analysis_EMB_ex35_size-effect-embedding

April 19, 2023

1 Examining size effect with Embeddings

1.1 Experiment description

1.1.1 Narrative set-up

Recent results suggest that our current methodology is unable to reproduce the prior results utilizing only degree information (ex33v2.1, see Reference Figure (1)). However, this does not rely on embedding information at all and hence, under logistic regression, should be able to reproduce prior "DC"-classifier results nearly exactly, up to very minor fluctuations due to random observations. Hence, we find ourselves needing to re-examine the fundamentals of our current workflow's reconstruction.

This experiment is a follow-up to EMB_ex34 which established the inconsistency of network size in current experiments and prior work is responsible for the observed performance discrepancies. See Reference Figure (2) for an annotated figure illustrating this phenomena.

1.1.2 Goal

The main goal of this experiment is to run an "all features" version of both our current LogReg-classifier and our previous "DC" classifier on the same LFR benchmarks to see if an exactly equivalent experimental setting is able to produce comparable results.

This is motivated by the results of EMB_ex34 suggesting that size discrepancies, originally enacted for speed with the slow embedding process, is the primary contributor to current performance discrepancies.

2 Set-up

2.1 Package management

2.2 Global config

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3 Experiment

3.1 Function set-up

3.2 Data set-up

3.2.1 Specify parameters

3.2.2 Sample duplex

```
setting… -N 1000
setting… -k 6.0
setting… -maxk 31.622776601683793
setting… -t1 2.1
setting… -t2 1.0
setting… -mu 0.1

************************************************************
number of nodes:        1000
average degree: 6
maximum degree: 32
exponent for the degree distribution:   2.1
exponent for the community size distribution:   1
mixing parameter:       0.1
number of overlapping nodes:    0
number of memberships of the overlapping nodes: 0
************************************************************

------------------------------------------------------------
community size range automatically set equal to [3 , 32]
it took too long to decide the memberships; I will try to change the community
sizes
new community sizes
10 5 7 10 26 18 8 32 7 5 12 6 3 29 7 10 24 14 10 18 4 6 3 9 12 3 6 4 21 13 9 11
19 4 25 13 5 18 9 3 21 7 5 4 13 3 10 23 10 8 6 26 3 9 6 3 8 5 23 18 3 25 4 18 11
30 30 13 12 14 6 6 6 3 5 21 3 6 27 10 7 20 3 11 30 7

it took too long to decide the memberships; I will try to change the community
sizes
new community sizes
5 7 10 26 18 8 32 7 5 12 6 3 29 7 10 24 14 10 18 4 6 3 9 12 3 6 4 21 13 9 11 19
4 25 13 5 18 9 3 21 7 5 4 13 3 10 23 10 8 6 26 3 9 6 3 8 5 23 18 3 25 10 18 11
30 30 13 12 14 6 6 6 3 5 21 3 6 27 10 7 20 7 11 30 7

it took too long to decide the memberships; I will try to change the community
sizes
new community sizes
7 10 26 18 8 32 7 5 12 6 3 29 7 10 24 14 10 18 4 6 3 9 12 3 6 4 21 13 9 11 19 4
25 13 5 18 9 3 21 7 5 5 13 3 10 23 10 8 6 26 3 9 6 3 8 5 23 18 3 25 10 18 11 30
30 13 12 14 6 6 6 3 5 21 7 6 27 10 7 20 7 11 30 7
```

```
it took too long to decide the memberships; I will try to change the community
sizes
new community sizes
10 26 18 8 32 7 5 12 6 3 29 7 10 24 14 10 18 4 6 3 9 12 3 6 4 21 13 9 11 19 7 25
13 5 18 9 3 21 7 5 5 13 3 10 23 10 8 6 26 3 9 6 3 8 5 23 18 3 25 10 18 11 30 30
13 12 14 6 6 6 7 5 21 7 6 27 10 7 20 7 11 30 7

it took too long to decide the memberships; I will try to change the community
sizes
new community sizes
26 18 8 32 7 5 12 6 3 29 7 10 24 14 10 18 4 6 3 9 12 3 6 10 21 13 9 11 19 7 25
13 5 18 9 3 21 7 5 5 13 3 10 23 10 8 6 26 3 9 6 3 8 5 23 18 7 25 10 18 11 30 30
13 12 14 6 6 6 7 5 21 7 6 27 10 7 20 7 11 30 7

it took too long to decide the memberships; I will try to change the community
sizes
new community sizes
18 8 32 7 5 12 6 3 29 7 10 24 14 10 18 26 6 3 9 12 3 6 10 21 13 9 11 19 7 25 13
5 18 9 3 21 7 5 5 13 3 10 23 10 8 6 26 3 9 6 7 8 5 23 18 7 25 10 18 11 30 30 13
12 14 6 6 6 7 5 21 7 6 27 10 7 20 7 11 30 7

it took too long to decide the memberships; I will try to change the community
sizes
new community sizes
8 32 7 5 12 6 3 29 7 10 24 14 10 18 26 6 3 9 12 3 6 10 21 13 9 11 19 7 25 13 5
18 9 3 21 7 5 5 13 3 10 23 10 8 6 26 8 9 6 7 8 5 23 18 7 25 10 18 11 30 30 13 12
14 6 6 6 7 18 21 7 6 27 10 7 20 7 11 30 7

it took too long to decide the memberships; I will try to change the community
sizes
new community sizes
32 7 5 12 6 3 29 7 10 24 14 10 18 26 6 3 9 12 3 6 10 21 13 9 11 19 7 25 13 5 18
9 3 21 7 5 5 13 8 10 23 10 8 6 26 8 9 6 7 8 8 23 18 7 25 10 18 11 30 30 13 12 14
6 6 6 7 18 21 7 6 27 10 7 20 7 11 30 7

building communities…
connecting communities…
recording network…


--------------------------------------------------------------------------
network of 1000 vertices and 3325 edges;         average degree = 6.65

average mixing parameter: 0.10348 +/- 0.116826
p_in: 0.524891  p_out: 0.000602304

Segmentation fault
```

```
Number of common edges removed: 17
Number of inactive nodes removed from layer 1: 0
Number of inactive nodes removed from layer 2: 0
Size of active node set union from layers 1 and 2: 2000
```

