IBPSA-Project 1 – WP1.2: Uncertainty Emulator

Expert meeting online | 13/10/2020

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MEETING AGENDA

- Brief summary of the activity
  - Autoregressive model
  - ECDF
- Proposal of approach to follow and next steps
- Some discussion points

1. Brief summary of the activity

- OBJECTIVE:

  Develop an emulator of the weather forecast uncertainty to be implemented as part of the *BOPTEST*

- Approches:
  - **Autoregressive** model
  - **ECDF – QQ mapping**

- Weather prediction data and real on-site measurements
  - **Berkeley** (USA) – Lawrence Berkeley National Laboratory
  - **Oslo** (Norway) – Norwegian Meteorological Institute
  - **Leuven** (Belgium) – Vliet Building in KU Leuven

1. Brief summary of the activity

AUTOREGRESSIVE MODEL

- Literature review → Autoregressive models widely used (weather predictions for buildings)
- Selected model:

$$e_{j+1} = Fe_j + Kw_j$$

w_k: N(0,1)
F, K: calibration parameters

- Krzysztof Arendt's model → very similar

  User defined inputs:
  - Controllable autocorrelation
  - Controllable mean absolute error
  - Error dimension

  Technical limitation → convergence for some combinations of parameters

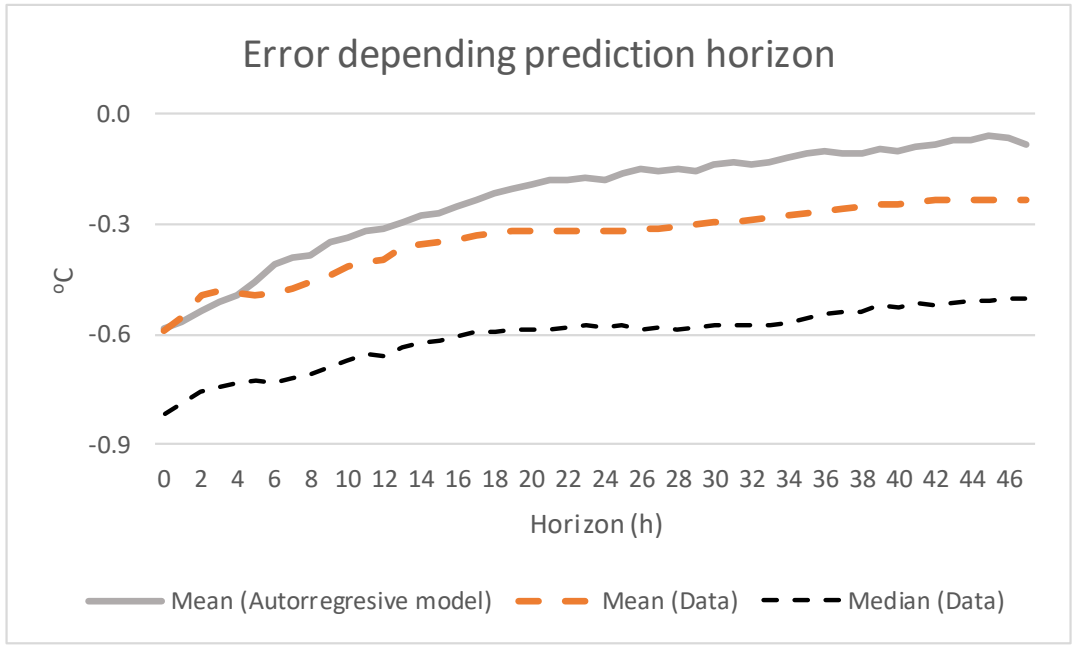
- Variables to study: **outdoor temperature**, solar radiation, wind speed, relative humidity

