

# CERTIFICATE



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**K.T.H.M. COLLEGE NASHIK-422002.**

A Project Report On

**“Statistical Approach to Analyse Foreign Direct Investment in India”**

Submitted to



**Savitribai phule university, Pune**

In the partial fulfilment of T .Y. B.Sc.(statistics)

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# ACKNOWLEDGEMENT

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# INTRODUCTION

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The purpose of this project is to study the different aspects related to Foreign Direct Investment. A foreign direct investment (FDI) is an investment made by a firm or individual in one country into business interests located in another country.

Foreign Direct Investment (FDI) is the practice of starting or investing in businesses in foreign countries. For example, if an American multinational firm opens up operations in China or India, either by opening up its own premises or by partnering with a local firm, that investment would be considered part of FDI. Economists track the flows of FDI between countries as this is seen as an important contributor to economic growth.

FDI can help foster and maintain economic growth, both for the recipient country and for the country making the investment. For example, a developing country might benefit from incoming FDI as a way of financing the construction of new infrastructure or providing employment for its local workforce. On the other hand, multinational companies can benefit from FDI as a way to expand their footprint into international markets. One of the main disadvantages of FDI, however, are that it tends to rely on the involvement or oversight of multiple governments, leading to higher levels of political risk.

Types of Foreign Direct Investment: Foreign direct investments are commonly categorized as being horizontal, vertical or conglomerate. A horizontal direct investment refers to the investor establishing the same type of business operation in a foreign country as it operates in its home country, for example, a cell phone provider based in the United States opening stores in China.

One of the largest examples of Foreign Direct Investment (FDI) today is the Chinese initiative known as One Belt One Road (OBOR). It involves contributing substantial FDI toward a range of infrastructure programs throughout Africa, Asia, and even parts of Europe. The FDI is typically funded by Chinese stateowned enterprises or other organizations associated with the Chinese government. Similar programs are also undertaken by other nations and international bodies, such as Japan, the United States, and the European Union (EU).

# VARIABLE DESCRIPTION

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## **Foreign Direct Investment (FDI):**

A foreign direct investment (FDI) is an investment in the form of a controlling ownership in a business in one country by an entity based in another country. It is thus distinguished from a foreign portfolio investment by a notion of direct control. FDI is the practice of starting or investing in businesses in foreign countries. It highly depends on economic factors like GDP of a country, government policies and returns on investment in a country.

## **Nominal Exchange Rate:**

The nominal exchange rate is an unadjusted weighted average rate at which one country's currency exchanges for a basket of multiple foreign currencies. The nominal exchange rate is the amount of domestic currency needed to purchase foreign currency. An increase in FDI will increase the demand for the currency of the receiving country, and raise its exchange rate.

## **Trade Openness:**

Trade Openness is the sum of imports and exports. Imports: Goods or services that are produced abroad. Exports: Goods or services produced locally and sold abroad. Higher openness of trade has significant positive impact on FDI inflows.

## **Gross Domestic Product:**

Gross domestic product (GDP) is a monetary measure of the market value of all the final goods and services produced in a specific time period. Increase in GDP shows that there is a good trend of investment in Foreign Direct investment (FDI) in an economy.

**Inflation Rate:**

Inflation refers to the rise in the prices of most goods and services of daily or common use, such as food, clothing, housing, recreation, transport, consumer staples, etc. Inflation measures the average price change in a basket of commodities and services over time. FDI is considered as an important and popular tool for economic growth. Inflation directly affects the economy. The relationship between inflation and economic growth is either positive or negative. Low level of inflation is a sign of economic stability in the country, low rate of inflation increases the return on FDI.

**Labour Force:**

Labour force is the labour pool either in employment or unemployed. It is generally used to describe those working for a single company or industry. The effects of foreign direct investments (FDI) on host countries' economies are mainly related to the increase of labour productivity through technological transfer, management and marketing proficiency that enables long term technological progress and economic growth.

# METHODOLOGY

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In this project we have used Multiple Linear Regression using R-software and Time Series analysis using MS-Excel.

## Multiple Linear Regression:

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

$$y = Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_p X_p + \epsilon$$

Where,  $\beta_1, \beta_2, \dots, \beta_p$  are constants (known as regression coefficients) and  $\epsilon$  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,  
$$E(Y|X = x) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_p X_p$$
- ii) The parameter  $\beta_i, i = 1, 2, 3, \dots, p$  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  $\beta_i, i = 1, 2, \dots, p$  are also called partial coefficients.

