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Estimation Parameters of Unemployment (Case Study in East Java Province)

Melki Imamastri Puling Tang, Erna Apriliani and Endah Rokhmati

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ESTIMATION PARAMETERS OF UNEMPLOYMENT

(Case Study in East Java Province)

Puling Tang[1] and Apriliani, Rokhmati [2, 3]

[1] melkipulingtang@gmail.com
[2] aprilmath12@gmail.com
[3]endahrmp@gmail.com

Abstract

Unemployment in an area becomes more serious if there is relatively slow employment growth and a rapid increase in the growth rate of the workforce Unemployment is a very complex problem because it affects and is influenced by many interacting factors, following a pattern that is not always easy to understood. The magnitude of the unemployment rate can be said to be very important in measuring the success of economic development in a region. This research leads to parameter estimation of the unemployment model.Estimated parameters include the rate of unemployment increase,the rate of change in the number of unemployed employed, the rate of people hired resigning or being laid off from their jobs, unemployment mortality rate, labor migration rate, the rate of reduction in job vacancies available due to lack of government funding, the level of infrastructure,and small and medium enterprises.These parameters can affect the unemployment rate , the employment rate , and job vacancies . To overcome the unemployment rate for employment (job vacancies), one of the efforts made by the government is to increase investment, especially in the infrastructure sector, revitalizing supporting facilities for the agricultural sector, and clearing new land and small and medium enterprises. Keywords: Estimation parameters of unemployment.

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1 Introduction

The phenomenon of unemployment only occurs when the number of labor force in a country is much larger than the number of job opportunities or job vacancies in that country. As a result, part of the workforce becomes unable to work and is forced to be temporarily unemployed until new additional job vacancies are available according to their skill qualifications. The population that is included in the labor force is the population of working age (15 years to 64 years) who is employed, or has a job but temporarily does not work and is unemployed. The Open Unemployment Rate is the percentage of the total unemployed against the total labor force. Based on data from BPS East Java, 2018 states that the total workforce in August 2018 was 21.30 million people, an increase of 0.36 million people compared to August 2017. Meanwhile, the Labor Force Participation Rate also increased by 0.59 points. In the past year, unemployment increased by 11.98 thousand people, while The Open Unemployment Rate fell to 3.99 percent in August 2018. Judging from the level of education, TPT for Vocational High Schools still dominates among other education levels, namely 8.83 percent [1]. To overcome the number of unemployed to employment (job vacancies), one of the efforts made by the government in this case is to increase investment (I), especially in the infrastructure sector, revitalizing supporting facilities for the agricultural sector, and clearing new land (I_1) and small and medium enterprises (I_2), both of which are assumed to be positive parameters. Both parameters are assumed to be time dependent functions. Researchers assume that when E (t) ≤V (t) <W (t), the number of unemployed will decrease. In this case, maximizing job vacancies and minimizing the unemployment rate. Parameter estimation (parameter estimation) is used as an estimation of parameter characteristics, because its nature is an estimate or an estimate, the value of the estimator will of course not exactly match the parameter value of the actual data, it is expected that the estimator value will approach the actual parameter value. Based on the above background, researchers are interested in conducting research: "Estimation of Parameters of the Unemployment Model.

2 Teoritical Review

2.1 Dynamic System Model

Dynamic system is a condition which is influenced by time (t). If is continuous, the dynamic system form is expressed as a system of differential equations. A system of first-order differential equations:

Ranea and Sarah [2] state that the unemployment model is closely related to:

- All entrants in the unemployment category are fully eligible and competent for employment.
- Some unemployed people can be employed.
- The transition rate from unemployed to employed persons is proportional to the number of unemployed persons and the number of vacancies available is denoted by W (t) and V (t), respectively.
- The number of people employed denoted by E (t) can be affected, in which case some employers may return or lay off employees or vice versa, some workers may resign. They will, however, join the unemployed population.
- Vacancies are only created due to retirement, death or migration of employed persons.
- The unemployment rate of migration and mortality is assumed to be proportional to the number of unemployed.