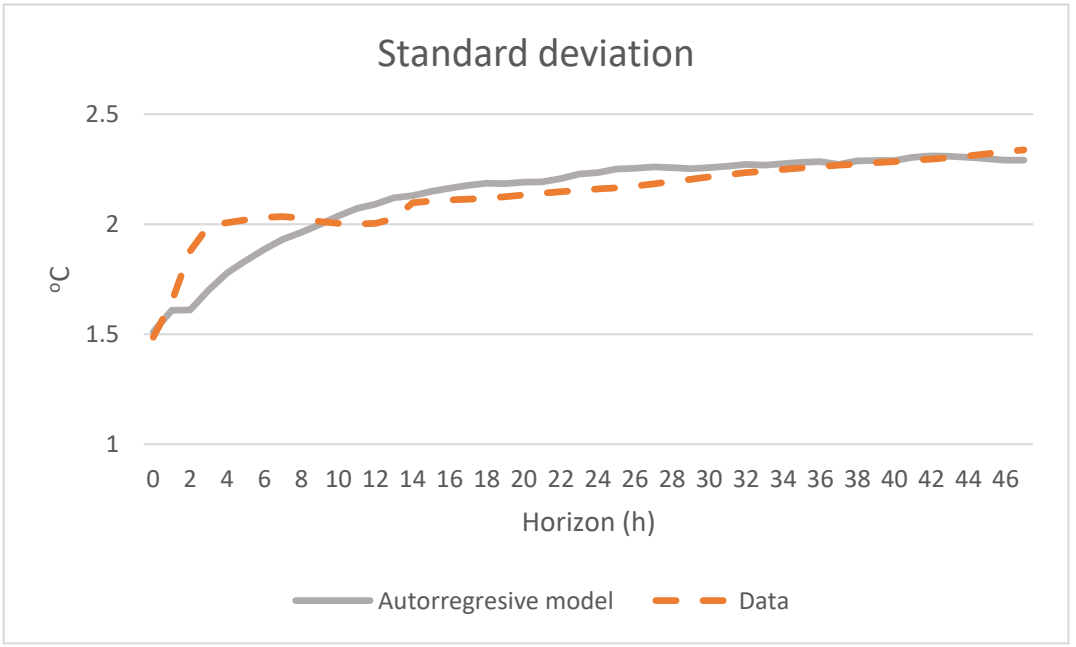
1. Brief summary of the activity

AUTOREGRESSIVE MODEL

MAIN CONCLUSIONS

Berkeley



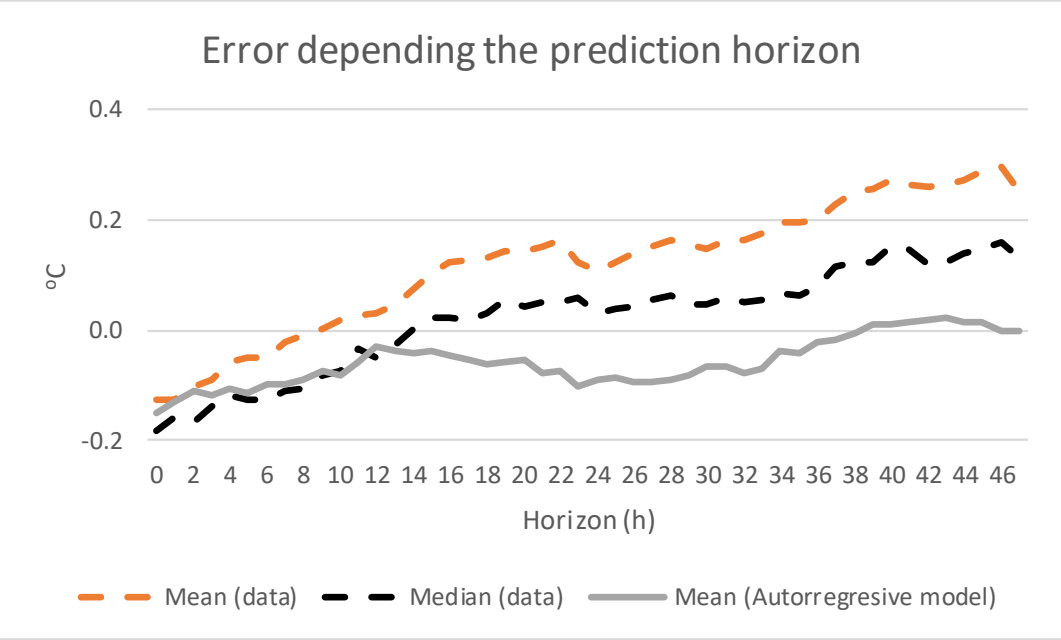


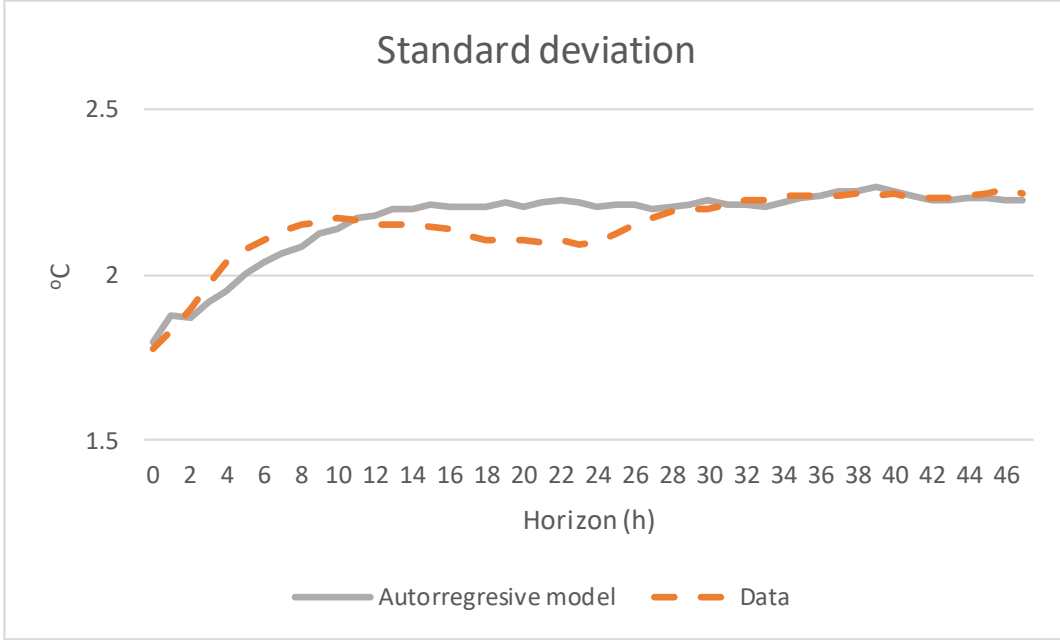
1. Brief summary of the activity

AUTOREGRESSIVE MODEL

MAIN CONCLUSIONS

