NDMVP SAMAJ'S

K.T.H.M. COLLEGE, NASHIK

(K.R.T. Arts, B.H. Commerce, A.M. Science College)

A PROJECT REPORT

ON

A Statistical Analysis of Inflation rate in India

Submitted to

SAVITRIBAI PHULE PUNE UNIVERSITY, PUNE

In the partial fulfillment of T.Y. B.Sc. (STATISTICS)

Submitted by

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Under the guidance of
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Assistant Professor
Department of Statistics

2018-2019

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K.T.H.M. COLLEGE, NASHIK-422 002

DEPARTMENT OF STATISTICS

CERTIFICATE

This is certify that Mr. Keng Chetan Ramdas successfully completed their project entitled "*A statistical analysis of Inflation rate in India*" and completed his work satisfactorily as a part of B.Sc. (Statistics) program under my guidance and supervision during the academic year 2018-19.

Ms. Nutan Vijay Khangar
(PROJECT GUIDE)

Dr. Padhye A. S.
(HEAD OF DEPARTMENT)

ACKNOWLEDGEMENT

An accomplishment and final outcome of this project required a lot of guidance and assistance from many people and I am extremely privileged to have got this all along the completion to my project. All that I have done only due to such supervision and assistance and I would not forget to thank them.

I respect and thank Dr. A. S. Padhye, Head, Department of Statistics and also an experience project guide, for providing me opportunity to do the project work and giving us all support and guidance which made me complete the project duly. I am extremely thankful to her providing such a nice support and guidance, although she had busy schedule managing the regular lectures as well as important meetings.

I own my deep gratitude to our project guide Ms. N. V. Khangar, Assistant Professor, Department of Statistics, who took keen interest on our project work and guided us all along, till the completion of our project work by providing all the necessary information for developing a good system.

I am thankful to and fortunate enough to get constant encouragement, support and guidance from **all Teaching Staff,** Department of Statistics who helped us in successfully completing our project work.

- Keng Chetan Ramdas
- Golesar Roshan Ramnath
- Acharya Raj Pandharinath
- Walve Ganesh Sampat
- Gunjal Akshay Keda

Declaration

We declare that the project entitled “A statistical analysis of Inflation rate in India”, submitted by us, for the partial fulfillment of our Bachelor degree of Science in Statistics during (2018-2019) is our original work.

We further declare that the analysis has been carried out based on the secondary data collected from open data sources. We have given our best and hope that our project work may be helpful for our nation to grow up vigorously.

- Keng Chetan Ramdas
- Golesar Roshan Ramnath
- Acharya Raj Pandharinath
- Walve Ganesh Sampat
- Gunjal Akshay Keda

Date:

Place:

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Introduction

The purpose of this project is to study the different aspects related to inflation rate. India is being a fastest growing and developing county. The main problem of the world economy is the generalized growth of the prices. Inflation is the main factor economic crisis, discourage the investments and determines the migration of capital to other countries or real estate. The broken equilibrium created by inflation strongly affects the decisions of private sector to invest or develop, with the final effect in decreasing of production.

In the econometric model, the main statistical indicator for the inflation rate is the national consumer price index(CPI). Inflation is also identified with the fall of market value of money with particular economic system. Inflation's effects on an economy are various and can simultaneously positive and negative. Negative effects of inflation include an increase in opportunity, cost of holding money and uncertainty over future inflation which may discourage investment and savings will increase in the future. Positive effects include ensuring that central banks and adjust real interest rates (intended to mitigate) recessions) and encouraging investments in non-monetary capital projects.

Whereas moderate and mild inflation is considered as a sign of healthy economy, inflation government sector above these mild levels is considered to have negative impact. When government increases the money supply and taxes, people are eager to spend more money.

With the growth of inflation rate of taxes also increases and so people are even more willing to spend money for two core reasons: to avoid paying taxes on holding currency and to buy products before they increase in price.

MOTIVATION

It is mandatory for all T.Y.B.Sc (Statistics) Students to select topic for project and work on it. Selection of topic is the first and important part for the project work. So topic should be not only interesting but also conclusive up to certain level.

In this era, inflation rate plays major role to define growth of any country. We are curious to know the manner in which factors affect on inflation rate. Therefore we do the work with inflation rate.

Abstract

A statistical analysis of inflation rate to study the effects of inflation on Indian economy with respect to the factors like crude oil production, unemployment rate, import, export, agricultural production, government expenditure, money supply, nominal exchange rate. For this, we collect the secondary data from various open data sources (websites). Analyzed the collected data using R software and MS-Excel and compared the actual with predicted value by exponential smoothing method.

The conclusion based on the results which based on regression analysis and time series analysis.

Keywords **:** Inflation rate, Multiple regression analysis, time series analysis.

Why we chose secondary data?

Sometimes there are some restrictions to collect the primary data, in this situations, to study the problem other options is work with secondary data.

For e.g.

1. If an entrepreneur is considering opening a new business, he or she could leverage census data that has been collected by the government.
2. If a researchers wants to analyze the rainfall of country then it is impossible to collect primary data of rainfall or it needs more manpower, money and time.

In our case study, inflation is micro-economic variable which depends on such factors like money supply, government expenditure, crude oil production import and exports of country, and to collect the primary data of these variables is nothing possible as college student.

Variable Descriptions

Inflation: Inflation is generally define as the increase of price of goods and services over a certain period of time,as opposed to deflation, which describes a decrease of these prices. Inflation is significant economic indicator for a country. The inflation rate is a rate at which the general rise in level of prices, goods and services in an economy occurs and how it affects the cost of living of those living in a particular country.

When government increases the money supply and taxes, people are eager to spent more money. With the growth of inflation rate of taxes also increases and so people are even more willing to spent money for to core reasons: to avoid paying taxes on holding currency and to buy products before they increase in price.

From an economic and business perspective, the inflation rate directly relates to gross domestic product, money supply, export, price of import, exchange rate, government expenditure, agricultural production, price crude oil petroleum, unemployment rate, etc. inflation may also result from either increase in aggregate demand or decrease in aggregate supply, these two sources effect price level in economy. And inflation resulting from increase in aggregate demand is called demand pooled inflation. Demand pooled inflation arises due to many factor like money supply, government expenditure, export and gross domestic product, etc. Cost push inflation may be defined as the increase in general price level resulting from increase in cost of production. The main sources of cost push inflation may be decreasing aggregate supply that may be due to cost of production, increasing wages, higher import, rising taxes, budget deficit.

Consumer price index(CPI):the overall measure foe weighted average of prices of basket of consumer goods and services such as transportation, food and medical care. Changes in CPI are used to assess price changes associated with the cost of leaving.

