REVIEW OF RESEARCH

"AN ECONOMETIRC ANALYSIS OF AGRICULTURE MAJOR CROPS OF INDIA"

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ABSTRACT:

Agriculture is an important sector in India. It is indispensible for the sustenance and growth of the Indian economy. On an average, about 70% of the households and 10% of the urban population is dependent on agriculture as their source of livelihood. Today, India is a major supplier of several agricultural commodities like tea, coffee, rice, spices, oil meals, fresh fruits, fresh vegetables, meat and its preparations and marine products to the international market. India is a large producer of several agricultural products. In terms of quantity of production, India is the top producer in the world in milk, and second largest in wheat and rice. Agricultural production is prone to several risks which affect both producers and consumers. In order to enhance investment and achieve a sustained increase in production, coherent and integrated long-term strategies and policies are required to reduce risk aversion and build flexibility among Indian rural producers. There is a need to provide remunerative prices for farmers in order to increase the incomes of farmers. In this research paper researcher's objective is to study and analysis the major agriculture crops in India.

KEYWORDS: *Agriculture production,Major agriculture crops, Measurement of descriptive statistics, Correlation, Multiple regression analysis, Autocorrelation, Multicolinearity, Hetroscedasticity etc.*

INTRODUCTION

Now India ranks first in the world in the production of tea and groundnuts. It ranks second in the world in the production of rice, sugarcane, jute and oil seeds. Till recent past before independence our agriculture depended on rains. Our farmers were using the primitive methods of agriculture. For years they have been sowing the seeds produced by them. Now high yielding varieties from Government farms are being supplied to the farmers. These improved and better seeds have considerably raised our farm produce agriculture etc.

Over 58% of plays a vital role in the Indian economy, Agriculture is the backbone of our country. It includes farming of crops, animal husbandry, pisciculture; agro-forestry rural households primarily depend on agriculture. Agriculture along with fisheries, forestry and other allied sectors contribute around 14% to the overall GDP of our country.

IMPORTANCE OF AGRICULTURE:

Agriculture plays a crucial role in the life of an economy. It is the backbone of our economic system. Agriculture not only provides food and raw material but also employment opportunities to a very large proportion of population. The following facts clearly highlight the importance of agriculture in this country.

1. Source of Livelihood:

In India the main occupation of our working population is agriculture. About 70 % of our population is directly engaged in agriculture. In advanced

countries, this ratio is very small being 5 % in U.K., 4 % in USA., 16 % in Australia, 14% in France, 21 % in Japan and 32 % in USSR.

2. Contribution to National Income:

Agriculture is the premier source of our national income. According to National Income Committee and C.S.O., in 1960-61, 52 %of national income was contributed by agriculture and allied occupations. In 1976-77, this sector alone contributed 42.2 %while in 1981-82, its contribution was to the tune of 41.8 %.In 2001-02, it contributed around 32.4 per cent of national income. This was further reduced to 28 per cent in 1999-2000. Contrary to this, the proportion of agriculture in U.K. is only 3.1, in USA it is 3 %, 2.5 % in Canada, 6% in Japan, 7.6 % in Australia. The mere conclusion of all this is that more developed a country the smaller is the contribution of agriculture in national output.

3. Supply of Food and Fodder:

Agriculture sector also provides fodder for livestock (35.33 crores). Cow and buffalo provide protective food in the form of milk and they also provide draught power for farm operations. Moreover, it also meets the food requirements of the people. Import of food grains has been very small in recent years, rather export avenues are being looked for.

4. Importance in International Trade:

It is the agricultural sector that feeds country's trade. Agricultural products like tea, sugar, rice, tobacco, spices etc. constitute the main items of exports of India. If the development process of agriculture is smooth, export increases and imports are reduced considerably.

5. Marketable Surplus:

The development of agricultural sector leads to marketable surplus. As country develops more and more people are to be engaged in mining, manufacturing and other non- agricultural sector. All these people depend upon the food production which they can meet from the marketable surplus.

6. Source of Raw Material:

Agriculture has been the source of raw materials to the leading industries like cotton and jute textiles, sugar, tobacco, edible and non-edible oils etc. All these depend directly on agriculture. According to United Nations Survey, the industries with raw material of agricultural origin accounted for 50 %of the value added and 64% of all jobs in the industrial sector

7. Contribution to Foreign Exchange Resources:

Agricultural sector constitutes an important place in the country's export trade. According to an estimate, agricultural commodities like jute, tobacco, oilseeds, spices, raw cotton, tea and coffee accounted for about 18 per cent of the total value of exports in India. This shows that agriculture products still continue to be significant source of earning foreign exchange.

8. Vast Employment Opportunities:

The agricultural sector is significant as it provides greater employment opportunities in the construction of irrigation projects, drainage system and other such activities with the fast growing population and high incidence of unemployment and disguised unemployment in backward countries, it is only agriculture sector which provides more employment chances to the labour force. In this way, significance of agriculture emerges more and more.

9. Overall Economic Development:

In the course of economic development, agriculture employs majority of people. This means raising the level of the national income and standard of living of the common man. The rapid" rate of growth in agriculture sector gives progressive outlook and further motivation for development. As a

result, it helps to create proper atmosphere for general economic development of the economy. Thus, economic development depends on the rate at which agriculture grows.

10. Source of Saving:

Improvement in agriculture can go a long way in increasing savings. It is seen that rich farmers have started saving especially after green revolution in the country. This surplus amount can be invested in agriculture sector for further; development of the sector. Saving potentials are large in agriculture sector which can be properly tapped for the development of the country.

11. Source of Government Income:

In India, many state governments get sizeable revenue from the agriculture sector. Land revenue, agricultural income tax, irrigation tax and some other types of taxes are being levied on agriculture by the state governments. Moreover, considerably revenue is earned by way of excise duty and export duty on agricultural products. Raj committee on Agricultural Taxation has suggested imposition of taxation on agricultural income for raising revenue.

12. Basis of Economic Development:

Prof. Nurkse has laid sufficient emphasis on the improvement of agriculture for a balanced growth of an economy. The development of agriculture provides necessary capital for the development of other sectors like industry, transport and foreign trade. In fact, a balanced development of agriculture and industry is the need of the day. From the above, explanation it may be concluded that agriculture occupies an important place in the development of an economy. It is in fact, a pre-condition for economic up liftmento give stagnant agricultural growth a boost; a shift must be made from concentrating on the country's food security to focusing on the farmers' income security. The government has responded to the problem by constituting a panel, which will recommend ways to double the income of farmers by 2022. While this may be an overtly ambitious target, if we want to boost stagnated agricultural growth a shift has to be made, as finance minister ArunJaitley said in parliament, from food security of the nation to income security of the farmers. However, there are many hurdles that have to be crossed if we want to achieve this objective.

