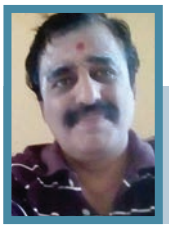
Estimation of Errors: New Audit Model Assists Auditor to Make In-Depth Inferential Audit Analysis

In the rapidly changing world, auditors are also expected to finish their tasks and submit their results/reports to the stakeholders within a short span of time. This necessitates the exploration of appropriate and apt methodology to scrutinise financial transactions with lightning speed with the due consideration of accuracy and scarce audit resources. The development of appropriate technique to project the audit violations to the entire financial transactions from the sample transactions for deriving audit conclusion is inevitable in the present swift environment. This Inferential Audit Analysis primarily requires the identification of the suitable estimators for projecting the errors in the financial-data-set. The identification of the best estimator to determine the monetary value of probable violating transactions in the entire financial-data-set is one of the primary concerns of any auditor. Therefore, a preliminary attempt was made to develop a new audit-model to project the error in the financial-data set from samples scientifically for deriving useful audit conclusions. Read on to know more…



Dr. L. Kailasam

(The author is Company Secretary and Cost Accountant. He can be reached at lkailasam@yahoo.co.in.)

Developing an Efficient Estimator

The financial-data-set under audit purview contains numerous transactions and has specific monetary values recognised as *book amount (recorded-amount)*. The proposed model involves the selection of the sample transactions from the financial-data-set. By considering the audit resources and availability

of time and audit risk, the auditor may determine the number of sample transactions he could audit. The total monetary amount of the sample audited by the auditor is labeled as *audited amount*. The difference between the book amount and the audited amount of each transaction is christened as the *error amount*.

In the proposed audit model, the entire task was broken into three Phases. In the first Phase, the errors in the financial-data-set were estimated by using different estimators, which involves following three steps.

The first step requires designing of sample size as well as selection of individual transactions from the financial-data-set. Standard on Auditing 500[1] suggests various methods for selecting audit samples, which ultimately provide a basis for drawing conclusions about the entire financial transactions.

In the second step, auditor has to perform compliance testing by adopting the appropriate audit procedures on each financial transaction selected. If the errors in the financial statements affect the decision of the users, then such errors are to be treated as "Material". If the errors exceed the prescribed Materiality, the auditor may request the auditee to consider the modifications in the financial statements. In the last step, the probable errors, which are likely to creep in the financial statements, are to be estimated by using appropriate statistical methods. The auditor necessarily informs the results to the auditee and requests his reasons or explanations on the deviation noticed and include the appropriate audit opinion in his report, if required.

The primary aim of the present study is to develop an efficient estimator and demonstrate its usefulness in projecting the errors that crept in the entire financial-data-set and restricted to classical or auxiliary estimators only and attributing and Bayesian and other methods are not considered. Though there are many classical estimators available for projecting the error, the present study is further restricted to Mean-per-unit estimator, Ratio estimator, Regression estimator and PPS estimators only. A new Best Linear Unbiased (BLU) Estimator is proposed and their comparative analysis with other classical estimators is also attempted in this study.

In Phase II, the efficiency of the estimators was evaluated by calculating their variance. In the last Phase, the error in the entire financial-data-set is ascertained. The documentation of the scientific evaluation of the estimating errors in the financial-data-set and getting the concurrence of the auditee as well as by including the same in the Audit Report, if required, would enable the auditor to safeguard him from the future risks.

In order to have a better understanding os the projecting efficiency of the various Estimators to determine audited value of the entire financial transactions, a practical example is given below.

Example

An Archaeological Project was taken by Mani & Co based on the evidence collected by them pertaining to the Cheran Senguttuvan Dynasty near Poovar, adjacent to Thiruvananthapuram. The supporting evidence collected during the period of Anizham Thirunal Marthandavarma indicated that there was a possibility of drowning of cargo ship near Ophir (Poovar) believed to belong to King Solomon of Jerusalem which might have carried gold, silver, pearls, etc., in the ninth century. Mani &Co allotted a sum of ₹500 Crore for exploring the treasure in the Solomon's ship.

