# IMPACT OF COVID-19 PANDEMIC IN HEALTH SERVICES USAGE

David Moriña, Amanda Fernández-Fontelo, Pere Puig and Montserrat Guillén

Universitat de Barcelona
Facultat d'Economia i Empresa

Fundación MAPFRE

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# 2 Who?

- PhD in Mathematics, Universitat Autònoma de Barcelona, 2013 (New models for discrete time series)
- Department of Econometrics, Statistics and Applied Economics
- Riskcenter-IREA

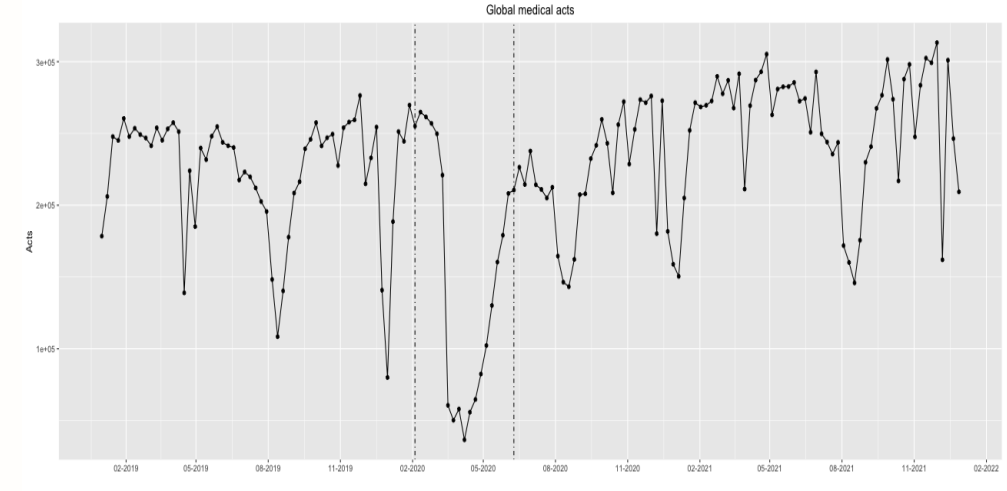
# 3 Why?

- There is an enormous global concern around 2019-novel coronavirus (SARS-CoV-2) infection in the last months, leading the World Health Organization (WHO) to declare public health emergency in early 2020
- The consequences derived from the pandemic caused by this virus have had a profound effect on many areas of human activity
- In addition to the direct consequences, in 2020 a decrease in use of health services has been detected, both those belonging to the Public Health System and services associated with private health insurances

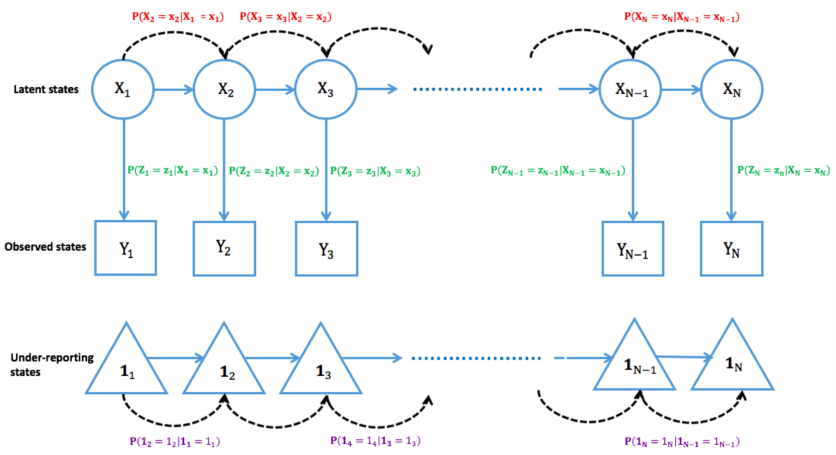
# 4 Why?

- The question is to know if, either due to the effect of postponing visits or due to the consequences of having suffered the virus (persistent Covid or secondary effects), there will be an excess of claims in 2022 and the following years
- There is already evidence of a higher frequency of use of Health services in the Public System but it is difficult to determine if the highest frequency of claims that will be observed will be equal to or greater than the infra-loss rate that was observed during the pandemic period

# 5 Why?

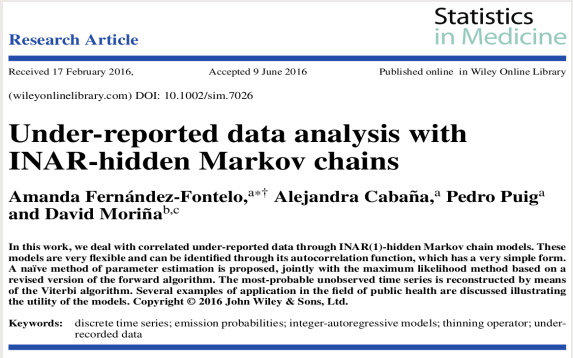

Global medical acts
Acts
3e+05
2e+05
1e+05
02-2019
05-2019
08-2019
11-2019
02-2020
05-2020
08-2020
11-2020
02-2021
05-2021
08-2021
11-2021
02-2022