3.2.3 Compute remnants

3.3 Feature calculation

```
Computing transition probabilities: 100%|     | 1000/1000 [00:00<00:00,
2059.93it/s]
Generating walks (CPU: 1): 100%|     | 1/1 [00:00<00:00,  1.37it/s]
Generating walks (CPU: 2): 100%|     | 1/1 [00:00<00:00,  1.48it/s]
Generating walks (CPU: 3): 100%|     | 1/1 [00:00<00:00,  1.24it/s]
Generating walks (CPU: 4): 100%|     | 1/1 [00:00<00:00,  1.38it/s]
Generating walks (CPU: 5): 100%|     | 1/1 [00:00<00:00,  1.43it/s]
Generating walks (CPU: 6): 100%|     | 1/1 [00:00<00:00,  1.61it/s]
Generating walks (CPU: 7): 100%|     | 1/1 [00:00<00:00,  1.84it/s]
Generating walks (CPU: 8): 100%|     | 1/1 [00:00<00:00,  1.76it/s]
Generating walks (CPU: 11): 0it [00:00, ?it/s]
Generating walks (CPU: 12): 0it [00:00, ?it/s]
Generating walks (CPU: 9): 100%|     | 1/1 [00:00<00:00,  1.70it/s]
Generating walks (CPU: 10): 100%|     | 1/1 [00:00<00:00,  1.79it/s]
Generating walks (CPU: 13): 0it [00:00, ?it/s]
Generating walks (CPU: 14): 0it [00:00, ?it/s]
Generating walks (CPU: 15): 0it [00:00, ?it/s]
Generating walks (CPU: 16): 0it [00:00, ?it/s]
Computing transition probabilities: 100%|     | 1000/1000 [00:00<00:00,
2159.24it/s]
Generating walks (CPU: 1): 100%|     | 1/1 [00:00<00:00,  1.86it/s]
Generating walks (CPU: 2): 100%|     | 1/1 [00:00<00:00,  1.80it/s]
Generating walks (CPU: 3): 100%|     | 1/1 [00:00<00:00,  1.75it/s]
Generating walks (CPU: 4): 100%|     | 1/1 [00:00<00:00,  1.78it/s]
Generating walks (CPU: 5): 100%|     | 1/1 [00:00<00:00,  1.73it/s]
Generating walks (CPU: 6): 100%|     | 1/1 [00:00<00:00,  1.87it/s]
Generating walks (CPU: 7): 100%|     | 1/1 [00:00<00:00,  1.84it/s]
Generating walks (CPU: 8): 100%|     | 1/1 [00:00<00:00,  1.95it/s]
Generating walks (CPU: 11): 0it [00:00, ?it/s]
Generating walks (CPU: 12): 0it [00:00, ?it/s]
Generating walks (CPU: 9): 100%|     | 1/1 [00:00<00:00,  1.79it/s]
Generating walks (CPU: 13): 0it [00:00, ?it/s]
Generating walks (CPU: 10): 100%|     | 1/1 [00:00<00:00,  1.97it/s]
Generating walks (CPU: 14): 0it [00:00, ?it/s]
Generating walks (CPU: 15): 0it [00:00, ?it/s]
Generating walks (CPU: 16): 0it [00:00, ?it/s]
Computing transition probabilities: 100%|     | 1000/1000 [00:00<00:00,
2445.46it/s]
Generating walks (CPU: 1): 100%|     | 1/1 [00:00<00:00,  2.02it/s]
```

```
Generating walks (CPU: 2): 100%|     | 1/1 [00:00<00:00,  2.00it/s]
Generating walks (CPU: 3): 100%|     | 1/1 [00:00<00:00,  2.01it/s]
Generating walks (CPU: 4): 100%|     | 1/1 [00:00<00:00,  1.85it/s]
Generating walks (CPU: 5): 100%|     | 1/1 [00:00<00:00,  1.96it/s]
Generating walks (CPU: 6): 100%|     | 1/1 [00:00<00:00,  1.85it/s]
Generating walks (CPU: 7): 100%|     | 1/1 [00:00<00:00,  1.97it/s]
Generating walks (CPU: 11): 0it [00:00, ?it/s]
Generating walks (CPU: 8): 100%|     | 1/1 [00:00<00:00,  1.94it/s]
Generating walks (CPU: 12): 0it [00:00, ?it/s]
Generating walks (CPU: 9): 100%|     | 1/1 [00:00<00:00,  1.95it/s]
Generating walks (CPU: 13): 0it [00:00, ?it/s]
Generating walks (CPU: 10): 100%|     | 1/1 [00:00<00:00,  1.90it/s]
Generating walks (CPU: 14): 0it [00:00, ?it/s]
Generating walks (CPU: 15): 0it [00:00, ?it/s]
Generating walks (CPU: 16): 0it [00:00, ?it/s]
Computing transition probabilities: 100%|     | 1000/1000 [00:00<00:00,
2419.58it/s]
Generating walks (CPU: 1): 100%|     | 1/1 [00:00<00:00,  1.84it/s]
Generating walks (CPU: 2): 100%|     | 1/1 [00:00<00:00,  1.91it/s]
Generating walks (CPU: 3): 100%|     | 1/1 [00:00<00:00,  1.86it/s]
Generating walks (CPU: 4): 100%|     | 1/1 [00:00<00:00,  1.92it/s]
Generating walks (CPU: 5): 100%|     | 1/1 [00:00<00:00,  1.89it/s]
Generating walks (CPU: 6): 100%|     | 1/1 [00:00<00:00,  1.89it/s]
Generating walks (CPU: 7): 100%|     | 1/1 [00:00<00:00,  1.96it/s]
Generating walks (CPU: 11): 0it [00:00, ?it/s]
Generating walks (CPU: 8): 100%|     | 1/1 [00:00<00:00,  1.94it/s]
Generating walks (CPU: 12): 0it [00:00, ?it/s]
Generating walks (CPU: 9): 100%|     | 1/1 [00:00<00:00,  1.97it/s]
Generating walks (CPU: 13): 0it [00:00, ?it/s]
Generating walks (CPU: 10): 100%|     | 1/1 [00:00<00:00,  2.00it/s]
Generating walks (CPU: 14): 0it [00:00, ?it/s]
Generating walks (CPU: 15): 0it [00:00, ?it/s]
Generating walks (CPU: 16): 0it [00:00, ?it/s]
Computing transition probabilities: 100%|     | 1000/1000 [00:00<00:00,
2761.26it/s]
Generating walks (CPU: 1): 100%|     | 1/1 [00:00<00:00,  1.89it/s]
Generating walks (CPU: 2): 100%|     | 1/1 [00:00<00:00,  1.80it/s]
Generating walks (CPU: 3): 100%|     | 1/1 [00:00<00:00,  1.67it/s]
Generating walks (CPU: 4): 100%|     | 1/1 [00:00<00:00,  1.68it/s]
Generating walks (CPU: 5): 100%|     | 1/1 [00:00<00:00,  1.77it/s]
Generating walks (CPU: 6): 100%|     | 1/1 [00:00<00:00,  1.65it/s]
Generating walks (CPU: 7): 100%|     | 1/1 [00:00<00:00,  1.86it/s]
Generating walks (CPU: 11): 0it [00:00, ?it/s]
Generating walks (CPU: 8): 100%|     | 1/1 [00:00<00:00,  1.82it/s]
Generating walks (CPU: 12): 0it [00:00, ?it/s]
Generating walks (CPU: 9): 100%|     | 1/1 [00:00<00:00,  1.65it/s]
Generating walks (CPU: 13): 0it [00:00, ?it/s]
Generating walks (CPU: 10): 100%|     | 1/1 [00:00<00:00,  1.73it/s]
```

```
Generating walks (CPU: 14): 0it [00:00, ?it/s]
Generating walks (CPU: 15): 0it [00:00, ?it/s]
Generating walks (CPU: 16): 0it [00:00, ?it/s]
Computing transition probabilities: 100%|      | 1000/1000 [00:00<00:00,
2515.03it/s]
Generating walks (CPU: 1): 100%|      | 1/1 [00:00<00:00,  1.92it/s]
Generating walks (CPU: 2): 100%|      | 1/1 [00:00<00:00,  1.71it/s]
Generating walks (CPU: 3): 100%|      | 1/1 [00:00<00:00,  1.83it/s]
Generating walks (CPU: 4): 100%|      | 1/1 [00:00<00:00,  1.68it/s]
Generating walks (CPU: 5): 100%|      | 1/1 [00:00<00:00,  1.68it/s]
Generating walks (CPU: 6): 100%|      | 1/1 [00:00<00:00,  1.71it/s]
Generating walks (CPU: 7): 100%|      | 1/1 [00:00<00:00,  1.69it/s]
Generating walks (CPU: 11): 0it [00:00, ?it/s]
Generating walks (CPU: 8): 100%|      | 1/1 [00:00<00:00,  1.79it/s]
Generating walks (CPU: 12): 0it [00:00, ?it/s]
Generating walks (CPU: 9): 100%|      | 1/1 [00:00<00:00,  1.84it/s]
Generating walks (CPU: 13): 0it [00:00, ?it/s]
Generating walks (CPU: 10): 100%|      | 1/1 [00:00<00:00,  1.83it/s]
Generating walks (CPU: 14): 0it [00:00, ?it/s]
Generating walks (CPU: 15): 0it [00:00, ?it/s]
Generating walks (CPU: 16): 0it [00:00, ?it/s]
Computing transition probabilities: 100%|      | 1000/1000 [00:00<00:00,
2989.80it/s]
Generating walks (CPU: 1): 100%|      | 1/1 [00:00<00:00,  1.94it/s]
Generating walks (CPU: 2): 100%|      | 1/1 [00:00<00:00,  2.02it/s]
Generating walks (CPU: 3): 100%|      | 1/1 [00:00<00:00,  1.93it/s]
Generating walks (CPU: 4): 100%|      | 1/1 [00:00<00:00,  1.93it/s]
Generating walks (CPU: 5): 100%|      | 1/1 [00:00<00:00,  1.81it/s]
Generating walks (CPU: 6): 100%|      | 1/1 [00:00<00:00,  1.80it/s]
Generating walks (CPU: 7): 100%|      | 1/1 [00:00<00:00,  1.96it/s]
Generating walks (CPU: 11): 0it [00:00, ?it/s]
Generating walks (CPU: 8): 100%|      | 1/1 [00:00<00:00,  1.85it/s]
Generating walks (CPU: 12): 0it [00:00, ?it/s]
Generating walks (CPU: 9): 100%|      | 1/1 [00:00<00:00,  1.97it/s]
Generating walks (CPU: 13): 0it [00:00, ?it/s]
Generating walks (CPU: 10): 100%|      | 1/1 [00:00<00:00,  1.91it/s]
Generating walks (CPU: 14): 0it [00:00, ?it/s]
Generating walks (CPU: 15): 0it [00:00, ?it/s]
Generating walks (CPU: 16): 0it [00:00, ?it/s]
Computing transition probabilities: 100%|      | 1000/1000 [00:00<00:00,
2847.43it/s]
Generating walks (CPU: 1): 100%|      | 1/1 [00:00<00:00,  1.99it/s]
Generating walks (CPU: 2): 100%|      | 1/1 [00:00<00:00,  1.97it/s]
Generating walks (CPU: 3): 100%|      | 1/1 [00:00<00:00,  1.91it/s]
Generating walks (CPU: 4): 100%|      | 1/1 [00:00<00:00,  1.78it/s]
Generating walks (CPU: 5): 100%|      | 1/1 [00:00<00:00,  2.00it/s]
Generating walks (CPU: 6): 100%|      | 1/1 [00:00<00:00,  1.91it/s]
Generating walks (CPU: 7): 100%|      | 1/1 [00:00<00:00,  1.80it/s]
```

```
Generating walks (CPU: 11): 0it [00:00, ?it/s]
Generating walks (CPU: 8): 100%|      | 1/1 [00:00<00:00,  1.93it/s]
Generating walks (CPU: 12): 0it [00:00, ?it/s]
Generating walks (CPU: 9): 100%|      | 1/1 [00:00<00:00,  1.91it/s]
Generating walks (CPU: 13): 0it [00:00, ?it/s]
Generating walks (CPU: 10): 100%|      | 1/1 [00:00<00:00,  1.95it/s]
Generating walks (CPU: 14): 0it [00:00, ?it/s]
Generating walks (CPU: 15): 0it [00:00, ?it/s]
Generating walks (CPU: 16): 0it [00:00, ?it/s]
Computing transition probabilities: 100%|      | 1000/1000 [00:00<00:00,
3218.28it/s]
Generating walks (CPU: 1): 100%|      | 1/1 [00:00<00:00,  1.92it/s]
Generating walks (CPU: 2): 100%|      | 1/1 [00:00<00:00,  2.04it/s]
Generating walks (CPU: 3): 100%|      | 1/1 [00:00<00:00,  1.79it/s]
Generating walks (CPU: 4): 100%|      | 1/1 [00:00<00:00,  1.92it/s]
Generating walks (CPU: 5): 100%|      | 1/1 [00:00<00:00,  1.96it/s]
Generating walks (CPU: 6): 100%|      | 1/1 [00:00<00:00,  1.75it/s]
Generating walks (CPU: 11): 0it [00:00, ?it/s]
Generating walks (CPU: 7): 100%|      | 1/1 [00:00<00:00,  1.84it/s]
Generating walks (CPU: 8): 100%|      | 1/1 [00:00<00:00,  1.95it/s]
Generating walks (CPU: 12): 0it [00:00, ?it/s]
Generating walks (CPU: 13): 0it [00:00, ?it/s]
Generating walks (CPU: 9): 100%|      | 1/1 [00:00<00:00,  1.89it/s]
Generating walks (CPU: 10): 100%|      | 1/1 [00:00<00:00,  1.97it/s]
Generating walks (CPU: 14): 0it [00:00, ?it/s]
Generating walks (CPU: 15): 0it [00:00, ?it/s]
Generating walks (CPU: 16): 0it [00:00, ?it/s]
Computing transition probabilities: 100%|      | 1000/1000 [00:00<00:00,
3177.46it/s]
Generating walks (CPU: 1): 100%|      | 1/1 [00:00<00:00,  1.99it/s]
Generating walks (CPU: 2): 100%|      | 1/1 [00:00<00:00,  2.02it/s]
Generating walks (CPU: 3): 100%|      | 1/1 [00:00<00:00,  1.92it/s]
Generating walks (CPU: 4): 100%|      | 1/1 [00:00<00:00,  1.99it/s]
Generating walks (CPU: 5): 100%|      | 1/1 [00:00<00:00,  1.99it/s]
Generating walks (CPU: 10):   0%|          | 0/1 [00:00<?, ?it/s]87it/s]
Generating walks (CPU: 11): 0it [00:00, ?it/s]
Generating walks (CPU: 7): 100%|      | 1/1 [00:00<00:00,  1.82it/s]
Generating walks (CPU: 12): 0it [00:00, ?it/s]
Generating walks (CPU: 8): 100%|      | 1/1 [00:00<00:00,  1.80it/s]
Generating walks (CPU: 13): 0it [00:00, ?it/s]
Generating walks (CPU: 9): 100%|      | 1/1 [00:00<00:00,  1.85it/s]
Generating walks (CPU: 10): 100%|      | 1/1 [00:00<00:00,  1.92it/s]
Generating walks (CPU: 14): 0it [00:00, ?it/s]
Generating walks (CPU: 15): 0it [00:00, ?it/s]
Generating walks (CPU: 16): 0it [00:00, ?it/s]
