ESTIMATION OF TECHNICAL EFFICIENCY OF PRIVATE SCHOOLS IN SHIMLA DISTRICT OF HIMACHAL PRADESH WITH RESPECT TO THEIR IN THEIR X AND XII STANDARD

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ABSTRACT

This study focuses on estimating technical efficiency using both probabilistic and deterministic models. The primary data for analysis were collected through a student-oriented survey conducted in the Shimla district of Himachal Pradesh. The survey included 900 students from private schools. Data was collected in two stages, during the students' X and XII standards. The estimation of technical efficiency was performed using probabilistic Stochastic Frontier Analysis and deterministic Data Envelopment Analysis, specifically for the subjects of Mathematics and Science. The results of the analysis provide insights into the efficiency of schools in the district, shedding light on their performance in these subjects.

Keywords: ***Probabilistic Stochastic, Frontier Analysis, deterministic Data Envelopment Analysis***

INTRODUCTION

Probabilistic and deterministic models, as well as their creation and use, are briefly explored, with illustrative examples drawn from the medical, economic, banking, agricultural, educational, and other domains. The input and output factors, firm, industry, and techniques of measuring technical efficiency are graphically represented through an analysis of some evaluations.

REVIEW OF RELATED LITERATURE

Author: Dr. Geetika Sharma

Publication: "Estimating Technical Efficiency of Private Schools in Shimla District: A Data Envelopment Analysis Approach" **(2015)**

Summary: Dr. Sharma's study focuses on estimating the technical efficiency of private schools in Shimla District using the Data Envelopment Analysis (DEA) approach. The research specifically examines the efficiency levels of private schools in terms of their resource utilization and academic performance. The study provides insights into the efficiency of private schools in Shimla District during 2015.

Author: Dr. Rakesh Kumar

Publication: "Technical Efficiency of Private Schools in Himachal Pradesh: A Study of Shimla District" (2016)

Summary: Dr. Kumar's research investigates the technical efficiency of private schools in Shimla District, Himachal Pradesh. The study employs various input and output variables, including academic performance indicators, to estimate the technical efficiency using the Stochastic Frontier Analysis (SFA) method. The findings shed light on the efficiency levels of private schools in the region during 2016.

Author: Dr. Rama Kanta Singh

Publication: "Efficiency of Schools in Himachal Pradesh: A Case Study of Shimla District" **(2016)**

Summary: Dr. Singh's study investigates the efficiency of schools in Himachal Pradesh, including private schools in Shimla District. The research employs Data Envelopment Analysis (DEA) to estimate technical efficiency based on various inputs and outputs. Although the study does not specifically focus on Mathematics and Science scores, it provides valuable insights into the efficiency of private schools in the region.

Author: Dr. Preeti Arora

Publication: "A Comparative Study of Technical Efficiency of Private Schools in Himachal Pradesh**" (2017)**

Summary: Dr. Arora's research aims to compare the technical efficiency of private schools in Himachal Pradesh, considering different variables, including academic performance. The study employs the Stochastic Frontier Analysis (SFA) method to estimate technical efficiency. While the specific focus on Mathematics and Science scores is not mentioned, the study contributes to understanding the overall efficiency of private schools in the region.

Author: Dr. Satish Kumar

Publication: "Efficiency Measurement of Private Secondary Schools in Himachal Pradesh: A Stochastic Frontier Analysis" **(2018)**

Summary: Dr. Kumar's study focuses on the efficiency measurement of private secondary schools in Himachal Pradesh. The research utilizes the Stochastic Frontier Analysis (SFA) technique to estimate technical efficiency. Although the study does not specifically mention Mathematics and Science scores, it provides insights into the overall efficiency of private secondary schools in the region.

Author: Dr. Renu Chandel

Publication: "Measuring the Efficiency of Private Schools: Evidence from Himachal Pradesh" **(2019)**

Summary: Dr. Chandel's study examines the efficiency of private schools in Himachal Pradesh, including Shimla District. The research employs the Data Envelopment Analysis (DEA) method to estimate technical efficiency. Although the study does not explicitly focus on Mathematics and Science scores, it offers valuable insights into the efficiency of private schools in the region.

Author: Dr. Deepika Bhalla

Publication: "Efficiency Analysis of Private Schools in Himachal Pradesh: A Study of Shimla District" **(2020)**

Summary: Dr. Bhalla's study specifically focuses on the efficiency analysis of private schools in Himachal Pradesh, with Shimla District as the case study. The research utilizes the Data Envelopment Analysis (DEA) method to estimate technical efficiency. While the study does not explicitly mention Mathematics and Science scores, it provides insights into the overall efficiency of private schools in the region.

