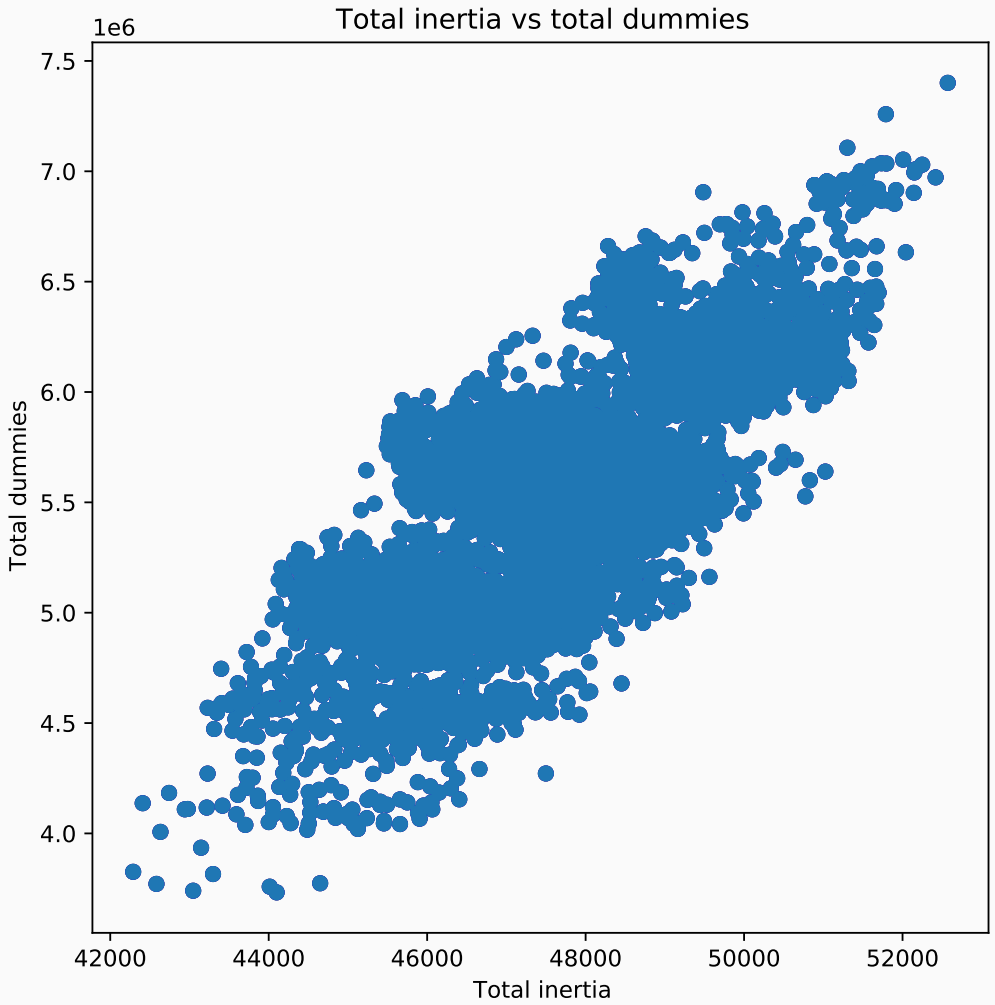


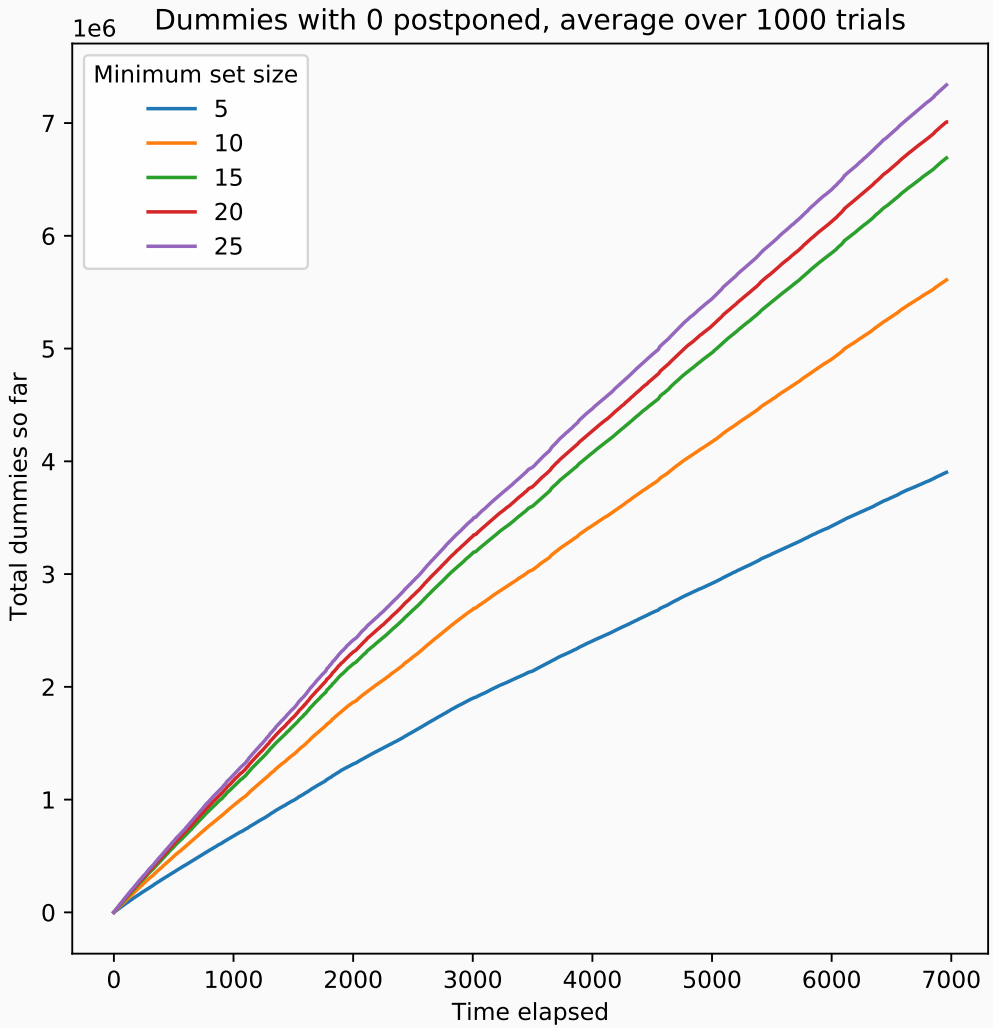
K-means attempts to minimize the **inertia** of each cluster.