Inflation rate = [(current CPI –previous CPI)/Previous CPI]*100

Money supply(M3): The entire stock of currency in other instrument in a country's economy of a particular time. The money supply can includes coins, cash and balances held in a checking and saving accounts durable goods. a category of a consumer goods, durable and products that do not have to be purchased frequently i.e. appliances, home and office furnishing, lawn and garden equipment etc.

Unemployment rate: An economic condition marked by the fact that individuals actively seeking job remain unhired. Unemployment is express as a percentage of total available work force.

Imports: Goods or services that are produced abroad.

Exports: Goods are services produced locally and sold abroad. Higher inflation can also affect export by having direct impact an input costs such as materials and labor.

Crude petroleum: A thick flammable yellow to black mixture of gases liquid and solid hydrocarbons that occurs naturally beneath the earth's surface. Inflation will increase if the price of crude oil increases and vice versa. Crude oil or petroleum is an important commodity, which is connected to a lot of things. In terms of inflation, oil prices directly affect the prices of goods made with petroleum products. Increases in oil prices can depress the supply of other goods because they increase the costs of producing them.

Gross domestic production: Higher inflation leads to a lower unemployment rate, further fueling demand.Thegeneral level of prices can rise due to inflation, leading to an increase in nominal GDP even if the volume of goods and services produced is unchanged. This is real GDP.

Nominal exchange rate of INR in USD: The higher the inflation, the less a currency is worth over time. The opposite is also true. Inflation represent the overall increase in price of goods. Because the prices of goods are increasing, the same amount of money can buy goods hour over time.

Government expenditure: Inflation is the sustained increase in the general price level over a given period of time. Higher government spending will lead to demand pooled of inflation. This is because government spending is a component of aggregate demand. Inflation occurs when the economy's aggregate volume of money expenditure grows the faster rate than its total real output grows.

Collected Data

Year	Inflation	Unemployment rate	Crude oil petroleum	Money supply	Export	Import
2001	3.77	4.33	178418240	5435.3	20901797.34	245197971.9
2002	4.31	4.43	184055080	5759.7	25513727.66	29720587.4
2003	3.81	4.31	185887610	6051.2	29336764.75	35910766.37
2004	3.77	4.37	189463550	6418.2	37533952.62	50106454.03
2005	4.25	4.4	179298300	6676.2	45441786.15	66040890.33
2006	5.79	4.24	189313160	7075.5	57177928.52	84050631.33
2007	6.39	4.06	190031690	7466.9	65587352.18	101231169.9
2008	8.32	4.12	560387850	8216.9	84075505.87	137443555.5
2009	10.83	3.75	607894611	8469.5	84553364.38	136373554.8
2010	12.11	3.54	688041255	8811.2	113696426.4	168346695.6
2011	8.87	3.53	692017330	9640.4	146595940	23454324.45
2012	9.3	3.62	688171117	10514.2	163431829	266916195.7
2013	10.92	3.46	686826110	11026	190501108.9	271543390.7
2014	6.37	3.41	680882633	11692.1	189634841.8	273708657.8
2015	5.88	3.49	671611511	12357.1	171638440.4	249030553.8
2016	4.97	3.51	652117925	1320	184943355.3	257767536.7
2017	2.49	3.52	604598631	13843.3	195651452.8	300103343.4

Year	Agricultural production(Oilseeds) (in million tons)	Agricultural Production(Food grains) (in million tons)	GDP	Government expenditure(in billions rupees)
2001	20.66	212.85	4.8	4269.46
2002	14.84	174.78	4.3	4387.26
2003	25.19	213.174	8.3	4778.6
2004	24.35	198.36	6.2	5197.37
2005	27.98	208.6	8.4	5969.96
2006	24.29	217.28	9.2	7263.98
2007	29.76	230.78	9	8995.44
2008	27.72	234.47	7.4	10423.43
2009	24.88	218.11	7.4	12175.4
2010	32.48	244.49	10.4	13323.96
2011	29.8	259.29	7.2	14352.73
2012	30.94	257.13	6.5	15875.74
2013	32.75	265.04	3.2	16949.72
2014	27.51	252.02	7.4	18251.91
2015	22.09	251.57	7.8	19751.94
2016	31.28	275.11	7.6	22177.5
2017	31.31	284.83	6.7	24422.13

Descriptive Statistics of variables

- Inflation rate (dependent variables):

Min.	1st Qu.	Median	Mean	3rd Qu.	Max
2.49	4.25	5.88	6.597	8.87	12.11

- Unemployment rate :

Min.	1st Qu.	Median	Mean	3rd Qu.	Max
3.41	3.52	3.75	3.888	4.31	4.43

- Crude oil production :

Min.	1st Qu.	Median	Mean	3rd Qu.	Max
178418240	189313160	604598631	460530388	680882633	692017330

- Money supply(M3):

Min.	1st Qu.	Median	Mean	3rd Qu.	Max
1320	6418	8217	8281	10514	13843

- Nominal exchange rate :

Min.	1st Qu.	Median	Mean	3rd Qu.	Max
41.35	45.32	47.19	51.31	56.57	67.79

- Export :

Min.	1st Qu.	Median	Mean	3rd Qu.	Max
20901797	45441786	84553364	106247975	171638440	195651453

- Import :

Min.	1st Qu.	Median	Mean	3rd Qu.	Max
23454324	50106454	136373555	145662840	257767537	300103343

- Agricultural production (oil seeds) :

Min.	1st Qu.	Median	Mean	3rd Qu.	Max
14.84	24.35	27.72	26.93	30.94	32.75

- Agricultural production(food grains) :

Min.	1st Qu.	Median	Mean	3rd Qu.	Max
174.8	213.2	234.5	235.2	257.1	284.8

- Government expenditure:

Min.	1st Qu.	Median	Mean	3rd Qu.	Max
4269	4269	5970	12175	12269	16950

Conversion of the technical problem into statistical problem

OBJECTIVES: (Technical problems of study)

1. To study the effect of other economical factors on inflation rate.
2. To estimates the inflation rate.
3. To study the trend and patterns of inflation rate.
4. To forecast the inflation rate in future.

STATISTICAL TOOLS: (Conversion)

- Multiple regression model.
- Time series analysis
  - Exponential smoothing

Methodology

Multiple Linear Regression Analysis.

Consider, a situation involving response variable Y and p regressors or explanatory variable denoted by $X_1, X_2, \ldots\ldots, X_p$. A multiple linear regression model relating p regressors to response variable Y can be expressed as,

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_p x_p + \epsilon$$

Where, $\beta_1, \beta_2, \ldots, \beta_p$ are constants (known as regression coefficients) and ϵ is random error.

