Forecast the Number of Unemployed in Thailand Classified by Education Level using Differential Equation Model

Kachin Goganutapon

Program in Applied Mathematics,Faculty of Science and Technology,

Valaya Alongkorn Rajabhat University under the Royal Patronage,

Khlong Luang, Phathum Thani 13180, Thailand.

E-mail: Kachin@vru.ac.th

Abstract

The purpose of this study were 1) to construct the appropriate model forecasting for the number of unemployed in Thailand classified by education level using differential equation model , the primary and lower education, junior high school, senior high school, vocational certificate, high vocational certificate and higher education, and 2) Predict the number of unemployed people in Thailand classified by education in the future using information from the website of the National Statistical Office from 2001 to 2017, totally 17 values. Is divided into 2 sets, set 1 is data from year 2001 to year 2016, 16 values for creating differential equations to predict the number of unemployed in Thailand check the relationship between the differential equation model and the real value and the suitability of the forecasting model with the correlation coefficient (R), coefficient of determination (R^2) coefficient of improvement decision (R^2 - Adjusted), estimation of standard error of regression equation and analysis of the recession, respectively. Set 2 had 5 values from 2013 to 2017 for comparing accuracy of the forecasts via criteria of the lowest root mean squared error (RMSE) and mean absolute percentage error (MAPE).

The research found that

1. Differential equation model for forecasting the number of unemployed by qualification achieved in Thailand

Primary and lower education is $\widehat{Y}_1(t) = -0.173t^3 + 2.425t^2 - 11.593t + 98.335$

Junior high school is $\widehat{Y}_2(t) = 0.063t^3 + 0.750t^2 - 8.874t + 85.717$

Senior high school is $\widehat{Y}_3(t) = 0.077t^3 + 0.610t^2 - 5.729t + 49.191$

Vocational certificate is $\widehat{Y}_4(t) = 0.013t^3 + 0.238t^2 - 1.598t + 18.844$

High vocational certificate is $\widehat{Y}_5(t) = 0.030t^3 + 0.352t^2 - 3.029t + 32.082$

Higher education is $\widehat{Y}_6(t) = 0.119t^3 + 0.791t^2 - 4.567t + 83.141$

2. Number of unemployed graduates' primary and lower education have a tendency to decrease but the unemployed graduates junior high school graduation, senior high school graduation, vocational certificate graduation, high vocational certificate graduation and higher education graduation upward trend.

Keywords: differential equation, unemployed , forecast

1. Introduction

Population is a resource national manpower that plays an important role in success or failure to develop the country. Therefore, it is very important to analyze the current situation of population, manpower, labor and unemployment in order to set guidelines for solving problems from the unemployment situation, termination and demand for labor surveyed by national statistical office. The results of the labor force survey in April 2017 found that the number of people aged from ¬ 15 years up to 55.89 million people who live in the labor force or those who are ready to work 37.89 million people. Which consists of 37.09 million active people, 4.73 thousand hundred unemployed people and 3.24 hundred thousand people waiting for the season, while those outside the labor force or those who are not ready to work 18.00 million people,

including house wife, student, and elderly people. In April 2017, the unemployment situation were 4.73 hundred thousand people, or 1.2 percent of the unemployment rate, compared to the same period in 2016. The number of unemployed increased by 7.7 ten thousand people (from 3.96 hundred thousand to 4.73 hundred thousand people) and compared to March 2017, the number of unemployed decreased by 2.3 thousand people (from 4.96 hundred thousand people to 7.73 hundred thousand people) when comparing the unemployment rate with the same period of the previous year. The result of the unemployment rate increased (from 1.0 percent to 1.2 percent) compared to the previous month. The unemployment rate decreased (from 1.3 percent to 1.2 percent). Unemployment according to the level of education achieved in April 2017, it was found that the unemployed higher education graduated

1. 92 hundred thousand people (2.3 percent unemployment rate), followed by the upper junior high school, 1.08 hundred thousand people (1.7 percent), junior high school graduated 8.9 ten thousand people (1.4 percent), primary education graduated 6.0 thousand people (0.7 percent) and those who do not have education and lower than 2.2 ten thousand people (0.3 percent) compared to the same period of 2016. Found that, the number of detractors In the senior high school graduated increased by 2.8 ten thousand people, higher education increased by 2.6 ten thousand people, primary education graduated increased by 1.9 thousand people and junior high school graduated increased by 8.0 thousand people for those who do not have education and lower than primary education graduated, the number of unemployed reduced down 4.0 thousand people [1].

For this research, the researcher wanted to study the movement of the number of unemployed. In the past, to create a model for differential equations to predict the number of unemployed in the country. Separating the qualification achieved to know the trend of the number of unemployed how it looks if the number of unemployed in the future decreases would have a positive impact on national development planning. For that reason, the researcher therefore is interested in studying the formation of differential equations. To predict the number of unemployed by classifying graduates who are primary education graduated and lower, junior high school graduated, senior high school graduated, vocational certificate graduated, high vocational certificate graduated and higher education

graduated in the creation of differential equations to predict the number of unemployed will determine the trend equation that is suitable for the number of unemployed by the level of education achieved and then apply the trend equation to create the differential equation model In the construction of the differential equation model, this is a forecast of future unemployment trends for information on various agencies, including education, government, private sector, public sector and related sectors.

