

ASSESSMENT 2: DATA MODELLING REPORT

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INTRODUCTION

OVERVIEW OF THE CASE STUDY

This report addresses a case study involving Revolution Consulting, an IT consulting firm known for its high-quality engagements and expertise in AI, Machine Learning, and Data Science. The company recently has observed a decline in the quality of work produced by its consultants, coinciding with increased project delays and client complaints. This situation is further exacerbated by a noticeable uptick in consultant turnover, with new hires seemingly unable to match the knowledge and skill level of their predecessors. (RMIT University, School of Science, 2024)

REFINEMENT OF BUSINESS NEED INTO RESEARCH GOAL

In response to these challenges, this report aims to refine the pressing business need — understanding and mitigating consultant turnover into a focused research goal. By leveraging data science techniques, the objective is to dissect employment data and survey responses to unearth underlying factors contributing to the turnover phenomenon.

RESEARCH GOAL STATEMENT

The research goal of this project is succinctly defined as follows: to analyse employment and survey data to identify the primary drivers of consultant turnover at Revolution Consulting. Through this analysis, the project aims to offer actionable insights and

recommendations that the company can implement to bolster employee retention, thereby improving overall work quality and client trust.

By aligning the research goal with the company's needs and providing a structured approach to analysis and recommendation, this report aims to equip Revolution Consulting with the tools to address its current challenges and pave the way for sustained success.

FEATURES OVERVIEW

#	Feature name	# unique values	Type	Description
1	EmployeeID	1470	Interval/Ratio	Unique identifier for each employee
2	Age	43	Interval/Ratio	Age of the employee in years
3	Resigned	2	Nominal	Whether the employee has resigned (Yes or No)
4	BusinessTravel	3	Nominal	Frequency of business travel
5	BusinessUnit	3	Nominal	Business unit of the employee
6	EducationLevel	5	Ordinal	Level of education of the employee
7	Gender	2	Nominal	Gender of the employee
8	JobSatisfaction	4	Ordinal	Level of job satisfaction
9	MaritalStatus	3	Nominal	Marital status of the employee
10	MonthlyIncome	1349	Interval/Ratio	Monthly income of the employee
11	NumCompaniesWorked	10	Interval/Ratio	Number of companies the employee has worked for
12	OverTime	2	Nominal	Whether the employee works overtime
13	PercentSalaryHike	15	Interval/Ratio	Percent increase in salary
14	PerformanceRating	2	Ordinal	Performance rating of the employee
15	AverageWeeklyHoursWorked	23	Interval/Ratio	Average number of hours worked per week
16	TotalWorkingYears	40	Interval/Ratio	Total number of years the employee has worked
17	TrainingTimesLastYear	7	Interval/Ratio	# of times the employee has been trained in the last year'
18	WorkLifeBalance	4	Ordinal	Work-life balance rating
19	YearsAtCompany	37	Interval/Ratio	# of years the employee has worked at the company
20	YearsInRole	19	Interval/Ratio	# of years the employee has been in their current role
21	YearsSinceLastPromotion	16	Interval/Ratio	# of years since the employees last promotion
22	YearsWithCurrManager	18	Interval/Ratio	# of years the employee has had their current manager

METHODOLOGY

OVERVIEW

The overarching goal of this data modelling exercise is to identify and understand the key factors contributing to employee turnover at Revolution Consulting. This will be achieved by analysing the dataset, which contains various attributes of employees' professional and demographic profiles.

OBJECTIVES

1. **Descriptive Analysis:** Conduct a comprehensive descriptive analysis to summarize the central tendency, dispersion, and shape of the dataset's distribution. This includes evaluating employee demographics, job characteristics, and other relevant attributes.
2. **Inferential Analysis:** Apply inferential statistics to determine if there are any significant differences between employees who have resigned and those who have not, considering various factors such as age, gender, income level, and work-life balance.

- 3. Clustering Analysis:** Explore the data to find meaningful clusters of employees, such as those with similar job satisfaction levels, income brackets, or work-life balance ratings. This will assist in recognizing distinct patterns and characteristics among different employee groups.

By adhering to this methodology, we intend to deliver actionable insights that Revolution Consulting can leverage to address the issue of employee turnover and improve overall operational efficiency.

PROCESS

1. PRELIMINARY OBSERVATIONS FROM DESCRIPTIVE STATISTICS – INTERVAL/RATIO VARIABLES (SEE APPENDIX A FOR THE GRAPHS)

- **Age:** The workforce has a wide age range (18 to 60 years), with an average age of around 37 years. This suggests a mixture of experience levels, which could impact turnover if there are generational expectations or preferences at play.
- **EducationLevel:** Education levels span from 1 to 5, which might correspond to different educational qualifications. The average education level is close to 3, possibly indicating most employees have a Bachelor's degree if we assume 3 represents that level.
- **JobSatisfaction:** Scores range from 1 to 4, with an average score slightly above the midpoint (2.73). This could indicate moderate satisfaction levels overall, but the impact of lower satisfaction on turnover should be investigated.
- **MonthlyIncome:** There is a significant range in monthly income (from 1009 to 19999), with a standard deviation (4707.96) suggesting a wide disparity in earnings among employees. Income is a critical factor in turnover rates and warrants deeper analysis.
- **NumCompaniesWorked:** Employees have worked with 0 to 9 other companies before, with an average of about 2.7. Employees with a history of frequent job changes might be more prone to leaving.
- **PercentSalaryHike:** Employees received salary hikes between 11% to 25%, with an average increase of about 15.21%, showing variability in salary adjustments. Understanding if salary hikes influence retention could be key for turnover analysis.
- **PerformanceRating:** Most employees have a performance rating of 3 or 4, with a mean slightly above 3, indicating generally good performance levels across the board. The distribution of performance ratings relative to turnover could reveal if high performers or low performers are more likely to leave.
- **AverageWeeklyHoursWorked:** Employees work between 40 to 71 hours per week, with an average of about 43 hours. Workload is a common factor affecting job satisfaction and turnover.
- **TotalWorkingYears:** The total working years range from 0 to 40, with an average of 11.28 years, indicating a diverse range of experience levels. Employees' tenure may correlate with their likelihood to stay with the company.
- **TrainingTimesLastYear:** Employees received training 0 to 6 times last year, with most receiving training 2 or 3 times. The role of professional development opportunities in employee retention could be explored.
- **WorkLifeBalance:** Rated between 1 to 4, with an average close to 3. The balance between work and personal life is a significant factor that could influence an employee's decision to resign.
- **YearsAtCompany:** Employees have been at the company for 0 to 40 years, with an average of 7 years. Longevity at the company might impact employees' decisions to stay or leave.

