GROUP 8

Work Participation, productivity, and mental and physical health outcomes among the elderly in India.

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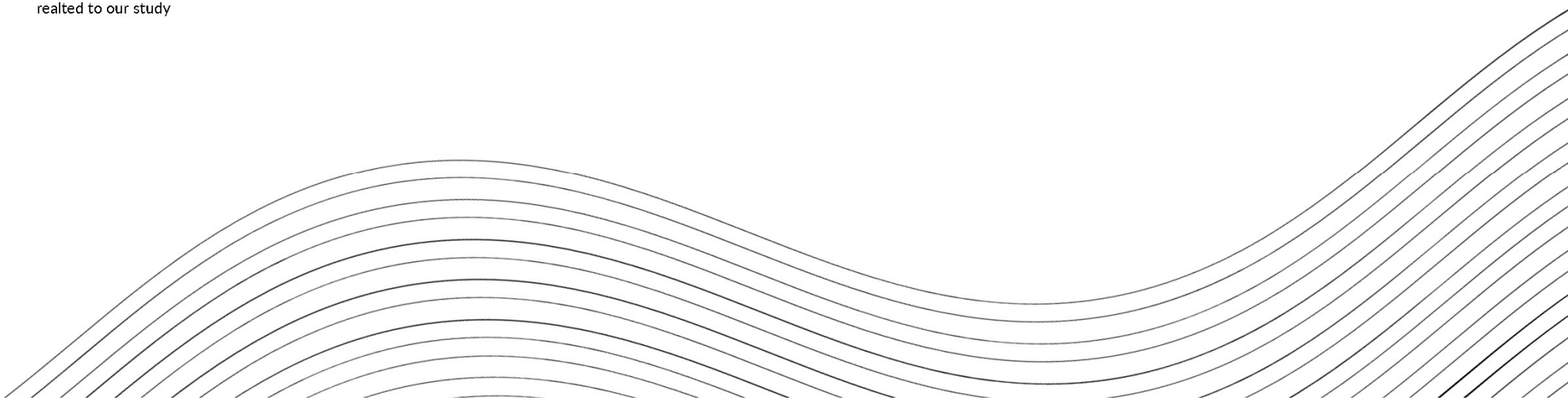


INTRODUCTION

Motivation

Problem Statement

Application

Objective

MOTIVATION

As the elderly population in India continues to grow, there is a pressing need to investigate the complex relationship between work participation, productivity, and the mental and physical health outcomes of this demographic. Recent research has highlighted the significance of work in shaping the well-being of older individuals in India, with factors like life satisfaction, informal sector employment, work stress, multimorbidity, depression, and chronic diseases playing pivotal roles.

GLOBAL PERSPECTIVES AND TRENDS

Global studies highlight aging in the workforce and the need for policies supporting older workers' productivity and health. Research emphasizes factors contributing to positive health outcomes in the elderly. The COVID-19 pandemic's impact on older workers is also a focus, prompting strategies to address related challenges, underscoring the importance of promoting healthy aging through informed policies and interventions.

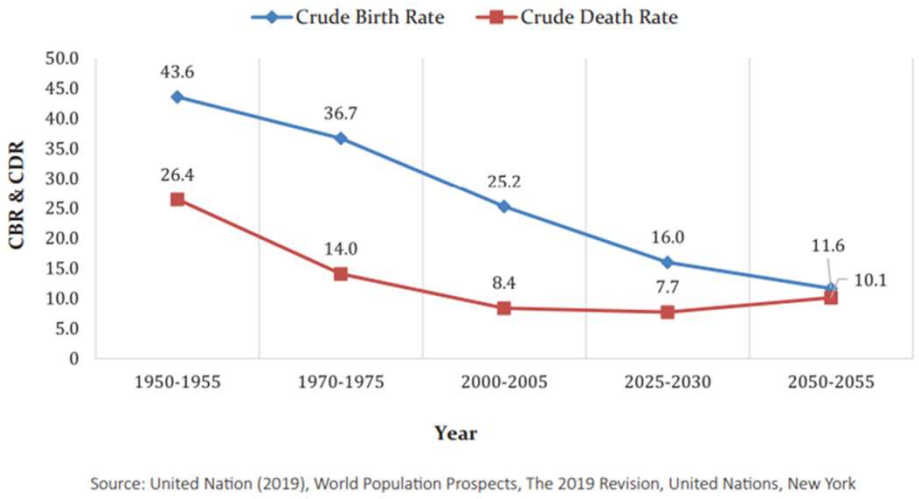
CURRENT TRENDS

- While global ageing can be seen as a symbol of medical, social, and economic advances, it has led to health, social, and economic consequences over the past half-century.

- Population ageing represents major policy challenges and therefore threatens to topple existing insurance and pension systems and create health system overload; thus, it calls for a review of existing models of healthcare, familial, and social support.

- In the 21st century, the phenomenon of global ageing has the potential to fundamentally alter disease burdens, the health care system and its costs, family and social structure, economies and trade, and human migration patterns.

