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Content

1 Personnel Planning

1.1 Estimate the future number of nurses for FAU Clinic

The FAU Clinic's initiative to ascertain the necessary nursing staff for their upcoming emergency department can be efficiently accomplished through strategic workforce planning. The methodical execution of this plan, incorporating key theoretical models such as the Human Resources (HR) Staffing Model, will provide a reliable projection. The subsequent operationalization of these models can be managed through digital tools and data analytics, streamlining the process. The initial groundwork for this undertaking can be established by applying the HR Staffing Model. This model assists in projecting future employment needs by determining the Gross Employment Requirement (GER), which itself is a summation of the Net Employment Requirement (NER) and the Reserve Employment Requirement (RER). The GER calculation will need to take into account the current nurse count, predicted future hires (EH), and anticipated departures (EA). This allows for the calculation of the projected nursing workforce and the necessary new hires. Beyond numerical projections, the alignment of the workforce with the clinic's strategic goals is a crucial aspect of workforce planning.

This strategic alignment can be guided by a seven-step workforce planning model:

1) Define the organization's strategic direction.

2) Survey the internal and external environments.

3) Develop a model of the current workforce.

4) Forecast future workforce needs and project future workforce availability.

5) Identify gaps and design strategies to bridge these gaps.

6) Assess the effectiveness of these strategies and modify them as required.

These theoretical models can be operationalized through the application of data analytics and HR technology. For instance, a Workforce Planning Platform can help create tangible scenarios to address future hurdles, streamline recruitment processes, optimize related expenses, and thus enhance hiring quality. It can also help identify key skills and competencies crucial in a healthcare setting.

A multitude of variables should be considered when estimating the exact number of nurses required in the emergency department. These include patient-to-staff ratios, shift timings, the day and month, vacation schedules, and the overall availability of nurses. It's also critical to consider the qualitative, quantitative, and spatial elements of staffing. The answers to questions

such as 'How many nurses?', 'When and where are the nurses required?' and 'What skills are required?' will ensure that the appropriate number of nurses, with the correct skills, are available at the right place and time. By integrating HR staffing models, workforce planning processes, and data-driven decision-making, the FAU Clinic can accurately estimate the number of nurses needed in their new emergency department. This comprehensive approach will not only align with their strategic goals but also help achieve the clinic's mission, objectives, and goals.

1.2   The market for future nurses

The FAU Clinic's recruitment strategy for nurses should ideally be based on an in-depth understanding of the current labor market, skill requirements, and the competitive landscape. Considering the ongoing shortage of nurses and the rising demand for health services, active recruiting is likely to be more effective in this scenario. This approach involves proactively searching for potential candidates and directly engaging them, which can be significantly more effective in a competitive market or when there is a scarcity of talent.

Here are some strategic recommendations:

1. Leverage professional social networks: Platforms like LinkedIn are invaluable resources for active recruitment. The FAU Clinic can reach out to potential candidates directly through these platforms, engaging them with information about the Clinic's values, work environment, and opportunities for professional growth. Additionally, the Clinic could also take advantage of LinkedIn's job posting and sponsored content features to increase visibility among potential candidates.

2. Participate in job fairs and nursing conferences: Job fairs and nursing conferences are great opportunities for the FAU Clinic to connect with potential candidates. Through these events, the Clinic can directly interact with a large number of potential candidates, provide information about the Clinic, and initiate the recruitment process for interested individuals.

3. Collaborate with nursing schools and universities: Forming partnerships with nursing schools and universities can provide a steady stream of potential recruits. The Clinic could offer internships, job-shadowing opportunities, and even scholarships to encourage students to consider working at the Clinic after graduation.

4. Employee referral program: Current employees can be an excellent source of potential candidates. The FAU Clinic could incentivize its employees to refer qualified individuals from their personal and professional networks.

5. Online job boards and websites: Posting vacancies on popular job websites like Indeed or Monster can significantly increase the visibility of the Clinic's nursing positions.

6. Involvement in community events: This is a more indirect form of active recruitment. By being visibly involved in community events, the FAU Clinic can improve its reputation and visibility, making it a more attractive employer.

In conclusion, the FAU Clinic should invest in active recruitment strategies to effectively hire nurses in the current labor market scenario. By leveraging various channels and approaches, the Clinic can improve its reach, engage potential candidates more effectively, and enhance its overall recruitment process.

1.3   The nurses needed per shift

To assess the reliability of these results, we need to consider factors such as

Data Quality and Validity:

The reliability of the results heavily depends on the quality and validity of the input data. If the data is accurate then the results are accurate

Approach and Conducted Steps:

The approach taken in this analysis involved formulating the nurse staffing problem as a linear programming optimization model. The steps conducted in the approach are as follows:

Data Preprocessing: The raw data from the CSV file was loaded and processed. The 8-hour shifts and the average number of patients per hour were transformed into a suitable format for the optimization model. The missing values were filled with zeros, and the 'X' values were converted to 1, representing the presence of patients needing assistance.

Model Formulation: The optimization model was formulated to minimize the total cost (wages) for nurses while ensuring that the service level requirement is met for each time window. Decision variables were introduced to represent the number of nurses for each shift.

Objective Function and Constraints: The objective function aimed to minimize the total cost of nurses' wages, and constraints were set to ensure that the number of nurses attending patients satisfies the service level requirements for each time window.

Solving the Model: The PuLP library was used to solve the linear programming problem and obtain the optimal number of nurses required for each shift.

Findings and Implications:

Based on the results obtained from the optimization model, the required number of nurses for each 8-hour shift in the new emergency room at the FAU Clinic is as follows:

- Shift 0 (06:00 – 07:00): 14 nurses

- Shift 1 (12:00 – 13:00): 10 nurses

- Shift 2 (Other Night Shift): 13 nurses

The implications of these findings for the FAU Clinic are significant:

Resource Allocation: The optimized nurse staffing numbers provide guidance to the management for allocating nursing staff efficiently across shifts. Adequate staffing during peak hours can ensure prompt patient care and optimize resource utilization.

Cost Management: By minimizing the total cost (wages) while maintaining the desired service level, the clinic can manage its staffing expenses effectively. This cost optimization can have positive financial implications for the clinic.

Patient Care: Ensuring that the required number of nurses is available during busy hours can enhance the quality of patient care and reduce wait times for patients needing assistance. This can lead to higher patient satisfaction and improved health outcomes.

Scalability and Flexibility: The optimization model provides a scalable solution that can be adapted to handle changes in patient demand and operational requirements. The management can use the model to adjust nurse staffing levels based on fluctuating patient volumes.

Continuous Improvement: The model can serve as a valuable tool for continuous improvement in nurse staffing decisions. By updating the input data and conducting regular sensitivity analysis, the FAU Clinic can continuously optimize its nurse staffing strategy.

However, to enhance the reliability of the results, the management should consider the factors, such as validating the model against historical data, evaluating the model assumptions, and

performing sensitivity analysis. Involving domain experts and clinical staff in the decision-making process can also add confidence to the results.