# 6 How?


Latent states
Observed states
Under-reporting states
$P(X_2 = x_2|X_1 = x_1)$
$P(X_3 = x_3|X_2 = x_2)$
$P(X_N = x_N|X_{N-1} = x_{N-1})$
$X_1$
$X_2$
$X_3$
$X_{N-1}$
$X_N$
$P(Z_1 = z_1|X_1 = x_1)$
$P(Z_2 = z_2|X_2 = x_2)$
$P(Z_3 = z_3|X_3 = x_3)$
$P(Z_{N-1} = z_{N-1}|X_{N-1} = x_{N-1})$
$P(Z_N = z_n|X_N = x_N)$
$Y_1$
$Y_2$
$Y_3$
$Y_{N-1}$
$Y_N$
$1_1$
$1_2$
$1_3$
$1_{N-1}$
$1_N$
$P(1_2 = 1_2|1_1 = 1_1)$
$P(1_4 = 1_4|1_3 = 1_3)$
$P(1_N = 1_N|1_{N-1} = 1_{N-1})$

# Previously proposed models

## Independent under-reporting states



Research Article

Statistics in Medicine

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### Under-reported data analysis with INAR-hidden Markov chains

Amanda Fernández-Fontelo,[a*†] Alejandra Cabaña,[a] Pedro Puig[a] and David Moriña[b,c]

**In this work, we deal with correlated under-reported data through INAR(1)-hidden Markov chain models. These models are very flexible and can be identified through its autocorrelation function, which has a very simple form. A naïve method of parameter estimation is proposed, jointly with the maximum likelihood method based on a revised version of the forward algorithm. The most-probable unobserved time series is reconstructed by means of the Viterbi algorithm. Several examples of application in the field of public health are discussed illustrating the utility of the models. Copyright © 2016 John Wiley & Sons, Ltd.**

**Keywords:** discrete time series; emission probabilities; integer-autoregressive models; thinning operator; under-recorded data

# Previously proposed models

## Serially dependent under-reporting states

RESEARCH ARTICLE

WILEY Statistics in Medicine

**Untangling serially dependent underreported count data for gender-based violence**

**Amanda Fernández-Fontelo[1,2] | Alejandra Cabaña[2] | Harry Joe[3] | Pedro Puig[1,4] | David Moriña[4]**

[1]School of Business and Economics, Humboldt-Universität zu Berlin, Berlin, Germany

[2]Departament de Matemàtiques, Universitat Autònoma de Barcelona, Barcelona, Spain

[3]Department of Statistics, University of British Columbia, Vancouver, Canada

[4]Barcelona Graduate School of Mathematics, Departament de Matemàtiques, Universitat Autònoma de Barcelona, Bellaterra, Spain

**Correspondence**
Amanda Fernández-Fontelo, School of Business and Economics, Humboldt-Universität zu Berlin, 10178 Berlin, Germany; or Departament de Matemàtiques, Universitat Autònoma de Barcelona, 08193 Barcelona, Spain.
Email: fernanda@hu-berlin.de

Underreporting in gender-based violence data is a worldwide problem leading to the underestimation of the magnitude of this social and public health concern. This problem deteriorates the data quality, providing poor and biased results that lead society to misunderstand the actual scope of this domestic violence issue. The present work proposes time series models for underreported counts based on a latent integer autoregressive of order 1 time series with Poisson distributed innovations and a latent underreporting binary state, that is, a first-order Markov chain. Relevant theoretical properties of the models are derived, and the moment-based and maximum-based methods are presented for parameter estimation. The new time series models are applied to the quarterly complaints of domestic violence against women recorded in some judicial districts of Galicia (Spain) between 2007 and 2017. The models allow quantifying the degree of underreporting. A comprehensive discussion is presented, studying how the frequency and intensity of underreporting in this public health concern are related to some interesting socioeconomic and health indicators of the provinces of Galicia (Spain).

# Previously proposed models

## Non-stationary processes

PLOS ONE

RESEARCH ARTICLE

### Estimating the real burden of disease under a pandemic situation: The SARS-CoV2 case

**Amanda Fernández-Fontelo[1]*, David Moriña[2,3,4], Alejandra Cabaña[2], Argimiro Arratia[5], Pere Puig[2]**

**1** Chair of Statistics, School of Business and Economics, Humboldt-Universität zu Berlin, Berlin, Germany, **2** Departament de Matemàtiques, Barcelona Graduate School of Mathematics (BGSMath), Universitat Autònoma de Barcelona, Barcelona, Spain, **3** Department of Econometrics, Statistics and Applied Economics, Riskcenter-IREA, Universitat de Barcelona, Barcelona, Spain, **4** Centre de Recerca Matemàtica (CRM), Barcelona, Spain, **5** Department of Computer Science, Universitat Politècnica de Catalunya, Barcelona, Spain

* fernanda@hu-berlin.de

### Abstract

The present paper introduces a new model used to study and analyse the severe acute respiratory syndrome coronavirus 2 (SARS-CoV2) epidemic-reported-data from Spain. This is a Hidden Markov Model whose hidden layer is a regeneration process with Poisson immigration, Po-INAR(1), together with a mechanism that allows the estimation of the under-reporting in non-stationary count time series. A novelty of the model is that the expectation of the unobserved process's innovations is a time-dependent function defined in such a way that information about the spread of an epidemic, as modelled through a Susceptible-Infectious-Removed dynamical system, is incorporated into the model. In addition, the parameter controlling the intensity of the under-reporting is also made to vary with time to adjust to possible seasonality or trend in the data. Maximum likelihood methods are used to estimate the parameters of the model.

Check for updates

OPEN ACCESS

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**David Moriña, Amanda Fernández-Fontelo, Pere Puig and Montserrat Guillén**

Thank you!

dmorina@ub.edu