Bitcoin Alpha Trust Network Project

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Background

- Overview:
  - Bitcoin---first decentralized digital currency, established in 2009
  - Peer to Peer, direct transactions
  - As award for mining
  - Bitcoin Alpha --- Trading platform

- Research Questions:
  - Are the ratings effective in recognizing frauds?
  - How do Bitcoin transactions change overtime?
 - How to predict transactions?

Background

- Data:
  - Bitcoin Alpha Trust Network
    - A trust weighted signed network from a Bitcoin trading platform called Bitcoin Alpha collected by S. Kumar, F. Spezzano, V.S. Subrahmanian, C. Faloutsos. In 2016.
  - Features:
    - Source: Rater
    - Target: Ratee
    - Rating: from -10 (total distrust) to +10 (total trust)
    - Time: Time of the rating (from Nov. 2011 till Jan. 2016)
  - Nodes: 3,783
  - Edges: 24,186
  - Range of edge weight: -10 to +10
  - Percentage of positive edges: 93%
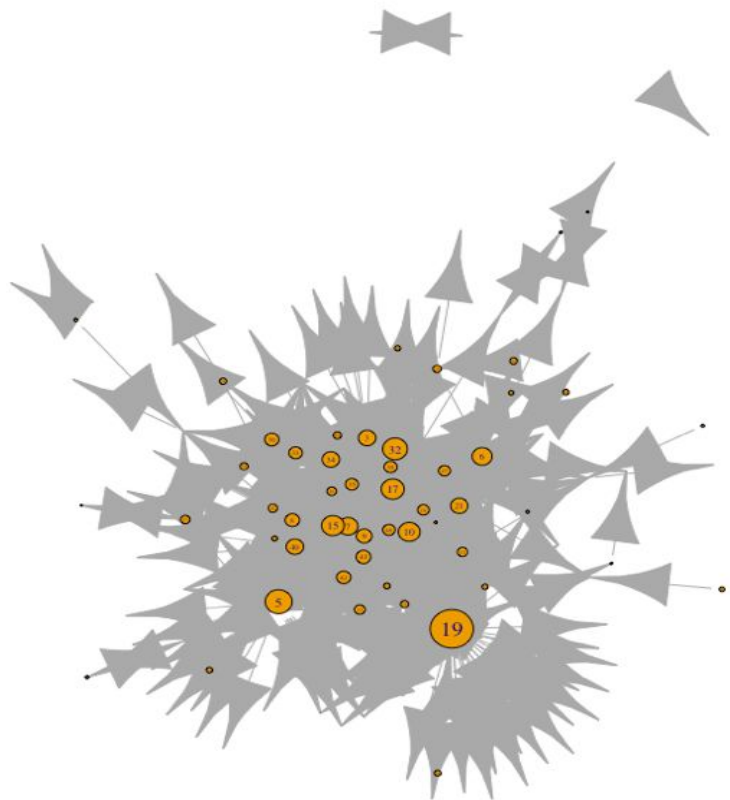 - Only using 2015 observations: accepted as payment

