PARAMETRIC AND ARTIFICIAL INTELLIGENCE BASED METHODS FOR FORECASTING SHORT TERM ELECTRICITY LOAD DEMAND

NORIZAN MOHAMED

UNIVERSITI TEKNOLOGI MALAYSIA

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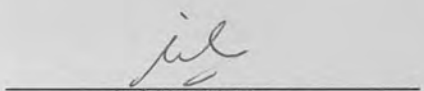

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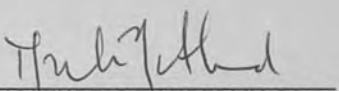

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Name of Supervisor I	:	Assoc. Prof. Dr. Maizah Hura Ahmad
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Name of Supervisor II	:	Prof. Dr. Zuhaimy Ismail
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Nama dan Alamat Pemeriksa Luar : **Prof. Dr. Anton Abdulbasah Kamil**
Mathematics,
School of Distance Education,
Universiti Sains Malaysia,
11800 USM, Pulau Pinang

Nama dan Alamat Pemeriksa Dalam : **Prof. Madya Dr. Muhammad Hisyam Lee**
Pusat Penyelidikan dan Pengurusan (RMC),
UTM, Johor Bahru.

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PARAMETRIC AND ARTIFICIAL INTELLIGENCE BASED METHODS FOR FORECASTING SHORT TERM ELECTRICITY LOAD DEMAND

NORIZAN MOHAMED

A thesis submitted in fulfilment of the
requirements for the award of the degree of
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Faculty of Science
Universiti Teknologi Malaysia

MAY 2011

I declare that this thesis entitled "*Parametric and artificial intelligence based methods for forecasting short term electricity load demand*" is the result of my own research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

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Name : Norizan Mohamed

Date : 12.05.2011

To My Family, Love You All

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ABSTRACT

The purpose of this study was to develop the best model for forecasting Malaysia load demand. In an attempt to find the best model, a one year half-hourly load demand for Malaysia was used with the mean absolute percentage error (MAPE) as the forecasting accuracy. This study considered three methods namely the double seasonal ARIMA model, the multilayer feed-forward neural network model and the hybridization of these methods. The double seasonal ARIMA model was proposed due to the existence of two seasonal cycles in the load data. Analysis were done by using SAS package. However, to analyze the multilayer feed-forward neural network model, MATLAB and S-plus packages were employed. Meanwhile, SAS, MATLAB and S-plus were utilized to analyze the hybrid model. The $ARIMA(0,1,1)(0,1,1)^{48}(0,1,1)^{336}$ with in-sample MAPE of 0.9906% was proposed as the best double SARIMA model for this study. The MAPE for one-step ahead out-sample forecasts for any horizons were all less than 1%. However, the MAPE for k-step ahead out-sample forecasts were greater than 1%. The best multilayer feed-forward neural network model was composed of three input nodes, three hidden nodes and one output node gave the in-sample MAPE of 1.1402%. The MAPE for both out-sample forecasts of all lead time horizons were greater than 1%. The best hybrid model gave the in-sample MAPE of 0.9502%. The MAPE for both out-sample forecasts of all lead time horizons were all less than 1%. Hence, it can be concluded that the hybrid model is more accurate than the single models.

ABSTRAK

Kajian ini bertujuan membina model terbaik bagi penelahan tenaga elektrik di Malaysia. Untuk mendapatkan model terbaik, data setiap setengah jam tenaga elektrik bagi tempoh setahun digunakan dengan peratus purata ralat mutlak (PPRM) sebagai ukuran kejituan telahan. Tiga kaedah iaitu model Purata Bergerak Terkamir Autoregresi Dua Musim (PBTADM), model rangkaian neural pelbagai lapis suap hadapan dan model gabungan dipertimbangkan. Model PBTADM diperkenalkan kerana wujudnya dua musim dalam data tenaga elektrik. Model PBTADM dianalisis menggunakan pakej SAS. Untuk model rangkaian neural pelbagai lapis suap hadapan, analisis dijalankan menggunakan dua pakej MATLAB dan S-plus. Sementara itu, untuk model gabungan ketiga-tiga pakej SAS, MATLAB dan S-plus perlu digunakan. $ARIMA(0,1,1)(0,1,1)^{48}(0,1,1)^{336}$ dengan PPRM di dalam sampel sebanyak 0.9906% telah dicadangkan sebagai model PBTADM yang terbaik. Penelahan di luar sampel satu-langkah kehadapan memberikan PPRM kurang dari 1% untuk semua julat telahan. Sebaliknya, untuk semua julat telahan k-langkah kehadapan PPRM melebihi 1%. Kajian mendapati model rangkaian neural pelbagai lapis suap hadapan terbaik terdiri daripada tiga unit input, tiga unit tersembunyi dan satu unit output, memberikan PPRM di dalam sampel sebanyak 1.1402%, manakala PPRM untuk kedua-dua penelahan di luar sampel melebihi 1%. Model gabungan terbaik memberikan PPRM di dalam sampel sebanyak 0.9502%. Kedua-dua penelahan di luar sampel menghasilkan PPRM kurang dari 1%. Oleh itu, model gabungan adalah lebih jitu daripada model-model tunggal.