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The PHE report and the deaths that went away

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As you will recall from the previous discourses on this topic[1,2] Public Health England (PHE) recently produced a report[3] using the EuroMOMO methodology[4] which conveniently expunged from history the sudden and unexplained increase in deaths which occurred across England and Wales from February 2012 to around July 2013.

On this occasion I will attempt to explain one of the errors into which even professional modellers can fall, namely, *never trust a model to work outside the limitations of its hidden assumptions.*

Figure 1: Trend in deaths for the whole of the UK plus forecast to 2020

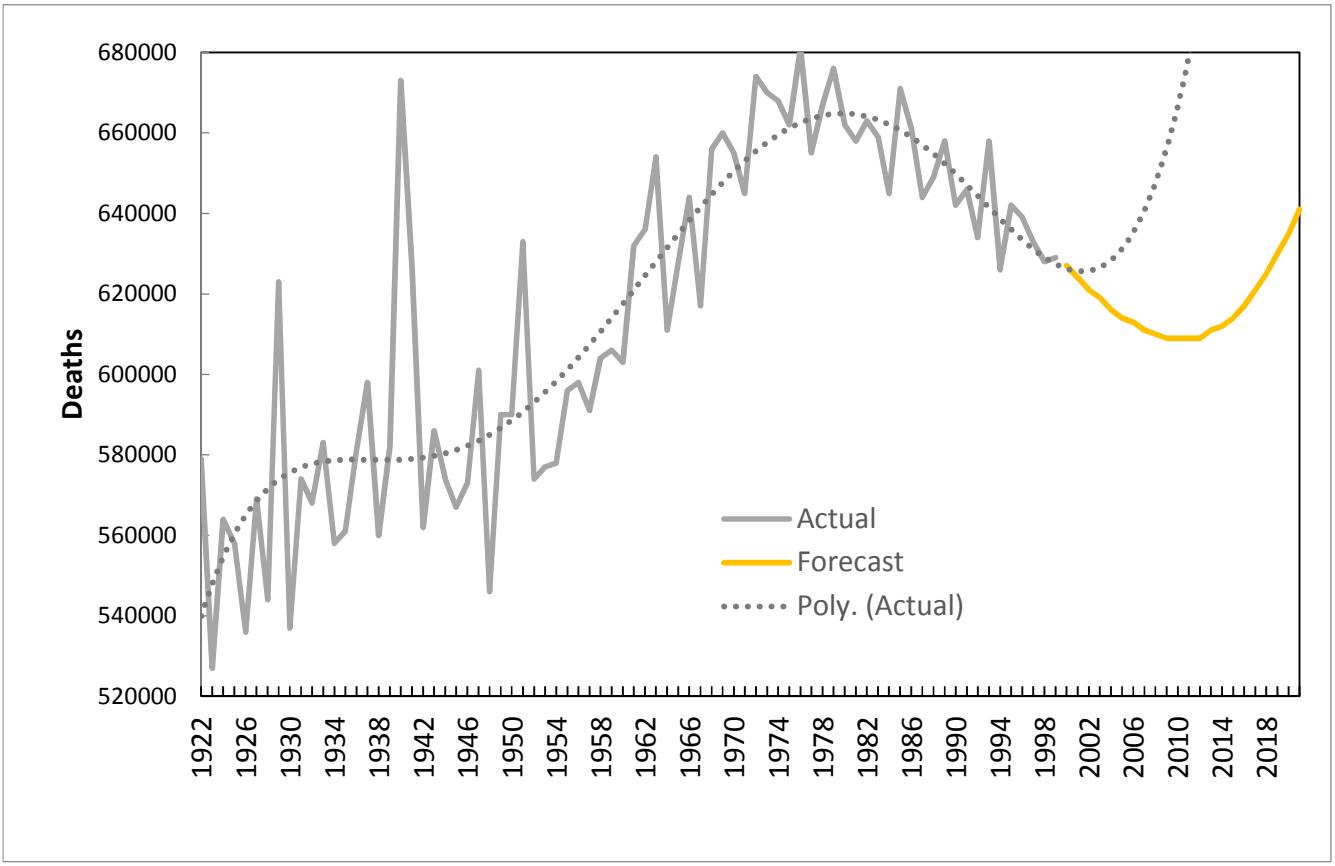

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Figure 1 shows deaths for the whole of the UK between 1922 and 1999 (this and other data from Office of National Statistics). The large peaks are due to Influenza epidemics and are greatly diminished since widespread vaccination was implemented in the 80's and 90's. Those who have had the delight of doing undergraduate mathematics will recall that you can approximate any model using a polynomial. This has been detailed in Figure 1 where it can be seen that the polynomial does a reasonable job (with limitations) of following the trend in deaths but immediately fails beyond the last data point, i.e. it has gone beyond the limits of its useful application.

The forecast line is the estimate of future deaths prepared by the Government Actuary (GA) taking past and future trends in births, deaths, life expectancy, immigration, etc into account. For the most part the GA trend line is useful in giving the expected average deaths into the future. Note that the line trends downward over the period 2008 to 2013 during which the baseline in the PHE report trended slightly upward. So what could potentially be going wrong in the EuroMOMO methodology?

To get to the bottom of the matter I asked PHE to let me know the exact date range that was used to calculate the baseline in their report. In answer to my question (by email) I received the following two answers. Answer 2 was in response to my request to 'just tell me the exact dates that went into the baseline' …… Sir Humphrey[5] would be proud!