POPULATION AGEING IN INDIA

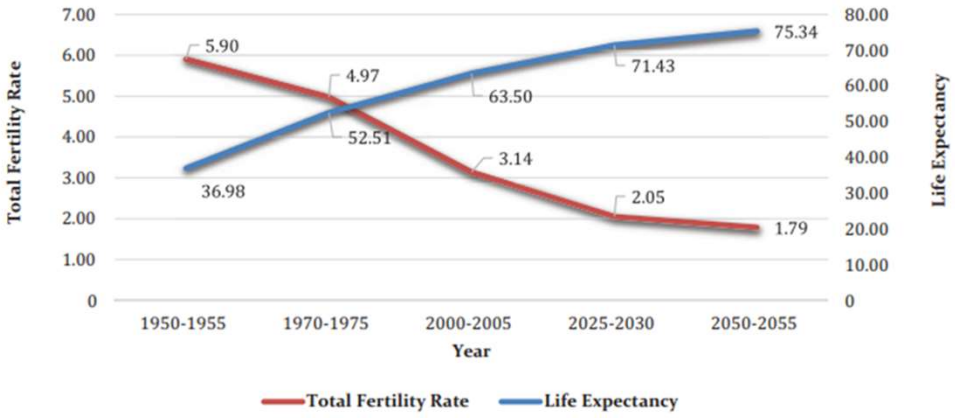


Source: United Nation (2019), World Population Prospects, The 2019 Revision, United Nations, New York

Trends in crude birth and death rate, India, 1950-2050

India's population distribution trends reveal a decline in the child population to 18.5% by 2050 from 37.5% in 1950. The working-age group (15-59 years) is expected to increase from 58.4% in 2000 to 62% by 2050. The median age will rise from 21.3 in 1950 to 38.1 in 2050, reflecting demographic transition.

DEMOGRAPHY OF AGEING IN INDIA



Source: United Nation (2019), World Population Prospects, The 2019 Revision, United Nations, New York

Life expectancy and Fertility rate, India, 1950-2050

India experiences unprecedented demographic shifts, with rising longevity and declining fertility creating a 'demographic dividend' but also increasing the elderly population, especially those aged 60 and above.

CHALLENGES
FACED BY THE ELDERLY IN INDIA

Healthcare: In India, inadequate infrastructure and expertise challenge elderly care. High healthcare costs, financial support gaps, and social isolation compound concerns, aggravated by the prevalence of chronic diseases among seniors.

Work Participation and Productivity: India's elderly workforce, influenced by education, socioeconomic status, gender, location, and health, often works informally, impacting health negatively.

Social and Economic Vulnerabilities: India's elderly, differing in education, income, gender, and residence, encounter disparities in healthcare, support, and finances, impacting well-being and work.

Mental Health: Common mental health challenges among India's elderly, including depression and anxiety, can detrimentally affect work participation and overall quality of life.

IMPACT
ON PRODUCTIVITY AND WORK

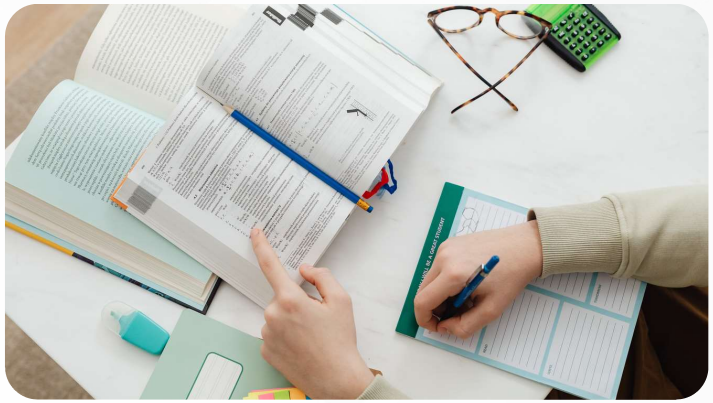
Health Status: In India, health impacts work in old age; chronic diseases reduce productivity. Healthy aging is crucial for elderly work participation.

Informal Sector Employment: Many elderly in India work informally, lacking social security and facing poor health outcomes, which can lower productivity and increase vulnerability.

Social Support and Living Arrangements: Elderly well-being in India hinges on living arrangements and support; dissatisfaction affects health, work, and productivity.

APPLICATION
OF THIS STUDY

Research findings on employment, productivity, and health among India's elderly have policy implications. Policymakers can use this knowledge for retirement age decisions, social security benefits, and healthcare policies, promoting well-being and economic productivity. Additionally, these insights contribute to the global understanding of healthy ageing and inform international policies for elderly individuals' better quality of life.



RESEARCH OBJECTIVES
ON PRODUCTIVITY AND WORK

- Understand work, productivity, and health in India's elderly.
- Investigate employment's impact on health for policy insights.
- Explore productivity's role in work and health connections.
- Identify determinants for better elderly health.
- Inform global policies for healthy aging through research.

PROBLEM STATEMENT

“The prospect of living a longer life appears to be heightened when individuals opt to delay their retirement.”

RELATED SURVEYS

Several studies conducted in India have explored the relationship between health issues, socioeconomic factors, and workforce participation among the elderly population. The field of Impact on Productivity and Well-being of Elderly Workers has few research papers that can provide valuable insights into this topic.

