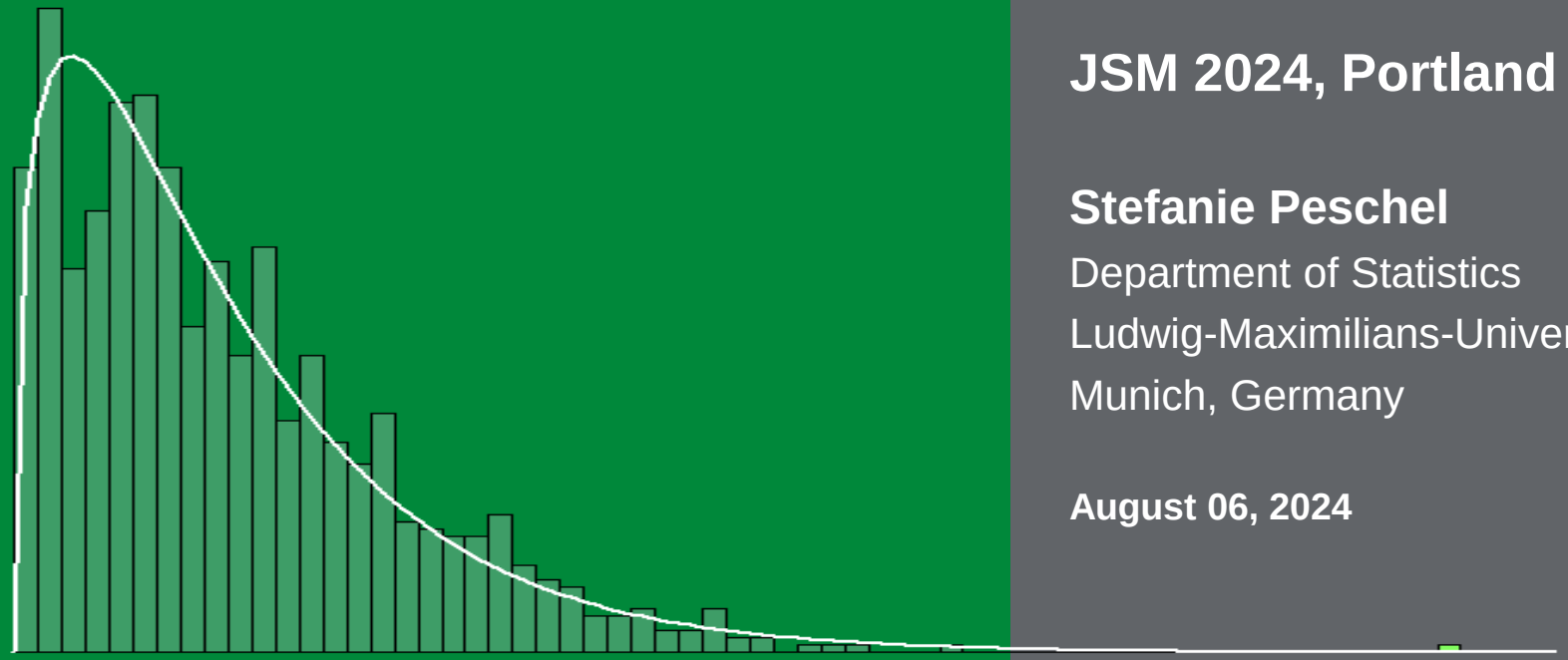
LMU LUDWIG-MAXIMILIANS-UNIVERSITÄT MÜNCHEN

