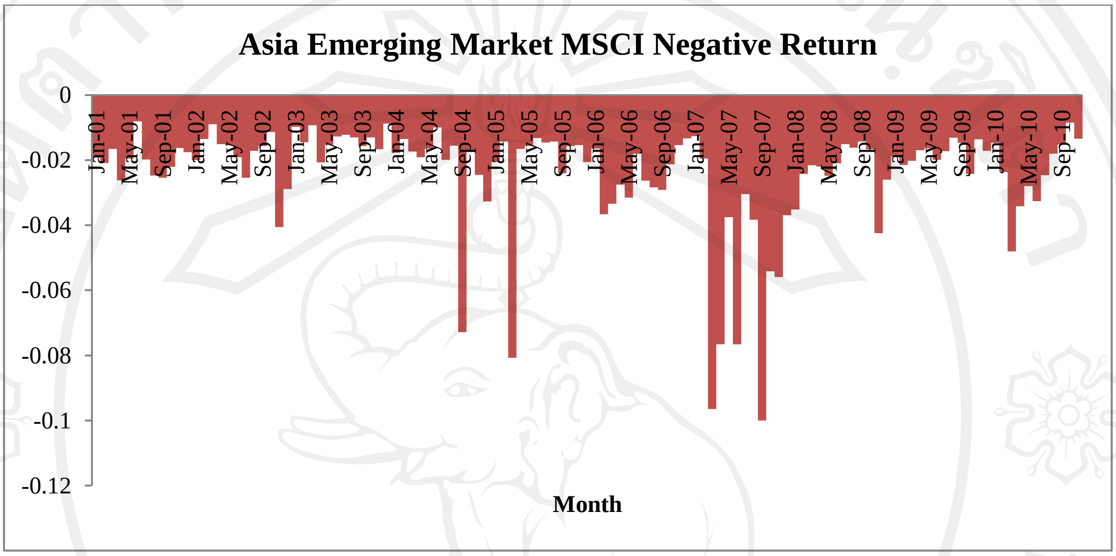
CHAPTER 4

THE EMPIRICAL RESULTS

4.1 The empirical result of Generalized Extreme values (GEV)

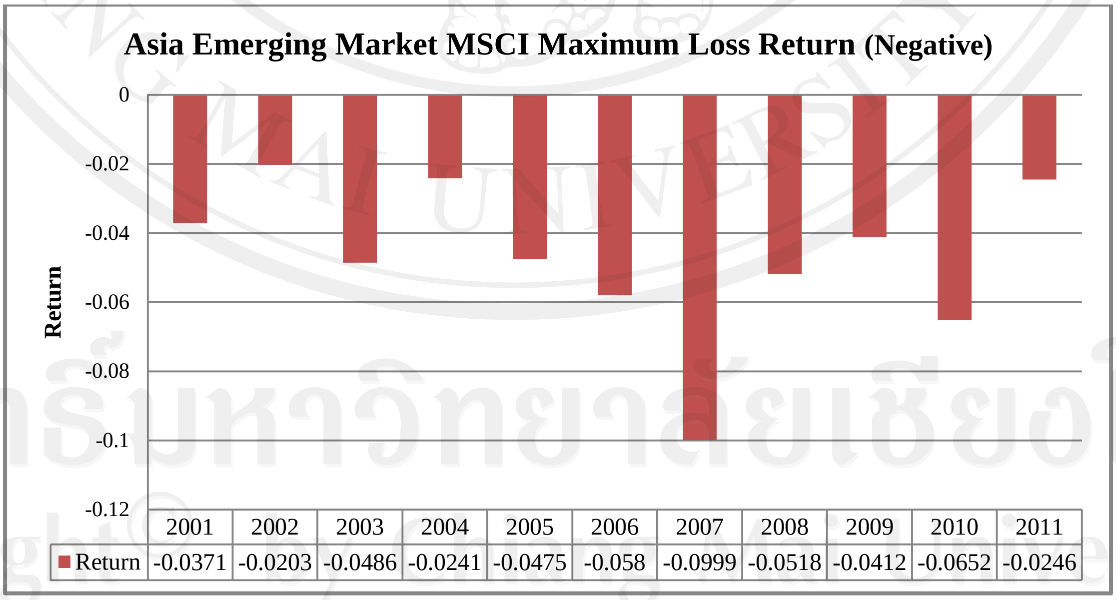
In this study of the generalized extreme values, datasets are the maximum loss return of monthly and yearly. Datasets are collected from the Morgan Stanley Capital International (MSCI). The study emphasizes the Emerging Markets of Asia. The stock of this study is the Asian Emerging Market Morgan Stanley Capital International or Asian EM MSCI. Figure 4.1 represents a loss return of Asian Emerging Market MSCI, monthly, with a maximum loss return of -0.09994% in September 2007 and a minimum loss return of nearly -0.0202% in July 2002. Figure 4.2 represents the return of Asian Emerging Market MSCI, yearly, with a maximum loss return of -0.0999% in the year of 2007 and a minimum loss return of nearly -0.0202% in the year of 2002. The research found that the investigations' used methods of maxima or minima such as compositions of Mott (1992), Eddy (1997), and Gilli & Kellezi (2006). A generalized extreme value of the study uses to analyze the minima method. The minima blocks including the both monthly and yearly maximum loss return in each period, which fit to a GEV distribution that according their research, the usual methods for maxima apply by realizing that $\min\{X_1,...,X_n\} = -\max\{-X_1,...,-X_n\}$. That is the negative transformation of the data $(Y_1 = -X_1,...,Y_n = -X_n)$ is fit to the GEV distribution. This study applied the block minima method of the Extreme Value theory. The research shows that monthly and yearly datasets divided into 121 and 11 blocks, respectively.

As shown in table 4.1, the research found that observations' negative transformations of the data are 121 and 11 which are the minima block (maximum loss return) of 121 months and 11 years. In the 121 minima block, mean of the data is 0.0271 and standard deviation is 0.0150. Minimum and maximum of the monthly dataset are 0.0202 and 0.0999. Median of the data is 0.0193. Also, the first quartile and the third quartile are 0.0126 and 0.02736, respectively. In the 11 minima block, mean of the data is 0.047 and standard deviation is 0.0227. Minimum and maximum of the yearly dataset are 0.0202 and 0.0999. Median of the data is 0.047. Also, the first quartile and the third quartile are 0.0308 and 0.0549, respectively.



Source: Computed Result

Figure 4.1: The percentage of Asia Emerging Market Morgan Stanley Capital International Return in Monthly



Source: Computed Result

Figure 4.2: The percentage of Asia Emerging Market Morgan Stanley Capital International Annual Return

Table 4.1: Descriptive Statistics of Daily Asia EM MSCI Returns from Fitting Monthly and Yearly Minima Block (Maximum Loose Return)

	Monthly	**Yearly**
Observations	121	11
Mean	0.0271	0.0470
Standard Deviation	0.0150	0.0227
Minimum	0.00202	0.0202
1st Quartile	0.0126	0.0308
Median	0.0193	0.0475
3rd Quartile	0.0274	0.0549
Maximum	0.0999	0.0999

Source: Computed Result

Table 4.2: Generalized Extreme Value Parameter Estimates from Fitting Minima Block of Monthly and Yearly (Maximum Loose Return)

	Parameter	**Estimate**	**Std. Error**
(a) Monthly	Location (μ)	0.01554	0.00088
	Scale (σ)	0.00849	0.00065
	Shape (ξ)	0.22480	0.08099
Negative log-likelihood: -370.4428			
(b) Yearly	Location (μ)	0.03671	0.00570
	Scale (σ)	0.01593	0.00428
	Shape (ξ)	0.07298	0.29965
Negative log-likelihood: -27.6916			

Source: Computed Result

The study transferred the negative return and fitted the monthly and yearly maximum loss (negative) return's the Asia Emerging Market Morgan Stanley Capital

International (Asia EM MSCI). Here, results are presented in terms of the transformed minima except where noted. Maximum-likelihood fitted parameter values and other information are summarized in table 4.2. The minima blocks of negative returns have been fitted to GEV model with monthly and yearly block sizes. Maximization of the GEV log-likelihood for the datasets result to the parameters estimation which are μ (location parameter), σ (scale parameter), and ξ (shape parameter). The generalized extreme value parameters (μ, σ, ξ) estimate from fitting monthly minima block (maximum loss return) that are 0.01554, 0.00849, and 0.22480, respectively. The standard errors are 0.00088, 0.00065 and 0.08099 for μ, σ, and ξ respectively. The generalized extreme value parameters (μ, σ, ξ) estimate from fitting yearly maximum loss return that are 0.03671, 0.01593, and 0.07298. The standard errors are 0.0057, 0.00428, and 0.29965 for μ, σ, and ξ exclusively. Standard error explains the deviation of model. If standard error closes to zero, the model will have a less deviation. But standard error separates oneself from zero; the model will have a less deviation

According to O. Rafael García-Cueto and Néstor Santillán-Soto (2008) wrote the parameter μ represents the location parameter ($-\infty < \mu < \infty$), determining the location of the peak of function; σ the scale parameter ($\sigma > 0$), determining the "wideness" of the distribution, and ξ the all-important shape parameter ($-\infty < \xi < \infty$) which determines the nature of tail behavior of the maximum distribution. The distribution of the sample maximum, say observation, will asymptotically follow either Fréchet ($\xi > 0$), Weibull ($\xi < 0$), or Gumbel ($\xi = 0$) distribution (Naveau et al., 2005). From parameter calculation, the study finds three parameters in the both case, which accord with above condition. The tail index, ξ, of the study is the extreme value in case of Fréchet because shape parameter is positive. Shape parameter gives an indication of the heaviness of the tail, the larger ξ, the heavier the tail. Manfred Gilli and Evis KÄellezi (2006) as, in general, one cannot fix an upper bound for financial losses, only distributions with shape parameter $\xi > 0$ are suited to model financial return distributions.

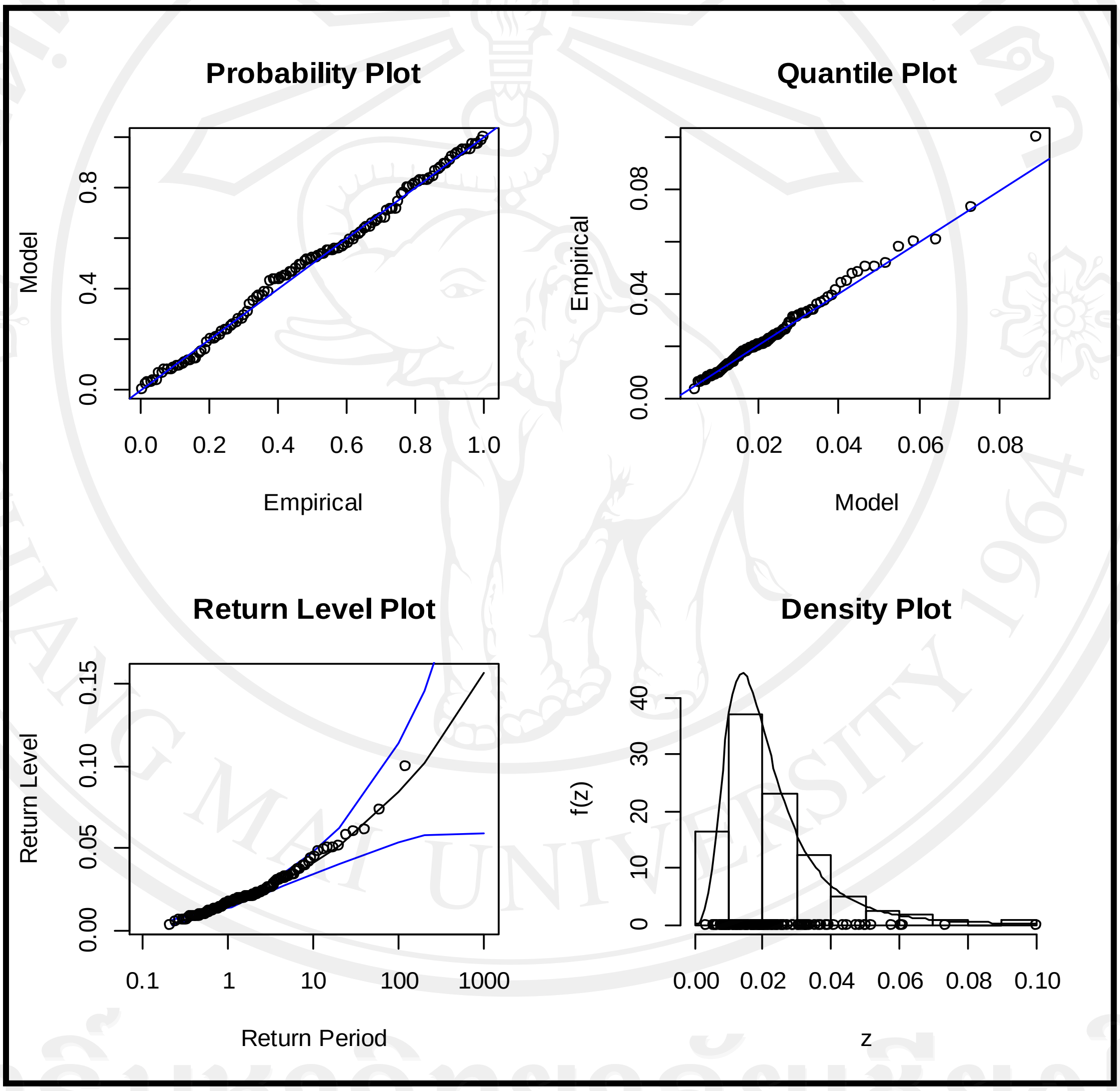
Although it is impossible to check the validity of an extrapolation based on a GEV model, assessment of its reasonableness can be made based on the observed data. Four graphical analyses assist with model checking followed Castillo et al

(2005) and Coles (2001). Diagnostic plots assessing the accuracy of the GEV model fitted to these data are shown in Fig. 4.3, 4.4. Probability plots compare the empirical and fitted distribution functions. If the GEV model is a good fit, the fitted distribution function should approximate the empirical one and the probability plot should lie close to the diagonal. Departures from linearity signal some weakness in the fit of the GEV model.

A limitation of the probability plot for assessing the fit of extreme value models is that both the empirical and fitted probability distributions approach increases, while it is the accuracy of the model for large values that is of the greatest interest. Thus, probability plots are the least helpful in the area of the greatest concern. This limitation is avoided by quintile plots comparing the empirical and estimated values. These two plots contain the same information, but are presented on different scales.

The third type is a return level plot, in which plots estimated return levels against their associated return periods on a logarithmic scale so that the tail of the distribution is compressed and the return level estimates for long return periods are displayed. The linearity of the plot in this case provides a baseline against which to judge the effect of the estimated shape parameter (ξ). Confidence intervals for the estimated return level can be included on the plot to increase its informativeness. Empirical values can also be included, for added diagnostic value – if the model estimates and empirical values are not roughly similar, the adequacy of the GEV model is open to question. Finally, probability density functions of the fitted model can be compared to a histogram of the empirical data. Since the shape of a histogram depends importantly on the choice of groupings, this plot is generally less informative than the probability, quintile, and return level plots.

Figure 4.3 and figure 4.4 are the diagnostic plots from fitting the maximum loss monthly and yearly returns data to the generalized extreme value distribution. Quintile and return-level graph are for the negative transformed minima from upper left to lower right: probability, quintile, return level, and histogram with fitted GEV density. The variance diagnostic plots for assessing the accuracy of the GEV model covers pending to the daily Emerging Market MSCI return are shown in figure 4.3 and figure 4.4. The probability plot corresponds to the model as near-linear but the quintiles plot corresponds to the model as near-linear only in the beginning while then diverge outward in the end. This means that the distribution of model is not reliable in the long term. The return level curve asymptotes to a finite level as a consequence of the positive estimate of ξ, though since the estimate is close to zero. The estimated curve is closed to linear.

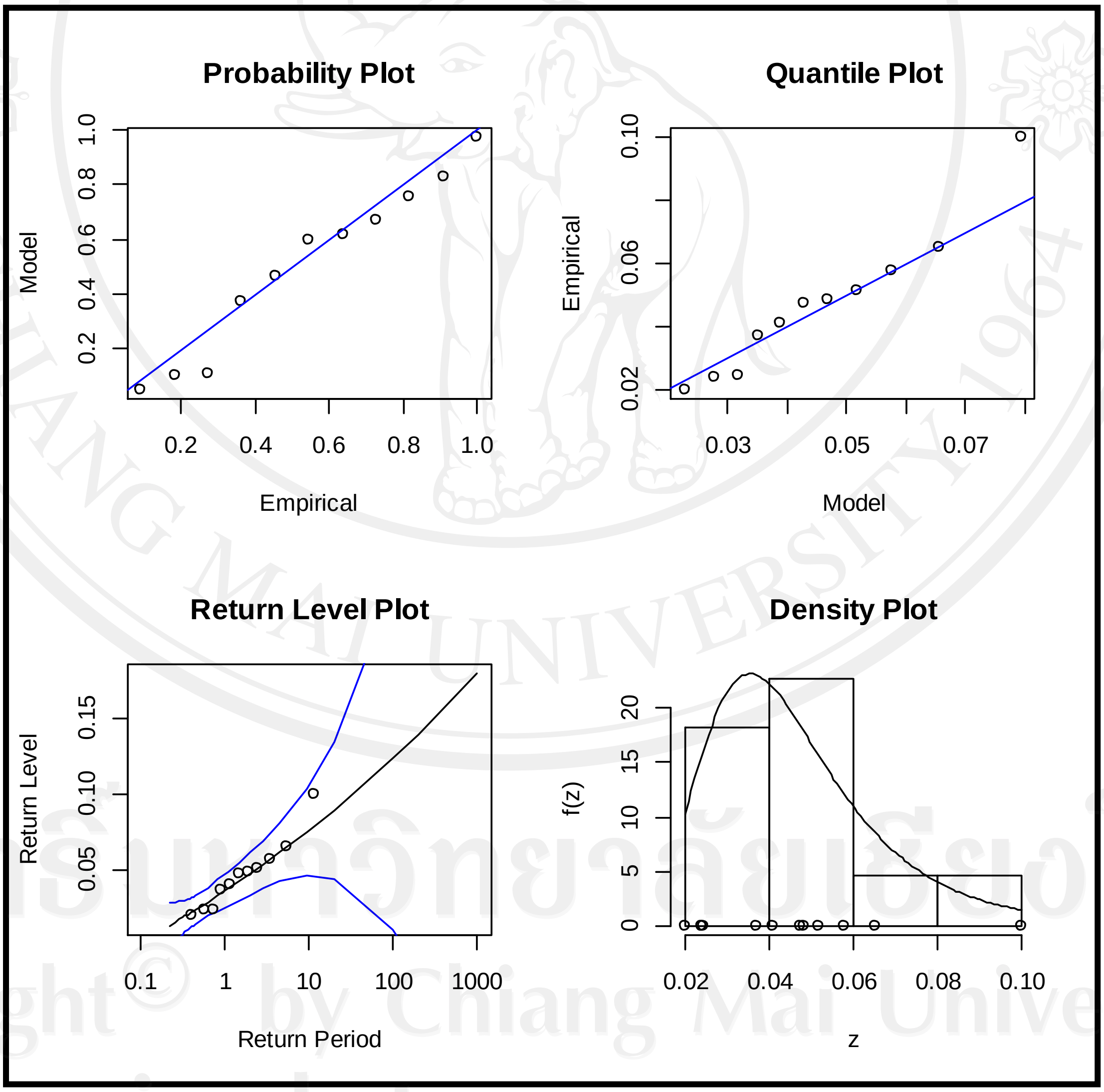


Source: Computed Result

Figure 4.3: Diagnostic Plots from Fitting the Minimum Monthly Returns Data to the Generalized Extreme Value Distribution

According to Gilli & Kellezi (2006), the tail index (ξ) gave an indication of the heaviness of the tail (ξ), the larger ξ, the heavier the tail. As, in general, one could not fix an upper bound for financial losses, only distributions with shape parameter $\xi \geq 0$

are suited to model financial return distributions. The density estimate seems consistent with the histogram of the data with short tailed in the left and the long tailed in the right. In financial modeling, extreme quantities of the daily returns are generally referred to as the ‘‘Value-at-Risk’’ (VaR) (Coles, 2001; Reiss & Thomas, 2001). VaR is the standard risk measurement used to protect portfolio holders against adverse market conditions and prevent them from taking extraordinary risks. Standard methods for calculating the VaR assume normality of the data; unfortunately, this assumption is often strongly violated as the unconditional distribution of financial time series is known to be fat-tailed.



