CHAPTER 4

Empirical Results

The initial objectives of this research are to identify the core model of this study and to forecast the Internet user numbers in Thailand for the next ten years. Therefore, this chapter is divided into two sections as follow

4.1 Parameter Estimation Using MCMC and Model Identification

By inference, the priors are as follow

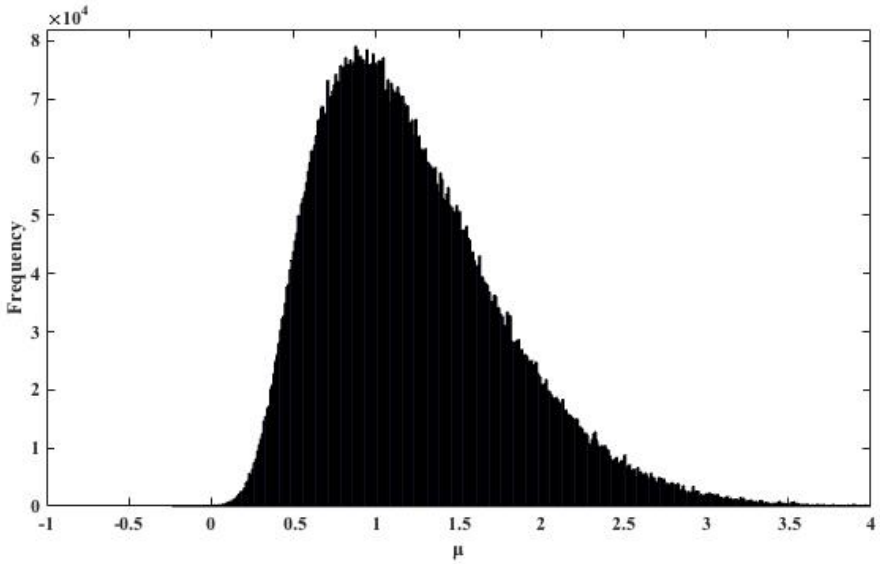
$$f(\mu,\sigma) = f(\mu)f(\sigma) \tag{4.1}$$

, where

$$f(\mu) \sim N(0.33,1) \tag{4.2}$$

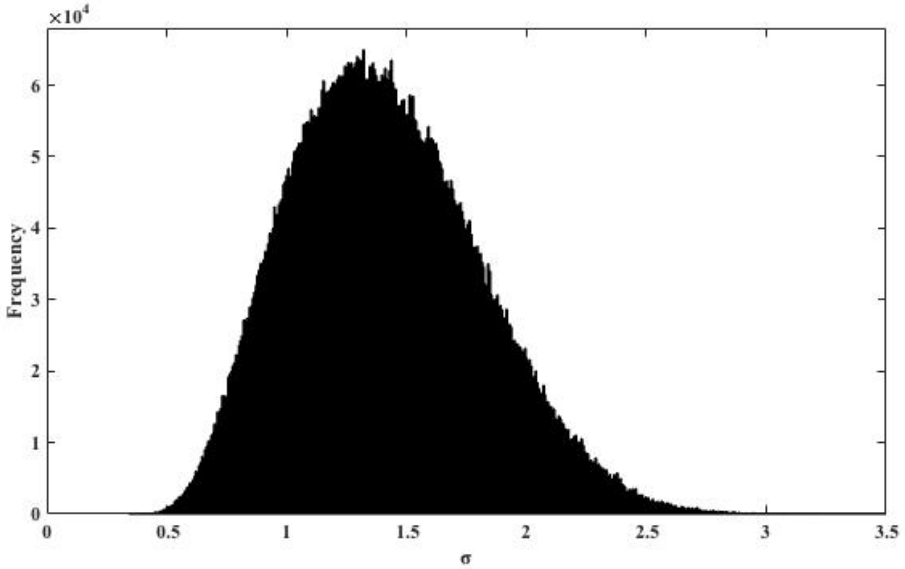
$$f(\sigma) \sim INVGAMMA(1,1) \tag{4.3}$$

The normal distribution was applied to the μ prior. In contrast, as σ cannot be negative, the inverse gamma distribution, which has non-negative property, was applied to the σ prior. Furthermore, the complete number of realisations was accounted for 1,000,000 with the 100,000-realisation burn-in. In addition, the histograms of the posterior distribution of parameters μ and σ was illustrated in Figure 4.1 and Figure 4.2 respectively.



