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RESEARCH ARTICLE

History of Darjeeling District Migration Between 1872-2011

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Abstract

The human migration is one of the fundamental aspects of social science. Even though it is an interdisciplinary research problem, currently History scholars are also attracted with this problem. Many classical queries such as who moves, when do they move, what are the historical events associated with the movements, why do they move, what are the impacts when they live there are frequently arisen in migration related social science research problems. It is admitted that historical data sets are not exact as obtained from scientific experiments, or physical measurements. It is always important to study history with exact robust estimated historical data which can only be derived by adopting some scientific modeling approach from the raw available data. The current article aims to study the history of migration, or equivalently population growth trend of Darjeeling District, West Bengal, India from 1872 to 2011 using census data, adopting cubic spline and probabilistic parametric models. The current paper not only develops the robust estimates of population growth data during this period, but also focuses on many migration related social science research problems as stated above. All these above mentioned historical events are located from the developed cubic spline and probabilistic parametric models. Note that, probabilistic parametric model provides better estimates than the cubic spline model within this period.

Keywords: Cubic spline, Darjeeling District, Gamma & Log-normal models, History of migration, Joint generalized linear models, Migration problems, Population growth trend.

1 | INTRODUCTION

Human migration denotes the mobility of people from one region to another as temporarily or permanently. A primary problem of social science is human migration. Currently it is studied in different subjects such as Sociology, History, Geography, Economics, Demography, Statistics etc. History of internal migration in the Indian subcontinent is primarily given in many books such as by Mitra (1952), Zacharia (1964), Chattopadhyaya (1987), Subba (1988), Datta (2003) etc. History of migration in West Bengal and North Bengal are given in many books and research articles

such as by Mitra (1962), Subba (1988), Hazarika (2000), Datta (2003), Datta (2004), Ghosh (2013), Saha and Ghosh (2013), Saikia and Joe (2016), Das and Ansary (2017) etc.

The present article focuses on social science migration related problems regarding Darjeeling district so we concentrate our literature study with North Bengal and Darjeeling district only. It is well known with a long historical tradition that Jalpaiguri and Darjeeling districts are geographically and strategically migrant-prone zones. In 1869, modernization of Jalpaiguri and Darjeeling had been started by joining Eastern Duars with Goalpara, and Western Duars with Jalpaiguri, and Kalimpong with Darjeeling. Therefore, the year 1869 was a turning point of the migration process, and the current study is started from the close of this year.

Migration of Darjeeling district is a geo-historical phenomenon. Its geographical location turned it into a migrant-prone zone. It is located at the India's Himalayan borderland, so it has realized a sequence of migration from time immemorial (Subba, 1988). Darjeeling and Jalpaiguri districts are the junction between North-Eastern India and the rest of India. Their hilly tracts are the Himalayan borderland which are still attractive for the people from different areas of India and abroad. Up to the sixteenth century, most of the political centers of Bengal were in North Bengal which encouraged immigration of people from different areas. After the sun-set of Gour, the origin of Koch-Kamta kingdom excited the invited migration process. With the foundation of the British rule over this region, modernization of the two districts had been started with the development of tea industry, communication, agriculture, business, administrative, military services etc. During the British colonial period the migration process was invited. But in the post colonial period, there were many events such as political disturbances in the hill areas (for example Chinese occupation of Tibet), India's partition, atrocities in East Pakistan, poverty of Eastern Nepal, political disturbances in Assam, Babri Mosque broken etc. which created a new type of migration known as forced migration (or Refugee Migration) (Nanda, 2005; Saikia and Joe, 2016; Das and Ansary, 2017). This process is still continued due to political turmoil in the adjacent State Assam and Bangladesh (Saikia and Joe 2016; Das and Ansary, 2017).

India witnessed a massive internal and overseas migration in the nineteenth century (Chattopadhyaya, 1987). When Darjeeling and Jalpaiguri came under British imperial yoke, they were a prominent region of migration, which was mentioned in the report by Hon'ble Sir Richard Temple (1874, p.82). These regions have already achieved and still are achieving significant realization of steady and continuous migrants flow from different parts of India and the adjacent border countries (Datta, 2003). During the Revenue Survey of Rangpur in 1858-59, the permanently settled population of the Jalpaiguri district was 189,067 (Mitra, 1952). At the first systematic census in 1871-72, the recorded population of Jalpaiguri district was 327,985 (Jalpaiguri Census Handbook, 1961). At the close of the Bhutan war, the estimated population of the Western Duars (from a survey of the Western Duars (1865-67)) was 49,620, which was not correct (Mitra, 1952). In the special census of the Deputy Commissioner, the population of the Western Duars was 100,111 (Mitra, 1952). Allowing errors in the population counting, it is observed that the migration process began from the neighbouring districts to the fertile wasteland of the Western Duars as soon as British rule ensured the safety of life and property. Subsequent censuses revealed more remarkable population increase. In 1881 it increased to 182,687, in 1891 to 296,348 and in 1901 to 410,606 (Saha and Ghosh, 2013).

It is shown in the above that the reported population data in the beginning of some censuses were not exact. It may be true for all the subsequent censuses also. Census population data may be incorrect due to many problems such as incorrect responses, absence of the family members during survey time, observations are recorded from an unauthorized representative, wrongly tabulated data etc. Best of our knowledge, very little study regarding the historical events that are related with this migration problems

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has been made using robust estimated data adopting probabilistic modeling. The present article attempts to bring out the robust estimate of Darjeeling district population census data from 1972 to 2011 using probabilistic modeling. Two different parametric fitted curves such as joint Gamma and Log-normal models, and one non-parametric cubic spline curve have been derived for estimating the Darjeeling district population census data from 1972 to 2011. Curve fitting has been diagnosed using graphical analysis. Based on the estimated population data, historical events associated with the migration problems have been located.

The article is organized as follows. The next section presents the principle of identifying migration using historical trends of population growth, and the subsequent sections present respectively materials and methods, results, and discussion and conclusion. It is identified herein that the response population growth fitted parametric mean trend curve is a non-linear polynomial of degree four of transformed time (t). The cubic spline model has been derived. It is found that the parametric model gives a better estimate than the cubic spline model within the range. Both the developed models can forecast the mean population growth at any time during the period from 1872-2011, which are more robust and consistent than the recorded data.

MIGRATION STUDY USING HISTORICAL POPULATION GROWTH TREND CURVE

It is well known that the population growth rate is always decreasing if there is no immigration, or emigration (Goon, Gupta and Dasgupta, 2002). Therefore, the population growth trend curve should be smoothly increasing, which reveals no significant immigration. But at any point of time interval, if there is an abnormal increase in the trend curve, which reveals a significant immigration during that period. In addition, the abnormal increase of the mean trend curve can indicate some migration related historical events also. Again, the variance trend curve can indicate many historical events during the period which are related with the migration problems. Therefore, the current migration study is based on the mean and variance trend curves of population growth. The present report aims to study migration related social science research problems for Darjeeling district using the above principle with the help of population growth trend curves. The idea of trend curve is described in the following paragraphs.

The word "Trend" is connected with a long period time data set, known as time series containing four parts such as Secular trend (or Trend) (T_t), Seasonal variation (S_t), Cyclical variation (C_t), and Irregular variation (I_t). Generally, the trend is known as the persevering and gradual movement of the series for a long period of time. So, the long term movement of a time series data set for smooth downward decrease or upward increase is defined as a trend. The periodic variation of a time series data set with period of length less than or equal to one year is defined as seasonal variation, while the periodic variation having period of length more than one year is termed as cyclical variation. Any abrupt variation such as very low decreased or very high increase of time series data at a certain point of time due to some unpredicted cause is termed as Irregular variation. Illustrative trend study can be found in many books such as by Montgomery, Jennings and Kulachi, (2016); Shumway and Stoffer, (2017).

The current article shows the logical problem of isolating trends from a historical time series data set applying the time series analysis. Practically, it develops to isolate the best secular trend connected with a historical time series data set. Secular trend problems can be viewed as one of historical descriptions. A historian always presents the trend from his/her mass of material, an illustrative substance that presents clearly the nature of the primary factors which have been at work.

It was written in the preface of the book by Professor Schlesinger entitled- *Political and Social History of the United States,* that continuous stresses have been used on the great dynamic currents which have shaped the nation's life. Following Professor Schlesinger, these stresses were, and still are (i) the nationality growth; (ii) the continuous struggle for improver democracy; (iii) the fighting for social advancement, including women and children progress, the successive humanitarian reform activities and contest for free public schools; (iv) continuous production methods improvement and its distribution

(applying improved machinery and technology and the required social adjustments thereby); and (iv) the national boundaries expansion. These are all encountered as continuing and continuous processes parallel to secular trends (Schlesinger, 1926, p. viii).

The matter of secular trend illustrates, it may be expressed, definitely a particular case of historical description. The historical components consist of a significant numerical number series, which are presented by special non-statistical information. Practically, the historical problem is to display the best description possible of the principal tendencies which these facts present. The statistician displays this historical illustration, not in words, but in mathematical forms such as using lines or curves. In practice, he/she displays the historical trends description in terms of secular trends adopting mathematical (or probabilistic) models (Mills, 1932; Frickey, 1934). Thus, the mathematical models, displaying lines, or curves termed as ”secular trend” reveals the use of someone’s discretionary judgment.

In practice, the trend problem is a statistical statement which is converted to a mathematical basis, along with the necessary investigation of the characteristics of the original data. There may be contrary opinions regarding the validity of the historical trend idea as a statistical statement. Actually this kind of statistical expression can have no value, or little unless the obtaining methods are preceded by a wide theoretical exploration, or through historical investigation, or both, which should be based on the factors behind the time series data, otherwise it should not be accepted as the secular trend. In practice, a mathematical curve option to display the primary trend is limited to functions such as the straight line, linear polynomial, logarithmic parabola, simple logistic, Gompertz equation, which satisfy the original data characteristic variations. The above stated functions only represent the mean trend, assuming variance is constant, which is not true always for historical data. It is noted that variance has its own interpretations, and it could occur due to many problems, which are also related to some historical events. For non-constant variance historical data, both mean and variance functions should be considered jointly (Lee, Nelder, Pawitan, 2017). Joint mean and variance trend functions are very little illustrated in statistical time series analysis (Montgomery, Jennings and Kulachi, 2016; Shumway and Stoffer, 2017).

2 | MATERIAL & STATISTICAL METHODS

Materials

The report has executed Darjeeling district population growth trend curve from 1872 to 2011 using the census data given by the Govt. of India, and collecting from previous research article by Saha and Ghosh (2013). Darjeeling district population census data from 1901 to 2011 is given in the s ite—www.censusindia.gov.in/2011census/PCA/A-2_Data_Tables/19%20A-2%20West%Bengal.pdf, and from 1872 to 1891 the census data are recorded from Saha and Ghosh (2013). It is mentioned in the Introduction Section that census data in 1872 were contradictory, also in the subsequent censuses there may be some errors in the census data. For ready reference, Darjeeling district population census data from 1872 to 2011 are given in Table 1.

TABLE 1: Original Population and estimated population growth trend for Darjeeling district from1872 to 2011

Year	Darjeeling district census population (P_D)	Waits x	t=(Year-1941)/10	Cubic spline fitted P_D	Gamma fitted P_D	Log-normal fitted P_D	% increase of population
1872	94712	3	-7	111764.5	94732.11	94731.99	----------
1881	155179	4	-6	154860	159065.7	159015.4	63.84
1891	223314	4	-5	197955.6	215956.9	215862.1	43.91
1901	265780	4	-4	238954.3	257291.6	257169	19.02
1911	279899	5	-3	278086.9	288742.1	288589.5	5.31
1921	294237	3	-2	321389.7	303735.7	303635	5.12
1931	332061	3	-1	376213.1	331139.1	331051.4	12.86
1941	390899	6	0	451649.6	388521.7	388361	17.72
1951	459617	8	1	556743.4	472269.2	472032.8	17.58
1961	624640	8	2	700066	588659.4	588389.4	35.90
1971	781777	10	3	878486.2	785695.3	785243.2	25.16
1981	1024269	8	4	1091705	1019082	1018659	31.02
1991	1299919	8	5	1331535	1346419	1345884	26.91
2001	1609172	4	6	1586598	1608495	1608367	23.79
2011	1846823	4	7	1841661	1828161	1828132	14.77

Statistical Methods

Census population data are always positive integer, discrete, finite and large. It is well known that dis-crete Binomial distribution is asymptotic normal for large sample size, and with small success probability (Goon et al., 2002). So, for large sample size, discrete response variables can be considered as continuous. Here Darjeeling district census population data are large positive integers, so it may be considered as a continuous random variable. In regression models for positive continuous observations, analysis can often be based on either the log-normal or the gamma model (Firth 1988). For constant variance both the models give similar analysis (Firth 1988). But for non-constant variance, analysis outcomes from these two models may be different (Das and Lee 2009). For non-constant variance, joint generalized linear models (JGLMs) are commonly used (Lee et al. 2017). JGLMs are elaborately given in the book by Lee et al. (2017). For ready reference, very shortly both the JGLMs are given as follows.

Log-normal JGLMs: In case of a continuous positive random response variable 'y' along with different variance (σ_i^2), and mean $\mu i = E(yi)$, satisfying $Var(yi) = \sigma_i^2\ \mu_i^2 = \sigma_i^2\ V(\mu_i)$ say, where V(.) is known as variance function, the log transformation $zi = \log(yi)$ is usually taken to stabilize the variance $Var(zi) \approx$, but the variance may not be stabilized always. In order to derive an improved model, JGLMs for the mean and dispersion are commonly used. Assuming log-normal distribution of the response, JGLM of the mean and dispersion model (response yi , with $zi = \log(yi)$) are presented by

$E(z_i) = \mu_{zi} = x_i^t \beta$, $Var(z_i) = \sigma_{zi}^2$, and $\log(\sigma_{zi}^2) = g_i^t \gamma$,

where x_i^t and g_i^t are the vectors of independent variables associated with the regression coefficients β and γ, respectively.

Gamma JGLMs: For the same y_i's as above V(.) displays the variance function, and the variance has two parts such that σ_i^2 (independent of mean changes)and $V(\mu i)$(dependent on the mean changes).

It is known that GLM family distribution is displayed by $V(\mu_i)$. For example, if

$V(\mu)=\mu$, it is Poisson, and it is Normal or Gamma according as $V(\mu)= 1$, or $V(\mu) =\mu^2$, etc. Gamma JGLMs mean & dispersion models are represented by

$$\eta_i = g(\mu_i) = x_i^t \beta \text{ and } \varepsilon_i = h(\sigma_i^2) = w_i^t \gamma,$$

where g(.) & h(.)are the GLM link functions for the mean & dispersion linear predictors respectively, and , are the vectors of independent variables/ factors, associated with the mean and dispersion parameters respec-tively. Maximum likelihood (ML) method is adopted to estimate mean parameters, while the restricted ML (REML) method is applied to estimate dispersion parameters (Lee et al. 2017).

STATISTICAL & GRAPHICAL ANALYSIS

The response Darjeeling district census population (DDCP) has been modeled by JGLMs with both Gamma & Log-normal distributions. Here DDCP is considered as the dependent, and the census time and a weighted variable x are considered as explanatory variables. Note that the weighted variable x is taken according as the number of incidences occurred in the surrounding neighbor states or countries during the corresponding decade census year. Values of the weighted variable x are given in Table 1.

The best model has been accepted based on the lowest Akaike information criterion (AIC) value (within each class), which minimizes both the squared error loss and predicted additive errors (Hastie et al. 2009, p. 203—204). Based on the AIC criterion, both the JGLMs Gamma (AIC = 338.3351) and Log-normal (AIC=338.4608) fits give similar outputs as the AIC difference is less than one which is insignificant. The final DDCP Gamma and Log-normal JGLMs analysis outcomes are displayed in Table 2.

The derived DDCP (Table 2) probabilistic model is a data developed model, which is to be tested using model diagnostic tools. Valid conclusions are derived from the data developed probabilistic model. For the joint Gamma fitted DDCP models (Table 2), model diagnostic graphical analysis is displayed in Figure 1. In Figure 1(a), absolute residuals for the fitted DDCP (Table 2) are plotted with respect to fitted values, which is exactly flat linear straight line,

concluding that variance is constant with the running means. Figure 1(b) displays the normal probability plot for the fitted DDCP mean model (Table 2), which does not indicate any lack of fit. These two figures do not indicate any discrepancy in the fitted DDCP model (Table 2). These two figures show that the Gamma fitted DDCP model is an approximate of its true model.

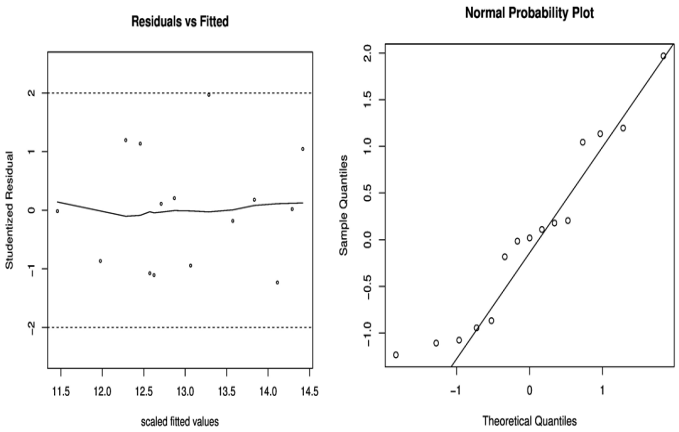

Figure 1(a) Figure 1(b)

FIGURE 1: For the Gamma fitted models of Darjeeling population growth trend (Table 2), the (a) absolute student residuals plot with the fitted values, and (b) the normal probability plot for the

Non-parametric function estimation method (Cubic Splines)

The non-parametric function estimation is clearly illustrated in several statistical research papers by Ruppert, Wand, Carrol (2003); Green and Silverman (1994); Wahba (1990). In practice, for fitting trends, one can use a known functional form which is termed as a parametric model. However, we adopt the smooth function even though its form is unknown, which is called a non-parametric function. In this article, we adopt a cubic spline as a non-parametric trend estimation method, and its fitting can be obtained using R-package given in (Lee, Roonnegaard and Noh, 2017).

RESULTS

Table 2 displays the summarized outcomes of DDCP growth under both the gamma and lognormal model analyses. It is found herein that no factor is significant in the dispersion model under both the distribution. Here it is derived that both the gamma and lognormal fitted mean model of DDCP is a fourth degree function of time "t", along with the weighted variable x. Note that time "t" is the transformed time, where $t = (\text{Year} - 1941)/10$ (shown in Table 1). in both the gamma and lognormal fitted mean model,t (P<0.0001), t^2 (P<0.0001), t^3 (P<0.0001) and t^4 (P<0.0001) are significant, and the weighted variable x (P=0.1090) is partially significant. Both the mean model fits give similar results (Table 2). Gamma fitted DDCP mean ($\hat{\mu}$ model (Table 2) is $\hat{\mu}$= exp.(12.7925063 + 0.1438118 t + 0.0246217t^2 + 0.0013611t^3-0.0004604t^4+0.0129330x),and the gamma fitted DDCP dispersion $(\hat{\sigma}^2)$ model is = exp. (-6.753).

TABLE 2: Gamma and Log-normal fitted population growth trendfor Darjeeling district from 1872 to 2011

Model	Covariate	Gamma fit				Log-normal fit			
		Estimate	Standard error	t-value	P-value	Estimate	Standard error	t-value	P-value
Mean model	Intercept	12.7925	0.0504	253.796	<0.0001	12.7925	0.0500	255.669	<0.0001
	t	0.1438	0.0091	15.644	<0.0001	0.1438	0.0091	15.766	<0.0001
	t^2	0.0246	0.0019	12.421	<0.0001	0.0246	0.0019	12.510	<0.0001
	t^3	0.0013	0.0002	6.255	<0.0001	0.0013	0.0002	6.296	<0.0001
	t^4	-0.0004	0.0001	-10.644	<0.0001	-0.0004	0.0001	-10.718	<0.0001
	x	0.0129	0.0080	1.600	0. 0109	0.0128	0.0080	1.602	0.0109
Dispersion model	Intercept	-6.753	0.4713	-14.33	<0.0001	-6.758	0.4714	-14.34	<0.0001
AIC		338.3351				338.4608			

3 | DISCUSSION & CONCLUSIONS

The article has focused on the migration problems of Darjeeling district from 1872 to 2011 using the DDCP growth trend curves through the non-parametric cubic spline, and the parametric gamma and lognormal models. It has been mentioned in the introduction ection that census data may not be exact always. Note that history research study is always information based. Moreover, the exact information reveals many social, economic, and political status of the society during the considered periods, which are the fundamental historical research study subjects. In practice, historians alwaystry to study history of migration (or other

social events) with some illustrations, percentage, simple arithmetic, maps, graphs and statistical figures, etc.,(Datta, 2003; Datta 2004; Ghosh, 2013; Saha and Ghosh, 2013; Das and Ansary, 2017). Best of our knowledge, there is a little migration history study using advanced population growth trend curve prob-abilistic modeling. Thus, the present findings can't be compared with the earlier similar studies, while the present results can be compared with the previous census records as in Table 1 and also in Figure 2.

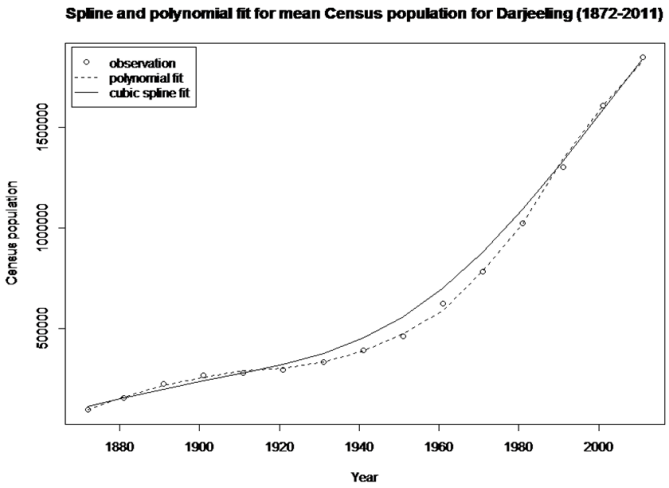

FIGURE 2: Scattered plot of the original observations and the smooth fitted mean trend curves for polynomial and cubic spline

Figure 2 displays the scattered plots of the recorded DDCP data, and the mean fitted gamma and cubic spline curves, against the time. Gamma fitted values are more close to the original data than the cubic spline fit. At the boundary points, both the gamma and the cubic spline DDCP trend curves are steady (Figure 2). At the boundaries, and also within the period 1872 to 2011, the gamma fitted polynomial DDCP trend curve gives better estimates than the cubic spline model. Moreover, both the gamma fitted DDCP polynomial trend and the cubic spline give efficient estimates in future and also in past. These two mean DDCP fitted trend curves (Figure 2) show that population growth trend in the Darjeeling district was non-uniformly increasing, which indicates that immigrants occurred at different times during the period 1972 to 2011.

Figure 2 shows that from 1872 to until 1900, DDCP growth trend slope was very high (Table 3), indicating that a large number of immigrants came to the Darjeeling district during that period. Note that slope (tanθ) of the line is the tangent of the angle (θ) formed by the segmented straight line with the X-axis. It was started from 1872, which is clear from the slope of Figure 2, and it continued until 1900. It is noted that modernization of Jalpaiguri and Darjeeling was started in 1869 (Saha and Ghosh 2013), so immigrants from different areas of India and also the neighboring border countries such as Nepal and Tibet came to the newly developing Darjeeling district. The British first acquired the hill territory in1835, while it was almost entirely under forest, and in practice it was uninhabited (Dash, 1947, p.49). East India Company decided to develop Darjeeling as a hill resort, and it was given an opportunity to the neighboring people to immigrate there. Therefore, a large number of people from Nepal and Sikkim came to settle there, consequently the original inhabitants probably Lepchas were rapidly outnumbered by the settlers.

Originally, Darjeeling-Sikkim region was a single political territory inhabited by a few tribes such as Lepchas, Limbus, Bhutias and Mangars until the annexation of the different parts of Darjeeling by the British just about the mid-nineteenth century (Subba , 1988). Until 1850, Sikkim ruled over the present Siliguri subdivision, which was populated by Rajbansis. With the development of British rule, Darjeeling district was going to be populated by two large immigrants such as Nepalese and plain peoples, where plain peoples were mainly the Bengalis (from Kolkata, East Pakistan, neighboring areas and States), Marwari (from Rajasthan, Haryana), Biharis (from Bihar), etc. It is well known that the Nepalese were the most dominant group immigrated in the Darjeeling district over the years. Note that the British India had a good relationship with Nepal after 1857, as the Nepali army helped the British to suppress the Indian Rebellion of 1857. Then British Govt. had taken control over India from East India Company in 1858.