Source: Computed Result

Figure 4.4: Diagnostic Plots from Fitting the Minimum Yearly Returns Data to the Generalized Extreme Value Distribution

Table 4.3: Estimated Return Levels and Shape Parameter with 90%, 95% and 99% Confidence Intervals for Return Periods from Monthly Minima Block

Categorizes			**5-Year**	**10-Year**	**20-Year**
Return Level			**0.0307**	**0.0404**	**0.0514**
Shape Parameter			**0.2248**	**0.2248**	**0.2248**
90 Percent Confidence	**Return Level**	Lower Bound	0.0278	0.0358	0.0442
		Upper Bound	0.0344	0.0472	0.0633
	Shape Parameter	Lower Bound	0.1021	0.1021	0.1021
		Upper Bound	0.3670	0.3670	0.3670
95 Percent Confidence	**Return Level**	Lower Bound	0.0272	0.0351	0.0431
		Upper Bound	0.0352	0.0488	0.0664
	Shape Parameter	Lower Bound	0.0809	0.0809	0.0809
		Upper Bound	0.3964	0.3964	0.3964
99 Percent Confidence	**Return Level**	Lower Bound	0.0263	0.0337	0.0412
		Upper Bound	0.0370	0.0527	0.0724
	Shape Parameter	Lower Bound	0.0417	0.0417	0.0417
		Upper Bound	0.4557	0.4557	0.4557

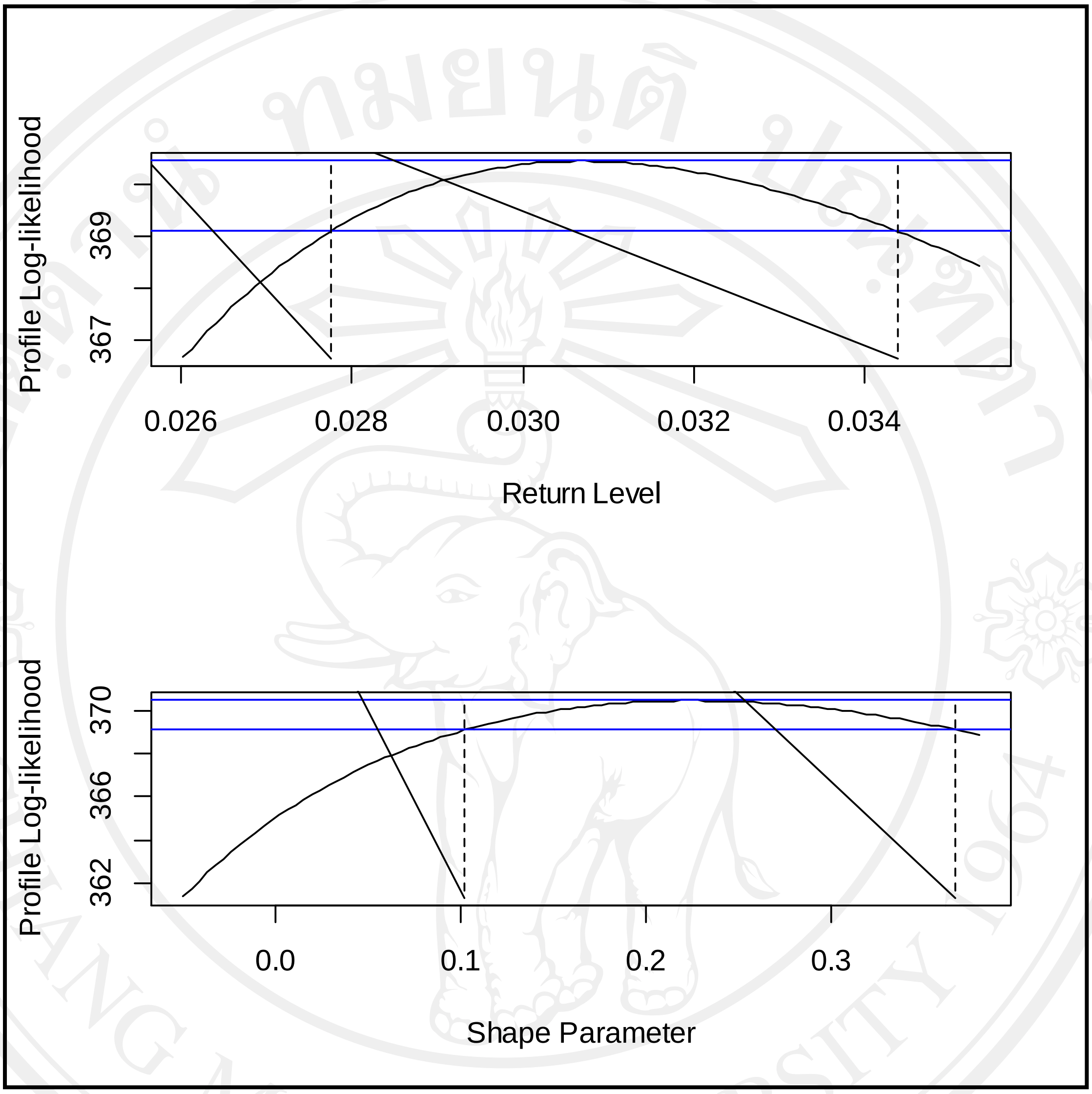
Source: Computed Result

Given the fit of the model, and assuming the relative stability of the process producing the fastest times, for Table 4.3 presents the daily Asia Emerging Market MSCI return in US dollars based on generalized extreme value analysis in during the period between 2001 through to 2011 in order to forecast the Asia Emerging Market MSCI return for the next five, ten, and twenty years. For a fit to the Asian Emerging MSCI monthly maximum loss returns model predicts the estimated 5-year return level to be 0.0307 with 90% confidence interval (0.0278, 0.0344), 95% confidence interval (0.0272%, 0.0352%), and 99% confidence interval (0.0263, 0.0370), respectively. For 10-year it is 0.0404 with 90% confidence interval (0.0358, 0.0472), 95% confidence interval (0.0351, 0.04882), and 99% confidence interval (0.03337, 0.0527), respectively. For 20-year it is 0.0514 with 90% confidence interval (0.0442, 0.0633), 95% confidence interval (0.0431, 0.0664), and 99% confidence interval (0.0412, 0.0724), respectively. Thus, once the Asian Emerging Market MSCI we should expect to see a negative log-daily value at a risk of between 0.0263 and 0.0370 for the next 5 years, between 0.0337 and 0.0527 for the next 10 years, between 0.0412 and 0.0724 for the next 20 years at 99% confidence interval, in the order from upper and lower bonds in table 4.3.

As referred that the log-likelihood estimates from the fitting monthly minimum return in table 4.2 are μ (location parameter) amounts 0.01554, σ (scale parameter) amounts 0.00849, and ξ (shape parameter) amounts 0.22480. First, the conclusion for fitting monthly maximum loss return case, Value at Risk from the generalized extreme value estimates gives the result as 0.0307 percent in the next 5 years (table 4.3). This implies that, the extreme loss in every day will exceed to 0.0307% with 1% risk. It determines that if the investor invests US$1 million in the Asian Emerging Market MSCI return, the investors are 99% confident that our daily loss at worst will not exceed US$307. Whereas, the investors are 1% confident that our loss return will exceed 0.0307% or US$307 if the investor has an investment of US$1 million in the Morgan Stanley Capital International market.

Second, VaR from the generalized extreme value estimates gives the result as 0.0404% in the next 10 years (table 4.3). This implies that, the extreme loss in every day will exceed to 0.0404% with 1% risk. It determines that if the investor invests US$1 million in the Asian Emerging Market MSCI return, the investors are 99% confident that our daily loss at worst will not exceed US$404. Whereas, if the investors are 1% confident that our loss return will exceed 0.0404% or US$404 if the investors have an investment of US$1 million in the Morgan Stanley Capital International market.

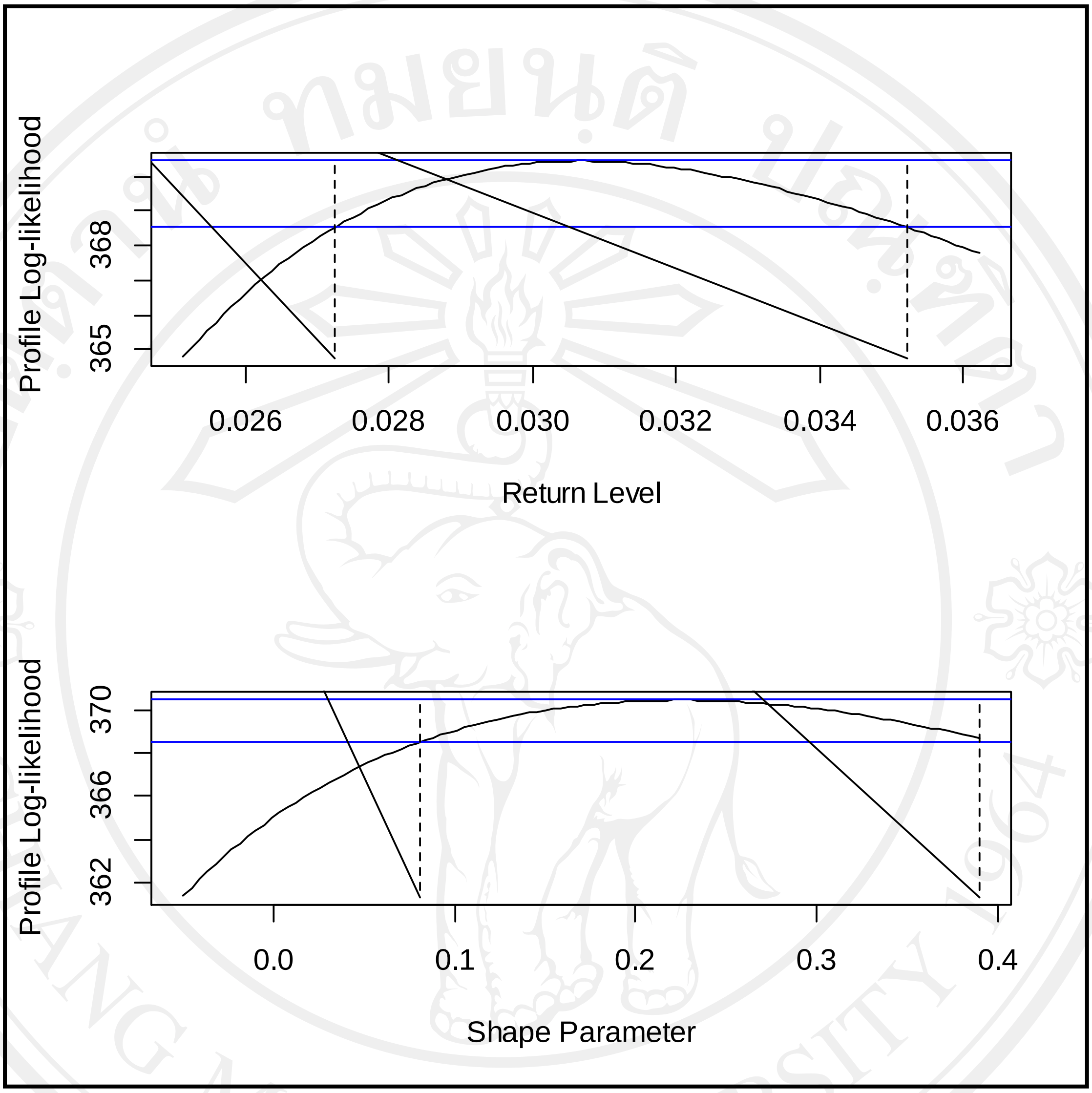
Last, the Value at Risk from the generalized extreme value estimates gives the result as 0.0514% in the next 20 years (table 4.3). This implies that, the extreme loss in every day will exceed 0.0514% with 1% risk. It determines that if the investor invests $1 million in the Asian Emerging Market MSCI return, the investors are 99% confident that our daily loss at worst will not exceed US$514. Whereas, the investors are 1% confident then our loss return will exceed 0.0514% or US$514 if the investor has an investment of US$1 million in the Morgan Stanley Capital International market.



Source: Computed Result

Figure 4.5: Profile Log-Likelihood for GEV 5-year Return Level and Shape Parameter at 90% Confident Interval from Fit Monthly Maximum Loss Return

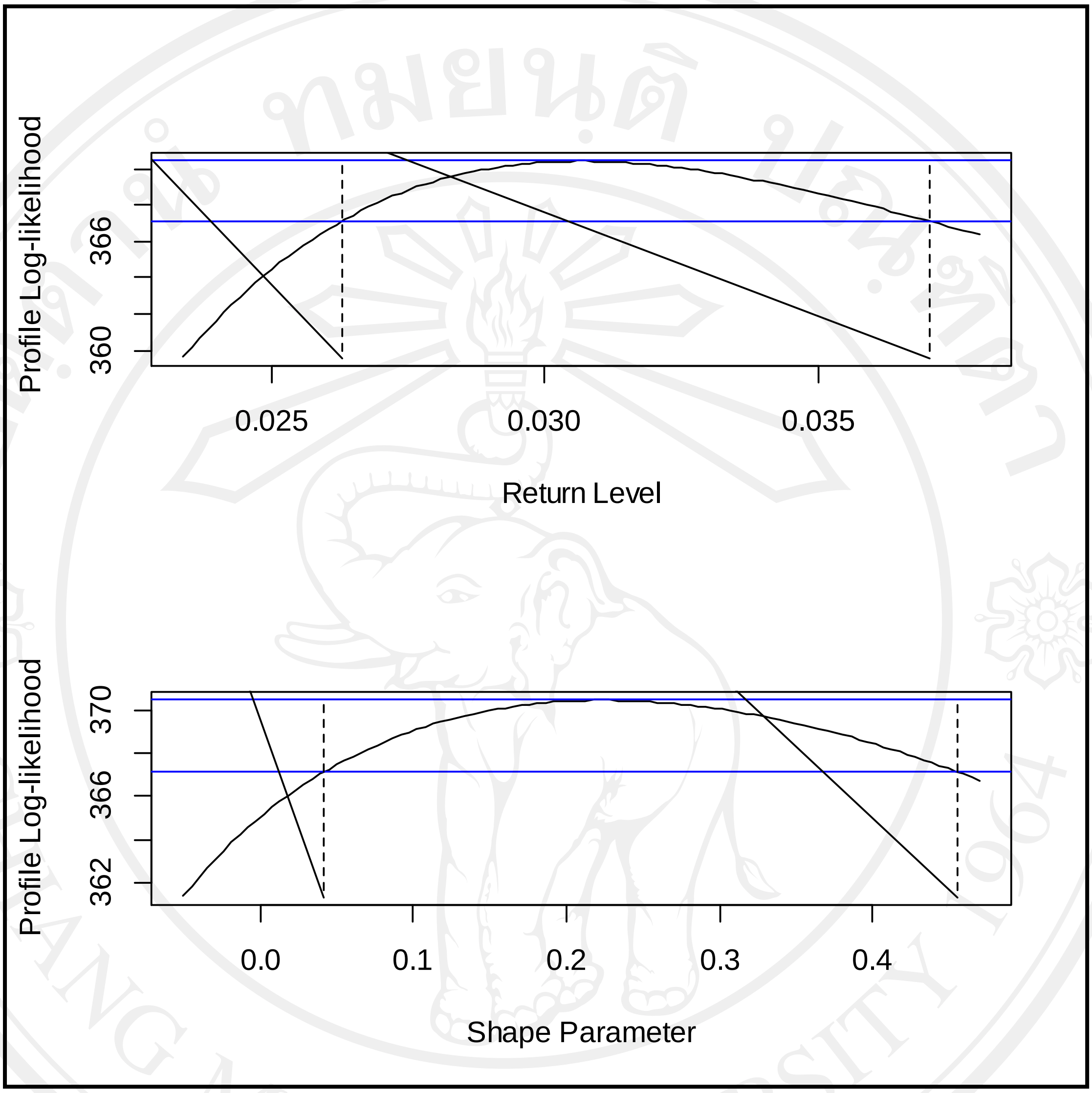
The profile log-likelihood for GEV 5-year return level and shape parameter at 90% confident interval from fit monthly maximum loss return shows as figure 4.5. The estimated return level is 0.0307 and estimated (MLE) shape parameter is 0.2248 in accordance with table 4.3. Moreover, a 5-year return level at 90% confidence interval approximately is between 0.0278 and 0.0344. A shape parameter at 90% confidence interval approximately is between 0.1021 and 0.3670.



Source: Computed Result

Figure 4.6: Profile Log-Likelihood for GEV 5-year Return Level and Shape Parameter at 95% Confident Interval from Fit Monthly Maximum Loss Return

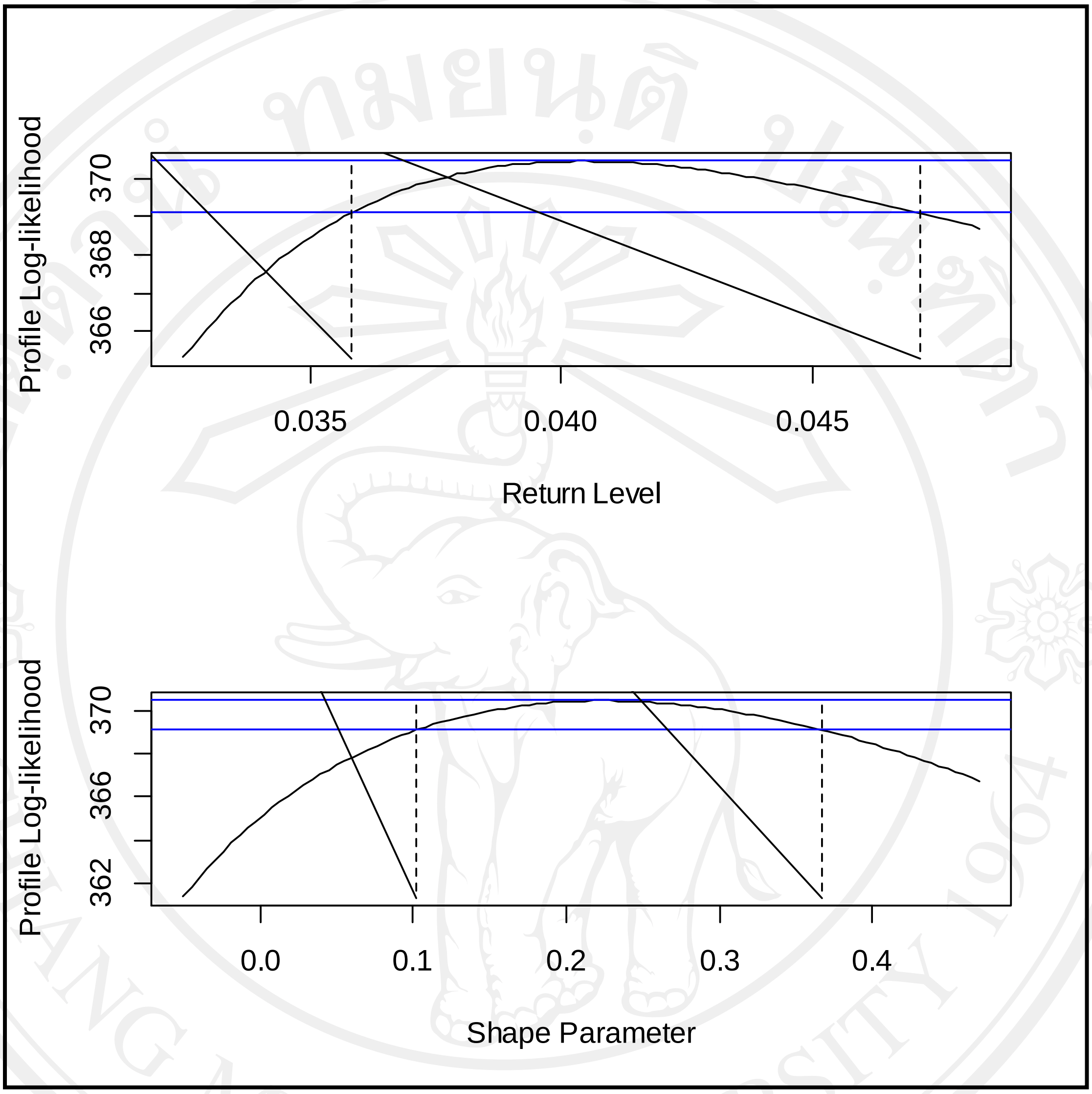
The profile log-likelihood for GEV 5-year return level and shape parameter at 95% confident interval from fit monthly maximum loss return shows as figure 4.6. The estimated return level is 0.0307 and estimated (MLE) shape parameter is 0.2248 in accordance with table 4.3. Moreover, a 5-year return level at 95% confidence interval approximately is between 0.0272 and 0.0352. A shape parameter at 95% confidence interval approximately is between 0.0809 and 0.3964.



Source: Computed Result

Figure 4.7: Profile Log-Likelihood for GEV 5-year Return Level and Shape Parameter at 99% Confident Interval from Fit Monthly Maximum Loss Return

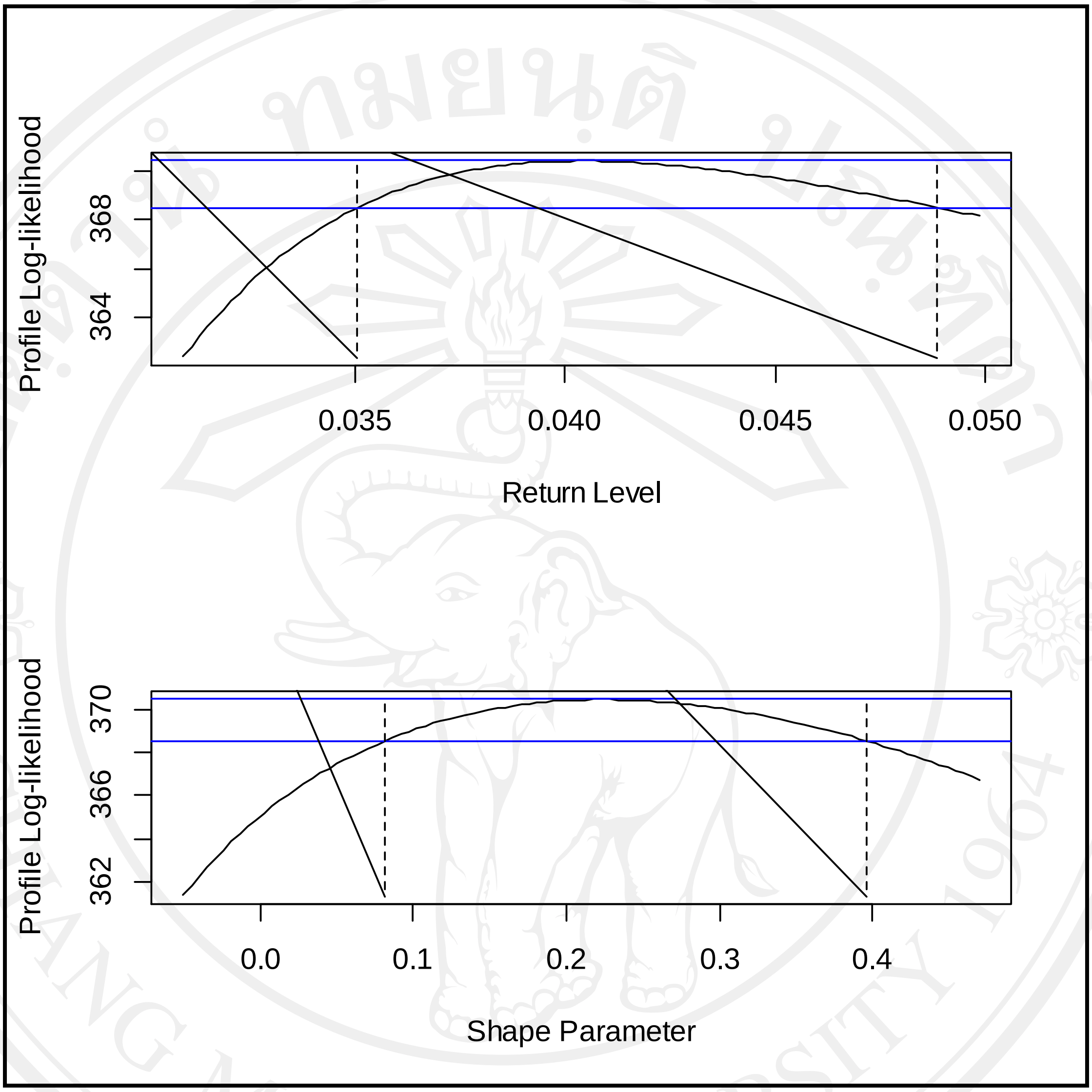
The profile log-likelihood for GEV 5-year return level and shape parameter at 99% confident interval from fit monthly maximum loss return shows as figure 4.7. The estimated return level is 0.0307 and estimated (MLE) shape parameter is 0.2248 in accordance with table 4.3. Moreover, a 5-year return level at 99% confidence interval approximately is between 0.0263 and 0.0370. A shape parameter at 99% confidence interval approximately is between 0.0417 and 0.4557.