2. Materials and Experiment

This research is conducted to create a differential equation model to predict the number of unemployed. By using statistical achievement program the data used in the study were obtained from the website, social database and quality of life system, the office of the Economic Development Board and National society is a time series of unemployed people that are aged 15 years and over (thousands), classified by graduated level achieved from the year 2001 to year 2017, data 16 valve, the researcher has divided the data into 2 sets, which is set 1 is the data from 2001 to year 2016, 15 values. [2] For creating differential equations by using the statistical achievement program create a scatter diagram to study the movement of time series is a preliminary consideration of what time series has changed. What time-series components are there (trends, seasonal, cyclical or unusual events) based on the graph of time series versus time for the proper selection of statistical methods for further data analysis [3] calculates the trend equation that fits the time series

of the number of unemployed. Classified by graduated level achievement and then apply the trend equation to create the differential equation model checking the relationship of the value of the equation model and the true value to calculate the correlation coefficient (R), coefficient of determination (R^2), coefficient of determination (R^2 - Adjusted), standard error estimation of regression equation (Standard error of the estimate) and check the suitability of the differential equation model with real values by the regression analysis. Set 2 is the year 2013 to year 2017, 5 values for precision checking used by considering the mean absolute percentage error (MAPE) and the square root of the root mean squared error (RMSE). Both values must be low. Therefore, being classified as a model that is suitable for the time series [4].

Show as follows $MAPE = \frac{100}{n_2} \sum_{t=1}^{n_2} \left| \frac{e_t}{Y_t} \right|$ and $RMSE = \sqrt{\frac{1}{n_2} \sum_{t=1}^{n_2} e_t^2}$

When $e_t = Y_t - \hat{Y}_t$

Y_t means the actual value in time period t,

$\hat{Y}_t$ means the forecast values for time period t.

t represents the time period, which has a value from 1 to n_2, where n_2 represents the amount of data in the time series, set 2 [5].

The researcher determined the differential equation model for forecasting the number of unemployed in Thailand by qualifying as follows.

To $\hat{Y}_1(t)$ Instead of the differential equation model for forecasting number of unemployed

who have completed primary and lower education at the time t determined by

$$\hat{Y}_1(t) = \frac{dEs(t)}{dt} + Es(t)$$

To $\hat{Y}_2(t)$ Instead of the differential equation model for forecasting number of unemployed who have completed Junior high school at the time t determined by

$$\hat{Y}_2(t) = \frac{dJh(t)}{dt} + Jh(t)$$

To $\hat{Y}_3(t)$ Instead of the differential equation model for forecasting the number of unemployed who have completed senior high school at the time t determined by

$$\hat{Y}_3(t) = \frac{dHs(t)}{dt} + Hs(t)$$

To $\hat{Y}_4(t)$ Instead of the differential equation model for forecasting the number of unemployed who have completed vocational certificate at the time t determined by

$$\hat{Y}_4(t) = \frac{dVs(t)}{dt} + Vs(t)$$

To $\hat{Y}_5(t)$ Instead of the differential equation model for forecasting the number of unemployed who have completed high vocational certificate at the time t determined by

$$\hat{Y}_5(t) = \frac{dHv(t)}{dt} + Hv(t)$$

To $\hat{Y}_6(t)$ Instead of the differential equation model for forecasting the number of unemployed who have completed higher education at the time t determined by

$$\hat{Y}_6(t) = \frac{dHe(t)}{dt} + He(t)$$

When $Es(t), Jh(t), Hs(t), Vc(t), Hv(t)$ and $He(t)$ Is the trend equations of unemployed who have completed primary education and lower, Junior high school graduates, senior high school graduates, vocational certificate graduated, higher vocational certificate graduated and higher education graduated at the time t.

3. Results and Discussion

3.1 The results of the creation of differential equation models for forecasting number of unemployed classified by education.

3. 1. 1 Differential equation model for forecasting the number of unemployed who have completed primary education and lower.

Consider the scatter diagram of the number of unemployed. Graduated from primary education and lower than the year 2001 to year 2016, as shown in Figure 1.
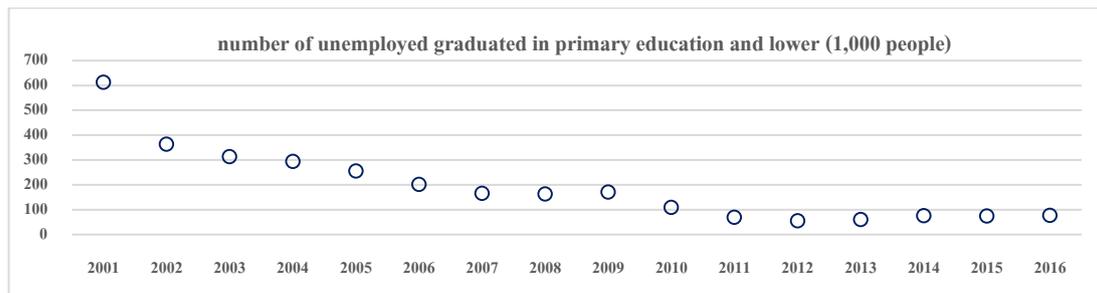

Figure 1 The scatter diagram for the number of unemployed graduated in primary education and lower.