2. PRELIMINARY OBSERVATIONS FROM DESCRIPTIVE STATISTICS – CATEGORICAL VARIABLES (SEE APPENDIX B FOR THE GRAPHS)

The proportions I have calculated for each categorical variable give us a clear picture of the composition of the dataset.

- **Resigned:** Approximately 16.1% of employees have resigned, which indicates the turnover rate that needs to be addressed.
- **BusinessTravel:** A significant majority of the employees (about 70.9%) travel rarely, which could suggest that frequent travel might be a contributing factor to employee turnover.
- **BusinessUnit:** The "Consultants" unit comprises the majority of the workforce (about 65.4%). If consultants have a higher turnover rate, this could significantly impact the overall business.
- **Gender:** The gender distribution is 60% male and 40% female. If resignation rates significantly differ between genders, it could point to issues that may need to be addressed in terms of workplace culture or policy.
- **MaritalStatus:** Married employees make up about 45.8%, singles 31.9%, and divorced 22.2%. Turnover trends across these groups could reveal if marital status influences job stability.
- **OverTime:** Around 28.3% of employees work overtime. A higher turnover among these employees might indicate that work-life balance is a factor in the decision to leave the company.

In the next steps we will discuss how these proportions relate to the turnover rates. For example, if most employees who have resigned belong to the "Consultants" business unit and frequently work overtime, these factors could be considered significant in predicting turnover and should be the focus of retention strategies.

3. INFERENCE ANALYSIS

For the inferential analysis, I examined whether there are statistically significant differences in factors such as age, gender, income level, and work-life balance between employees who have resigned and those who have not.

I focused on a few key analyses:

- **T-tests** to compare the mean values for numerical variables like age and monthly income.
- **Chi-square** tests for categorical variables like Gender and WorkLifeBalance.

T-TEST FINDINGS AND IMPLICATIONS

The T-test results for numerical variables provide insightful details on the differences between employees who have resigned and those who have not. Here's a summary of the findings and their implications:

Significant Differences (p-value < 0.05)	Not Significant Differences (p-value ≥ 0.05)
Age: Highly significant (p < 0.001), suggesting younger employees are more likely to resign.	EducationLevel: No significant difference, suggesting education level might not be a direct factor in resignation decisions.
JobSatisfaction: Significant (p < 0.001), indicating job satisfaction levels are associated with resignation decisions.	NumCompaniesWorked: Not significant, indicating the number of companies worked at previously may not directly influence resignation.
MonthlyIncome: Highly significant (p < 0.001), showing income levels play a crucial role in employees' decisions to stay or leave.	PercentSalaryHike: Not significant, suggesting the percentage of salary hike alone might not be a deciding factor for resignation.
AverageWeeklyHoursWorked: Extremely significant (p < 0.001), suggesting a strong association between hours worked and likelihood of resignation.	PerformanceRating: Not significant, indicating performance ratings may not directly influence resignation decisions.
TotalWorkingYears: Highly significant (p < 0.001), indicating employees with fewer working years may be more prone to resign.	YearsSinceLastPromotion: Not significant, suggesting time since last promotion might not be a direct factor influencing resignation decisions.
TrainingTimesLastYear: Significant (p = 0.022), suggesting the amount of training could influence resignation decisions.	
WorkLifeBalance: Significant (p = 0.014), indicating work-life balance is a factor in resignation decisions.	
YearsAtCompany: Highly significant (p < 0.001), suggesting tenure at the company influences resignation likelihood.	
YearsInRole: Highly significant (p < 0.001), indicating length of time in the current role is associated with resignation decisions.	
YearsWithCurrManager: Highly significant (p < 0.001), suggesting the duration with the current manager may influence the decision to resign.	

IMPLICATIONS:

- Factors such as **Age**, **JobSatisfaction**, **MonthlyIncome**, and **AverageWeeklyHoursWorked** are critical in understanding employee turnover. These suggest areas where interventions could be most effective, such as improving job satisfaction, adjusting workloads, and ensuring competitive compensation.
- **WorkLifeBalance** and **TrainingTimesLastYear** highlight the importance of supporting employees' personal needs and professional development as strategies to retain talent.
- The lack of significance in variables like **EducationLevel** and **PerformanceRating** suggests that resignation decisions might be influenced more by workplace conditions and personal circumstances than by these attributes.

CHI-SQUARE TEST FINDINGS AND IMPLICATIONS

The Chi-square test results for categorical variables in relation to the **Resigned** status provide valuable insights into which factors might be associated with employee resignation. Here's a summary of the findings:

Significant Associations (P-value < 0.05)	Not Significant Association (P-value ≥ 0.05)
BusinessTravel: The Chi-square statistic of 24.182 with a P-value of 0.000 suggests a significant association between business travel frequency and resignation. This indicates that the pattern of business travel (Travel Rarely, Travel Frequently, Non-Travel) is related to whether an employee resigns.	Gender: The Chi-square statistic of 1.117 and a P-value of 0.291 indicate no significant association between gender and resignation, suggesting that male and female employees resign at similar rates, based on the data.
BusinessUnit: With a Chi-square statistic of 10.796 and a P-value of 0.005, there's a significant association between the business unit of employment and resignation. This suggests that belonging to different business units (e.g., Consultants, Sales, Business Operations) affects resignation rates.	
MaritalStatus: The Chi-square statistic of 46.164 and a P-value of 0.000 indicate a significant association between marital status and resignation, suggesting that marital status (Married, Single, Divorced) influences an employee's decision to resign.	

OverTime: The Chi-square statistic of 87.564 with a P-value of 0.000 strongly suggests a significant association between overtime work and resignation. Employees who work overtime appear more likely to resign compared to those who do not.

