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Multivariate Analysis and Statistical Learning

Monte Carlo Simulation on Binomial Random Graph

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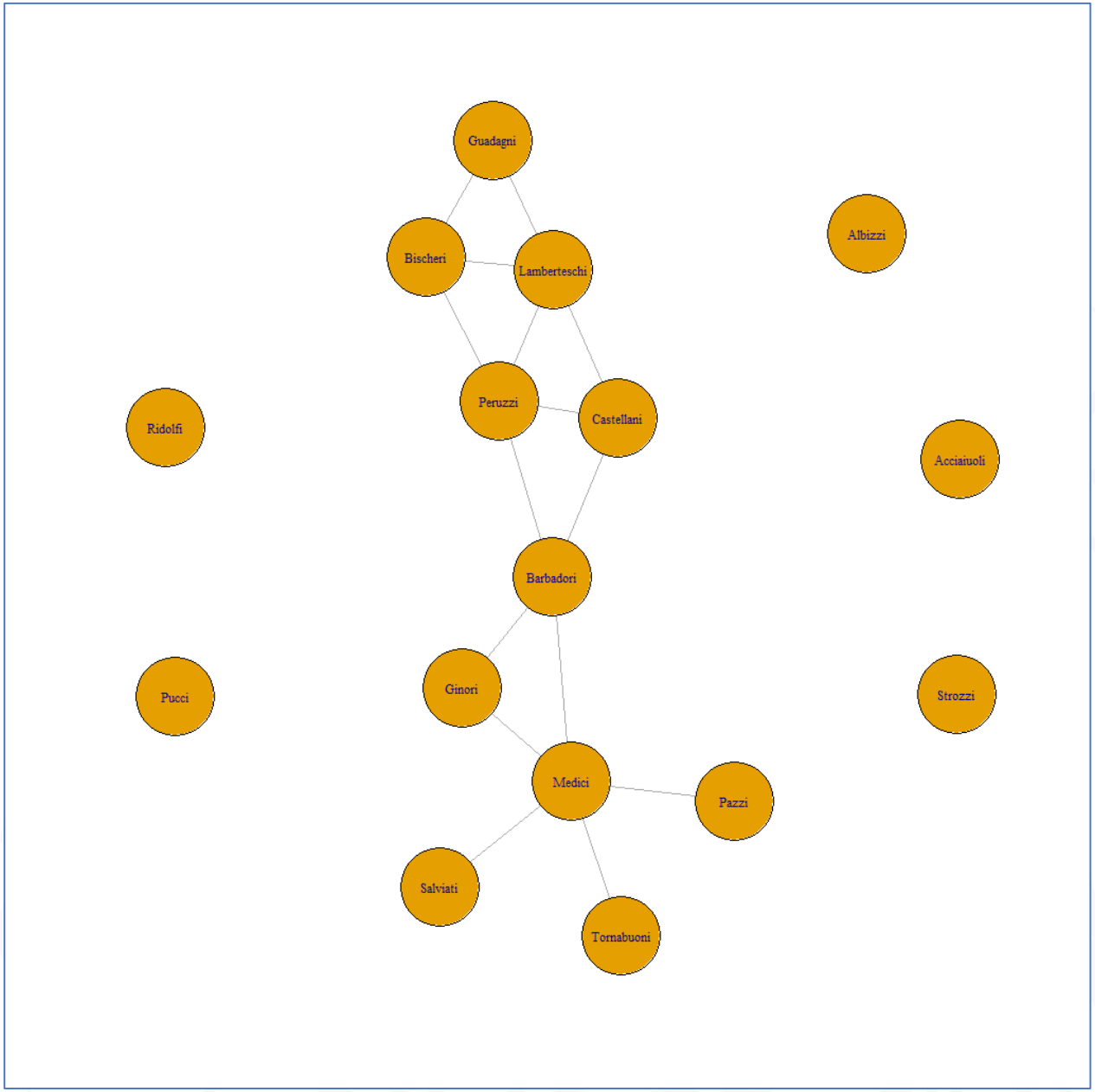
The problem

Simulate graphs that correctly catch features and characteristics of the observed network.

The observed network represents business among Renaissance Florentine Families



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Monte Carlo Simulation

We take the density of the observed graph (pmle) and simulate B graphs with the same density. To show usefulness and limits of Monte Carlo simulation let's check results against two statistics: density and transitivity

```
B ← 1000
rhoSim ← c()
traSim ← c()
for (b in 1:B) {
  Ysim = matrix(0, n, n)
  tmp = rbinom(n*(n-1)/2, 1, pmle)
  Ysim[lower.tri(Ysim)] = tmp
  Ysim = Ysim + t(Ysim)
  brgSim ← graph_from_adjacency_matrix(Ysim)
  rhoSim[b] ← mean(Ysim)
  traSim[b] ← transitivity(brgSim)
}
```