Which creates a trend equation $Es(t)$ which is suitable for the number of unemployed who have completed primary and lower education can be used to create a differential equation model as follows

$$\hat{Y}_1(t) = \frac{dEs(t)}{dt} + Es(t)$$
$$= -0.173t^3 + 2.425t^2 - 11.593t + 98.335$$

When $Es(t) = -0.173t^3 + 2.943t^2 - 17.478t + 115.813$

at the time t

The graph shows the relationship $\hat{Y}_1(t)$ between the number of unemployed who have completed primary education and lower. As shown in Figure 2.
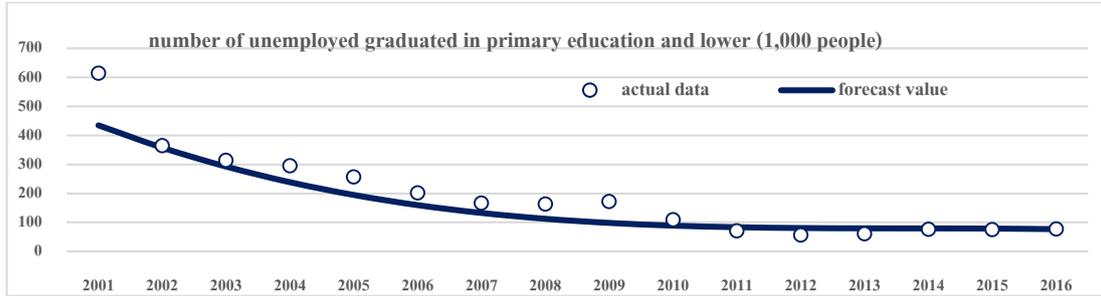
Figure 2 Graph of $\widehat{Y}_1(t)$ and number of unemployed who have completed primary education and lower.

Check the relationship between the values of $\widehat{Y}_1(t)$ and the number of unemployed who have completed primary education and lower by to calculation the R value, R^2 value R^2 - Adjusted, the standard error estimation of the regression equation by showing in the Model Summary as shown in Table 1.

Table 1 Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate
0.9955	0.9909	0.9888	11.7252

From Table 1, it is found that the value of R, R^2 and value R^2 - Adjusted values are approaching 1, indicating that the value $\widehat{Y}_1(t)$ and the number of unemployed who have completed primary education and lower have a positive correlation.

Check the suitability of the value of $\widehat{Y}_1(t)$ for use in forecasting the number of unemployed who have completed primary education and lower by to calculation Regression analysis which is shown in the form of the ANOVA as shown in Table 2.

Table 2 ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Regression	195397.4218	3	65132.4739	473.7609	0.0000
Residual	1787.2351	13	137.4796		
Total	197184.6569	16			

From Table 2, it is found $\widehat{Y}_1(t)$ that it is appropriate to predict the number of unemployed who have completed primary education and lower with statistical significance at .01 level (F = 473.7609).

Check the accuracy of the forecasting model. By applying forecast values $\widehat{Y}_1(t)$ to compare with the actual data of the number unemployed who have completed primary education and lower in Thailand in the years 2013 to year 2017, as shown in Table 3.

Table 3 Forecasting values $\widehat{Y}_1(t)$ and actual data of the number of unemployed who have completed primary education and lower in Thailand than in year 2013 to year 2017 (thousands of people), MAPE and RMSE.

duration	2013	2014	2015	2016	2017	MAPE	RMSE
actual data	61.47	76.65	75.52	77.64	93.4	12.23	12.58
$\widehat{Y}_1(t)$	79.73	79.44	78.82	76.85	72.48		

From Table 3, the mean absolute percentage error and the square root of the mean square error are acceptable low values. Shows that the forecast value $\widehat{Y}_1(t)$ is accurate in predict the number of unemployed who have completed primary education and lower in Thailand.

3.1.2 Differential equation model for forecasting number of unemployed who have completed junior high school.

Consider the scatter diagram of the number of unemployed who have completed junior high school than the year 2001 to year 2016, as shown in Figure 3.
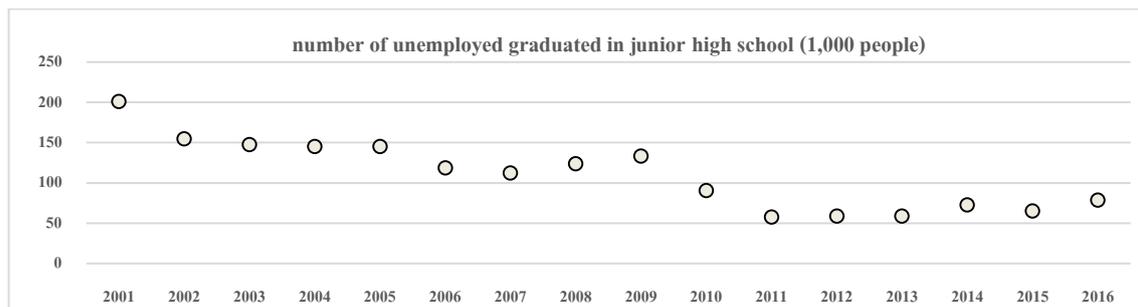

Figure 3 The scatter diagram for the number of unemployed graduated in junior high school.