IMPLICATIONS:

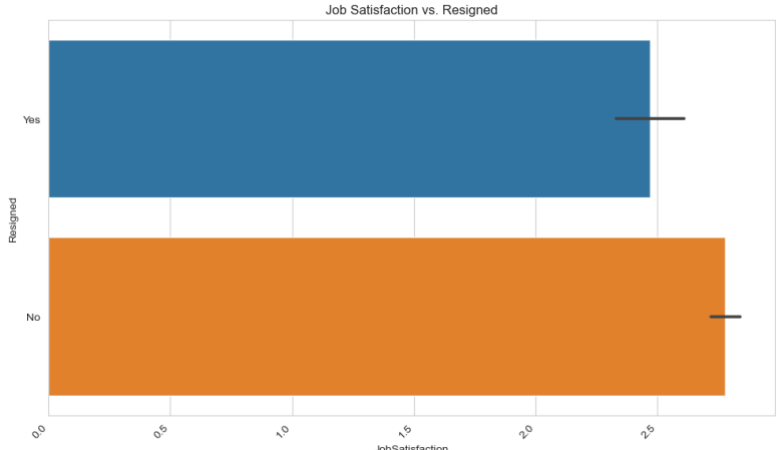
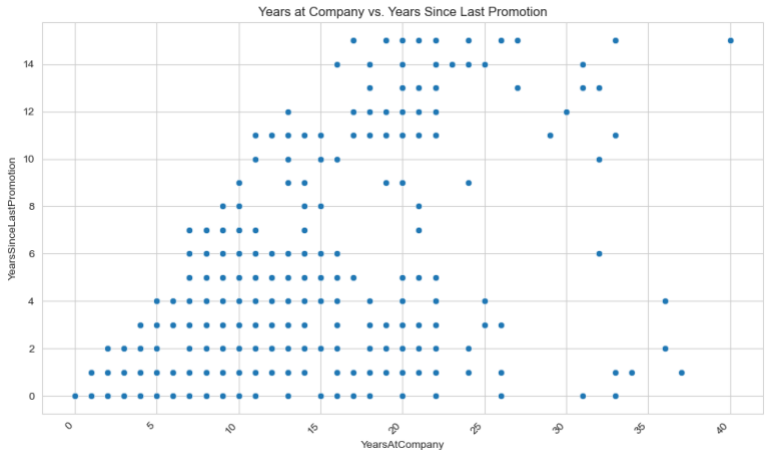
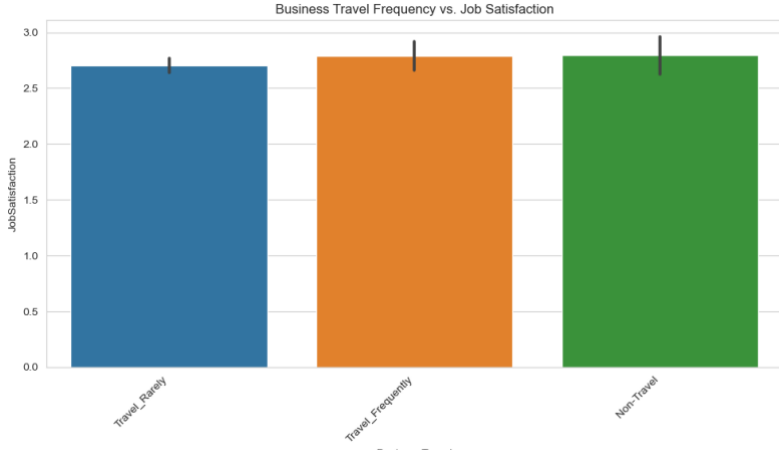
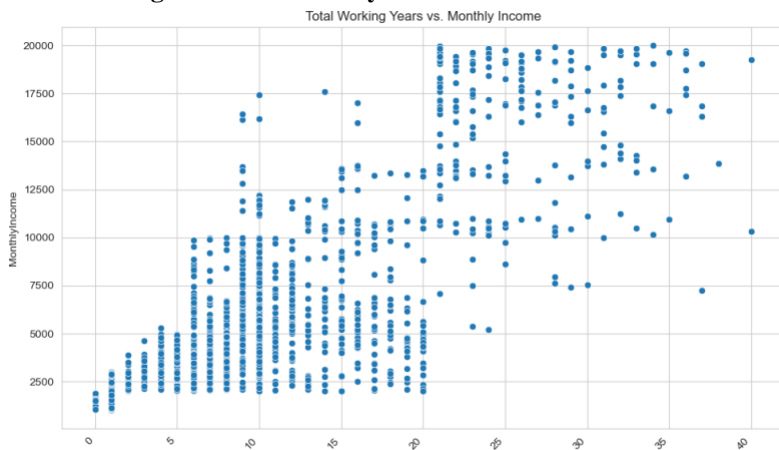
- **BusinessTravel** and **OverTime:** The significant associations with resignation suggest that work-related stressors, such as frequent business travel and required overtime, might contribute to higher resignation rates. It may be beneficial for the company to review policies related to travel and overtime to improve employee retention.
- **BusinessUnit** and **MaritalStatus:** These factors' association with resignation suggests that specific environmental or cultural aspects within different business units might affect employee satisfaction and retention differently. Additionally, personal life circumstances reflected by marital status could influence an employee's decision to stay or leave.
- **Gender Neutrality:** The lack of association between gender and resignation suggests that the company's environment or culture does not disproportionately affect one gender over the other in terms of resignation rates, which is a positive finding in terms of gender equality.

