



Optimization of the efficiency of PhD students by employing cavity magnetrons

S17 Research Unit

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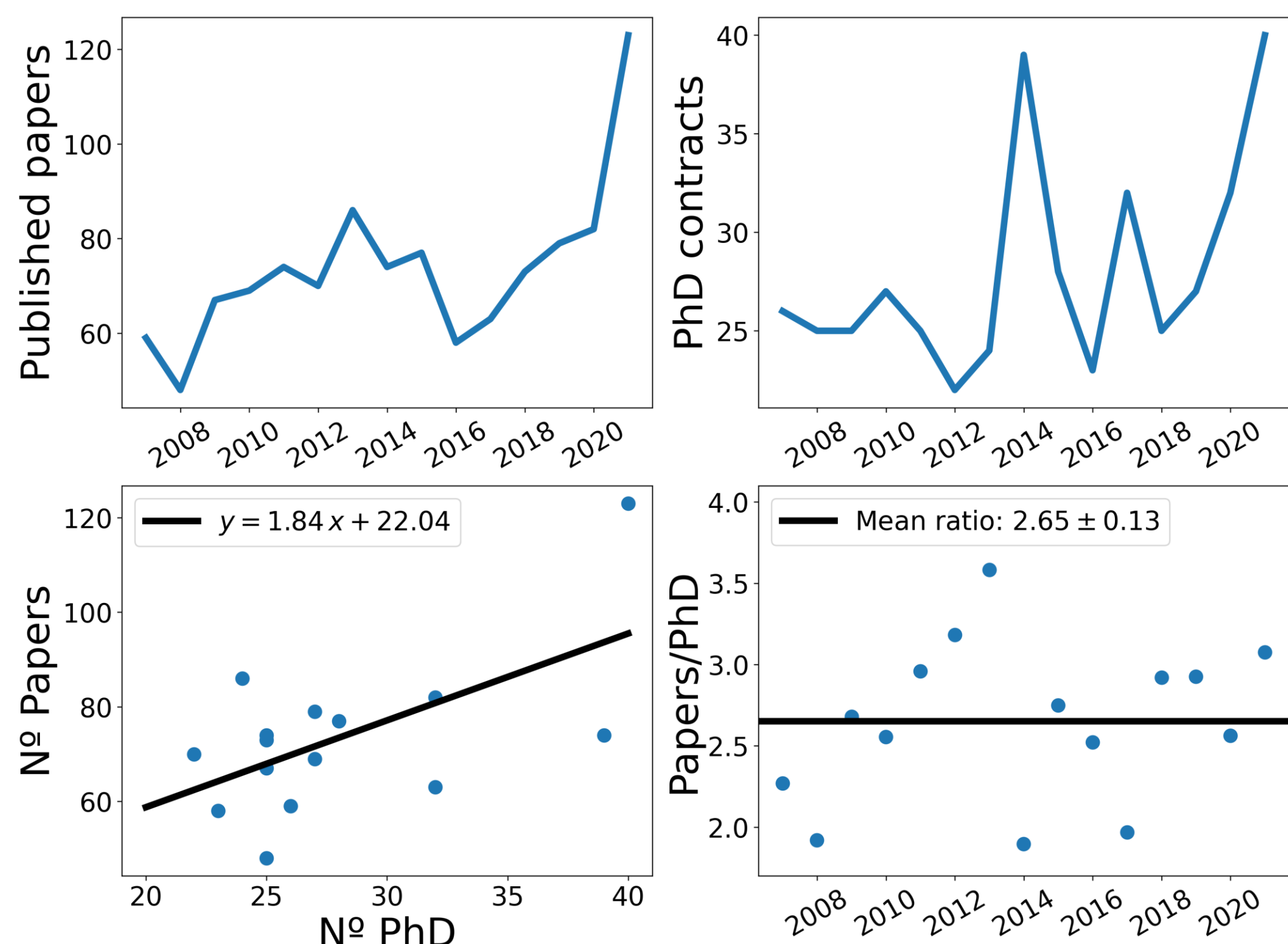


