SEASONALITY IN THE INCIDENCE OF STRIKES IN THE BOMBAY TEXTILE INDUSTRY

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1. Introduction

Strikes, apart from rates of labour turnover and absenteeism, constitute the only visible quantitative indicator of *articulate* industrial unrest. Scientific analysis of strike data will therefore be a valuable guide to any scheme attempted to lessen group tension.

In a paper presented at the International Statistical Conferences, 1951 (Som and Ray, 1951), we had studied the trends and the cycles of the frequency, the magnitude (average number of workers involved per strike), and the duration (average number of days lost per worker involved) of strikes—the three components of mandays lost due to strikes—in India for the period 1927-45. In this paper the existence of any seasonal variation in the incidence of strikes has been investigated into.

2. Previous studies

The Editor of the Labour Gazette (1926) did not seem to find any seasonal variation in strikes in Bombay. K. B. Madhava (1927) contended this and applying a test[1] to the strike data of 1921-26 for Bombay observed some seasonal effect during the second half of the year. Madhava and Poornapregna (1931) adjusted the total number of strikes in India for the period 1921-29 by a second degree curve and calculated the seasonal indices therefrom. The first half of the year was shown to have relatively larger number of strikes. Madhava and Krishna Murthy (1941) observed similar characteristics in the number of strikes in India for the period 1920-38.[2]

Strike figures have been seen to follow some seasonal pattern in other countries also. In the U.S.A., for example, studies notably by Florence Peterson (1937) and Dale Yoder (1938) have shown the number of strikes to increase during the spring months, maintain a fairly high level during the summer and fall, and then diminish with the advent of winter.

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[1] The observed number of strikes in each month was tested against the expected number, which was calculated as: total for a year/12 $= np$, and the variance $= npq$.

[2] N. S. R. Sastry (1947) observed a similar seasonal pattern in the days lost due to strikes in Indian industries for the period 1921-39.

3. Present study

The strike is essentially a social phenomenon and has to be studied in terms of group behaviour. For arriving at meaningful conclusions, the data on strikes must have distinguishable physical significance. We have noted earlier (Som and Ray, 1951) how the social, political, psychological and economic conditions may affect strikes; to have some understanding of the economic factors and underlying forces, studies have to be made in specific, homogeneous fields.

The strike pattern is expected to vary from place to place; and any real seasonal fluctuation of strikes in a particular industry (e.g., textiles) may conceivably be blurred and the individualities of the separate series submerged when data for all industries are lumped together. In the present paper the number of strikes "started in each month" in the textile industry in the Bombay province for 1943-51 (table 1) has been made the subject of investigation. The series of the number of strikes started in each month has purposely been considered as the items of that series do not overlap as those of the other series, that on the number of strikes in progress in each month, do.

Table 1. Strikes "Started in each month" in the Textile Industry in Bombay State[3]

year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1943	22	12	20	25	4	6	2	1	2	2	2	3
1944	4	6	5	9	8	3	0	2	5	8	4	11
1945	2	6	13	2	8	16	10	7	8	17	13	11
1946	24	32	10	30	33	20	32	22	19	31	11	14
1947	14	21	35	36	31	23	32	23	38	21	6	10
1948	18	12	31	12	23	17	13	12	8	17	7	16
1949	17	9	8	4	8	8	31	16	7	13	13	13
1950	7	12	10	8	10	9	2	5	4	9	9	15
1951	16	6	9	12	11	18	9	8	4	8	15	9

Source : *Labour Gazette* (Bombay), Vols. 23-32.

4. Testing the significance of seasonal variations

To test the significance of the seasonal variations, paired t's were calculated for each of the 66 combinations of the months. The paired t's were used because of the likely correlations between the figures for each pair of months. We have thus 66 t's, each with 8 degrees of freedom, the distribution of which is shown in Table 2.

[3] Strikes involving less than ten workers are excluded from these figures.

TABLE 2. DISTRIBUTION OF t (8 d.f.)

t		theoretical frequency	observed frequency
lower limit	upper limit		
	−3.355	0.33	—
	−2.896	0.33	—
	−2.306	0.99	1
	−1.860	1.65	—
	−1.397	3.3	1
	−1.108	3.3	2
	−0.889	3.3	—
	−0.706	3.3	1
	−0.546	3.3	2
	−0.399	3.3	3
	−0.262	3.3	4
	−0.130	3.3	2
	0	3.3 }	5
0		3.3 }	
0.130		3.3	6
0.262		3.3	2
0.399		3.3	2
0.546		3.3	3
0.706		3.3	8
0.889		3.3	2
1.108		3.3	6
1.397		3.3	11
1.860		1.65	4
2.306		0.99	1
2.896		0.33	—
3.355		0.33	—
	total	66	66

In calculating the t's, a definite order of months (starting from January) was followed. Although at the 5 per cent level of significance (2.5 per cent in each of the two tails) 3.3 of the 66 t's are expected to come out significant, while in our case there are two such t's, the preponderance of the positive t's is clearly manifest in table 2. A χ^2 calculated to test the consilience between the theoretical and the observed t-distributions is found to be $\chi^2=36.16$ (7 d.f.), with the probability of obtaining such a large χ^2 or larger by fortuitous causes lying much below 0.01. We should thus be inclined to reject the hypothesis of conformity and tentatively say that the incidence of strikes in the Bombay textile industry follows seasonal fluctuations, the predilection being for the earlier months.[4]

[4] In his study of American strikes, Yoder (1938) noted the number of t's which were significant at the 5% level of significance, and not the distribution of the 66 t's. This may give misleading results, as in the present example this would be tantamount to saying, on the basis of the two (out of the expected 3.3) t's significant at the 5% level of significance, that there is no real seasonal fluctuations in the incidence of strikes in the Bombay textile industry.