Figure 2 shows that from 1901 to 1921, DDCP growth trend slope (tanθ) (Table 3) was the smallest, indicating that there were no migrations, or a very few number of immigrants came to the Darjeeling district during that period. From 1921 to 2011, the DDCP growth trend slope (Table 3) was comparatively very high (than the period from 1901 to 1920)

and it was fluctuating at different census years, concluding that a large number of immigrants came to the Darjeeling district during that period. From 1921 to 1951, there were different historical events that occurred during this period in India and neighboring countries. The Indian freedom fighting revolution had been growing stronger day by day after 1920. The British Govt. had been punishing the freedom fighters. So, many freedom fighters were forced to take shelter there from different parts of India. In 1947, independence of India, partitioning of India, and religious violence after independence of India in East Pakistan, many Hindus people were forced to come to India, North Bengal and Darjeeling.

Tibet had declared independence from China in 1913. But Chinese invading started Tibet in 1950, and it continued for a long time. In 1951, the Tibetans signed a seventeen-point agreement reaffirming China's sovereignty over Tibet and providing an autonomous administration led by the Dalai Lama. In 1959 the 14th Dalai Lama fled from Tibet to northern India under cover where he established the Central Tibetan Administration. Many people felt that Tibet should not be part of China because they were constantly under attack in different ways rather often. Tibet had *de facto* been its own country before 1951. So, many Tibetans came to Darjeeling. The Tibet Autonomous Region within China was officially established in 1965. In the late 1940s, newly emerging pro-democracy movements and political parties in Nepal were critical of the Rana autocracy. Following the success of Indian Independence Movement which Nepalese activists had taken part in, with India's support and cooperation of King Tribhuvan, Nepali Congress was successful in toppling the Rana regime, establishing a parliamentary democracy. Consequently, many Nepalese were coming continuously in Darjeeling.

Figure 2 shows that DDCP growth trend slope ($\tan\theta$) (Table 3) was very high (than the period from 1920 to 1950) with a little fluctuating during the period from 1951 to 2001, concluding that a large number of immigrants came to the Darjeeling district during that period. From 1951 to 2001, there were different historical events that occurred during this period in the neighboring states and countries. The religious violence after independence of India in East Pakistan (presently Bangladesh) was continued strongly up to approximately 1965 (due to partition of India),and it was occurred there in many times such as 1970-71 (Independence of Bangladesh), 1992 (Babri Mosque was broken in India), 2001-2003 (Political distur-bances in Bangladesh), and it is still there. In 1971, due to the war of independence in East Pakistan, most of the Hindu families were forced to come to India, North Bengal and Darjeeling. This process of Hindu people migration from Bangladesh to India is still continued. From 1951, many people from Tibet were coming to Darjeeling due to being constantly under attack by China. After a decade of power wrangling between the king and the government, King Mahendra (ruled 1955–1972) scrapped the democratic experiment in 1960, and a "partyless" Panchayat system was made to govern Nepal. The political parties were banned and politicians imprisoned or exiled. So, many Nepales were coming to Darjeeling. From 1965, there were continuous political disturbances regarding Assamese and non-Assames (Bengalis, Behari, Marwari, Nepalese) in Assam, and it is still there. In 1980, it was very strong, so many non-Assamese mainly Bengalis were coming to Darjeeling and North Bengal, and it is still present. Migration in Darjeeling was reduced a little from 2001 to 2011.

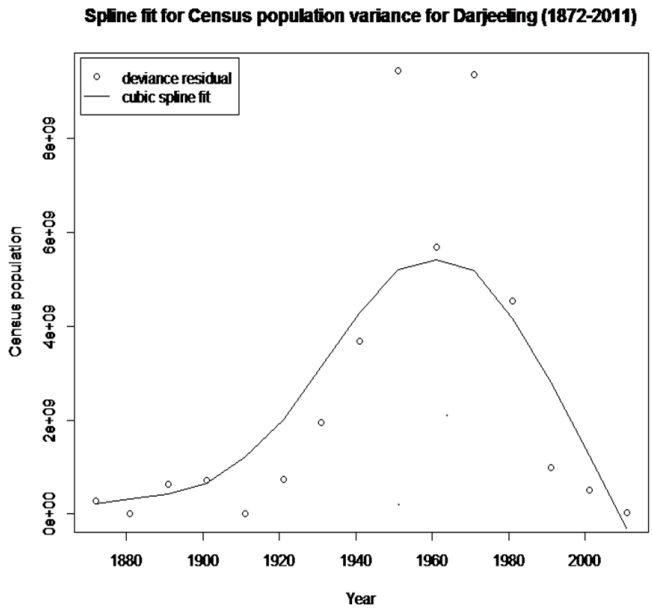

FIGURE 3: Scattered plot of the deviance residuals anddispersion plot cubic spline

