Forecasting in Supply Chain

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Why do you need forecasts in supply chains?

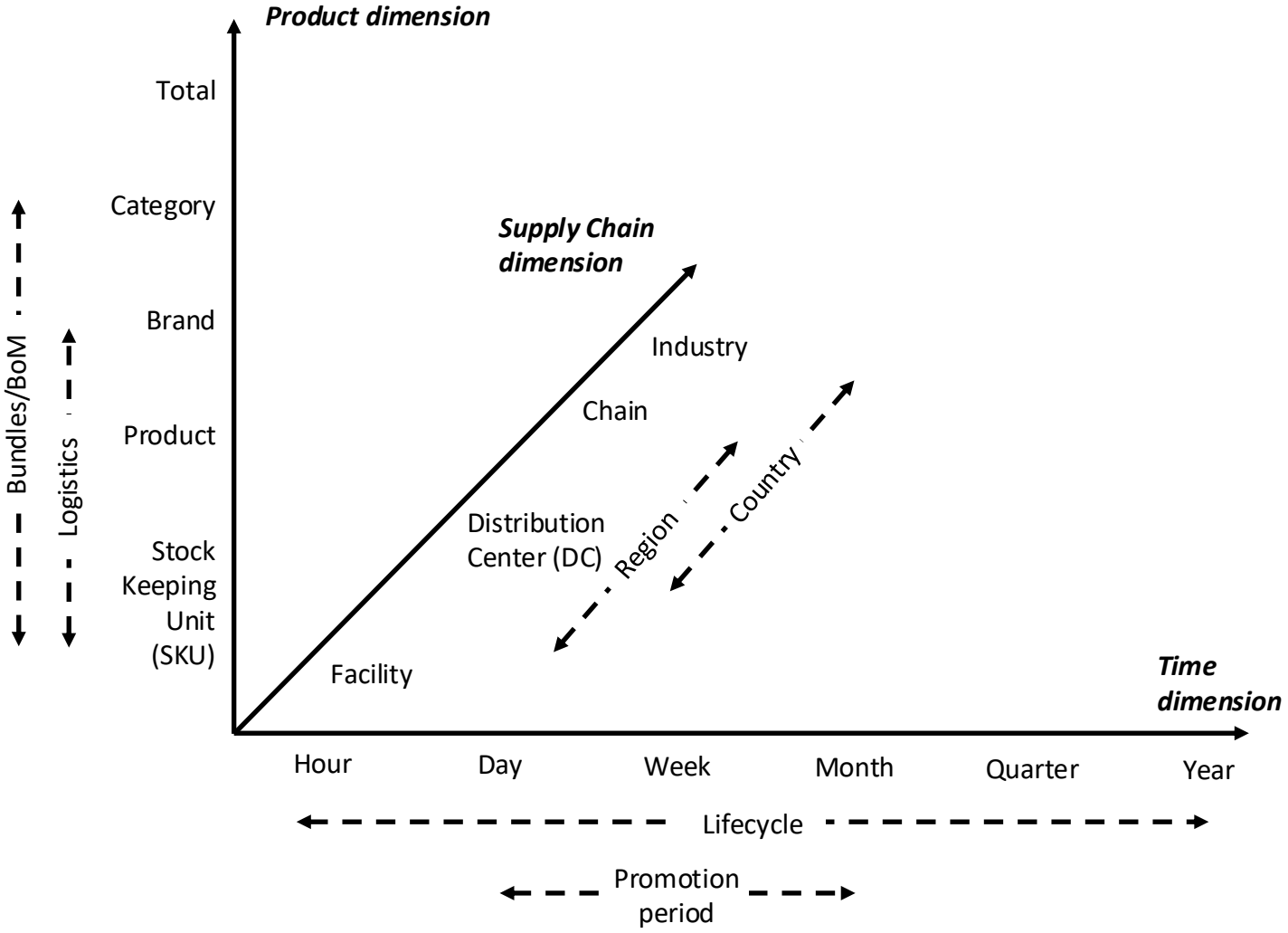
- Strategic planning
  - Where to open new warehouse – or close old ones
  - Vaccine choices
  - Other strategic decisions (e.g., Local vs. global manufacturing strategy etc.)

