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Classification of Capital Expenditures and Revenue Expenditures: An Analysis of Correlation and Neural Networks

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ABSTRACT

The classification between the capital expenditures and revenue expenditures is one of the common problems in the accounting literature since it has a significant impact on financial statements. This study aims to analyze the correlation of classification model such as Neural Networks (NN) in order to develop a model that can be trained to recognize hidden patterns of the borderline between the two expenditures types, viz: the capital and revenue expenditure. Twelve criterions were identified in order to classify between the two expenditures types and a Backpropagation Learning was utilized in this study. The highest classification accuracy obtained by NN is 94.20%. Correlation analysis reveals a significant correlation between some identified criterions with the model's target. Strong correlation between target and criterion LASMFY (0.532) indicates that any expenditure lasts for more than a fiscal year will be more probable to be classified into a capital expenditure. Also, criterion RESALE proves its strong influence, with correlation of (-0.874) which implies more probability of classification into revenue expenditure if any expenditure was spent for intent for resale. Medium correlation shown by criterion REGULR (-0.251) indicates a moderate probability of classification into revenue expenditure if expenditure was spent in a regular basis.

Keywords:
Capital Expenditure, Revenue Expenditure, Classification, Regression, Neural Network

1.0 INTRODUCTION

The classification between the capital expenditures and revenue expenditures is one of the common problems in the accounting literature since it has a significant impact on financial statements. Thompson (2002) pointed out that the misclassification between capital and revenue expenditures has a great impact on the integrity of the financial statements. If revenue expenditure is treated as a capital expenditure, some consequences that likely to occur are the expenditure will not be labelled as the income statement or the balance sheet, overstating the profit figure in the income statement or overstating the value of the assets in the balance sheet. On the other hand, if capital expenditure is treated as a revenue expenditure, the expenditure will not be labeled as the balance sheet or the income statement, understating the profit figure in the income statement or understating the value of the assets in the balance sheet.

In summary, the missdistinction between a capital and a revenue expenditure will result in financial statements do not fairly represent the financial position of any company. It is practically difficult in some cases to draw a line between capital and revenue expenditures since a single item of expenditure can be revenue expenditure and sometimes can be a capital expenditure. For example, wages for labour spent on transporting merchandise to stores is revenue expenditure while if the same wages spent for labour on installing a new machine will be grouped as capital expenditure (Al-Daif, 1981). Anthony and Reece (1995) emphasized on the same point saying that the distinction between expenditures that are capitalized and expenditures that are expensed as period costs is not entirely clear-cut. For instance, the betterments and repairs and maintenance where a betterment is added to the cost of the asset while maintenance is considered work done to keep an asset in good operating condition or to bring it back to good operating condition if the assets has broken down. The distinction between maintenance expenses and betterments is that maintenance keeps the asset in good condition but in no better than when it was purchased or extends its useful life beyond the original estimate of useful life. In practice, the line between the two is difficult to draw.

Traditionally financial domain used to employ the latest technologies in order to facilitate its various daily tasks. Recently, financial expertise started to incorporate AI techniques due to the increasing need to fulfill analysis functions with a considerable complexity in less time, cost and higher accuracy. In the last several years, NN

became very popular as a powerful technique in classification, patterns recognition and prediction tasks (Blass & Crilly, 1992). NN is made of set of processing units called the neurons as it mimics the human brain. NN can learn and store knowledge by changing the weights associated with the neurons connections which can be used to solve a given problem via training and experience (Thulasiram *et al.*, 2003).

Neural networks are becoming increasingly adaptable; thus their use is expected to become more common and widespread in time (Cerullo & Cerullo, 2006). The boom in applications covers a wide range of business interests, ranging from finance management to forecasting and production. Thus, an NN can solve a much broader range of problems than, for example an expert system. Therefore, this study attempts to demonstrate the potential use of NN in classifying the Capital expenditures from the Revenue expenditures based on several attributes.

This paper is organized into 5 sections. Section 2 discusses the capital and revenue expenditures. The methodology for conducting the analysis is explained in Section 3. The results are the subject of discussion in Section 4. Finally, the conclusion and future research are presented in Section 5.

2.0 CAPITAL AND REVENUE EXPENDITURES

To prelude, financial statements should be introduced prior to describe capital and revenue expenditures. According to Anthony and Reece (1995), financial statements are normally produced at the end of each financial period which can be a calendar year or a month; the main two financial statements are the Balance sheet statement and income statement (Profit and Loss). Fess and Warren (1987) defined the Balance sheet statement as a snapshot of the company financial position on a given date and it consists of two sides:

- The assets side (what company owns) such like buildings, furniture, vehicles, machines, cash etc.
- The liabilities (what company owes to others) and owner's equity side. Borrowed loans, credit amounts due to suppliers are listed under liabilities and company capital stock; retained earnings are listed under owner's equity. The asset side must always equal to (balance) the liabilities plus owner's equity side.

