CHAPTER 3

DATA AND METHODOLOGY

3.1 Source of Data

For this study, a total of 48 individual daily stock data were obtained for the period 1st of July 1995 to 30th of June 2000. For the construction of Japanese candlestick chart and exponential moving average, the data obtained include the daily opening price, day high, day low and closing price. The securities were randomly chosen from different sectors in KLSE, with 39 securities from the Main Board and 9 securities from the Second Board.

3.1.1 Price Field

The open, high, low and closing prices are explained as below:

i) Open – This is the price of the first trade of the day.

ii) High – This is the highest price that the security traded during the day. It is a point where more seller than buyers.

iii) Low – This is the lowest price that the security traded during the day. It is a point where more buyer than seller.

iv) Close – This is the last price that the security traded during the day.

3.2 Assumption

The analysis of the trading techniques is performed with the following assumptions: an initial capital of RM1,000; the transaction cost comprising brokerage charges and stamp duty, amounting to 1.25% of the value of the security for every buy and sell transaction, will be incurred; there is no lot size restrictions. For "out of market" situation after a security is sold when selling signal is captured, an investor will invest his money in a bank before the next buying signal. Annual saving interest rate published by Bank Negara Malaysia is used for the interest calculation. The total amount, which is inclusive of capital and interest, will be invested when the next buying signal is observed.

For buy-and-hold strategy, the assumption is that an investor will buy the security on 1st of July 1995 and hold till the end of the sample period which is 30th of June 2000.

3.3 Trading techniques

As stated in earlier chapter, 3 trading techniques will be used in this study. Each technique will be defined in details as below:

3.3.1 Moving average

The exponential weighted moving average (EWMA) is chosen for this study. Gifford (1995) indicates that all the prices in the data series are used in the calculation for EWMA, but the contribution of earlier data will become less significant when time passes. The word 'weighted' means that the most recent

price is given very much more emphasis than the earlier data. The effect is that the data will become more sensitive to price change and the signals will come through earlier and at a better price.

Ravindran (1997) brings up the following point of how exponential weighted moving average is calculated. The weighting factor is based on an exponential power of a base fraction. The power of the fraction increases for each day. For example, if 2/10 is the fraction, then the most recent weighting is 1 (2/10 to the power of zero), the weighting for the day before is 2/10 (2/10 to the first power), and the weighting for a day earlier is 4/100 (2/10 to the second power).

$$EWMA\ (t) = [\ CP(t) - EWMA\ (t\text{-}1)] \times Exponent + EWMA\ (t\text{-}1)$$

Where

EWMA= Exponential Weighted Moving Average

Exponent = 2/n

n = total number of periods to be included in the calculation

t = position of the EWMA being studied

CP (t) = closing price at period t

EWMA (t) = EWMA at period t

For example:

EWMA(today) = [today's closing price – EWMA (previous day)] x (2/n) +

EWMA (pervious day)

The crossover moving average model is used in this study. The model comprises two exponential moving averages of different time periods, one short-term moving average and one long-term moving average, which will give automatic buy and sell signal. A signal to buy is given when the short-term moving average rises above the long-term moving average while a signal to sell occurs when the short-term moving average crosses below the long-term moving average. In this study, the short-term period used is 7 days and the long-term period used is 21 days.

3.3.2 Japanese Candlestick Chart

Japanese candlestick chart (JCC) displays the open, high, low and closing prices in a format similar to bar-chart, but in such a manner that it places special emphasis on the opening and closing prices and the relationship between them. Japanese candlestick analyst traditionally views the open and closing prices as the most critical of the day. Exhibit 3.1 shows how the 4 prices are used to construct a candlestick chart. Nison (1991) indicates that the thick part of the candlestick chart is the *real body*. When the real body is black or filled in, it means the close of the session was lower than the open. A long black candlestick reflects a bearish period where the market opened near its high and closed near its low. If the real body is white or empty, it means the close was higher than the open. A long white candlestick reflects a bullish period where the market opened near the low and closed near the high of the session. The thin lines above and below the real body are called the shadows. The shadow above the real body is called the upper shadow which is the high

of the session. The shadow under the real body is known as the lower shadow which is the low of the session.