- Tactical planning
  - Allocation planning
  - Price optimization
  - Campaign planning
  - Procurement
  - Supplier negotiations
  - Logistics

- Operational planning
  - Store replenishment
  - Distribution centre (DC) replenishment

Forecasting dimensions and granularities

Different planning processes require forecasts on different aggregation levels



- Store replenishment: SKU × Day × faclity
- Distribution center (DC) replenishment: SKU × Week × DC (or multiple stores)
- Promotion planning: Brand/Category × Promotion period × Chain/Format
- Markdown planning: SKU/Product × Hour/Day × Location
- Assortment planning: Product × Lifecycle × Chain
- Allocation management: Product × Lifecycle × Location
- Workforce management: Total assortment × Day × Location
- Supplier negotiations: Brand × Year × Chain

Adapted from Fildes, Ma & Kolassa (2022, *IJF*, https://doi.org/10.1016/j.ijforecast.2019.06.004), in turn adapted from Syntetos et al. (2016, *EJOR*, https://doi.org/10.1016/j.ejor.2015.11.010)

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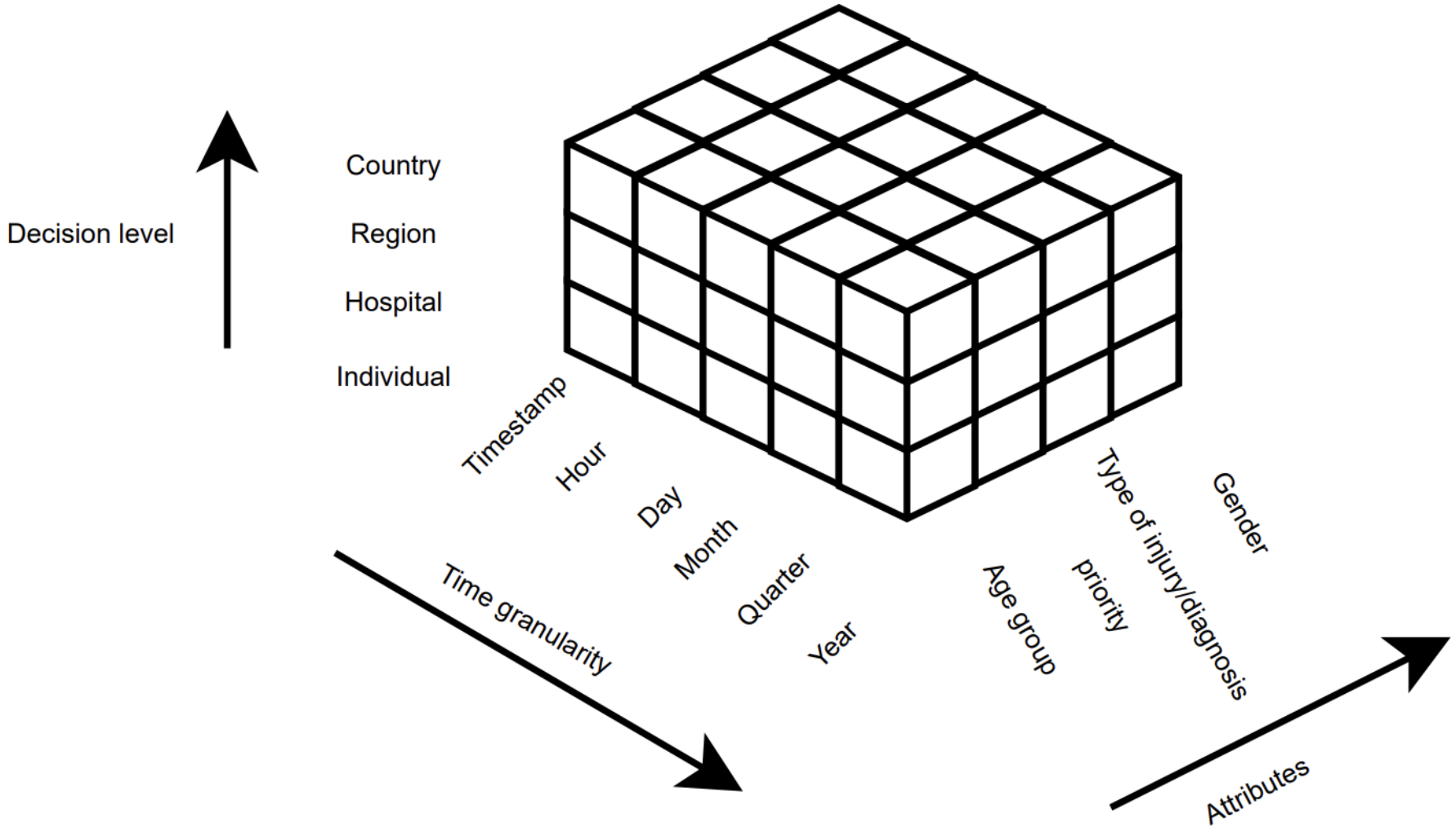
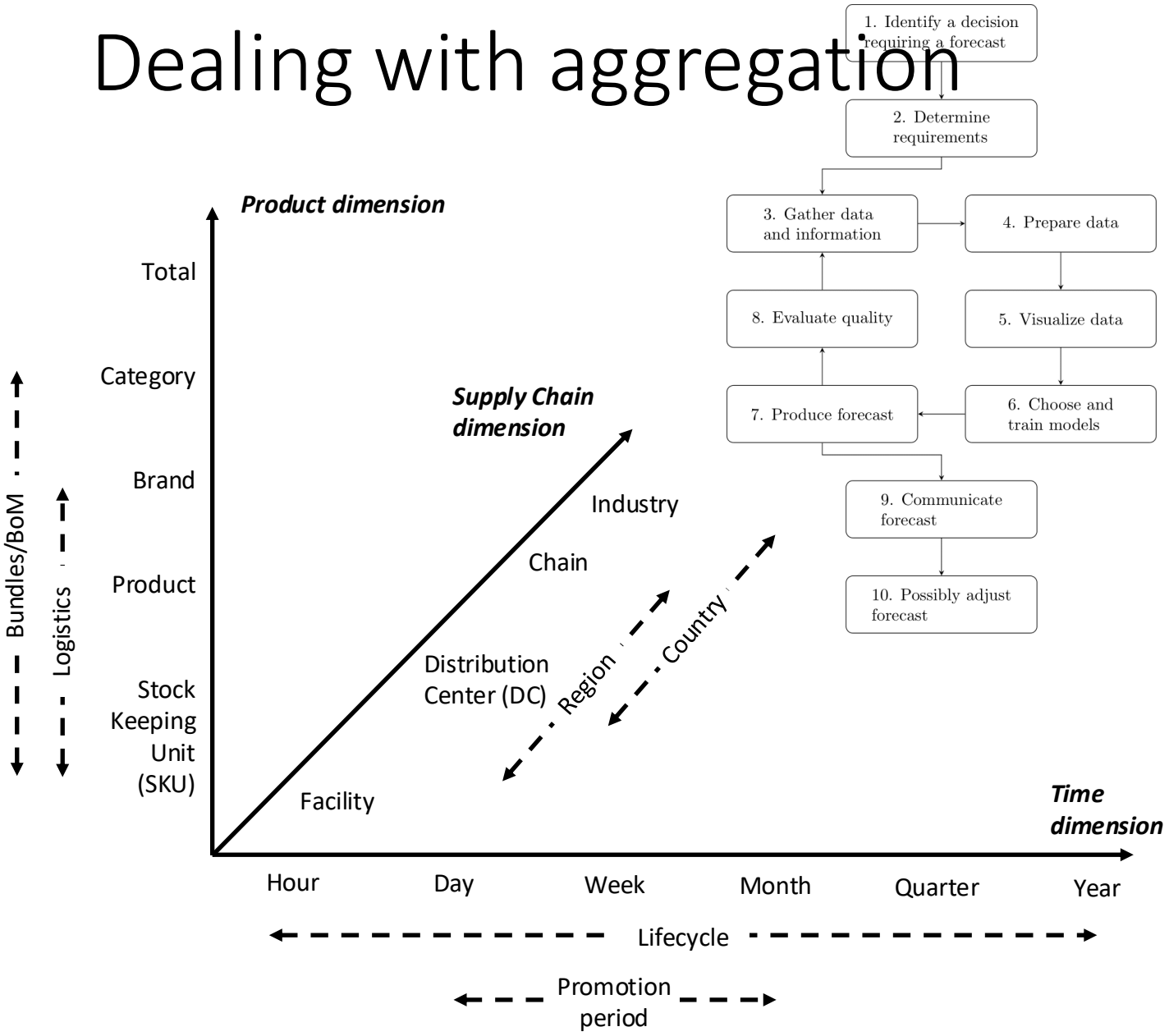
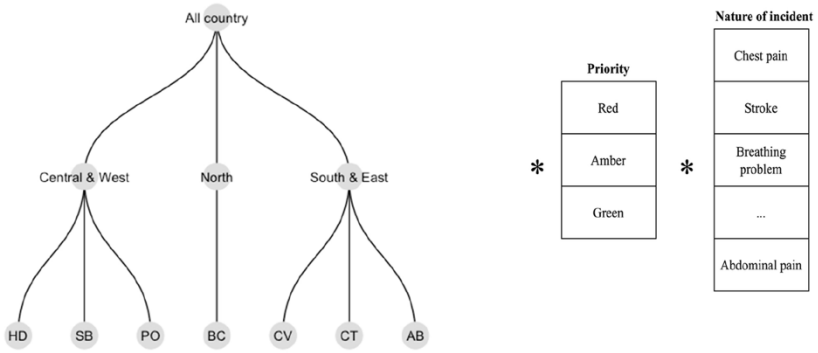


