THE VALUE AT RISK (VAR) IN THE BANKING SYSTEM OF AZERBAIJAN

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Abstract

Value at risk was calculated on the GAP between loans and deposits of the banks of the Azerbaijan banking system with 95% of confidence level and holding periods for 10 days. The average interest rates of loans were taken as risk factor in calculating of VAR. In statistics analysis, it was defined that, exchange rate of USdollars against Azerbaijan manat which is one of the market risk factors don`t follow the normal distribution. Calculation of VAR of these banks wasn't possible by reason of the very risk factor. However, it was defined that, the average interest rate of the loans follow the normal distribution and this risk factor can be used in calculating of VAR. Normal distribution was substantiated by χ^2 test statistics.

Key words: Value at Risk (VAR), χ^2 test statistics, normal distribution, market risk, standard error, holding period, observation frequency, expected frequency.

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Introduction

As the future results of banking operations are unknown they are always under the possible risks. In other words the risk is related to future expectations, its management and estimation assumes a vital importance. Banks always confront with some losses. However, we cann't call all kind of losses as risk. In other words, the losses expected by banks aren't the risk. The risk is such loss which banks doesn't expect it **[1, p.6]**. How much money do banks need for covering the unexpected losses? It is very important question for the banks. Banks are operating in the framework of mutual relations in the modern world economical system. Consequently, risky operations held by one bank may influence to the overall banking system of the country. If bank hasn`t got a sufficient fund for providing the depositors' demands, it may cause the bank run. Bank run is a majority of depositors' demands at the same time. Even, information about imminence of lack of liquidity in one bank may be spread and it may cause to the other banks run. Unless this problem is regularized, the process may develop on a mass scale and it causes the bank panic. That is why; the regularization of banks' activities is very urgent problem. The regularization of bank has following purposes:

- To provide the activity of banks in accordance with prudence norms,
- To mitigagate the system risk, implemenatation of support mechanism which covering of the system **[2, p. 71]**.

Bank for International Settlements was founded to adjust of the world banking system on Bazel, Switzerland in 1930. 55 central banks of the world have joined Bank for International Settlements. At the end of 20th century Hestatt Bank of Germany became bankrupt and it influenced very badly international financial market. In 1974, petrol crisis happened to the rise in price of petrol made by OPEC. These two actions caused to establishing of Basel Committee on Banking Supervision by Bank for International Settlements. VAR is a main tool in the risk management at banks. Calculation of unexpected losses and also mitigation of the risk can be succeeded by means of this tool.

1. Theory and methodology of the calculation of VAR.

Everyone resembles the Moon. One has an obscure side and doesn`t show oneself to anybody.

Mark Twain ***[3, p. 305]***

As it is mentioned above, VAR calculation assumes a great importance in risk management. And what does VAR mean? VAR expresses the maximum losses may be appeared in certain confidence interval within certain holding period. In other word, if VAR is defined 100 thousand manat in 99% confidence interval and within 10 days as holding period, it means that VAR of bank for next 10 days may be more than 100 thousand manat with probablity of 1%. This information is useful for covering of the unexpected losses of banks in future. In generaly, the risks are classified in three groups:

1. Market risk
2. Credit risk
3. Operational risk

VAR model is mostly used in analyzing of market risks. VAR model is grounded on the basis principles of statistics. Therefore in first the statistic analysis should be applied to the statistic series used in modelling of VAR. In the same time the statistic series have to follow the normal distribution. If the risk factor doesn`t follow the normal distribution, so the calculated VAR will give the incorrect information and it will increase the risk in banks. Theoretically normal distribution is tested by Jarque-Bera value **[3, p.155]**. In other way, we can use chi-square test (Fit test) statistic for testing of normal distribution **[4, p.87]**. Jarque-Bera value is formulated as following:

$$JB = n\left[\frac{S^2}{6} + \frac{(K-3)^2}{24}\right]$$ **[5, p.148]** 1.1

Where,

n- Simple size

S- Skewness coefficent

K- Kurtosis coefficent

If K=3, S=0 in equation 1.1, Jarque-Bera value will equal to 0 (zero). It shows that, statistic datum follow the normal distribution.

The following information may be usefull:

If skewness coefficent = 0; distribution is symmetric.

If skewness coefficent < 0; distribution inclines to right.

If skewness coefficent >0; distribution inclines to left.

If kurtosis coefficent =3; distribution is a normal.

If kurtosis coefficent < 3; normal curve is sharp.

If kurtosis coefficent >3; normal curve is flat and wide.

Asymptotically, JB statistic follows the chi-square distribution with 2 d.f (Degree of freedom). But, in our task the chi-square distribution is 7 df. That is why; we must test the chi-square criterion. The chi-square criterion is defined as following:

$$\chi^2 = \sum_{i=1}^{k} \frac{(O_i - E_i)^2}{E_i} \quad \textbf{[6, p.92]} \qquad 1.2$$

Where,

O_i- observed frequency for category i

E_i- expected frequency for category i

k- Number of categories

The expected frequency is calculated by

$$E_i = n(F(Y_u) - F(Y_l)) \qquad 1.3$$

Where,

F- Cumulative distribution function,

Y_u- Upper limit for category i,

Y_l- Lower limit for category i,

n- Sample size.

Note: the expected frequency for each category must equal to 5 or more. If necessary, the adjacency categories may be combined.

We can calculate χ^2 (Fit test) value with the equality in 1.2.

Acceptance or rejection of the hypothesis of H_0 is determined after calculated the value of χ^2 (Fit test) by equation 1.2 and then it is compared with the critic value shown in statistic tables. Application of Fit tests and Hypothesis can be pointed in summary as following: **[7, p.461, 462]**.