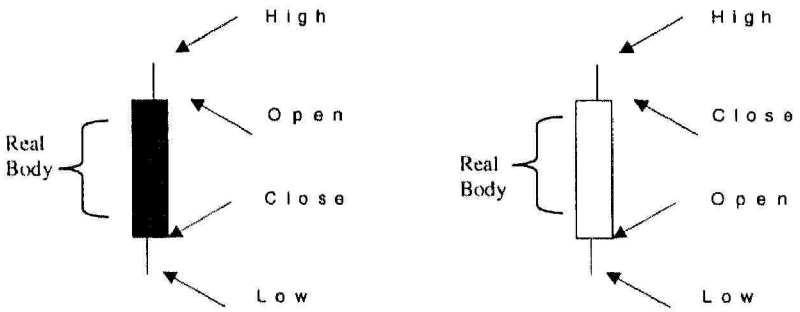
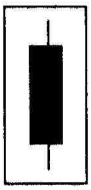


Exhibit 3.1 : Black Candlestick and White Candlestick

3.3.2.1 Common Candlestick Terminology

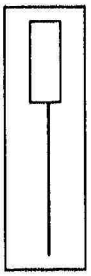
The following is a list of some individual candlestick terms.

i) The Black Candlestick – when the close is lower than the open

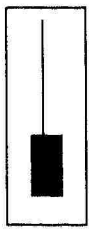


ii) The White Candlestick – when the close is higher than the open

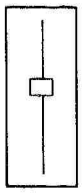
iii) The Shaven Head – a candlestick with no upper shadow



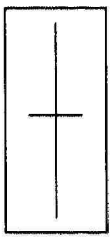
iv) Shaven Bottom – a candlestick with no lower shadow



v) Spinning Tops – candlestick with small real body

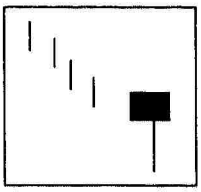


vi) Doji lines – have no real body. This represents when the Open and Close are the same or very close

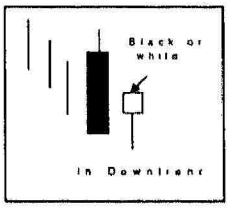


As four prices of data are used to construct the candle, there are numerous ways in which they are plotted. Some of these formations have special names and can have forecasting characteristics of their own. They can generate signals either as bottom reversal, top reversal or continuations. Some of the common formations are shown in details as below and a sample of the details trades using Japanese candlestick chart is shown in Appendix 1.

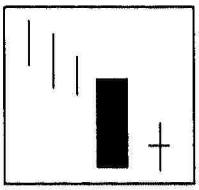
a) Bottom Reversal (Bullish Signal)



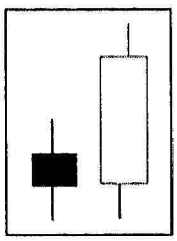
Hammer – It is a small black real body with a very long lower shadow and no upper shadow. When it appears in a downtrend, it is a bullish hammer.



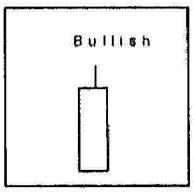
Harami – A small real body follows an unusually long real body. It is a bottom reversal when it appears in a downtrend.



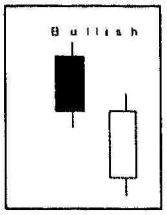
Harami–Cross This bottom reversal signal is comprised of a doji on the second session after a tall black candlestick line



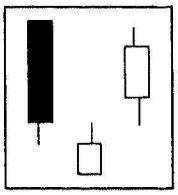
Engulfing Pattern – The bullish engulfing pattern is comprised of a large white real body which engulfs a small black real body in a downtrend.



