UNECE Applying Data Science and Modern Methods Group

Achievements in 2023 and Plans for 2024

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BY HLG - MOS

About the Group

The Applying Data Science and Modern Methods Group (ADSaMM) was established in 2022, with the aim to identify concrete opportunities to modernize NSO's business processes.

Currently, there are 41 members from 19 organizations.

Three task teams have been formed to work on Modelling, Data Editing, and Responsible AI.

Understanding and Selecting Models and Methods

Problem:

NSOs want to modernize and use new methods and ML models alongside existing statistical methods

Knowledge is very fragmented across multiple disciplines making it difficult to:

- Identify and find suitable methods and algorithms for a problem

- Ensure their validity and accuracy – before and after deploying

- Share and implement the solutions

Understanding and Selecting Models and Methods

Work of the group in 2023:

- Discussing and drafting a classification of statistical methods and algorithms

- Investigation of LLMs as 'methodological advisors'

- Extending and linking with existing standards - GSIM (Process Method), CSPA and GSBPM

- Supporting guidance for algorithm selection and evaluation

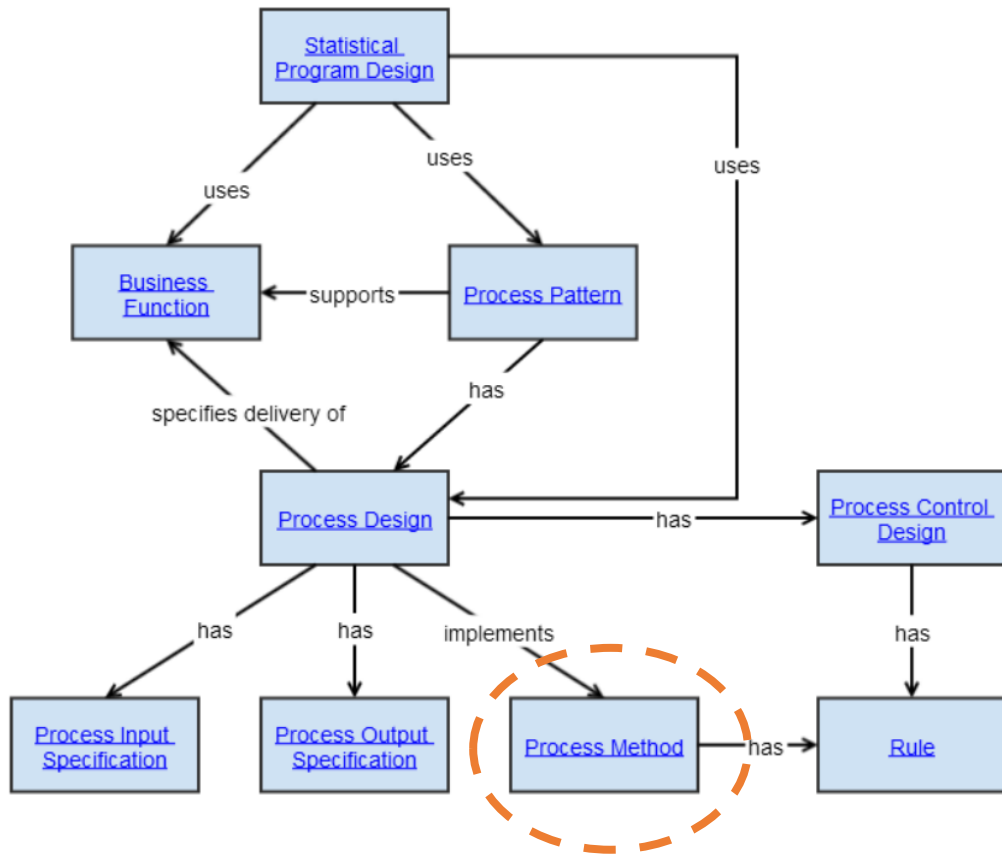- Method / Algorithm template

Documents in progress

01
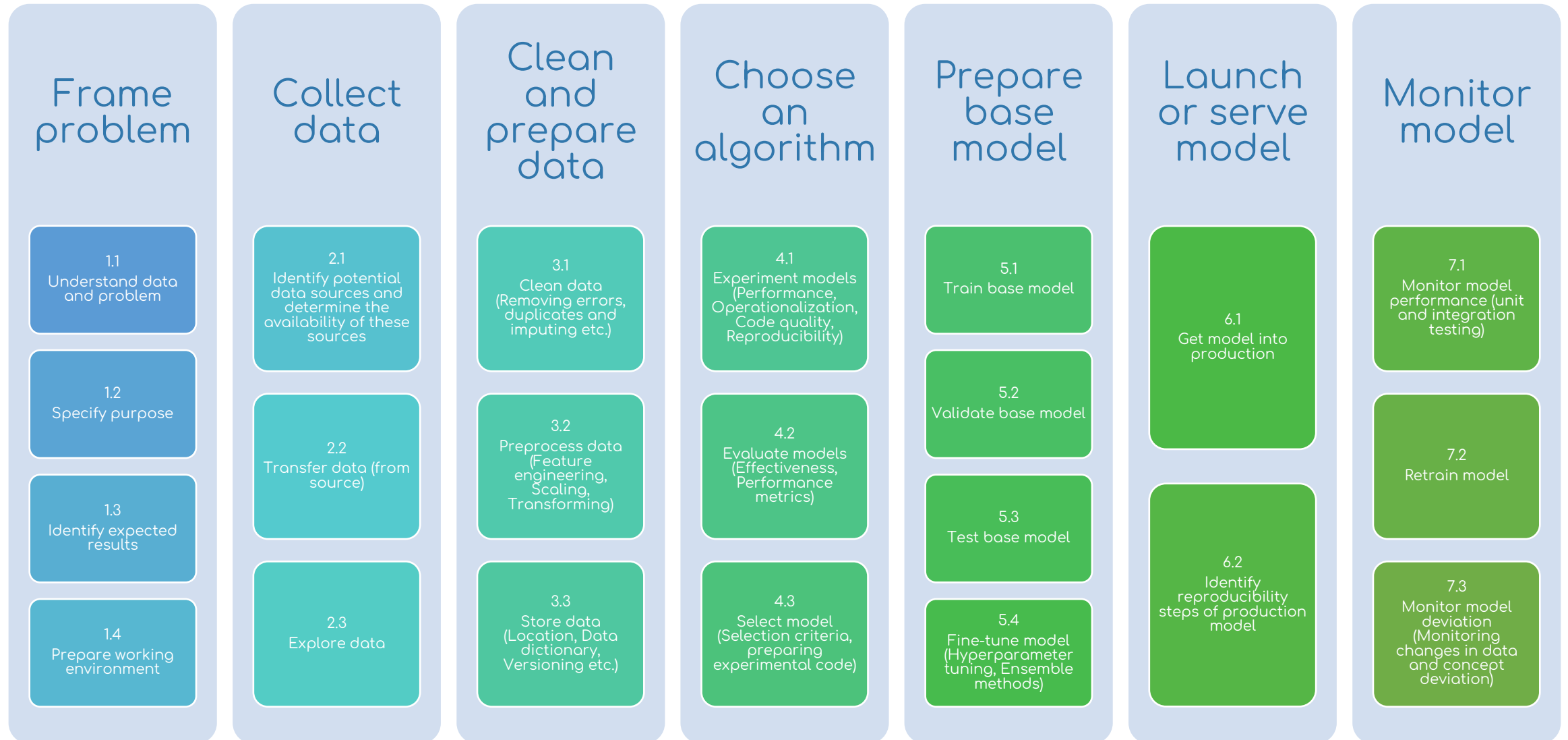
Framework for algorithms and methods

02

Guidance on use of LLMs for methodological advice

Understanding and Selecting Models and Methods

- Statistical offices discuss "process method" from GSIM a lot... yet dedicate no standards to it

- How do we find, support and classify methods?

