NETWORK SCIENCE
WINTER 2021

Item Basket Revenue Maximization

Team Members:
Pragya Dara (MT19126)
Shraddha Gupta (MT19072)
Swati Verma (MT19073)

Problem Definition

- Goal of any business is to maximise their revenue
- In case of businesses like amazon or even small grocery stores where the business people have information about the purchasing history of the customers. This data can be used for strategising.
- **Shopping carts to co-purchasing network**
- **Co-purchase network**
  Nodes-> All items
  Edges-> 2 items are connected if they are purchased together
- Let's assume two items are frequently bought together. Decreasing the price of product 1 by 5% and increasing the price of product 2 by 10% might increase the overall revenue.

Data Generation

We have generated 10 random co-purchasing networks

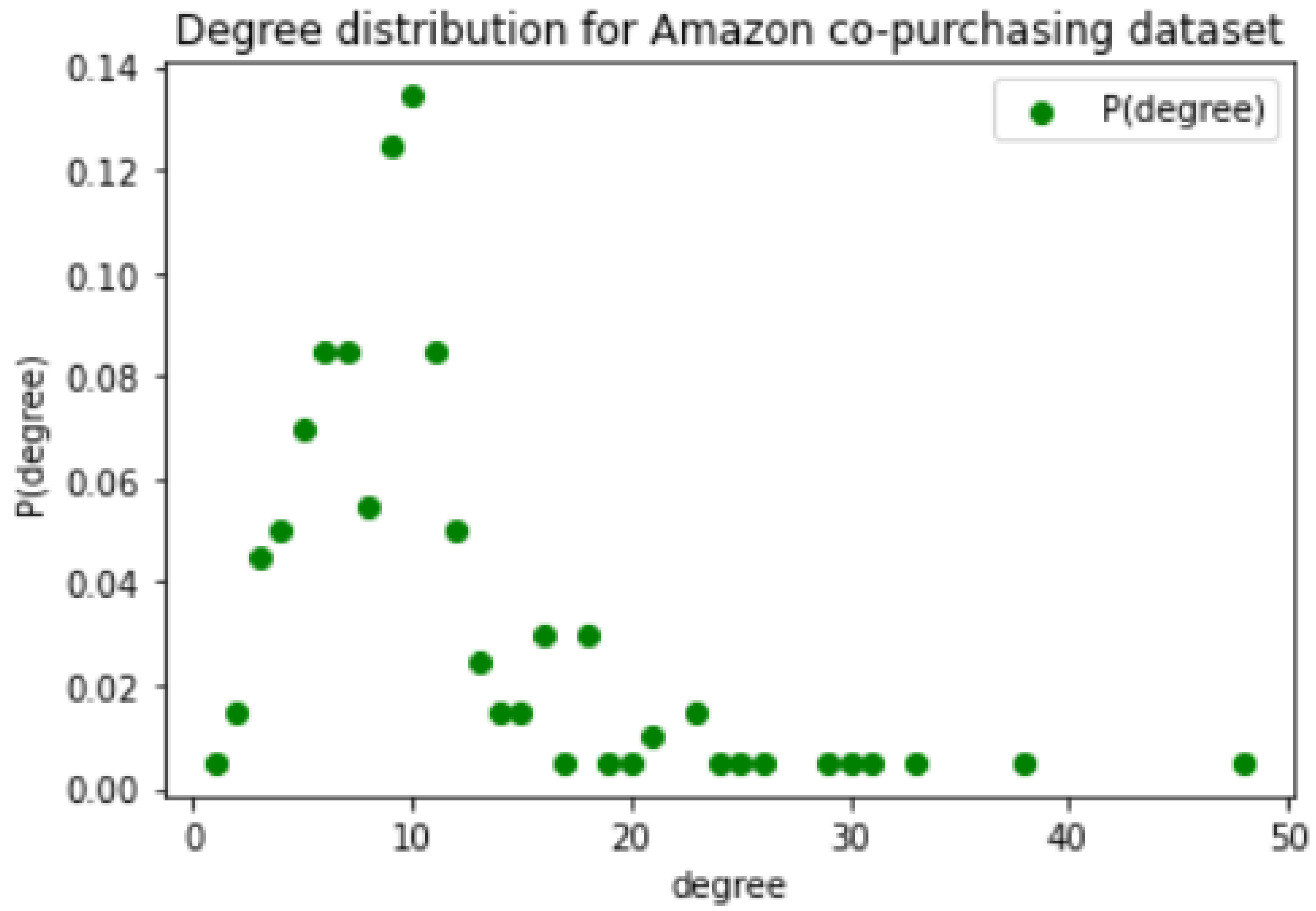
Each network is made of 500 items and 1000 carts