For instance, our average yield per hectare is 39% below than that of China and for rice this figure is 46%. Even Bangladesh, Vietnam and Indonesia fare better than India in case of rice yield. Further, there is a huge inter-regional variation; the wheat and rice yield from Haryana and Punjab is much higher than from the other states.

A study conducted by the National Mission for Sustainable Agriculture on micro irrigation in 64 districts of 13 states (Andhra Pradesh, Bihar, Chhattisgarh, Gujarat, Haryana, Karnataka, Maharashtra, Odisha, Rajasthan, Tamil Nadu, Sikkim, Uttar Pradesh and Uttarakhand), reveals that there were significant reductions in the use of water and fertilizer but the yield of crops increased up to 45% in wheat, 20% in gram and 40% in soybean. However, high initial costs deter farmers to adopt this technology.

One of the major factors that have deterred private players from entering the agricultural sector is the long pending reform of wholesale markets, which are regulated by the Agriculture Produce Management Committee (APMC) Act. The AMPC forces the farmers to sell their produce in government-controlled marketing yards.

Crop Seasons in India

India is the top producer of many crops in the world. There can be many ways to divide the types of crops (based on area, season, economic value etc.). Based on seasons, the crops in India are divided into three types; Rabi, Kharif and Zaid.

Kharif Crops

- Sown in June-July when rains first begin (Monsoon crop).

- Harvested in September-October.
- Requires lot of water and hot weather to grow.
- Example: Rice, Jowar, Bajra, Maize, Cotton, Groundnut, Jute, Sugarcane, Turmeric, Pulses

Rabi Crops

- Sown in October-November
- Harvested in April-May.
- Requires warm climate for germination of seeds and maturation and cold climate for the growth.
- Example: Wheat, Oat, Gram, Pea, Barley, Potato, Tomato, Onion, Oil seeds (like Rapeseed, Sunflower, Sesame, Mustard) etc.

Zaid Crops

- Grown between March-June between Rabi and Kharif crop seasons.
- Early maturing crops.
- Example: Cucumber, Bitter Gourd, Pumpkin, Watermelon, Muskmelon, Moong Dal etc.

Categories of Crops in India

The major crops can all be divided into four main categories depending on their usage.

1. Food Crops (Wheat, Maize, Rice, Millets and Pulses etc.)
2. Cash Crops (Sugarcane, Tobacco, Cotton, Jute and Oilseeds etc.)
3. Plantation Crops (Coffee, Coconut, Tea, and Rubber etc.)
4. Horticulture crops (Fruits and Vegetables)

Major Crops in India

Now let us look at the major crops in India in detail.

Rice

Rice is a tropical crop that can be grown almost throughout the year. It depends on atmospheric moisture and rainfall for irrigation. India is the 2nd largest producer of rice in the world. India has largest area in world under rice cultivation. Productivity is low compared to wheat because Green Revolution primarily boosted wheat production in India.The traditional rice fields are known as paddy fields and require.

Wheat

It is the 2nd most important food crop in India. It is a Rabi crop. India stands second in production of wheat worldwide. It is more flexible in terms of climactic and other conditions of growth.

Cotton

Cotton is a tropical and subtropical Kharif crop. It is a fibre crop and is known as 'White gold'. India ranks 3rd in the production of cotton worldwide. It is a dry crop but roots need timely supply of water at maturity.

Jute

Jute is a tropical plant that requires hot and humid climate. It is one of the most important natural fibres in terms of cultivation and usage. Almost 85% of the world's jute is cultivated in the Ganges Delta.

Sugarcane

Sugarcane is an important cash crop. India stands at 2nd position among all countries in the world in its production. Sugarcane crop requires long rainy season of at least 7-8 months. Traditional

Sugarcane Production was in North India but it has also shifted to South India. North India Sugarcane is of sub-tropical variety and so have low sugar content. Also sugar factories have to remain shut in winter seasons in North India. South India- Tropical Variety and coastal areas hence have high sugar content and high yield.

OBJECTIVE OF STUDY

- To study the Indian major agricultural crops productions.
- To study the correlations between all crops.
- To study themultiple regression models
- Find out the Multicolinearity problem.
- To study the other statistical methods.
- To suggest possible solution of their problems.

HYPOTHESIS

- India is one of the largest producers of wheat and rice then other crops.
- Testing of data should be normally distributed, if the data not follow normal distribution.so, we use spearman's rank correlation test.
- Find out the stationary from PACF graph.
- Find out the regression coefficient are significant or not.
- Find out the multicollenearity problems.

RESEARCH METHODOLOGY

The research methodology for this study has collected secondary data from RBI.ORG.IN.This data includes major crops (All crops, Food-grains, Cereals, Rice, Wheat, Coarse-cereals, Pulses, Non-food-grains, Oil-seeds, Groundnut, Sesamum, Rapeseed / Mustard, Cotton, Jute, Sugarcane and Tobacco.) in India for year 1996 to 2017. Further the data is about the indices, so for correlation and regression analysis needs to transform them for linearity. Here we have used log transformation. All of the analysis is done on transformed data.

ANALYSIS OF THE DATA

Descriptive Statistics

	N	Minimum	Maximum	Mean		Std.	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Statistic	Std. Error	Statistic	Std. Error
All_crops	22	4.61	5.33	4.9188	.05790	.27156	.430	.491	-1.711	.953
Food_grain	22	4.54	5.27	4.8798	.05688	.26679	.507	.491	-1.573	.953
Cereals	22	4.33	4.81	4.6952	.02302	.10797	-1.925	.491	5.056	.953
Rice	22	4.09	4.78	4.6490	.03145	.14749	-2.844	.491	10.107	.953
Wheat	22	4.62	4.90	4.7743	.01503	.07049	-.487	.491	.001	.953
Coarse_cereals	22	4.44	4.92	4.6733	.02519	.11815	.010	.491	-.212	.953
Pulses	22	4.44	4.81	4.6368	.02305	.10812	-.454	.491	-.732	.953
Nonfood_grains	22	4.60	5.22	4.8966	.04811	.22564	.347	.491	-1.625	.953
Oil_seeds	22	4.21	4.93	4.6293	.03877	.18185	-.605	.491	.094	.953
groundnut	22	3.96	4.97	4.5300	.05547	.26018	-.522	.491	-.312	.953
sesamum	22	4.36	5.05	4.6962	.03878	.18190	.104	.491	-.740	.953
Rapeseed_mustard	22	4.07	5.01	4.5772	.05438	.25505	-.221	.491	-.602	.953
Cotton	22	4.39	6.04	5.1213	.10411	.48830	.265	.491	-1.067	.953
Jute	22	4.16	4.97	4.8389	.03708	.17394	-3.139	.491	11.638	.953
Sugarcane	22	4.62	5.04	4.8203	.02197	.10307	-.243	.491	.042	.953
Tobacco	22	4.06	4.90	4.5608	.03973	.18633	-1.063	.491	2.574	.953
Valid N (listwise)	22									

Table no-1.Descriptive statistics

Conclusion:

From descriptive statistics, we can observe that skewness and kurtosis are not nearer to 0 & 3 respectively, so there is less chance for data to follows normal distribution.