- Statistical Process: what is done
  Statistical Method: how it is done

Generic Machine Learning Process Model

Frame problem	Collect data	Clean and prepare data	Choose an algorithm	Prepare base model	Launch or serve model	Monitor model
1.1 Understand data and problem	**2.1** Identify potential data sources and determine the availability of these sources	**3.1** Clean data (Removing errors, duplicates and imputing etc.)	**4.1** Experiment models (Performance, Operationalization, Code quality, Reproducibility)	**5.1** Train base model	**6.1** Get model into production	**7.1** Monitor model performance (unit and integration testing)
1.2 Specify purpose	**2.2** Transfer data (from source)	**3.2** Preprocess data (Feature engineering, Scaling, Transforming)	**4.2** Evaluate models (Effectiveness, Performance metrics)	**5.2** Validate base model	**6.2** Identify reproducibility steps of production model	**7.2** Retrain model
1.3 Identify expected results	**2.3** Explore data	**3.3** Store data (Location, Data dictionary, Versioning etc.)	**4.3** Select model (Selection criteria, preparing experimental code)	**5.3** Test base model		**7.3** Monitor model deviation (Monitoring changes in data and concept deviation)
1.4 Prepare working environment				**5.4** Fine-tune model (Hyperparameter tuning, Ensemble methods)		

Understanding and Selecting Models and Methods

Algorithm and model selection is multidimensional:

- Type of problem
- Interpretability requirements
- Data size
- Data complexity
- Resource constraints
- Available domain knowledge

Can LLMs help?

Testing standardised queries across multiple LLMs shows:

- ! Responses often correct but obvious or limited
- ! LLM does not show 'skepticism' of the user nor query back
- ! Popular or frequent advice features more than the most correct advice

Still need methodologists

Accelerating the Implementation of ML Solutions for Data Editing

Machine Learning (ML) has good potential to provide efficiency gains in editing, complementing or replacing traditional methods, as well as for improving quality in ways that may be difficult to achieve with traditional methods.

However, many of the barriers preventing NSOs from implementing ML methods for editing are not methodological.
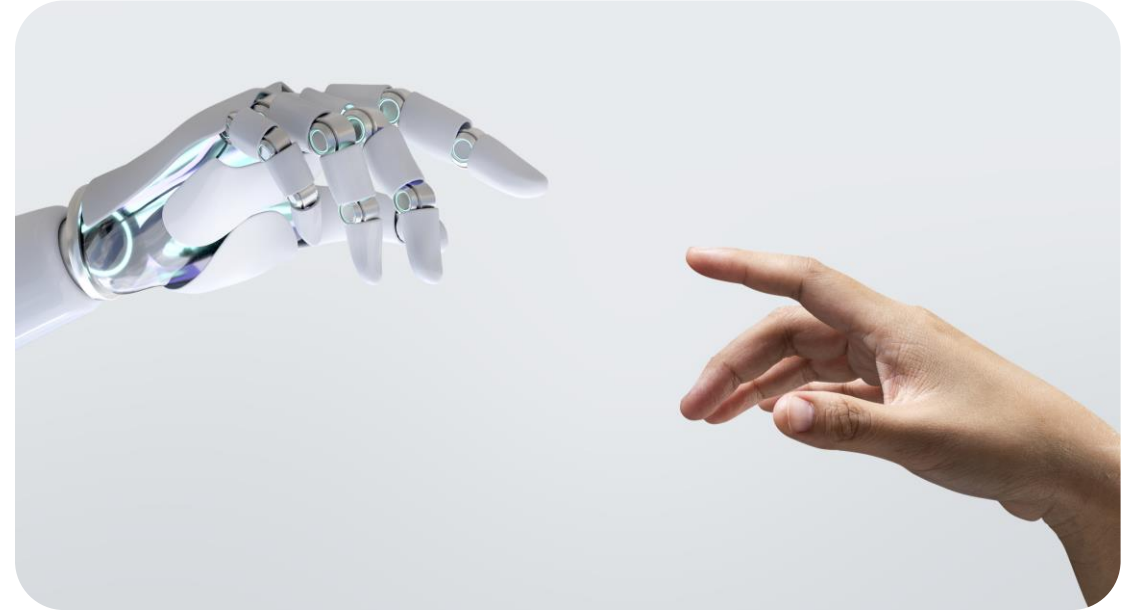
The aim of this project has been to identify these barriers and provide guidance on how to avoid or overcome them.

Task Team 2

Accelerating the Implementation of ML Solutions for Data Editing

The project collected use cases from a range of NSOs and other official statistics agencies, identifying common issues and drawing out solutions.

Contributing agencies have included

Statistics Canada

Australian Bureau of Statistics

SCB Statistics Sweden

INSTITUTO NACIONAL DE ESTATÍSTICA STATISTICS PORTUGAL

FSO

INE Instituto Nacional de Estadística

BIS

Assistance was also provided by the chair of the Expert Meeting on Statistical Data Editing and the organising committee of the UNECE Machine Learning for Official Statistics Workshop 2023.