Source: Computed Result

Figure 4.8: Profile Log-Likelihood for GEV 10-year Return Level and Shape Parameter at 90% Confident Interval from Fit Monthly Maximum Loss Return

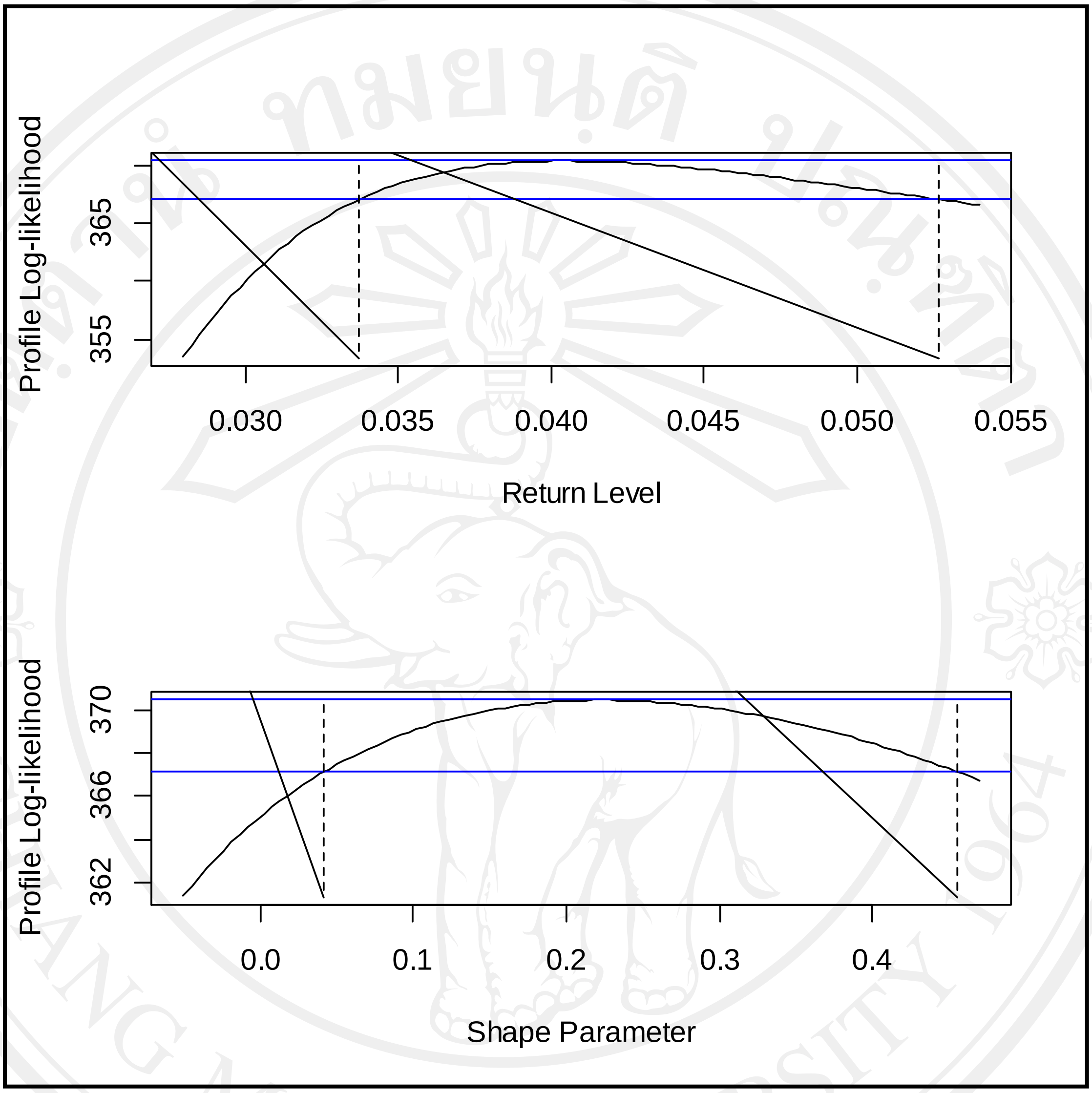
The profile log-likelihood for GEV 10-year return level and shape parameter at 90% confident interval from fit monthly maximum loss return shows as figure 4.8. The estimated return level is 0.0404 and estimated (MLE) shape parameter is 0.2248 in accordance with table 4.3. Moreover, a 10-year return level at 90% confidence interval approximately is between 0.0358 and 0.0472. A shape parameter at 90% confidence interval approximately is between 0.1021 and 0.3670.



Source: Computed Result

Figure 4.9: Profile Log-Likelihood for GEV 10-year Return Level and Shape Parameter at 95% Confident Interval from Fit Monthly Maximum Loss Return

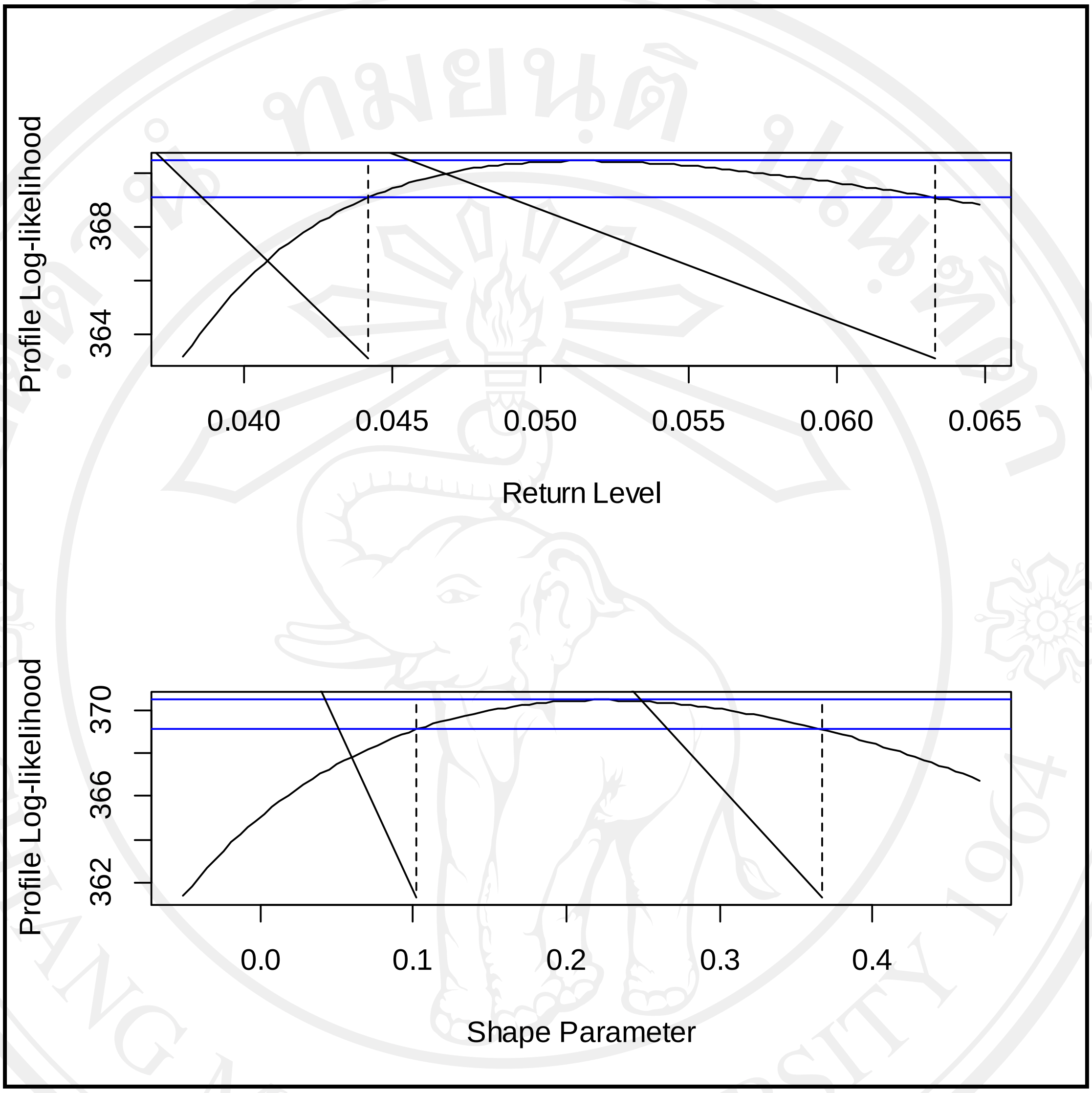
The profile log-likelihood for GEV 10-year return level and shape parameter at 95% confident interval from fit monthly maximum loss return shows as figure 4.9. The estimated return level is 0.0404 and estimated (MLE) shape parameter is 0.2248 in accordance with table 4.3. Moreover, a 10-year return level at 95% confidence interval approximately is between 0.0351 and 0.0488. A shape parameter at 95% confidence interval approximately is between 0.0809 and 0.3964.



Source: Computed Result

Figure 4.10: Profile Log-Likelihood for GEV 10-year Return Level and Shape Parameter at 99% Confident Interval from Fit Monthly Maximum Loss Return

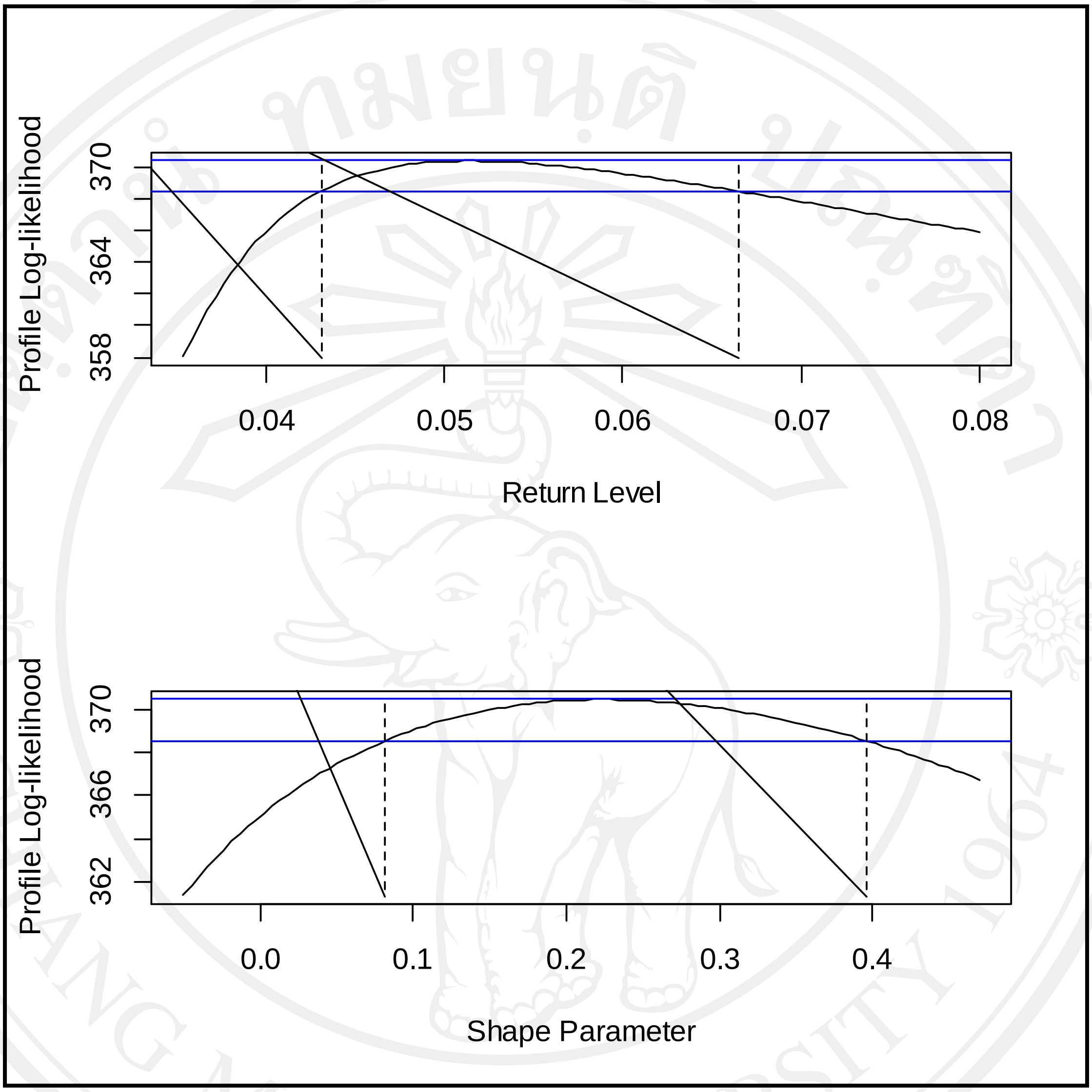
The profile log-likelihood for GEV 10-year return level and shape parameter at 99% confident interval from fit monthly maximum loss return shows as figure 4.10. The estimated return level is 0.0404 and estimated (MLE) shape parameter is 0.2248 in accordance with table 4.3. Moreover, a 10-year return level at 99% confidence interval approximately is between 0.0337 and 0.0527. A shape parameter at 95% confidence interval approximately is between 0.0417 and 0.4557.



Source: Computed Result

Figure 4.11: Profile Log-Likelihood for GEV 20-year Return Level and Shape Parameter at 90% Confident Interval from Fit Monthly Maximum Loss Return

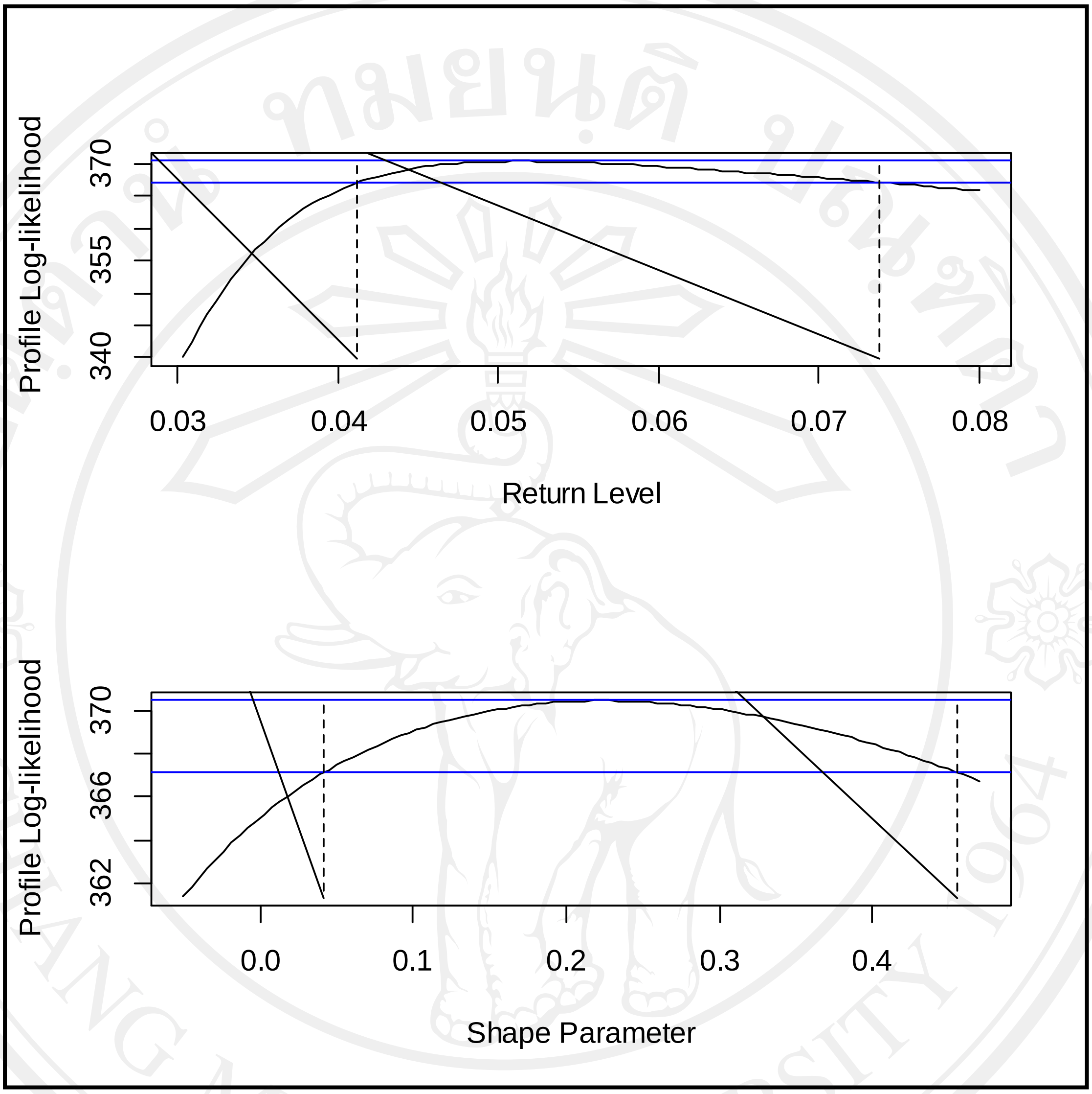
The profile log-likelihood for GEV 20-year return level and shape parameter at 90% confident interval from fit monthly maximum loss return shows as figure 4.11. The estimated return level is 0.0514 and estimated (MLE) shape parameter is 0.2248 in accordance with table 4.3. Moreover, a 20-year return level at 90% confidence interval approximately is between 0.0442 and 0.0633. A shape parameter at 90% confidence interval approximately is between 0.1021 and 0.3670.



Source: Computed Result

Figure 4.12: Profile Log-Likelihood for GEV 20-year Return Level and Shape Parameter at 95% Confident Interval from Fit Monthly Maximum Loss Return

The profile log-likelihood for GEV 20-year return level and shape parameter at 95% confident interval from fit monthly maximum loss return shows as figure 4.12. The estimated return level is 0.0514 and estimated (MLE) shape parameter is 0.2248 in accordance with table 4.3. Moreover, a 20-year return level at 95% confidence interval approximately is between 0.0431 and 0.0664. A shape parameter at 95% confidence interval approximately is between 0.0809 and 0.3694.



Source: Computed Result

Figure 4.13: Profile Log-Likelihood for GEV 20-year Return Level and Shape Parameter at 99% Confident Interval from Fit Monthly Maximum Loss Return

The profile log-likelihood for GEV 20-year return level and shape parameter at 99% confident interval from fit monthly maximum loss return shows as figure 4.13. The estimated return level is 0.0514 and estimated (MLE) shape parameter is 0.2248 in accordance with table 4.3. Moreover, a 20-year return level at 99% confidence interval approximately is between 0.0412 and 0.0724. A shape parameter at 99% confidence interval approximately is between 0.0417 and 0.4557.