PROPOSED WORK

WORK PARTICIPATION TASK

Here we find the possible jobs a person can do on the basis of the skills a person possesses.

PRODUCTIVITY TASK

Helps find whether the person would be more productive compared to a young person or not on basis of the work efficiency.

MENTAL HEALTH TASK

Mental health prediction model for identification of groups under higher risk of suffering with mental illness.

WORK PARTICIPATION TASK

In the work participation task, the focus was on identifying suitable job opportunities based on an individual's skills. A comprehensive dataset of job titles and corresponding skills was obtained, allowing for the clustering of similar job titles. This clustering facilitated the suggestion of potential jobs for individuals based on their skill sets, aligning their capabilities with available employment opportunities.

DETAILED PROCESS

01 DATA FINDING

02 FEATURE SELECTION

03 DATA CLEANING

04 DATA IMPORTING

05 JOB SKILLS VECTORIZATION

06 JOB TITLE SYNTHESIS

07 VECTOR EXTRACTION AND STANDARDIZATION

08 DIMENSIONALITY REDUCTION

09 CLUSTER ANALYSIS WITH K-MEANS

10 VISUALIZATION

DETAILED PROCESS

01

DATA IMPORTATION

Acquired the dataset through meticulous retrieval procedures, ensuring data integrity and completeness for subsequent analysis

02

FEATURE SELECTION

Engaged in a thoughtful process of feature selection, considering domain expertise and project requirements to identify key variables crucial for achieving the project's objectives

03

DATA CLEANING

1Executed a thorough data cleaning process, addressing challenges such as redundant information, duplicate entries, and the presence of extraneous symbols. This phase focused on enhancing the dataset's quality and reliability.

04

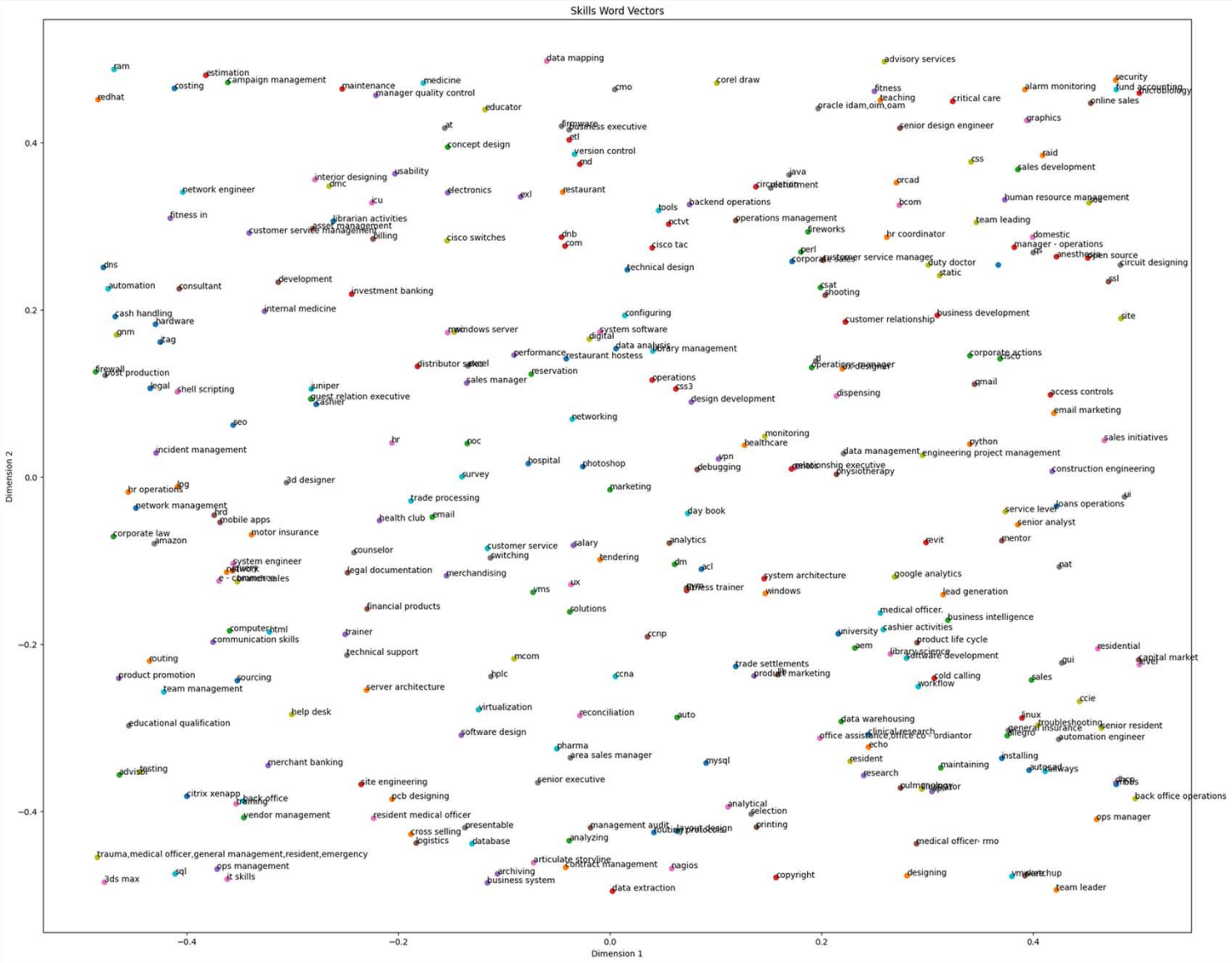
NUMPY ARRAY CREATION

Leveraged the power of numpy arrays to efficiently structure and manage the job titles and job skills data, laying a robust foundation for subsequent computations.

