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Analysis on the Risk Alarming of Futures

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Abstract

It is well-known that futures transaction of negotiable securities and stocking are highly risky. How to prevent the risk is very important for the investor. During the actual investment, the capability of controlling risk is often showed through the capability of risk assessment. Up-to-date, many researchers are only limited to study one variable about it. In this paper, based on the actual transaction, discussing many uncertain factors and probability characters, applying extremum theory and considering fully the uncertainty from the price volatilities of futures, the new model of risk alarming is given.

Keywords: Extremum theory, Futures, Risk alarming, VAR method

1. Introduction

Since the breaking out of the 1997 Asian financial crisis, new characteristics of world financial risk have developed (for example the loss of long-term capital management in 1998). The loss is caused not from one kind of risk factor, but from the combination of credit risk and market risk. Financial crisis makes people to pay much attention to the combination of market risk and credit risk and measurement problems of controlling risk. Thus a new theory managing risk, called all-round risk management model, is emphasized. Simultaneously, higher requirement is provided for the technique of protecting from risk and validity of applying models. In order to make risk management objective and scientific, a kind of quantitative analysis technique is adopted in market-risk management. A large number of statistical models are used to identify, measure and inspect the risk. Among the different methods of risk management, VAR method is the most standing-out (Pietro Penza, 2001). It is more appropriate and scientific than traditional risk management. VAR is defined as the maximum predicted loss based on determined confidence level and aiming term. That is to say, VAR records the loss money of all kinds of investment combination at a certain probability level and its properties include providing concluded measurement value and combined future loss, which is showed according to random models. The value depends on the range of selected time and is decided by the selected probability level. The conception of VAR is simple, but it is very difficult to use it properly. The model chosen has much effect on the VAR. Nowadays, some models, such as parametric normal models, historic models, and risk matrix of Morgan Bank and credit matrix system are all based on ordinary financial capital and the risk of formerly created financial equipment. What is more, they are mostly analyzed by only one risk factor and different risk reasons are missed, such as the combination of different risks. Thus it is not enough to measure the total risk. However, in our county, VAR method application is a new field in financial action.

In this paper, joint probability theory is provided, including basic financial variable (such as interest rate, exchange rate, merchandise price, stocking value, futures value), basic financial variable (such as GDP value, spot price) and market risk factors (such as risk of all-round relevant price, operating risk and system web risk). Based on the text of actual futures transaction, we obtain the dependence between investing risk and all affecting factors in order to reduce investment loss, considering many kinds of uncertainty factors affecting up-and-down price and those of probability characteristics, applying multivariate joint probability theory for non-Gauss procedure and different relevance, we obtain the dependence between investing risk and all affecting factors in order to reduce investment loss.

2. Joint Probability Theory

In the course of discussing futures transaction of negotiable securities and stocking, it is necessary to adopt outer loadings in different return periods as basis.

Definition: Return period is defined as month interval, that is equal or surpass average somewhat month occurring once.

Provided that some distribution density function f(x) of random variable's maximum η in one month is showed as Fig.1

<Figure 1>

If

$$p\{\eta \geq x_p\} = p' \tag{1}$$

Written as

$$T = \frac{1}{p'},\ p = 1 - p' \tag{2}$$

Thus, x_p is called the value occurring once in T month. T is called return period and p' is called design frequency. For example, if $p' = 1\%(p = 0.99)$, a mark $x_{0.99}$ can be found, and $T = \frac{1}{0.01} = 100$, $x_{0.99}$ is the value occurring once in hundred month.

In probability statistics, mark in common use is

$$p\{\eta < x_p\} = p \tag{3}$$

Thus, from the relation between p and p', (4) can be obtained.

$$p\{\eta < x_p\} = p = 1 - \frac{1}{T} \tag{4}$$

It is necessary to point out that x_p, that is to say T-month return period, can not stand for only once just in T months and can not assure bankroll is safe when x_p is a design value during the T months. If the maximum of possession value of η in T months is written as ζ_T, then ζ_T is a random variable too. We called the probability that value of ζ_T is less than x_p is assurance rate, written as $P_{insurance}$. As

$$p_{insurance} = p\{\zeta_T < x_p\} \tag{5}$$

From the formula (4), based on binomial probability theory, equation (6) can be obtained

$$p_{insurance} = p\{\zeta_T < x_p\} = p^T = [1 - \frac{1}{T}]^T \tag{6}$$

When T is large enough, $p_{insurance} \approx \frac{1}{e} = 0.368$. That is to say, according to value of x_p, design assurance rate in T months is only 36.8%, and broken rate (dangerous rate) 63.2%. Thus the latter is higher.