Table 4.4: Estimated Return Levels and Shape Parameter with 90%, 95% and 99% Confidence Intervals for Return Periods from Annual Block Minima

Categorizes			**5-Year**	**10-Year**	**20-Year**
Return Level			**0.0620**	**0.0757**	**0.0895**
Shape Parameter			**0.0754**	**0.0754**	**0.0754**
90 Percent Confidence	**Return Level**	Lower Bound	0.0482	0.0586	0.0676
		Upper Bound	0.0943	0.1586	0.2773
	Shape Parameter	Lower Bound	-0.3038	-0.3038	-0.3038
		Upper Bound	0.8829	0.8829	0.8829
95 Percent Confidence	**Return Level**	Lower Bound	0.0459	0.0560	0.0648
		Upper Bound	0.1139	0.2000	0.4600
	Shape Parameter	Lower Bound	-0.3744	-0.3744	-0.3744
		Upper Bound	0.9500	1.1311	1.1327
99 Percent Confidence	**Return Level**	Lower Bound	0.0412	0.0511	0.0596
		Upper Bound	0.2092	0.3459	0.3124
	Shape Parameter	Lower Bound	-0.5397	-0.5397	-0.5397
		Upper Bound	1.1173	1.1910	1.1000

Source: Computed Result

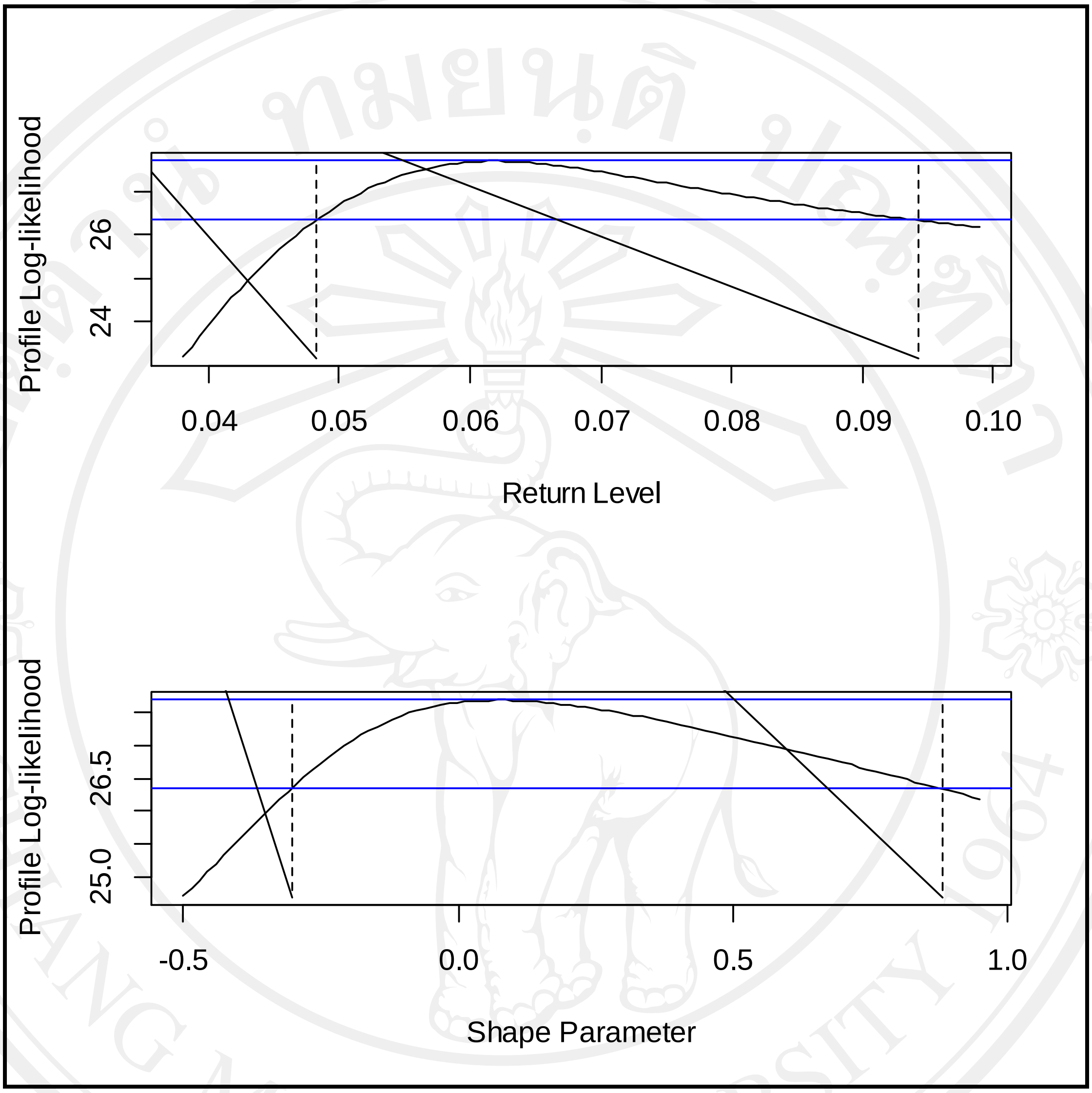
Table 4.4 presents the daily Asian emerging market MSCI return in US dollars based on generalized extreme value analysis during the period between 2001 through 2011 in order to forecast the Asian Emerging Market MSCI return for the next five, ten, and twenty years. For the Asian Emerging Market MSCI yearly maximum loss returns model predicts the 5 year return level to be 0.0620 with 90% confidence interval (0.0482, 0.0943), 95% confidence interval (0.0459, 0.1139) and 99% confidence interval (0.0412, 0.2092), respectively. For 10-year it is 0.0757 with 90% confidence interval (0.0586, 0.1586), 95% confidence interval (0.0560, 0.2000), and 99% confidence interval (0.0511, 0.3459), respectively. For 20-year it is 0.0895 percent with 90% confidence interval (0.0676, 0.2773), 95% confidence interval (0.0648, 0.4600), and 99% confidence interval (0.0596, 0.3124), respectively. Thus, once the Asian Emerging Market MSCI, we should expect to see a negative log-daily

VaR of between 0.0412 and 0.2092 for the next 5 years, between 0.0511 and 0.3459 for the next 10 years, and between 0.0596 and 0.3124 for the next 20 years at 99% confidence interval, in the order from upper and lower bonds in table 4.4.

As referred that the log-likelihood estimates from the fitted yearly minimum return in table 4.2 are μ (location parameter) amounts 0.03671, σ (scale parameter) amounts 0.01593, and ξ (shape parameter) amounts 0.07298. First, the conclusion for fitting annual maximum loss return case, Value at Risk from the generalized extreme value estimates gives the result as 0.0620% in the next 5 years (table 4.4). This implies that, the extreme loss in every day will exceed to 0.0620% with 1% risk. It determines that if the investor invests US$1 million in the Asian Emerging Market MSCI return, the investors that are 99% confident the daily loss at worst will not exceed US$620. Whereas, the investors that are 1% confident the loss return will exceed 0.0620% or US$620 if the investor has an investment of US$1 million in the Morgan Stanley Capital International market.

Second, Value at Risk from the generalized extreme value estimates gives the result as 0.0757 percent in the next 10 years (table 4.4). This implies that, the extreme loss in every day will exceed to 0.0757 percent with 1% risk. It determines that if the investor invest US$1 million in the Asian emerging market MSCI return, the investor that are 99% confident our daily loss at worst will not exceed US$757. Whereas, the investor that are 1% confident our loss return will exceed 0.0757 percent or US$757 if the investor has an investment of US$1 million in the Morgan Stanley Capital International market.

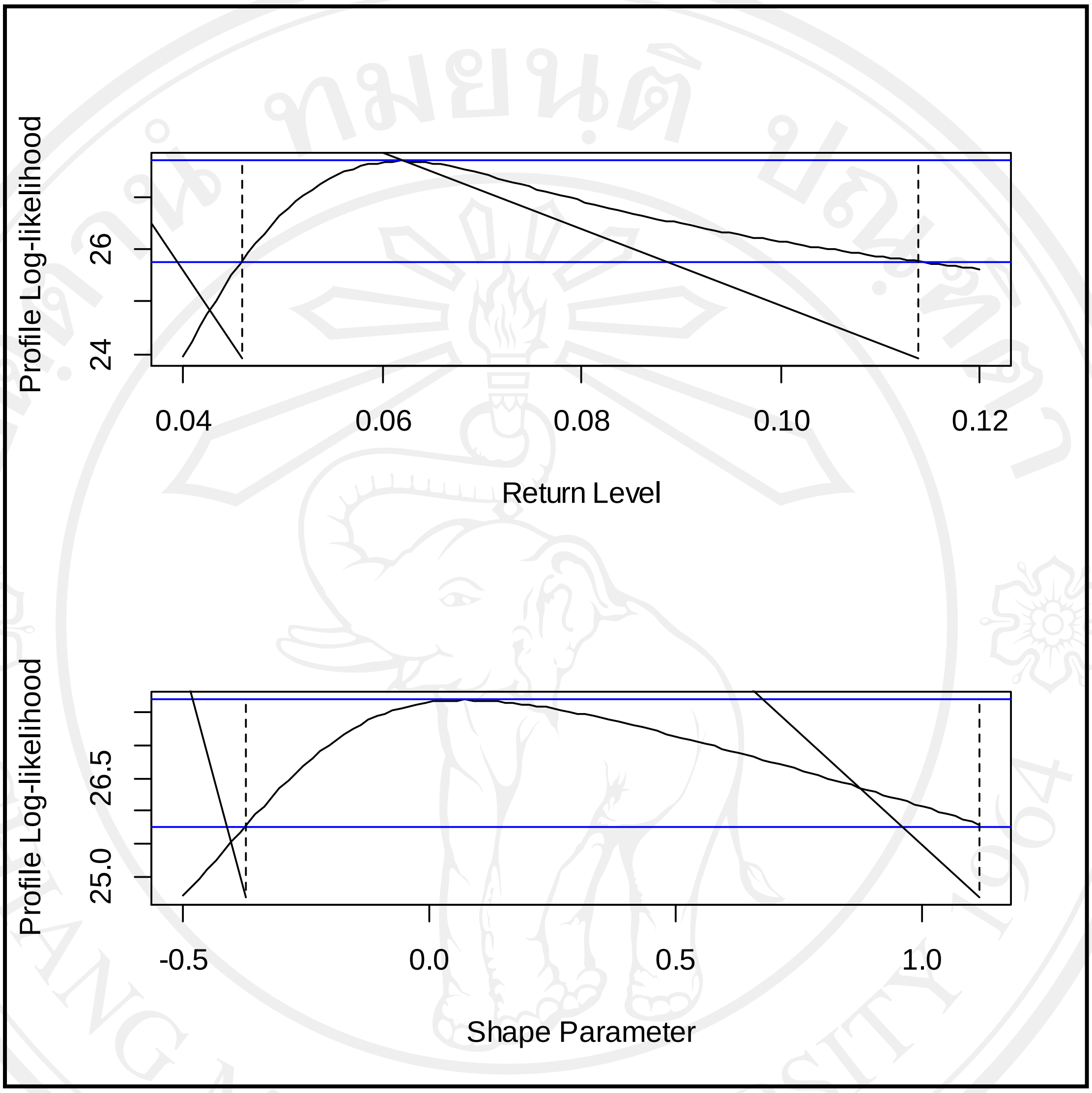
Last, Value at Risk from the generalized extreme value estimates gives the result as 0.0895 percent in the next 20 years (table 4.4). This implies that, the extreme loss in every day will exceed 0.0895 percent with 1% risk. It determines that if the investor invest US$1 million in the Asian emerging market MSCI return, the investor that are 99% confident our daily loss at worst will not exceed US$895. Whereas, the investor that is 1% confident our loss return will exceed 0.0895 percent or US$895 if the investor have an investment of US$1 million in the Morgan Stanley Capital International market.



Source: Computed Result

Figure 4.14: Profile Log-Likelihood for GEV 5-year Return Level and Shape Parameter at 90% Confident Interval from Fit Annual Maximum Loss Return

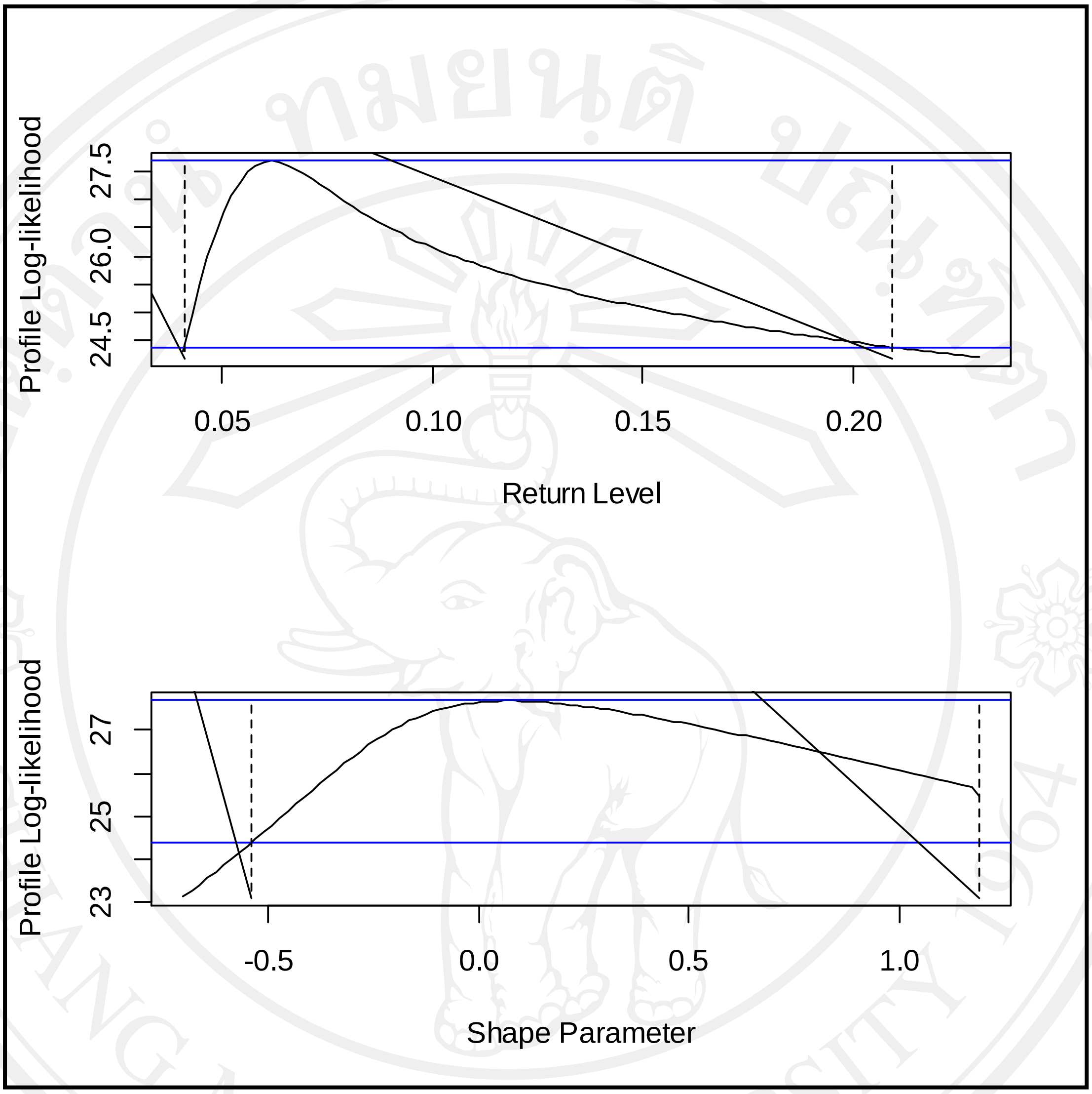
The profile log-likelihood for GEV 5-year return level and shape parameter at 90% confident interval from fit annual maximum loss return shows as figure 4.14. The estimated return level is 0.0620 and estimated (MLE) shape parameter is 0.0754 in accordance with table 4.4. Moreover, a 5-year return level at 90% confidence interval approximately is between 0.0482 and 0.0943. A shape parameter at 90% confidence interval approximately is between -0.3038 and 0.8829.



Source: Computed Result

Figure 4.15: Profile Log-Likelihood for GEV 5-year Return Level and Shape Parameter at 95% Confident Interval from Fit Annual Maximum Loss Return

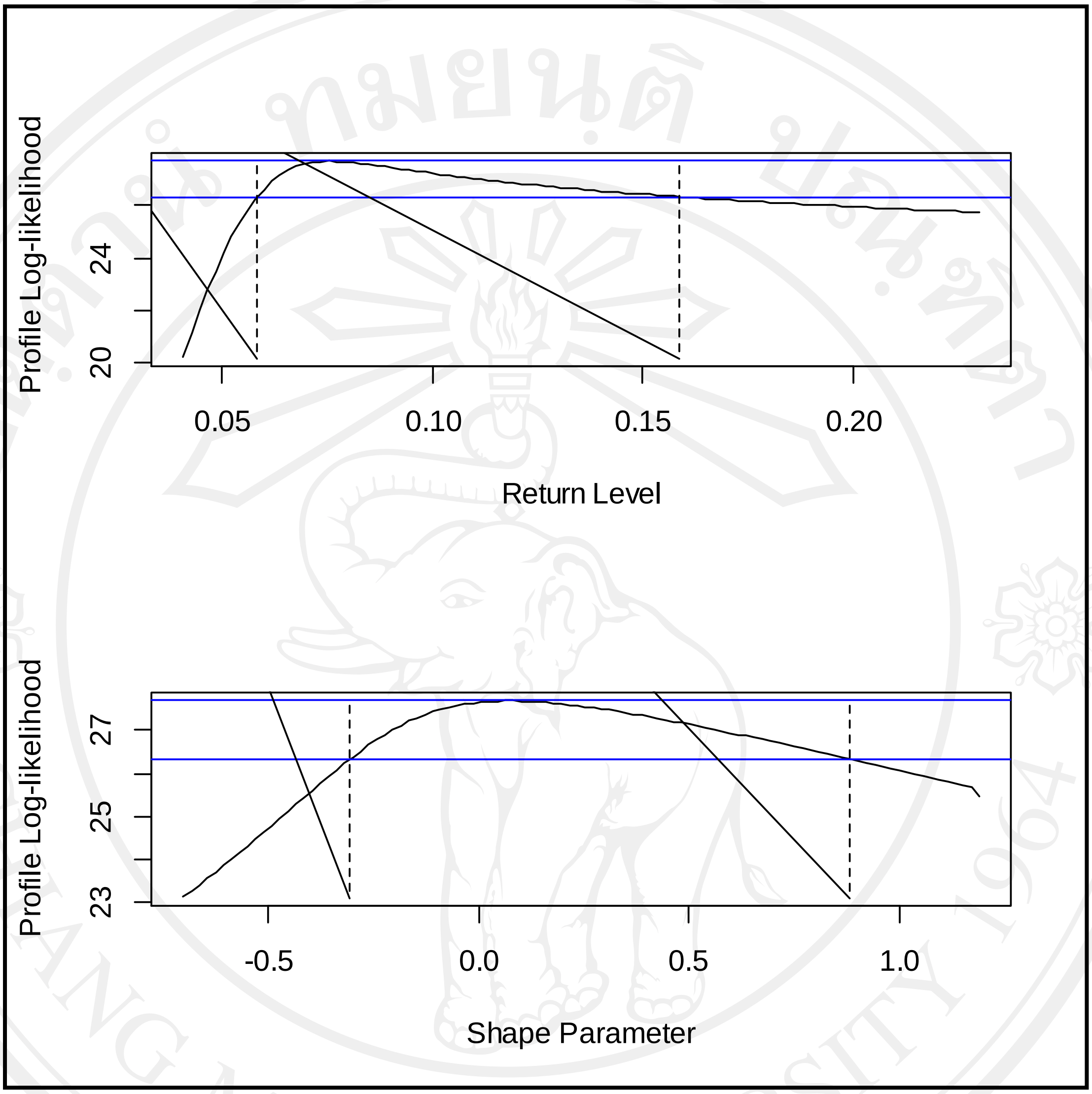
The profile log-likelihood for GEV 5-year return level and shape parameter at 95% confident interval from fit annual maximum loss return shows as figure 4.15. The estimated return level is 0.0620 and estimated (MLE) shape parameter is 0.0754 in accordance with table 4.4. Moreover, a 5-year return level at 95% confidence interval approximately is between 0.0459 and 0.1139. A shape parameter at 95% confidence interval approximately is between -0.3744 and 0.9500.



Source: Computed Result

Figure 4.16: Profile Log-Likelihood for GEV 5-year Return Level and Shape Parameter at 99% Confident Interval from Fit Annual Maximum Loss Return

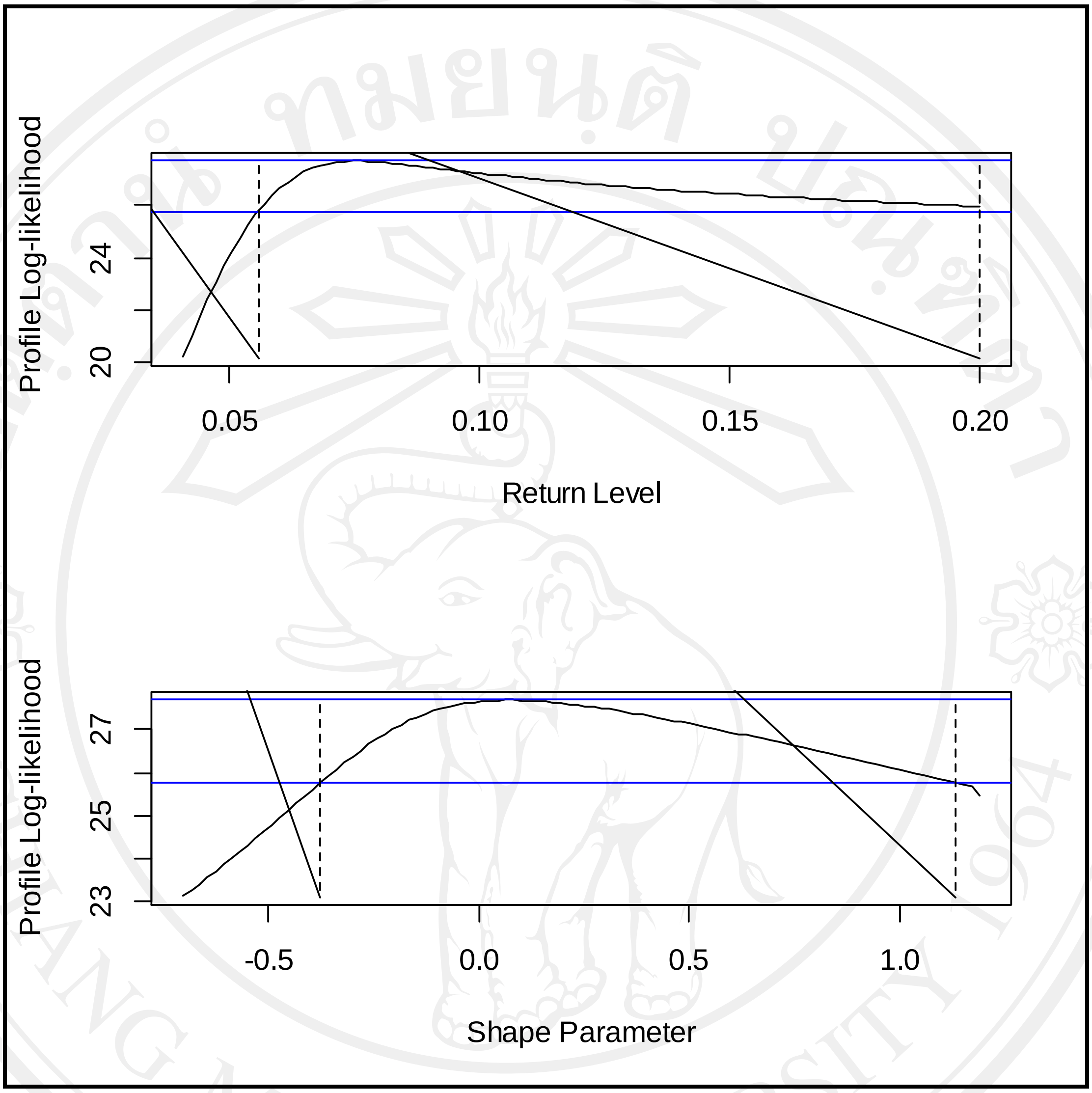
The profile log-likelihood for GEV 5-year return level and shape parameter at 99% confident interval from fit annual maximum loss return shows as figure 4.16. The estimated return level is 0.0620 and estimated (MLE) shape parameter is 0.0754 in accordance with table 4.4. Moreover, a 5-year return level at 99% confidence interval approximately is between 0.0412 and 0.2092. A shape parameter at 99% confidence interval approximately is between -0.5397 and 1.1173.