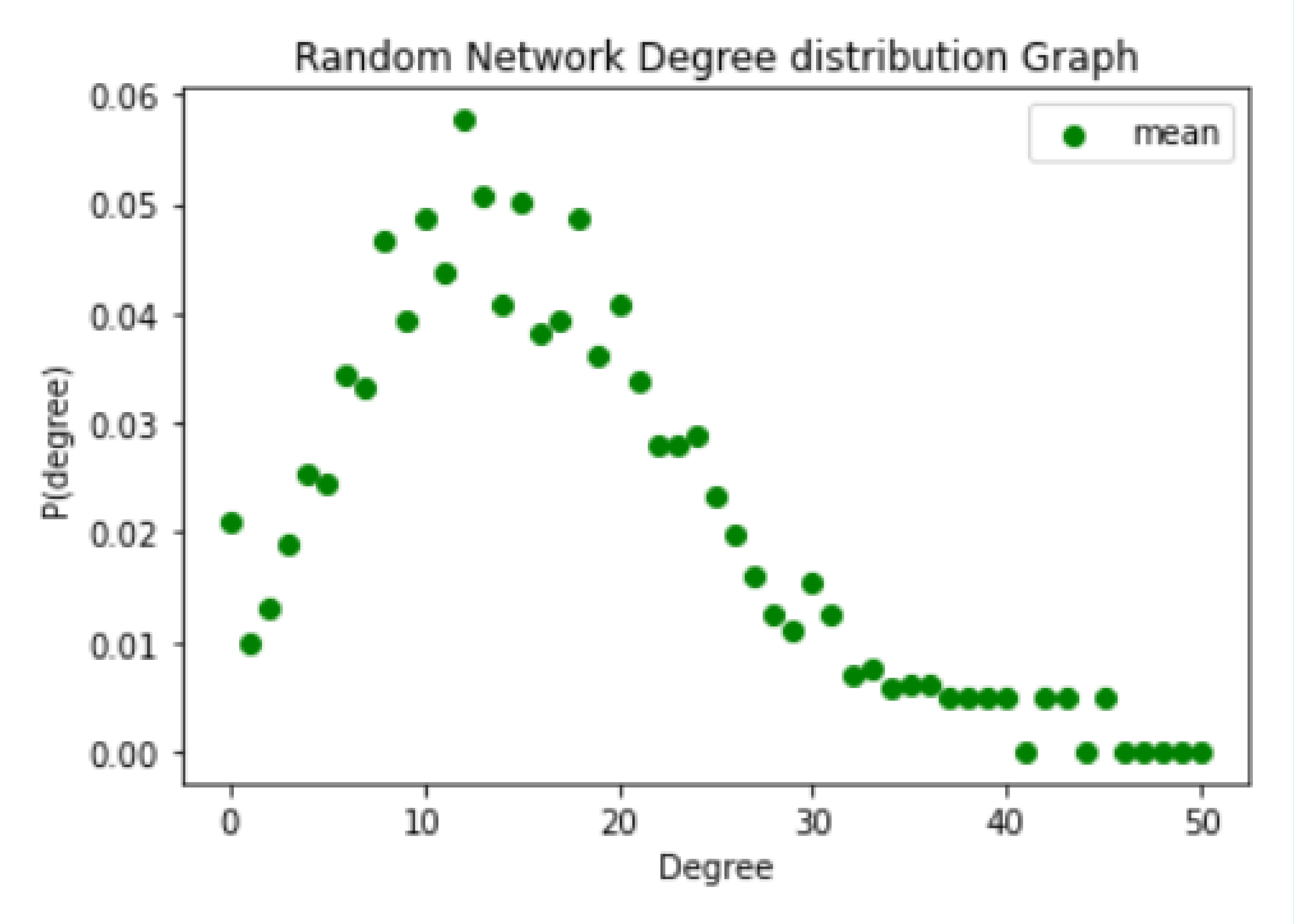
The carts are then converted to co-purchasing networks

