



Individual Coursework Submission Form

Specialist Masters Programme

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Introduction

In response to SFB's restructuring plans, a predictive framework has been developed to estimate which employees are likely to accept a Rationalization Compensation Contract (RCC) if offered. Using historical employee data, attrition probabilities are calculated and applied to current workforce profiles, enabling the identification of potential leavers. These probabilities serve as the basis for defining RCC-eligible groups and formulating an optimization model that minimizes severance costs while adhering to business and departmental constraints. The following analysis presents this end-to-end approach, combining predictive analytics with operational decision-making to guide an effective restructuring strategy.

Task 1: Attrition Prediction Model Using Historical Closure Data

Exploratory Data Analysis and Preprocessing

A predictive model was developed using historical employee data consisting of demographic, job-related, and satisfaction metrics for over 1,000 individuals. The dataset exhibited significant class imbalance, with only 17% of employees having accepted an RCC during a prior closure. To address this, balanced class weights were applied during model training.

Initial analysis revealed several non-informative or constant features, which were removed. Skewed financial and tenure-related variables were log-transformed and scaled to improve model performance. A preprocessing pipeline was built to impute missing values, encode categorical features, and normalize numerical ones.

Model Fitting

Multiple classification algorithms were evaluated, including logistic regression, decision tree, random forest, and support vector machine (SVM). The SVM model achieved the best performance, with an ROC-AUC of 0.876 and a recall of 83%, making it well-suited for identifying likely leavers.

Feature Analysis

Feature importance analysis highlighted key predictors of RCC acceptance. Employees in operational roles, frequent travellers, those working overtime, and unmarried individuals showed higher likelihood of leaving. In contrast, high performers were more likely to stay, underscoring the importance of retaining top talent during restructuring.

Task 2: Predicting Attrition Likelihood for Lyon Employees

The trained SVM model was deployed on a new dataset representing employees from a prospective closure site in Lyon. To maintain consistency, the same preprocessing pipeline was applied as in the earlier analysis. The model generated attrition probabilities for each employee, estimating their likelihood of accepting an RCC offer. These predictions were compiled into a structured output file to support data-driven decision-making in severance planning and optimization.

Task 3: Defining Objective Groups for RCC Allocation

To effectively implement a rationalization strategy while meeting the organizational requirement that RCCs be offered only to “objectively defined” groups, the team adopted a segmentation approach based on business-relevant employee characteristics, using deterministic rule-based clustering. This allowed for a balance between analytical precision, ethical compliance, and operational feasibility.

Definition of Groups (Clusters)

Employees were segmented into strategic groups (or “clusters”) based on a combination of features relevant to workforce planning and attrition risk:

- **Department:** Human Resources, Sales, and Research & Development.
- **Tenure:** Categorized into three brackets – 0–3 years, 3–10 years, and 10+ years at the company
- **Salary:** Divided into four quartiles based on monthly income
- **Performance Rating:** Employees’ latest performance scores.

Each cluster was assigned a unique identifier in the format.

For instance, a cluster labelled "RD-T3-10-SL2-P4" would represent R&D employees with 3–10 years of tenure, in the second salary quartile, and with a performance rating of 4.

This approach ensures full transparency in how groups are defined and allows management to make targeted decisions while adhering to the constraint of group-based RCC offerings.

Expected Attrition and Financial Metrics

For each employee, the predicted probability of accepting an RCC offer (from Task 2) was combined with financial data to calculate:

- **Expected Annual Savings:** Estimated based on the employee’s monthly income, assuming departure following RCC acceptance.
- **Expected Severance Cost:** A combination of legal minimums (based on tenure) and a random incentive component, scaled by the likelihood of the employee accepting the RCC.

These metrics were aggregated at the cluster level, generating strategic insights per group:

- Average attrition probabilities
- Total expected leavers
- Aggregate income savings
- Total severance cost and expected severance cost.

Considerations in Group Definition

The granularity of groups

The rule-based clustering strategy employed in this analysis was designed to navigate the trade-off between granularity and practicality in group definition.