Answer 1

"I understand that the EuroMOMO baseline is modelled using a glm poisson [Generalised Linear Model (GLM) Poisson] distribution corrected for over dispersion. The model is fitted on a historical dataset of 5 years, excluding a period to correct for reporting delay (the most recent 50 weeks). Spring and summer weeks are used to fit the baseline when it is assumed that additional processes leading to excess deaths are not likely to happen. These parameters are standard across all European participating countries."

Answer 2

"The baseline shown in the figure in the PHE report was produced with data up to week 24 2013. The model is fitted on a historical dataset of five years (back to week 25 2008), excluding the most recent 50 weeks to correct for reporting delay, so week 25 2008 – week 26 2013. Out of this times series, spring and summer weeks are used to fit the baseline. For exact details and clarification on the spring and summer weeks, you will need to contact the European team to check."

In plain English, I think this means that data from the summer months of 2008 through to 2012 was used to calculate the baseline. In the following discussion I am not attempting to replicate EuroMOMO but to illustrate the principles.

Figure 2 shows why the use of the summer months may be desirable, namely, the variability in deaths around the median value is lowest from 26th February to 12th October which roughly corresponds to the summer months. Hence the baseline seeks to exclude the more volatile deaths during the winter months. However the six summer months (May to September) only account for 45% of the total deaths and *it goes without saying that you can only die once*. So if you die this year you cannot die in the next and vice versa. Hence there is a strong argument for using the total deaths in favor of just the summer deaths despite the higher volatility.

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Figure 2: Ratio of daily maximum to median deaths (1989 to 2000)