In order to make the capital safe in T months, we can obtain x value according to determined T and $p_{insurance}$. x is written as x_p. From the formula (3) $p\{\eta < x_q\} = q$ and $p_{insurance}$'s definition, it can be found to $P_{insurance} = p\{\varsigma_T < x_q\} = q^T$. Such as T=100 month, $P_{insurance}$= 0.90, then $1 - \frac{1}{q} \approx 949$ month. That is to say, in order to assure safety having 90% grasp in 100 months, a 1000 month return level can be used as design criterion.

Definition: Compound extremum distribution is defined as the function $F_0(x)$ consisted of the distribution law of a discrete random variable and the distribution function $G(x)$ of a continuous random variable. Its expression is

$$F_0(x) = \sum_{k=0}^{\infty} p_k[G(x)]^k \tag{7}$$

In actual application, the discrete random variable is usually supposed to agree with Poisson distribution. That is:

$$p_k = \frac{\lambda^k}{k!}e^{-\lambda},\ k = 0,\ 1, \cdots \tag{8}$$

When it is applied to Equation (7), then

$$F_0(x) = exp(-\lambda[1 - G(x)]) \tag{9}$$

Gumbel distribution is a familiar distribution of continuous random variable

$$G(x) = e^{-e^{-\alpha(x-\beta)}} \tag{10}$$

In which: α and β are two parameters of Gumbel distribution, then $\hat{x}_p = F_0^{-1}(1 - p)$.

3. Empirical Analysis

In this paper, the writer selected two groups of data, respectively, which are the weekly highest price and the weekly closing price from January 5, 2007 to January 3, 2008 from rubber 0801 contract, of which the date for settlement is January 2008. The data source is statistical data from the Stock Exchange website.

Let's assume m is a natural number and let m be an observation period. In this observation period, let the number of the data exceeding a certain number be a discrete random variable. Poisson distribution can fit this discrete random variable and $pearson - x^2$ check can do the goodness of fit test.

Based on the logarithmic difference method, the writer transforms the weekly highest price and the weekly closing price of futures contract into weekly logarithmic yield time series. The formula standardizing data is: $r_t = 100 \times \ln(p_t/p_{t-1})$. In which: r_t is logarithmic yield, P_t is the highest price and closing price of futures contracts weekly. On the basis of the above, we get two groups of logarithmic yield data, respectively noted as data I and data II.

< Table 1 >

< Figure 2 >

< Table 2 >

< Table 3 >

When the confidence level is 75% and the threshold is different, the x^2 values are shown in table 4:

< Table 4 >

< Table 5 >

When the continuous random variable agrees with Gumbel distribution, the effect of data fitting is shown as follow:

< Figure 3-6 >

Let's assume that exchange controls risk alarming at the two different probabilities of margin consuming, which are 5% and 1%, respectively. The calculated results are shown in Table 6. From table 6, we can see if the probability of margin consuming is 1%, the average margin levels calculated from compound extreme value distribution and extreme value distribution are both greater than 5%, and if the probability of margin consuming is 5%, the margin levels calculated from data I and II are respectively 6.96% and 6.20%. If applying the same method to soybean commodity futures (in Table 7), we will see the margin level of rubber futures with larger price fluctuation is much greater than soybean's.

< Table 6 >

< Table 7 >

4. Conclusion

(1) In this paper, based on various factors impacting financial risk and their related impact, the writer solves the VAR problem. By comparing the varieties of futures with the property of non-Gaussian and different relevance, the writer sets up a new risk alarming model of futures. The new model takes the uncertainty of price volatilities into account, so it improves the current VAR method with single factor, which is commonly used in financial risk analysis.

(2) In this paper, the risk alarming model of futures built on the example of rubber futures can be applied to other varieties of futures. In particular, it can be applied to the risk alarming of upcoming stock index futures. In the application, what only need to do is inputting the data from different risk sources, and then the analysis and the risk alarming will be finished.

