A Statistical Study of Three Major Crops of India

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ABSTRACT
Agriculture is largest and important sector of Indian Economy. The major objective of this paper is to examine the production growth of food grains for different seasons for the sustainability of agricultural sector in the next decade. The analytics considers the data for the period of 2003-2016. The major conclusions drawn from this paper is that the various crop productions show that a major increase almost in total output over the years. This paper recommends some measures as a positive step to improve the production of crop of the agricultural sector in India.

Keywords
Major crops, Rice, Jowar and Maize ,Analysis of variance, Most common hoc tests ,Regression, Statistical significance.

1. INTRODUCTION
Agriculture is the largest and an important sector in Indian economy. It is indispensible for the sustenance and growth of Indian economy. India is a large producer of several agricultural products. In terms of quantity of production, India is the second largest producer in jowar and rice. In this study, the objective is to study major agricultural crop production(Ajit Kaur Bhatia, Rajender Prasad, S.K Shama and Rajinder Kaur (2005);J S Dhekale, Rajendar Prasad and V K Gupta (2003)). The secondary source data is used to see if any pattern can be observed and is studied by analyzing the data with some popular statistical techniques. (Mann, Prem S (1995);Trochim, William M.K (2006);Jaccard. J; Becker, M.A.Wood.G (1984).;Bailey R.A (2008);Cochran, William G; Cox, Gertrude M (1992);Ronald A Fisher(1954);Ajit Kaur Bhatia, Rajender Prasad, S.K Shama and Rajinder Kaur (2005);J S Dhekale, Rajendar Prasad and V K Gupta (2003)). Three major agricultural crops, viz., Rice, Jowar and Maize have been considered under Rabi and Kharif seasons

2. DATA DESCRIPTION AND SOURCE OF DATA
Here, the Secondary data is collected from Agricultural Statistics Division, Directorate of Economics and Statistics, Department of Agriculture, Cooperation and Farmers welfare. The data is collected for the years 2003-2016 for three major crops rice, jowar and maize for two seasons Rabi and Kharif.

Table 1: Production in million tones

Crop	Season	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10
Rice	Kharif	78.62	72.23	78.27	80.17	82.66	84.91	75.92
	Rabi	9.91	10.90	13.52	13.18	14.03	14.27	13.18
Jowar	Kharif	4.84	4.04	4.07	3.71	4.11	3.05	2.76
	Rabi	1.84	3.20	3.56	3.44	3.81	4.19	3.93
Maize	Kharif	12.73	11.48	12.16	11.56	15.11	14.12	12.29
	Rabi	2.25	2.70	2.55	3.54	3.85	5.61	4.43

Table 1: Production in million tones (continued)

Crop	Season	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16
Rice	Kharif	80.65	92.78	92.37	91.50	91.39	90.59
	Rabi	15.33	12.52	12.87	15.15	14.09	12.77
Jowar	Kharif	3.44	3.29	2.84	2.39	2.30	1.87
	Rabi	3.56	2.69	2.44	3.15	3.15	2.72

Maize	Kharif	16.64	16.49	16.19	17.14	17.01	15.50
	Rabi	5.09	5.27	6.06	7.11	7.16	5.53

3. DATA ANALYSIS OF THE DATA

3.1 Descriptive Statistics

Descriptive Statistics are used to describe the basic features of the data in a study. They provide simple summaries about the sample and the measures. Descriptive Statistics provides a quick method to make comparisons between different data sets and to spot the smallest and largest values and trends or changes over a period of time.In the data set various descriptive comparisons have made for three major crops rice, jowar and maize during Rabi and Kharif. These measures show what value is in the middle of this data? And where does

a particular data value stand with respect, with the other values in the data set? For instance in the table mean Rabi rice production is 13.2092 million tones. This single number describes that the estimated production in any year should be around 13.2092 million tones. Dispersion refers to the spread of the values around the central tendency (mean).There are two common measures of dispersion, Range and Standard deviation. Range is simply the highest value minus lowest value. For the above data, for instance, for Rabi season the rice production has the highest production which is 15.33 tones and lowest production is 9.91 tones. So for Rabi season the rice production range is15.33-9.91=5.42.The standard deviation is a more accurate and detailed estimate of dispersion .The standard deviation shows the relation that set of production values to the mean of the sample. The standard deviation allows us to reach some conclusions about specific production values in our distribution (Table 2).