Assumptions:

i) Errors are independent and normally distributed with $E(\epsilon) = 0$, $var(\epsilon) = \sigma^2$

ii) Measurements on regressors are without error or with negligible error.

NOTE:

i) Multiple regression model can also be written as

$$E(Y|X = x) = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_p x_p$$

ii) The parameter β_i ,i = 1,2,3,…..,p represents the expected change in response Y per unit change in x_i when all the remaining regressors x_j ($j \neq i$) are held constants. Hence the parameters β_i,i=1,2,…,p are also called partial coefficients.

Estimation of regression Coefficients:

To fit the regression model, it is required to estimates the parameters, or regression coefficients, $\beta_1, \beta_2, \beta_3, \ldots\ldots, \beta_p$.

The method of least squares can be used to estimate the regression coefficients in multiple linear regression.

Suppose n (> p + 1) observations are available. Suppose y_j denote j^{th} observation on response variable y, j = 1,2,….,n. Let x_{ij} denote j^{th} observation on i^{th} regresssor x_i. The data can be written as shown in the following

Observation	**Response**	**Regressos**			
j	**Y**	$\mathbf{X_1}$	$\mathbf{X_2}$	**…**	$\mathbf{X_p}$
1	y_1	x_{11}	x_{21}	…	x_{p1}
2	y_2	x_{12}	x_{22}	…	x_{p2}
:	:	:		…	:
n	y_n	x_{1n}	x_{2n}	…	x_{np}

We may write sample regression model as

$$y_i = \beta_0 + \beta_1 x_{1j} + \beta_2 x_{2j} + \ldots\ldots + \beta_p x_{pj} + \varepsilon_j, \; j = 1,2,\ldots..,n$$
$$= \beta_0 + \sum_{i=1}^{p} \beta i \; xij + \varepsilon_j$$

The least square function is

$$S(\beta_1, \beta_2, \beta_3, \ldots\ldots\ldots, \beta_p) = \sum_{j=1}^{n} \varepsilon^2$$
$$= \sum_j [y_j - \beta_0 - \sum_{i=1}^{p} \beta i \; xij \,]^2$$

In order to get least square estimates of β's, the function $S(\beta_1, \beta_2, \beta_3, .., \beta_p)$ Must minimized with respect to $\beta_0, \beta_1, \beta_2, \ldots\ldots\ldots, \beta_p$. Therefore the least square estimates of $\beta_0, \beta_1, \beta_2, \ldots\ldots\ldots, \beta_p$ must satisfy the following equations.

$$\frac{\partial S}{\partial \beta 0}_{\beta 0, \beta 1, \beta 2, \ldots\ldots\ldots, \beta p} = 0$$

And $$\frac{\partial S}{\partial \beta i}_{\beta 0, \beta 1, \beta 2, \ldots\ldots\ldots, \beta p} = 0 \qquad i = 1,2,\ldots,p$$

i.e. $$-2\sum_j [y_j - \beta_0 - \sum_{i=1}^{p} \beta i \; xij \,]^2 = 0$$

and $$-2\sum_j [y_j - \beta_0 - \sum_{i=1}^{p} \beta i \; xij \,]^2 \, x_{ij} = 0$$

Simplifying these equations we get p+1 normal equations. The solution to these normal equations will be the least square estimators $\hat{\beta}_0, \hat{\beta}_1, \beta_2, \ldots\ldots\ldots, \hat{\beta}_p$.

In multiple regression theory it is convenient to use matrix notation than scalar notation. Therefore we use matrix notation henceforth. In matrix notation, the regression model can be written as

$$y = X\beta + \varepsilon$$

where, $y = (y_1 \ y_2 \ \dots \ y_n)'$ a $n \times 1$ vector of observations

$\beta = (\beta_0 \ \beta_1 \ \dots \ \beta_n)'$ a $(p \times 1) \times 1$ vector of observations

and $\varepsilon = (\varepsilon_1 \ \varepsilon_2 \ \dots \ \varepsilon_n)'$ a $n \times 1$ vector of observations

Fitting of Multiple Regression Model using R-software :

R commands for multiple regression model

```
##Creates vectors of dependent variable and independent variable

y=c()        #dependent variable

x1=c()       #1st  independent variable or regressor

x2=c()       #2nd independent variable or regressor

.

.

xn=c()     #nth independent variable or regressor



t=lm(y~x1+x2+x3……+xn)      # regression y on x1, x2,……,xn

summary(t)           #it gives ANOVA table
```

Forward Selection Method:

This model begins with a regression model consisting of intercept term only. The "best" model by this method is developed by adding regressors into the model one at a time. Suppose, we have a set of p regressor selected is the one that has the largest simple correlation with the response variable Y. Suppose that this regressor is X_1. This is also the regressor that will produce the largest value of F statistics for testing significance of regression. This regressor is added to the model if the F statistics exceeds a preselected F value, F_{IN}. For selected level of significance α, F_{IN} is given by $F_{1,n-p-1,\alpha}$ where, p is number of regressors.

The second regressor selected is the one that now has largest correlation with Y after adjusting for the effect of the first regressor in the model(X_1).

This criterion is also equivalent to selecting the regresor based on partial F statistics.

Partial F statistics for regresorX_j given X_1 is calculated as,

$$F = SSR(X_j/X_1) / MS_{res}(X_1, X_j)$$

$$= SSR(X_1,X_j)\text{-}SSR(X_1)/ -MS_{res}(X_1, X_j) \qquad j=2,3,\ldots\ldots p$$

Suppose partial F statistics corresponding to X_2 is largest. If it exceeds F_{IN}, we add X_2 to the model.

Backward Elimination Method:

Backward elimination method works in opposite direction of forword selection method. It begins with a regression model that includes all candidate regressors. Then the partial F-statistic value is computed for every regressor treatment as if it were the last to enter the model. The lowest partial F statistic value (say, F_{low}) is compared with a preselected F value, say F_{out}. For significance level α, F_{out} is given by $F_{1,n-p-1,\alpha}$ where p is number of regressors.

If $F_{low}<F_{out}$ then that regressor is removed from the model. Now a regression model with remaining regressors is fitted, partial F-statistics are

calculated and the procedure is repeated. The method terminates when the smallest partial F value is greater than the preselected cut-off value F_{out}.

Stepwise Regression Method:

In forward selection method, once a regressor is added into the model, it is included in all the subsequent models. In backward elimination method, once a regressor is removed, it is never included in subsequent models.

Stepwise regression method is a combination of forward selection selection and backward elimination method.

Stepwise regression method starts with regression model including single best regressor. Regressors are added to the model if the additions are worthwhile. At every step significance, it is removed from the model. The method continues till an appropriate model is developed.