08

JOB SKILLS VECTORIZATION

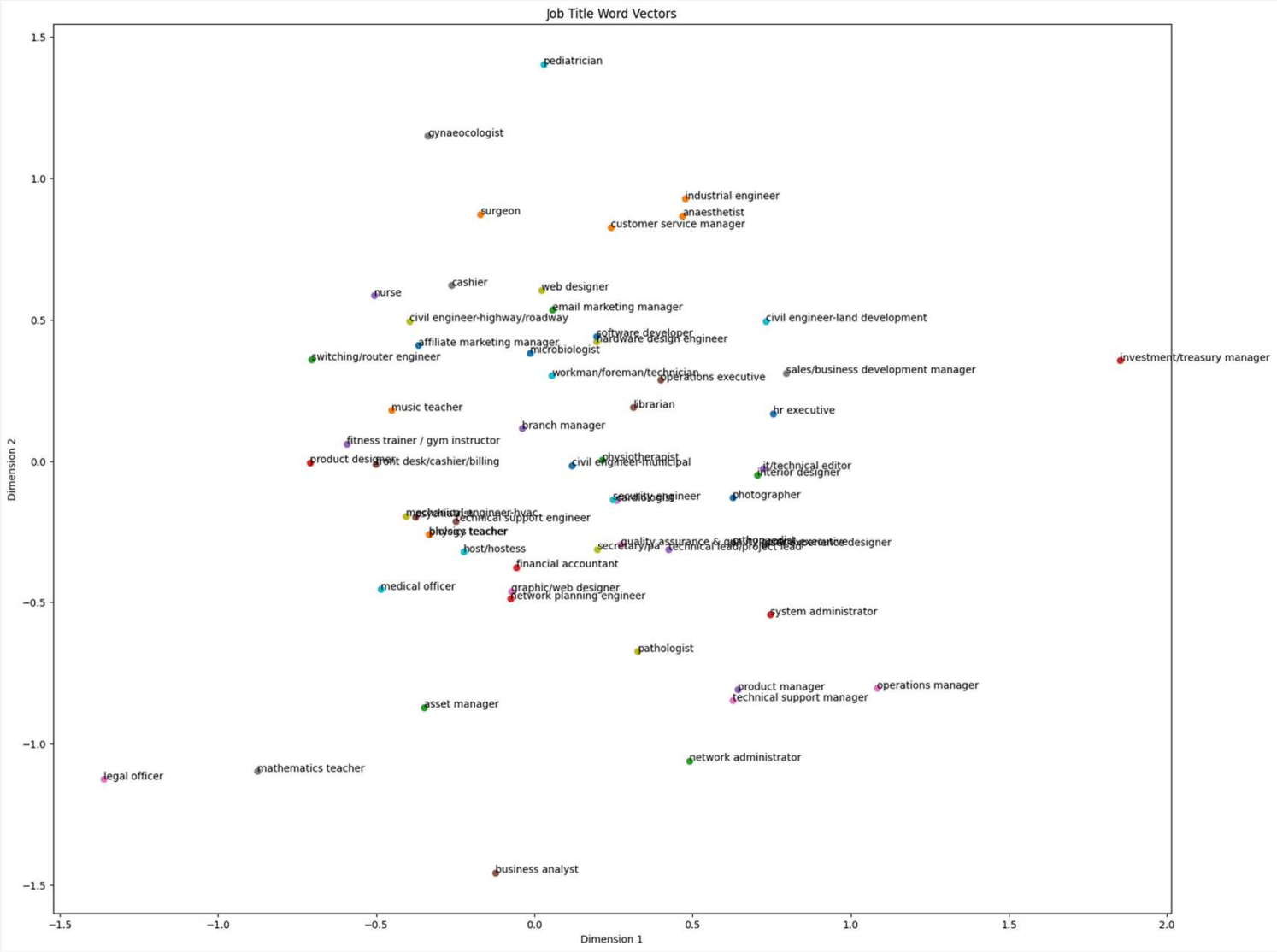
Applied advanced vectorization techniques, specifically Word2Vec, to the job skills data. Word2Vec is a sophisticated method that converts textual information, such as job skills, into numerical representations. Instead of treating words individually, Word2Vec considers the context and relationships between words.



09

JOB TITLE SYNTHESIS

Innovatively synthesized job titles by amalgamating related job skills. This step aimed at creating consolidated and distinct titles



10 VECTOR EXTRACTION AND STANDARDIZATION

Extracted vector representations corresponding to the synthesized job titles. These vectors served as essential numerical descriptors for each title, facilitating subsequent analyses. Implemented vector standardization techniques to ensure uniform scales across all job title vectors. This step mitigated potential biases that could arise from variations in vector magnitudes.

