

## Rutgers Business School Continuous Auditing & Reporting Lab Paper series

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### Announcements

# RUTGERS

Business School

**ACCOUNTING RESEARCH CENTER AND  
CONTINUOUS AUDITING AND REPORTING LAB**

### About this Lab

[The Car Lab \(Continuous Auditing & Reporting Lab\)](#) has been the world leader for the last 30 years in Accounting Information Systems research as rated by Brigham Young University and has partnerships with standard setters and many private organizations. The CAR Lab is a research group where each research project uniquely benefits practice and contributes to academic research.

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**CAR Lab Paper Series**

## **"Prediction Error, Noise, and Bias of Auditors' Going Concern Opinions and the Role of Machine Learning"**

### *Research Paper No. 1*

This research studies the error, bias, and noise of auditors' going concern opinion (GCO) in predicting firm default and we examine the role of machine learning (ML) in impacting the above prediction features. We find that advanced machine learning models can significantly reduce the error, bias, and noise of default firms compared to GCO, consistent with the theory in Kahneman et al. (2021). Following Kahneman et al. (2021), we also explore the value of diversity in improving prediction quality. To that end, we construct four "artificial auditors" representing Big4 auditors and we find that the consensus from these artificial auditors can significantly reduce the prediction error compared to GCO, which is issued by one auditor. Our study adds to the accounting literature by examining the quality of GCO and the mechanism through which ML improves default prediction from the angle of prediction error, bias, and noise.

## **"Using Supervised Learning Algorithms to Predict Discontinued Operations in Nonprofit Institutions"**

### *Research Paper No. 2*

Nonprofit organizations play an important role in economy worldwide. The operation of those organizations primarily rely on the donation from donors. However, the discontinued operation of non-profit organizations due to financial reasons have brought the problem of unbalanced economy resource allocation. The prediction of bankruptcy or dissolution of for-profit companies has been widely studied using different data analytic methodologies, and various machine learning approaches have been evaluated and demonstrated effective. However, the prediction of non-profits discontinued operation is still rarely studied. This study attempts to do such prediction comparing the performance of Logistic Regression, Decision Tree, Random Forest, Multilayer Perceptron, Support Vector Machine and Bayes Net. The overall effectiveness of different prediction performance will be assessed.

## **"Continuous Student Performance Monitoring with SWAM"**

### *Research Paper No. 3*

SWAM is a platform that offers students many different modules, which cover a variety of topics. Students could take a 1-credit worth module and focus on a particular Emphasis, or take multiple credits covering different modules for different Emphasis. The important part of this course is that they can Build Your Own Courses (BYOC). The purpose of this new learning approach is to offer them the freedom to choose the learning topics based on their interests, flexibly earn required education credits, and take the courses whenever and wherever you want. The instructor closely monitors the students learning progress and provides timely feedback and assistance when needed.

## **"Outlier Detection Analysis: an Integrated Application to the Financial Data"**

### *Research Paper No. 4*

We identify the popular categories of algorithms by means of extensive literature search utilizing various keywords, such as "outlier detection survey", "outlier detection literature review", "outlier detection methods review", etc. The most influential and popular surveys are selected to identify theoretically well-developed and widely-used categories of outlier detection approaches. This study provides overview descriptions for each popular algorithm including basic information, validation process, and utilization of real and synthetic datasets. We summarize some common tools and packages that can be used to perform the tasks of outlier detection, as well as demonstrate the usage of the reviewed methods on the example of one specific credit card dataset from Taiwan. Finally, we discuss certain characteristics of accounting and auditing data, and pinpoint caveats often

encountered when accounting researchers/auditors attempt to apply outlier detection approaches in their domains.

### **"Business News Headlines and the Prophetic Vision of Bankruptcies: An Application of Natural Language Processing"**

#### *Research Paper No. 5*

This is the first study using New Headline to predict bankruptcy. News headlines potentially serve as unique indicators of sentiment and information as they are concisely worded and convey the sentiment and tone of the subsequent article. News headlines are efficient and effective sources of information. It contains succinct phrases and less repetition of words, which significantly reduce the impact of irrelevant words for natural language processing. This study is relevant to a growing accounting literature that attempts to improve the ability for auditors and other stakeholders to predict bankruptcy by examining the textual data from different sources.