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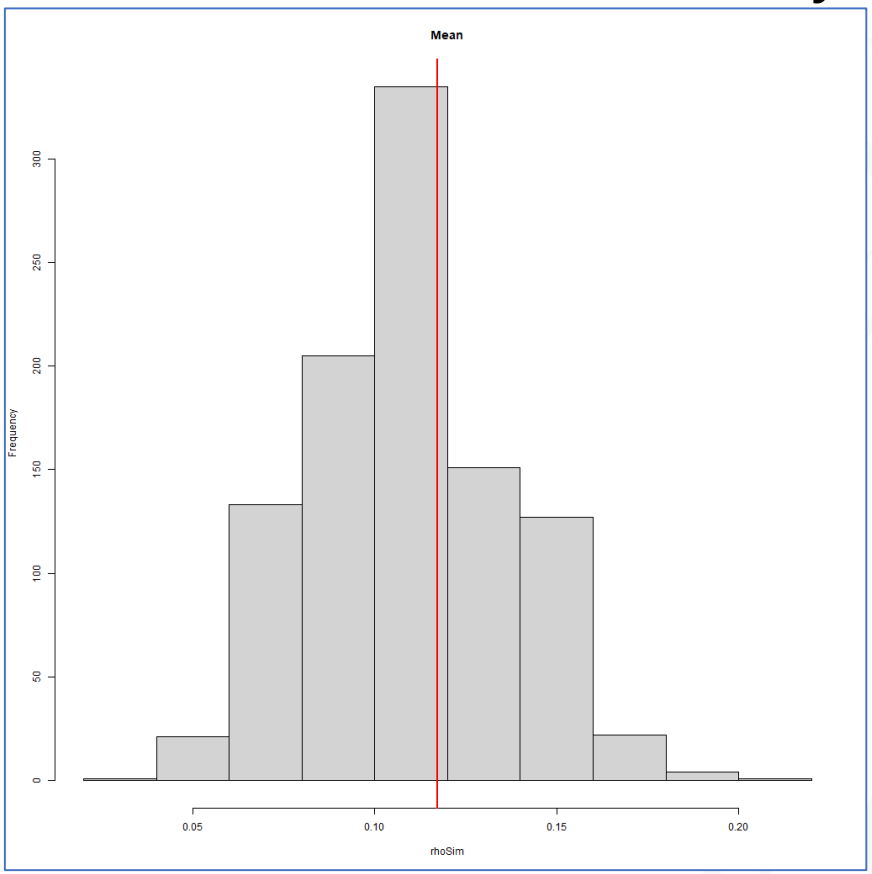
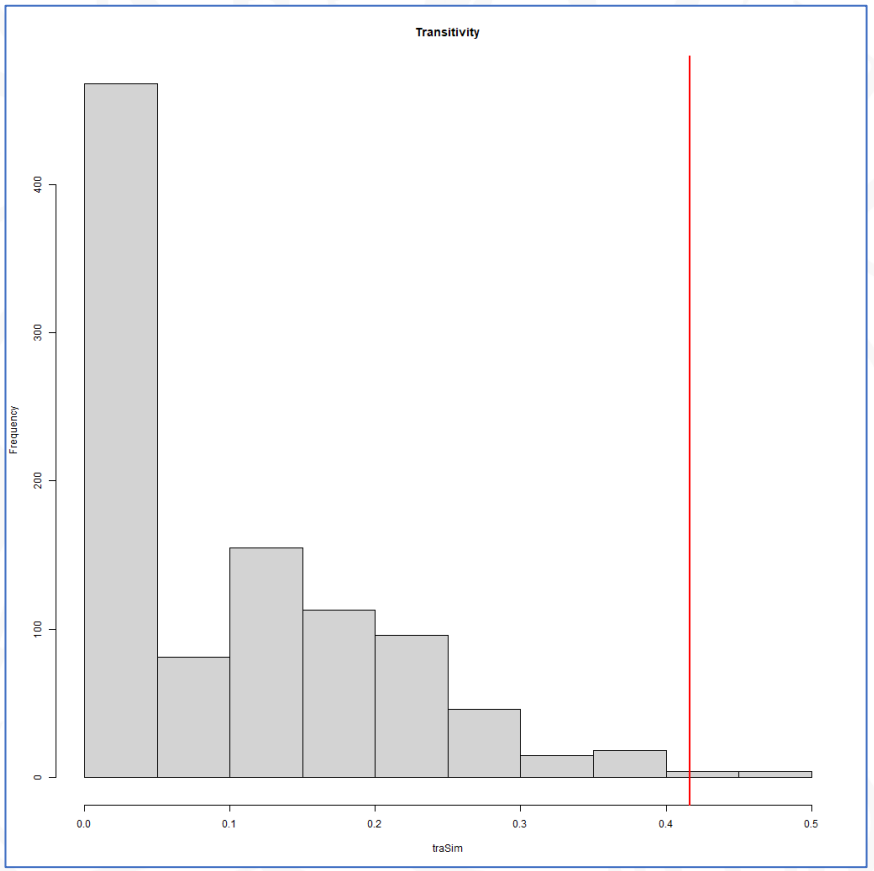
Results

Density



Transitivity



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Conclusions

Monte Carlo simulation is a powerful tool in the toolbox of statisticians and data scientists, but remember that the power is not in the tools but in those who know how to use them.

To be in control you need to know the usefulness and limitations of your tools.

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References

Mark Newman (2018)

Networks: an introduction

M. E. J. Newman, D. J. Watts, and S. H. Strogatz (2010)

Random graph models of social networks