Time series analysis:-

Time series analysis is used for forecasting the CPI inflation rate. Time series is a series of statistical observation arrange in a chronological order. According to Spiegel, mathematically a time series is defined by the values Y_1, Y_2, Y_3,……., Y_n. of the variable Y at a times t_1 ,t_2, …..,t_n. thus the time series is a function of time i.e. Y = F(t). In other worlds, in time series time plays the role of an independent variable and Y(t) is dependent variable. we denote time series by Y(t). In the form of function the time series may be written as follows :

t : t_1 t_2 …. t_n …..

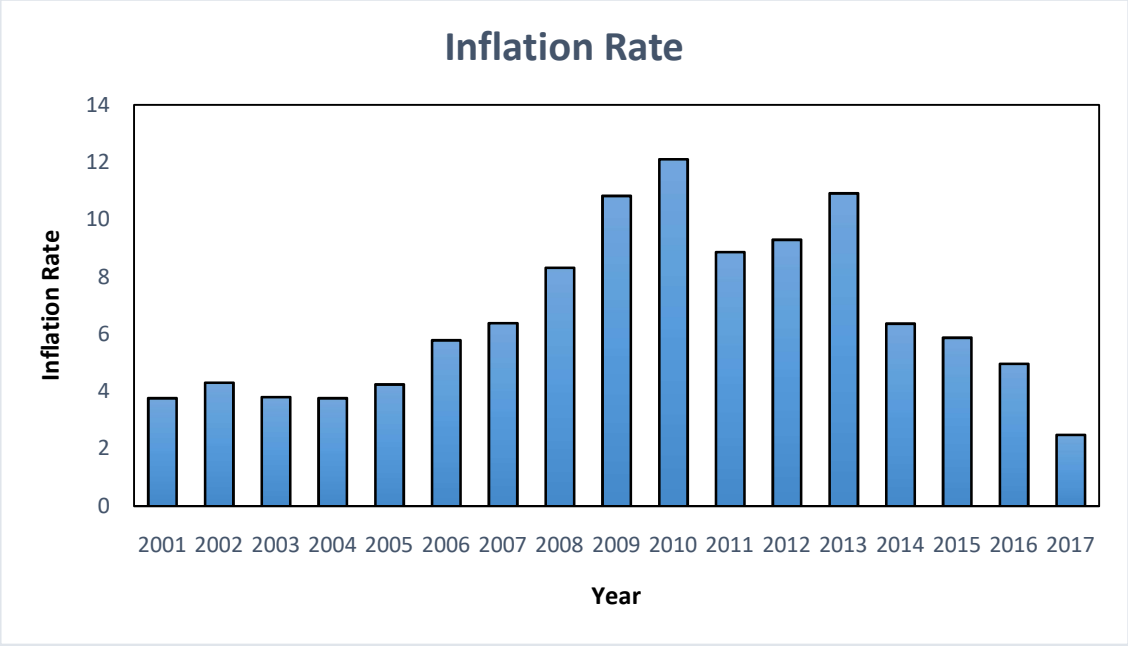
Y_t :Y_1 Y_2 …. Y_n ….

Statistical analysis

Representation of data

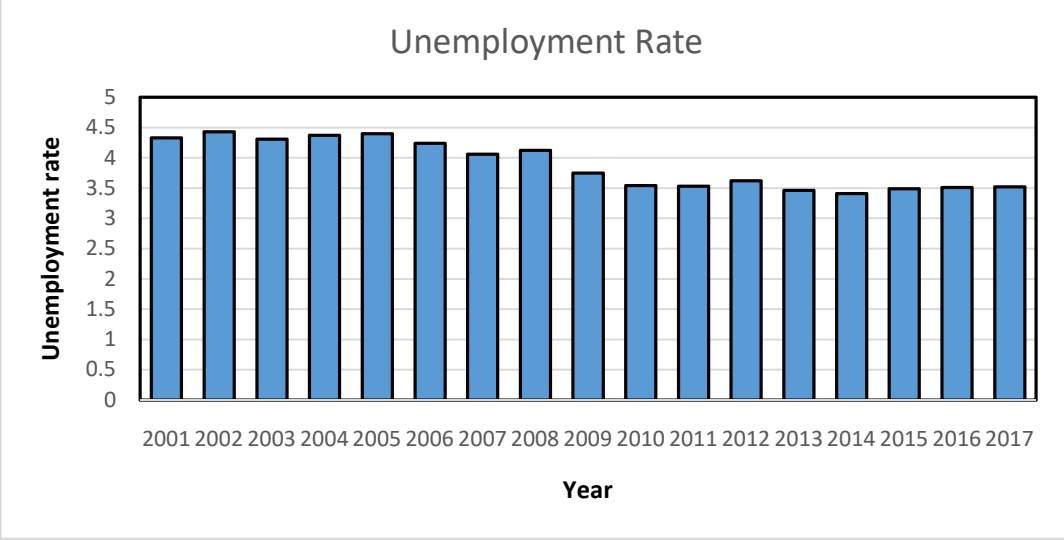
❖ Representation of dependent variable and independent variable.

- **Inflation rate**



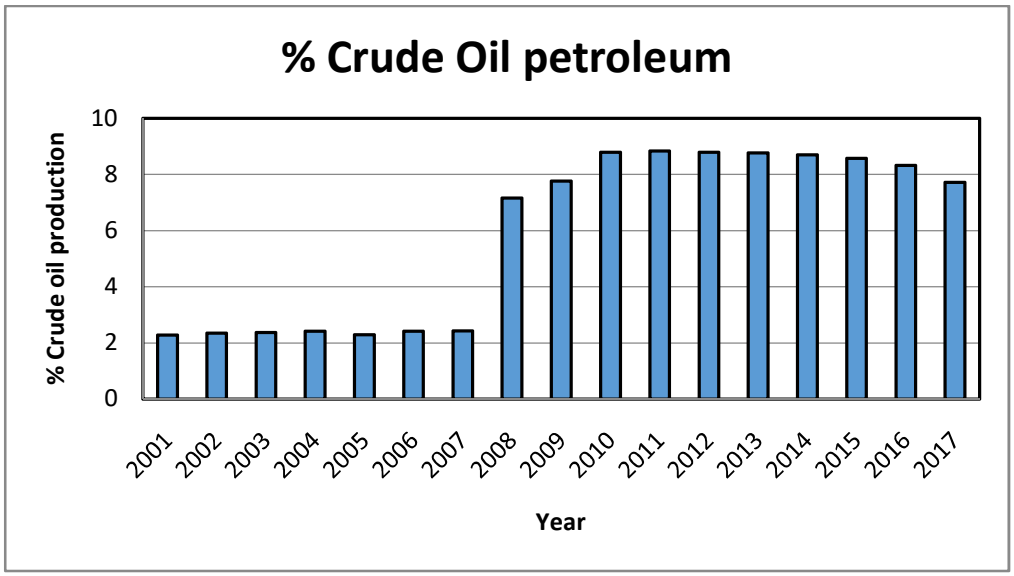
From above graph it is observed that, the inflation rate is highest in year 2010. In year 2017 it is very low.