11 DIMENSIONALITY REDUCTION

Utilized t-Distributed Stochastic Neighbour Embedding (t-SNE) to reduce the dimensionality of job title vectors. This transformation from 128 to 2 dimensions optimized visualization, enhancing interpretability.

12

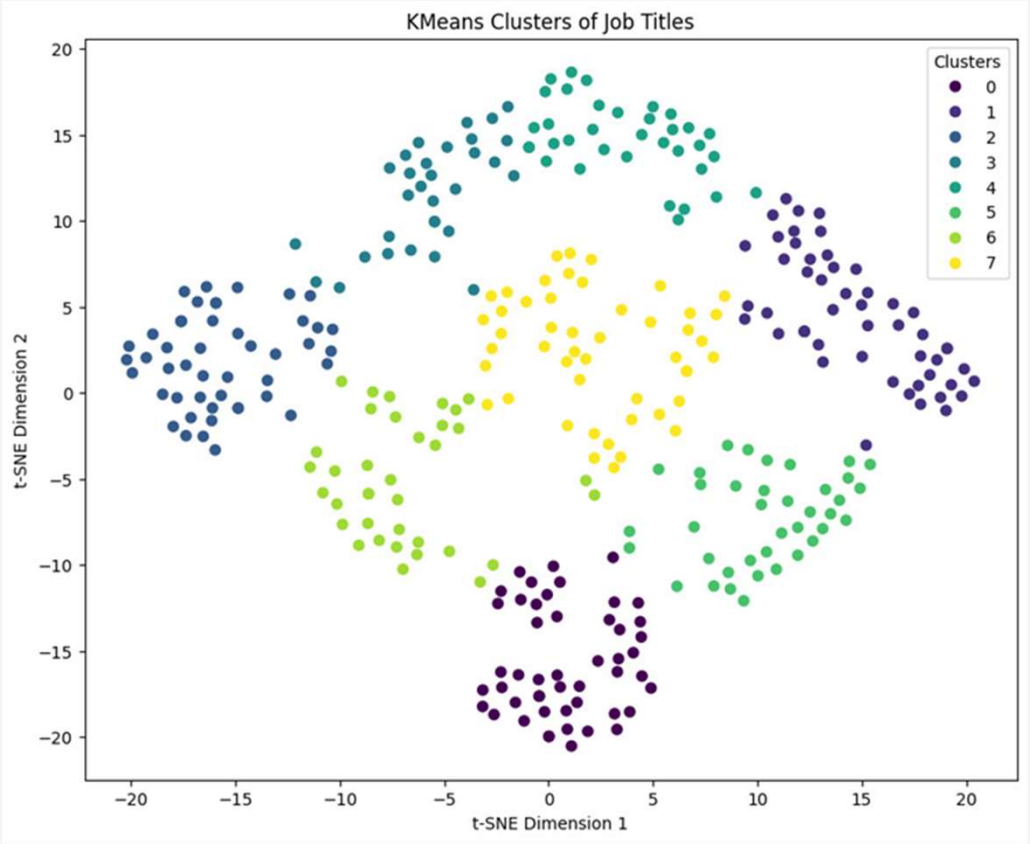
CLUSTER ANALYSIS WITH K-MEANS

K-Means Clustering is an unsupervised learning algorithm that is used to solve the clustering problems in machine learning or data science. In this topic, we will learn what is K-means clustering algorithm, how the algorithm works, along with the Python implementation of k-means clustering.

13

VISUALIZATION

Generated visually appealing representations of the clustered job title vectors. The visualizations provided an intuitive and insightful overview of the relationships and structures inherent in the data.



Representation of all job clusters

PRODUCTIVITY TASK

Job Recommendation Endpoint

- We have written "/recommend" api endpoint to handle job recommendation requests.
- It expects JSON data in the request body containing a "job" and "age".
- The endpoint calls the recommendedJob function with the provided job and age.
- The recommended jobs are then sent as the response.

Job Recommendation Logic

- The recommendedJob function is defined to provide job recommendations based on the current job and age.
- It uses the getRelatedJobs function to fetch jobs related to the current job.
- The related jobs are then sorted using the sortJobs function based on the provided age.
- The sorted jobs are logged to the console for debugging purposes.
- The function returns the sorted jobs.

Sort and Related Jobs Functions

- The code imports the sortJobs function from a "./helpers/sort.js" file.
- It also imports the getRelatedJobs function from a "./data/relatedJobs.js" file.
- These functions are crucial for sorting jobs and obtaining related jobs, respectively.