FACULTY OF MATHEMATICS, INFORMATICS, AND STATISTICS

DEPARTMENT OF STATISTICS

Mind your zeros: accurate p-value approximation in permutation testing



Bio DS Lab

Biomedical Statistics & Data Science Lab

mcml Munich Center for Machine Learning

JSM 2024, Portland

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Ludwig-Maximilians-Universität München (LMU)
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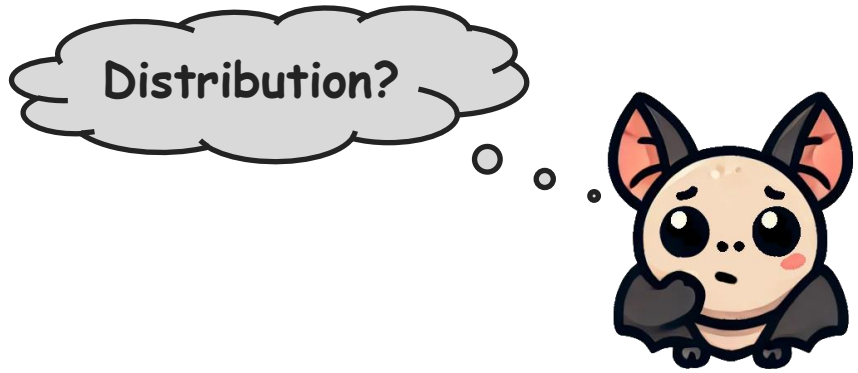
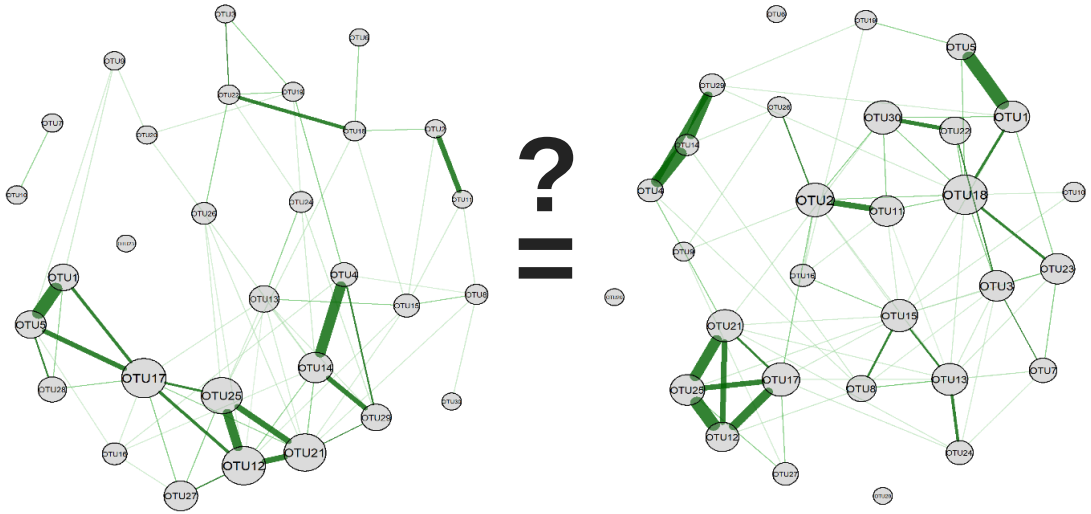
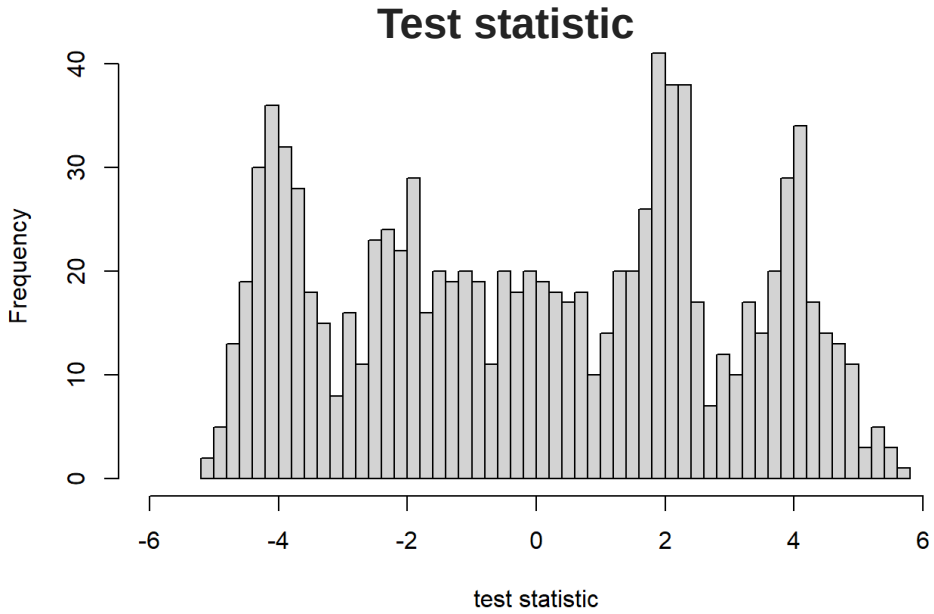
Hypothesis testing



Different network properties?





