

Statistical Analysis of Religious Population in Asian Countries

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Author's contribution

The sole author designed, analyzed and interpreted and prepared the manuscript.

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ABSTRACT

Asian history and culture have been influenced by a number of religions i.e. Hinduism, Islam, Buddhism, Christianity, Sikhism, Shamanism, etc. These traditions offer spiritual guidelines but also set moral and ethical standards for the daily life of the people in Asian countries. The main purpose of this study is to find out, how Asian religious population is changing over time? Religious population data for different census years have been collected from the website of Asian countries. As population varies over time, religious population data is time series data. There are mainly four types of variations observed in time series data namely seasonal variation, cyclical variation, trend and irregular or random variation. Time series analysis and analysis of variance have been applied for analyzing the data. It is observed that percentages of some religious groups are decreasing and for some religious group are increasing gradually. Also the percentages of some religious groups become stagnant in the sense that no significant change.

Keywords: Religious population; trend analysis; ANOVA; Friedman's test; F-test.

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1. INTRODUCTION

The population of the world in 2010 was about 6.9 billion. Out of them 31.4% Christians, 23.2% Muslims, 16.4% with No Religion affiliation, 15% Hindus, 7.1% Buddhists, 5.9% Folk Religionists, 1% Other Religions [1]. With the exception of Buddhists, all of the major religious groups are expected to increase in number by 2050. But some will not keep pace with global population growth and as a result are expected to make up a smaller percentage of the world's population in 2050 than they did in 2010 [1]. Muslims are expected to grow faster than other religions because they have the highest fertility rates among major religious groups in the world, highest proportion of young people and compared to other religions more people are switching towards Islam/Muslims [1].

Asian population is 4.2 billion, which is more than 60% of the World population. There are 48 countries in Asia but more than 60% of Asian population lives in two countries, China (1.3 billion) and India (1.2 billion). About 75% of Asian population lives in five countries China, India, Indonesia, Pakistan and Bangladesh and 25% population lives in the remaining 43 countries [2, 3]. In Asia there are 7% Christians, 24.33% Muslims, 21.17% with no Religion affiliation, 25.27% Hindus, 11.87% Buddhists, 9% Folk Religionists, 1.28% other Religions [4]. In this article we would like to highlight the changes in religious population of five countries China, India, Indonesia, Pakistan and Bangladesh.

Population as well as religious population is time series data as these varies over time. Four types

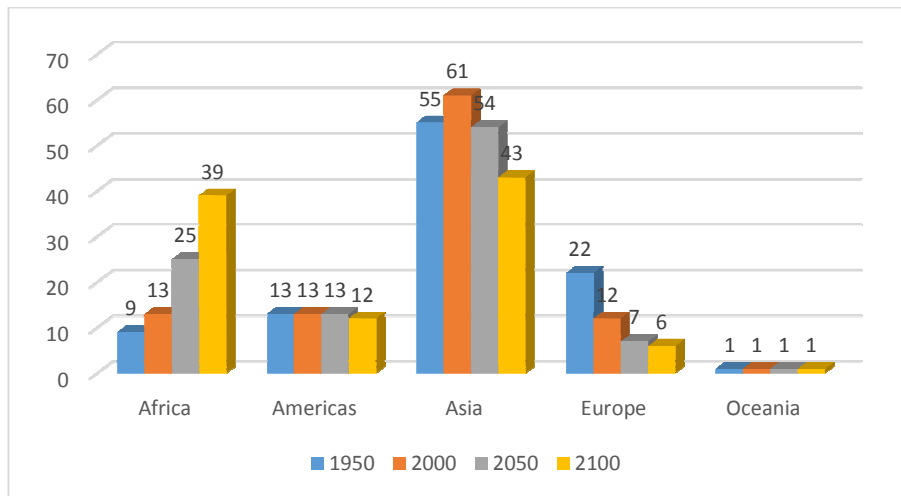
of variations are observed in time series data namely seasonal variation, cyclical variation, trend and irregular or random variation. Usually census data is 10 yearly so there is no seasonal variation in the data. As population census was conducted mainly after World War-II in many Asian countries, data are available for less than ten census years. With less than ten data points it is not feasible to study cyclical variation. So we did the trend analysis and analysis of variance. It is observed that percentages of some religious groups are decreasing and for some religious groups are increasing gradually. Also the percentages of some religious groups become stagnant in the sense that no significant progress or regression.

2. DATA

Data have been collected from internet [4] and presented in Tabular and Graphical forms. Continent-wise world population data from 1950 to 2100 are presented in Graph 1 and in Table 1.

Currently more than 60% world population lives in Asia. There are five major religious groups in the world namely Christians (31.4%), Muslims (23.2%), Hindus (15%), Buddhists (7.1%) and Folk religions (5.9%) [1]. Percentages of world religious population in 2010 and projected population in 2050 are presented in Table 2.