Computing transition probabilities: 100%|      | 1000/1000 [00:00<00:00,
3493.03it/s]
Generating walks (CPU: 1): 100%|      | 1/1 [00:00<00:00,  1.97it/s]
```

```
Generating walks (CPU: 2): 100%|     | 1/1 [00:00<00:00,  2.00it/s]
Generating walks (CPU: 3): 100%|     | 1/1 [00:00<00:00,  1.97it/s]
Generating walks (CPU: 4): 100%|     | 1/1 [00:00<00:00,  1.96it/s]
Generating walks (CPU: 5): 100%|     | 1/1 [00:00<00:00,  1.90it/s]
Generating walks (CPU: 6): 100%|     | 1/1 [00:00<00:00,  1.87it/s]
Generating walks (CPU: 7): 100%|     | 1/1 [00:00<00:00,  1.81it/s]
Generating walks (CPU: 11): 0it [00:00, ?it/s]
Generating walks (CPU: 8): 100%|     | 1/1 [00:00<00:00,  1.94it/s]
Generating walks (CPU: 12): 0it [00:00, ?it/s]
Generating walks (CPU: 13): 0it [00:00, ?it/s]
Generating walks (CPU: 9): 100%|     | 1/1 [00:00<00:00,  1.88it/s]
Generating walks (CPU: 14): 0it [00:00, ?it/s]
Generating walks (CPU: 10): 100%|     | 1/1 [00:00<00:00,  2.01it/s]
Generating walks (CPU: 15): 0it [00:00, ?it/s]
Generating walks (CPU: 16): 0it [00:00, ?it/s]
Computing transition probabilities: 100%|     | 1000/1000 [00:00<00:00,
3572.09it/s]
Generating walks (CPU: 1): 100%|     | 1/1 [00:00<00:00,  1.88it/s]
Generating walks (CPU: 2): 100%|     | 1/1 [00:00<00:00,  1.99it/s]
Generating walks (CPU: 3): 100%|     | 1/1 [00:00<00:00,  1.95it/s]
Generating walks (CPU: 4): 100%|     | 1/1 [00:00<00:00,  1.87it/s]
Generating walks (CPU: 5): 100%|     | 1/1 [00:00<00:00,  1.87it/s]
Generating walks (CPU: 6): 100%|     | 1/1 [00:00<00:00,  1.82it/s]
Generating walks (CPU: 11): 0it [00:00, ?it/s]
Generating walks (CPU: 7): 100%|     | 1/1 [00:00<00:00,  1.82it/s]
Generating walks (CPU: 8): 100%|     | 1/1 [00:00<00:00,  1.99it/s]
Generating walks (CPU: 12): 0it [00:00, ?it/s]
Generating walks (CPU: 13): 0it [00:00, ?it/s]
Generating walks (CPU: 9): 100%|     | 1/1 [00:00<00:00,  1.88it/s]
Generating walks (CPU: 14): 0it [00:00, ?it/s]
Generating walks (CPU: 10): 100%|     | 1/1 [00:00<00:00,  1.90it/s]
Generating walks (CPU: 15): 0it [00:00, ?it/s]
Generating walks (CPU: 16): 0it [00:00, ?it/s]
Computing transition probabilities: 100%|     | 1000/1000 [00:00<00:00,
4472.74it/s]
Generating walks (CPU: 1): 100%|     | 1/1 [00:00<00:00,  2.03it/s]
Generating walks (CPU: 2): 100%|     | 1/1 [00:00<00:00,  1.93it/s]
Generating walks (CPU: 3): 100%|     | 1/1 [00:00<00:00,  1.87it/s]
Generating walks (CPU: 4): 100%|     | 1/1 [00:00<00:00,  1.83it/s]
Generating walks (CPU: 5): 100%|     | 1/1 [00:00<00:00,  1.91it/s]
Generating walks (CPU: 6): 100%|     | 1/1 [00:00<00:00,  1.78it/s]
Generating walks (CPU: 11): 0it [00:00, ?it/s]
Generating walks (CPU: 7): 100%|     | 1/1 [00:00<00:00,  1.84it/s]
Generating walks (CPU: 12): 0it [00:00, ?it/s]
Generating walks (CPU: 8): 100%|     | 1/1 [00:00<00:00,  1.89it/s]
Generating walks (CPU: 13): 0it [00:00, ?it/s]
Generating walks (CPU: 9): 100%|     | 1/1 [00:00<00:00,  1.97it/s]
Generating walks (CPU: 14): 0it [00:00, ?it/s]
```

```
Generating walks (CPU: 10): 100%|     | 1/1 [00:00<00:00,  1.89it/s]
Generating walks (CPU: 15): 0it [00:00, ?it/s]
Generating walks (CPU: 16): 0it [00:00, ?it/s]
Computing transition probabilities: 100%|     | 1000/1000 [00:00<00:00,
4375.32it/s]
Generating walks (CPU: 1): 100%|     | 1/1 [00:00<00:00,  2.01it/s]
Generating walks (CPU: 2): 100%|     | 1/1 [00:00<00:00,  1.90it/s]
Generating walks (CPU: 3): 100%|     | 1/1 [00:00<00:00,  1.80it/s]
Generating walks (CPU: 4): 100%|     | 1/1 [00:00<00:00,  1.72it/s]
Generating walks (CPU: 5): 100%|     | 1/1 [00:00<00:00,  1.79it/s]
Generating walks (CPU: 6): 100%|     | 1/1 [00:00<00:00,  1.88it/s]
Generating walks (CPU: 11): 0it [00:00, ?it/s]
Generating walks (CPU: 7): 100%|     | 1/1 [00:00<00:00,  1.83it/s]
Generating walks (CPU: 12): 0it [00:00, ?it/s]
Generating walks (CPU: 8): 100%|     | 1/1 [00:00<00:00,  1.84it/s]
Generating walks (CPU: 13): 0it [00:00, ?it/s]
Generating walks (CPU: 9): 100%|     | 1/1 [00:00<00:00,  1.83it/s]
Generating walks (CPU: 14): 0it [00:00, ?it/s]
Generating walks (CPU: 10): 100%|     | 1/1 [00:00<00:00,  2.01it/s]
Generating walks (CPU: 15): 0it [00:00, ?it/s]
Generating walks (CPU: 16): 0it [00:00, ?it/s]
Computing transition probabilities: 100%|     | 1000/1000 [00:00<00:00,
5036.44it/s]
Generating walks (CPU: 1): 100%|     | 1/1 [00:00<00:00,  1.94it/s]
Generating walks (CPU: 2): 100%|     | 1/1 [00:00<00:00,  2.01it/s]
Generating walks (CPU: 3): 100%|     | 1/1 [00:00<00:00,  1.68it/s]
Generating walks (CPU: 4): 100%|     | 1/1 [00:00<00:00,  1.81it/s]
Generating walks (CPU: 5): 100%|     | 1/1 [00:00<00:00,  1.84it/s]
Generating walks (CPU: 11): 0it [00:00, ?it/s]/1 [00:00<?, ?it/s]
Generating walks (CPU: 6): 100%|     | 1/1 [00:00<00:00,  1.66it/s]
Generating walks (CPU: 7): 100%|     | 1/1 [00:00<00:00,  1.91it/s]
Generating walks (CPU: 12): 0it [00:00, ?it/s]
Generating walks (CPU: 13): 0it [00:00, ?it/s]
Generating walks (CPU: 8): 100%|     | 1/1 [00:00<00:00,  1.66it/s]
Generating walks (CPU: 9): 100%|     | 1/1 [00:00<00:00,  1.98it/s]
Generating walks (CPU: 14): 0it [00:00, ?it/s]
Generating walks (CPU: 10): 100%|     | 1/1 [00:00<00:00,  2.02it/s]
Generating walks (CPU: 15): 0it [00:00, ?it/s]
Generating walks (CPU: 16): 0it [00:00, ?it/s]
Computing transition probabilities: 100%|     | 1000/1000 [00:00<00:00,
4097.24it/s]
Generating walks (CPU: 1): 100%|     | 1/1 [00:00<00:00,  1.84it/s]
Generating walks (CPU: 2): 100%|     | 1/1 [00:00<00:00,  1.81it/s]
Generating walks (CPU: 3): 100%|     | 1/1 [00:00<00:00,  1.70it/s]
Generating walks (CPU: 4): 100%|     | 1/1 [00:00<00:00,  1.70it/s]
Generating walks (CPU: 5): 100%|     | 1/1 [00:00<00:00,  1.82it/s]
Generating walks (CPU: 6): 100%|     | 1/1 [00:00<00:00,  1.87it/s]
Generating walks (CPU: 7): 100%|     | 1/1 [00:00<00:00,  1.89it/s]
```

```
Generating walks (CPU: 11): 0it [00:00, ?it/s]
Generating walks (CPU: 8): 100%|      | 1/1 [00:00<00:00,  1.88it/s]
Generating walks (CPU: 12): 0it [00:00, ?it/s]
Generating walks (CPU: 9): 100%|      | 1/1 [00:00<00:00,  1.86it/s]
Generating walks (CPU: 13): 0it [00:00, ?it/s]
Generating walks (CPU: 14): 0it [00:00, ?it/s]
Generating walks (CPU: 10): 100%|      | 1/1 [00:00<00:00,  2.03it/s]
Generating walks (CPU: 15): 0it [00:00, ?it/s]
Generating walks (CPU: 16): 0it [00:00, ?it/s]
Computing transition probabilities: 100%|      | 1000/1000 [00:00<00:00,
4641.09it/s]
Generating walks (CPU: 1): 100%|      | 1/1 [00:00<00:00,  1.76it/s]
Generating walks (CPU: 2): 100%|      | 1/1 [00:00<00:00,  1.76it/s]
Generating walks (CPU: 3): 100%|      | 1/1 [00:00<00:00,  1.68it/s]
Generating walks (CPU: 4): 100%|      | 1/1 [00:00<00:00,  1.67it/s]
Generating walks (CPU: 5): 100%|      | 1/1 [00:00<00:00,  1.74it/s]
Generating walks (CPU: 11): 0it [00:00, ?it/s]
Generating walks (CPU: 12): 0it [00:00, ?it/s]
Generating walks (CPU: 6): 100%|      | 1/1 [00:00<00:00,  1.49it/s]
Generating walks (CPU: 7): 100%|      | 1/1 [00:00<00:00,  1.62it/s]
Generating walks (CPU: 8): 100%|      | 1/1 [00:00<00:00,  1.80it/s]
Generating walks (CPU: 13): 0it [00:00, ?it/s]
Generating walks (CPU: 9): 100%|      | 1/1 [00:00<00:00,  1.89it/s]
Generating walks (CPU: 14): 0it [00:00, ?it/s]
Generating walks (CPU: 10): 100%|      | 1/1 [00:00<00:00,  2.02it/s]
Generating walks (CPU: 15): 0it [00:00, ?it/s]
Generating walks (CPU: 16): 0it [00:00, ?it/s]
Computing transition probabilities: 100%|      | 1000/1000 [00:00<00:00,
4768.51it/s]
Generating walks (CPU: 1): 100%|      | 1/1 [00:00<00:00,  1.99it/s]
Generating walks (CPU: 2): 100%|      | 1/1 [00:00<00:00,  2.04it/s]
Generating walks (CPU: 3): 100%|      | 1/1 [00:00<00:00,  1.71it/s]
Generating walks (CPU: 4): 100%|      | 1/1 [00:00<00:00,  1.64it/s]
Generating walks (CPU: 5): 100%|      | 1/1 [00:00<00:00,  1.86it/s]
Generating walks (CPU: 11): 0it [00:00, ?it/s]/1 [00:00<?, ?it/s]
Generating walks (CPU: 6): 100%|      | 1/1 [00:00<00:00,  1.54it/s]
Generating walks (CPU: 12): 0it [00:00, ?it/s]
Generating walks (CPU: 7): 100%|      | 1/1 [00:00<00:00,  1.73it/s]
Generating walks (CPU: 8): 100%|      | 1/1 [00:00<00:00,  1.80it/s]
Generating walks (CPU: 13): 0it [00:00, ?it/s]
Generating walks (CPU: 14): 0it [00:00, ?it/s]
Generating walks (CPU: 9): 100%|      | 1/1 [00:00<00:00,  1.77it/s]
Generating walks (CPU: 15): 0it [00:00, ?it/s]
Generating walks (CPU: 10): 100%|      | 1/1 [00:00<00:00,  2.00it/s]
Generating walks (CPU: 16): 0it [00:00, ?it/s]
Computing transition probabilities: 100%|      | 1000/1000 [00:00<00:00,
5130.01it/s]
Generating walks (CPU: 1): 100%|      | 1/1 [00:00<00:00,  1.95it/s]
```

```
Generating walks (CPU: 2): 100%|      | 1/1 [00:00<00:00,  1.80it/s]
Generating walks (CPU: 3): 100%|      | 1/1 [00:00<00:00,  1.91it/s]
Generating walks (CPU: 4): 100%|      | 1/1 [00:00<00:00,  1.85it/s]
Generating walks (CPU: 5): 100%|      | 1/1 [00:00<00:00,  1.82it/s]
Generating walks (CPU: 11): 0it [00:00, ?it/s]
Generating walks (CPU: 6): 100%|      | 1/1 [00:00<00:00,  1.77it/s]
Generating walks (CPU: 12): 0it [00:00, ?it/s]
Generating walks (CPU: 13): 0it [00:00, ?it/s]
Generating walks (CPU: 7): 100%|      | 1/1 [00:00<00:00,  1.65it/s]
Generating walks (CPU: 8): 100%|      | 1/1 [00:00<00:00,  1.80it/s]
Generating walks (CPU: 14): 0it [00:00, ?it/s]
Generating walks (CPU: 15): 0it [00:00, ?it/s]
Generating walks (CPU: 9): 100%|      | 1/1 [00:00<00:00,  1.69it/s]
Generating walks (CPU: 10): 100%|      | 1/1 [00:00<00:00,  1.85it/s]
Generating walks (CPU: 16): 0it [00:00, ?it/s]
Computing transition probabilities: 100%|      | 1000/1000 [00:00<00:00,
6206.02it/s]
Generating walks (CPU: 1): 100%|      | 1/1 [00:00<00:00,  1.92it/s]
Generating walks (CPU: 2): 100%|      | 1/1 [00:00<00:00,  1.88it/s]
Generating walks (CPU: 3): 100%|      | 1/1 [00:00<00:00,  1.68it/s]
Generating walks (CPU: 4): 100%|      | 1/1 [00:00<00:00,  1.85it/s]
Generating walks (CPU: 11): 0it [00:00, ?it/s]/1 [00:00<?, ?it/s]
Generating walks (CPU: 5): 100%|      | 1/1 [00:00<00:00,  1.56it/s]
Generating walks (CPU: 6): 100%|      | 1/1 [00:00<00:00,  1.61it/s]
Generating walks (CPU: 12): 0it [00:00, ?it/s]
Generating walks (CPU: 7): 100%|      | 1/1 [00:00<00:00,  1.77it/s]
Generating walks (CPU: 13): 0it [00:00, ?it/s]
Generating walks (CPU: 8): 100%|      | 1/1 [00:00<00:00,  1.86it/s]
Generating walks (CPU: 14): 0it [00:00, ?it/s]
Generating walks (CPU: 9): 100%|      | 1/1 [00:00<00:00,  1.78it/s]
Generating walks (CPU: 15): 0it [00:00, ?it/s]
Generating walks (CPU: 10): 100%|      | 1/1 [00:00<00:00,  1.91it/s]
Generating walks (CPU: 16): 0it [00:00, ?it/s]
```

