UNIVERSITI PUTRA MALAYSIA

FORECASTING EXPORT OF SELECTED TIMBER PRODUCTS FROM PENINSULAR MALAYSIA USING TIME SERIES ANALYSIS

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MASTER OF SCIENCE

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FORECASTING EXPORT OF SELECTED TIMBER PRODUCTS FROM PENINSULAR MALAYSIA USING TIME SERIES ANALYSIS

By

DIANA EMANG

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfillment of the Requirements for the Degree of Master of Science

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Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfillment of the requirement for the degree of Master of Science

FORECASTING EXPORT OF SELECTED TIMBER PRODUCTS FROM PENINSULAR MALAYSIA USING TIME SERIES ANALYSIS

By

DIANA EMANG

July 2011

Chair : Awang Noor Abd. Ghani, PhD
Faculty : Faculty of Forestry

The export of timber products from Peninsular Malaysia is an important economic trade for the country. With the changes in world's economies, it highlights the need to apply the forecasting methods in anticipating the trend in the export of timber products from Peninsular Malaysia. This study was done by analyzing 110 quarterly observations data (from March 1982 to June 2009) of sawntimber, mouldings and chipboard volume (m^3) with four time series methods (the Seasonal Holt-Winters and ARAR algorithms as well as the ARMA and Seasonal ARIMA models). The quarterly observations data was taken from the *Report on Timber Export Statistics (Peninsular Malaysia)*, published by the Malaysia Timber Industry Board (MTIB) Resource Centre. The data were divided into two portions where the first 100 quarterly observations (calibration

data set or within-sample data) were used in the modelling process. The remaining ten quarterly observations (validation data set or out-of-sample data) were used to assess the forecasting abilities based on the measures of accuracy including mean absolute error (MAE), root mean square error (RMSE) and mean absolute percentage error (MAPE). MAPE was considered to be the decisive factors in measuring the accuracy of the forecasts as it presented different levels of model accuracy evaluations. Results have shown that the modelling process on the within-sample data in the export of sawntimber indicated the ARAR algorithm had produced the best forecast. From the assessments on the out-of-sample data, the forecasting abilities showed ARAR algorithm had the lowest MAPE at 17.27%. For a six quarters period into the future, the estimated exports of sawntimber range from 100,000 m^3 to 700,000 m^3 at 95% confidence intervals. For mouldings and chipboard, the modelling process showed that the Seasonal ARIMA (1, 0, 4) X $(0, 1, 0)_4$ model produced the best forecasts. The assessments on the out-of-sample data for the Seasonal ARIMA (1, 0, 4) X $(0, 1, 0)_4$ model showed the forecasting abilities with the lowest forecast errors where MAPE was at 18.83%. For the export in six quarters ahead, the forecasts are expected more than 150,000 m^3 at 95% confidence level. The study concluded that the forecasts offer favorable amounts that based on the assumptions that all related events in the export for these timber products will not drastically change the forecasts. This study illustrates the anticipated trend in the export of the selected timber products from Peninsular Malaysia that both public and private sectors could utilize in their decision making of future planning in order to meet the export demand.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains

MERAMALKAN EKSPORT PRODUK KAYU TERPILIH DI SEMENANJUNG MALAYSIA MENGGUNAKAN ANALISIS SIRI MASA

Oleh

DIANA EMANG

Julai 2011

Pengerusi : Awang Noor Abd. Ghani, PhD
Fakulti : Fakulti Perhutanan

Eksport produk kayu balak dari Semenanjung Malaysia merupakan satu perdagangan ekonomi terpenting kepada negara. Dengan perubahan ekonomi dunia, ia mengetengahkan keperluan untuk menggunakan kaedah ramalan dalam meramalkan aliran eksport produk kayu balak dari Semenanjung Malaysia. Kajian ini dilakukan dengan menganalisis 110 data suku tahunan (dari March 1982 hingga June 2009) bagi isipadu (m^3) kayu gergaji, kayu kumai dan papan serpi dengan empat kaedah siri masa (algoritma *Seasonal Holt-Winters* dan *ARAR* dan juga model-model *ARMA* dan *Seasonal ARIMA*). Data suku tahunan ini telah diambil dari *Report on Timber Export Statistics (Peninsular Malaysia)*, yang dikeluarkan oleh *Malaysia Timber Industry Board (MTIB) Resource Centre.* Data ini telah dibahagi kepada dua bahagian di mana 100

data suku tahunan bahagian pertama *(calibration data set or within-sample data)* digunakan untuk proses pemodelan. Data suku tahunan yang selebihnya sebanyak sepuluh data *(validation data set or out-of-sample data)* digunakan untuk menilai keupayaan ramalan berdasarkan pengukuran ketepatan *mean absolute error (MAE), root mean square error (RMSE)* dan *mean absolute percentage error (MAPE)*. *MAPE* dianggap sebagai faktor penentu dalam mengukur ketepatan ramalan kerana ia mempersembahkan pelbagai tahap penilaian ketepatan bagi model yang digunakan. Keputusan proses pemodelan ke atas *within-sample data* bagi eksport kayu gergaji menunjukkan algoritma *ARAR* telah mengeluarkan ramalan yang terbaik. Dari penilaian ke atas *out-of-sample data,* keupayaan ramalan menunjukkan algoritma *ARAR* mempunyai nilai *MAPE* yang terendah pada 17.27%. Untuk tempoh masa enam sukuan ke hadapan, ramalan eksport untuk kayu gergaji ialah antara 100000 m^3 dengan 700000 m^3 pada selang keyakinan 95%. Untuk kayu kumai dan papan serpih, proses pemodelan menunjukkan model *Seasonal ARIMA* (1, 0, 4) X $(0, 1, 0)_4$ menghasilkan ramalan yang terbaik. Penilaian ke atas *out-of-sample data* untuk model *Seasonal ARIMA* (1, 0, 4) X $(0, 1, 0)_4$, menunjukkan keupayaan ramalan dengan ralat yang terendah dimana *MAPE* ialah 18.83%. Untuk tempoh masa enam sukuan ke hadapan, eksport diramalkan mencapai lebih dari 150000 m^3 pada selang keyakinan 95%. Kajian ini merumuskan bahawa ramalan ini menawarkan jumlah eksport berdasarkan andaian bahawa aktiviti berkaitan eksport produk kayu ini tidak berubah secara drastik. Kajian ini menunjukkan ramalan ke atas aliran eksport produk kayu balak dari Semenanjung Malaysia yang boleh digunapakai oleh pihak awam dan swasta dalam membuat

keputusan untuk perancangan masa hadapan agar memenuhi permintaan eksport.

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I certify that a Thesis Examination Committee has met on 15 July 2011 to conduct the final examination of Diana Emang on her thesis entitled "Forecasting Export of Selected Timber Products from Peninsular Malaysia using Time Series Analysis" in accordance with the Universities and University Colleges Act 1971 and the Constitution of Universiti Putra Malaysia [P.U. (A) 106] 15 March 1998. The Committee recommends that the student be awarded the Master of Science.

Members of the Examination Committee were as follows:

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This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfillment of the requirement for the degree of Master of Science. The members of the Supervisory Committee were as follows:

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Date:

DECLARATION

I declare that the thesis is my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously, and is not concurrently, submitted for any other degree at Universiti Putra Malaysia or at any other institution.

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DIANA EMANG

Date: 15 July 2011

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