If the current growth rate and trend continues, it is expected that in 2050, more than 60% of world population will belong to two major religions Christian and Muslim. The reasons behind this are obvious from the following presentations.



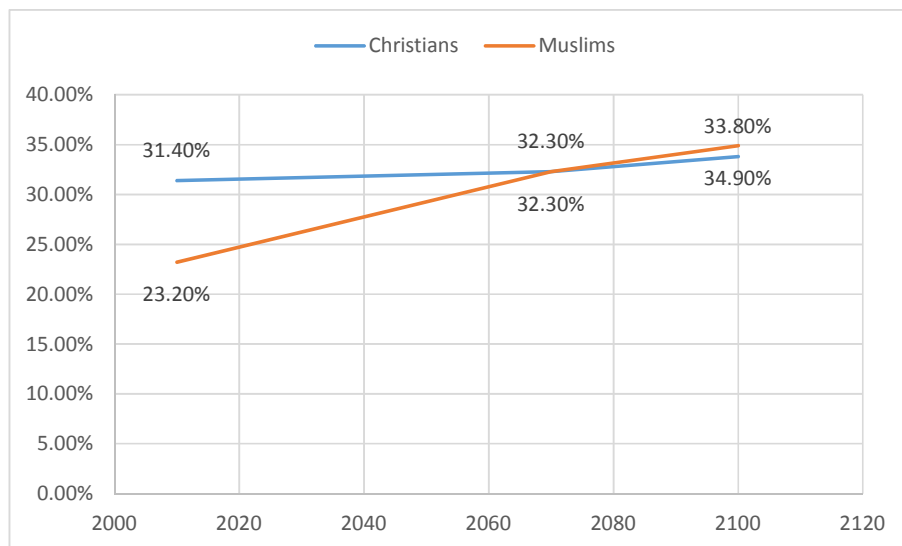
Graph 1. Percentage population distribution across the continents from 1950 to 2100 [4]

Table 1. Continent-wise world population (in 1000) data from 1950 to 2100 [4]

Population mid-year	Africa	Americas	Asia	Europe	Oceania	World
1950	228827	339484	1395749	549043	12675	2525779
1960	285270	424791	1694650	605517	15775	3026003
1970	366475	519017	2128631	657369	19681	3691173
1980	478459	618950	2634161	694510	22968	4449049
1990	629987	727489	3213123	723248	26969	5320817
2000	808304	841695	3717372	729105	31224	6127700
2010	1031084	942692	4165440	740308	36659	6916183
2020	1312142	1037449	4581523	743569	42066	7716749
2030	1634366	1120044	4886846	736364	47317	8424937
2040	1998821	1183328	5080419	723887	52232	9038687
2050	2393175	1227767	5164061	709067	56874	9550945
2060	2797337	1256296	5152203	690622	60940	9957399
2070	3195254	1270522	5074753	672505	64305	10277339
2080	3569537	1271719	4957154	658812	66939	10524161
2090	3903239	1263337	4833369	648740	68715	10717401
2100	4184577	1249293	4711514	638816	69648	10853849

Table 2. Size and projected growth of major religious groups in the world [1]

Religious group	2010 Population in thousands	% Of World population in 2010	Projected 2050 population (in 1000)	% Of world population in 2050	Population growth 2010-2050 (in 1000)	% Increase 2010-2050
Christians	2168330	31.4	2918070	31.4	749740	34.58
Muslims	1599700	23.2	2761480	29.7	1161780	72.62
Unaffiliated	1131150	16.4	1230340	13.2	99190	8.77
Hindus	1032210	15	1384360	14.9	352140	34.12
Buddhists	487760	7.1	486270	5.2	-1490	-0.31
Folk religions	404690	5.9	449140	4.8	44450	10.98
Other religions	58150	0.8	61450	0.7	3300	5.67
Jews	13860	0.2	16090	0.2	2230	16.09
World total	6895850	100	9307200	100	2411340	34.97



Graph 2. Projections of Christian and Muslim shares of world population [1]

Table 3. Projected cumulative change in world population (in 1000) due to religious switching, 2010-2050 [1]

	Buddhu	Other religion	Unaffiliate	Folk religion	Jews	Hindu	Christian	Muslim
in	3370	3040	97080	5460	320	260	40060	12620
out	6210	1160	35590	2850	630	250	106110	9400
Net change	-2840	+1880	+61490	+2610	-310	10	-66050	3220

Table 4. Total fertiity rate in the world by religions 2010-2015 [1]

Buddhists	Other religion	Unaffiliated	Folk religion	Jews	Hindus	World	Christian	Muslim
1.6	1.7	1.7	1.8	2.3	2.4	2.5	2.7	3.1

Table 5. Percentage age distribution of religions in the world 2010 [1]

	Buddhist	Other religion	Unaffiliated	Folk religion	Jews	Hindus	World	Christian	Muslim
<15	20	21	19	22	21	30	27	27	34
15-59	65	65	68	67	59	62	62	60	60
60 & >	15	14	13	11	20	8	11	14	7

Figures may not add to 100% due to rounding.

