PREFACE

I (Saikat Ghosh, M.SC Statistics, Delhi University) have been selected as the intern for the year 2015-16 for MOSPI's Regional Office, NSSO (FOD), Gangtok. The objective of the scheme is to familiarize students with the Official Statistical System of the country with specific reference to data collection, processing & analysis, publication & dissemination needs.

In NSSO (FOD), Gangtok we have chosen to do our project on CPI (U). we want to analyze the data and draw a conclusion at the end of the internship.

Acknowledgement

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Introduction:

A consumer Price Index (CPI) is designed to measure the changes over time in the general level of retail prices of goods and services consumed by a reference population. These indices reflect the fluctuations in retail prices pertaining to specific segments of the population in the country. As a first step, Central Statistical Organization has taken a decision to complete CPI for remaining segment of the population i.e. rural in near future.

Prices utilized in the index compilation are defined as the money actually charged from the consumer by the shopkeeper for the item with required specification for the specified unit of sale.

At present four CPIs covering different segments of population i.e. industrial workers (IW), urban non-manual employees (UNME), agricultural and rural labors (AL/RL), are compiled and released at national level.

CPI (U) would be compiled for each State/UT as well as at all India level. Weighting diagrams of the CPI (U) have been derived from the results of the NSS 61st round of Consumer Expenditure Survey (2004 – 2005). In all 310 towns have been selected covering all the States and UTs from which 1114 price quotations (schedules) are to be collected every month.

Method:

The Price of well-defined variety of an item collected from the selected shop/outlet on a scheduled day of price collection under given circumstances of sale from at a point of time is called a Price Quotation. Successive comparable quotations constitute a time series to be taken into account in the compilation of the CPI. To have a meaningful comparison of price it is essential that item(s) with same specification is priced at equal interval. Thus, main components of price collection mechanism may be enumerated as follows:

- Shops / Outlets
- Specifications
- Unit of sale
- Price collection

As it is proposed to compile monthly indices, regular price collection has to be carried out every month from the selected shops/outlets of the selected towns according to the specifications fixed for each item at the time of market survey. During the market survey each quotation allotted to a town has also been tagged with

a specific week of the month. Collection of price data for each quotation will have to be completed within the week specified for that quotation.

Following schedules will be canvassed for collection of prices and house rent data:

i. Sch. 3.04: for collection of price data in respect of goods/ services other than PDS items every month.
ii. Sch. 3.04 (PDS): for collection of price data in respect of PDS items only at the State/UT capitals on monthly basis.

Sch. House Rent: for collection of house rent data on six-monthly basis. Items supplied under Public Distribution System: Prices of items supplied under the Public Distribution System (PDDS) do not undergo frequent changes and are uniform within each State/UT. Hence, prices of PDS items are required to be collected once in a month only at the state/UT. Hence, prices of PDS items are required to be collected once in a month only at the state/UT capitals from the office of Food & Civil Supply of the respective State Government / UT Administration, which is responsible for fixing the prices of PDS items.

COMPILATION OF INDICES:

Compilation of CPI numbers for items other than house rent consists of two stages i.e.

(i) Calculation of price indices for elementary aggregates (item level indices) and
(ii) The aggregation of these elementary price indices to higher level indices using the weights associated with each level.

Laspeyres' formula is used for aggregation of indices. Specifications of items have been selected on the basis of popularity in the respective areas. These specifications are different in terms of units, quantity, quality etc. for different price schedules. Prices relative of each product specification (current month price/base year average price) is worked out. Average of these price relatives under the respective item multiplied with 100 gives the index for that item.

In case of seasonal items of vegetables and fruits, whenever prices of these items are not reported in a particular month, weights of such items are imputed on pro-rata basis to the items in the respective section (root vegetables, fresh vegetables, fresh fruits, and dry fruits).