Table 2: Descriptives

	N	Mean	Standard Deviation	Std.Error
Rabi_rice	13	13.2092	1.5282	0.42319
Kharif_rice	13	84.0123	7.05369	1.95634
Rabi_jowar	13	3.2062	0.65346	0.18124
Kharif_jowar	13	3.2854	0.85596	0.23740
Rabi_maize	13	4.7038	1.64492	0.45662
Kharif_maize	13	13.9554	3.35836	0.93144
Total	78	20.3954	29.16088	3.30182

Table 2: Descriptives(continued)

95% Confidence Interval for Mean		Minimum	Maximum
Lower Bound	Upper Bound		
12.2872	14.1313	9.91	15.33
79.7498	88.2748	72.23	92.78
2.8113	3.6010	1.84	4.19
2.7681	3.8026	1.87	4.84
3.7098	5.6979	2.25	7.16
11.9259	15.9848	5.16	17.14
13.8206	26.9701	1.84	92.78

3.2 One Way ANOVA

The overall ANOVA is seen for all crops Rabi and Kharif seasons the Rice, Jowar and Maize production there is more significant difference between the groups of Rabi and kharif of Rice , Jowar and Maize crops indicating that for all the years the average production is not the same and has variations indicating that there is some sort of environmental and other climatic changes show this variation (table 3).

Table 3:ANOVA

rabi_rice

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	64670.755	5	12934.151	1154.376	.000
Within Groups	806.721	72	11.204		
Total	65477.476	77			

3.3 Post Hoc Tests

From Table 4 given below, it is clear that Post hoc analysis is a step wise multiple comparisons procedure used to identify sample means that are significantly different from each other .Post hoc test is used whenever a significant difference between three or more sample means has been revealed by an analysis of variance (ANOVA) test .The most common hoc tests are Tukey HSD, Scheff, LSD (Fisher's least significant difference), Bonferroni, Dunnett t (2 sided) tests. All these tests are used to determine whether any of the differences between means are statistically different. These tests are used to find out which pairs of means are significant. To determine the difference the p value is tested at 5% los (significant value) to assess the null hypothesis. The null hypothesis states that all means are equal usually a significant level (denoted as p or alpha) of 0.05 works well. If p>0.05 then there is no significant difference between means of different groups. In the above table 3 the mean differences with the symbol * has significant difference between group means.

Table 4 :Multiple Comparisons

Dependent Variable: rabi_rice

	(I) target	(J) target	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Tukey HSD	Rabi_rice	Kharif_rice	-70.80308*	1.31292	.000	-74.6471	-66.9590
		rabi_jowar	10.00308*	1.31292	.000	6.1590	13.8471
		kharif_jowar	9.92385*	1.31292	.000	6.0798	13.7679
		rabi_maize	8.50538*	1.31292	.000	4.6613	12.3494
		kharif_maize	-.74615	1.31292	.993	-4.5902	3.0979
	Kharif_rice	Rabi_rice	70.80308*	1.31292	.000	66.9590	74.6471
		rabi_jowar	80.80615*	1.31292	.000	76.9621	84.6502
		kharif_jowar	80.72692*	1.31292	.000	76.8829	84.5710
		rabi_maize	79.30846*	1.31292	.000	75.4644	83.1525
		kharif_maize	70.05692*	1.31292	.000	66.2129	73.9010
	rabi_jowar	Rabi_rice	-10.00308*	1.31292	.000	-13.8471	-6.1590
		Kharif_rice	-80.80615*	1.31292	.000	-84.6502	-76.9621
		kharif_jowar	-.07923	1.31292	1.000	-3.9233	3.7648
		rabi_maize	-1.49769	1.31292	.863	-5.3417	2.3464
		kharif_maize	-10.74923*	1.31292	.000	-14.5933	-6.9052
	kharif_jowar	Rabi_rice	-9.92385*	1.31292	.000	-13.7679	-6.0798
		Kharif_rice	-80.72692*	1.31292	.000	-84.5710	-76.8829
		rabi_jowar	.07923	1.31292	1.000	-3.7648	3.9233
		rabi_maize	-1.41846	1.31292	.888	-5.2625	2.4256
		kharif_maize	-10.67000*	1.31292	.000	-14.5141	-6.8259
	rabi_maize	Rabi_rice	-8.50538*	1.31292	.000	-12.3494	-4.6613
		Kharif_rice	-79.30846*	1.31292	.000	-83.1525	-75.4644
		rabi_jowar	1.49769	1.31292	.863	-2.3464	5.3417
		kharif_jowar	1.41846	1.31292	.888	-2.4256	5.2625
		kharif_maize	-9.25154*	1.31292	.000	-13.0956	-5.4075
	kharif_maize	Rabi_rice	.74615	1.31292	.993	-3.0979	4.5902
		Kharif_rice	-70.05692*	1.31292	.000	-73.9010	-66.2129
		rabi_jowar	10.74923*	1.31292	.000	6.9052	14.5933
		kharif_jowar	10.67000*	1.31292	.000	6.8259	14.5141
		rabi_maize	9.25154*	1.31292	.000	5.4075	13.0956
Scheffe	Rabi_rice	Kharif_rice	-70.80308*	1.31292	.000	-75.2957	-66.3104
		rabi_jowar	10.00308*	1.31292	.000	5.5104	14.4957
		kharif_jowar	9.92385*	1.31292	.000	5.4312	14.4165
		rabi_maize	8.50538*	1.31292	.000	4.0127	12.9980
		kharif_maize	-.74615	1.31292	.997	-5.2388	3.7465
	Kharif_rice	Rabi_rice	70.80308*	1.31292	.000	66.3104	75.2957
		rabi_jowar	80.80615*	1.31292	.000	76.3135	85.2988
		kharif_jowar	80.72692*	1.31292	.000	76.2343	85.2196

