

Model governance

SALARY PREDICTION MODEL



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**Model Governance Document for Salary Prediction Model**

**1. Introduction**

**1.1 Project Overview**

This project focuses on developing a predictive model to estimate salary ranges using a comprehensive dataset with over 1.6 million job descriptions. The model considers various factors such as qualifications, experience, job title, role, sector, industry, and type of work to provide accurate salary range predictions. The model is intended to aid both individuals in negotiating salaries and organizations in structuring competitive compensation packages.

**1.2 Purpose of Model Governance**

The purpose of this document is to establish a governance framework specifically for the salary prediction model, ensuring its continued accuracy, fairness, and compliance with industry standards. The governance framework will cover aspects such as monitoring the model’s performance, managing risks, and documenting any updates or changes to the model.

**1.3 Audience**

This document is intended for the data science team, HR professionals, business analysts, and decision-makers who are directly involved in the deployment, maintenance, and utilization of the salary prediction model.

**2. Variable Level Monitoring**

**2.1 Model Build Variable Level Statistics**

During the model development, the following statistics were captured for each feature:

* **Experience:** The dataset showed a strong correlation between years of experience and salary. The mean experience was calculated at 7.2 years, with a standard deviation of 4.1 years.
* **Job Title:** The model initially included over 147 unique job titles, which were grouped into broader categories for better prediction accuracy.
* **Sector and Industry:** Certain sectors, like Financial Services, showed a significant influence on salary predictions, with a mean salary 20% higher than other sectors. Industry-specific caps and floors were implemented to prevent skewed results.

**2.2 Acceptable Ranges**

Acceptable ranges were determined based on historical salary data and industry benchmarks:

* **Experience:** 0 to 40 years. Any data outside this range was flagged as a potential outlier.
* **Salary:** The salary range was expected to be between $59,000 and $105,000. Values outside this range were considered either entry-level anomalies or executive outliers.

**2.3 Caps & Floors**

To manage outliers:

* **Caps and Floors:** Cap and floor is not required for the current dataset as there are not any outliers in the numerical data. But outliers should be considered for future.

**2.4 Missing Values**

Handling missing data was crucial given the size of the dataset:

* **Sector Gaps:** Missing sector data was imputed using the mode of the sector.
* **Industry Gaps:** Missing industry data was filled using the most common industry within the same sector, ensuring that imputation did not introduce bias.

**2.5 Variable Drift Monitoring Tolerance**

Given the dynamic nature of the job market, ongoing monitoring for variable drift is essential:

* **Drift Tolerance:** A tolerance level of 5% was set for significant variables like experience and industry. If drift exceeds this threshold, a review is triggered to adjust the model as necessary.

**3. Model Monitoring, Health & Stability**

**3.1 Initial Model Fit Statistics**

The initial model was validated with the following results:

* **Accuracy:** 82.05%, indicating strong overall performance in predicting salary ranges.
* **AUC:** 0.9539, reflecting the model’s high ability to distinguish between different salary ranges.
* **F1 Score:** 81.95%, ensuring a good balance between precision (82.48%) and recall (82.05%).
* **Sector Sensitivity:** Special attention was given to sectors like Financial Services and Energy, where the model showed varying degrees of sensitivity, necessitating sector-specific adjustments.

**3.2 Model Performance Monitoring**

The model's performance is regularly monitored to ensure its continued accuracy:

* **Monthly Monitoring:** Monthly checks are conducted to track any significant shifts in the model’s accuracy or predictive power. This includes re-evaluating the model’s performance on new data.
* **Quarterly Reviews:** Every quarter, the model undergoes a comprehensive review, including a re-assessment of key features such as sector and industry relevance, to ensure that it continues to reflect current market trends.

**3.3 Model Health Checks**

Regular health checks include:

* **Degradation Detection:** Automated alerts are set up to detect when model performance drops below 80% accuracy. If such a drop is detected, an immediate analysis is triggered.
* **Market Condition Monitoring:** The model’s assumptions are regularly tested against changing market conditions, particularly during economic downturns or industry shifts, ensuring it remains relevant.

**4. Risk Tiering**

**4.1 Risk Assessment**

The model’s risks were classified as follows:

* **Low Risk:** No significant drift detected, and the model is performing within expected accuracy ranges. Standard monitoring is sufficient.
* **Medium Risk:** Minor deviations in accuracy or variable drift approaching the 5% threshold. Increased monitoring and possible recalibration required.
* **High Risk:** Significant drop in model performance or major market shifts detected. Immediate intervention required, possibly involving a full model rebuild.

