FINAL SOLUTION SUMMARY

I. Project Overview

This portfolio project aims to identify which Human Resources (HR) policy areas are most associated with employee attrition and to propose data-driven policy improvements to reduce turnover risk. Acting as a data analyst, I simulate delivering recommendations to HR leadership and business unit managers by using historical internal HR data from IBM.

Through exploratory data analysis, statistical modeling (logistic regression and decision trees), and business-focused interpretation, the project investigates how policy-related factors—such as compensation, career advancement, and work-life balance—impact employee retention. The ultimate goal is to surface actionable insights that can inform policy refinement, improve people-related KPIs, and reduce the high cost associated with employee turnover.

This diagnostic and exploratory project was completed over six weeks and prioritizes clarity, interpretability, and business relevance in its insights and recommendations.

II. Business Questions

1. Which HR policy areas (e.g., compensation, promotion, work-life balance) are most associated with employee attrition?
2. What is the relative influence of each policy-related factor on the risk of turnover?
3. Which employee segments are most vulnerable to leaving, based on policy-related patterns?
4. What practical, data-driven HR policy adjustments can reduce attrition in high-risk groups?

III. SUMMARY OF RECOMMENDATIONS

REDUCE EMPLOYEE ATTRITION RATE

- Employees are required to work overtime
  High risk of attrition due to burnout and poor work-life balance
  - Set a maximum limit on overtime hours per month, especially in high-demand departments
  - Reallocate workloads or add temporary staff during peak periods
  - Provide training for managers and employees on time management and productivity
- Employee is at a Junior level
  Likely to leave early due to lack of career visibility and growth
  - Define clear career development paths starting from onboarding
  - Implement a mentoring or buddy system with experienced staff
  - Conduct more frequent performance reviews (e.g., every 6 months) to provide early promotion opportunities
- Compensation & Rewards are not attractive
  - Monthly income is less than 2,696
    - Junior employees with <3 years in role and since last promotion
      High turnover risk due to low pay, perceived career stagnation, and lack of progression
      - Design structured salary increases tied to time-in-role and recent promotion history
      - Offer milestone-based retention bonuses (e.g., after 1, 2, and 3 years in role)
      - Provide training and coaching to accelerate promotion readiness
    - Other employees (not junior or with ≥3 years)
      May leave if they feel their compensation is not aligned with contribution
      - Re-evaluate salary using market benchmarking
      - Align salary reviews with actual responsibilities and performance
  - No stock option benefits
    - Married employees
      More sensitive to the lack of long-term financial benefits like stock options
      - Prioritize stock option plans for married employees after a minimum tenure
      - Clearly communicate the value, eligibility, and long-term benefit of stock ownership
    - Single & Divorced employees
      Less sensitive to stock options, but still need meaningful benefits
      - Offer learning & personal development budgets
      - Provide flexible work arrangements or extra personal leave

IV. HIGH-RISK EMPLOYEE SEGMENTS

#	Segment Description	Attrition Rate (Segment)	Attrition Rate (Comparison)	Relative Risk	Key Drivers
1	Overtime workers	30,5%	10.4% (no overtime)	2.9×	Burnout, lack of work-life balance, heavy workload
2	Junior employees (<3 years in role & since last promotion)	26,3%	10.1% (others)	2.6×	Career stagnation, lack of promotion, unmet growth expectations
3	Low-income employees (< 2,696)	31,3%	12.3% (≥ 2,696)	2.5×	Perceived unfair pay, external opportunities, misalignment of value
4	Employees without stock options (Level = 0)	24,4%	9.9% (with stock options)	2.5×	Lack of long-term incentive, feeling undervalued
4,1	Married employees without stock options	20,3%	10.2% (married with options)	2.0×	Financial insecurity, misalignment with life stage needs

V. KEY INSIGHTS & RECOMMENDATIONS

1.OVERTIME INCREASES ATTRITION RISK

1.1.Employees working overtime face nearly 3x higher attrition risk

The data shows a clear and statistically significant relationship between overtime and employee attrition:

- Among employees who work overtime, the attrition rate is 30.5%
- Among those who do not work overtime, the attrition rate drops to just 10.4% (Figure 1)

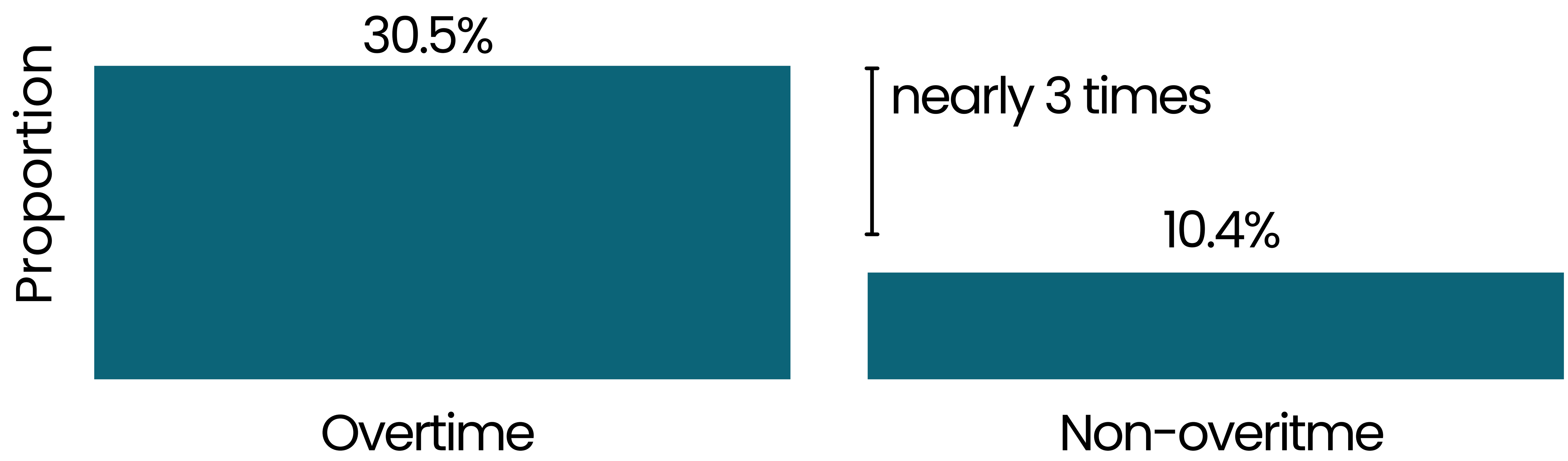
This means that employees who work overtime are almost three times more likely to leave the company compared to their peers who do not work overtime.

To validate this relationship, a Chi-squared test with Yates' correction was performed:

- X-squared = 87.564, df = 1, p-value < 2.2e-16
- Since the p-value is much smaller than the significance level of 0.05, we reject the null hypothesis (H_0)

This confirms that the difference in attrition rates between the two groups is not due to random chance, and that working overtime is statistically associated with a significantly higher likelihood of leaving the organization.

Figure 1. Attrition Probability by Overtime Status



1.2.Overtime may signal deeper organizational & psychological risks

Overtime, while sometimes necessary in short bursts, can signal deeper organizational issues when it becomes the norm rather than the exception. In this analysis, a disproportionately high attrition rate among employees who regularly work overtime suggests more than just long hours — it reflects potential burnout, lack of work-life balance, and perceived unfairness in workload distribution.

From a psychological standpoint, sustained overtime gradually erodes employees' sense of control over their time — a key driver of motivation and well-being. When individuals feel their time is constantly stretched beyond formal expectations, they may perceive the company as disorganized, unempathetic, or misaligned with their values. This undermines trust and emotional attachment to the organization, even among previously committed employees.

From an organizational view, widespread overtime may reflect inefficient capacity planning, especially during peak demand cycles or in resource-constrained departments. It can also signal a gap in productivity management, where employees may not be equipped with the skills or autonomy to manage workloads effectively — resulting in effort that does not translate into sustainable performance.

