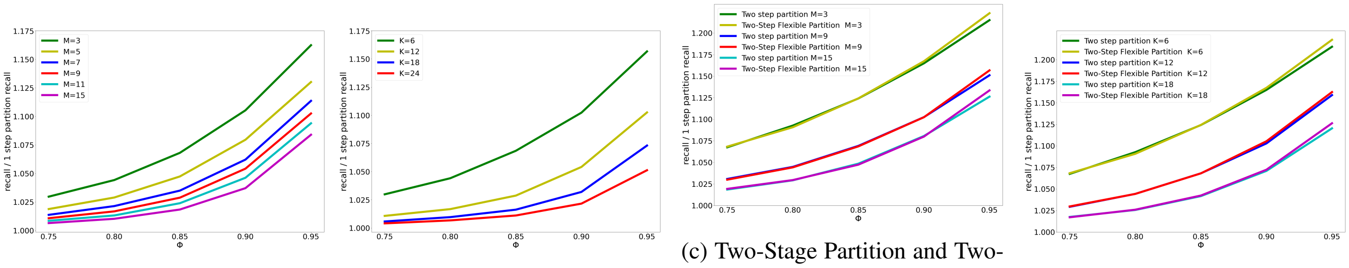


(a) Two-Stage Partition compared to 1-step Partition for different m and ϕ values. All runs with $k = 12$.

(b) Two-Stage Partition compared to 1-step Partition for different k and ϕ values. All runs with $m = 9$.

(c) Two-Stage Partition and Two-Stage Flexible Partition compared to 1-step Partition for different m and ϕ values. All runs with $k = 18$.

(d) Two-Stage Partition compared to 1-step Partition for different k and ϕ values. All runs with $m = 3$.

Figure 3: Percent of improvement in recall compared to 1-step Partition. All runs with optimal f for that m, k, and ϕ.

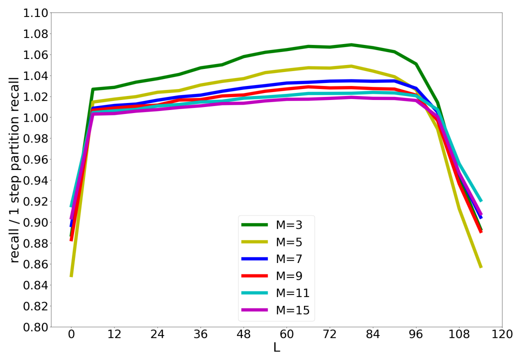


Figure 4: Percent of improvement of Two-Stage Partition recall over 1-step partition, for different values of l. All runs with $\phi = 0.85$, $k = 12$, $f = \frac{2m}{10}$, $h = 0$.

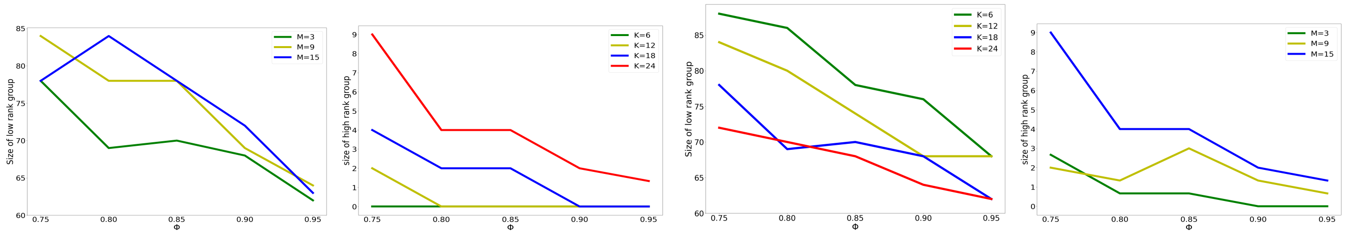
we see that is better to drop a large number of candidates after first round, ideally will be in range of $\frac{n}{2}$ to $\frac{3}{4}n$ candidates, with the precise value depending on the precise values of ϕ, k and m (see Figure 4). When k is smaller, a higher l seems to work better (as can seen in Figure 5c), perhaps because when we choose fewer candidates there is less likelihood they will end up in the bottom $\frac{3}{4}n$ after the first round, and as number of winners increase we need to be more cautious about those we eliminate. We found that higher ϕ values will lead to lower l values, probably since when reviewers are more noisy we also need be more cautious about the amount of data we use to eliminate agents. When m is large, a larger l works better (as can seen in Figure 5a), probably because the significant number of reviews means we have enough information about the candidate even from the first stage, allowing us to eliminate with confidence. For h (the size of the group of candidates we pass after the first stage), we see quite the opposite picture of that of l. It is better for h to be small, in range of $0 - \frac{k}{3}$ candidates, with the precise value depending on the precise ϕ, k and m (see Figure 6). When k is larger, a higher h seems to work better (as can seen in Figure 5b), perhaps because when we choose more candidates we probably will be in the top $\frac{k}{3}$ on the first round, and as number of winners decrease we need to be more cautious about those we choose. We found that higher ϕ values will lead to lower h values, probably since when reviewers are more noisy we also need be more cautious about the candidates we choose. When m is large, a larger h works better (as can seen in Figure 5d), probably because the significant number of reviews means we have enough information about the candidate even from the first stage, allowing us to choose with confidence.

