Topical Applications of Mathematics

Old New Year PUPIL TEXT

The Russian New Year is officially celebrated on January 1st – but many Russians still celebrate 'Old New Year' on January 13th.

Why is this?

Activity 1

Find out about the Julian and Gregorian calendars.

Most of the world now uses the **Gregorian** calendar, at least for international communications, but the Russian Orthodox Church continues to use the Julian calendar and many people in Russia enjoy celebrating the New Year twice!

The Gregorian calendar is a reform of the **Julian** calendar which was named after Julius Caesar and was in use in Russia until 1918.

The Julian calendar was introduced in 45 BC and was based on the assumption that the length of a year was $365\frac{1}{4}$ days. To compensate for this, each year consisted of 365 days, with February having an extra day (29th) every 4 years (leap years).

We now know that the length of a year is approximately 365.2422 days!

Activity 2

On average, how much time is gained per year when using the Julian calendar? After 1000 years, how many days have been gained?

Losing a week in the calendar over a long period has little effect on countries near the equator but for European countries the effect was beginning to have serious consequences. Indeed by the 16th century about $12\frac{1}{2}$ days had been lost since 45 BC so that seasons were beginning to lag behind the calendar. This was important for farmers and others. By this time scientists were able to more accurately measure the length of a year.

Activity 3

In Western Europe, what events are usually in line with the seasons? (For example, bulbs flowering in Spring.)

Pope Gregory XIII of Rome decreed that:

- October 4th 1582 should be followed by October 15th 1582

- only 1 in 4 century years would be a leap year so that 1600, 2000, 2400, etc. would have an extra day but 1700, 1800, 1900, 2100, etc. would not be leap years.

Activity 4

With the Gregorian calendar, what is the average length of a year?

Is there still a problem?

The **Gregorian calendar** was adopted at various times by different countries: for example, by Spain, Portugal, France and most of Italy in 1582.

Britain was in no mood to follow advice from Rome in the 16th century and it was not until 1750 that an Act was passed by Parliament to introduce the Gregorian calendar. By then Britain had in fact gained another day as there had been a leap year in 1700 (most of the rest of Europe was already using the Gregorian calendar by this time), so it was decreed that:

- September 2nd 1752 should be followed by September 14th 1752

which put us in step with most of Europe.

There was rioting on the streets as people believed that the state was 'stealing' 11 days!

Activity 5

When will the Russian 'Old New Year' change date from January 13th?

How often will it change?

Although the Gregorian calendar is accepted internationally, there are many interesting calendars in use including the **Jewish** calendar, **Islamic** calendar and the **Chinese** calendar.

Activity 6

Find out about another calendar used somewhere in the world.

How does this calendar compare to the Gregorian calendar?

One real issue that is complicated by the different calendars is the date of Easter. This is dependent on both the Gregorian and Jewish calendars.

Information about this is given in a separate resource in this series.

We'll look now at an algorithm to work out the day of the week for any date in the last or the current century.

Algorithm

This algorithm will give the day of the week for particular date in a previous year.

(An algorithm is a set of mathematical instructions that must be followed in a fixed order, to obtain the answer to a mathematical problem.)

Here we'll find the day of the week on which a person was born if we know that their birth date was **March 21st 1944**.

Step	***Instruction***	***Example***
1.	Work out *D*, the day of the year of the birth date	$D = 31 + 29 + 21 = 81$
2.	Let $Y =$ year	$Y = 1944$
3.	Calculate $S = D + Y + \left[\frac{Y-1}{4}\right] - \left[\frac{Y-1}{4}\right]$ which means ignore the remainder	$\frac{Y-1}{4} = \frac{1943}{4} = 485\frac{3}{4}$ $\left[\frac{Y-1}{4}\right] = 485$
4.	Let $S = D + Y + \left[\frac{Y-1}{4}\right]$	$S = 81 + 1944 + 485$ $= 2510$
5.	Calculate $S \div 7$ and note the remainder	$S \div 7 = 358$ remainder 4
6.	The remainder is the KEY to the day of the week: $R = 0$: Friday $R = 1$: Saturday $R = 2$: Sunday, etc.	$\left[\frac{Y-1}{4}\right] = 485$ $R = 4$ gives Tuesday, i.e. 21st March 1944 was a Tuesday.

Activity 7

*Work out the day of the week that **you** were born on. (Check that you have the correct answer.)*

Activity 8

Extend this method to any date, based on the Gregorian calendar.