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Stochastic Modelling for Child labour Data in Andhrapradesh and Telangana

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Abstract:

In this article we have extracted child labour data from census data of the years 1981, 1991 and 2001in each district. Using these three census data we interpolated the child labour for the year 1986 and 1996 using population interpolation formula from vital statistics theory. For this data we fitted three different models with one explanatory variable and identified the model whichever suited the most. At present as 2011 census data is available; we extracted child labour data from 2011 census and compared with the forecasted values. It has been observed that majority of the predicted values are close to the observed values.

Keywords — **Interpolation, child labour, stochastic model, adequacy, statistical significance**

I. INTRODUCTION

Throughout history, children have been working under very unhealthy and hazardous conditions. The prevalence of child labour is one of the most important problems especially in developing countries such as India. Families conceive the opinion that more the children they have, more the successful they are in surviving because children can work or be sold. Low income, lack educational facilities, lack of awareness of benefits of education, illiteracy and ignorance of parents are some of the reasons which breed child labour.

According to the international labour organization (ILO) child labour definition is as follows:

Children under the age 15 who are involved in one or more types of circumstances described below can be called **"Child Labour"**.

1) Full-time work that is performed by kids under the age of 15.
2) Work that prevents kids from attending school.
3) Work that is hazardous to kid's physical, mental or emotional health.

II. CHILD LABOUR AT A GLANCE

Child labour is not only a social problem but also an economic one. The statistics say that almost 55% of the children of the world are working under crying and torturous circumstances. Child labour has been the vital negative social practice fostered the poor and under developed countries.

According to a study conducted by the ILO, child labour forms 11% to 20% of the work force in the Third World countries. The study further revealed that despite the efforts to eradicate child labour in the past two decades at least one hundred million children are still being exploited by the labour market.

The world considers the issue of child labour serious one in Sub-Saharan Africa. ILO statistics states that over 40% of children of Africa working as slaves in private households. African experts would believe that it is not really a serious issue.

China accounts for the third largest in the world in number of child labour. The reasons for

increasing child labour in China are Population size, Nation's poverty, Costly school education, less education opportunities etc.

III. CHILD LABOUR IN INDIA

According to the India census of 1991, there are 11.28 million working children under the age of fourteen years. In India 80% of the child labour is in the country rural areas working in agriculture activities such as fanning, livestock rearing, forestry and fisheries and 20% in manufacturing, servicing and communications. The Hindi belt which includes Bihar, Madhya Pradesh, Rajasthan, Uttar Pradesh known as BIMSRU states account for 1.27 crores of working children. Rajasthan alone accounts for over 12.6 lakhs of child workers. The world's highest number of working children are in India.

IV. CHILD LABOUR IN ANDHRA PRADESH AND TELANGANA

As the study was done before June 2014, observations were recorded for combined Andhra Pradesh.

Andhra Pradesh with 13.6 lakhs child labour stands second in the national list after U.P. The internal institute for social and economic change (ISEC) estimates that 20% of child labour of Andhra Pradesh are working in Visakhapatnam, Hyderabad and costal districts of Andhra Pradesh.

Statistical analysis reveals that more than 5% of rural population in Andhra Pradesh represents child labour i.e. approximately 45 lakhs children are far away from primary education in this state. Further, 5% of the population consisting of uneducated children is either employed in industrial sectors or working in farm sectors.

V. PREVIOUS STUDIES

M.Singh (1980) was conducted on 300 children, out of which 203 were boys (67.7%) and 97 were girls (32.3%). Out of 300 children, 211 (70.3%) worked under employer and 69 (29.7%) were self-employed. This study says that male children shouldered the family's economic responsibilities.

Sharma (1982) found that 565 of the respondents had to work for 15-18 hours per day for earning their livelihood of Rs. 85.

Gangrade (1998), Dept. of social work, Delhi in 1998 says through his study that Child labour contributes over 20% of GNP in India**.**

Chandra shekar C.P. and Amitho Bhattacharya (2001) the three qualitative variables, namely, Parental Background, Regional Factors and Cast factors are responsible for child labour. They used Spearman's rank correlation to test the correlation between child labour and the facts mentioned above. The rank correlation between Parent's Back ground and Child labour is 0.78, whereas the rank correlation between Regional factors and Child labour, Cost factors and Child labour found to be 0.55 and 0.334, respectively. Statistical conclusion is that child labours are much influenced by parental background.