1. To set the *zero* and *alternative* hypothesis;

H_0: Probabilities of elements of each *k* interval which determined via observations characterize the existing probabilities in the population.

H_a: Probabilities of elements of each *k* interval which determined via observation don`t characterize the existing probabilities in the population.

2. The observation frequency O_i of each interval is found on based of obtained datum.

3. Suppose that hypothesis of H_0 is correct and the expected frequency is calculated (in the population) for each interval by means of probability (p_i) for each interval multiplied by number of observation (n).

4. The value of statistic test is calculated by equation (1.2).

5. Determining of rejection or acceptance of the hypothesis. This matter is fulfilled in two directions.

a) Probability value approach (p-value approach):

If $p \leq \alpha$, H_0 is rejected.

b) Critic value approach:

If $\chi^2 \geq \chi^2_\alpha$, H_0 is rejected.

α =*(k-c)* is the level of importance with degree of freedom. In calculation of degree of freedom *k*– number of determined intervals, *c*= estimated number of parameters of the tested distribution and it is taken as + 1 **[6]**. For instance: If the number of intervals is 20, after this we test the statistic series whether they follow the normal distribution or not, then c=2+1 and the degree of freedom (d.f) will be =20-3=17.

After determined the normality or asymptoticness of statistic series taken as risk factors then we can start to calculate the VAR which assumes a great importance in risk management. First of all it should be noted that there are 3 methods in calculation of VAR: **[3, p.308, 309]**.

1. Parametric or Variance-Covariance method
2. Monte-Carlo method
3. Historical simulation method.

We investigate the matter on based of parametric method. Calculation of VAR is mostly depended on level of confidence, holding period, given value, the parameters of risk **[1, p.80]**.

1. **Confidence level:** This parameter determines that by which probability the unexpected losses will not exceed the value of VAR wherein the level of confidence is accepted at the beginning and its value is taken from Z-statistic and inputted to the calculation.
2. **Holding period:** It points how long the value inputted to calculation will hold. In international practice this parameter is mostly admitted for 1 or 10 days and inputted to the calculation as a square root of admitted number of days. **Datum series:** By standpoint of statistics the more these series cover the long period the better results will be succeed in.
3. **Risk factors:** While calculating of market risk the interest rate and exchange rate are basically taken as main risk factor.

VAR used mainly in calculation of market risk is formulated as the following equation. **[3, p.167]**.

$$VAR = Z * \sigma * \sqrt{t} * V \quad (1.4)$$

Here, *Z*- is the statistic table index of confidence interval admitted beforehand, σ- daily standard error of risk factor, *t* – holding period, *V*- the value of portfolio.

Daily standard error of risk factor is usually calculated on yearly basis. Transition from yearly standard error to monthly, quarterly and daily ones is implemented. **[3, p.152]**. If yearly standard error is known, then

$$\sigma_{daily} = \sigma_{yearly} * \frac{1}{\sqrt{252}} \quad (1.5)$$

$$\sigma_{monthly} = \sigma_{yearly} * \frac{1}{\sqrt{12}} \quad (1.6)$$

$$\sigma_{quarterly} = \sigma_{yearly} * \frac{1}{\sqrt{4}} \quad (1.7)$$

VAR of a portfolio is determined by aforementioned equation (1.4). VAR of two portfolios is different from VARs calculated on each portfolio in separately. Because while calculating of VAR of two portfolios the main determinative factor among risk factors is a attitude of correlation and when it gets a positive or negative mark VAR will change towards decreasing in or increasing in. If we calculate the portfolio VAR having two factors A and B, the value of σ shown in equation 1.4 is calculated as following: **[3, p.167]**.

$$\sigma = \sqrt{\omega_A^2\sigma_A^2+\omega_B^2\sigma_B^2 + 2\rho_{AB}\omega_A\sigma_A\omega_B\sigma_B} \quad (1.8)$$

Here, ω- special weight of proper risk factor in total portfolio, σ- daily standard error of proper risk factor, ρ- available correlation among risk factors.

Sometimes the portfolio of a bank is exposed number of risk factors "n" and it rise importance for bank in practically to calculate the VAR on whole risk factors. Notwithstanding the portfolio of a bank is undergone to either one or two or also number of *n* risk factors, VAR is calculated by equation 1.4. But differences appear in determination of quantity of σ. Determination of quantity of σ for portfolio having two factors is given by equation 1.8. Let`s draw our attention to the determination of quantity of σ for estimating VAR of portfolio consisting of *n* risk factors. The quantity is calculated as below mentioned **[3, p.312]**.

$$\sigma^2 = [\omega_1, \omega_2, \dots, \omega_n] * \begin{bmatrix} \sigma_{11}, \sigma_{12}, \dots, \sigma_{1n} \\ \sigma_{21}, \sigma_{22}, \dots, \sigma_{2n} \\ \dots \dots \dots \dots \dots \dots \dots \\ \sigma_{n1}, \sigma_{n2}, \dots, \sigma_{nn} \end{bmatrix} * \begin{bmatrix} \omega_1 \\ \omega_2 \\ \vdots \\ \omega_n \end{bmatrix} \quad (1.9)$$

$$\sigma_{ii} = \sigma_i^2 \quad (1.10)$$

$$\sigma_{ij} = \rho_{ij}\sigma_i\sigma_j \quad (1.11)$$

Here, ω- special weight of proper risk factor in total portfolio, σ- daily standard error of proper risk factor, ρ- available correlation among risk factors.

2. Value at risk (VAR) emanated from exchange rate and interest rate risk.

Exchange risk factor.

