

Predictive Modeling for Policy Lapse Forecasting Using Machine Learning

DISSERTATION

Submitted in partial fulfillment of the requirements of the

Degree: **MTech in Data Science and Engineering**

By

Justin P Mathew

Under the supervision of

Venkata Girish Kumar Nidra
Assistant Consultant

BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE
Pilani (Rajasthan) INDIA

(June, 2024)

BIRLA INSTITUTE OF TECHNOLOGY & SCIENCE, PILANI
SECOND SEMESTER 2023-24

DSECLZG628T DISSERTATION

Dissertation Title : Predictive Modeling for Policy Lapse Forecasting Using Machine Learning

Name of Supervisor : Venkata Girish Kumar Nidra

Name of Student : Justin P Mathew

ID No. of Student :

Courses Relevant for the Project & Corresponding Semester:

1. Introduction to Data Science
2. Machine Learning
3. Deep Learning
4. Data Visualization & Interpretation

Abstract

This dissertation investigates the intersection of Public Policy Analysis, Predictive Analytics, and Policy Lifecycle Management, aiming to develop and apply predictive models to forecast policy lapses. Policy lapses—failures in policy renewal, enforcement, or compliance—can lead to considerable disruptions and inefficiencies. Traditionally, policy management has been reactive, addressing lapses only after they occur. However, the advent of predictive analytics offers a promising shift towards a proactive approach.

Predictive analytics leverages historical data and statistical algorithms to forecast future events with high accuracy. In policy management, these tools can analyze patterns and identify indicators preceding policy lapses. Factors such as policy age, compliance rates, economic conditions, and stakeholder engagement can be systematically evaluated to predict the likelihood of a policy failing to sustain its intended impact. This dissertation aims to bridge the gap between traditional policy analysis and modern predictive methodologies by developing robust predictive models. These models will provide policymakers with early warnings and actionable insights, enabling them to preemptively address potential lapses, thereby enhancing the efficiency and effectiveness of policy management and contributing to the overall stability and sustainability of public administration practices. The research employs a mixed-methods approach, combining quantitative data analysis with qualitative assessments to ensure a comprehensive understanding of the factors influencing policy lapses.

The objectives of this dissertation include developing a predictive model for policy lapses using advanced statistical techniques and machine learning algorithms, identifying key predictors of policy lapses, validating the predictive model with historical policy data, and assessing its practical implications for policymakers. The research also aims to enhance policy lifecycle management by providing recommendations for using predictive analytics to reduce policy lapses and contribute to the broader field of predictive analytics in public administration.

Additionally, the dissertation will propose future research directions to refine predictive models and explore their applicability in different policy environments.

The scope of this dissertation encompasses several key areas like predictive analytics. It includes a comprehensive literature review on policy lifecycle management, policy lapses, and predictive analytics; data collection from historical policy records or open-source datasets; model development using advanced statistical techniques and machine learning algorithms; model validation with historical data; analysis of key predictors; and practical implications assessment. The dissertation will provide actionable recommendations for improving policy lifecycle management and contribute to the field by developing a scalable and adaptable predictive model.

The research is structured into several phases, beginning with a literature review and conceptual framework, then data collection, model development, model validation, analysis of key predictors, assessment of practical implications, and finally, writing and finalizing the dissertation. Each phase is designed to systematically build towards enhancing policy lifecycle management through predictive analytics.

In summary, this dissertation explores the potential of predictive analytics to transform policy lifecycle management by reducing the occurrence of policy lapses through informed, proactive decision-making. By developing and validating predictive models, the research aims to provide policymakers with the tools necessary to anticipate and mitigate policy lapses, thereby enhancing the sustainability and effectiveness of public policies.

Key Words:

- Machine Learning,
- Predictive Analytics
- Proactive Decision-Making
- Policy Lapses
- Policy Management

BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI
II SEMESTER 23-24
DSECLZG628T DISSERTATION
Dissertation Outline

BITS ID No.

Name of Student: Justin P Mathew

Name of Supervisor: Venkata Girish Kumar Nidra

Designation of Supervisor: Assistant Consultant

Qualification and Experience: B.Tech, 16 years

Official E- mail ID of Supervisor:

Topic of Dissertation: Predictive Modeling for Policy Lapse Forecasting Using Machine Learning

(Signature of Student)

(Signature of Supervisor)

Date: 07/06/2024

Date: 07/06/2024

Project Work Title

Predictive Modeling for Policy Lapse Forecasting using Machine Learning

Discussion on the chosen topic

The primary purpose of this dissertation is to develop and apply predictive models to forecast policy lapses, thereby enhancing policy lifecycle management and sustainability. By integrating advanced statistical techniques and machine learning algorithms, the research aims to provide policymakers with early warnings and actionable insights to preemptively address potential lapses. The expected outcome includes a robust predictive model capable of accurately forecasting policy lapses, detailed insights into the factors influencing these lapses, and practical recommendations for policymakers to improve policy management and sustainability.

