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# Trading Thaidex SET50 Exchange Traded Fund (TDEX) with Gaussian Distribution

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#### Abstract

The main objectives of this research are to apply the Gaussian distribution and find the appropriate parameters (n-periods and oversold and overbought zones) for trading TDEX. This research uses the database which collected 2,765 records of the daily price of TDEX such as opening, high, low, and closing from efin stock pickup software since September 6, 2007, to December 28, 2018. These data computed the Z from last n-periods closing price to simulate the trading TDEX and compute the statistical results. The Z must configure 3 parameters together. The first parameter is a number of days vary from 5 to 50 with increments of 5. Next, the second parameter is the oversold zone vary from 0 to -4 with decrements of 0.1. Lastly, the third parameter is the overbought zone vary from 0 to 4 with increments of 0.1. All parameters will be adjusted to find the entry point that makes the best opportunity or the maximum profit. This research will initiate a new buying position when the Z indicator drops to an oversold zone or lower and then holds the TDEX until the Z indicator reaches an overbought zone or over.

The trading TDEX results from the Gaussian distribution show that, in the condition where the oversold and overbought zones were asymmetry, the maximum net profit of 9.80 occurs at a number of days, the oversold zone, and the overbought zone of 20, -2.8, and 3.1-3.2, respectively. On the other hand, if they are symmetry, the maximum net profit of 8.05 occurs at a number of days, the oversold zone, and the overbought zone of 25, -2.9, and 2.9, respectively. Meanwhile, the return using buy and hold for the whole period is 4.54.

Keywords: Thaidex, TDEX, SET50, Exchange Traded Fund, Gaussian Distribution

#### 1. Introduction

Exchange traded fund (ETF) is a type of investment fund traded on stock exchanges, which owns assets (stocks, commodities, bonds, etc.) and divides ownership of itself into shares that are held by shareholders. ETFs have been available in the US since 1993 and in Europe since 1999. An ETF is similar in many ways to traditional mutual funds and stills maintaining all the features of ordinary stock. There are many types of ETF such as Index ETFs, Stock ETFs, Bond ETFs, Commodity ETFs, currency ETFs. They may be attractive among investments for many reasons such as:

- ETFs generally have lower costs than other investment products because most ETFs are not actively managed and have lower marketing, distribution and accounting expenses.

- ETFs can be bought and sold at current market prices at any time during the trading day, unlike mutual funds, which can only be traded at the end of the trading day.

- ETFs have transparent portfolios and are priced at frequent intervals throughout the trading day.

The Stock Exchange of Thailand (n.d.) stated that Thaidex SET50 Exchange Traded Fund or TDEX is the first equity ETF in Thailand. It is a passively managed ETF established on September 6, 2007. The objective of the Fund is to achieve a price and yield performance, before fees, expenses, and tax. That is generally similar to that of the SET50 index. The Fund will invest at least 65% of its net asset value in equity instruments, focusing on components of the SET50 index. Buying TDEX is similar to buying 50 blue chips of Thailand at the same time which has a correlation of 98% to the SET Index. The market capitalization of SET50 stocks cover around 80% by total market capitalization in Thailand

TDEX is a new alternative tool which diversifies risk, has low initial investment and a low management fee. TDEX facilitates your asset allocation to the market in the most simple and easiest way and is the least expensive way to cover the Thai market. TDEX is suitable for new investors who have no experience in securities trading and is also commonly used for hedging purposes.



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Figure 1 Closing price of TDEX since September 6, 2007 to December 28, 2018

TDEX diversifies risk by investing in SET50 stocks through different sectors such as Energy & Utilities, Banking, Construction Materials, Information & Communication Technology, Transportation & Logistics, etc. TDEX is similar to holding a stock which the daily closing price of TDEX since September 6, 2007, to December 28, 2018, as shown in Figure 1. The daily Investors can buy or sell at any broker which trading commission is only 0.10 % compared to 0.25 % for the stock.

Investors may receive capital gain from a rise in the price of TDEX which corresponds to the increase in the SET50 Index. Investors may receive dividends, no more than four times a year at a rate of not more than 100% of accumulated profit or net profit of the interim accounting period to pay such dividend, whereby such dividend payment will not cause the fund to have an increase in accumulated loss in the interim accounting period.