### **"Text Visual Analysis in Auditing: Data Analytics for Journal Entries Testing"**

#### *Research Paper No. 6*

In this study, we propose Text Visual Analysis (TVA) approach for auditing. We argue that integration of text analysis and data visualization can improve the efficiency of audit data analytics for textual data in the organization's accounting information system for journal entry testing. The proposed method can be used for identifying unusual journal entries based on textual data of the transactions including descriptions and comments. This paper can contribute to both textual analysis and data visualization literature in accounting research by introducing the integration of two different domains. In addition, this study can provide guidance for audit practitioners and standard setters on how to apply textual analysis in audit tasks.

### **"GASB Post Implementation Review: A Process of Unstructured Data Collection"**

#### *Research Paper No. 7*

The governmental accounting has a very wide range of information users, so does the public pension accounting. Moreover, responses about the pension accounting would be expected to be different according to the group to which each stakeholder belongs. In order to deliver more transparent status about the public pension system to information users, in 2012, the Government Accounting Standards Board (GASB) introduced new standards—No. 67 Financial Reporting for Pension Plans and No. 68 Accounting and Financial Reporting for Pensions — by amending their existing standards No. 25 and No. 27. This research starts from filling this gap between the GASB standard and its implementation by the entities. This research will review a wide collection of CAFRs from different sources by developing automated ways. Based on collected and extracted necessary information, this research will provide the full picture of the implementation status of the GASB's new standards No. 67 and No. 68.

### **"Blockchain-Enabled Continuous Audit: Implementation of Blockchain- Enabled Smart Contract with the Integration of Business Process Management"**

#### *Research Paper No. 8*

The main flow of the proposed framework is as follows: 1. A business process model is extracted from event logs using PM. The process model is inserted into BPM software to monitor and control the operations. 2. The state government and related parties communicate on the web application for inter-organizational transactions while maintaining their own information system. 3. BPM component enables monitoring business processes. The business operation logs are recorded on the database system and the Blockchain. The process model is updated using PM if necessary. 4. Smart contracts are updated and refined through the PM. 5. Internal and external auditors continuously monitor business processes and operations while citizens monitor the Blockchain and smart contracts for fairness, accuracy, efficiency, and effectiveness of procurement processes.

**"Blockchain for Improving Management and Transparency in Public Procurement: A Proposal for Smart Contracts Model for the Executive Branch of the State of Santa Catarina, Brazil"**

*Research Paper No. 9*

This project aims to develop a Blockchain-enabled Smart Contract prototype for the Executive Branch of the State of Santa Catarina to manage the list of the essential materials. The prototype uses the Blockchain Ethereum, a public blockchain without permission, to achieve complete transparency for the object of the prototype. Due to avoid unnecessary costs incurring to process a transaction on the Mainnet, the prototype has been mock tested on one of the Testnet. The authentication and registering functions are borrowed from MetaMask, a digital wallet, to interact with Ethereum's network. This project built a Dapp to integrate Ethereum blockchain, smart contracts, and user interface.

**"Discuss the Financial Distress of Local Governments: Using Machine Learning to Predict the Possibility of Bankruptcy"**

*Research Paper No. 10*

The Census Bureau classifies local governments as 1) General purpose: cities and counties 2) Special-purpose: school districts, water authorities and other narrowly-defined municipalities. Consequences of bankruptcy protection: Credit ratings drop, borrowing costs increase; Temporary cash flow relief (dissipate within a few years), Various literature on assessment of municipality financial condition.

**"A Predictive Analytical Approach to the Evaluation of Internal Controls"**

*Research Paper No. 11*

This study applies a Predictive Analytical Approach to establish an Internal Control Evaluation Model. It integrates process mining and machine learning into the traditional audit procedures, performs full population testing, systematically evaluates business transactions, assesses control risks, and identifies potential control issues. The internal control evaluation model identifies potential control issues and missing controls in the purchase approval and disbursement processes, including segregation of duties. It directs the auditors' investigation to high-risk control areas.

**"Using Machine Learning to Detect and Predict Restatements - The Enigma of Unlabeled Positives"**

*Research Paper No. 12*

This study explores the issue of "unlabeled positives" in accounting research that uses machine learning to detect or to predict financial statement restatements. In restatement prediction and detection, extant accounting research adopts supervised learning which assumes that the dataset has complete labels and that the absence of a restatement label indicates a clean financial report. To address the existence of unlabeled positives in restatements, we introduce a semi-supervised learning technique called Positive-Unlabeled (PU) learning to accounting researchers. Our initial evidence shows that PU Learning is superior to supervised learning in detecting and predicting restatements, especially the unlabeled positive instances. Data and Methods We obtained COMPUSTAT population from 2000 to May 2021 and matched with restatement data from the Audit Analytics database. After handling missing values, we retained 65,817 firm-year observations with 25 variables. PU learning is the setting where a learner only has access to positive and unlabeled data. The most commonly made assumptions is the Selected Completely at Random (SCAR) assumption: the labeled examples are selected independent of their attributes from the positive distribution. We use SCAR-Elkanoto (Elkan and Noto, 2008), SCAR-KM2 (Ramaswamy et al., 2016), SCAR-TIcE (Bekker and Davis, 2018) in our experiment. A less restrictive assumption is Selected at Random.