Therefore, addressing this issue requires not only limiting overtime, but also restructuring how work is distributed, and enabling employees and managers with the right tools and mindsets to manage time more efficiently. Only by tackling both the symptom (overtime) and the root causes (planning, process, capability) can the organization reduce attrition while protecting productivity.

1.3.Three actionable recommendations to reduce overtime-driven attrition

Based on the strong association between excessive overtime and higher attrition risk, the following actions are recommended to address both the symptom (overtime) and its underlying drivers:

1. Set a formal policy to limit excessive overtime

- Establish and communicate a company-wide guideline that defines acceptable overtime thresholds (e.g., not exceeding 8–10 hours/week).
- Implement monitoring systems (via HRIS or timesheets) to track overtime usage across departments.
- Empower team leaders to proactively flag and address situations where overtime becomes chronic or unbalanced.

Expected Outcome: Reduce burnout and signal to employees that their time and well-being are valued.

2. Reallocate workforce and optimize staffing during peak periods

- Conduct workload and capacity assessments in departments with high overtime and attrition levels.
- Strategically reassign or temporarily reinforce teams during seasonal peaks or project crunch periods.
- Consider rotational task planning or temporary hiring where appropriate.

Expected Outcome: Prevent systemic overload, improve resource planning, and balance effort across teams.

3. Provide training on time management and planning

- Develop short-form training or coaching sessions for employees and team leads on task prioritization, delegation, and workload planning.
- Encourage the use of tools (e.g., shared calendars, project trackers) to help individuals better manage deliverables within regular working hours.
- Integrate time-management skills into onboarding and leadership development programs.

Expected Outcome: Equip employees with the skills to manage workload efficiently and reduce reliance on overtime as a coping mechanism.

2.JUNIOR EMPLOYEES ARE MOST LIKELY TO LEAVE

2.1.Junior Employees Have 2.6x Higher Attrition Rate Than Others

The data shows a clear and statistically significant relationship between job level and employee attrition:

- Among Junior employees, the attrition rate is 26.3%
- Among non-Junior employees, the attrition rate drops to just 10.1% (Figure 2)

This means that Junior employees are approximately 2.6 times more likely to leave the company compared to their peers at higher job levels.

To validate this relationship, a Chi-squared test with Yates' correction was performed:

- X-squared = 65.219, df = 1, p-value = 6.701×10^{-16}
- Since the p-value is much smaller than the significance level of 0.05, we reject the null hypothesis (H_0)

This confirms that the observed difference in attrition rates between Junior and non-Junior groups is statistically significant and unlikely due to random chance, indicating that job level is strongly associated with likelihood of attrition.

Figure 2. Attrition Probability by Job Level

2.2.Lack of Career Visibility and Early Support Drives Turnover

The significantly higher attrition rate among Junior employees suggests more than just lack of experience — it points to unmet expectations, limited visibility into growth opportunities, and insufficient early-stage support.

From a psychological standpoint, early-career employees often seek clarity, recognition, and a sense of progression. Without a clear understanding of how they can grow within the company, even capable individuals may feel stagnant or disconnected from long-term goals. This ambiguity, combined with limited feedback and guidance, can create anxiety and reduce commitment — prompting them to look elsewhere for faster or more visible career advancement.

From an organizational lens, high turnover among Junior employees may reflect a gap in career development infrastructure. Many companies focus heavily on recruiting young talent, but fail to nurture them post-onboarding. Without structured mentoring, goal setting, or regular check-ins, these employees may feel isolated, unsure whether they are on track — or even seen.

Therefore, addressing this issue requires more than compensation or workload changes. It requires building confidence in long-term growth, beginning with onboarding, reinforced through mentorship, and sustained via timely performance reviews that create transparent pathways to advancement.