		rabi_maize	79.30846*	1.31292	.000	74.8158	83.8011
		kharif_maize	70.05692*	1.31292	.000	65.5643	74.5496
	rabi_jowar	Rabi_rice	-10.00308*	1.31292	.000	-14.4957	-5.5104
		Kharif_rice	-80.80615*	1.31292	.000	-85.2988	-76.3135
		kharif_jowar	-.07923	1.31292	1.000	-4.5719	4.4134
		rabi_maize	-1.49769	1.31292	.933	-5.9903	2.9949
		kharif_maize	-10.74923*	1.31292	.000	-15.2419	-6.2566
	kharif_jowar	Rabi_rice	-9.92385*	1.31292	.000	-14.4165	-5.4312
		Kharif_rice	-80.72692*	1.31292	.000	-85.2196	-76.2343
		rabi_jowar	.07923	1.31292	1.000	-4.4134	4.5719
		rabi_maize	-1.41846	1.31292	.947	-5.9111	3.0742
		kharif_maize	-10.67000*	1.31292	.000	-15.1626	-6.1774
	rabi_maize	Rabi_rice	-8.50538*	1.31292	.000	-12.9980	-4.0127
		Kharif_rice	-79.30846*	1.31292	.000	-83.8011	-74.8158
		rabi_jowar	1.49769	1.31292	.933	-2.9949	5.9903
		kharif_jowar	1.41846	1.31292	.947	-3.0742	5.9111
		kharif_maize	-9.25154*	1.31292	.000	-13.7442	-4.7589
	kharif_maize	Rabi_rice	.74615	1.31292	.997	-3.7465	5.2388
		Kharif_rice	-70.05692*	1.31292	.000	-74.5496	-65.5643
		rabi_jowar	10.74923*	1.31292	.000	6.2566	15.2419
		kharif_jowar	10.67000*	1.31292	.000	6.1774	15.1626
		rabi_maize	9.25154*	1.31292	.000	4.7589	13.7442
LSD	Rabi_rice	Kharif_rice	-70.80308*	1.31292	.000	-73.4203	-68.1858
		rabi_jowar	10.00308*	1.31292	.000	7.3858	12.6203
		kharif_jowar	9.92385*	1.31292	.000	7.3066	12.5411
		rabi_maize	8.50538*	1.31292	.000	5.8881	11.1226
		kharif_maize	-.74615	1.31292	.572	-3.3634	1.8711
	Kharif_rice	Rabi_rice	70.80308*	1.31292	.000	68.1858	73.4203
		rabi_jowar	80.80615*	1.31292	.000	78.1889	83.4234
		kharif_jowar	80.72692*	1.31292	.000	78.1097	83.3442
		rabi_maize	79.30846*	1.31292	.000	76.6912	81.9257
		kharif_maize	70.05692*	1.31292	.000	67.4397	72.6742
	rabi_jowar	Rabi_rice	-10.00308*	1.31292	.000	-12.6203	-7.3858
		Kharif_rice	-80.80615*	1.31292	.000	-83.4234	-78.1889
		kharif_jowar	-.07923	1.31292	.952	-2.6965	2.5380
		rabi_maize	-1.49769	1.31292	.258	-4.1150	1.1196
		kharif_maize	-10.74923*	1.31292	.000	-13.3665	-8.1320
	kharif_jowar	Rabi_rice	-9.92385*	1.31292	.000	-12.5411	-7.3066
		Kharif_rice	-80.72692*	1.31292	.000	-83.3442	-78.1097
		rabi_jowar	.07923	1.31292	.952	-2.5380	2.6965
		rabi_maize	-1.41846	1.31292	.284	-4.0357	1.1988
		kharif_maize	-10.67000*	1.31292	.000	-13.2873	-8.0527

