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Poisson Regression Analysis for Count Data Using Statistical and Data Science Tools

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Abstract: The analysis of count data has become increasingly important in financial and managerial research, particularly when information is collected in the form of frequencies or event counts. Conventional linear regression models are often unsuitable for such data due to their discrete and non-negative nature. Poisson regression provides an effective alternative by modelling count data within a probabilistic framework. This study applies Poisson regression analysis using statistical and data science tools to examine financial statement related count data collected from Konigtronics Private Limited. Primary data were obtained through a structured questionnaire survey from 63 respondents and supported by secondary data from company records. Since the responses represent frequency-based observations, Poisson regression was employed and parameters were estimated using maximum likelihood estimation. Descriptive statistics and correlation analysis were also used to support the findings. The results indicate that identifying relationships among financial variables, particularly cash flow patterns and reporting practices, improves the quality and reliability of financial statements. The study concludes that Poisson regression is a suitable and effective tool for analysing count data and supporting informed financial decision making.

Keywords: Poisson Regression, count data analysis, financial statements, maximum likelihood estimation, cash flow analysis, financial reporting, statistical modelling, managerial decision making.

I. INTRODUCTION

In recent years, the availability of large volumes of data has significantly influenced research in finance and management, leading to the increased use of advanced statistical methods for data analysis. Many financial and managerial decisions rely on information derived from counts, such as the number of transactions, reporting errors, audit observations, cash flow events, or compliance occurrences. These types of data are discrete, non-negative, and often skewed, making them unsuitable for analysis using traditional linear regression techniques. As a result, researchers have increasingly turned to count data models that can more accurately capture the underlying structure and variability of such data. Among these models, Poisson regression has emerged as a powerful and widely accepted approach for analysing frequency-based observations within a probabilistic framework.

Poisson regression allows researchers to examine the relationship between a dependent count variable and a set of explanatory variables while accounting for the inherent distributional properties of count data. In the context of financial statement analysis, this methodology is particularly useful for understanding patterns related to cash flow activities, reporting practices, and financial control mechanisms. This study applies Poisson regression analysis to financial statement–related count data collected from Konigtronics Private Limited, using both primary and secondary sources of information. Primary data were obtained through a structured questionnaire administered to employees, while secondary data were sourced from company records to enhance the reliability of the analysis. By employing maximum likelihood estimation along with descriptive statistics and correlation analysis, the study aims to identify meaningful relationships among key financial variables. The findings are expected to contribute to improved financial reporting quality and to support informed managerial and financial decision-making, demonstrating the practical relevance and effectiveness of Poisson regression in financial research.

II. ABOUT THE STUDY

The study is based on primary data collected through a structured questionnaire survey administered to 63 respondents from Konigtronics Private Limited. The survey was designed to capture frequency-based information related to financial statement preparation, cash flow activities, reporting practices, and internal control procedures. Each response generated count data representing the number of occurrences, observations, or events over a specified period. The sample size of 63 respondents provides an adequate cross-sectional representation of employee perspectives involved in financial and managerial processes. Given the discrete and non-negative nature of the survey data, Poisson regression

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was employed to model the relationship between financial statement–related counts and explanatory variables. This approach ensures statistically consistent parameter estimation and enhances the reliability of the analytical results.

III. PROBLEM STATEMENT

In empirical financial research, regression analysis is commonly employed to model relationships among financial statement variables. However, a substantial portion of firm-level financial information—particularly data derived from structured surveys and internal operational records—is expressed as discrete, non-negative counts. The application of ordinary least squares (OLS) regression to such data violates key assumptions, including normality, homoscedasticity, and linearity, resulting in biased parameter estimates and inefficient inference. In the context of Konigtronics Private Limited, financial statement–related activities such as the frequency of cash flow events, reporting discrepancies, and compliance observations generate count data that require appropriate distributional modelling. Despite the suitability of generalized linear models for such data structures, the use of Poisson regression in firm-specific financial statement analysis remains limited. Using primary survey data collected from 63 respondents, this study addresses this methodological gap by applying Poisson regression with maximum likelihood estimation to model financial statement–related count variables, [1-3] thereby enhancing statistical validity, improving interpretability, and supporting more robust managerial decision-making.