Income Statement is also known as a profit and loss statement (P&L), which is a statement of a company's profit or loss during any one given period of time which can be a year or a month, The income statement generates either profit or loss after deducting the expenses from the revenues (company sales) (Short & Welsch, 1990). Davis and Pain (2002) indicated that the importance of financial statements is to help the upper level of management to make the proper business decision, and there are many outside parties who depend on the financial statements such as tax department, investors in the stock market, banks for evaluation of loan application and others.

Capital expenditures as per Al-Daif (1981) are defined as items spent in order to help in generating profits for long period (a year or more) such as a purchase or creating of assets such as building, furniture, machines, vehicles and others. These items are depreciated over the items useful life. Capital expenditure always appear in the balance sheet, therefore it does not directly reduce the profit. Revenue expenditures are costs incurred for the daily running of the business such as payroll, rental, utilities, wages, stationary and others. Expense incurred in setting the fixed assets in proper condition by maintenance and restorations are revenue expenditures. Revenue expenditure goes directly to the income statement in order to be charged against profit (Fess & Warren, 1987). Examples of capital expenditures include additional expenditures to a plant asset, expenditures that increase operating efficiency or capacity for the remaining useful life of an asset and expenditures that increase the useful life of an asset beyond the original estimate.

Expenditures for ordinary maintenance and repairs of a recurring nature should be classified as revenue expenditures. Some businesses establish a minimum amount required to classify an item as a capital expenditure. A simple model suggested by Fess and Warren (1987) illustrates how the above examples classify between capital and revenue expenditures (Figure 1).

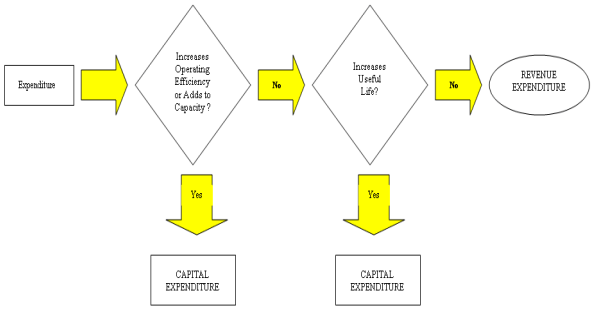

Figure 1: Classification process between capital and revenue expenditures.
Source: Fess, P., & Warren, C. (1987). *Accounting Principles* .South-Western Publishing Co.

Following the trend of other non-engineering domains, finance field seeks to employ artificial intelligence techniques in order to push forward various financial tasks to a higher accuracy and lesser consumption of time and cost. The ability to learn, recognize hidden patterns, predict and classify are the key factors behind this trend. Following is some examples of financial utilizations of AI techniques:

Thulasiram *et al.* (2003) pointed out to the increasing trend of employing NN in many problems in finance such as mortgage risk assessment, economic prediction, portfolio selection diversification and others. The ability to model nonlinear processes with few assumptions is one of the key elements behind this trend. An approach for classification of corporate financial performance has been presented by Qian (2007) using NN with backpropagation algorithm in order to process data with financial ratios. The findings indicate that Levenberg Marque training error is smallest among four learning algorithms and its performance was better. Kumar and Walia (2006) presented two NN models for the purpose of cash forecasting for a bank branch, the first one is the daily model which takes the parameter values for a day as input in order to forecast cash requirements for the next day, and the second one is a weekly basis model, which takes the withdrawal affecting input patterns of a week to predict cash requirement for the next week. Their system demonstrated better performance than other cash forecasting systems. In another study, Yip *et al.* (1997) proved that the NN generally perform better than time series smoothing methods of forecasting future sales).

Another application of NN classification is the insurance underwriting which was conducted by Yan and Bonissone (2006). Qi and Wu (2003) used NN for the exchange rate nonlinear predictability The study was carried out for predicting four currencies within one, six and twelve months. The findings show that NN model without monetary fundamentals forecasts better in British pounds and Canadian dollars.

Credit card fraud is another financial application that has been investigated by Shen *et al.* (2007). Decision Tree was employed as a classification model for credit card fraud detection. Jie and Xiao-Feng (2006) integrated Decision tree and genetic algorithms in an attempt to improve the prediction ability of corporate financial distress by dynamically selecting financial ratios in the modeling process. This study has shown that the prediction accuracy of the model was 93.75%.

Having gone through AI applications literature within finance domain, it is realized that AI techniques in general and NN in particular comprises of powerful potentials in recognizing patterns and classification. Therefore it is reasonable to exploit such a technique in this study.

