Notes: Paper: Heirarchical Time Series

# Paper Link:

<https://doi.org/10.1016/j.eswa.2021.115102>

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# Summary:

* **Reconciliation** is needed to have **Coherence** in forecasted predictions
* In literature, **reconciliation** is done in post processing after forecasting, whereas in this paper, they trained a **ML Model**  to directly forecast **coherent** predictions
* **ML model**  learns coherence/reconciliation from the training

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# Pre-requisite Terms:

## Coherence Defn:

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This paper focuses on **cross-sectional coherence**

## Top Down and Bottom Up:

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## Hierarchical and Non-Hierarchical

Hierarchical = top-down or bottom-up relatable data

Non-Hierarchical = Single lone time series that does not add up to any hierarchy.

## Traditional Methods of Reconciliation

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## Leading to this work:

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# Methodology:

## High level plan (Algorithm):

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Work with:

* **Explanatory variables** (Features extracted from Time-series via neural net)
* **CNNs** (1D)

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Three datasets:

1. Italian Grocery
2. Electricity Demand, Switzerland
3. Walmart

### Train- Forecast – Standard Time Series

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### Hierarchy Used:

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### 2 step process:

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1. First, generates a **forecast** for time-series at a **selected level of hierarchy**
2. Second, **disintegrates it downwards**

^ Jointly learns how to **disintegrate downwards + generate forecast** for the hierarchical time series

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A diagram of a training process

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## Equations & Constraints:

### Equation: Model Prediction

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### Equation: Constraints – Sum of child equal to parent:

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Basically this is the sum??

Saying the upper hierarchy is the sum of all the entries of the immediate lower hierarchy

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### Eqn: Loss function:

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## Forecasting Methodoly:

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### Forecasting in Univariate Time Series

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### Averaging Multiple Forcast of same Series:

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### Train-Test Split of Forecasting Data

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### Error Metrics: Forecasting

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MASE & SMAPE

Need further reading on MASE, interpretability

**What is in-sample one-step ahead Naïve Forecast? (denominator of MASE eqn)**

**How does this form of MASE interpret**

# Dataset Description:

## Italian Pasta Dataset:

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# Results:

## MASE after Training:

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A graph with numbers and lines

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