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Question 1

Question Type: MultipleChoice

Financial institutions need to take volatility clustering into account:

1. To avoid taking on an undesirable level of risk

2. To know the right level of capital they need to hold

3. To meet regulatory requirements

4. To account for mean reversion in returns

Options:

A- 2, 3 and 4

B- 1 & 2

C- 1, 2 and 3

D- 1, 2 and 4

Answer:

B

Explanation:

Volatility clustering leads to levels of current volatility that can be significantly different from long run averages. When volatility is running high, institutions need to shed risk, and when it is running low, they can afford to increase returns by taking on more risk for a given amount of capital. An institution's response to changes in volatility can be either to adjust risk, or capital, or both. Accounting for volatility clustering helps institutions manage their risk and capital and therefore statements I and II are correct.

Regulatory requirements do not require volatility clustering to be taken into account (at least not yet). Therefore statement III is not correct, and neither is IV which is completely unrelated to volatility clustering.

Question 2

Question Type: MultipleChoice

As the persistence parameter under EWMA is lowered, which of the following would be true:

Options:

A- The model will react slower to market shocks

B- The model will react faster to market shocks

C- High variance from the recent past will persist for longer

D- The model will give lower weight to recent returns

Answer:

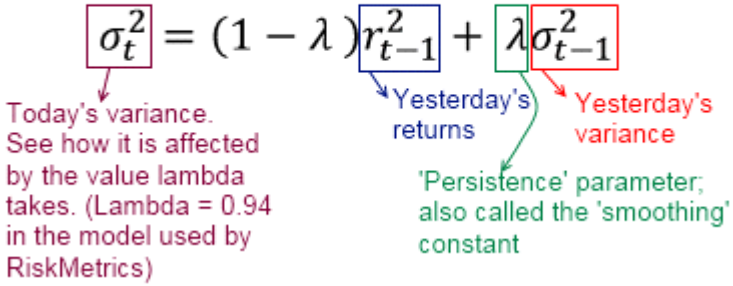
B

Explanation:

The persistence parameter, , is the coefficient of the prior day's variance in EWMA calculations. A higher value of the persistence parameter tends to 'persist' the prior value of variance for longer. Consider an extreme example - if the persistence parameter is equal to 1, the variance under EWMA will never change in response to returns.

1 - is the coefficient of recent market returns. As is lowered, 1 - increases, giving a greater weight to recent market returns or shocks. Therefore, as is lowered, the model will react faster to market shocks and give higher weights to recent returns, and at the same time reduce the weight on prior variance which will tend to persist for a shorter period.

Therefore Choice 'b' is the correct answer. To be sure, look at how the variance calculation behaves in response to lambda in the EWMA equation below:



Question 3

Question Type: MultipleChoice

Which of the following is not a limitation of the univariate Gaussian model to capture the codependence structure between risk factros used for VaR calculations?

Options:

A- The univariate Gaussian model fails to fit to the empirical distributions of risk factors, notably their fat tails and skewness.

B- Determining the covariance matrix becomes an extremely difficult task as the number of risk factors increases.

C- It cannot capture linear relationships between risk factors.

D- A single covariance matrix is insufficient to describe the fine codependence structure among risk factors as non-linear dependencies or tail correlations are not captured.

Answer:

C

Explanation:

In the univariate Gaussian model, each risk factor is modeled separately independent of the others, and the dependence between the risk factors is captured by the covariance matrix (or its equivalent combination of the correlation matrix and the variance matrix). Risk factors could include interest rates of different tenors, different equity market levels etc.

While this is a simple enough model, it has a number of limitations.

First, it fails to fit to the empirical distributions of risk factors, notably their fat tails and skewness. Second, a single covariance matrix is insufficient to describe the fine codependence structure among risk factors as non-linear dependencies or tail correlations are not captured. Third, determining the covariance matrix becomes an extremely difficult task as the number of risk factors increases. The number of covariances increases by the square of the number of variables.

But an inability to capture linear relationships between the factors is not one of the limitations of the univariate Gaussian approach - in fact it is able to do that quite nicely with covariances.

