

Webinar for Scottish Independent Actuaries

Mortality shocks in insurer data

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1. Covid-19
2. Annuity portfolios
3. Non-parametric approach
4. Semi-parametric approach
5. Conclusions

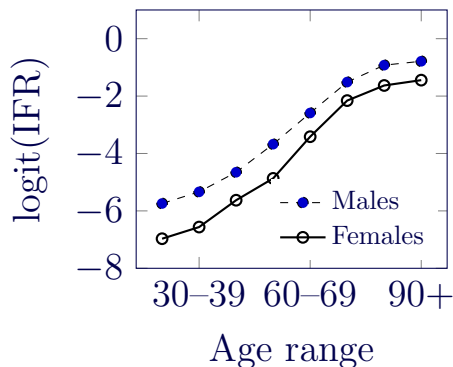
1 Covid-19

- Covid-19 is the disease caused by the novel SARS-CoV-2 virus[†].
- Covid-19 can be fatal...

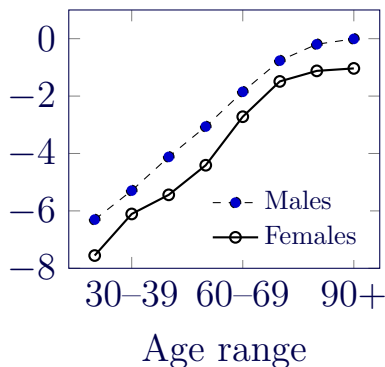
[†]The Novel Coronavirus Pneumonia Emergency Response Epidemiology Team [2020].

Logit(mortality) by age for confirmed covid-19 infection[‡].

(a) Spain



(b) Italy



[‡]Own calculations using data from CCAES [2020] and ISS [2020].
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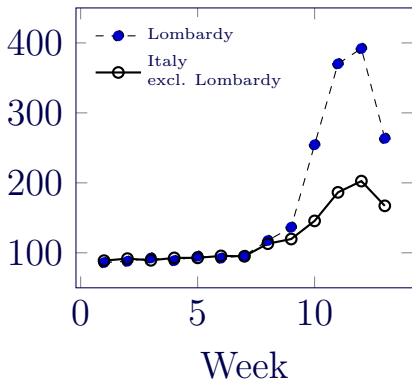
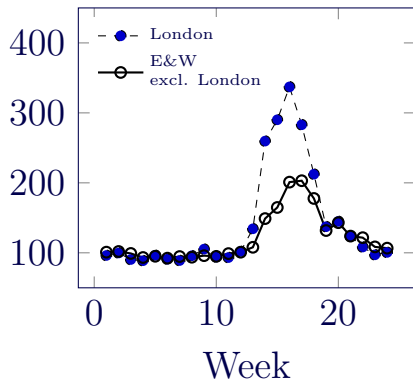
- Covid-19 is the disease caused by the novel SARS-CoV-2 virus[†].
- Covid-19 can be fatal...
...and its arrival was obvious in national mortality statistics...

[†]The Novel Coronavirus Pneumonia Emergency Response Epidemiology Team [2020].

Deaths in early 2020 as percentage of average in 2015–2019♣.

(a) England & Wales

(b) Italy



♣ Source: own calculations using data from ONS [2020] and Istat [2020].

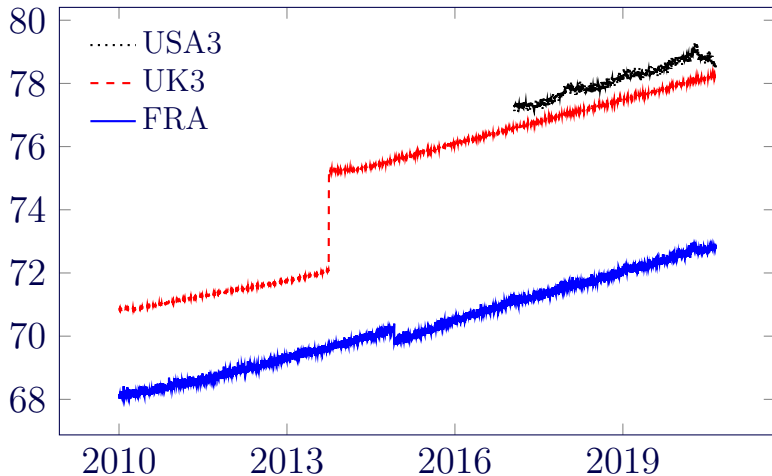
2 Annuity portfolios

2 Annuitant experience data

Portfolio	Cumulative deaths	In-force 1st April 2020
FRA	47,026	251,330
UK3	109,878	146,269
USA3	145,153	723,762

Data extracted in September 2020.

