

Advanced Data Analytics and Optimal Control of Multi-zone Air Handling Units

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Objective: To apply advanced data analytics and optimization algorithms for energy-efficient control of AHUs.

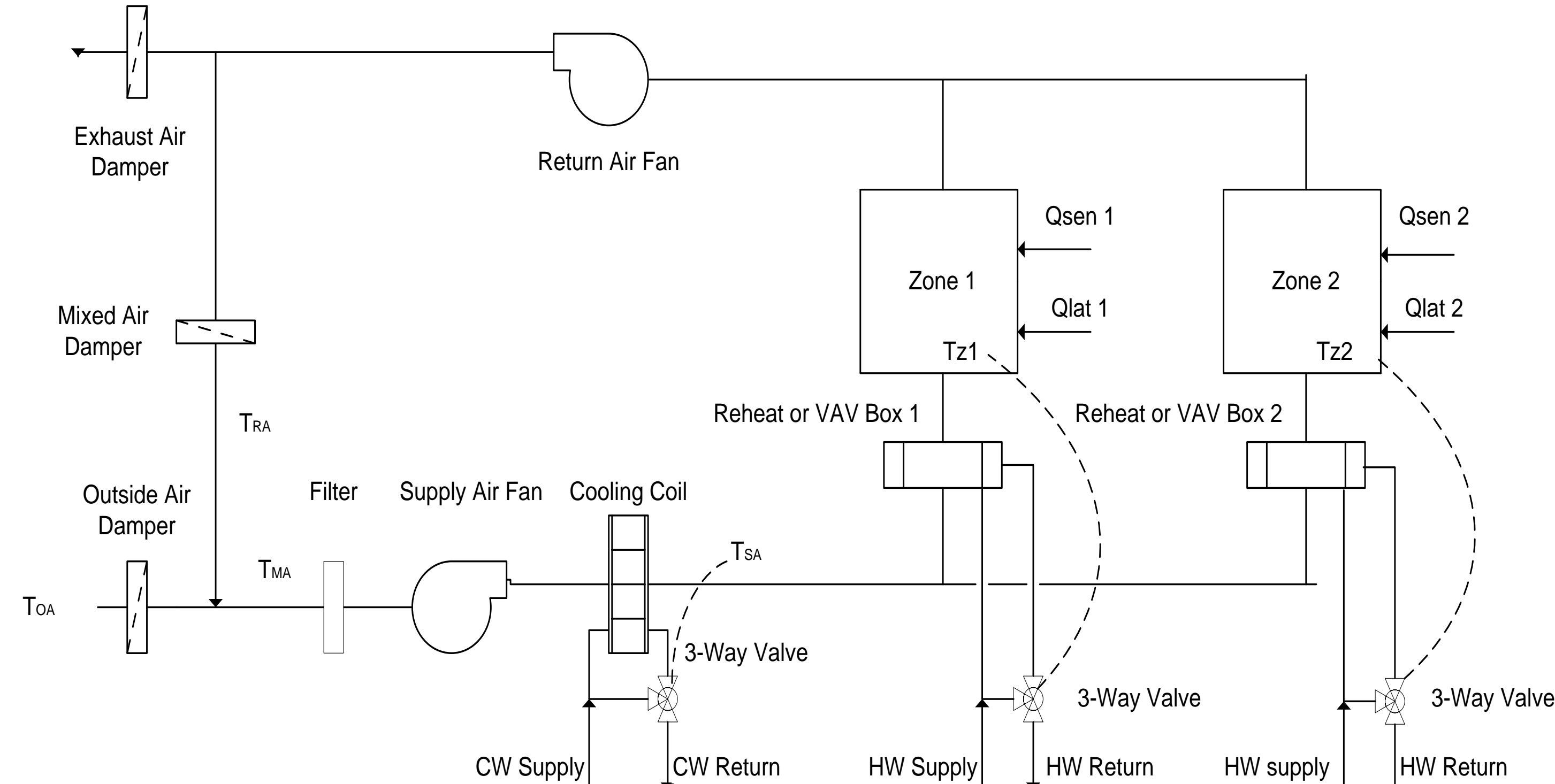
Motivation:

- Buildings-related energy use is 10% of total US energy, 50% of which is HVAC.
- Traditional rules-based controls are the norm but require extensive system level knowledge and continuous M&V for efficient operation.
- There is a clear need for a powerful yet generic framework for intelligent and optimal control of energy systems.