3.4 Model training and evaluation

3.5 LogReg-FR reconstruction

```
Frac  0.1

Computing transition probabilities: 100%|      | 1000/1000 [00:00<00:00,
2303.15it/s]
Generating walks (CPU: 1): 100%|      | 1/1 [00:00<00:00,  1.94it/s]
Generating walks (CPU: 2): 100%|      | 1/1 [00:00<00:00,  1.92it/s]
Generating walks (CPU: 3): 100%|      | 1/1 [00:00<00:00,  1.89it/s]
Generating walks (CPU: 4): 100%|      | 1/1 [00:00<00:00,  1.78it/s]
Generating walks (CPU: 5): 100%|      | 1/1 [00:00<00:00,  1.97it/s]
```

```
Generating walks (CPU: 6): 100%|      | 1/1 [00:00<00:00,  1.90it/s]
Generating walks (CPU: 7): 100%|      | 1/1 [00:00<00:00,  1.75it/s]
Generating walks (CPU: 8): 100%|      | 1/1 [00:00<00:00,  1.89it/s]
Generating walks (CPU: 11): 0it [00:00, ?it/s]
Generating walks (CPU: 12): 0it [00:00, ?it/s]
Generating walks (CPU: 9): 100%|      | 1/1 [00:00<00:00,  1.82it/s]
Generating walks (CPU: 13): 0it [00:00, ?it/s]
Generating walks (CPU: 10): 100%|      | 1/1 [00:00<00:00,  1.90it/s]
Generating walks (CPU: 14): 0it [00:00, ?it/s]
Generating walks (CPU: 15): 0it [00:00, ?it/s]
Generating walks (CPU: 16): 0it [00:00, ?it/s]
Computing transition probabilities: 100%|      | 1000/1000 [00:00<00:00,
2217.39it/s]
Generating walks (CPU: 1): 100%|      | 1/1 [00:00<00:00,  1.85it/s]
Generating walks (CPU: 2): 100%|      | 1/1 [00:00<00:00,  1.80it/s]
Generating walks (CPU: 3): 100%|      | 1/1 [00:00<00:00,  1.77it/s]
Generating walks (CPU: 4): 100%|      | 1/1 [00:00<00:00,  1.61it/s]
Generating walks (CPU: 5): 100%|      | 1/1 [00:00<00:00,  1.65it/s]
Generating walks (CPU: 6): 100%|      | 1/1 [00:00<00:00,  1.81it/s]
Generating walks (CPU: 7): 100%|      | 1/1 [00:00<00:00,  1.65it/s]
Generating walks (CPU: 11): 0it [00:00, ?it/s]
Generating walks (CPU: 8): 100%|      | 1/1 [00:00<00:00,  1.79it/s]
Generating walks (CPU: 12): 0it [00:00, ?it/s]
Generating walks (CPU: 9): 100%|      | 1/1 [00:00<00:00,  1.75it/s]
Generating walks (CPU: 13): 0it [00:00, ?it/s]
Generating walks (CPU: 10): 100%|      | 1/1 [00:00<00:00,  1.82it/s]
Generating walks (CPU: 14): 0it [00:00, ?it/s]
Generating walks (CPU: 15): 0it [00:00, ?it/s]
Generating walks (CPU: 16): 0it [00:00, ?it/s]

#Training set score  0.9678659286592866
#Intercept =  -5.735093428530228
#Degree coefficient =  23.78617582163337
#Embedding coefficient =  375.8962531211286


Frac  0.2

Computing transition probabilities: 100%|      | 1000/1000 [00:00<00:00,
2538.18it/s]
Generating walks (CPU: 1): 100%|      | 1/1 [00:00<00:00,  2.01it/s]
Generating walks (CPU: 2): 100%|      | 1/1 [00:00<00:00,  1.96it/s]
Generating walks (CPU: 3): 100%|      | 1/1 [00:00<00:00,  1.82it/s]
Generating walks (CPU: 4): 100%|      | 1/1 [00:00<00:00,  1.90it/s]
Generating walks (CPU: 5): 100%|      | 1/1 [00:00<00:00,  1.95it/s]
Generating walks (CPU: 6): 100%|      | 1/1 [00:00<00:00,  1.94it/s]
Generating walks (CPU: 7): 100%|      | 1/1 [00:00<00:00,  1.81it/s]
Generating walks (CPU: 11): 0it [00:00, ?it/s]
Generating walks (CPU: 8): 100%|      | 1/1 [00:00<00:00,  1.98it/s]
```

```
Generating walks (CPU: 12): 0it [00:00, ?it/s]
Generating walks (CPU: 9): 100%|      | 1/1 [00:00<00:00,  1.83it/s]
Generating walks (CPU: 13): 0it [00:00, ?it/s]
Generating walks (CPU: 10): 100%|      | 1/1 [00:00<00:00,  1.96it/s]
Generating walks (CPU: 14): 0it [00:00, ?it/s]
Generating walks (CPU: 15): 0it [00:00, ?it/s]
Generating walks (CPU: 16): 0it [00:00, ?it/s]
Computing transition probabilities: 100%|      | 1000/1000 [00:00<00:00,
2509.03it/s]
Generating walks (CPU: 1): 100%|      | 1/1 [00:00<00:00,  2.00it/s]
Generating walks (CPU: 2): 100%|      | 1/1 [00:00<00:00,  2.03it/s]
Generating walks (CPU: 3): 100%|      | 1/1 [00:00<00:00,  1.95it/s]
Generating walks (CPU: 4): 100%|      | 1/1 [00:00<00:00,  1.88it/s]
Generating walks (CPU: 5): 100%|      | 1/1 [00:00<00:00,  1.94it/s]
Generating walks (CPU: 6): 100%|      | 1/1 [00:00<00:00,  2.01it/s]
Generating walks (CPU: 7): 100%|      | 1/1 [00:00<00:00,  1.94it/s]
Generating walks (CPU: 11): 0it [00:00, ?it/s]
Generating walks (CPU: 8): 100%|      | 1/1 [00:00<00:00,  1.96it/s]
Generating walks (CPU: 12): 0it [00:00, ?it/s]
Generating walks (CPU: 9): 100%|      | 1/1 [00:00<00:00,  1.99it/s]
Generating walks (CPU: 13): 0it [00:00, ?it/s]
Generating walks (CPU: 10): 100%|      | 1/1 [00:00<00:00,  1.98it/s]
Generating walks (CPU: 14): 0it [00:00, ?it/s]
Generating walks (CPU: 15): 0it [00:00, ?it/s]
Generating walks (CPU: 16): 0it [00:00, ?it/s]

#Training set score  0.9378843788437884
#Intercept =  -4.595676989428328
#Degree coefficient =  12.560351893937275
#Embedding coefficient =  287.04839607285163


Frac  0.30000000000000004

Computing transition probabilities: 100%|      | 1000/1000 [00:00<00:00,
2607.76it/s]
Generating walks (CPU: 1): 100%|      | 1/1 [00:00<00:00,  1.87it/s]
Generating walks (CPU: 2): 100%|      | 1/1 [00:00<00:00,  1.83it/s]
Generating walks (CPU: 3): 100%|      | 1/1 [00:00<00:00,  1.75it/s]
Generating walks (CPU: 4): 100%|      | 1/1 [00:00<00:00,  1.77it/s]
Generating walks (CPU: 5): 100%|      | 1/1 [00:00<00:00,  1.82it/s]
Generating walks (CPU: 6): 100%|      | 1/1 [00:00<00:00,  1.93it/s]
Generating walks (CPU: 7): 100%|      | 1/1 [00:00<00:00,  1.87it/s]
Generating walks (CPU: 11): 0it [00:00, ?it/s]
Generating walks (CPU: 8): 100%|      | 1/1 [00:00<00:00,  1.90it/s]
Generating walks (CPU: 12): 0it [00:00, ?it/s]
Generating walks (CPU: 9): 100%|      | 1/1 [00:00<00:00,  1.88it/s]
Generating walks (CPU: 13): 0it [00:00, ?it/s]
Generating walks (CPU: 10): 100%|      | 1/1 [00:00<00:00,  1.79it/s]
```

```
Generating walks (CPU: 14): 0it [00:00, ?it/s]
Generating walks (CPU: 15): 0it [00:00, ?it/s]
Generating walks (CPU: 16): 0it [00:00, ?it/s]
Computing transition probabilities: 100%|      | 1000/1000 [00:00<00:00,
2722.03it/s]
Generating walks (CPU: 1): 100%|      | 1/1 [00:00<00:00,  1.77it/s]
Generating walks (CPU: 2): 100%|      | 1/1 [00:00<00:00,  1.72it/s]
Generating walks (CPU: 3): 100%|      | 1/1 [00:00<00:00,  1.85it/s]
Generating walks (CPU: 4): 100%|      | 1/1 [00:00<00:00,  1.71it/s]
Generating walks (CPU: 5): 100%|      | 1/1 [00:00<00:00,  1.68it/s]
Generating walks (CPU: 6): 100%|      | 1/1 [00:00<00:00,  1.80it/s]
Generating walks (CPU: 11): 0it [00:00, ?it/s]/1 [00:00<?, ?it/s]
Generating walks (CPU: 7): 100%|      | 1/1 [00:00<00:00,  1.62it/s]
Generating walks (CPU: 8): 100%|      | 1/1 [00:00<00:00,  1.86it/s]
Generating walks (CPU: 12): 0it [00:00, ?it/s]
Generating walks (CPU: 9): 100%|      | 1/1 [00:00<00:00,  1.94it/s]
Generating walks (CPU: 13): 0it [00:00, ?it/s]
Generating walks (CPU: 10): 100%|      | 1/1 [00:00<00:00,  1.79it/s]
Generating walks (CPU: 14): 0it [00:00, ?it/s]
Generating walks (CPU: 15): 0it [00:00, ?it/s]
Generating walks (CPU: 16): 0it [00:00, ?it/s]

#Training set score  0.9075953259532595
#Intercept =  -3.993125793881938
#Degree coefficient =  8.233990067319144
#Embedding coefficient =  244.12010044407455


Frac  0.4

Computing transition probabilities: 100%|      | 1000/1000 [00:00<00:00,
2941.28it/s]
Generating walks (CPU: 1): 100%|      | 1/1 [00:00<00:00,  1.91it/s]
Generating walks (CPU: 2): 100%|      | 1/1 [00:00<00:00,  1.96it/s]
Generating walks (CPU: 3): 100%|      | 1/1 [00:00<00:00,  1.93it/s]
Generating walks (CPU: 4): 100%|      | 1/1 [00:00<00:00,  1.80it/s]
Generating walks (CPU: 5): 100%|      | 1/1 [00:00<00:00,  1.80it/s]
Generating walks (CPU: 6): 100%|      | 1/1 [00:00<00:00,  1.83it/s]
Generating walks (CPU: 7): 100%|      | 1/1 [00:00<00:00,  1.78it/s]
Generating walks (CPU: 11): 0it [00:00, ?it/s]
Generating walks (CPU: 12): 0it [00:00, ?it/s]
Generating walks (CPU: 8): 100%|      | 1/1 [00:00<00:00,  1.71it/s]
Generating walks (CPU: 13): 0it [00:00, ?it/s]
Generating walks (CPU: 9): 100%|      | 1/1 [00:00<00:00,  1.79it/s]
Generating walks (CPU: 10): 100%|      | 1/1 [00:00<00:00,  1.96it/s]
Generating walks (CPU: 14): 0it [00:00, ?it/s]
Generating walks (CPU: 15): 0it [00:00, ?it/s]
Generating walks (CPU: 16): 0it [00:00, ?it/s]
Computing transition probabilities: 100%|      | 1000/1000 [00:00<00:00,
```

```
2945.93it/s]
Generating walks (CPU: 1): 100%|      | 1/1 [00:00<00:00,  1.91it/s]
Generating walks (CPU: 2): 100%|      | 1/1 [00:00<00:00,  1.81it/s]
Generating walks (CPU: 3): 100%|      | 1/1 [00:00<00:00,  1.81it/s]
Generating walks (CPU: 4): 100%|      | 1/1 [00:00<00:00,  1.92it/s]
Generating walks (CPU: 5): 100%|      | 1/1 [00:00<00:00,  1.95it/s]
Generating walks (CPU: 6): 100%|      | 1/1 [00:00<00:00,  1.91it/s]
Generating walks (CPU: 7): 100%|      | 1/1 [00:00<00:00,  1.86it/s]
Generating walks (CPU: 11): 0it [00:00, ?it/s]/1 [00:00<?, ?it/s]
Generating walks (CPU: 8): 100%|      | 1/1 [00:00<00:00,  1.91it/s]
Generating walks (CPU: 12): 0it [00:00, ?it/s]
Generating walks (CPU: 13): 0it [00:00, ?it/s]
Generating walks (CPU: 9): 100%|      | 1/1 [00:00<00:00,  1.73it/s]
Generating walks (CPU: 14): 0it [00:00, ?it/s]
Generating walks (CPU: 10): 100%|      | 1/1 [00:00<00:00,  1.73it/s]
Generating walks (CPU: 15): 0it [00:00, ?it/s]
Generating walks (CPU: 16): 0it [00:00, ?it/s]

#Training set score  0.897140221402214
#Intercept =  -3.6506366810532236
#Degree coefficient =  5.678566580052748
#Embedding coefficient =  217.80013265737605


Frac  0.5

Computing transition probabilities: 100%|      | 1000/1000 [00:00<00:00,
3306.64it/s]
Generating walks (CPU: 1): 100%|      | 1/1 [00:00<00:00,  1.88it/s]
Generating walks (CPU: 2): 100%|      | 1/1 [00:00<00:00,  1.99it/s]
Generating walks (CPU: 3): 100%|      | 1/1 [00:00<00:00,  1.72it/s]
Generating walks (CPU: 4): 100%|      | 1/1 [00:00<00:00,  2.02it/s]
Generating walks (CPU: 5): 100%|      | 1/1 [00:00<00:00,  1.96it/s]
Generating walks (CPU: 6): 100%|      | 1/1 [00:00<00:00,  2.04it/s]
Generating walks (CPU: 7): 100%|      | 1/1 [00:00<00:00,  1.89it/s]
Generating walks (CPU: 11): 0it [00:00, ?it/s]
Generating walks (CPU: 12): 0it [00:00, ?it/s]
Generating walks (CPU: 8): 100%|      | 1/1 [00:00<00:00,  1.74it/s]
Generating walks (CPU: 13): 0it [00:00, ?it/s]
Generating walks (CPU: 9): 100%|      | 1/1 [00:00<00:00,  1.93it/s]
Generating walks (CPU: 14): 0it [00:00, ?it/s]
Generating walks (CPU: 10): 100%|      | 1/1 [00:00<00:00,  1.93it/s]
Generating walks (CPU: 15): 0it [00:00, ?it/s]
Generating walks (CPU: 16): 0it [00:00, ?it/s]