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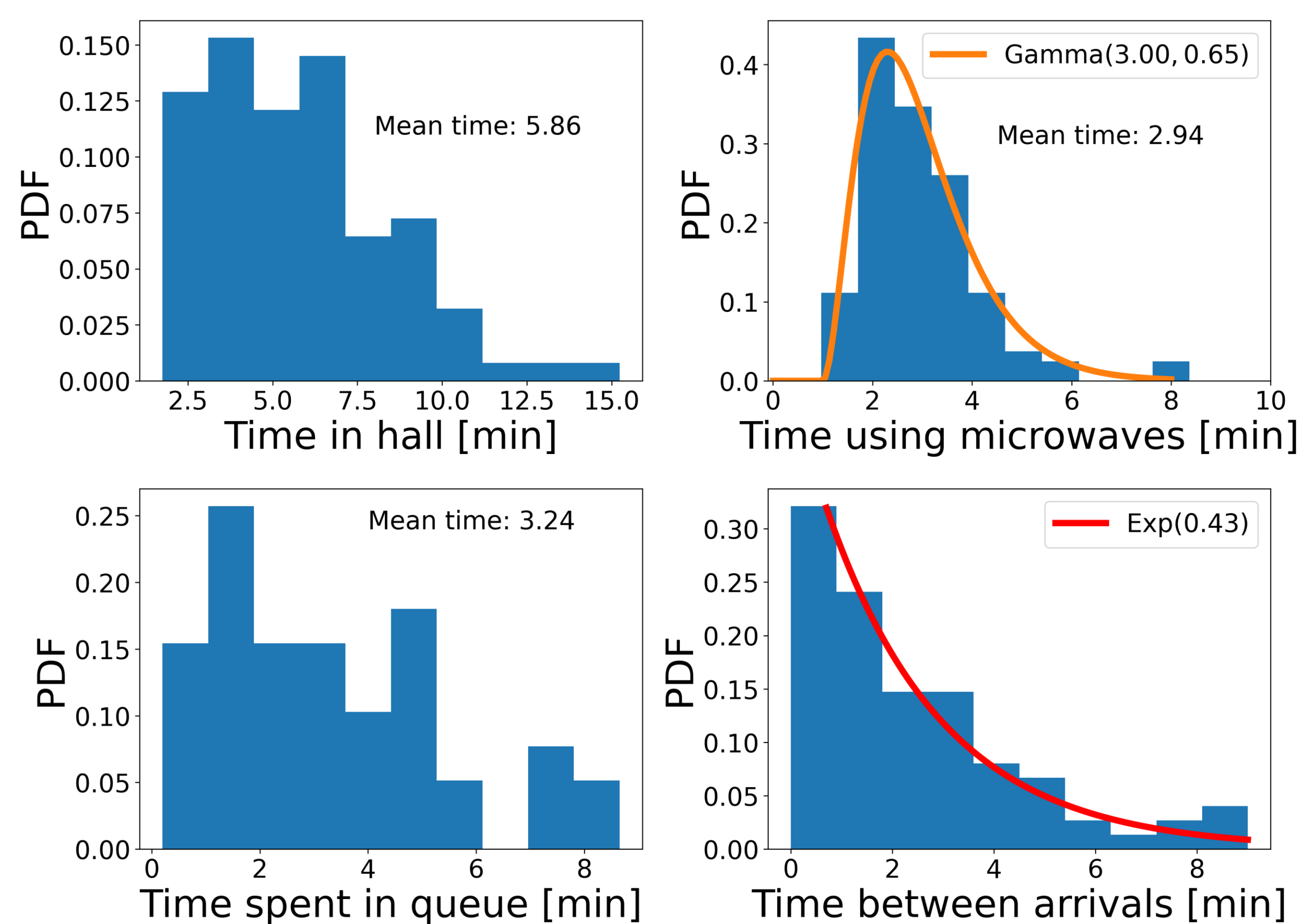
Introduction

- Both the number of papers yearly published at IFISC and the number of PhD students show a growing trend since IFISC's foundation.
- The number of published papers is positively correlated with the number of PhD students --> approximately constant rate of papers per PhD student.
- However, the rate microwave/PhD shows a decreasing tendency. This severely impacts paper production efficiency, due to increasing waiting times in queues.**
- To investigate the effects of queue formation at IFISC, we designed a data acquisition assay and developed three different stochastic models.
- We determine the dependency between the number of microwaves, number of PhD students and lost time.



Data acquisition and methods

- We measure four quantities: time between two arrivals, time spent of queue, time spent heating and total time; and we obtain the corresponding histograms.
- The microwave usage time and the time between arrivals can be modelled by a Gamma distribution and an exponential distribution respectively.



- The average time lost in queues can be transformed to an annual loss of papers and/or money. To do so, we multiply this time by the mean number of papers published by a PhD in one year or the annual salary of a PhD, respectively.