House rent index is compiled by chain base method. Two categories of dwellings viz. rented dwellings and self-owned dwellings are considered in the compilation of the house rent index. The rental equivalence approach is adopted in respect of self-owned dwellings. For each State/UT, previous five months and current month data are used to compile rent relatives for the current month. Rent relative is calculated as current month rent/rent six months ago and then simple average relative is worked out by classifying the dwellings by number of living rooms (1 room, 2 rooms, 3 rooms and 4 or more rooms). These rent relatives are weighted to get a combined rent relative using the estimated proportions of dwellings under each group, obtained from the NSS 65th round survey (2008-09) on Housing Conditions. House rent index is obtained by multiplying the combined rent relative with the corresponding rent index six months ago.

For PDS items, price relatives are worked out separately for Above Poverty Line (APL) and Below Poverty Line (BPL) categories. These price relatives are combined with the respective share of expenditure as obtained from the Consumer Expenditure Survey (2004-05).

All India index at sub group level is compiled by taking the respective expenditure of the State/UT (average household expenditure X total estimated households) as weights. Rural and urban indices are also combined by taking expenditure as weight so as to get State/UT and national indices.

Price Index:

A **price index** is a *weighted* average of price relatives for a given class of goods or services in a given region, during a given interval of time. It is a statistic designed to help to compare how these price relatives, taken as a whole, differ between time periods or geographical locations.

Price indexes have several potential uses. For particularly broad indices, the index can be said to measure the economy's general price level or a cost of living. More narrow price indices can help producers with business plans and pricing. Sometimes, they can be useful in helping to guide investment.

A price index is a measure of the proportionate, or percentage, changes in a set of prices over time.

Some notable price indices:

- Consumer price index
- Producer price index
- GDP deflator

Here we have to discuss on Consumer price index only.

Consumer Price Index (CPI):

A consumer price index (CPI) measures changes in the prices of goods and services that households consume. Such changes affect the real purchasing power of consumers' incomes and their welfare. As the prices of different goods and services do not all change at the same rate, a price index can only reflect their average movement. A price index is typically assigned a value of unity, or 100, in some reference period and the values of the index for other periods of time are intended to indicate the average proportionate, or percentage, change in prices from this price reference period. Price indices can also be used to measure differences in price levels between different cities, regions or countries at the same point in time.

Much of our project on price indices is concerned with two basic questions:

• Exactly what set of prices should be covered by the index?
• What is the most appropriate way in which to average their movements?

Consumer price indices (CPIs) are index numbers that measure changes in the prices of goods and services purchased or otherwise acquired by households, which households use directly, or indirectly, to satisfy their own needs and wants. Consumer price indices can be intended to measure either the rate of price inflation as perceived by households, or changes in their cost of living (that is, changes in the amounts that the households need to spend in order to maintain their standard of living). There need be no conflict between these two objectives. In practice, most CPIs are calculated as weighted averages of the percentage price changes for a specified set, or "basket", of consumer products, the weights reflecting their relative importance in household consumption in some period. Much depends on how appropriate and timely the weights are.

The main topics covered in this project are as follows:

− The origins and uses of CPIs;
− Choice of Index Number
− Price indices based on baskets of goods and services
− Calculating a Laspeyres' Index
− Rate of Inflation
− Method of Mathematical Curve

The origins and uses of consumer price indices

CPIs must serve a purpose. The precise way in which they are defined and constructed depends very much on what they are meant to be used for, and by whom. CPIs have a long history dating back to the eighteenth century. Laspeyres and Paasche indices, which are still widely used today, were first proposed in the 1870s. They are explained below. The concept of the cost of living index was introduced early in the twentieth century.

Traditionally, one of the main reasons for compiling a CPI was to compensate wage-earners for inflation by adjusting their wage rates in proportion to the percentage change in the CPI, a procedure known as indexation. For this reason, official CPIs tended to become the responsibility of ministries of labour, but most are now compiled by national statistical offices. A CPI that is specifically intended to be used to index wages is known as a compensation index.

CPIs have three important characteristics. They are published *frequently*, usually every month but sometimes every quarter. They are available *quickly*, usually about two weeks after the end of the month or quarter. They are also usually *not revised*. CPIs tend to be closely monitored and attract a lot of publicity.

As CPIs provide timely information about the rate of inflation, they have also come to be used for a wide variety of purposes in addition to indexing wages. For example:
• CPIs are widely used to index pensions and social security benefits.
• CPIs are also used to index other payments, such as interest payments or rents, or the prices of bonds.