Source: Own Illustration

Figure 4.1: Histogram of μ with 100,000-realisation burn-in



Source: Own Illustration

Figure 4.2: Histogram of σ with 100,000-realisation burn-in

The mean is applied to the estimate. Accordingly, the parameters $\hat{\mu}$ and $\hat{\sigma}$ are identified as follow

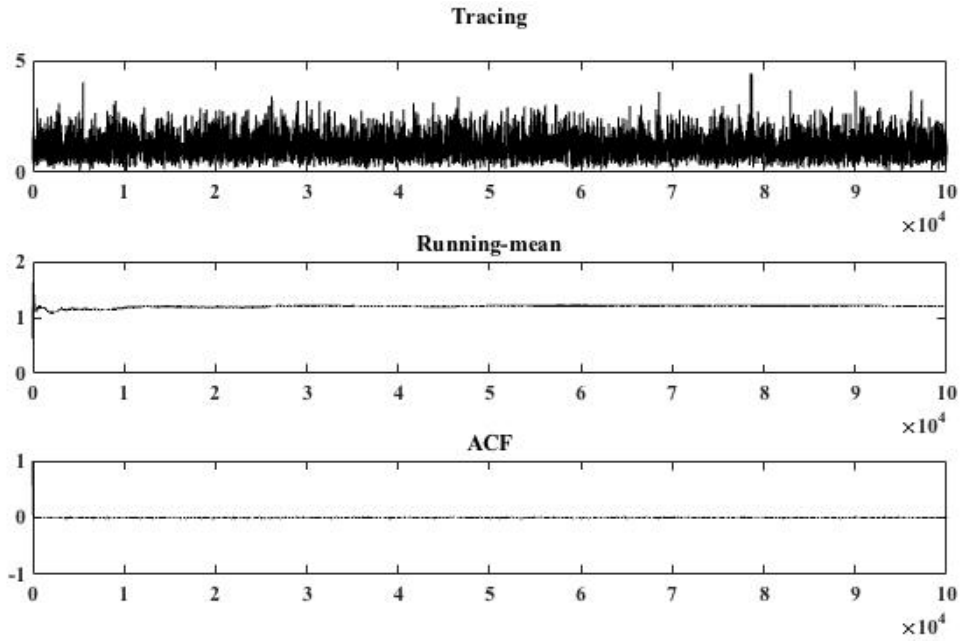
(4.4)

$$\hat{\mu} = 1.2147$$

(4.5)

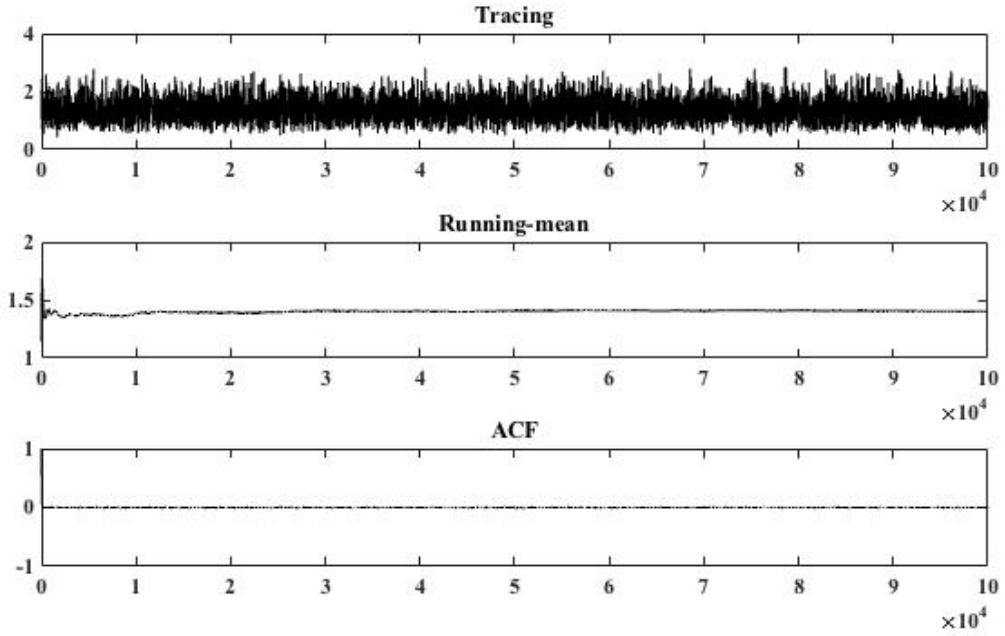
$$\hat{\sigma} = 1.4112$$

The convergence diagnostics of $\hat{\mu}$ and $\hat{\sigma}$ are certified through plotting the tracing, running-mean and autocorrelation function (ACF) in Figure 4.3 and Figure 4.4, respectively.



Source: Own Illustration

Figure 4.3: Convergence diagnostics of $\hat{\mu}$ via plotting the tracing, running-mean and autocorrelation function (ACF)



Source: Own Illustration

Figure 4.4: Convergence diagnostics of $\hat{\sigma}$ via plotting the tracing, running-mean and autocorrelation function (ACF)

After the substitution of the identified values, $\hat{\mu}$ and $\hat{\sigma}$, the complete core model of this study is as follow

$$U_t = U_0 \exp\left(1.2147t - \frac{(1.4112)^2}{2}t + 1.4112B_t\right) \tag{4.6}$$

To recall, $\hat{\mu}$ signifies the growth rate whereas $\hat{\sigma}$ implies the degree of fluctuation in the model. From the parameter estimation processes, the $\hat{\mu}$ and $\hat{\sigma}$ equals 1.2147 and 1.4112 respectively. The interpretation of the values is that the number of Internet user in Thailand has growth rate of 1.2147 with the fluctuation level of 1.4112.