Ahuge H.L. (1998) he collected primary data from 225 members in Andhra Pradesh to access the attributes of child labour like inherited jobs, family conditions and Jewnil neglected problems. He constructed pie diagram and observed that 25% of the labour are influenced by inherited jobs, 35% are influenced by jewnil neglected problems and 40% are influenced by family conditions. Statistical conclusion is that child labours are much influenced by family conditions.

Mccleland and Garge (1992) they used the three measures, namely, Media campaigning, legal measures and parent counselling to reduce the child labour and tested for their significance. Their study says that legal measures are the prime source of controlling child labour. The ANOVA value for other methods has compelled to reject the Hypothesis. However, parent counselling is moderately found to be effective at the value of 0.061 in reducing child labour employment.

VI. NEED FOR THE STUDIES

It is already stated that child labour is also an economic problem. In the literature referred so far statistical model fitting for child labour is not done. So in this paper we have taken up fitting of

statistical model to child labour data, collected from the Directorate of censes, Andhra Pradesh.

VII. TREATMETN OF THE DATA

We have taken census data of child labour of the years 1981, 1991 and 2001, in each district. In Census, workers are classified into two categories as main workers and marginal workers. Though main workers number has declined from 4.3% of 1991 census to 2.3% in 2001 census in state, there is a substantial increase in marginal workers in every category of worker irrespective of gender and region. As a result, despite the number of main workers declining from 9.08 million in 1991 to 5.78 million in 2001 in India the total number of children in the work force has increased. A large part of the increase was accounted for by the increase in marginal workers, which increased from 2.2 million in 1991 to 6.89 million in 2001 in India.

The trends between 1991 and 2001 of declining main workers along with increasing marginal workers may indicate the change in the nature of work done by children. We calculated the sum of "Male main workers and Male marginal workers", "Female main workers and Female marginal workers" for rural and urban areas separately for each district, also the district as a whole. Using these three censes data we interpolated the child labour for the year 1986 and 1996 using population interpolation formula from vital statistics theory.

i.e. Arithmetic mean of P_0 and P_1 is $[(P_0+P_1)/2]$ where P_0 and P_1 are two census points.

VIII. STOCHASTIC MODELLING

For this data we fitted the three different curves with one explanatory variable. Namely, straight line, second degree parabola and exponential curve whichever the curve suited the most. We identified the best model for all the district's data sets in rural as well as urban and male, female with in region separately. The fitted models are initially tested for their adequacy through graphical method. The fitted models along with R^2 values for all districts are presented here. The graphs are not presented here due to lack of space.

It is observed that all the three curves gave good fit in different regions under different genders. The reason could be migration of people from one region to another region.

IX. MODEL ADEQUACY

To ensure adequacy of these models statistically for using forecasting of child labour in 2011, we tested them for statistical significance. We tested all the fitted models for overall significance by the F-test statistic given as $F = \frac{(R^2/k)}{(\frac{1-R^2}{n-k-1})} \sim F_{(k, n-k-1)}$

Where n= number of observations = 5

k= number of independent variables = 1

The hypothesis here is H_0: R^2 value is insignificant.

It has been observed that almost all R^2 values are significant at 1% level of significance for all districts urban and rural regions in male and female categories. Hence, it can be concluded that all the fitted models are adequate to explain the variation in the actual child labour data to the maximum extent. These values are presented in the following tables.