2.3.3 Strategic Actions to Retain Early-Career Talent

To address the high attrition rate among Junior employees, organizations should focus on improving early-career development, visibility, and support. The following three strategies are recommended:

1. Establish Clear Career Roadmaps

- Develop role-specific progression frameworks that outline the skills, behaviors, and milestones required for advancement
- Communicate these paths during onboarding and follow-up sessions so Junior employees understand what "growth" looks like and how to achieve it
- Collaborate with team leads to set realistic timelines for promotions or internal transfers

Expected Outcome: Increase clarity, motivation, and long-term retention among early-career staff.

2. Implement a Mentoring or Buddy Program

- Pair Junior employees with experienced team members to provide guidance, feedback, and informal support
- Mentors can help navigate company culture, understand performance expectations, and build social connection
- This program should be structured but flexible, allowing both formal check-ins and informal conversations

Expected Outcome: Reduce feelings of isolation, build belonging, and accelerate confidence during the first 6–12 months.

3. Conduct Regular Performance Check-ins and Growth Conversations

- Move beyond annual performance reviews by integrating quarterly development-focused check-ins
- Use these conversations to revisit goals, identify skill gaps, and provide recognition or course correction early
- Equip managers with tools to give constructive feedback and identify high-potential talent for targeted development

Expected Outcome: Foster a sense of progress and alignment, increasing both engagement and loyalty during the most fragile phase of the employee lifecycle.

3.UNATTRACTIVE COMPENSATION IS A KEY TURNOVER DRIVER

3.1.EMPLOYEES EARNING LESS THAN 2,696 ARE MORE LIKELY TO LEAVE

3.1.1.Employees Earning Less Than 2,696 Have 2.5x Higher Attrition Rate Than Higher Earners

The data reveals a strong and statistically significant association between monthly income and employee attrition:

- Among employees earning less than 2,696, the attrition rate is 31.3%
- Among those earning 2,696 or more, the attrition rate drops to 12.3% (Figure 3)

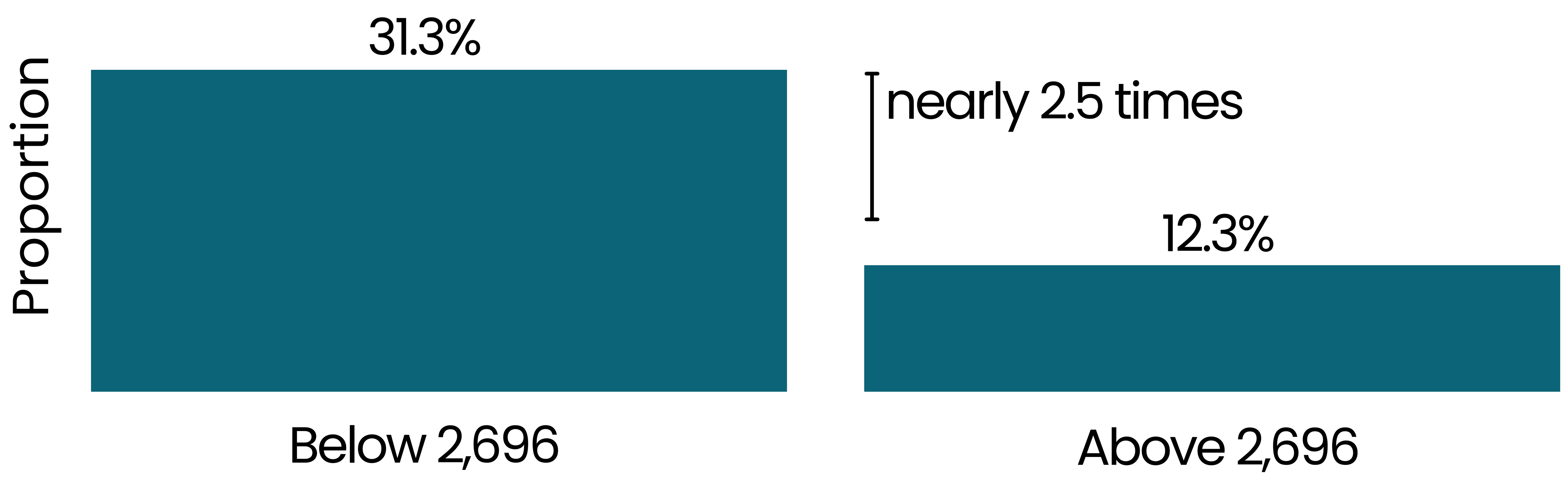
This means that low-income employees are more than 2.5 times more likely to leave the organization compared to their higher-earning peers.