Computing transition probabilities: 100%|      | 1000/1000 [00:00<00:00,
3249.20it/s]
Generating walks (CPU: 1): 100%|      | 1/1 [00:00<00:00,  1.88it/s]
Generating walks (CPU: 2): 100%|      | 1/1 [00:00<00:00,  2.01it/s]
Generating walks (CPU: 3): 100%|      | 1/1 [00:00<00:00,  1.89it/s]
```

```
Generating walks (CPU: 4): 100%|      | 1/1 [00:00<00:00,  1.89it/s]
Generating walks (CPU: 5): 100%|      | 1/1 [00:00<00:00,  1.89it/s]
Generating walks (CPU: 6): 100%|      | 1/1 [00:00<00:00,  1.85it/s]
Generating walks (CPU: 7): 100%|      | 1/1 [00:00<00:00,  1.93it/s]
Generating walks (CPU: 11): 0it [00:00, ?it/s]
Generating walks (CPU: 12): 0it [00:00, ?it/s]
Generating walks (CPU: 8): 100%|      | 1/1 [00:00<00:00,  1.83it/s]
Generating walks (CPU: 9): 100%|      | 1/1 [00:00<00:00,  1.94it/s]
Generating walks (CPU: 13): 0it [00:00, ?it/s]
Generating walks (CPU: 10): 100%|      | 1/1 [00:00<00:00,  2.02it/s]
Generating walks (CPU: 14): 0it [00:00, ?it/s]
Generating walks (CPU: 15): 0it [00:00, ?it/s]
Generating walks (CPU: 16): 0it [00:00, ?it/s]

#Training set score  0.8985239852398524
#Intercept =  -3.453106969603653
#Degree coefficient =  4.719413244524364
#Embedding coefficient =  197.38154993105448


Frac  0.6

Computing transition probabilities: 100%|      | 1000/1000 [00:00<00:00,
3644.10it/s]
Generating walks (CPU: 1): 100%|      | 1/1 [00:00<00:00,  1.99it/s]
Generating walks (CPU: 2): 100%|      | 1/1 [00:00<00:00,  1.94it/s]
Generating walks (CPU: 3): 100%|      | 1/1 [00:00<00:00,  2.02it/s]
Generating walks (CPU: 4): 100%|      | 1/1 [00:00<00:00,  1.83it/s]
Generating walks (CPU: 5): 100%|      | 1/1 [00:00<00:00,  1.94it/s]
Generating walks (CPU: 6): 100%|      | 1/1 [00:00<00:00,  1.82it/s]
Generating walks (CPU: 11): 0it [00:00, ?it/s]
Generating walks (CPU: 7): 100%|      | 1/1 [00:00<00:00,  2.05it/s]
Generating walks (CPU: 8): 100%|      | 1/1 [00:00<00:00,  1.94it/s]
Generating walks (CPU: 12): 0it [00:00, ?it/s]
Generating walks (CPU: 13): 0it [00:00, ?it/s]
Generating walks (CPU: 9): 100%|      | 1/1 [00:00<00:00,  1.97it/s]
Generating walks (CPU: 14): 0it [00:00, ?it/s]
Generating walks (CPU: 10): 100%|      | 1/1 [00:00<00:00,  1.95it/s]
Generating walks (CPU: 15): 0it [00:00, ?it/s]
Generating walks (CPU: 16): 0it [00:00, ?it/s]
Computing transition probabilities: 100%|      | 1000/1000 [00:00<00:00,
3686.73it/s]
Generating walks (CPU: 1): 100%|      | 1/1 [00:00<00:00,  1.89it/s]
Generating walks (CPU: 2): 100%|      | 1/1 [00:00<00:00,  1.96it/s]
Generating walks (CPU: 3): 100%|      | 1/1 [00:00<00:00,  1.86it/s]
Generating walks (CPU: 4): 100%|      | 1/1 [00:00<00:00,  1.79it/s]
Generating walks (CPU: 5): 100%|      | 1/1 [00:00<00:00,  1.92it/s]
Generating walks (CPU: 6): 100%|      | 1/1 [00:00<00:00,  1.84it/s]
Generating walks (CPU: 11): 0it [00:00, ?it/s]
```

```
Generating walks (CPU: 7): 100%|      | 1/1 [00:00<00:00,  1.83it/s]
Generating walks (CPU: 12): 0it [00:00, ?it/s]
Generating walks (CPU: 8): 100%|      | 1/1 [00:00<00:00,  2.07it/s]
Generating walks (CPU: 13): 0it [00:00, ?it/s]
Generating walks (CPU: 9): 100%|      | 1/1 [00:00<00:00,  1.86it/s]
Generating walks (CPU: 14): 0it [00:00, ?it/s]
Generating walks (CPU: 10): 100%|      | 1/1 [00:00<00:00,  1.94it/s]
Generating walks (CPU: 15): 0it [00:00, ?it/s]
Generating walks (CPU: 16): 0it [00:00, ?it/s]
```

```
#Training set score  0.8972939729397293
#Intercept =  -2.8721008599229223
#Degree coefficient =  3.8791901992037245
#Embedding coefficient =  170.72194343093875
```

```
Frac  0.7
```

```
Computing transition probabilities: 100%|      | 1000/1000 [00:00<00:00,
4412.84it/s]
Generating walks (CPU: 1): 100%|      | 1/1 [00:00<00:00,  1.86it/s]
Generating walks (CPU: 2): 100%|      | 1/1 [00:00<00:00,  2.05it/s]
Generating walks (CPU: 3): 100%|      | 1/1 [00:00<00:00,  1.86it/s]
Generating walks (CPU: 4): 100%|      | 1/1 [00:00<00:00,  1.78it/s]
Generating walks (CPU: 5): 100%|      | 1/1 [00:00<00:00,  1.67it/s]
Generating walks (CPU: 6): 100%|      | 1/1 [00:00<00:00,  1.71it/s]
Generating walks (CPU: 11): 0it [00:00, ?it/s]
Generating walks (CPU: 7): 100%|      | 1/1 [00:00<00:00,  1.79it/s]
Generating walks (CPU: 12): 0it [00:00, ?it/s]
Generating walks (CPU: 8): 100%|      | 1/1 [00:00<00:00,  1.85it/s]
Generating walks (CPU: 13): 0it [00:00, ?it/s]
Generating walks (CPU: 9): 100%|      | 1/1 [00:00<00:00,  1.84it/s]
Generating walks (CPU: 14): 0it [00:00, ?it/s]
Generating walks (CPU: 10): 100%|      | 1/1 [00:00<00:00,  1.99it/s]
Generating walks (CPU: 15): 0it [00:00, ?it/s]
Generating walks (CPU: 16): 0it [00:00, ?it/s]
Computing transition probabilities: 100%|      | 1000/1000 [00:00<00:00,
3952.65it/s]
Generating walks (CPU: 1): 100%|      | 1/1 [00:00<00:00,  2.05it/s]
Generating walks (CPU: 2): 100%|      | 1/1 [00:00<00:00,  1.93it/s]
Generating walks (CPU: 3): 100%|      | 1/1 [00:00<00:00,  2.06it/s]
Generating walks (CPU: 4): 100%|      | 1/1 [00:00<00:00,  1.96it/s]
Generating walks (CPU: 5): 100%|      | 1/1 [00:00<00:00,  1.96it/s]
Generating walks (CPU: 6): 100%|      | 1/1 [00:00<00:00,  1.78it/s]
Generating walks (CPU: 11): 0it [00:00, ?it/s]
Generating walks (CPU: 7): 100%|      | 1/1 [00:00<00:00,  1.72it/s]
Generating walks (CPU: 8): 100%|      | 1/1 [00:00<00:00,  1.75it/s]
Generating walks (CPU: 9): 100%|      | 1/1 [00:00<00:00,  2.01it/s]
Generating walks (CPU: 12): 0it [00:00, ?it/s]
```

```
Generating walks (CPU: 13): 0it [00:00, ?it/s]
Generating walks (CPU: 10): 100%|      | 1/1 [00:00<00:00,  1.94it/s]
Generating walks (CPU: 14): 0it [00:00, ?it/s]
Generating walks (CPU: 15): 0it [00:00, ?it/s]
Generating walks (CPU: 16): 0it [00:00, ?it/s]
```

```
#Training set score  0.9117466174661747
#Intercept =  -2.712102631936065
#Degree coefficient =  3.573573209411484
#Embedding coefficient =  165.3725531545081
```

```
Frac  0.7999999999999999
```

```
Computing transition probabilities: 100%|      | 1000/1000 [00:00<00:00,
5199.11it/s]
Generating walks (CPU: 1): 100%|      | 1/1 [00:00<00:00,  1.91it/s]
Generating walks (CPU: 2): 100%|      | 1/1 [00:00<00:00,  1.86it/s]
Generating walks (CPU: 3): 100%|      | 1/1 [00:00<00:00,  1.61it/s]
Generating walks (CPU: 4): 100%|      | 1/1 [00:00<00:00,  1.76it/s]
Generating walks (CPU: 5): 100%|      | 1/1 [00:00<00:00,  1.76it/s]
Generating walks (CPU: 11): 0it [00:00, ?it/s]/1 [00:00<?, ?it/s]
Generating walks (CPU: 6): 100%|      | 1/1 [00:00<00:00,  1.73it/s]
Generating walks (CPU: 7): 100%|      | 1/1 [00:00<00:00,  1.89it/s]
Generating walks (CPU: 12): 0it [00:00, ?it/s]
Generating walks (CPU: 8): 100%|      | 1/1 [00:00<00:00,  1.96it/s]
Generating walks (CPU: 13): 0it [00:00, ?it/s]
Generating walks (CPU: 9): 100%|      | 1/1 [00:00<00:00,  1.98it/s]
Generating walks (CPU: 14): 0it [00:00, ?it/s]
Generating walks (CPU: 10): 100%|      | 1/1 [00:00<00:00,  2.02it/s]
Generating walks (CPU: 15): 0it [00:00, ?it/s]
Generating walks (CPU: 16): 0it [00:00, ?it/s]
Computing transition probabilities: 100%|      | 1000/1000 [00:00<00:00,
4427.93it/s]
Generating walks (CPU: 1): 100%|      | 1/1 [00:00<00:00,  1.84it/s]
Generating walks (CPU: 2): 100%|      | 1/1 [00:00<00:00,  1.93it/s]
Generating walks (CPU: 3): 100%|      | 1/1 [00:00<00:00,  1.96it/s]
Generating walks (CPU: 4): 100%|      | 1/1 [00:00<00:00,  1.54it/s]
Generating walks (CPU: 5): 100%|      | 1/1 [00:00<00:00,  1.70it/s]
Generating walks (CPU: 11): 0it [00:00, ?it/s]
Generating walks (CPU: 6): 100%|      | 1/1 [00:00<00:00,  1.61it/s]
Generating walks (CPU: 7): 100%|      | 1/1 [00:00<00:00,  1.79it/s]
Generating walks (CPU: 12): 0it [00:00, ?it/s]
Generating walks (CPU: 13): 0it [00:00, ?it/s]
Generating walks (CPU: 8): 100%|      | 1/1 [00:00<00:00,  1.64it/s]
Generating walks (CPU: 14): 0it [00:00, ?it/s]
Generating walks (CPU: 9): 100%|      | 1/1 [00:00<00:00,  1.59it/s]
Generating walks (CPU: 15): 0it [00:00, ?it/s]
Generating walks (CPU: 10): 100%|      | 1/1 [00:00<00:00,  1.68it/s]
```

```
Generating walks (CPU: 16): 0it [00:00, ?it/s]

#Training set score  0.9354243542435424
#Intercept =  -2.5180687236792254
#Degree coefficient =  4.354203142780152
#Embedding coefficient =  170.9099070581465


Frac  0.8999999999999999

Computing transition probabilities: 100%|      | 1000/1000 [00:00<00:00,
4780.65it/s]
Generating walks (CPU: 1): 100%|      | 1/1 [00:00<00:00,  1.95it/s]
Generating walks (CPU: 2): 100%|      | 1/1 [00:00<00:00,  1.82it/s]
Generating walks (CPU: 3): 100%|      | 1/1 [00:00<00:00,  1.80it/s]
Generating walks (CPU: 4): 100%|      | 1/1 [00:00<00:00,  1.74it/s]
Generating walks (CPU: 5): 100%|      | 1/1 [00:00<00:00,  1.88it/s]
Generating walks (CPU: 11): 0it [00:00, ?it/s]/1 [00:00<?, ?it/s]
Generating walks (CPU: 6): 100%|      | 1/1 [00:00<00:00,  1.72it/s]
Generating walks (CPU: 12): 0it [00:00, ?it/s]
Generating walks (CPU: 7): 100%|      | 1/1 [00:00<00:00,  1.68it/s]
Generating walks (CPU: 13): 0it [00:00, ?it/s]
Generating walks (CPU: 14): 0it [00:00, ?it/s]
Generating walks (CPU: 8): 100%|      | 1/1 [00:00<00:00,  1.64it/s]
Generating walks (CPU: 9): 100%|      | 1/1 [00:00<00:00,  1.85it/s]
Generating walks (CPU: 15): 0it [00:00, ?it/s]
Generating walks (CPU: 10): 100%|      | 1/1 [00:00<00:00,  1.90it/s]
Generating walks (CPU: 16): 0it [00:00, ?it/s]
Computing transition probabilities: 100%|      | 1000/1000 [00:00<00:00,
4875.50it/s]
Generating walks (CPU: 1): 100%|      | 1/1 [00:00<00:00,  2.07it/s]
Generating walks (CPU: 2): 100%|      | 1/1 [00:00<00:00,  1.95it/s]
Generating walks (CPU: 3): 100%|      | 1/1 [00:00<00:00,  1.50it/s]
Generating walks (CPU: 4): 100%|      | 1/1 [00:00<00:00,  1.72it/s]
Generating walks (CPU: 11): 0it [00:00, ?it/s]/1 [00:00<?, ?it/s]
Generating walks (CPU: 5): 100%|      | 1/1 [00:00<00:00,  1.59it/s]
Generating walks (CPU: 6): 100%|      | 1/1 [00:00<00:00,  1.72it/s]
Generating walks (CPU: 12): 0it [00:00, ?it/s]
Generating walks (CPU: 7): 100%|      | 1/1 [00:00<00:00,  1.72it/s]
Generating walks (CPU: 13): 0it [00:00, ?it/s]
Generating walks (CPU: 8): 100%|      | 1/1 [00:00<00:00,  1.81it/s]
Generating walks (CPU: 14): 0it [00:00, ?it/s]
Generating walks (CPU: 9): 100%|      | 1/1 [00:00<00:00,  1.86it/s]
Generating walks (CPU: 15): 0it [00:00, ?it/s]
Generating walks (CPU: 10): 100%|      | 1/1 [00:00<00:00,  1.93it/s]
Generating walks (CPU: 16): 0it [00:00, ?it/s]

#Training set score  0.9560270602706027
