**Analysis of Career Pathways Based on the Social Network Analysis**

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# **Abstract**

Changing careers is quite an unusual event. There are always ways to move from one position to another, whether within the same industry or across industries. This study tries to figure out the features and patterns of trajectories from one occupation to another one. Due to the advantages of social network analysis (SNA) for tracking the evolution of a behavior or state, social network analysis is used in this study. The network is constructed with different occupations, which are defined by 2002 Census Occupation Code, as nodes. Each node has attributes representing the importance of some skills. An edge between A and B represents the existence of transition from occupation A to B, and the weight of an edge is proportional to the number of times of the transition.

Some community detection algorithms are used attempting to explore potential classification relationships between different occupations. …

Major findings… Any implications… The conclusions…

**Keywords:** Social Network analysis, Career Trajectory

# **Introduction**

It is quite common for a person to embark on a different work, whether these works are in the same industry or not. There is a claim that people typically change jobs seven times in their lifetime, which there's no real data to support. However, according to a poll conducted by Harris Poll in 2021 exclusively for Fast Company, it shows that more than half (52%) of American employees were considering making a career change that year, and 44% had already planning to make the switch (Dishman 2021). LinkedIn published a blog with the topic of the most common career transitions for recruiters. It found that approximately half (51%) of former recruiters still stayed in the field of human resources only making a transition to another HR role. The top two fields that the former recruiters turned to outside the human resource are sales and business development (LinkedIn 2023). From these, it can be said that making a career change to a lesser or greater extent is a choice for many people, and discovering the characteristics and patterns is a topic worth exploring.

Some research aims at the reasons for career change for some specific groups, either in a particular field, age group, gender, etc. For people who have fieldwork experiences, the existence of violations of rules defining appropriate conduct would result in a change of career path. One of the reasons that encourage people to pursue their academic work is productive and enjoyable field experiences. Contrarily, negative field experiences would directly lead to career stalling, moves, or leaving (Nelson et al. 2017). For workers in STEM, even the birth of a child can affect the career path more than some other fields. 43% of new mothers and 23% of new fathers leave full-time STEM employment switching to part-time work or exiting the labor force after their first child (Cech and Blair-Loy 2019). Moreover, the choice of career path is affected by the perception gained during childhood. Children’s perceived academic, social, and self-regulatory efficacy influence the types of occupational activities for which they judge themselves to be efficacious both directly and through their impact on academic aspirations (Bandura et al. 2001).

Some tools including different models and methodologies are utilized to job mobility related topics. The article (Xu et al. 2015) investigated what extent the job change occasion can be predicted based on the career mobility and daily activity pattern of individuals. They tried to predict whether an employee will change job or not sometime in the following months, based on the professional and social linkage datasets, which include personal resumes and historical check-in records in location-based social networks. With these prior data, some classification algorithms are used, for example, regression trees (CART), support vector machine (SVM), Adaboost, and random forest. The comprehensive importance of features indicated people may keep stable job change preference from their historical experience and follow the job mobility regularity of environment. (Xu et al. 2014) proposed a technique to calculate the professional similarity between two individuals by modeling individuals’ profile on LinkedIn as a time-series sequence of positions.

Social network analysis (SNA) is a method based on sociology and graph theory, which is a powerful tool for tracking the evolution of a behavior or state. It has been applied to many career-related fields, such as e-recruitment. (Milovanović et al. 2022) used SNA for the preselection of candidates. A network was created by the most frequently used terms. (Toteva and Gourova 2011) built a network based on social network sites. A node could represent a person or a web page. A node with high degree could be a person who has many connections to the high-level specialists or who has wide interests and hobbies or published contents on many pages.

In this article, social network analysis is applied to explore the features and patterns of trajectories from one occupation to another one no matter what industry they are in. Data used for this study is from the official website of U.S. department of labor. The datasets include data from large nationally representative longitudinal surveys, as well as licensed data on occupational transitions from online career profiles, etc. (“Career Pathways Descriptive and Analytical Study Data,” n.d.), which provide the individual information about career trajectories over time. The network is constructed with different occupations as nodes. The occupations are defined according to the 2002 Census Occupation Code (US Census Bureau 2023), which is a four-character code that identifies the generic occupation. Each node has attributes that come from the dataset representing the importance of some skills. An edge between A and B represents the existence of transition from occupation A to B, and the weight of an edge is proportional to the number of times of the transition. The following research questions were formulated:

(1) Which occupations have the highest/lowest outflow/inflow rates?