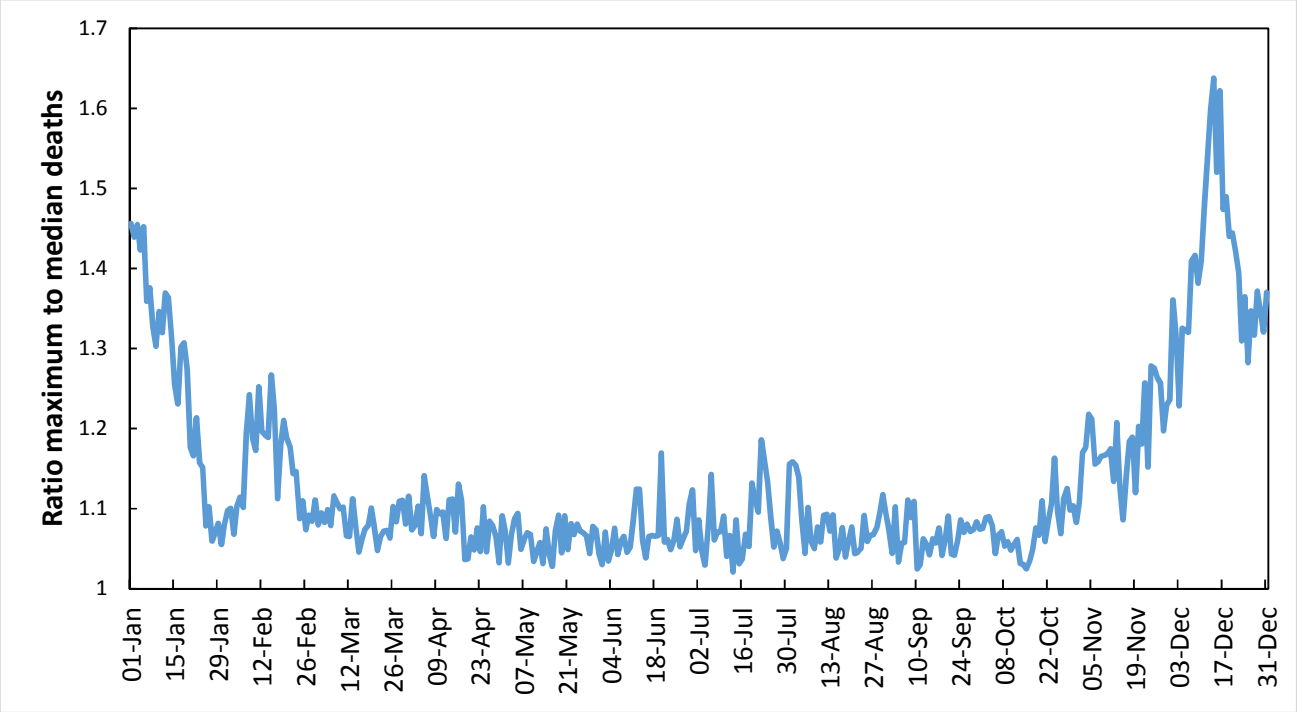

Figure 3: Hypothetical baseline using 'whole year' or 'summer' deaths in England & Wales

