Statistical analysis for health expenditures by Gujarat state government in India

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Abstract

Social sector is a very important sector among other sectoral services for any governmental set up. It is imperative for any government to take sufficient care about education and health services in the relevant service sectors. Since community health is an essential subject it needs prior investigation for any governmental set up to give due importance in this respect. Gujarat state in India is considered to be a progressive state with good and efficient governance since its inception. Gujarat state is also considered to be one of the richest states in India. It may be worthwhile to examine and evaluate about the health expenditure pattern incurred by the state government. In this paper a statistical analysis is carried out to build up a model approach by means of considering semi log linear models for the total expenses by the state government in health sector and also total budgetary expenses during the year 2004-2014. Based upon the fitted model projections are carried out and prior estimates are obtained which may be made useful for state planning exercises.

Keywords: SLLM, GSDP, HEDI (Health Expenses Disbursement Indicators), Projection.

Introduction

For any country health care is a very responsible factor for its people as it becomes a prime necessity for welfare and development of the country. Of course health is a state subject and state polices have an important impact upon public health expenditure in India. For any state education, health services, human development etc. are very important factors for growth and development of the state. A common approach is that per capita income or GDP can measure growth of the data but this is not true because development aspects are also based upon health sector development programmes.

State government also receives support from central government by means of number of centrally sponsored programmes and various national programmes.

After independence control exercised by central has been reduced in many areas, which in turn exhibits wider scope for improving their performance level and initiatives.

There are many studies carried out related with health care expenditure particularly for our country like India. It is also necessary to analyze the pattern of variation for health expenditure incurred by state government in India about further courses of action in this direction.

In this paper we want to study the pattern of variations in health expenditure done by Gujarat state government in India and also about total expenditure incurred by state government of Gujarat.

This is viewed by carrying out the Statistical analysis using semi log linear models for the concerned topics. It may also be worthwhile to examine the role of state domestic project (GSDP) for health expenditure by government and total expenditure by state government. We have defined health expenses disbursement indicator (HEDI) which can give a comparative view for the whole scenario.

We have used the data published by the state government of Gujarat in their annual budgetary reports during the years 2004-2005 to 2015-2016. Since the statistical models proposed are found to be best fitted further projections are carried out for the next course of five years period. This may be useful for state government planning exercises in terms of policy decisions pertaing to health care and related expenditures of state government. In this paper methodological aspects are in section-2, statistical analysis in section-3 and final concluding remarks are given in section-4.

Methodology

Semi log linear Models: We consider Semi log linear Models to explain the behaviour of the variables concerned, which is represented as under

MODEL-1
We define $\text{Log } Y_1 = \alpha_1 + \beta_1 X + U_1$ (1)

Where: Y_1 = Health Expenditure of the State Government of Gujarat. X = Year. α_1 and β_1 are the parameters. U_1 = Disturbance term.

Under the usual normality assumptions we can fit this model and determine $\hat{\alpha_1}$ and $\hat{\beta_1}$ so that

$$\hat{Log_e Y_1} = \hat{\alpha_1} + \hat{\beta_1} X \tag{2}$$

From equation (2) the estimated value of Y_1 (i.e. $\hat{Y_1}$) can be obtained for given X.

MODEL-2
We define $\log Y_2 = \alpha_2 + \beta_2 X + U_2$ (3)

Where: Y_2 = Total Expenditure by the State Government of Gujarat. X = Year. α_2 and β_2 are the parameters. U_2 = Disturbance term

Under the usual normality assumptions we can fit this model and determine $\hat{\alpha_2}$ and $\hat{\beta_2}$ so that

$$\hat{Log_e Y_2} = \hat{\alpha_2} + \hat{\beta_2} X \tag{4}$$

From equation (4) the estimated value of Y_2 (i.e. $\hat{Y_2}$) can be obtained for given X.

Health expenses disbursement indicators: Let us define two indicators expressed as Health Expenses Disbursement Indicators (HEDI).

HEDI: We compute the ratio (expressed in %) by the following formula

$I_1(X) = [Y_1(x) / Y_2(x)] * 100$

Where: $Y_1(x)$ = Health Expenses by State Government of Gujarat for year X. $Y_2(x)$ = Total Expenditure by State Government of Gujarat for year X.