### **"Expected Loan Loss Provisioning Using a Machine Learning Approach"**

#### *Research Paper No. 13*

Estimating expected Loan Loss Allowance (LLA) in banks is a critical but also difficult problem in accounting estimates. The issue has become of increasing interest to academics and regulators with the FASB and IASB issuing new regulations for loan impairment. However, till now, few studies have looked at the application of machine learning in managerial subjective estimates, especially in the LLA. And no published research has been done to model and predict loan losses using other types of machine learning algorithms than regression so far. Therefore, in this paper, I want to fill in the gap by using multiple machine learning algorithms to model and predict loan losses in banks.

### **"Continuous Monitoring with Interactive Data Visualization: An Application to Healthcare Payroll Process"**

#### *Research Paper No. 14*

This paper presents a framework of proactive and intelligent continuous control monitoring (CCM) that helps management gain higher assurance over business processes and alleviate information overload. We adopt a design science approach towards systematically developing CCM artifacts, including operation & control violation display and multidimensional anomaly detection. We illustrate the design with an implementation project whereby a CPA firm, the firm's hospital client, and Rutgers CAR Lab work together to improve the assurance of payroll reviews. This study contributes to the auditing literature by first envisioning that interactive data visualization and machine learning technologies can alleviate information overload for management in CCM. Second, We provide real-world evidence on the improvement brought to economic and behavioral aspects of control monitoring process and document how it happens. We show that emerging technologies substantially improve efficiency and effectiveness of risk assessment, anomaly inspection, and loss prevention. We also contribute to the internal control practice by providing a guidance of artifact development, application, and maintenance, for practitioners to follow.

### **"Audit with Machine Learning: Applying an Unsupervised Algorithm on Journal Entries of an Australian Bank"**

#### *Research Paper No. 15*

The nature of audit determines that it is an outlier detection process under a specific context. On the other hand, the effectiveness of machine learning on outlier detection has been proved in fields such as chemistry and medicine. However, extant literature on using machine learning for audit purpose has not solved several challenges. First, how to fit data analytics with machine learning in audit context is still uncertain and ambiguous. Second, consequence of applying machine learning is still unclear. Third, auditors have difficulty to document audit evidence from machine learning due to its unobservable working process. Taking the concerns into account, we proposed a methodology called audit with machine learning (AML) that can serve as a complementary tool in journals testing. It identifies entries with potential risk of misstatement among full population and convert machine learning results into understandable fact to auditors who will make the final decision. In addition, to address large number of outliers, AML is not identifying every risky entry but potential risks with a sample of entries so that auditors can determine if the risks are material or not. If auditors do find the risk worth their attention, they can develop a series of rules to extract all the related entries by themselves.

### **"Channel Stuffing Detection Model: Using Processing Mining"**

#### *Research Paper No. 16*

Sales activity management is a big challenge for multinational corporations, especially corporations in manufacturing industry. Since these corporations usually have so many branches around the world, and different branches may have different



sales strategies, policies, SAP systems, etc. So it difficult for management and internal control department to monitor and compare different branches' performance and compliance. This study aims to develop a channel stuffing detection model, as well as a continuous monitoring system to ensure that all sales are being recorded to the correct period, sales activities are conducted in accordance with the company's policy.

### **"Cybersecurity Risk Disclosure During the COVID-19 Pandemic"**

#### *Research Paper No. 17*

With the rapid development of Information technology (IT), firms are relying on technology almost in every aspect of their business operation. Because of this, there are more and more cybersecurity breaches happened in firms' daily activities. Breached firms experienced substantial loss of revenues, customer base, reputation, and business opportunities, and most of the breached firms spent millions of dollars improving security solutions and expanding security procedures following the attacks. Since the outbreak of Covid-19 in January 2020, people are required to work from home, which significantly reduce the cost on commuting but also brought other risks. Cybersecurity Ventures' estimation that cybercrime damage costs could potentially double during the Coronavirus outbreak period is concerned not only with phishing scams, but also with ransomware attacks, insecure remote access to corporate networks, remote workers exposing login credentials and confidential data to family members and visitors to the home, and other threats. According to many surveys and prior works, firm costed more to handle their cybersecurity risks during the Covid-19 pandemic than before. This study aims to find out whether firms provide more cybersecurity risk disclosures related to the remote work environment and the pandemic after the outbreak of the Covid-19, following the guidance from the SEC.