Traditionally, policy management has relied on reactive measures, addressing policy lapses only after they have occurred. This approach often results in significant disruptions and inefficiencies, as policymakers are unable to anticipate and mitigate issues before they escalate. Limitations of the existing process include Lack of early warning systems for policy lapses, Insufficient use of historical data to predict future policy performance, Limited integration of quantitative and qualitative data in policy analysis and Reactive rather than proactive decision-making frameworks.

The selected methodology combines advanced statistical techniques and machine learning algorithms, which are justified for several reasons:

1. **Accuracy:** Machine learning algorithms can process large datasets and identify complex patterns, leading to highly accurate predictions.
2. **Proactivity:** Predictive models provide early warnings, enabling proactive policy management.
3. **Scalability:** The methodology can be adapted to various policy domains and contexts.
4. **Comprehensiveness:** Combining quantitative data analysis with qualitative insights ensures a holistic understanding of factors influencing policy lapses.

The methodology for this project involves several key steps:

1. **Literature Review:** Conduct a thorough review of existing literature on policy lifecycle management, policy lapses, and predictive analytics.
2. **Data Collection:** Gather historical policy data from various sectors, including governmental and non-governmental organizations, or utilize open-source datasets.
3. **Model Development:** Develop predictive models using advanced statistical techniques and machine learning algorithms, incorporating variables such as policy age, compliance rates, economic conditions, and stakeholder engagement levels.
4. **Model Validation:** Test and validate the predictive models using historical data to ensure their accuracy and reliability.
5. **Analysis of Key Predictors:** Identify and analyze the critical predictors of policy lapses, examining their individual and combined effects.
6. **Practical Implications:** Assess the practical implications of the predictive models for policy management and develop actionable recommendations for policymakers.
7. **Recommendations:** Provide guidelines for utilizing predictive analytics to enhance policy sustainability and reduce the risk of lapses.
8. **Documentation:** Compile the findings, methodologies, and recommendations into a comprehensive dissertation document.

The benefits of this dissertation include

1. **Improved Policy Management:** Policymakers can use predictive models to anticipate and mitigate policy lapses, leading to more efficient and effective management.
2. **Proactive Decision-Making:** Early warnings enable policymakers to take proactive measures, reducing the occurrence of policy lapses.
3. **Enhanced Sustainability:** By addressing potential issues before they escalate, policies are more likely to sustain their intended impact.
4. **Practical Recommendations:** The study provides actionable insights and guidelines for policymakers, improving resource allocation and strategic planning.

The interdisciplinary nature of this research combines quantitative and qualitative approaches, ensuring a comprehensive understanding of policy lapses. The dissertation aims to identify areas for future research, focusing on refining predictive models and exploring their use in diverse policy environments. The ultimate goal is to transform policy lifecycle management, making it more proactive, efficient, and sustainable.

Detailed plan of work

Phase 1 : Literature Review and Conceptual Framework : 3 weeks: Comprehensive review of existing literature on policy lifecycle management, policy lapses, and predictive analytics.

Phase 2 : Data Collection and Preprocessing : 4 weeks : Collection of quantitative data from historical policy records across various sectors or open source datasets.

Phase 3 : Model Development : 4 weeks : Development of a predictive model using advanced statistical techniques and machine learning algorithms.

Phase 4 : Model Validation : 2 weeks : Testing and validation of the predictive model using historical data.

Phase 5 : Analysis of Key Predictors : 1 week : In-depth analysis of the critical predictors of policy lapses.

Phase 6 : Practical Implications and Recommendations : 1 week : Assessment of the practical implications of the predictive model for policy management. Development of actionable recommendations for policymakers to utilize predictive analytics in enhancing policy sustainability and reducing lapses.

Phase 7 : Writing and Finalization : 1 week : Completion of the dissertation document, including all chapters, references, and appendices. Final review and editing to ensure clarity, coherence, and adherence to academic standards.

1. Broad Area of Work

This dissertation explores the intersection of Public Policy Analysis, Predictive Analytics, and Policy Lifecycle Management. It aims to develop and apply predictive models to forecast policy lapses. By using advanced statistical techniques and machine learning, the research seeks to improve prediction accuracy and provide useful insights for policymakers. This approach combines quantitative data analysis with qualitative insights to address key challenges in policy management and sustainability.