In conclusion, the optimization model offers valuable insights into nurse staffing requirements for the FAU Clinic's new emergency room. The management can utilize these results to make informed decisions, improve patient care, and achieve cost-effective nurse staffing while considering the reliability and validity of the input data and model assumptions.

```
Problem MODEL has 24 rows, 3 columns and 24 elements
Coin0008I MODEL read with 0 errors
Option for timeMode changed from cpu to elapsed
Continuous objective value is 1126.75 - 0.00 seconds
Cgl0004I processed model has 0 rows, 0 columns (0 integer (0 of which binary)) and 0 elements
Cbc3007W No integer variables - nothing to do
Cuts at root node changed objective from 1166 to -1.79769e+308
Probing was tried 0 times and created 0 cuts of which 0 were active after adding rounds of cuts (0.000 seconds)
Gomory was tried 0 times and created 0 cuts of which 0 were active after adding rounds of cuts (0.000 seconds)
Knapsack was tried 0 times and created 0 cuts of which 0 were active after adding rounds of cuts (0.000 seconds)
Clique was tried 0 times and created 0 cuts of which 0 were active after adding rounds of cuts (0.000 seconds)
MixedIntegerRounding2 was tried 0 times and created 0 cuts of which 0 were active after adding rounds of cuts (0.000 seconds)
FlowCover was tried 0 times and created 0 cuts of which 0 were active after adding rounds of cuts (0.000 seconds)
TwoMirCuts was tried 0 times and created 0 cuts of which 0 were active after adding rounds of cuts (0.000 seconds)
...

The number of nurses needed for shift 0 is 14 nurses
The number of nurses needed for shift 1 is 10 nurses
The number of nurses needed for shift 2 is 13 nurses
```

2 Sourcing and Acquisition

2.1 How to Make the Right Hiring Decision

Recruitment is a vital process for any organization, including the FAU Clinic, particularly when they're on the verge of setting up a new department that requires critical care nurses. This process holds paramount importance because it enables the organization to acquire the necessary talent with the appropriate skills, knowledge, and experience to ensure successful operations.

In terms of importance, the recruitment process is the first step towards building a competent workforce. It allows the FAU Clinic to identify, attract, and shortlist potential candidates who can contribute to the organization's goals and objectives. A well-structured recruitment process ensures that only the most qualified candidates are selected, thereby enhancing the quality of the workforce and boosting the organization's performance.

The recruitment process typically starts with the establishment of a positive employer brand through HR marketing. A strong employer brand projects the FAU Clinic as an attractive place to work, making it more appealing to the potential candidates. HR marketing department's role here is critical as it helps to position the organization as an employer of choice, highlighting its work culture, employee benefits, growth opportunities, and more. This strategy not only helps to attract a larger pool of candidates but also aids in retaining the existing employees.

Next, the FAU Clinic should focus on analyzing and determining the specific skills required for the critical care nurse positions. The skill requirements would ideally be based on the nature of the new department and the responsibilities that the new hires would need to undertake. Identifying the right skills and competencies is essential to ensure a good Person-Job-Fit, a concept that emphasizes the alignment between a candidate's abilities and job requirements.

Once the applications start coming in, the focus shifts to selection, which is the process of shortlisting the most suitable candidates based on their skills, experience, and other relevant factors. The personnel selection is aimed at identifying the candidates with the highest fit with

the job and the organization, considering factors such as Person-Organization-Fit, Person-Group-Fit, and Person-Supervisor-Fit. A comprehensive and fair selection process helps to avoid biases and ensures diversity, which is particularly important in a sensitive setting like a clinic.

The HR department must then assess the cost-benefit ratios of the recruitment activities to improve the efficiency of the process continuously. After the successful candidates are hired, onboarding and integration become crucial to help the new hires adjust to the work environment and perform at their best. In conclusion, the recruitment process, facilitated by HR marketing, plays a vital role in bringing in the right talent for FAU Clinic's new emergency department. Ensuring an efficient and fair recruitment and selection process will help the clinic achieve its objectives and deliver superior patient care services. It will also contribute to a diverse and inclusive work environment, ultimately leading to a higher level of job satisfaction among the employees. 2 a

2.2   Automation of personnel recruitment

FAU Clinic is motivated to automate their personnel recruitment process for a variety of reasons. A primary motivation would be to enhance efficiency. The healthcare industry is a fast-paced environment that often requires quick and effective decision-making. Automated recruitment could streamline the hiring process, significantly reducing time spent on sorting through applications and identifying suitable candidates. Moreover, automation could help in precisely defining the skillsets required for specific roles, thus ensuring a good fit between job roles and new hires.

Another key motivation could be cost-effectiveness. Automation could reduce the human resources required for recruitment and thus potentially lower the recruitment costs. Furthermore, it could also minimize errors associated with manual recruitment processes, leading to better hiring decisions that reduce turnover and associated costs.

One strategy FAU Clinic could employ is to use data-driven personnel marketing. By implementing job recommender systems, the clinic could match jobs to candidates' profiles more effectively and precisely. These systems use data mining and machine learning algorithms to identify the best-fit candidates for each job based on a wide range of criteria, including

qualifications, experience, skills, and career aspirations.

However, automating decision-making using data-driven approaches is not without challenges. There could be a risk of inherent bias in the data used to train the machine learning models, potentially leading to discrimination against certain groups. In a healthcare environment, this could translate to missed opportunities to hire diverse staff, which in turn could impact patient care.

Additionally, data-driven approaches may not accurately assess some intangible aspects such as interpersonal skills and cultural fit within the organization. These aspects are crucial in a healthcare setting, where teamwork and patient interaction play a pivotal role.

FAU Clinic can address these drawbacks by ensuring a balanced and ethical use of data-driven approaches. Regular audits of the algorithms can help identify and mitigate any bias, thus promoting fair and equitable hiring practices.

Moreover, the clinic should incorporate human judgment into the recruitment process to complement automated decision-making. For instance, personal interviews conducted by experienced recruiters can assess a candidate's cultural fit and interpersonal skills more effectively.

Also, the clinic should maintain transparency with candidates about the use of data-driven recruitment, which helps build trust and ensure ethical standards are met.

In sum, while automating the recruitment process can offer numerous benefits, it's essential that FAU Clinic approaches this with careful consideration of potential challenges and a commitment to maintaining a balanced, transparent, and fair recruitment process.

2.3 Data driven recruitment

Finding Relevant Rules:

The code follows several steps to find relevant association rules related to applicants who were hired as critical care nursing. Here are the steps:

Data Preprocessing: The original dataset is loaded from the CSV file, and unnecessary columns like 'gender', 'location', 'hired', 'family_nurse', 'occupational_health_nursing', and 'gerontological_nursing' are dropped. The 'experience' column is then binned into categories (0-5, 5-10, 10-15, 15+) to make it suitable for the analysis.

One-Hot Encoding: The dataframe is one-hot encoded to convert categorical variables like 'experience', 'education', and 'field' into binary columns.

Apriori Algorithm: The Apriori algorithm is applied to find frequent itemsets with a minimum support of 0.02. This step helps identify combinations of skills that are frequently associated with critical care nursing applicants.

Association Rules: Association rules are generated from the frequent itemsets using the confidence metric with a minimum threshold of 0.25. These rules represent the likelihood of specific skills being associated with critical care nursing positions.

Filtering Rules: The rules are filtered to include only those where the consequent is 'critical_care_nursing', ensuring that we focus on rules specifically relevant to the target position.