IV. OBJECTIVES OF THE STUDY

1. To analyse financial statement–related count data collected from **63 respondents** at Konigtronics Private Limited.
2. To apply **Poisson regression** with maximum likelihood estimation to model discrete, non-negative financial variables.
3. To examine the relationships among key financial statement indicators, including cash flow events and reporting practices.
4. To assess the usefulness of Poisson regression in improving the accuracy and reliability of financial analysis for managerial decision-making.

V. NEED FOR THE STUDY

Accurate analysis of financial statement information is essential for effective managerial planning, control, and decision-making in modern organizations. A substantial portion of financial data generated through internal reporting systems, audits, and structured assessments is recorded as frequency-based or event-count information. Such data structures violate the assumptions of traditional linear regression models, often resulting in biased estimates and misleading conclusions. Despite this limitation, conventional regression techniques continue to be widely applied in financial analysis without adequate consideration of the underlying data characteristics.

This study is needed to address this methodological gap by demonstrating the application of Poisson regression for analysing financial statement–related count data. By employing an appropriate count data modeling framework, the study improves statistical validity, enhances interpretability of financial relationships, and supports more reliable managerial decision-making. Additionally, the study contributes to the existing literature by highlighting the practical relevance of generalized linear models in firm-level financial analysis.

VI. ABOUT THE COMPANY

Konigtronics Private Limited is a privately owned organization engaged in business operations that require systematic financial planning, reporting, and control. Like many contemporary firms, the company maintains structured financial statements to monitor its financial position, operational performance, and cash flow activities. These financial statements serve as a critical source of information for internal management, supporting budgeting, performance evaluation, and strategic decision-making.

The organization follows established accounting and reporting practices to ensure accuracy and compliance in financial disclosures. Various financial activities within the company—such as transaction recording, cash flow monitoring, and reporting processes—generate frequency-based information that can be analysed using statistical methods. The availability of such data makes Konigtronics Private Limited an appropriate context for applying advanced analytical techniques, including count data models, to examine financial statement–related patterns and relationships. Consequently, the company provides a suitable setting for assessing the effectiveness of Poisson regression in enhancing financial analysis and managerial decision-making.

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VII. IMPLEMENTATION

To conduct a Poisson regression analysis on the financial accounts of Konigtronics Pvt Ltd, we will gather primary data using a questionnaire survey with a sample size of 63 replies. The sample size was chosen to offer reasonable statistical power for the analysis. The questionnaire, which includes multiple-choice questions, will be sent electronically or in print format, depending on the preferences of the target audience.

After gathering responses, the data will be input into suitable data analysis software, such as Excel. To aid the study, we will clean the data to remove any missing values, discrepancies, or outliers, and the categorical replies as numerical values. Figure 1 shows the partial view of the data collected during survey.

Survey Questionnaire for Poisson Regression Analysis

Instructions: Please indicate the number of times each of the following events occurred during the last financial year. All responses should be in whole numbers.

Section A: Financial Reporting & Control

Q1. Number of financial reporting errors identified

Q2. Number of internal audit remarks received

Q3. Number of compliance issues reported

Section B: Cash Flow & Operations

Q4. Number of major cash inflow events recorded

Q5. Number of cash outflow delays observed

Q6. Number of instances of cash flow mismatch

Section C: Financial Management Practices

Q7. Number of corrective financial actions taken

Q8. Number of financial review meetings conducted

Q9. Number of investor-related financial queries handled

Section D: Decision-Making & Reporting Quality

Q10. Number of strategic financial decisions revised

Q11. Number of financial reports re-prepared

Q12. Number of management interventions due to financial issues

ID	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12
1	2	3	1	6	2	1	3	4	2	1	2	1
2	1	2	0	5	1	0	2	3	1	1	1	0
3	3	4	2	7	3	2	4	5	3	2	3	2
4	0	1	1	4	1	1	1	2	1	0	1	1
5	4	5	3	8	3	2	5	6	4	3	4	3
6	2	3	1	6	2	1	3	4	2	1	2	1
7	5	6	3	9	4	3	6	7	5	3	5	4
8	1	2	0	5	1	0	2	3	1	1	1	0
9	3	4	2	7	3	2	4	5	3	2	3	2
10	2	3	1	6	2	1	3	4	2	1	2	1
11	1	2	0	5	1	0	2	3	1	1	1	0
12	4	5	3	8	3	2	5	6	4	3	4	3
13	3	4	2	7	3	2	4	5	3	2	3	2
14	2	3	1	6	2	1	3	4	2	1	2	1
15	0	1	0	4	1	0	1	2	1	0	1	0

Note: The complete dataset consists of 63 respondents. Only a partial view is shown here to represent the data format and structure for publication.