Source: Computed Result

Figure 4.17: Profile Log-Likelihood for GEV 10-year Return Level and Shape Parameter at 90% Confident Interval from Fit Annual Maximum Loss Return

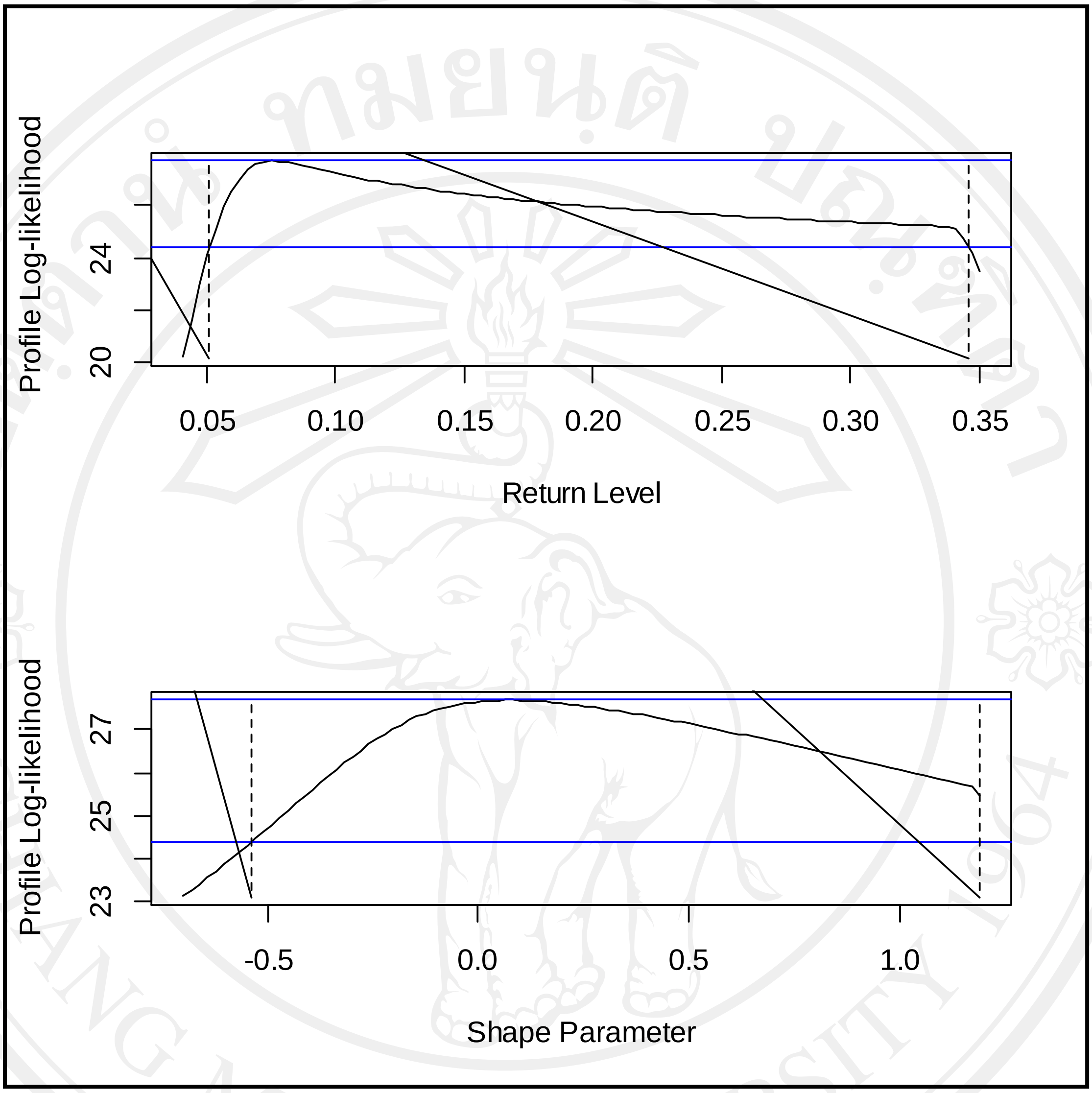
The profile log-likelihood for GEV 10-year return level and shape parameter at 90% confident interval from fit annual maximum loss return shows as figure 4.17. The estimated return level is 0.0757 and estimated (MLE) shape parameter is 0.0754 in accordance with table 4.4. Moreover, a 10-year return level at 90% confidence interval approximately is between 0.0586 and 0.1586. A shape parameter at 90% confidence interval approximately is between -0.3038 and 0.8829.



Source: Computed Result

Figure 4.18: Profile Log-Likelihood for GEV 10-year Return Level and Shape Parameter at 95% Confident Interval from Fit Annual Maximum Loss Return

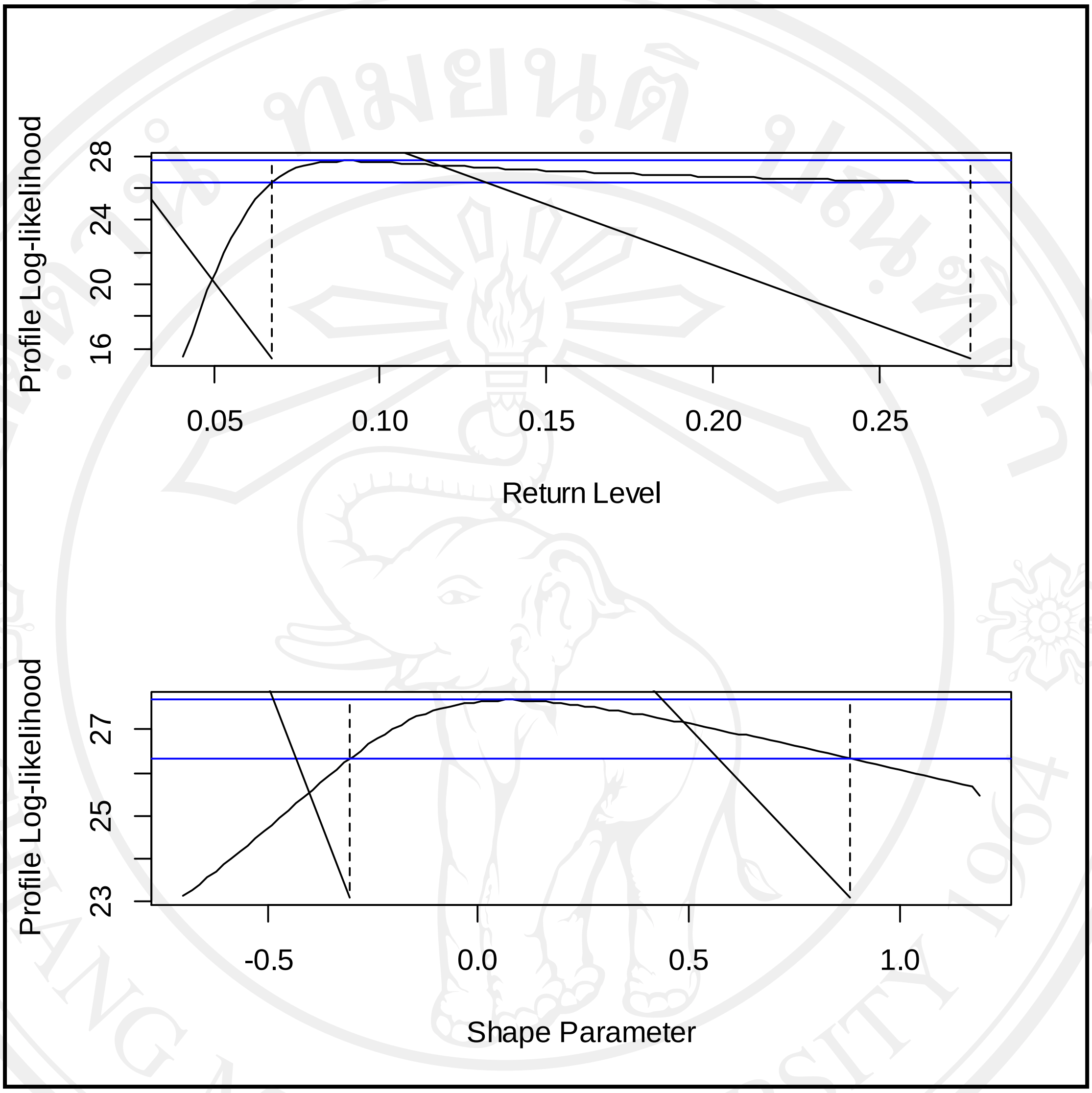
The profile log-likelihood for GEV 10-year return level and shape parameter at 95% confident interval from fit annual maximum loss return shows as figure 4.18. The estimated return level is 0.0757 and estimated (MLE) shape parameter is 0.0754 in accordance with table 4.4. Moreover, a 10-year return level at 95% confidence interval approximately is between 0.0560 and 0.2000. A shape parameter at 95% confidence interval approximately is between -0.3744 and 1.1311.



Source: Computed Result

Figure 4.19: Profile Log-Likelihood for GEV 10-year Return Level and Shape Parameter at 99% Confident Interval from Fit Annual Maximum Loss Return

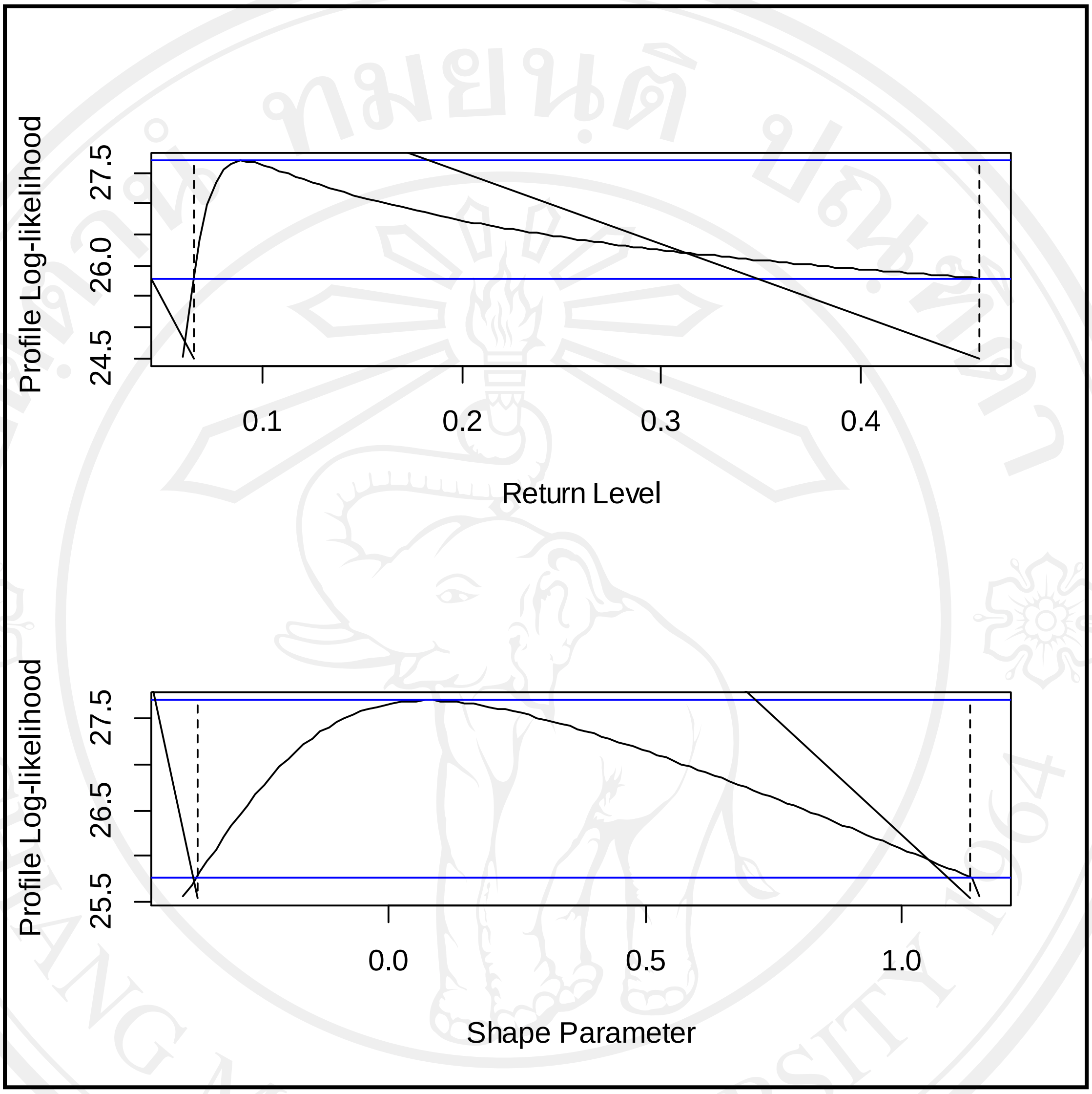
The profile log-likelihood for GEV 10-year return level and shape parameter at 99% confident interval from fit annual maximum loss return shows as figure 4.19. The estimated return level is 0.0757 and estimated (MLE) shape parameter is 0.0754 in accordance with table 4.4. Moreover, a 10-year return level at 99% confidence interval approximately is between 0.0511 and 0.3459. A shape parameter at 99% confidence interval approximately is between -0.5397 and 1.1910.



Source: Computed Result

Figure 4.20: Profile Log-Likelihood for GEV 20-year Return Level and Shape Parameter at 90% Confident Interval from Fit Annual Maximum Loss Return

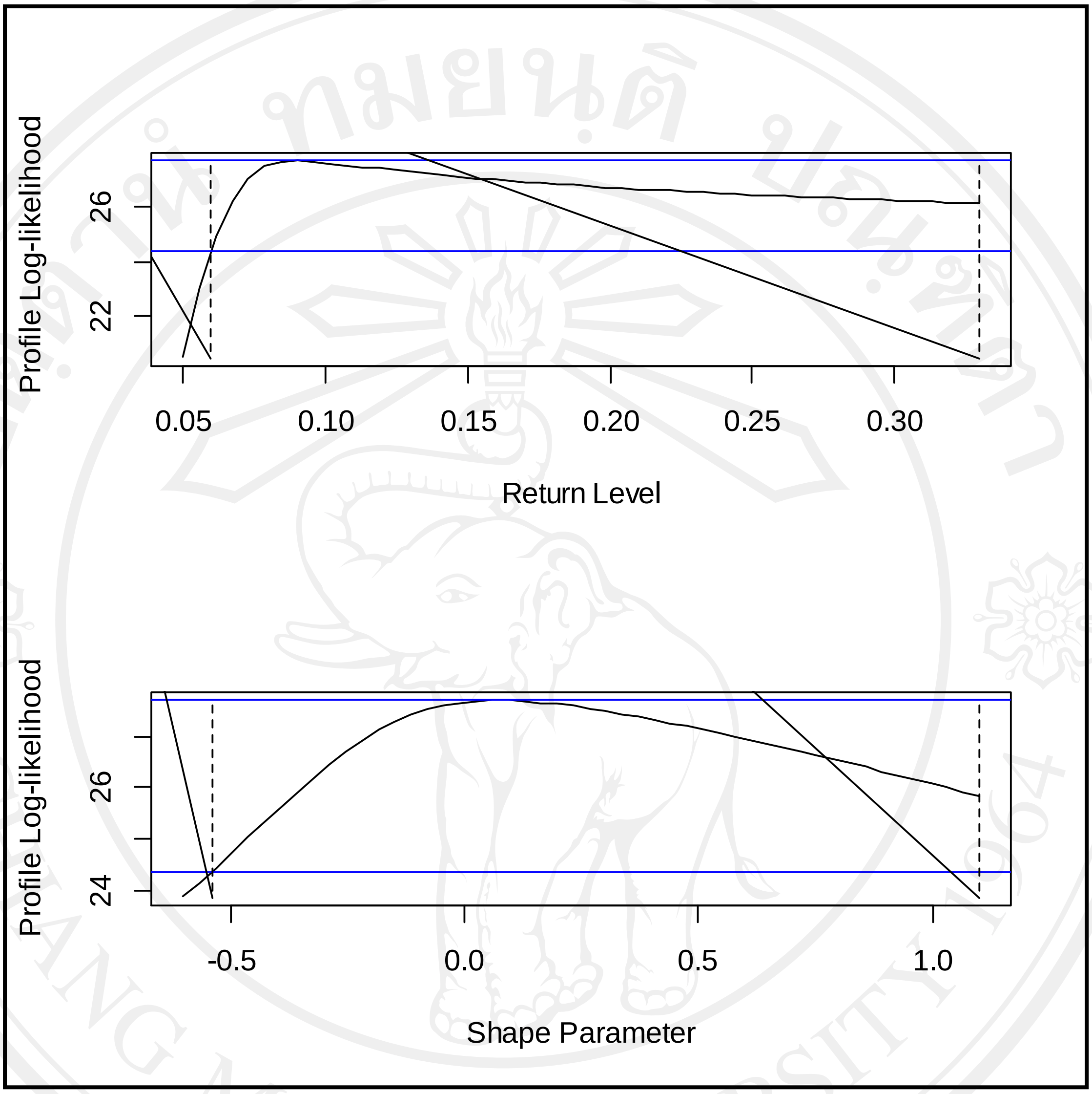
The profile log-likelihood for GEV 20-year return level and shape parameter at 90% confident interval from fit annual maximum loss return shows as figure 4.20. The estimated return level is 0.0895 and estimated (MLE) shape parameter is 0.0754 in accordance with table 4.4. Moreover, a 20-year return level at 90% confidence interval approximately is between 0.0676 and 0.2773. A shape parameter at 90% confidence interval approximately is between -0.3038 and 0.8829.



Source: Computed Result

Figure 4.21: Profile Log-Likelihood for GEV 20-year Return Level and Shape Parameter at 95% Confident Interval from Fit Annual Maximum Loss Return

The profile log-likelihood for GEV 20-year return level and shape parameter at 95% confident interval from fit annual maximum loss return shows as figure 4.21. The estimated return level is 0.0895 and estimated (MLE) shape parameter is 0.0754 in accordance with table 4.4. Moreover, a 20-year return level at 95% confidence interval approximately is between 0.0648 and 0.4600. A shape parameter at 95% confidence interval approximately is between -0.3744 and 1.1327.



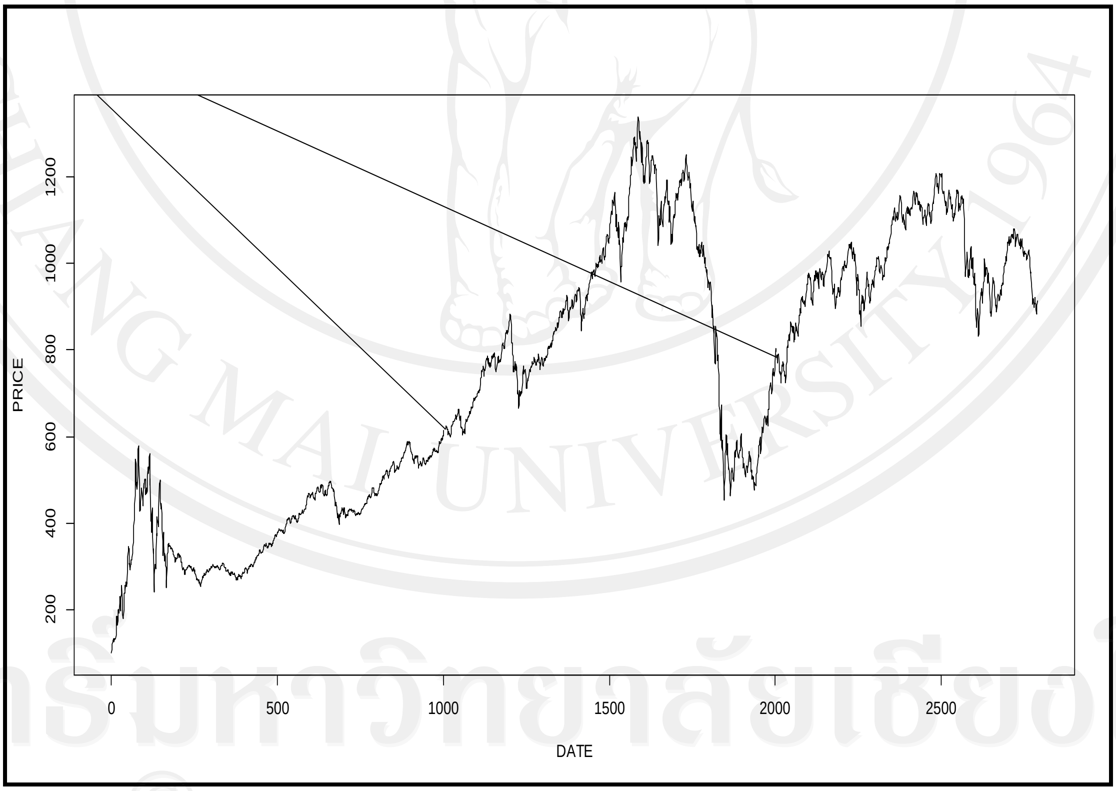
Source: Computed Result

Figure 4.22: Profile Log-Likelihood for GEV 20-year Return Level and Shape Parameter at 99% Confident Interval from Fit Annual Maximum Loss Return

The profile log-likelihood for GEV 20-year return level and shape parameter at 99% confident interval from fit annual maximum loss return shows as figure 4.22. The estimated return level is 0.0895 and estimated (MLE) shape parameter is 0.0754 in accordance with table 4.4. Moreover, a 20-year return level at 99% confidence interval approximately is between 0.0595 and 0.3124. A shape parameter at 99% confidence interval approximately is between -0.5397 and 1.1000.