	rabi_maize	Rabi_rice	-8.50538*	1.31292	.000	-11.1226	-5.8881
		Kharif_rice	-79.30846*	1.31292	.000	-81.9257	-76.6912
		rabi_jowar	1.49769	1.31292	.258	-1.1196	4.1150
		kharif_jowar	1.41846	1.31292	.284	-1.1988	4.0357
		kharif_maize	-9.25154*	1.31292	.000	-11.8688	-6.6343
	kharif_maize	Rabi_rice	.74615	1.31292	.572	-1.8711	3.3634
		Kharif_rice	-70.05692*	1.31292	.000	-72.6742	-67.4397
		rabi_jowar	10.74923*	1.31292	.000	8.1320	13.3665
		kharif_jowar	10.67000*	1.31292	.000	8.0527	13.2873
		rabi_maize	9.25154*	1.31292	.000	6.6343	11.8688
Bonferroni	Rabi_rice	Kharif_rice	-70.80308*	1.31292	.000	-74.7895	-66.8167
		rabi_jowar	10.00308*	1.31292	.000	6.0167	13.9895
		kharif_jowar	9.92385*	1.31292	.000	5.9374	13.9103
		rabi_maize	8.50538*	1.31292	.000	4.5190	12.4918
		kharif_maize	-.74615	1.31292	1.000	-4.7326	3.2403
	Kharif_rice	Rabi_rice	70.80308*	1.31292	.000	66.8167	74.7895
		rabi_jowar	80.80615*	1.31292	.000	76.8197	84.7926
		kharif_jowar	80.72692*	1.31292	.000	76.7405	84.7133
		rabi_maize	79.30846*	1.31292	.000	75.3221	83.2949
		kharif_maize	70.05692*	1.31292	.000	66.0705	74.0433
	rabi_jowar	Rabi_rice	-10.00308*	1.31292	.000	-13.9895	-6.0167
		Kharif_rice	-80.80615*	1.31292	.000	-84.7926	-76.8197
		kharif_jowar	-.07923	1.31292	1.000	-4.0656	3.9072
		rabi_maize	-1.49769	1.31292	1.000	-5.4841	2.4887
		kharif_maize	-10.74923*	1.31292	.000	-14.7356	-6.7628
	kharif_jowar	Rabi_rice	-9.92385*	1.31292	.000	-13.9103	-5.9374
		Kharif_rice	-80.72692*	1.31292	.000	-84.7133	-76.7405
		rabi_jowar	.07923	1.31292	1.000	-3.9072	4.0656
		rabi_maize	-1.41846	1.31292	1.000	-5.4049	2.5679
		kharif_maize	-10.67000*	1.31292	.000	-14.6564	-6.6836
	rabi_maize	Rabi_rice	-8.50538*	1.31292	.000	-12.4918	-4.5190
		Kharif_rice	-79.30846*	1.31292	.000	-83.2949	-75.3221
		rabi_jowar	1.49769	1.31292	1.000	-2.4887	5.4841
		kharif_jowar	1.41846	1.31292	1.000	-2.5679	5.4049
		kharif_maize	-9.25154*	1.31292	.000	-13.2379	-5.2651
	kharif_maize	Rabi_rice	.74615	1.31292	1.000	-3.2403	4.7326
		Kharif_rice	-70.05692*	1.31292	.000	-74.0433	-66.0705
		rabi_jowar	10.74923*	1.31292	.000	6.7628	14.7356
		kharif_jowar	10.67000*	1.31292	.000	6.6836	14.6564
		rabi_maize	9.25154*	1.31292	.000	5.2651	13.2379

Dunnett t (2-sided)[b]	Rabi_rice	kharif_maize	-.74615	1.31292	.970	-4.1210	2.6287
	Kharif_rice	kharif_maize	70.05692*	1.31292	.000	66.6821	73.4317
	rabi_jowar	kharif_maize	-10.74923*	1.31292	.000	-14.1240	-7.3744
	kharif_jowar	kharif_maize	-10.67000*	1.31292	.000	-14.0448	-7.2952
	rabi_maize	kharif_maize	-9.25154*	1.31292	.000	-12.6263	-5.8767
*. The mean difference is significant at the 0.05 level.							
b. Dunnett t-tests treat one group as a control, and compare all other groups against it.							