Sorting Rules: The rules are then sorted in descending order based on the lift metric to identify the most meaningful associations with critical care nursing.

Relevant Skills for Critical Care Nursing Applicants:

From the output, the top rules indicate the relevant skills that are associated with applicants hired as critical care nursing:

• Rule 1: (professional, patience, empathy) -> (critical_care_nursing)

• Rule 2: (confidence, patience, empathy) -> (critical_care_nursing)

• Rule 3: (education_master, empathy, patience) -> (critical_care_nursing)

The top rules suggest that applicants with skills such as 'professional', 'confidence', 'patience', and 'empathy' are more likely to be hired for critical care nursing positions. Additionally, having a 'master' level of education also increases the likelihood of being selected for this role.

Support, Confidence, and Lift:

In the first rule (professional, patience, empathy) -> (critical_care_nursing):

Support: The support value represents the proportion of transactions (in this case, applicant profiles) that contain both 'professional', 'patience', 'empathy', and 'critical_care_nursing' skills.

A high support indicates that this combination of skills is relatively common among all applicants.

Confidence: Confidence represents the conditional probability of the consequent (critical_care_nursing) given the antecedent (professional, patience, empathy). In this case, a confidence of 0.58 means that 58% of applicants with 'professional', 'patience', and 'empathy' skills were hired as critical care nursing.

Lift: Lift is the ratio of the observed confidence to the expected confidence if the antecedent and consequent were independent. It helps determine how much more likely the consequent is given the antecedent than if they were independent. A lift value greater than 1 indicates a positive association between the antecedent and consequent. In this case, the lift of 5.967 suggests that applicants with 'professional', 'patience', and 'empathy' skills are about 5.97 times more likely to be hired as critical care nursing compared to the baseline probability.

Issue with Applicants Hired for Critical Care Nursing:

Based on the analysis, there is no issue with applicants being hired for critical care nursing positions. The association rules provide valuable insights into the relevant skills and characteristics that successful applicants possess. The rules highlight the important skills that are positively associated with being hired in the critical care nursing role, such as 'professionalism', 'patience', 'empathy', and higher education levels.

Error Type and Mitigation:

There is no evident issue or error with the hiring process as indicated by the analysis. However, one potential concern is the reliance solely on association rules to make hiring decisions. While the rules provide valuable insights, they do not consider other essential factors such as experience level, qualifications, and individual interview performance.

To mitigate any potential issues with the hiring process, the FAU Clinic should adopt a comprehensive approach that includes the following:

Holistic Evaluation: Consider a holistic evaluation of applicants that takes into account various factors like experience, qualifications, certifications, and skills. Association rules should be used as a supplementary tool rather than the sole determinant of hiring decisions.

Expert Involvement: Involve domain experts, such as critical care nursing managers and experienced nurses, in the hiring process. Their expertise can add valuable insights and ensure that the right candidates are selected for critical care nursing positions.

Interview Assessment: Conduct in-depth interviews to assess applicants' communication skills, problem-solving abilities, and cultural fit within the organization.

In conclusion, the analysis using association rules has shed light on the relevant skills for applicants hired as critical care nursing. However, it is crucial for the FAU Clinic to adopt a comprehensive and well-rounded hiring process that considers various factors and involves domain experts to ensure successful hiring decisions. A careful and balanced approach will lead to the selection of qualified and capable individuals who can contribute significantly to the critical care nursing team.

```
                                              antecedents  \
      980                    (professional, patience, empathy)
      921                      (confidence, patience, empathy)
     1032              (education_master, empathy, patience)
      310                              (professional, empathy)
     1684  (field_family nurse practitioner, confidence, ...
      292                                (confidence, empathy)
     1021              (experience_5-10, patience, empathy)
      953   (field_family nurse practitioner, confidence, ...
      387                          (education_master, empathy)
     1043              (patience, empathy, education_other)


                 consequents  antecedent support  consequent support  \
      980   (critical_care_nursing)            0.057333            0.097333
      921   (critical_care_nursing)            0.062000            0.097333
     1032   (critical_care_nursing)            0.087333            0.097333
      310   (critical_care_nursing)            0.079333            0.097333
     1684   (critical_care_nursing)            0.053333            0.097333
      292   (critical_care_nursing)            0.080667            0.097333
     1021   (critical_care_nursing)            0.107333            0.097333
      953   (critical_care_nursing)            0.068000            0.097333
      387   (critical_care_nursing)            0.129333            0.097333
     1043   (critical_care_nursing)            0.067333            0.097333


           support  confidence      lift  leverage  conviction  zhangs_metric
     ...
     1021  0.036000    0.335404  3.445929  0.025553    1.358218       0.795148
      953  0.022667    0.333333  3.424658  0.016048    1.354000       0.759657
      387  0.041333    0.319588  3.283435  0.028745    1.326646       0.798745
     1043  0.021333    0.316832  3.255120  0.014780    1.321295       0.742807
```

3   Onboarding and Performance

3.1   A new hire

The onboarding process is a crucial step in integrating new employees, especially in critical roles like emergency department nurses. FAU Clinic acknowledges the significance of a well-structured onboarding process, as it directly affects the nurse's productivity, job satisfaction, and long-term commitment to the organization. Moreover, a thorough onboarding process is vital in ensuring efficiency and fostering a sense of belonging within the team, which ultimately impacts patient outcomes.

To begin the onboarding process effectively, FAU Clinic should introduce the new nurse to the organization's mission, vision, and values. By aligning the nurse's personal values with the clinic's foundational principles, a shared vision is created. This alignment facilitates the socialization process, which is essential for achieving a harmonious fit between the individual and the organization.

Implementing structured socialization tactics, as suggested by Van Maanen and Schein, would be beneficial. A formal approach can acquaint the nurse with the emergency department's policies, procedures, and standard practices. Subsequently, a sequential approach should outline the order of learning programs and activities, providing a clear roadmap to integration into the team.

To instill confidence and reduce uncertainty, FAU Clinic should establish a fixed timeline for the onboarding process. Additionally, assigning an experienced peer or mentor through a serial approach will offer invaluable guidance, support, and feedback, thereby accelerating the nurse's adjustment process.

An investiture approach, where the new nurse receives positive feedback from experienced peers, will reinforce self-efficacy and role clarity, both crucial for successful adjustment and productivity. Encouraging newcomer information seeking will further enhance the onboarding process, empowering the nurse to seek information and address any knowledge gaps.

To enhance the onboarding experience, FAU Clinic could consider implementing a content-based recommender system. This system would create a user profile for the new nurse and suggest connections with existing employees who share similar interests or backgrounds. This will foster the formation of social relationships critical for the nurse's integration, sense of belonging, and overall job satisfaction.

Maintaining a supportive, open, and welcoming organizational climate, with visible management support for the new nurse, is equally vital. Providing regular training and opportunities for skill enhancement, as well as encouraging autonomy in their role, will contribute to the nurse's professional development.

Keeping communication lines open and promoting feedback and dialogue will foster a positive work environment. Over time, these onboarding strategies will lead to increased organizational commitment, greater job satisfaction, and improved job performance for the new nurse. More importantly, a successful onboarding process will nurture the nurse's sense of professional identity, personal well-being, and their ability to provide high-quality care to patients at FAU Clinic.