Then we obtain the Health Expenses Disbursement Indicator (HEDI) by constructing its indices for the respective years with 2004-2005 as the base year. The indicator computed this way shows the relative growth pattern of HEDI during subsequent years as compared to the base year.

HEDI at GSDP: Let us define G(x) = Gujarat State Domestic Product (GSDP) at current prices for the year X, then first we compute the ratio (expressed in %) by the following formula

$I_2(X) = (Y_1(x)/G(x)) * 100$

This gives the values of $Y_1(x)$ deflated by GSDP at current prices. Then we obtain the Health Expenses Disbursement Indicator (HEDI) at GSDP by constructing its indices for the respective years with 2004-2005 as the base year.

The indicator computed this way shows the relative growth pattern of HEDI (at GSDP) during subsequent years as compared to the base year.

Results and discussion

As discussed above we have fitted the models M_1 and M_2 for the data of Gujarat State Government. For the fitted model M_1 the results obtained are shown in the Tables-1 to 6.

Table-1: Year and health expenditure.

Year	X	Health Expenses Y_1 (In Crores)	ln Y_1
2004-2005	1	971.07	6.878399
2005-2006	2	1069.33	6.974788
2006-2007	3	1146.11	7.044129
2007-2008	4	1374.27	7.225678
2008-2009	5	1601.45	7.378665
2009-2010	6	2285.06	7.734148
2010-2011	7	3010.45	8.009845
2011-2012	8	3328.39	8.110244
2012-2013	9	4626.36	8.439526
2013-2014	10	5083.49	8.533753
2014-2015	11	6366.9	8.758868
2015-2016	12	7406.45	8.910107
2016-2017	13	8146.13	9.005298

Source: Annual health budget of Gujarat state government.

Table-2: Regression statistics.

Regression Statistics	
Multiple R	0.993108
R Square	0.986264
Adjusted R Square	0.985015
Standard Error	0.094212
Observations	13

Table-3: Analysis of variance (ANOVA).

	df	SS	MS	F	Significance F
Regression	1	7.010146	7.010146	789.793152	1.35589E-11
Residual	11	0.097635	0.008876		
Total	12	7.107781			

Table-4: Table for t statistics.

	Co-eff	Stan-dard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	6.549535	0.05543	118.1596	1.996E-18	6.427534903	6.671534	6.427535	6.671534
year	0.196258	0.006983	28.10326	1.3559E-11	0.180887697	0.211629	0.180888	0.211629

Table-5: Estimated values of Y_1.

year	X	$\hat{\ln Y_1} = \hat{\alpha_1} + \beta_1 \hat{X}$	$\hat{Y_1}$
2004-2005	1	6.74579275	850.47
2005-2006	2	6.94205095	1034.89
2006-2007	3	7.13830916	1259.29
2007-2008	4	7.33456737	1532.36
2008-2009	5	7.53082557	1864.64
2009-2010	6	7.72708378	2268.97
2010-2011	7	7.92334199	2760.98
2011-2012	8	8.11960019	3359.67
2012-2013	9	8.3158584	4088.19
2013-2014	10	8.51211661	4974.68
2014-2015	11	8.70837481	6053.39
2015-2016	12	8.90463302	7366.02
2016-2017	13	9.10089123	8963.27

Table-7: Years and total expenditures.

Year	X	Total Expenses Y_2 (In Crores)	$\ln Y_2$
2004-2005	1	37885.33	10.54231924
2005-2006	2	37148.72	10.52268459
2006-2007	3	39089.7	10.57361428
2007-2008	4	42556.25	10.65858201
2008-2009	5	51752.35	10.85422512
2009-2010	6	59951.78	11.00129585
2010-2011	7	71743.8	11.18085672
2011-2012	8	79236.92	11.28019763
2012-2013	9	98141.51	11.4941657
2013-2014	10	104417.38	11.55615142
2014-2015	11	116136.02	11.66251737
2015-2016	12	132412.85	11.79367997
2016-2017	13	149465.58	11.91482141

Source: Annual health budget of Gujarat state government.