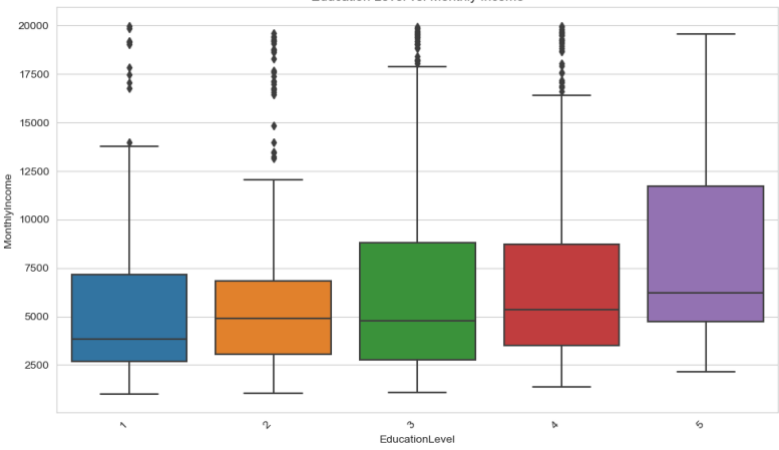
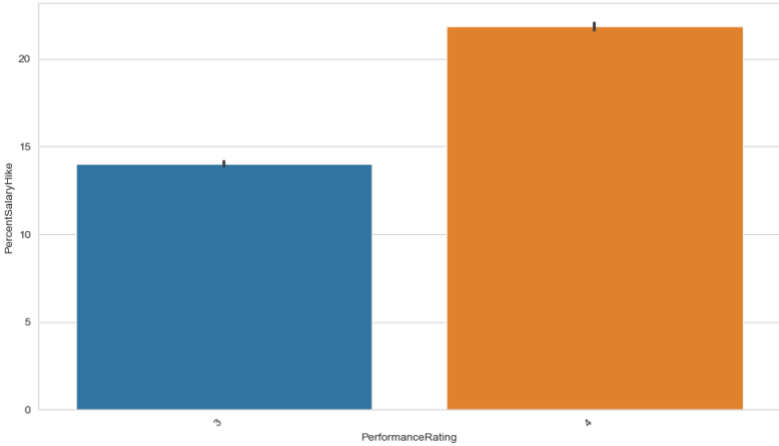
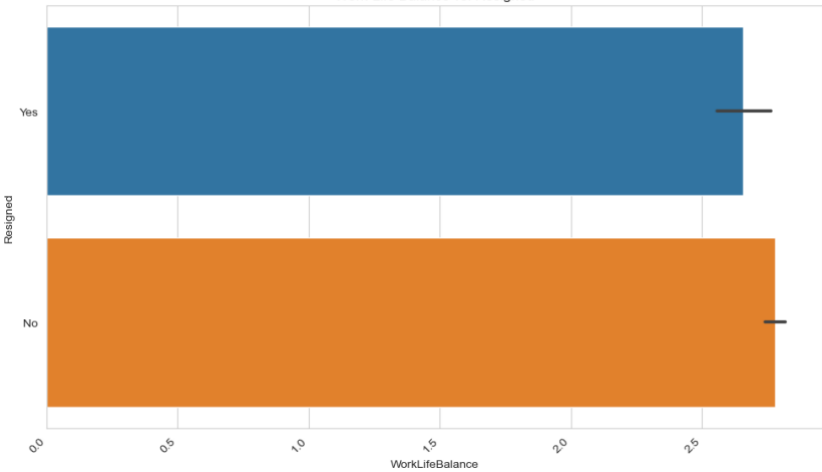
EXPLORING RELATIONSHIPS

SELECTING PAIRS OF ATTRIBUTES

When choosing attribute pairs, it's beneficial to consider combinations that are likely to offer meaningful insights into employee behavior or the company's operations. Here are ten pairs selected based on these criteria:

#	Visualization	Insights
1	Age and MonthlyIncome 	<p>The scatter plot suggests that there might be a positive relationship between age and monthly income, with income tending to increase as employees get older. This could indicate that experience, which often correlates with age, may be rewarded with higher pay.</p>
2	Gender and MonthlyIncome 	<p>The box plot reveals a distribution of monthly income by gender. While both genders have a wide range of incomes. The plot suggests some differences, but a deeper statistical analysis would be required to confirm the extent and significance of these differences.</p>
3	JobSatisfaction and Resigned	<p>There's an indication that job satisfaction levels might influence resignation decisions, emphasizing the importance of maintaining high job satisfaction.</p>

	<p>Job Satisfaction vs. Resigned</p> 	
4	<p>YearsAtCompany and YearsSinceLastPromotion</p> <p>Years at Company vs. Years Since Last Promotion</p> 	<p>The scatter plot shows how the number of years at the company relates to the years since the last promotion. A positive correlation can be noticed, suggesting that the longer someone stays at a company, the more promotions they might receive.</p>
5	<p>BusinessTravel and JobSatisfaction</p> <p>Business Travel Frequency vs. Job Satisfaction</p> 	<p>The bar plot suggests a relationship between the frequency of business travel and job satisfaction levels. It indicates that employees who travel more or less frequently report similar levels of job satisfaction.</p>
6	<p>TotalWorkingYears and MonthlyIncome</p> <p>Total Working Years vs. Monthly Income</p> 	<p>The scatter plot illustrates how monthly income correlates with the total number of working years. It suggests a general trend where income tends to increase with the accumulation of working years, implying that experience pays off. However, there's considerable variability, indicating that other factors also play significant roles in determining income.</p>

7	EducationLevel and MonthlyIncome 	<p>The box plot for education level against monthly income aims to uncover if higher education levels correlate with higher incomes. This visualization suggests that while there might be a trend towards higher income with higher education, there's considerable overlap in income ranges.</p>
8	PerformanceRating and PercentSalaryHike 	<p>The bar plot illustrates the relationship between performance ratings and the percentage salary hike employees receive. This plot helps to identify that higher performance ratings directly correlate with higher salary increases.</p>
9	WorkLifeBalance and Resigned 	<p>The bar plot findings suggest work-life balance may impact resignation rates, underscoring its importance in employee retention strategies.</p>
10	YearsWithCurrManager and JobSatisfaction	<p>The point plot explores the relationship between the duration an employee has spent with their current manager and their job satisfaction levels. It shows that longer relationships with a manager lead to lower job satisfaction in some cases. This could indicate how management stability affects employee morale and satisfaction.</p>



DATA MODELLING AND EXPLORATION

GOALS

- **Attrition Drivers:** To pinpoint the drivers of attrition at Revolution Consulting by examining factors such as salary, workload, work environment, and career progression opportunities.
- **Risk Assessment:** To assess the risk of turnover for individual employees or groups within the company, enabling targeted interventions.
- **Strategy Development:** To develop data-driven strategies that Revolution Consulting can implement to improve employee retention, thereby enhancing the quality of work and client satisfaction.
- **Policy Recommendations:** To recommend changes in company policies or practices that could lead to a more engaged and stable workforce.