To validate this relationship, a Chi-squared test with Yates' correction was conducted:

- X-squared = 61.145, df = 1, p-value = 5.30×10^{-15}
- Since the p-value is significantly lower than the 0.05 threshold, we reject the null hypothesis (H_0)

This provides strong statistical evidence that income level is associated with attrition rate, and supports the alternative hypothesis (H_1) that a minimum income threshold of 2,696 helps reduce the likelihood of attrition.

Figure 3. Attrition Probability by Monthly Income Level



3.1.2.Newer Junior Employees Are More Sensitive to Low Pay

However, when we segment further by job level and tenure, the effect of low income is not uniform.

Group	Attrition Rate (Low Income)	Attrition Rate (High Income)	Observation
Junior < 3Y in Role & Promotion	**36,8%**	**21,4%**	**Most affected**
Others (Not Junior or ≥ 3 years)	17,6%	11,1%	Less affected

While low income is generally associated with higher attrition, our segmented analysis reveals that this effect is particularly pronounced among Junior employees with less than 3 years in their current role and since last promotion. In this group, the attrition rate among low-income earners reaches 36.8%, significantly higher than the 21.4% observed among their higher-paid peers — a clear signal of disengagement when financial rewards do not align with career growth expectations.

From a behavioral perspective, early-stage employees often equate compensation not only with value but also with progress. When salary stagnates while effort and tenure accumulate, it can create a sense of being undervalued or overlooked, especially in the absence of promotion or recognition. This dissonance is further amplified when they compare themselves with peers or market benchmarks, leading to dissatisfaction and ultimately, attrition.

In contrast, for more experienced or stable employees (not Junior or with ≥3 years), the difference in attrition between income groups narrows (17.6% vs. 11.1%). While pay remains a factor, its influence may be moderated by job security, organizational loyalty, or non-financial benefits that accumulate over time. This suggests that the impact of income on attrition diminishes as employees gain tenure and internal stability — but mismatched compensation can still drive discontent if salary does not reflect actual contributions.

Addressing these nuanced drivers requires differentiated strategies:

- For junior employees early in their journey, focus on predictable growth paths, performance-tied raises, and milestone recognition to signal value and progression.
- For more tenured staff, emphasis should shift to fairness, transparency, and external competitiveness in salary structures to reinforce long-term engagement.

3.1.3.Tailored Compensation Strategies to Reduce Income-Driven Attrition

3.1.3.1.Junior Employees (<3 Years in Role & Since Last Promotion)

This group is the most vulnerable to attrition when income remains stagnant. The following actions aim to signal progress, boost morale, and retain early-stage talent:

1.Introduce structured salary increases tied to time-in-role and performance

- Define clear salary progression aligned with tenure and performance benchmarks to reward consistency and development.

Expected Outcome: Reinforces sense of progress and fairness.

2.Offer milestone-based retention bonuses at 1, 2, and 3 years in role

- Provide financial incentives that reward loyalty and sustained contribution at critical early stages.

Expected Outcome: Encourages short-term retention and long-term planning.

3.Provide upskilling opportunities to support readiness for promotion

- Offer targeted training, mentoring, or stretch assignments to prepare junior staff for next-level roles.

Expected Outcome: Increases engagement and internal mobility readiness.

3.1.3.2.Other Employees (Not Junior or ≥ 3 Years in Role/Promotion)

This group is less sensitive to base income but more likely to disengage when compensation does not reflect experience or responsibility:

1.Re-evaluate salary using market benchmarking

- Conduct external salary comparisons to ensure competitiveness and prevent perception of stagnation or underpayment.