## **R- software commands for correlation matrix and to fit multiple regression:**

```
>y=c()                # to create a vector of variable Y.  
>x1=c()               # to create a vector of variable X1.  
.  
.  
> mp=cbind(y,x1,x2,....,xn)  
>cor(mp)              # to get correlation matrix  
>mreg=lm(y~x1+x2+....+xn) # Regression of y on x1,x2,..xn.  
>summary (mreg)       # gives ANOVA table.
```

## **Time Series Analysis:**

In time series analysis we have fitted different models to predict the trend of foreign direct investment in India.

The fitted models are linear, exponential and 2<sup>nd</sup> degree polynomial. The respective R squared value for each model has been calculated for further comparison. Also, future values of FDI have been predicted using the best fitted model.

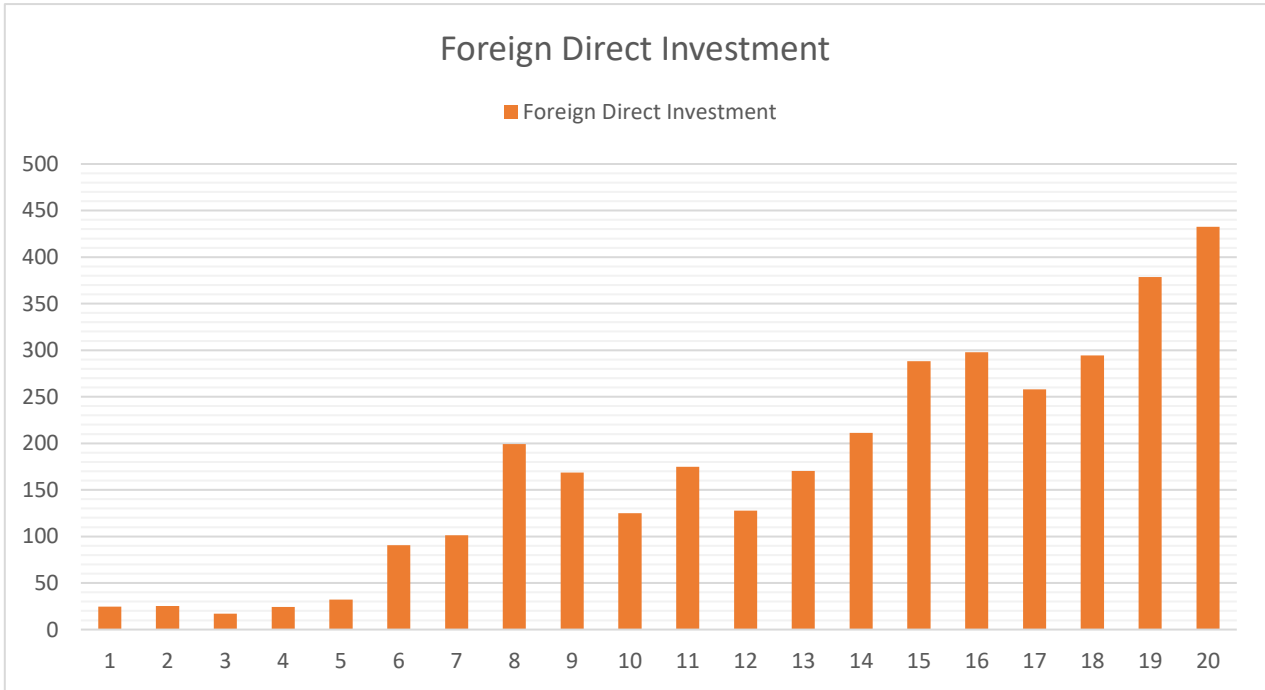


# COLLECTED DATA

Year	Foreign Direct Investment	Nominal exchange rate	Trade Openness (import+export)	GDP	Inflation Rate	Labour Force
2001	24.5	47.7	6.02	23.56	3.78	40.67
2002	25.2	48.4	7.36	25.36	4.30	41.70
2003	16.93	46.0	8.54	28.42	3.81	42.75
2004	24.4	44.9	11.95	32.42	3.77	43.81
2005	32.2	44.3	15.25	36.93	4.25	44.91
2006	90.7	45.3	19.45	42.95	5.80	45.19
2007	101.4	40.2	22.38	49.87	6.37	45.47
2008	199.2	45.9	29.43	56.30	8.35	45.74
2009	168.6	47.4	29.46	64.78	10.88	46.03
2010	124.9	45.6	37.6	77.84	11.99	46.30
2011	174.8	47.9	48.72	90.10	8.86	46.38
2012	127.7	53.2	55.48	99.44	9.31	46.47
2013	170.3	60.5	60.49	112.34	10.91	46.91
2014	211.3	61.1	61	124.68	6.35	47.33
2015	288.3	65.5	57.74	137.72	5.87	47.73
2016	297.9	67.0	61.5	153.92	4.94	48.12
2017	257.8	65.5	69.63	170.98	2.49	48.45
2018	294.4	69.9	82.34	189.71	4.86	48.76
2019	378.6	74.8	80.44	203.40	7.66	49.47
2020	432.5	74.1	70.41	194.82	6.20	50.10

1. Foreign Direct Investment figures are in ₹ thousand crores.□
2. Nominal exchange is for USD(\$) to INR(₹).
3. Trade openness figures are in ₹ lac crores.
4. GDP figures are in ₹ lac crores.
5. Inflation rate is in %
6. Labour force figures represent the population in crores.