3.2 Recommender System

The recommender system uses the TfidfVectorizer from scikit-learn to transform the text data into numerical representations and then calculates the cosine similarity between employees based on their profiles. The top five existing employees with the highest similarity scores to the new employee (with ID 'emp_033') are recommended as potential connections for social onboarding.

Step-by-Step Explanation:

• Data Preprocessing:

◦ The necessary libraries, pandas, and numpy are imported.

◦ The dataset is read using pandas, and the 'teams', 'hobbies', and 'sports' columns are extracted.

• Text Data Processing:

◦ A function called 'create_soup' is defined, which concatenates the text data from 'teams', 'hobbies', and 'sports' columns to create a combined string for each employee. This combined string is referred to as 'soup'.

◦ The 'soup' is created for each employee using the 'apply' function.

• TF-IDF Vectorization:

◦ The TfidfVectorizer from scikit-learn is used to convert the text data (soup) into numerical representations.

◦ The 'stop_words' parameter is set to 'english' to remove common English words that do not contribute much to the similarity calculation.

◦ The tfidf_matrix is created, representing the TF-IDF scores for each word in the soup across all employees.

• Cosine Similarity Calculation:

◦ The cosine similarity is calculated between employees based on the tfidf_matrix. Cosine similarity measures the cosine of the angle between two vectors and provides a similarity score between 0 and 1, where 1 indicates identical profiles.

• Recommendation Function:

◦ The function 'get_recommendations' takes an employee ID as input and returns the top five most similar employees based on cosine similarity scores.

◦ The function first finds the index of the employee with the specified ID in the dataset.

◦ It then fetches the cosine similarity scores for that employee with all other employees.

◦ The similarity scores are sorted in descending order to get the most similar employees.

◦ The function returns the top five most similar employees' IDs.

```
...    1      emp_002
       28     emp_029
       24     emp_025
       26     emp_027
       17     emp_018
       Name: id, dtype: object
```

3.3   Performance analysis

Employee performance is influenced by a range of factors, broadly categorized into three main groups: firm/environment-related factors, job-related factors, and employee-related factors. These factors interact within the workplace environment, ultimately impacting employees' commitment, motivation, and overall performance.

Firm/environment-related factors play a crucial role in enhancing employee performance. Organizational climate, management support, and training are key components in this category. By fostering an encouraging climate and providing strong management support, FAU Clinic can instill a sense of commitment and proactivity in its employees. Regular training programs not only improve job-related skills but also cultivate a culture of adaptability and flexibility. Thus, it is essential for FAU Clinic to focus on developing an organizational culture that supports its employees and promotes a positive working environment. Moreover, consistent support from management, addressing employee concerns promptly and appropriately, is vital for bolstering performance. Regular training sessions should also be implemented to keep employees updated with the latest skills and knowledge relevant to their roles.

Job-related factors also significantly impact employee performance. Job autonomy, job environment, and job communication are key aspects to consider. By granting employees more autonomy in decision-making and task execution, FAU Clinic can empower them, leading to increased efficiency and job satisfaction. Creating a clean, comfortable, and safe work environment is crucial for fostering productivity and employee well-being. Additionally, effective communication channels, both from and to the employees, should be established to promote a transparent and cohesive work atmosphere.

Employee-related factors play a significant role in determining performance outcomes. Skill flexibility, intrinsic motivation, and proactivity are vital components. Hiring and cultivating employees with diverse skills will allow FAU Clinic to adapt quickly to changes and stay competitive. To boost intrinsic motivation, implementing rewards and recognition programs can be highly effective. Encouraging proactivity and initiative-taking should be woven into the clinic's work culture to inspire employees to perform efficiently and positively influence their peers.

As part of its onboarding process, FAU Clinic can consider implementing a content-based recommender system. This system would generate profiles for new employees based on their data and provide recommendations to connect them with colleagues who share similar interests. By facilitating socialization and fostering a sense of belonging and integration in the workplace, this strategy can have a positive impact on employee performance.

In conclusion, by carefully considering and addressing the firm/environment-related factors, job-related factors, and employee-related factors, FAU Clinic can significantly enhance employee performance. Tailoring the recommended strategies to the clinic's unique needs and characteristics will pave the way for overall organizational growth and success.

3.4   Employee performance analysis

The data science project conducted for the FAU Clinic aimed to analyze the current employee data and determine the core underlying causes of performance issues among nurses. The project sought to provide three key insights: (1) Employee job role performance analysis, (2) Top important factors affecting performance, and (3) A trained machine learning model to predict employee performance.

Step 1: **Exploratory Data Analysis (EDA)**

The first step involved exploring the dataset using Python and pandas. The dataset, "clinic_performance.csv," was loaded into a pandas DataFrame, and basic summary statistics were obtained using the describe() function. This helped in understanding the distribution and range of numerical features.

For the first insight, "Employee job role performance analysis," the average performance rating for each job role was calculated using the groupby() function, and the results were sorted in descending order to identify the top-performing job roles. A bar plot was created using seaborn to visualize the average performance rating for each job role.

Step 2: **Data Preprocessing**

To address the second insight, "Top important factors affecting performance," data preprocessing was performed. Categorical data was converted to numerical format using one-hot encoding. The Pearson correlation coefficients were calculated between each feature and the target variable, i.e., "PerformanceRating," to identify the most important factors affecting

performance. The correlation scores were sorted in descending order, and the top four features were selected for analysis.

Step 3: **Model Building and Evaluation**

To address the third insight, "A trained machine learning model to predict employee performance," a Gradient Boosting Classifier model was built using the GradientBoostingClassifier class from scikit-learn. The dataset was split into training and testing sets using the train_test_split function. Categorical features were label-encoded to prepare the data for training.

The model was trained on the training data using fit() and used to make predictions on the test set using predict(). The model's accuracy was evaluated using the accuracy_score function from scikit-learn.

Additionally, the R-squared score, which measures the goodness of fit of the model, was calculated using the r2_score function. R-squared values range from 0 to 1, with higher values indicating a better fit of the model to the data.

Results and Findings

Employee Job Role Performance Analysis: The analysis revealed that "Gerontological nurse," "Medical surgical nurse," and "Nurse Anesthetist" were the top-performing job roles in terms of average performance rating. This insight can help the clinic focus on the strengths of these job roles and identify potential areas of improvement for others.

Top Important Factors Affecting Performance: The top four important factors affecting employee performance, based on correlation scores, were "EmpEnvironmentSatisfaction," "EmpLastSalaryHikePercent," "EmpWorkLifeBalance," and "YearsSinceLastPromotion." Addressing these factors could lead to improvements in overall performance.

Machine Learning Model for Predicting Performance: The Gradient Boosting Classifier model achieved an accuracy of approximately 91.34% in predicting employee performance. The R-squared score of 0.66 indicated that the model explained about 66% of the variance in the target variable.

Implications and Recommendations

The insights gained from the data science project can provide valuable information to the top-level management of the FAU Clinic. By focusing on the strengths of top-performing job roles and addressing the important factors affecting performance, the clinic can devise targeted

strategies for employee development and retention. Additionally, the trained machine learning model can be used for predicting employee performance, enabling proactive measures to improve individual and team productivity.

It is important to note that the model's performance can be further improved by optimizing hyperparameters, exploring other machine learning algorithms, and collecting additional data. Regular monitoring and updating of the model will ensure its effectiveness over time.