EDA
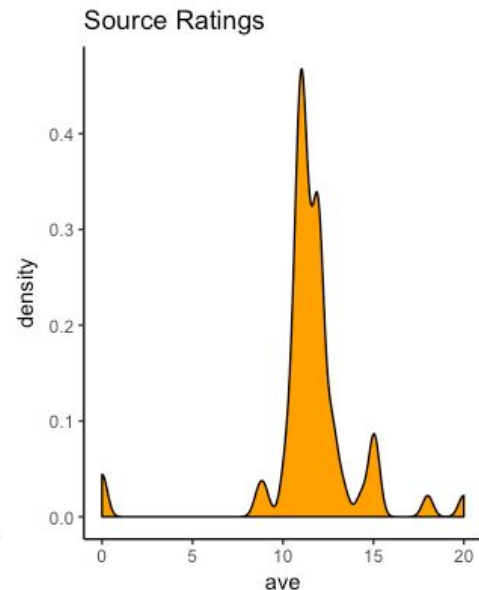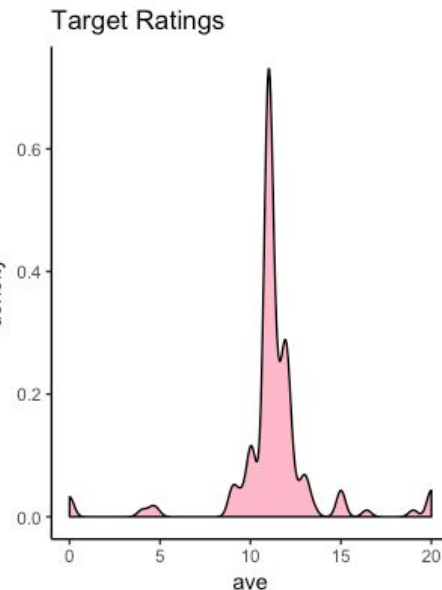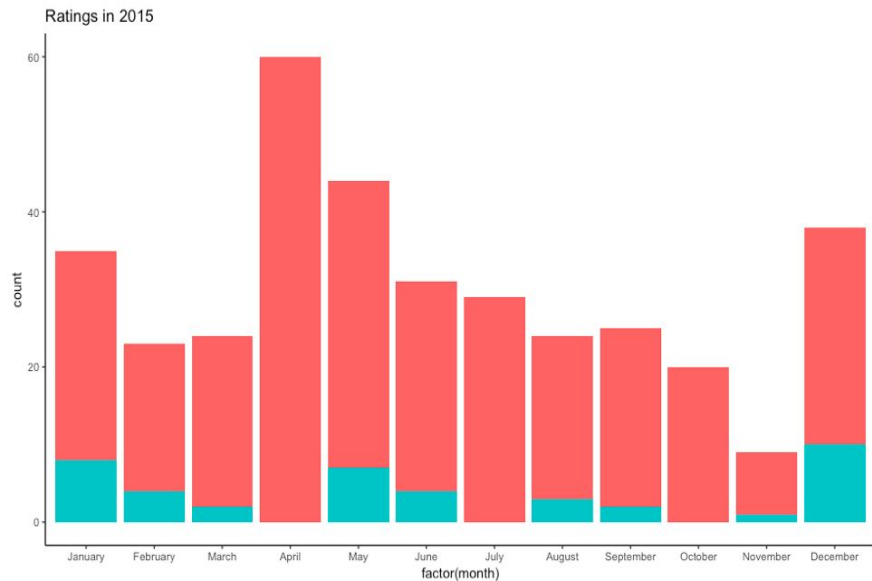
- Most targets have received <2 negative reviews
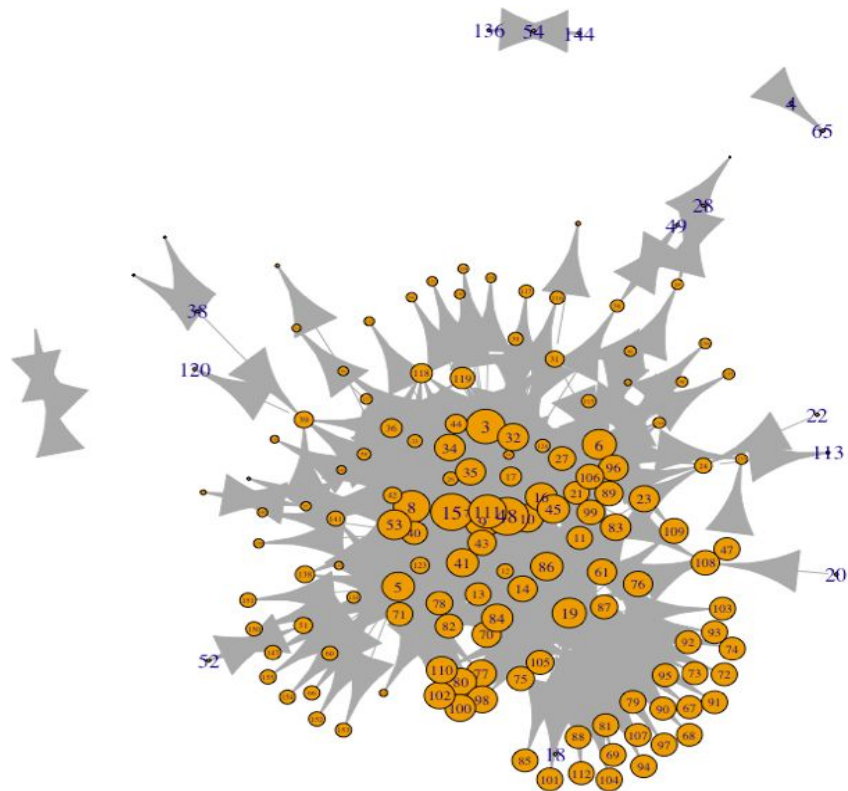- Even if some targets have received negative ratings in the past, they still have ratings after that