Tests of Normality

Hypothesis:

H_0:The data is Normal.

H_1:The data is not Normal.

Tests of Normality

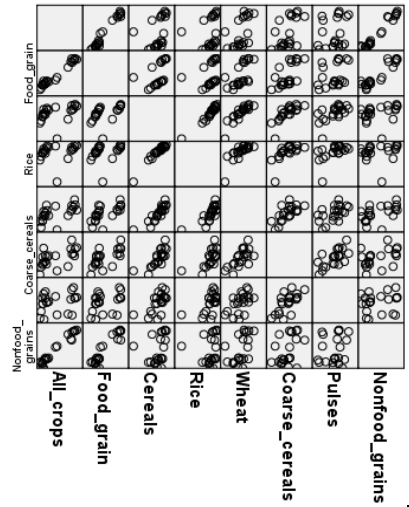
	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
All_crops	.238	22	.002	.818	22	.001
Food_grain	.255	22	.001	.819	22	.001
Cereals	.176	22	.075	.832	22	.002
Rice	.247	22	.001	.705	22	.000
Wheat	.105	22	.200	.968	22	.659
Coarse_cereals	.132	22	.200	.981	22	.928
Pulses	.170	22	.099	.931	22	.131
Nonfood_grains	.261	22	.000	.855	22	.004
Oil_seeds	.101	22	.200	.967	22	.650
groundnut	.143	22	.200	.958	22	.454
sesamum	.086	22	.200	.983	22	.952
Rapeseed_mustard	.109	22	.200	.979	22	.904
Cotton	.139	22	.200	.954	22	.380

Conclusion

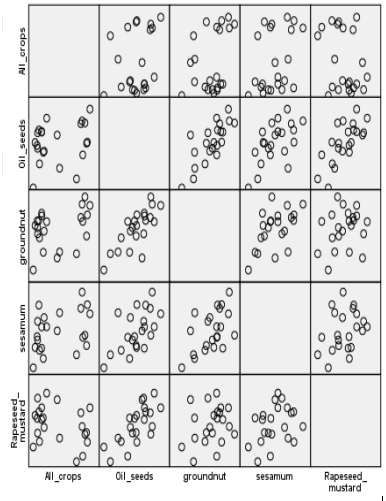
Here, p values >α for Wheat, Coarse-cereals, Pulses, Oilseeds, groundnut, sesamum, Rapeseed/mustard, Cotton, Sugarcane, so we do not reject Ho.

Here, p values <α for All crops, Food grain, Cereals, Rice, Nonfood grains, Jute, Tobacco. So the data not follow normal distribution. So, we use spearman's rank correlation test.

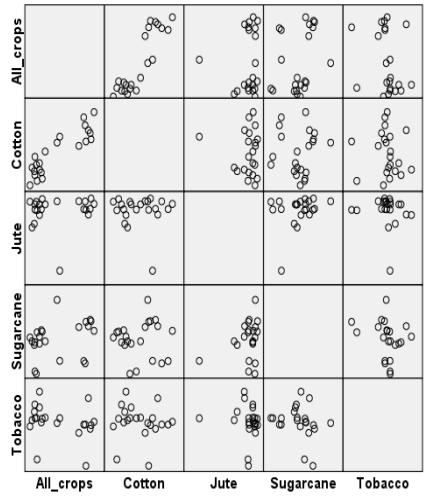
Correlation Analysis



Scatter plot group-1



Scatter plot group-2

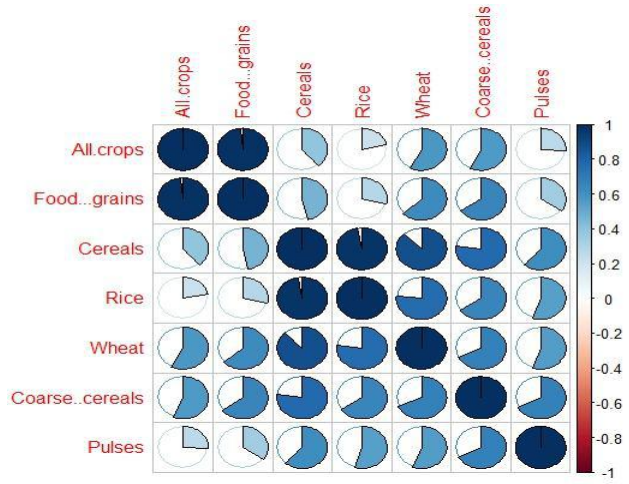


Scatter plot group-3

Conclusion:

From the scatter plots we observe that for majority of variable pairs, nonlinear relationship is there. Therefore, to study the significance of correlation, we have used spearman rank correlation because of three reasons, (i) no. of observation are 22 only (ii) non normal data and (iii) non linearity of the data.

Significant testing of correlation coefficient
Correlation (group-1)



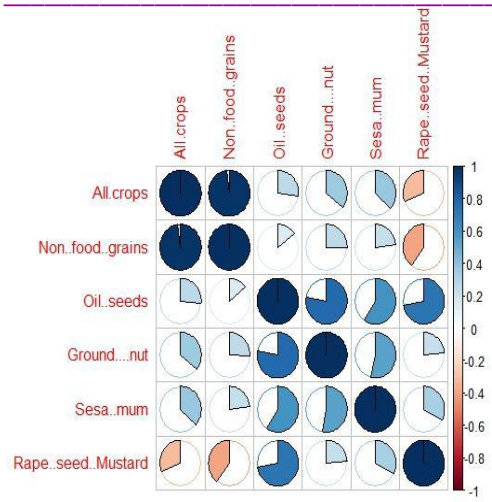
Conclusion:

From the Correlation pie chart we can see that pairs of variable is having statistically significant correlation at dark blue colors are highly significance and blue colors are lower level significance.