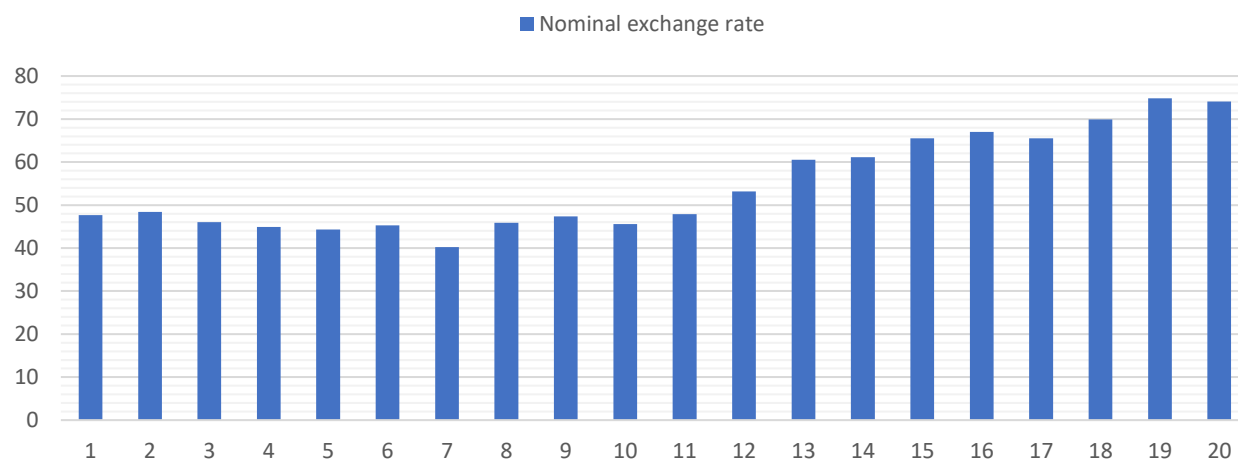
# REPRESENTATION OF DATA



Minimum	16.93
Q1	76.08
Median	169.45
Mean	172.08
Q3	265.43
Maximum	432.50

**Interpretation:** Foreign Direct Investment shows the cyclic trend of increase and decrease but, it has been increased in overall time period.

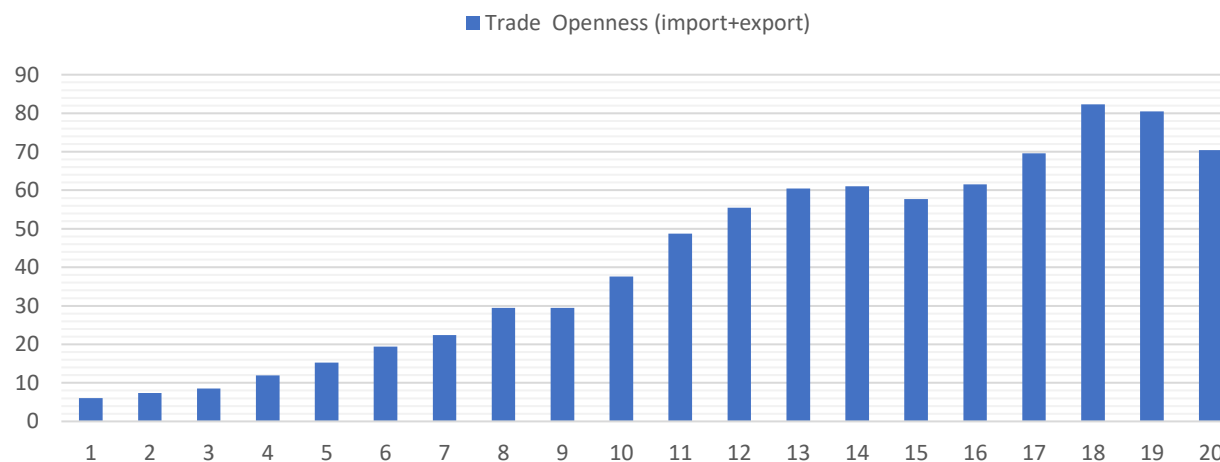
### Nominal exchange rate



Minimum	40.20
Q1	45.83
Median	48.15
Mean	54.76
Q3	65.50
Maximum	74.80

**Interpretation:** The nominal exchange rate has been declined in initial years but from 2011 it is increasing. It was highest in 2019.

