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TO MEASURE THE EXTENT OF VARIATION IN MAJOR PULSE CROP

D.P. Singh, M.S. Paikra, A.K. Thakur and Deo Shankar
S.G. College of Agriculture and Research Station, Jagdalpur
Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.) India

Abstract: Arhar, Moong, Urd and Kulthi are an important pulse crop of the Chhattisgarh, India. The data pertaining to area, production and productivity (yield) of important pulse crop were collected for different districts and state as a whole for the period of 14 years (1998 to 2011) from the Department of Agriculture, Govt. of Chhattisgarh, India. Among the pulse crop considered for the study in period I and period II. Mann-Whitney U test statistics and Friedman's two way variability test method such as used to test variability of area, production and productivity of different districts of Chhattisgarh, India.

Keyword: Area, production, pulse, Mann-Whitney U and Friedman

I. INTRODUCTION

Pulses dominantly constitute the staple diet of the people in India. India is the largest producer and consumer of pulses in the world. A study by the Tata Strategic Management Group analyses the pulses market in India to understand each state's contribution. India produces a quarter of the world's pulses, accounting for one third of the total acreage under pulses. Indians consume 30 per cent of the world's pulses, but domestic production of pulses has not kept pace with population growth. The top five states, which are Madhya Pradesh, Maharashtra, Uttar Pradesh, Rajasthan and Andhra Pradesh, account for over 75 per cent of total production. Madhya Pradesh is the highest pulse-producing state (3.2 million tonnes/annum) followed by Maharashtra and Uttar Pradesh. Pulses are important food crops due to their high protein and essential amino acid content. A pulse sometimes called a "grain legume". Arhar is the most common pulse eaten all over India. The production of urd is mostly confined to the Asian countries as their tropical climates and soil type suit the pulse's cultivation. The largest producer of this pulse is India followed by Myanmar and Thailand.

II. MATERIALS AND METHODS

Mann Whitney test is used to test variability in crop between two periods. The study period will be divided into two periods, period I (1998-2004) and period II (2004-2011) the significance different in Coefficient of Variation (CV) values of two periods based on various regions for each crop may be tested by Mann-Whitney test. Coefficient of variation of crop output will be computed for each district for both the period. The null Hypothesis $H_0 : CV(P_1) = CV(P_2)$ will be tested against the alternative hypothesis $H_1 : CV(P_1) \neq CV(P_2)$. The values CV's for a particular crop were combined for different district and arranged in ascending order and ranked 1 to n. Mann-Whitney U statistics is computed by following formula.

$$U = R1 - \frac{n(n+1)}{2}$$

Where U = Mann-Whitney statistics

n = Number of districts

R1 = Sum of ranks for first period

If the computed value is more than tabulated value the reject the null hypothesis which says that there is no difference in the CV of period first and second.

A. Friedman two way analyses

Variability based on crop output will be study for period I (1998-2004) and period II (2005-2011) separately by testing the null hypothesis that is different district belonging to populations corresponding to distribution function that are identical with each other, against the alternative hypothesis (H_1) that is some of the distribution function differ at least with respect to their location parameter. The shifting of the position of the districts, if any on the basis of variability (C.V.) can be studied between two periods with the help of this test.

Following steps are involved in application of Friedman's test.

1. Arrange C.V's of all crops for each district in ascending order in both the periods separately.
2. Districts are allotted ranks from 1 to K where K is number of districts under study for each crops separately for both periods I & II.

3. Obtained the total ranks over different order statistics for each districts in two period separately and
4. Compute the test statistics to test null-hypothesis against alternative hypothesis

$$\chi_r^2 = \frac{12}{Nk(k+1)} \sum_{i=1}^k R_i^2 \quad 3N(K-1)$$

Where

χ_r^2 = Friedman test statistics distributed as Chi-square variate (k-1) degrees of freedom.

K = number of districts

N= number of crops

R_i = The sum of ranks of the i^{th} districts and χ_r^2 is distributed as Chi-square variate with (k-1) degrees of freedom.