**4.2 Trigger Points for Action**

Specific triggers for action include:

* **Accuracy Drop:** A decrease in model accuracy below 80% triggers an in-depth review.
* **Drift Detection:** If any key variable shows a drift exceeding 5%, the model is flagged for re-evaluation and potential retraining.
* **Sector Changes:** Significant changes in industry conditions, such as those caused by regulatory changes or market disruptions, trigger a review of the model’s underlying assumptions.

**4.3 Action Plan**

Actions based on risk levels include:

* **No Action (Low Risk):** Standard monitoring continues, with no immediate changes required.
* **Report and Investigate (Medium Risk):** Detailed analysis of the variable in question and potential recalibration.
* **Refit or Rebuild (High Risk):** If the model’s performance deteriorates significantly, a decision is made to either refit the existing model with new data or rebuild it entirely with updated features.

**5. Documentation and Reporting**

**5.1 Version Control**

A detailed version history is maintained, documenting:

* **Model Updates:** Every change to the model, including parameter adjustments, is logged with justifications and outcomes.
* **Deployment Records:** Dates and details of each deployment are recorded to track the model’s evolution and performance over time.

**5.2 Reporting Schedule**

A structured reporting schedule ensures transparency:

* **Monthly Reports:** Summary reports are generated monthly, detailing key performance metrics and any anomalies detected.
* **Quarterly Reviews:** In-depth reports are prepared quarterly, including trend analyses, risk assessments, and any recommended actions for model improvement.

**5.3 Stakeholder Communication**

Effective communication strategies include:

* **Real-Time Alerts:** Immediate alerts to stakeholders if critical thresholds are breached, ensuring quick action can be taken.
* **Regular Updates:** Routine updates on model performance, upcoming changes, and potential impacts on business decisions.

**6. Governance Framework**

**6.1 Roles and Responsibilities**

Clear roles are assigned for managing the model:

* **Data Science Team:** Responsible for day-to-day model monitoring, performance assessment, and implementing updates.
* **Business Analysts:** Provide insights on market trends and ensure the model aligns with current business needs.
* **HR Professionals:** Utilize the model for salary setting and ensure the predictions are practical and applicable.
* **Decision-Makers:** Approve significant changes to the model and ensure that all governance practices are followed.

**6.2 Decision-Making Process**

A structured process for decision-making includes:

* **Assessment:** Regular assessments to determine if changes are needed based on model performance and market conditions.
* **Approval:** Decision-makers review and approve any significant changes to the model, ensuring they are aligned with business objectives.
* **Implementation:** Once approved, changes are implemented and documented, with all stakeholders informed of the updates.

**6.3 Compliance and Ethics**

Compliance with industry standards and ethical practices is ensured:

* **Bias Mitigation:** Continuous checks for bias in the model, especially concerning sensitive variables like gender or ethnicity.
* **Data Privacy:** Adherence to data privacy laws, ensuring that all data used is anonymized and securely stored.

**7. Conclusion**

**7.1 Summary**

This Model Governance Document outlines a comprehensive approach to ensuring the ongoing accuracy, fairness, and relevance of the salary prediction model. By establishing clear guidelines for variable monitoring, model health checks, risk management, and stakeholder communication, the model is well-positioned to continue delivering valuable insights.

**7.2 Future Considerations**

To further strengthen the model governance framework:

* **Advanced Monitoring:** Consider implementing machine learning-driven monitoring for real-time drift detection.
* **Model Expansion:** Explore the inclusion of additional variables or the extension of the model to different geographic regions.
* **Continuous Improvement:** Regularly update the model with new data to ensure it remains current and aligned with industry trends.

**8. Appendices**

**8.1 Glossary**

* **Drift:** A change in the statistical properties of the input data, which can affect model performance if not addressed.
* **PSI (Population Stability Index):** A metric used to detect shifts in the distribution of model input variables.

**8.2 Detailed Performance Metrics**

* **Accuracy Trends:** Graphs and tables showing changes in the model’s accuracy over time.
* **Drift Detection:** Reports detailing any instances of variable drift and the actions taken in response.

**8.3 Monitoring Tools and Technologies**

To effectively monitor and maintain the salary prediction model, the following tools and technologies have been implemented:

**1. Python and Colab Notebooks**

* **Purpose:** Python is used for all model development, data preprocessing, and performance evaluation. Colab Notebooks provide an interactive environment for running and documenting scripts related to data analysis and model monitoring.
* **Usage:** Regularly scheduled scripts run within Colab Notebooks are used to generate performance reports, track variable drift, and check for data integrity.

**2. Automated Alert Systems**

* **Purpose:** Automated alerts notify the team when certain thresholds are breached, such as a drop in model accuracy or significant variable drift.
* **Usage:** Integrated with cloud platforms or monitoring dashboards, these alert systems ensure that any issues are addressed promptly.