Figure 3 displays the variance plots for cubic spline fit, while Figure 3 shows that population growth vari-ance in Darjeeling was increasing from 1872 up to around 1887, after that up to 1920 population growth variance was almost stable. Again from 1921 up to 1983, population growth variance was very high, and after that it was decreasing. Thus, Figure 3 indicates that immigrants were very high from 1872 to 1887, and there were very few immigrants from 1888 to 1920, and after that there were very large immigrants up to 1983, after that immigrants were decreasing up to 2011. This fact is also reflected in the both fitted mean plots (Figure 2). Thus, the variance plot Figure 3 has many interpretations, which are also related to some historical events as stated above.

The fast growth of migration in Darjeeling, backed by the colonial domination apparently changed the traditional socio-economic structure in Darjeeling, while its Pre-British economy was closely the Asiatic Mode typology (Marian, 1977). The village societies raised a character of an enclave, consumption and production being guided by their own ethos and needs had developed a culture of self-sufficiency which was not disturbed by any demographic change like the pre-colonial immigration. Post migration played a major role in changing the ecology and

social organization of the Darjeeling district from time to time (Roy, 2005). The agrarian relations in Darjeeling district are changing in the wake of urbanization, spread of education, and demographic pressure that is migration (Subba 1988, Roy 1961). Up to 1951, the agrarian society was not significant in Darjeeling, but after the 1951 census, it increased in volume significantly. The gradual polarization of the classes were noticed in the Darjeeling, conse-quently, the Sharecroppers association, or Pakhurey Sangh was introduced there. It was observed that lower castes of Nepalese were immigrated in large numbers than upper caste in Darjeeling, and they were the most dominat group. Therefore, Nepalese social relation, culture, casteism greatly influenced the Darjeeling society. There are mainly three caste groups—high (Bahuns, Thakuries, Chhetries), mid-dle (Newars, Mangar, Gurung) and low (untouch-able). The plain migrants like Bengalis, Marwaries etc. occupied the most of the professional services in Darjeeling. Thus, a mixed new cultural society was developed in Darjeeling due to migration.

The current research has focused on some migra-tion related social science research problems such as when do the immigrants move, why do they move, what are the historical events that are related with these migration problems, and what are the social cultural effects of the Darjeeling district due to migration? In addition, the report has derived the estimated census population using statistical para-metric and non-parametric methods. The estimates are very close to the census data (Table 1 and Figure 2). Based on the estimated model, the report has focused all the above migration related social science research problems for Darjeeling district. Mainly two purposes have been considered in the current research. The first is to compare our estimated census data to the recorded census data (Table 1 and Figure 2). A second purpose was to evaluate the statistical assumptions followed by the response census pop-ulation number. The current outcomes, though not completely conclusive, are revealing:

- The current outcomes are very close to 96% cases to the recorded census data (Figure 2).
- Historical census population growth trend has been expressed using a mathematical curve.
- Accepted models have been verified by both mean and dispersion plots.

Two principal conclusions can be drawn from the present research. First, in order to reduce the con-troversy for wrongly recorded census data, statistical modeling can be more effective. A second conclu-sion has to do with the use of statistical models. While further research is called for, we find that a gamma and lognormal models

give similar analy-sis as the AIC difference is less than one, which is insignificant. In addition, these are much more effective than traditional linear polynomial, or the logarithmic parabola, or the Gompertz equation, as they better fit the data. Present outcomes are explained from the mathematical models (Table 2), Figure 2 and Figure 3 also. Shortly, research should have greater faith on the current outcomes than those emanating from other models.

TABLE 3: Slopevalues at different time points for the segmented straight lines

From year, X-axis value (x1)	To Year, X-axis value (x2)	Y- axis value (y1)	Y- axis value (y2)	Slope tan(θ)
1872	1901	125000.00	250000.00	4310.345
1901	1921	250000.00	291666.60	2083.33
1921	1941	291666.60	375000.00	4166.67
1941	1961	375000.00	604165.70	11458.29
1961	1981	604165.70	1062498.30	22916.63
1981	2001	1062498.30	1604164.10	27083.29
2001	2011	1604164.10	1833330.40	22916.63

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