Unlike other economical fields banks earn their profits through financial funds drawn from outside which it becomes the source of great risks. Contemprorary banking system always faces to market risks. Determination of market risk factors and calculation of unexpected risks come from these ones conveys a vital importance for banks. Mainly exchange and interest rate should be taken as market risk factors in Azerbaijan banking system. This research work involves the indicators of banking system of Azerbaijan utilized of them in commonly and have made effort to determine the VAR over the country in generally. In previous section includes theoretical-methododical remarks those determine the quantities admitted as risk factor by standpoint of whether they follow the normal or asymptotic distribution which will be used in calculating of VAR. In first let`s look at the exchange rate factor. Floating-regulating exchange rate regime is being implemented in Azerbaijan. Statistic datum of exchange rate of 1 US dollar against the Azerbaijan manat has been taken for the period beginning from January 2005 until June 2012. Statistic series of exchange rate factor was given in table 2.1.

Table 2.1. Statistic datum on exchange rate[1]

Date	Average exchange rate	Date	Average exchange rate	Date	Average exchange rate	Date	Average exchange rate
2005:01	0.981982	2007:01	0.87340000	2009:01	*0.80550000*	2011:01	*0.79860000*
2005:02	0.98125800	2007:02	*0.87130000*	2009:02	*0.80910000*	2011:02	0.79630000
2005:03	0.97741800	2007:03	*0.87010000*	2009:03	*0.80750000*	2011:03	***0.79770000***
2005:04	0.96686200	2007:04	*0.86810000*	2009:04	0.80450000	2011:04	*0.79280000*
2005:05	0.95774600	2007:05	*0.86450000*	2009:05	*0.80460000*	2011:05	*0.79120000*
2005:06	0.94742200	2007:06	*0.85700000*	2009:06	0.80460000	2011:06	*0.78820000*
2005:07	0.94170200	2007:07	*0.85630000*	2009:07	0.80460000	2011:07	0.78710000
2005:08	0.93233400	2007:08	*0.85490000*	2009:08	0.80440000	2011:08	0.78670000
2005:09	0.91676200	2007:09	*0.85370000*	2009:09	0.80430000	2011:09	*0.78690000*
2005:10	0.91771200	2007:10	*0.85190000*	2009:10	0.80410000	2011:10	*0.78720000*
2005:11	0.92074600	2007:11	*0.84920000*	2009:11	0.80390000	2011:11	*0.78720000*
2005:12	0.92060600	2007:12	*0.82260000*	2009:12	0.80400000	2011:12	*0.78690000*
2006:01	0.92080000	2008:01	*0.84710000*	2010:01	0.80450000	2012:01	*0.78650000*
2006:02	0.91580000	2008:02	*0.84570000*	2010:02	0.80450000	2012:02	*0.78640000*

[1] Source: Statistic bulletin of the Central Bank of the Republic of Azerbaijan.

2006:03	0.91280000	2008:03	*0.84100000*	2010:03	0.80430000	2012:03	*0.78650000*
2006:04	0.90790000	2008:04	*0.83150000*	2010:04	*0.80440000*	2012:04	*0.78630000*
2006:05	0.90310000	2008:05	*0.82790000*	2010:05	0.80440000	2012:05	0.78620000
2006:06	0.89840000	2008:06	*0.81850000*	2010:06	0.80430000	2012:06	0.78610000
2006:07	0.89310000	2008:07	*0.80930000*	2010:07	*0.80420000*		
2006:08	0.88700000	2008:08	*0.81330000*	2010:08	*0.80420000*		
2006:09	0.87970000	2008:09	*0.81440000*	2010:09	*0.80400000*		
2006:10	0.87530000	2008:10	*0.81170000*	2010:10	0.80260000		
2006:11	0.87470000	2008:11	*0.81050000*	2010:11	*0.80110000*		
2006:12	0.87420000	2008:12	*0.80680000*	2010:12	*0.80000000*		

If exchange rate factor follows the normal distribution then it can be used in calculating VAR by determining any current net portfolio for certain holding period. In technically by using "Jarque-Bera" test of "EViews" program we can test whether series follows the normal distribution or not. **[5,p.152]**. Results of underlined test were depicted in diagram A.

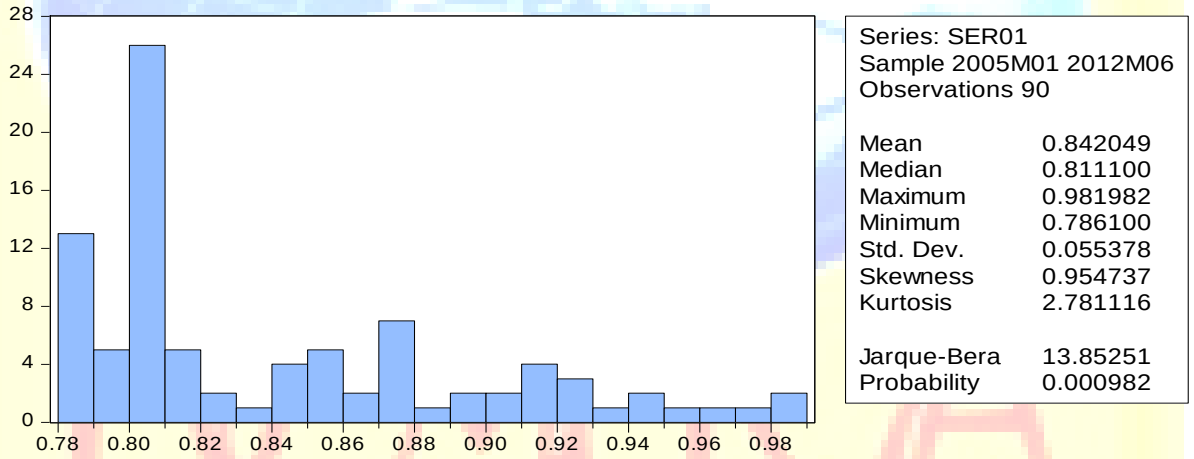

Diagram A. Jarque-Bera test.