Dealing with aggregation



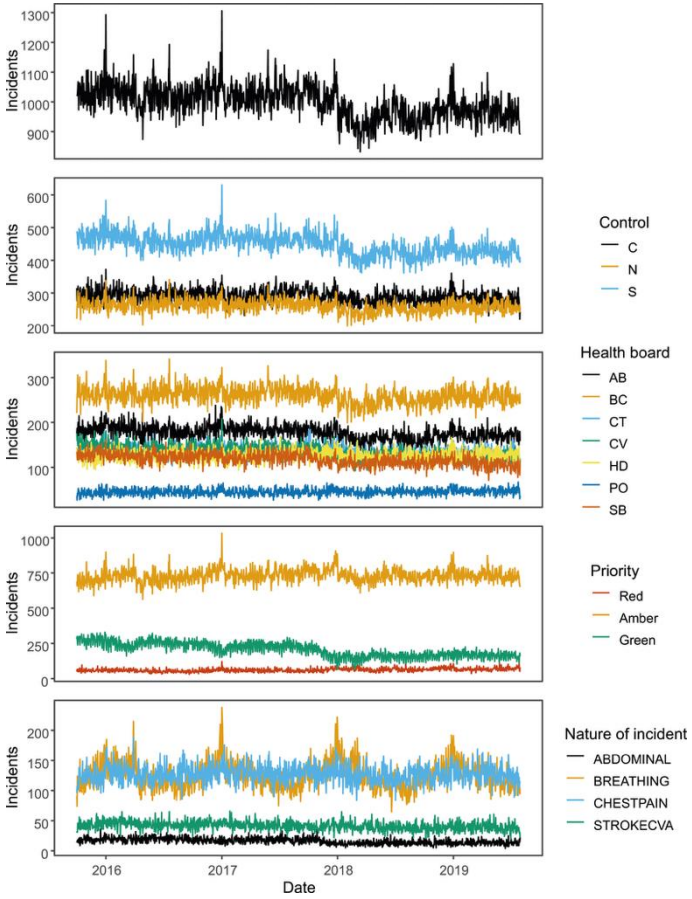
- Adapt the forecasting process to what is required for a subsequent decision (https://dfep.netlify.app/sec-forecasting-workflow)
- Regression & ML methods can leverage predictors on various aggregations – ARIMA & Exponential Smoothing cannot
- Possibly look at *hierarchical reconciliation* approaches (Athanasopoulos et al., 2024, https://doi.org/10.1016/j.ijforecast.2023.10.010) – but note numerical complexity
- Hierarchical reconciliation also works in the time dimension https://doi.org/10.1016/j.ijforecast.2013.09.006)