EDA

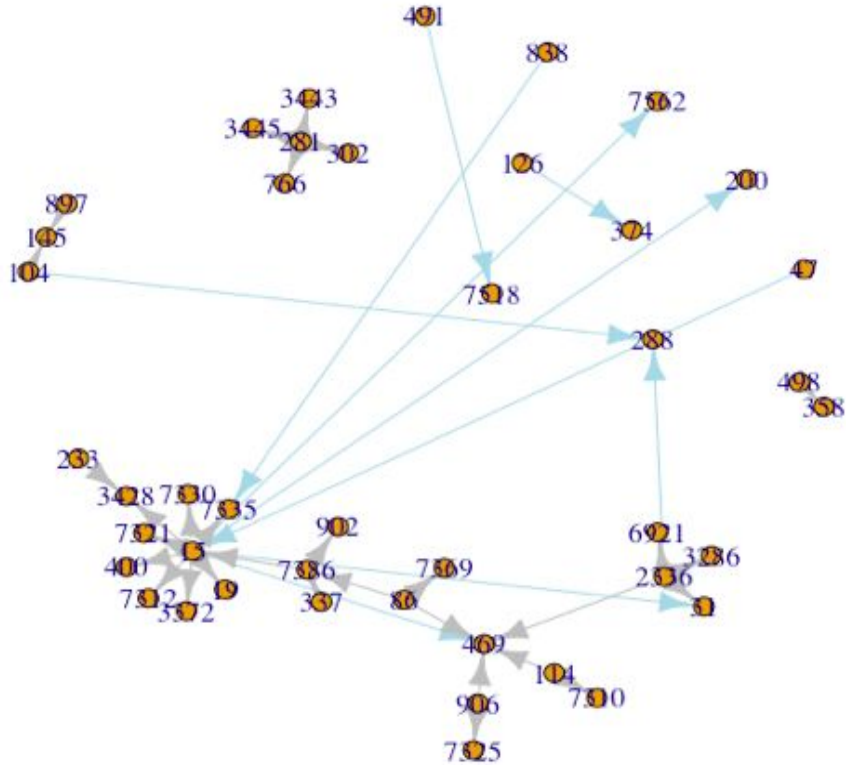Fruchterman Reingold

Degree
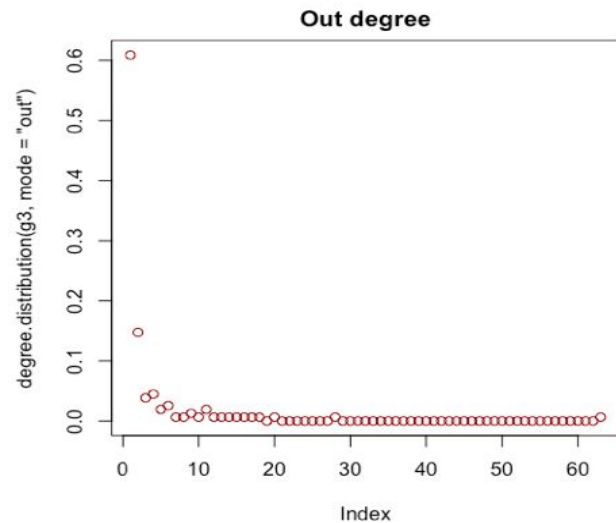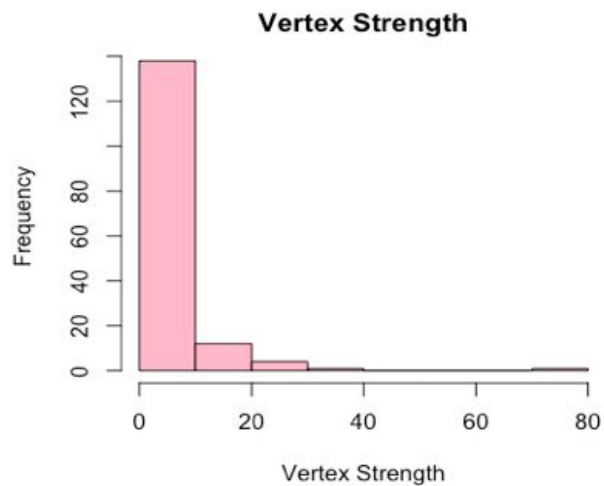