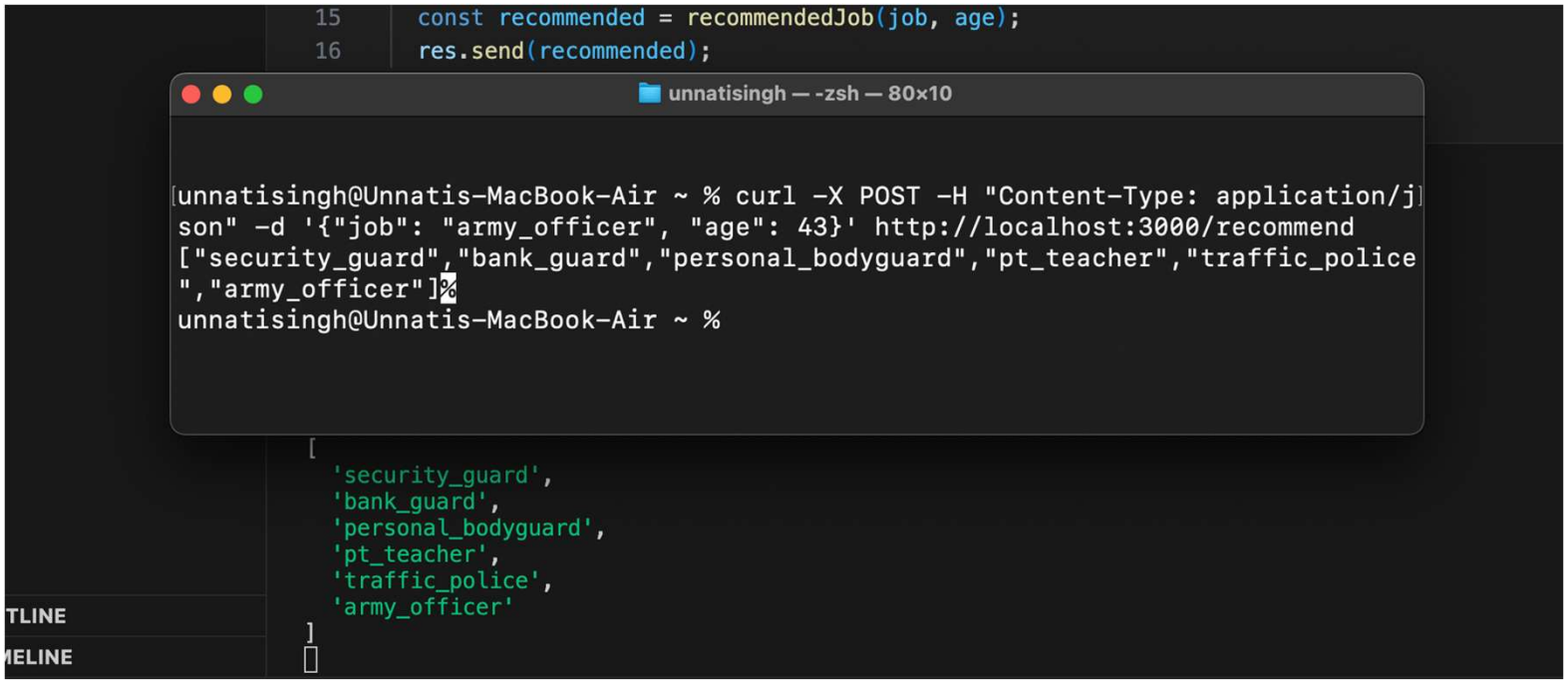
Server Start and Port Configuration

- The server listens on a specified port (or defaulting to 3000) using app.listen.
- A console log statement indicates when the server has started and on which port.

Middleware Usage for JSON Parsing

- The express.json() middleware is used to parse incoming JSON data from requests.
  - This is crucial for extracting job and age data from the POST request body.

Code snippet output



Project Functionalities Documentation

JavaScript Implementation for API and On-the-Fly Calculations

Utilized JavaScript to implement the API layer, facilitating seamless communication between the front-end and back-end components. Additionally, incorporated on-the-fly calculations to dynamically process and update data in real-time, enhancing the responsiveness of the application.

C++ for Data Transformation and Precalculations

Employed C++ for handling data transformation tasks and precalculations. This allowed for efficient processing of large datasets and the execution of complex algorithms, optimizing performance in scenarios requiring heavy computational tasks.

Ranking Clustering Algorithm Output by Productivity

Designed and implemented a clustering algorithm to organize data. The output of the algorithm was ranked based on productivity, providing insights into the effectiveness of the clustering process in categorizing data according to specified criteria.

Relative Increase in Appraisal as a Productivity Measure

Utilized the relative increase in appraisal as a key productivity measure. This metric served as an indicator of performance improvement, allowing for a quantitative assessment of the impact of various factors on job productivity within the clustering model.

Dynamically Calculated Job Suitability Based on Age

Implemented dynamic calculations to assess the suitability of a job for an individual based on their age. This feature provided personalized recommendations by considering age as a determining factor in job compatibility within the model.

Relative Productivity =

$$\frac{\text{Avg Appraisal After That Age} - \text{Avg Appraisal Before That Age}}{\text{Avg Appraisal Before That Age}}$$

User Interface for Model Interaction

Developed a user-friendly interface to facilitate user interaction with the model. The interface allowed users to input parameters, visualize clustering results, and obtain personalized recommendations based on the model's calculations.