Hierarchical Time Series Forecasting in Emergency Medical Services

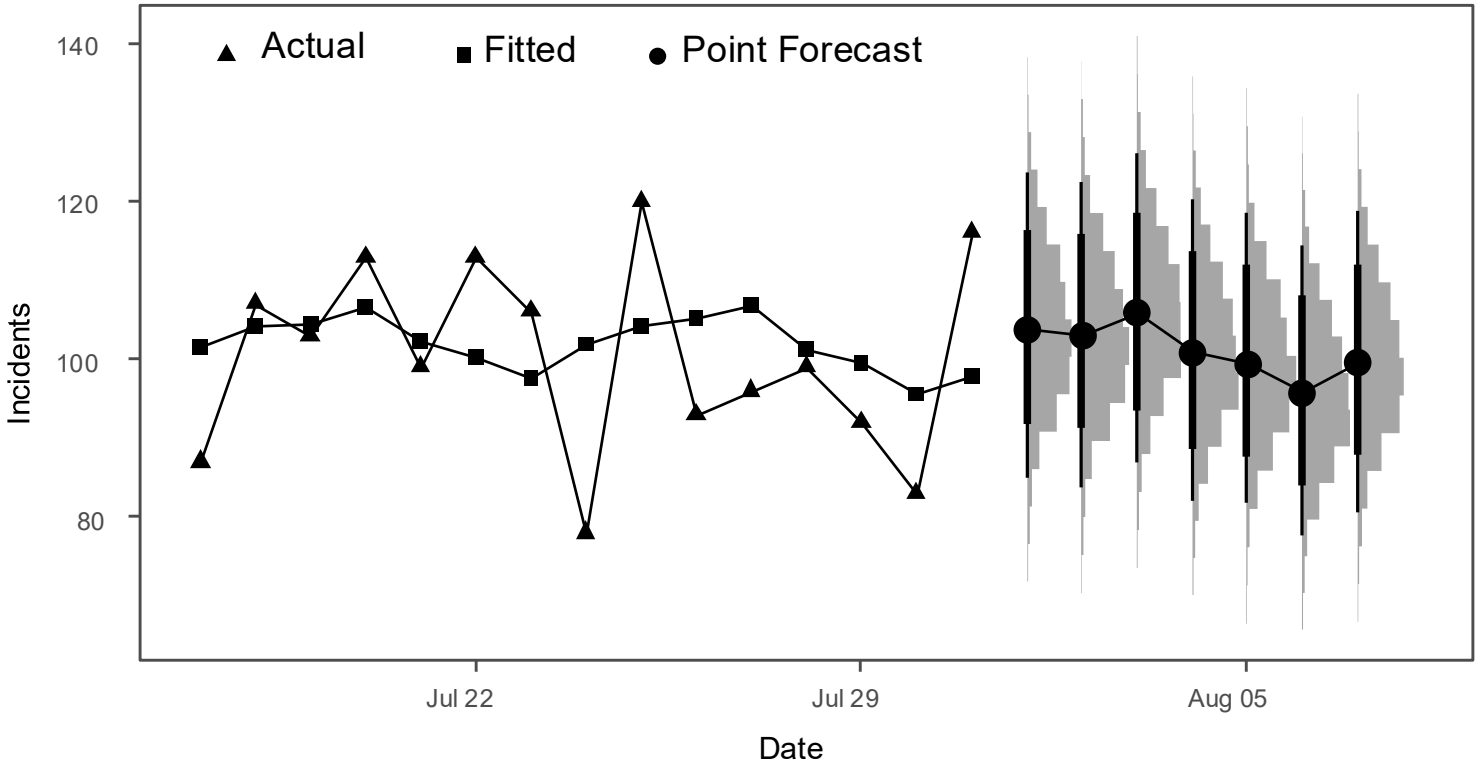


(a) Hierarchical structure[1]

(b) Grouped structure[2]



A graphical illustration of the forecast distribution



Some points to consider

- Planning may require forecasting at various levels of temporal and hierarchical levels, ensure having the right toolbox allowing for that.
- Integrate domain knowledge in the forecasting process, especially to understand data, check its quality, and collect further data about events affecting your data.
- Forecasting models can effectively capture the effect of special events, make sure they are incorporated into your model.
- Forecasting daily, and sub-daily (e.g., hourly, 30 minutes, 15 minutes, etc) require models capable of capturing multiple seasonal cycles.
- Assess the level of uncertainty using full predictive density. But how to use it to inform decisions and what to communicate from, is for you and your team to decide.
- Consider using simple benchmarks, as they can be competitive, and also reduce running time.
- Long-term forecasts are inherently more challenging. Employing hybrid approaches that integrate statistical forecasting, human judgement, and operational research may be the most effective way to utilise them accurately.

Thank you.

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