Spearman's rho	All crops	Food grains	Cereals	Rice	Wheat	Coarse cereals	pulses
All crops	1.00	0.96	0.68	0.61	0.71	0.62	0.33
Food grains	0.96	1.00	0.74	0.62	0.74	0.67	0.43
Cereals	0.68	0.74	1.00	0.95	0.93	0.79	0.61
Rice	0.61	0.62	0.95	1.00	0.85	0.69	0.53
Wheat	0.71	0.74	0.93	0.85	1.00	0.66	0.50
Coarse cereals	0.62	0.67	0.79	0.69	0.66	1.00	0.63
Pulses	0.33	0.43	0.61	0.53	0.50	0.63	1.00

n=22

P- VALUE	All crops	Food grains	Cereals	Rice	Wheat	Coarse cereals	pulses
All crops		0.0000	0.0005	0.0024	0.0002	0.0022	0.1303
Food grains	0.0000		0.0000	0.0022	0.0000	0.0006	0.0466
Cereals	0.0005	0.0000		0.0000	0.0000	0.0000	0.0028
Rice	0.0024	0.0022	0.0000		0.0000	0.0004	0.0103
Wheat	0.0002	0.0000	0.0000	0.0000		0.0007	0.0177
Coarse cereals	0.0022	0.0006	0.0000	0.0004	0.0007		0.0016
Pulses	0.1303	0.0466	0.0028	0.0103	0.0177	0.0016	



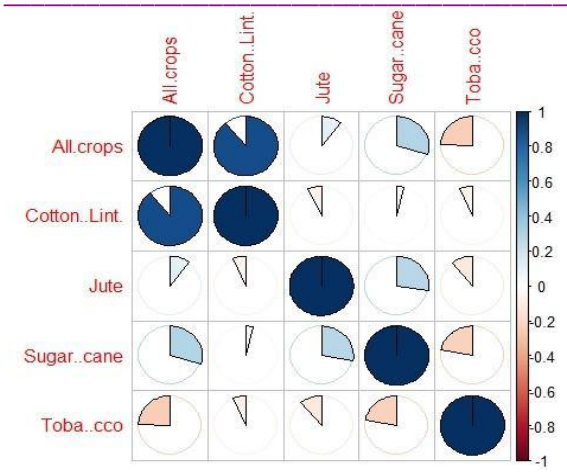
Conclusion:

From the Correlation pie chart we can see that pairs of variable is having statistically significant correlation at dark blue colors are highly significance, blue colors are lower level significance and red colors are negative level significance.

Spearman's rho	All crops	Non Food grains	Oilseeds	Groundnut	Sesamum	Rapeseed Mustard
All crops	1.00	0.95	0.32	0.36	0.41	-0.18
Non-food grains	0.95	1.00	0.20	0.29	0.25	-0.27
Oilseeds	0.32	0.20	1.00	0.76	0.59	0.69
Groundnut	0.36	0.29	0.76	1.00	0.53	0.19
Sesamum	0.41	0.25	0.59	0.53	1.00	0.34
Rapeseed Mustard	-0.18	-0.27	0.69	0.19	0.34	1.00

n=22

P-VALUE	All crops	Non Food grains	Oilseeds	Groundnut	Sesamum	Rapeseed Mustard
All crops		0.0000	0.1500	0.0978	0.0584	0.4358
Non-food grains	0.0000		0.3629	0.1874	0.2683	0.2295
Oilseeds	0.1500	0.3629		0.0000	0.0035	0.0004
Groundnut	0.0978	0.1874	0.0000		0.0105	0.3935
Sesamum	0.0584	0.2683	0.0035	0.0105		0.1223
Rapeseed Mustard	0.4358	0.2295	0.0004	0.3935	0.1223	



Conclusion:
From the Correlation pie chart we can see that pairs of variable is having statistically significant correlation at dark blue colors are highly significance, blue colors are lower level significance and red colors are negative level significance.

Spearman's rho	All crops	Cotton	Jute	Sugarcane	Tobacco
All crops	1.00	0.83	0.27	0.51	-0.33
Cotton	0.83	1.00	0.07	0.12	-0.15
Jute	0.27	0.07	1.00	0.23	-0.31
Sugarcane	0.51	0.12	0.23	1.00	-0.41
Tobacco	-0.33	-0.15	-0.31	-0.41	1.00

n=22

P-VALUE	All crops	Cotton	Jute	Sugarcane	Tobacco
All crops		0.0000	0.2223	0.0165	0.1296
Cotton	0.0000		0.7626	0.5973	0.4934
Jute	0.2223	0.7626		0.2961	0.1668
Sugarcane	0.0165	0.5973	0.2961		0.0580
Tobacco	0.1296	0.4934	0.1668	0.0580	

REGRESSION ANALYSIS

Food grain

Type of the model	Model eq.	coefficient	Sign.	Model sign.	Adj R	S.E
Exponential	$E(Y_t)= \beta_0 * e^{\beta 1 * t}$	0.196 1.857	0.00 0.00	0.00	0.969	0.010

Conclusion: Here, all regression coefficients are significant in all these models.

Wheat

Type of the model	Model eq.	coefficient	Sign.	Model sign.	Adj R	S.E
Exponential	E(Yt)= β0* e β1* t	0.031 4.092	0.005 0.00	0.005	0.296	0.012

Conclusion: Here, all regression coefficients are significant in this entire model.

Coarse Cereals

Type of the model	Model eq.	coefficient	Sign.	Model sign.	adj R	S.E
Exponential	$E(Y_t)= \beta_0 * e^{\beta 1 * t}$	0.053 3.606	0.006 0.00	0.006	0.285	0.0251

Conclusion: Here, all regression coefficients are significant in this entire model.

Nonfood grain

Type of the model	Model eq.	coefficient	Sign.	Model sign.	adj R	S.E
Exponential	$E(Y_t)= \beta_0 * e^{\beta 1 * t}$	0.165 2.173	0.00 0.00	0.00	0.955	0.010

Conclusion: Here, all regression coefficients are significant in this entire model.

Cotton

Type of the model	Model eq.	coefficient	Sign.	Model sign.	adj R	S.E
Exponential	$E(Y_t)= \beta_0 * e^{\beta 1 * t}$	0.310 1.111	0.00 0.00	0.00	0.776	0.045

Conclusion: Here, all regression coefficients are significant in this entire model

According to economic theories other regression models (inverse, compound, power, S and growth) are not suggest to study variables, so we suggest exponential models.

