



Differentially Private β -model and synthetic graphs

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The β -model of random graphs is an exponential family model with the degree sequence as a sufficient statistic. We characterize conditions that lead to a quadratic time algorithm to check for the existence of maximum likelihood estimator (MLE) of the β -model, and show that the MLE never exists for the degree partition β -model. Then motivated by a confidentiality problem of preserving privacy of individual relations in networks while at the same time supporting utility for statistical inference, we present a differentially private estimator of the parameters of β -model. We show that the estimator is asymptotically consistent and normally distributed – it achieves the same rate as the non-private estimator. Our techniques involve releasing the degree sequence using Laplace mechanism and constructing a maximum likelihood estimate of the degree sequence, which is equivalent to projecting the noisy degree sequence on the set of all “graphical” degree sequences. We present an efficient algorithm for the projection which also outputs a synthetic graph. We evaluate our estimator on real graphs and compare it with current algorithms to release degree distributions and find that it does much better.

Keywords: random graphs; beta model; MLE existence; privacy.