#Intercept =  -1.745997074815984
```

```
#Degree coefficient =  5.416821337916421
#Embedding coefficient =  165.074529660268



Frac  0.1

Computing transition probabilities: 100%|      | 1000/1000 [00:00<00:00,
2184.00it/s]
Generating walks (CPU: 1): 100%|      | 1/1 [00:00<00:00,  1.65it/s]
Generating walks (CPU: 2): 100%|      | 1/1 [00:00<00:00,  1.75it/s]
Generating walks (CPU: 3): 100%|      | 1/1 [00:00<00:00,  1.76it/s]
Generating walks (CPU: 4): 100%|      | 1/1 [00:00<00:00,  1.62it/s]
Generating walks (CPU: 5): 100%|      | 1/1 [00:00<00:00,  1.67it/s]
Generating walks (CPU: 6): 100%|      | 1/1 [00:00<00:00,  1.60it/s]
Generating walks (CPU: 7): 100%|      | 1/1 [00:00<00:00,  1.77it/s]
Generating walks (CPU: 11): 0it [00:00, ?it/s]
Generating walks (CPU: 8): 100%|      | 1/1 [00:00<00:00,  1.60it/s]
Generating walks (CPU: 12): 0it [00:00, ?it/s]
Generating walks (CPU: 9): 100%|      | 1/1 [00:00<00:00,  1.74it/s]
Generating walks (CPU: 13): 0it [00:00, ?it/s]
Generating walks (CPU: 10): 100%|      | 1/1 [00:00<00:00,  1.75it/s]
Generating walks (CPU: 14): 0it [00:00, ?it/s]
Generating walks (CPU: 15): 0it [00:00, ?it/s]
Generating walks (CPU: 16): 0it [00:00, ?it/s]
Computing transition probabilities: 100%|      | 1000/1000 [00:00<00:00,
2256.57it/s]
Generating walks (CPU: 1): 100%|      | 1/1 [00:00<00:00,  1.88it/s]
Generating walks (CPU: 2): 100%|      | 1/1 [00:00<00:00,  1.80it/s]
Generating walks (CPU: 3): 100%|      | 1/1 [00:00<00:00,  1.82it/s]
Generating walks (CPU: 4): 100%|      | 1/1 [00:00<00:00,  1.86it/s]
Generating walks (CPU: 5): 100%|      | 1/1 [00:00<00:00,  1.92it/s]
Generating walks (CPU: 6): 100%|      | 1/1 [00:00<00:00,  1.84it/s]
Generating walks (CPU: 7): 100%|      | 1/1 [00:00<00:00,  1.92it/s]
Generating walks (CPU: 11): 0it [00:00, ?it/s]
Generating walks (CPU: 8): 100%|      | 1/1 [00:00<00:00,  1.88it/s]
Generating walks (CPU: 12): 0it [00:00, ?it/s]
Generating walks (CPU: 9): 100%|      | 1/1 [00:00<00:00,  1.81it/s]
Generating walks (CPU: 10): 100%|      | 1/1 [00:00<00:00,  1.90it/s]
Generating walks (CPU: 13): 0it [00:00, ?it/s]
Generating walks (CPU: 14): 0it [00:00, ?it/s]
Generating walks (CPU: 15): 0it [00:00, ?it/s]
Generating walks (CPU: 16): 0it [00:00, ?it/s]

# option 4 , embedding + intercept
#Training set score  0.9561668681983071
#Intercept =  -4.314448727632949
#Embedding coefficient =  314.541164562627
```

```
Frac  0.2

Computing transition probabilities: 100%|     | 1000/1000 [00:00<00:00,
2421.00it/s]
Generating walks (CPU: 1): 100%|     | 1/1 [00:00<00:00,  1.78it/s]
Generating walks (CPU: 2): 100%|     | 1/1 [00:00<00:00,  1.77it/s]
Generating walks (CPU: 3): 100%|     | 1/1 [00:00<00:00,  1.93it/s]
Generating walks (CPU: 4): 100%|     | 1/1 [00:00<00:00,  1.74it/s]
Generating walks (CPU: 5): 100%|     | 1/1 [00:00<00:00,  1.84it/s]
Generating walks (CPU: 6): 100%|     | 1/1 [00:00<00:00,  1.69it/s]
Generating walks (CPU: 7): 100%|     | 1/1 [00:00<00:00,  1.82it/s]
Generating walks (CPU: 11): 0it [00:00, ?it/s]
Generating walks (CPU: 8): 100%|     | 1/1 [00:00<00:00,  1.77it/s]
Generating walks (CPU: 12): 0it [00:00, ?it/s]
Generating walks (CPU: 9): 100%|     | 1/1 [00:00<00:00,  1.94it/s]
Generating walks (CPU: 10): 100%|     | 1/1 [00:00<00:00,  1.84it/s]
Generating walks (CPU: 13): 0it [00:00, ?it/s]
Generating walks (CPU: 14): 0it [00:00, ?it/s]
Generating walks (CPU: 15): 0it [00:00, ?it/s]
Generating walks (CPU: 16): 0it [00:00, ?it/s]
Computing transition probabilities: 100%|     | 1000/1000 [00:00<00:00,
2383.88it/s]
Generating walks (CPU: 1): 100%|     | 1/1 [00:00<00:00,  1.95it/s]
Generating walks (CPU: 2): 100%|     | 1/1 [00:00<00:00,  1.80it/s]
Generating walks (CPU: 3): 100%|     | 1/1 [00:00<00:00,  1.80it/s]
Generating walks (CPU: 4): 100%|     | 1/1 [00:00<00:00,  1.81it/s]
Generating walks (CPU: 5): 100%|     | 1/1 [00:00<00:00,  1.84it/s]
Generating walks (CPU: 6): 100%|     | 1/1 [00:00<00:00,  1.80it/s]
Generating walks (CPU: 7): 100%|     | 1/1 [00:00<00:00,  1.75it/s]
Generating walks (CPU: 11): 0it [00:00, ?it/s]
Generating walks (CPU: 8): 100%|     | 1/1 [00:00<00:00,  1.81it/s]
Generating walks (CPU: 12): 0it [00:00, ?it/s]
Generating walks (CPU: 9): 100%|     | 1/1 [00:00<00:00,  1.79it/s]
Generating walks (CPU: 13): 0it [00:00, ?it/s]
Generating walks (CPU: 10): 100%|     | 1/1 [00:00<00:00,  1.96it/s]
Generating walks (CPU: 14): 0it [00:00, ?it/s]
Generating walks (CPU: 15): 0it [00:00, ?it/s]
Generating walks (CPU: 16): 0it [00:00, ?it/s]

# option 4 , embedding + intercept
#Training set score  0.9245767835550182
#Intercept =  -3.6645080648391755
#Embedding coefficient =  256.4024342683022


Frac  0.30000000000000004

Computing transition probabilities: 100%|     | 1000/1000 [00:00<00:00,
```

```
2644.75it/s]
Generating walks (CPU: 1): 100%|     | 1/1 [00:00<00:00,  1.79it/s]
Generating walks (CPU: 2): 100%|     | 1/1 [00:00<00:00,  1.88it/s]
Generating walks (CPU: 3): 100%|     | 1/1 [00:00<00:00,  1.83it/s]
Generating walks (CPU: 4): 100%|     | 1/1 [00:00<00:00,  1.71it/s]
Generating walks (CPU: 5): 100%|     | 1/1 [00:00<00:00,  1.77it/s]
Generating walks (CPU: 6): 100%|     | 1/1 [00:00<00:00,  1.79it/s]
Generating walks (CPU: 7): 100%|     | 1/1 [00:00<00:00,  1.86it/s]
Generating walks (CPU: 11): 0it [00:00, ?it/s]
Generating walks (CPU: 8): 100%|     | 1/1 [00:00<00:00,  1.92it/s]
Generating walks (CPU: 12): 0it [00:00, ?it/s]
Generating walks (CPU: 9): 100%|     | 1/1 [00:00<00:00,  1.83it/s]
Generating walks (CPU: 13): 0it [00:00, ?it/s]
Generating walks (CPU: 10): 100%|     | 1/1 [00:00<00:00,  2.01it/s]
Generating walks (CPU: 14): 0it [00:00, ?it/s]
Generating walks (CPU: 15): 0it [00:00, ?it/s]
Generating walks (CPU: 16): 0it [00:00, ?it/s]
Computing transition probabilities: 100%|     | 1000/1000 [00:00<00:00,
2584.00it/s]
Generating walks (CPU: 1): 100%|     | 1/1 [00:00<00:00,  1.98it/s]
Generating walks (CPU: 2): 100%|     | 1/1 [00:00<00:00,  1.93it/s]
Generating walks (CPU: 3): 100%|     | 1/1 [00:00<00:00,  1.94it/s]
Generating walks (CPU: 4): 100%|     | 1/1 [00:00<00:00,  1.87it/s]
Generating walks (CPU: 5): 100%|     | 1/1 [00:00<00:00,  1.85it/s]
Generating walks (CPU: 6): 100%|     | 1/1 [00:00<00:00,  1.74it/s]
Generating walks (CPU: 7): 100%|     | 1/1 [00:00<00:00,  1.81it/s]
Generating walks (CPU: 11): 0it [00:00, ?it/s]
Generating walks (CPU: 8): 100%|     | 1/1 [00:00<00:00,  1.85it/s]
Generating walks (CPU: 12): 0it [00:00, ?it/s]
Generating walks (CPU: 9): 100%|     | 1/1 [00:00<00:00,  1.77it/s]
Generating walks (CPU: 13): 0it [00:00, ?it/s]
Generating walks (CPU: 10): 100%|     | 1/1 [00:00<00:00,  1.83it/s]
Generating walks (CPU: 14): 0it [00:00, ?it/s]
Generating walks (CPU: 15): 0it [00:00, ?it/s]
Generating walks (CPU: 16): 0it [00:00, ?it/s]

# option 4 , embedding + intercept
#Training set score  0.8982769044740024
#Intercept =  -3.332709897674164
#Embedding coefficient =  228.49978263451214


Frac  0.4

Computing transition probabilities: 100%|     | 1000/1000 [00:00<00:00,
2777.97it/s]
Generating walks (CPU: 1): 100%|     | 1/1 [00:00<00:00,  1.94it/s]
Generating walks (CPU: 2): 100%|     | 1/1 [00:00<00:00,  1.84it/s]
Generating walks (CPU: 3): 100%|     | 1/1 [00:00<00:00,  1.88it/s]
```

```
Generating walks (CPU: 4): 100%|      | 1/1 [00:00<00:00,  1.75it/s]
Generating walks (CPU: 5): 100%|      | 1/1 [00:00<00:00,  1.73it/s]
Generating walks (CPU: 6): 100%|      | 1/1 [00:00<00:00,  1.71it/s]
Generating walks (CPU: 7): 100%|      | 1/1 [00:00<00:00,  1.84it/s]
Generating walks (CPU: 11): 0it [00:00, ?it/s]
Generating walks (CPU: 8): 100%|      | 1/1 [00:00<00:00,  1.91it/s]
Generating walks (CPU: 12): 0it [00:00, ?it/s]
Generating walks (CPU: 9): 100%|      | 1/1 [00:00<00:00,  1.72it/s]
Generating walks (CPU: 13): 0it [00:00, ?it/s]
Generating walks (CPU: 10): 100%|      | 1/1 [00:00<00:00,  1.94it/s]
Generating walks (CPU: 14): 0it [00:00, ?it/s]
Generating walks (CPU: 15): 0it [00:00, ?it/s]
Generating walks (CPU: 16): 0it [00:00, ?it/s]
Computing transition probabilities: 100%|      | 1000/1000 [00:00<00:00,
2866.98it/s]
Generating walks (CPU: 1): 100%|      | 1/1 [00:00<00:00,  1.92it/s]
Generating walks (CPU: 2): 100%|      | 1/1 [00:00<00:00,  1.89it/s]
Generating walks (CPU: 3): 100%|      | 1/1 [00:00<00:00,  1.87it/s]
Generating walks (CPU: 4): 100%|      | 1/1 [00:00<00:00,  1.76it/s]
Generating walks (CPU: 5): 100%|      | 1/1 [00:00<00:00,  1.86it/s]
Generating walks (CPU: 6): 100%|      | 1/1 [00:00<00:00,  1.91it/s]
Generating walks (CPU: 7): 100%|      | 1/1 [00:00<00:00,  1.86it/s]
Generating walks (CPU: 11): 0it [00:00, ?it/s]
Generating walks (CPU: 8): 100%|      | 1/1 [00:00<00:00,  1.83it/s]
Generating walks (CPU: 12): 0it [00:00, ?it/s]
Generating walks (CPU: 9): 100%|      | 1/1 [00:00<00:00,  1.88it/s]
Generating walks (CPU: 13): 0it [00:00, ?it/s]
Generating walks (CPU: 10): 100%|      | 1/1 [00:00<00:00,  1.87it/s]
Generating walks (CPU: 14): 0it [00:00, ?it/s]
Generating walks (CPU: 15): 0it [00:00, ?it/s]
Generating walks (CPU: 16): 0it [00:00, ?it/s]

# option 4 , embedding + intercept
#Training set score  0.8855804111245466
#Intercept =  -3.041674294278916
#Embedding coefficient =  217.28277956607732


Frac  0.5

Computing transition probabilities: 100%|      | 1000/1000 [00:00<00:00,
3134.65it/s]
Generating walks (CPU: 1): 100%|      | 1/1 [00:00<00:00,  1.85it/s]
Generating walks (CPU: 2): 100%|      | 1/1 [00:00<00:00,  1.85it/s]
Generating walks (CPU: 3): 100%|      | 1/1 [00:00<00:00,  1.79it/s]
Generating walks (CPU: 4): 100%|      | 1/1 [00:00<00:00,  1.68it/s]
Generating walks (CPU: 5): 100%|      | 1/1 [00:00<00:00,  1.66it/s]
Generating walks (CPU: 6): 100%|      | 1/1 [00:00<00:00,  1.65it/s]
Generating walks (CPU: 11): 0it [00:00, ?it/s]
```

```
Generating walks (CPU: 7): 100%|      | 1/1 [00:00<00:00,  1.77it/s]
Generating walks (CPU: 12): 0it [00:00, ?it/s]
Generating walks (CPU: 8): 100%|      | 1/1 [00:00<00:00,  1.79it/s]
Generating walks (CPU: 13): 0it [00:00, ?it/s]
Generating walks (CPU: 9): 100%|      | 1/1 [00:00<00:00,  1.78it/s]
Generating walks (CPU: 14): 0it [00:00, ?it/s]
Generating walks (CPU: 10): 100%|      | 1/1 [00:00<00:00,  1.82it/s]
Generating walks (CPU: 15): 0it [00:00, ?it/s]
Generating walks (CPU: 16): 0it [00:00, ?it/s]
Computing transition probabilities: 100%|      | 1000/1000 [00:00<00:00,
3050.59it/s]