If you can shoulder more risk and invest your money for a longer time period, you may try investing your capital in ETFs. Since these corporations employ financial experts, nowadays lots of investors opt to put their money in ETFs. Prior to investing your hard-earned money in these funds, you have to perform your own research. You should research about the past performance of the company you will be investing in and the industries they work with. Remember: The past performance can in no way guarantee future results.

The lure of big money has always thrown investors into the lap of stock markets. Many people take to trading in the mistaken belief that it is the simplest way of making money. In fact, it is not easy. Please beware; the stock market is like a deep and big well. No matter how much money you put in it, it can all vanish. There are no short-cuts, no magical key or 'holy grail' when you trade in stock markets. You cannot learn to trade in a day or even a few weeks, sometimes not even in months. Investing software and trading books by themselves can't make you enormously wealthy. In addition, successful traders do not only requires oodles of patience and discipline but also a great deal of research. They must keep reading all the new research on security analysis that they can get their hands on.

Security analysis is the analysis of tradeable financial instruments. Security analysis is typically divided into fundamental analysis and technical analysis.

- Fundamental analysis is a method of evaluating a security in an attempt to assess its intrinsic value, by examining fundamental business factors such as financial statements, related economic and other qualitative and quantitative factors.



- Technical analysis is a methodology that makes buy and sell decisions using upon price trends, momentum and market statistics. It primarily involves studying charts showing the trading history and statistics for security analyzed. Quantitative analysis may use indicators from both areas.

Technical analysis is a self-fulfilling prophecy and gives deep insight into crowd behavior. It has become extensive in recent years. There are several categories of technical analysis such as Price indicators, Support and Resistance levels, Momentum indicators, Volume indicators, Oscillators, and Statistical price movement indicators. In this research, we set focus on using a well-known statistical distribution called Gaussian distributions to trade TDEX.

Wikipedia (2019) stated that, in probability theory, Gaussian or Gauss or Laplace–Gauss or normal distribution is a very common, most popular, and most important continuous probability distribution which has been studied under various names for nearly 300 years. Though the normal distribution was known from the writings of Abraham de Moivre who worked on it in 1733, we may conclude that he was its originator. Gauss is often given credit for the discovery, and the normal distribution is often referred to as the Gaussian distribution. This distribution usually works well with a large dataset. When we use large size data for other distributions, it converges in distributions by central limit theorem to the normal. Many studies of statistics originated from Gauss are often used in the natural and social sciences to represent real-valued random variables whose distributions are unknown and allow us to understand markets, prices, and probabilities among other applications.

Miller (2013) concluded that the graph of Gaussian distribution looks like a symmetrical smooth bell curve with mean and variance parameters as shown in Figure 2. If the data follow a Gaussian distribution, we will find that 68.26% of all scores fall within -1 and +1 standard deviations of the mean, 95.44% fall within two standard deviations, and 99.72% fall within three standard deviations as shown in Figure 3. It is the reason why we let the oversold and overbought in this research varied from -4 to 4.

Westfall (2018) has shown that the Gaussian distributions can be characterized by their mean which measures the center of distribution while the standard deviation measures volatility and tells investors what kind of performance of returns can be expected. Smaller standard deviations mean less risk for investment while higher standard deviations mean a higher risk. The prices deviate far away from the mean might revert back to the mean so that traders might be able to take advantage of these situations. Further, the prices that trade in a small range might ready for a breakout. Livetraders (2018) stated that the often-used technical indicator for standard deviations for upper and lower bands with a 21-day moving average.

In statistics, the standard normal distribution, represented by the letter Z, is the Gaussian or normal distribution having a mean of 0 and a standard deviation of 1. We can transform data values to be Z by the formula  $Z = (x-\mu)/\sigma$  which the data is x, the mean is  $\mu$  and the standard deviation is  $\sigma$ .



Figure 2 The bell curve of Gaussian distributions with mean and variance parameters



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Figure 3 The probability or area under the curve of Gaussian distributions

In technical analysis, the application of the Gaussian distributions for trading TDEX, Z measures the difference among the closing price from n-period moving average given the n-period standard deviation. If Z equals zero means the closing price is the same as its moving average. Z could be positive or negative and indicates whether the closing price is above or below its moving average. Z is positive when the closing price is above the moving average while Z is negative when the closing price is below the moving average. Just like Bollinger bands, Z uses a user-selected standard deviation as the upper band and volatile scope as the lower band, which in this research called the overbought and oversold zone, respectively. From the above concept, we get the idea to purchase TDEX when the price is cheap or Z breaks through the oversold zone (Z on the left tail of normal curve) and sell TDEX when the price is expensive or Z breaks through the overbought zone (Z on the right tail of normal curve).