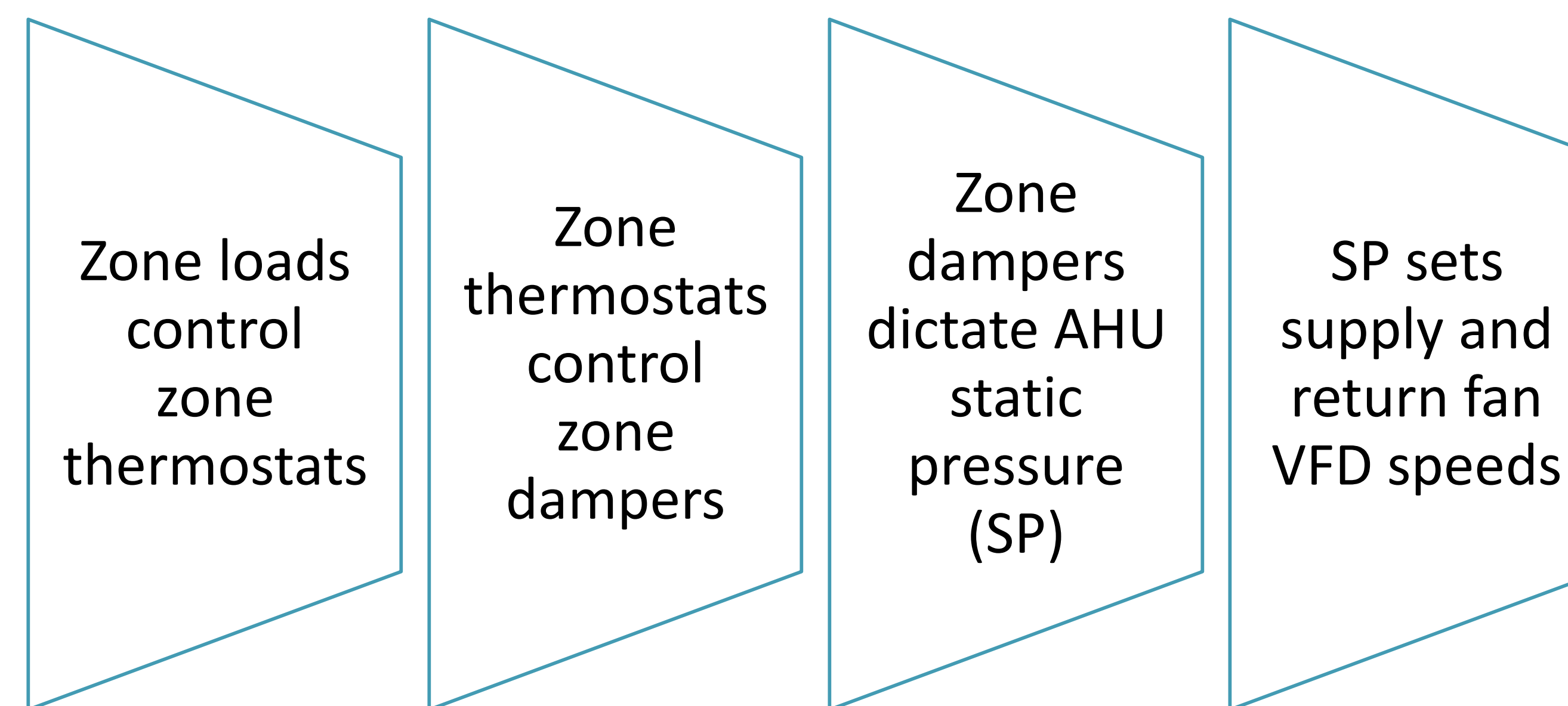
Methodology:

- Acquire, clean and warehouse data.
- Detect faulty data points and discard.
- Generate a system emulator model using ANN or other advanced machine learning algorithms to develop a control surface.
- Use a reinforcement learning framework to navigate the control surface to reach operational optimality while improving the system emulator over time using transfer learning.