- **Unemployment rate:**



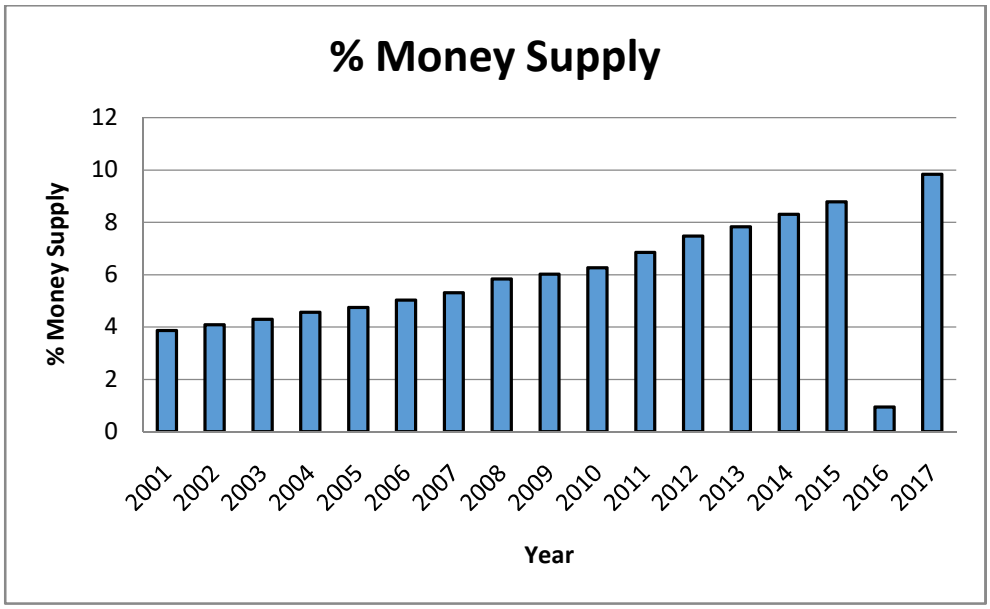
Interpretation: From above graph it is clear that, the unemployment rate is highest in year 2002 then it decrease up to year 2010 and stable from 2010 or not much variation in unemployment rate.

- **Crude Oil production**



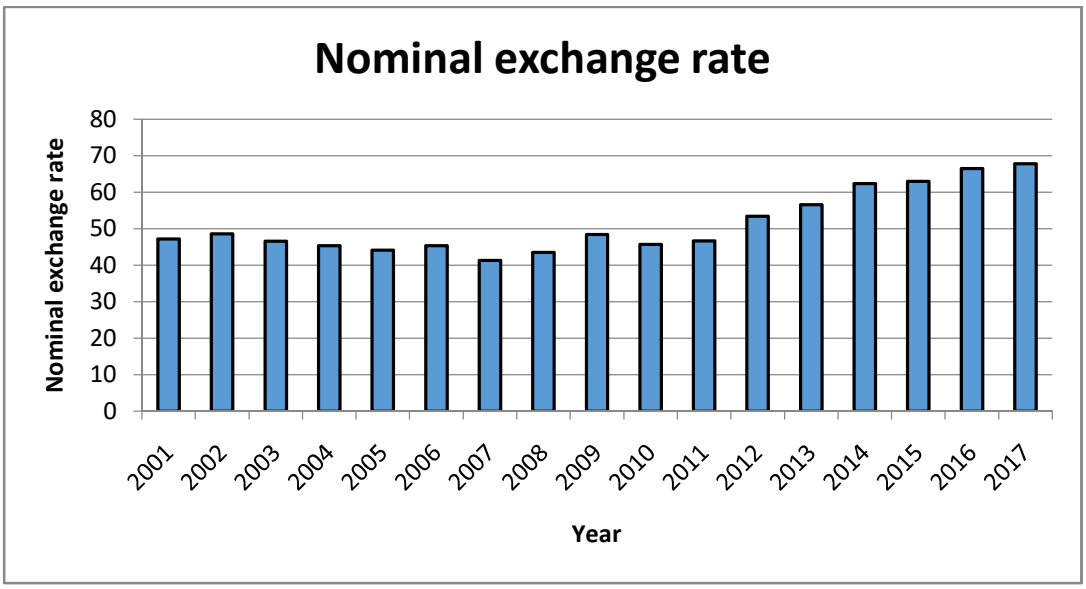
Interpretation: From graph it is clear that, the crude oil production is highest in year 2002 then it decrease up to year 2010 and stable from 2010.

- **Money supply:**



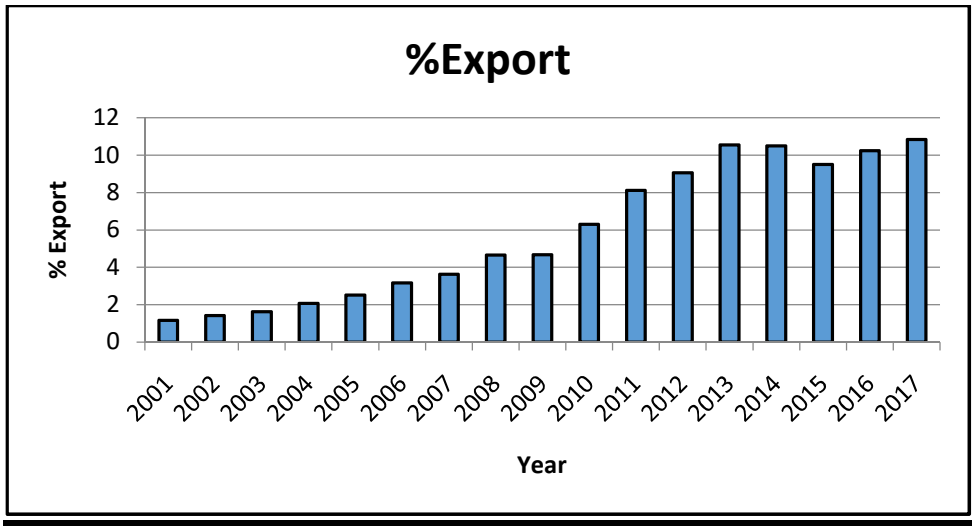
Interpretation: From graph it is clear that, money supply increases per year and it has a trend but in year 2016 the sudden decrease in money supply and again it follows trend.