Average age of in-force annuitants.



3 Non-parametric approach

- $\{y + t_i\}$ is the set of distinct dates of death,
- d_{y+t_i} is the number of deaths at date $y + t_i$, and
- $l_{y+t_i^-}$ is the number of lives immediately before $y + t_i$.

- Only need:
 - ▶ Date of annuity commencement,
 - ▶ Date of annuity cessation, and
 - ▶ Nature of cessation (death, withdrawal etc).
- No personal data required.
- GDPR does not apply.

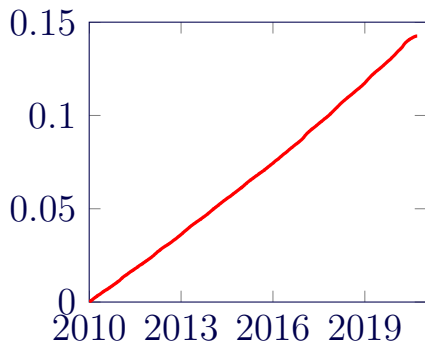
$$\hat{\Lambda}_{y,t} = \sum_{t_i \leq t} \frac{d_{y+t_i}}{l_{y+t_i^-}} \quad (1)$$

$$\hat{\mu}_{y+t} = \frac{1}{c} \left(\hat{\Lambda}_{y,t+c/2} - \hat{\Lambda}_{y,t-c/2} \right) \quad (2)$$

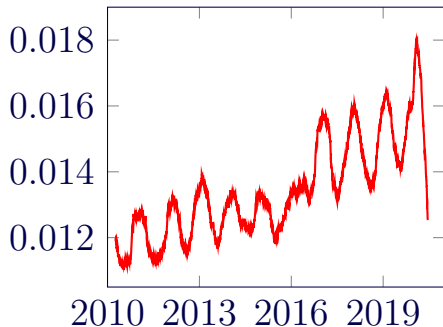
where $c > 0$ is the bandwidth parameter.

See blog for more details.