Norway





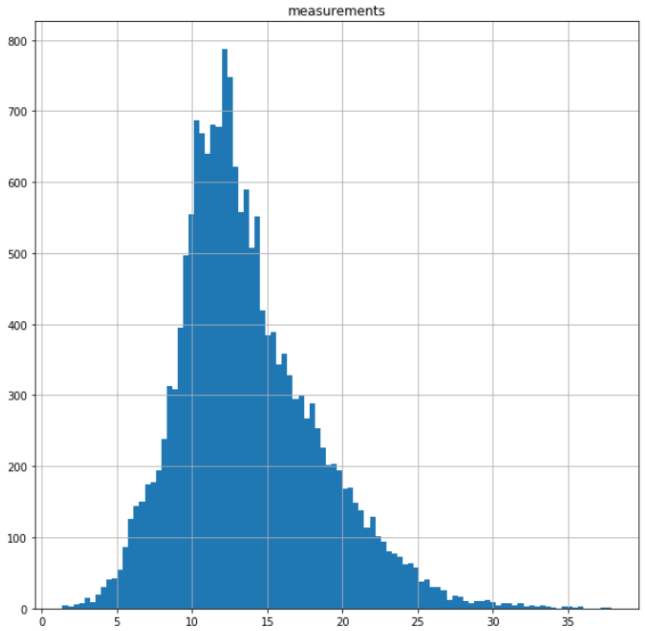
1. Brief summary of the activity

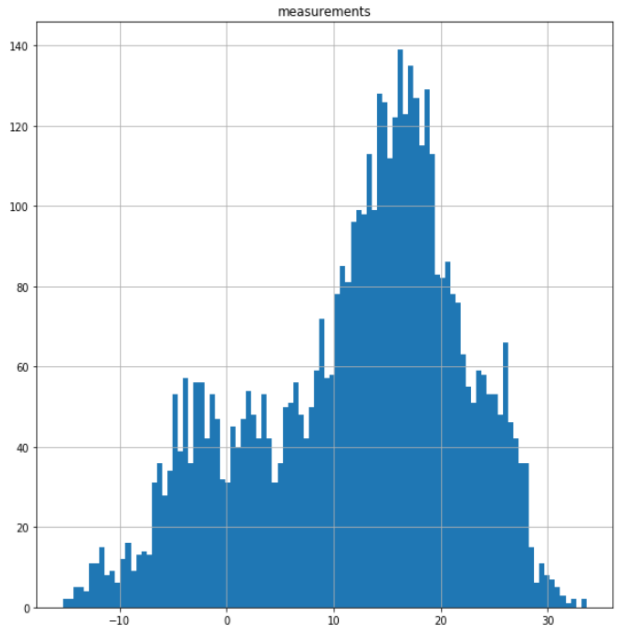
AUTOREGRESSIVE MODEL

MAIN CONCLUSIONS

- Possible causes for the differences:
  - Data distribution is slightly deviated from normal distribution