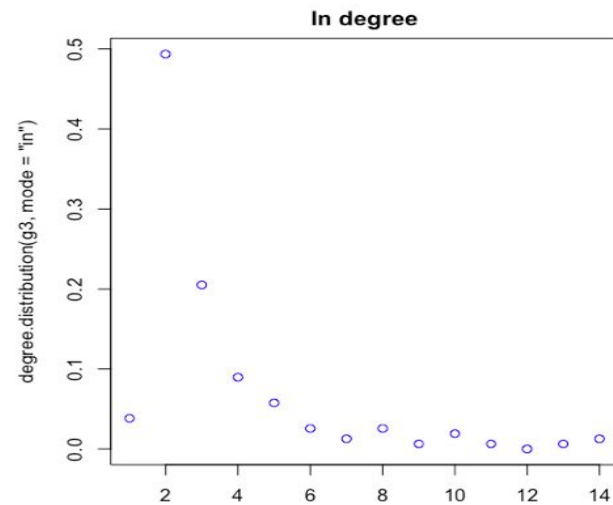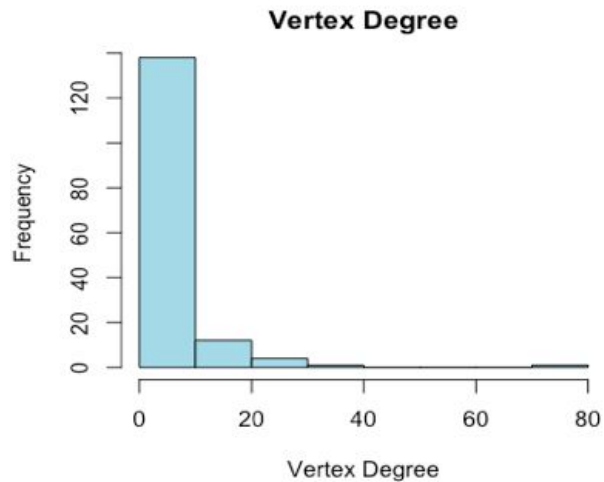
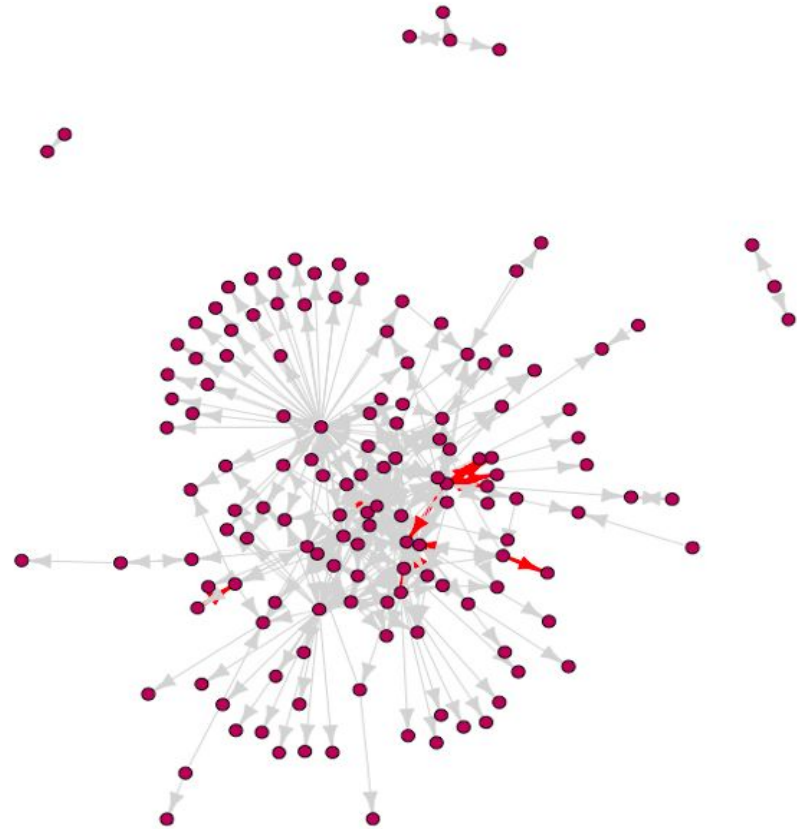# Hub & Authority Scores