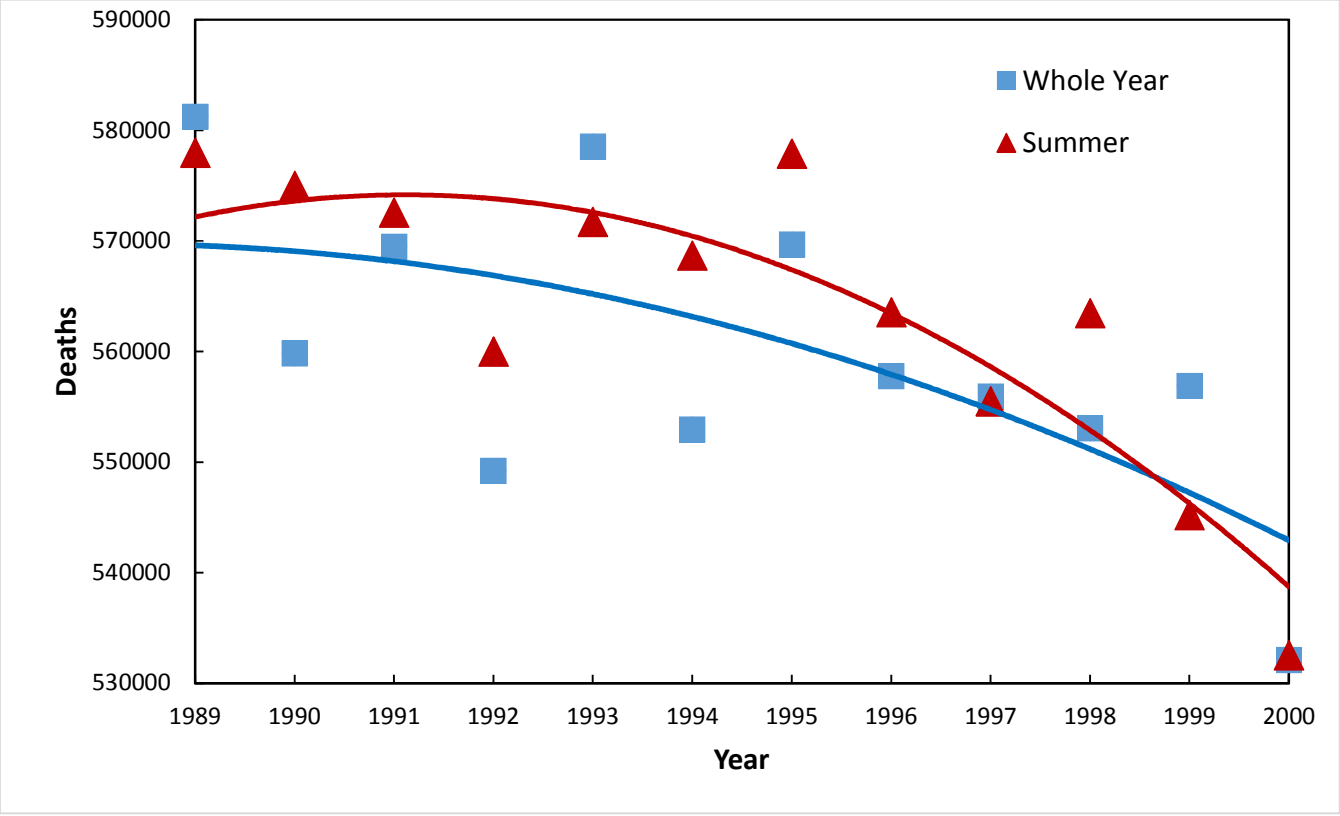

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Figure 3 attempts to illustrate how this could affect the calculation of the baseline by taking the trend in whole year deaths and comparing this to the trend in summer deaths (on this occasion May to September deaths multiplied by 2.64 to give a full year total).

In England & Wales the peak which occurs around 1980 for the whole of the UK (Figure 1) occurs later at around 1993 and is somewhat flatter, however, it does continue to decline beyond 2000 as is the case for the UK.

Therefore, which hypothetical baseline in Figure 3 is correct? The trend line using 'summer deaths' has less scatter due to the fact that the highest variation occurs in the winter but the 'whole year' trend encompasses all the deaths (nearly twice as many). The answer is probably neither is 'correct' but is a reflection of two different approaches.

However, using the 'summer' method in Figure 3 leads to the conclusion that 1993 is not a high year but using the 'whole year' method it is high. In the last update in this series[2] I demonstrated (using a chart with daily deaths) that 1993 was indeed a high year during which one of the outbreaks of the new type of infection occurred early in the year (as was the case in 2012 in England and Wales) but slightly earlier in Scotland[6].

There are two fundamental reasons why the use of deaths in the summer months between 2008 and 2012 would give an incorrectly upward sloping baseline:

1. Although total deaths between 2008 and 2011 were decreasing the majority of the decrease was in the winter months and is therefore (wrongly) excluded from the EuroMOMO baseline calculation. This would tend to give a flat baseline rather than a declining one.

2. The large step-like increase in deaths which commenced in February 2012 continued through the summer of 2012 and was therefore part of the baseline. Add this to an already apparently flat baseline from 2008 to 2011 and this will largely be responsible for tilting the baseline trend upward.

To include a period of very high deaths at the end of a time series is in itself ***not*** good practice because if you do so you have assumed that the high deaths are 'normal' behavior. Hence, at the very least the PHE report should be re-calculated excluding the summer of 2012.

We are only left to surmise that the period of high deaths was seen as 'embarrassing' because no one at the DH/PHE/NHS England had any real answers and EuroMOMO gave a convenient 'official' escape clause to as it were, bury the dead.

The question remains are we dealing with genuine cyclical epidemics?

You may be helped by publications at www.hcaf.biz in the 'Emergency Admissions' and other pages to reach your informed decision as to whether billions of pounds of healthcare expenditure rest upon the answer to this question.

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3. Public Health England (2013) Excess winter mortality report 2012 to 2013. Available from https://www.gov.uk/government/publications/excess-winter-mortality-2012-to-2013
4. Details of EuroMOMO available at www.euromomo.eu
5. Sir Humphrey is a fictional senior civil servant in the television series 'Yes Minister' and 'Yes, Prime Minister', see http://en.wikipedia.org/wiki/Humphrey_Appleby
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P.S. There are more publications to come……..