3.4 Homogenous Subsets

Table 5:Homogeneous Subsets rabi_rice

	target	N	Subset for alpha = 0.05		
			1	2	3
Tukey HSD	rabi_jowar	13	3.2062		
	kharif_jowar	13	3.2854		
	rabi_maize	13	4.7038		
	Rabi_rice	13		13.2092	
	kharif_maize	13		13.9554	
	Kharif_rice	13			84.0123
	Sig.		.863	.993	1.000
Scheffe	rabi_jowar	13	3.2062		
	kharif_jowar	13	3.2854		
	rabi_maize	13	4.7038		
	Rabi_rice	13		13.2092	
	kharif_maize	13		13.9554	
	Kharif_rice	13			84.0123
	Sig.		.933	.997	1.000
Means for groups in homogeneous subsets are displayed.					
a. Uses Harmonic Mean Sample Size = 13.000.					

The homogenous subsets output is produced by a request for post hoc test and addresses the same questions as the multiple comparisons table for post hoc analysis i.e. which pair of groups have significantly different means on the dependent variable.

3.5 Means Plot

Means plot figure is used to see if the mean varies between different groups of the data. In the above sample plot different crops with different seasons provide the grouping. A mean plot can then be generated with these groups to see if the mean is increasing or decreasing over the time. This sample plot shows a shift of location after Kharif rice.

Also, linear regression has been fitted for three crops and it has been found that during Rabi season the production of Rice and Jowar seem to be the same during this season. Maize has a significant production indicating that a change when compared to Rice and Jowar, while during Kharif there is a clear cut significant production for all the three crops that is Rice, Jowar and Maize. Thus, this analysis indicates a significant pattern during Kharif and a different pattern during Rabi seasons.

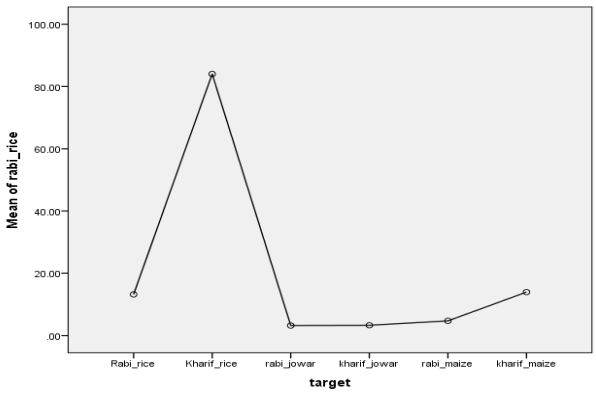

Fig1: Means Plot

3.6 Regression Analysis

3.6.1 Regression Analysis for rabi_rice

Table 6: Variables Entered/Removed

Model	Variables Entered	Variables Removed	Method
1	Year	.	Enter

a. Dependent Variable: rabi_rice.

b. All requested variables entered.

Table 7: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.515	.265	.199	1.36585

a. Predictors: (Constant), year

Table8: ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
	Regression	7.417	1	7.417	3.976	.072

	Residual	20.521	11	1.866		
	Total	27.938	12			

a. Dependent Variable: rabi_rice

b. Predictors: (Constant), year

Table 9 :Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
	Constant	-392.344	203.399		-1.929	.080
	year	.202	.101	.515	1.994	.072

a. Dependent Variable: rabi_rice

3.6.2 Regression Analysis for kharif_rice

Table 10: Variables Entered/Removed

Model	Variables Entered	Variables Removed	Method
1	year	.	Enter

a) Dependent Variable: kharif_rice
b) All requested variables entered.