### **"Measuring Text Information of Green House Gas (GHG) Emission"**

#### *Research Paper No. 18*

Main hypothesis: mandatory greenhouse gas reporting law, which is about financial information, also lead to non-financial disclosure about GHG/Carbon, Imagine firms have high GHG emission. They have to reveal the number of emission by mandatory law. They may not want to reveal the information since it could cause bad image to stakeholders. If firm concerns this, they may want to explain/excuse the high emission with non-financial information. Of course, they may not care at all and that is why they have high emission. In that case, they may not disclose additional non-information to stakeholders. If some firms have low GHG emission, they may want to appeal more their low emission with non- financial information. Or they may not since they think their financial information(number of emission of GHG) enough. Verifying the hypothesis shows whether non- financial information complements or substitutes financial information.

### **"Impact of Business Analytics on Managerial Accounting"**

#### *Research Paper No. 19*

Over the years, the role of management accountants has expanded from historical reporting to more real-time reporting. Currently, managerial accounting has evolved into the "Predictive Analytics Era," and managers are interested in knowing what has happened and what will happen in the future (Cokins, 2013). Previous literature discussed the impact of business analytics on managerial accounting and how business analytics measure corporate performance (Appelbaum, Kogan, Vasarhelyi, & Yan, 2017; Nielsen, Nielsen, Jacobsen, & Pedersen, 2014), but little research explored the application of business analytics in management accounting in a government procurement point of view.

### **"Impact of the Remote Working Environment on Cybersecurity Risk in Organizations"**

#### *Research Paper No. 20*

Cybersecurity is the way that organizations can protect their information, intangible assets, and communications while operating within the cyberspace. Since cybersecurity issues have seen multiple SEC regulations over the years, they have begun to become more important to companies as regulation on cybersecurity disclosure becomes stricter. In 2019, with the start of COVID-19, almost all company operations were moved to a virtual environment including online meetings, online transactions, and conducting overall online business. Software's in the remote working environment include telecommunication services such as WebEx, Skype, and Zoom. We want to test whether the increase in the use of the remote working environment has increased cybersecurity risk of firms.

### **"Predicting the Discontinuity of Non-Profit Organizations Using the Machine Learning Approach"**

*Research Paper No. 21*

In the United States, NPO usually defined as the organization granted the tax-exempt status by the Internal Revenue Service (IRS). Organizations are tax-exempt if they meet the requirements of Internal Revenue Code Section 501(c)(3). For accountability and transparency purposes, IRS required NPOs that have gross receipts that are greater than or equal to \$200,000 or \$500,000 in total assets to fill form 990 annually (Internal Revenue Service, 2019). According to IRS, if the organization is facing the situation as Liquidation, Termination, Dissolution, or Significant Disposition of Assets, it means that NPO is having discontinuity issues and should file Schedule N of form 990 (Internal Revenue Service, 2020). Non-profit organizations worked as public service providers deserve a healthier financial environment. It is important to the economic and social benefits that a large number of healthy NPOs keep serving the people and the country. To do that, identifying the financial challenges and the cause of the discontinuity became the focus of this paper. The research question became what are the signs of NPOs' discontinuity by examining the Form 990 database.

### **"Audit 4.0-based ESG Assurance: An Example of Using Satellite Images on GHG Emissions"**

*Research Paper No. 22*

As Environment, Social, and Governance (ESG) information has become an essential resource for investors globally (Amelzadeh and Serafeim, 2018), regulators are making significant efforts on standardizing its reporting process and assuring its quality. While an increasing number of companies have started ESG disclosure, it is usually not fully substantiated with supporting information. Thus, assurance that attests the metrics on ESG reports free of material errors is in urgent demand. However, the existing ESG assurance procedures face some key challenges, such as how to exercise professional skepticism and judgment. This study proposes an innovative method to improve ESG assurance base on Big Data and emerging technologies in Audit 4.0 to enable timely and accurate auditing. This study first discusses a novel process of assuring ESG reports via extending the Audit 4.0 paradigm to the ESG domain. Following the process, a case study is conducted to explore new audit evidence of satellite images on the estimation of methane, one major component of greenhouse gas (GHG), and creates a continuous assurance dashboard to reduce the risk of greenwashing. This study pioneers the use of satellite images to provide insights for regulators and companies to monitor and assure ESG reports continuously.