Modelling the supply of a Hospital - Challenge 1

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November 12, 2023

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Our initial approach:

1. Create new variables: Time between purchases, type of product, price per unit, etc.
2. Analyze the relations between variables.
3. Separate the data by hospitals and product.

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Problems we encountered:

1. No identifiable/useful correlation.
2. Lack of data.

Assumptions

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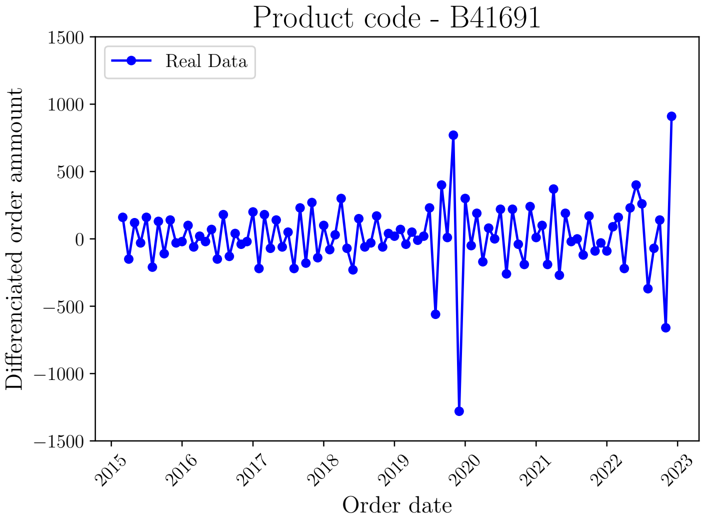
$\downarrow$

$\boxed{\text{Time Series}}$

The model: ARMA(p,q)/GARCH(P,Q)



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Let $\{Y_n\}_n$ be a stochastic process and $\{\epsilon_n\}_n$ a Gaussian $WN^1(0, \sigma_\epsilon^2)$. We say that $\{Y_n\}_n$ is an $ARMA(p, q)/GARCH(P, Q)$ process if for some constant parameters μ, $\{\phi_i\}_{i=1}^p$, $\{\theta_j\}_{j=1}^q$, $\{\alpha_i\}_{i=1}^P \geq 0$, $\{\beta_j\}_{j=1}^Q \geq 0$ and $\omega > 0$, the following equation holds:

$$Y_t = \mu + \sum_{i=1}^{p} \phi_i (Y_{t-i} - \mu) + a_t + \sum_{j=1}^{q} \theta_j a_{t-j},$$

$$a_t = \sigma_t \epsilon_t,$$

$$\sigma_t = \sqrt{\omega + \sum_{i=1}^{P} \alpha_i a_{t-i}^2 + \sum_{j=1}^{Q} \beta_j \sigma_{t-j}^2}.$$

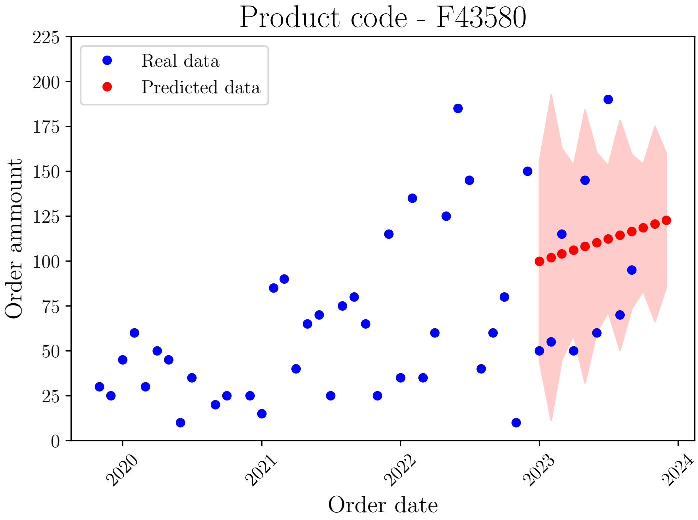
[1] a white noise

Purchase Plan for 2023

	F43580	B41691	E69682	...	E64544
01/2023	100	1317	308	...	2062
02/2023	102	1536	310	...	2085
03/2023	104	1380	313	...	2108
⋮	⋮	⋮	⋮	⋱	⋮
10/2023	119	1572	332	...	2268
11/2023	121	1549	335	...	2290
12/2023	123	1593	337	...	2313

Table: Forecast of the order amount per month for every product in 2023.

Results



Product code - F43580
Real data
Predicted data
Order ammount
Order date
225
200
175
150
125
100
75
50
25
0
2020
2021
2022
2023
2024

Possible improvements

Some improvements we would have added to our model if we had had more time and a broader dataset:

1. We would have predicted the product demand for each hospital, rather than for the whole region.
2. We would have searched for an optimum purchase price for every product.
3. We would have studied some products we were not able to fit with the $ARMA(p, q)/GARCH(P, Q)$ model.
4. We would have adjusted the value of the variance of the white noise (σ_ϵ^2) of each model.

Final remarks