

FINANCE DIVISION

UNIVERSITY OF OXFORD

An Excel Adventure in Dates and Times

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Finance Training and Learning Team

Why Does Easter Move Around?

- Festival linked to Jewish calendar
 - Events several days into Passover festival
 - Begins on 15th day of Nisan (spring month)
- Jewish months begin at new moon
 - 15th day is immediately after full moon
 - "Easter" is first Sunday after that



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Jewish Months Are Fixed, Right?

- They're lunar (29 or 30 days)
 - 12 lunar months = 11 days behind solar year
 - 13 lunar months = 19 days ahead
- So Jewish years have 12 or 13 months
 - Originally decided by observation
- 4th century calendar used 19 year cycle
 - The Metonic Cycle
 - Extra month in years 3,6,8,11,14,17 and 19
 - "Misses" 19 solar years by only a few hours

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What Did The Early Christians Do?

- Asked Jewish friends when Passover was
- Quartodeciman Controversy - 155 AD
 - Asia Minor (Polycarp) - Nisan 14
 - Rome (Anicetus) – First Sunday after Nisan 14


Agreed to disagree!




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Council of Nicea – 325 AD


- Unity a strong aim of the Council
- Argued Jewish calendar now in error
 - "Nisan 14 should never precede vernal equinox!"
- Proposed a new "Christian Nisan"
 - Lots of new tables produced
 - Took centuries to agree details



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Calculating Easter – Medieval Style

- People made tables like this
- Vernal equinox - March 21st
- Golden Number
 - Year mod 19 + 1

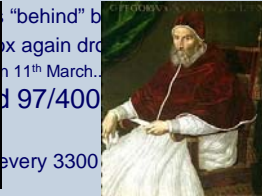


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Great Calendar Change - 1582

- Julian (Caesar) to (Pope) Gregorian

- Julian "lost" 1 day every 128 years



- Gregorian "gained" 1 day every 3300 years



So everyone adopted this straight away?



- Straight from October 4th to October 15th
 - Protestant states all switched by 1700 except...



- Straight from September 2nd to 14th in 1752
 - Sweden tried to move over gradually



- 30th February 1712



And then there's the Eastern Churches

- They still use the Julian Calendar

- 1997 meeting in Syria to agree conformity with West



Agreed to disagree!



Calculating Modern Easter

- First Sunday after first full moon after vernal equinox: **22nd March - 25th April**

- New table based on Epact – moon age at New Year
 - Julian Epact = $11 * (\text{GoldenNumber} - 1) \bmod 30$
 - Age of moon on 22nd March
 - Solar Equation = $(3 * \text{century}) / 4$
 - Difference between Julian and Gregorian Calendars
 - Lunar Equation = $(8 * \text{century} + 5) / 25$
 - Difference between Julian calendar and Metonic cycle

Gregorian Epact = Julian Epact – Solar Equation + Lunar Equation + 8



Easter in Excel

- Competition held by Hans Herber

- Shortest formula to calculate Easter from 1900-2078
 - Shortest to work with any date setting by Thomas Jansen
 - Assuming the year is stored in A1...

`=DOLLAR((("4"&A1)/7+MOD(19*MOD(A1,19)-7,30)*14%)*7-6`



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