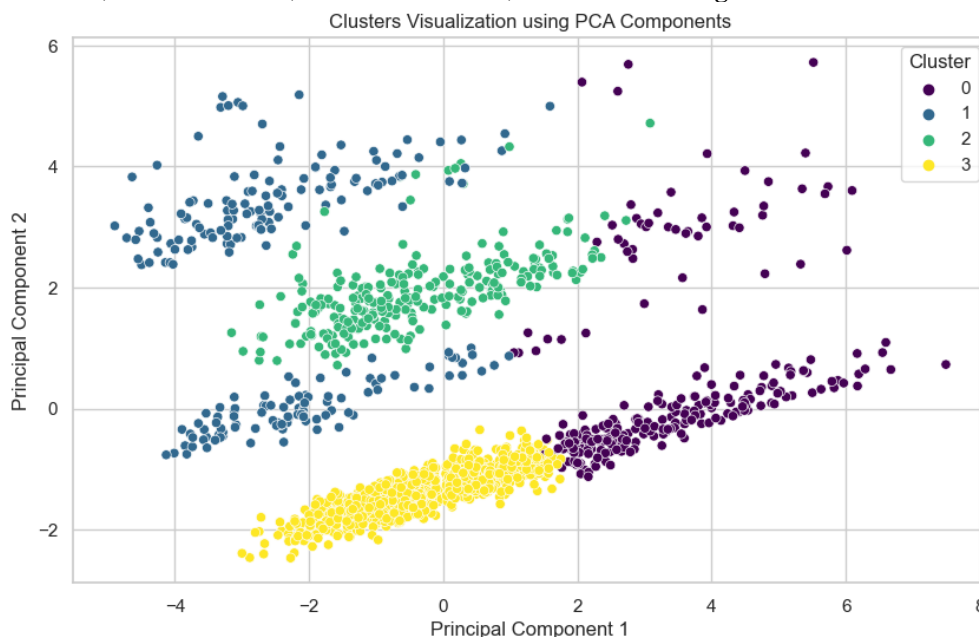
EVALUATION STRATEGY

To address management's questions and explore the speculated employee clusters within the data, we can use unsupervised learning techniques, specifically clustering. Clustering will help identify patterns and groupings in the data that may correspond to the categories of interest mentioned by management:

- Employee remuneration, age groups, etc.
- Employees who are likely to churn due to a lack of career progression
- Satisfied employees who do not need to be focused on
- Newer employees who might leave due to concerns about pay and work/life balance

K-MEANS CLUSTERING

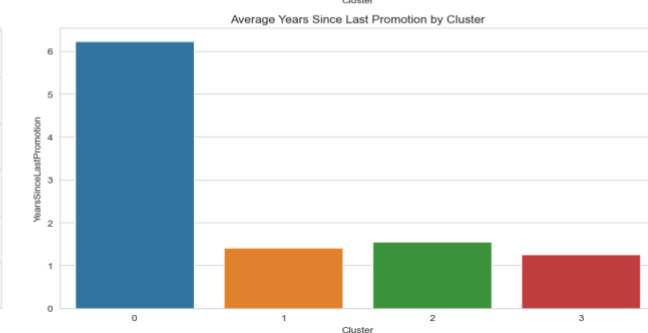
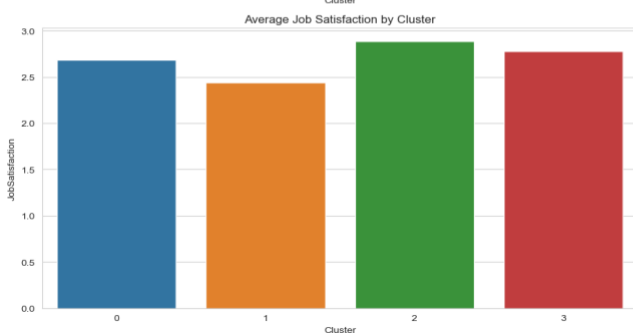
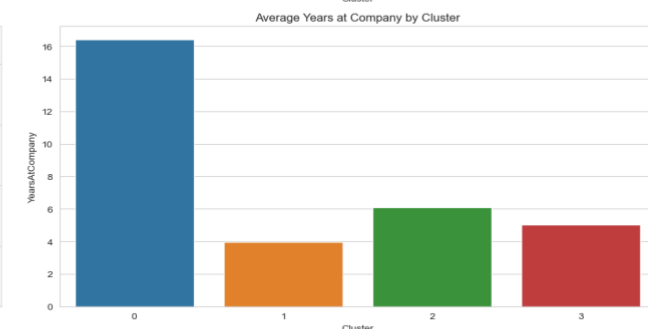
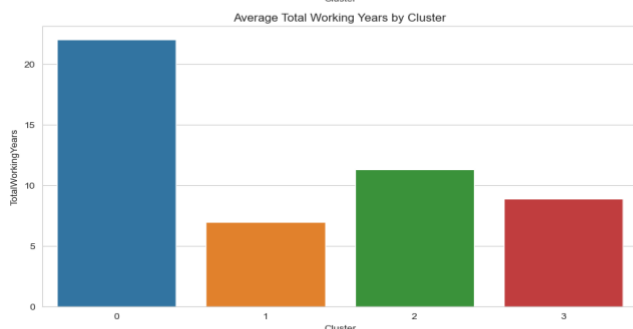
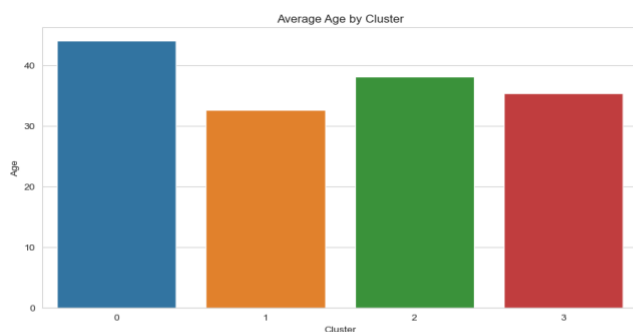
I used the **K-Means** clustering algorithm, which is widely used for partitioning data into clusters based on similarity. To do so, I first selected relevant features that could influence these groups, such as **MonthlyIncome**, **Age**, **YearsAtCompany**, **YearsSinceLastPromotion**, **JobSatisfaction**, **WorkLifeBalance**, and **TotalWorkingYears**.