CA. Karuda was appointed to scrutinise the accounts of M/s Mani & Co. While analysing the Exploration Account, he found that an account of balance of ₹5,04,731 was recorded under 'Miscellaneous Assets'.

While making further analysis of the Book balance, he found that this Miscellaneous Assets consisted of one hundred transactions. He decided to audit initially ten transactions by using appropriate sampling technology in order to derive the conclusions and recommendations. He made a detailed compliance testing on the selected ten transactions and found that three transactions did not comply with the Rules as detailed in Table No 1.

TABLE NO - 1- SELECTION OF TRANSACTION FOR PPS ESTIMATOR

Transaction	Book amount	Audited amount	Difference	Ratio
x_1	2035	2035	0	1
x_2	5071	5071	0	1
x_3	1210	1210	0	1
x_4	397	397	0	1
x_5	2807	2807	0	1
x_6	7969	7969	0	1
x_7	2753	2753	0	1
x_8	8412	7912	500	0.94056
x_9	7264	6764	500	0.93117
x_{10}	7786	7286	500	0.93578
Total	45704	44204	1500	9.80751

[1] Published in Chartered Accountant Journal - July 2007

The various statistics required for the above example are evaluated and given in Annexure I. The formulae used in the study for projection of account balance and comparative efficiency of the estimator are given in Annexure II.

The evaluation made for estimating the accounting balance by the above four estimators were consolidated and given in the following Table No. 2.

TABLE NO 2 – EVALUATION OF ACCOUNTING BALANCE BY THE VARIOUS ESTIMATORS

Eqn. No.	Estimators	Formula	Numerical Value	Estimated value
1	Mean-per-unit estimator	$\hat{X} = N\,\hat{x}$	4420.40*100	442040
2	Ratio estimator	$\hat{X} = (\hat{x} / \hat{y})*Y$	4420.40/4570.4*504731	488166
3	Regression Estimator	$N\hat{x} + sxy/ s2\hat{y}\ (Y-N\hat{y})$	(100*4420.4) + (8082946.84/9522763.16) *(504731-100*4570.40)	482520
4	PPS Estimator	$\hat{X} = Y/n\ (\Sigma xi/yi)$	(504731/10)*(9.6963)	489402

BLU Estimator

If the population value is highly skewed, the confidence interval of the Mean-per-unit estimator did not reflect the normal level. The Ratio estimator has also similar deficiencies. The performance of PPS estimator is comparatively better than the remaining estimators but it is also generally poor. Therefore, a preliminary attempt was made to determine a new estimator by applying the basic principles of Econometrics. The following steps are required for the development of the new Best Linear Unbiased (BLU) Estimator.

Step 1- Selection of the minimum three PPS samples

In the proposed audit model, it is necessary to take minimum of three samples, preferably by PPSWR method and the compliance testing necessarily to be adopted in respect of the samples selected. The Book value and audited value of the three samples are to be recorded in the given Table No 3.

TABLE NO - 3 – ESTIMATIONS UNDER BLU ESTIMATOR

S.No.	SAMPLE NO. 1			SAMPLE NO. 2			SAMPLE NO. 3		
	Book Amount	Audited Amount	Error	Book Amount	Audited Amount	Error	Book Amount	Audited Amount	Error
1	12605	11605	1000	23686	22800	886	18581	17581	1000
2	23412	22912	500	28650	27200	1450	19719	19219	500
3	9135	8135	1000	9043	8985	58	11748	11148	600
4	19446	19446	0						
Total	64598	62098	2500	61379	58985	2394	50048	47948	2100

Step 2 - Determination Best Linear Unbiased Estimates

After evaluating the total of the book value and the corresponding total of the errors, the Best Linear Unbiased Estimates (BLUE) will be found by using the values by adopting Ordinary Linear Square (OLS) Method.

The above data could be fixed in the following format

$$Error = \beta_0 + \beta_1 * Book\ Value + \varepsilon \qquad (2.1)$$

where β_0 is constant, β_1 is slope coefficient and ε is unexplained error term.