System:



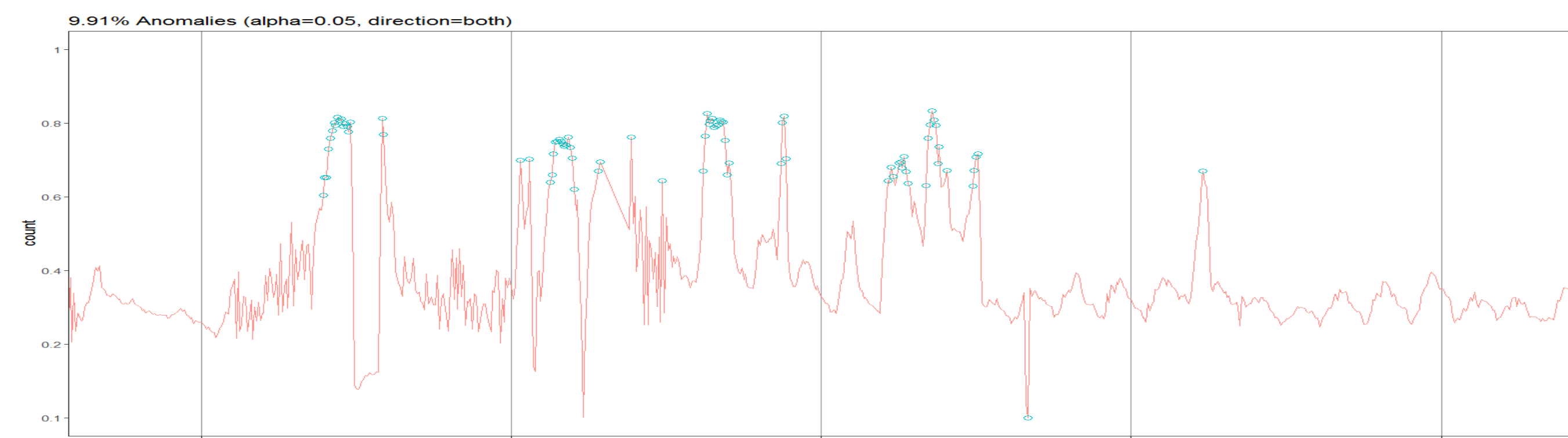
System Operation Intuition



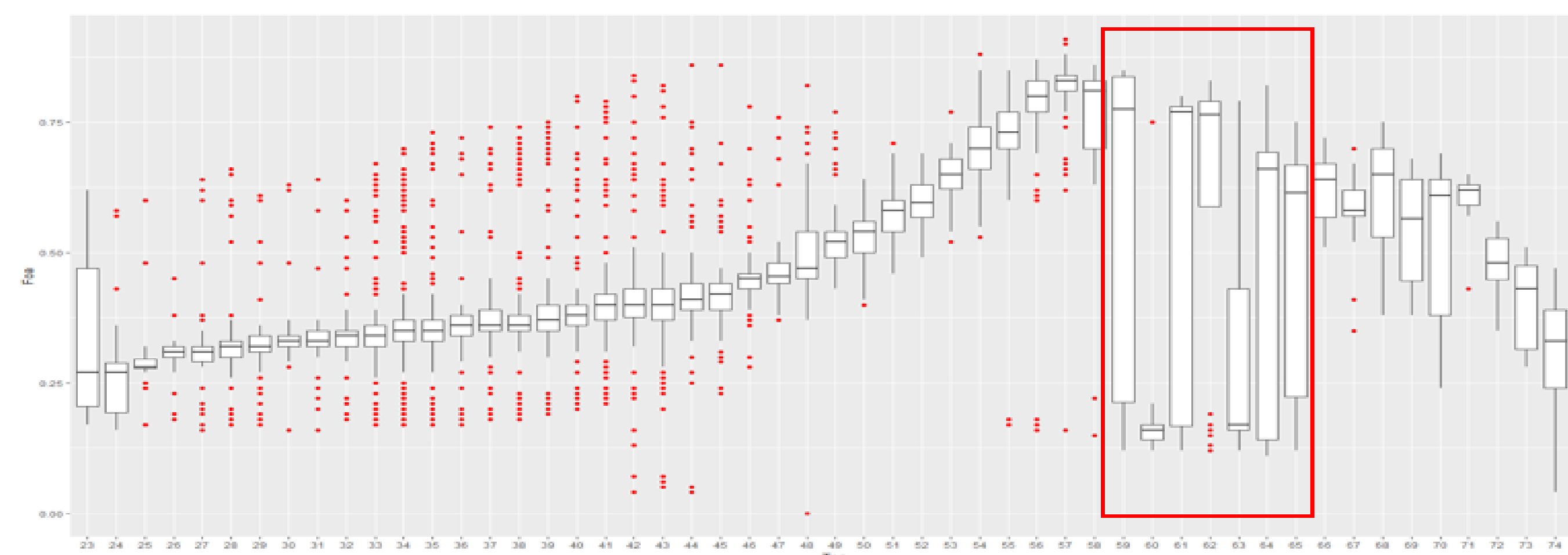
Results:

Faulty Data Detection:

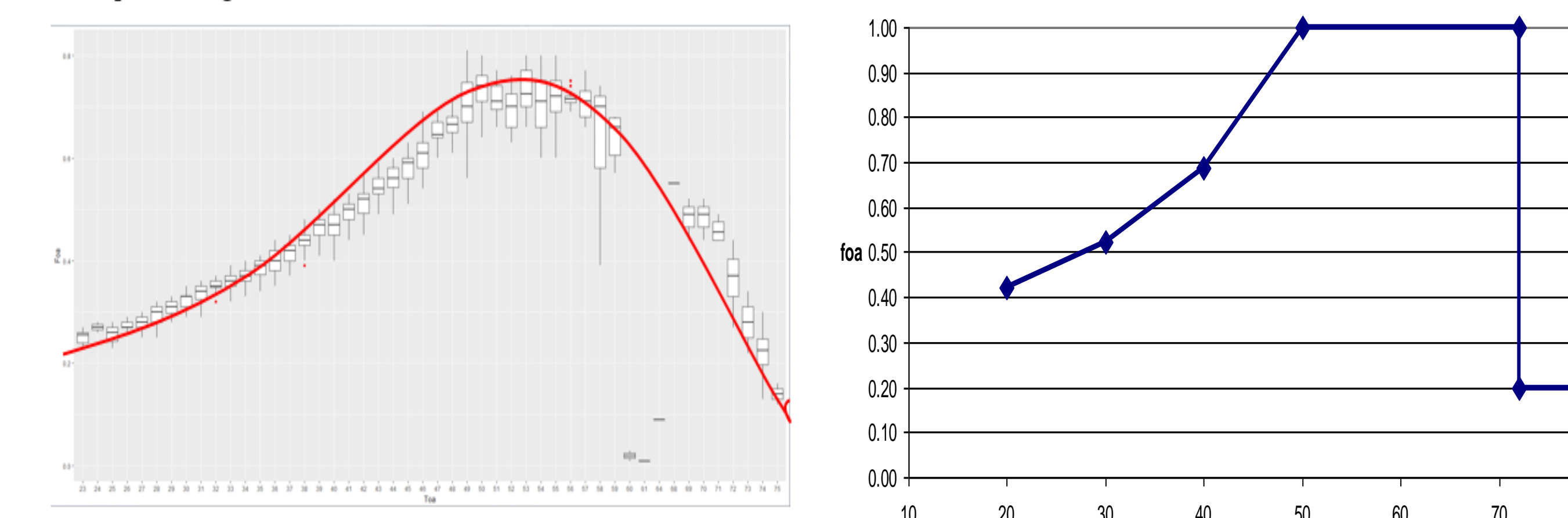
a. Time-series Anomaly Detection



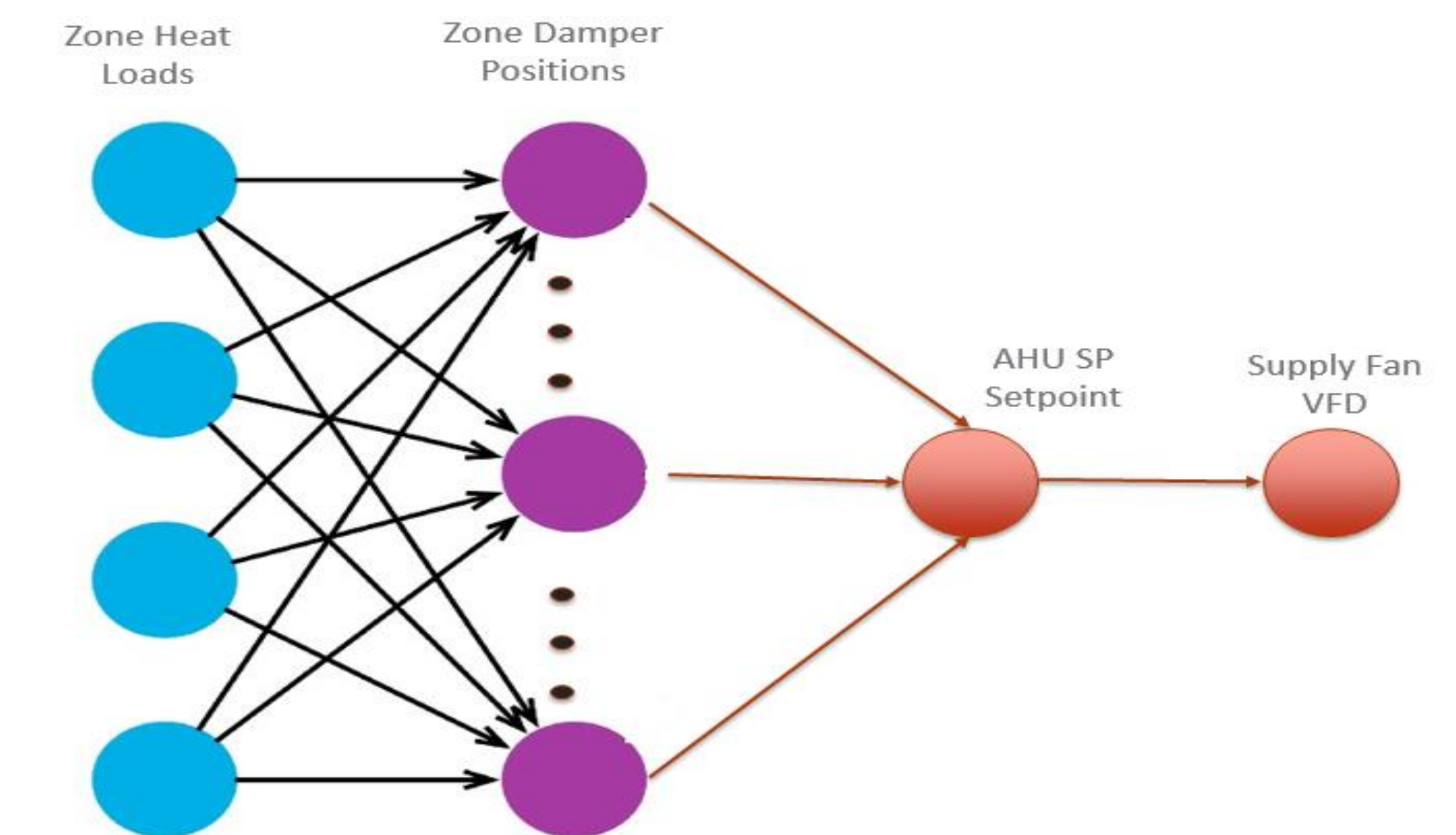
