A Predictive Ordered Logistic Regression Model for Quality Review of Control Risk Assessments

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Background

• Management and external auditors are required to report on the adequacy of internal controls (SOX 404)

• Internal audit quality is important to external auditors as well as management (Gramling & Vandervelde, 2006)

• External auditors are encouraged to take the work of internal auditors into consideration (AS No. 5)

• The quality of internal audit affects external auditors in 3 phases (SAS No. 65) (AU Section 322):
  – Risk assessment
  – Understanding, documenting, and testing internal controls
  – Substantive testing

• Control Risk Assessments (CRA): a popular tool that helps the auditors to get a better understanding of business processes
Information Overload

- Big data causes a shift towards audit-by-exception

- Prior Continuous Auditing (CA) and Continuous Control Monitoring (CCM) research focused on detecting exceptions efficiently

- Analysis usually yields large amounts of exceptions, overloading auditors with information due to sub-optimal business processes or overly conservative CA/CCM system (Alles et al. 2006, 2008; Debreceny et al. 2003)

- Human users perform complex aggregation and processing tasks poorly (Iselin, 1988; Kleinmunitz, 1990)
Objectives & Research Questions

• Objectives
  – Formulate a predictive model for preliminary control risk assessment
  – Identify exceptions (quality review)
  – Propose a methodology to prioritize these exceptions (Exceptional Exceptions)

• Research Questions
  1. How can we verify and review the quality of internal auditors’ judgment in control risk assessments?
  2. How can we prioritize the exceptions that deviate from the norms?
Data

• Source: Multinational consumer products company
• Issues identified by location and business process (e.g. Distribution, Payroll, Purchasing, A/P)

Data breakdown:

<table>
<thead>
<tr>
<th></th>
<th>FY 08/09</th>
<th>FY 09/10</th>
<th>FY 10/11</th>
<th>All (08-11)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS</td>
<td>344</td>
<td>305</td>
<td>275</td>
<td>924</td>
</tr>
</tbody>
</table>
Ordered Logistic Regression

- Variables: ordinal and labeled (audit risk levels)

**Ordered Logistic Regression:**

\[
\text{logit} = \ln \left( \frac{\text{prob(event)}}{1 - \text{prob(event)}} \right) = \beta^T x_i + \varepsilon_i = \beta_0 + \beta_1 CC + \beta_2 MC + \beta_3 NMC
\]

- Predicted probability:

\[
\text{PredProb} = \hat{P}(C_i|x) = \frac{1}{1 + e^{-(\beta^T x_i + \varepsilon_i)}}
\]

  - \(\beta^T\) is a vector of Intercepts
  - \(x_i\) is the vector of coefficients
  - The class with the highest calculated probability is the predicted class
# Outliers Identification and Ranking

<table>
<thead>
<tr>
<th>Record</th>
<th>CC</th>
<th>MC</th>
<th>NMC</th>
<th>Calc_H</th>
<th>Calc_M</th>
<th>Calc_L</th>
<th>Assign. Class</th>
<th>Pred. Class</th>
<th>Ratio</th>
<th>Diff.</th>
</tr>
</thead>
<tbody>
<tr>
<td>123456</td>
<td>0</td>
<td>2</td>
<td>3</td>
<td>0.60719</td>
<td>0.39195</td>
<td>0.00086</td>
<td>M</td>
<td>H</td>
<td>0.64551</td>
<td>0.21524</td>
</tr>
</tbody>
</table>

**Outliers’ disagreement measure:**

\[
\text{Ratio} = \frac{\text{Calc.prob Assigned Class}}{\text{Calc.prob Predicted Class}}
\]

\[
\text{Difference} = \text{Calc.prob Predicted Class} - \text{Calc.prob Assigned Class}
\]

\[
\text{Ratio} = \frac{0.39195}{0.60719} = 0.64551
\]

\[
\text{Difference} = 0.60719 - 0.39195 = 0.21524
\]

The lower (bigger) the ratio (difference), the more suspicious the record is
Main Findings

• Accuracy of the fitted model is 93%, indicating that only 7% of the records deviated from the model.

• Predictive power of the model is 76.36%.

• Top 20 outliers using both ranking metrics were the same, and were sent to the company for further investigation.

• Interesting finding: 3 records with no issues, but High risk.

• Check for robustness and consistency: sliding window technique
  – Coefficients differed slightly, but top 20 outliers were the same.
Conclusion

• **Contribution:**
  – Proposed a methodology for external auditors to review the quality of auditors’ judgment of CRAs
  – Proposed a methodology to prioritize outliers, thus increasing audit efficiency by helping auditors focus their efforts on more suspicious records
  – Developed a methodology for consistency check, which can provide non-experts with expert-like knowledge

• **Future Research:**
  – Develop more sophisticated ranking techniques and compare their performance
Thank You!