It is evident that total fertility rate, change due to religious switching and proportion of young people are very high among Muslims compared to other religions in the world. Graph 2 indicates that, if current trend continues, Muslims would out number Christian population after 2070. Percentage population distribution in Asian Countries and growth of major religious groups in Asia are presented in the following Tables 6 and 7.

More than 60% of Asian population lives in two countries China and India. About 75% of Asian population lives in 5 countries China, India, Indonesia, Pakistan and Bangladesh. Percentages of religious population in these five countries are presented in Graph 3.

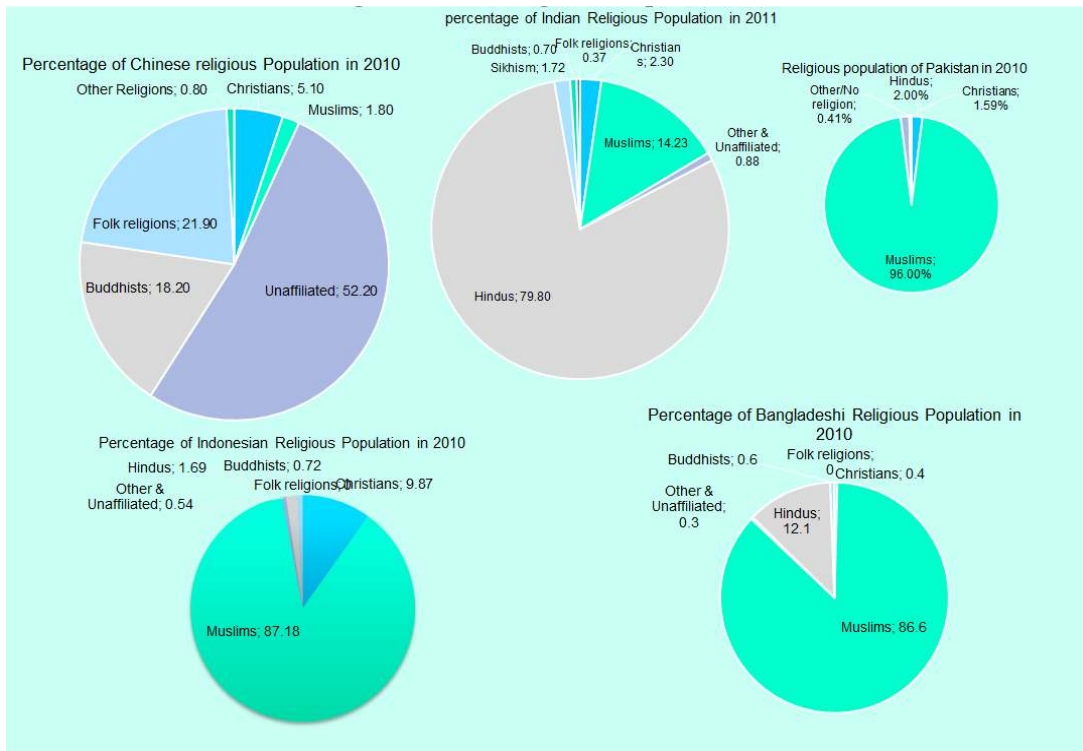
Census data are not available for all Asian countries in the internet. Seven census-years data for two countries (India and Indonesia) [6,7] are available in the internet and presented in the following Tables 8 and 9.

Table 6. Percentage population distribution in Asian countries in 2010 [4]

Country	China	India	Indonesia	Pakistan	Bangladesh	Japan	Philippine	Other	Total
Population	31.35%	29.72%	5.84%	4.39%	3.63%	2.90%	2.35%	19.82%	100

Table 7. Size and projected growth of major religious groups in Asia [4]

Religious group	2010 population (in 1000)	% of Asian population in 2010	Projected 2050 population (in 1000)	% of Asian population in 2050	Population growth 2010-2050 (in 1000)	% Increase 2010-2050
Christians	287100	7.08	381200	7.72	94100	32.80%
Muslims	986420	24.33	1457720	29.52	471290	47.8
Unaffiliated	858490	21.17	837790	16.97	-20700	-2.4
Hindus	1024630	25.27	1369600	27.74	344970	33.7
Buddhists	481480	11.87	475840	9.64	-5640	-1.2
Folk religions	364690	8.99	366860	7.43	2170	0.6
Other Religions	51920	1.28	48650	0.99	-3280	-6.3
Jews	200	0.00	240	0.00	40	21.2
Asia Total	4054930	100.0	4937900	100	882950	21.8



Graph 3. Percentages of Asian religious population in five countries [5,6,7,8,9]

Table 8. Indian religious population distribution (in percentages) [6]