Screenshots of the bar plot for employee job role performance analysis and the output of the machine learning model evaluation can be included in the report to provide visual representation and support the findings.

```
[69]    ✓   0.2s
..
        Employee Job Role Performance Analysis:
         EmpJobRole
        Gerontological nurse          3.000000
        Medical surgical nurse        3.000000
        Nurse Anesthetist             3.000000
        Occupational Health nurse     2.936170
        Health Informatics            2.859375
        Critical care nurse           2.855556
        Healthcare Representative     2.848485
        Practitioner nurse            2.833333
        Family nurse                  2.775510
        Name: PerformanceRating, dtype: float64
```

```
...
2    EmpEnvironmentSatisfaction       0.466283       0.466283
6      EmpLastSalaryHikePercent       0.296237       0.296237
9            EmpWorkLifeBalance       0.163075       0.163075
11      YearsSinceLastPromotion      -0.162383       0.162383
```

```
Model Accuracy: 0.9133858267716536
Age: 0.011043818046633503
Gender: 5.293589406713965e-05
MaritalStatus: 0.002233766252370908
EmpJobRole: 0.023502281423791974
DistanceFromHomeKm: 0.025534581874605236
EmpEnvironmentSatisfaction: 0.3014288561544219
EmpHourlyRate: 0.014914161790346766
EmpJobInvolvement: 0.0007743521772687982
EmpJobSatisfaction: 0.002560852826648207
OverTime: 0.001929072630617123
EmpLastSalaryHikePercent: 0.21702871006089097
EmpRelationshipSatisfaction: 0.0048551109763488335
TotalWorkExperienceInYears: 0.013278079327942767
EmpWorkLifeBalance: 0.06861504055214288
ExperienceYearsInCurrentRole: 0.07996688698564425
YearsSinceLastPromotion: 0.22965682763520093
Attrition: 0.002624665391057675
Predicted Value: 4.91847030386141
Actual Value: 3
R-squared Score: 0.6572860447185813
```

	Actual Value	Predicted value	Difference
328	3	3	0
247	3	3	0
570	3	3	0
145	2	2	0
496	3	3	0
405	3	3	0
165	3	3	0
77	3	3	0
533	3	3	0
163	3	3	0
271	3	3	0
31	3	3	0
55	2	2	0
90	3	3	0
575	3	3	0
76	3	3	0
2	4	4	0
256	2	3	-1
311	4	4	0
333	4	4	0

```
                      Results: Ordinary least squares
=================================================================================
Model:                    OLS              Adj. R-squared (uncentered): 0.976
Dependent Variable:       y                AIC:                         820.2282
Date:                     2023-07-30 12:53 BIC:                         895.8593
No. Observations:         632              Log-Likelihood:              -393.11
Df Model:                 17               F-statistic:                 1498.
Df Residuals:             615              Prob (F-statistic):          0.00
R-squared (uncentered):   0.976            Scale:                       0.20876
---------------------------------------------------------------------------------
          Coef.      Std.Err.       t        P>|t|       [0.025      0.975]
---------------------------------------------------------------------------------
x1        0.0084     0.0026      3.2343      0.0013       0.0033      0.0136
x2        0.0357     0.0378      0.9448      0.3452      -0.0385      0.1098
x3        0.0244     0.0256      0.9542      0.3404      -0.0258      0.0747
x4        0.0071     0.0065      1.0914      0.2755      -0.0057      0.0200
x5       -0.0014     0.0022     -0.6324      0.5274      -0.0057      0.0029
x6        0.2819     0.0160     17.5835      0.0000       0.2504      0.3134
x7        0.0018     0.0009      2.0389      0.0419       0.0001      0.0035
x8        0.0526     0.0246      2.1428      0.0325       0.0044      0.1008
x9        0.0267     0.0161      1.6529      0.0989      -0.0050      0.0583
x10       0.0310     0.0418      0.7413      0.4588      -0.0511      0.1130
x11       0.0664     0.0046     14.3355      0.0000       0.0573      0.0755
x12       0.0139     0.0164      0.8448      0.3985      -0.0184      0.0461
...
```

4 Well-Being

4.1 The importance of well-being

Well-being is a multifaceted concept, involving emotional, employment, purpose-driven, financial, physical, social, and career aspects. A high level of well-being contributes significantly to productivity, lower absenteeism, and overall employee performance. Therefore, it is in the interest of FAU Clinic's manager to implement practical strategies to monitor and promote the well-being of its medical staff.

From a theoretical perspective, there are various influences on well-being including income, social events, biological factors, personality, demographic variables, and elements from both work and private life. According to Pfeffer's research, there are seven key factors impacting health and well-being on the job: job design, overtime, social support, conflicts between family and work commitments, perceived fairness, layoffs, and health insurance.

The Challenge-Hindrance Framework, which assumes two types of stress (challenge stressors and hindrance stressors), can also influence well-being. Challenge stressors can motivate, as people see room to grow, whereas hindrance stressors can demotivate, as people perceive their efforts to be out of balance with the outcome.

The more recent phenomenon of technostress, or stress that arises from using ICTs, also plays a significant role. Factors contributing to technostress include techno-overload, techno-invasion, techno-complexity, techno-insecurity, and techno-uncertainty. How individuals cope with these stressors depends on their appraisal of the situation, their personality traits, and perceived control over their environment.

In order to monitor and enhance the well-being of the medical staff at FAU Clinic, several practical approaches can be employed. One method is regular surveys or questionnaires assessing aspects of well-being such as job satisfaction, work-life balance, and feelings of stress or overload. These assessments can also investigate the impact of technostress, examining how the use of ICTs in the clinic affects employees' well-being.

The clinic could also consider implementing a workplace wellness program, providing resources and initiatives to promote healthy behaviors, manage stress, and improve work-life balance. Such programs can include flexible work hours, regular breaks, health and fitness initiatives, and mental health resources.

Additionally, FAU Clinic can focus on creating a healthy, inclusive work culture, providing clear roles and autonomy to its employees, and ensuring a fair salary and rewards system. Ensuring that the clinic's goals and values align with those of its employees can also significantly contribute to their sense of purpose and overall well-being.

Lastly, it's important to offer opportunities for career development, as career well-being is closely tied to an individual's overall sense of well-being. This could involve providing ongoing training and professional development opportunities, as well as support and guidance for career progression.

In the age of data, FAU Clinic can also consider building a regression model using data on various factors influencing well-being, and using this model to predict and manage employee well-being. This would involve training the model on historical data, and then applying it to current data to make predictions about employees' well-being. Such a model could also be used to identify the most significant factors influencing well-being, allowing FAU Clinic to target its interventions more effectively.

In summary, the well-being of the medical staff at FAU Clinic is influenced by a wide range of factors, and the management of these factors requires a comprehensive, multifaceted approach. Regular monitoring, a healthy work culture, a wellness program, fair rewards, and data analysis are all potential strategies to improve the well-being of the clinic's staff.