The value of Jarque-Bera test is estimated by equation (1.1). In previous section results of Jarque-Bera test were explained and found that results of test wasn`t reliable. So, in case of skewness is zero and kurtosis is three we can say that it follows net normal distribution. As shown in diagram distribution doesn`t follow normal distribution.

Additionally, the examination of normalcy can be implemented by appliying of statistic analysis. We have already stressed theoretical-methodical essentials of statistic analysis of the normal distribution. That`s why, we will cross to analzing of exact results. Let`s note that in first for to implementing statistic analysis of normal distribution we have to set the equivalent new

series by dividing in groups of series given in Table 2.3. Our purpose is to make possible for statistical analyze of graphic of distribution of series by determining these groups and their frequencies. Setting of statistic groups and main statistic parameter (average and standard error) were shown in Table 2.2.

Before analyzing the table let`s note some statistic methods used in setting statistic groups. The determinative factor for grouping is broadness of groups that is to say the existing difference between upper and bottom limits. Broadness of all groups is equal to each others and determined by formula as below mentioned:

$$R = \frac{Z-A}{k} = \frac{0.981982-0.7861}{8} = 0.02448525 \quad \textbf{[8, p.171]} \qquad (2.1)$$

Here, *R*- value of broadness, *Z*– the biggest value of series, *A* – the least value of series, k - number of groups.

The value of k in the equation (2.1) that is to say number of groups 8 is found by "Sturchess manner" **[8, p.170]**. In accordance with this manner quantity of group is determined as following,

$$k = 1 + 3.3 * \log(n) = 7.449 \qquad (2.2)$$

Here, *n*- number of observations.

Groupping of series can be implemented by utilizing of the broadness value of the group (*R*) and number of groups (*k*). Information about groupping and some main statistic parameters was depicted in the Table 2.2.

Table 2.2. Groups and statistic parameters.

Number of row	Group interval (x_{i-1}, x_i)		Frequency (O_i)	Average interval $\frac{(x_{i-1}+x_i)}{2}$	Weight average (3*4)	Standard deviation (4 - $\bar{x}$)	Average square deviation $(4 - \bar{x})^2$
	1	2	3	4	5	6	7
1	$-\infty$	0.78610	0				
2	0.786100	0.81059	45	0.79834263	35.9254181	-0.04325728	0.001871192
3	0.810585	0.83507	7	0.82282788	5.75979513	-0.01877203	0.000352389
4	0.835071	0.85956	9	0.84731313	7.62581813	0.005713225	0.000032641

5	0.859556	0.88404	9	0.87179838	7.84618538	0.030198475	0.000911948
6	0.884041	0.90853	5	0.89628363	4.48141813	0.054683725	0.002990310
7	0.908526	0.93301	8	0.92076888	7.366151	0.079168975	0.006267727
8	0.933012	0.95750	2	0.94525413	1.89050825	0.103654225	0.010744198
9	0.957497	0.98198	5	0.96973938	4.84869688	0.128139475	0.016419725
10	0.981982	$+\infty$	0				
					$\sum 5=$ 75.743991		
$\bar{x}$					$\bar{x}=$ 0.8415999		
Dispersion							$\sum 7/10 =$ 0.00395901293
Standard error (σ)							$\sqrt{\sum 7/10} =$ 0.062920687

In the next stage we will determine the criterion of χ^2. Through this criterion we can examine the reliability of coincidence probability of X chance quantity i.e. any sample of exchange rate of US dollar against the Azerbaijan manat out of whole population into the appropriate group. Calculation of criterion of χ^2 and its theoretical essentials were informed in I section. That is why we will cross to the calculation directly.

Table 2.3. Value of the criteria of χ^2

Number	Group interval		Observation frequency (O_i)	Z- values of standard normalisation	Probability with 95% confidence interval (p_i)	Expected frequency (in population) $(E_i = 90 * pi$	$\frac{(O_i - E_i)^2}{E_i}$
1	$-\infty$	0.78610	0	-0.88206124	0.1711	15.399	15.399
2	0.786100	0.81059	45	-0.49291658	0.12010	10.809	108.1529
3	0.810585	0.83507	7	-0.10377191	0.14920	13.428	3.077091
4	0.835071	0.85956	9	0.285372755	0.19640	17.676	4.258485
5	0.859556	0.88404	9	0.674517421	0.13660	12.294	0.88258
6	0.884041	0.90853	5	1.063662087	0.10150	9.135	1.871727
7	0.908526	0.93301	8	1.452806753	0.06450	5.805	0.829978
8	0.933012	0.95750	2	1.841951419	0.02840		
9	0.957497	0.98198	5	2.231096086	0.02000		
10	0.981982	$+\infty$	0		0.01220	5.454	0.438232
					$\sum p$=1.0	$\sum E$=90	
							$\chi^2 =$

							$\sum \frac{(O_i - E_i)^2}{E_i} = 134.91$

The value of criteria χ^2 was found as 134.91 from table 2.3. Now let`s determine to accept or reject the null hypothesis. Hypotesis will be as following:

H_0: Probabilities of elements of each *k* interval which determined via observations characterize the existing probabilities in the population.

H_a: Probabilities of elements of each *k* interval which determined via observation don`t characterize the existing probabilities in the population.

