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Administrative Data Quality Challenges through the Lens of e-Invoice

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Topics

1. Context
2. Data Quality: Challenges and Methodology
3. Collaborative efforts
4. Application to other cases
5. Conclusions

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1. Context

- The use of administrative data has been a constant over the years at Statistics Portugal (INE), aiming a significant impact on reducing the statistical burden
- 2020 brought three new features to Statistics Portugal's production:
  - The negative impact of the COVID-19 on the response rates to business surveys
  - Receiving a huge amount of data from the electronic invoicing system (tax authority)
  - The creation of a new unit dedicated to the collection, analysis and quality treatment of administrative data
  - Management support for training in new skills (data science) tools and techniques, for all organisational units

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1. Context

- INE receives monthly, from the Tax Authority, about 100 M records (x 3 months, since January 2024) regarding taxable amounts aggregated by issuer and buyers

- These amounts result from invoices issued by legal entities (or natural) persons based in Portugal

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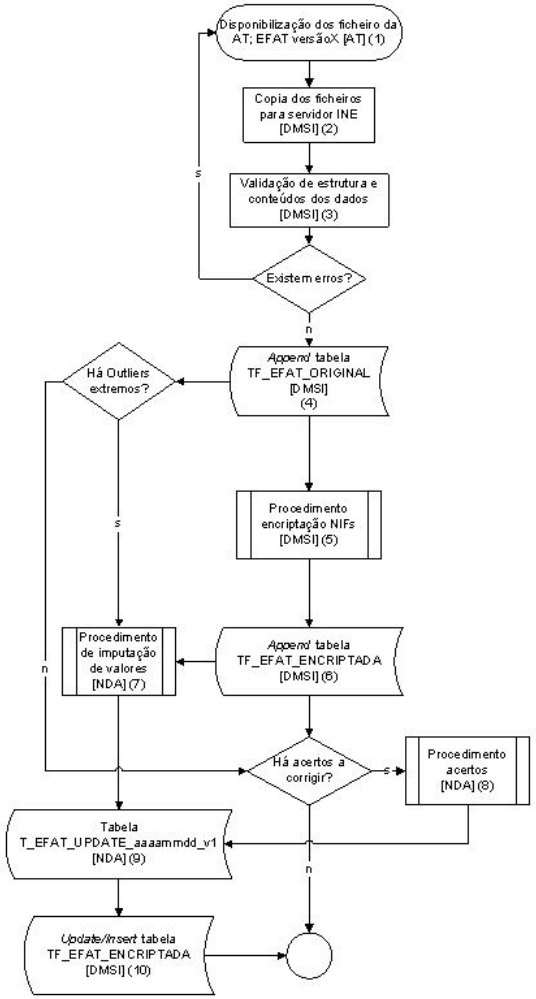
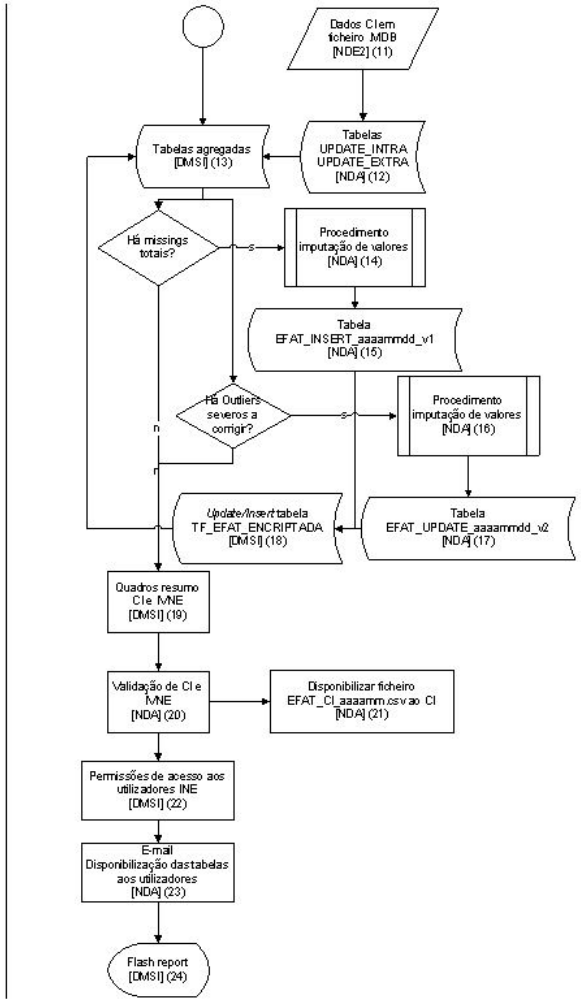
2. Data Quality: Challenges and Methodology