District	Fitted models for urban population	
	Male	Female
1.ADILABAD	$y = 1734.2e^{0.0204x}$	$y = 45.214x^2 + 40.5x + 1066.2$
2.NIZAMABAD	$y = 105x^2 - 141.5x + 1724$	$y = 1737.8e^{-0.229x}$
3.KARIMNAGAR	$y = 34.607x^2 - 403.25x + 2097.7$	$y = 2720.9e^{-0.232x}$
4.MEDAK	$y = 59.25x^2 - 90.25x + 1197.4$	$y = 29.25x^2 - 104.25x + 783.4$
5.HYDERABAD	$y = 431.46x^2 + 954.25x + 12275$	$y = 431.89x^2 + 1305.7x + 3345.5$
6.R.R.D	$y = 4416.8e^{0.3432x}$	$y = 1955.1e^{0.4648x}$
7.MAHBUBNAGAR	$y = 94.071x^2 - 342x + 2085.3$	$y = 1826.1e^{-0.109x}$
8.NALGONDA	$y = 91.071x^2 - 224x + 1302.9$	$y = 942.37e^{-0.055x}$
9.WARANGAL	$y = 18.643x^2 - 17.5x + 1544.9$	$y = 1649.9e^{-0.167x}$
10.KHAMMAM	$y = -21.429x^2 - 7x + 1610.9$	$y = 79.75x + 860.9$
11.SRIKAKULAM	$y = 1431.2e^{-0.125x}$	$y = 1033.7e^{-0.039x}$
12.VIZIANAGARAM	$y = -52.821x^2 - 75.75x + 2207.7$	$y = -2.25x^2 + 64.75x + 1058.2$
13.VISHAKAPATNAM	$y = 42.964x^2 + 191.75x + 3514.4$	$y = 48x^2 + 351.5x + 1658.4$
14.EAST GODAVARI	$y = 6252.6e^{-0.211x}$	$y = 1658.6e^{-0.065x}$

15.WEST GODAVARI	$y = 4900.7e^{-0.149x}$	$y = 2139.5e^{-0.058x}$
16.KRISHNA	$y = 7932.9e^{-0.093x}$	$y = 3430.7e^{-0.027x}$
17.GUNTUR	$y = -84x^2 - 199x + 7882.8$	$y = -175.29x^2 + 74.5x + 5349.8$
18.PRAKASAM	$y = 2311.5e^{-0.097x}$	$y = 1838.4e^{-0.152x}$
19.NELLORE	$y = -3.8571x^2 - 273.5x + 3139.9$	$y = 1491.5e^{-0.079x}$
20.CUDDAPAH	$y = 2943.4e^{-0.102x}$	$y = 44.786x^2 - 153.5x + 1574.8$
21.KURNOOL	$y = 6753.2e^{0.0097x}$	$y = 4210.4e^{0.0619x}$
22.ANANTAPUR	$y = -138.64x^2 + 309x + 5256.1$	$y = 313.75x + 2462.9$
23.CHITTOOR	$y = 3019e^{-0.097x}$	$y = 6.2143x^2 - 75.5x + 1205$

District	Fitted models for rural population	
	Male	Female
1.ADILABAD	$y = 25609e^{-0.154x}$	$y = -209.68x^2 - 1598.8x + 29315$
2.NIZAMABAD	$y = -4121x + 24439$	$y = -4465x + 29959$
3.KARIMNAGAR	$y = 770.14x^2 - 9271.5x + 29896$	$y = -8221.5x + 46529$
4.MEDAK	$y = -3571.8x + 32127$	$y = -523x + 31483$
5.HYDERABAD	Y=0	Y=0
6.R.R.D	$y = 23380e^{-0.2x}$	$y = -266.68x^2 - 1604.3x + 21747$
7.MAHBUBNAGAR	$y = -2050.8x + 61930$	$y = 5415.3x + 63477$
8.NALGONDA	$y = -6668.8x + 35620$	$y = -196.71x^2 - 302x + 39143$
9.WARANGAL	$y = -6825.8x + 32898$	$y = -1309.6x^2 - 3448.8x + 39592$
10.KHAMMAM	$y = -74.036x^2 - 3066.3x + 31330$	$y = -155.5x + 33461$
11.SRIKAKULAM	$y = -5327.3x + 27320$	$y = -527.36x^2 - 3781x + 30918$
12.VIZIANAGARAM	$y = -1881.3x + 29156$	$y = -197.46x^2 + 13.25x + 30032$
13.VISHAKAPATNAM	$y = 30545e^{-0.187x}$	$y = -629.89x^2 - 3013.3x + 33066$
14.EAST GODAVARI	$y = 5.1429x^2 - 8641x + 46254$	$y = -422.89x^2 - 2030.3x + 20992$
15.WEST GODAVARI	$y = -120.32x^2 - 6510.8x + 41303$	$y = -1289.3x^2 - 2334.8x + 32619$
S	$y = -4692x + 32110$	$y = -978.21x^2 - 2471x + 36577$
17.GUNTUR	$y = -526.18x^2 - 4992.8x + 44669$	$y = -1468.5x^2 - 2723.5x + 58570$
18.PRAKASAM	$y = -3072x + 28760$	$y = -568.5x^2 - 2506.5x + 41005$
19.NELLORE	$y = -27.429x^2 - 3692x + 21868$	$y = -2901.8x + 22284$
20.CUDDAPAH	$y = 18062e^{-0.249x}$	$y = 248.57x^2 - 4110x + 22832$
21.KURNOOL	$y = 50778e^{0.0137x}$	$y = 5117.8x + 58581$
22.ANANTAPUR	$y = -321.21x^2 - 4514x + 40295$	$y = -865.18x^2 - 2387.8x + 43284$
23.CHITTOOR	$y = 29178e^{-0.197x}$	$y = -4136.8x + 31180$