Which creates the trend equation $Jh(t)$ which is suitable for the number of unemployed who have completed junior high school can be used to create a differential equation model as follows.

$$\widehat{Y}_2(t) = \frac{dJh(t)}{dt} + Jh(t)$$
$$= 0.063t^3 + 0.750t^2 - 8.874t + 85.717$$

When $Jh(t) = 0.063t^3 + 0.561t^2 - 9.995t + 95.712$

at the time t

The graph shows the relationship $\widehat{Y}_2(t)$ between the numbers of unemployed who have completed junior high school. As shown in Figure 4.
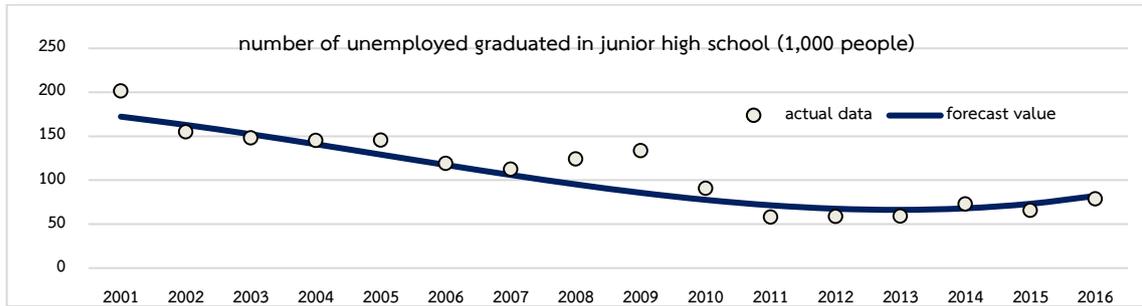

Figure 4 Graph of $\widehat{Y}_2\ t$ and number of unemployed who have completed junior high school

Check the relationship between the values of $\widehat{Y}_2(t)$ and the number of unemployed who have completed junior high school by to calculation R value, R^2 value, R^2 - Adjusted value, standard error estimation of regression equation by showing in the Model Summary table as shown in Table 4

Table 4 Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate
0.9302	0.8652	0.8342	14.5288

From Table 4, it is found that the value of R, R^2 and R^2 - Adjusted values are approaching 1, indicating that the value $\widehat{Y}_2(t)$ and the number of unemployed who have completed junior high school have a positive correlation.

Check the suitability of the value $\widehat{Y}_2(t)$ for use in forecasting the number of unemployed who have completed junior high school by to calculation Regression analysis which is shown in the form of the ANOVA as shown in Table 5.

Table 5 ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Regression	17619.9030	3	5873.3010	27.8240	0.0000
Residual	2744.1020	13	211.0850		
Total	20364.0050	16			

From Table 5, it is found that $\hat{Y}_2(t)$ that it is appropriate to predict the number of unemployed who have completed junior high school with statistical significance at .01 level (F = 27.8240).

Check the accuracy of the forecasting model. By applying forecast values $\hat{Y}_2(t)$ compared with the actual data of the number of unemployed who have completed junior high school in Thailand in the years 2013 to year 2017, as shown in Table 6.

Table 6 Forecast value $\hat{Y}_2(t)$ and actual data of the number of unemployed who have completed junior high school in Thailand than in year 2013 to year 2017 (thousands of people), MAPE and RMSE.

duration	2013	2014	2015	2016	2017	MAPE	RMSE
actual data	59.02	72.93	65.50	78.71	87.9	8.65	6.31
$\hat{Y}_2\ t$	66.28	68.02	73.16	82.08	95.16		

From Table 6, the average absolute error percentage and the square root of the mean square error are acceptable low values. Shows that the forecast value $\hat{Y}_2(t)$ is accurate in predicting the number of unemployed who have completed junior high school in Thailand.

3.1.3 Differential equation model for forecasting number of unemployed who have completed senior high school.

Consider the scatter diagram of the number of unemployed who have completed senior high school than the year 2001 to year 2016, as shown in Figure 5.
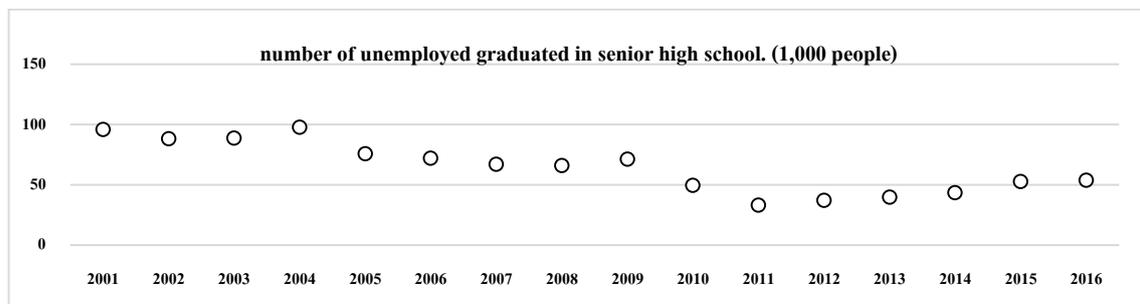

Figure 5 The scatter diagram for the number of unemployed graduated in senior high school.