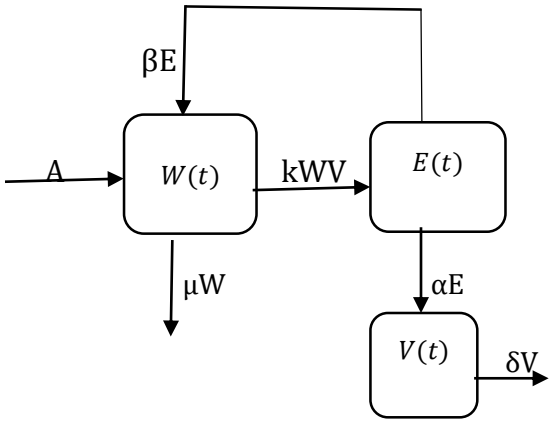

Figure 2.1: Flow chart of the unemployment model (Ranea and Sarah, 2018) [2]

Thus, the dynamics of the nonlinear model is regulated by the following system of ordinary differential equations: [2]

$$\begin{cases} \frac{dW(t)}{dt} = A - kW(t)V(t) + \beta E(t) - \mu W(t) \\ \frac{dE(t)}{dt} = kW(t)V(t) - \beta E(t) - \alpha E(t) \\ \frac{dV(t)}{dt} = \alpha E(t) - \delta V(t) \end{cases} \quad (2.1)$$

2.2 Point Equalibrium

Suppose a system of differential equations is stated as follows.

$$\dot{x} = f(x), \quad x \in \mathbb{R}^n \quad (2.2)$$

Definition 2.1[3]
The point $\bar{x} \in \mathbb{R}^n$is called the point of equilibrium (equilibrium point) of the system (2.2) if $f(\bar{x}) = 0$

Definition 2.2 [3]
The point of equilibrium $\bar{x} \in \mathbb{R}^n$of the system (2.2) is said to be

- Locally stable if for every $\varepsilon > 0$ there is $\delta > 0$ such that for every solution $x(t)$ that satisfies $\|x(t_0) - \bar{x}\| < \delta$ applies $\|x(t_0) - \bar{x}\| < \varepsilon$ for every $t \geq t_0$
- Locally asymptotically stable if the equilibrium point $\bar{x} \in \mathbb{R}^n$is stable and there is $\delta_0 > 0$ such that for any solution $x(t)$ that satisfies $\|x(t_0) - \bar{x}\| < \delta$ applies $\lim_{t\to\infty} x(t) = \bar{x}$
- Unstable if the equilibrium point $\bar{x} \in \mathbb{R}^n$does not satisfy (1).

2.3 Linearation

Analysis of the stability of the system of nonlinear differential equations is carried out by means of linearity. To find the linearity result of a system of nonlinear differential equations, the Jacobian matrix is used.

Definition 2.3 [4]
Given function $f = f_1, \dots, f_n$ on the system $\dot{x} = f(x)$ with $f_i \in C(E), i = 1,2, \dots, n$. Matrix

$$Jf(\bar{x}) = \begin{bmatrix} \frac{\partial f_1}{\partial x_1}(\bar{x}) & \frac{\partial f_1}{\partial x_2}(\bar{x}) & \dots & \frac{\partial f_1}{\partial x_n}(\bar{x}) \\ \frac{\partial f_2}{\partial x_1}(\bar{x}) & \frac{\partial f_2}{\partial x_2}(\bar{x}) & \dots & \frac{\partial f_2}{\partial x_n}(\bar{x}) \\ \vdots & \vdots & \vdots & \vdots \\ \frac{\partial f_n}{\partial x_1}(\bar{x}) & \frac{\partial f_n}{\partial x_2}(\bar{x}) & \dots & \frac{\partial f_n}{\partial x_n}(\bar{x}) \end{bmatrix} \quad (2.3)$$

Named the Jacobian matrix of f at point x.

2.4 Eigen Values

Definition 2.5 [5]
If A is an n x n matrix, then a non-zero vector x on $\mathbb{R}^n$ is called the eigenvector of A if Ax is a scalar multiple of x, i.e.

$$Ax = \lambda x \quad (2.4)$$

2.5 Routh-Hurwitz Criteria

A system of characteristic equations in the form of a polynomial is given as follows:

$$f(s) = a_0 s^n + a_1 s^{(n-1)} + \cdots + a_{n-1} s + a_n \qquad (2.5a)$$

If equation (2.5a) has a negative real part then

$$\frac{a_1}{a_0} > 0, \frac{a_2}{a_1} > 0, \ldots, \frac{a_n}{a_{n-1}} > 0 \qquad (2.5b)$$