Table-6: Projactions of Y_1.

year	X	$\hat{\ln Y_1} = \hat{\alpha_1} + \beta_1 \hat{X}$	$\hat{Y_1}$
2017-2018	14	9.29714943	10906.88
2018-2019	15	9.49340764	13271.94
2019-2020	16	9.68966585	16149.84
2020-2021	17	9.88592405	19651.79
2021-2022	18	10.0821823	23913.11

Table-8: Regression statistics.

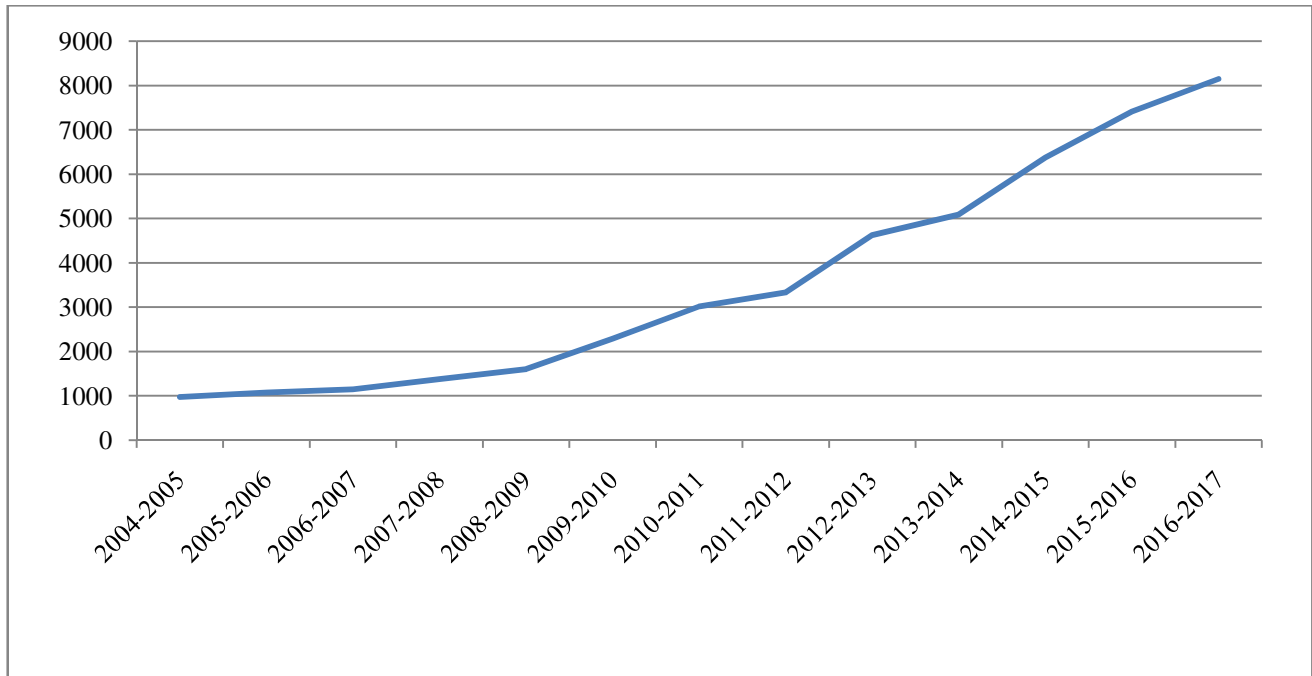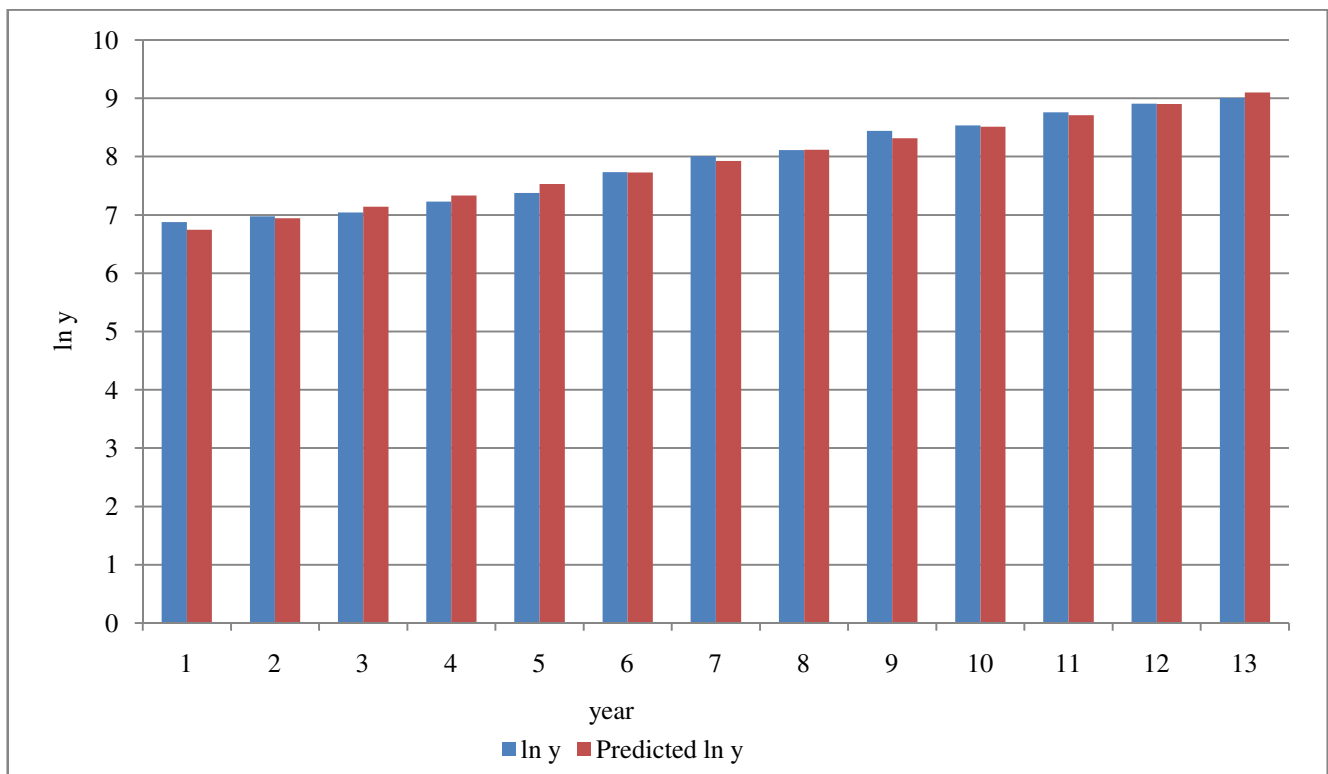| Regression Statistics	
Multiple R	0.991288907
R Square	0.982653698
Adjusted R Square	0.981076762
Standard Error	0.06888184
Observations	13