Religious group	1951	1961	1971	1981	1991	2001	2011
Hindus	84.1	83.45	82.73	82.3	81.53	80.46	79.8
Muslims	9.8	10.69	11.21	11.75	12.61	13.43	14.23
Christians	2.3	2.44	2.6	2.44	2.32	2.34	2.3
Sikhs	1.79	1.79	1.89	1.92	1.94	1.87	1.72
Buddhists	0.74	0.74	0.7	0.7	0.77	0.77	0.7
Jains	0.46	0.46	0.48	0.47	0.4	0.41	0.37
Zoroastrians	0.13	0.09	0.09	0.09	0.08	0.06	0.01
Other/No religion	0.43	0.43	0.41	0.42	0.44	0.72	0.9

Table 9. Indonesian religious population (in percentages) [7]

Religious group	1971	1980	1985	1990	2000	2005	2010
Hindus	1.94	1.94	1.94	1.83	1.81	1.73	1.69
Muslims	87.51	87.94	86.92	87.21	88.22	88.58	87.18
Christians	8.21	8.8	9.59	9.62	8.92	8.86	9.87
Buddhists	0.92	0.92	0.98	1.03	0.84	0.61	0.72
Other/No religion	1.42	0.4	0.58	0.32	0.2	0.11	0.38

3. MATERIALS AND METHODS

Religious population varies over time and hence it is time series data. There are four types of variations generally observed in time series data namely seasonal variation, cyclical variation, trend and irregular or random variation. Here the data is 10 yearly so

there is no seasonal variation in the data. As population census was conducted mainly after World War-II, in many Asian countries, data are available for less than ten census years. With less than ten data points it is not feasible to study cyclical variation. So this study conducts the trend analysis and analysis of variance.

As religious population data varies from religion to religion and over time, we consider randomized complete bock design for the analysis of variance [10 and 11] to test whether there are significant variations among the religions as well as between time (years). The following two sets of null and alternative hypotheses are considered.

- (i)
 - H_0 : There are no significant differences of religious populations between time variables (years).
 - H_a : There exist significant differences of religious populations between time variables (years).

The test statistic to test the above hypotheses is F which follows Snedecor's F-distribution with 6 and error degrees of freedom.

- (ii)
 - H_0 : There are no significant differences of religious populations between religious groups.
 - H_a : There exist significant differences of religious populations between religious groups.

The test statistic to test the above hypotheses is F [10] which follows Snedecor's F-distribution with 7 (for Indian) or, 4 (for Indonesian) and error degrees of freedom. F-test requires normality assumption.

The basic assumption of analysis of variance is, data must be at least approximately normal. It is not feasible to test normality by only 7 years data. Keeping this in mind, we have also applied Friedman's test [12] to test the above hypotheses. The test statistic for Friedman's test

$$\text{is, } M = \frac{12}{bk(k+1)} \sum_{j=1}^k R_j^2 - 3b(k+1), \text{ where } b =$$

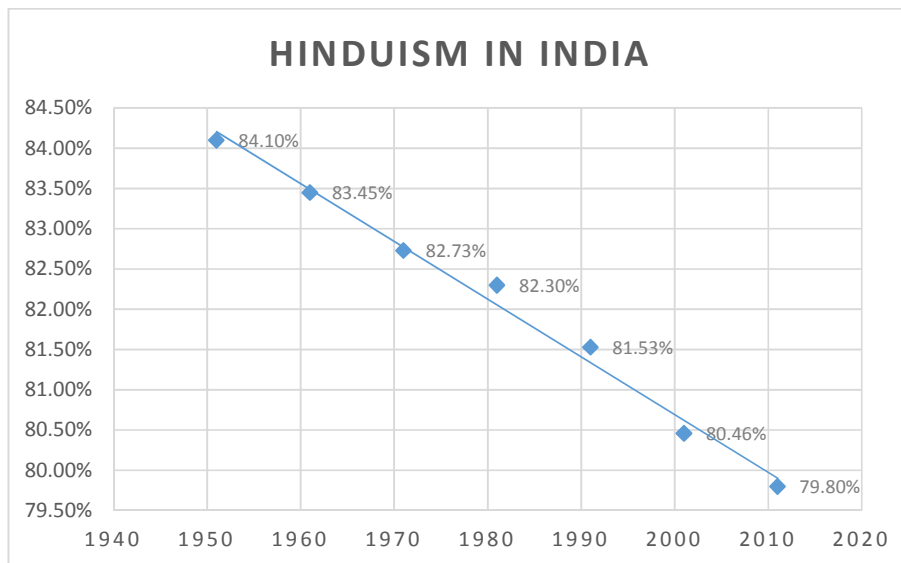
number of blocks, k = number of treatments, R_j = sum of ranks for j^{th} treatment. If the value of the block variable is large (> 5) or, the number of observations is large ($bk > 5$), then M follows a Chi-square distribution with $(k-1)$ degrees of freedom. The decision Rule is, reject H_0 if M exceeds the critical value where the critical values are available in the Friedman's test Table for different values of b , k , and α significance levels. If the values of n or k are not included in the table, approximate critical values are obtained from the chi-squared distribution using $k-1$ degrees of freedom and α significance levels.