# 2. Objectives

The main objectives of this research are to apply the Gaussian distribution and find the appropriate parameters (n-period and oversold and overbought zones) for trading TDEX.

### 3. Materials and Methods

 $Z = (c-\mu)/\sigma$ 

- 3.1 The first step was to create the database which collected 2,765 records of the daily price of TDEX (such as Opening, High, Low and Closing) from efin stock pickup software from September 6, 2007, to December 28, 2018.
- 3.2 The second step was to compute  $\mu$  and  $\sigma$  from last n-period closing price, n is the number of days varies from 5 to 50 with increments of 5 and then computes Z using the formula:

which c is the daily closing price of TDEX.

 $\boldsymbol{\mu}$  is the n-period moving average.

 $\sigma$  is the n-period standard deviation.

- 3.3 The third step was to simulate the trading results.
  - 3.3.1 Let the oversold varied from 0 to -4 with decrements of 0.1 and the overbought varies from 0 to 4 with increments of 0.1.
  - 3.3.2 Making a decision to trade TDEX according to the following conditions:
    - If Z was less than the oversold, bought TDEX at the next day opening price and held it until sold at the next day opening price when Z was greater than the overbought.
- 3.4 The fourth step was to compute the statistical results of trading TDEX (such as number of trade, percentage of a win, percentage of loss, profit & loss, etc.)
- 3.5 The fifth step was to analyze the statistical results.
  - (The limitation of this research was the commission fee. The investors must pay the commission fee each time trading TDEX but, in this research, the profit was calculated without the fee.)



### 4. Results and Discussion

Considering the result for the backtest of the whole period TDEX data from September 6, 2007, to December 28, 2018, it was found that the opening price of TDEX on September 6, 2007, was 5.89 baht per share and the closing price of TDEX on December 28, 2018, was 10.43 baht per share. The return or total profit on buying and holding over the whole period is 4.54 baht per share or 77.08% and the average profit per year is 0.40 baht per share or 6.81%. The descriptive statistics for all results (16,000 cases) was shown in Table 1.

	Unit	Mean	SD	Min	Max	Skewness	Kurtosis
Trade	(times)	16.14	23.39	0	161	2.48	8.03
Win	(%)	78.69	15.55	25.00	100	0.04	-0.78
Loss	(%)	28.96	9.85	7.69	100	1.27	4.30
Profit	(points)	5.18	2.62	0.06	18.27	0.86	2.44
Loss	(points)	-3.29	3.20	0.00	-16.90	-1.20	1.00
Net Profit	(points)	1.49	1.88	-4.28	9.80	0.55	-0.10
	(%)	23.17	34.22	-59.91	217.11	1.55	3.88

Table 1 The descriptive statistics for all possible results

As shown in Tables 1, a number of times to trade TDEX by Z was between 0-161 times, and the average was about 16.14 times with a standard deviation of 23.39. The opportunity to win was between 25-100%, of which an average was 78.69% and a standard deviation was 15.55 while the opportunity to lose was between 7.69-100%, of which an average was 28.96% and a standard deviation was 9.85. The average profit and loss per trade were 5.18 and -3.29 points, respectively. The relationship between the number of days, the oversold zone, the overbought zone, net profit, and percent for winning was shown in figure 4-6.









Figure 5 (Left) A scatterplot shows the relationship between the oversold zone (X-axis) and net profit (Y-axis), (Right) A scatterplot shows the relationship between the oversold zone (X-axis) and percent for winning (Y-axis)



Figure 6 (Left) A scatterplot shows the relationship between the overbought zone (X-axis) and net profit (Y-axis), (Right) A scatterplot shows the relationship between the overbought zone (X-axis) and percent for winning (Y-axis)

From Figure 4-6, the scatterplots indicate no relationship between the number of days, the oversold zone, the overbought zone, and both variables (number of days and percent for winning). Notice that the maximum net profit occurred at a number of days of 20, the oversold zone of -2.8, and the overbought zone of 3.1 or 3.2. Moreover, the descriptive statistics of the top 20 net profit from all possible cases were analyzed as shown in Table 2 and the top 20 net profit in the condition where the oversold and overbought were symmetry was analyzed as shown in Table 3.