Generating walks (CPU: 1): 100%|      | 1/1 [00:00<00:00,  1.97it/s]
Generating walks (CPU: 2): 100%|      | 1/1 [00:00<00:00,  1.66it/s]
Generating walks (CPU: 3): 100%|      | 1/1 [00:00<00:00,  1.85it/s]
Generating walks (CPU: 4): 100%|      | 1/1 [00:00<00:00,  1.71it/s]
Generating walks (CPU: 5): 100%|      | 1/1 [00:00<00:00,  1.60it/s]
Generating walks (CPU: 6): 100%|      | 1/1 [00:00<00:00,  1.57it/s]
Generating walks (CPU: 7): 100%|      | 1/1 [00:00<00:00,  1.80it/s]
Generating walks (CPU: 11): 0it [00:00, ?it/s]
Generating walks (CPU: 8): 100%|      | 1/1 [00:00<00:00,  1.83it/s]
Generating walks (CPU: 12): 0it [00:00, ?it/s]
Generating walks (CPU: 9): 100%|      | 1/1 [00:00<00:00,  1.78it/s]
Generating walks (CPU: 13): 0it [00:00, ?it/s]
Generating walks (CPU: 10): 100%|      | 1/1 [00:00<00:00,  1.93it/s]
Generating walks (CPU: 14): 0it [00:00, ?it/s]
Generating walks (CPU: 15): 0it [00:00, ?it/s]
Generating walks (CPU: 16): 0it [00:00, ?it/s]
```

```
# option 4 , embedding + intercept
#Training set score  0.873639661426844
#Intercept =  -2.7470037576463264
#Embedding coefficient =  179.77444425492985
```

```
Frac  0.6
```

```
Computing transition probabilities: 100%|      | 1000/1000 [00:00<00:00,
3253.58it/s]
Generating walks (CPU: 1): 100%|      | 1/1 [00:00<00:00,  1.91it/s]
Generating walks (CPU: 2): 100%|      | 1/1 [00:00<00:00,  1.88it/s]
Generating walks (CPU: 3): 100%|      | 1/1 [00:00<00:00,  1.90it/s]
Generating walks (CPU: 4): 100%|      | 1/1 [00:00<00:00,  1.70it/s]
Generating walks (CPU: 5): 100%|      | 1/1 [00:00<00:00,  1.70it/s]
Generating walks (CPU: 6): 100%|      | 1/1 [00:00<00:00,  1.76it/s]
Generating walks (CPU: 11): 0it [00:00, ?it/s]/1 [00:00<?, ?it/s]
Generating walks (CPU: 7): 100%|      | 1/1 [00:00<00:00,  1.73it/s]
Generating walks (CPU: 8): 100%|      | 1/1 [00:00<00:00,  1.88it/s]
Generating walks (CPU: 12): 0it [00:00, ?it/s]
Generating walks (CPU: 13): 0it [00:00, ?it/s]
```

```
Generating walks (CPU: 9): 100%|      | 1/1 [00:00<00:00,  1.75it/s]
Generating walks (CPU: 14): 0it [00:00, ?it/s]
Generating walks (CPU: 10): 100%|      | 1/1 [00:00<00:00,  1.82it/s]
Generating walks (CPU: 15): 0it [00:00, ?it/s]
Generating walks (CPU: 16): 0it [00:00, ?it/s]
Computing transition probabilities: 100%|      | 1000/1000 [00:00<00:00,
3736.31it/s]
Generating walks (CPU: 1): 100%|      | 1/1 [00:00<00:00,  1.89it/s]
Generating walks (CPU: 2): 100%|      | 1/1 [00:00<00:00,  1.56it/s]
Generating walks (CPU: 3): 100%|      | 1/1 [00:00<00:00,  1.88it/s]
Generating walks (CPU: 4): 100%|      | 1/1 [00:00<00:00,  1.76it/s]
Generating walks (CPU: 5): 100%|      | 1/1 [00:00<00:00,  1.62it/s]
Generating walks (CPU: 6): 100%|      | 1/1 [00:00<00:00,  1.58it/s]
Generating walks (CPU: 11): 0it [00:00, ?it/s]
Generating walks (CPU: 7): 100%|      | 1/1 [00:00<00:00,  1.69it/s]
Generating walks (CPU: 12): 0it [00:00, ?it/s]
Generating walks (CPU: 8): 100%|      | 1/1 [00:00<00:00,  1.76it/s]
Generating walks (CPU: 9): 100%|      | 1/1 [00:00<00:00,  1.91it/s]
Generating walks (CPU: 13): 0it [00:00, ?it/s]
Generating walks (CPU: 14): 0it [00:00, ?it/s]
Generating walks (CPU: 10): 100%|      | 1/1 [00:00<00:00,  1.78it/s]
Generating walks (CPU: 15): 0it [00:00, ?it/s]
Generating walks (CPU: 16): 0it [00:00, ?it/s]
```

```
# option 4 , embedding + intercept
#Training set score  0.879081015719468
#Intercept =  -2.4042819809484763
#Embedding coefficient =  162.52885521247893
```

```
Frac  0.7
```

```
Computing transition probabilities: 100%|      | 1000/1000 [00:00<00:00,
3622.35it/s]
Generating walks (CPU: 1): 100%|      | 1/1 [00:00<00:00,  1.89it/s]
Generating walks (CPU: 2): 100%|      | 1/1 [00:00<00:00,  1.82it/s]
Generating walks (CPU: 3): 100%|      | 1/1 [00:00<00:00,  1.75it/s]
Generating walks (CPU: 4): 100%|      | 1/1 [00:00<00:00,  1.70it/s]
Generating walks (CPU: 5): 100%|      | 1/1 [00:00<00:00,  1.63it/s]
Generating walks (CPU: 6): 100%|      | 1/1 [00:00<00:00,  1.74it/s]
Generating walks (CPU: 11): 0it [00:00, ?it/s]
Generating walks (CPU: 7): 100%|      | 1/1 [00:00<00:00,  1.81it/s]
Generating walks (CPU: 12): 0it [00:00, ?it/s]
Generating walks (CPU: 8): 100%|      | 1/1 [00:00<00:00,  1.85it/s]
Generating walks (CPU: 13): 0it [00:00, ?it/s]
Generating walks (CPU: 9): 100%|      | 1/1 [00:00<00:00,  1.74it/s]
Generating walks (CPU: 14): 0it [00:00, ?it/s]
Generating walks (CPU: 10): 100%|      | 1/1 [00:00<00:00,  1.84it/s]
Generating walks (CPU: 15): 0it [00:00, ?it/s]
```

```
Generating walks (CPU: 16): 0it [00:00, ?it/s]
Computing transition probabilities: 100%|      | 1000/1000 [00:00<00:00,
3819.08it/s]
Generating walks (CPU: 1): 100%|      | 1/1 [00:00<00:00,  1.77it/s]
Generating walks (CPU: 2): 100%|      | 1/1 [00:00<00:00,  1.83it/s]
Generating walks (CPU: 3): 100%|      | 1/1 [00:00<00:00,  1.66it/s]
Generating walks (CPU: 4): 100%|      | 1/1 [00:00<00:00,  1.63it/s]
Generating walks (CPU: 5): 100%|      | 1/1 [00:00<00:00,  1.71it/s]
Generating walks (CPU: 6): 100%|      | 1/1 [00:00<00:00,  1.78it/s]
Generating walks (CPU: 7): 100%|      | 1/1 [00:00<00:00,  1.89it/s]
Generating walks (CPU: 8): 100%|      | 1/1 [00:00<00:00,  1.88it/s]
Generating walks (CPU: 9): 100%|      | 1/1 [00:00<00:00,  1.93it/s]
Generating walks (CPU: 11): 0it [00:00, ?it/s]
Generating walks (CPU: 12): 0it [00:00, ?it/s]
Generating walks (CPU: 13): 0it [00:00, ?it/s]
Generating walks (CPU: 14): 0it [00:00, ?it/s]
Generating walks (CPU: 10): 100%|      | 1/1 [00:00<00:00,  2.08it/s]
Generating walks (CPU: 15): 0it [00:00, ?it/s]
Generating walks (CPU: 16): 0it [00:00, ?it/s]

# option 4 , embedding + intercept
#Training set score  0.8813482466747279
#Intercept =  -1.9282316801439907
#Embedding coefficient =  150.79821417675768


Frac  0.7999999999999999

Computing transition probabilities: 100%|      | 1000/1000 [00:00<00:00,
4483.29it/s]
Generating walks (CPU: 1): 100%|      | 1/1 [00:00<00:00,  1.92it/s]
Generating walks (CPU: 2): 100%|      | 1/1 [00:00<00:00,  1.79it/s]
Generating walks (CPU: 3): 100%|      | 1/1 [00:00<00:00,  1.86it/s]
Generating walks (CPU: 4): 100%|      | 1/1 [00:00<00:00,  1.66it/s]
Generating walks (CPU: 5): 100%|      | 1/1 [00:00<00:00,  1.79it/s]
Generating walks (CPU: 6): 100%|      | 1/1 [00:00<00:00,  1.71it/s]
Generating walks (CPU: 11): 0it [00:00, ?it/s]
Generating walks (CPU: 7): 100%|      | 1/1 [00:00<00:00,  1.73it/s]
Generating walks (CPU: 12): 0it [00:00, ?it/s]
Generating walks (CPU: 8): 100%|      | 1/1 [00:00<00:00,  1.83it/s]
Generating walks (CPU: 13): 0it [00:00, ?it/s]
Generating walks (CPU: 9): 100%|      | 1/1 [00:00<00:00,  1.77it/s]
Generating walks (CPU: 14): 0it [00:00, ?it/s]
Generating walks (CPU: 10): 100%|      | 1/1 [00:00<00:00,  1.77it/s]
Generating walks (CPU: 15): 0it [00:00, ?it/s]
Generating walks (CPU: 16): 0it [00:00, ?it/s]
Computing transition probabilities: 100%|      | 1000/1000 [00:00<00:00,
4153.32it/s]
Generating walks (CPU: 1): 100%|      | 1/1 [00:00<00:00,  1.77it/s]
```

```
Generating walks (CPU: 2): 100%|      | 1/1 [00:00<00:00,  1.84it/s]
Generating walks (CPU: 3): 100%|      | 1/1 [00:00<00:00,  1.80it/s]
Generating walks (CPU: 4): 100%|      | 1/1 [00:00<00:00,  1.69it/s]
Generating walks (CPU: 5): 100%|      | 1/1 [00:00<00:00,  1.72it/s]
Generating walks (CPU: 6): 100%|      | 1/1 [00:00<00:00,  1.79it/s]
Generating walks (CPU: 11): 0it [00:00, ?it/s]
Generating walks (CPU: 12): 0it [00:00, ?it/s]
Generating walks (CPU: 7): 100%|      | 1/1 [00:00<00:00,  1.60it/s]
Generating walks (CPU: 8): 100%|      | 1/1 [00:00<00:00,  1.70it/s]
Generating walks (CPU: 13): 0it [00:00, ?it/s]
Generating walks (CPU: 9): 100%|      | 1/1 [00:00<00:00,  1.82it/s]
Generating walks (CPU: 14): 0it [00:00, ?it/s]
Generating walks (CPU: 10): 100%|      | 1/1 [00:00<00:00,  1.78it/s]
Generating walks (CPU: 15): 0it [00:00, ?it/s]
Generating walks (CPU: 16): 0it [00:00, ?it/s]

# option 4 , embedding + intercept
#Training set score  0.900241837968561
#Intercept =  -1.447397195285757
#Embedding coefficient =  141.34702335622447


Frac  0.8999999999999999

Computing transition probabilities: 100%|      | 1000/1000 [00:00<00:00,
4445.89it/s]
Generating walks (CPU: 1): 100%|      | 1/1 [00:00<00:00,  1.87it/s]
Generating walks (CPU: 2): 100%|      | 1/1 [00:00<00:00,  1.77it/s]
Generating walks (CPU: 3): 100%|      | 1/1 [00:00<00:00,  1.73it/s]
Generating walks (CPU: 4): 100%|      | 1/1 [00:00<00:00,  1.63it/s]
Generating walks (CPU: 5): 100%|      | 1/1 [00:00<00:00,  1.68it/s]
Generating walks (CPU: 6): 100%|      | 1/1 [00:00<00:00,  1.83it/s]
Generating walks (CPU: 11): 0it [00:00, ?it/s]
Generating walks (CPU: 7): 100%|      | 1/1 [00:00<00:00,  1.75it/s]
Generating walks (CPU: 12): 0it [00:00, ?it/s]
Generating walks (CPU: 13): 0it [00:00, ?it/s]
Generating walks (CPU: 8): 100%|      | 1/1 [00:00<00:00,  1.72it/s]
Generating walks (CPU: 9): 100%|      | 1/1 [00:00<00:00,  1.81it/s]
Generating walks (CPU: 14): 0it [00:00, ?it/s]
Generating walks (CPU: 10): 100%|      | 1/1 [00:00<00:00,  1.93it/s]
Generating walks (CPU: 15): 0it [00:00, ?it/s]
Generating walks (CPU: 16): 0it [00:00, ?it/s]
Computing transition probabilities: 100%|      | 1000/1000 [00:00<00:00,
4954.17it/s]
Generating walks (CPU: 1): 100%|      | 1/1 [00:00<00:00,  1.91it/s]
Generating walks (CPU: 2): 100%|      | 1/1 [00:00<00:00,  1.75it/s]
Generating walks (CPU: 3): 100%|      | 1/1 [00:00<00:00,  1.74it/s]
Generating walks (CPU: 4): 100%|      | 1/1 [00:00<00:00,  1.80it/s]
Generating walks (CPU: 5): 100%|      | 1/1 [00:00<00:00,  1.56it/s]
```

```
Generating walks (CPU: 11): 0it [00:00, ?it/s]
Generating walks (CPU: 6): 100%|      | 1/1 [00:00<00:00,  1.71it/s]
Generating walks (CPU: 12): 0it [00:00, ?it/s]
Generating walks (CPU: 7): 100%|      | 1/1 [00:00<00:00,  1.74it/s]
Generating walks (CPU: 13): 0it [00:00, ?it/s]
Generating walks (CPU: 8): 100%|      | 1/1 [00:00<00:00,  1.76it/s]
Generating walks (CPU: 9): 100%|      | 1/1 [00:00<00:00,  1.81it/s]
Generating walks (CPU: 14): 0it [00:00, ?it/s]
Generating walks (CPU: 15): 0it [00:00, ?it/s]
Generating walks (CPU: 10): 100%|      | 1/1 [00:00<00:00,  1.76it/s]
Generating walks (CPU: 16): 0it [00:00, ?it/s]
```

```
# option 4 , embedding + intercept
#Training set score  0.9068923821039904
#Intercept =  -0.6774263022443305
#Embedding coefficient =  133.64917535674314
```