Berkeley





Norway

1. Brief summary of the activity

AUTOREGRESSIVE MODEL

MAIN CONCLUSIONS

TECHNICAL LIMITATIONS

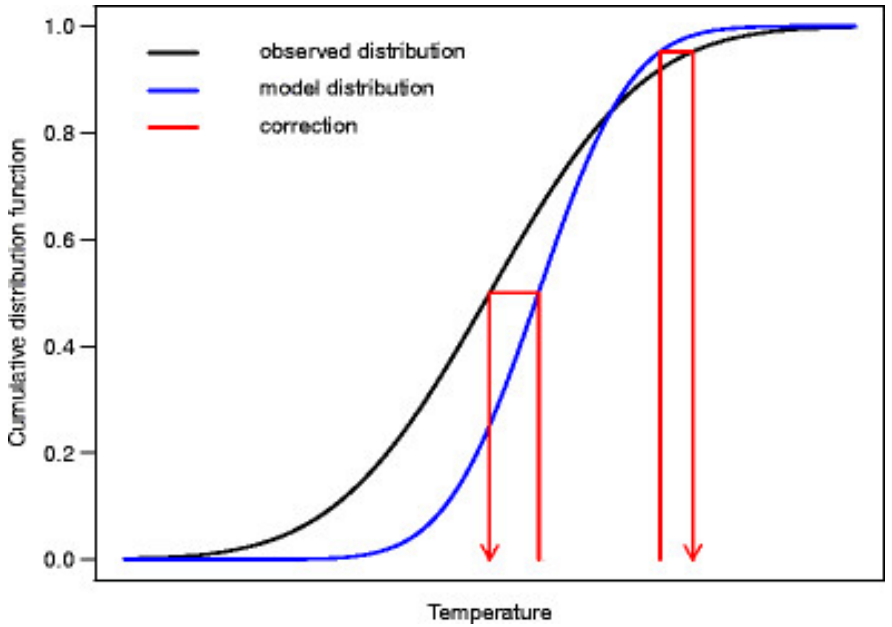
- Selected data based model → **Initialization** (first error calculation)
  - An initial error model generated from the data and predictions
  - The initialization error is dependant on the location and the predicted temperature

- Preliminary results for other variables:
  - **Solar radiation** → the tendency, if an offset is considered, match
  - **Wind speed**, **humidity** → the tendency did not match. Few data available. Great variability in the case of the wind speed
  - Further research is required for these variables

1. Brief summary of the activity

ECDF – QQ mapping

- Proposed by a company working on this field. It is used to **correct the bias in the weather predictions**
- Some related literature, no previous cases found for weather predictions uses in buildings applications
- ECDF – build a new ECDF of the predicted variable by including a bias/error in the ECDF built with historic data
- Studied variables: outdoor temperature

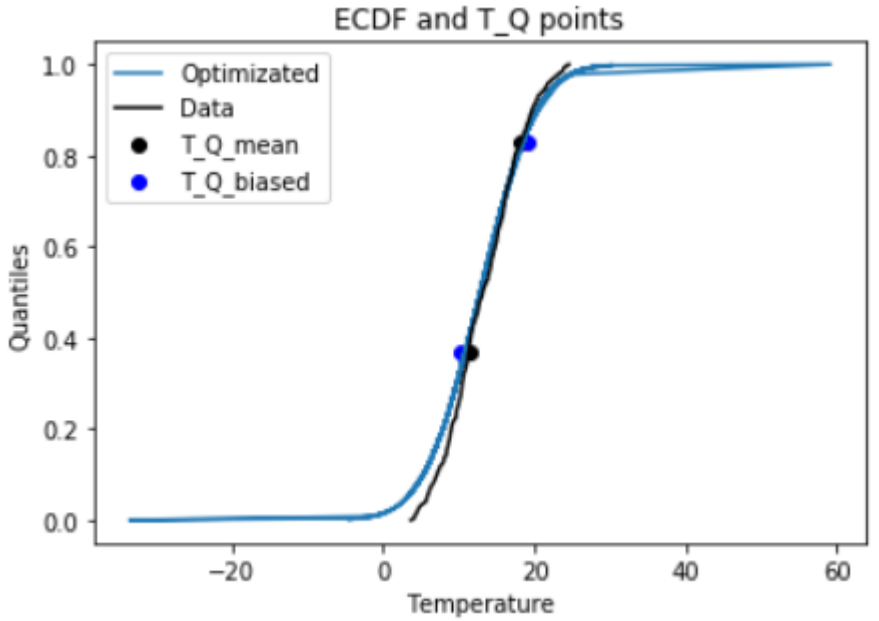


1. Brief summary of the activity

ECDF – QQ mapping

MAIN CONCLUSIONS

- The model works well with the intermediate data, but presents great errors in the extremes of the ECDF
- The tendency of the error with respect to the **time at which the prediction** → has the same tendency as the real data
- Greater complexity to find something consistent



2. Proposal of approach

Short term (until February)

- Follow the **autoregressive model** approach.
- Have a first working version for February.
- Next steps:
  - Find a more robust solution (address the encountered technical limitations and optimize the code)
  - Integration of the solution in the BOPTEST and coordination between them

Long term (from February on)

- Continue the study on the **ECDF – QQ mapping** approach.

3. Some discussion points

- **How should the uncertainties be defined? How much freedom is given to the MPC-tester to modify them?**
  - Define different scenarios and the user can choose one (scenario without uncertainties, scenario with high uncertainty, with low uncertainty…)
  - Other possibilities?