Negative vs Good ratings

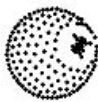Negative Ratings Network

Good Ratings Network

Dynamic Network
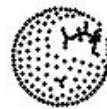

t=0-31   t=31-62   t=62-93   t=93-124   t=124-155   t=155-186   t=186-217   t=217-248

t=248-279   t=279-310   t=310-341   t=341-372

Animation

ERGM

- *Exponential random graph model*
  (ERGM)

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Summary of model fit
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Formula:   bitcoin_network ~ edges

Iterations:  7 out of 20

Monte Carlo MLE Results:
      Estimate Std. Error MCMC % p-value
edges -4.18655    0.05296      0  <1e-04 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

    Null Deviance: 33521  on 24180  degrees of freedom
 Residual Deviance:  3761  on 24179  degrees of freedom

AIC: 3763    BIC: 3771    (Smaller is better.)
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Summary of model fit
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Formula:   bitcoin_network ~ edges + absdiff("rate")

Iterations:  7 out of 20

Monte Carlo MLE Results:
             Estimate Std. Error MCMC % p-value
edges         -4.13172    0.06444      0  <1e-04 ***
absdiff.rate  -0.02487    0.01758      0    0.157
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

    Null Deviance: 33521  on 24180  degrees of freedom
 Residual Deviance:  3758  on 24178  degrees of freedom