Multiple server model (MSM)

- Standard model from queue formation theory [1].
- Birth and death process.
- Constant birth and death rates.

Self-organization model (SOM)

- Assumes ideal organization of PhD students, so that queue formation is minimum.
- However, it includes a tendency to wait for peers to eat together: post-heating waiting times.

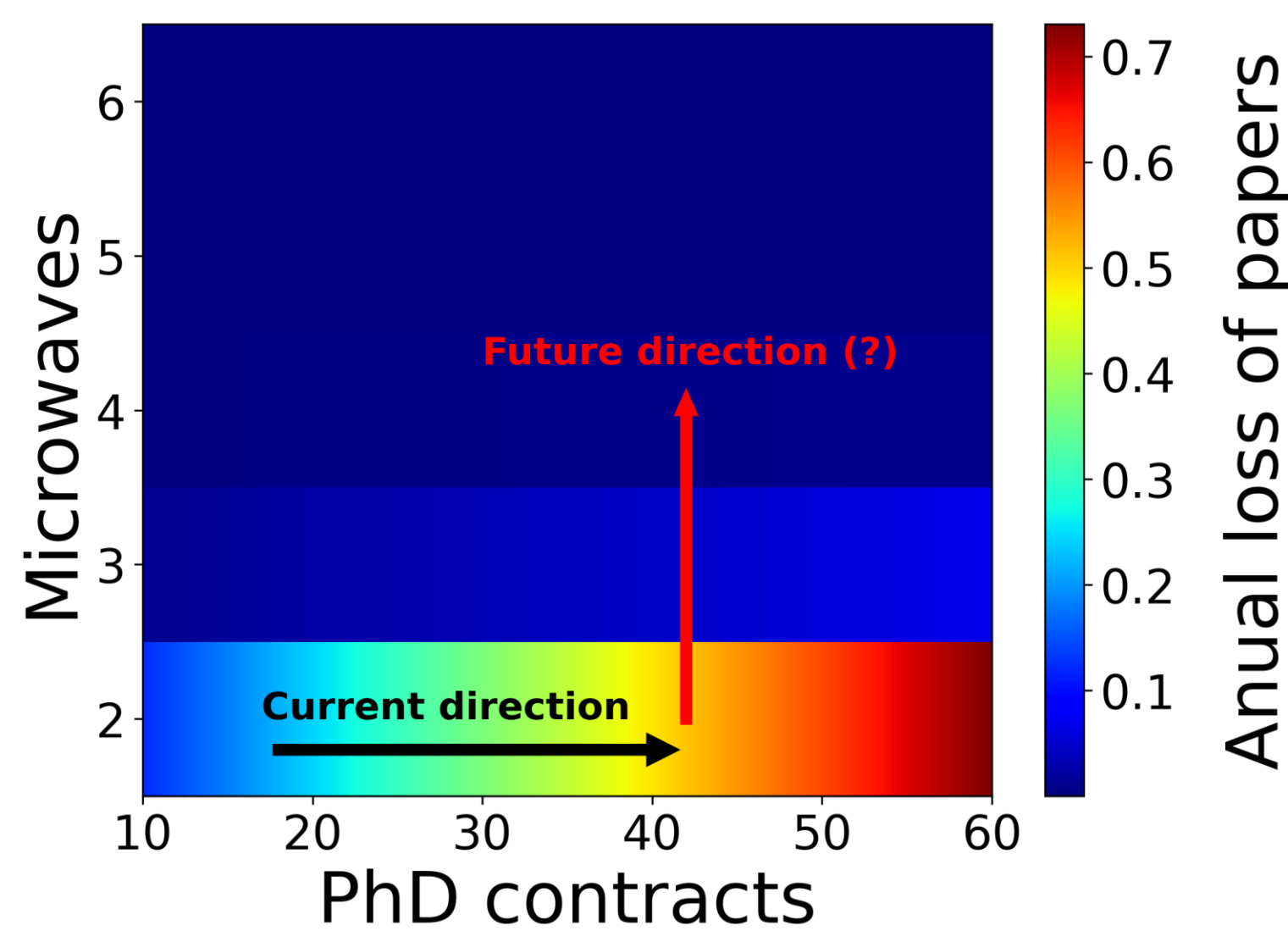
Data-driven simulation [2]

- Simulates time spent in queue from the empirical data.
- Samples arrival time and heating time from the fitted probability distributions.