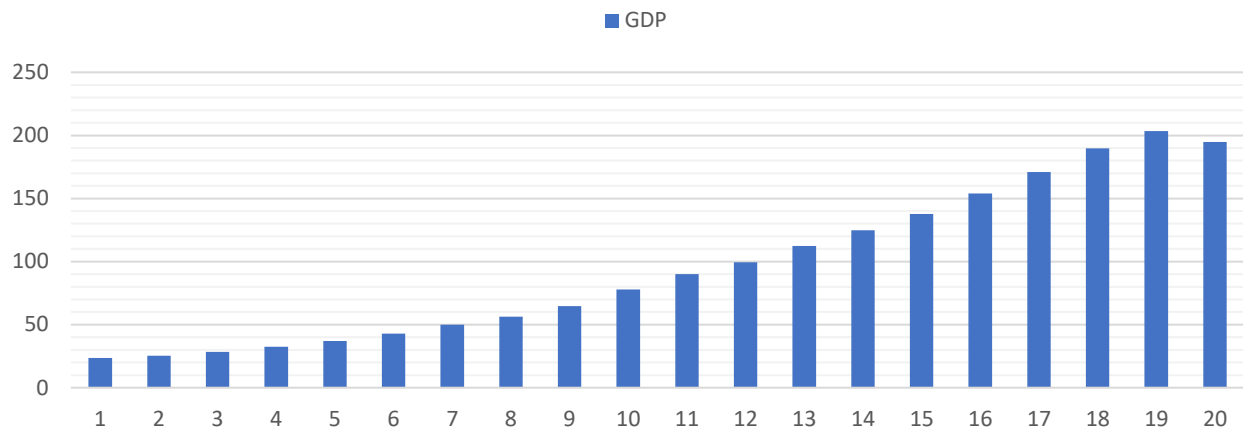
### Trade Openness (import+export)



Minimum	6.02
Q1	18.40
Median	43.16
Mean	41.76
Q3	61.12
Maximum	82.34

**Interpretation:** From the graph it can be seen that 2018 was the year with highest trade of ₹82.34 lac crores in the form of export and import.

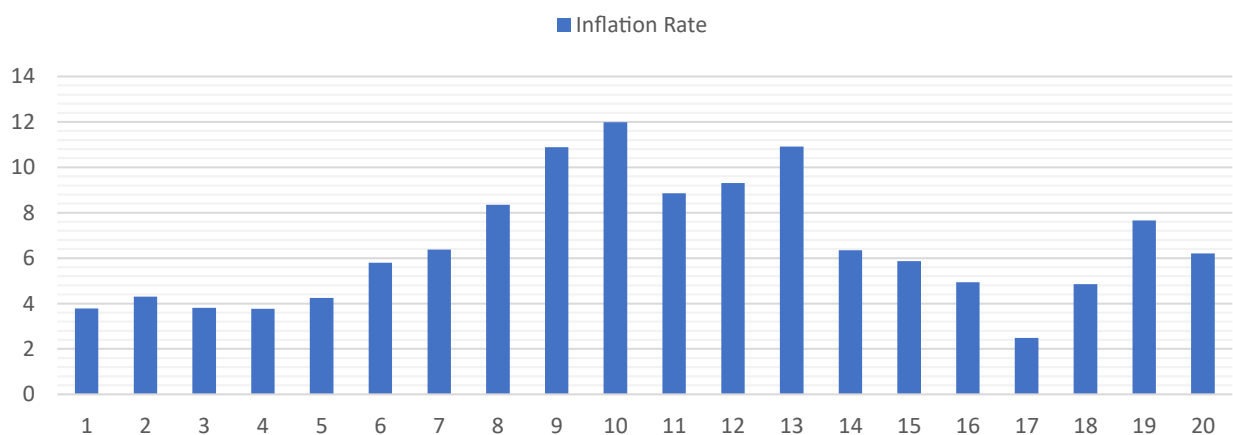
## Gross Domestic Product



Minimum	23.56
Q1	41.45
Median	83.97
Mean	95.78
Q3	141.77
Maximum	203.40

**Interpretation:** GDP shows the increasing trend from 2001 to 2019. 2020 can be considered as a exception in which it has been decreased.