AIC: 3762    BIC: 3779    (Smaller is better.)
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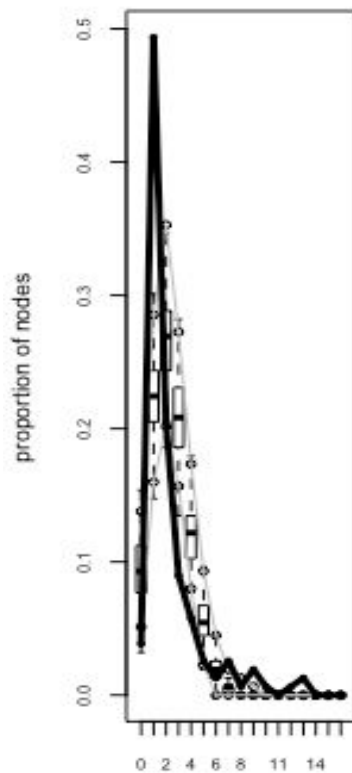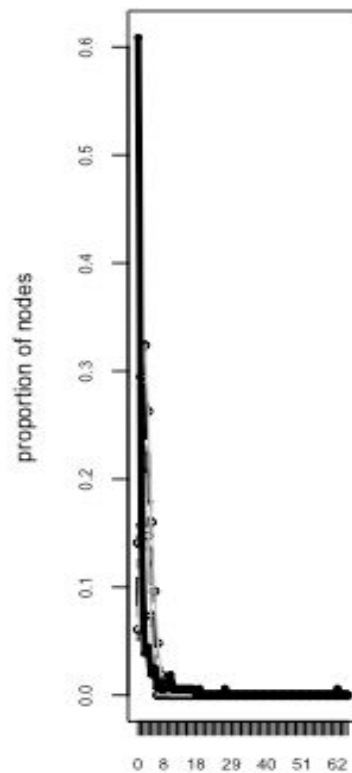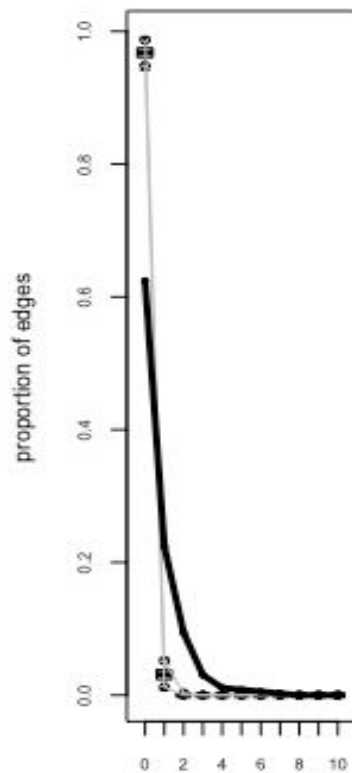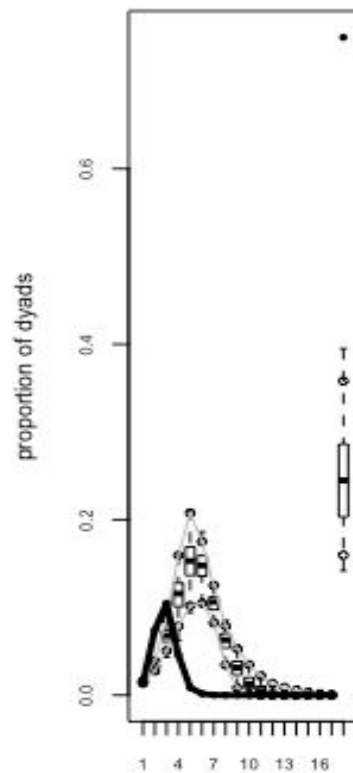
Goodness of fit

Latent Position Model

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Summary of model fit
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Formula:    bitcoin_network ~ euclidean(d = 2)
Attribute: edges
Model:     Bernoulli
MCMC sample of size 4000, draws are 10 iterations apart, after burnin of 10000 iterations.
Covariate coefficients posterior means:
            Estimate    2.5%   97.5% 2*min(Pr(>0),Pr(<0))
(Intercept) -1.6179 -1.8195 -1.4168            < 2.2e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Overall BIC:        4044.432
Likelihood BIC:     3272.81
Latent space/clustering BIC:      771.6224