4.2 Forecasting the Internet User Numbers

Based on the estimates of model parameters, Monte Carlo simulation is applied to generate the sample paths. Monte Carlo simulation takes the independent samples from the space with respect to the probability distribution and therefore, simulates the probability space.

Recall, one of the SBM properties,

(4.7)

$$dB_t = B_{t+dt} - B_t$$

then, dB_t is normal distribution which has mean zero and variance dt, $dB_t \sim N(0, dt)$. Therefore,

(4.8)

$$B_{t_{k+1}} - B_{t_k} = \sqrt{dt_k} Z_{t_k}$$

(4.9)

$$Z_{t_k} \sim N(0,1)$$

Using the Euler Scheme,

(4.10)

$$S_{t_{k+1}} = S_{t_k} + S_{t_k}[\mu(t_{k+1} - t_k) + \sigma(B_{k+1} - B_k)]$$

, where

$$k = 0, \ldots, n-1$$

As a result, the Monte Carlo simulation generates 5 sample paths, shown in Figure 4.5.

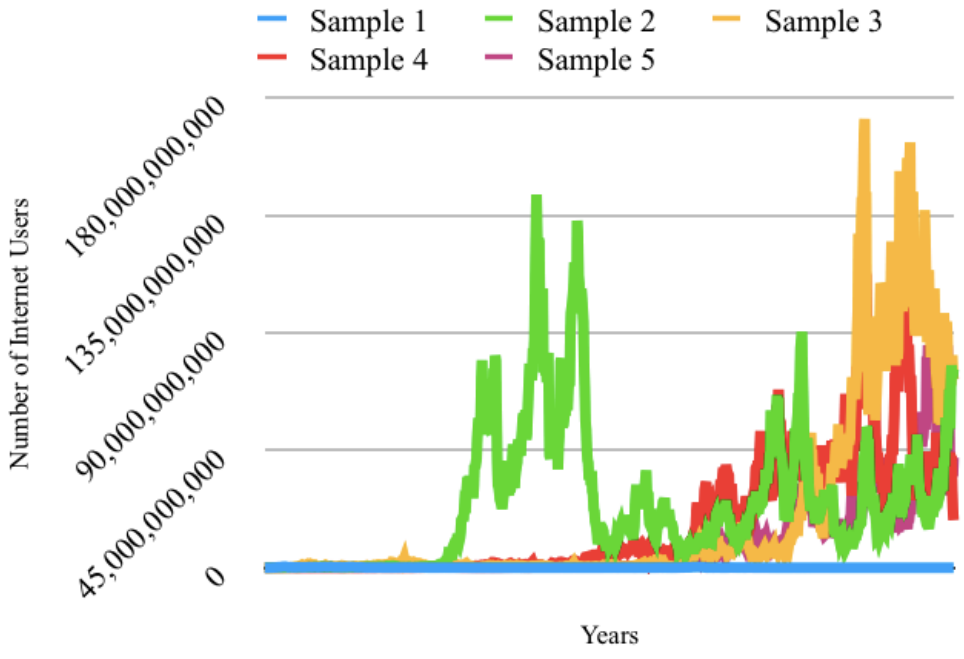


Figure 4.5: 5 Sample paths from Monte Carlo simulation

Equally important, the 10-year means of annual internet user number are generated on a logarithmic scale from the year 2017 onwards, plotted in Figure 4.6.

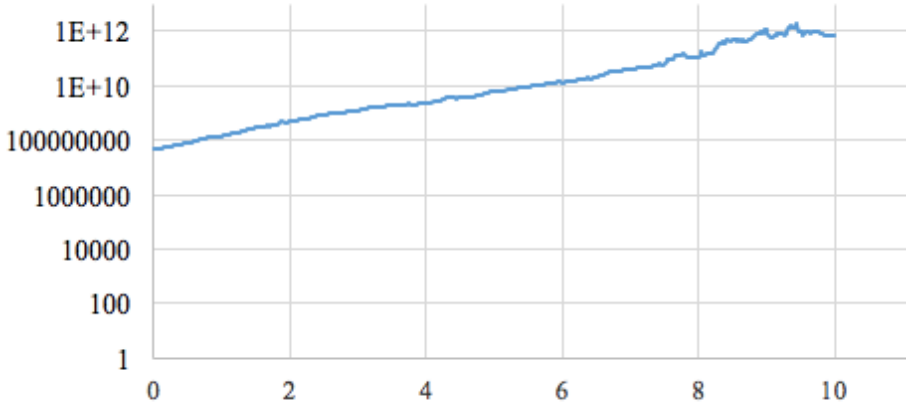


Figure 4.6: Annual mean of Internet user number from the year 2017 onwards

If the existing capacity is designed for the number of internet user $1.0x10^{10}$, then infrastructure should be expanded before year 6 after 2016, i.e. 2022.