DEVELOPMENT OF FORECASTING MODEL FOR SAWN TIMBER EXPORT PRICE IN SABAH

TIEW YEE WEN

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Disahkan oleh:

(TANDATANGAN PUSTAKAWAN)

Nama Penyelia: Hj. Noraini Abdullah, NORAINI ABDULLAH
Lecturer
Mathematic and Economic
School of Science Technology
Universiti Malaysia Sabah

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ABSTRACT

Sabah timber industry is facing a shortage of raw material due to past over-logging and lack of sustainable forest management program (Borneo Post Online, 2012). This critical situation has forced this industry to depend on other means for sustainability, especially for sawn timber. Hence, this research endeavours to give a mathematical approach for a more sustainable industry by modelling the export price of sawn timber in Sabah. Time series and artificial neural network (ANN) are used to develop forecasting model of the sawn timber export price. In this research, Autoregressive Moving Average (ARMA) model is utilized which incorporates the times series model-building procedures, while ANN is solved using the MATLAB Toolbox with one dependent and two independent variables. The historical monthly data on sawn timber export price of 228 observations is acquired from the Department Statistic of Sabah from 1991 to 2009. The data must achieve the assumption of stationary before the ARMA model is determined. The best model in ARMA and ANN is determined by obtaining the minimum value in the eight selection criteria (8SC). Finally, MAPE is used to check the validity of the best model. The results show that the best model for ARMA model is M23.0.1, while best neural network model is the single layer of 4 which is based on the R^2 value, MSE value and standardized residuals.

PERKEMBANGAN DALAM MODEL RAMALAN UNTUK KAYU BERGERGAJI EKSPORT DI SABAH

ABSTRAK

Industri perkayuan di Sabah sedang menghadapi krisis kekurangan kayu mentah disebabkan pembalakan yang tidak terkawal dan kekurangan program pengurusan hutan yang mampan (Borneo Post Online, 2012). Keadaan yang critical ini telah mendeksa industri perkayuan ini untuk bergantung kepada teknik alternatif demi kelestarian, terutamanya bagi kayu bergergaji. Maka, kajian ini dijalankan untuk memberi pendekatan matematik dalam memodelkan harga eksport kayu bergergaji bagi membolehkan industri perkayuan menjadi lebih mampan di Sabah. Dalam kajian ini, siri masa dan model rangkaian neural (ANN) telah digunakan untuk membina model unjuran harga eksport kayu bergergaji. Model Autoregresi dan Purata Bergerak (ARMA) digunakan dengan melibatkan prosedur pembinaan model siri masa, manakala model rangkaian neural diselesaikan dengan menggunakan 'MATLAB Toolbox' bersama-sama dengan satu pembolehubah bersandar dan dua pembolehubah tidak bersandar. Data harga eksport kayu bergergaji sebanyak 228 cerapan dari tahun 1991 hingga 2009 diperolehi daripada Jabatan Statistik Sabah. Data tersebut mesti mencapai andaian pegun sebelum model ARMA boleh ditentukan. Model terbaik daripada ARMA dan ANN boleh ditentukan dengan menggunakan lapan kriteria pemilihan (8SCs). Akhir sekali, MAPE digunakan untuk menyemak kesahihan model yang terbaik. Hasil kajian telah menunjukkan bahawa model terbaik untuk ARMA ialah M23.0.1, manakala model terbaik untuk rangkaian neural ialah lapisan tunggal ke-4 yang berdasarkan nilai R^2, nilai MSE dan ralat piawai.

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LIST OF SYMBOLS

$>$	more than
$<$	less than
$=$	equal to
$\neq$	not equal to
$\geq$	more than or equal to
$\leq$	less than or equal to
$\sum$	summation of
u_t	white noise error term
Δ	difference operator
α	level of significant
df	degree of freedom
m	gradient of the line
T	target value
c	constant

CHAPTER 1

INTRODUCTION

1.1 Overview

Timber is one of Malaysia's export commodities and it has been contributing and generating Malaysia's economy. The timber sector has been continuously contributing to the country's income from the nineteenth century till present. Henceforth, the role of the timber sector in developing Malaysia's economy is unquestionable. Timber industry has much to offer us and at the same time, Mother Nature must not be exploited easily without boundaries. There have to have certain limitations to logging activities in order to preserve and conserve our nature surrounding us.