Figure-1: Expenses for health.

Figure-2: Year line fit plot.

Fitted model explains about 98.62% variation and it is highly significant statistic (as well as F) is also found to be highly significant. 95% confidence limits are obtained as shown in the above Table-4, which can be made useful for future predictions. Since model is best fit to the relevant data. We obtain its projections for future years from (2017-2018 to 2021-2022). Graphical presentation for the data on expenditures for health by Gujarat state is given in Figure–1 and the fitted model is expressed in Figure–2. For the fitted model M_2 the results obtained are shown in the Tables-7 to 12.

Table-9: Analysis of variance (ANOVA).

	df	SS	MS	F	Significance F
Regression	1	3	2.956621654	623.14093	4.90046E-11
Residual	11	0	0.004744708		
Total	12	3			

Table-10: Table for t statistics.

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	10.26435113	0	253.27499	4.562E-22	10.17515286	10.353549	10.17515	10.35355
Year	0.127456557	0	24.962799	4.9005E-11	0.116218631	0.1386945	0.116219	0.138694

Table-11: Estimated values of Y_2 (total expenditure).

year	X	$\hat{\ln} Y_2 = \hat{\alpha_2} + \hat{\beta_2} X$	$\hat{Y}_2$
2004-2005	1	10.3918077	32591.52
2005-2006	2	10.5192642	37021.87
2006-2007	3	10.6467208	42054.46
2007-2008	4	10.7741774	47771.15
2008-2009	5	10.9016339	54264.95
2009-2010	6	11.0290905	61641.49
2010-2011	7	11.156547	70020.75
2011-2012	8	11.2840036	79539.06
2012-2013	9	11.4114601	90351.25
2013-2014	10	11.5389167	102633.19
2014-2015	11	11.6663733	116584.69
2015-2016	12	11.7938298	132432.69
2016-2017	13	11.9212864	150434.99

Table-12: Projections of Y_2 (total expenditure).

year	X	$\hat{\ln} Y_2 = \hat{\alpha_2} + \hat{\beta_2} X$	$\hat{Y}_2$
2017-2018	14	10.2643511	170884.45
2018-2019	15	12.1761995	194113.72
2019-2020	16	12.303656	220500.67
2020-2021	17	12.4311126	250474.54
2021-2022	18	12.5585692	284522.93

Fitted model explains about 98.26% of the values R^2 and t statistic (as well as F) are also found to be highly significant. 95% confidence limits are obtained as shown in the above table 10, which can be made useful for future predictions. Since model is best fit to the relevant data. We obtain its projections for future years from (2017-2018 to 2021-2022)

Graphical presentation for the data on expenditures for health by Gujarat Estate is given in Figure–3 and the fitted model is expressed in Figure-4. HEDI as expressed in the above methodology the results for HEDI and its indicator are as shown in the Table-13.

As expressed in the above methodology the results for HEDI at GSDP and its indicator are as shown in the Table-14.

Table-13: Table for health expense and Disbursement Indicators (HEDI).

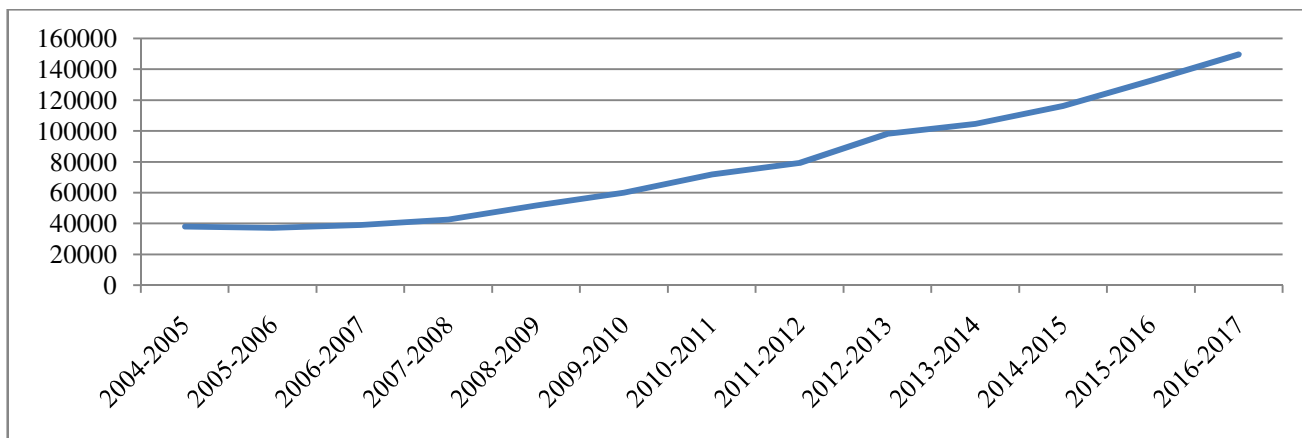| Year	HEDI	Indicator
2004-2005	2.56	100
2005-2006	2.87	112.11
2006-2007	2.93	114.45
2007-2008	3.22	125.78
2008-2009	3.09	120.70
2009-2010	3.81	148.83
2010-2011	4.19	163.67
2011-2012	4.20	164.06
2012-2013	4.71	183.98
2013-2014	4.86	189.84
2014-2015	5.59	214.06

HEDI (at GSDP).