If $\chi^2 \geq \chi^2_\alpha$ H_0 is rejected. So in order to determine the acception or rejection of null hypothesis we need the criric value of criteria of χ^2. The given criterion χ^2_α is a statistic table value of the criteria of χ^2 with *d.f* degree of freeedom and α confidence cooeficient. As underlined in previous section *d.f* degree of freeedom is determined as (*d.f*)=*k*–*c*, and because of number of estimated parameters of normal distribution is 2 it will be *c*=2+1. Number of groups (*k*) will be equal to 10. Hence *d.f* degree of freeedom is 7. Statistic table value of the criteria of χ^2 with 95% confidence interval and 7 *d.f* degree of freeedom makes $\chi^2_\alpha = 14.067$ **[8, p.1196]**.

Because,

$$\chi^2 = 134.91 > \chi^2_\alpha = 14.067 \qquad (2.3)$$

H_0 -is rejected.

So, exchange risk factor of US dollar against the Azerbaijan manat don`t follow the normal distribution. Economical quantities usually follow normal distribution only if economical process is chance phenomenon. By reason of exchange rate of Azerbaijan manat is formed on floating-regulating regime its normalcy is disturbed. We can come to a conclusion that in practically it is useless for countries joining to regulating exchange rate regime to estimate of VAR emanated from change in exchange rate of national currency. Hence, determination of unexpected losses of banking system of Azerbaijan, in other word VAR emanated from by reason of change up or down of exchange rate of US dollar against the Azerbaijan manat will be of no use in practically.

Risk factor of the average interest rate on loan

In modern banking system banks is facing to the average interest rate risk on loans which is a kind of market risk resulting unexpected losses. Interest rate risk is closely bound up with period of assets and liabilities. According to the theory the interest rate risk become more for a longer period. **[1, p.64]**. Let`s point some specific particularities which we come across in estimation of VAR in Azerbaijan banking system emanated from interest rate risk. So, average interest rate of loans and deposits was given seperately in statistic bulletin of Central Bank of the Republic Azerbaijan. We will start to determine the portfolio exposed to risk for finding of VAR. In theoretical literatures for finding of VAR emanated from from interest rate risk , the Gap of assets and liabilities depended on interest rate was shown as *(V)* which given by equation 1.4 in I section. If assets and liabilities gap is positive by standpoint of analyzing we will include the average interest rate on loans as a risk factor, otherwise the average interest rate on deposits. Statistic datums on loans and deposits for II quarter of 2012 was pulished in Banks and Business Journal (9). Positive gap of assets and deposits of 32 banks in Azerbaijan banking system were shown in this journal which it makes inevitable to admit the the average interest rate on loans as a risk factor. Statistic datum of interest rate was shown in Table 2.4 for a period from January 2005 until July 2012.

Table 2.4. Statistic datum of risk factor(average interest rate on loans)[2]

Date	Average interest rate on loans	Date	Average interest rate on loans	Date	Average interest rate on loans	Date	Average interest rate on loans
2005:01	15.55	2007:01	16.50	2009:01	17.45	2011:01	16.37
2005:02	16.03	2007:02	16.23	2009:02	18.75	2011:02	16.40
2005:03	15.34	2007:03	16.32	2009:03	17.37	2011:03	16.43
2005:04	15.69	2007:04	15.28	2009:04	17.42	2011:04	16.41
2005:05	16.19	2007:05	15.46	2009:05	16.25	2011:05	16.54
2005:06	15.74	2007:06	15.46	2009:06	17.12	2011:06	16.50
2005:07	16.33	2007:07	15.63	2009:07	17.12	2011:07	16.39
2005:08	15.97	2007:08	16.85	2009:08	15.34	2011:08	16.40
2005:09	15.81	2007:09	16.91	2009:09	14.86	2011:09	16.19
2005:10	15.66	2007:10	17.06	2009:10	14.63	2011:10	16.07

[2] Source: Statistic bulletin of the Republic of Azerbaijan.

2005:11	15.57	2007:11	17.15	2009:11	16.23	2011:11	16.21
2005:12	15.62	2007:12	17.46	2009:12	14.65	2011:12	16.24
2006:01	15.14	2008:01	16.97	2010:01	15.92	2012:01	16.27
2006:02	15.54	2008:02	17.49	2010:02	13.97	2012:02	16.24
2006:03	16.03	2008:03	17.62	2010:03	15.84	2012:03	16.17
2006:04	15.74	2008:04	17.71	2010:04	13.99	2012:04	16.09
2006:05	15.84	2008:05	17.89	2010:05	14.17	2012:05	16.05
2006:06	15.83	2008:06	17.94	2010:06	15.88	2012:06	15.99
2006:07	15.85	2008:07	17.76	2010:07	16.06	2012:07	15.65
2006:08	16.05	2008:08	18.21	2010:08	15.93		
2006:09	16.31	2008:09	18.22	2010:09	15.85		
2006:10	16.25	2008:10	18.25	2010:10	14.10		
2006:11	16.31	2008:11	17.99	2010:11	14.06		
2006:12	16.32	2008:12	18.08	2010:12	13.66		

If interest rate has normal distribution as a risk factor then we can calculate VAR on Gap of 727million manat for a certain holding period. In practically we can examine via "Jarque-Bera" test in "EViews" program module whether series follow the normal distribution or not. **[5, p.152]**. We can see the results of test depicted in diagram B.