4.2   FAU Clinic well-being

Correlation Heatmap
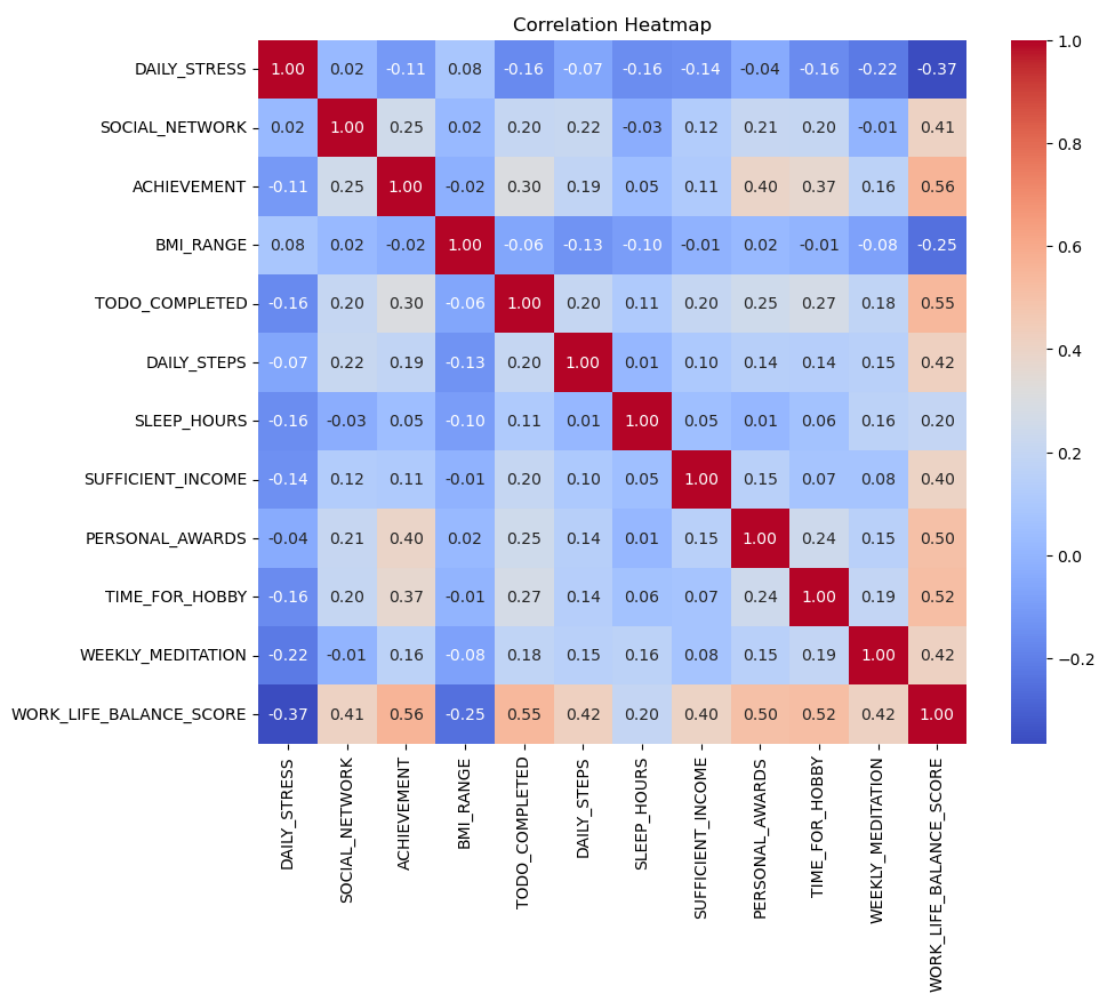
ACHIEVEMENT	0.561244
TODO_COMPLETED	0.545503
TIME_FOR_HOBBY	0.516967
PERSONAL_AWARDS	0.504224
DAILY_STEPS	0.422981
WEEKLY_MEDITATION	0.416171
SOCIAL_NETWORK	0.412586
SUFFICIENT_INCOME	0.403561
DAILY_STRESS	0.365394
BMI_RANGE	0.251988
SLEEP_HOURS	0.196395
GENDER	0.039881
AGE	NaN

The table above shows the importance of each feature in predicting the Work Life Balance (WLB) score, in descending order of importance. Here are the top five features:

TODO_COMPLETED: The number of tasks completed seems to have the highest influence on the WLB score. This implies that completing tasks might bring a sense of accomplishment and control over work, thus improving the WLB score.

ACHIEVEMENT: The level of achievement also has a high influence on the WLB score. This suggests that feeling successful and achieving goals can significantly contribute to a positive work-life balance.

TIME_FOR_HOBBY: The time dedicated to hobbies is the third most influential factor. This underlines the importance of personal time and activities outside of work in maintaining a healthy work-life balance.

PERSONAL_AWARDS: Personal awards also significantly impact the WLB score. Recognition and awards might boost self-esteem and satisfaction, contributing to a better work-life balance.

SUFFICIENT_INCOME: Having a sufficient income is another key factor. Financial stability can relieve stress and improve the perception of work-life balance.

4.3   FAU predictive model

```
Mean Squared Error: 296.9775146051749
R-squared: 0.8505126479990518
Predicted WLB Score: 623.3539482233402
Actual WLB Score (from test set): 644.3
                    Coefficient
SUFFICIENT_INCOME    21.420230
TIME_FOR_HOBBY        3.290859
TODO_COMPLETED        3.233018
ACHIEVEMENT           3.070453
PERSONAL_AWARDS       3.035575
SLEEP_HOURS           2.837295
SOCIAL_NETWORK        2.787850
WEEKLY_MEDITATION     2.636228
DAILY_STEPS           2.594979
DAILY_STRESS         -5.601828
BMI_RANGE           -16.740577
```

It appears that the factors that most influence the WLB score are the number of tasks completed (TODO_COMPLETED), achievements (ACHIEVEMENT), time for hobbies (TIME_FOR_HOBBY), whether income is sufficient (SUFFICIENT_INCOME), and personal awards (PERSONAL_AWARDS).

Based on these findings, FAU Clinic could potentially help its employees improve their WLB score by:

Encouraging task completion: Provide resources and tools that help employees manage their tasks effectively. This could include project management tools or training on time management techniques.

Recognizing achievements: Make sure to acknowledge and celebrate employees' accomplishments. This could help boost their morale and job satisfaction, contributing to a better WLB score.

Allocating time for hobbies: Encourage employees to take breaks and pursue their hobbies. This can help them relax and prevent burnout, improving their well-being and WLB score.

Ensuring sufficient income: If possible, ensure that employees are paid sufficiently for their work. Financial stress can significantly impact well-being, so ensuring fair pay could help improve WLB scores.