Nominal Exchange rate:



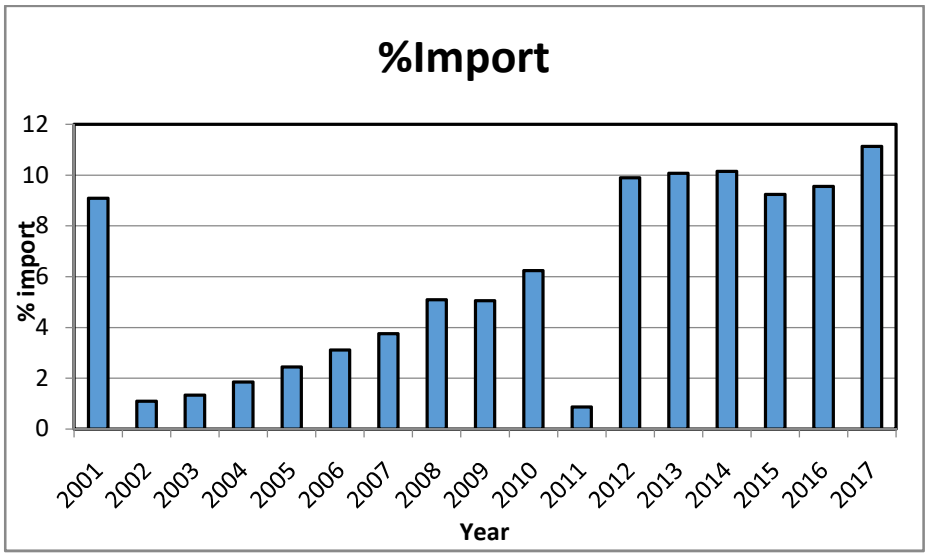
Interpretation: From the graph, it is clear that, nominal exchange rate is maximum in year 2017 and minimum in year 2007.

- **Export:**



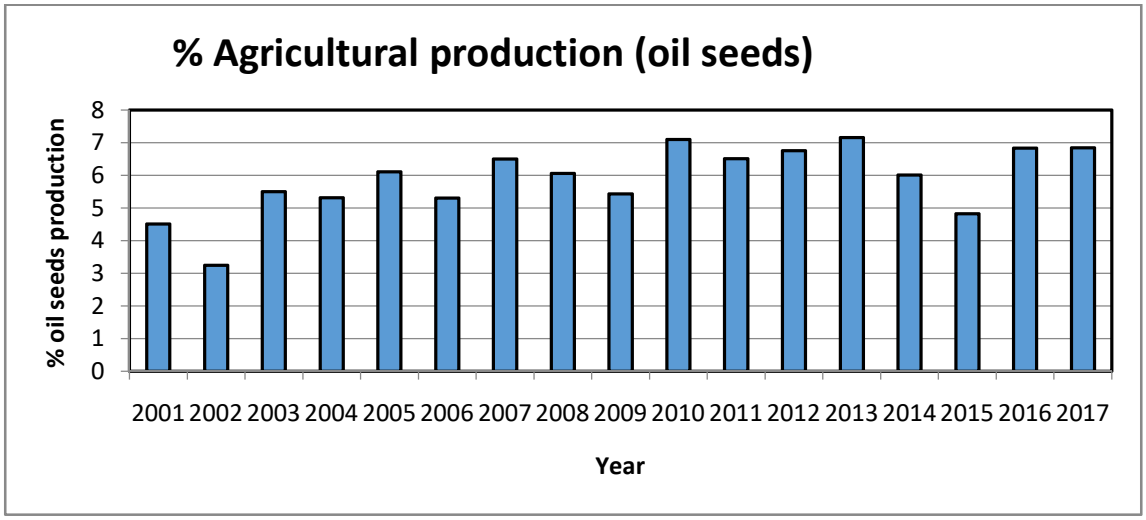
Interpretation: From graph it is clear that, export in India is highest in year 2017 and minimum in year 2001.

- **Import:**



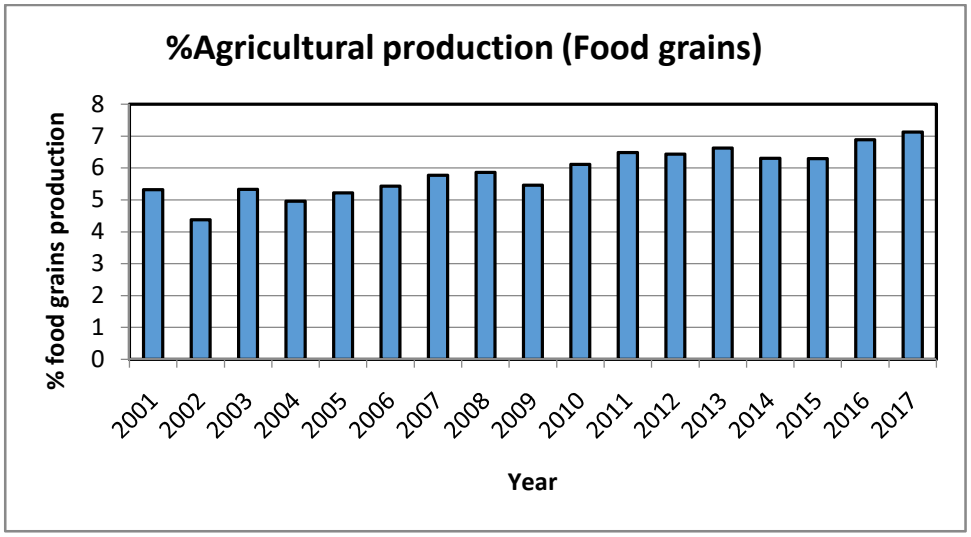
Interpretation: From graph it is clear that, import is highest in year 2017 i.e. 11.2% and very low in year 2011 i.e. 0.8%.