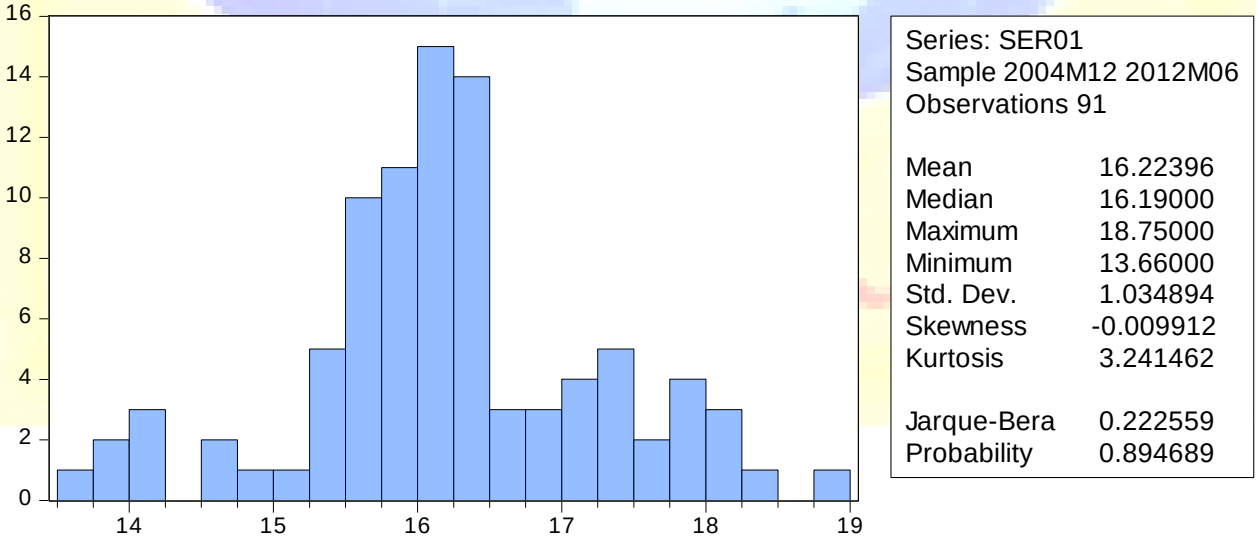

Diagram B. *Jarque-Bera test of the distribution of average interest rate on loans.*

The value of Jarque-Bera test through equation 1.1. The results of Jarque-Bera test has explained in previous section and results of test could be considered reliable on these criterions. So, if skewness is zero, kurtosis is three it is said that distribution is normal. As it seems from

diagram it is possible to say that distribution is normal. But, if we pay attention to the cooefficient of kurtosis we can see it is insignificantly different than 3. It is known that kurtosis value being more than three brings the cavity to the graphic of normal distribution. If cavity exceeds the certain limit it may diminish the significancy of normal distribution.

In order to remove all doubts we can examine the normality by testing. In previous sections it has been touched upon the theoretical-methodical essentials of statistic analyse of normal distribution. In first, for implementing of statistic analyse of normal distribution it must be set the equivalent new series by dividing in groups of series given in table 2.4. Our purpose is to make possible for statistical analyze of graphic of distribution of series by determining these groups and their frequencies. Setting of statistic groups and main statistic parameters (average and standard error) were shown in Table 2.5.

Table 2.5. Groups and statistic parameters.

Number of series	Group interval (x_{i-1}, x_i)		Frequency (O_i)	Avarage of interval $\frac{(x_{i-1}+x_i)}{2}$	Weight average (3*4)	Average deviation (4 - $\bar{x}$)	Average square deviation $(4 - \bar{x})^2$
	1	2	3	4	5	6	7
1	$-\infty$	13.66	0				
2	13.66	14.30	6	13.97785	83.8670906	-2.27034600	5.15447095
3	14.30	14.93	3	14.61355	43.840636	-1.63464912	2.67207774
4	14.93	15.57	8	15.24924	121.993938	-0.99895224	0.99790558
5	15.57	16.20	29	15.88494	460.663233	-0.36325536	0.13195446
6	16.20	16.84	22	16.52064	363.453991	0.27244152 0	0.07422438
7	16.84	17.47	11	17.15633	188.719661	0.90813839 9	0.82471535
8	17.47	18.11	8	17.79203	142.336238	1.54383527 9	2.38342737

9	18.11	18.75	4	18.42773	73.7109064	2.179532159	4.75036043
10	18.75	$+\infty$	0				
					$\sum 5=$ 1478.58569		
					$\bar{x}=$ 16.2481944		
Dispersion							$\sum 7/10 =$ 1.699
Standard error (σ)							$\sqrt{\sum 7} =$ 1.303

In the next stage we will determine the criterion of χ^2. About calculation of criteria χ^2, its theoretical essentials was imformed in I section. That is why we step over directly to the calculation. From table 2.6 the value of χ^2 was found as 8.799.

Now, let`s determine the acceptance of null hypothesis or rejection of hypothesis. Hypothesis will be as following:

H_0: Probabilities of elements of each *k* interval determined via observation characterize the existing probabilities in the population.

H_a: Probabilities of elements of each *k* interval determined via observation don`t characterize the existing probabilities in the population.

Table 2.6. Value of criteria χ^2.