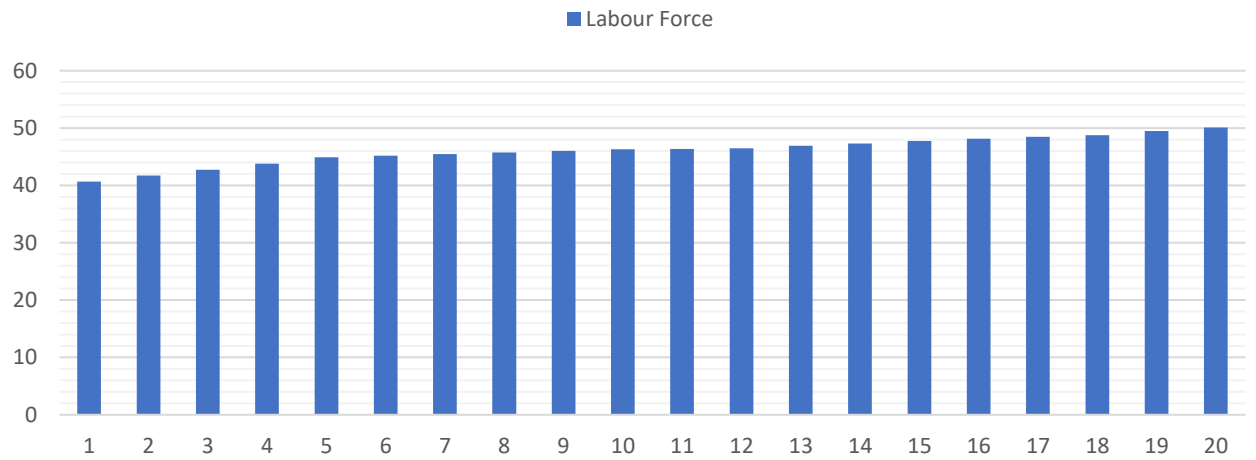
## Inflation Rate



Minimum	2.490
Q1	4.287
Median	6.035
Mean	6.537
Q3	8.477
Maximum	11.990

**Interpretation:** From the ghrph it is clear that inflation rate was very high for time period of 2009 to 2013. In 2010 it was highest (11.99%).

## Labour Force



Minimum	40.67
Q1	45.12
Median	46.34
Mean	46.11
Q3	47.83
Maximum	50.10

**Interpretation:** Each year the constant increase in working population can be seen in the graph. From 2001 to 2020 it has been increased by 9.43 crores.

# STATISTICAL ANALYSIS OF DATA

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## Correlation Matrix:

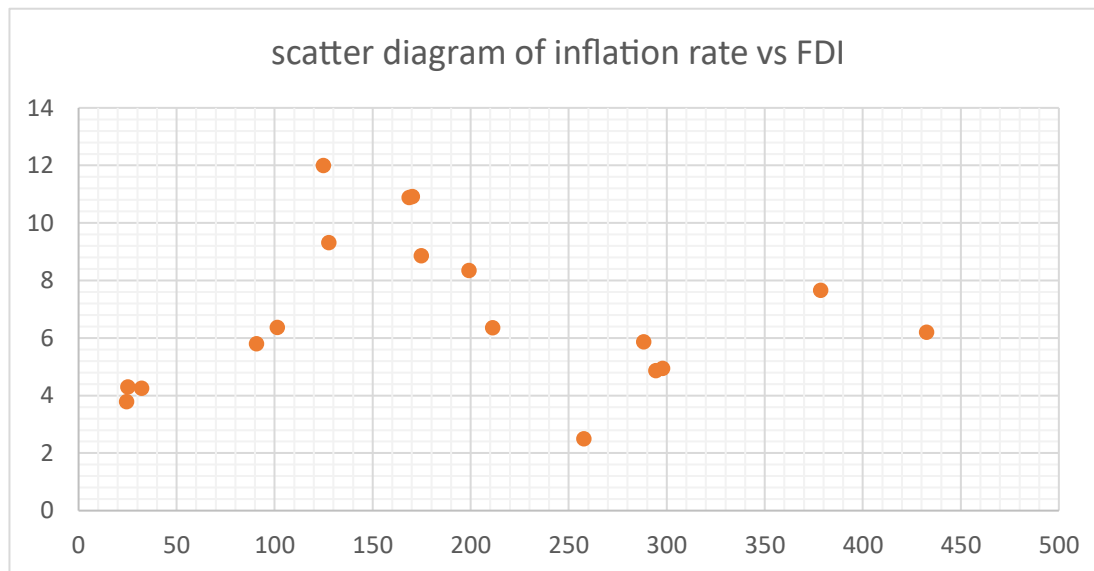
Let,  
Dependent variable-  
Y: Foreign Direct Investment.