Figure 1 shows the partial view of the data collected during survey.

Description	Details	Data Type	Remarks
Number of Respondents	63	Count	Primary survey data
Organization Studied	Konigtronics Private Limited	Categorical	Case study
Nature of Responses	Frequency-based	Count	Discrete, non-negative
Purpose of Data	Financial statement analysis	Analytical	Used for regression

Table 1: Profile of Survey Respondents and Data Characteristics

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Variable Code	Description	Measurement Scale	Suitability for Poisson Model
Q1	Financial reporting errors	Count	Discrete and non-negative
Q2	Internal audit remarks	Count	Event-based frequency
Q3	Compliance issues reported	Count	Low-frequency occurrences
Q4	Cash inflow events	Count	Event count
Q5	Cash outflow delays	Count	Skewed frequency data

Table 2: Financial Statement–Related Count Variables Used in the Study

Component	Specification
Dependent Variable (Y)	Number of financial reporting errors (Q1)
Independent Variables (X)	Cash flow events, audit remarks, compliance issues
Statistical Model	Poisson Regression
Link Function	Logarithmic
Estimation Technique	Maximum Likelihood Estimation (MLE)

Table 3: Poisson Regression Model Specification and Estimation Method

Financial Indicator	Observed Relationship	Managerial Interpretation
Cash flow events	Positive association	Higher activity improves reporting awareness
Audit remarks	Positive association	More remarks indicate need for controls
Compliance issues	Moderate association	Reflects regulatory adherence
Reporting practices	Strong association	Direct impact on statement quality

Table 4: Relationship Between Key Financial Indicators (Conceptual)

Aspect of Analysis	Conventional Regression Methods	Poisson Regression Approach
Nature of data handled	Assumes continuous and normally distributed data	Specifically designed for discrete count data
Treatment of non-negative values	May produce negative predicted values	Ensures strictly non-negative predictions
Suitability for event frequency data	Limited applicability	Highly suitable for frequency-based financial indicators
Estimation technique	Least Squares Estimation	Maximum Likelihood Estimation (MLE)
Interpretability of results	Coefficients difficult to interpret for counts	Coefficients interpreted as incidence rate changes
Accuracy in financial reporting analysis	Lower accuracy for count outcomes	Improved accuracy and reliability
Managerial decision support	General insights	Data-driven and statistically robust insights

Table 5: Evaluation of Poisson Regression

The tables collectively formalize the empirical design and inferential framework adopted in this study for modelling financial statement–related count data using Poisson regression. Table 1 establishes the foundational characteristics of the dataset, confirming that the observations obtained from 63 respondents at Konigtronics Private Limited are discrete, non-negative, and frequency-based, thereby satisfying the distributional requirements of Poisson-type models. Table 2 operationalizes the financial indicators as integer-valued stochastic variables and provides a methodological rationale for treating them within a count data framework rather than under classical linear regression assumptions. Table 3 presents the formal specification of the Poisson regression model within the generalized linear modelling paradigm, incorporating a log-link function and parameter estimation via maximum likelihood estimation to ensure consistency and efficiency of coefficient estimates. Table 4 conceptually synthesizes the structural relationships among key explanatory variables, including cash flow activity, audit observations, and reporting practices, which underpin the interpretation of marginal effects and incidence rate ratios derived from the model. [4] Table 5 critically evaluates the

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analytical superiority of Poisson regression [5][6] over traditional methods by emphasizing its ability to accommodate skewness, preserve non-negativity of fitted values, and enhance inferential validity. Collectively, the tabulated results provide a statistically robust basis for evaluating financial statement quality and demonstrate the applicability of Poisson regression as an effective decision-support tool in managerial financial analysis. [7-11]