Inertia as an Indicator of Performance



Each dot here represents 1 clustering setup (with a different random seed)

Cluster Sizes



(On a dataset of 100 users)

Picking a Budget

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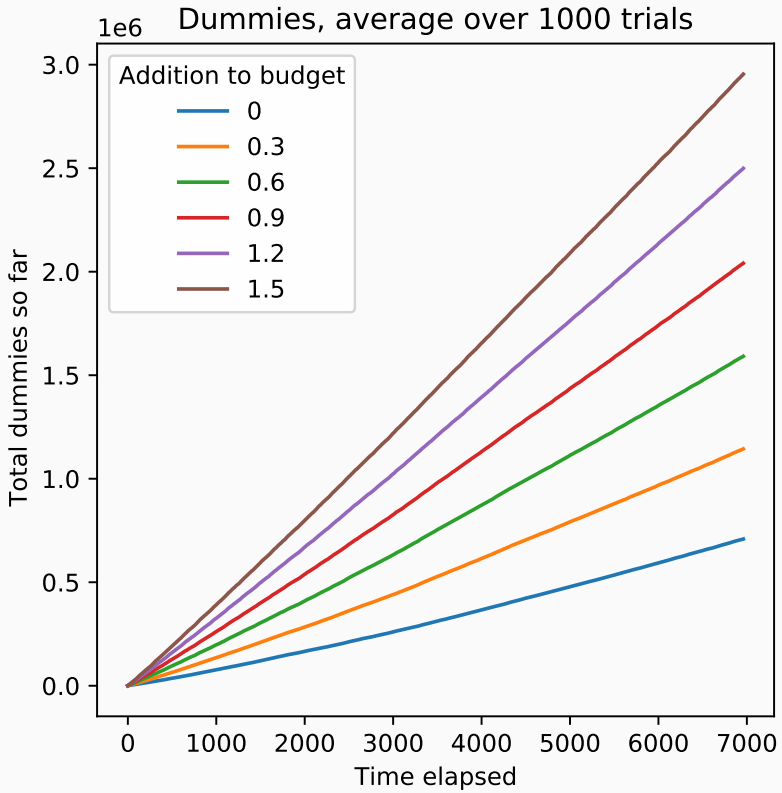
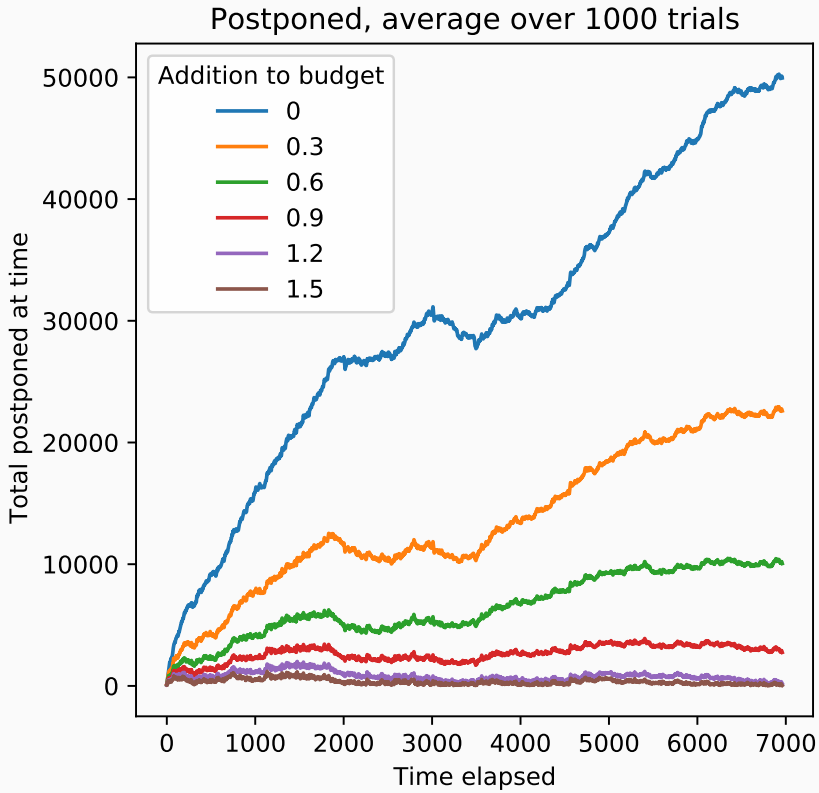
In general, we care more about reducing postponed messages over reducing dummy messages.

The Solution

$$\text{budget} = \text{mean} \cdot (1 + \text{addition to budget})$$





Future Research

- Testing this on bigger datasets

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- Looking more closely at the people who make up the sets here

Acknowledgements

- Kyle Hogan
- Dr. Gerovitch & Prof. Devadas
- PRIMES Program & MIT

Thanks for listening!