Covariate coefficients MKL:
            Estimate
(Intercept) -3.165863
```
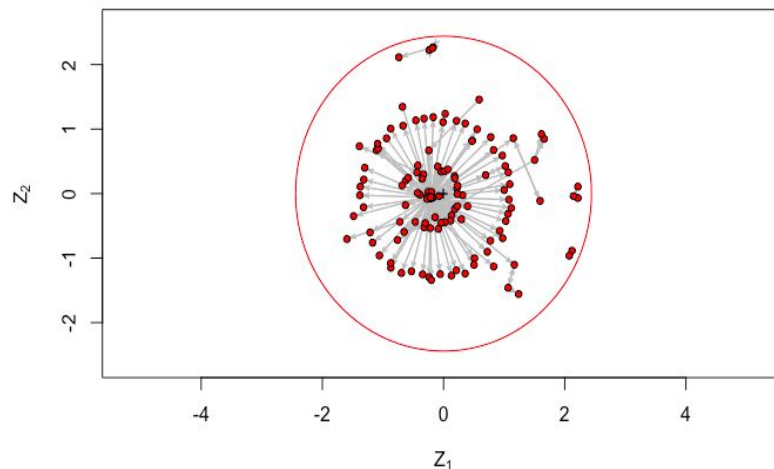

MKL Latent Positions of samp_fit

Latent Position Model with clustering

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Summary of model fit
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Formula:   bitcoin_network ~ euclidean(d = 2, G = 2)
Attribute: edges
Model:     Bernoulli
MCMC sample of size 4000, draws are 10 iterations apart, after burnin of 10000 iterations.
Covariate coefficients posterior means:
          Estimate    2.5%    97.5% 2*min(Pr(>0),Pr(<0))
(Intercept)  -1.6695 -1.8608 -1.4729           < 2.2e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Overall BIC:        4007.556
Likelihood BIC:     3265.803
Latent space/clustering BIC:      741.7529

Covariate coefficients MKL:
          Estimate
(Intercept) -3.163059
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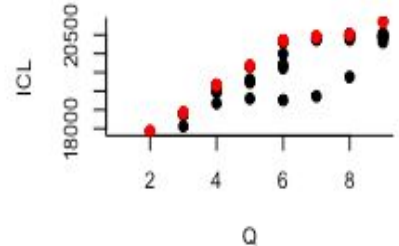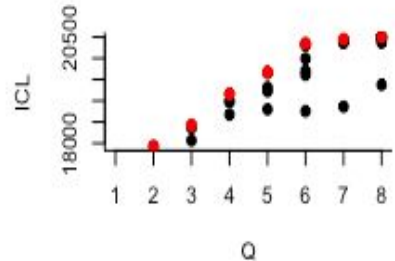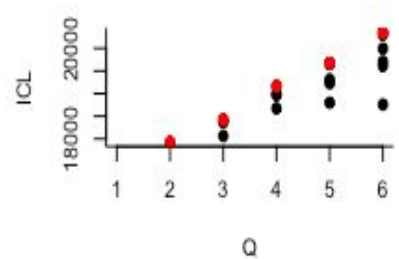

MKL Latent Positions of samp_fit2
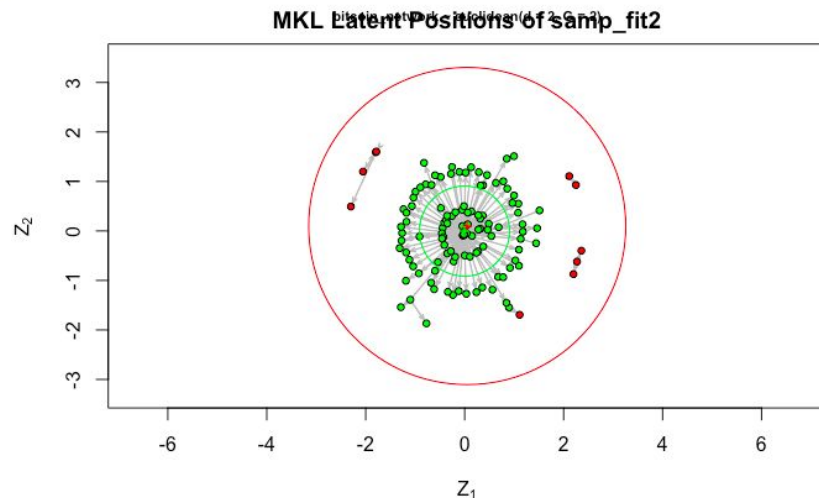
Methodology

- Stochastic Block Model
  Gaussian

Reference

1. https://snap.stanford.edu/data/soc-sign-bitcoinalpha.html