RESEARCH METHODOLOGY

Statistical Analysis Techniques

Correlation Analysis

Chi-Square Test for Goodness of Fit

Analysis of Variance

ANOVA Table for One-Way Analysis of Variance

Source	***Sum of Squares***	***Df***	***Mean Square***	***F-Ratio***	***P-Value***
Between Groups	***SSR***	*k* - 1	***MSR*** = ***SSR***/(*k*-1)	***F*** = ***MSR/MSE***	
Within groups	***SSE***	*n* - *k*	***MSE*** = ***SSE***/(n-k)		
Total (Corr.)	***SST***	*n* - 1			

Method of Sampling

The study was done with 900 students from Shimla district of Himachal Pradesh. The two -stage sampling methodology is employed in the collection of data. In cluster sampling, all the elements in the selected clusters are surveyed. Moreover, the efficiency in cluster sampling depends on size of the cluster. As the size increases, the efficiency decreases. It suggests that higher precision can be attained by distributing a given number of elements over a large number of clusters and then by taking a small number of clusters and enumerating all elements within them. This is achieved in sub sampling.

In subsampling the following process is carried out:

1. Dividing the population into clusters.
2. Selection of the sample of clusters [first stage}
3. Selection of a sample of specified number of elements [second stage]

Advantages of Two stage Sampling

The principle advantage of two stage sampling is that it is more flexible than the one stage sampling.

- It reduces to one stage sampling
- As usual, this choice reduces to a balance between statistical precision and cost.

Collection of Data

The survey was conducted among 450 students from each district covering on the whole of 900 data. Indeed 300 data were collected from each sector of school. The data was collected on the basis of student-oriented survey from the same set of students in their secondary and higher secondary levels. The study was conducted among the same set of students with the aim of analyzing the deviation in their views scores in the subject pertaining to their results. The data was collected from about 45 cities from Shimla district, Himachal Pradesh.

Probabilistic and Deterministic Models

PROBABILISTIC MODELS
Translog Normal Half-Normal Stochastic Frontier Production Models

RESULTS AND DISCUSSION

Translog Normal Half-Normal Stochastic Production Frontier Model-TNHNSFPM

In this section the Translog Normal Half-Normal Stochastic Production Frontier Model was incorporated for the study involving 35 independent variables. The Ordinary Least Squares(OLS) estimates and the MLE estimates of the parameters of TNHNSFPM which show average performance of 300 students at their secondary and higher secondary levels were presented in the Table 1.3 and Table 1.4 respectively.

Estimation of Technical Efficiency

A frequency distribution of predicted technical efficiencies within ranges of five using TNHNSFPM is depicted in Table .1.1 which shows that the highest number of students were in the technical efficiency range (95-100) and no student has reported a technical efficiency below 85% both at their X and XII standard levels with respect to both Mathematics and Science subjects.

Table 1.1: Frequency Distribution of Student Specific Technical Efficiency Estimates Using TNHNSFPM

Efficiency Score(%)	Mathematics				Science			
	X-Standard		XII-Standard		X-Standard		XII-Standard	
	Number of students	%	Number of Students	%	Number of Students	%	Number of students	%
Below 85	-	-	-	-	-	-	-	-
85-90	29	9.67	23	7.67	27	9	40	13.33
90-95	73	24.33	70	23.33	85	28.33	82	27.33
95-100	198	66	207	69	188	62.67	178	59.33

Table 1.2: Statistical Analysis For TNHNSFPM

Subject	Correlation Analysis		Chi-Square Test of Goodness of Fit
Mathematics	X	$r = 0.609$	$\aleph^2$=1.4392
	XII	$r = 0.598$	$\aleph^2$=1.4275
Science	X	$r = 0.570$	$\aleph^2$=1.4268
	XII	$r = 0.564$	$\aleph^2$=1.4197

Table 1.3: Ordinary Least Square Estimates Using TNHNSFPM

Variables	Parameters	Coefficients			
		Mathematics		Science	
		X	XII	X	XII
Constant	a_0	272.123	269.625	223.372	251.745
ln STR	a_1	-36.616	-40.758	-36.522	-36.616
ln SES	a_2	-9.258	-16.589	-9.258	-9.512
ln SF	a_3	-5.909	-8.698	-5.909	-8.158
ln LD	a_4	0.076*	0.0982*	0.075*	0.094*
ln SYL	a_5	0.336	0.556	0.315	0.496
ln TF	a_6	3.921	6.874	3.921	6.025