Expected Outcome: Increases perceived fairness and market alignment.

2.Align salary reviews with actual responsibilities and performance

- Move beyond fixed-cycle reviews by allowing mid-cycle adjustments based on workload changes, role expansion, or outstanding contribution.

Expected Outcome: Retains high performers and improves satisfaction among tenured staff.

3.2.LACK OF STOCK OPTIONS LINKED TO HIGHER ATTRITION

3.2.1.Employees Without Stock Options Have a 2.5x Higher Attrition Rate

The data reveals a significant relationship between stock option benefits and employee attrition:

- Among employees with stock options (stock option level ≥1), the attrition rate is 9.9%
- Among those without stock options (stock option level = 0), the attrition rate rises sharply to 24.4% (Figure 4)

This means that employees who do not receive stock option benefits are approximately 2.5 times more likely to leave the company compared to those who do.

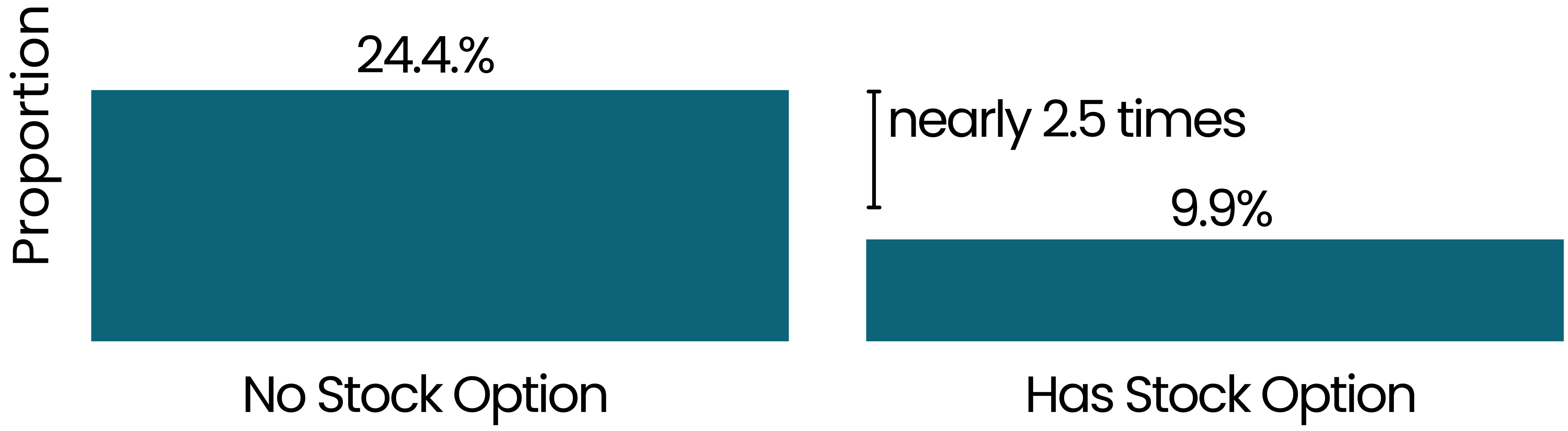
To validate this difference, a Chi-squared test with Yates' continuity correction was conducted:

- X-squared = 55.025, df = 1, p-value = 1.19×10^{-13}

Since the p-value is far below the standard significance level of 0.05, we reject the null hypothesis (H_0) and accept the alternative (H_1).

This provides strong statistical evidence that the absence of stock option benefits is significantly associated with a higher risk of attrition.

Figure 4. Attrition Probability by Stock Option Level



3.2.2.Married Employees Are Especially Sensitive to the Lack of Stock Options

While the overall analysis shows that employees without stock option benefits have 2.5x higher attrition, segmenting the data by marital status reveals interesting differences in how stock option benefits influence different demographic groups.

