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## Approaching energy efficiency and higrothermal comfort from univariate to functional data

Recent advances in the Internet of Things (IoT) and sensor technologies have provided powerful tools for the continuous, real-time monitoring of highly complex systems characterized by a wide range of features. This is particularly relevant for HVAC systems in buildings, where the objective is to maintain appropriate levels of hygrothermal comfort while minimizing energy consumption. As such, monitoring and controlling energy use, temperature, and humidity is essential for the efficient operation of any building, including shopping malls, hospitals, industrial facilities, and, of course, residential homes.

This paper presents several case studies that demonstrate the use of control charts and capability analysis to detect anomalies and manage both energy consumption and hygrothermal comfort. These case studies include applications in shopping centers, hotels, and other types of buildings. The approach ranges from traditional univariate control charts to more advanced methods where each data point is a curve (Functional Data Analysis, or FDA), as well as various multivariate techniques based on vector data.

The study incorporates both conventional statistical methods and control chart techniques developed by the authors themselves, some of which are implemented in statistical packages such as qcr.

### Special/ Invited session

### Classification

Mainly application

### Keywords

Statistical Process Control, Capability Analysis, Energy Efficiency, Buildings, Case Studies.

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