Accelerating the Implementation of ML Solutions for Data Editing

Issues/barriers identified were

- ! Driver of the problem

- ! Lack of labels/training data

- ! Relationship between IT, methodology/data science team(s) and business areas

- ! Input and feedback from subject matter experts

- ! Transparency and understanding of methods

- ! IT issues

Output

Final report

Will include discussion and advice on addressing the issues listed and a collated set of the use cases gathered during the project

Progress

We expect to finalise the report by end November 2023

Accelerating the Implementation of ML Solutions for Data Editing

How the project can help you

01 If you want to forestall issues/obstacles in an ML for editing project before you undertake it

May be applicable to ML projects for other applications too

02 If you want to find out about what other NSOs are doing for editing

The use cases are not focussed on technical details, but do contain a short description of the methods used

Responsible AI

Background and Goals

In today's landscape, the widespread use of AI and ML has amplified the significance of fundamental principles like ethics, privacy, fairness, and legality.

As part of addressing these crucial aspects, the task team has set out to establish a unified standard for the responsible design, development, and implementation of AI-based solutions within NSOs and official statistical-producing organizations.

The primary objective is to ensure that these innovative methods align with ethical and human-centric perspectives amidst this rapidly evolving AI environment.

Challenges Faced

Crafting guidelines within a dynamically shifting and rapidly evolving AI landscape proved to be a formidable challenge.

The need to continually adapt guidelines to keep pace with emerging technologies like generative AI and the extensive utilization of LLMs.

We encountered occasional challenges in team contributions due to the busy schedules or other commitments of our team members.

Responsible AI

Deliverables

Status Update

Deliverable 1

Guidance Document

📈 Progress

We are currently at the finalization stage and have scheduled independent reviews for the document. This document encompasses core guiding principles for responsible AI and associated guidelines.

The guidance document lists core guiding principles for responsible AI/ML and provides comprehensive guidelines

This document represents the NSOs **values** when it comes to the design, development, deployment and monitoring of ML and AI-based systems and models

These practical guidelines can be referred to, consulted, and used when working on a ML or data science project

Responsible AI

Deliverables

Status Update

Deliverable 2

Assessment Tool (Checklist)

📈 Progress

The checklist is in its finalization phase, aiming to provide a comprehensive tool for assessing responsible AI implementation.

The checklist is a structured set of questions derived from the guidelines, systematically designed for each phase of the ML project lifecycle

It can be used as a self-assessment tool enabling project teams to ensure alignment with NSO and industry best practices during the design, development, deployment, and monitoring of ML projects

Utilized during peer reviews, project teams complete the checklist, enabling evaluators to incorporate it into the review process alongside other documentation and materials

Responsible AI

Deliverables

Status Update

Deliverable 3

Review/Audit Process Description

Progress

This detailed process is now finalized, outlining a meticulous review and audit framework for ensuring responsible AI practices.

To ensure that ML and data science projects and processes are aligned with the NSO's core guiding principles of responsible AI, including those outlined in the guidance document, **they must go through a review process**. This review process serves as a checkpoint for assessing the ethical implications of the technology and ensuring that it aligns with the agency's values.

The extent to which a ML processes/project at the NSO meet the Framework's requirements is evaluated through a self-assessment using a checklist, a peer review (ethical and methodological), a presentation to a scientific review committee, or a combination of these methods.

The review process is a crucial step in transitioning from a prototype or proof of concept (PoC) to the production version of an ML process/project.

Provides a structured process for NSOs to conduct audits or peer reviews of ML projects as desired.

Future Work Plans
And Your Feedback

Proposals for the next year work

- Practical application of the Responsible AI

- Uncertainty Quantification in Machine Learning

- Graph Modeling and Graph Databases

New ideas that are related to our broad areas of interest supposed to be presented every meeting

> What gaps need to be filled in existing works under HLG-MOS and other international organizations, considering urgency and importance?

> Are there additional areas of work you suggest the group consider, and how should the group address these issues?

> Do you agree with the focus of the task teams, and what would be a useful output for the international statistical community?

> What opportunities for collaboration exist with your organization in addressing these issues?

Thank you