Quantile regression for physiological regime-switching body core temperature predictive models

By:
Lei Ruoxuan

Supervisor:
Associate Professor Chen Ying
Co-supervisor: Dr. Seng Kok Yong (DSO)
Co-supervisor: Dr. Guo Jia (NUS)

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Abstract

Monitoring human body core temperature (CT) is important for controlling the risk of physical injuries and illness such as heat stroke during physical activities and military operations. Measuring core temperature needs either surgical insertion or ingestible thermometer pills, which is often impractical due to budget constraints or medical contraindications. This makes CT prediction a relevant and necessary task in the physical intensive activities.

Many physiological predictive models have been proposed, which assume the relationship between CT and the exogenous measurable variables is stable overall, while the dependence could be heterogeneous from extreme situations to normal cases. In the Online Kalman Filter (OKF) modelling framework, we develop quantile regression to identify the quantile dependent structure of CT. We implement the developed models to 3 real datasets provided by DSO National Laboratories and investigate whether a comprehensive understanding helps to improve the prediction accuracy.

In particular, we use the in-sample test and out-of-sample test to compare the prediction accuracy among the ordinary least square based predictions and quantile regression based predictions. We find that in dataset AVIS and SIO, coefficients are different with quantile, while in the EAS dataset, these coefficients are consistent.

Both the in-sample test and out-of-sample test show that quantile regression does not improve much on the prediction accuracy of CT, compared to the predictions based on least square. The in-sample test suggests that for AVIS and SIO dataset, OKF model with cubic term is superior, while for EAS dataset, OKF model with quadratic term performs better than the alternatives. The out-of-sample test suggests that for AVIS dataset and SIO marching part, OKF linear model has best accuracy, while for EAS dataset and SIO rest part, OKF model with cubic term outperforms.