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Туре	Net Profit	# Trade	# Win	# Loss	# Draw	%Win	%Loss	%Draw
Normal(20,-2.8,3.1)	9.80	3	3	0	0	100.00	0.00	0.00
Normal(20,-2.8,3.2)	9.80	3	3	0	0	100.00	0.00	0.00
Normal(20,-2.7,3.1)	9.19	3	3	0	0	100.00	0.00	0.00
Normal(20,-2.7,3.2)	9.19	3	3	0	0	100.00	0.00	0.00
Normal(25,-2.9,3.3)	8.68	2	2	0	0	100.00	0.00	0.00
Normal(25,-2.7,3.3)	8.63	2	2	0	0	100.00	0.00	0.00
Normal(25,-2.8,3.3)	8.63	2	2	0	0	100.00	0.00	0.00
Normal(20,-2.6,3.1)	8.46	3	3	0	0	100.00	0.00	0.00
Normal(20,-2.6,3.2)	8.46	3	3	0	0	100.00	0.00	0.00
Normal(25,-2.6,3.3)	8.07	2	2	0	0	100.00	0.00	0.00
Normal(25,-2.9,2.9)	8.05	4	4	0	0	100.00	0.00	0.00
Normal(25,-2.9,3)	8.05	4	4	0	0	100.00	0.00	0.00
Normal(25,-2.9,3.1)	8.05	4	4	0	0	100.00	0.00	0.00
Normal(25,-2.7,2.9)	8.00	4	4	0	0	100.00	0.00	0.00
Normal(25,-2.8,2.9)	8.00	4	4	0	0	100.00	0.00	0.00
Normal(25,-2.7,3)	8.00	4	4	0	0	100.00	0.00	0.00
Normal(25,-2.8,3)	8.00	4	4	0	0	100.00	0.00	0.00
Normal(25,-2.7,3.1)	8.00	4	4	0	0	100.00	0.00	0.00
Normal(25,-2.8,3.1)	8.00	4	4	0	0	100.00	0.00	0.00
Normal(25,-2.9,3.2)	7.77	3	3	0	0	100.00	0.00	0.00

Table 2 The descriptive statistics of the top 20 net profit from all possible case (16,000 cases)

**Table 3** The descriptive statistics of the top 20 net profit from all possible case (16,000 cases) on condition that the oversold and overbought were symmetry

	6	5						
Туре	Net Profit	# Trade	# Win	# Loss	# Draw	%Win	%Loss	%Draw
Normal(25,-2.9,2.9)	8.05	4	4	0	0	100.00	0.00	0.00
Normal(25,-2.8,2.8)	7.34	5	5	0	0	100.00	0.00	0.00
Normal(30,-2.9,2.9)	7.19	5	5	0	0	100.00	0.00	0.00
Normal(35,-3,3)	6.96	2	2	0	0	100.00	0.00	0.00
Normal(35,-3.1,3.1)	6.60	1	1	0	0	100.00	0.00	0.00
Normal(35,-3.2,3.2)	6.60	1	1	0	0	100.00	0.00	0.00
Normal(50,-3.5,3.5)	6.60	1	1	0	0	100.00	0.00	0.00
Normal(40,-3.2,3.2)	6.39	1	1	0	0	100.00	0.00	0.00
Normal(45,-3.3,3.3)	6.39	1	1	0	0	100.00	0.00	0.00
Normal(50,-3.3,3.3)	6.39	1	1	0	0	100.00	0.00	0.00
Normal(50,-3.4,3.4)	6.39	1	1	0	0	100.00	0.00	0.00
Normal(40,-3.1,3.1)	6.35	2	2	0	0	100.00	0.00	0.00
Normal(20,-2.8,2.8)	6.26	6	6	0	0	100.00	0.00	0.00
Normal(05,-0.1,0.1)	6.09	26	13	13	0	50.00	50.00	0.00
Normal(40,-2.6,2.6)	5.98	9	7	2	0	77.78	22.22	0.00
Normal(35,-2.5,2.5)	5.91	11	9	2	0	81.82	18.18	0.00
Normal(45,-3.2,3.2)	5.78	1	1	0	0	100.00	0.00	0.00
Normal(15,-2.8,2.8)	5.65	4	4	0	0	100.00	0.00	0.00
Normal(20,-2.7,2.7)	5.61	6	6	0	0	100.00	0.00	0.00
Normal(40,-2.7,2.7)	5.55	8	6	2	0	75.00	25.00	0.00

