THE PROGNOSTIC VALUE OF SCHEDULE RATING

BY
CHARLES N. YOUNG

INTRODUCTION

Since the inception of schedule rating, more than a dozen years ago, there has been a respectable minority of casualty men who have believed that the particular plan in use at any given time was hopelessly inadequate as a measure of differences in physical hazard. A somewhat smaller number, impressed with the unquestionable importance of the human element in industrial safety, have felt that any attempt to differentiate between plants on the basis of physical hazard was, and must forever remain, futile and unsatisfactory.

Thanks to the "noble discontent" of these men, and of those friends of the schedule who have recognized and have been willing to correct its apparent faults, several important changes in contents and structure have been made. Probably the most ardent opponents of schedule rating will concede that these changes mark progress, and that the present Industrial Compensation Rating Schedule comes closer to measuring the physical factors in industrial injury than did those which preceded it. At any rate, its use is now almost universal in this country; no effort has been made in this paper to compare it with any other schedule now in effect.

It is significant that those who speak of abolishing schedule rating generally affirm at the same time their faith in experience rating and in the possibility of obtaining thereby not only a more equitable risk rate, but also an even greater stimulus for the correction of unsafe conditions than is now afforded by the combined plans. It is with the relation of the schedule to equitable rates that this paper is primarily concerned. Equitable rates are and should remain the first concern of underwriting and of merit rating. After the underwriter has done his part, schedule and experience rating should converge on one object—the production of an equitable rate for the individual risk. If the application of the schedule does not, on the average, result in a closer approximation to actual cost of the individual risk than would be pro-

duced by the manual rate, then the necessity for modification or abolition of the schedule may be regarded as established. It was with the idea of substituting a definite analysis of this question for varied opinions, too often predicated on a background of isolated cases, that this paper was undertaken.

Method of Analysis

A group of sixty risks was taken by the simple process of including data for the current policy year on all risks consisting of one plant, subject both to schedule and experience rating, under consecutive letters of an alphabetical file. The total subject premium (Column 51 of Application for Experience Rating) for these sixty risks amounted to $366,593, a figure which is believed to be sufficiently large to justify the conclusion that the characteristics here investigated are not likely to differ widely from those of other random groups of similar size. Probable differences in the loss ratio of other groups are of only incidental interest in this connection, and will not affect the comparability of the results. It should be clearly kept in mind that the question is not whether any particular classification schedule, classification or state should be rated or not; however, as a matter of information, the distribution of risks by classification schedules is given in Table VI., and the distribution by states is given in Table VII.

The aggregate loss on any risk is subject to extreme variations, the swing of which is exceeded only by that of the "Excess" portion. The same considerations, therefore, which prompted the general adoption of a higher credibility factor for the "Normal" experience, dictate the use of Normal Expected Loss (Item 19) and Total Modified Normal Loss (Item 16) in measuring the degree of correspondence obtained by the application of the schedule. In other words, the value of the schedule is better measured by its possible reflection of the "Normal" cost of all injuries, than by the "Excess" cost of the less frequent and more fortuitous serious cases.

To determine the effect of eliminating schedule rating, Item 19 was recomputed at manual rates, for each risk. This quantity is herein referred to as "Normal Expected Loss, at Manual Rate," and is summarized in Column 3 of Table I., under eight items representing the various conditions encountered. A direct comparison of the approximation in each condition is then possi-

ble. For example, Column 10 shows that in 15 cases the manual premium was below the losses but approximated them more closely by $1,829, than did the schedule premium. These results together with corresponding totals for Columns 11, 12 and 13 are shown in the Summary of Results below this table. The findings are discussed under a subsequent heading.

A check on the method employed in Table I. was made in the following manner. The sixty risks were divided according to size, into two groups, aggregating approximately equal Normal Expected Loss, at Manual Rate. The first contained ten risks, aggregating $76,785 for this quantity, and $171,751 for the Total Premium Subject to Experience Rating. This is shown in Table II., together with the actual schedule and experience rates, expressed as index numbers, and the corresponding values of Items 19 and 16, from the Application for Experience Rating. The second contained fifty risks, each having a Normal Expected Loss, at Manual Rate, less than $4,000 and aggregating $80,797 for this quantity and $194,842 for the Total Premium Subject to Experience Rating. This is shown in Table IV., as indicated for Table II., above. Each of these groups was computed separately.

The Normal Expected Losses, at Manual Rate for each risk served as common denominators for two series of index numbers, whose numerators were the corresponding values for Items 19 and 16 respectively. It is apparent that, as the classifications subject to schedule rating contribute widely varying proportions of the total risk premium, no valid conclusions can be drawn from the schedule rate alone; this item is included, however, as a matter of information. It will perhaps be equally apparent that the difference in size of the risks in each group will prevent the arithmetic average of the index numbers described in this paragraph from being an acceptable average for the group. The true values are the weighted averages based on the aggregate ratios at the bottom of Tables II. and IV. From these averages the deviations of Tables III. and V. are computed. The items in all four tables have been arrayed in the order of decreasing values of the Schedule Premium Index.

The two series of index numbers described above are pairs of variants, the correlation of, or causal relation between, which can be subjected to rigid statistical analysis. Their degree of

correspondence or divergence is a definite and ascertainable quantity, and the probable error due to sampling can easily be obtained. This gives at once the limits within which half of any similar tests might be expected to fall. Unfortunately, the theory of correlation has not been as freely applied by casualty insurance men as its importance would warrant. It is very extensively used in the fields of biology, medicine and pedagogy. Consideration is here given only to the standard or "product-moments" method developed by Prof. Karl Pearson, well-known biometrician of the University of London. Those who may desire a rigid derivation of this formula by the integration of the correlation surface can find it in Forsyth's "Mathematical Analysis of Statistics," pp. 212-213. A satisfactory general discussion of this subject, with examples, may be found in Chaddock's "Principles and Methods of Statistics," Chapter XII. The coefficient, r, may be obtained as follows:

Let x_1, x_2, x_3, etc., be the deviations of the items of the subject from the average,
and y_1, y_2, y_3, etc., be the deviations of the items of the relative from the average.
Let σ_1 be the standard deviation of the subject,
and σ_2 be the standard deviation of the relative.
Let n be the total number of pairs of items.
Then

$$r = \frac{\Sigma \cdot (xy)}{n\,\sigma_1\,\sigma_2}$$

and the probable error $= \dfrac{.67\,(1 - r^2)}{\sqrt{n}}$

Result of Analysis

From the Summary of Results, Table I. it appears that in 35 risks out of 60 the schedule was more successful than the manual in approximating the losses. The margin of 10 risks in favor of the schedule may be expressed, for purposes of comparison, as a Numerical Coefficient of Risk Equity, equal to:

$$\frac{\text{Schedule} - \text{Manual}}{\text{Schedule} + \text{Manual}} = \frac{35 - 25}{35 + 25} = + \frac{10}{60} = + .17$$

A similar margin against the schedule would then be expressed as $-.17$, and the possible values would vary from $+1$ to -1.

There is also a monetary balance of $6,200 in favor of the schedule. That is, after making due allowance for the 25 cases in which the manual approximated the losses more closely than the schedule, the fact remains that on the entire group the schedule came $6,200 closer to the individual losses than did the manual.

From the Summary of Results, Table I., as in the preceding paragraph, this may be expressed as a Monetary Coefficient of Risk Equity, equal to:

$$\frac{\text{Schedule} - \text{Manual}}{\text{Schedule} + \text{Manual}} = \frac{8839 - 2639}{8839 + 2639} = + \frac{6200}{11478} = + .54$$

Against the above results must be placed the fact that for the sixty risks under consideration, taken as a whole, the schedule produced a premium shortage of $6,736, as compared with the manual premium. This should not be interpreted as indicating that the schedule is necessarily out of balance by 4.3%, but does direct attention to the importance of careful periodic revision of the tabular values, to keep them in line with existing conditions. Such revisions, as they may be needed, will certainly not lessen the prognostic value of the schedule.

From Tables II. and IV., it appears that both Schedule and Experience Premium Indices were materially lower for the small group of large risks than for the large group of small risks. The importance of determining whether or not these indications are sustained by the combined experience of individual companies and groups has been forced on the attention of the companies upon more than one occasion. This is of vital interest in determining the results which should be produced by both schedule and experience rating plans, but is of only incidental interest in the present investigation.

Table III. shows the coefficient of correlation for the ten large risks to be $+ .38 \pm .18$. This value is large enough to afford significant evidence of direct correlation between physical conditions as measured by the schedule and the incurred experience. It is vitiated somewhat by the fact that it is only a little more than twice as large as the probable error. An idea of the extent of this objection may be derived as follows: The coefficients resulting from a number of similar tests may be expected to group themselves in a normal frequency distribution. The probable error, that is, the limit within which half of these coeffi-

cients may be expected to fall, is $\pm$ .18 from the ascertained value. But in a normal frequency distribution, the probable error equals .6745 σ, where σ is the standard deviation. Hence σ = .18/.6745 or .27. Tables of probability integrals expressed in terms of x/σ are available (*e. g.*, Medical Biometry and Statistics, Appendix IV., Raymond Pearl). Hence, .38/.27 = 1.41, and the corresponding area is .421. Adding to this the area above the norm, .500, it is seen that in 100 similar tests, 92 may be expected to result in a positive correlation, that is, a coefficient between 0, denoting absence of correlation, and + 1.00, denoting perfect direct correlation.

Table V. shows the coefficient of correlation for the fifty smaller risks to be + .31 $\pm$ .09. Here σ = .09/.6745 or .13, and .31/.13 = 2.38, the corresponding area being .491. Adding .500, it is seen that 99 out of 100 similar tests may be expected to show a coefficient not less than 0. The coefficient of + .31 $\pm$ .09, here obtained, while it does not show marked correlation, is nevertheless determined with sufficient certainty to have evidential value.

The higher coefficient obtained for the larger risks, while not definitely established, is yet not without significance; it is at least indicative of the greater stability recognized in the credibility factors of the experience plan. Similar evidence of interest is found in a comparison of the coefficients of dispersion, (ratio of average, or standard, deviation to average value of variant) for Tables III. and V. For the large risks, the coefficient of dispersion based on average deviation for the Schedule Premium Index is given by .084/.92 or .091. The corresponding value for the Experience Premium Index is .203/.79 or .257. The average swing of the losses is thus seen to be 2.8 times as great as the effect of schedule rating. For the smaller risks the corresponding coefficient for the Schedule Premium Index is .057/.99 or .058, and for the Experience Premium Index is .731/1.20 or .609. Here the average swing of the losses is 10.5 times as great as the effect of schedule rating, for risks having an average subject premium of nearly $3,900.

Cost of Schedule Rating

The sixty risks here investigated probably develop an annual premium not far from $100,000. The saving which might be

expected to result from the abolishing of schedule rating may fairly be estimated at .3 per cent, or $300 for this premium.

Conclusions

1. Whether measured by a direct comparison of the closeness with which it approximates the losses of the individual risk or by recognized methods of determining causal relationships, the schedule shows a materially closer agreement with the risk experience than is shown by the manual rate. Except in the case of comparatively large risks, only a small portion of this advantage is offset by experience rating.

2. The extreme variations in the experience of the smaller risks, even of those large enough to qualify for experience rating, indicate that a given premium modification obtained through experience rating alone would entail a material sacrifice of stability as compared with the present plan of distributing a portion of such modification over all risks presenting similar hazards. A further consideration is that the definite and determinate character of a schedule modification makes it a more powerful incentive to safety activity by the employer than is the fear of a possible future loss from the same cause. Even though the entire cost of such losses, if and when they occur, were paid by the employer, that inherent, optimistic faith which cannot be escaped leads him to an ill-founded confidence in the immunity of himself and his employees. This mental attitude on the part of the employer even now operates to discourage safeguarding. Substandard guards on contracting and other risks not subject to schedule rating are the rule rather than the exception.

3. The saving which would result from abolishing schedule rating is too insignificant in comparison with its prognostic value to deserve serious consideration.

Suggestions for Further Investigation

1. Systematic attention should be given to the residue of the schedule, with the object of isolating such more important non-mechanical hazards as may be remediable. Recent changes in the schedule indicate a tendency toward simplification at any price. It would seem that a more accurate reflection of the causes of industrial injury would be secured by closer cooperation between claim, statistical and engineering departments of the com-

panies, together with intensive efforts to educate the assured in more careful reporting. Exact knowledge of how injuries occur is an absolute necessity if insurance is to fulfill its recognized obligation in helping to prevent them.

2. Attention should be given to the possibility of retaining, on a specific charge basis, if necessary, recognized hazards, even though seldom occurring and therefore having slight effect on the aggregate loss. The real question is not whether a particular hazard increases the resulting total loss one-half of one percent or some other figure, but (to paraphrase a well-known couplet regarding church members):

What kind of rate would my rate be,
If every employer were just like me?

In other words, the primary purpose of schedule rating is to reflect the hazards of *individual risks*. It is successful only insofar as it reflects the measurable and potential causes of loss in each risk, even though some of such causes may seldom appear in other risks, and therefore may not have a material influence on the aggregate loss. The inclusion of such items on a specific charge basis would direct the employers' attention to their importance in his plant, and facilitate their elimination, as well as assist in balancing the safety organization credits upon a more defensible basis. It would charge only those risks having conditions which a real safety organization should remedy, rather than penalize those risks which have an effective organization, by offsetting a portion of their earned credit.

3. It is suggested that other carriers make tests on a random sampling of their business, similar to that outlined above, and submit same to the National Council as a basis for such correction of the above conclusions as the facts so disclosed may warrant.

TABLE I

Column 1	2	3	4	5	6	7	8	9	10	11	12	13	14
					Margin by which Losses Exceed Premiums		Margin by which Premiums Exceed Losses		Margin by which Losses are More Closely Approximated by				
									Manual		Schedule		
	No. of Risks	Normal Expected Loss, at Manual Rate	Normal Expected Loss, at Schedule (Item 19)	Modified Normal Loss (Item 16)	At Manual (5–3)	At Schedule (5–4)	At Manual (3–5)	At Schedule (4–5)	Below	Above	Below	Above	Risk Numbers
Schedule Charge:													
1. Both Manual and Schedule below Losses	16	25,386	26,540	46,993	21,607	20,453					1,154		11, 13, 14, 16, 17, 18, 22, 24, 25, 26, 27, 28, 29, 30, 31, 32.
2. Manual below and Schedule above Losses	1	4,833	5,575	5,076	243			499	256				1.
3. Both Manual and Schedule above Losses	10	24,962	25,772	17,521			7,441	8,251		810			2, 3, 12, 15, 19, 20, 21, 23, 35, 41.
Schedule same as Manual:													
1. Both Manual and Schedule below Losses	1	680	680	1,268	588	588			.....	.....	.....	.....	33.
Schedule Credit:													
1. Both Manual and Schedule below Losses	12	25,931	24,392	37,431	11,500	13,039			1,539				8, 36, 40, 42, 45, 46, 47, 48, 50, 51, 52, 55.
2. Manual above and Schedule below Losses													
a. Manual nearer Loss	1	1,173	1,131	1,169		38	4		34				43.
b. Schedule nearer Loss	1	7,474	6,486	6,574		88	900				812		9.
3. Both Manual and Schedule above Losses	18	67,143	60,270	42,050			25,093	18,220				6,873	4, 5, 6, 7, 10, 34, 37, 38, 39, 44, 49, 53, 54, 56, 57, 58, 59, 60.
	60	157,582	150,846	158,082	33,938	34,206	33,438	26,970	1,829	810	1,966	6,873	

SUMMARY OF RESULTS

	Number of Risks on which Losses are More Closely Approximated by		Numerical Balance in favor of Schedule
	Manual	Schedule	
Losses Exceed Premiums	15*	17	2
Premiums Exceed Losses	10	18	8
Totals	25	35	10

	Margin by which Losses are More Closely Approximated by		Monetary Balance in Favor of Schedule
	Manual	Schedule	
Losses Exceed Premiums	1,829	1,966	137
Premiums Exceed Losses	810	6,873	6,063
Totals	2,639	8,839	6,200

*Includes the one case where schedule does not change

TABLE II

EXHIBIT OF RISKS HAVING A NORMAL EXPECTED LOSS, AT MANUAL RATES, GREATER THAN $4,000

Risk No.	Schedule Rate Index	Experience Rate Index	Normal Expected Loss, at Manual Rate	Normal Expected Loss, at Schedule (Item 19)	Modified Normal Loss (Item 16)
1	1.161	.976	4,833	5,575	5,076
2	1.047	.933	5,445	5,590	5,171
3	1.003	.971	7,940	7,964	7,441
4	.982	.895	4,059	3,988	2,886
5	.950	1.007	7,650	7,285	7,142
6	.913	.718	18,157	16,886	10,489
7	.884	.793	5,095	4,523	2,554
8	.882	1.162	4,570	4,036	5,955
9	.866	.976	7,474	6,486	6,574
10	.711	.923	11,562	8,297	7,465
Totals			76,785	70,630	60,753
Simple Averages	.940	.935			

Schedule Premium Index = 70,630/76,785 = .92
Experience Premium Index = 60,753/76,785 = .79

TABLE III

CALCULATION OF KARL PEARSON'S COEFFICIENT OF CORRELATION FOR RISKS HAVING A NORMAL EXPECTED LOSS, AT MANUAL RATES, GREATER THAN $4,000

Risk No.	Schedule Premium Index	S. P. I. Deviation	S. P. I. Deviation²	Experience Premium Index	E. P. I. Deviation	E. P. I. Deviation²	(S. P. I. Dev.)(E. P. I. Dev.) +	(S. P. I. Dev.)(E. P. I. Dev.) −
1	1.15	.23	.0529	1.05	.26	.0676	.0598	
2	1.03	.11	.0121	.95	.16	.0256	.0176	
3	1.00	.08	.0064	.94	.15	.0225	.0120	
4	.98	.06	.0036	.71	.08	.0064		.0048
5	.95	.03	.0009	.93	.14	.0196	.0042	
6	.93	.01	.0001	.58	.21	.0441		.0021
7	.89	.03	.0009	.50	.29	.0841	.0087	
8	.88	.04	.0016	1.30	.51	.2601		.0204
9	.87	.05	.0025	.88	.09	.0081		.0045
10	.72	.20	.0400	.65	.14	.0196	.0280	
	(9.40)	.84	.1210	(8.49)	2.03	.5577	.1303	.0318
							−.0318 (Subtracting)	
Simple Averages	(.94)	.084	.0121	(.85)	.203	.0558		
Standard deviations (Root-mean-square)			$\sigma_1 = .110$			$\sigma_2 = .236$	$.0985 = \Sigma (x\,y)$	
Premium Indices (Weighted-from Table II.)	.92			.79				

$$r = \frac{\Sigma (x\,y)}{n\,\sigma_1\,\sigma_2} = + \frac{.0985}{10 \times .110 \times .236} = + \frac{.0985}{.2596}$$

$$= + .38$$

$$\text{Probable Error} = \pm \frac{.67\,(1 - r^2)}{\sqrt{n}} = \pm \frac{.67\,(1 - .38^2)}{\sqrt{10}}$$

$$= \pm .18$$

$$\text{Then } r = + .38 \pm .18$$

TABLE IV

EXHIBIT OF RISKS HAVING A NORMAL EXPECTED LOSS, AT MANUAL RATES, LESS THAN $4,000

Risk No.	Schedule Rate Index	Experience Rate Index	Normal Expected Loss, at Manual Rate	Normal Expected Loss, at Schedule (Item 19)	Modified Normal Loss (Item 16)
11	1.260	1.107	1,131	1,378	2,301
12	1.225	.950	1,340	1,641	1,285
13	1.215	1.031	1,242	1,491	1,826
14	1.121	1.565	496	556	3,930
15	1.100	.938	629	692	381
16	1.177	1.170	911	997	2,442
17	1.099	1.024	1,310	1,410	1,600
18	1.069	.994	745	794	796
19	1.065	.840	1,620	1,722	487
20	1.048	.894	1,242	1,300	686
21	1.053	.815	1,739	1,830	151
22	1.052	1.655	2,690	2,781	6,694
23	1.083	.863	1,092	1,124	92
24	1.018	1.181	821	835	1,923
25	1.050	1.226	816	831	1,897
26	1.020	1.252	2,745	2,796	5,342
27	1.069	1.128	1,542	1,573	2,107
28	1.027	1.052	1,660	1,696	2,131
29	1.018	1.016	2,900	2,954	3,283
30	1.010	1.267	1,150	1,160	2,712
31	1.010	1.234	1,632	1,646	3,172
32	1.016	1.133	3,595	3,642	4,837
33	1.000	1.098	680	680	1,268
34	.995	.950	1,288	1,281	924
35	1.026	.828	3,430	3,439	1,610
36	.990	.997	2,493	2,469	2,566
37	.963	.980	856	851	800
38	.986	.856	3,296	3,279	1,704
39	.986	.879	942	934	113
40	.974	1.074	2,460	2,397	3,121
41	.970	.950	485	470	217
42	.926	.993	1,160	1,114	1,193
43	.917	.994	1,173	1,131	1,169
44	.945	.884	1,375	1,319	647
45	.940	1.561	1,998	1,909	7,134
46	.940	1.246	1,805	1,719	3,095
47	.946	1.025	2,125	2,021	2,329
48	.930	1.014	1,717	1,628	1,759
49	.953	.881	1,512	1,444	739
50	.937	1.044	1,318	1,236	1,532
51	.918	1.080	2,320	2,185	2,692
52	.906	1.000	1,678	1,585	1,713
53	.940	.929	1,149	1,081	575
54	.879	.945	559	524	224
55	.915	1.356	2,287	2,093	4,342
56	.900	.906	2,272	2,085	1,517
57	.910	.874	1,045	954	242
58	.893	.924	940	846	421
59	.882	.997	3,761	3,338	3,049
60	.829	.900	1,625	1,355	559
Totals			80,797	80,216	97,329
Simple Averages	1.002	1.050			

Schedule Premium Index = 80,216/80,797 = .99
Experience Premium Index = 97,329/80,797 = 1.20

TABLE V

CALCULATION OF KARL PEARSON'S COEFFICIENT OF CORRELATION FOR RISKS HAVING A NORMAL EXPECTED LOSS, AT MANUAL RATES, LESS THAN $4,000

Risk No.	Schedule Premium Index	S. P. I. Deviation	S. P. I. Deviation²	Experience Premium Index	E. P. I. Deviation	E. P. I. Deviation²	(S. P. I. Dev.)(E. P. I. Dev.) +	(S. P. I. Dev.)(E. P. I. Dev.) −
11	1.22	+.23	.0529	2.03	+ .83	.6889	.1909	
12	1.22	+.23	.0529	.96	− .24	.0576		.0552
13	1.20	+.21	.0441	1.47	+ .27	.0729	.0576	
14	1.12	+.13	.0169	7.92	+6.72	45.1584	.8736	
15	1.10	+.11	.0121	.61	− .59	.3481		.0649
16	1.09	+.10	.0100	2.68	+1.48	2.1904	.1480	
17	1.08	+.09	.0081	1.22	+ .02	.0004	.0018	
18	1.06	+.07	.0049	1.07	− .13	.0169		.0091
19	1.06	+.07	.0049	.30	− .90	.8100		.0630
20	1.05	+.06	.0036	.55	− .65	.4225		.0390
21	1.05	+.06	.0036	.09	−1.11	1.2321		.0666
22	1.03	+.04	.0016	2.49	+1.29	1.6641	.0516	
23	1.03	+.04	.0016	.08	−1.12	1.2544		.0448
24	1.02	+.03	.0009	2.34	+1.14	1.2996	.0342	
25	1.02	+.03	.0009	2.32	+1.12	1.2544	.0336	
26	1.02	+.03	.0009	1.94	+ .74	.5476	.0222	
27	1.02	+.03	.0009	1.36	+ .16	.0256	.0048	
28	1.02	+.03	.0009	1.28	+ .08	.0064	.0024	
29	1.02	+.03	.0009	1.13	− .07	.0049		.0021
30	1.01	+.02	.0004	2.36	+1.16	1.3456	.0232	
31	1.01	+.02	.0004	1.94	+ .74	.5476	.0148	
32	1.01	+.02	.0004	1.35	+ .15	.0225	.0030	
33	1.00	+.01	.0001	1.86	+ .66	.4356	.0066	
34	1.00	+.01	.0001	.72	− .48	.2304		.0048
35	1.00	+.01	.0001	.47	− .73	.5329		.0073
36	.99	.00	.0000	1.03	− .17	.0289	.....	.....
37	.99	.00	.0000	.93	− .27	.0729	.....	.....
38	.99	.00	.0000	.52	− .68	.4624	.....	.....
39	.99	.00	.0000	.12	−1.08	1.1664	.....	.....
40	.97	−.02	.0004	1.27	+ .07	.0049		.0014

Risk No.	Schedule Premium Index	S. P. I. Deviation	S. P. I. Deviation²	Experience Premium Index.	E. P. I. Deviation	E. P. I. Deviation²	(S. P. I. Dev.)(E. P. I. Dev.) +	(S. P. I. Dev.)(E. P. I. Dev.) −
41	.97	−.02	.0004	.45	− .75	.5625	.0150	
42	.96	−.03	.0009	1.03	− .17	.0289	.0051	
43	.96	−.03	.0009	1.00	− .20	.0400	.0060	
44	.96	−.03	.0009	.47	− .73	.5329	.0219	
45	.95	−.04	.0016	3.57	+2.37	5.6169		.0948
46	.95	−.04	.0016	1.71	+ .51	.2601		.0204
47	.95	−.04	.0016	1.10	− .10	.0100	.0040	
48	.95	−.04	.0016	1.02	− .18	.0324	.0072	
49	.95	−.04	.0016	.49	− .71	.5041	.0284	
50	.94	−.05	.0025	1.16	− .04	.0016	.0020	
51	.94	−.05	.0025	1.16	− .04	.0016	.0020	
52	.94	−.05	.0025	1.02	− .18	.0324	.0090	
53	.94	−.05	.0025	.50	− .70	.4900	.0350	
54	.94	−.05	.0025	.40	− .80	.6400	.0400	
55	.92	−.07	.0049	1.90	+ .70	.4900		.0490
56	.92	−.07	.0049	.67	− .53	.2809	.0371	
57	.91	−.08	.0064	.23	− .97	.9409	.0776	
58	.90	−.09	.0081	.45	− .75	.5625	.0675	
59	.89	−.10	.0100	.81	− .39	.1521	.0390	
60	.83	−.16	.0256	.34	− .86	.7396	.1376	
Totals	(50.06)	2.86	.3080	(62.89)	36.53	73.8247	2.0018	.5224
							−.5224 (Subtracting)	
Simple Averages	(1.00)	.057	.0062	(1.26)	.731	1.4765		

Standard deviations (Root-mean-square) $\sigma_1 = .078$ $\sigma_2 = 1.215$ $1.4794 = \Sigma (x\,y)$

Premium Indices .99 1.20 (Weighted-from Table IV.)

$$r = \frac{\Sigma (x\,y)}{n\,\sigma_1\,\sigma_2} = + \frac{1.4794}{50 \times .078 \times 1.215}$$

$$= + .31$$

$$\text{Probable error} = \pm \frac{.67\,(1 - r^2)}{\sqrt{n}} = \pm \frac{.67\,(1 - .31^2)}{\sqrt{50}}$$

$$= \pm .09$$

Then $r = + .31 \pm .09$

TABLE VI

DISTRIBUTION BY CLASSIFICATION SCHEDULE.

Schedule	No. of Risks
Food and Tobacco	9
Textiles	3
Laundries	2
Leather	4
Paper and Pulp	1
Paper Goods	3
Printing	4
Wood	10
Metal Forming	10
Machine Shops	8
Clay Products	3
Chemicals (Groups 558 and 561)	3
Total	60

TABLE VII.

DISTRIBUTION BY STATE.

State	No. of Risks.
Alabama	4
California	1
Georgia	12
Illinois	11
Kentucky	1
Louisiana	1
Maryland	1
Massachusetts	6
Michigan	1
New Jersey	2
New York	18
Texas	1
Virginia	1
Total	60