(2) What occupations are suitable as intermediate bridges from occupation A to occupation B?

(3) Are there any occupations that can be seen as core occupations?

(4) Are there clear categories for career transitions?

(5) What are some of the jobs from cross-cutting industries?

(6) Do occupations show a tendency to cluster according to the skills required?

(7) What characterizes a career change in the field of computer technology?

# **Methods**

Centrality

Community Detection

Partition Similarity Measure: Normalized mutual information

# **Results**

Basic network information

# **Conclusions**

# **References**

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# **Appendices**

**Tabel x.x.**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **In-degree** | **Out-degree** | **Closeness Centrality** | **Betweenness Centrality** | **Eigenvector**  **Centrality** |
| 1 | Unemployed | Unemployed | Unemployed | Unemployed | Unemployed |
| 2 | Student | Student | Student | Student | Student |
| 3 | Retail salespersons (4760) | Retail salespersons (4760) | Retail salespersons (4760) | Retail salespersons (4760) | Retail salespersons (4760) |
| 4 | Cashiers  (4720) | Cashiers  (4720) | Cashiers  (4720) | Laborers and freight, stock, and material movers, hand  (9620) | Cashiers  (4720) |
| 5 | Waiters and waitresses (4110) | Laborers and freight, stock, and material movers, hand  (9620) | Waiters and waitresses (4110) | Cashiers  (4720) | Waiters and waitresses (4110) |
| 6 | Laborers and freight, stock, and material movers, hand  (9620) | Waiters and waitresses (4110) | Laborers and freight, stock, and material movers, hand  (9620) | Waiters and waitresses (4110) | Customer service representatives  (5240) |
| 7 | Customer service representatives  (5240) | Stock clerks and order fillers  (5620) | Customer service representatives  (5240) | Customer service representatives  (5240) | Laborers and freight, stock, and material movers, hand  (9620) |
| 8 | Stock clerks and order fillers  (5620) | Customer service representatives  (5240) | Stock clerks and order fillers  (5620) | Construction laborers (6260) | Stock clerks and order fillers  (5620) |
| 9 | Driver/sales workers and truck drivers (9130) | Driver/sales workers and truck drivers (9130) | Driver/sales workers and truck drivers (9130) | Stock clerks and order fillers  (5620) | Driver/sales workers and truck drivers (9130) |
| 10 | First-line supervisors/managers of retail sales workers (4700) | Cooks  (4020) | Construction laborers (6260) | Driver/sales workers and truck drivers (9130) | First-line supervisors/managers of retail sales workers (4700) |
| 11 | Construction laborers (6260) | Secretaries and administrative assistants  (5700) | First-line supervisors/managers of retail sales workers (4700) | Secretaries and administrative assistants  (5700) | Receptionists and information clerks  (5400) |
| 12 | Secretaries and administrative assistants (5700) | First-line supervisors/managers of retail sales workers (4700) | Secretaries and administrative assistants (5700) | Grounds maintenance workers (4250) | Secretaries and administrative assistants (5700) |