Independent variables-  
X1: Nominal Exchange Rate  
X2: Trade Openness  
X3: Gross Domestic Product (GDP)  
X4: Inflation Rate  
X5: Labour Force

	Y	X1	X2	X3	X4	X5
Y	1.00000					
X1	0.8845623	1.0000000				
X2	0.8908236	0.88439592	1.0000000			
X3	0.9389526	0.94837734	0.9687187	1.0000000		
X4	0.1436187	0.09571434	0.2044487	0.0506433	1.0000000	
X5	0.9124975	0.77863934	0.9213003	0.9125328	0.25698179	1.0000000

**Interpretation:** From the correlation matrix, it can be seen that the correlation between FDI and Inflation rate is not considerable. FDI has considerable correlation with all the independent variables except inflation rate.

**Exclusion of Inflation rate as a regressor:**



**Conclusion:** From the correlation matrix , correlation between Foreign Direct Investment and inflation rate is 0.1436187  
Here,  $0.1436187 < 0.3$

Also the scatter diagram of inflation vs FDI doesn't show any trend.  
Hence we can say that there is no significant correlation between inflation rate and Foreign Direct Investment.

Therefore we have decided to exclude variable X4 i.e. Inflation rate from Regression Analysis to get more accuracy and better fitted regression model.

# Regression Analysis:

We have, Foreign Direct Investment as a response (dependent) variable i.e. Y and an inflation rate has been excluded for regression we have 4 regressors (independent variables) i.e. X1, X2, X3 and X5.

Our linear regression model is of type,  
$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_5 X_5$$

Commands for fitting multiple regression equation and the output are as follows.

```
>y=c(24.5,25.2,16.93,24.4,32.2,90.7,101.4,199.2,168.6,124.9,174.8,127.7,1
70.3,211.3,288.3,297.9,257.8, 294.4, 378.6,432.5)
>x1=c(47.7,48.4,46.0,44.9,44.3,45.3,40.2,45.9,47.4,45.6,47.9,53.2,60.5,61.1
,65.5,67.0,65.5,69.9,74.8,74.1)
>x2=c(6.02,7.36,8.54,11.95,15.25,19.45,22.38,29.43,29.46,37.6,48.72,55.48
,60.49,61,57.74,61.5,69.63,82.34,80.44,70.41)
>x3=c(23.56,25.36,28.42,32.42,36.93,42.95,49.87,56.30,64.78,77.84,90.10,
99.44,112.34,124.68,137.72,153.92,170.98,189.71,203.40,194.82)
>x5=c(40.67,41.70,42.75,43.81,44.91,45.19,45.47,45.74,46.03,46.30,46.38,
46.47,46.91,47.33,47.73,48.12,48.45,48.76,49.47,50.10)
```

```
> mreg=lm(y~x1+x2+x3+x5)
```

```
> summary(mreg)
```

Call:

```
lm(formula = y ~ x1 + x2 + x3 + x5)
```



Residuals:

Min	1Q	Median	3Q	Max
-62.803	-21.377	-1.049	23.917	84.981

	Estimate	Std. Error	t value	Pr(> t )
(Intercept)	-1364.042	594.363	-2.295	0.0366 *
x1	3.036	3.485	0.871	0.3973
x2	-2.422	1.547	-1.565	0.1383
x3	1.262	1.198	1.054	0.3088
x5	29.278	11.832	2.475	0.0258 *
---				

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

Residual standard error: 35.68 on 15 degrees of freedom

Multiple R-squared: 0.9223, Adjusted R-squared: 0.9016

F-statistic: 44.54 on 5 and 15 DF, p-value: 3.76e-08

### Interpretation of output:

From the output ,  $\beta_0 = -1364.042$ ,  $\beta_1 = 3.036$ ,  $\beta_2 = -2.422$ ,  $\beta_3 = 1.262$  and  $\beta_5 = 29.278$

Hence, the fitted regression model is,

$$Y = -1364.042 + 3.036X_1 - 2.422X_2 + 1.262X_3 + 29.278X_5$$

### Test for Significance of Regression:

Hypothesis-

$$\begin{array}{ll} H_0: \beta_i = 0 \\ \text{v/s } H_1: \beta_i \neq 0 \end{array} \quad i = 1, 2, \dots, 5.$$

**Decision rule:** If  $p\text{-value} < \alpha$ , then we can reject  $H_0$  at  $100\alpha\%$  l.o.s.

From output,  $p\text{-value} = 3.76e-08$  and  $\alpha = 0.05$ .  
Here,  $p\text{-value} < \alpha$