Which creates a trend equation $Hs(t)$ which is suitable for the number of unemployed who have completed senior high school can be used to create a differential equation model as follows:

$$\widehat{Y}_3(t) = \frac{dHs(t)}{dt} + Hs(t)$$
$$= 0.077t^3 + 0.610t^2 - 5.729t + 49.191$$

When $Hs(t) = 0.077t^3 + 0.378t^2 - 6.484t + 55.675$

at the time t

The graph shows the relationship $\widehat{Y}_3(t)$ between the numbers of unemployed who have completed senior high school. As shown in Figure 6.
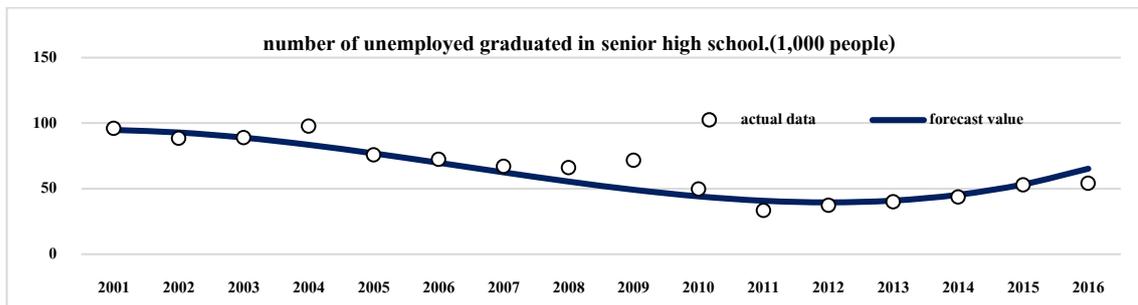

number of unemployed graduated in senior high school.(1,000 people)

Figure 6 Graph of $\widehat{Y}_3(t)$ and number of unemployed who have completed senior high school.

Check the relationship between the values of $\widehat{Y}_3(t)$ and the number of unemployed who have completed senior high school by to calculation the R value, R^2 value R^2 - Adjusted, the standard error estimation value of the regression equation by showing in the Model Summary table as shown in Table 7.

Table 7 Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate
0.9003	0.8106	0.7669	9.4420

From Table 7, it is found that the value of R, R^2 and R^2 - Adjusted values are approaching 1, indicating that the value $\widehat{Y}_3(t)$ of the number of unemployed who have completed senior high school have a positive correlation.

Check the suitability of the value $\widehat{Y}_3(t)$ for use in forecasting the number of unemployed who have completed senior high school by to calculation Regression analysis which is shown in the form of the ANOVA as shown in Table 8.

Table 8 ANOVA

	Sum of Squares	**df**	**Mean Square**	**F**	**Sig.**
Regression	4960.0650	3	1653.3550	18.5460	0.0000
Residual	1158.9580	13	89.1510		
Total	6119.0230	16			

From Table 8, it is found $\widehat{Y}_3(t)$ that it is appropriate to predict the number of unemployed who have completed senior high school with statistical significance at the level of .01 (F = 18.5460).

Check the accuracy of the forecasting model. By applying forecast values $\widehat{Y}_3(t)$ compare with the actual data of the number unemployed who have completed senior high school in Thailand in the year 2013 to year 2017, as shown in Table 9.

Table 9 Forecast value $\widehat{Y}_3(t)$ and actual data of the number of unemployed who have completed senior high school in Thailand than in year 2013 to year 2017 (thousands of people), MAPE and RMSE

duration	2013	2014	2015	2016	2017	MAPE	RMSE
actual data	39.86	43.55	52.93	54.01	66.03	10.39	8.64
$\widehat{Y}_3(t)$	40.93	45.37	53.31	65.24	81.60		

From table 9, the average absolute error percentage and the square root of the mean square error are acceptable low values. Shows that the forecast value $\widehat{Y}_3(t)$ is accurate in predicting the number of unemployed who have completed senior high school in Thailand.

3.1.4 Differential equation model for forecasting number of unemployed who have completed vocational certificate.

Consider the scatter diagram of the number of unemployed who have completed vocational certificate than the year 2001 to year 2016, as shown in Figure 7.
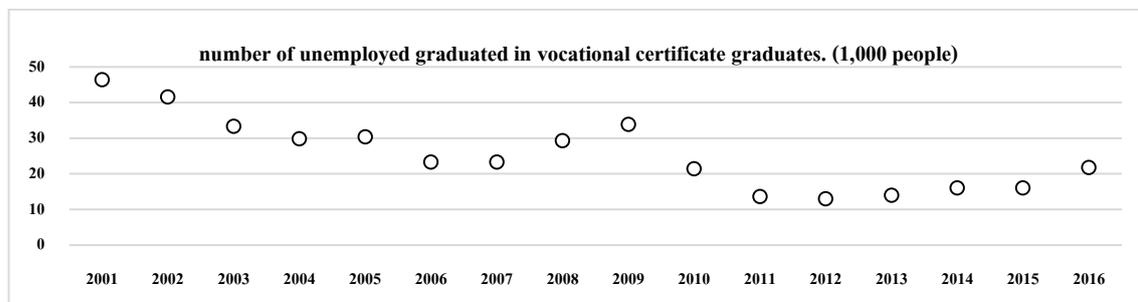

Figure 7 The scatter diagram for the number of unemployed graduated in vocational certificate graduates.

Which creates trend equations $Vc(t)$ which is suitable for the number of unemployed who have completed vocational certificate can be used to create a differential equation model as follows

$$\hat{Y}_4(t) = \frac{dVc(t)}{dt} + Vc(t)$$
$$= 0.013t^3 + 0.238t^2 - 1.598t + 18.844$$

When $Vc(t) = 0.013t^3 + 0.199t^2 - 1.996t + 20.840$

at the time t

The graph shows the relationship $\hat{Y}_4 \ t$ between the numbers of unemployed who have completed vocational certificate. As shown in Figure 8.

Figure 8 Graph $\hat{Y}_4(t)$ and number of unemployed who have completed vocational certificate.