Minitab and excel are used to analyze the data.

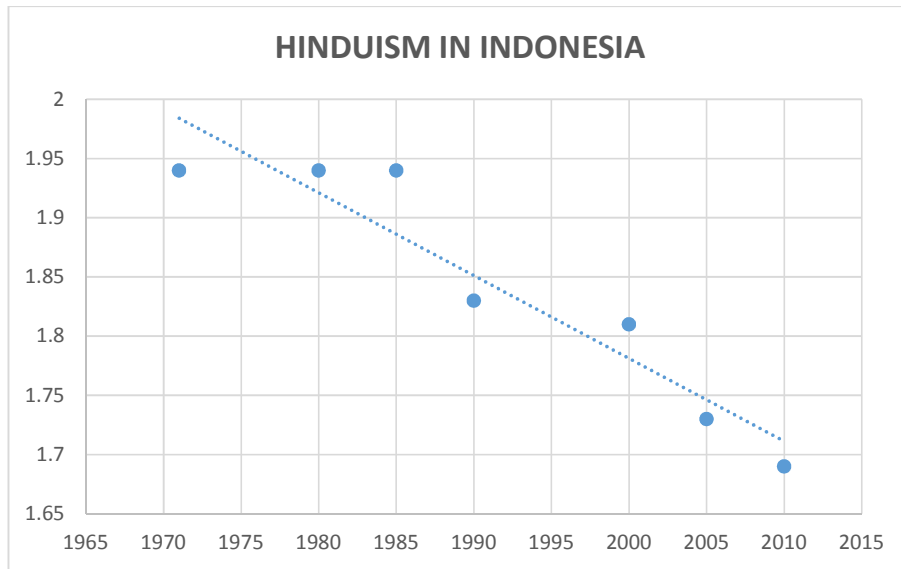
4. RESULTS AND DISCUSSION

Trend lines of major religions in India and Indonesia are presented in the following graphs.

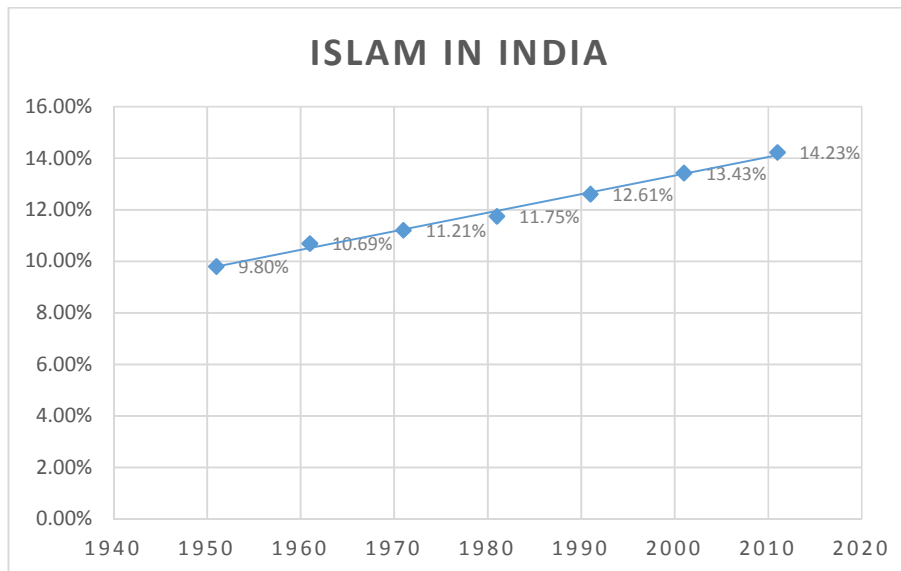
Graphs 4 and 5 indicate that there is decreasing trend of the proportions of Hindu population in both India and Indonesia.



Graph 4. Trend of Hindu population in India [6]



Graph 5. Trend of Hindu population in Indonesia [7]



Graph 6. Trend of Muslim population in India [6]