3 Other Result and Discussion

The Unemployment rate W(t) employment rate E(t), and employment rate V(t)

a. The increase in the unemployment rate W(t) is the result of the increase in parameters A and βE. The reduction in the unemployment rate W(t)occurs when the parameters for kWV and μW are reduced. When there is a level of investment $(I_1 + I_2)$, it will affect the reduction of the unemployment rate as much as the level of investment $(I_1 + I_2)$.

b. The increase in the level of workers E(t) is caused by the increase in the parameters kWV and $(I_1 + I_2)$. The reduction in the level of E(t) workers results from a decrease in βE and αE. workers E(t) will increase when there is an increase in the number of unemployed workers employed (k) and the investment level $(I_1 + I_2)$ Increases. Employee E (t) will decrease if there is a rate of employed people resigning, or being laid off from their job (βE) as well as the poverty rate and the rate of migration, retirement or worker mortality (αE).

c. The increase in the level of job vacancies V(t) is caused by the increase in the αE parameter. The job vacancy rate V(t) will increase if there is a migration, pension or death rate of workers (αE) and the job vacancy rate V (t) is caused by a decrease in the parameter of the rate of reduction in vacancies available due to lack of government funding (δV)

From a, b, and c above, the model compartment for unemployment is shown in Figure 3.**1** below

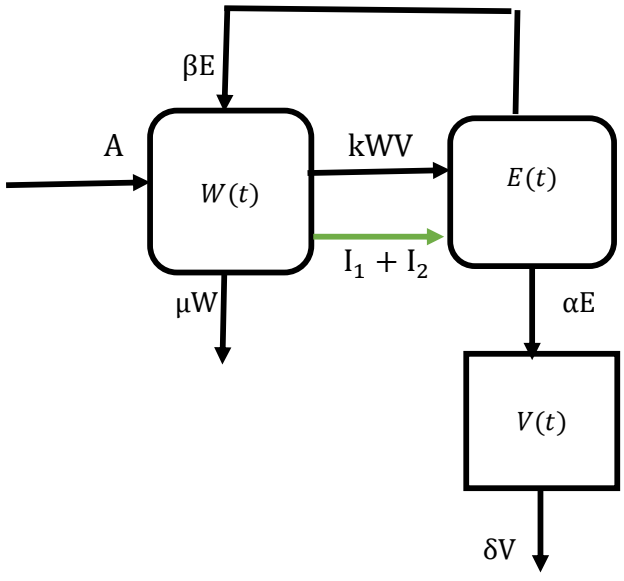

Figure 3.1. Flow chart of unemployment model when there is investment

Thus, the dynamics of the nonlinear model are governed by the following system of ordinary differential equations

$$\begin{cases} \frac{dW(t)}{dt} = A - kW(t)V(t) + \beta E(t) - \mu W(t) - (I_1 + I_2) \\ \frac{dE(t)}{dt} = kW(t)V(t) - \beta E(t) + (I_1 + I_2) - \alpha E(t) \\ \frac{dV(t)}{dt} = \alpha E(t) - \delta V(t) \end{cases} \quad (3.1)$$

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3.1 Determination of Equalibrium Points

In the equilibrium analysis, the unemployment model is in equation (3.1). When $\dot{W} = 0$, $\dot{E} = 0$ and $\dot{V} = 0$, the following system of equations is obtained:

$$\begin{aligned} &A - kWV + \beta E - \mu W - (I_1 + I_2) = 0 \\ &kWV - \beta E + (I_1 + I_2) - \alpha E = 0 \\ &\alpha E - \delta V = 0 \end{aligned} \quad (3.2)$$

$$Q^* = (W^*, E^*, V^*) = \left(\frac{\delta(\alpha+\beta-(I_1+I_2))}{\alpha k}, \frac{A}{\alpha} - \frac{\delta\mu(\alpha+\beta)+(I_1+I_2)}{\alpha^2 k}, \frac{\alpha E^*}{\delta}\right). \quad (3.3)$$

When $(E_0 = 0)$ and $V_0 = 0$, then the free work equilibrium is denoted by

$$Q_0 = (W_0, E_0, V_0) = \left(\frac{A}{\mu}, 0, 0\right) . \quad (3.4)$$

Equilibrium point $E_0 = 0$ indicates the work-free equilibrium where $W_0 = \frac{A}{\mu}$. dan $W^* = \frac{\delta((\alpha+\beta)-(I_1+I_2))}{\alpha k}$. As a result, the equilibrium point of the mathematical model has 2 equilibrium points, namely:

- Work-free equilibrium point

$$Q_0 = (W_0, E_0, V_0) = \left(\frac{A}{\mu}, 0, 0\right)$$

- The point of equilibrium is work

$$Q^* = (W^*, E^*, V^*) = \left(\frac{\delta(\alpha+\beta-(I_1+I_2))}{\alpha k}, \frac{A}{\alpha} - \frac{\delta\mu(\alpha+\beta)+(I_1+I_2)}{\alpha^2 k}, \frac{\alpha E^*}{\delta}\right)$$

3.2 Until Data Attathments

Tables

	Level							
Year	A	k	β	μ	α	δ	I_1	I_2
2000	0	0	-0.00287356	-0.08182	0.0534045	0.0625	-0.06977	0.000347
2001	0.036697	0	0.004322767	0.009901	-0.1013942	-1.94117647	0.175	-0.00035
2002	0.119469	0.248473	-0.00143472	-0.01961	0.0423131	-4.375	0.021277	0.000463
2003	-0.01186	0.177814	0.002873563	0.01	0.0690122	-1.11111111	-0.10417	-0.00046
2004	0.702	-0.18837	-0.00286533	0.019802	0.0126582	-59.5	-0.06977	0.000347
2005	-0.09283	-0.05973	0.004310345	0.009709	0.04625	-1.22507123	0.175	-0.0015
2006	-0.12047	0.30853	-0.00286123	-0.00962	0.0083632	0.17721519	-0.14894	0.004633
2007	-0.05449	-0.13731	-0.00143472	-0.02913	-0.0011848	-0.60215054	-4.395	-0.00346
2008	-0.20872	-0.05627	-0.00287356	0.3	-0.0510083	2.621621622	-0.00295	0.000347
2009	-0.163a39	0.65247	-0.00144092	6.615385	0.0125	-0.38059701	-0.00443	0.000578
2010	-0.19529	0.042268	0.004329004	-0.86465	0.008642	-2.30120482	-0.01484	-0.02404
2011	-0.23265	-0.42829	-0.08477011	6.313433	-0.0085679	-2.14814815	0.014307	0.024751
2012	0.051345	-0.31661	-0.07692308	-0.89796	-0.0123457	-1.16935484	-0.00074	0.000231
2013	-0.02558	0.017722	0.183673469	0.03	0.0125	-1.52380952	0.007429	-0.00139

2014	0.066826	-0.00995	-0.16522989	-0.02913	0.0123457	1.545454545	0.006637	-0.00093
2015	0	0.040201	0.206540448	3	0.0085366	0	-0.01538	0.002316
2016	-0.10515	-0.00966	-0.12410842	0.075	-0.0084643	0.678571429	-0.11458	0.017793
2017	-0.0025	0.04878	-0.05700326	-0.06977	0.004878	-0.9787234	-0.0084	0
2018	-0.01754	-0.1093	-0.09671848	-0.75	-0.0169903	6	-0.03136	0.005222
2019	-0.01754	0.002611	0.718929254	3		0	-0.03136	0.005222
2020	-0.01754	0	-1	0.75		-1	-0.03136	0.005222

3.3 Numerical Simulasi

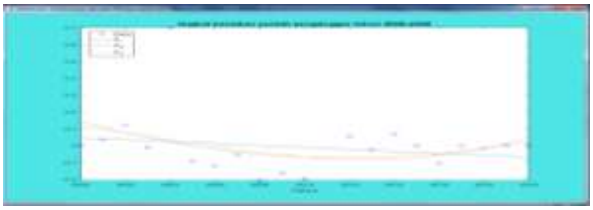

Figure 3.2 The rate of increase in unemployment(A)

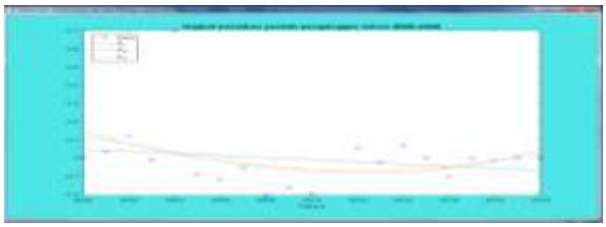

Figure 3.3 The level of unemployment employed (k)