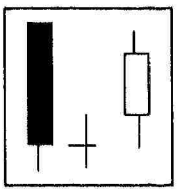
Belt Hold Lines – A bullish belt hold is a tall white candlestick that opens on its low. At a low price area, this is a bullish signal.



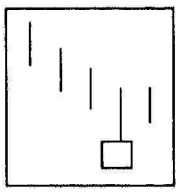
Counterattack Lines – This pattern is formed when opposite colored candlesticks have the same close. Bullish counterattack line occurs during a decline and it is a bottom reversal.



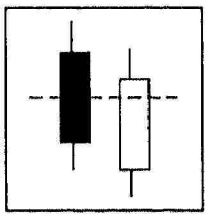
Morning Star – This major bottom reversal pattern is formed by three candlesticks. A long black real body follows by a small real body which gaps lower to form a star. The third is a white candlestick that closes well into the first session's black real body.



Morning Doji Star – This pattern is considered more bullish than the regular morning star.

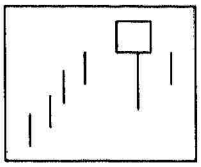


Inverted Hammer – This is a candlestick line that has a long upper shadow and a small real body at the lower end. of the session There is no, or very little lower shadow. It is a bullish signal.

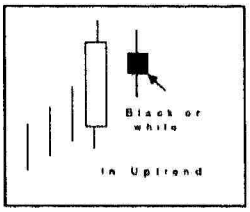


Piercing Pattern – In a downtrend, this pattern is a bottom reversal signal.

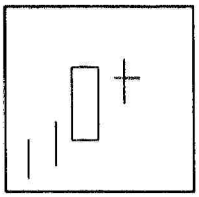
b) Top Reversal (Bearish Signal)



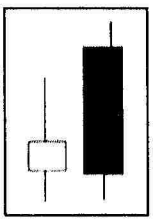
Hanging Man – It is a small real white body with a very long lower shadow and no upper shadow. When it appears in an uptrend, it is a bearish hanging man.



Harami – A small real body follows an unusually long real body. It is a top reversal when it appears in an uptrend.

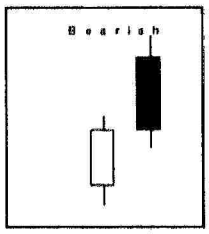


Harami–Cross This top reversal signal is comprised of a doji on the second session after a tall white candlestick line.

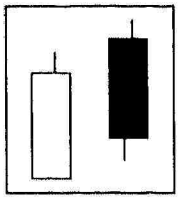


Engulfing Pattern – The bearish engulfing pattern is comprised of a large black real body which engulfs a small white real body in an uptrend.

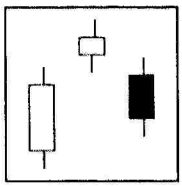
Belt Hold Lines – A bearish belt hold is a tall black candlestick that opens on its high. At a low price area, this is a bearish signal.



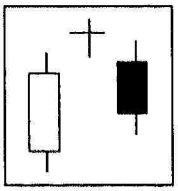
Counterattack Lines – This pattern is formed when opposite colored candlesticks have the same close. When bearish counterattack line occurs, it is a top reversal.



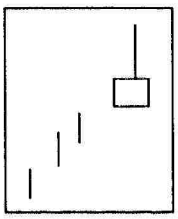
Dark-Cloud Cover – This is a bearish reversal signal. In an uptrend, a long white candlestick is followed by a black candlestick that opens above the prior white candlestick's high.



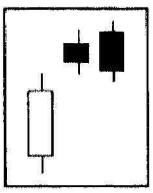
Evening Star – This pattern is formed by three candlesticks and is a major top reversal pattern.



Evening Doji Star – This pattern is a bearish signal and because there is a doji in it, it is considered more bearish than the regular evening star.