- Validation of data structure
- Hashing of personal identifiers
- Normalisation of attributes (country codes)
- Adding attributes from other sources
- Imputation of outliers and missing values
- Correction of negatives values
- Comparison with other datasets
- 24h to treat each reference month





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2. Data Quality: Challenges and Methodology

Missing values

- **Total missing**: in one period, an issuer does not have any value
- **Partial missing**: in one period, an issuer has, simultaneously, less invoiced value and less “buyers”
- When missing values are identified, for most relevant issuers, we need to **estimate**
- Using the time series of the taxable values (VT) of each issuer, we make forecasts and provide **imputed data** to the users

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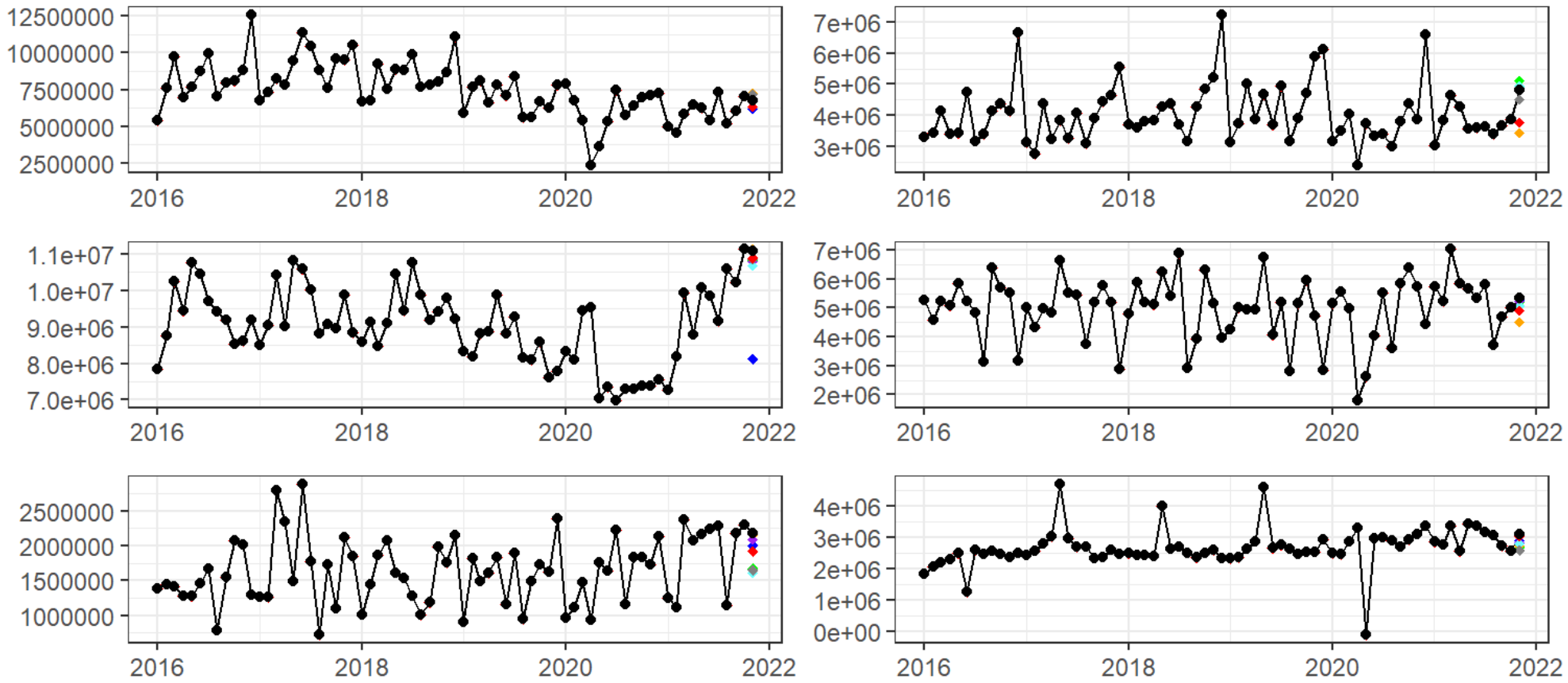
2. Data Quality: Challenges and Methodology

