

INTRODUCTION

To “Calendar Problems” & “A Universal Calendar”

Nearly 60 years ago, while conversing with a friend, she told me her date of birth (day, month, year). I waited about 10 seconds and told her it was a Tuesday. She was astounded and said that I must have some supernatural powers!

I had read about formulas for finding the ‘day’ of a ‘date’. I had figured my own way, –which in simple terms – required adding 4 small numbers derived from the date and dividing the sum by 7. The remainder (0,1,2.....6) gave the ‘day’ (0 for Sunday, 1 for Monday). With some practice, I could do the arithmetic mentally in about 10 seconds.

Later, I realized that the ‘day-date’ problem is more than a popular parlor game trick. There is some very interesting recreational mathematics involved. Essentially the day corresponding to a given date is found by counting the number of days elapsed between a *reference date of known day*, and the given date. Usually the reference is January 1, 1900 (Monday). Complications arise in the counting process due to some vagaries of the calendar: (1) the number of days in a month is 28/29, 30 or 31, (2) leap year (multiple of 4) has an extra day (366 days instead of 365 days) with some exceptions, (3) the exceptions are years ending in ‘00’ but not multiples of 400. (e.g. year 2000 was a leap year). The Gregorian calendar in use today, has a 400-year cycle; the calendars for two years 400 years apart are the same. Further, in a given century, there is a 28-year cycle.

The “*four-numbers formula*” is the basis of many interesting problems (See the article “*Calendar Problems*” published originally in *The Hindu* as “*The Day and the Date*” in September 1994). Some correction to the formula is required depending on the century. For 20th century (1900-1999), there is no correction, but for the 21st century (2000-2099) the correction is –1. For example July 7, 1912 was a Sunday, but July 7, 2012 was a Saturday. Calendar problems are not very common in recreational mathematics. The field is open for innovation.

Recently I realized that even the “four-numbers formula” is a little difficult for laymen. So I devised a Universal Calendar with 3 Tables, all in one page. (See the article “*A Universal Calendar*”). By scanning a few columns/rows one can quickly determine the day corresponding to a given date. (It is recommended that the Universal Calendar be printed out for handy use).

However, solving other calendar problems with the Tables is not always easy. See “*Additional Notes*” for the kind of problems the Universal Calendar can handle. In general, the best tool for solving problems is the “four-numbers formula” given in “*Calendar Problems*”.

Today, most of the world follows the Gregorian calendar introduced by Pope Gregory XII in 1582. The Julian calendar in use since 46 BCE was advanced by 10 days to remove the accumulated error in time keeping, arising from the mismatch between the calendar and the astronomical year (orbital period of the earth around the Sun). This was done by stipulating October 5, 1582 as October 15, 1582. According to the Julian calendar all years ending in ‘00’, being multiples of 4, were considered as leap years. To avoid future corrections, it was mandated that of the years ending in ‘00’ – the centesimal years – only those that are multiples of 400 will be considered as leap years. This simple, ingenious prescription, reducing the number of days in a 400-year cycle by 3, would keep the calendar synchronized with the astronomical year.

Pope Gregory’s calendar was adopted in Great Britain and the American colonies only in 1752. It is reported that the Russian Church today still follows the Julian calendar. Christmas is celebrated on January 7 (*The Hindu* supplement “*Young World*”, August 23, 2011). January 7 of the Gregorian calendar corresponds to December 25 (in the year before) in the Julian calendar. The interval between the two dates is 13 days instead of 10 days (in 1582) because in the 430 years that have elapsed, the divergence between the two dates has increased by 3 days.

There are very small corrections made to the duration of the day, defined as time the earth takes to rotate one full turn around its axis. They are needed to

account for the variation in the day caused by the wobble of the axis. On June 30, 2012, the last minute before midnight was stipulated to have 61 seconds instead of 60. These adjustments are made from 1972 and so far ‘leap seconds’ have been added 25 times in the last 50 years. (*The Hindu*, June 29, 2012). As a time keeper the earth is accurate only up to a second in 2 years on the average, or 1 part in 60 million. It is noteworthy that some crystal-driven clocks in the consumer electronic market have comparable accuracy.

There are numerous other calendars in use by different religious groups for festivals, rituals etc. Some of them are lunar unlike the solar Gregorian calendar; some others are hybrid (luni-solar). For example the date of Easter *Sunday* is determined according to a luni-solar calendar. It is in commemoration of the resurrection of Jesus Christ. Easter Sunday is observed on ‘*the first Sunday after the full moon on or next after the vernal equinox*’. The date (which is always a Sunday) can be spread over an interval of few weeks in March-April, depending on the year. It was on 26 March in 1967 and 22 April in 1962. Lent, the period of religious fasting observed by Roman Catholics and some other Christians starts on Ash *Wednesday*, about 45 days before Easter Sunday. It covers 40 *weekdays* of fasting up to Easter Sunday (*Merriam-Webster Seventh New Collegiate Dictionary* c early 1960’s).

These calendars co-exist with the Gregorian calendar, which is internationally adopted for civil, and business purposes. They all have a 7-day week. Is it possible to devise a simple ‘day-date’ formula for any of them? This question is worth exploring.

The two articles “*Calendar Problems*” and “*A Universal Calendar*” may be read together. They can motivate readers to devise new problems.

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