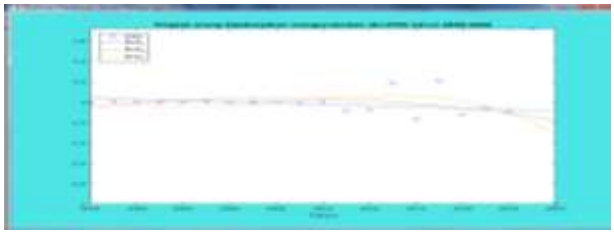

Figure 3.4 Rate of worker resigning, or being laid off (β)

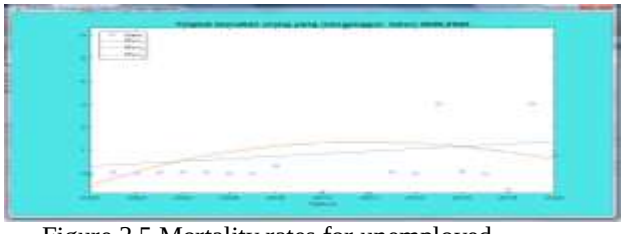

Figure 3.5 Mortality rates for unemployed

Figure 3.6 Labor migration rate (α)

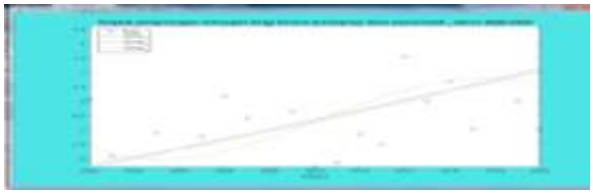

Figure 3.7 The parameter of the rate of reduction in job vacancies available due to lack of government funding (δ)

Figure 3.8 Estimated Parameters for the level of investment in infrastructure, revitalization of supporting facilities for the agricultural sector, and new land clearing(I_1)

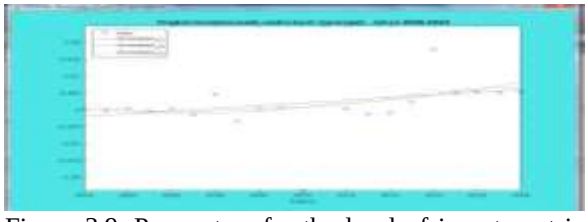

Figure 3.9. Parameters for the level of investment in small and medium enterprises (I_2)

4 Conclusion

- The dynamic system of the nonlinear ordinary differential equation model on unemployment ie

$$\begin{cases} \frac{dW(t)}{dt} = A - kW(t)V(t) + \beta E(t) - \mu W(t) - (I_1 + I_2) \\ \frac{dE(t)}{dt} = kW(t)V(t) - \beta E(t) + (I_1 + I_2) - \alpha E(t) \\ \frac{dV(t)}{dt} = \alpha E(t) - \delta V(t) \end{cases}$$

- Numerical simulation on parameter estimation using matlab states that the curve that approximates the rate of increase in the number of unemployed (A) is the parameter estimate curve A_1 (linear parameter estimate); The curve that approximates the data on the rate of change in the number of unemployed employed (k) is the result of the estimated value of the k_2 parameter (quadratic parameter estimate); The curve that approximates the data on the rate of people being employed resigning, or being laid off from their job / poverty rate (β)) is the estimate curve β_3(estimated cubic parameter); The curve approximating the parameter estimation data for the unemployment rate(μ) is μ_2 (quadratic estimation parameter); The curve that approximates the data parameter estimation of the rate of migration, retirement or worker mortality (α) is α_3 (cubic estimation parameter). The curve that approximates the parameter estimate of the rate of reduction in job vacancies available due to lack of government funding (δ) is δ_3 (estimated cubic parameter); The curve that approximates the parameter estimation data for the level of investment in infrastructure, revitalization of supporting facilities for the agricultural sector, and new land clearing (I_1)) is adalah $(I_1)_3$ (estimation parameter cubic); and the curve that approximates the parameter estimate data (I_2) is $(I_2)_3$ (cubic parameter estimate)

5 Sugestion

Researchers suggest that the government must provide and create more a lot of work (δ down) to deal with the problem unemployment problem (W^* reduced).

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