• CPIs are also commonly used as a proxy for the general rate of inflation, even though they measure only consumer inflation. They are used by some governments or central banks to set inflation targets for purposes of monetary policy.
• The price data collected for CPI purposes can also be used to compile other indices, such as the price indices used to deflate household consumption expenditures in national accounts, or the purchasing power parities used to compare real levels of consumption in different countries.

These varied uses can create conflicts of interest. For example, using a CPI as an indicator of general inflation may create pressure to extend its coverage to include elements that are not goods and services consumed by households, thereby changing the nature and concept of the CPI. It should also be noted that because of the widespread use of CPIs to index a wide variety of payments – not just wages, but social security benefits, interest payments, private contracts, etc. – extremely large sums of money turn on their movements, enough to have a significant impact on the state of government finances. Thus, small differences in the movements of CPIs resulting from the use of slightly different formulae or methods can have considerable financial implications. CPI methodology is important in practice and not just in theory.

Choice of index number:

The first question is to decide on the kind of index number to use. The extensive references dealing with index theory in the bibliography reflect the fact that there is a very large literature on this subject. Many different kinds of mathematical formulae have been proposed over the past two centuries. While there may be no single formula that would be preferred in all circumstances, most economists and compilers of CPIs seem to be agreed that, in principle, the index formula should belong to a small class of indices called *superlative* indices. A superlative index may be expected to provide an approximation to cost of living index. A characteristic feature of a superlative index is that it treats the prices and quantities in both periods being compared symmetrically. Different superlative indices tend to have similar properties, yield similar results and behave in very similar ways. Because of their properties of symmetry, some kind of superlative index is also likely to be seen as desirable, even when the CPI is not meant to be a cost of living index.

When a monthly or quarterly CPI is first published, however, it is invariably the case that there is not sufficient information on the quantities and expenditures in the current period to make it possible to calculate a symmetric, or superlative, index.

While it is necessary to resort to second-best alternatives in practice, being able to make a rational choice between the various possibilities means having a clear idea of the target index that would be preferred in principle. The target index can have a considerable influence on practical matters such as the frequency with which the weights used in the index should be updated.

Here we can get the base year quantity and price easily and we can collect Current year price and quantity as well. So here we use Laspayers' Price Index.

Price indices based on baskets of goods and services:

The purpose of an index number may be explained as comparing the values of households' expenditures on consumer goods and services in two time periods. Knowing that expenditures have increased by 5 per cent is not very informative if we do not know how much of this change is attributable to changes in the prices of the goods and services, and how much to changes in the quantities purchased. The purpose of an index number is to decompose proportionate or percentage changes in value aggregates into their overall components of price and quantity change. A CPI is intended to measure the price component of the change in households' consumption expenditures. One way to do this is to measure the change in the value of an aggregate, holding the quantities constant.

Calculating a Laspeyres' Index:

A Laspeyres Index is known as a "base-weighted" or "fixed-weighted" index because the price increases are weighted by the quantities in the base period. The Consumer Price Index is an example of a Laspeyres Index. In this example, 2005 will serve as the base year. Formally, the calculation is written,

$$\mathbf{Lt} = \frac{\sum \mathbf{p_1 q_0}}{\sum \mathbf{p_0 q_0}}$$

where the subscript "0" refers to the base year value for goods, and "1", refers to the current year.
p and q denote price and quantity respectively

Rate of Inflation:

To calculate the rate of inflation between any two years, simply calculate the percentage change between the index values:

$$\textbf{Inflation Rate}_{2005-2006} = \frac{150-100}{100} = .5*100 = 50\%$$

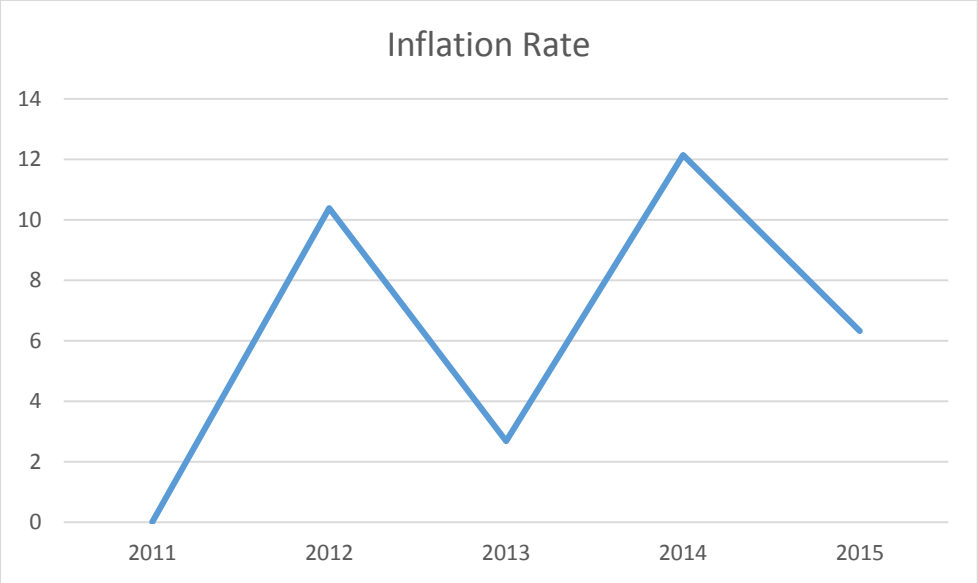
$$\textbf{Inflation Rate}_{2005-2006} = \frac{220-150}{150} = .47*100 = 47\%$$

	Laspeyres Index Value	Inflation Rate
2005	**100**	**-**
2006	**150**	**50%**
2007	**220**	**47%**

Inflation is defined as an increase in the price level. When the price level increases from one year to the next, this is **Inflation**. Inflation slowed a bit between 2006 and 2007. When the rate of inflation has decreased, this is known as Disinflation. The price level has increased, so the rate of inflation is still positive. However, the price level has increased at a slower rate than the previous year. So disinflation has occured between 2006 and 2007. If the inflation rate is actually negative, then Deflation has occured. If the index value fell to 190 in 2008, for example (if we added that year to the table), then the inflation rate between 2007 and 2008 would be negative and that would be a deflation.

In our case,

Year	CPI(Laspayers' Price Index)	Index Value	Inflation Rate
2011	1.096394173	109.6394173	-
2012	1.210265132	121.0265132	10.38595082
2013	1.242646285	124.2646285	2.67554207
2014	1.39352056	139.352056	12.14136934
2015	1.481567646	148.1567646	6.318319809



Here, we can see that Inflation is present in the every alternative year i.e. in the year 2012 and 2015. Deflation is also present in the year 2013 and 2015.

Method of Mathematical Curves:

When the trend to be linear or approximately linear, either for original variable or for a transformed variable, We have the equation as follows:

$$T_t = a + bt$$

The constants "a" and "b" are estimated by the method of least squares. Suppose we are given the values y_t for n equidistant values of t. The method of least squares requires tha "a" and "b" should be determined that $\sum_t (y_t - T_t)^2 = \sum_t (y_t - a - bt)^2$ is a minimum with respect to "a" and "b". Then, the estimates of constants a and b will be solutions of the normal equations:

$$\sum y_t = na + b\sum t$$

$$\sum t y_t = a\sum t + b\sum t^2$$

If "â" and "$\hat{b}$" be the estimates of "a" and "b" respectively, the trend equation becomes

$$T_t = \hat{a} + \hat{b}t.$$

Using this we can find the trend value for any given time t.

Remarks:
The Successive points of time will generally be equidistant; hence considering the mid-point of the entire time span as origin, sum of t values can be reduced to zero. If d be the common difference between two successive time values, then, depending on odd or even number of values, one may take d or d/2 as the new unit for t fr ease of computations.