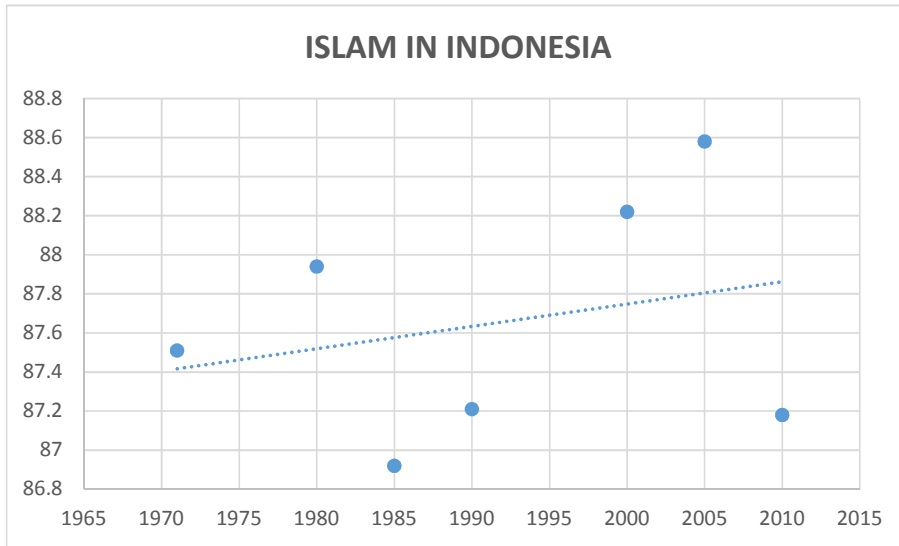
Graphs 6 and 7 indicate that there is increasing trend of the proportions of Muslim population in both India and Indonesia.

Graph 12 indicates that there is neither increasing nor decreasing trend of the proportion of Sikh population in India.

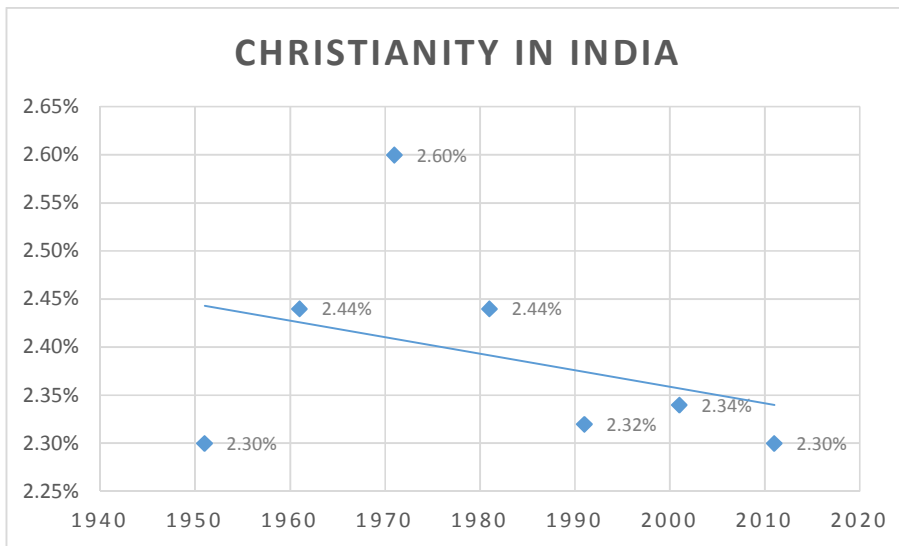
Graphs 8 and 9 indicate that there is decreasing trend of the proportion of Christian population in India but increasing trend of that in Indonesia.

These graphs show that there are some variations between years for each religion in India and Indonesia. This study conducts analysis of variance method to test whether these variations are statistically significant. The test results are given in the following Tables 10 and 11.

Graphs 10 and 11 indicate that there is increasing trend of the proportion of Buddha population in India but decreasing trend of that in Indonesia.



Graph 7. Trend of Muslim population in Indonesia [7]



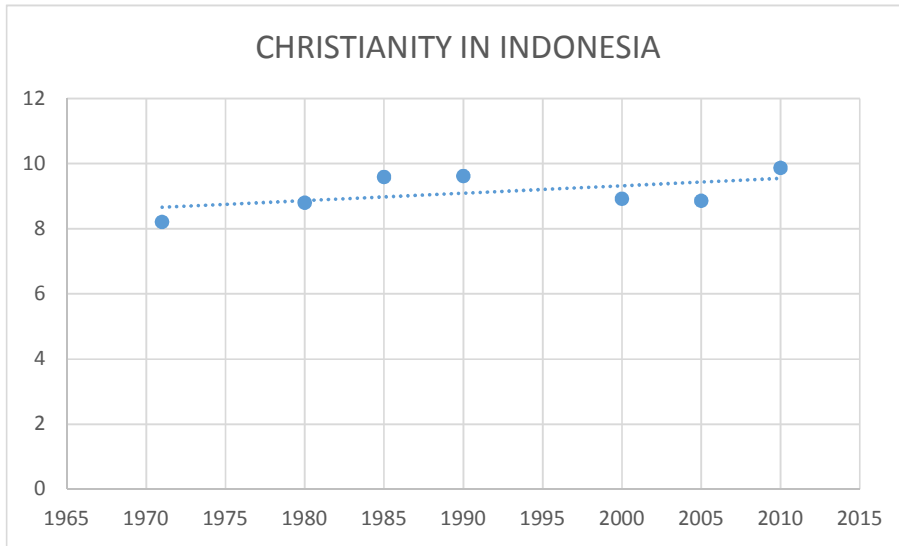
Graph 8. Trend of Christian population in India [6]