Table 11: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.830	.688	.660	4.11200

a. Predictors: (Constant), year

Table 12: ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
	Regression	411.061	1	411.061	24.11	.000
	Residual	185.994	11	16.909		
	Total	597.055	12			

a) Dependent Variable: kharif_rice

b) Predictors: (Constant), year

Table 13 :Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
	Constant	-2935.228	612.347		4.793	.001
	year	1.503	.305	.830	4.931	.000

a. Dependent Variable: kharif_rice

3.6.3 Regression Analysis for rabi_jowar

Table 14: Variables Entered/Removed

Model	Variables Entered	Variables Removed	Method
1	Year	.	Enter

a) Dependent Variable: rabi_jowar.

b) All requested variables entered

Table 15: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.81	.007	.084	0.68026

b. Predictors: (Constant), year

Table 16: ANOVA

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	0.34	1	.034	.073	.792
Residual	5.090	11	.463		
Total	5.124	12			

a) Dependent Variable: rabi_jowar

b) Predictors: (Constant), year

Table 17: Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
	Constant	30.582	101.303		.302	.768
	year	-0.014	.050	.081	.270	.792

a. Dependent Variable: rabi_jowar

3.6.4 Regression Analysis for kharif_jowar

Table 18: Variables Entered/Removed

Model	Variables Entered	Variables Removed	Method
1	Year	.	Enter

a. Dependent Variable: kharif_jowar.

b. All requested variables entered

Table 19: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.927	.860	.847	0.33429

c. Predictors: (Constant), year

Table 20: ANOVA

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	7.563	1	7.563	67.676	.000
Residual	1.229	11	.112		
Total	8.792	12			

a) Dependent Variable: kharif_jowar

b) Predictors: (Constant), year

Table 21: Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
	Constant	412.812	49.781		8.293	.000
	year	-.204	.025	-.927	-8.227	.000

a. Dependent Variable: kharif_jowar

3.6.4 Regression Analysis for maize_rabi

Table 22: Variables Entered/Removed

Model	Variables Entered	Variables Removed	Method
1	Year	.	Enter

a) Dependent Variable: maize_rabi

b) All requested variables entered.

Table 23: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.912	.832	.816	0.70511

d. Predictors: (Constant), year

Table 24: ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
	Regression	27.000	1	27.000	53.306	.000
	Residual	5.469	11	.497		
	Total	32.469	12			

a) Dependent Variable: maize_rabi

b) Predictors: (Constant), year

Table 25 : Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
	Constant	-769.092	105.004		-7.324	.000
	year	.385	.052	.912	-7.369	.000

a. Dependent Variable: maize_rabi.

3.6.6 Regression Analysis for maize_kharif

Table 26: Variables Entered/Removed

Model	Variables Entered	Variables Removed	Method
1	Year	.	Enter

a) Dependent Variable: maize_kharif

b) All requested variables entered

Table 27: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.710	.503	.458	2.47175

e. Predictors: (Constant), year

Table 28: ANOVA

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	68.138	1	68.138	11.153	.007
Residual	67.205	11	6.110		
Total	135.343	12			

a) Dependent Variable: maize_kharif

b) . Predictors: (Constant), year

Table 29: Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
	Constant	-1215.28	368.086		-3.302	.007
	year	.612	.183	.710	-3.340	.007

a. Dependent Variable: maize_kharif.

b. Dependent Variable: maize_kharif.

For Regression analysis, for instance if we take maize_kharif in Model summary table (table 27), the table provides R and R^2 values. The R value represents the simple correlation and is 0.710, which indicates a high degree of Correlation, the R^2 value indicates how much of the total variation in the dependent variable(production for maize_kharif) can be explained by the independent variable(year). In this case R^2 is 0.503 i.e. 50.3% can be explained, which is large. Increase in R^2 value means increase in the model's fit is statistically significant.

The next table is ANOVA table (table 28)which report how well the regression equation fit the data (i.e. predict the dependent variable). In this table the significance is 0.007>0.05 indicates that overall the regression model is not statistically significant .The coefficient table (table 29)provides us with necessary information to predict production from year as well as determine whether year contributes statistical significance to the model, it also shows the regression coefficients, intercept and the significance of all coefficients .It is found that linear regression analysis estimate the linear regression function to be y(production) = -1215.288+0.612*x(year) .

4. CONCLUSION

The significant value (p value) for each term tests the null hypothesis that the coefficient is equal to zero (no effect). A low p-value (<0.05) indicates the rejection of the null hypothesis. In other words a predictor that has a low p-value is likely to be a meaningful addition to this model because changes in the predictor's value are related to changes in the response variable. Conversely a larger (insignificant) p-value suggests that changes in the predictor are not associated with changes in the response (dependent variable) . The conclusion drawn can help in the future prediction of production of three major crops.

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