**Decision:** We can reject  $H_0$  at 5% level of significance.

**Conclusion:** We conclude that atleast one regressors is significant.

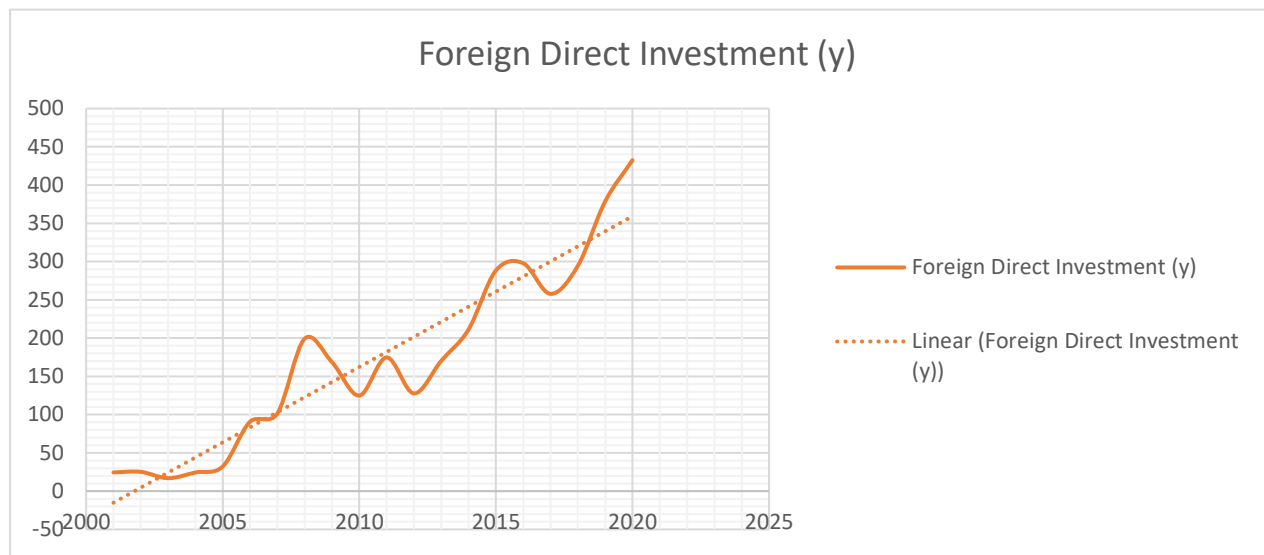
### **Interpretation of p values for individual regression coefficients:**

From the output we can see that  $p\text{-value}$  for  $X_5$  is less than 0.05, hence  $X_5$  is significant. Also,  $X_1$ ,  $X_2$  and  $X_3$  are not significant for  $\alpha = 0.05$ .

# Time series analysis:

we are using following data to fit different trend lines and to calculate R squared value for each model.

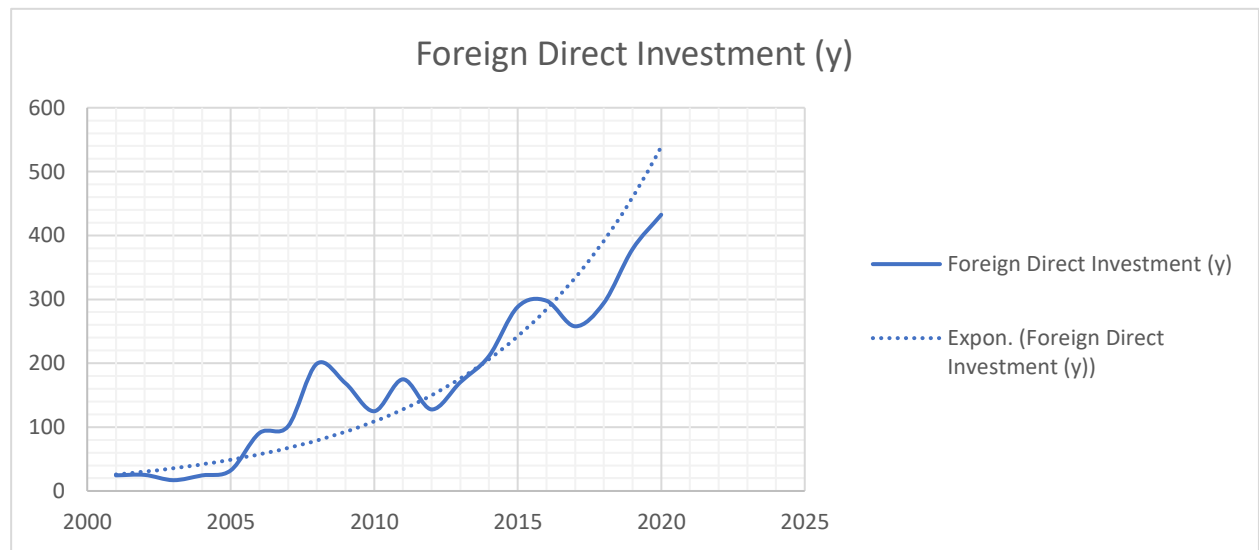
Year (x)	Foreign Direct Investment (y)
2001	24.5
2002	25.2
2003	16.93
2004	24.4
2005	32.2
2006	90.7
2007	101.4
2008	199.2
2009	168.6
2010	124.9
2011	174.8
2012	127.7
2013	170.3
2014	211.3
2015	288.3
2016	297.9
2017	257.8
2018	294.4
2019	378.6
2020	432.5