Number of row	Group interval		Observation frequency (O_i)	Z- values of standard normalization	Probability within 95% reliable interval (p_i)	Expected frequency(in population) $(E_i = 90 * pi$	$\frac{(O_i - E_i)^2}{E_i}$
1	$-\infty$	13.66	0	-2.478143820	0.005400	8.05350	0.11124
2	13.66	14.30	6	-1.863608650	0.020200		
3	14.30	14.93	3	-	0.062900		

				1.249073480			
4	14.93	15.57	8	-0.634538310	0.169300	15.40630	3.56044
5	15.57	16.20	29	-0.020003140	0.222300	20.22930	3.80266
6	16.20	16.84	22	0.594532030	0.262100	23.85110	0.14367
7	16.84	17.47	11	1.209067199	0.152200	13.85020	0.58654
8	17.47	18.11	8	1.823602368	0.073400		
9	18.11	18.75	4	2.438137538	0.025100	9.60960	0.59461
10	18.75	$+\infty$	0		0.007100		
					$\sum p$=1.0000	$\sum E$=91	
							$\chi^2 = \sum \frac{(O_i - E_i)^2}{E_i} = 8.799$

If $\chi^2 \geq \chi^2_\alpha$ H_0 is rejected. So in order to determine the acception or rejection of null hypothesis we need (χ^2_α) the criric value of criteria of χ^2 . The given criteria of χ^2_α is a statistic table value of the criteria of χ^2 with *d.f* degree of freeedom and α confidence cooeficient. As underlined in previous section *d.f* degree of freeedom is determined as (*d.f*)=*k*–*c*, and because of number of estimated parameters of normal distribution is 2 it will be *c*=2+1. Number of groups (*k*) will be equal to 10. Hence *d.f* degree of freeedom is 7. Statistic table value of the criteria of χ^2 with 95% confidence interval and 7 *d.f* degree of freeedom make $\chi^2_\alpha = 14.067$ **[8, p.1196]**.

So, because of

$$\chi^2 = 8.799 < \chi^2_\alpha = 14.067 \qquad (2.4)$$

Hypothesis of H_0 is not rejected.

Hence, determination of unexpected losses of banking system of Azerbaijan emanated from by reason of change up or down of interest rate on loans, in other word VAR will be of importance in practically.

Estimation of Value at Risk.

As a result of statistic analyse we come to a conclusion that average interest rate on the loans could be used in calculating of VAR. We know that the previous one year`s time series should be applied in calculating of VAR by means of variance-covariance methods. **[3, p.308]**. By utilizing of this statistic datum we will determine the yearly standard error of this risk factor which is one of the necessary parameters in estimating VAR. Naturally this kind of calculation of standard error is annual datum. In practically taking of holding period on daily basis usually assume more significance for estimating of VAR in the banking system. In accordance with recommendations of Basel Committee it is expedient to take the very period for 10 days. So, we can obtain the daily data from equation (1.5) of yearly standard error. The calculation of standard error of average interest rate on loans as risk factor was given in Table 2.7.

Table 2.7. Calculation of standard error of average interest rate on loans.

	Average interest rate on loans ($\square_{\square}$)	Average deviation($\square_{\square}$ − $\square$	Average square deviation $(\square_{\square} - \overline{\square})^2$
2011:08	16.39552036	0.2652940	0.0703809
2011:09	16.18695093	0.0567246	0.0032177
2011:10	16.07281516	-0.0574110	0.0032960
2011:11	16.20757954	0.0773532	0.0059835
2011:12	16.23846643	0.1082401	0.0117159
2012:01	16.26791580	0.1376895	0.0189584
2012:02	16.24426330	0.1140370	0.0130044
2012:03	16.17071240	0.0404861	0.0016391
2012:04	16.08861060	-0.0416160	0.0017319
2012:05	16.04509213	-0.0851340	0.0072478
2012:06	15.99319135	-0.1370350	0.0187786
2012:07	15.65159815	-0.4786280	0.2290849
	$\sum_{\square=1}^{12} \square_{\square}$= 193.5627162		
	$\overline{\square}$= 16.13022635		
			$\square = \sqrt{\frac{\sum_{\square=1}^{12}(\square_{\square}-\overline{\square})^2}{\square-1}}$= 0.1870924

The calculated standard error in Table 2.7 is annual data and we can calculate daily standard error by using equation (1.5).

$$\square_{\square\ddot{u}\square\square\ddot{u}\square} = \square_{\square\square\square\square\square} * \frac{1}{\sqrt{252}} = 0.1871 * 0.06299 = 0.01179 \qquad (2.5)$$

Z-statistic table value of normal distribution as an important parameter in the calculation of VAR must be determined after defining of daily standard error. Z-statistic table value of normal distribution with 95% reliable interval is 1.96 **[8, p.1193]**. So, if daily standard error of interest rate of loans and Z-statistic table value of normal distribution are known as well as holding period is admitted for 10days we can calculate VAR of the gap of assets and liabilities depending on interest rate. Table 2.8 includes the gaps on the loans and deposits for 37 banks of banking system of Azerbaijan.

Table 2.8. Loans and deposits of banks and Gaps between loans and deposits.[3]

2012 R1									
Number	Name of bank	Loans (mln AZN)	Deposits (mln AZN)	Gap (mln AZN)	Number	Name of bank	Loans (mln AZN)	Deposits (mln AZN)	Gap (mln AZN)
1	IBA	3120.2	2762.6	357.6	17	AFB BANK	95.6	47.2	48.4
2	Kapital Bank	884	419.5	464.5	18	Rabitabank	92.3	80	12.3
3	Tekhnikabank	400.6	258.5	142.1	19	Parabank	78	64	14
4	Accessbank	311.3	128	183.3	20	Kredobank	72.3	15.7	56.6
5	Unibank	300.8	234.2	66.6	21	Caucasus Development Bank	54.3	9.3	45
6	Bank of Baku	279.2	211.5	67.7	22	NBCBank	53.1	30.2	22.9
7	Damirbank	257.2	133.2	124	23	Atrabank	46.2	19.5	26.7
8	Zaminbank	220.8	82.1	138.7	24	Bank VTB (AZ)	45.9	2.7	43.2
9	Bank Respublika	184	175.4	8.6	25	Bank BTB	41.7	16.3	25.4
10	Muganbank	182.6	92.4	90.2	26	United Credit Bank	41.5	20	21.5
11	Bank of Azerbaijan	147.1	88.8	58.3	27	Dekabank	38.9	8.3	30.6
12	Nikoil Bank	136.3	118.3	18	28	Azer-Turk Bank	36.9	32.7	4.2
13	Turanbank	134.1	79.4	54.7	29	Ganjabank	35.7	5	30.7
14	ASB	129.7	39.3	90.4	30	Gunaybank	26.8	10.5	16.3
15	RoyalBank	120.7	80.1	40.6	31	Eurobank	26	0.3	25.7
16	Yapı Kredi Bank	118.7	97.1	21.6	32	NBP Baku	3.7	0.5	3.2