Check the relationship between the values of $\hat{Y}_4(t)$ and the number of unemployed who have completed vocational certificate by to calculation the R value, R^2 value, R^2 - Adjusted value, the standard error estimation of regression equation by showing in the Model Summary table as shown in Table 10.

Table 10 Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate
0.8629	0.7446	0.6857	4.2227

From Table 10, it is found that the value of R, R^2 and R^2 - Adjusted values are approaching 1, indicating that the value $\hat{Y}_4(t)$ of the number of unemployed who have completed vocational certificate have a positive correlation.

Check the suitability of the value $\hat{Y}_4(t)$ for use in forecasting the number of unemployed who have completed vocational certificate level by to calculation Regression analysis which is shown in the form of the ANOVA as shown Table 11.

Table 11 ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Regression	675.9110	3	225.3037	12.6353	0.0004
Residual	231.8069	13	17.8313		
Total	907.7179	16			

From Table 11, it is found $\widehat{Y}_4(t)$ that it is appropriate to predict the number of unemployed who have completed vocational certificate with statistical significance at the level of .01 (F = 12.6353).

Check the accuracy of the forecasting model. By applying forecast values $\widehat{Y}_4(t)$ compared with the actual data of the number of unemployed who have completed vocational certificate in Thailand in the year 2013 to year 2017, as shown in Table 12.

Table 12 Forecast value $\hat{Y}_4$ t and actual data of the number of unemployed who have completed vocational certificate in Thailand then in year 2013 to year 2017 (thousands of people), MAPE and RMSE.

duration	2013	2014	2015	2016	2017	MAPE	RMSE
actual data	14.10	16.10	16.10	21.90	27.2	14.80	2.75
$\widehat{Y}_4(t)$	17.07	18.39	20.57	23.69	27.82		

From Table 12, the average absolute error percentage and the square root of the mean square error are acceptable low values. Shows that the forecast value $\widehat{Y}_4(t)$ is accurate in predicting the number of unemployed who have completed vocational certificate in Thailand.

3. 1. 5 Differential equation model for forecasting number of unemployed who have completed high vocational certificate.

Considering the scatter diagram of the number of unemployed who have completed high vocational certificate than the year 2001 to year 2016, as shown in Figure 9.
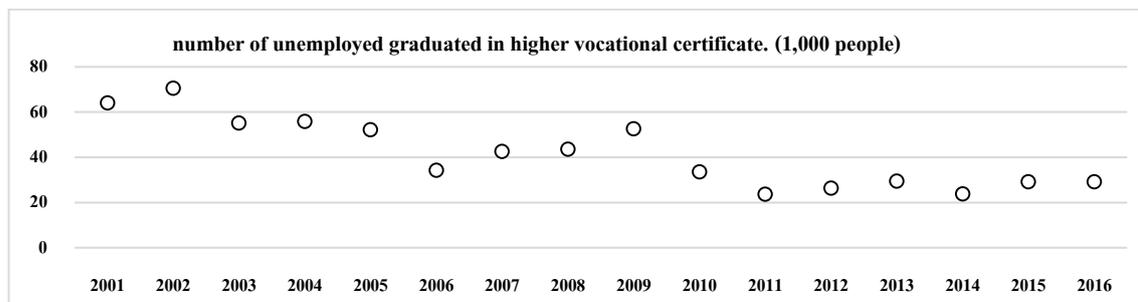

Figure 9 The scatter diagram for the number of unemployed graduated in higher vocational certificate.

Which creates trend equations $Hv(t)$ which is suitable for the number of unemployed who have completed high vocational certificate can be used to create a differential equation model as follows.

$$\widehat{Y}_5(t) = \frac{dHv(t)}{dt} + Hv(t)$$
$$= 0.03t^3 + 0.352t^2 - 3.029t + 32.082$$

When $Hv(t) = 0.03t^3 + 0.262t^2 - 3.552t + 35.634$

at the time t

The graph shows the relationship $\widehat{Y}_5(t)$ between the numbers of unemployed who have completed high vocational certificate. As shown in Figure 11.
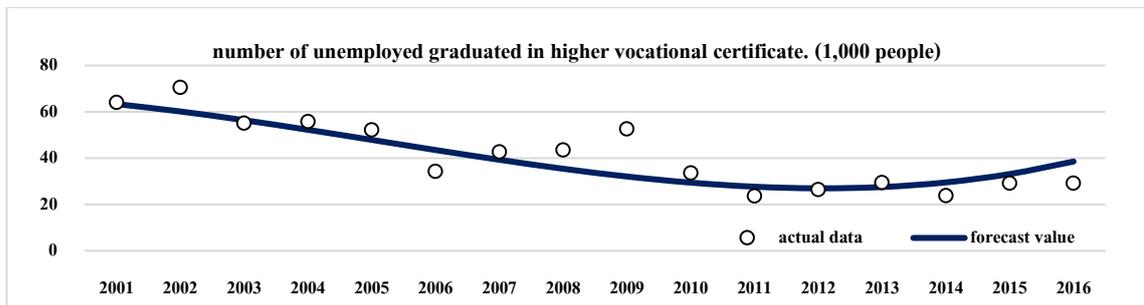

Figure 11 Graph of $\widehat{Y}_5(t)$ and number of unemployed who have completed higher vocational certificate.

Check the relationship between the values of $\widehat{Y}_5(t)$ and the number of unemployed who have completed high vocational certificate by to calculation the R value, R^2 value, R^2-Adjusted value, the standard error estimation of regression equation by showing in the Model Summary table as shown in Table 13.