$$y = 19.706x - 39447$$

$$R^2 = 0.8935$$

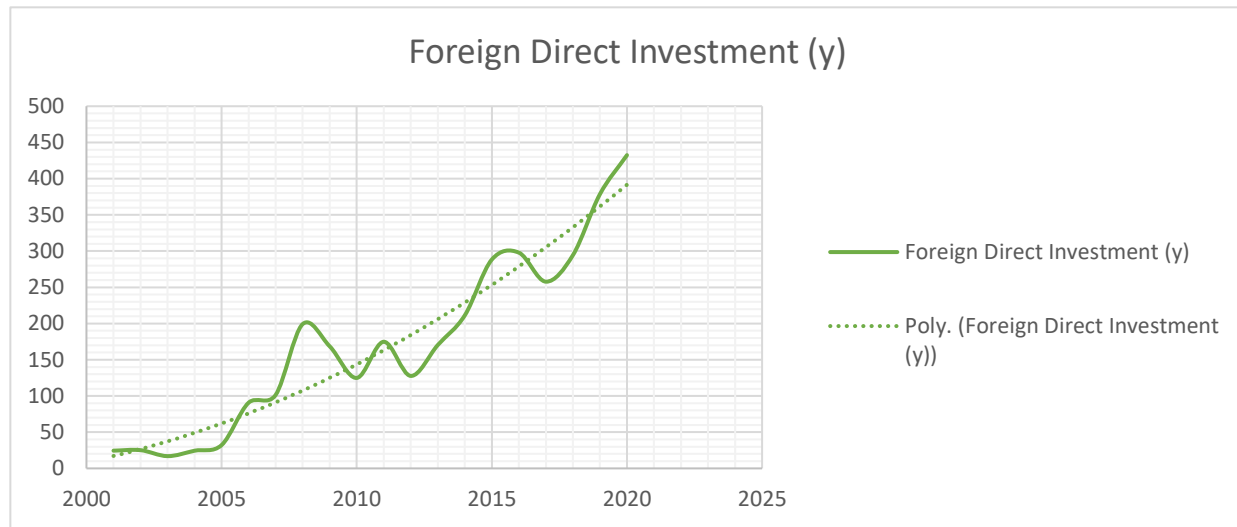
**Fig. Linear model**



$$y = 2E-138e^{0.16x}$$

$$R^2 = 0.8483$$

**Fig. Exponential model**



$$y = 0.5674x^2 - 2261.9x + 2E+06$$

$$R^2 = 0.913$$

**Fig. Polynomial model**

**Interpretation:** From the graphs,  
 $R^2$  (Exponential) <  $R^2$  (linear) <  $R^2$  (Polynomial)  
 Therefore, second degree polynomial is the better fit for given data.

The equation of best fitted model is-

$$y = 0.5674x^2 - 2261.9x + 2E+06$$

i.e.  $y = 0.5674x^2 - 2261.9x + 2254206.835$

**Prediction of future values of FDI using the equation:**

Year	Foreign Direct Investment
2021	418.76
2022	450.86
2023	484.09
2024	518.46
2025	553.96

# RESULTS

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- From the analysis, it is found that **Foreign Direct Investment** has significant positive correlation with Nominal Exchange Rate, Trade Openness, GDP and Labour Force.
- The fitted multiple linear regression model is-  
 **$Y = -1364.042 + 3.036X_1 - 2.422X_2 + 1.262X_3 + 29.278X_5$** .
- Also, by following the trend in Foreign Direct Investment (FDI), we can conclude that, there will be **28% increase** in FDI from the year 2020 (Rs 432.5 thousand crores) to the year 2025 (Rs 553.96 thousand crores).
- **Foreign Direct Investment** is the very essential factor to boost the economy of a country. So in the future, if India wants to attract more FDI, then focus should be on reskilling and upskilling of Labour and forming suitable policies, which will ease the establishment of Business firms and Industries.

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