Table 10. ANOVA table for Indian religious population

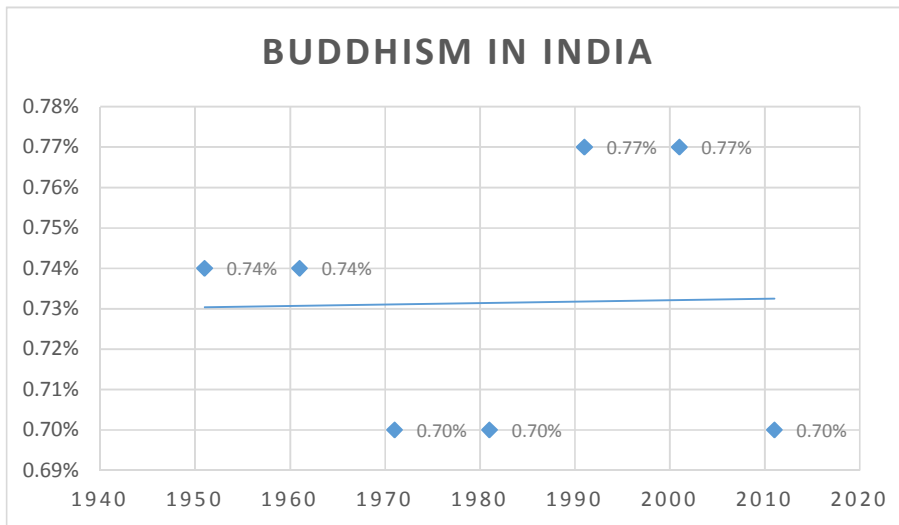
ANOVA						
Source of variation	SS	df	MS	F	P-value	F crit
Religions	39445.5	7	5635.071	8016.982	0	2.237
Year	0.012061	6	0.002	0.003	1	2.324
Error	29.52145	42	0.703			
Total	39475.03	55				

Table 11. ANOVA table for Indonesian religious population

Source of variation	SS	df	MS	F	P-value	F crit
Religions	40403.114	4	10100.779	42862.482	0.000	2.776
Year	0.006	6	0.001	0.004	1.000	2.508
Error	5.656	24	0.236			
Total	40408.78	34				



Graph 9. Trend of Christian population in Indonesia [7]



Graph 10. Trend of Buddhist population in India [6]

This study has considered the following hypotheses.

- (a) H_{10} : No significant differences of religious population proportions between years.
 H_{1a} : Significant differences of religious population proportions between years.
- (b) H_{20} : No significant differences of religious population proportions between religions.
 H_{2a} : Significant differences of religious population proportions between religions.

The test results indicate that there are significant variations between religions but no significant variations between years.

This study has also applied Friedman's test for which first the data have been ranked within the rows and obtain the following Tables 12 and 13 for India and Indonesia respectively.

To test the hypotheses in (a), the value of the test statistic for Indian population is

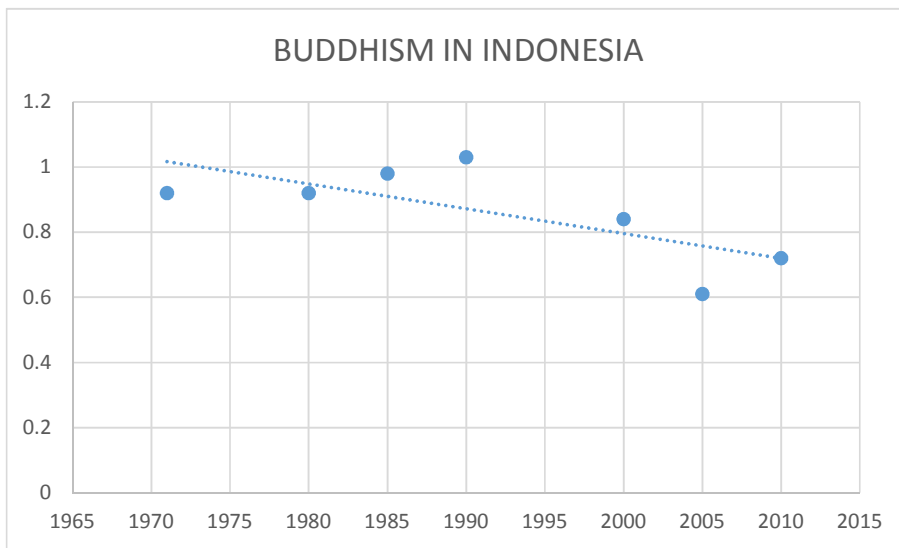
$$M = 12 * 7308.5 / (8 * 7 * 8) - 3 * 8 * 8 = 195.763 - 192 = 3.763.$$

The critical value at 5% level of significance is 12.592 and the decision rule is, Reject H_{10} if $M > 12.592$.