Multiple Regression model for the study variable:

H_0: The Fitted Regression model is insignificant

H_1: The Fitted Regression model is significant

$$Y_t = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \ldots\ldots\ldots \beta_{16} X_{16i} + u_t \quad \ldots (1)$$

Where, *Y= All crops*

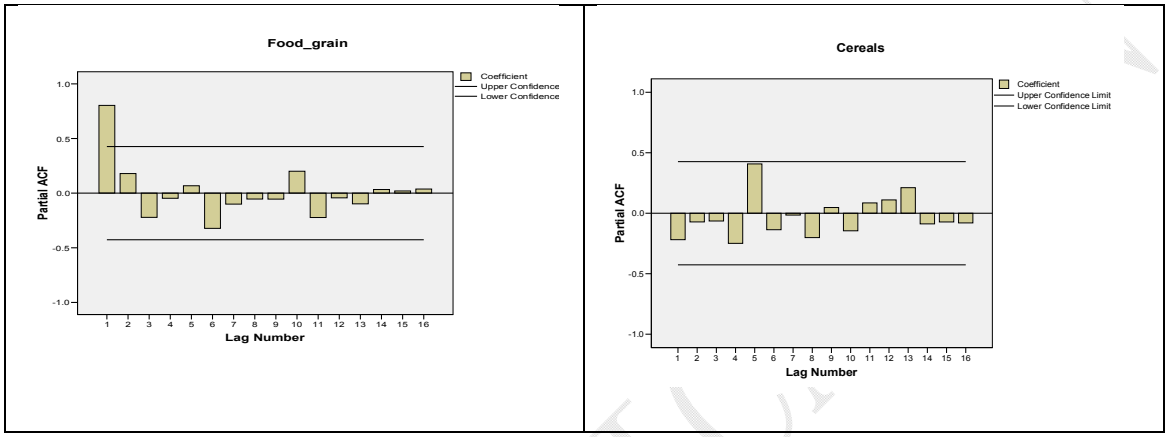
X1= Food grain
X2=Cereals
X3=Rice
X4=Wheat
X5=Coarse-cereals
X6=Pulses
X7=Nonfood-grains
X8=Oil-seeds
X9=Groundnut
X10=Sesamum
X11=Rapeseed/Mustard
X12=Cotton
X13=Jute
X14=Sugarcane
X15=Tobacco

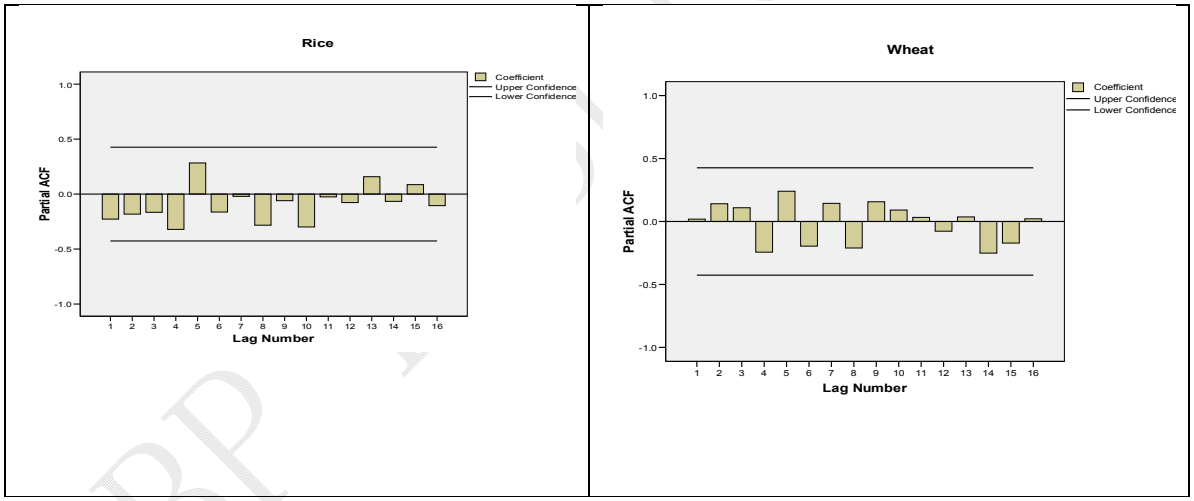
Coefficients:

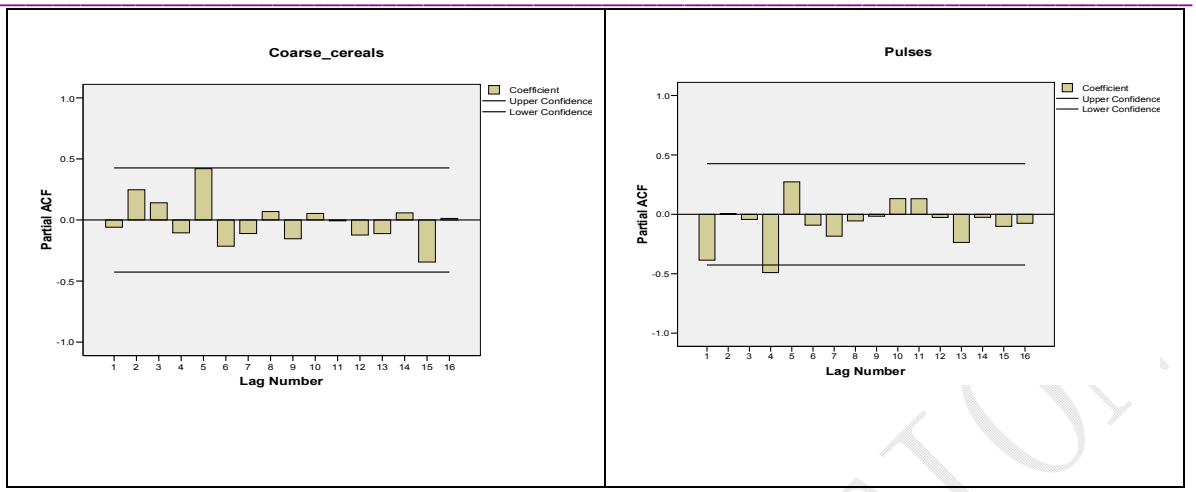
	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept)	5.528e-01	4.357e-07	1.269e+06	<2e-16 ***
Food grains	-3.950e-01	3.057e-07	-1.292e+06	<2e-16 ***
Cereals	6.436e+00	3.671e-06	1.753e+06	<2e-16 ***
Rice	-2.705e+00	1.793e-06	-1.509e+06	<2e-16 ***
Wheat	-1.981e+00	1.285e-06	-1.542e+06	<2e-16 ***
Coarse cereals	-9.833e-01	1.734e-07	-5.672e+06	<2e-16 ***
Pulses	1.554e-01	1.331e-07	1.168e+06	<2e-16 ***
Non-food grains	1.218e+00	3.977e-07	3.062e+06	<2e-16 ***
Oilseeds	-9.393e-02	3.381e-07	-2.778e+05	<2e-16 ***
Groundnut	-1.997e-02	8.300e-08	2.405e+05	<2e-16 ***