Marital Status	Attrition Rate (No Stock Option)	Attrition Rate (Has Stock Option)	Statistically Significant?
Married	**10,2%**	**20,3%**	✅ **Yes (p = 0.0014)**
Single & Divorced	9,4%	25,7%	❌ No (p > 0.05)

While the lack of stock option benefits is generally associated with higher attrition, our segmented analysis reveals that this effect is particularly pronounced among married employees. In this group, the attrition rate among those without stock options reaches 20.3%, nearly double the 10.2% observed among those who receive them — highlighting a clear disconnect between long-term compensation structures and the expectations of employees with family responsibilities.

From a behavioral standpoint, married employees may perceive stock options as both a financial safety net and a long-term investment in the company's future—one that aligns with their own life goals such as home ownership, children's education, or retirement planning. When such long-term incentives are absent, it may signal a lack of commitment from the employer, triggering feelings of insecurity or underappreciation. This mismatch between employee expectations and available rewards may erode trust and push high-risk individuals to explore opportunities that offer more comprehensive financial packages, including equity or long-term wealth-building options.

In contrast, among single and divorced employees, while the difference in attrition rates also appears large (25.7% vs. 9.4%), statistical testing shows that this variation is not significant. This suggests that stock options may be less relevant or motivating for these groups, who may instead prioritize immediate and flexible benefits—such as opportunities for personal growth, learning budgets, or improved work-life balance. As employees in these groups may place less weight on long-term financial tools, a lack of stock options does not significantly affect their decision to stay or leave.

Addressing these diverging needs requires differentiated engagement strategies:

- For married employees, highlight and expand access to equity-based rewards, especially after a defined tenure, while making the long-term value of stock ownership clear and accessible.
- For single and divorced employees, focus on offering greater autonomy, personal development resources, and flexible arrangements that support their current lifestyle and individual goals.

3.2.3.Retention Strategies Should Reflect Life Stage and Incentive Priorities

3.2.3.1. Married Employees

This group demonstrates a significantly higher sensitivity to the lack of stock option benefits. The following actions are designed to reinforce long-term commitment and financial alignment:

1.Prioritize stock option plans for married employees after a minimum tenure (e.g., 1 year)

- Establish a clear, tenure-based eligibility policy that grants access to stock options after employees reach a defined milestone.

Expected Outcome: Strengthens perceived investment from the company and incentivizes long-term retention.

2.Clearly communicate the value, eligibility, and long-term benefits of stock ownership

- Ensure that married employees fully understand how stock options contribute to long-term financial planning and total compensation.

Expected Outcome: Increases perceived value of equity incentives and builds trust through transparency.

3.2.3.2.Single & Divorced Employees

Although stock options do not significantly influence attrition for this group, they may be motivated by flexibility, autonomy, and short-term rewards. Tailored engagement strategies should focus on addressing these priorities:

1.Offer learning and personal development budgets

- Provide annual allowances or access to learning platforms that support personal or career growth.

Expected Outcome: Boosts intrinsic motivation and builds skills aligned with individual aspirations.

2.Provide flexible work arrangements or extra personal leave

- Allow greater control over work hours or additional leave days to support personal well-being and independence.

Expected Outcome: Enhances work-life balance and employee satisfaction without relying on financial incentives.

VI. EMPLOYEE LIFECYCLE HEATMAP

Risk Segment / Stage	Onboarding 0–6M	6M–1Y Milestone	1–2Y Growth Phase	>2Y Maturity & Stabilization
1. Overtime Workers	🟡 Monitor workload in early ramp-up	🔵 Set OT limits 🔵Time manage training	🔵 Reallocate workload 🔵 Add temporary staff during peak load	🔵 Promote wellness & work-life balance practices
2. Junior Employees (<3Y in role & promotion)	🔵 Onboard with career path clarity	🔵 Implement buddy/mentoring system	🔵 Frequent performance reviews 🔵 Promotion readiness coaching	🟡 Offer internal mobility opportunities
3.1. Junior + Income <2,696	🔵 Offer market-aligned base salary	🔵 Structured salary plan intro	🔵 Milestone bonuses at 1, 2, 3Y 🔵 Training for promotion readiness	🔵 Time-in-role salary raise reinforcement
3.2. Other Employees + Income <2,696	🟡 Salary check after onboarding	🔵 Review salary fairness vs. contribution	🔵 Market benchmarking review	🔵 Performance-aligned raise adjustments
4.1. Married Employees Without Stock Options	🟡 Identify marital status (if declared)	🟡 Communicate LT benefits strategy	🔵 Offer stock options after 1Y 🔵 Communicate eligibility/value	🔵 Reinforce equity benefit in retention efforts
4.2. Single & Divorced Without Stock Options	🔵 Flexible work environment onboarding	🟡 Offer development fund intro	🔵 Provide personal dev. budgets 🔵 Optional leave/flex time	🟡 Support career planning or lifestyle benefits