Awarding personal achievements: Recognize and reward personal milestones and achievements. This can boost morale and provide a sense of accomplishment, contributing to better well-being and a higher WLB score.

```
                    Results: Ordinary least squares
==============================================================================
Model:                  OLS              Adj. R-squared (uncentered): 0.991
Dependent Variable:     WORK_LIFE_BALANCE_SCORE AIC:                177490.2804
Date:                   2023-07-29 20:27 BIC:                       177574.7449
No. Observations:       15972            Log-Likelihood:            -88734.
Df Model:               11               F-statistic:               1.639e+05
Df Residuals:           15961            Prob (F-statistic):        0.00
R-squared (uncentered): 0.991            Scale:                     3920.7
------------------------------------------------------------------------------
                      Coef.     Std.Err.      t       P>|t|     [0.025    0.975]
------------------------------------------------------------------------------
DAILY_STRESS          12.9899   0.3507    37.0374    0.0000    12.3024   13.6773
SOCIAL_NETWORK        5.1711    0.1719    30.0823    0.0000    4.8342    5.5081
ACHIEVEMENT           3.1135    0.2117    14.7086    0.0000    2.6986    3.5284
BMI_RANGE             31.3312   0.9460    33.1194    0.0000    29.4769   33.1855
TODO_COMPLETED        4.7120    0.2106    22.3767    0.0000    4.2993    5.1248
DAILY_STEPS           6.2855    0.1793    35.0613    0.0000    5.9341    6.6369
SLEEP_HOURS           38.1369   0.3093    123.2854   0.0000    37.5306   38.7433
SUFFICIENT_INCOME     75.3761   1.0698    70.4597    0.0000    73.2793   77.4730
PERSONAL_AWARDS       4.0106    0.1794    22.3542    0.0000    3.6589    4.3622
TIME_FOR_HOBBY        3.8314    0.2028    18.8959    0.0000    3.4340    4.2288
WEEKLY_MEDITATION     5.8046    0.1736    33.4301    0.0000    5.4643    6.1450
------------------------------------------------------------------------------
```

5   Turnover

5.1   High Turnover rate

Employee turnover is a common challenge faced by many organizations, and the FAU Clinic is no exception. It refers to the rate at which employees leave the company, either voluntarily or involuntarily, during a specific period and need to be replaced. Managing turnover is crucial as it can result in substantial costs and the loss of valuable institutional knowledge.

Various scientific theories offer insights into understanding turnover. One such theory is the Job Embeddedness Theory, which suggests that employees are more likely to remain in their jobs when they feel deeply connected to their organization and the community around it. Strong connections and a sense of belonging make them less inclined to consider leaving.

Another relevant theory is the Unfolding Model of Turnover, which proposes that turnover is often triggered by significant events that prompt employees to reevaluate their positions. Depending on how they interpret and process these events, employees may decide to leave or recommit to the organization. March and Simon's theory emphasizes the role of perceived contributions and incentives in turnover decisions. When employees feel that their contributions outweigh the rewards they receive from the organization, they may be more inclined to seek opportunities elsewhere.

Employee turnover can be influenced by various factors, including job dissatisfaction, limited opportunities for career advancement, inadequate compensation, poor management, and attractive job offers from other companies. Personal reasons such as family matters and health issues can also play a significant role in an employee's decision to leave.To tackle high turnover rates, the FAU Clinic can adopt a range of strategies. Regular employee surveys and exit interviews can provide valuable insights into the specific reasons behind turnover. Armed with this information, the clinic can develop targeted interventions to address identified issues effectively.

For instance, enhancing the work environment and job design can help alleviate job dissatisfaction, while investing in employee development and offering growth opportunities can encourage employees to envision a long-term future with the organization. Promoting a positive organizational culture and building strong team dynamics can foster a sense of belonging and attachment, reducing the likelihood of employees seeking opportunities elsewhere.

Additionally, leveraging predictive analytics can aid the clinic in identifying employees at risk of leaving. Analyzing data on employee behavior, performance, and other relevant factors can help predict potential turnover, allowing the clinic to take proactive measures to retain valuable staff. Managing employee turnover is vital for the FAU Clinic's success. By drawing insights from various theories, understanding the underlying factors, and implementing targeted strategies, the clinic can improve employee retention, enhance overall organizational performance, and create a thriving work environment.

5.2   Why employees quit

Attributes correlated with the label column 'left'

From the correlation analysis, we find that the 'left' column is most positively correlated with 'time_spend_clinic' (0.13) and 'average_montly_hours' (0.07). This suggests that employees who spend more time at the clinic or work more hours per month are more likely to leave.

The 'left' column is most negatively correlated with 'satisfaction_level' (-0.39) and 'Work_accident' (-0.15). This suggests that employees who have a lower satisfaction level or have had a work accident are more likely to leave.

Average satisfaction level of employees that leave FAU Clinic

The average satisfaction level of employees that leave the FAU Clinic is approximately 0.44.

Does salary play a role for staff who decide to quit their job?

Based on the crosstab, we see that salary does seem to play a role in an employee's decision to leave. Employees with a low salary have the highest rate of leaving (about 28.56%), followed by those with a medium salary (about 21.03%). Employees with high salaries have the lowest rate of leaving (about 6.75%).
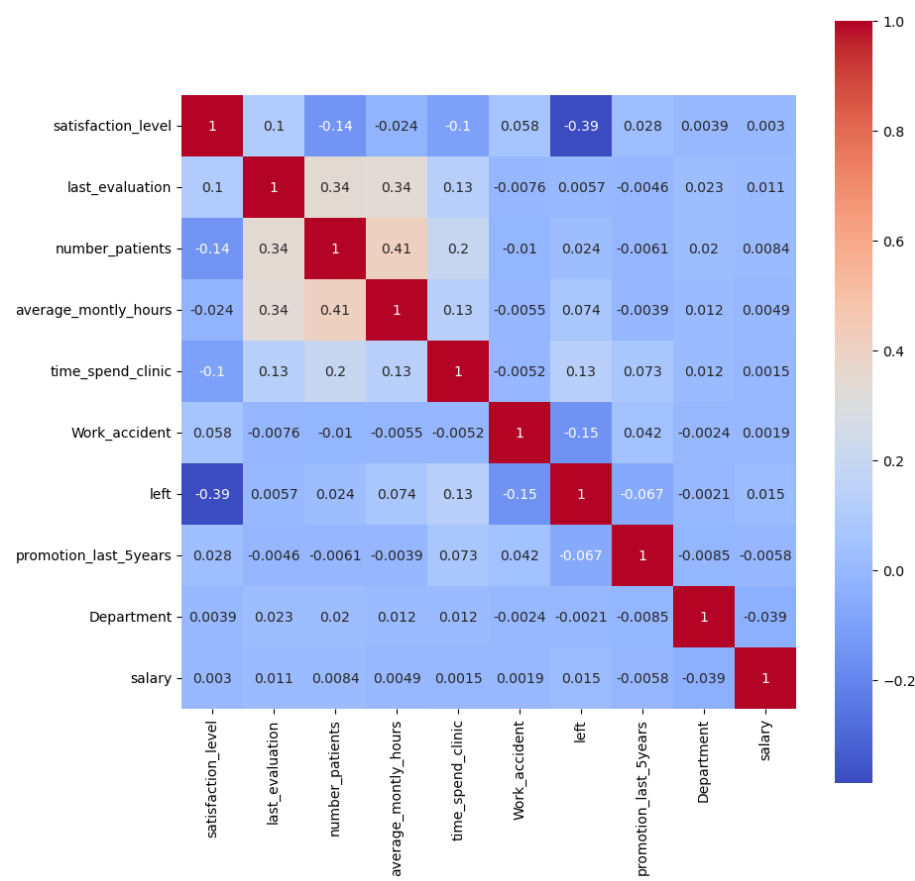
Average satisfaction level of employees who left: 0.4377889447236182
Avg_Satisfection_Level_Employee_Leaving_With_Rescpect_to_Salary : 1.3628140703517588

+ Code   + Markdo

```
...   Model Accuracy: 0.978021978021978
      Confusion Matrix:
       [[1935   21]
       [  35  557]]
      Classification Report:
                   precision    recall  f1-score   support

               0       0.98      0.99      0.99      1956
               1       0.96      0.94      0.95       592

        accuracy                           0.98      2548
       macro avg       0.97      0.97      0.97      2548
    weighted avg       0.98      0.98      0.98      2548
```

5.3 Turnover prediction

The accuracy of the model on the test data is approximately 79.43%. The classification report also provides additional details about the model's performance:

The precision for predicting that an employee will not leave (class 0) is 0.82, meaning that when the model predicts an employee will not leave, it's correct about 82% of the time.

