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To Prove That the 13th Day of the Month Is More Likely to Be a Friday than Any Other Day of the Week

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reversing the list. It is easy to verify that under this system, new tunes are introduced at the average rate of one every n weeks.) *Added in proof:* Each tune loses popularity at most n times; therefore at least N/n tunes occur in N weeks, and $1/N$ is indeed the answer.

Leicester University and University College London ROY O. DAVIES

TO PROVE THAT THE 13TH DAY OF THE MONTH IS MORE LIKELY TO BE A FRIDAY THAN ANY OTHER DAY OF THE WEEK

BY S. R. BAXTER

It must be remembered that one does not get a leap year at the turn of a century unless the year is divisible by 400.

Let a be the equivalent of a certain day of the week, succeeded by $b,\ldots,g$. Then, for 28 years that end with a leap year, which do not overlap from one century into another:

Year	*Date of 1 Jan.*	*Year*	*1/1*	*Year*	*1/1*	*Year*	*1/1*
1	*a*	8*	*b*	15	*d*	22	*f*
2	*b*	9	*d*	16*	*e*	23	*g*
3	*c*	10	*e*	17	*g*	24*	*a*
4*	*d*	11	*f*	18	*a*	25	*c*
5	*f*	12*	*g*	19	*b*	26	*d*
6	*g*	13	*b*	20*	*c*	27	*e*
7	*a*	14	*c*	21	*e*	28*	*f*

* leap year

In these 28 years, January 1st has an equal distribution of days in leap years and in non-leap years. Hence there is no need to look into periods of 28 years like this, since there are no variations which will make the 13th more or less likely to be a Friday.

Let us now consider a period of 400 years, starting at a year of the form $400n+1$ (n is a positive integer). In that year, let A be the day of the 1st Jan., succeeded by $B,\ldots, G$.

Year; 1/1	*Year; 1/1*	*Year; 1/1*	*Year; 1/1*	*Year; 1/1*	*Year; 1/1*	*Year; 1/1*	*Year; 1/1*
1-28–	92* B	102 G	193 B	203-30–	294 A	331-58–	395 G
29-56–	93 D	103-30–	194 C	231-58–	295 B	359-86–	396* A
57-84–	94 E	131-58–	195 D	259-86–	296* C	387 D	397 C
85 A	95 F	159-86–	196* E	287 F	297 E	388* E	398 D
86 B	96* G	187 A	197 G	288* G	298 F	389 G	399 E
87 C	97 B	188* B	198 A	289 B	299 G	390 A	400* F
88* D	98 C	189 D	199 B	290 C	300 A	391 B	(01 A,
89 F	99 D	190 E	200 C	291 D	301 B	392* C	etc re-
90 G	100 E	191 F	201 D	292* E	302 C	393 E	currs)
91 A	101 F	192* G	202 E	293 G	303–30-	394 F	

The 1st of January 1968 was a Monday. From the table, one can see that the year 359 has day D as the 1st of Jan., hence year 368 will begin with day A.

Hence $A \equiv$ Monday. So, summing up the last table:

Letter	*Frequency* Non-leap years	*Frequency* Leap years
$A \equiv$ Monday	7(→0)	1(→0)
$B \equiv$ Tuesday	8(→1)	2(→1)
$C \equiv$ Wednesday	7(→0)	2(→1)
$D \equiv$ Thursday	8(→1)	1(→0)
$E \equiv$ Friday	7(→0)	3(→2)
$F \equiv$ Saturday	7(→0)	1(→0)
$G \equiv$ Sunday	7(→0)	3(→2)

The figures after the arrows have been obtained by subtracting 7 for the first column and 1 for the second. This is permissible since we are only comparing frequencies.

Now let us consider the days on which the 13th occurs, according to the day on which January 1st falls. Let January 1st be day 7, and let days 2, . . ., 1 follow. Then:

Date	*Day* *N-leap year*	*Day* *Leap year*	*Date*	*Day* *N-leap*	*Day* *Leap*
Jan. 13th	6	6	Jul. 13th	5	6
Feb. 13th	2	2	Aug. 13th	1	2
Mar. 13th	2	3	Sep. 13th	4	5
Apr. 13th	5	6	Oct. 13th	6	7
May 13th	7	1	Nov. 13th	2	3
Jun. 13th	3	4	Dec. 13th	4	5

Day No.	*Total Freq.* *Non-leap yr.*	*Total Freq.* *Leap year*
1	1	1
2	3	2
3	1	2
4	2	1
5	2	2
6	2	3
7	1	1

Then one can use these frequencies to amplify our previous table.

Frequencies

	From *leap year* with Jan 1 as Tuesday	*From non-leap year* with Jan 1 as Tuesday	From *leap year* with Jan 1 as Wednesday.	From *non-leap year* with Jan. 1 as Thursday	From 2 *leap years* with Jan 1 as Friday	From 2 *leap years* with Jan 1 as Sunday	TOTAL
Mondays	1	1	3	2	2	4	13
Tuesdays	1	1	1	2	4	4	13
Wednesdays	2	3	1	1	6	2	15
Thursdays	2	1	2	1	2	4	12
Fridays	1	2	2	3	2	6	*16* ←
Saturdays	2	2	1	1	4	2	12
Sundays	3	2	2	2	4	2	15

From this one can see that Friday is the most frequent, and therefore the most probable day.

Eton College S. R. BAXTER (when age 13)

MATHEMATICAL GROUPS IN CAMPANOLOGY

BY B. D. PRICE

Groups have for several hundred years been used in the composition of long peals in change ringing, as was mentioned on p. 399 of the *Gazette*. A brief outline of their use for the non-ringing mathematician may be of some interest.

The English art of change-ringing is founded on the sounding of consecutive permutations of the bells being rung (usually 6, 8, 10 or 12 in the diatonic scale descending to the tonic), the bells being swung through a full circle or nearly so, and small differences in energy induced by pulling or checking the rope cause small changes in the highest point reached at consecutive swings, and hence large differences in the period of swing, so that bells up to 4 tons in weight may be controlled by one person, and permutations created by advancing or retarding the several swings. It is an invariable rule that a bell may move only one place in successive permutations,