Figure-3: Total expense of government.
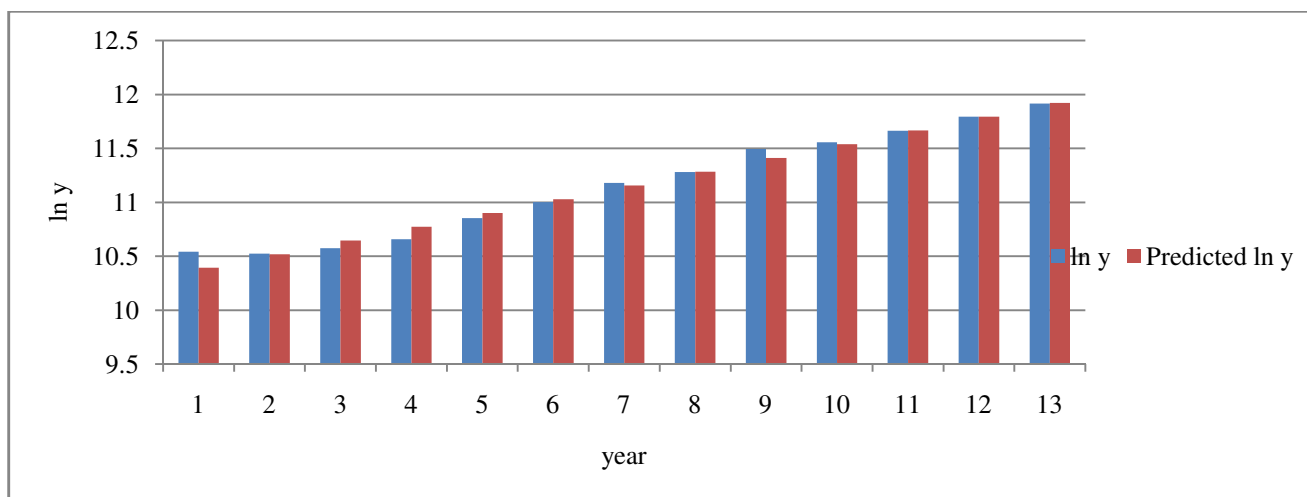
Figure-4: Year line fit plot.

Table-14: Indicator of health and total expenditure.

Year	HEDI	Indicator
2004-2005	0.47	100
2005-2006	0.45	95.75
2006-2007	0.39	82.98
2007-2008	0.41	87.23
2008-2009	0.43	91.49
2009-2010	0.52	110.64
2010-2011	0.57	121.28
2011-2012	0.54	114.89
2012-2013	0.64	136.17
2013-2014	0.63	134.04
2014-2015	0.71	151.06

Conclusion

Projections obtained for health expenditure of Gujarat state during the subsequent years represent a statistical forecast which may be helpful to the state government for its further planning exercises. It may be noted that the expenses for the year 2017-2018 which will be around 10906.88 crore rupees and it will be more than double for the fourth coming year 2021-22.

In a similar way on the basis of statistical model fitted for total government expenditure by Gujarat state is predicted (based upon Table-2) that for the year 2017-18 it will be 170884.45 crores and will gradually increase upto 284522.93 crores for the year 2021-22. Thus this estimated total expenditure will have growth of about 13.30% per year.

Indicator defined as HEDI given in Table -3 above shows that as compared to the base year (i.e, 2004-05) HEDI increases from 2.56 to 5.59 which is almost more than double during the years 2004-05 to 2014-15. It's corresponding indicator also suggests that it is doubled during 2004-05 to 2014-15. The growth rate for corresponding indicator is 10.37% per year.

HEDI (at GSDP) as computed in Table-4 shows that HEDI at GSDP increases from 0.47 in 2004-05 to 0.71 in 2014-15. Its corresponding indicator as computed with 2004-05 as a base year shows that this series is fluctuating and it's AGR (annual growth rate) is about 4.64% per year.

The purpose of this study is to visualize in general the track for government expenditures done by Gujarat state and it's health sector and total government expenditure during the course of our study period. What we may conclude on the basis of our theoretical exercise is that all these expenses are not sufficient to meet with health requirement of people. In general proportionally it does not reflect any significant encouraging results. State government can think in this direction and spare more funds for utilization in health sector which is one of the prime necessity today.

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