Nodes (V)-> 500 items

Links (E)-> u,v are connected if bought together in at least 1 cart

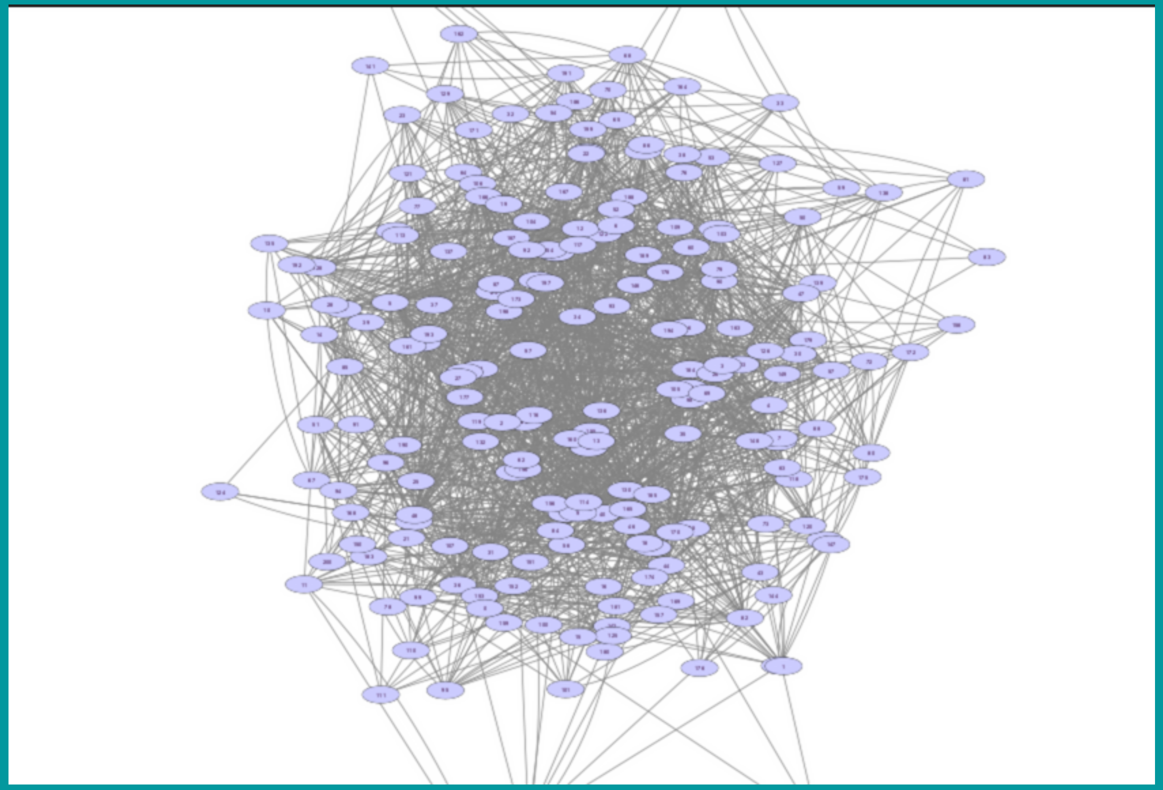
Degree Distribution Comparison





Analysis Done

Network Visualization using cytoscape



Clustering Coefficient (0.0145)

Characteristic path length (0.0033)

Algorithm implemented

Revenue = $$\sum_{u \in V} price(u) \times (f(u) + \sum_{u,v \in E} g(u,v)).$$

Problem = Maximize Revenue

$$\arg \max_{|\Delta(u)| \leq \chi, |\Delta(v)| \leq \chi} \sum_{u \in V} p'(u) \times (f'(u) + \sum_{u,v \in E} g'(u,v)))...($$

$$\text{where} \begin{cases} p'(u) &= price(u) \times (1 + \Delta(u)) \\ f'(u) &= f(u) \times (1 - \Delta(u)) \\ g'(u,v) &= g(u,v) \times (1 - (w_u \Delta(u) + w_v \Delta(v)) \end{cases}$$

Algorithm implemented

1. **Strategy1:** Let u be the item whose price change yields maximum revenue gain. Fix the price of u and iterate over the rest of the items.