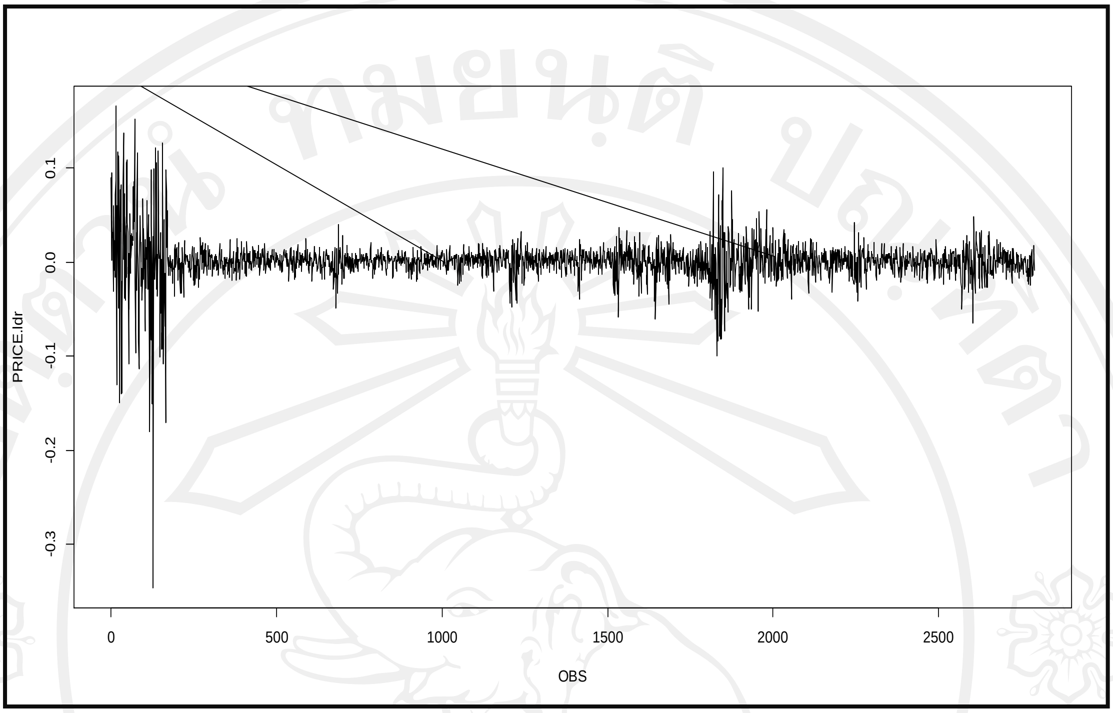
4.2 The empirical result of Generalized Pareto Distribution (GPD)

Extreme value theory is turning out to be increasingly popular in financial applications. Because financial dissolution is determined more by extreme changes in market conditions than by typical ones, this is not surprising. Fig. 4.23 shows the daily closing prices of Asian Emerging Market Morgan Stanley Capital International (MSCI) stock market indices for the period from January 1, 2002 to December 31, 2011. As the closing prices show, the level of the process has changed emphatically over the observation period – the process is non-stationary. Empirical studies in finance advise that an approximation of stationary can be achieved by taking the logarithms of ratios of successive observations (rescaled by 100 for convenience). These log-daily returns show the resulted in figure 4.24. For the analysis we calculate the log-daily return values to focus on extreme declines in figure 4.25.



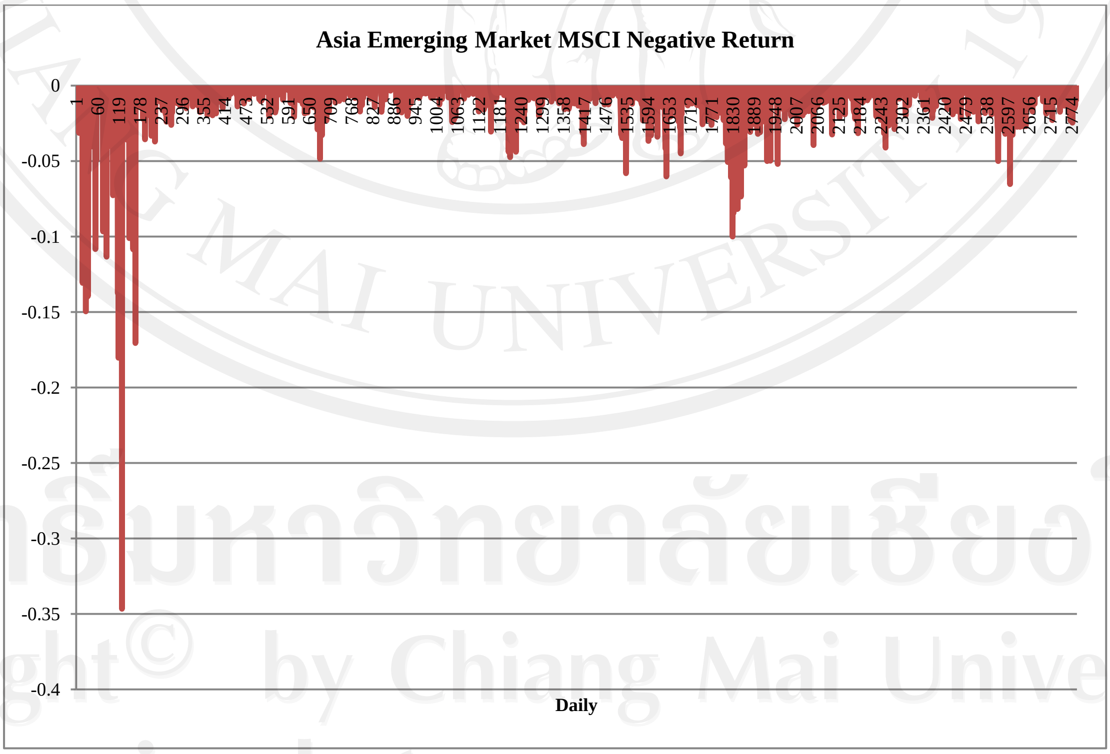
Source: MSCI Inc.

Figure 4.23: Annual Asia EM MSCI Price from 2001 to 2011



Source: Computed Result

Figure 4.24: Daily Asia EM MSCI Percentage Return from 2001 to 2011



Source: Computed Result

Figure 4.25: Daily Asia EM MSCI Negative Percentage Return

Table 4.5: Descriptive Statistics of Daily Asia EM MSCI Returns

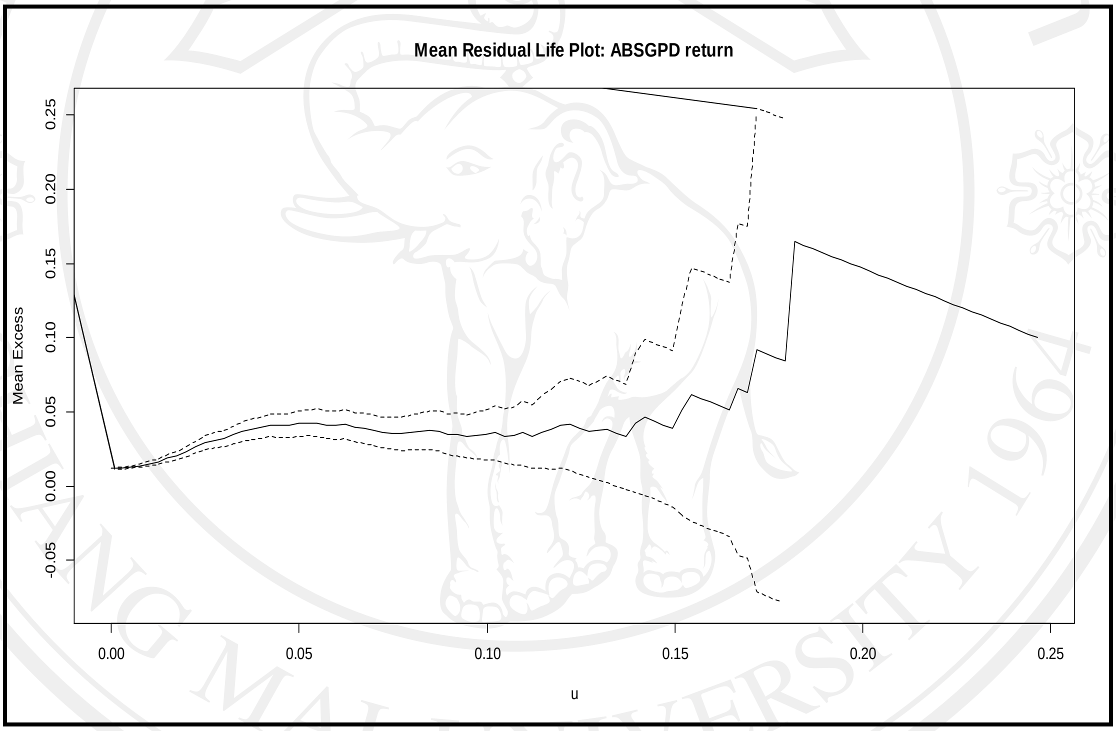
	Daily
Observations	2789
Mean	0.0121
Standard Deviation	0.0184
Minimum	0.0000
1st Quartile	0.0034
Median	0.0071
3rd Quartile	0.0137
Maximum	0.03465

Source: Computed Result

As shown in Table 4.5, it was found that observation of data is 2,789. Mean of the data is 0.0121 and standard deviation is 0.0184. Minimum and Maximum of data are 0.0000 and 0.3465. Median of data is 0.0071. Also, the first quartile and the third quartile are 0.0034 and 0.0137, respectively.

In financial modeling, extreme quintiles of the daily returns are generally referred to as the ''Value-at-Risk'' (VaR) (Coles, 2001; Reiss & Thomas, 2001). VaR is the standard risk measurement used to protect portfolio holders against adverse market conditions and prevent them from taking extraordinary risks. Standard methods for calculating the VaR assume normality of the data; unfortunately, this assumption is often strongly violated as the unconditional distribution of financial time series is known to be fat-tailed. As illustrated below, the GPD threshold model provides a method for estimating the VaR directly and more reliably, and the return level plot graphs VaR against risk (Coles, 2001).

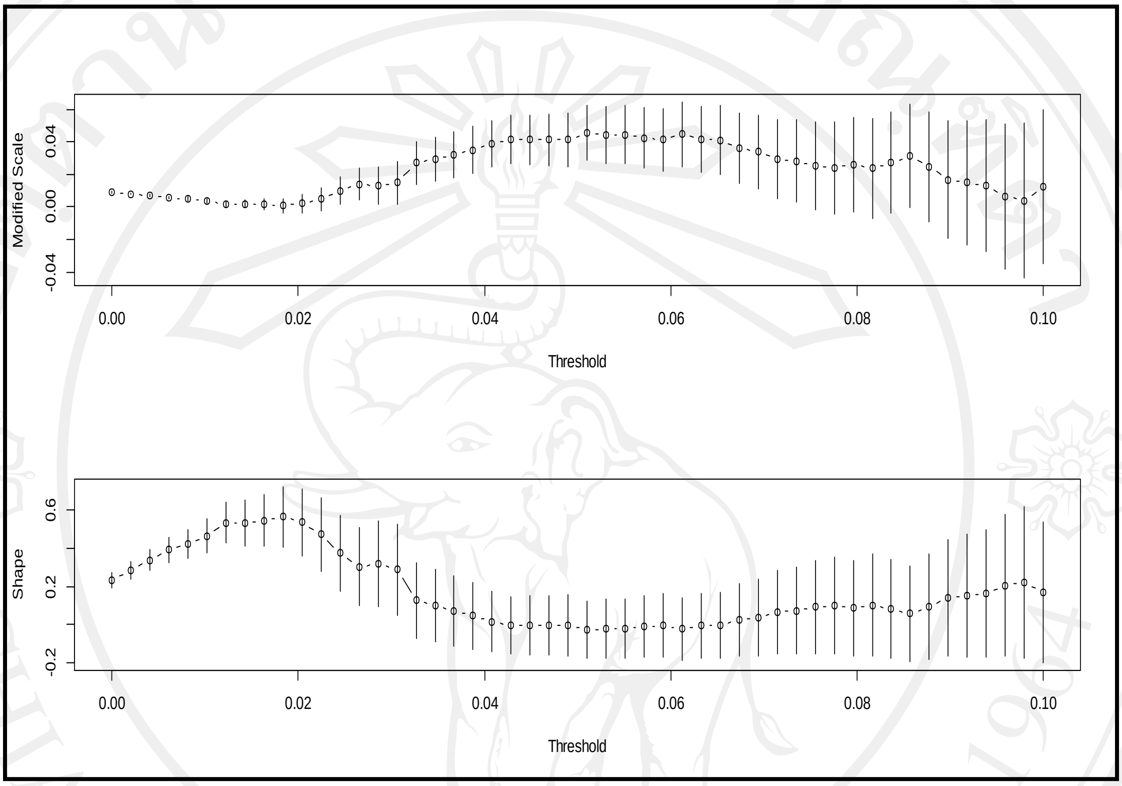
The research analyzes the transformed data using extreme value methods, and in particular threshold exceedence models, to better understand the properties of its extremes. Before proceeding, however, we must first select a threshold level, *u*. The choice of threshold has considerations analogous to those for selection of blocks. Too low a threshold is likely to violate the asymptotic foundation of the model; too high a threshold will generate too few excesses for precise estimation. Ideally, the threshold selected is the lowest possible, while still permitting the limit model to provide a reasonable approximation. Two methods are available for setting the threshold level. One is an exploratory method carried out prior to model estimations the other assesses the stability of parameter estimates for models fit across a range of thresholds.



Source: Computed Result

Figure 4.26: Mean Residual Life Plot for Daily Asia EM MSCI Price Return

The exploratory approach is based on mean residual life plots, which graph the means of the threshold exceedences across a range of values of *u* (threshold levels). At levels of u for which the GPD model is appropriate, the means should change linearly with *u*. Figure 4.26 shows the mean residual life plot with approximate 95% confidence intervals for the daily Asian EM MSCI return. The graph appears to curve from u_0 to $u_{0.25}$, beyond which it is approximately linearity. Accordingly, it might be concluded that there is some evidence for linearity around u_0 to $u_{0.10}$. This suggests a threshold of 0.04 in figure 4.27, which yields 78 exceedences in the series of 2,789 daily observations and 10.215 cases of exceedance rate (per year) on average.



Source: Computed Result

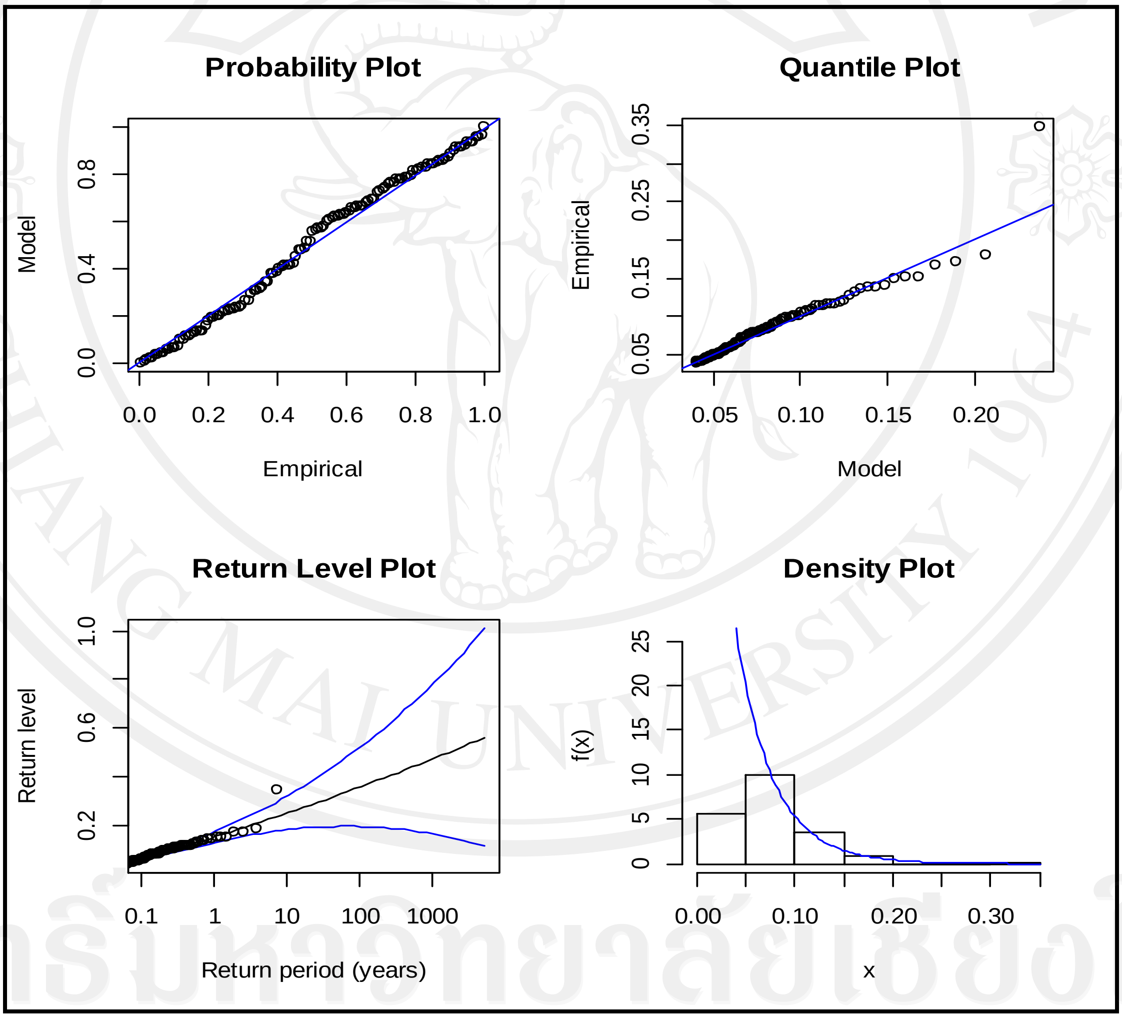
Figure 4.27: Parameter Estimates against Threshold for Daily Asia EM MSCI Price Return

The second, and complementary, according to Castillo et al. (2005) and Coles (2001) technique is to fit the GPD to a range of thresholds and to look for stability in parameter estimates. If the GPD is a good fit for excesses above a threshold, then excesses of a higher threshold, *u*, should also follow a GPD, and the shape parameters, ξ, of the two distributions should be identical. Figure 4.27 plots the values of parameter estimates for scale (σ) and shape (ξ) across a range of possible threshold values, *u*, for the Asia EM MSCI data. The change in the pattern observed in the mean residual life plot for high thresholds is also seen here, but the changes are now seen to be small relative to the 95% confidence intervals. Threshold of 0.04 thus appear reasonable.

Table 4.6: Generalized Pareto Distribution Parameter Estimates from the Daily Asia EM MSCI Price Return

	Parameter	Estimate	Std. Error
Daily Asia EM	Scale (σ)	0.0405	0.0069
MSCI Return	Shape (ξ)	0.0754	0.1276
Negative log-likelihood: -166.1285			

Source: Computed Result



Source: Computed Result

Figure 4.28: Diagnostic Plots for Threshold Model Compared to the Daily Asia EM MSCI Price Return

The results of peak over threshold of negative returns, listed in table 4.6, show the estimates of two parameters σ (scale parameter) and ξ (shape parameter) and the estimates of standard error of the parameters. Maximization of the Generalized Pareto Distribution log-likelihood for the dataset leads to the estimate: σ (scale parameter) is 0.0405, and ξ (shape parameter) is 0.0754 with a corresponding maximized log-likelihood of -166.1285. The standard errors are 0.0069 and 0.1276 for σ, and ξ respectively. The parameter σ the scale parameter ($\sigma > 0$), determining the “wideness” of the distribution, and ξ the all-important shape parameter ($-\infty < \xi < \infty$) which determines the nature of tail behavior of the maximum distribution. From parameters calculation conclude the study that is in line of the theory. The wideness of distribution (scale parameter) equal 0.0405 and tail behavior of the maximum distribution (shape parameter) equal 0.0754 that accordance with the above features. Both of the standard errors close to zero result to a less deviation of the model.

The diagnostic plots for assessing the accuracy of the fitted generalized pareto distribution parameter models are shown in figure 4.28. The near-linearity of the probability plot gives little cause to doubt the validity of the fitted model. The quintile plot does, however, diverge from linearity with the model estimate lower than the two highest empirical values, and as a result, the 95% confidence bounds on the return level plots become quite large for high return periods. The linearity of the return level plot reflects the insignificant estimate for the shape parameter, ξ. The corresponding density estimates seem quite consistent with the histograms of the data. Overall, the diagnostic plots provide reasonable support for the fit of the GPD model.

