

**INTEREST TABLE FOR ALL RATES,
AND SPECIALLY APPLICABLE TO
MUTATIONS OF INTEREST AND
VARYING BALANCES**

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by Hannyngton

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HANNYNGTON

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AND

VARYING BALANCES.

BY

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INTRODUCTION.

THERE are in common use two methods (besides direct computation) of finding the interest on money for short periods, and there are accordingly two kinds of Table for this purpose. One is the old or detached system, which gives for the stated number of days the interest on sums from £1 upwards. Thus, on a series of deposits and withdrawals, each entry has its own statement and answer; each requires a separate reference to the Table, and the sum of all completes the laborious work. The other and better way is the progressive system. Each amount on both sides of the account is multiplied by the number of days it has run; the sum of the products is then taken, and the difference of the sums is an amount the interest on which for one day is the full balance payable; and this may be obtained by a single reference to a Table of Interest on Products. The standard Interest Tables, of both kinds, contain usually a variety of rates, and are referred to accordingly.

There is a third method, not in common use, but known and practised in some banks, and which may be called the commutative method. By a simple and ingenious expedient, rates of interest not constant are changed into a constant rate, by which means a material saving of time and labour is effected.

If a number be multiplied by 5, and if one-tenth of the product be taken, then the number is virtually halved; and conversely, if a number be doubled, and one-tenth of the double be taken, we obtain one-fifth of that number.

Also, if two numbers be multiplied or divided by the same quantity, whether such quantity be whole or fractional, the results are to each other in the same proportion as the original numbers.

Let us now for illustration compare two successions of numbers, the latter being one-fifth of the former:—

First series . .	1	$1\frac{1}{2}$	2	$2\frac{1}{2}$	3	$3\frac{1}{2}$	4	$4\frac{1}{2}$	5	$5\frac{1}{2}$	6
Second series . .	.2	.3	.4	.5	.6	.7	.8	.9	1	1.1	1.2

We may consider the first series as rates per cent., and in the second we may then remark that the rate of 5 per cent. has for its counterpart unity.

In consequence of this relation the rate of 5 per cent. may be taken as a standard rate at which any sum at profit for one day returns interest for just one day, whereas the other rates below and above the standard will return less or more than one day's interest, according to the standard. For instance, 4 per cent. will return eight-tenths of a day's interest at the standard rate, and 6 per cent. will return one day and two-tenths of a day's interest at the standard rate. The reduced or increased factor for the day being in all cases *one-tenth of the doubled rate.*

The possibility thus made evident of bringing all rates of interest to one standard, suggests further the convenience of keeping a register of days in accordance with all mutations of interest. Such a register might be nearly in the following form:—

(1) Day of the Month.	(2) Rate per Cent.	(3) Rates, or Day Factors.	(4) Sum of the Day Factors.
1	5	1'0	1'0
2	5	1'0	2'0
3	3	0'6	2'6
4	3	0'6	3'2
5	3	0'6	3'8
6	3½	0'7	4'5
7	3½	0'7	5'2
8	4	0'8	6'0
9	4	0'8	6'8
10	4½	0'9	7'7
11	4	0'8	8'5
12	4	0'8	9'3
13	3½	0'7	10'0
14	2½	0'5	10'5
15	2	0'4	10'9
&c.			

This will be readily understood, and in practice only the first and fourth columns need be recorded, the daily operation being merely to add one-tenth of the doubled rate to the sum of the day factors as brought on continually. The marginal register shows that, owing to the supposed changes of interest, the 15 *actual* days give only 10'9 complete interest days. That is to say, £100 invested at the beginning of the month, and subject to mutations of interest as noted, would, in 15 days, return 10'9 days' interest at the standard rate.

This register is *not* a passing record, useless as an old almanac; but is, on the contrary, of continued service. A deposit of £100 was lodged on the 3rd and withdrawn on the 13th: what interest should it return? The corresponding sums of the day factors are 2'6 and 10'0. The *difference* of these, 7'4, is the day factor for the intervening period of 10 days; and interest at the standard rate would be returnable for 7'4 days.

So far all is clear, but now comes a difficulty. What if not only the rates but the sums at interest vary during a given period? How shall an account current be dealt with? Just, I say, as is done in the progressive system; only instead of the actual days, use their commuted equivalents. An example will make this plain. The data have been supplied by an experienced banker:—

Balance- Amount.	Days.	Products.	Total Products.	Rate.	Interest.
1,000	10	100,00			
3,000	3	90,00			
100	7	7,00			
7,000	2	140,00			
200	5	10,00			
9,000	3	270,00	61,700	at 6 per cent.	10 2 10
700	4	28,00			
1,000	3	30,00			
800	7	56,00	11,400	at 4 per cent.	1 5 0
2,000	4	80,00			
3,000	2	60,00			
300	6	18,00	15,800	at 4½ per cent.	1 19 0
1,000	7	70,00			
4,000	10	400,00	47,000	at 2½ per cent.	3 4 4
800	5	40,00			
1,000	4	40,00	8,000	at 5 per cent.	1 11 11
34,900	82			Total interest..	£17 13 1

This is a fair specimen of the progressive method. The final result is obtained by summing the results of five references to as many rates of interest in a large book of tables.