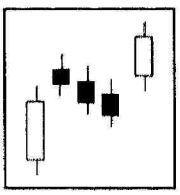


Shooting Star – It is a candlestick with a long upper shadow with little, or no lower shadow, and a small real body near the lows of the session that arises after an uptrend . It is a bearish candlestick signal in an uptrend.



Upside gap Two crows – It is a top reversal signal. The first line is a long white candlestick and follow by a black candlestick which gaps higher. The third line is another black candlestick which opens above the second line's open and closes under the second line's close.

c) Continuation Pattern



Mat Hold Pattern - This pattern is a bullish continuation pattern.

3.3.3 Buy-and-Hold Strategy

Buy-and-hold strategy (BNH) is a form of naïve analysis. The investor will do serious company analysis and will buy the security if it represents a good value. He will hold the investment and favour for longer-term results. The security will be sold only after certain time period.

3.4 Statistical Analysis

The statistical tests that are used in this study include the One-Way ANOVA, Two-Way ANOVA, Tukey test and Chi-square test. The SPSS program is used for computation.

The rate of return for a particular stock sold on day-t is calculated as:

$$R_t = 100 \cdot \ln\left(\frac{P_t}{P_{t-1}}\right)$$

where P_t is the stock price on day t

P_{t-1} is the previous price at which the stock was bought

Both P_t and P_{t-1} are adjusted for brokerage charges and stamp duty as mentioned in Section 3.2. The details of the calculation for the rate of returns for a particular stock are shown in Appendix 2.

3.4.1 Analysis of Variances

3.4.1.1 One-Way ANOVA

The following two hypotheses are tested using the one-way ANOVA:

i) The returns of stocks for the 6 sectors in the Main Board are significantly different for each trading technique.

ii) The returns of stocks for the Main Board and the Second Board are significantly different for each trading technique.

Model: $x_{ij} = \mu + \tau_i + e_{ij}$

$$\sum_{i=1}^{k} r_i \tau_i = 0 \qquad \begin{matrix} i = 1,2,\ldots,k \\ j = 1,2,\ldots,r_i \end{matrix}$$

$e_{ij} \sim IN(0, \sigma^2)$

Where x = return

k = 6 for the first hypothesis

k = 2 for the second hypothesis

τ_i = return for sector i for the first hypothesis and board i for the second hypothesis

r_i = number of observations for sector i for the first hypothesis and board i for the second hypothesis

The null and alternative hypotheses are as follows:

H_o : $\tau_i = 0 \; \forall \; i$

H_1 : At least one $\tau_i \neq 0$

Test statistic, $F = \frac{MST}{MSE}$

Where MST = Mean Square Treatment (sector or board)

MSE = Mean Square Error

Reject H_0 if $F \geq F_{v1,v2;\alpha}$

Do not reject H_0 if $F < F_{v1,v2;\alpha}$

Where

v_1 = k-1 (1^{st} d.f.)

v_2 = N-k (2^{nd} d.f.)

α = significance level (0.05 is used for this study)

$N = \sum_{i=1}^{k} r_i$ = total number of observations

3.4.1.2 Two-Way ANOVA

There are 2 sets, each with 2 hypotheses are tested using the two-way ANOVA:

ia) There is a difference in the performance of stock among the 3 stock trading techniques under board classification.

ib) There is a difference in the performance of stock between the Main Board and Second Board.

iia) There is a difference in the performance of stock among the 3 stock trading techniques under sector classification.

iib) There is a difference in the performance of stock among the 6 sectors.

The model for the two-way ANOVA is given by:

Model : $x_{ijm} = \mu + \alpha_i + \beta_j + \gamma_{ij} + \varepsilon_{ijm}$

$i = 1,\ldots, k$

$j = 1,2,3$; $m = 1,2,\ldots r_i$

where α_i is the row effect (Board or Sector)

β_j is the column effect (Trading Techniques)

$\gamma_{ij} = (\alpha\beta)_{ij}$ is the row-column interaction

$$\sum_{i=1}^{k} \alpha_i = \sum_{j=1}^{3} \beta_j = \sum_{i=1}^{k} \gamma_{ij} = \sum_{j=1}^{3} \gamma_{ij} = 0$$