By applying Ordinary Least square methodology (OLS), the values of β0 and β1 could be found and given below.

Error = 742.050+0.027* Book Value

Step 3 Determination of error estimate and book balance

The newly developed BLU Estimator will be used to estimate the amount of the error likely to exist in the entire accounting population. By deducting the estimated errors in the accounting population from the Book value, the estimated value of the transactions could be found.

By substituting the book value of 5,04,731 i.e. total book value in the equation (2.1), it is possible to ascertain the total error in the accounting population

Error = 742.050+0.027* 504731
= 14369.78

The error in the entire accounting population will be ₹14370 and hence, the estimated account balance will be ₹4,90,361.

The estimated value of all classical estimators the percentage of variation are consolidated and given in Table No 4

TABLE NO 4- ESTIMATED VALUE AND VARIANCE OF VARIOUS ESTIMATORS

Sl. No.	Particulars	Mean per unit Estimator	Ratio Estimator	Regression Estimators	PPS Estimator	BLUE Estimator
1	Estimated value	442040	488166	482520	489402	490361
2	Book Value	504731	504731	504731	504731	504731
3	Difference	62691	16565	22211	15329	14370
4	Percentage of variation	12.42	3.28	4.40	3.04	2.85

From the above table it is found that the percentage of variation of the estimated value and book value falls between 2.85% to 12.42%. However, it is not possible to conclude which estimator is exactly predicting the account balance and hence, necessary to identify the estimator which could give most nearer amount of account balance. This could be judged based on the efficiency of the estimators as discussed in the subsequent section.

Efficiency of the Estimators

The error estimators are useful in estimating the mistakes from the observed data. The present study is restricted to point estimators only and the interval estimator is out of the scope of the present review. The unbiasedness, efficiency, sufficiency as well as consistency are considered as important factors while deciding the best estimators.

The estimator having the least variance is termed as efficient estimator. If there are estimators α_1 and α_2 with variances Var (α_1) and Var (α_2), and if Var (α_1) < Var (α_2), then α_1 is efficient estimator compared to α_2. If there are more than two estimators, there often exists one with the lowest variance, which is efficient estimator compared to others.

Apart from this, BLU is a linear function, a random variable in the regression model. It is also unbiased, and has minimum variance in the class of all such linear unbiased estimators, and hence, BLU estimator with the least variance is found to be the best efficient estimator.

In this study, the errors based on Mean-per-unit estimator, Ratio estimator, Regression Estimator, PPS Estimator and BLU estimator were estimated and a preliminary attempt on the comparison of the estimating capacity of the various estimators was made by determining the variance of these estimators. The formula adopted and valuated results are given in the following Table No 5

TABLE NO - 5 – EVALUATION OF VARIANCE

Sl.	Estimator	Formula	Numerical Value	Variance
1	Mean-per-unit estimator	$S^2_{\hat{x}}$= {N (N-)/n}*$s^2_{\hat{x}}$	(100(100-10/10)) * 8497674	84126972600
2	Ratio Estimator	{N (N-n)/n}*($s^2_{\hat{x}}$ - 2($\hat{x}$ / $\hat{y}$)s_{xy}+($\hat{x}$ / $\hat{y}$)* s^2_y)	(100(100-10)/10)*(8497674-2*0.96718*8082947+0.96718*	1,86,53,13,503
3	Regression Estimator	{N (N-n)/n} ($s^2_{\hat{x}}$(1-r^2_{xy})	900*(8497674(1-(0.99838^2)))	2, 47, 59,146
4	PPS Estimator	$S^2_{\hat{x}}$= {Y(Y-n)/n}*s_t2 $t_i = y_i - x_i / y_i$	(504731*(504731-10)/10) *0.002702	6, 88, 33,000
5	BLU Estimator	Var (β_2} = σ^2 /Σxi^2	1.221708 / 116818674	0.0000000105

From the above table, it is found that BLU estimator has the least variances and hence it is the best estimator for predicting the value of the account balance compared to other estimators. By making above detailed analysis CA. Karuda concluded that the BLU estimator is most efficient estimator, since it has lesser variance and a sum of ₹14,370 has to be disallowed and the estimated value of the book balance will be of ₹4,90,361.