RESULTS

Based on the clustering analysis and the summary I have performed, I can make some initial interpretations of the clusters:

Attribute	Cluster 0 (Experienced and Well-Remunerated)	Cluster 1 (Least Experienced and Lower Income)	Cluster 2 (Mid-Level Experience and Income)	Cluster 3 (Relatively New, Low Income)
Age	On average, the oldest.	Youngest on average.	Mid-range average age.	Relatively young.
Monthly Income	Highest average monthly income.	Lowest average monthly income.	Mid-range average monthly income.	Lower than average monthly income, but higher than cluster 1.
Total Working Years	Most experienced with the highest average total working years.	Least amount of work experience.	Moderate level of work experience.	Less experienced than clusters 0 and 2 but more than cluster 1.
Years At Company	Longest average tenure at the company.	Shortest average tenure at the company.	Moderate average tenure at the company.	Relatively new to the company.
Job Satisfaction	Moderate job satisfaction.	Lowest job satisfaction, which is concerning.	Slightly higher job satisfaction compared to clusters 1 and 3.	Low job satisfaction, though not the lowest.
Years Since Last Promotion	Longest time since the last promotion, which could be a point of concern regarding career progression.	Shortest time since the last promotion, which is expected given the overall low tenure.	Average time since the last promotion.	Similar to cluster 1, which may not be as much of a concern due to shorter tenure.



INSIGHTS AND RECOMMENDATIONS FOR MANAGEMENT:

- **Cluster 0:** This group appears to be well-experienced and well-paid but has not seen a promotion in a while. Management could look into career development and advancement opportunities for this group to ensure they remain motivated and see a path forward within the company.
- **Cluster 1:** Being the least experienced and lowest-paid group with the lowest job satisfaction, initiatives to enhance their engagement could be beneficial. This could include mentorship programs, training, and development opportunities to increase their skills, job satisfaction, and eventually, their income.
- **Cluster 2:** This group has moderate experience and income and seems to be relatively satisfied with their jobs. However, management should ensure that their career paths are clear and that they receive recognition and opportunities to continue to grow.
- **Cluster 3:** This group, while not the least experienced, still has low income and job satisfaction. Efforts to improve their compensation and work-life balance could be important. Regular check-ins and feedback sessions may help to identify specific issues and retain talent in this group.

DISTRIBUTION OF CLUSTERS ACROSS THREE DIFFERENT PAIRS OF FEATURES



Observations				Insights
# Clusters	Age vs Monthly Income by Cluster	Total Working Years vs Job Satisfaction by Cluster	Years At Company vs Years Since Last Promotion by Cluster	
Cluster 0 ●	Contains older employees with higher incomes.	There doesn't appear to be a strong relationship between total working years and job satisfaction, although there is a slight concentration of higher job satisfaction in the middle range of working years for clusters 2 and 3.	There are some employees in cluster 0 who have not been promoted for an extended period, despite being at the company for many years.	Cluster 0 may contain more senior and higher-paid employees who may be at risk of leaving if they feel their career progression has stalled, as indicated by the longer periods since their last promotion.
Cluster 1 ●	Spread across various ages but with lower income levels.		Clusters 1 and 3, representing less tenured employees, have shorter periods since the last promotion, which aligns with their shorter employment duration.	Cluster 1 may represent entry-level or lower-paid employees who are more widely distributed across ages. This group may require career development support and could be at risk of turnover if they are dissatisfied with their compensation.
Cluster 2 ●	Generally, in the mid-range for both age and income.			Cluster 2 seems to be mid-career employees with moderate income and job satisfaction. This group might benefit from targeted retention strategies and opportunities for advancement to prevent turnover.
Cluster 3 ●	Represents younger employees with lower income levels.			Cluster 3 includes younger, less experienced employees who might be more sensitive to initial career development and compensation.

RECOMMENDATIONS

- **Retention Strategies:** For clusters 0 and 2, consider career development programs and pathways to promotion to keep experienced talent engaged.
- **Compensation Reviews:** For clusters 1 and 3, review compensation and benefits packages to ensure they are competitive and equitable across all age groups.
- **Career Development:** Implement or enhance training and mentorship programs for cluster 1 to aid in skill development and career progression.
- **Recognition Programs:** Create or improve recognition programs that highlight employee achievements, especially for those in cluster 0 who have not been promoted recently, to enhance satisfaction and loyalty.

DISCUSSION

KEY INSIGHTS AND THEIR IMPLICATIONS

1. Employee Compensation and Career Progression:

- The positive relationship between age and monthly income suggests that experience is rewarded with higher pay. However, there's a risk that younger employees may seek competitive compensation elsewhere.
- Clusters identified in k-means clustering highlighted a segment of well-experienced but potentially under-promoted employees, which could lead to dissatisfaction and turnover.

2. Job Satisfaction:

- The significant relationship between job satisfaction levels and resignation decisions underscores the importance of maintaining high job satisfaction to retain employees.

3. Work-Life Balance:

- The association between work-life balance and resignation rates emphasizes the necessity of policies that support a healthy balance to reduce turnover.

4. Impact of Management:

- The duration an employee spends with their current manager affects job satisfaction, with potential implications for management practices and their stability.

KEY DRIVERS OF ORGANIZATIONAL ISSUES

- **Workplace Conditions:** Overwork and lack of clear career advancement paths appear to be significant drivers of employee turnover.
- **Remuneration and Recognition:** Competitive compensation and regular recognition are crucial in retaining talent, especially for more experienced employees.
- **Professional Development:** Opportunities for skill enhancement and career progression are vital for job satisfaction and retention, particularly for less experienced employees.

CONCLUSION AND RECOMMENDATIONS

The analysis has revealed that while Revolution Consulting rewards experience, there may be gaps in addressing the needs and expectations of its diverse workforce. To reduce turnover, the company should focus on improving job satisfaction through better compensation, clear career development opportunities, work-life balance, and supportive management practices.