Legend:

🔵 = Should be implemented at this stage

🟡 = Can be implemented or supported (depending on context and available resources)

VII. LIMITATIONS & NEXT STEPS

1.WHAT THIS PROJECT DOESN'T COVER (YET)

1.Synthetic dataset with limited context

The IBM HR dataset used in this project is publicly available and synthetically generated. As a result, some variables (e.g., promotion timeline, satisfaction level) may not fully reflect the complexity of real-world employee behavior or organizational dynamics.

2.No time-based data for trend analysis

The dataset does not include time-series information (e.g., hire date, resignation date, monthly performance), limiting the ability to analyze trends over time or detect early warning signals for attrition.

3.No external benchmarking or market salary data

Compensation-related insights are based solely on internal data. Without external benchmarking, it's difficult to assess whether "low income" reflects actual market underpayment or internal disparities.

4.No predictive modeling applied (yet)

The project currently focuses on exploratory and explanatory analysis. Predictive models (e.g., attrition risk scoring) have not been implemented, limiting actionability in real-time decision-making.

2.HOW TO ELEVATE THIS PROJECT FURTHER

1.Build predictive models to estimate attrition risk

Implement machine learning models such as logistic regression, decision trees, or XGBoost to predict the likelihood of attrition for individual employees. This would extend the project from insight generation to proactive intervention.

2.Develop interactive dashboards for HR decision-makers

Visualize key insights and KPIs (e.g., attrition by segment, income bands, overtime impact) using tools like Power BI or Tableau. This enhances clarity and enables real-time monitoring in a business context.

3.Automate the analytics workflow using RMarkdown or Python

Turn the project into a reusable analytics pipeline that includes data cleaning, EDA, hypothesis testing, and reporting — all reproducible with minimal manual effort.

4.Compare findings with other public HR datasets

Validate key patterns (e.g., overtime impact, junior attrition) by applying the same methodology to other open-source datasets. This will strengthen the generalizability of insights.

VIII. CONCLUSION

This project explored key drivers of employee attrition using the IBM HR dataset, combining exploratory data analysis, hypothesis testing, and targeted solution design. By segmenting employees based on factors such as job level, overtime status, compensation, and stock option benefits, we identified high-risk groups and proposed tailored retention strategies.

Our findings confirm that attrition is not uniformly distributed. Junior employees, those working overtime, and staff earning below a critical income threshold are significantly more likely to leave the organization. Moreover, the absence of long-term incentives like stock options further increases risk—particularly among married employees who may be more sensitive to long-term financial security.

The recommendations put forth are grounded in data and behavioral insight, emphasizing both structural solutions (e.g., salary progression, stock benefits) and experience-focused interventions (e.g., mentorship, performance reviews). These proposals aim to not only reduce attrition but also build a workplace culture that values growth, fairness, and wellbeing.

While this analysis is based on synthetic data, the approach mirrors real-world HR decision-making: uncovering root causes, designing evidence-based strategies, and balancing short-term fixes with long-term cultural investment.

Going forward, this project can be expanded with predictive modeling, dashboard development, and testing across different datasets to further validate insights and sharpen recommendations. Ultimately, it demonstrates how HR data—when properly analyzed—can drive meaningful change and inform smarter people strategies.