E-invoice time series are very heterogeneous (difficult to fit a unique model)



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2. Data Quality: Challenges and Methodology

Evaluate, continuously, different nowcasting algorithms:

- Auto ARIMA, TRAMO/SEATS, X-13 ARIMA-SEATS, Kalman Smoothing, Prophet

Apply those to each time series and comparing the estimation with the data received on a second version:

- Root Mean Square Deviation (RMSD)
- Mean Absolute Percentage Deviation (MAPD) (better metric heterogeneous T.S.)

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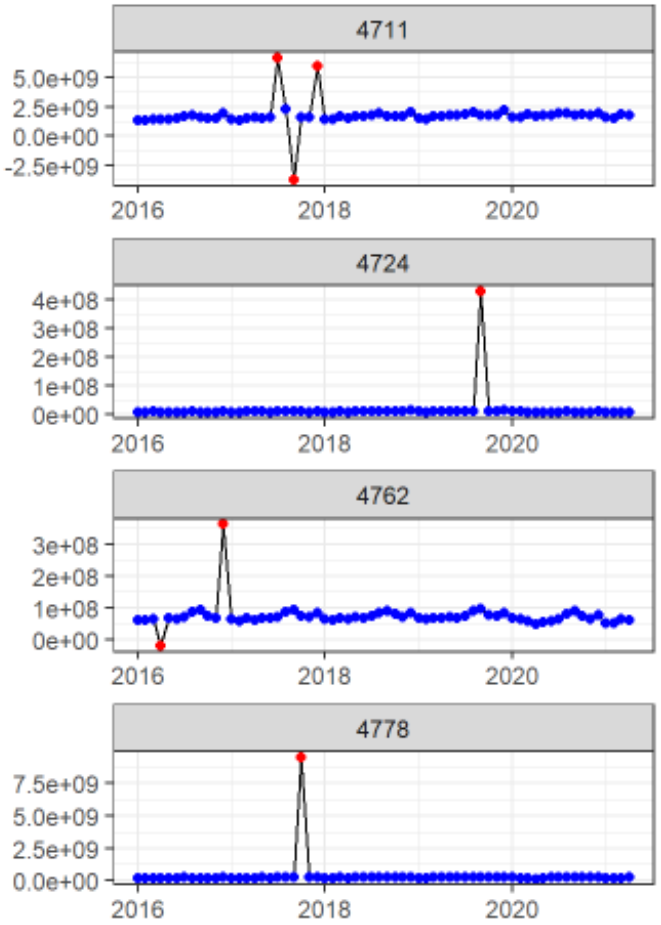
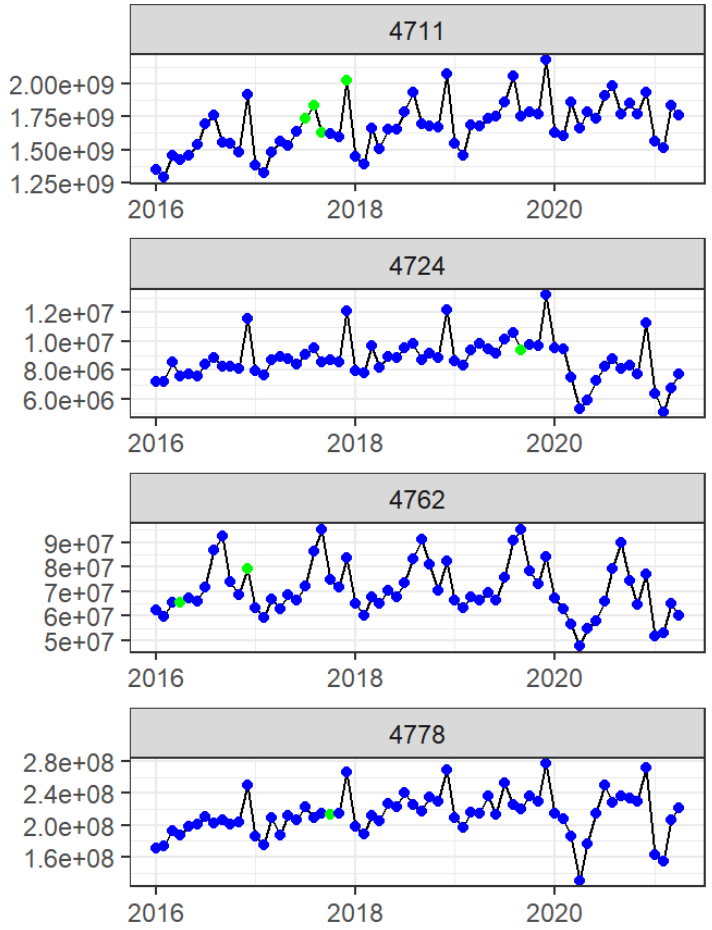
2. Data Quality: Challenges and Methodology