III. RESULTS AND DISCUSSION

Table 1.1 represent Mann-Whitney U Statistics value to test variability in different crops output between two period, period I (1998-2004) and period II (2004-2011) which is summarized below.

- 1.1 **Arhar** : All the sixteen district of Chhattisgarh are included in the analysis. The computed value (231) is more than the table value (64) at 5 per cent and sum of rank for the period I (367) is more than sum of ranks for period II (161).
- 1.2 **Moong**: All the sixteen district of Chhattisgarh are included in the analysis. The computed value (157) is lesser than Table value (64) 5 per cent and sum of rank for the period I (293) is more than sum of ranks for period II (235).
- 1.3 **Urd**: All the sixteen district of Chhattisgarh are included in the analysis. The computed value (149) is lesser than Table value (64) 5 per cent and sum of rank for the period I (285) is more than sum of ranks for period II (243).
- 1.4 **Kulthi**: All the sixteen district of Chhattisgarh are included in the analysis. The computed value (177) is lesser than Table value (51) 1 per cent and sum of rank for the period I (313) is more than sum of ranks for period II (215).

Table 1.1 Mann-Whitney Statistics (U) values to test variability in different crops output between two period, period I (1998-2004) and period II (2005-2011)

Crop	No. of Districts	Sum of Ranks		Mann-Whitney U
Arhar	16	367	161	231**
Moong	16	293	235	157 ^{NS}
Urd	16	285	243	149 ^{NS}
Kulthi	16	313	215	177 ^{NS}

Note:** Indicates significant at 0.01 percent and ^{NS} indicates Non-significant

Table 1.4 Variability between districts and crops with respect to yield and production

	Period I		Period II	
	χ_r^2	Significance	χ_r^2	Significance
Variability between districts (area)	21.79	0.01	33.46	0.01
Variability between crops (area)	20.21	0.01	6.15	0.11
Variability between districts (production)	21.81	0.01	24.81	0.01
Variability between crops (production)	14.93	0.01	1.13	0.54
Variability between districts (yield)	24.28	0.01	29.95	0.01
Variability between crops (yield)	24.52	0.01	3.97	0.44

Test of variability between districts and crops with respect to area and production

Test of variability between districts (area)

The calculated value of Friedman test statistics χ_r^2 (21.79) for period I and for period II (33.46) in different districts of Chhattisgarh, where the value for period I & period II is significant at 1 per cent. This implies that there is significant variability in area with respect to districts in period I than in period II.

Test of variability between crops (area)

The calculated value of Friedman test statistics χ_r^2 (20.21) for period I and χ_r^2 (6.15) for period II in between crop where the value for period I & period II is significant at 1 per cent and 11 per cent respectively, it implies that there is significant difference between crop area in period I & period II.

Test of variability between districts (production)

The calculated value of Friedman test statistics χ_r^2 (21.81) for period I and for period II (24.81) in different districts for production of Chhattisgarh, where the value for period I & period II is significant at 1 per cent. This implies that there is significant variability in production with respect to districts in period I than in period II.

Test of variability between crops (production)

The calculated value of Friedman test statistics χ_r^2 (14.93) for period I and χ_r^2 (1.13) for period II is significant at 5 percent and 1 percent respectively, it implies that there is significant difference between crop production in period I & period II.

Test of variability between districts (yield)

The calculated value of Friedman test statistics χ_r^2 (24.28) for period I and for period II (29.95) in different districts of Chhattisgarh which are significant at 1 per cent, implying acceptance of alternative hypothesis, i.e. the variability in district yields is different order during both period I and period II.

Test of variability between crops (Yield)

The calculated value of Friedman test statistics χ_r^2 (24.52) for period I and for period II (3.97) in different districts of Chhattisgarh which are statistically significant, implying the rejection of null hypothesis, i.e. the variability is presence among crop with respect to yield during both period I and period II.

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