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An intelligent system for power system operation is considered to require an allowance for a certain level of supply failure and other risks. The reason for this is that, considering the example of an autonomous car, if safety is the top priority, the intelligent system is expected to stop the car, and such system would be impractical. Thus, a certain level of risk must be allowed in order to achieve autonomous cars, and the same is true for intelligent systems for power system operation.

To ensure that intelligent systems do not hinder the energy market, it is necessary to establish theories and methods that deal with this risk in a scientific and quantitative manner. If this risk is treated ambiguously, for example, the costs of transmission and reserve capacity will increase, which may reduce the profits of energy market participants.

One of the sources of this risk is forecast error of electricity demand forecasts. Although many techniques have been proposed to reduce forecast errors, it is considered impossible to reduce forecast errors to zero. It is difficult to know the magnitude of forecast error in advance, and quantitative evaluation of forecast error is a difficult problem.

Currently, there is no roadmap for the development of theories and techniques to evaluate the impact of forecast errors on power system operations. Therefore, it is important to start with or to revisit a basic statistical analysis of forecast errors. For example, it is important to analyze periods during which large forecast errors are likely to occur.

Future work is to develop more advanced techniques for the statistical analysis. For example, our group is developing a technique to facilitate the analysis of trends in forecast errors by extracting a few representative patterns of forecast errors from 365 days of forecast errors by using a clustering technique called K-means, which is one of the most popular machine learning methods. In addition, eXplainable AI (XAI), a technique for interpreting the results of machine learning forecasts, has been highlighted in recent years and may be related to this technology. Furthermore, techniques to evaluate the results of the statistical analysis of forecast errors in terms of demand and supply operations and energy markets are also required. Stochastic and scenario-based unit commitment are conventional methods that may be relevant, but further research is needed to make it practical.