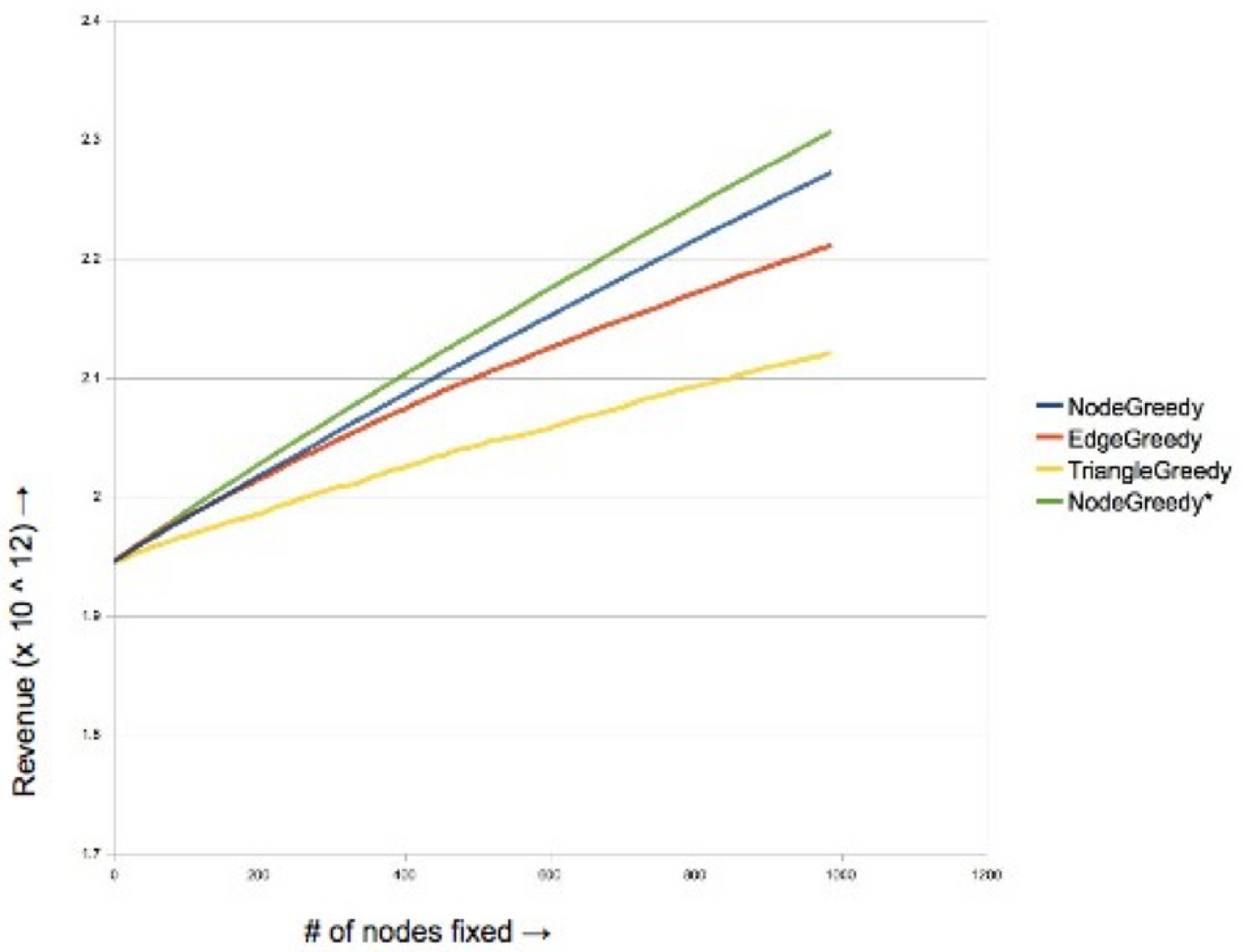
2. **Strategy2:** Let $u - v$, be an edge in the graph G such that locally changing the price of u and v yields maximum revenue gain. Break ties arbitrarily. Fix the price of u and v and iterate over the graph induced by rest of the items.

3. **Strategy3:** Same as *strategy 2* except we break ties based on the number of triangles in which the edge participates.

4. **Strategy4:** Order the items statically based on the maximum increase in revenue that can achieved by varying respective item prices. Pick the items in this order and locally fix their prices.

Results

Research Paper Results



Our Results