- No classical distribution
- Parametric assumptions not met

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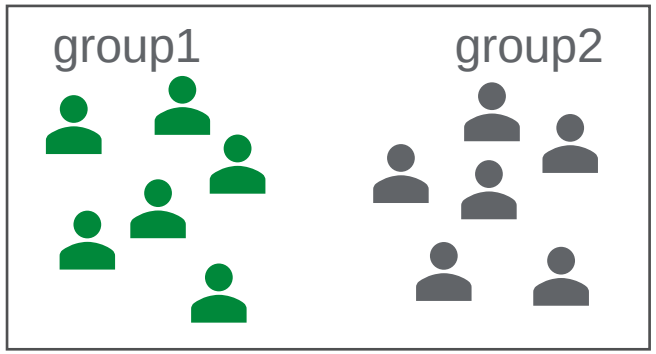
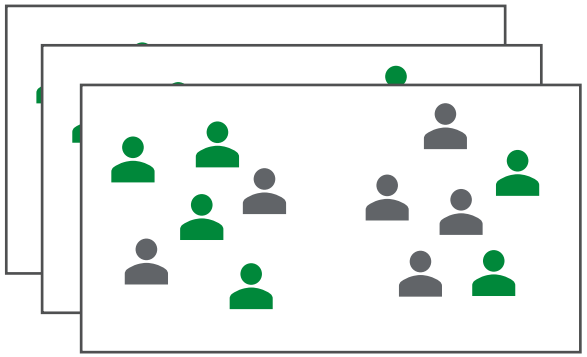
Permutation testing