$k = 2$ for the first set of hypotheses

$k = 6$ for the second set of hypotheses

$\varepsilon_{ijm} \sim IN(0, \sigma^2)$

The null and alternative hypotheses for testing whether the three trading techniques perform differently are as follows:

$H_o : \beta_j = 0$ $j = 1,2,3$

H_1: At least one $\beta_j \neq 0$

The null and alternative hypotheses for testing whether the board effect in the first set of hypotheses or sector effect in the second set of hypotheses are significant are as follows:

$H_o : \alpha_i = 0$ $\quad i = 1,...,k$

H_1: At least one $\alpha_i \neq 0$

The test statistic for the hypothesis of no difference in the performance of the 3 trading techniques is given by:

$$F = \frac{MST}{MSE}$$

Where MST = Mean Square for Technique

MSE = Mean Square Error

The critical region is $F > F_{2,v2;\alpha}$

Where $v_2 = N-3k$

The test statistic for the hypothesis of no difference in the performance of stock between boards or among sectors is given by:

$$F = \frac{MSB}{MSE}$$

Where MSB = Mean Square for Board or Sector

The critical region is $F > F_{k-1,v2;\alpha}$

Where $v_2 = N-3k$

3.4.2 Test on means after experimentation

If we reject null hypothesis after performing the ANOVA test, we may want to look for the treatment differences that are responsible. The Tukey test will be carried out for this purpose.

3.4.2.1 Tukey Test

The null and alternative hypotheses are as follows:

$H_0 : \mu_i = \mu_j$

$H_1 : \mu_i \neq \mu_j$

i,j = 1,2,....6 for the hypothesis of there is a difference in the returns among the sectors for each trading technique in the one-way ANOVA

i,j = 1,2,3 for the hypothesis of there is a difference in the performance of the 3 stock trading techniques in the two-way ANOVA

Reject H_0 if $\left|\overline{x}_{i.} - \overline{x}_{j.}\right| > q_{\alpha,t,error df}\sqrt{\frac{MSE}{\widetilde{r}}}$

$$\tilde{r} = \frac{t}{\left(\frac{1}{r_1}\right)+\left(\frac{1}{r_2}\right)+.....+\left(\frac{1}{r_t}\right)}$$

where q = critical value

t = 6 for the hypothesis in the one-way ANOVA

t = 3 for the hypothesis in the two-way ANOVA

r_i = number of observations for sector i for the hypothesis in the one-way ANOVA and for trading technique i for the hypothesis in the two-way ANOVA.

3.4.3 The Chi-square Test

The chi-square test is a goodness-of-fit test. In this study, the test is conducted to examine whether each trading technique has the same probability to emerge as the best performance trading technique.

The null and alternative hypotheses are as follows:

H_o : $P_1 = P_2 = P_3$

H_1: At least 2 P's are different

Test statistic, $$\chi^2 = \sum\left[\frac{(0_i - e_i)^2}{e_i}\right] \sim \chi^2_{(2)}$$

where e_i is the expected value for trading technique-i

0_i is the observed value for trading technique-i

At significance level, $\alpha = 0.05$

Reject H_0 if $\chi^2 \geq \chi^2_{2,\alpha}$

Do not Reject H_0 if $\chi^2 < \chi^2_{2,\alpha}$

3.5 Computation – Metastock for Windows

Metastock for Windows version 6.52 is the software that is used to facilitate the study of the performance of the exponential moving average and Japanese candlestick chart. It is a program used to analyze price trend in future, option and stock markets by analyzing historical data.

In Metastock for Windows, the historical price data is downloaded from Bloom Berg which is an online data vendor. For the purpose of this study, the daily stock price is used. The graph of exponential moving average and Japanese candlestick chart can be created easily by choosing the right indicator and time period. The graphs are used to identify the buying and selling signals of stocks, for both the technical trading techniques.