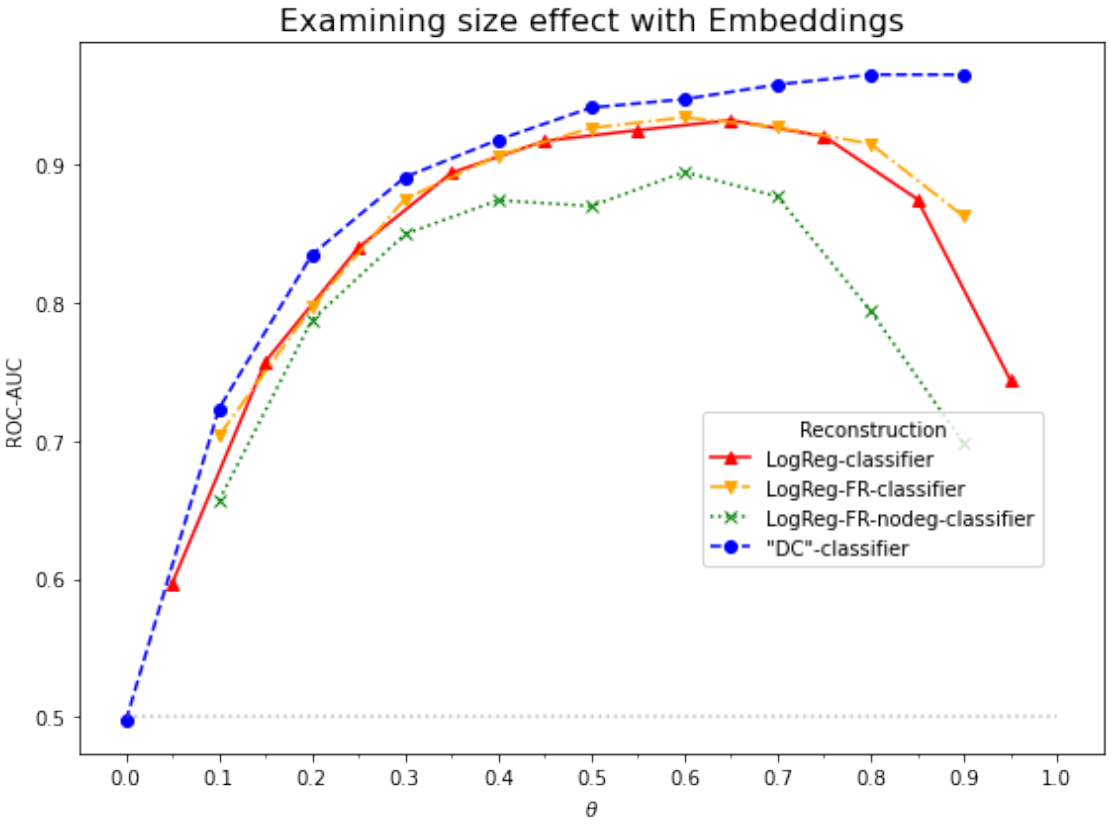
3.6 "DC"-Reconstruction

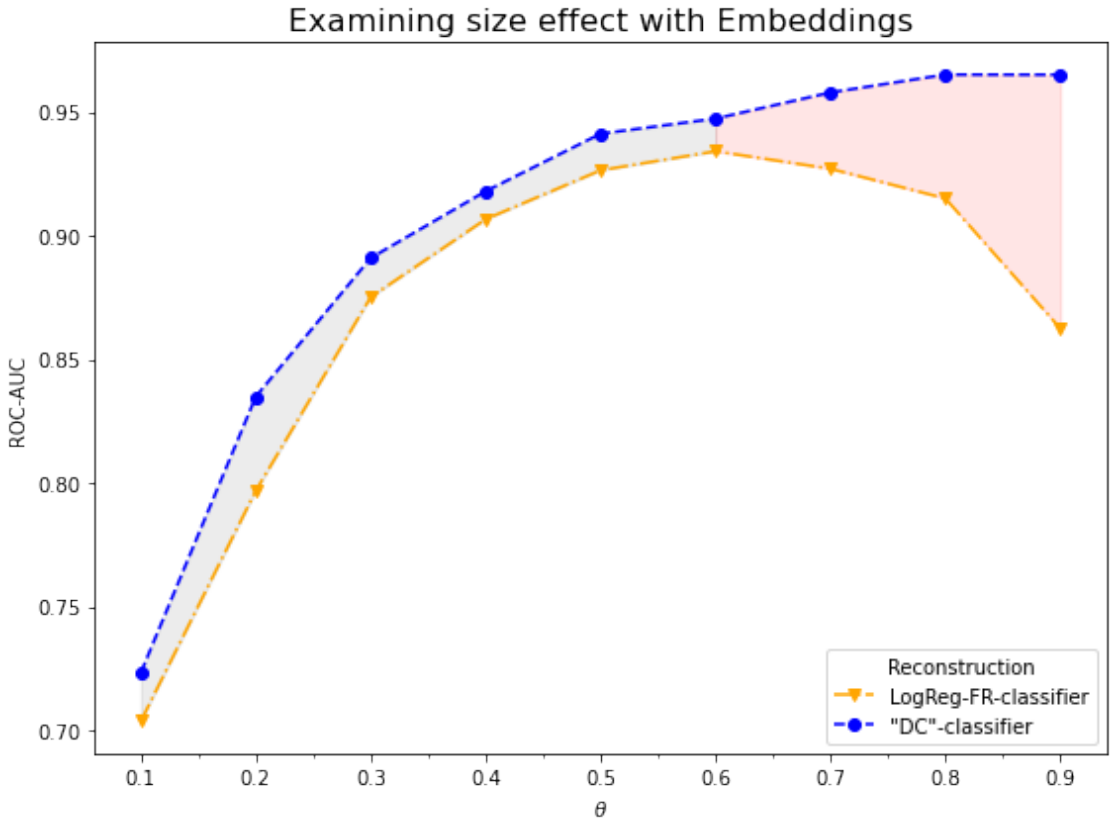
```
# 0.00   0.90
# 0.10   0.90
# 0.20   0.90
# 0.30   0.90
# 0.40   0.90
# 0.50   0.90
# 0.60   0.90
# 0.70   0.90
# 0.80   0.90
# 0.90   0.90
```

---

4 Analysis

[56]: `Text(0.5, 1.0, 'Examining size effect with Embeddings')`


Examining size effect with Embeddings
ROC-AUC
0.9
0.8
0.7
0.6
0.5
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
θ
Reconstruction
LogReg-classifier
LogReg-FR-classifier
LogReg-FR-nodeg-classifier
"DC"-classifier



5 Appendix

5.1 Referenced figures

Reference Figure (1): EMB_ex33v2.1 results compared with prior results.

Reference Figure (2): EMB_ex34 results show casing effect of network size on reconstruction.