Smaller groups, created through fine-grained segmentation, offer a high degree of targeting precision. They allow the organization to focus RCC offerings on employee segments with a higher probability of acceptance and greater financial return in terms of cost savings. This can lead to a more efficient restructuring outcome, with minimal disruption to core operations. However, the downside lies in perceived fairness and transparency—overly narrow group definitions may appear arbitrarily constructed or selectively biased, raising ethical concerns or internal resistance.

On the other hand, larger groups, such as entire departments or broad salary bands, are easier to justify from a policy and communication standpoint. They inherently support the principles of equity and transparency, as they apply uniform criteria across wider swaths of the workforce. However, this inclusivity comes at the expense of financial efficiency. RCCs may be offered to employees who are unlikely to accept them or who hold strategic value to the organization, thereby reducing the overall effectiveness of the program.

Recognizing these trade-offs, this analysis adopted moderately sized clusters rooted in objective business dimensions—department, tenure, salary quartile, and performance rating. This approach delivers a measured compromise, ensuring ethical defensibility while retaining a strategic focus on financial impact and organizational needs.

Non-Discriminatory Grouping Assurance

To ensure that the RCC grouping strategy remains fair, ethical, and legally sound, several safeguards were integrated into the clustering process to prevent both direct and indirect discrimination:

- **Exclusion of Protected Attributes:** The group formation logic explicitly excluded any protected characteristics such as age, gender, ethnicity, or religion—even if such data were available. By focusing solely on non-sensitive features, the approach adheres to ethical standards and complies with anti-discrimination regulations.
- **Use of Objective, Business-Critical Criteria:** The segmentation was based exclusively on variables that are operationally and economically relevant to workforce planning—namely, department affiliation, tenure at the company, salary quartile, and performance rating. These criteria are defensible from both a managerial and strategic standpoint, ensuring that group definitions are driven by organizational needs rather than personal characteristics.

In essence, the grouping methodology was guided by transparency, reproducibility, and business logic. These design choices enable BAP to implement its restructuring plan with confidence in the fairness and inclusivity of its approach, while also maintaining operational effectiveness and compliance with ethical norms.

Task 4: Optimization Model for RCC Allocation

To implement a cost-effective and compliant workforce restructuring strategy, an optimization model was developed using Excel Solver. The model was designed to assist BAP in identifying employee groups at SFB that should be offered RCCs while minimizing overall severance costs.

This task builds on the earlier clustering and prediction steps (Tasks 1–3), utilizing the predicted probabilities of RCC acceptance and groupings data formed to support financially strategic decisions.

Modelling Objective

The optimization problem was formulated to determine which employee groups should be selected for RCC offers, such that the following business constraints are satisfied:

- At least €3,000,000 in salary cost savings,
- At least 40 employees are expected to leave, and
- Each department (HR, Sales, R&D) retains at least 80% of its workforce.

The Three Building Blocks

The optimization model applied follows a standard mathematical programming structure built on three essential components: decision variables, an objective function, and a set of constraints. These components were operationalized using Excel Solver to identify the most cost-effective way to offer Rationalization Compensation Contracts (RCCs) while satisfying all restructuring requirements defined by the business.

1. Decision Variables

A decision variable represents a controllable input in the optimization process — a value the model can change to arrive at the best outcome.

In this model, a binary decision variable was defined for each employee group (cluster). A cluster is a group of employees grouped by Department (HR, Sales, or R&D) and Salary Level (SL1–SL4). The variable takes on the following values:

- 1 - RCCs are offered to the employees in that group
- 0 - RCCs are not offered to that group

These decision variables serve as the "switches" that Excel Solver toggles on or off in different combinations to identify the group selection that minimizes the overall severance cost while meeting all specified constraints.

2. Objective Function

The objective function defines the goal of the optimization — in this case, the minimization of expected severance costs associated with offering RCCs.