References

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Table 1. Basic Statistic of yield

	mean	standard deviation	skewness	kurtosis	variance
Data I	0.5097	3.5177	-0.1401	2.9969	12.3743
Data II	0.5996	3.3273	-0.0014	3.8897	11.0711

Table 2. Poisson distribution fitting data I

Number of exceeding the threshold in a observation period		0	1	2	3	4	$\hat{\lambda}$
Threshold	mean+var/2=2.9846	2	4	2	3	1	1.7500
	mean+var/3=4.6345	5	5	2	0	0	0.7500
	mean+var/2=6.6968	10	1	1	0	0	0.2500

Table 3. Poisson distribution fitting data II

Number of exceeding the threshold in a observation period		0	1	2	3	4	$\hat{\lambda}$
Threshold	mean+var/5=2.8138	3	4	3	2	0	1.3333
	mean+var/3=4.2900	5	5	2	0	0	0.7500
	mean+var/2=6.1351	10	2	0	0	0	0.1667

Table 4. x^2 values with different threshold

Threshold		mean+var/5	mean+var/3	mean+var/2
χ^2	I	0.2328	0.0991	0.0896
	II	0.0310	0.0991	0.0039

Table 5. Parameters estimated of Gumbel distribution

	Data I	Data II
α	0.3556	0.3760
β	-1.0893	-0.9128

Table 6. Margin level of natural rubber (%)

	Probability of margin consuming	Margin level calculated from compound extremum distribution（%）	Margin level calculated from extremum distribution（%）
Data I	5%	6.96	7.26
	1%	11.6	11.8
Data II	5%	6.20	6.99
	1%	10.6	11.3

Table 7. Margin level of soybean (%)

	Probability of deposit consuming	Margin level gotten from compound extremun distribution（%）	Margin level gotten from extremum distribution（%）
Data I	5%	5.06	4.27
	1%	7.44	6.63
Data II	5%	4.26	3.99
	1%	6.44	6.15

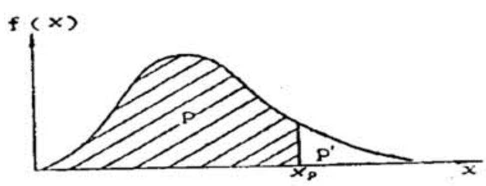

Figure 1.

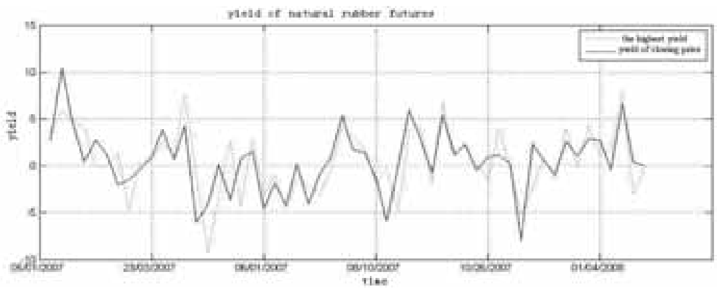

Figure 2. The Futures Logarithmic Yield of Data I

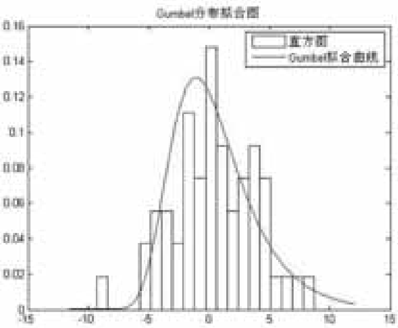

Figure 3 The Graph of Gumbel probability density function fitting data Ⅰ

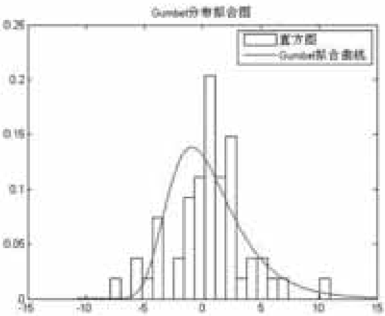

Figure 4 The Graph of Gumbel probability de function fitting data Ⅱ

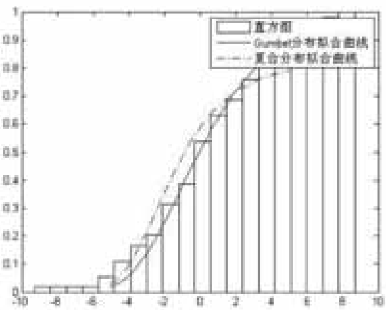

Figure 5 The Graph of Gumbel distribution function fitting data Ⅰ

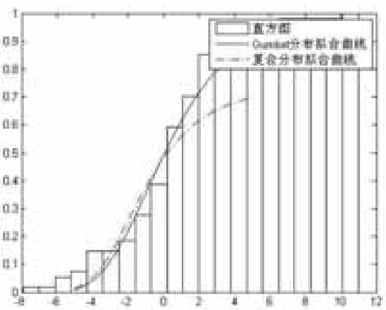

Figure 6 The Graph of Gumbel distribution function fitting data Ⅱ