The critical value of F at 10% level of significance with (1, 5) degrees of freedom is 4.06

In the below tables * indicates statistical significance of R^2, which implies adequacy of the model.

Computed values of R^2 and F for urban population

District	Male		Female	
	R^2	F	R^2	F
1.ADILABAD	0.06	5.31*	0.95	88.46*
2.NIZAMABAD	0.96	129.05*	0.98	217.22*
3.KARIMNAGAR	1.00	5550.56*	0.89	40.45*
4.MEDAK	0.97	149.32*	0.99	569.71*
5.HYDERABAD	0.98	252.73*	0.99	422.35*
6.R.R.D	0.97	153.73*	0.97	172.94*
7.MAHBUBNAGAR	0.99	590.24*	0.82	23.52*
8.NALGONDA	0.98	299.88*	0.98	205.97*
9.WARANGAL	0.95	91.71*	1.00	2267.73*
10.KHAMMAM	0.92	60.53*	0.75	15.09*
11.SRIKAKULAM	0.55	6.21*	0.10	5.03*
12.VIZIANAGARAM	0.97	138.68*	1.00	49995.00*
13.VISHAKAPATNAM	0.99	857.07*	1.00	2168.91*
14.EAST GODAVARI	0.97	178.15*	0.92	56.58*
15.WEST GODAVARI	0.77	16.89*	0.34	26.2*
16.KRISHNA	0.87	33.64*	0.85	27.51*
17.GUNTUR	0.98	282.36*	0.93	63.49*
18.PRAKASAM	0.96	119.07*	0.99	556.80*
19.NELLORE	1.00	0.00	0.48	4.61*
20.CUDDAPAH	0.99	719.64*	0.99	526.91*
21.KURNOOL	0.99	382.60*	0.70	11.93*
22.ANANTAPUR	0.98	255.42*	0.98	238.90*
23.CHITTOOR	1.00	4540.45*	1.00	6245.00*

Computed values of R^2 and F for rural population

District	Male		Female	
	R^2	F	R^2	F
1.ADILABAD	0.94	79.75*	1.00	2375.95*
2.NIZAMABAD	0.97	165.65*	0.97	142.49*
3.KARIMNAGAR	1.00	6245.00*	0.89	41.21*
4.MEDAK	0.97	154.74*	0.62	8.02*
6.R.R.D	1.00	4161.67*	1.00	1510.15*
7.MAHBUBNAGAR	0.75	15.06*	0.97	162.79*

