

# Adaptive Conformal Predictions for Time Series

Margaux Zaffran<sup>1,2,3</sup> Olivier Feron<sup>1</sup> Yannig Goude<sup>1</sup> Julie Josse<sup>2</sup> Aymeric Dieuleveuil<sup>3</sup>  
<sup>1</sup>Electricité De France, Paris, France <sup>2</sup>INRIA, Montpellier, France <sup>3</sup>Ecole Polytechnique, Paris, France

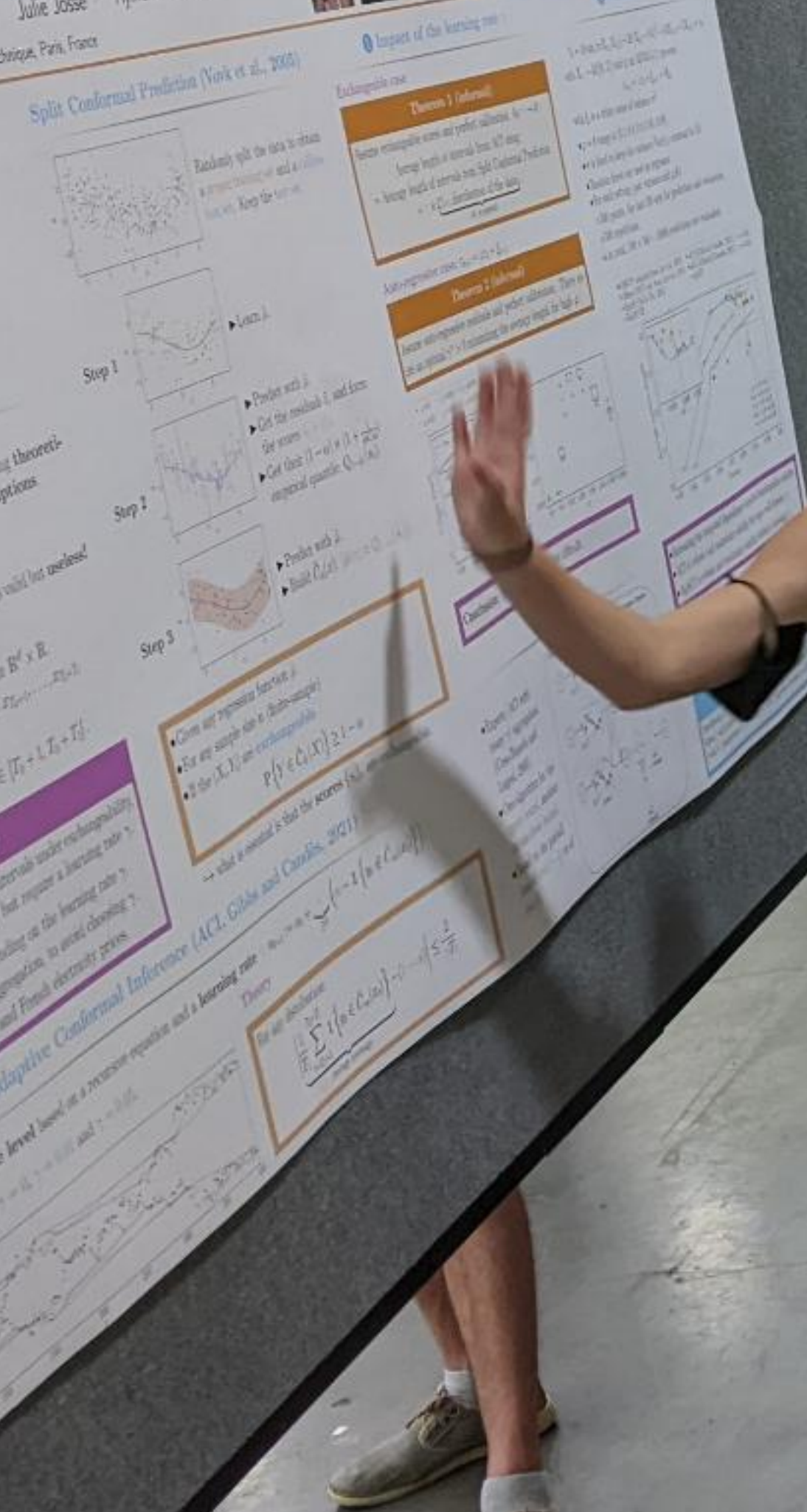


Control validity  
Produce predictive intervals around forecasts, enjoying theoretical guarantees on their coverage with few assumptions  
Optimize efficiency  
The intervals should be as small as possible  
Bad example: outputting  $\{0, 100\}$  at the time  $t$  would not be useful

Setting in time series  
• Data:  $T_t$  observations  $(x_1, y_1), \dots, (x_{T_t}, y_{T_t}) \in \mathbb{R}^d \times \mathbb{R}$   
• Aim: provide for  $T_t$  subsequent observations  $x_{T_t+1}, \dots, x_{T_t+T}$   
→ Build the smallest interval  $C_t$  such that  
$$P\{Y_t \in C_t(x_t) \mid \mathcal{H}_t\} \geq 1 - \alpha, \quad \text{for } t \in [T_t + 1, T_t + T]$$

Summary  
Conformal prediction gives predictive intervals under non-independence and time series. ACI can be used but requires a learning step.  
• Theory on ACI's efficiency depending on the learning step.  
• Algorithm based on expert aggregation, to avoid choosing.  
• Numerical tests: synthetic and French electricity prices.

Adaptive Conformal Inference (ACI, Goude and Coudane, 2021)  
Use an effective quantile level based on a monotone regression and a learning step.  
Illustration: ACI with  $\alpha = 0.05$  and  $\lambda = 0.01$



Impact of the learning step

Background: see

Thermostat case

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