1.1.1 Background of Timber Industry in Malaysia

Timber industry in Malaysia began in the East Malaysian state of Sabah in the 1880s. During 1880s, East Malaysian was better known as the British North Borneo. The timber industry had only become significant in the East Malaysian state of Sabah after World War II. This came after the attempts to introduce timber industry into the state of Sarawak had met with dead end. During that time, Sarawak was under the ruling of Raja Brooke and then, subsequently taken over by the British colony from 1946. Gradually, the timber industry in Sarawak had surpassed Sabah in both logs export as well as production. The timber industry did not take place in just the East

Malaysia states. In fact, the timber industry had spread to the Peninsular Malaysia or better regarded as the British Malaya back in those years after 1945.

Photo 1.1 Logging activities in Sabah forests
(Source: Sabah Forestry Department)

For Sabah's timber industry, it all started in the town of Sandakan. There was a piece of land located near to the seaport town of Sandakan and this piece of land had to be cleared and the trees were to be raised to the ground as to give way to sugar planting. When this actually happened, there was a chance of sale of felled timber from the land clearance. The first export activity of logs happened in February 1885. Felled timber was shipped to Australia and this led to other shipments. Sandakan by the 1930s had turned into one of the world's major timber ports.

From 1910 onwards, timber had become Sabah's foremost export commodity. Nevertheless, like any other export commodities, logs had attained their highest peak in 1937. Sabah who was under the British Empire was the third largest timber exporter with her markets ranging from Hong Kong, Australia, Japan right up to Britain and that was before 1941.

Small quantities of tropical hardwood, *belian*, had been exported to Calcutta as well to Hong Kong by Sarawak's Borneo Company. Large scale operations in Sarawak at some stage in the period of pre-1941 were very difficult to be carried out due to lack of experience, harsh terrain and also the fluctuating timber prices.

European-owned VAMCO Timber Company initiated the export of plywood and sawn timber in the 1930s. Some of the Chinese logging companies did supply to the overseas market.

1.2 The Production of Timber in the Malaysia Market

In the late 1960s, both the timber exports and production that originated from Peninsular Malaysia had become very crucial. Both the exports and production had contributed to Malaysia's income at that time. The mass production of timber not only from the Peninsular Malaysia but also from Sabah and Sarawak had turned the timber industry into the country's third leading export commodity after tin and rubber. Malaysia in the 1980s and 1990s had managed to secure the place as the leading number one producer of tropical hardwood whereby the exports of timber from Malaysia had accounted as much as 37 percent of the world timber production particularly in the year 1998. Anyway, Chief Minister Datuk Musa Aman stated that the export of raw and semi-processed timber is discouraged in Sabah in order to ensure the sufficient supply of material for local industries (The Star, 28 March 2011). From sawn timber industry, it gives birth to timber-based industries. A wide assortment of wood products had been manufactured and these wood products comprised of plywood, sawn timber as well as veneer even right up to prefabricated houses and furniture which include rattan furniture for the local and overseas markets. Table 1.1 shows the production of rattan and bamboo for year 2008-2009.

District	Rattan (Metric Tonnes)		Bamboo (Running meter)	
	2008	2009	2008	2009
Kunak	75.00	0	-	0
Tawau	-	0	-	0
Lahad Datu	-	0	-	0
Tambunan	66.30	56.00	3,736.10	4,124.00
Sandakan	-	0	-	0
Total	141.30	56.00	3,736.10	4,124.00

Table 1.1 Production of rattan and bamboo for year 2008-2009 (Source: www.forest.sabah.gov.my)

1.3 Types of Sawn Timber

Generally, sawn timber is defined as timber that has been produced when a log is sawn longitudinally in order to produce pieces of sawn timber. Each of this has a rectangular or square cross section.