Quantization of Generative AI Model (4-bit Quantization)

Quantized a generative AI model to operate on personal laptops efficiently. The model was adapted using 4-bit quantization, resulting in a reduction in accuracy. However, this trade-off made development more accessible and cost-effective, enabling deployment on resourceconstrained devices

MENTAL HEALTH TASK

OVERVIEW

- the Mental Health Prediction Model was designed to address the critical need for early identification of individuals or groups susceptible to mental health challenges, with a focus on ethical considerations and future implications for public health initiatives.
- This initiative holds significance in the broader context of mental health awareness and proactive healthcare, contributing to the overall well-being of individuals and communities.

DATASET

whole study was done using data from Open Sourcing Mental Health (OSMI) available download from Kaggle.

The study focused on the Mental Health Survey 2014, which garnered responses from over 1200 participants

WORKFLOW

01 DATA IMPORT

02 EDA

03 LOGISTIC REGRESSION

04 DECISION TREE MODEL

05 HYPER PARAMETER TUNING

06 COMPARISON OF MODELS

07 CONCLUSION

DATA IMPORT

LIBRARIES USED

Pandas and NumPy:

Purpose: Data manipulation and analysis.

Matplotlib and Seaborn:

- Purpose: Data visualization.

Scikit-Learn:

- Purpose: Machine learning tools and algorithms.

StatsModels:

- Purpose: Statistical models and tests.

DATA CLEANING

Checked for missing values

Uniformly renamed columns for clarity and consistency

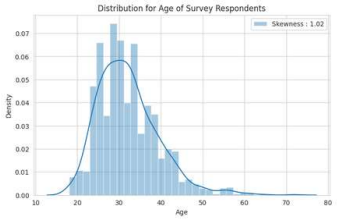
Replaced invalid age entries with the median age

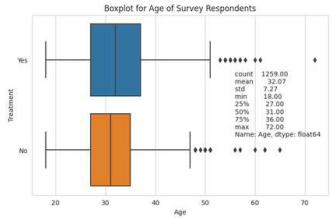
Consolidated gender categories into 'Male', 'Female', and 'Queer'

Encoded binary categorical variables into numeric format

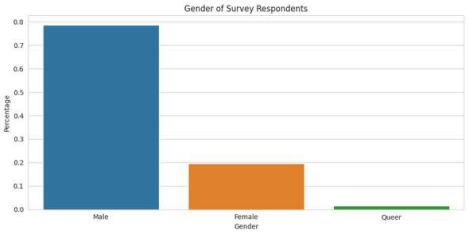
Transformed categorical variables into dummy variables for logistic regression

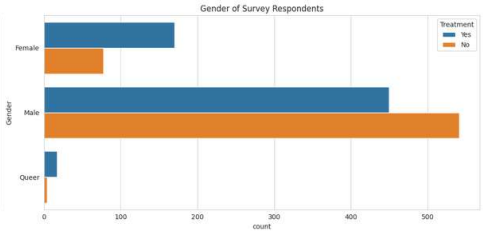
KEY INSIGHTS FROM EDA & VISUALIZATION



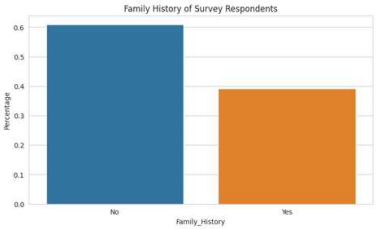


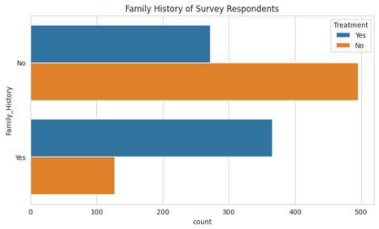
01 AGE OF THE RESPONDENTS OF SURVEY



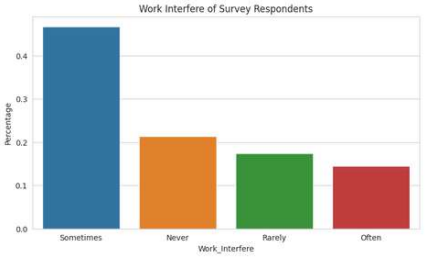


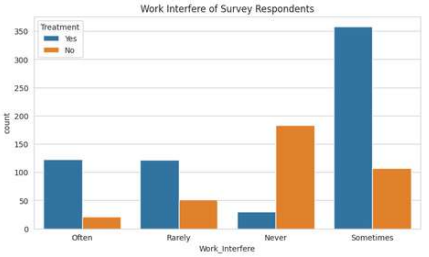
02 GENDER INFORMATION OF THE RESPONDENTS OF SURVEY





03 FAMILY HISTORY DATA ABOUT MENTAL ILLNESS OF RESPONDENTS





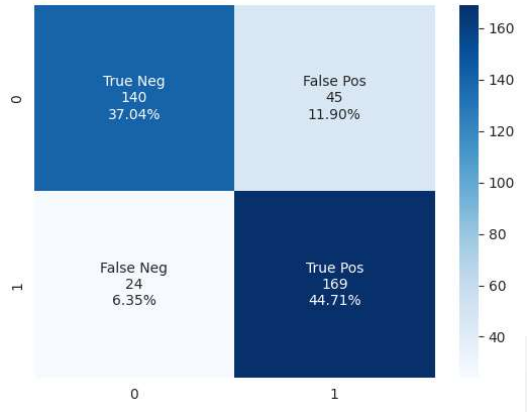
04 OPINION ABOUT THE INTERFERENCE OF MENTAL HEALTH IN THEIR WORK

LOGISTIC REGRESSION

applied logistic regression model using the Logit class from StatsModels.