- **Enhance Compensation Structure:** Conduct regular market comparisons to ensure salaries are competitive, especially for high-performing younger employees.
- **Clear Career Pathways:** Develop transparent and accessible career progression routes to help employees envision a long-term future within the company.
- **Strengthen Management Training:** Invest in management training to ensure that managers can effectively support their teams and foster a positive work environment.
- **Expand Training and Development Programs:** Offer comprehensive training and mentorship programs to facilitate continuous professional growth.
- **Review Workload and Recognition Policies:** Monitor workloads to prevent burnout and create recognition programs that celebrate employee achievements.
- **Tailored Retention Strategies:** Implement targeted retention strategies for different clusters of employees, addressing their unique needs and preferences.

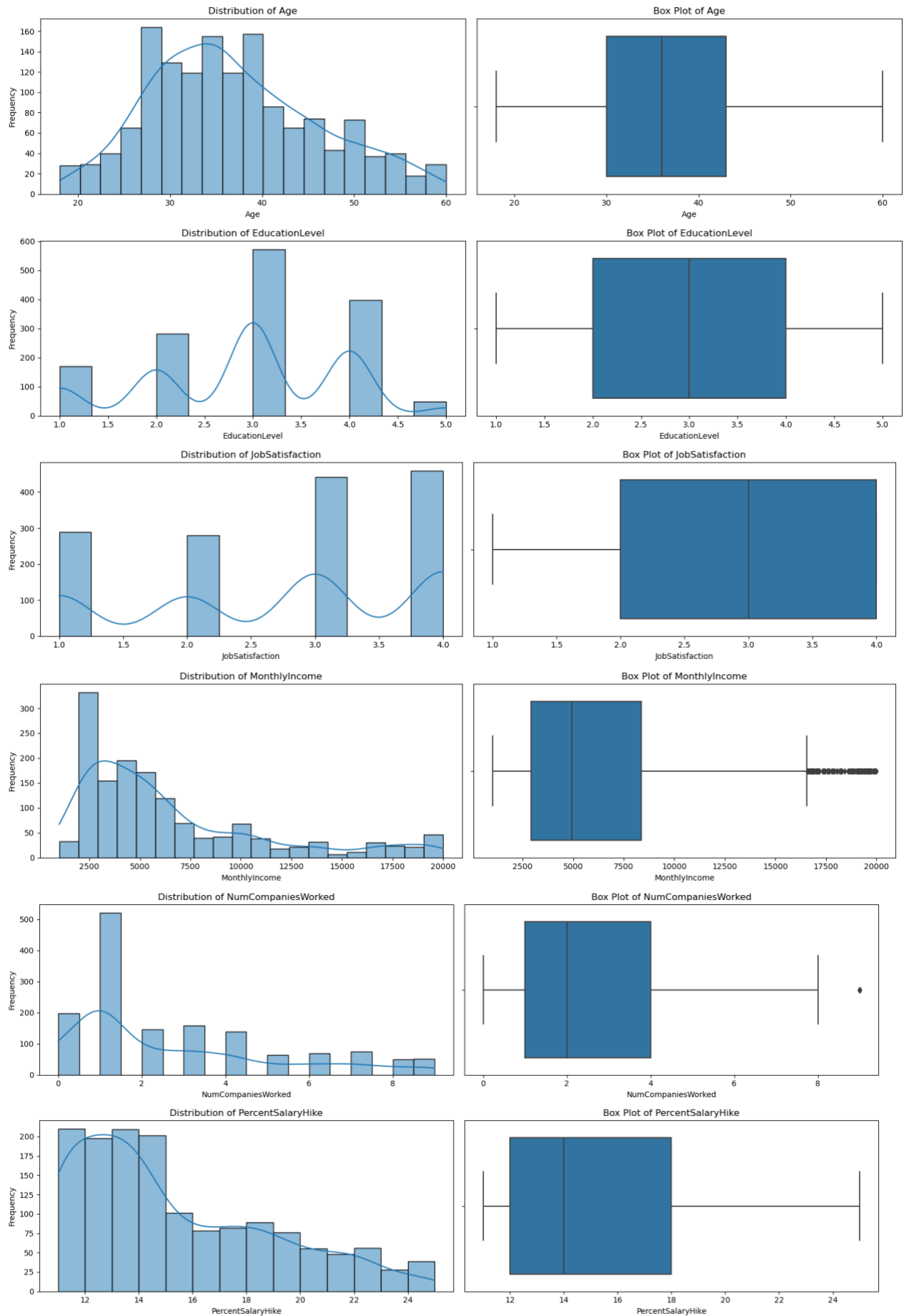
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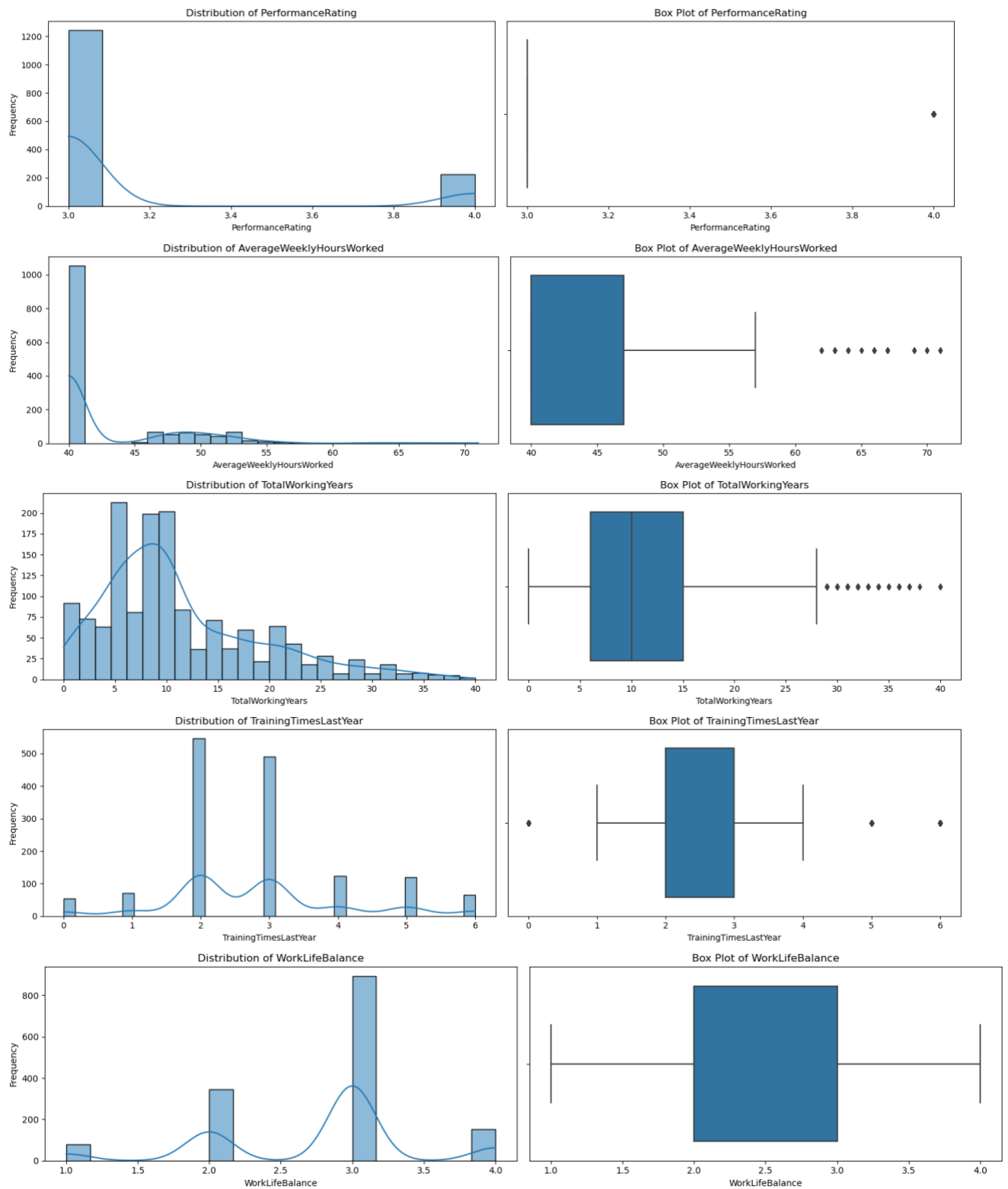
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APPENDIX