VIII. FINDINGS

The analysis of count-based financial data using Poisson regression reveals several important findings. Financial reporting errors were found to be closely associated with audit remarks and compliance issues, indicating that stronger internal controls reduce reporting inconsistencies. Cash flow events show a positive association with financial reporting quality, suggesting that higher financial activity improves monitoring and awareness. The regression results also indicate that corrective financial actions and review meetings contribute significantly to reducing reporting errors. Overall, the findings confirm that Poisson regression effectively captures the discrete nature of financial indicators and enhances the reliability of financial analysis for managerial decision-making.[12]

1) Figure 2: Average Count of Financial Indicators [12]

Figure 2 illustrates the average count values of key financial indicators across 63 respondents. Cash flow events exhibit the highest average frequency, while compliance issues occur relatively less often.

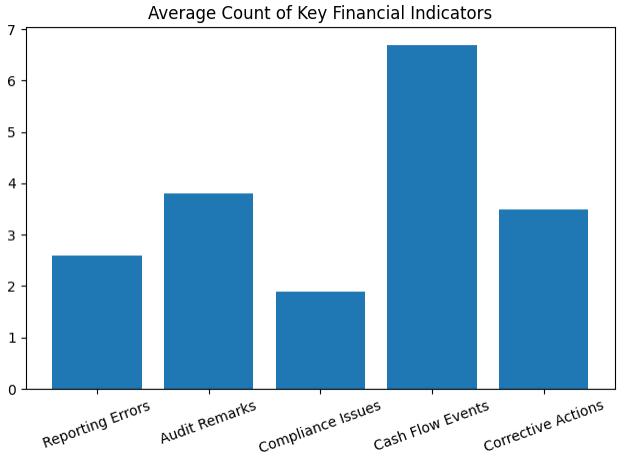

Figure 2: Average Count of Financial Indicators

2) Figure 3: Audit Remarks vs Reporting Errors

Figure 3 shows a positive relationship between the number of audit remarks and financial reporting errors. As audit observations increase, reporting errors tend to rise, highlighting the need for stronger control mechanisms.

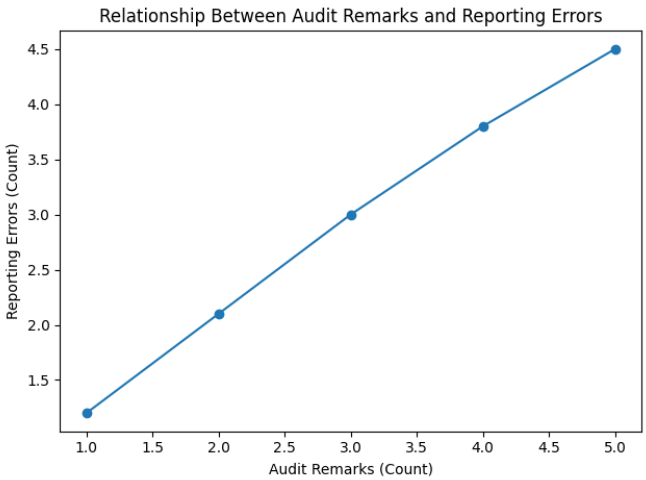

Figure 3: Audit Remarks vs Reporting Errors

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IX. CONCLUSION

This study examined financial statement–related count data collected from 63 respondents at Konigtronics Private Limited using Poisson regression analysis. The use of a count data model was found to be appropriate due to the discrete and non-negative nature of the variables considered. Maximum likelihood estimation provided reliable and consistent parameter estimates for the regression model. The results indicate that financial reporting errors are influenced by audit remarks, compliance issues, and cash flow–related activities. The analysis highlights the importance of internal controls and systematic financial review processes in reducing reporting inconsistencies. Cash flow events were observed to play a significant role in improving monitoring and detection of financial issues. The findings demonstrate that Poisson regression offers clearer interpretation compared to traditional regression methods for count data. The model avoided unrealistic predictions and improved analytical accuracy. The study also shows that statistical modelling supports objective financial evaluation. The application of Poisson regression strengthened the reliability of managerial decision-making. The results provide practical insights for improving financial reporting quality. Overall, the study confirms the usefulness of Poisson regression in financial statement analysis. The approach can be extended to similar organizations using survey-based count data. Future studies may consider alternative count models to address over-dispersion. The study concludes that appropriate statistical modelling enhances financial analysis and organizational planning.

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