Table 13 Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate
0.8691	0.7554	0.6990	6.5868

From Table 13, it is found that the value of R value, R^2 and R^2 - Adjusted values are approaching 1, indicating that the value $\widehat{Y}_5(t)$ of the number of unemployed who have completed high vocational certificate have a positive correlation.

Check the suitability of the value $\widehat{Y}_5(t)$ for use in forecasting the number of unemployed who have completed high vocational certificate by to calculation Regression analysis which is shown in the form of the ANOVA as shown Table 14.

Table 14 ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Regression	1741.9557	3	580.6519	13.3833	0.0003
Residual	564.0203	13	43.3862		
Total	2305.9760	16			

From Table 14, it is found $\hat{Y}_5(t)$ that it is appropriate to predict the number of unemployed who have completed high vocational certificate with statistical significance at the level of .01 level (F = 13.3833).

Check the accuracy of the forecasting model. By applying forecast values $\hat{Y}_5(t)$ compared with the actual data of the number of unemployed who have completed high vocational certificate in Thailand in the year 2013 to year 2017, as shown in Table 15.

Table 15 Forecast value $\hat{Y}_5$ t and actual data of the number of unemployed who have completed high vocational certificate in Thailand then in year 2013 to year 2017 (thousands of people), MAPE and RMSE.

duration	2013	2014	2015	2016	2017	MAPE	RMSE
actual data	29.56	23.83	29.28	29.22	45.33	15.45	5.27
$\hat{Y}_5(t)$	27.55	29.54	33.14	38.54	45.92		

From Table 15, the average absolute error percentage and the square root of the mean square error are acceptable low values. Shows that the forecast value $\hat{Y}_5(t)$ is accurate in predicting the number of unemployed who have completed high vocational certificate in Thailand.

3.1.6 Differential equation model for forecasting number of unemployed who have completed higher education.

Consider the scatter diagram of the number of unemployed who have completed higher education than the year 2001 to year 2016, as shown in Figure 12.
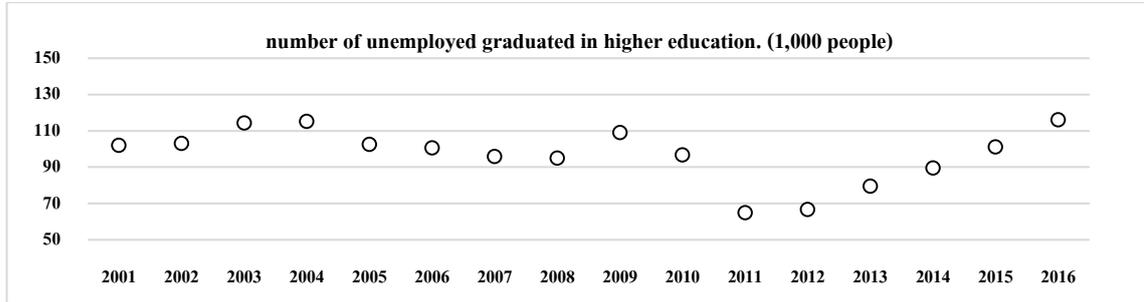
Figure 12 The scatter diagram for the number of unemployed graduated in higher education.

Which creates trend equations $He(t)$ which is suitable for the number of unemployed who have completed higher education can be used to create a differential equation model as follows.

$$\hat{Y}_6(t) = \frac{dHe(t)}{dt} + He(t)$$
$$= 0.119t^3 + 0.791t^2 - 4.567t + 83.141$$

When $He(t) = 0.119t^3 + 0.435t^2 - 5.437t + 88.579$

At the time t.

The graph shows the relationship $\hat{Y}_6(t)$ between the numbers of unemployed who have completed higher education. As shown in Figure 13.
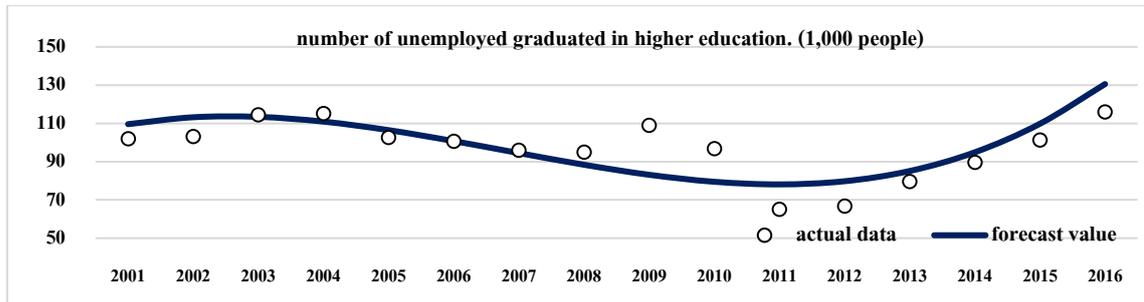

Figure 13 Graph of $\hat{Y}_6(t)$ and number of unemployed who have completed higher education.

Check the relationship between the values of $\hat{Y}_6(t)$ and the number of unemployed who have completed higher education by to calculation the R value, R^2, R^2- Adjusted value and the standard error estimation of the regression equation by showing in the Model Summary table as shown in Table 16.

Table 16 Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate
0.8797	0.7739	0.7416	10.5732

From Table 16, it is found that the value of R value, R^2 and R^2 - Adjusted values are approaching 1, indicating that the value $\widehat{Y}_6(t)$ of the number of unemployed who have completed higher education have a positive correlation.