3.0 METHODOLOGY

Following DeLurgio (2000) and Kaastra and Boyd (1996), this study encompasses eight steps as shown in Figure 2:

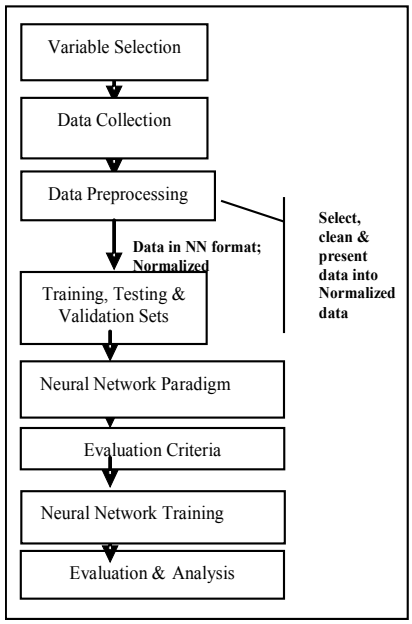

Figure 2: The adopted research methodology

During the **Variable Selection Phase**, the best combination of criterions was selected. The capital and revenue expenditures transactions were collected during the **Data Collection Phase** in order to prepare the dataset for training, testing and validation sets. Within the **Data Preprocessing Phase**, raw data was clean from any outliers or missing data, after which the data was then normalized using an appropriate technique. The normalized dataset was allocated to training, testing and validation sets according to a predetermined proportion. The next step includes conducting several experiments in order to get the best architecture of NN model. The parameters of the model were set during the **Evaluation Criteria** phase. The final NN architecture was obtained after **NN Training** phase has been completed. The process of final evaluation of the model was conducted during the **Evaluation and Analysis** phase.

4.0 RESULTS

A Chi-square has been examined in order to support the existence of an overall relationship between the identified criterions and the target (Capital and Revenue

Expenditures) as shown in Table 1. The significance value of Chi-square is less than the level of significance of 0.05; therefore the existence of a relationship between all criterions and the model target was supported.

Table 1: *Chi-square test*

		Chi-square	df	Sig.
Step 1	Step	967.381	12	.000
	Block	967.381	12	.000
	Model	967.381	12	.000

The correlation results between target and input variables are shown in Table 2. The results prove the existence of significant correlation between them within a 2-tailed significance level of 0.01.

Table 2: *Correlations results*

Independent Variables	Code	Spearman's rho Correlation With Target	Sig.
1. Does it exceed the threshold?	EXTHR	-.190(**)	.000.
2. Does expenditure last for more than fiscal year?	LASMFY	532(**)	.000
3. Is there an asset purchase/ creation?	ASSRCR	.256(**)	.000
4. Is there a significant improvement to the original functionality of an existing asset?	SIGIMP	.160(**)	.000
5. Is expense regular/ cyclical?	REGULR	-.251(**)	.000
6. Does it extend asset's useful life?	EXTLIFE	.165(**)	.000
7. Is it a deferred expenditure?	DEFRRD	.168(**)	.000
8. Is it a restoration expense?	RESTOR	-.211(**)	.000
9. Does it change asset purchase price?	ASSPRICE	.173(**)	.000
10. Intent for re-sale?	RESALE	-.874(**)	.000
11. Does it increase business earning capacity?	EARCAP	.143(**)	.000
12. Does it restore an asset to its original operating capacity?	RESORGN	-.539(**)	.000

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

Based on the results shown in Table 2, there is a strong correlation between target and criterion "Does expenditure last for more than one fiscal year?" (LASMFY, 0.532), which indicates that any expenditure lasts for more than a fiscal year will be more probable to be classified into a capital expenditure. Same conclusion goes to criterion "Does it restore an asset to its original operating capacity?" (RESORGN) with a strong correlation of (-0.539) which indicates any expenditure that restored an existing asset to its original operating capacity will have more probability to be classified into a capital expenditure as well. Also, criterion "Intent for re-sale?" (RESALE) proves its strong influence, since its correlation was (-0.874). This implies that an example (or case) is more likely to be classified as a revenue expenditure if any expenditure was spent for intent of resale. Medium correlation is shown by criterion "Is expense regular/ cyclical?" (REGULR, -0.251) indicates a moderate probability of classification into a revenue expenditure if expenditure was spent in a regular basis. The criterions with weak correlations represent less possibility of an example to be classified into either the two expenditures TYPE (capital or revenue expenditure). This implies that each of these criterions heavily depends on the contribution of the rest of criterions in order to be able to classify correctly. These conclusions were found to be in line with the definitions of capital and revenues expenditure drawn by accounting authors such as Al-Daif (1981) and Fess and Warren (1987). The best combination of parameters for the obtained NN model has achieved 94.20% accuracy with parameters shown in Table 3.