Discussion

In this paper we investigate using a two-stage mechanism for peer-evaluation. While the use of such mechanisms in the real-world has expanded in the past few years (**?**), beyond the basic intuition behind it (focusing reviews on more "divisive" papers), there has not been, to our knowledge, any further investigation of this idea. Here, we took the most widely explored strategyproof mechanism – Partition – and examined its performance when adding a Two-Stage component to it, using two different methods to implement how the mechanisms decide on which candidates to focus (a fixed set vs. a flexible, changing set of papers).

While it seems the intuition is indeed correct, and focusing on a subset of papers does improve the performance of the peer-evaluation mechanism, the improvement was not where we expected it to be. We expected the "borderline" papers to be more exact. That is, that the paper ranked at $k - 1$ will more surely be included vs the paper ranked at $k + 1$. However, our simulations showed that this is not the key benefit of the Two-Stage mechanisms, but rather the more "middle-of-the-road" papers. Those ranked around $\frac{k}{2}$ benefited most, as their chance of being included in the winning set increased dramatically. It seems that borderline papers are hard to differentiate, even when getting more reviews; while the better papers were able to more clearly establish their quality.

In addition we were able to explore what parameters improve the algorithms' performance best, depending on the values of m, k, and ϕ. Somewhat surprisingly, a fairly small benefit first stage suffices to help the algorithms' performance, as long as enough papers are rejected. While this may seem counter-intuitive, it seems the limited signal in the first stage is enough such that the chances of getting enough reviews to counter it is of low-enough probability to not be



(a) Best performing size of l (bottom-ranked set size) for different m and ϕ values. All runs with $k = 18$.

(b) Best performing size of h (top-ranked set size) for different k and ϕ values. All runs with $m = 15$.

(c) Best performing size of l (bottom-ranked set size) for different k and ϕ values. All runs with $m = 3$.

(d) Best performing size of h (top-ranked set size) for different m and ϕ values. All runs with $k = 24$.

Figure 5: Best performing size of top/bottom set for different values. All runs with optimal f for that m, k, and ϕ.

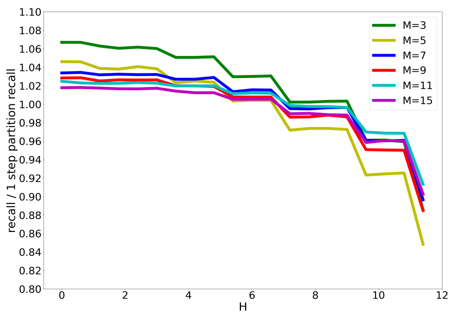


Figure 6: Percent of improvement of Two-Stage Partition recall over 1-step partition, for different values of h. All runs with $\phi = 0.85$, $k = 12$, $l = 0.7$, $f = 0.2$.

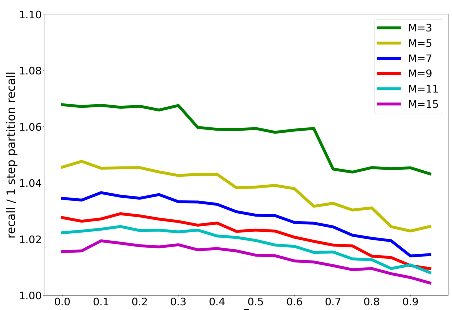


Figure 7: Percent of improvement of Two-Stage Partition recall over 1-step partition, for different values of f. All runs with $\phi = 0.85$, $k = 12$, $l = 0.7$, $h = 0$.

worth it.

There are some obvious extensions to this work: first and foremost, examining if we see similar outcomes in other peer-evaluation mechanisms. We hypothesize that we will see something similar (e.g., the two stages help the middle-of-the-road papers the most), but this has yet to be examined. Furthermore, for other mechanisms a two-stage mechanism may not be as straightforwardly strategyproof, and may require a far more complex re-working of the algorithms to accommodate a two-stage system. Beyond this, examining outcomes in distribution that are not Mallows may lead to deeper understanding of the two-stage systems (though, so far, peer-evaluation papers, requiring a ground-truth to compare themselves to, focus on Mallows distribution for comparison and quality estimates).

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