Check the suitability of the value $\widehat{Y}_6(t)$ for use in forecasting the number of unemployed who have completed higher education by to calculation Regression analysis which is shown in the form of the ANOVA as shown Table 17.

Table 17 ANOVA

	Sum of Squares	**df**	**Mean Square**	**F**	**Sig.**
Regression	5356.1666	2	2678.0833	23.9559	0.0000
Residual	1565.0896	14	111.7921		
Total	6921.2562	16			

From Table 17, it is found $\widehat{Y}_6(t)$ that it is appropriate to predict the number of unemployed who have completed higher education with statistical significance at the level of .01 (F = 23.9559).

Check the accuracy of the forecasting model. By applying forecast values $\widehat{Y}_6(t)$ compare with the actual data of the number unemployed who have completed higher education in Thailand in year 2013 to year 2017, as shown in Table 18.

Table 18 Forecast value $\widehat{Y}_6(t)$ and actual data of the number of unemployed who have completed higher education in Thailand then in year 2013 to year 2017 (thousands of people), MAPE and RMSE.

duration	**2556**	**2557**	**2558**	**2559**	**2560**	**MAPE**	**RMSE**
actual data	79.53	89.63	101.21	116.04	130.84	10.91	14.66
$\widehat{Y}_6(t)$	85.11	94.89	109.81	130.57	157.89		

From Table 18, the average absolute error percentage and the square root of the mean square error are acceptable low values. Shows that the forecast value $\widehat{Y}_6(t)$ is accurate in predicting the number of unemployed who have completed higher education in Thailand.

3.2 Predict the number of unemployed in Thailand

From the table to check the accuracy of the forecasting model $\widehat{Y}_1(t), \widehat{Y}_2(t), \widehat{Y}_3(t), \widehat{Y}_4(t), \widehat{Y}_5(t)$ and $\widehat{Y}_6(t)$ find that it can accurately predict the number of unemployed classified by education

is primary education and lower, junior high school , senior high school, vocational certificate, high

vocational certificate and higher education respectively as shown in Table 19.

Table 19 Forecasting the number of unemployed classified by education in Thailand (thousand people) the year 2018 to year 2022

duration	number of unemployed classified by education in Thailand (thousand people)					
	$\hat{Y}_1(t)$	$\hat{Y}_2(t)$	$\hat{Y}_3(t)$	$\hat{Y}_4(t)$	$\hat{Y}_5(t)$	$\hat{Y}_6(t)$
2018	64.68	112.78	102.86	33.03	55.46	192.48
2019	52.42	135.32	129.48	39.42	67.34	235.05
2020	34.65	163.15	161.91	47.04	81.77	286.32
2021	10.36	196.67	200.61	55.99	98.84	346.98
2022	-21.51	236.24	246.05	66.33	118.83	417.76

From Table 19 found that the number of unemployed who have completed primary education and lower have a tendency to decrease but the unemployed who have completed junior high school, senior high school, vocational certificate, high vocational certificate and higher education upward trend.

4. Conclusions

This research presents the creation of differential equations that are suitable for time series, number of unemployed classified by education: primary education and lower, junior high school, senior high school, vocational certificate, high vocational certificate and higher education by using data from the website of the National Statistical Office from year 2001 to year 2017, 17 values, the researcher has divided the data into 2 sets, set 1 is the data from the year 2001 to year 2016, 16 values for creating differential equations to predict the

number of unemployed in Thailand check the relationship between the differential equation model and the real value and the suitability of the forecasting model With the correlation coefficient (R), coefficient of determination (R^2), coefficient of improvement decision $(R^2$ - Adjusted$)$, estimation of standard error of regression equation and analysis of the recession, respectively. Set 2 is the year 2013 to year 2017, 5 values for precision checking. By considering the MAPE and RMSE. Both values must be low, found that the differential equation model $\hat{Y}_1(t), \hat{Y}_2(t), \hat{Y}_3(t), \hat{Y}_4(t), \hat{Y}_5(t)$ and $\hat{Y}_6(t)$ the relationship the same high level is appropriate. and accurate in forecasting $\hat{Y}_1(t), \hat{Y}_2(t),$ $\hat{Y}_3(t), \hat{Y}_4(t), \hat{Y}_5(t)$ and $\hat{Y}_6(t)$ the number of unemployed classified by the education that graduated: primary education and lower, junior high school, senior high school, vocational certificate, high vocational certificate and higher education, respectively, as shown in Table 1 to Table 18 when

using forecast values and used to predict the trend of the number of unemployed classified by educational in Thailand. Found that the number of unemployed who have completed primary education and lower have a tendency to decrease but the unemployed who have graduated from junior high school, senior high school, vocational certificate, high vocational certificate and higher education upward trend which is consistent with the summary for the working population management in April 2017 that says the number of unemployed at the senior high school increased by 2.8 ten thousand people, higher education increased by 2.6 thousand people. Primary education and lower increased by 1.9 ten thousand people and junior high school increased by 8.0 thousand. For those without education and lower than primary education the number of unemployed decreased by 4.0 thousand, however, the number of unemployed has always changed. Therefore, when there is current information, the researcher should apply to improve the differential equation model. In order to obtain a model of differential equations that are suitable for forecasting and add more precision to be used to predict the number of future unemployed [1].

5. References

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