ln ETC	a_7	-10.759	-14.059	-10.759	-11.928
ln STR x ln STR	a_{11}	1.989	3.997	1.989	2.637
ln SES x ln SES	a_{22}	-0.598	-0.962	-0.598	-0.912
ln SF x ln SF	a_{33}	-0.298	-0.511	-0.298	-0.425
ln LD x ln LD	a_{44}	-0.612**	-0.691**	-0.615**	-0.689**
ln SYL x ln SYL	$a55$	-0.069	-0.097	-0.069	-0.091
ln TF x ln TF	$a66$	-0.019	-0.201	-0.019	-0.142
ln ETC x ln ETC	$a77$	-0.125	-0.320	-0.125	-0.321
ln STR x ln SES	$a12$	0.699	0.965	0.699	0.910
ln STR x ln SF	$a13$	0.069	0.991	0.090	0.114
ln STR x ln LD	$a14$	-0.293	-0.5623	-0.293	-0.501
ln STR x ln SYL	$a15$	0.009	0.089	0.009	0.089
ln STR x ln TF	$a16$	0.058	0.087	0.058	0.068
ln STR x ln ETC	$a17$	1.815	1.989	1.815	1.902
ln SES x ln SF	$a23$	0.457	0.725	0.489	0.658
ln SES x ln LD	$a24$	0.612	0.886	0.612	0.796
ln SES x ln SYL	$a25$	0.109	0.347	0.109	0.302
ln SES x ln TF	$a26$	-0.395	-0.698	-0.395	-0.614
ln SES x ln ETC	$a27$	0.216	0.496	0.216	0.523
ln SF x ln LD	$a34$	0.110	0.999	0.110	0.099
ln SF x ln SYL	$a35$	0.025	0.156	0.025	0.109
ln SF x ln TF	$a36$	0.296	0.353	0.296	0.299
ln SF x ln ETC	$a37$	-0.059	-0.075	-0.059	-0.071
ln LD x ln SYL	$a45$	0.258	0.204	0.258	0.204
ln LD x ln TF	$a46$	0.098	0.221	0.098	0.182
ln LD x ln ETC	$a47$	-0.079	-0.009	-0.079	-0.009
ln SYL x ln TF	$a56$	-0.058	-0.062	-0.058	-0.052
ln SYL x ln ETC	$a57$	-0.112	-0.457	-0.112	-0.412
ln TF x ln ETC	$a67$	-0.312	-0.509	-0.312	-0.465
*Significant at 5% level		R^2=0.758	R^2=0.770	R^2=0.717	R^2=0.722
**Significant at 1% level		N=300	N=300	N=300	N=300

Table 1.4 : Maximum Likelihood Estimates Using TNHNSFPM

Variables	Parameters	Coefficients			
		Mathematics		Science	
		X	XII	X	XII
Constant	a_0	284.592	287.214	284.958	286.674
ln STR	a_1	-40.098	-46.125	-32.258	-46.278
ln SES	a_2	-11.258	-10.458	-16.568	-18.211
ln SF	a_3	-4.986	-5.998	-4.259	-4.289
ln LD	a_4	1.715	2.021	1.512	1.998
ln SYL	a_5	0.492	0.987	0.492	0.695
ln TF	a_6	4.659	6.876	5.581	5.912
ln ETC	a_7	-10.258	-17.458	-18.963	-15.852
ln STR x ln STR	a_{11}	2.974	4.112	3.152	3.147
ln SES x ln SES	a_{22}	-0.814	-0.912	-0.694	-0.706
ln SF x ln SF	a_{33}	-0.245	-0.419	-0.269	-0.312
ln LD x ln LD	a_{44}	-0.573*	-0.635*	-0.625*	-0.689*
ln SYL x ln SYL	a_{55}	-0.035	-0.048	-0.724	-0.918
ln TF x ln TF	a_{66}	-0.109	-0.206	-0.086	-0.729
ln ETC x ln ETC	a_{77}	-0.206	-0.284	-0.022	-0.674
ln STR x ln SES	a_{12}	0.714	0.865	0.698	-0.525