(a) $\hat{\Lambda}_{2010,t}$

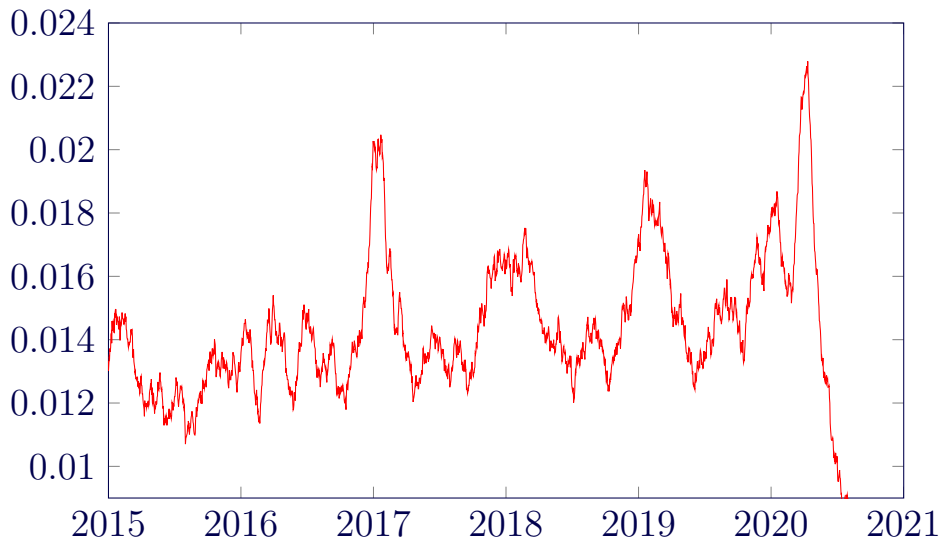


(b) $\hat{\mu}_{2010+t}$

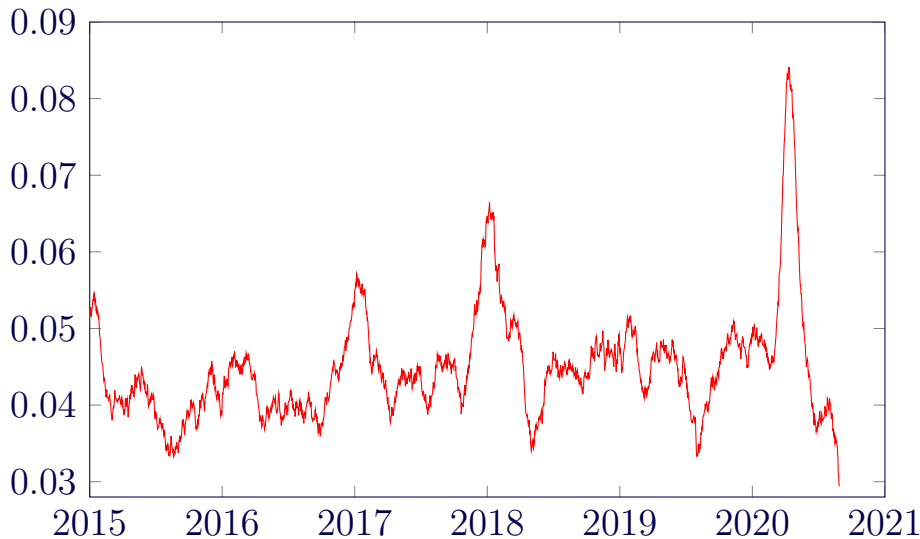


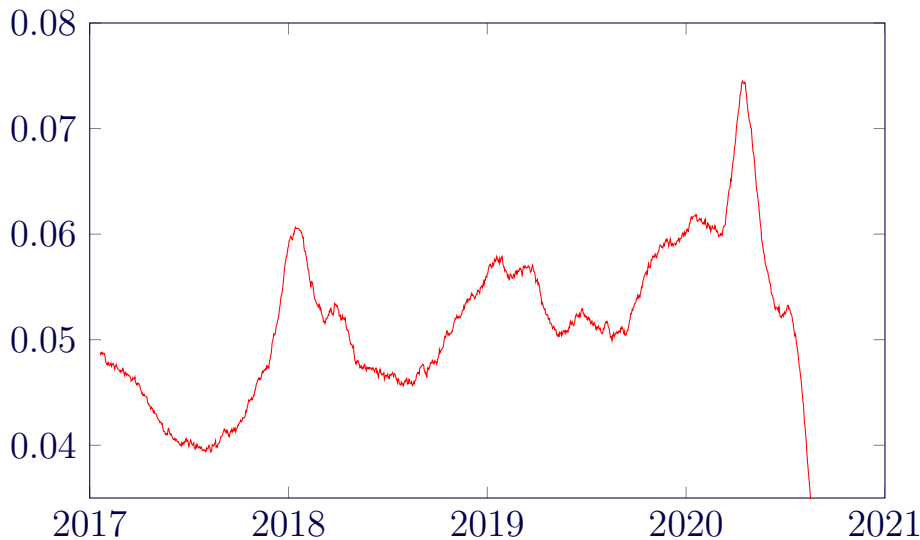
See blog for more details.

3 FRA $\hat{\mu}_{2015+t}$, $c = 0.2$



3 UK3 $\hat{\mu}_{2015+t}, c = 0.2$





Advantages:

- Reveals seasonal variation.
- Reveals mortality spikes
- Requires no personal data.

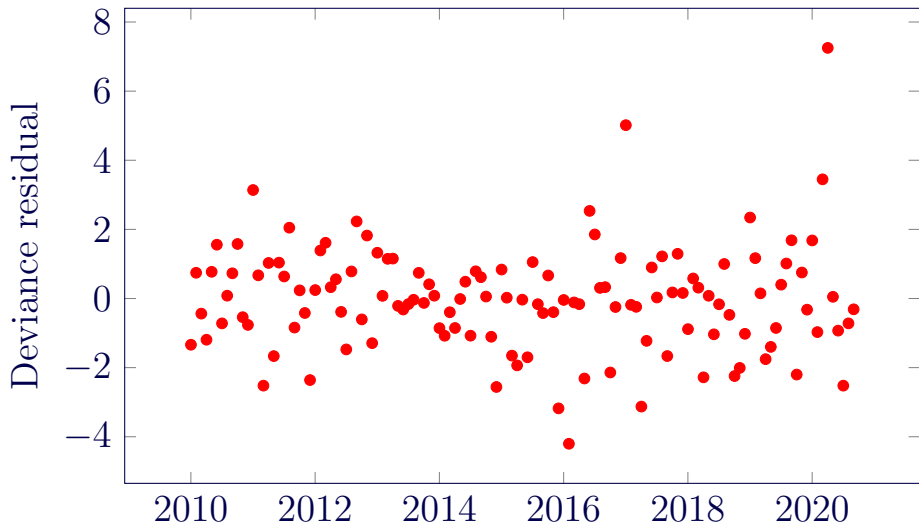
Drawbacks:

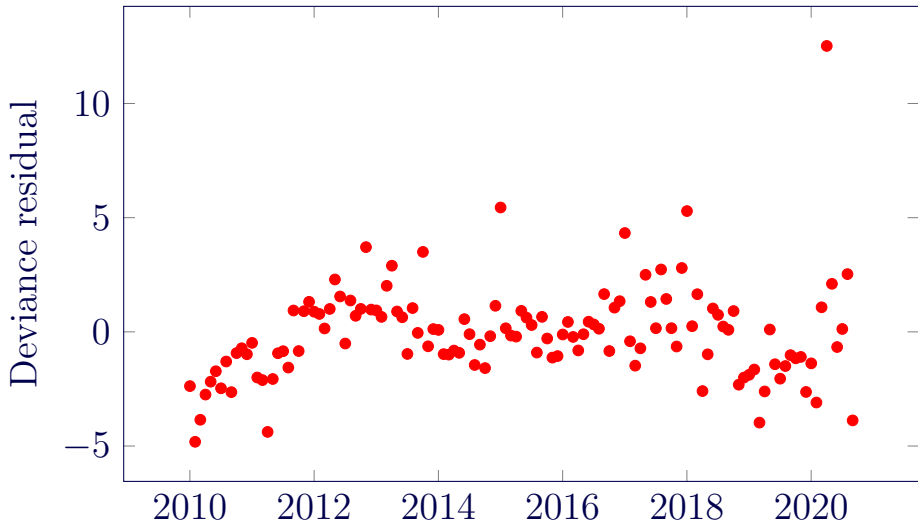
- Smoothing understates shock.
- Can't disentangle shock from seasonal effect.
- Doesn't allow for risk factors.
- Lose most recent $c/2$ years due to smoothing...
...and more due to IBNR.

4 Semi-parametric approach

- Fit a model with factors desired...
...and allow for season[♠] and IBNR.
- Plot deviance residuals by month.
- Residuals should have:
 - ▶ An approximate $N(0,1)$ distribution,
 - ▶ No trend or pattern, and
 - ▶ Few values outside ± 1.96 .

♠ See Richards et al. [2020].





The April 2020 residuals are...

- 7 standard deviations for the French portfolio.
- 12 standard deviations for the UK portfolio.

5 Conclusions

- Covid-19 shock detectable in annuity portfolios.
- Impact varies by portfolio.
- Non-parametric tools don't require personal data.
- Residual plots noisy, but don't smooth down shock.

- CCAES. Actualización no. 120. Enfermedad por el coronavirus (COVID-19). 29.05.2020. Technical Report 120, Centro de Coordinación de Alertas y Emergencias Sanitarias, May 2020.
- ISS. Epidemia COVID-19 Aggiornamento nazionale 16 giugno 2020 — ore 11:00. Technical report, Istituto Superiore de Sanità, 2020.
- Istat. Total deaths per age class, week of demographic event and municipality of residence at the time of death. Technical report, Istituto Nazionale di Statistica, 2020. URL <https://www.istat.it/en/archivio/240106>.

- ONS. Deaths registered weekly in England & Wales. Technical report, 2020. URL <https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/deaths/datasets/weeklyprovisionalfiguresondeathsregisteredinen>
- S. J. Richards, S. J. Ramonat, G. Vesper, and T. Kleinow. Modelling seasonal mortality with individual data. *Scandinavian Actuarial Journal*, pages 1–15, 2020. doi: 10.1080/03461238.2020.1777194.

The Novel Coronavirus Pneumonia Emergency Response Epidemiology Team. The epidemiological characteristics of an outbreak of 2019 novel coronavirus diseases (COVID-19) — China, 2020. *China CDC Weekly*, 2:113, 2020. ISSN 2096-7071. URL <http://weekly.chinacdc.cn//article/id/e53946e2-c6c4-41e9-9a9b-fea8db1a8f51>.

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