b. Statistical Outliers and Inferential Variance Bands



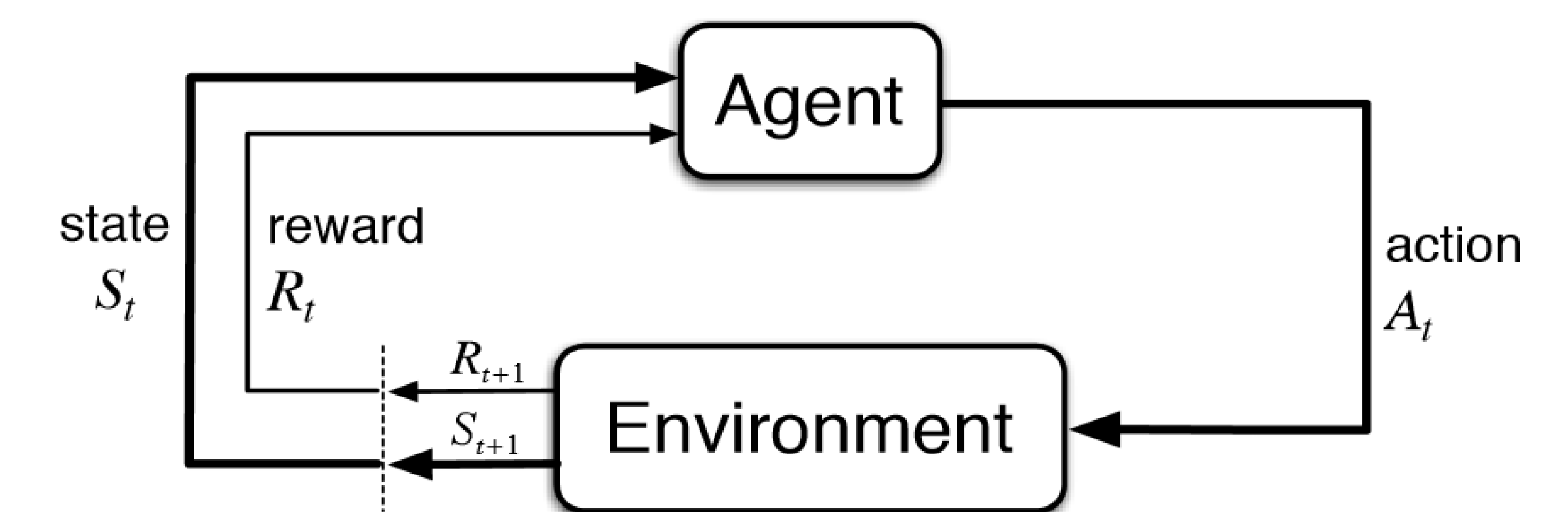
c. Naïve Estimation vs. Expected Operation Curve