2. Objectives

The objectives of my project are as follows:

- **Develop a Predictive Model for Policy Lapses:** Create a robust predictive model utilizing advanced statistical techniques and machine learning algorithms to forecast policy lapses accurately.
- **Identify Key Predictors of Policy Lapses:** Determine and analyze the critical factors that influence policy lapses, such as policy age, compliance rates, economic conditions, and stakeholder engagement levels.
- **Validate the Predictive Model:** Test and validate the predictive model using historical policy data from various sectors to ensure its accuracy and reliability.
- **Assess Practical Implications:** Evaluate the practical implications of the predictive model for policymakers and stakeholders, focusing on its potential to inform proactive decision-making and resource allocation.
- **Enhance Policy Lifecycle Management:** Develop recommendations for using predictive analytics to improve policy lifecycle management, aiming to reduce the occurrence of policy lapses and enhance policy sustainability.
- **Contribute to Predictive Analytics in Public Administration:** Contribute to the broader field of predictive analytics by offering a scalable model applicable across various policy domains and contexts.
- **Propose Future Research Directions:** Identify areas for future research to refine predictive models and explore their applicability in different policy environments, ensuring the continued advancement of policy management practices.

3. Scope of Work

Scope of this dissertation is to design and develop predictive models for forecasting policy lapses within the domain of public policy management and predictive analytics. This involves a detailed exploration of the factors influencing policy lapses. The specific scope includes:

1. **Literature Review:** Conduct a comprehensive review of existing literature on policy lifecycle management, policy lapses, and predictive analytics. Analyze previous studies on predictive modeling in policy management and identify gaps in current research.
2. **Data Collection:** Gather historical policy data from various sectors, including governmental and non-governmental organizations, or find open-source datasets.
3. **Model Development:** Utilize advanced statistical techniques and machine learning algorithms to develop a predictive model for forecasting policy lapses. Incorporate variables such as policy age, compliance rates, economic indicators, and stakeholder engagement levels into the model.
4. **Model Validation:** Test the predictive model using historical data to evaluate its accuracy and reliability. Perform sensitivity analyses to determine the robustness of the model under different scenarios.
5. **Analysis of Key Predictors:** Identify and analyze the critical predictors of policy lapses, examining their individual and combined effects. Explore how different factors interact and contribute to the likelihood of a policy lapse.
6. **Practical Implications:** Assess the practical implications of the predictive model for policy management, focusing on its potential to inform proactive decision-making. Develop guidelines for policymakers on how to utilize predictive analytics to enhance policy sustainability.
7. **Recommendations:** Provide actionable recommendations for improving policy lifecycle management based on the findings of the predictive model. Suggest strategies for preemptive interventions to mitigate the risk of policy lapses.

8. **Contribution to Knowledge:** Contribute to the field of public policy and predictive analytics by developing a scalable and adaptable predictive model. Offer insights into the integration of quantitative and qualitative data in forecasting policy outcomes.

9. **Future Research Directions:** Identify potential areas for future research to further refine predictive models and explore their applicability in diverse policy contexts. Propose longitudinal studies to track the effectiveness of predictive models over time.

The scope of this dissertation is designed to provide a comprehensive framework for understanding and forecasting policy lapses, ultimately aiming to enhance policy management practices and ensure greater policy sustainability.

4. Detailed Plan of Work

Serial Number of Task / Phases	Tasks or subtasks to be done (be precise and specific)	Start Date-End Date	Planned duration in weeks	Specific Deliverable in terms of the project
1.	Literature Review	Jun 9 - Jun 29 2024	3	Identification of gaps and potential research questions
2.	Data Collection	Jun 30 - Jul 13 2024	2	Dataset in CSV format
3.	Clean and preprocess data	Jul 14 - Jul 27 2024	2	Cleaned and preprocessed dataset ready for analysis
4.	Model Development	Jul 28 - Aug 24 2024	4	Developed and enhanced predictive model
5.	Model Validation	Aug 25 - Sep 7 2024	2	Validation results and accuracy metrics
6.	Analysis of Key Predictors	Sep 8 - Sep 14 2024	1	List and analysis of key predictors
7.	Practical Implications and Recommendations	Sep 15 - Sep 21 2024	1	Practical guidelines and recommendations for policymakers
8.	Writing and Finalization	Sep 22 - Sep 28 2024	1	Completed dissertation document

5. Literature References

The following are referred journals from the preliminary literature review.

[1] Barsotti, F., Milhaud, X. & Salhi, Y. (2016). Lapse risk in life insurance: Correlation and contagion effects among policyholders' behaviors.

[2] Ćurak, M., Podrug, D. & Poposki, K. (2015). Policyholder and Insurance Policy Features as Determinants of Life Insurance Lapse - Evidence from Croatia

Supervisor's Rating of the Technical Quality of this Dissertation Outline

EXCELLENT / GOOD / FAIR/ POOR (Please specify): EXCELLENT

Supervisor's suggestions and remarks about the outline (if applicable).

Date: 07/06/2024

(Signature of Supervisor)

Name of the supervisor: Venkata Girish Kumar Nidra

Email Id of Supervisor:

Mob # of supervisor: