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Module : 09 Obsolescence factor: Definition and Calculation

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Module 9
Obsolescence factor: Definition and Calculation

I. Objectives

- to discuss the meaning, definition, and concept of obsolescence factors.
- to identify the types of Obsolescence factors.
- to show the steps and methodology to calculate obsolescence factors.
- to explain the application of obsolescence factors in Collection Development of the library.
- to show the methodology for using Semi log graph to get obsolescence factors.

II. Learning Outcome

After completion of this module, you will be familiar with various concepts of obsolescence of literature; you have learnt how to compute various parameters such as obsolescence factor, utility factor, half-life, etc; you are also now familiar with exponential distribution, geometric distribution, etc.

III. Module Structure

1. Introduction
2. Meaning and Definition
3. Types of Obsolescence
4. Theoretical framework for the Obsolescence factors
5. Worked out Example
6. Summary
7. References

1. Introduction

'Obsolete' generally means out of date or no longer in use. The process of becoming obsolete is known as obsolescence. It is also often referred to as 'phenomenon of replacement.' The term obsolescence was used for the first time by Gross and Gross in 1927. They analyzed the references in the 1926 volume of the Journal of Chemical Literature and observed that the number of references fell to one-half in fifteen years. Obsolescence is thus a characteristic of scientific and technical literature. Thus, obsolescence means decreasing value of functional and physical assets or value of a product or facility from technological changes rather than deterioration. Every newborn grows old and eventually dies. This is universally accepted as truth. So, perplexity sets in when sometimes it is reported that "life expectancies may not always decrease as organisms grow older". It was reported in Science and quoted in the Times of India dated 30th Oct. 1992 that the results of certain experiments on fruit flies indicated that once a fly was past a certain age, its life expectancy may increase with age. Is this consistent with the universal truth stated in the first line above? Such seeming anomalies may be reconciled only through a detailed study of the phenomenon of aging.

The concept obsolescence is of obvious interest to information theoreticians who concern themselves with the development of career and librarians who administer growing collection in finite spaces. Such librarians look to research on obsolescence to help them decide which item to keep and which to store or discard in order to make room for new acquisitions. Increased periodical costs have made imperative to cancel some subscriptions and librarians have turned once again to obsolescence research in hope that the concept can be employed to forecast future as well as to describe the current or past use.

2. Meaning and Definition

Obsolescence means the decreasing value of functional and physical assets from technological change rather than deterioration. It is characterized by terminology and metaphors that link inevitable organic (aging or decay) or scientific phenomenon (half life) to the phenomenon of changing use or published literature over a period of time. In other words, obsolescence is decline in the usage of literature over a period of time. When the use of document ceases, it is termed as obsolete.

3. Types of Obsolescence

Actually obsolescence implies a relation between time and use but the effect of time are revealed in different ways. The impact of time on use of document can be studied in two ways: namely synchronous studies and dia-chrounus studies (Line, 1970). Synchronous studies are made on records of uses or references at one point in time and compress the uses against the age of distribution of the materials used or cited. With respect to obsolescence studies majority of the studies have used citations, records of consultations or loans.

In synchronous study the citations are counted back ward i.e. references in an journal articles is examined to find out how many references have been cited for that particular year. Like, year wise references are analyzed. Half life annual aging factor and utility factors are studied with this type of study. The half life of journal article is the time during which half of all the currently active literature was used. The median of an age distribution in other words is half life.

In diachronous study the successive observations at different time are made by counting the citations in forward direction i.e. counting the citations that an article or journal published in 2005 is going to get in year 2006, 2007…etc. This type of study is helps in determining the rate at which the citations decline in future. Many studies have been undertaken in this field. Some of the notable studies in the field are Gros and Gross (1927), Burton and Kessler (1960), Kent and Others (1979), Jain (1966), Brookes (1970), Line (1970, 1974) Ravichandra Rao (1971), Sangam (1989), Moed (1998), Gupta (1997,1998), etc.

While studying and reviewing the studies in the field of obsolescence, it is observed that very few studies have been done. Though new indicators and methods are being developed and applied to study the obsolescence, the case studies are found to be very less. In the present study an attempt has been made to identify the obsolescence factors and pattern in the field of chemical science.

4. Theoretical framework for the Obsolescence factors

Burton and Kebler (1960) were the first to use the term 'half-life' as applied to documents in 1960. It is defined as 'the time during which one-half of all the currently active literature published.' It is the period of time needed to account for one-half all the citations received by a group of publications. The concept of half-life is always discussed in the context of diachronous studies. More precisely, Line and Sandison (1974) refer to diachronous studies in those that follow the use of particular items through successive observations at different points in time, whereas synchronous studies are concerned with the plotting the age distribution of material used at one point of time. However, there is no reason to suppose that the half-life for some subject is the same as the median citation age in that subject. Half-life in the context of synchronous data is referred to as median age of the citations / references. The use of literature may decline much faster with data of ephemeral relevance, if it is in the form of reports, thesis, advance communication or pre-print and in the context of advancing technology. However, the use of literature may decline slowly when it is descriptive (e.g., taxonomic botany) and critical (e.g., literary criticism).

Brookes (1970) in one of his articles argued that if growth rates of literature and contributors are equal then the obsolescence rate remains constant. In this sense growth and obsolescence are related. Ravichandra Rao and Meera (1991) studied the relationship between growth and obsolescence of literature, particularly in mathematics. Gupta (1999) studied the relationship between growth rates and obsolescence rates and half-life of theoretical population genetics literature. He observed that the lognormal distribution fits very well to the age distribution of citations over a period of time.

In the analysis of obsolescence, Brookes (1970) argued that the geometric distribution expresses the idea that when a reference is made to particular periodical of age t years $(1-a)\ a^{t-1}$. '$a\ (< 1)$' is a parameter – the annual aging factor; it is assumed to be constant over all values of t. Let $U = 1 + a^2 + a^3 + a^4 + \ldots. + a^t + \ldots.$ i.e., $U = 1/(1-a)$. Similarly if $U(t) = a^t + a^{t+1} + a^{t+1} + a^{t+2} + \ldots\ldots = a^t (U(0)$, then $U(t)/U(0) = a^t$. Using this relation, by graphical method, we can compute half-life as well as 'a'.If we assume that the literature is growing exponentially at an annual rate of g, we then have $R(T) = R(0)e^{gT}$, where R(T) is the number of references made to the literature during the year T. We also have

$$U(0) = R(0)/(1-a_0) \text{ and } U(T) = R(T)/(1-a_T)$$

Where a_0 and a_T are the annual aging factors corresponding to the years 0 and T respectively. Under the assumption that utility remains constant (U(0) = U(T)) , we have$R(0)/(1-a_0) = R(T))/(1-a_T)$. By substituting the value of R(T), we get a relationship value between the growth and the obsolescence:

$$\mathbf{e^{gT}} = (1-a_T)/(1- a_0)$$

However, Egghe and Ravichandra Rao (1992) showed that the obsolescence factors (aging factors) ‘a’ is not a constant, but merely a function of time. They have also shown that the function ‘a’ has a minimum which is obtained at a time t later than the time at which the maximum of the number of citations is reached.

Egghe (1993) developed a model to study the influence of growth on obsolescence. He obtained different results for the synchronous and diachronus studies. He argued that for an increase of growth implies an increase of obsolescence for the synchronous case and for the diachronous case, it is quite the opposite. In order to derive the relationship, he also assumed the exponential models for growth as well as for obsolescence. In another paper, for the diachronous aging distribution and based on a decreasing exponential model, Egghe (2000) derived first citation distribution. In his study he assumed the distribution of the total number of citations received conforms to a classical Lotka’s function (16). The first citation distribution is given by

$\phi (t_1) = \gamma (1- a^{t1})^{\alpha-1}$

where γ is the fraction of papers that eventually get cited; t_1 is the time of the citation, ‘a’ is the aging rate and α is Lotka’s exponent. Egghe and Ravichandra Rao (2002) in their study in 2002 observed that the cumulative distribution of the age of the most recent references is the dual variant of the first citation distribution. This model is different from the first citation distribution. In another study, Egghe and Rao (2001) have shown the general relation between the first citation distribution and the general citation age distribution; if Lotka’s exponent α = 2, both these distributions are the same. In the same study, they have argued that the distribution of n^{th} citation is similar to that of the first citation distribution. Egghe, Rao and Rousseau (1995) studied the influence of production on utilization function. Assuming an increasing exponential function for production and a decreasing one for aging, these authors have shown that in the synchronous case, the greater the increase in production, the greater the obsolescence; however, for the diachronous case it is quite the opposite. This proof is different from the earlier one derived by Egghe.

The study of obsolescence, in practical terms, is related to changes in the use of documents over time. Line and Sandison (1974), Jain (1966a, 1966b), Kent at el. (1979) in their Pittsburgh study; and FussIer and Simon (1969) attempt to prove the hypothesis that are used declines over time. Line and Sandison, however, arguedthat this hypothesis is to be tested first and should not be made a starting assumption. Brookes (1970) claims that; the decline of use over time conforms closely to a negative exponential distribution. He hypothesizes that the number of references to an issue is a function of its age~, and he assumes the function to be a geometric distribution:

$p(t) = (1-a)a^t \qquad 0 \leq t \leq \infty \quad$ and $\; 0 \leq a \leq 1.$

p(t) is the probability mass function of reference to an issue of the journal of age t years; if R references are made to a given periodical during its first year of life, then references can be expected during its second year, a^2Rreferences can be expected during its third year, and so on. Under the assumption that a is constant for all values of tand for a <1, the series a^t converges to the sum $\frac{1}{1-a}$ as $t \rightarrow \infty$. . Therefore, the total number of references that will be made to it during its infinite life time is

$$U(o) = \frac{R}{1-a}$$

If the periodical is t years old, then the number of further references to it can be computed by:

$$U(t) = \sum_{i=t}^{\infty} p(t) = \frac{Ra^t}{1-a} = a^t U(0)$$

U(o)is called the total utility of a periodical which hasjust been published. Brookes (1970) suggests a graphical method for computing a. The function $\frac{1}{1-a}$ is called the utility factor of the periodicals. Under the assumption that the literature is growing exponentially at an annual rate of growth g, we have:

$R(T) = Re^{gt}$

where R(T)is the number of articles at time T and Ris the number of articles at time T=O. Brookes (1970) and also Line (1970) have discussed the computational aspects of half-life, utility factor, etc. in their articles. Below a worked out example has been given in this regard.

5. Worked out Example

We considered synchronous approach to collect the data for obsolescence analysis. The citation appended to the articles published in the following two journals

- Indian Journal of Experimental Biology (CSIR), New Delhi
- Asian Journal of Chemistry" New Delhi.

were considered as source data. We have collected the dta for five years (2001-2005).For computation of obsolescence rate, the graphical method as explained by Brookes may be used. The data is given in Table 2. Table 1 gives the summary of the data.
Below, an attempt has been made to fit the exponential distribution, to compute the ageing factor, utility factor and half-life.

Year	Asians Journal of Chemistry			Indian Journal of Exp. Biology		
	Articles	References	Citation ate	Articles	References	Citation Rate
2001	276	1409	5.11	378	4735	12.53
2002	271	1583	5.66	314	4494	14.31
2003	302	1783	5.90	278	3772	13.57
2004	295	1878	6.37	297	3009	10.13
2005	351	2470	7.04	265	5059	19.09
Total	**1495**	**9073**	**6.02**	**1534**	**22069**	**13.926**

Table-1: Average Citation Rate of Journals

Some Observation: Out of 30142 references 38% are received for the publications of the last 10 years; 69.57% for the last two decade; 93 % for the last four decade, 99.10% citations are received for the last 6 decades and only 0.9% are for the other decades which are 269 in number. The half of the citations has been produced up to the age of 13 years (15180). Maximum number of references has been observed in the year 2000 (1562 i.e. 5.08%) followed by 1998 (1530), 1996 (1510) and 1997 (1501).This shows that scholars are using current information for their research purposes. More than 117 articles are from the age more than 71 to 105 years.

Year	**Age (x)**	**Citations**	**Cumulative Citations**	**Tail**	**% of Citations**	**% Cumulative Citations**
2005	0	15	15	30142	0.049764	0.049764
2004	1	191	206	30127	0.633667	0.683432
2003	2	410	616	29936	1.360228	2.04366
2002	3	761	1377	29526	2.524716	4.568376
2001	4	1221	2598	28765	4.050826	8.619202
2000	5	1562	4160	27544	5.182138	13.80134
1999	6	1497	5657	25982	4.966492	18.76783
1998	7	1530	7187	24485	5.075974	23.84381
1997	8	1501	8688	22955	4.979762	28.82357
1996	9	1510	10198	21454	5.009621	33.83319
1995	10	1276	11474	19944	4.233296	38.06649
1994	11	1306	12780	18668	4.332825	42.39931
1993	12	1278	14058	17362	4.239931	46.63924
1992	13	1122	15180	16084	3.722381	50.36162
1991	14	1070	16250	14962	3.549864	53.91149
1990	15	971	17221	13892	3.221419	57.1329
1989	16	882	18103	12921	2.92615	60.05905
1988	17	757	18860	12039	2.511446	62.5705
1987	18	734	19594	11282	2.43514	65.00564
1986	19	716	20310	10548	2.375423	67.38106
1985	20	662	20972	9832	2.196271	69.57733
1984	21	723	21695	9170	2.398646	71.97598
1983	22	595	22290	8447	1.97399	73.94997
1982	23	553	22843	7852	1.834649	75.78462
1981	24	529	23372	7299	1.755026	77.53965
1980	25	475	23847	6770	1.575874	79.11552
1979	26	479	24326	6295	1.589145	80.70466
1978	27	444	24770	5816	1.473028	82.17769
1977	28	396	25166	5372	1.313781	83.49147
1976	29	333	25499	4976	1.104771	84.59624
1975	30	359	25858	4643	1.191029	85.78727
1974	31	386	26244	4284	1.280605	87.06788
1973	32	311	26555	3898	1.031783	88.09966
1972	33	272	26827	3587	0.902395	89.00206
1971	34	254	27081	3315	0.842678	89.84473
1970	35	284	27365	3061	0.942207	90.78694

1969	36	239	27604	2777	0.792914	91.57986
1968	37	230	27834	2538	0.763055	92.34291
1967	38	178	28012	2308	0.590538	92.93345
1966	39	189	28201	2130	0.627032	93.56048
1965	40	143	28344	1941	0.474421	94.0349
1964	41	135	28479	1798	0.44788	94.48278
1963	42	100	28579	1663	0.331763	94.81454
1962	43	127	28706	1563	0.421339	95.23588
1961	44	159	28865	1436	0.527503	95.76339
1960	45	91	28956	1277	0.301904	96.06529
1959	46	104	29060	1186	0.345034	96.41032
1958	47	101	29161	1082	0.335081	96.74541
1957	48	100	29261	981	0.331763	97.07717
1956	49	80	29341	881	0.26541	97.34258
1955	50	64	29405	801	0.212328	97.55491
1954	51	66	29471	737	0.218964	97.77387
1953	52	72	29543	671	0.238869	98.01274
1952	53	65	29608	599	0.215646	98.22839
1951	54	53	29661	534	0.175834	98.40422
1950	55	44	29705	481	0.145976	98.5502
1949	56	49	29754	437	0.162564	98.71276
1948	57	47	29801	388	0.155929	98.86869
1947	58	27	29828	341	0.089576	98.95826
1946	59	27	29855	314	0.089576	99.04784
1945	60	18	29873	287	0.059717	99.10756
1944	61	20	29893	269	0.066353	99.17391
1943	62	12	29905	249	0.039812	99.21372
1942	63	22	29927	237	0.072988	99.28671
1941	64	14	29941	215	0.046447	99.33316
1940	65	20	29961	201	0.066353	99.39951
1939	66	12	29973	181	0.039812	99.43932
1938	67	19	29992	169	0.063035	99.50236
1937	68	16	30008	150	0.053082	99.55544
1936	69	7	30015	134	0.023223	99.57866
1935	70	10	30025	127	0.033176	99.61184
	71	117	30142	117	0.388163	100
Total		**30142**			100	

Table-2: Citation Frequency Distribution of Journals

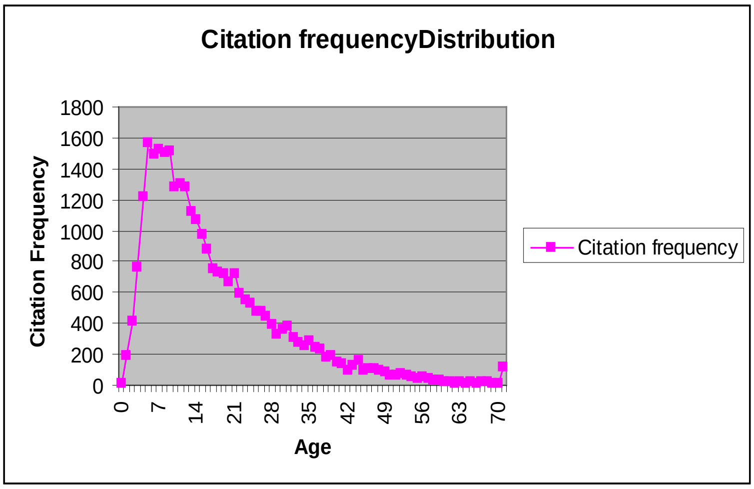


Fig.1: Citation Frequency Distribution

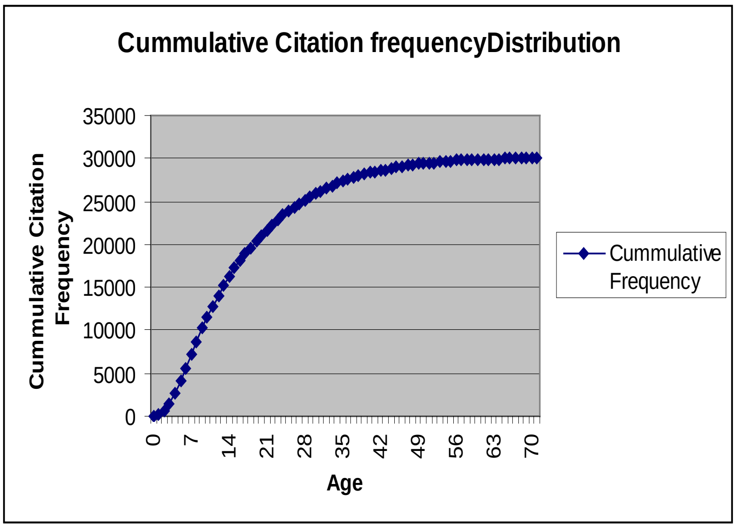


Fig.2: Cumulative Citation frequency Distribution

Test of Exponentially of Citation Distribution

The data of column 5 of table-3 are plotted as frequency polygon 'AA' in figure 3. The curve AA looks like a negative exponential distribution. The data indicates a roughly declining trend in the frequency citations as against the cited ages. The points are concentrated at one end and the curve tapers off gradually to years at the other end while an initial build-up occurs from the first entry (t = 0).With the help of table 3 the values of $\bar{X}$ and σ are calculated; Mean =17.06234; Variance =159.2974; SD =12.62131; also, in order to test the exponentially of the distribution, another test i.e. Kolmogorov-Smirnov Test (K-S Test), is applied. The observed value of cumulative citation frequencies are calculated and presented in column 6 of Table-3. The calculation of the estimated values: -

$F(x)=l-e^{\Theta x}$ ....(1)

Where x = 0,1,2,3,4,5,.......

and $\theta = \frac{1}{\bar{x}}$

The estimated values using (10 are presented in column 7 (represented as E(x) in Table-3.To test the exponentiality of the distribution, K-S test is used. According to this test, the maximum deviation in observed and estimated values, 'D' is calculated as follows: D = $|F(x)-E_n(x)|$. At the 0.01 level of significance, the K-S statistics is equal to $1.63/ n^{1/2}$. If 'D' is greater than K-S statistics; than the distribution does not fit the theoretical distribution at this level of significance. In this case n =71, hence K-S statistics for the 0.01 level should be $1.63/70^{1/2}$ =0.1948 and the value of 'D' should not exceed this. The examination of the data of column 6, 7 and 8of table-3 reveals that 'D' value does not exceed the 0.1948 limits, Theeta value 0.058609 and D value is 0.193445and hence it confirms statistically that the distribution of the data follows negative exponential distribution.

Year	**Age**	**Citations**	**%**	**Cumulative**	**F(x)**	**E(x)**	**D**
	x	**f(x)**	**xf(x)**	**x^2f(x)**	**Observed**		
2005	0	15	0	0	0.000498	0	0.000498
2004	1	191	191	191	0.006337	0.056924	0.050588
2003	2	410	820	1640	0.013602	0.110608	0.097006
2002	3	761	2283	6849	0.025247	0.161236	0.135989
2001	4	1221	4884	19536	0.040508	0.208982	0.168474
2000	5	1562	7810	39050	0.051821	0.25401	0.202189
1999	6	1497	8982	53892	0.049665	0.296475	0.24681
1998	7	1530	10710	74970	0.05076	0.336522	0.285763
1997	8	1501	12008	96064	0.049798	0.37429	0.324493
1996	9	1510	13590	122310	0.050096	0.409908	0.359812
1995	10	1276	12760	127600	0.042333	0.443499	0.401166
1994	11	1306	14366	158026	0.043328	0.475177	0.431849
1993	12	1278	15336	184032	0.042399	0.505052	0.462653
1992	13	1122	14586	189618	0.037224	0.533227	0.496003
1991	14	1070	14980	209720	0.035499	0.559798	0.524299
1990	15	971	14565	218475	0.032214	0.584856	0.552642
1989	16	882	14112	225792	0.029261	0.608487	0.579226
1988	17	757	12869	218773	0.025114	0.630774	0.60566
1987	18	734	13212	237816	0.024351	0.651792	0.627441
1986	19	716	13604	258476	0.023754	0.671613	0.647859
1985	20	662	13240	264800	0.021963	0.690307	0.668344
1984	21	723	15183	318843	0.023986	0.707936	0.683949
1983	22	595	13090	287980	0.01974	0.724561	0.704821
1982	23	553	12719	292537	0.018346	0.74024	0.721894
1981	24	529	12696	304704	0.01755	0.755027	0.737477
1980	25	475	11875	296875	0.015759	0.768972	0.753213
1979	26	479	12454	323804	0.015891	0.782123	0.766231
1978	27	444	11988	323676	0.01473	0.794525	0.779795
1977	28	396	11088	310464	0.013138	0.806222	0.793084
1976	29	333	9657	280053	0.011048	0.817252	0.806205
1975	30	359	10770	323100	0.01191	0.827655	0.815745
1974	31	386	11966	370946	0.012806	0.837466	0.82466

1973	32	311	9952	318464	0.010318	0.846718	0.8364
1972	33	272	8976	296208	0.009024	0.855443	0.846419
1971	34	254	8636	293624	0.008427	0.863672	0.855245
1970	35	284	9940	347900	0.009422	0.871433	0.86201
1969	36	239	8604	309744	0.007929	0.878751	0.870822
1968	37	230	8510	314870	0.007631	0.885653	0.878023
1967	38	178	6764	257032	0.005905	0.892162	0.886257
1966	39	189	7371	287469	0.00627	0.898301	0.89203
1965	40	143	5720	228800	0.004744	0.90409	0.899346
1964	41	135	5535	226935	0.004479	0.90955	0.905071
1963	42	100	4200	176400	0.003318	0.914698	0.911381
1962	43	127	5461	234823	0.004213	0.919554	0.915341
1961	44	159	6996	307824	0.005275	0.924133	0.918858
1960	45	91	4095	184275	0.003019	0.928452	0.925433
1959	46	104	4784	220064	0.00345	0.932525	0.929075
1958	47	101	4747	223109	0.003351	0.936366	0.933015
1957	48	100	4800	230400	0.003318	0.939988	0.936671
1956	49	80	3920	192080	0.002654	0.943404	0.94075
1955	50	64	3200	160000	0.002123	0.946626	0.944503
1954	51	66	3366	171666	0.00219	0.949664	0.947475
1953	52	72	3744	194688	0.002389	0.95253	0.950141
1952	53	65	3445	182585	0.002156	0.955232	0.953075
1951	54	53	2862	154548	0.001758	0.95778	0.956022
1950	55	44	2420	133100	0.00146	0.960183	0.958724
1949	56	49	2744	153664	0.001626	0.96245	0.960824
1948	57	47	2679	152703	0.001559	0.964588	0.963028
1947	58	27	1566	90828	0.000896	0.966603	0.965708
1946	59	27	1593	93987	0.000896	0.968504	0.967609
1945	60	18	1080	64800	0.000597	0.970297	0.9697
1944	61	20	1220	74420	0.000664	0.971988	0.971325
1943	62	12	744	46128	0.000398	0.973583	0.973185
1942	63	22	1386	87318	0.00073	0.975086	0.974357
1941	64	14	896	57344	0.000464	0.976505	0.97604
1940	65	20	1300	84500	0.000664	0.977842	0.977179
1939	66	12	792	52272	0.000398	0.979103	0.978705
1938	67	19	1273	85291	0.00063	0.980293	0.979663
1937	68	16	1088	73984	0.000531	0.981415	0.980884
1936	69	7	483	33327	0.000232	0.982473	0.98224
1935	70	10	700	49000	0.000332	0.98347	0.983139
	71	117	8307	589797	0.003882	0.984411	0.98053
Total		**30142**	**514293**	**13576583**			**0.983139**

Table-3: Citation Frequency Distribution of Journals and Parameter values

i. Annual Ageing Factor (=AAF)

Based on the negative exponential function over time or obsolescence annual aging factor is the ratio of percentage of non-used (or used) documents in successive years. In case of citations this may be measured in proportion to number of citations received in library context.

The AAF = "a" has been calculated graphically, following the procedure suggested by Brookes.

The data of column 5 of table-3are plotted on semi-log paper and are shown in figure 3.

i. On axis 'X' (linear scale), the values of citation ages, that is, of 't'
ii. in years are taken, starting with the year 2005 (t = 0), as the base year,the values were taken from t = 0 to t = 71;
iii. On the 'Y' axis, on to left hand side, the values of cumulative citations from "Tail" that is, 30142 for 2005, are taken on log scale,
iv. The resultant line by joining maximum point on a straight time, 'XY' is plotted;
v. For convenience sake, a parallel line to 'XY' is drawn from the point 'T' (t) =10,000; on this line T(t) for t =1 gives the value of T(l) = a^1 = a the Annual Aging Factor;
vi. The value of 'a' from this line, directly reads from the graph infigure ' 28' is equal to '0.94' approximately;
vii. The scale on the left hand is graduated to find out different values of 'a' directly from graph, from 1.0 to 0.1;
viii. The time 'OA' reads the values of t = 0 to t = 20; and value for 'A' on the line at the extreme right is 0.1.
ix. Taking this value to the left hand side, another line O 'A' is drawn parallel to 'XY'.
x. Similarly, the parallel lines could be drawn to head the value for the values more than 70 years.
xi. It could be observed from these lines that only one straight line is not possible for the whole data. There may be a few more lines depending upon the nature of literature of a specific subject at a particular time.

The values of 'a' thus should be calculated by using the following formula:

$T(t) = a^t$

The value as read directly from the graph for t = 1, is found to be 0.94

The value of using parallel 'OA'

$a^6 = 0.77$

6 log (a) = log (0.77)

by solving this equation we get,

log a = log (0.77) /6

= - 0.04356

a = e - 0.957374

Therefore,

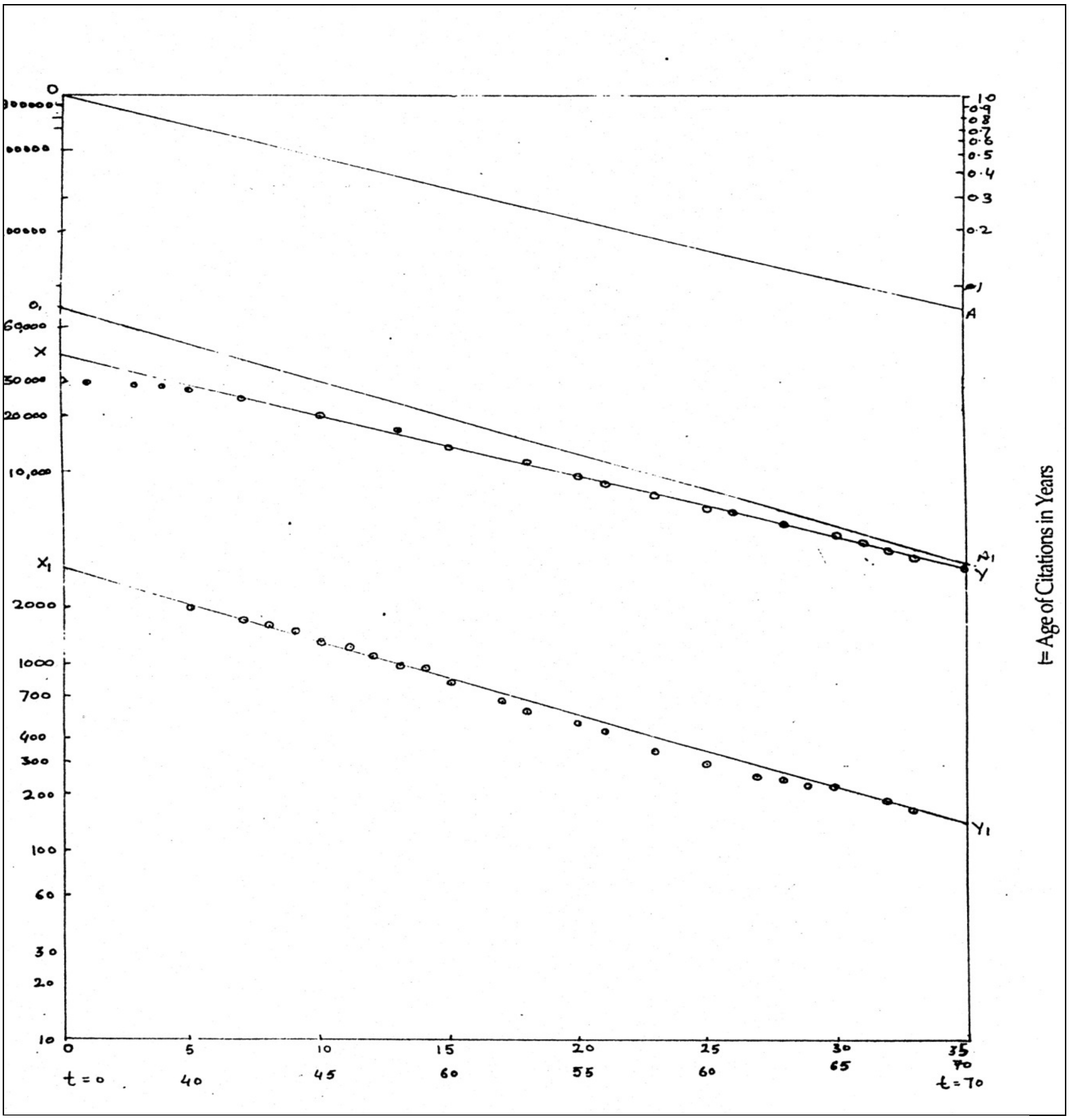
a = 0.957374

The average value of 'a' can be taken as,

a =0.94 + 0.957374 /2

= 0.948687

Therefore **A A F =0. 0948687**



t= Age of Citations in Years

Fig.3: Semi log Curves for T (t) and t

ii. Half-life

The time calculated/ expected during which half the use of individual articles constituting a literature has been or expected to be made.The half-life can be determined from the graph in such a way that relation a^h= 0.5 will hold well. The value as observed from the graph is 15 years. As calculated from the above relation, h = 13.15865 years which is almost near to the observed value.The half-life for the value of 'a' of chemical science journals literature can be calculated as follows,

$\text{Log}(0.948687)^h = \log 0..5$
h log 0.948687 = h log 0.5
we get the equation as
-0.69315/- 0.05268
h = 13.15865

iii. Utility factor (U)
Utility factor can be calculated by using the relationship, u - 1/1 -a
U=l/(l-a)
=1/1-0.948
U = 19.48831

iv. Mean

The value of the mean (m) can be calculated from the value of AAF by using following formula,
$1/m = \log_e a = \log_e 1/a$ and a = 0.948
$\log_e a = \log_e 1/0.948$
1/m = 0.052676
m= 18.98392

Both values (frequency table value 17.06234 and 18.98392) being almost the same, confirm the exponential nature of the distribution and also justify the correctness of the average value of 'a' and this finding proves that **Citation frequency distribution in chemical science journals follows exponential pattern**.

v. Corrected Obsolescence Factor (a)

The corrected obsolescence factor is the factor by which the active life of an individual article on a set of documents tends to delay annually.
It has been calculated by using the following formulae,
$\acute{\alpha} = (0.5)^{1/m} = (0.5)^{0.052676}$
ά = 0.1.037187

U - m =**19.48831**-18.98392= 0.504389

6. Summary

i. Indian J Experimental Biology has received 22069 references for 1534 articles at the average of 13.926 citations per article while Asian Journal of Chemistry has received 9073 references for 1495 articles at the average of 6.02 references per article Over all, these two journals have received 30,142 references for 3,027 articles at the rate of 9.95 references per article for 5 year data.

ii. **The Annual Ageing Factor** (AAF) = "a" as calculated from the graph is found to be **A A F =0. 0948687**

iii. The value of **half life** as observed from the graph is 15 years. As calculated from the above relation, h = 13.15865 years which is almost near to the observed value.

iv. The value of **Utility factor (U)** is **U = 19.48831**

v. The value of the **mean (m**) is = 18.98392 which confirmsthe exponential nature of the distribution and also justify the correctness of the average value of ‘a’.

vi. Citation frequency distribution in chemical science journals follows exponential patter.

vii. The **Corrected Obsolescence Factor** (a) was found to be = 0.504389

Findings of the Obsolescence factors are useful in understanding the researchers to what extent they can go back to obtain the required published information in their particular field of interest. In the evolution of life there is a theory called “use and disuse” which means the one always in use continuous to exist where as the one which is not in use perishes gradually. Similarly in the field of literature also the publication may go on decreasing with the advancement of age.

The obsolescence studies are helpful in discarding older materials in libraries; decisions regarding back volumes of periodicals; predicting the future use of literature; serving as a tool to measure the citable or usable documents in the field of chemical science. Results of this study cannot be generalized with other subjects and subfields.

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