There are four main types of timber species that made up sawn timber. They are the heavy hardwood, medium hardwood, light hardwood and softwood.

1.3.1 Heavy Hardwood

a. Balau/ Selangan Batu

The botanical name for Balau is *Shorea spp., Barbata and Ciliata (section Eushorea Brandis) sub-groups*. It comes from the family of Dipterocarpaceae. Balau can be found widely throughout the dipterocarp forest with the exception only in peat swamp forests. It is best discovered in large quantity in the hilly terrains.

The sapwood is reasonably well-defined and has lighter colour compared to the heartwood. Sapwood or known as laburnum is referring to the juvenile, outermost wood which is alive in a growing tree while heartwood or duramen refers to the portion in the tree bark that exists as a consequence of a naturally happening chemical transformation which has turn out to be more resistant to decay. The heartwood becomes dead or non-living organism upon completion of spontaneous formation.

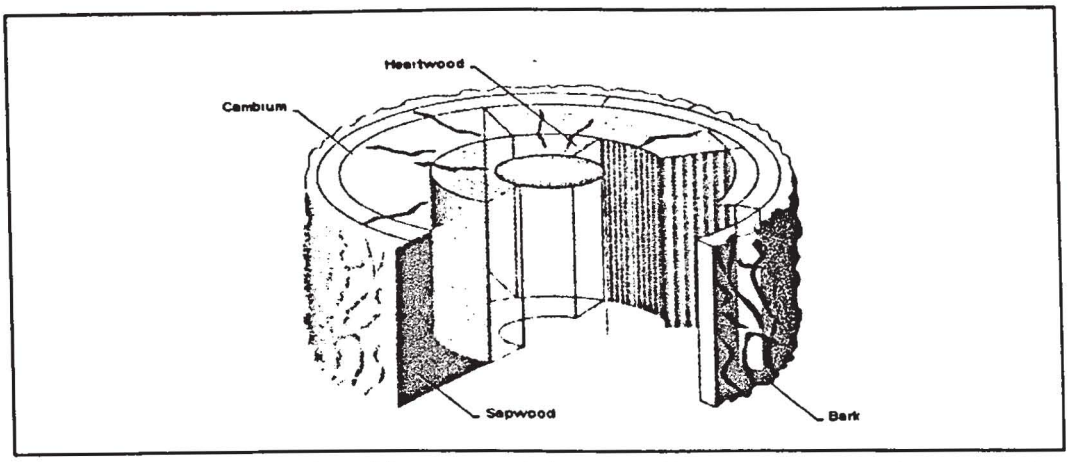

Photo 1.2 Sapwood and heartwood diagram (Source: www.tradeget.com)

The range of colours for the newly cut heartwood are yellow-brown, brown, brown with reddish tinge weathering eventually to a deeper shade of brown or reddish dark brown. The fade or dim strip figure is frequently observed when the grain is interlocked. The texture will be fine and smooth. Moreover, it has reasonably few vessels and these vessels come in medium-sized and with simple perforations. They are typically solitary with a small number of radial or oblique groups of 2 to 3. These vessels are moderately distributed. However, they are most likely to form short, oblique lines which are filled with tyloses. Tyloses as shown in Photo 1.3 are basically the outgrowth on parenchyma cells of vascular tissues or known as the xylem vessels. These vascular tissues are used to transport mineral and water throughout the plant. Moreover, tyloses are also been used to make the sapwood into heartwood for certain hardwood trees which have larger vessels. Besides that, tyloses are used to prevent further damage onto the tree when there is an infection or drought by falling off from the sides of the parenchyma cells and subsequently, blocking the vascular tissue. In addition, these blockages are used as gum plugs the minute the vessels are filled with air bubbles. This can help to form stronger heartwood as it slows down the rotting process.

Wood parenchyma is made up of both paratracheal and apotracheal types. Paratracheal parenchyma is defined as the axial parenchyma that is linked with the vessels or vascular tracheids. Hence, this paratracheal parenchyma is able to form

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