Conclusion

All the estimators discussed above including BLU Estimator provide approximate point estimates only; the estimation may not be precise, when sampling data contains rare errors or no errors or overstatements. The main reason being, the accounting population contains a non-standard mixture of degenerate distribution and a continuous distribution, which is also highly skewed. This has resulted in searching an alternative approach for the improved exact estimation of the accounting balance.

Many researchers like Kaplan made a detailed research in fining the alternative techniques for estimating the errors in the financial transaction population by using attribute sampling models such as Cell bound, Stringer bound, Multinomial bound. Frost and Tamura (1986, 1987) extended Kaplan's work and showed that mixture may cause the population error distribution to be highly skewed, especially when the error rate is low and errors are overstatements and this population skewness causes in turn the sampling distribution of the pivotal statistic to be skewed in the opposite direction[2]. The Bayesian models such as Felix and Grimlund method, Cox and Snell models, Multinomial Dirichiet bound, etc. could also be attempted to estimate the exact errors.

The researchers found that these techniques or the combination of these techniques lead to more accurate results compared to the classical estimators.

ANNEXURE - I – EVALUATION OF DIFFERENT STATISTIC

Sl. No.	Name of the Statistic/Notation used	Notation used	Corresponding value for the Example
1	Number of transactions in the entire account population	N	100
2	Number of transactions in the sample	.n	10
3	Book Amount of entire financial transactions	Y	504731
4	Estimated Amount of entire financial transactions	$\hat{X}$	Being evaluated
5	Mean of the sample of audited amount of transactions selected	$\hat{x}$	4420.40
6	Mean of the sample of book balance of the transactions selected	$\hat{y}$	4570.40
7	Variance of Estimated amount of entire financial transactions	$S^2\hat{x}$	Being evaluated
8	Variance of sample financial transactions audited $\hat{x}$	$s^2\hat{x}$	8497674
	SD of sample financial transactions audited $\hat{x}$	Σ	2915.077
9	Variance of sample financial transactions book amount $\hat{x}$	$s^2\hat{y}$	9522763
10	Mean of the difference between the booked amount and audited amount	$\hat{d}$	150
11	Sample Co-variance	s_{xy}	8082947
12	Correlation Coefficient	r_{xy}	0.99838
13	Sample Variance of taint (PPS Estimator)	s_t^2	0.002702
14	Variance (Y_i/X_i) (BLU Estimator)	σ^2	1.221708
15	Sum of X_i (BLU Estimator)	Σx_i^2	116818674

ANNEXURE II– FORMULAE OF ESTIMATORS AND ITS VARIANCE

Sl. No.	Particulars	Estimator Formula	Variance Formula
1	Mean per unit Estimator	$\hat{X} = N\,\hat{x}$	$S^2\hat{x} = \{N\,(N-n)/n\}*s^2\hat{x}$
2	Ratio Estimator	$\hat{X} = (\hat{x} / \hat{y})*Y$	$\{N(N-n)/n\}*(s^2\hat{x} - 2(\hat{x} / \hat{y})s_{xy}+(\hat{x} / \hat{y})*s^2\hat{y}$
3	Regression Estimators	$\hat{X} = N\hat{x} + s_{xy} / s^2\hat{y}\,(Y-N\hat{y})$	$S^2\hat{x} = \{N\,(N-n)/n\}\,(s^2\hat{x}(1-r^2_{xy})$
4	PPS Estimator	$\hat{X} = Y/n\,(\Sigma x_i/y_i)$	$S^2\hat{x} = \{Y(Y-n)/n\}*s_t^2$
5	BLU Estimator (Newly proposed)	$\beta_0+\beta_1*$ Book Value $+\varepsilon$	$\sigma^2 / \Sigma x_i^2$

[2] Frost PA and H Tamura 1986 Accuracy of auxiliary information interval estimation in statistical auditing. Journal of Accounting Research (Spring): 57-75.

Fall seven times and stand up eight. - Japanese Proverb