[3] http://biznesjurnal.com/component/search/?searchword=kredit&searchphrase=all

						branch			

After obtaining information of gap on loans and deposits we can calculate VAR on each of bank. For this purposes we use equation (1.4). VAR estimation was fulfilled on the banks as noted in Table 2.9.

Table 2.9. VAR on Banks.

□□□ = □ ∗ □ ∗ √□ ∗ □						
Number	Name of bank	GAP (million manat) (V)	Z-statistic table value by 95% confidence interval	Kreditlər üzrə orta faiz dərəcəsi risk faktorunun günlük standart səhvi (□)	Əldə tutma sürəsi (□ = *10*)	RMD (milyon man.)
1	ABB	357.6	1.96	0.01179	3.16	26.113
2	Capital Bank	464.5	1.96	0.01179	3.16	33.919
3	Tekhnikabank	142.1	1.96	0.01179	3.16	10.377
4	Accessbank	183.3	1.96	0.01179	3.16	13.385
5	Unibank	66.6	1.96	0.01179	3.16	4.863
6	Bank of Baku	67.7	1.96	0.01179	3.16	4.944
7	Demirbank	124	1.96	0.01179	3.16	9.055
8	Zaminbank	138.7	1.96	0.01179	3.16	10.128
9	Bank Respublika	8.6	1.96	0.01179	3.16	0.628
10	Muganbank	90.2	1.96	0.01179	3.16	6.587
11	Bank of Azerbaijan	58.3	1.96	0.01179	3.16	4.257
12	Nikoil Bank	18	1.96	0.01179	3.16	1.314
13	Turanbank	54.7	1.96	0.01179	3.16	3.994
14	ASB	90.4	1.96	0.01179	3.16	6.601
15	RoyalBank	40.6	1.96	0.01179	3.16	2.965
16	Yapı Kredi Bank (AZ)	21.6	1.96	0.01179	3.16	1.577
17	AFB BANK	48.4	1.96	0.01179	3.16	3.534
18	Rabitebank	12.3	1.96	0.01179	3.16	0.898
19	Parabank	14	1.96	0.01179	3.16	1.022
20	Kredobank	56.6	1.96	0.01179	3.16	4.133
21	Caucasus Development Bank	45	1.96	0.01179	3.16	3.286
22	NBCBank	22.9	1.96	0.01179	3.16	1.672
23	Atrabank	26.7	1.96	0.01179	3.16	1.950
24	Bank VTB (AZ)	43.2	1.96	0.01179	3.16	3.155

25	Bank BTB	25.4	1.96	0.01179	3.16	1.855
26	United Credit Bank	21.5	1.96	0.01179	3.16	1.570
27	Dekabank	30.6	1.96	0.01179	3.16	2.234
28	Azer-Turk Bank	4.2	1.96	0.01179	3.16	0.307
29	Ganjabank	30.7	1.96	0.01179	3.16	2.242
30	Gunaybank	16.3	1.96	0.01179	3.16	1.190
31	Eurobank	25.7	1.96	0.01179	3.16	1.877
32	NBP Baku branch	3.2	1.96	0.01179	3.16	0.234

So, as a result of up and down change of average interest rate on loans, the gap of assets and liabilities (loans and deposits) depending on interest rate will be exposed to a certain losses. Information about the very losses on each bank was given in Table 2.9. For example: If we glance at the table we see VAR of IBA (International Bank of Azerbaijan) totaled to 26.1 million manat. It means that as a result of up and down change of average interest rate on loans, maxsimum unexpected losses emanated from the gap of assets and liabilities (loans and deposits) depending on interest rate for next 10 days will not be more than 26.1million manat. Exceeding the losses for next 10 days may be possible only with a probability of 5%. Analogous approaching can be applied to other banks. Calculated VAR on each bank is expressed only losses appeared from change in average interest rate on loans. Whereas, it is possible to determine the losses emanated from other reliable statistic risk factors.

Conclusion

At last it is determined that, determination of unexpected losses of banking system of Azerbaijan in other word VAR emanated from by reason of change up or down of exchange rate of US dollar against the Azerbaijan manat will be of no importance in practically.

Because statistic datum of exchange rate of US dollar against the Azerbaijan manat don`t follow the normal distribution. But we have succeeded in determining of unexpected losses emanated from the gap of assets and liabilities depending on interest rate. Because the statistic series of average interest rate on loans from January 2005 until July 2012 follow the normal distribution. It gives opportunity to calculate VAR. As a result of up and down change of average interest rate on loan, VAR of the gap of assets and liabilities depending on interest rate on 32 banks of banking system of Azerbaijan was determined. Analyze has been continued in the example of IBA and VAR totaled to 26.1million on this bank. It means that as a result of up and

down change of average interest rate on loans, maxsimum unexpected losses emanated from the gap of assets and liabilities (loans and deposits) depending on interest rate for next 10 days will not be more than 26.1million manat. Exceeding the losses for next 10days may be possible only with a probability of 5%.

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