Given the fit of the model, the parameter estimates (table 4.7) yield the 5-year Value at Risk (measured as a decline in log-daily return) for the Asian Emerging Market MSCI of 0.2257 with 90% confidence interval (0.1860, 0.3299), with 95% confidence interval (0.1808, 0.3690), and with 99% confidence interval (0.1716, 0.4833). The 10-year estimates Value at RRisk of the Asian Emerging Market MSCI is 0.2645 with 90% confidence interval (0.2107, 0.4315), 95% confidence interval (0.2043, 0.4993), and 99% confidence interval (0.1937, 0.7096). The 20-year estimates Value at Risk of the Asian Emerging Market MSCI is 0.3054 with 90% confidence interval (0.2342, 0.4167), 95% confidence interval (0.2265, 0.6727), and

99% confidence interval (0.2138, 1.0419). Thus, once the Asian Emerging Market Morgan Stanley Capital International (MSCI) we should expect to see a negative log-daily Value at risk of between 0.2138 and 1.0419, for the next 20 years, between 0.1937and 0.7096 for the next 10 years, and between 0.1716 and 0.4833 for the next 5 years, in the order from upper and lower bonds in table 4.7.

Table 4.7: The Summary Results of Asia EM MSCI Return Level, Expected Shortfall, and Shape Parameter in Each Period Based on Generalized Pareto Distributions

Categorizes			**5-Year**	**10-Year**	**20-Year**
Return Level			**0.2257**	**0.2645**	**0.3054**
Expected Shortfall			**0.2846**	**0.3266**	**0.3708**
Shape Parameter			**0.0754**	**0.0754**	**0.0754**
90 Percent Confidence	**Return Level**	Lower Bound	0.1860	0.2107	0.2342
		Upper Bound	0.3299	0.4315	0.4167
	Shape Parameter	Lower Bound	-0.8365	-0.0837	-0.0837
		Upper Bound	0.3453	0.3453	0.3453
95 Percent Confidence	**Return Level**	Lower Bound	0.1808	0.2043	0.2265
		Upper Bound	0.3690	0.4993	0.6727
	Shape Parameter	Lower Bound	-0.0920	-0.0800	-0.0800
		Upper Bound	0.4116	0.4116	0.4116
99 Percent Confidence	**Return Level**	Lower Bound	0.1716	0.1937	0.2138
		Upper Bound	0.4833	0.7096	1.0419
	Shape Parameter	Lower Bound	-0.0040	0.0200	0.0180
		Upper Bound	0.4000	0.5562	0.5562

Source: Computed Result

As referred that the log-likelihood estimates are σ (scale parameter) amounts 0.0405 and ξ (shape parameter) amounts 0.0754 in table 4.6. Therefore, this study gives the result of Value at Risk at different values depending on time. First, for the next 5 years, Value at Risk from generalized pareto distributions estimates gives the result as 0.2257%. This implies that, the extreme loss daily 5 years return will exceed to 0.2257% with 1% risk. It means that if the investors invest US$1 million in the Asian Emerging Market MSCI return, the investors are 99% confident that the daily loss at worst will not exceed US$2,257 during one trade day. In other words, the investors are 1% confident that the daily loss will exceed to 0.2257% or US$2,257 during one trade day if the investors have an investment of US$1 million in that market. Then, the expected shortfall which is the average amount that is lost over a given day, assuming that the loss is greater than the 99th percentile of the loss distribution (Artzner, et al., 1999), shows the result as 0.2846% with 99% confidence intervals. It means that the maximum loss in one-day will be 0.2846% with 99% confidence intervals. In other words, if the investors invest US$1 million in the Asian Emerging Market MSCI, the investors are 99% confident that the daily average amount loss over the 99th percentile of the loss distribution is US$2,846.

Second, for the next 10 years, generalized pareto distribution estimates give the result as 0.2645%. This implies that, the extreme daily loss in 20 years return will exceed to 0.2645% with 1% risk. It means that if the investors invest US%1 million in the Asian Emerging Market MSCI return, the investors are 99% confident that the daily loss at worst will not exceed US$2,645 during one trade day. In other words, the investors that are 1% confident that the daily loss will exceed 0.2645% or US$2,645 during one trade day if the investors have an investment of US$1 million in that market. Then, the expected shortfall which is the average amount that is lost over a given day, assuming that the loss is greater than the 99th percentile of the loss distribution (Artzner, et al., 1999), shows the result as 0.3266% with 99% confidence intervals. It means that the maximum loss in one-day will be 0.3266% with 99% confidence intervals. In other word, if the investors invest US$1 million in the Asian emerging MSCI, the investors are 99% confident that the daily average amount loss over the 99th percentile of the loss distribution is US$3,266.

Lastly, for the next 20 years, generalized pareto distribution estimates give the result as 0.3054%. This implies that, the extreme loss in daily 20 years return will exceed to 0.3054% with 1% risk. It means that if the investors invest US$1 million in the Asian Emerging Market MSCI return, the investors are 99% confident that the daily loss at worst will not exceed US$3,054 during one trade day. In other word, the investors are 1% confident that the daily loss will exceed to 0.3054% or US$3,054 during one trade day if the investors have an investment of US$1 million in that market. Then, expected shortfall which is the average amount that is lost over a given day, assuming that the loss is greater than the 99th percentile of the loss distribution (Artzner, et al., 1999), shows the result as 0.3708% with 99% confidence intervals. It means that the maximum loss in one-day will be 0.3708% with 99% percent confidence intervals. In other word, if the investors invest US$1 million in the Asian Emerging Market MSCI, the investors are 99% confident that the daily average amount loss over the 99th percentile of the loss distribution is US$3,708.

The methodology applying the right tails case we change the sign of the returns so that positive values correspond to losses. The research considers the distribution, which allows the determination of the return level. That uses maximum likelihood estimations, which are one of the most common estimation procedures used in practice. Researchers also computed the likelihood-based interval estimates of the parameters and the quantities of interest which provide additional information related to the accuracy of the point estimates. These intervals, contrarily to those based on standard errors, do not rely on asymptotic theory results and restrictive assumptions. Another advantage of the likelihood-based approach is the possibility to construct joint confidence intervals. The profile log-likelihood function can then be used to compute separate or joint confidence intervals for each of the parameters. The function is called the relative profile log-likelihood function.

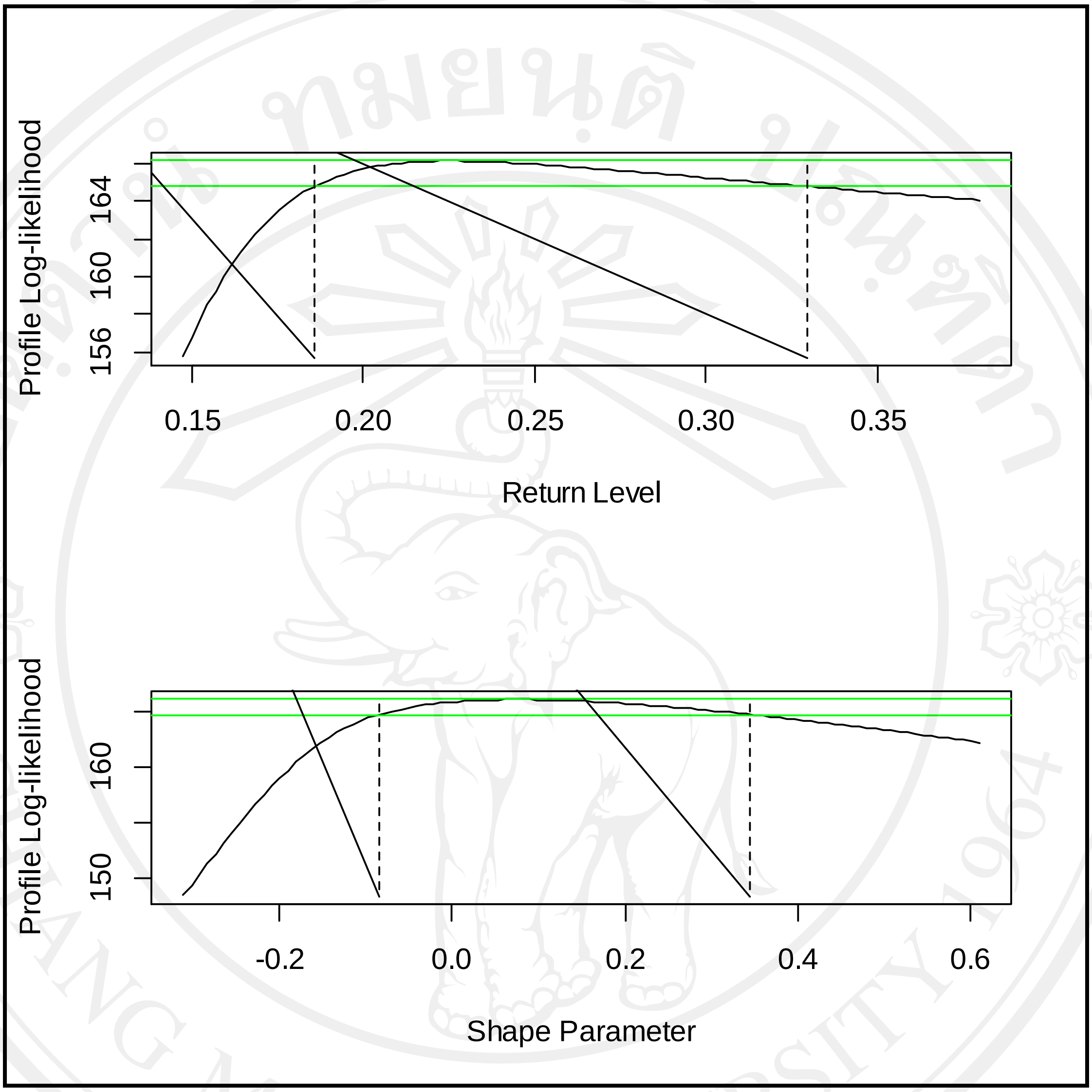


Figure 4.29: Profile Log-Likelihood for GPD 5-Year Return Level and Shape Parameter at 90% Confident Interval

The profile log-likelihood for GPD 5-year return level and shape parameter with 90% confident interval shows as figure 4.28. The estimated return level is 0.2257 and estimated (MLE) shape parameter is 0.0754 in accordance with table 4.7. Moreover, a 5-year return level at 90% confidence interval approximately is between 0.1860 and 0.3299. A shape parameter at 90% confidence interval approximately is between -0.8365 and 0.3453.

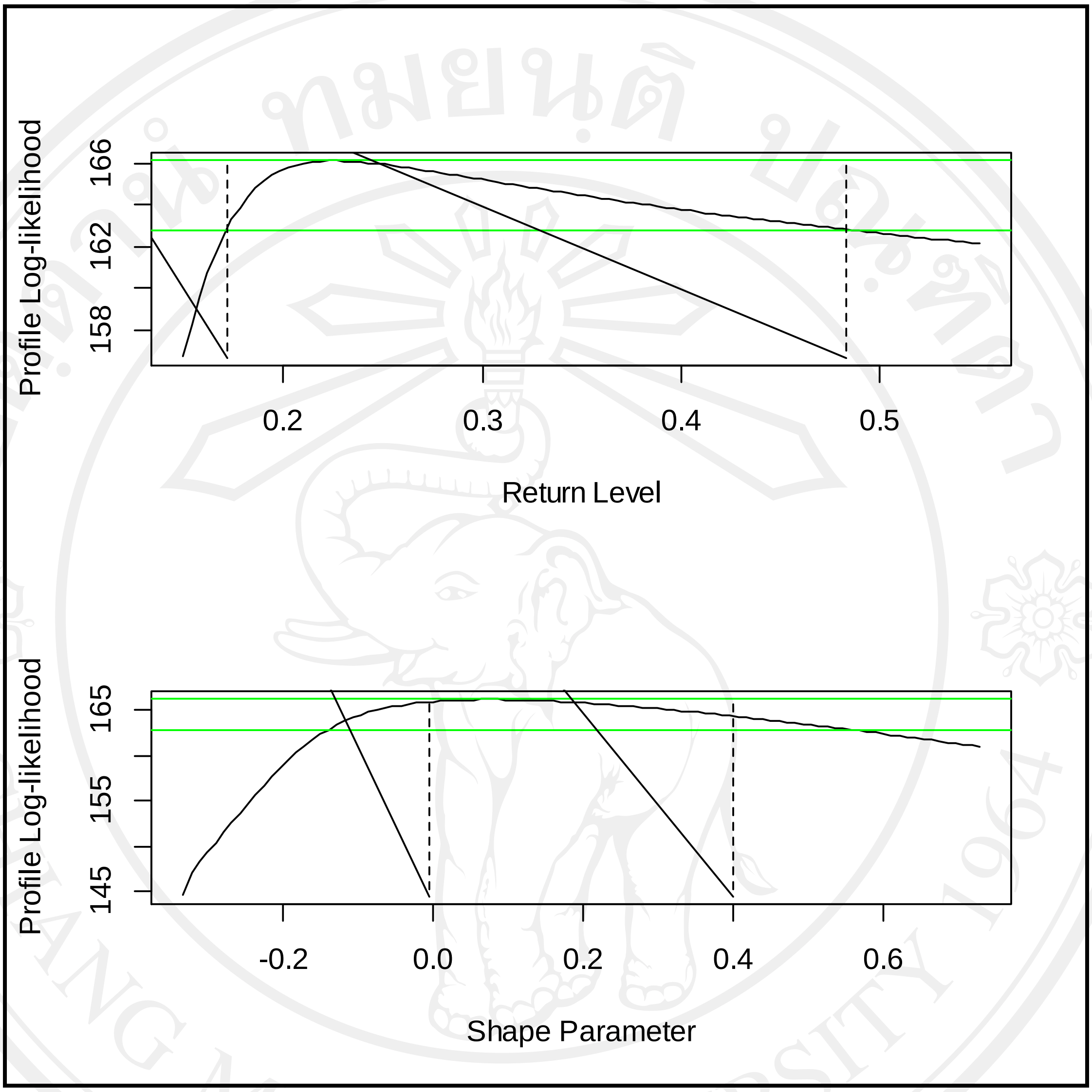


Figure 4.30: Profile Log-Likelihood for GPD 5-Year Return Level and Shape Parameter at 95% Confident Interval

The profile log-likelihood for GPD 5-year return level and shape parameter with 95% confident interval shows as figure 4.29. The estimated return level is 0.2257 and estimated (MLE) shape parameter is 0.0754 in accordance with table 4.7. Moreover, a 5-year return level at 95% confidence interval approximately is between 0.1808 and 0.3690. A shape parameter at 95% confidence interval approximately is between -0.0920 and 0.4116.

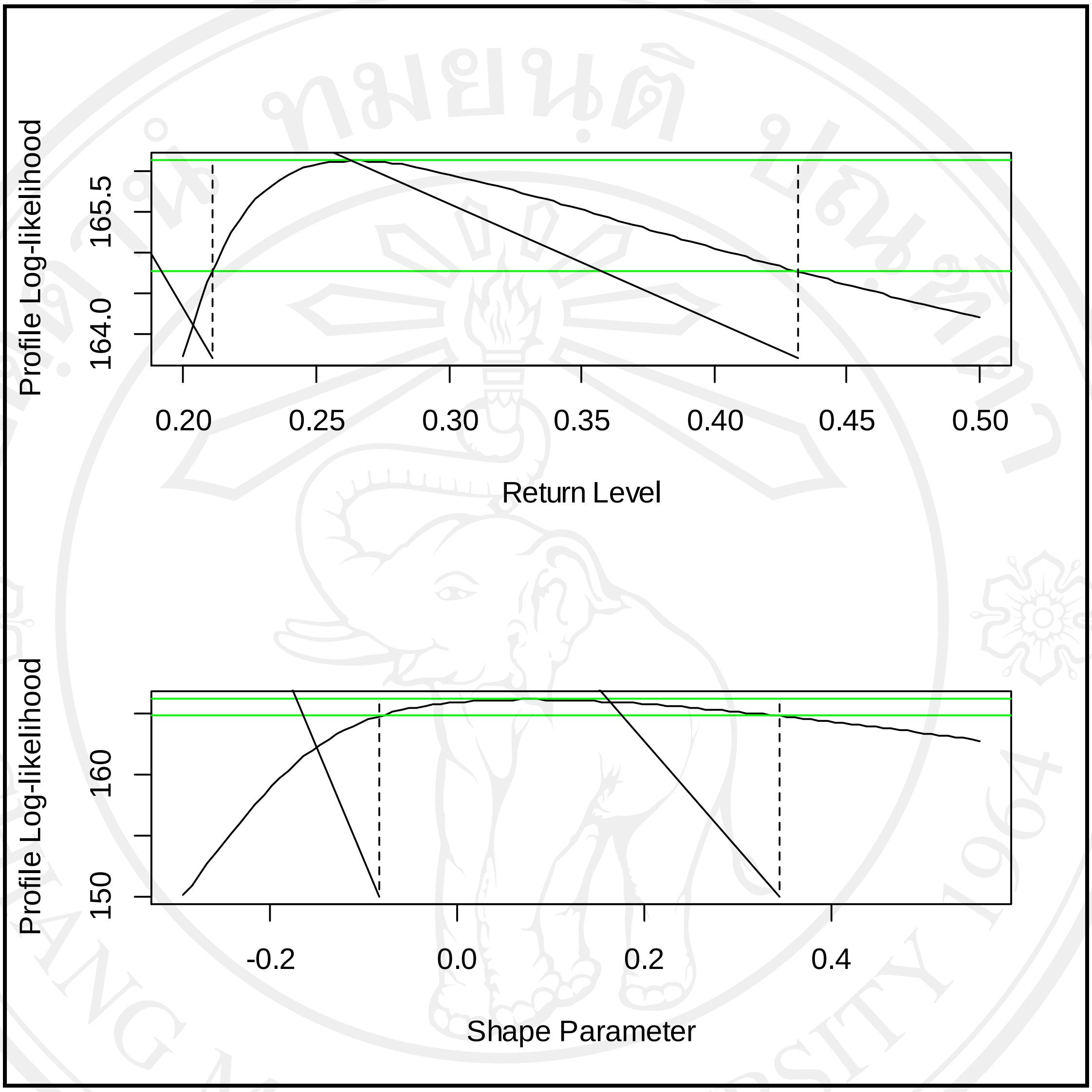


Figure 4.31: Profile Log-Likelihood for GPD 5-Year Return Level and Shape Parameter at 99% Confident Interval

The profile log-likelihood for GPD 5-year return level and shape parameter with 99% confident interval shows as figure 4.30. The estimated return level is 0.2257 and estimated (MLE) shape parameter is 0.0754 in accordance with table 4.7. Moreover, a 5-year return level at 99% confidence interval approximately is between 0.1716 and 0.4833. A shape parameter at 99% confidence interval approximately is between -0.0040 and 0.4000.

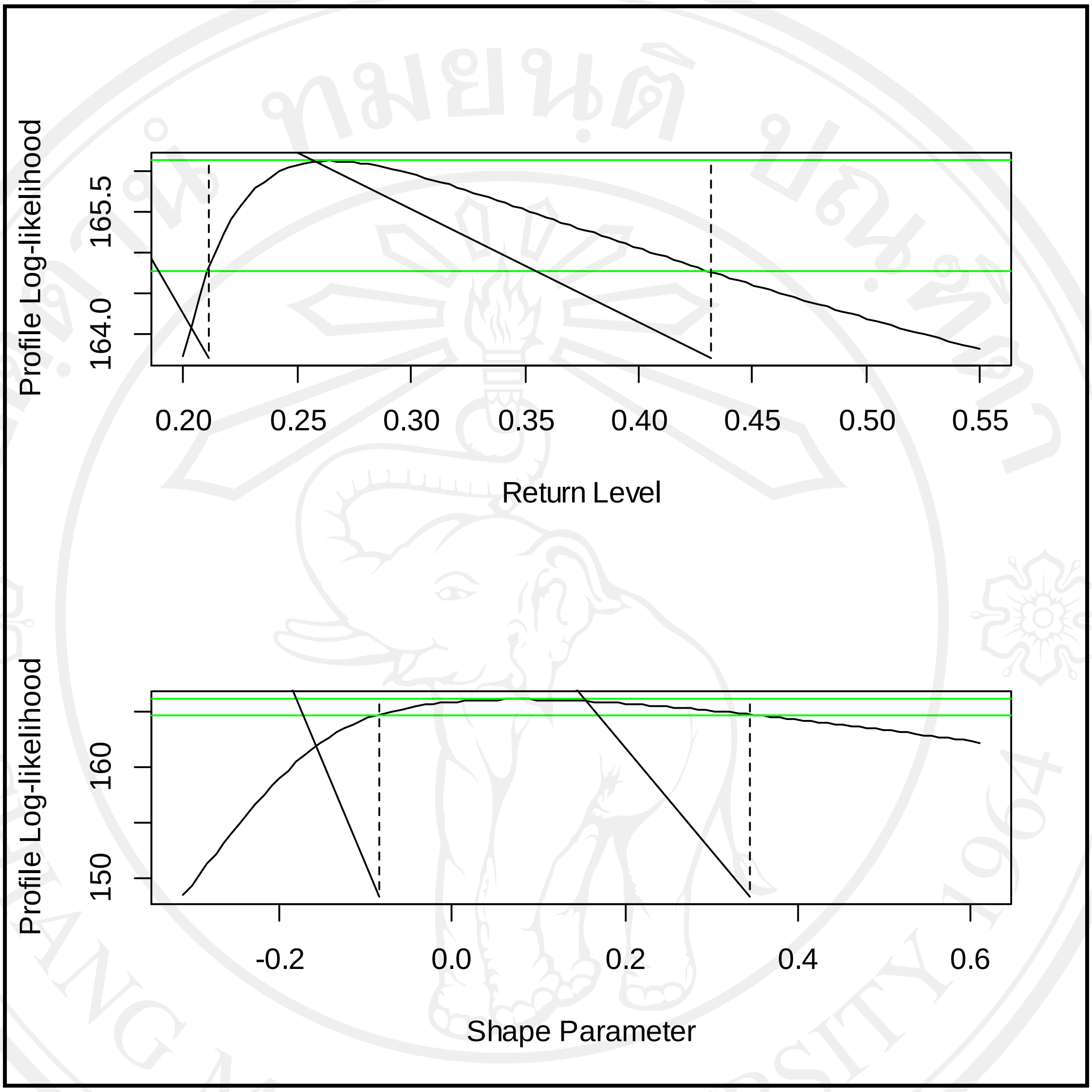


Figure 4.32: Profile Log-Likelihood for GPD 10-Year Return Level and Shape Parameter at 90% Confident Interval

The profile log-likelihood for GPD 10-year return level and shape parameter with 90% confident interval shows as figure 4.31. The estimated return level is 0.2645 and estimated (MLE) shape parameter is 0.0754 in accordance with table 4.7. Moreover, a 10-year return level at 90% confidence interval approximately is between 0.2107 and 0.4315. A shape parameter at 90% confidence interval approximately is between -0.0837 and 0.3453.