8.NALGONDA	0.97	156.81*	0.97	150.76*
9.WARANGAL	0.99	445.45*	0.98	313.47*
10.KHAMMAM	1.00	49995.00 *	0.40	34.01*
11.SRIKAKULAM	0.98	213.34*	1.00	2078.33*
12.VIZIANAGARAM	1.00	0.00	0.92	56.43*
13.VISHAKAPATNAM	0.99	500.05*	0.99	975.39*
14.EAST GODAVARI	1.00	0.00	0.99	975.39*
15.WEST GODAVARI	1.00	0.00	0.97	188.05*
16.KRISHNA	1.00	6245.00*	0.98	313.47*
17.GUNTUR	1.00	3566.43*	0.97	194.20*
18.PRAKASAM	1.00	1058.83*	0.99	842.46*
19.NELLORE	1.00	0.00	0.89	39.33*
20.CUDDAPAH	0.98	309.47*	1.00	9995.00*
21.KURNOOL	0.17	10.2*	0.87	33.11*
22.ANANTAPUR	1.00	8328.33*	0.99	362.65*
23.CHITTOOR	0.99	342.22*	1.00	49995.00 *

X. FORECASTING

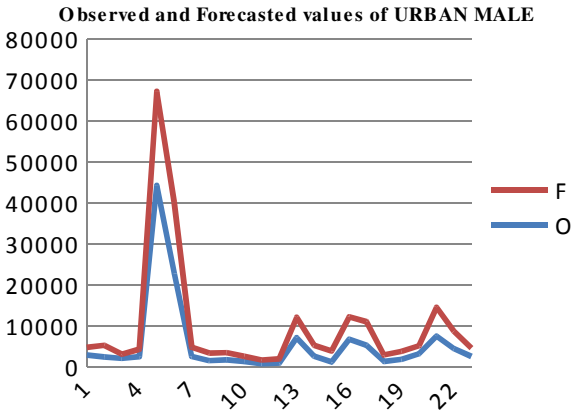
From the above tables, we observe that all models are adequate. Hence, using these models we forecasted child labour in 2011. The predicted values are presented the below tables district wise, within district region wise and within region gender wise.

In the following tables O-indicates observed child labour and F-indicates forecasted value of child labour.

TABLE FOR URBAN AREA:

OBSERVED AND FORECASTED VALUES OF URBAN POPULATION-2011				
District	MALE		FEMALE	
	O	F	O	F
1.ADILABAD	2908	1881	2152	1952
2.NIZAMABAD	2422	2838	1775	695
3.KARIMNAGAR	2074	1038	1653	1076
4.MEDAK	2510	1785	1780	835
5.HYDERABAD	44284	22995	34523	15479
6.R.R.D	22773	17430	18213	12549
7.MAHBUBNAGAR	2556	2223	2329	1181
8.NALGONDA	1528	1864	1048	756
9.WARANGAL	1712	1773	1453	846
10.KHAMMAM	1335	1240	1045	1180
11.SRIKAKULAM	805	868	550	885
12.VIZIANAGARAM	894	1060	552	1281
13.VISHAKAPATNAM	7137	4969	5454	3832
14.EAST GODAVARI	2620	2689	1493	1279
15.WEST GODAVARI	1192	2700	752	1697
16.KRISHNA	6749	5469	4569	3080
17.GUNTUR	5279	5743	3999	2843
18.PRAKASAM	1341	1568	1002	1001
19.NELLORE	1832	1984	1008	1087
20.CUDDAPAH	3210	1957	2057	1677
21.KURNOOL	7509	7020	5864	5393
22.ANANTAPUR	4448	4274	2840	3718
23.CHITTOOR	2545	2048	1648	1002

The values are exhibited in the following graphs separately for male and female.