RESTOR	ASSPRICE	RESALE	EARCAP	RESORGN	TYPE
NO	NO	YES	NO	NO	?
NO	YES	YES	NO	YES	?
YES	YES	NO	NO	NO	?
NO	NO	NO	NO	NO	?

Table 3: *NN parameters*

Parameter	Value
Number of hidden units	20
Learning rate	0.2
Momentum rate	0.1
Number of Epoch	100

Further evaluation of NN model for classification of some examples of expenditures transactions into either a capital or revenue expenditures were carried out. Following are four transactions with unknown type of expenditure:

- The first, expenditure exceeds the threshold and it was spent for intent for resale.
- The second, expenditure has changed the asset purchase price, it was spent for intent for resale and it restored the asset to its original operating capacity.
- The third, expenditure does not exceed the threshold, last for more than one fiscal year, it has extended the asset useful life, it was a restoration and it has changed the asset purchase price.
- The fourth, expenditure exceeds the threshold; it has significantly improved functionality of the asset and has extended the asset useful life.

Table 4 shows representation of the above expenditures against the identified criterions.

Table 4: *Representation of the four transactions against identified criterions*

N0	EXTHR	LASMFY	ASSCR	SIGIMP	REGULR	EXTLIFE	DEFRRD
1	YES	NO	NO	NO	NO	NO	NO
2	NO	NO	NO	NO	NO	NO	NO
3	NO	YES	NO	NO	NO	YES	NO
4	YES	NO	NO	YES	NO	YES	NO

Since every (YES) was normalized to (0) and (NO) to (1), thus Table 4 can be converted into normalized form in order to be ready for NN modeling as shown in Table 5.

Table 5: *Part of the four transactions in normalized form*

RESTOR	ASSPRICE	RESALE	EARCAP	RESORGN	TYPE
1	1	0	1	1	?
1	0	0	1	0	?
0	0	1	1	1	?
1	1	1	1	1	?

The above normalized transactions without target TYPE were included in the test portion of the model dataset and after training the dataset, the output (target) for these transactions is shown below.

```
Output Fields
MLP1
Symbol

1
1
0
0
```

Based on the results shown above,

- The first two transactions were revenue expenditures (since 1 is normalization of Revenue expenditure TYPE).
- The second two transactions were capital expenditures (since 0 is normalization of Capital expenditure TYPE).

Therefore the expenditure type for each of the transaction is written in Table 6.

Table 6: *The expenditure type for each transaction*

RESTOR	ASSPRICE	RESALE	EARCAP	RESORGN	TYPE
NO	NO	YES	NO	NO	REV
NO	YES	YES	NO	YES	REV
YES	YES	NO	NO	NO	CAP
NO	NO	NO	NO	NO	CAP

The results shown in Table 6 make sense due to the fact that

I. First transaction exceeded the threshold (which normally implies that expenditure is a capital), while it was spent for intent for resale, hence it is a revenue expenditure.
II. Second transaction has changed the asset purchase price; it restored the asset to its original operating capacity (this implies a capital classification) given that, it was spent for intent for resale therefore it is a revenue expenditure.
III. Third transaction lasts for more than one fiscal year, it has extended the asset useful life, it was a restoration and it has changed the asset purchase price, therefore it is a capital expenditure.
IV. Fourth one, exceeding threshold, significantly improved asset functionality and extended the asset useful life, therefore it is a capital expenditure.

5.0 CONCLUSION

The misclassification between capital expenditures and revenue expenditures will have a significant impact on the integrity of the financial statements that lead to financial statements do not fairly represent the company's financial position. Therefore accuracy in this process must be ensured. Furthermore, it is difficult to determine (in some cases) clear and straight forward determinants which can effectively classify between the two types of expenditures. Hence, there is a need for a model that can assist in this process. One possible way is to use NN approach that could be used to learn hidden patterns among variety of capital and revenue expenditures transactions. Once the model is proved to provide good accuracy (more than 90%), the model can be deployed to ease the process of classifying the capital from the revenue expenditures.

The selected NN model of this study has achieved accuracy of 97.51% for training and 94.20% for testing, which is good enough to demonstrate that NN model can be used as the classification model in accounting applications.

Optimum performance of NN model requires some key factors such as availability of a sufficient combination of identified criterions that effectively classify between the capital and revenue expenditures transactions and a suitable dataset that comprises of comprehensive transactions of both expenditures types. This is in addition to obtaining of proper network components such as number of hidden units, learning rate, momentum rate, activation function and number of epoch.

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