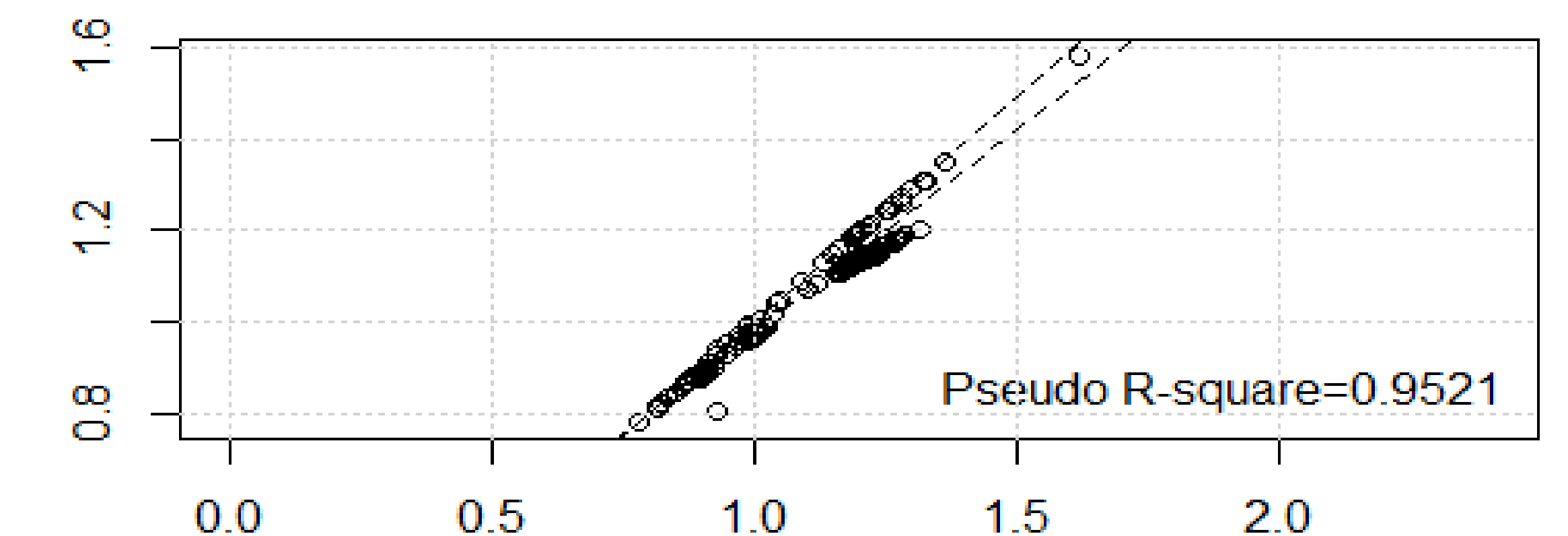
System Model:



Reinforcement Learning Framework:



Predicted vs. Observed df_predictSP_Upsample [whatif]



Optimal AHU SP Setpoint Profile:

Predicted Vs Observed Static Pressure