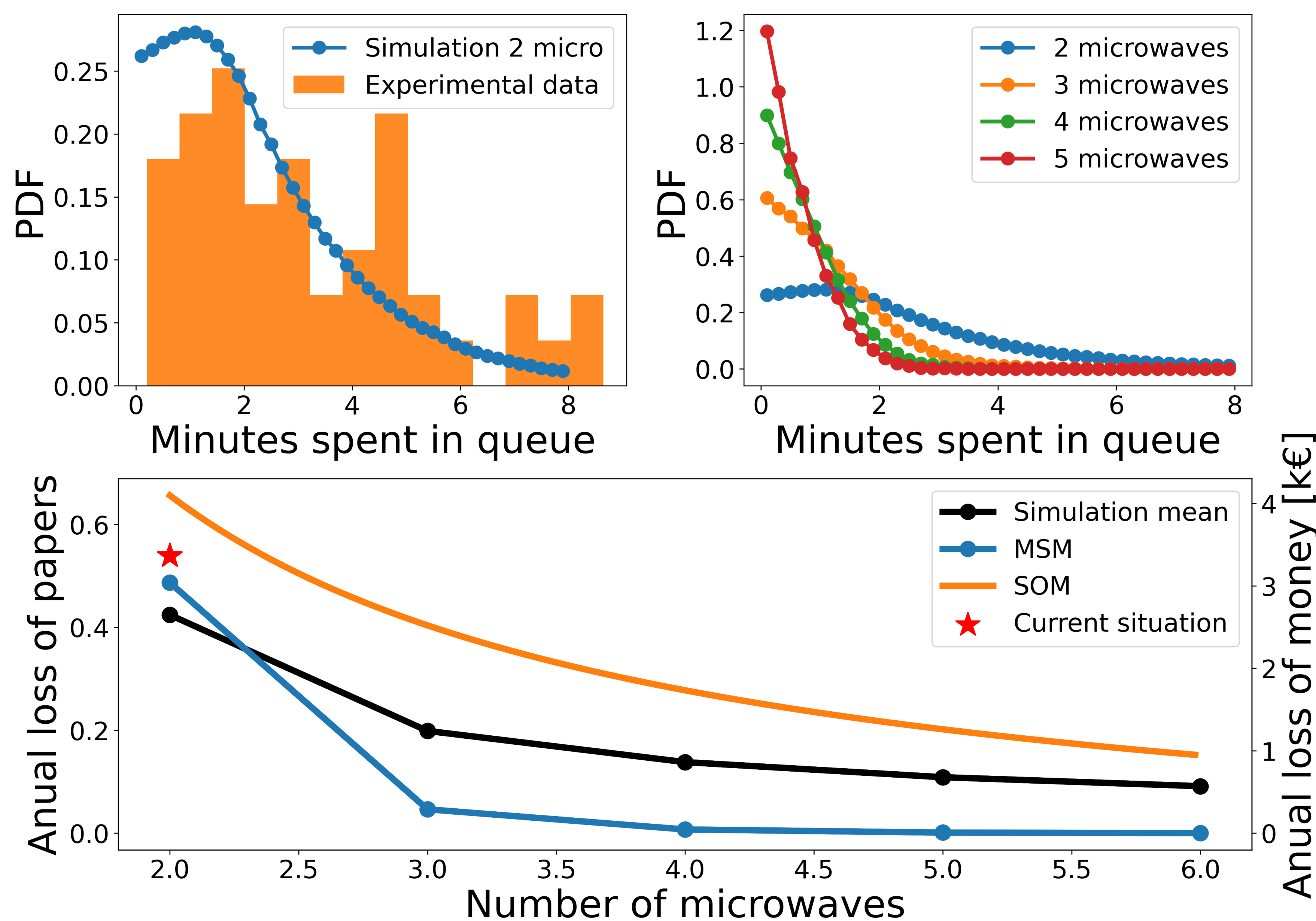
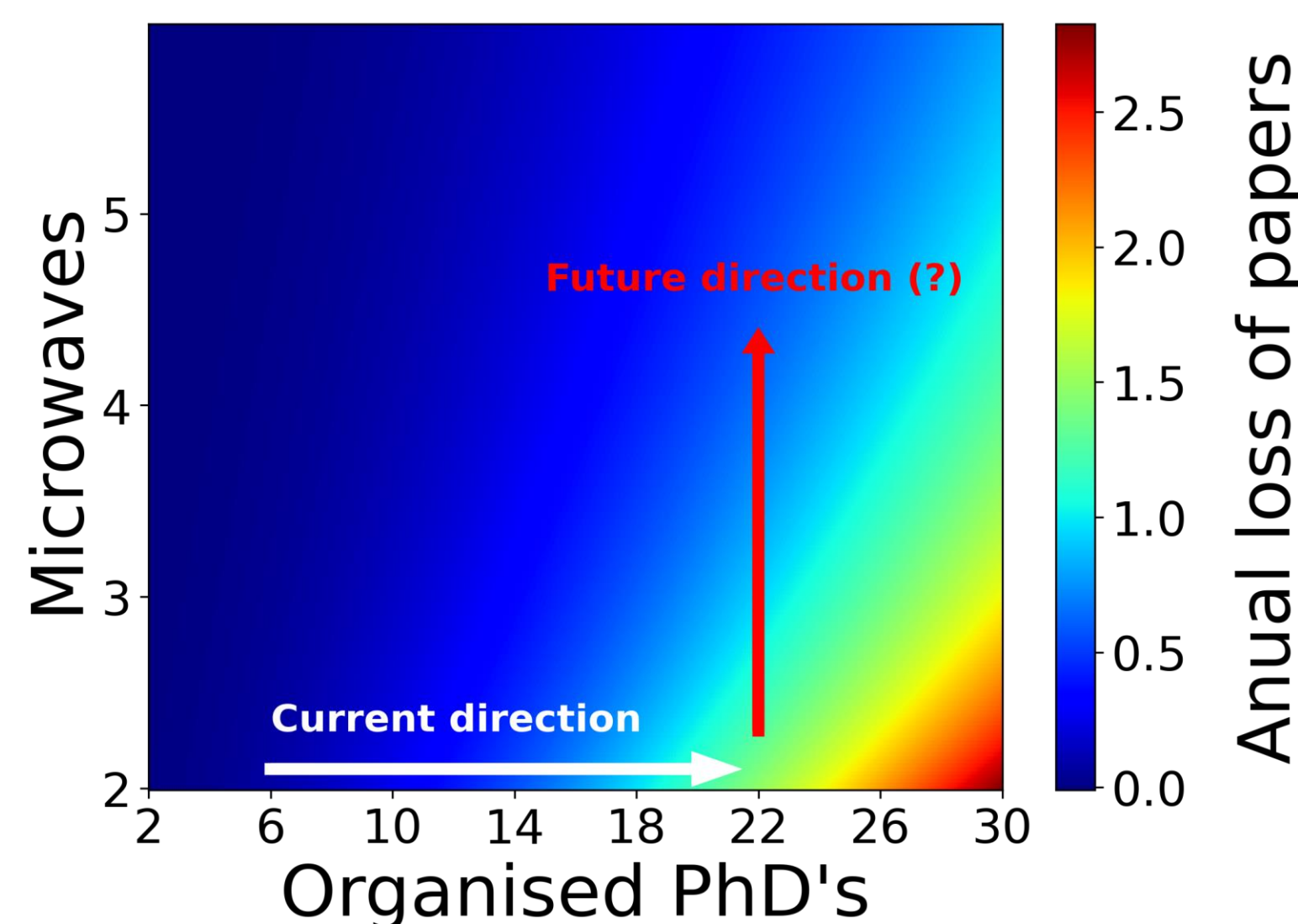
Results

- Both MSM and SOM predict an important loss of papers in the current situation. MSM predicts the loss of 0.5 papers per year, and SOC predicts the loss of more than one paper per year.
- Empirical queue distribution agrees with the data-driven model, confirming that it gives the most accurate predictions.
- Data-driven simulation predicts a loss of 0.55 papers and 3500€ per year.
- An additional microwave would reduce the loss of papers and money by more than a factor ½.

MSM



SOM



Conclusions

- Microwave queues represent a significant waste of time that adds up to one lost paper every two years.**
- Buying an extra microwave [3] would dramatically reduce the wasted time and thus improve PhD efficiency.**
- The same conclusions apply to buying an extra coffee machine and an extra printer for office S17.**

References

- [1] Cooper, R.B. Introduction to Queueing Theory. Macmillan, 1972.
- [2] <https://github.com/agimenezromero/Microwave-Queue-Simulator>
- [3] <https://www.amazon.es/>

Acknowledgements

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