As shown in Tables 2, if the oversold and overbought zones were asymmetry, the maximum net profit occurred at a number of days, the oversold zone, and the overbought zone of 20, -2.8, and 3.1-3.2, respectively. From Tables 3, if the oversold and overbought zone were symmetry, the maximum net profit occurred at a number of days, the oversold zone, and the overbought zone of 25, -2.9, and 2.9, respectively. The top 20 net profit in the condition where the oversold and overbought zones were symmetry was 8.05,



which was less than the asymmetry case of 9.80. The both maximum values were greater than buy and hold for the whole period. From Table 2 and 3, it was obvious that both maximum cases were a long-term investment because they had a number of times to trade only 3-4 times during 11 years of investment with 100% for winning.

#### 5. Conclusion

The Z or Z-score indicator in this research is not a new idea. It is a statistical measurement of a price's relationship to the mean in a group of prices. A Z-score of 0 means the score is the same as the mean and it can also be positive or negative, indicating whether it is above or below the mean and by how many standard deviations. In a normal distribution, one standard deviation to both the right and the left of the mean contains approximately 68%, two standard deviations contain 95.5% and three standard deviations contain 99.7% of all phenomena occurrences. Implement these concepts in the research, the price deviated to the distance of three standard deviations from its mean, there would be practically no threat of the continuation of the deviation from the mean, and the trader could buy security and wait for the price to return to the mean value. Unfortunately, the distribution of prices around the mean is not normal in the long term.

We already know that the Z is an oscillator that uses a number of days and the oversold and overbought zones to measure buying and selling pressure. The challenge is that defining overbought and oversold is not easy. Good traders have a method or set of rules for determining market extremes and, in many cases, they rely on indicators or levels. The objectives of this research are to apply the Gaussian distribution and find the optimum parameters (n-period and oversold and overbought zones) for trading TDEX. From the backtest, the result shows that in the condition where the oversold and overbought zones were asymmetry, the maximum net profit occurred at a number of days, the oversold zone, and the overbought zones of 20, -2.8, and 3.1-3.2, respectively. In contrast, for the symmetry case, the maximum net profit occurred at a number of days, the oversold zone of 25, -2.9, and 2.9, respectively. Meanwhile, the return on buying and holding over the whole period is 4.54.

If you read this paper carefully with an opened-mind, creativity, some knowledge of statistics, and some experience in investment, you will see that, although this research is not the perfect method, it is not useless because it gets to show how to apply the Gaussian distribution for investment and can be implemented in real life in many ways. For example, when you want to buy a stock or fund and do not know whether the price is cheap enough or not. The easy way for making a decision is to bring the last 20-days closing prices, then compute mean, standard deviation, and Z from the data. After that, considering the Z, if it is less than -2.8, it means that the price is cheap. You can buy the stock or fund at the next day opening price. In contrast, if the Z is greater than 3.2, the price is expensive, you can sell the stock or fund at the next day opening price.

Moreover, the z-score indicator can be seen as a supplement to Bollinger Bands. It offers a simple way to assess the position of the price that is resistance and support levels expressed by the Bollinger Bands. In addition, crossings of Z-score averages may signal the start or the end of a tradable trend. Traders may take a step further and look for stronger signals by identifying common crossing points of z-score, its average, and an average of average. In order to improve performance, traders can use different periods for the bands together with other periods for the moving averages. Nevertheless, Z-score is an extremely useful technique not only for trading but also for screening, stock picking, and portfolio structuring.

Finally, there is no holy grail when you trade the stocks or funds in real life, and every method must have strengths and limitations. This research is the same. There are many limitations to develop such as implementing with other stocks or funds in different situations and including stop-loss criteria into the methods and others.



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