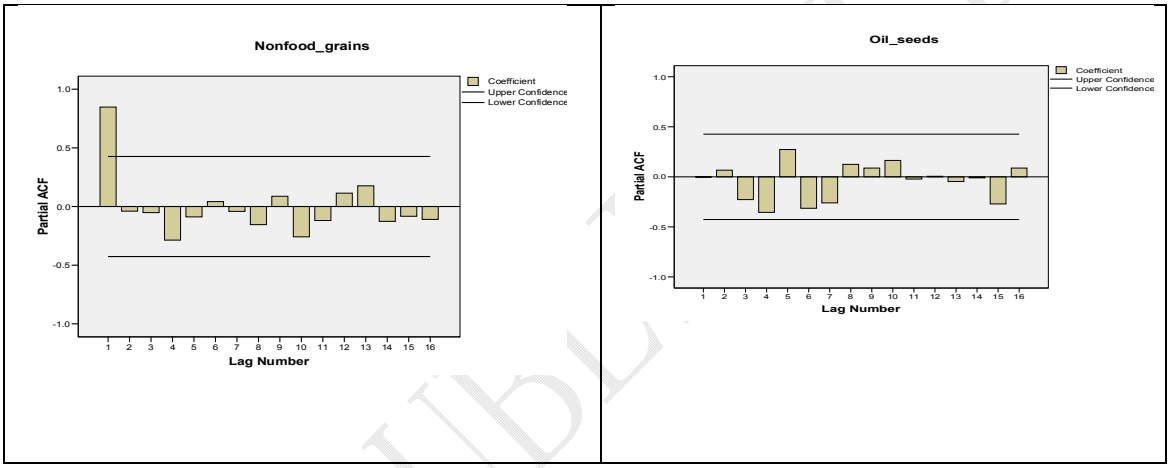
Sesamum	4.786e-02	1.232e-07	3.883e+05	<2e-16 ***
Rapeseed Mustard	-1.744e-01	7.483e-08	-2.331e+06	<2e-16 ***
Cotton	1.707e-01	8.570e-08	1.992e+06	<2e-16 ***
Jute	-8.183e-02	6.995e-08	-1.170e+06	<2e-16 ***
Sugarcane	-6.968e-01	3.273e-07	-2.128e+06	<2e-16 ***
Tobacco	2.046e-08	9.702e-08	2.110e-01	0.84

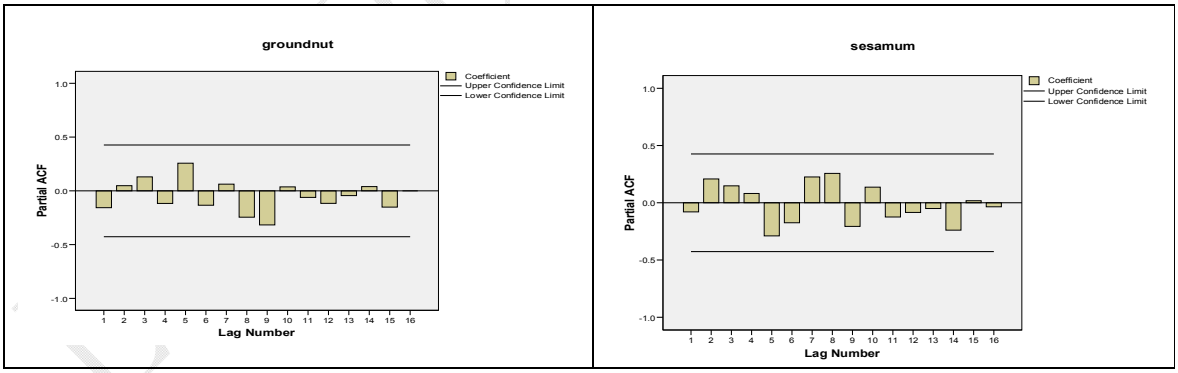
Autocorrelation:

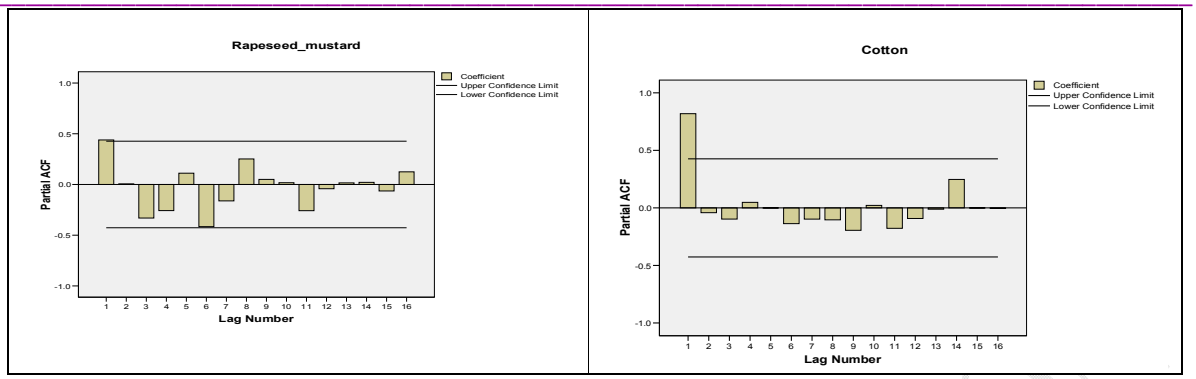


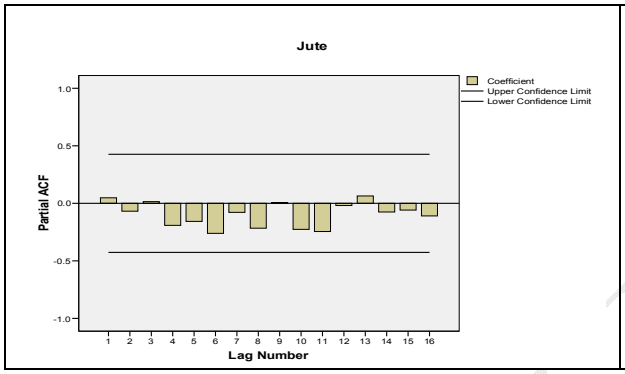


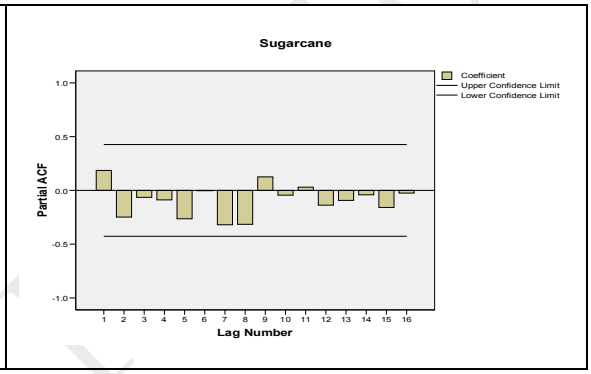

Coarse_cereals
Partial ACF
Lag Number
Coefficient
Upper Confidence
Lower Confidence
Pulses
Partial ACF
Lag Number
Coefficient
Upper Confidence
Lower Confidence