We will now exhibit the same account on the commutative system:—

Balances. Amount.	Commutd Days.	Products	Rate.
1,000	12'0	120,00	6 per cent.
3,000	3'6	108,00	
100	8'4	8,40	
7,000	2'4	168,00	
200	6'0	12,00	
9,000	3'6	324,00	4 per cent.
700	3'2	22,40	
1,000	2'4	24,00	
800	5'6	44,80	4½ per cent.
2,000	3'6	72,00	
3,000	1'8	54,00	
300	5'4	16,20	2½ per cent.
1,000	3'5	35,00	
4,000	5'0	200,00	5 per cent.
800	5'0	40,00	
1,000	4'0	40,00	
Sum....		1288,80	Interest, £17. 13s. 1½d.

The difference of work in this is not inconsiderable; for instead of five intermediate summations and five separate references, with a final summation, our comparatively small table at one rate, and with a single reference, places the result under the finger.

But this is not all. The following interest account, as actually rendered by a London Office, affords a further illustration of the detached as compared with the commutative method:—

1864.		1865.		£ s. d.	
Dec.	31. Balance	5½ per cent.	1,000	26	3 14 9
Jan.	26.	5 "	1,000	14	1 18 4
Feb.	9.	4½ "	1,000	35	4 6 3
March	16.	4 "	1,000	28	3 1 4
April	13.	3½ "	1,000	35	3 7 1
May	18.	4 "	1,000	21	2 6 0
June	8.	3½ "	1,000	7	0 13 5
"	15.	3 "	1,000	14	1 3 0
"	29.	2½ "	1,000	1	0 1 4
"	30.	"	1,000	41	2 16 1
August	10.	"	1,000	7	0 11 6
"	17.	3½ "	1,000	56	5 7 4
Oct.	12.	4 "	1,000	4	0 8 9
"	16.	4½ "	1,000	3	0 7 5
"	19.	"	"	"	"
"	2.	4½ "	3,000	17	6 5 9
"	19.	"	"	"	"
"	19.	5½ "	4,000	2	1 3 0
"	21.	6 "	4,000	47	30 18 0
"	7.	5½ "	4,000	24	13 16 2
"	31.	"	"	"	"
					<u>£82. 5 6</u>

By means of the annexed Mutation Register, prepared from this account, the computation may be worked thus:—

Oct. 19.	220'1 x 1000 = 220100
Dec. 31.	303'8
	837 x 4000 = 334800
Oct. 2.	
" 19.	15'3 x 3000 = 45900
17 x 1/16	600800
	<u>£82. 6s. 0d.</u>

*Interest Mutation Register of the
for the Year 1865.*

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	
1	105	313	593	856	1078	1309	1508	1663	1855	2065	2354	2714	1
2	210	343	602	864	1085	1317	1513	1668	1861	2072	2366	2726	2
3	315	373	611	872	1092	1325	1518	1673	1869	2079	2378	2738	3
4	420	383	620	880	1099	1333	1523	1678	1876	2086	2390	2750	4
5	525	393	629	888	1106	1341	1528	1683	1883	2093	2402	2762	5
6	630	403	638	896	1113	1349	1533	1688	1890	2100	2414	2774	6
7	735	413	647	904	1120	1357	1538	1693	1897	2107	2426	2786	7
8	840	423	656	912	1127	1365	1543	1698	1904	2114	2438	2798	8
9	945	432	665	920	1134	1372	1548	1703	1911	2121	2450	2810	9
10	1050	442	674	928	1141	1379	1553	1708	1918	2128	2462	2822	10
11	1155	451	683	936	1148	1386	1558	1714	1925	2135	2475	2834	11
12	1260	460	692	944	1155	1393	1563	1720	1932	2142	2487	2846	12
13	1365	469	701	952	1162	1400	1568	1726	1939	2150	2498	2858	13
14	1470	478	710	959	1169	1407	1573	1732	1946	2158	2510	2870	14
15	1575	487	719	966	1176	1414	1578	1738	1953	2166	2522	2882	15
16	1680	496	728	973	1183	1420	1583	1744	1960	2174	2533	2894	16
17	1785	505	737	980	1190	1426	1588	1750	1967	2183	2546	2906	17
18	1890	514	746	987	1197	1432	1593	1756	1974	2191	2558	2918	18
19	1995	523	755	994	1204	1438	1598	1762	1981	2199	2570	2930	19
20	2100	532	764	1001	1211	1444	1603	1768	1988	2207	2582	2942	20
21	2205	541	773	1008	1218	1450	1608	1774	1995	2215	2594	2954	21
22	2310	550	782	1015	1225	1456	1613	1780	2002	2223	2606	2966	22
23	2415	559	791	1022	1232	1462	1618	1786	2009	2231	2618	2978	23
24	2520	568	800	1029	1239	1468	1623	1792	2016	2239	2630	2990	24
25	2625	577	809	1036	1245	1474	1628	1798	2023	2247	2642	2998	25
26	2730	586	818	1043	1252	1480	1633	1804	2030	2255	2654	3010	26
27	2835	595	827	1050	1259	1486	1638	1810	2037	2263	2666	3022	27
28	2940	604	836	1057	1267	1492	1643	1816	2044	2271	2678	3034	28
29	3045	613	845	1064	1274	1498	1648	1822	2051	2279	2690	3046	29
30	3150	622	854	1071	1281	1503	1653	1828	2058	2287	2702	3058	30
31	3255	631	863	1078	1288	1509	1658	1834	2065	2295	2714	3070	31