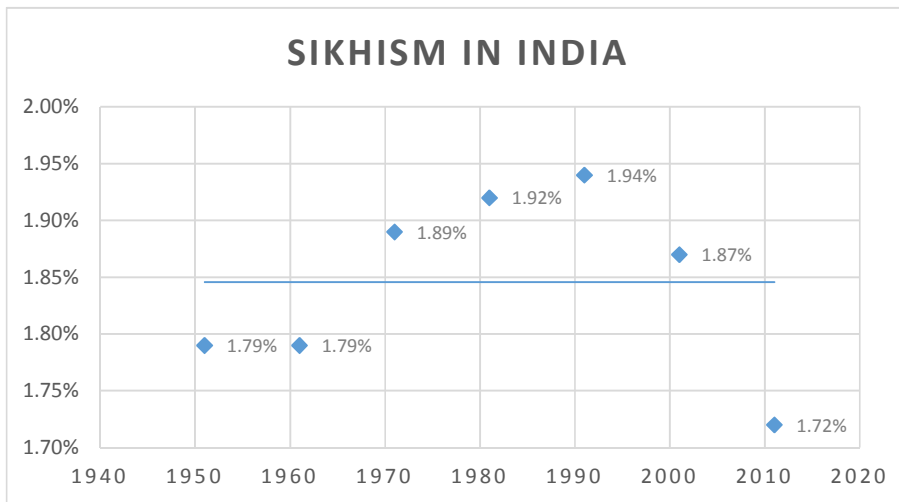
Therefore, the study does not have enough evidence to reject H_{10} , hence there are no significant difference between proportions of religious populations at different years.

Table 12. Friedman’s test results for Indian population

Religious group	1951	1961	1971	1981	1991	2001	2011
Hindus	7	6	5	4	3	2	1
Muslims	1	2	3	4	5	6	7
Christians	1.5	5.5	7	5.5	3	4	1.5
Sikhs	2.5	2.5	5	6	7	4	1
Buddhists	4.5	4.5	2	2	6.5	6.5	2
Jains	4.5	4.5	7	6	3	2	1
Zoroastrians	7	5	5	5	3	2	1
Other/No religion	3.5	3.5	1	2	5	6	7
R_j	31.5	33.5	35	34.5	35.5	32.5	21.5
R_j^2	992.25	1122.25	1225	1190.25	1260.25	1056.25	462.25
$\sum R_j^2 = 7308.5$							



Graph 11. Trend of Buddhist population in Indonesia [7]



Graph 12. Trend of Sikh population in India [6]

Table 13. Friedman’s test results for Indonesian population

Religious Group	1971	1980	1985	1990	2000	2005	2010
Hindus	6	6	6	4	3	2	1
Muslims	3	4	1	2	6	7	5
Christians	1	2	5	6	4	3	7
Buddhists	4.5	4.5	6	7	3	1	2
Other/No religion	7	5	6	3	2	1	4
R_j	21.5	21.5	24	22	18	14	19
R_j^2	462.25	462.25	576	484	324	196	361
$\sum R_j^2 = 2865.5$							

To test the hypotheses in (a), the value of the test statistic for Indonesian population is

$M = 12 \cdot 2865.5 / (5 \cdot 7 \cdot 8) - 3 \cdot 5 \cdot 8 = 122.807 - 120 = 2.807$. The critical value at 5% level of significance is 12.592 and the decision rule is, Reject H_{10} if $M > 12.592$.

Therefore, the study does not have enough evidence to reject H_{20} , hence there are no significant difference between proportions of religious populations at different years.

5. CONCLUSION

There are about seven billion people in the world and more than 60% of them live in Asia. More than 60% of Asian population lived in two countries India and Indonesia. Currently nearly 60% of world population belongs to two major religions Christian and Islam. Currently Christian population is highest in the world. It is observed that total fertility rate, change due to religious switching and proportion of young population for Muslims are very high compared to other religions. Islam is growing faster than any other religions in Asia and also in the world. If current trend continues, Muslims would out number Christian population after 2070. In Asia also Islam will be the leading religion.

The proportions of Hindus are decreasing but the proportions of Muslims are increasing gradually in both India and Indonesia. The proportions of Christians are decreasing in India but increasing gradually in Indonesia. The proportion of Buddhists is increasing in India but decreasing in Indonesia. There is neither increasing nor decreasing trend of the proportion of Sikh population in India.

The analysis of variance and Friedman’s tests indicate that the variations between yearly proportions of religious population for both India

and Indonesia are statistically insignificant. But the variations between the proportions of religious populations between religions are statistically significant.

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COMPETING INTERESTS

Author has declared that no competing interests exist.

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