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Obsolescence and Utility Factors of Periodical Publications: A Case Study.

(Documentation problems. 13).

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[The respective values of the Aging Factor, Half life, Mean life, Utility factor, and Obsolescence factor of periodicals *in radio engineering* and *chemistry* are determined. The differences in the values of these factors for the two periodicals and also the variation in the values over a period of time for one and the same periodical are commented upon. The usefulness of the findings of these studies in documentation service and in planning for the withdrawal of documents is mentioned.]

1 Scope of the Paper

11 CHARACTERISTICS OF PERIODICAL PUBLICATION

This paper reports the findings of a study of the factors mentioned below in respect of periodical publications:

1 Annual aging factor;
2 Obsolescence factor;
3 Half-life;
4 Mean life;
5 Utility factor; and
6 The difference, if any, in some of the above factors in respect of articles in the fields of Radio Engineering and Chemistry.

12 PATTERN OF USE OF DOCUMENTS

Information of the kind mentioned in Sec 11 is of help in finding out the pattern of use of periodical publications by specialists and also the pattern of change, if any, in such use over a period of time.

2 Definition

The following definitions of technical terms as given by Line (5) have been used:

21 Apparent Obsolescence Factor

The Apparent Obsolescence Factor is the factor by which the active life of articles in periodicals appear to decay annually as calculated from the difference in the number of articles cited in successive years.

22 Corrected Obsolescence Factor

The Corrected Obsolescence Factor is the factor by which the active life of an individual article in a set of documents tends to decay annually.

23 Half-Life

The Half-life is the time (actual or expected) during which half the total use of individual articles constituting the documents in a subject has been or is expected to be needed.

3 Procedure

The factors mentioned in Sec 1 can be determined by using the data on the pattern of citations of articles in a periodical.

31 Source of Data

For the subject Radio Engineering, the data about the citations of articles in *Proc IRE* for the period 1958–1962 and 1970 presented by Gundu Rao (3, 4) have been used. For the subject Chemistry, the data about the citations in 10 per cent of the articles published in the *Journal of the American Chemical Society* (=JACS) for the year 1960 were collected. Also, the data about the citations in all the articles in the first two issues (Jan and Feb) of the same periodical for 1950 were collected. This was done to examine whether there is any variation in the pattern of citation of documents in the beginning of the year in relation to that for the whole year. There was no significant difference in the two patterns.

4 Pattern of Distribution

41 PROC IRE

411 TABLE 1. *Year of publication of documents cited in Proc IRE, in* 1970

Year of documents cited (t)	N of documents cited in 1970	Cumulative frequency T(t)
(*a*)	(*b*)	(*c*)
1970	324	4,423
1969	883	4,099
1968	642	3,216
1967	579	2,574
1966	396	1,955
1965	362	1,599
1964	227	1,237
1963	177	1,010
1962	140	833
1961	98	693
1960	116	595
1959	70	479
1958	72	409
1957	46	337
1956	52	291
1955	22	239
1954	30	217
1953	27	187
1952	15	160
1951	30	145
1950	20	115
1949	11	95
1948	19	84
1947	43	65
1946	12	22
1945	10	10

* Comparatively very few documents published earlier to 1945 were cited in 1970. In fact, the total number of such documents was 36 over a 60-year period. Hence, these data are not given in the table.

412 TABLE 2. *Year of publication of documents cited for each of the years* 1958 *to* 1962

Year of documents cited	N of documents cited for the year					Average N of doc cited in 1958–65
	1958	1959	1960	1961	1962	
(*a*)	(*b*)	(*c*)	(*d*)	(*e*)	(*f*)	(*g*)
1962	..	..	..	..	119	119
1961	..	..	..	155	274	215
1960	..	..	134	292	124	183
1959	..	60	272	214	90	159
1958	64	198	156	92	64	115
1957	172	191	98	54	52	113
1956	174	116	72	49	33	89
1955	136	102	72	48	29	77
1954	79	99	38	46	25	57
1953	37	96	24	22	16	39
1952	68	54	19	26	13	36
1951	22	20	9	13	8	14
1950	9	13	14	23	11	14
1949	25	29	16	23	9	20
1948	9	13	11	9	17	12
1947	9	27	8	9	4	11
1946	13	11	10	5	2	8
1945	7	4	9	6	3	6
1944	6	6	6	5	1	5
1943	4	3	2	2	3	3
1942	6	2	2	..	..	2
1941	2	2	3	2	4	3
1940	5	1	5	1	4	3
1939	2	3	4	3	8	4
1938	3	3	5	2	1	3
1937	4	1	3	3	4	3
1936	6	6	6	..	1	4
1935	4	5	2	..	2	3
1934	2	2	..	2	2	2
1933	5	5	5	2	1	4
1932	3	3	..	1	1	2
1931	2	1	2	1	..	1

* Comparatively very few documents published earlier to 1931 were cited in the documents of 1958–62. Hence these data are not given in the table.

413 *Frequency Polygon*

Fig 1 given below is a frequency polygon for the data given in Table 1. Fig 2 is a frequency polygon for the pattern of the citation of articles in the *Proc IRE* for 1961, 1962 and for the grouped data for the period 1958 to 1962.

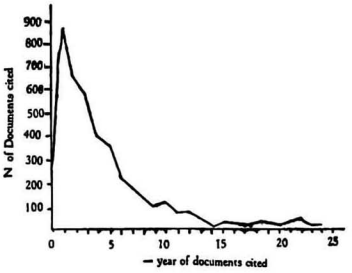

FIG. 1. Frequency polygon for the pattern of citation documents in *Proc IRE* (1970)

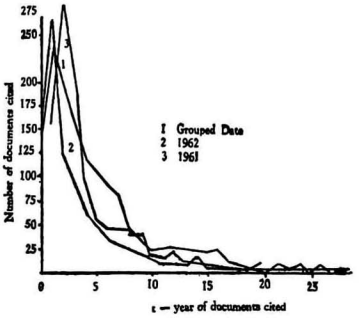

FIG. 2. Frequency polygon for the pattern of citation of documents in *Proc IRE* (1961, 1962, and grouped data)

414 *Annotation*

1 Fig 1 and 2 show that the sample points are concentrated at one end and the curves taper off gradually to zero at the other end. For such a type of distribution, the variance and the square of the mean are equal, or, in other words, the standard deviation and mean are equal. The mean and the variance for the data given in Table 1 are 4·7029 and 23·0908 respectively. The relative error and the percentage error are 0·9835 and 4·4 respectively (on the assumption that the mean is accurate). Therefore, the percentage error is insignificant. Hence, the pattern of citations of articles follows a negative exponential distribution.

2 Using the data for 1970 given in Table 1, and those for 1958–1962 given in Table 2, the distribution for the 12-year period 1958–1970 was studied. The mean and the variance of the distribution for the data for 1962 are 4·967 and 25·243 respectively. The square of the mean and variance are nearly equal. The relative error and percentage error of the variance are 0·02331 and 2·3 respectively (on the assumption that the mean is accurate). Fig 2 shows that there is no significant change in the pattern of the distribution of the documents cited for the period 1958 to 1962 and also for the year 1970. However, the mean of the distribution has been shifting slightly.

3 It has been found that a negative exponential distribution can be fitted for the data on citation for each of the years 1958, 1959, ... 1962. It has also been found that a negative exponential distribution fits with a much higher confidence for the grouped data for the period 1958 to 1962 than for the data for any one of the years taken alone (*See* Table 3). This may be due to the fact that the errors get eliminated in averaging the number of documents cited. The relative error and the percentage error of the variance for the grouped data are 0·1838 and 0·7 respectively (on the assumption that the mean is accurate).

415 *Distribution Pattern*

In Table 3 given below, a distribution has been fitted for two cases — namely (1) Considering the data for 1962; and (2) Omitting the data for 1962.

TABLE 3. *Year of Publication of documents cited for the grouped data for the years* 1958 *to* 1962

Year of documents cited* (t)	Average number of documents cited 1958 to 1962	Expected Frequency	
		By considering the data for 1962	By omitting he data for 1962
(*a*)	(*b*)	(*c*)	(*d*)
1962	119	284	..
1961	215	230	245
1960	183	187	201
1959	159	151	165
1958	115	122	135
1957	113	99	91
1956	89	82	76
1955	77	65	61
1954	57	53	51
1953	39	44	41
1952	36	37	34
1951	14	26	28
1950	14	23	23
1949	20	19	19
1948	12	15	15
1947	11	12	12
1946	8	10	10
1945	6	8	8
1944	5	7	7
1943	3	5	6
1942	2	4	5
1941	3	3	4
1940	3	3	3
1939	4	2	2
1938	3	2	2
1937	3	2	1
1936	4	1	1
1935	3	1	1
1934	2	1	1
1933	4	1	1
1932	2	1	1
1931	1	0	0

* Comparatively few documents published earlier to 1931 were cited. Hence, these data are not given in the table.

416 *Annotation*

From col *d* of Table 3, it can be seen that in the second case, the negative exponential distribution fits more accurately than it does for the first case. This may be due to the fact that

in the articles published in 1962, it will not be possible to cite all the relevant articles published in that year 1962. In other words, the data for 1962 is incomplete.

42 JOURNAL OF THE AMERICAN CHEMICAL SOCIETY

Studies similar to those done for the articles in the *Proc IRE* (*See* Sec 41 and its subdivisions) were carried out on the data on citations in the *Journal of the American Chemical Society* (= JACS) for the years 1950 and 1960. It has been found that the negative exponential distribution fits the pattern of citation of documents in JACS also for both the years 1950 and 1960. It has also been noted that there is no significant change in the pattern during the period 1950 to 1960 except that the mean of the distribution has shifted to the right. It is also worth noting that the mean life of the articles is greater in JACS than in *Proc IRE*.

5 Annual Ageing Factor, Half-Life, Utility Factor, and Obsolescence Factor

51 ANNUAL AGEING FACTOR

The Annual Ageing Factor (a) has been calculated graphically using the procedure suggested by Brookes (1, 2). Fig 3 gives the semilogarithmic curve for the grouped data for the period 1958 to 1962 for *Proc IRE* (*See* Table 2, col *g*). The straight line AB drawn parallel to the linearity of the plotted graph is the semilogarithmic graph of $T(t) = a^t$. $T(t)$ is the citation tail — that is, the cumulative frequency of the documents cited to the t^{th} year. When $t = 1$, $1 = T(1)$. The Annual Ageing Factor can be estimated from this relation. From the graph, we have T (8) and a^8. On solving this equation, we get a more accurate value for a.

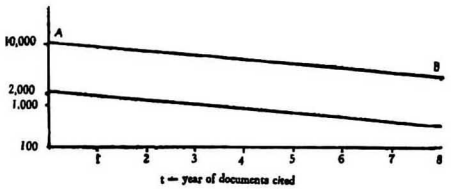

FIG. 3. Semilogarithmic curve for the grouped data for *Proc IRE* (1958–62)

From Table 4, it can be seen that the variation in the Ageing Factor in the successive years is insignificant, but it becomes significant over the period of 10 to 12 years and also for the grouped data.

52 HALF-LIFE

The Half-life (h) can be determined from the graph such that the relation $a = \frac{1}{2}$ will hold good. The mean (m) of the distribution can be obtained from the Annual Ageing Factor (a), using the following relationship:

$$\frac{1}{m} = -\log_e a = \log_e \frac{1}{a}$$

This relationship is true if the distribution follows a negative exponential distribution.

53 UTILITY FACTOR

The Utility Factor (u) can be calculated using the relationship $u = 1/(1 - a)$. This relationship shows that the Utility Factor will be very high when and only when the Annual Ageing Factor is high.

54 OBSOLESCENCE FACTOR

The Obsolescence Factor (α) has been calculated following the procedure suggested by Line (5) from the relation

$$\alpha = (0.5)^{1/5}$$

As in the case of the Annual Agening Factor, from Table 4 given below it can be seen that the variation of the Obsolescence Factor in the successive years is insignificant, but that it becomes significant over the period of 10 to 12 years and also for the grouped data.

55 TABLE 4. TABLE OF CONSTANTS

Description	*Proc IRE*					
	1958	1959	1960	1961	1962	Grouped Data
Ageing Factor (a) ..	0·8409	0·8126	0·8178	0·8409	0·8178	0·8567
Half-life (Years) (h) ..	4·0	3·5	3·7	4·0	3·7	4·3
Mean-life (Years) (m) ..	5·7765	4·8123	4·9667	4·4751	4·9667	6·4751
Utility factor (Years) (u)	6·2853	5·3362	5·4884	6·2833	5·5884	6·9
Corrected obsolescence factor (α) ..	0·8409	0·82038	0·82915	0·8409	0·82915	0·8548
$u - m$ ..	0·5088	0·5239	0·5217	0·5088	0·5217	0·4249

TABLE 4. TABLE OF CONSTANTS (*continued*)

Description	*Proc IRE*	*Journal of American Chemical Society*		Physics status solid*	Semi-conductor physics (6)
	1970	1950	1960	1968	1963/1968
Ageing Factor (*a*)	0·80705	0·9576	0·9049	0·863	0·79†
Half-life (Years) (*h*)	3·5	16·0	6·9	4·7	2·94
Mean-life (Years) (*m*)	4·6	23·2244	10·016	6·8	4·2397
Utility factor (Years) (*u*) ..	5·2	23·5849	10·5762	7·3	4·76
Corrected obsolescence factor (*a*)	0·82038	0·9932	0·9331	0·9031	0·84915
u — *m* ..	0·6	0·3609	0·5002	0·5	0·5203

* These values have been calculated by Brookes (1, 2).
† This value has been calculated by Line (5).

6 Comparison Between *Proc IRE* and *JACS*

61 ANNUAL AGEING FACTOR

From Table 4, it can be seen that for *JACS* the Annual Ageing Factor is high compared to that for *Proc IRE Physics status solid* and *Semiconductor physics*. For both the periodicals *Proc IRE* and *JACS* the value of the Annual Ageing Factor has decreased — that is, from 0·8567 for the period 1958–62 to 0·8071 for 1970 in the case of *Proc IRE* and from 0·9567 for 1950 to 0·9049 for 1960 in the case of *JACS*.

62 OBSOLESCENCE FACTOR

The variation in the Obsolescence Factor is more significant for the period 1960 to 1950 in the case of *JACS* than it is for *Proc IRE* for the period 1960 to 1970. The Obsolescence Factor for *JACS* 1960 is the highest in comparison to that for the other three periodicals.

63 HALF-LIFE

The Half-Life is the lowest for *Semiconductor physics* (1968), and highest for *JACS* (1960). The data for *JACS* (1950)

has not been considered as it relates only to the first two months of the year.

64 DIFFERENCE BETWEEN UTILITY FACTOR AND MEAN LIFE

The difference between the Utility Factor and Mean life (that is, $u = m$) is about 0·5 in most of the cases (*See* Table 4).

7 Conclusion

The data given in Table 4 shows that the value of the Average Ageing Factor is smaller for the more recent documents as compared to that for documents ten to twelve years older. Therefore, the utility factor has a lower value for the older documents than for the more recent ones. Studies similar to those described in this paper can be done on different varieties of documents and in different subject fields. Such information will be helpful in providing documentation service to specialists and in working out a programme for withdrawal from circulation of less used documents.

8 Acknowledgement

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