Each cluster has a pre-calculated expected severance cost, which is the product of:

- The average individual severance cost for employees in the cluster (based on salary and tenure rules), and the predicted attrition probability for that cluster (from Task 2).

$$\text{Expected Severance Cost} = \text{Individual Severance Cost} \times \text{Attrition Probability}$$

This expected value reflects a probabilistic financial impact, accounting for the fact that not every employee offered an RCC will accept it. Only a fraction — determined by the model's predicted attrition probability — will actually leave.

The objective function adds up the expected severance costs of all selected clusters (those with decision variable = 1). Excel Solver is then used to find the group selection that results in the lowest total expected severance cost, thereby optimizing the restructuring financially.

3. Constraints

To ensure the optimization output is not only cost-effective but also aligned with organizational requirements, three binding constraints were imposed:

a. Salary Savings Constraint

This constraint ensures that the total expected annual salary savings from employees who are likely to accept RCCs is at least €3 million. This financial threshold is critical to justify the restructuring from a cost-saving perspective.

b. Expected Exits Constraint

This constraint mandates that the total number of expected RCC acceptances across all selected clusters is at least 40 employees. It ensures that the scale of reduction is operationally meaningful and aligned with the company's downsizing targets.

Expected leavers are calculated as:

$$\text{Expected Leavers} = \text{Cluster Size} \times \text{Attrition Probability}$$

c. Departmental Retention Constraint

This constraint ensures that no department is disproportionately impacted. At least 80% of employees in each department must be retained after RCC offers are accepted. This prevents operational disruption and safeguards critical departmental capacity.

Results

| Metric | Requirement | Result |
|----------------------------|-----------------|-----------------|
| Total Salary Savings | ≥ 30000000 | €3,000,642 |
| Expected Number of Leavers | ≥ 40 | 43.89 employees |
| Total Severance Cost | | €1,718,706 |

Task 5: Evaluation of the Prediction-and-Optimization Approach

Advantages of the Approach

1. Data-Driven Decision Making

The approach ensures that RCC offers are guided by objective data — such as attrition probabilities, salaries, and severance costs — rather than intuition or subjective judgment. This promotes transparency and consistency in decision-making.

2. Cost Efficiency

By minimizing expected severance costs while satisfying operational constraints, the optimization model identifies the most financially prudent course of action. This enables BAP to meet savings targets while avoiding excessive spending on voluntary exits.

3. Ethical and Strategic Targeting

Prediction helps identify employees who are more likely to accept RCCs, reducing the risk of offering packages to those who would decline. This ensures RCCs are targeted at willing leavers, minimizing disruption and preserving high-retention segments.

4. Scalability and Replicability

Once built, the model can be reused or adapted for future restructuring scenarios, closures, or departments, providing a scalable and adaptable decision-support system.

Limitations and Risks

1. Dependence on Prediction Accuracy

The effectiveness of the optimization depends heavily on the reliability of the attrition predictions. If the model misestimates the likelihood of RCC acceptance, the expected savings and exits may not materialize as planned.

2. Static Snapshot

The model uses a static dataset and does not dynamically account for changes over time (e.g., evolving employee sentiment, labor market conditions, or policy shifts). This could limit its adaptability to sudden organizational changes.

3. Group-Level Implementation

Because RCCs must be offered to entire groups, the model's granularity is limited. High-performing individuals in otherwise at-risk groups may receive offers, which can pose retention risks or morale concerns.

5. Interpretation and Buy-in

The analytical nature of the approach may be difficult to interpret for non-technical stakeholders. Gaining executive and employee trust in the fairness of the model may require additional effort in communication and change management.

Key Assumptions and Their Validity

| Assumption | Validity | Description |
|--|----------------------------------|---|
| Past attrition behavior predicts RCC acceptance | Reasonable but context-sensitive | The prediction model is based on data from a previous closure. It assumes Lyon employees will behave similarly. |
| RCC acceptance decisions are independent | social effects may exist | The model assumes each employee decides independently, with no peer influence or collective behavior. |
| All RCCs must be offered at group level, not individually | Reasonably High | This is both a legal and modelling constraint. |