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	−0.546	3.3	2
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	−0.262	3.3	4
	−0.130	3.3	2
	0	3.3	5
0		3.3	
0.130		3.3	6
0.262		3.3	2
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0.546		3.3	3
0.706		3.3	8
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1.108		3.3	8
1.397		3.3	11
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The observed t's are however not independent and the present use of the t-distribution may perhaps be considered to be an unorthodox one. The approach is heuristic in nature, bearing pointers to further analysis.

As a next step, the method of analysis of variance has been applied. Though subject to limitations,[5] such a procedure for economic and social data is not unusual.

TABLE 3. ANALYSIS OF VARIANCE FOR THE DATA OF TABLE 1

variation due to	d.f.	mean square	F-ratio
year	8	537.83	15.30 **
month	11	132.64	3.70 **
error	88	35.02	

** Significant at 1% level.

The Year and the Month components come out highly significant, exceeding the 1 per cent level of significance. This confirms our previous conclusion. The analysis of variance is, however, not coterminous with the paired t's, one of the reasons being that it does not take cognizance of the correlation between the items. There is also the possibility that the influence of the secular trend may account for the differences between the months.

To eliminate the effect of trend (and cycle), the ingenious method of A. Wald (1936) was used.[6] If y_{ij} $(i=1, 2,\ldots,n; j=1, 2,\ldots,12)$ be the value of the original series in year i and month j, then with the assumptions:

(i) $y_{ij} = t_{ij}+s_{ij}+\epsilon_{ij}$, where t_{ij} is the sum of the trend and the cycle components, s_{ij} the seasonal component and ϵ_{ij} the random component in year i and month j;

(ii) $t_{ij}-T_{ij} \simeq 0$, where T_{ij} is the centred 12-month moving average of t_{ij};

(iii) $\bar{\epsilon} = \sum_{i,j} \epsilon_{ij}/12n \simeq 0$; $\bar{\epsilon}_j = \sum_i \epsilon_{ij}/n \simeq 0$;

(iv) the seasonal variation is composed of two parts: one strictly periodic with a period of 12 months and the other non-periodic, slowly changing its value with time;

Wald calculated the seasonal variations as follows:

The centred 12-month moving average is

$$Y_{ij} = [(y_{ij-6}+y_{ij+6})+2\sum_{h=-5}^{5} y_{ij+h}]/24;$$

the deviations of the values from the moving averages are

$$a_{ij} = y_{ij}-Y_{ij};$$

[5] Among the limitations, slight departure from normality, it is known (e.g., Gayen, 1950), does not usually vitiate the F-test.

[6] See Tintner (1952, Chap. 9).

the monthly means of these deviations are

$$\bar{a}_j = \sum_i a_{ij}/n.$$

The values of $\bar{a}_j$ are next corrected to make their sum equal zero:

$$\bar{a}'_j = \bar{a}_j - \frac{|\bar{a}_j|(\Sigma\bar{a}_j)}{\Sigma|\bar{a}_j|} .$$

The seasonal variation is then computed by the formula:

$$s_{ij} = \frac{\bar{a}'_j[\frac{1}{2}(\bar{a}'_{j-6}a_{ij-6}+\bar{a}'_{j+6}a_{ij+6})+\sum_{k=-5}^{5}\bar{a}'_{j+k}a_{ij+k}]}{\sum_j(\bar{a}'_j)^2} .$$

The seasonal variations s_{ij} as computed from the above formula are shown in Table 4.

TABLE 4. SEASONAL VARIATIONS

year	month											
	1	2	3	4	5	6	7	8	9	10	11	12
1944	1.52	0.60	6.41	−5.58	8.27	1.62	0.20	0.00	0.28	−2.07	−12.34	−2.24
1945	1.40	6.47	8.54	−12.00	20.56	12.05	4.15	3.22	−26.05	−5.74	−20.51	−9.52
1946	3.32	14.49	15.04	−17.38	48.03	20.67	6.07	3.10	20.57	−15.26	−52.38	−10.70
1947	4.70	21.97	16.95	−15.07	34.40	11.37	3.54	2.17	−18.08	−11.34	−58.89	−14.86
1948	5.90	25.62	34.75	−52.57	90.70	23.27	6.51	4.2[illegible]	−31.15	−11.24	−29.49	−1.65
1949	0.70	4.09	5.30	−6.01	4.73	−1.14	−0.33	−0.07	−3.30	−0.76	− 6.47	−4.14
1950	1.57	4.84	4.56	−5.80	13.96	4.61	1.32	0.05	−2.28	−0.14	3.28	0.46

The seasonal pattern is clear. The analysis of variance applied to the seasonals gives the result:

TABLE 5. ANALYSIS OF VARIANCE OF SEASONAL VARIATIONS

variation due to	d.f.	mean square	F-ratio
year	6	0.813	
month	11	18.029	9.15 **
error	66	1.970	

** Significant at 1% level.

The Month component stands out more clearly than before and comes out significant at the 1 per cent level, supporting our previous conclusions. The Year component is, on the other hand, not significant and shows that the use of the 12-month moving average has been successful in removing the trend and the cycle effects.

Tests thus go to show the presence of a seasonal pattern in the incidence of strikes in the textile industry in the Bombay State. Production in some industry is greatly influenced by the seasons, followed in the main by the frequency of strikes. Such then seems to be the present case.

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