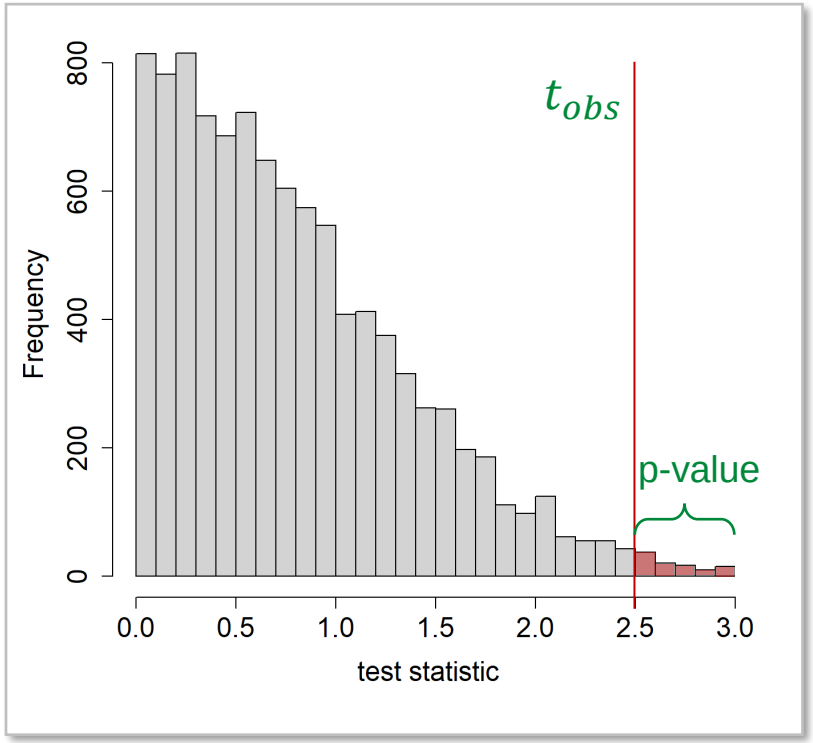
Observed data



Permutations



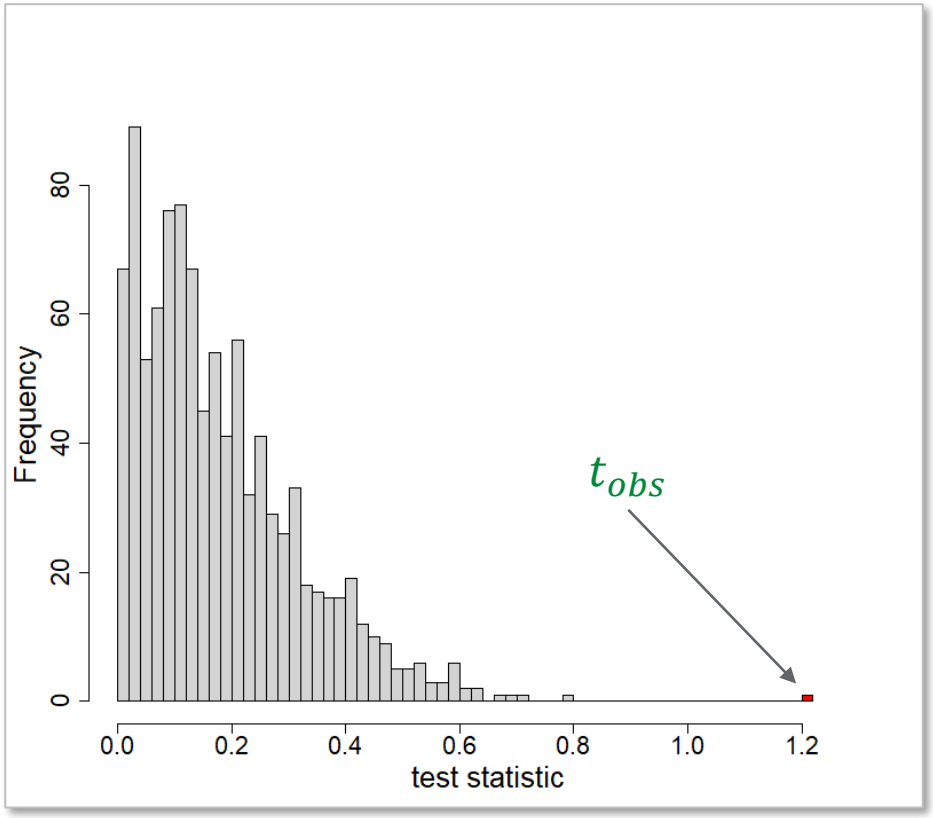
Distribution of t under H_0:



Empirical p-value:

$$p = \frac{\sum_{n=1}^{N} \boldsymbol{I}(t^* \geq t_{obs}) + 1}{N + 1}$$

Low number of permutations (here: N = 1000)



Empirical p-value:

$$p = \frac{1}{1001} \approx 0.001$$

→ **Low power in multiple testing setting**

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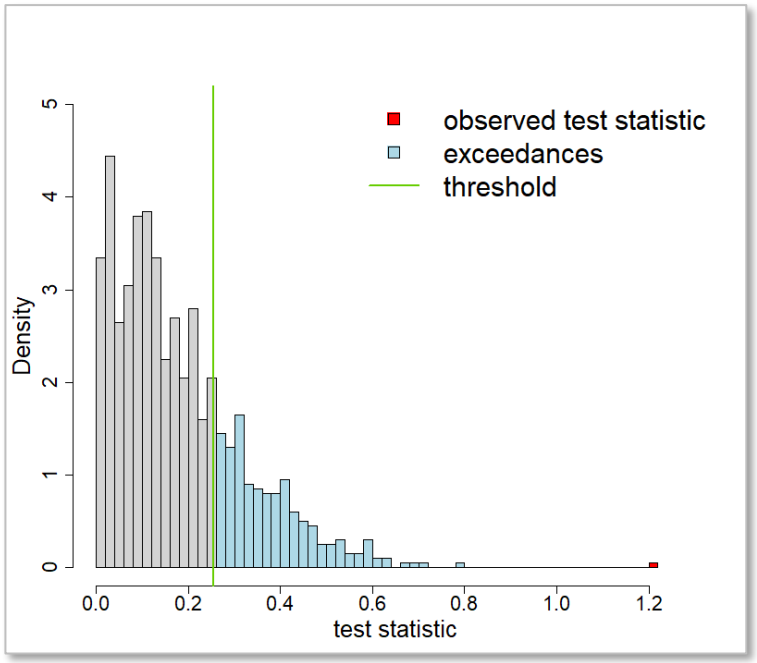
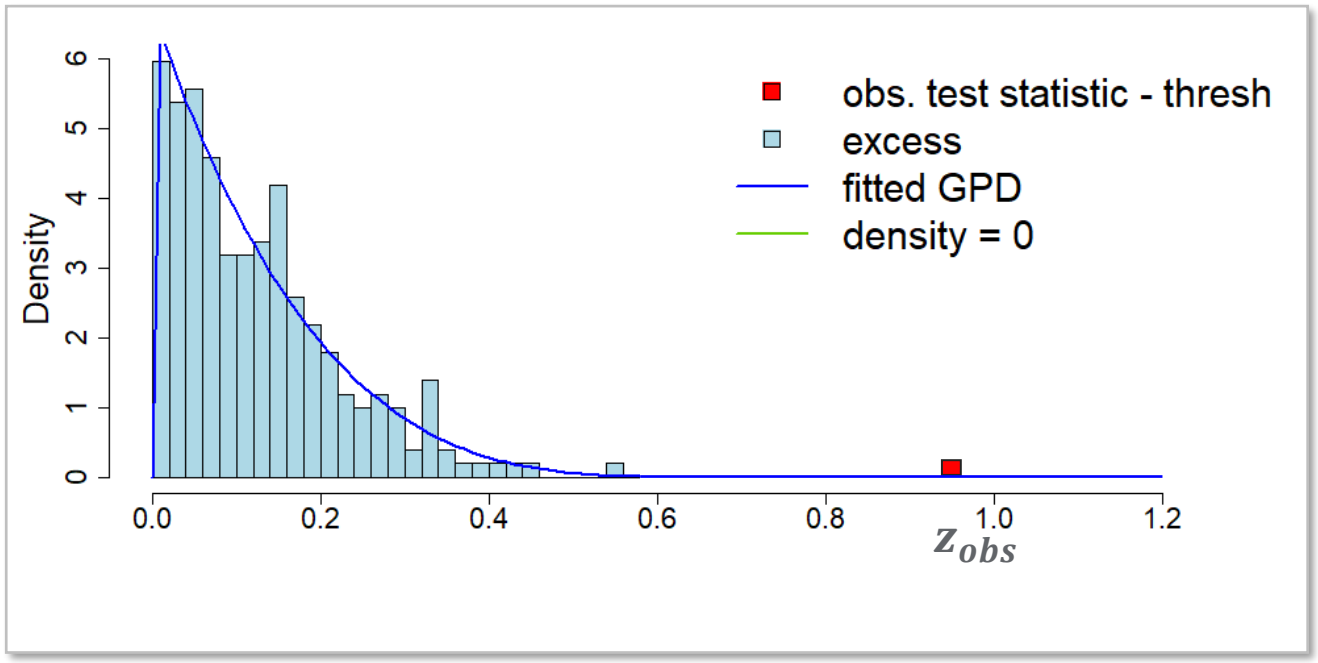
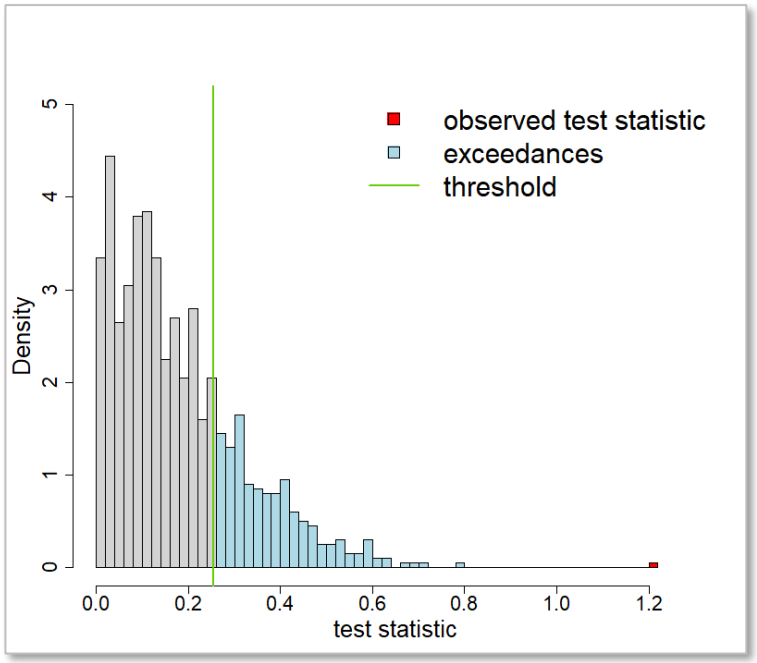
P-value approximation with the Generalized Pareto Distribution (GPD)