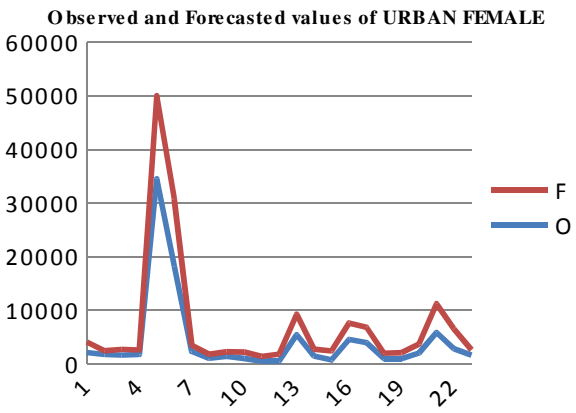
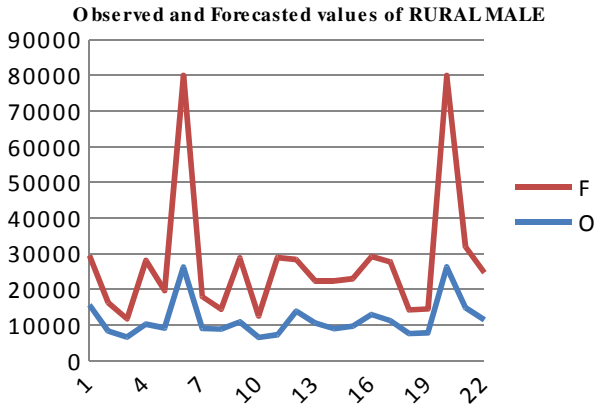
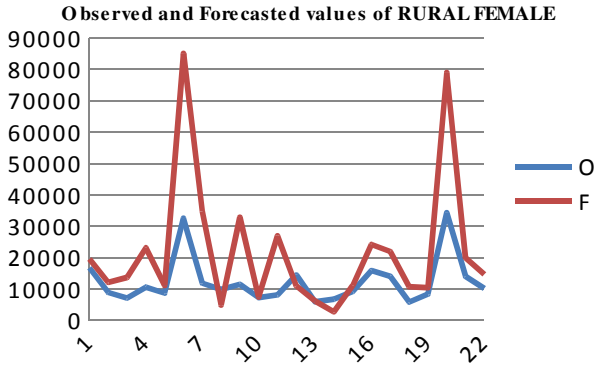


TABLE FOR RURAL AREA:

OBSERVED AND FORECASTED VALUES OF RURAL POPULATION-2011				
District	MALE		FEMALE	
	O	F	O	F
1.ADILABAD	15670	13831	16690	19565
2.NIZAMABAD	8304	7955	8844	12099
3.KARIMNAGAR	6619	5132	7093	13643
4.MEDAK	10254	17840	10553	23115
6.R.R.D	9187	10505	8644	11063
7.MAHBUBNAGAR	26246	53726	32532	85138
8.NALGONDA	9041	8945	11806	34787
9.WARANGAL	8866	5595	9794	4843
10.KHAMMAM	10913	17880	11453	32839
11.SRIKAKULAM	6531	6010	7224	7356
12.VIZIANAGARAM	7290	21630	8075	26925
13.VISHAKAPATNAM	13884	14457	14440	10935
14.EAST GODAVARI	10581	11772	5893	6105
15.WEST GODAVARI	8999	13335	6708	2651
16.KRISHNA	9652	13342	9118	11042
17.GUNTUR	12944	16279	15858	24180
18.PRAKASAM	11253	16472	14025	21883
19.NELLORE	7601	6661	5806	10677
20.CUDDAPAH	7837	6671	8320	10369
21.KURNOOL	26287	53638	34338	79052
22.ANANTAPUR	14864	17100	13974	19890
23.CHITTOOR	11423	13269	10148	14633

The values are exhibited in the following graphs separately for male and female.





XI. CONCLUSIONS

From the above graphs of observed and forecasted, we can see slightly over estimated trend in urban areas and heavily over estimated tendency in rural areas. The reason could be the government welfare schemes implemented at rural areas and situational migration of people from urban areas to rural areas to receive the welfare schemes in the past one and half decades. Nevertheless, fitted models forecast values under the assumption that the past trend prevails in future also.

REFERENCES

1. *Data base of Directorate of Census Surveys, Government of India.*
2. *Gangrade K.D (1998): Child labour in India, Department of social work, Delhi: Delhi University.*

3. *Sharma A.M (1982): Aspects of labour welfare and social security, Bombay: Himalaya publishing house.*
4. *Singh M (1980): Working children in Bombay – A study, New Delhi: Shipra publications.*
5. *Ahuge H.L (1998): Problems of Jewnil labour in Northern Andhra- A case study at Vishakhapatnam.*
6. *Chandra Shekar C.P and Amitho Battacharya (2001: Determinates of child labour: Oxfored publication.*
7. *Mceleland and Garge (1992): Initiate of employers in preventing child labour.*