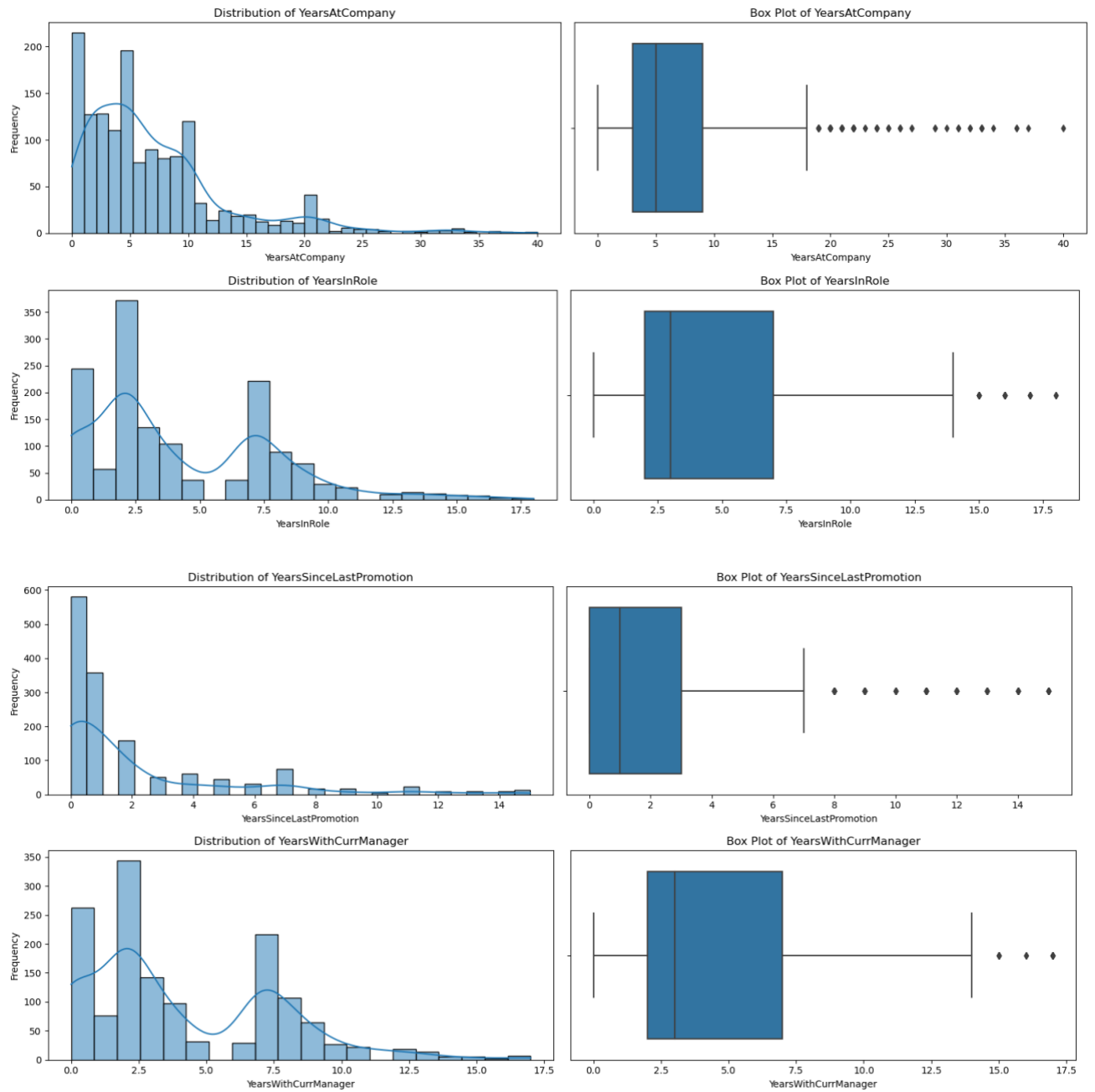
A. Distribution of numerical attributes



A. Distribution of numerical attributes



A. Distribution of numerical attribute



B. Distribution of categorical variables

