Problem of the Week, AY 2007 1 March 2007
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Problem 17

In the Georgian calendar:

(i) years not divisible by 4 are common years;
(ii) years divisible by 4 but not by 100 are leap years;
(iii) years divisible by 100 but not by 400 are common years;
(iv) years divisible by 400 are leap years;
(v) a leap year contains 366 days; a common year 365 days.

Prove that the probability that Christmas falls on a Wednesday is not $\frac{1}{7}$

Solution

It is obvious, from the above 5 rules, that the calendar shows a pattern which is repeated every 400 years.
In every 400 years there are 100 years which are divisible by 4. Since the 100^{th}, 200^{th} and 300^{th} years are common years, so there are 100 – 3 = 97 leap years in every 400 years. Therefore, the number of days in every 400 years is 400×365 + 97 = 146097 days which is divisible by 7 (146097/7 = 20871 weeks).
This means that although the Christmas day is changing from year to another yet it shows the same pattern every 400 years, and the probability that Christmas falls on a Wednesday can be calculated by dividing the number of years in which Christmas falls on a Wednesday (say "n") by 400

So, the probability that Christmas falls on a Wednesday = $\frac{n}{400}$

Since 400 is not divisible by 7, so $\frac{n}{400}$ can't be simplified into $\frac{1}{7}$

and therefore $\frac{n}{400} \neq \frac{1}{7}$

Thank you,
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