

### DATA ANALYTICS FOR MULTIVARIATE TIME SERIES ANALYSIS

Together with Malvern Panalytical, the Saxion research group (lectoraat) Ambient Intelligence is working on data-driven, predictive maintenance in the project *Predict to Prevent*. Malvern Panalytical is a high-tech, leading provider in solutions for measurement of elemental concentrations and material structures in physical samples. They serve many markets: from mining to cosmetics, and pharma to nanomaterials. Their instruments are costly, and maintenance on these instruments should be done timely and efficiently. Downtime of these instruments at the customers of Malvern Panalytical should be prevented as much as possible, in this context, their goal is to change from a reactive and preventive service for maintenance to a predictive service, that is, to go towards zero unplanned downtime.



Nowadays, maintenance engineers of Malvern Panalytical check their instruments (such as the Zetium in the picture) regularly and if they suspect a part to malfunction in the coming period, they replace it already. Besides, when the machine stops working, they are not always sure which part is broken, leading to swapping elements which are still in good condition. To optimize this maintenance process, we want to introduce *predictive maintenance*, through which *machine learning* can be used to predict when a machine will stop working and to show which part is the one that needs to be replaced.

### TASK DESCRIPTION

The data used to predict the malfunctions consist of multiple (300+) time series variables with varying units, frequencies, timestamps, and levels of detail. Over 30 instruments have collected such data for the past two years, for approximately 5 GB per month. This is a proper big data challenge for the data scientists at Malvern Panalytical and Saxion, and we welcome you to learn together with us how to tackle it using so-called *multivariate times series analysis*!

In this assignment, you will:

- Investigate best practices from literature and software frameworks for multivariate time series.
- Experiment with the data and algorithms you found during your research.
- Evaluate your models in a correct way.
- Operate within a team of experienced data scientists and data engineers of both Malvern Panalytical and Saxion.

### PRACTICAL INFORMATION

- **Student profile:** HBO-ICT Specialization Big Data Technologies.
- **Duration:** September 2022 – February 2023.
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