In the foregoing examples it may be, and has been objected that they present round numbers and are therefore easy. So they are, but it does not follow that more complex numbers are much more difficult. Here is an account which will speak for itself:—

Messrs. Brown, Jones, and Robinson, in Account with the National Discount Company, Limited.

1867.			£	s.	d.		£	s.	d.
April 1.	Balance	2 per cent.	52,264	8	6	1	2	17	2
" 2.	"	"	52,055	11	11	1	2	17	1
" 3.	"	"	47,998	10	5	1	2	12	7
" 4.	"	"	51,859	14	4	1	2	16	7
" 5.	"	2½	52,525	4	8	1	3	11	11
" 6.	"	"	56,251	14	4	2	7	14	1
" 8.	"	"	53,571	11	4	1	3	13	4
" 9.	"	"	47,153	9	7	1	3	4	6
" 10.	"	"	29,475	18	4	1	2	0	3
" 11.	"	2½	23,547	17	10	1	1	15	4
" 12.	"	"	25,226	10	6	1	1	17	10
" 13.	"	"	24,473	3	6	2	3	13	8
" 15.	"	"	24,297	4	4	1	1	16	4
" 16.	"	"	22,008	12	10	1	1	10	1
" 17.	"	3	25,021	17	4	1	2	1	0
" 18.	"	"	33,553	6	7	2	5	10	3
" 20.	"	"	37,625	12	8	2	6	3	8
" 22.	"	"	47,099	5	3	1	3	18	11
" 23.	"	"	27,756	2	7	1	2	5	7
" 24.	"	"	26,587	5	3	1	2	3	7
" 25.	"	"	24,087	5	3	1	1	19	7
" 26.	"	"	24,039	16	2	1	1	19	6
" 27.	"	3½	23,619	17	5	2	4	16	11
" 29.	"	"	21,104	19	0	1	2	3	3
" 30.	"	"							
							£75	6	0

The above is similar to many accounts in our books, and the interest was calculated upon it in six minutes and a half according to our system.

This account looks formidable, and certainly the computer, who, on the detached system worked out the interest in six and a half minutes deserves unqualified praise.

The account on the commutative system is very simple:—

1867.	Rate.	Daily Balances.	Sums. (3 figures cut off.)	Products.
April 1	2 per cent.	£ 52,264 8 6		
" 2	"	52,055 11 11		
" 3	"	47,998 10 5		
" 4	"	51,859 14 4	2020	8160
" 5	2½	52,525 4 8		
" 6	"	56,251 14 4		
" 7	"	56,251 14 4		
" 8	"	53,571 11 4		
" 9	"	47,153 9 7		
" 10	"	29,475 18 4	2952	14760
" 11	2½	23,547 17 10		
" 12	"	25,226 10 6		
" 13	"	24,473 3 6		
" 14	"	24,473 3 6		
" 15	"	24,297 4 4		
" 16	"	22,008 12 10	1440	7920
" 17	3	25,021 17 4		
" 18	"	33,553 6 7		
" 19	"	33,553 6 7		
" 20	"	37,625 12 8		
" 21	"	37,625 12 8		
" 22	"	47,099 5 3		
" 23	"	27,756 2 7		
" 24	"	26,587 5 3		
" 25	"	24,087 5 3		
" 26	"	24,039 16 2	3169	19014
" 27	3½	23,619 17 5		
" 28	"	23,619 17 5		
" 29	"	21,104 19 0	683	5122
" 30	Interest ...	75 6 2		54976