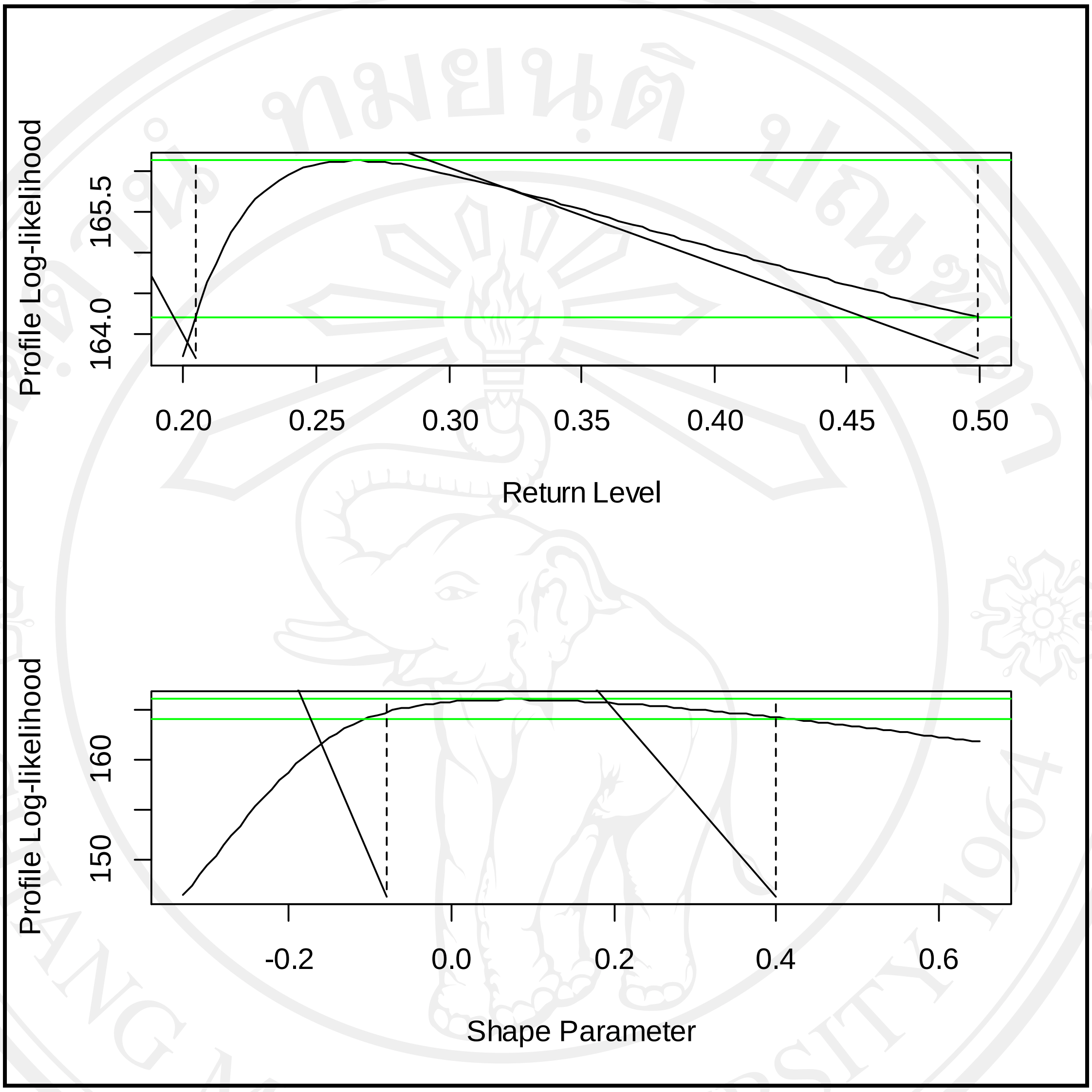


Figure 4.33: Profile Log-Likelihood for GPD 10-Year Return Level and Shape Parameter at 95% Confident Interval

The profile log-likelihood for GPD 10-year return level and shape parameter with 95% confident interval shows as figure 4.32. The estimated return level is 0.2645 and estimated (MLE) shape parameter is 0.3266 in accordance with table 4.7. Moreover, a 10-year return level at 95% confidence interval approximately is between 0.2043 and 0.4993. A shape parameter at 95% confidence interval approximately is between -0.0800 and 0.4116.

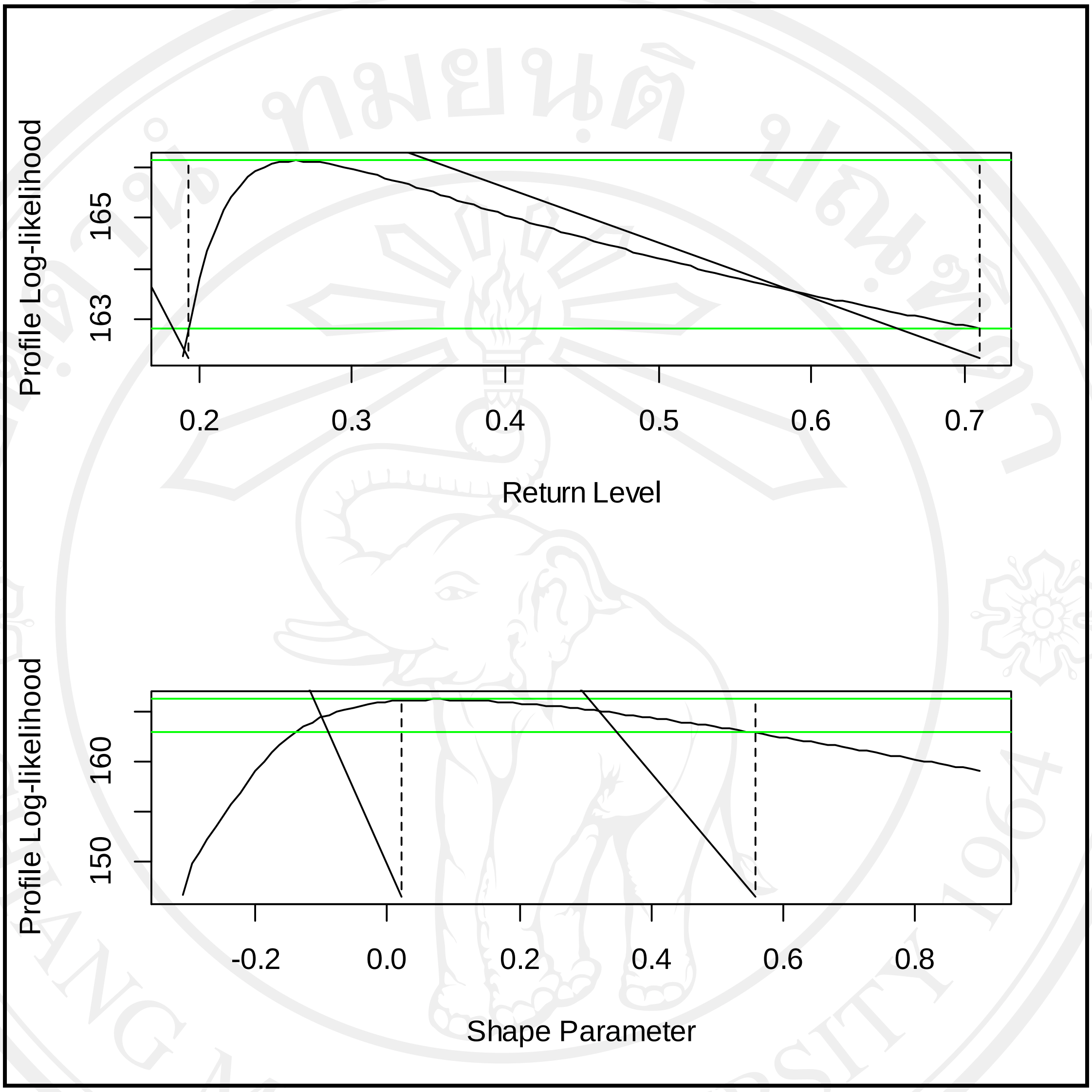


Figure 4.34: Profile Log-Likelihood for GPD 10-Year Return Level and Shape Parameter at 99% Confident Interval

The profile log-likelihood for GPD 10-year return level and shape parameter with 99% confident interval shows as figure 4.33. The estimated return level is 0.2645 and estimated (MLE) shape parameter is 0.0754 in accordance with table 4.7. Moreover, a 10-year return level at 99% confidence interval approximately is between 0.1937 and 0.7096. A shape parameter at 99% confidence interval approximately is between 0.0200 and 0.5562.

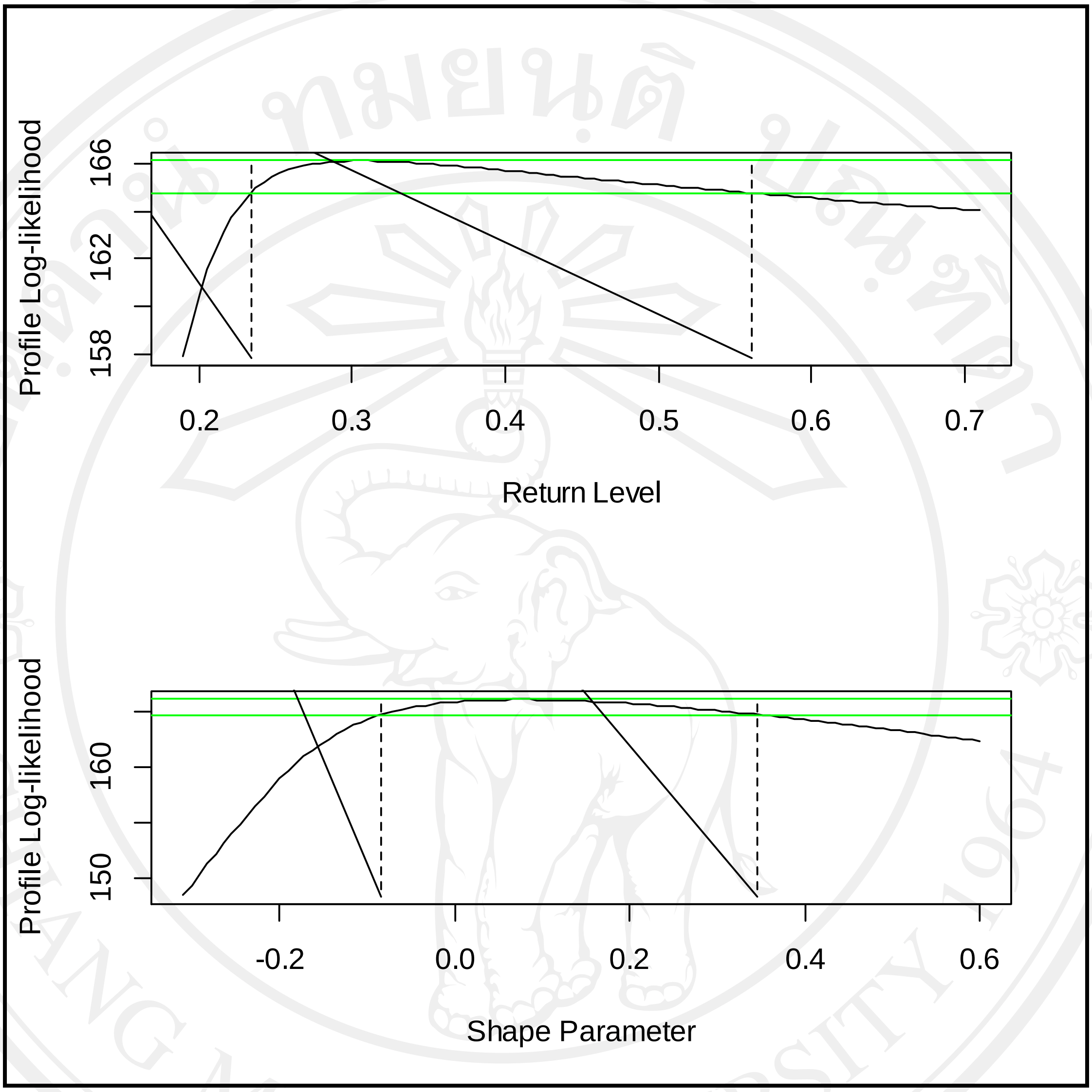


Figure 4.35: Profile Log-Likelihood for GPD 20-Year Return Level and Shape Parameter at 90% Confident Interval

The profile log-likelihood for GPD 20-year return level and shape parameter with 90% confident interval shows as figure 4.34. The estimated return level is 0.3054 and estimated (MLE) shape parameter is 0.0754 in accordance with table 4.7. Moreover, a 20-year return level at 90% confidence interval approximately is between 0.2342 and 0.4167. A shape parameter at 90% confidence interval approximately is between -0.0837 and 0.3453.

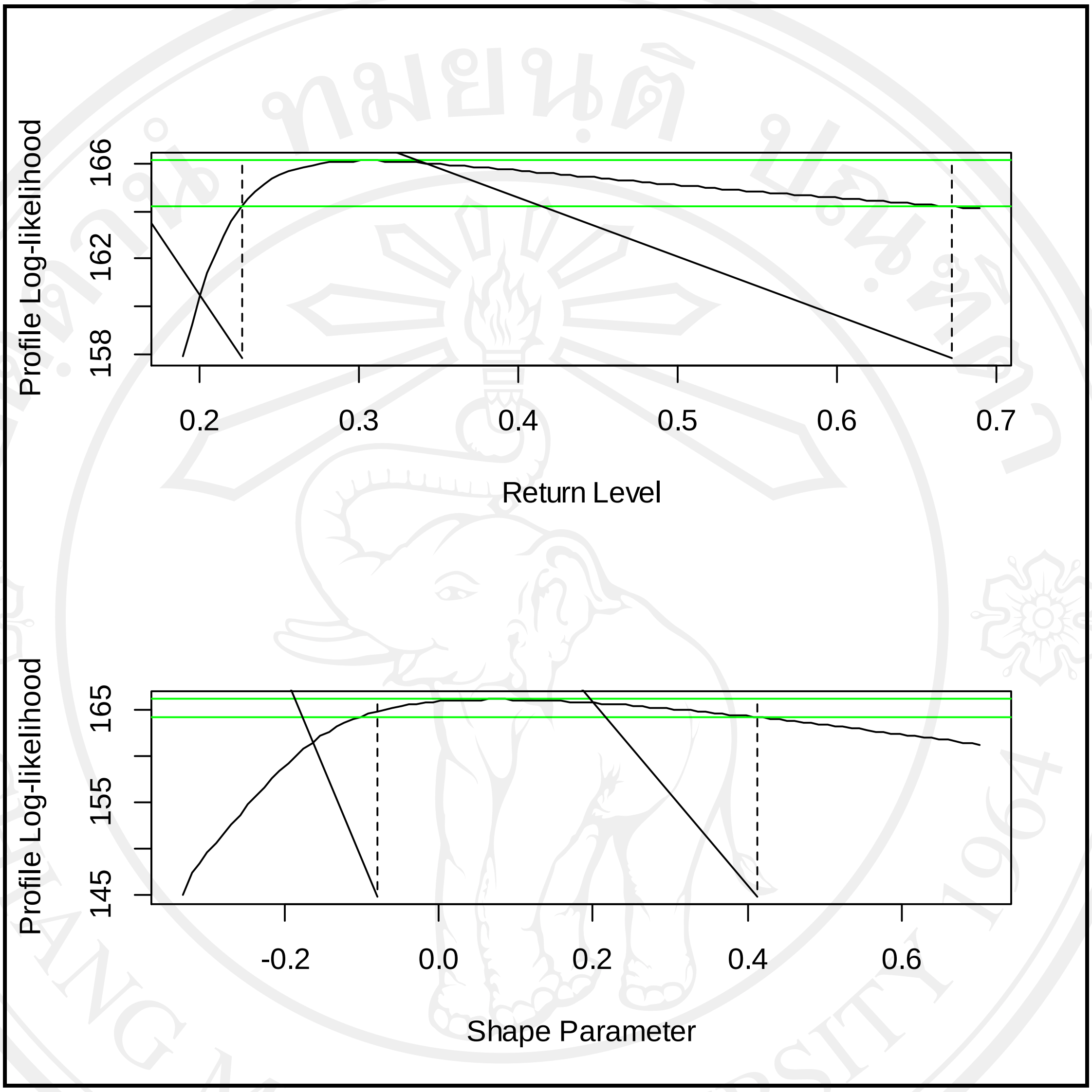


Figure 4.36: Profile Log-Likelihood for GPD 20-Year Return Level and Shape Parameter at 95% Confident Interval

The profile log-likelihood for GPD 20-year return level and shape parameter with 95% confident interval shows as figure 4.35. The estimated return level is 0.3054 and estimated (MLE) shape parameter is 0.0754 in accordance with table 4.7. Moreover, a 20-year return level at 95% confidence interval approximately is between 0.2265 and 0.6727. A shape parameter at 95% confidence interval approximately is between -0.0800 and 0.4116.

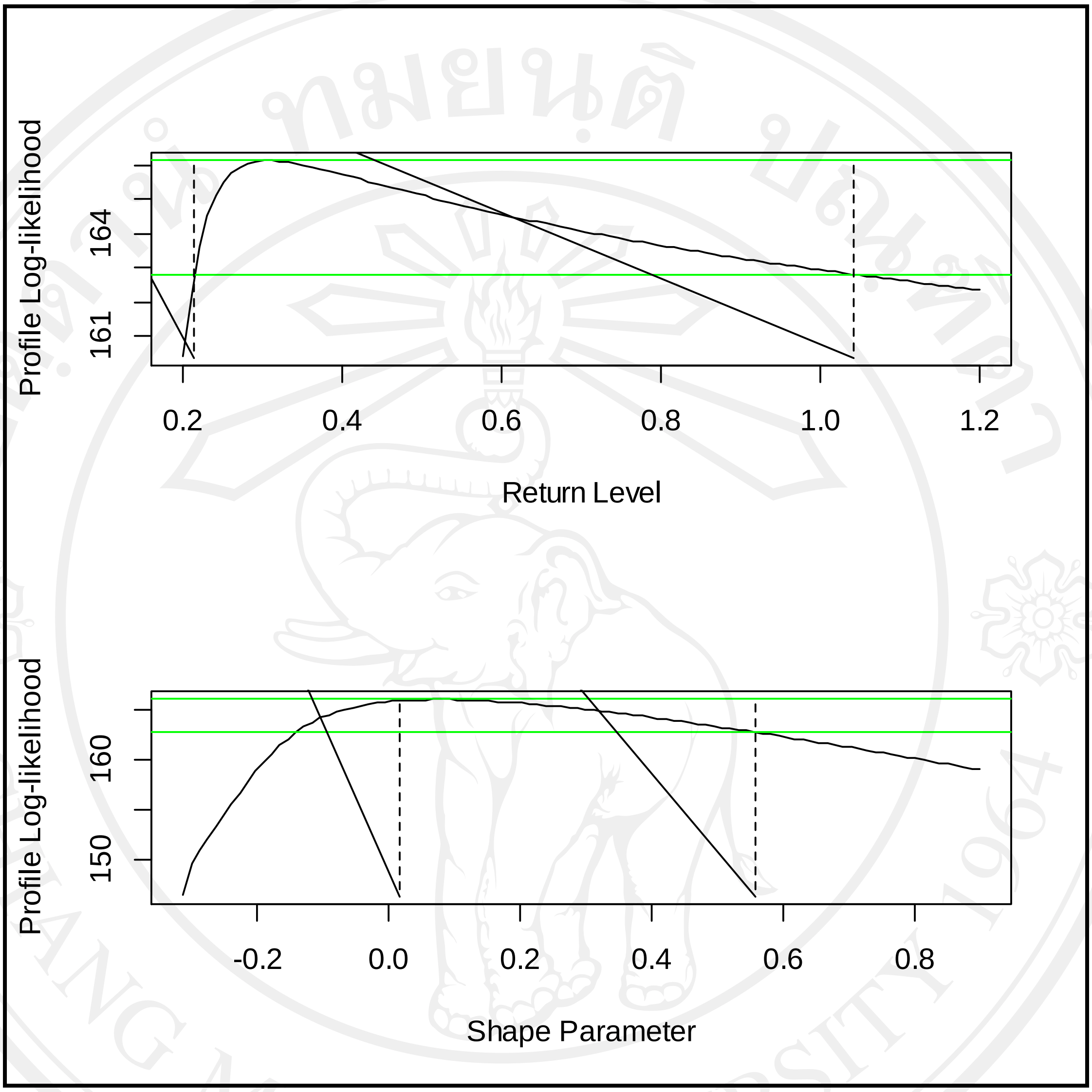


Figure 4.37: Profile Log-Likelihood for GPD 20-Year Return Level and Shape Parameter at 99% Confident Interval

The profile log-likelihood for GPD 20-year return level and shape parameter with 99% confident interval shows as figure 4.36. The estimated return level is 0.3054 and estimated (MLE) shape parameter is 0.0754 in accordance with table 4.7. Moreover, a 20-year return level at 99% confidence interval approximately is between 0.2138 and 1.0419. A shape parameter at 99% confidence interval approximately is between 0.0180 and 05562.