- **Agricultural production (Oil seeds):**



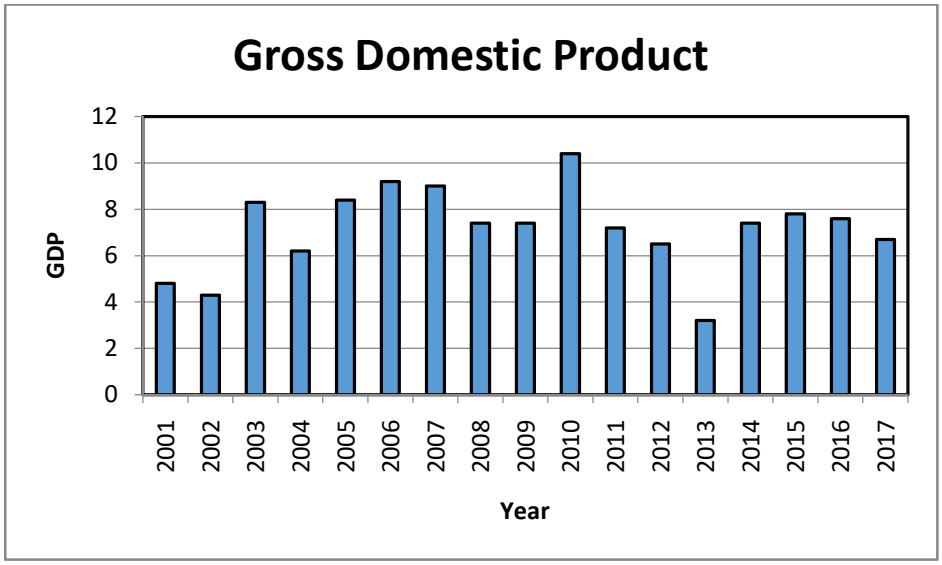
Interpretation: From graph it is clear that, the oil seeds production is highest in year 2013.It is about 7.1%.

- **Agricultural production (Food Grains):**



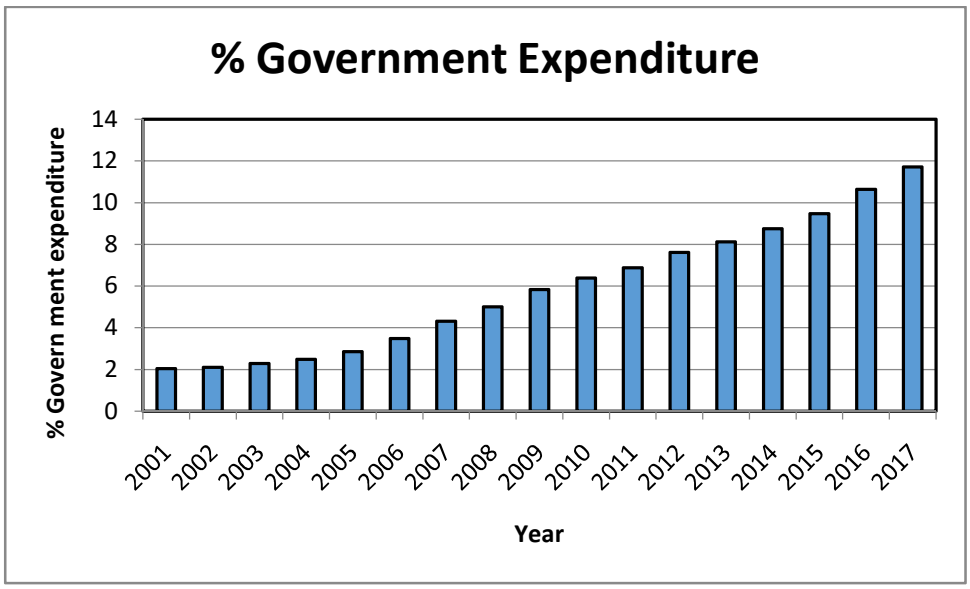
Interpretation: From graph it is clear that, the food grains production is highest in year 2017. It is about 7.08%.

- **Gross Domestic Product (GDP):**



Interpretation: From graph it is clear that, the GDP is highest in year 2010 and minimum in year 2013.

- **Government Expenditure:**



Interpretation: From graph it is clear that, Government expenditure has increasing trend.

Correlation matrix

	Y	*X1*	*X2*	*X3*	*X4*	*X5*	*X6*	*X7*	*X8*	*X9*	*X10*
Y	1										
X1	-0.5073	1									
X2	0.618033	-0.93737	1								
X3	0.275513	-0.56191	0.534465	1							
X4	-0.17338	-0.69127	0.589965	0.352372	1						
X5	0.316086	-0.94484	0.88357	0.568937	0.81	1					
X6	0.11624	-0.67121	0.60734	0.417763	0.769164	0.733211	1				
X7	0.447866	-0.61606	0.568232	0.272335	0.220046	0.617295	0.376155	1			
X8	0.274639	-0.88107	0.805236	0.476151	0.693055	0.92089	0.710855	0.772335	1		
X9	0.105117	-0.04476	-0.00441	-0.06201	-0.22275	-0.07286	-0.23277	0.287996	0.07171	1	
X10	0.211686	-0.91662	0.848312	0.514111	0.858664	0.965072	0.74537	0.576547	0.9201	0.014385	1

Interpretation: Inflation rate and crude oil production are negatively correlated. The correlation between crude oil production, agricultural production and inflation rate are considerable.

Multiple linear regression

To multiple linear regression model, we have inflation rate as a response(dependent) variable and 10 regressors(independent) variable. The regressors are crude oil production(in Rs. Thousand), unemployment rate ,export(in Rs. Lacks), import(in Rs. lacks),GDP growth rate, nominal exchange rate of INR in USD, money supply rate(M2), total government expenditure, agricultural production (0il seeds), agricultural production(food grains) etc. on which inflation rate is depends.

Hence our multiple linear regression model is,

$Y=\beta_0+\beta 1X1+\beta_2 X_2+\beta_{3\ X3} +\beta_4 X_4 +\beta_5 X_5 +\beta_6 X_6 +\beta_7 X_7 +\beta_8 X_8 +\beta_9 X_9 +\beta_{10}X_{10}$

Where,

Y= inflation rate

X_1= unemployment rate

X_2= crude oil production

X_3= money supply rate(M2)

X_4=Nominal exchange rate of INR in USD

X_5= Export

X_6= Import

X_7= Agricultural production (oil seeds)

X_8= Agricultural production(Food grains)

X_9=GDP growth rate

X_{10}= Governmental expenditure

First, we fit a regression model including all regressors, to check whether the significance of regression. Hence the R output of regression model is,

```
>mreg=lm(y~x1+x2+x3+x4+x5+x6+x7+x8+x9+x10)
> summary(mreg)
```

Call:

lm(formula = y ~ (x1+x2+x3+x4+x5+x6+x7+x8+x9+x10)

Coefficients:

	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept)	6.444e+01	1.851e+01	3.482	0.0176 *
X1	-8.205e+00	3.474e+00	-2.362	0.0646
X2	1.067e-08	4.145e-09	2.575	0.0498 *
X3	-1.319e-05	1.370e-04	-0.096	0.9270
X4	-2.399e-01	1.451e-01	-1.653	0.1592
X5	1.148e-08	6.652e-08	0.173	0.8697
X6	-2.989e-08	4.242e-08	-0.705	0.5125
X7	1.595e-01	1.400e-01	1.140	0.3060
X8	-4.715e-02	3.864e-02	-1.220	0.2768
X9	-3.913e-01	2.145e-01	-1.825	0.1276
X10	-5.238e-05	3.010e-04	-0.174	0.8687