The recall for predicting that an employee will not leave (class 0) is 0.93, meaning that the model correctly identified 93% of the employees who did not leave.

The precision for predicting that an employee will leave (class 1) is 0.60, meaning that when the model predicts an employee will leave, it's correct about 60% of the time.

The recall for predicting that an employee will leave (class 1) is 0.33, meaning that the model correctly identified 33% of the employees who left.

Now, let's look at the model's coefficients to see which factors are most important in predicting employee turnover:
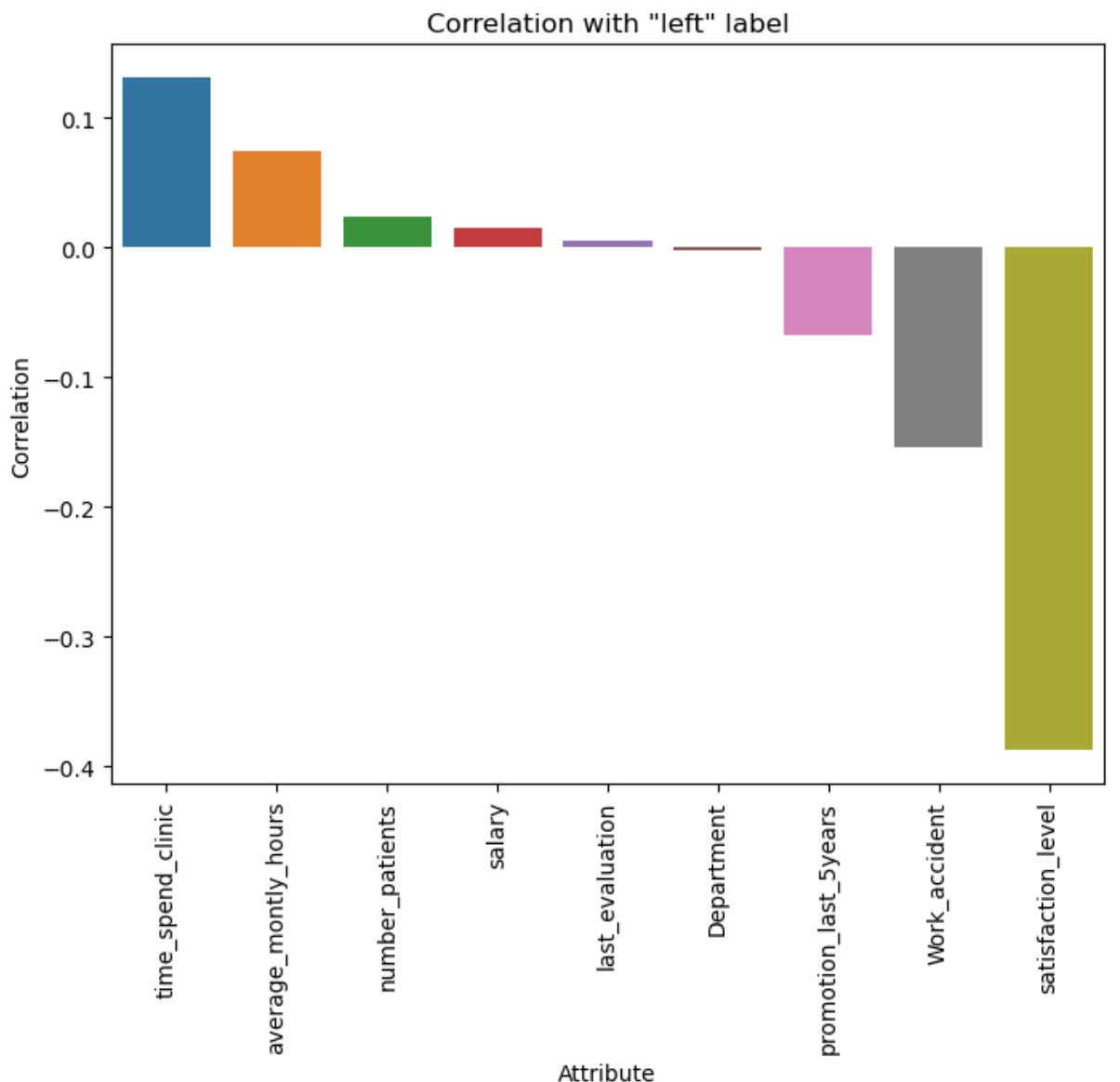
The model indicates that the 'satisfaction_level', 'time_spend_clinic, 'Work_accident', 'average_monutly_hours', and 'promotion_last_5years' are the most important factors in predicting whether an employee will leave. This means:

Employees with lower satisfaction levels are more likely to leave.

Employees with higher time spend on the clinic are more likrly to leave.

Employees who have had a work accident are more likely to leave.

Employees who have not received a promotion in the last 5 years are more likely to leave.

Employees with more monthly hours are more likely to leave compared to those with less hours,

Based on these insights, the FAU Clinic could potentially reduce turnover by:

Increasing employee satisfaction: This could be achieved through various means, such as offering professional development opportunities, fostering a positive work environment, recognizing employee achievements, and ensuring a good work-life balance.

Decrease monthly hours: Give the employess more free hours thus giving the time for them to relax and focus on thir life.

Improving workplace safety: By reducing the number of work accidents, the clinic could potentially reduce turnover.

Offering promotions: Regularly review employee performance and offer promotions to deserving employees. This could increase their job satisfaction and make them less likely to leave.

References

1.Slides from PA course

Declaration of Academic Integrity at the Schöller Endowed Chair for Information Systems

I hereby certify that I have prepared the submitted work independently, and without the unauthorized assistance of third parties, as well as without the use of unauthorized aids. The work has not been submitted in the same or similar form to any other examination authority, nor has it been accepted by any other examination authority as part of an examination.

The passages in the work, which have been taken from other sources in terms of wording or meaning, are identified by indicating the origin. This also applies to drawings, sketches, picture 3.4representations and sources from the Internet.

I am aware that the use of artificial intelligence is permitted for work at the Schöller Endowed Chair of Information Systems, Digitalization in Business and Society (esp. to improve the text written by myself). However, the intellectual core of the respective work has been developed by me, and the scientific methods that are part of the work have been carried out by myself. Furthermore, I have transparently communicated the aids used in the work.

Violations of the above-mentioned rules are to be qualified as deception or attempted deception and lead to an assessment of the examination with "failed". Further sanctions are possible in the case of multiple or particularly drastic violations of the rules by the examination board.

Md Rifat Hasan

First name Middle names Surname   Nuremberg, 2023-07-30