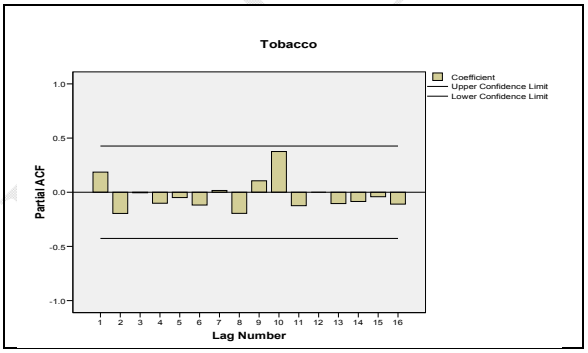

Nonfood_grains
Partial ACF
Lag Number
Coefficient
Upper Confidence
Lower Confidence
Oil_seeds
Partial ACF
Lag Number
Coefficient
Upper Confidence
Lower Confidence


groundnut
Partial ACF
Lag Number
Coefficient
Upper Confidence Limit
Lower Confidence Limit
sesamum
Partial ACF
Lag Number
Coefficient
Upper Confidence Limit
Lower Confidence Limit









Interpretation

From the PACF graphs we observed that series is not stationary. From the PACF graphs food grain, non-food grain, Rapeseed/ mustard and cotton are at 1 lag is out of control the limit. Most likely that there will be problem of autocorrelation in this final proposed model. Also observing the PACF of the fitted model 10th lag is going out of the control limits, but test for 10th order autocorrelation cannot be done because of small sample size.

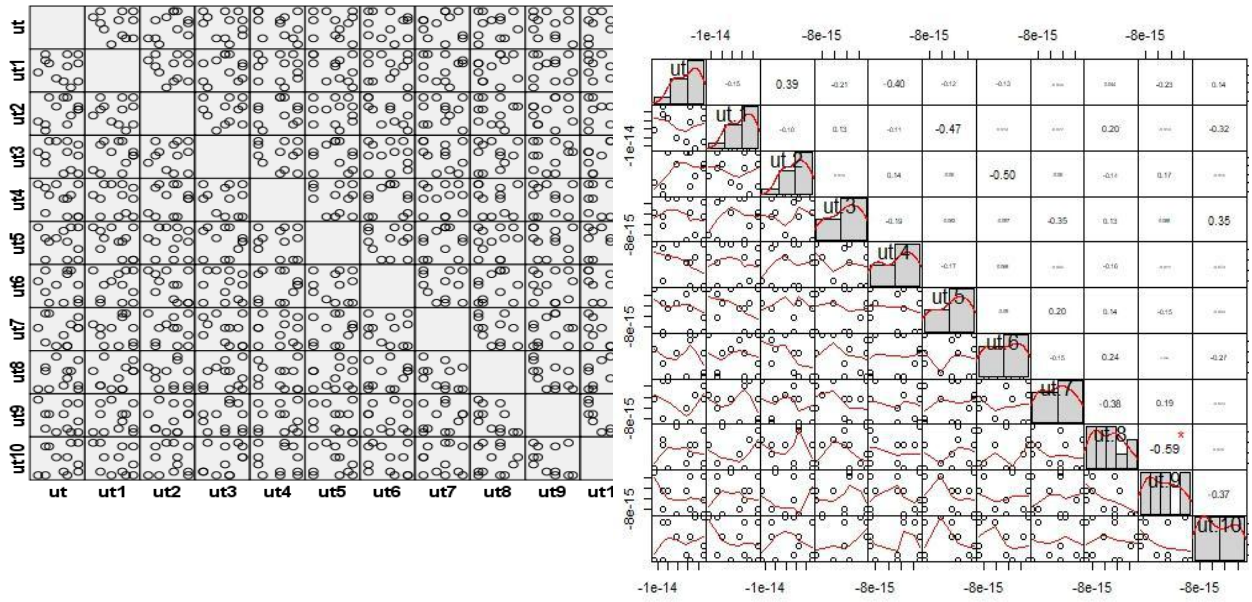
Heteroscedasticity:

H_0: There are Homoscedasticity in the residual.
H_1: There are Hetroscedasticity in the residual.

Observation	Predicted All crops	Residuals	|ui^|	ui^2
1	4.661289	-8.9E-16	8.88178E-16	7.89E-31
2	4.635597	-1.8E-15	1.77636E-15	3.16E-30
3	4.718789	-8E-15	7.99361E-15	6.39E-29
4	4.666655	-4.4E-15	4.44089E-15	1.97E-29
5	4.718789	-8E-15	7.99361E-15	6.39E-29
6	4.739616	-6.2E-15	6.21725E-15	3.87E-29
7	4.691572	-8.9E-15	8.88178E-15	7.89E-29
8	4.749517	-1.8E-15	1.77636E-15	3.16E-30
9	4.612461	-4.4E-15	4.44089E-15	1.97E-29
10	4.683335	-8.9E-15	8.88178E-15	7.89E-29
11	4.66742	-8.9E-16	8.88178E-16	7.89E-31
12	4.782057	-8.9E-15	8.88178E-15	7.89E-29
13	4.915759	-4.4E-15	4.44089E-15	1.97E-29
14	4.945699	-3.6E-15	3.55271E-15	1.26E-29
15	5.266332	-8.9E-16	8.88178E-16	7.89E-31
16	5.287159	-8.9E-16	8.88178E-16	7.89E-31
17	5.239115	-3.6E-15	3.55271E-15	1.26E-29
18	5.29706	-8E-15	7.99361E-15	6.39E-29
19	5.160004	-6.2E-15	6.21725E-15	3.87E-29
20	5.230878	-1.1E-14	1.06581E-14	1.14E-28
21	5.214963	-2.7E-15	2.66454E-15	7.1E-30
22	5.3296	-8.9E-15	8.88178E-15	7.89E-29

All crops	r	tcal	t_{tab}	p-value	Result
Food- grains	0.112	0.504050609	2.085963	0.619733	p-value>α ,so we accept Ho.
Cereals	0.235	1.081231435		0.29246	p-value>α ,so we accept Ho.
Rice	0.233	1.071498824		0.296706	p-value>α ,so we accept Ho.
Wheat	0.165	0.748156996		0.463073	p-value>α ,so we accept Ho.
Coarse cereals	0.357	1.709180005		0.10289	p-value>α ,so we accept Ho.
Pulses	0.135	0.60931628		0.549175	p-value>α ,so we accept Ho.
Non- food- grains	0.058	0.259821273		0.797658	p-value>α ,so we accept Ho.
Oil- seeds	0.273	1.26910115		0.218976	p-value>α ,so we accept Ho.
Ground- nut	0.216	0.989336268		0.334318	p-value>α ,so we accept Ho.
Sesamum	0.163	0.738839347		0.468587	P-value>α, so we accept Ho.
Rape- seed/ Mustard	0.1	0.449466575		0.657928	p-value>α ,so we accept Ho.
Cotton (Lint)	0.003	0.013416468		0.989428	p-value>α ,so we accept Ho.
Jute	0.406	1.986804562		0.060816	p-value>α ,so we accept Ho.
Sugar cane	-0.107	-0.481281575		0.63554	
Tobacco	-0.087	-0.390556697		0.700254	p-value<α ,so we reject Ho.