**Tabel x.x. Ten Occupations with Highest Centralities**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **In-degree** | **Out-degree** | **Closeness Centrality** | **Betweenness Centrality** | **Eigenvector**  **Centrality** |
| 1 | Retail salespersons  (4760) | Retail salespersons  (4760) | Retail salespersons  (4760) | Retail salespersons  (4760) | Retail salespersons  (4760) |
| 2 | Laborers and freight, stock, and material movers, hand  (9620) | Cashiers  (4720) | Laborers and freight, stock, and material movers, hand  (9620) | Laborers and freight, stock, and material movers, hand  (9620) | Cashiers  (4720) |
| 3 | Cashiers  (4720) | Laborers and freight, stock, and material movers, hand  (9620) | Cashiers  (4720) | Cashiers  (4720) | Laborers and freight, stock, and material movers, hand  (9620) |
| 4 | Stock clerks and order fillers  (5620) | Stock clerks and order fillers  (5620) | Waiters and waitresses  (4110) | Waiters and waitresses  (4110) | Waiters and waitresses  (4110) |
| 5 | Waiters and waitresses  (4110) | Waiters and waitresses  (4110) | Stock clerks and order fillers  (5620) | Stock clerks and order fillers  (5620) | Stock clerks and order fillers  (5620) |
| 6 | Customer service representatives  (5240) | Customer service representatives  (5240) | Customer service representatives  (5240) | Construction laborers  (6260) | Customer service representatives  (5240) |
| 7 | Driver/sales workers and truck drivers  (9130) | Construction laborers  (6260) | Driver/sales workers and truck drivers  (9130) | Customer service representatives  (5240) | Driver/sales workers and truck drivers  (9130) |
| 8 | Construction laborers  (6260) | Cooks  (4020) | First-line supervisors/managers of retail sales workers  (4700) | Driver/sales workers and truck drivers  (9130) | Cooks  (4020) |
| 9 | First-line supervisors/managers of retail sales workers  (4700) | Driver/sales workers and truck drivers  (9130) | Construction laborers  (6260) | Cooks  (4020) | First-line supervisors/managers of retail sales workers  (4700) |
| 10 | Cooks  (4020) | Secretaries and administrative assistants  (5700) | Cooks  (4020) | Secretaries and administrative assistants  (5700) | Receptionists and information clerks  (5400) |

**Tabel x.x. Ten Occupations with Lowest Centralities**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **In-degree** | **Out-degree** | **Closeness Centrality** | **Betweenness Centrality** | **Eigenvector**  **Centrality** |
| -10 | Commercial divers  (7520) | Electrical and electronics repairers, industrial and utility  (7100) | Podiatrists  (3120) | Mining and geological engineers, including mining safety engineers  (1500) | Podiatrists  (3120) |
| -9 | Shuttle car operators  (9730) | Budget analysts  (820) | 7070 | Conservation scientists and foresters  (1640) | Shoe and leather workers and repairers  (8330) |
| -8 | Sales engineers  (4930) | Lay-out workers, metal and plastic  (8160) | Shoe and leather workers and repairers  (8330) | Commercial divers  (7520) | 7070 |
| -7 | Chiropractors  (3000) | Urban and regional planners  (1840) | Electrical and electronics repairers, industrial and utility  (7100) | Multiple machine tool setters, operators, and tenders, metal and plastic  (8120) | Electrical and electronics repairers, industrial and utility  (7100) |
| -6 | 7070 | Mining and geological engineers, including mining safety engineers  (1500) | Nuclear technicians  (1940) | Shuttle car operators  (9730) | Nuclear technicians  (1940) |
| -5 | Subway, streetcar, and other rail transportation workers  (9260) | Conservation scientists and foresters  (1640) | Avionics technicians  (7030) | Sales engineers  (4930) | Avionics technicians  (7030) |
| -4 | Textile bleaching and dyeing machine operators and tenders  (8360) | Commercial divers  (7520) | Aircraft structure, surfaces, rigging, and systems assemblers  (7710) | 7070 | Aircraft structure, surfaces, rigging, and systems assemblers  (7710) |
| -3 | Agricultural inspectors  (6010) | Sales engineers  (4930) | Subway, streetcar, and other rail transportation workers  (9260) | Textile bleaching and dyeing machine operators and tenders  (8360) | Subway, streetcar, and other rail transportation workers  (9260) |
| -2 | Multiple machine tool setters, operators, and tenders, metal and plastic  (8120) | Textile bleaching and dyeing machine operators and tenders  (8360) | Multiple machine tool setters, operators, and tenders, metal and plastic  (8120) | Agricultural inspectors  (6010) | Multiple machine tool setters, operators, and tenders, metal and plastic  (8120) |
| -1 | Ship engineers  (9330) | Agricultural inspectors  (6010) | Ship engineers  (9330) | Ship engineers  (9330) | Ship engineers  (9330) |