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 1.091 on 5 degrees of freedom

Multiple R-squared: 0.9568, Adjusted R-squared: 0.8616

F-statistic: 10.06 on 11 and 5 DF, p-value: 0.009793

Hence, fitted regression model is,

$Y=(6.444e+01)+(-8.205e+00)X_1+(1.067e-08)X_2+(-1.319e-05)X_3+$
$(2.399e01)X_4+(1.148e-08)X_5+(-2.989e-08)X_6+(1.595e-01)X_7+(-4.715e-01)X_8+$
$(3.913e-01)X_9+(-5.238e-05)X_{10}$

Test for significance of regression:

We test,

$H_0 : \beta_i = 0$ v/s $H_1 : \beta_i \neq 0$, i=1,2,…….,10

Criteria: We may reject H_0 at α% l. o. s.

If p-value < α

Decision: From the output,

p-value = 0.009793 , α = 0.05

Here, P-value < 0.05

Conclusion: Hence, we concluded that at least one of the regressors is significant.

To obtain the best regression model, we use stepwise regression method using Minitab software.

The output is

Regression Analysis: Y versus X1, X2, X3, X4, X5, X6, X7, X8, X9, X10

```
Stepwise Selection of Terms

α to enter = 0.15, α to remove = 0.15


Analysis of Variance

Source      DF  Adj SS   Adj MS  F-Value  P-Value
Regression   2  113.73   56.867    33.21    0.000
  X2         1  109.60  109.596    64.01    0.000
  X4         1   61.14   61.136    35.71    0.000
Error       14   23.97    1.712
Total       16  137.71


Model Summary

      S    R-sq  R-sq(adj)  R-sq(pred)
1.30850  82.59%     80.11%      73.82%


Coefficients

Term          Coef   SE Coef  T-Value  P-Value   VIF
Constant     14.83      2.08     7.12    0.001
X2        0.000000  0.000000     8.00    0.001  1.53
X4         -0.2816    0.0471    -5.98    0.001  1.53
```

```
Regression Equation

Y = 14.83 + 0.000000 X2 - 0.2816 X4


Fits and Diagnostics for Unusual Observations

                              Std
Obs       Y    Fit  Resid  Resid
 13  10.920  8.174  2.746   2.23  R

R  Large residual
```

Hence the best fitted model is,

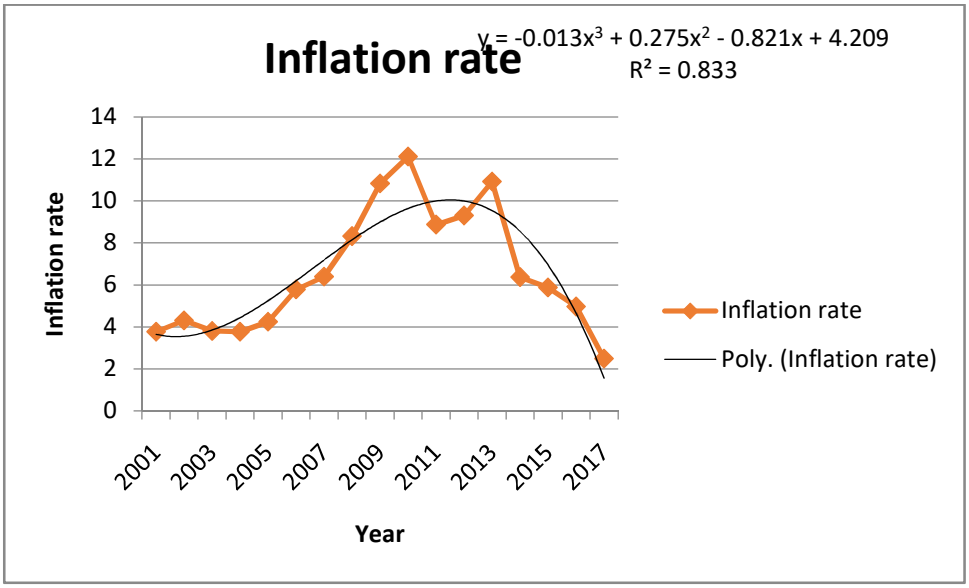
$$Y = 14.83 + 0.000000^{*} X2 - 0.2816 X4$$

From output, only two regressors are significant to predict y (response).

Interpretation : Inflation rate is mostly depends on crude oil production and nominal exchange rate of INR to USD. If unit change in crude oil production then inflation rate increase 0.00000023 and if unit change in nominal exchange rate then inflation rate changes 0.2816 times unit.

- **Fitting of trend line**

Year	Inflation
2001	3.77
2002	4.31
2003	3.81
2004	3.77
2005	4.25
2006	5.79
2007	6.39
2008	8.32
2009	10.83
2010	12.11
2011	8.87
2012	9.3
2013	10.92
2014	6.37
2015	5.88
2016	4.97
2017	2.49


Inflation rate
y = -0.013x³ + 0.275x² - 0.821x + 4.209
R² = 0.833
Inflation rate
14
12
10
8
6
4
2
0
2001
2003
2005
2007
2009
2011
2013
2015
2017
Year
Inflation rate
Poly. (Inflation rate)

Conclusion

The analysis investigated the inflation rate is mainly depends on crude oil production and nominal exchange rate. The average inflation rate in India is approximately 6.6. The minimum inflation rate in India is 2.49 in the year 2017 and maximum inflation rate 12.11 in year 2010.

Hence we conclude that decrease in nominal exchange rate and increase in crude oil production is necessary to stabilized inflation rate in India. It is also showed that internal and external factor of determinants inflation have effect on CPI inflation. By increasing this factors CPI inflation also increases that creates risk for our economy. Government of India shall take necessary steps for the controlling the level of CPI inflation in the economy to ensure the betterment of economy as whole by following measures:

- Development in agriculture sector.
- Controlled by strategic planning.
- Increase the oil production level and some alternative energy sources like coal, solar power and also wind power etc.
- The government should reduced borrowing.
- The government spending should be controlled.

Limitations of study

The study was faced with some limitations. The study was not conclusive as it did not include some of the other aspects that affect the inflation but not concentrated with crude oil production and nominal exchange rate. As this are observed as the key factor affecting inflation rate.

The limitations of time constraints and gathering of secondary information were also encountered in the study. This was because thee whole data was not radily available to the public and therefore the out from the study is not perfect as well.

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