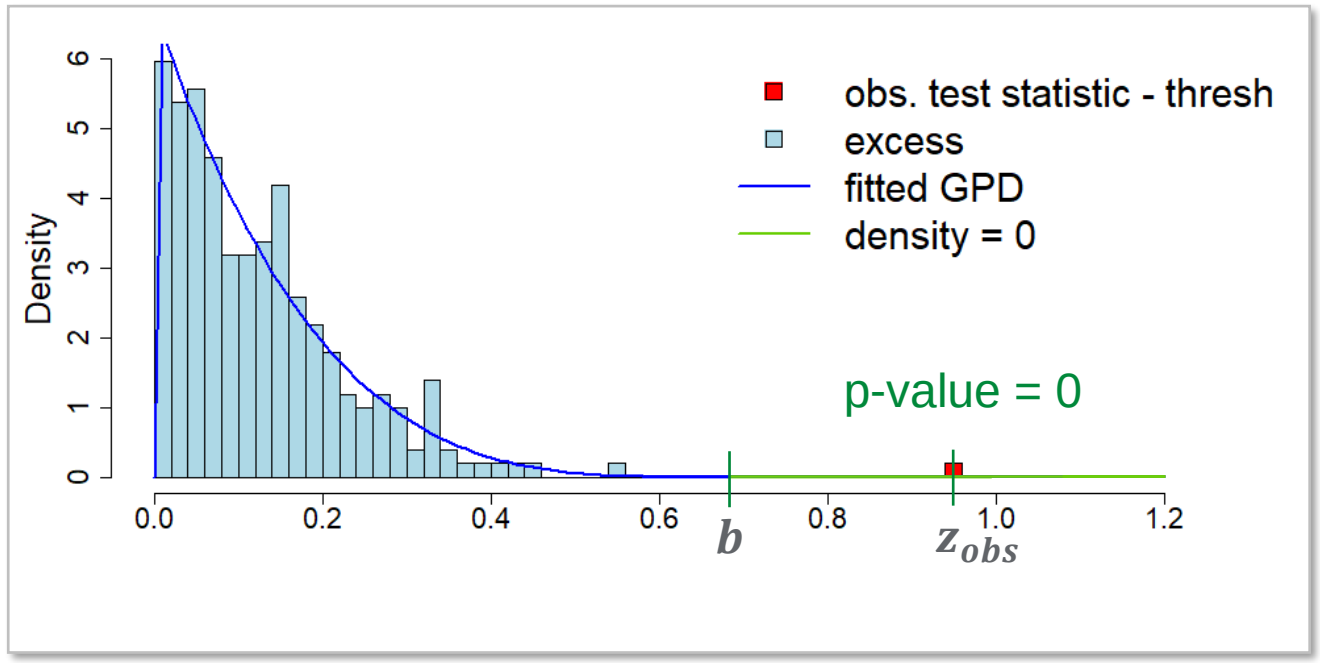




$$pval = \frac{N_{exc}}{N}\left(1 - F(t_{obs} - thresh)\right)$$

P-value approximation with the Generalized Pareto Distribution (GPD)





Estimated GPD parameters:

Shape: $\xi = -0.21785$ → Bounded support

Scale: $\sigma = 0.14890$

P-value is zero for extreme test statistics!

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Interested in our proposed approach?

Visit me in halls C&D

at poster number **11.**

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permAprox