Residual analysis



Interpretation:

From the scatter plot we observed that there is a no relation between residual and lag residuals. So we can say that there is a no problem of hetroscedastcity.

Conclusion:

From the Correlation chart we can see that pairs of variable is having statistically significant correlation or not and also show that it's sap linear or nonlinear. Here all residual term are nonlinear and normal curve arenegatively skewness.

Interpretation:

Here, P value >α so we accept H_0 i.e. The residual are Homoscedasticity.
GVLMA (Global Validation of Linear Models Assumptions)

Coefficients:

(Intercept)	Food grains	Cereals	Rice
5.528e-01	-3.950e-01	6.436e+00	-2.705e+00
Wheat	Coarse cereals	Pulses	Non-food grains
-1.981e+00	-9.833e-01	1.554e-01	1.218e+00
Oil seeds	Ground nut	Sesamum	Rapeseed Mustard
-9.393e-02	-1.997e-02	4.786e-02	-1.744e-01
Cotton (Lint)	Jute	Sugarcane	Tobacco
1.707e-01	-8.183e-02	-6.968e-01	2.046e-08

ASSESSMENT OF THE LINEAR MODEL ASSUMPTIONS USING THE GLOBAL TEST ON 4 DEGREES-OF-FREEDOM:

Level of Significance = 0.05

	Value	p-value	Decision
Global Stat	2.869e+00	0.5800	Assumptions acceptable.
Skewness	4.537e-13	1.0000	Assumptions acceptable.
Kurtosis	3.652e-01	0.5456	Assumptions acceptable.
Link Function	8.425e-01	0.3587	Assumptions acceptable.
Heteroscedasticity	1.661e+00	0.1975	Assumptions acceptable.

Multicolinearity:

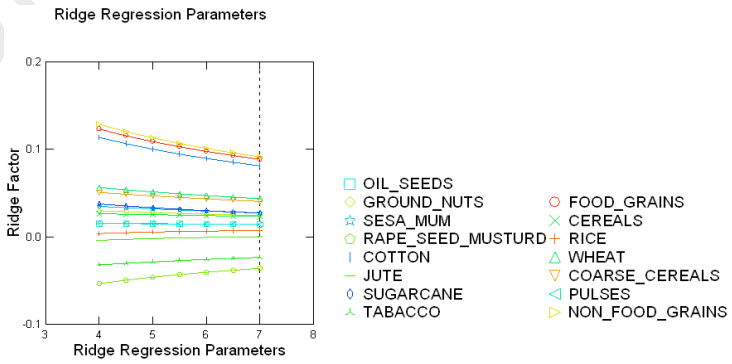
Model	Colinearity statistics	
(Constant)	VIF	Tolerance
Food_ grain	362.020837	0.002762272
Rice	122.655936	0.008152887
Wheat	88.147676	0.011344599
Coarse cereals	506.572249	0.001974052
Pulses	63.4955951	0.015749124
Oilseeds	380.355555	0.002629119
Groundnut	72.6658549	0.013761622
Sesamum	70.7497625	0.014134323
Rapeseed mustard	62.6057689	0.015972969
Cotton	302.912832	0.00330128
Jute	63.6094475	0.015720935
Sugarcane	7.30880939	0.13682119
Tobacco	85.2811014	0.011725927

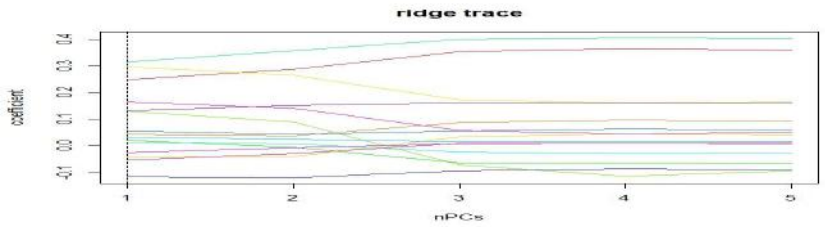
Conclusion:

From the multicollinearity table VIF > 10 so there is problem of multicolinearity.
Here, problem of multicollinerity so we use the ridge regression for remove the multicollinearity:

Ridge Regression:

Hoerl-Kennard-Baldwin (HKB) Estimator	:	0
Lawless & Wang (LW) Estimator	:	0
Minimum Value of Generalized Cross Validation (GCV) is at Lambda	:	6.1





Coefficients:

	Estimate sealed	Estimate std	Error sealed	t value sealed	Pr(>|t|)
(Intercept)	-1.02078	NA	NA	NA	NA
Food...grains	0.24904	0.30448	0.01518	20.061	< 2e-16 ***
Cereals	0.04290	0.02123	0.01210	1.754	0.07937
Rice	-0.04148	-0.02803	0.01625	1.726	0.08443
Wheat	0.29653	0.09579	0.02398	3.995	6.47e-05 ***
Coarse cereals	0.12962	0.07018	0.01478	4.747	2.06e-06 ***
Pulses	0.02186	0.01083	0.02179	0.497	0.61916
Non-food grains	0.31519	0.32591	0.01567	20.802	< 2e-16 ***
Oil seeds	0.01320	0.01100	0.01702	0.646	0.51807
Groundnut	0.03229	0.03850	0.02771	1.390	0.16468
Sesamum	0.05697	0.04749	0.02850	1.666	0.09572
Rapeseed Mustard	-0.11679	-0.13650	0.02523	5.411	6.27e-08 ***
Cotton Lint	0.13138	0.29399	0.02045	14.374	< 2e-16 ***
Jute	-0.02454	-0.01956	0.02827	0.692	0.48899
Sugarcane	0.16483	0.07785	0.02899	2.685	0.00725 **
Tobacco	-0.05250	-0.04483	0.02689	1.667	0.09546