Original data



Imputed data



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3. Collaborative efforts

- Using administrative data for Statistical purposes should **not be seen as a one-way** communication process
- In order to promote the use of data, it is important to know the **needs and expectations** of its users in the statistical production process
- To this end, **a close dialogue was/is promoted with data users** in order to consider and harmonize their needs in the adoption of a data treatment that is accepted by all
- To make it easier to analyse the data, a monthly 'Flash Report' is produced and delivered in 'R Flexdashboard' (soon using a 'shiny App')

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4. Application to other cases

The methodologies and insights gained from managing e-invoice data can be effectively applied to other administrative data sources

- Adapting standardized procedures (data loading, normalisation, validation)
- Customizing anomaly detection (and imputation) algorithms
- Improving data integrity and consistency (cross-dataset comparisons and temporal consistency checks)
- Promotion of collaboration and engagement of other units

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4. Application to other cases

Data sets being prepared for the application of these methodologies:

- Monthly pay statements (enhance the quality and reliability of employment and earnings data)
- International Trade, with identification of anomalies (speeding up correction work in data collection)
- Personal income tax data (IRS)
- Real estate transaction tax (IMT) and Property tax (IMI)
- …

Contributing to increase/improve the quality of the National Data Infrastructure

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5. Conclusions

1. Strong collaboration between different Units of the statistical production process plays a very important role
2. Investment in acquiring new skills (Data Science), tools and techniques, in order to overcome the difficulties in processing a massive set of data

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5. Conclusions

3. The e-invoice can be seen as a **a booster (PoC)** for the **treatment and use of administrative data** for statistical purposes:
   - Applies a set of procedures already in use in traditional sources (surveys)
   - Was recognized as the right way to apply for other data sources
   - Contributes to the construction and fulfilment of the objectives of the National Data Infrastructure
4. The work is not finished and is still evolving

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Obrigado
Thank you

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