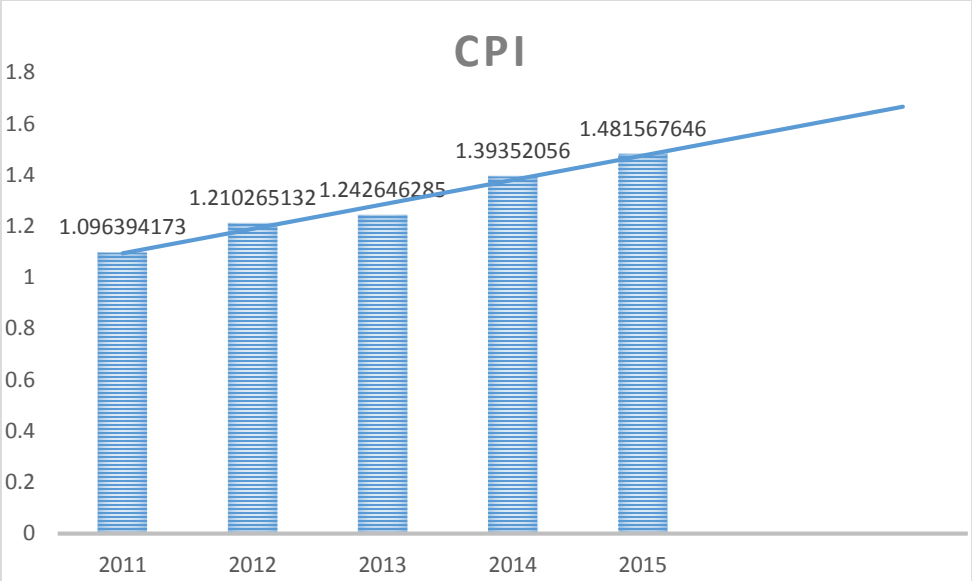
Merits:

1. This method is most objective, since the appropriate curve to be fitted can be objectively determined through graphical representation of the data or otherwise.
2. This method enables one to obtain the trend values for all the given points of time.
3. The method can be used for predicting future trend as it assumes a law of change.

Demerits:

1. The addition of even a single observation to the gien data necessitates all calculations to be done afresh.
2. It involves time consuming calculations, unless the trend equation is simple linear or quadratic.
3. The method is rigid. If there are sharp changes in the trend, then to use the method, separate trend equations are to be fitted to different parts.

From our data collected, we get



We can see that it's a "**Linear Trend**"

Year	t=2(Year-Mid Point)	CPI	Index value (y_t)	ty_t	t^2
2011	-4	1.096394173	109.6394173	-438.56	16
2012	-2	1.210265132	121.0265132	-242.05	4
2013	0	1.242646285	124.2646285	0	0
2014	2	1.39352056	139.352056	278.704	4
2015	4	1.481567646	148.1567646	592.627	16
Total	**0**	**6.424393796**	**642.4393796**	**190.72**	**40**

Putting the values in the Normal equations, We get

642.4393796	=	5a	and
190.7204748	=	40b	
â	=	128.4878759	
b̂	=	4.768011869	

The trend equation is	$T_t = 128.49 + 4.77t$

Now we can check that our filled model is suitable for our sample data or not.

Year	t	Forecasting from Model	Year	t	CPI calculated by Model	Observed CPI	error	$(O_{ij}-E_{ij})^2/E_{ij}$
2016	6	157.0959471	2011	-4	109.4158284	109.6394173	0.22358883	0.0004569
2017	8	166.6319709	2012	-2	118.9518522	121.0265132	2.07466105	0.03618454
2018	10	176.1679946	2013	0	128.4878759	124.2646285	4.22324741	0.13881324
2019	12	185.7040184	2014	2	138.0238997	139.352056	1.32815636	0.01278039
2020	14	195.2400421	2015	4	147.5599234	148.1567646	0.59684118	0.00241407
							8.44649482	0.19064914

χ^2 calc	0.19064914
χ^2 tab	9.48772904
p-value	0.99573528
d.f	4

Since p value is greater than α i.e 0.05, then we can conclude that we can accept our model

Hypothesis Testing:

We select null hypothesis as, our model is true. We find the CPI of previous year by the equation of our model. We find some error with respect to our observed data. So we construct Chi-Square test and hence we find that obtained p value is greater than 0.05 and calculated chi-sq. is less than tabulated chi-sq.
Therefore we accept that our model is true and we can forecast by our model.

References

- Instructions of CPI (U)
- Introduction of Statistics (P.K Giri & Jivan Mukhopadhyay)
- Internet Websites