The logistic regression model aims to model the log-odds of the binary outcome (Treatment) as a linear combination of the predictor variables.

TESTING PERFORMANCE OF OUR MODEL



confusion matrix of model using test set of our data

RESULT:-

Test performance:

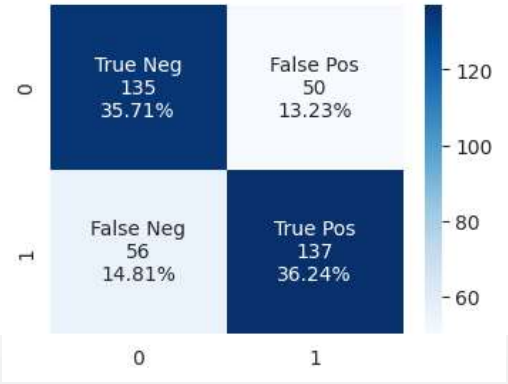
	Accuracy	Recall	Precision	F1
0	0.81746	0.875648	0.78972	0.830467

DECISION TREE MODEL

Created a Decision Tree classifier using scikit-learn's DecisionTreeClassifier

A Decision Tree model is a predictive algorithm that recursively splits data into subsets based on the most significant attribute, creating a tree-like structure used for classification or regression tasks.

TESTING PERFORMANCE OF OUR MODEL



confusion matrix of model using test set of our data

RESULT:-

```
Training performance:
    Accuracy  Recall  Precision   F1
0        1.0     1.0        1.0  1.0
Testing performance:
    Accuracy    Recall  Precision        F1
0  0.719577  0.709845    0.73262  0.721053
```

HYPER PARAMETER TUNING

Hyperparameter tuning is the optimization of settings (hyperparameters) for a machine learning model to enhance its performance on a given task, often achieved through systematic search methods.

TUNING OF LOGISTIC REGRESSION

The training and test performances are evaluated at different thresholds using the model_performance_classification function.
The balanced threshold is found by analyzing precision-recall curves.
The model performance is evaluated again on the test set using the tuned threshold.

TUNING OF DECISION TREE

The model performance is evaluated on both the training and test sets using the model_performance_classification function.
Feature importances are printed and visualized.
A Decision Tree with reduced depth (max_depth=4) is created and evaluated.

COMPARISON OF MODELS

Testing performance comparison:

	Logistic Regression	Logistic Regression Tuned	Decision Tree	Decision Tree Tuned
Accuracy	0.817460	0.825397	0.719577	0.730423
Recall	0.875648	0.943005	0.709845	0.792746
Precision	0.789720	0.767932	0.732620	0.780612
F1	0.830467	0.846512	0.721053	0.786632

The logistic regression tuned model is most ideal: Has the highest accuracy, recall, and F1 among the four models generated.

CONCLUSION

- The logistic regression and decision tree models were explored, and some manual tuning was performed to enhance their performance.
- These models are valuable for different reasons – logistic regression for its simplicity and interpretability, and decision tree for its ability to capture non-linear relationships in the data.
- The choice between these models may depend on factors such as the nature of the data and the importance of interpretability.

CONCLUSION AND FUTURE WORK

1. Occupational Engagement and Productivity:
   - Correlation between work engagement and improved mental and physical health.

2. Policy Implications for Healthy Aging:
   - Advocacy for policy reforms to enhance elderly individuals' well-being.

3. Focus on Employment and Productivity:
   - Prioritizing strategies to boost seniors' employment engagement and productivity.

4. Government Social Assistance and Healthcare Services:
   - Ensuring robust social aid and healthcare provisions for non-working seniors.

5. Future Research:
   - Investigating impact of specific labor types on cognitive and physical health.

6. Continued Research for Policy Informatics:
   - Ongoing studies to guide policies enhancing India's elderly population's welfare

CONCLUSION AND FUTURE WORK

- Longitudinal Aging Study in India (LASI) Findings:

- Altered social interactions induce stress, leading to cognitive decline [2].
- Health is the main determinant for working in old age [4].

- NSSO Survey Insights on Chronic Diseases:

- Prevalence of self-reported chronic disease: 21 per 100 elderly [5].
- Hypertension and diabetes are common, impairing work capacity [5].

- Factors Influencing Frailty in Elderly Population:

- Rural Bengaluru study: frailty linked to age, gender, education, occupation, and chronic diseases [20].
- Rural Thanjavur study: 30.65% prevalence of physical frailty; factors include age, gender, education, and chronic diseases [3].
- Central Rajasthan study: frailty associated with age, sex, education, occupation, and chronic diseases [11].

- Socioeconomic Factors and Workforce Participation:

- BKPAI survey: Socioeconomic status, social capital, and functional independence affect well-being [5].
- LASI wave analysis: Health, especially in rural areas, predicts labor force participation [18].
- Urban susceptibility to chronic ailments higher than in rural areas [3].

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THANK YOU ☺