

A Comparative Migration History Study Based on Statistical Trends Between Jalpaiguri and Darjeeling Districts in North Bengal for Periods (1872-2011)

Mahashweta Das and Malabika Ray

Article History

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Abstract

Saha and Ghosh (2013) (The Quarterly Review of Historical Studies, LIII (1&2):30-44) extensively studied the history of migration of both the districts of Jalpaiguri and Darjeeling in North Bengal during the colonial and post-colonial periods from 1869 to 1971. Human migration is a fundamental social science research problem that is an interdisciplinary research topic. Researchers from different branches such as Demography, Mathematics, Statistics, Social Studies and History are currently working on migration history. History of migration always searches for the basic *five* problems such as who changes places, when do they change of place, what are the social/political/historical events related with the change of place, why do they change of place, what are the social impacts when they settle there. The present article focuses a comparative study of migration history of both the districts of Jalpaiguri and Darjeeling based on the above basic migration problems, using census data, and adopting parametric gamma model and non-parametric cubic spline method. It is derived herein that both the mean and variance trend equations are different for two districts. In addition, all the above basic five migration problems are different in both the districts even though both the districts are located adjacent to each other.

Keywords: Basic migration problems; Darjeeling and Jalpaiguri Districts; Gamma joint generalized linear models; Parametric method; Non-parametric Cubic spline; Population growth trend.

INTRODUCTION

In general, human migration implies the mobility of people from one region to another as temporary or permanent. A fundamental social science problem is human migration. Presently, it is

* Department of History, The University of Burdwan, Burdwan, West Bengal, India

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studied in different disciplines such as Sociology, Demography, Geography, Economics, History, 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 Dash, (1947), Mitra (1962), Subba (1988), Hazarika (2000), Datta (2003), Datta (2004), Ghosh (2013), Saha and Ghosh (2013), Saikia and Joe (2016), Das and Ansary (2017), Das (2020a, 2020b) etc.

The present article focuses on social science migration related problems regarding Jalpaiguri and Darjeeling districts 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.

Human migration events in Jalpaiguri and Darjeeling districts are a geo-historical phenomenon. Its geographical location turned it into a migrant-prone zone. Both the districts are located at India's Himalayan borderland, so they have realized a sequence of migration from time immemorial (Subba, 1988). Geographically, both the 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 continuing 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 rule, 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). Rangpur Revenue Survey in 1858-59, presented the permanently settled population of the Jalpaiguri district was 189,067 (Mitra, 1952). In India's first census in 1871-72, the recorded population of Jalpaiguri district was 327,985. Subsequent censuses presented an unusual population increase. Saha and Ghosh (2013) presented the population in Jalpaiguri and Darjeeling districts for the census years 1972, 1981, and 1991, which are given in Table 1.

It is clear that India's beginning census such as 1872, 1881, 191 reported census populations were not accurate, and this may be true for all the censuses. Census recorded population figures may be erroneous due to some causes such as absence of the family members during survey time, incorrect responses, observations are collected from an unauthorized representative, wrongly typed data etc. The present article attempts to bring out the robust estimate of Darjeeling and Jalpaiguri districts population census data from 1972 to 2011 using probabilistic modeling. One parametric fitted curve such as joint gamma models, and one non-parametric cubic spline curve have been derived for estimating the Darjeeling and Jalpaiguri districts 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 focuses a comparative study of migration problems between Darjeeling and Jalpaiguri districts based on the following ways:

- Parametric gamma fitted joint generalized linear models (JGLMs) for population growth trend,
- Non-parametric cubic spline model fitting for population growth trend,
- Percentage difference,

- Examining slopes at different points of the fitted trend equations,
- Variance or dispersion plots,

The article is arranged as follows. The next section describes the historical and statistical trends for locating migration based on population growth trends, and the subsequent sections describe respectively materials and methods, results, and discussion and conclusion. It is developed herein that the response population growth fitted parametric mean trend curve for two districts 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.

HISTORICAL TREND CURVE OF POPULATION GROWTH FOR MIGRATION STUDY

Generally, population growth rate is very slow increasing, but for fitting the growth curve, it is assumed as decreasing (Goon, Gupta and Dasgupta, 2002), when there is no immigration, or emigration. In practice, small population growth rate ($\leq 4\%$) implies no migration, otherwise, there is migration. In addition, the variance trend curve of population growth may indicate many historical facts, which are connected with the migration problems. The current report focuses the migration study for Jalpaiguri and Darjeeling districts using parametric and non-parametric trend curves. The idea of the trend curve is clearly described in (Das 2020a, 2020b), which is very shortly given in the following paragraph.

In general, the word 'Trend' indicates a gradual smooth downward decrease or upward movement of the series for a long period of time. Trend is commonly used and studied in many disciplines, but it is properly studied in Statistics (Montgomery, Jennings and Kulachi, (2016); Shumway and Stoffer, (2017)). A historian always studies the trend using his/her volume of material in a descriptive way that reveals all the primary factors which are associated with the work (Mills, 1932). Professor Schlesinger explained in the preface of his book (Schlesinger, 1926, p. viii) some historical trend events such as the continuous movement for democracy improving; the nationality development; the

movement for social improvement, including women and children development along with the successive humanitarian reform activities and struggle for free public schools; expansion of the national boundaries; continuous process of improving production techniques and its distributions using newly developed advanced technology and tools.

Generally, the determination of trend is a statistical technique that is finally reduced to a mathematical equation, which is derived based on the original data along with its characteristics. In practice, there are many contrary opinions for the validity of the descriptive historical trend by a mathematical or probabilistic equation. Practically, such a probabilistic equation may not have any value if the derived equations are not based on the theoretical concepts, or the original historical investigations, which are related with the time series data. A probabilistic, or a mathematical trend equation expresses many functions such as linear straight line, or polynomial, Gompertz equation, simple logistic, logarithmic parabola that satisfy all possible variations of the original time series data set. The above trend equations only give the mean trend, as they are derived assuming constant variance, which may not be true for all time series data sets. For heteroscedastic historical time series data, both the mean and variance equations to be derived are considered jointly (Lee et al. 2017). Jointly mean and variance trend equations are not presented in statistical time series analysis (Montgomery et al. 2016; Shumway and Stoffer, 2017).

MATERIAL & STATISTICAL METHODS

Materials

The report has executed Jalpaiguri and Darjeeling districts population growth trend curves from 1872 to 2011 using the census data given by the Govt. of India, and collecting from a previous research article by Saha and Ghosh (2013). Jalpaiguri and Darjeeling districts census population data sets from 1901 to 2011 are displayed in the website— www.censusindia.gov.in/2011census/PCA/A-2_Data_Tables/19%20A-2%20West%20Bengal.pdf. Note that the census data in 1872 were contradictory, also in the subsequent censuses years such as 1881 and 1891 there may be some errors in the census data (Saha and Ghosh, 2013). For ready reference, Jalpaiguri and Darjeeling district population census data from 1872 to 2011 are displayed in Table 1.

Table 1 : Original Population and estimated population growth trend for Darjeeling and Jalpaiguri districts from 1872 to 2011

Year	Darjeeling district census population (P_D)	Jalpaiguri district census population (P_J)	Wait s x	t=(Year-1941)/10	Cubic spline fitted P_D	Gamma fitted P_D	Cubic spline fitted P_J	Gamma fitted P_J	% increase of population (P_D)	% increase of population (P_J)
1872	94712	327985	3	-7	111764.5	94732.11	321723.6	309570.4	-----	-----
1881	155179	383642	4	-6	154860	159065.7	396726	411292.3	63.84	16.97
1891	223314	453662	4	-5	197955.6	215956.9	471728.5	493357.3	43.91	18.25
1901	265780	546764	4	-4	238954.3	257291.6	547210	556778.8	19.02	20.52
1911	279899	663222	5	-3	278086.9	288742.1	622717.2	611650.9	5.31	21.30
1921	294237	695946	3	-2	321389.7	303735.7	710495.7	671912.8	5.12	4.93
1931	332061	740993	3	-1	376213.1	331139.1	825438.1	752832.8	12.86	6.47
1941	390899	847841	6	0	451649.6	388521.7	984971	871259.3	17.72	14.427
1951	459617	916747	8	1	556743.4	472269.2	1206845	1047239	17.58	8.13
1961	624640	1359292	8	2	700066	588659.4	1513296	1305204	35.90	48.27
1971	781777	1750159	10	3	878486.2	785695.3	1892447	1671976	25.16	28.76
1981	1024269	2214871	8	4	1091705	1019082	2338063	2166628	31.02	26.55
1991	1299919	2800543	8	5	1331535	1346419	2833358	2775387	26.91	26.44
2001	1609172	3401173	4	6	1586598	1608495	3355132	3409807	23.79	21.45
2011	1846823	3872846	4	7	1841661	1828161	3876906	3870650	14.77	13.87

Statistical Methods

Census population data are always positive integers, discrete, finite and large. Note that discrete Binomial distribution is asymptotic normal for large sample size, and with small success probability (Goon et al., 2002). For large sample sizes, discrete response variables can be considered as continuous. Here Jalpaiguri and Darjeeling districts census population data are large

positive integers, so they may be considered as a continuous random variable. For constant variance both the gamma and log-normal models give similar analysis (Firth 1988). But for unequal response variance, analysis outcomes from the log-normal and gamma JGLMs may be different (Das and Lee 2009). For both the responses, gamma JGLMs give better results, and JGLMs are described in (Lee et al. 2017; Das and Lee 2009). Note that the gamma JGLMs are given as follows.

Gamma JGLMs are considered for a continuous positive random response variable y_i 's along with different variance (σ_i^2), and mean $\mu_i = E(y_i)$, satisfying $\text{Var}(y_i) = \sigma_i^2 \mu_i^2 = \sigma_i^2 V(\mu_i)$ say, where $V(\cdot)$ is known as variance function. Note that $V(\cdot)$ displays the variance function, and the variance has two parts such that σ_i^2 and $V(\mu_i)$. 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

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

where $g(\cdot)$ & $h(\cdot)$ are the GLM link functions for the mean & dispersion linear predictors respectively, and x_i' , w_i' are the vectors of independent variables/ factors, associated with the mean and dispersion parameters respectively. Mean parameters are estimated by maximum likelihood method, and the dispersion parameters are estimated by restricted maximum likelihood method (Lee et al. 2017).

STATISTICAL & GRAPHICAL ANALYSIS

The response Darjeeling district census population (DDCP) (separately Jalpaiguri district census population (JDCP)) has been modeled by gamma JGLMs. Here DDCP (JDCP) 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 to the number of incidences occurring 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, which minimizes both the squared error loss and predicted additive errors (Hastie et al. 2009). Based on the AIC criterion, the final DDCP and JDCP gamma JGLMs analysis outcomes are displayed in Table 2.

The derived DDCP (JDCP) (Table 2) probabilistic model is a data developed model, which is to be tested using model diagnostic tools. For the joint gamma fitted DDCP models, model diagnostic graphical analysis is displayed in Figure 1. In Figure 1(a), absolute residuals for the fitted DDCP 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, which does not indicate any lack of fit. These two figures do not indicate any discrepancy in the fitted DDCP model (Table 2), and they show that the gamma fitted DDCP model is an approximation of its true model.

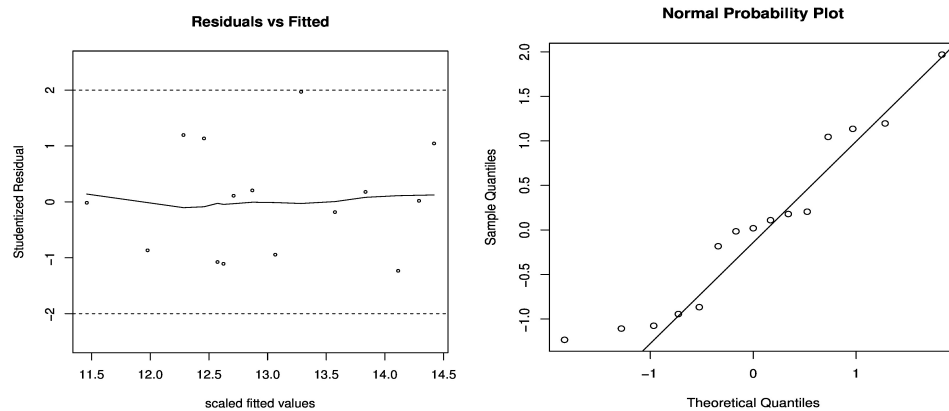


Figure 1(a)

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

Similarly, for JDCP, absolute residuals plot in Figure 2(a) and normal probability plot in Figure 2(b) are shown, which do not show any model fitting discrepancy. Therefore, the gamma fitted models for JDCP (Table 2) are very close to true unknown models.

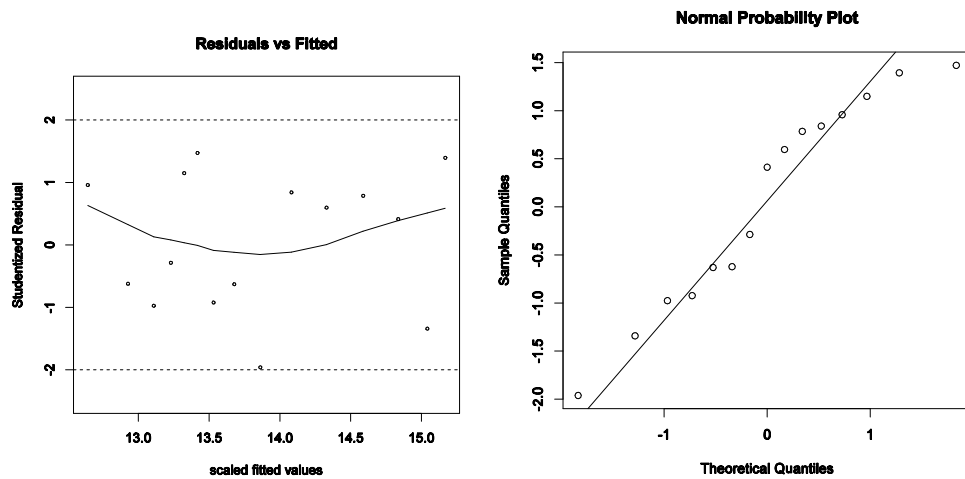


Figure 2: For the Gamma fitted models of Jalpaiguri population growth trend (Table 2), the (a) absolute student residuals plot with the fitted values, and (b) the normal probability plot for the mean

Non-parametric function estimation method (Cubic Splines)

The non-parametric function estimation procedures are elaborately described in many research papers such as Ruppert, Wand, Carrol (2003); Green and Silverman (1994); Wahba (1990). Practically, for fitting smooth trend curves, one can adopt a known functional form that is called a parametric model. However, one can use the smooth function, when its functional form is unknown that is termed a non-parametric function. In the current article, we apply 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 and JDCP growth under the gamma model analyses. It is found herein that no factor is significant in the dispersion model under the gamma distribution for DDCP, while two factors (t and x) are included for JDCP. Here it is derived that the gamma fitted mean model of DDCP and JDCP 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 the gamma fitted DDCP 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. For JDCP,

in the gamma fitted mean model, t ($P < 0.0001$), t^2 ($P < 0.0001$) and t^4 ($P < 0.0001$) are significant, but t^3 ($P = 0.2018$) is not significant. In the mean model t , t^2 , t^3 and t^4 are included due to functional marginality rule (i.e., if higher degree term is significant, then all its lower degree should be included) by McCullagh and Nelder (1989). In the dispersion model, t ($P = 0.0052$) and x ($P = 0.0325$) are significant.

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

$$\hat{\sigma}^2 = \exp.(-6.753).$$

Gamma fitted JDCP mean ($\hat{\mu}$) model (Table 2) is

$$\hat{\mu} = \exp.(13.6776949 + 0.1647137 t + 0.0192355 t^2 + 0.0003207 t^3 - 0.0002975 t^4),$$

and the gamma fitted JDCP dispersion ($\hat{\sigma}^2$) model is

$$\hat{\sigma}^2 = \exp.(-10.1405 - 0.5479 t + 0.6734 x).$$

Table 2: Gamma fitted population growth trend for Darjeeling and Jalpaiguri districts from 1872 to 2011

Model	Covariate	Darjeeling				Jalpaiguri			
		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	13.6776949	0.02030	673.731	<0.0001
	t	0.1438	0.0091	15.644	<0.0001	0.1647137	0.00852	19.328	<0.0001
	t ²	0.0246	0.0019	12.421	<0.0001	0.0192355	0.00214	8.972	<0.0001
	t ³	0.0013	0.0002	6.255	<0.0001	0.0003207	0.00025	1.277	0.2018
	t ⁴	-0.0004	0.0001	-10.644	<0.0001	-0.0002975	0.00004	-6.703	<0.0001
	x	0.0129	0.0080	1.600	0.0109	-----	-----	-----	-----
Dispersion model	Intercept	-6.753	0.4713	-14.33	<0.0001	-10.1405	2.0041	-5.060	<0.0001
	t	-----	-----	-----	-----	-0.5479	0.1954	-2.804	0.0052
	x	-----	-----	-----	-----	0.6734	0.3144	2.142	0.0325
AIC		338.3351				366.1231			

DISCUSSION & CONCLUSIONS

The article has focused on the migration problems of Jalpaiguri and Darjeeling districts from 1872 to 2011 using the DDCP and JDCP growth trend curves through the cubic spline and JGL gamma models. Note that history research study is always information based. Moreover, the exact information reveals many social, economic, political status of the society during the periods, which are the fundamental historical research study subjects. In practice, historians always try to study the history of migration (or other social events) with some illustrations, percentage, simple arithmetic, maps, graphs. Best of our knowledge, there is a little migration history study using advanced population growth trend curve probabilistic 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 Table1 and also in Figure 3.

The following differences of migration are observed between Darjeeling and Jalpaiguri districts.

- Both the mean and dispersion models of DDCP & JDCP are different.
- Percentage increase of population growth for two districts are different, which is shown in Table 3 & Figure 3. Note that for Darjeeling district, migration rate was the highest from 1872-1881, after that it was decreasing until 1903. From 1903-1923, the migration rate was the lowest, and after that it was again increasing.
- For Jalpaiguri district, the migration rate was increasing from 1872 to 1913. From 1913-1933, the migration rate was the lowest, and after that it was increasing.

Table 3: Percentage increase of populations in Darjeeling & Jalpaiguri Districts

Census Year	1872	1881	1891	1901	1911	1921	1931	1941	1951	1961	1971	1981	1991	2001	2011
% increas DDCP		63.84	43.91	19.02	5.31	5.12	12.86	17.72	17.58	35.90	25.16	31.02	26.91	23.79	14.77
% increas JDCP		16.97	18.25	20.52	21.30	4.93	6.47	14.43	8.13	48.27	28.76	26.55	26.44	21.45	13.87

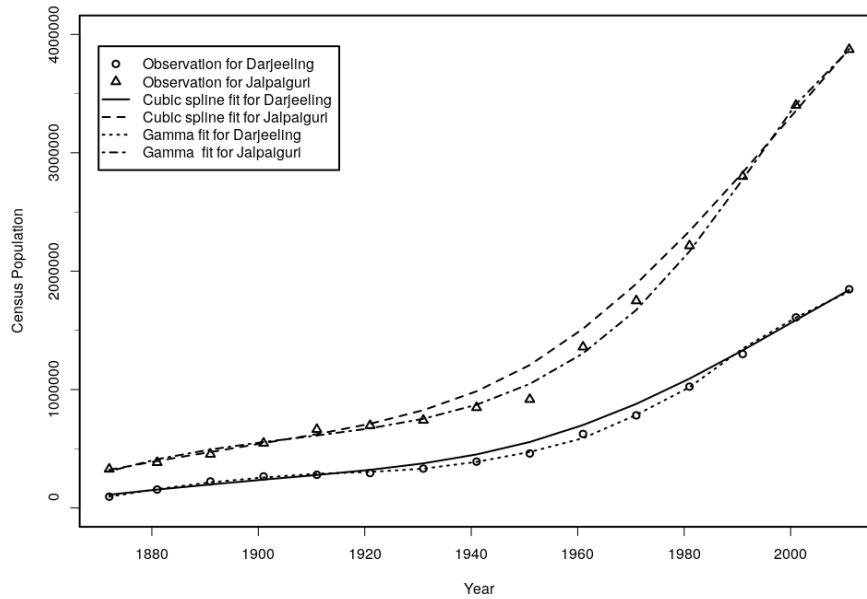


Figure 3: Scattered plot of the original observations and the smooth JGL gamma fitted mean trend curve and cubic spline for both Darjeeling and Jalpaiguri Districts

- Pulled factors for migration in Darjeeling district are British invitations for modernization of Jalpaiguri and Darjeeling, which was started in 1869; British Govt. was in good relation with the Nepali, as the Nepali army helped the British to suppress the [Indian Rebellion of 1857](#); tea industry; new business; tourism business; lots of jobs for developing hill resorts, etc. For Jalpaiguri district, all the above are the same, but here lands for agriculture are easily available. In addition, after the termination of Gour, the Koch-Kamta kingdom origin illuminated the invited migration process.
- Forced factors for migration in Darjeeling district are [Tibet](#) had declared independence from China in 1913. But Chinese [invading started in 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 due to Chinese [invading](#). The [Tibet Autonomous Region](#) within China was officially established in 1965. In Nepal,

there was a strong classifications with respect to caste, and lower caste Nepales are highly hated by the upper caste, so lower caste Nepali moved to Darjeeling district. In the late 1940s, newly emerging pro-democracy movements and political parties in Nepal were critical of the Rana autocracy. Following the success of the 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. 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.

- Forced factors for migration in Jalpaiguri district are some of the above, and from 1931 to 2011, there were different historical events that occurred in the adjacent States of India and the neighboring countries. The Indian freedom fighting revolution had been growing stronger day by day after 1921, and the freedom fighters were punished by the British Government, so they were forced to take shelter there mainly from East Bengal. 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, Jalpaiguri and Darjeeling. During the post-independence period of India, many religious violences were occurred in East Pakistan (presently Bangladesh), which were continued strongly up to approximately 1966, and they were occurred there in several times such as 1970-71 (Independence of Bangladesh), 1992-1993 (Babri Mosque was broken in India), 2001-2003 (Political disturbances in Bangladesh), and it is still there. In 1971, due the East Pakistan independence war, most of the Hindu families from East Pakistan were forced to come to India, Jalpaiguri and Darjeeling. This process of Hindu people migration from Bangladesh to India is still continuing. From 1962, there were continuous political disturbances regarding Assamese and non-Assamese (Bengalis, Behari, Marwari, Nepalese) in Assam, and it is still there. In 1980-1981, it was very strong, so many non-Assamese, mainly Bengalis were coming to Jalpaiguri and North Bengal, and it is still present.

- In Darjeeling district, 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. 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 lower caste Nepalese were the most dominant group that immigrated in the Darjeeling district over the years. 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.
- In Jalpaiguri district, until 1850, Sikkim ruled over the present Siliguri subdivision that was populated by Rajbansis. After the formation of the Jalpaiguri district 1869, the Brahman Bengalis, Kamrupis from Sylhet, Pandas from Orissa and a few other higher caste Bengali Hindus started to move into the district as government servants and professionals such as doctors and lawyers. Besides them, some Muslims from Noakhali and Tipperah (Comilla) districts came there as professionals, service-holders and moulvis. As merchants and traders, many Marwari and Kayastha Bengali Hindus came here. With the started of the tea plantations in the Jalpaiguri district, a large number of tribal immigrants such as Munda, Santal, and Oraon peasants from Santal Parganas and Chota Nagpur, along with Nepalese, Biharis and Dhangar Coolies numbering around 6000 came into Jalpaiguri district in 1877-78 (Saha and Ghosh, 2013). They were employed in tea gardens, road construction and railway. Hindus from East Pakistan, presently Bangladesh, Assam have been coming to Jalpaiguri district from early 1920, and it is still continuing.
- The fast growth of migration in Darjeeling, backed by colonial domination, apparently changed the traditional socio-economic structure in Darjeeling, while its Pre-British economy was closely the Asiatic Mode typology. The village societies raised a character of an enclave, consumption and production being guided by their own ethos and needs, and 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. 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 Darjeeling, consequently, the Sharecroppers association, or Pakhurey Sangh was introduced there. It was observed that lower castes of Nepalese were immigrated in larger numbers than upper caste in Darjeeling, and they were the most dominant group. Therefore, Nepalese social relation, culture, casteism greatly influenced the Darjeeling society. There are mainly three caste groups—high (Bahuns, Thakuries, Chhetries), middle (Newars, Mangar, Gurung) and low (untouchable). 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 Rajbansi Society was structured in terms of economic class definitions, or Varna differentiations. The society was almost egalitarian and it remained to be so even though the structural & functional variations between Jotedars, Adhiars and Chukanidars formalized by the instruction of a new community of Jotedars since 1895 whose background had induced them to plant the new culture of emerging class consciousness. Due to urbanism and English educated by the new Jotedars community, the old Jotedars society was affected. The new elitist outlook gradually influenced the Rajbansi Jotedars, and consequently, their caste consciousness slowly disappeared. The gradual spread of education inspired the Rajbansi Jotedars to accept the new functional and structurally changed cultural society (Marian, 1977). The Rajbansis were tried by family professionals and were normally disinclined to change professions. Due to some external causes, some important changes were introduced in their attitude to accept the new professions. For instance, the service class amongst the Rajbansi left their own villages for occupational reasons. The newly educated emerging middle class gradually received elitist status by replacing the old landlords. The transfer of jotes had many serious social implications. Some of the Rajbansi Jotedars who sold their jotes had turned into the tenants in the same land that they once owned. This has caused serious social reactions in the Rajbansi society. Consequently, many serious protest movements among the Rajbansi against the immigrant

Jotedars occurred which were not properly recorded. Due to immigration, the early Rajbansi society was completely affected (Roy, 2005).

- Figures 4 and 5 show the dispersion plots of population grown in Darjeeling and Jalpaiguri districts respectively, which are different. From these two figures, it is clear that dispersions of migration of the two districts were different. The variance plots Figures 4 and 5 reveal different dispersions, which are also related to some historical events as stated above.

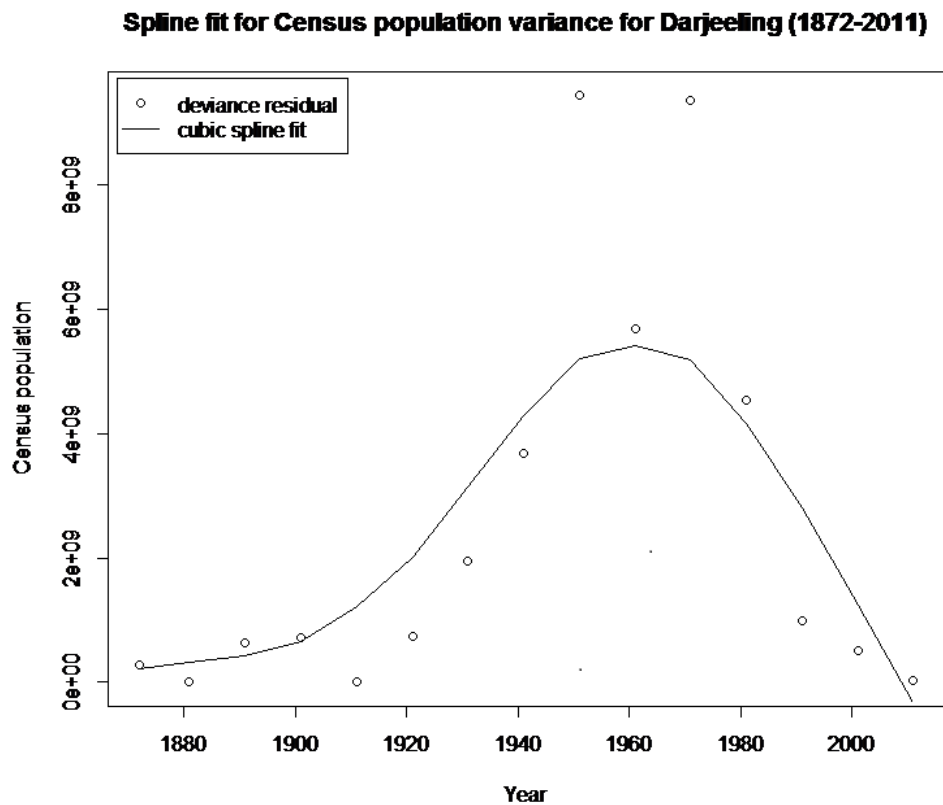


Figure 4: Scattered plot of the deviance residuals and dispersion plot cubic spline of Darjeeling District.

Spline fit for Census population variance for Jalpaiguri (1872-2011)

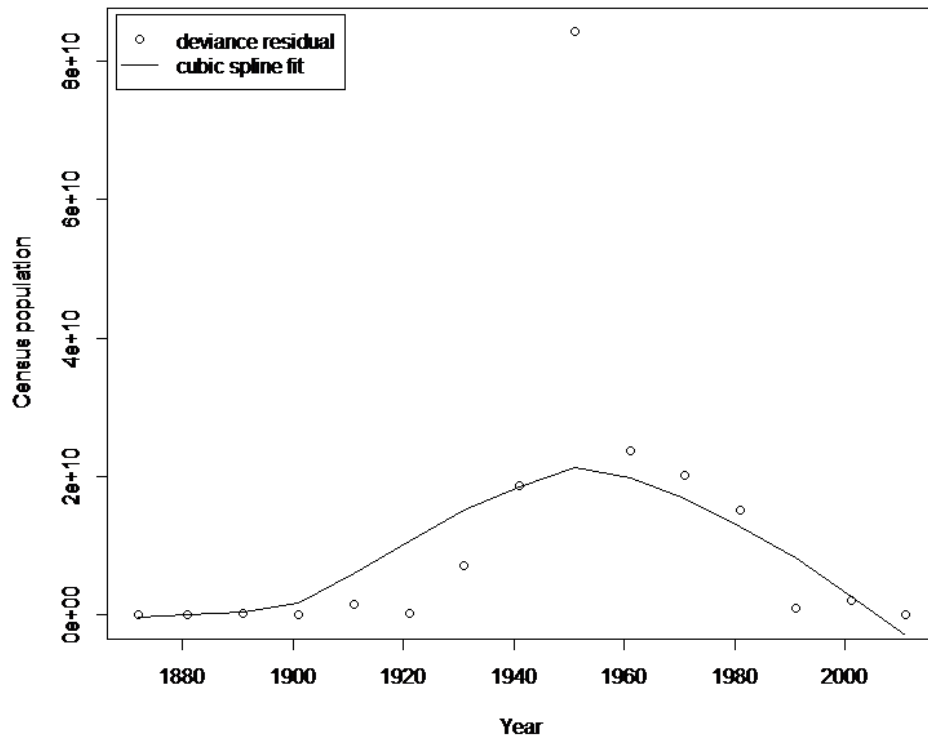


Figure 5: Scattered plot of the deviance residuals and dispersion plot of cubic spline

Table 3: Slope values at different time points of the DDCP & JDCP trend curves for the different 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)	Y- axis value (y1)	Y- axis value (y2)	Slope tan(θ)
		Darjeeling District			Jalpaiguri District		
1872	1901(J1911)	125000.00	250000.00	4310.345	285714.29	678571.425	10073.25
1901(J1911)	1921 (J1931)	250000.00	291666.60	2083.33	678571.425	749999.995	3571.4285
1921(J1931)	1941	291666.60	375000.00	4166.67	749999.995	928571.42	17857.1425
1941	1961 (J1951)	375000.00	604165.70	11458.29	928571.42	1071428.56	14285.714
1961(J1951)	1981(J1991)	604165.70	1062498.30	22916.63	1071428.56	2999999.99	48214.2857
1981(J1991)	2001 (J2011)	1062498.30	1604164.10	27083.29	2999999.99	3928571.42	46428.576
2001	2011	1604164.10	1833330.40	22916.63	-----	-----	-----

* Figure 3 shows the population growth trends of two districts Jalpaiguri and Darjeeling for all the points in the period 1872 to 2011. Slopes for different intervals for DDCP and JDCP are shown in Table 3, which are also different. Note that (J year) indicates the time for Jalpaiguri district in Table 3, and the only year in Table 3 indicates the time for Darjeeling district.

The present study is done based on JGL gamma models and cubic spline fitted models. It is observed in Figure 3 that JGL gamma models give better fit than cubic spline fitted models. In addition, JGL gamma fitted models are examined based on graphical diagnosis tools. Moreover, the estimated parameters are very stable as their standard errors are very small. Based on the parametric and non-parametric fitted trend equations, comparative migration study of the two adjacent districts is done here, which shows many interesting real facts that may help the social scientists researchers.

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