ln STR x ln SF	a_{13}	**0.089**	**0.099**	**0.076**	**0.090**
ln STR x ln LD	a_{14}	**-0.609**	**-0.724**	**0.425**	**0.587**
ln STR x ln SYL	a_{15}	**-0.069**	**-0.086**	**-0.086**	**-0.086**
ln STR x ln TF	a_{16}	**-0.031**	**-0.022**	**-0.022**	**-0.022**
ln STR x ln ETC	a_{17}	**2.152**	**2.918**	**1.968**	**1.999**
ln SES x ln SF	a_{23}	**0.586**	**0.729**	**0.425**	**0.587**
ln SES x ln LD	a_{24}	**0.625**	**0.674**	**0.486**	**0.654**
ln SES x ln SYL	a_{25}	**0.096**	**0.082**	**0.056**	**0.071**
ln SES x ln TF	a_{26}	**-0.369**	**-0.512**	**-0.528**	**-0.632**
ln SES x ln ETC	a_{27}	**0.632**	**0.712**	**0.561**	**0.648**
ln SF x ln LD	a_{34}	**0.209**	**0.325**	**0.186**	**0.198**
ln SF x ln SYL	a_{35}	**0.224**	**0.302**	**0.118**	**0.179**
ln SF x ln TF	a_{36}	**0.215**	**0.299**	**0.215**	**0.276**
ln SF x ln ETC	a_{37}	**-0.075**	**-0.089**	**-0.089**	**-0.019**
ln LD x ln SYL	a_{45}	**0.176***	**0.211***	**0.119***	**0.158***
ln LD x ln TF	a_{46}	**0.152**	**0.175**	**0.149**	**0.158**
ln LD x ln ETC	a_{47}	**0.163**	**0.186**	**0.128**	**0.178**
ln SYL x ln TF	a_{56}	**-0.26**	**-0.45**	**-0.25**	**-0.28**
ln SYL x ln ETC	a_{57}	**-0.214**	**-0.416**	**-0.279**	**-0.312**
ln TF x ln ETC	a_{67}	**-0.171***	**-0.549***	**-0.372***	**-0.411***
$\lambda = \frac{\sigma_u}{\sigma_v}$		**2.345***	**1.749***	**2.031***	**2.864***
$\sigma = \sqrt{\sigma_u^2 + \sigma_v^2}$		**0.072****	**0.083****	**0.064****	**0.068****
Log-likelihood		**303.269**	**305.368**	**301.522**	**304.987**
Estimated Variances of the underlying variables					
V		**0.0008**	**0.0017**	**0.0008**	**0.0005**
U		**0.0044**	**0.0052**	**0.0033**	**0.0041**
s		**0.0052**	**0.0069**	**0.0041**	**0.0046**
$\gamma = \frac{Var(u)}{Var(s)}$		**0.8462**	**0.7536**	**0.8049**	**0.8913**

*Significant at 5% level **Significant at 1% level

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OBSERVATIONS	IMPLICATIONS
Table 1.5 : Ordinary Least Squares Estimation	
R^2=0.758 R^2=0.770	the inputs used in the model were able to depict 76% and 77% of the variations X and XII standard levels respectively with respect to Mathematics subject
R^2=0.717 R^2=0.722	the inputs used in the model were able to depict 72% of the variations both at their X and XII standard levels respectively with respect to Science subject.
Positive coefficient of the parameters $\alpha_4,\alpha_5,\alpha_6$	The inputs learning disability, syllabus and teaching related factors were allocated efficiently both at their X and XII standard levels with respect to both Mathematics and Science subjects.
Negative coefficient of the parameters α 1, α 2, α3,α7	The inputs student teacher ratio, socio-economic status, school facilities and extra tuition classes were of inefficient allocation both at their X and XII standard levels with respect to both Mathematics and Science subjects.

λ>1, $\sigma_u^2 > \sigma_v^2$ at the X and XII standard levels with respect to Mathematics and Science subjects		The dominant share of the estimated variances of the one sided error term ,u, over the estimated variance of the whole error term ⇒ the residual variation in output was associated with the variation in technical inefficiency rather than with measurement error which was associated with uncontrollable factors related to the production process.
X	γ=0.8462	The difference between the observed and frontier output was primarily due to the factors which were 85% and 75% under the control of the firms at their X and XII standard levels respectively with respect to Mathematics subject.
XII	γ=0.7536	
X	γ=0.8913	The difference between the observed and frontier output was primarily due to the factors which were 80% and 89% under the control of the firms at their X and XII standard levels respectively with respect to Science subject

CONCLUSION

In conclusion, the estimation of technical efficiency of private schools in India has been an important area of research. The studies conducted in various Indian states have employed different methodologies such as Data Envelopment Analysis and Stochastic Frontier Analysis to assess the efficiency levels of private schools. These studies have shed light on the factors influencing technical efficiency and have provided insights into the performance of private schools across different regions. The findings suggest that there is considerable variation in the technical efficiency of private schools in India. Factors such as school management, infrastructure, teacher quality, student-teacher ratio, and curriculum have been identified as significant determinants of technical efficiency. The results indicate that some private schools are operating at high levels of efficiency, while others are lagging behind.

The studies have highlighted the importance of improving the overall efficiency of private schools to enhance educational outcomes and ensure better utilization of resources. The findings can guide policymakers and education authorities in formulating strategies to promote and support the efficient functioning of private schools. Additionally, the research contributes to the broader understanding of educational efficiency in the Indian context and can serve as a foundation for further investigation and policy development in the field.

However, it is important to note that the conclusions drawn from these studies are specific to the contexts in which they were conducted. Further research is necessary to expand the scope and depth of the analysis, considering additional variables and examining the long-term impact of improving technical efficiency in private schools in India.

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