A way to address these limitations is to consider joint distributions of the risk factors that capture the dynamic relationships between the risk factors, and that correlation is not a static number across an entire range of outcomes, but the risk factors can behave differently with each other at different intersection points.

Question 4

Question Type: **MultipleChoice**

Which of the following are considered properties of a 'coherent' risk measure:

1. Monotonicity

2. Homogeneity

3. Translation Invariance

4. Sub-additivity

Options:

A- 2 and 3

B- 2 and 4

C- 1 and 3

D- All of the above

Answer:

B

Explanation:

All of the properties described are the properties of a 'coherent' risk measure.

Monotonicity means that if a portfolio's future value is expected to be greater than that of another portfolio, its risk should be lower than that of the other portfolio. For example, if the expected return of an asset (or portfolio) is greater than that of another, the first asset must have a lower risk than the other. Another example: between two options if the first has a strike price lower than the second, then the first option will always have a lower risk if all other parameters are the same. VaR satisfies this property.

Homogeneity is easiest explained by an example: if you double the size of a portfolio, the risk doubles. The linear scaling property of a risk measure is called homogeneity. VaR satisfies this property.

Translation invariance means adding riskless assets to a portfolio reduces total risk. So if cash (which has zero standard deviation and zero correlation with other assets) is added to a portfolio, the risk goes down. A risk measure should satisfy this property, and VaR does.

Sub-additivity means that the total risk for a portfolio should be less than the sum of its parts. This is a property that VaR satisfies most of the time, but not always. As an example, VaR may not be sub-additive for portfolios that have assets with discontinuous payoffs close to the VaR cutoff quantile.

Question 5

Question Type: MultipleChoice

The largest 10 losses over a 250 day observation period are as follows. Calculate the expected shortfall at a 98% confidence level:

20m

19m

19m

17m

16m

13m

11m

10m

9m

9m

Options:

A- 19.5

B- 14.3

C- 18.2

D- 16

Answer:

C

Explanation:

For a dataset with 250 observations, the top 2% of the losses will be the top 5 observations. Expected shortfall is the average of the losses beyond the VaR threshold. Therefore the correct answer is (20 + 19 + 19 + 17 + 16)/5 = 18.2m .

Note that Expected Shortfall is also called conditional VaR (cVaR), Expected Tail Loss and Tail average.

Question 6

Question Type: MultipleChoice

A risk analyst attempting to model the tail of a loss distribution using EVT divides the available dataset into blocks of data, and picks the maximum of each block as a data point to consider.

Which approach is the risk analyst using?

Options:

A- Block Maxima approach

B- Peak-over-thresholds approach

C- Expected loss approach

D- Fourier transformation

Answer:

A

Explanation:

The risk analyst is using the block maxima approach. The data points that result will then be used to fit a GEV distribution.

Expected shortfall refers to the expected losses beyond a specified threshold. The peaks-over-threshold approach is an alternative approach to the block maxima approach, and involves considering exceedances above a threshold. Fourier transformation is not relevant in this context, and is a non-sensical option.

Question 7

Question Type: **MultipleChoice**

Which of the following are valid approaches for extreme value analysis given a dataset:

1. The Block Maxima approach

2. Least squares approach

3. Maximum likelihood approach

4. Peak-over-thresholds approach

Options:

A- 2 and 3

B- 1, 3 and 4

C- 1 and 4

D- All of the above

Answer:

C

Explanation:

For EVT, we use the block maxima or the peaks-over-threshold methods. These provide us the data points that can be fitted to a GEV distribution.

Least squares and maximum likelihood are methods that are used for curve fitting, and they have a variety of applications across risk management.

Question 8

Question Type: MultipleChoice

Which of the following belong to the family of generalized extreme value distributions:

1. Frechet

2. Gumbel

3. Weibull

4. Exponential

Options:

A- 4

B- 1, 2 and 3

C- 2 and 3

D- All of the above

Answer:

B

Explanation:

Extreme value theory focuses on the extreme and rare events, and in the case of VaR calculations, it is focused on the right tail of the loss distribution. In very simple and non-technical terms, EVT says the following:

1. Pull a number of large iid random samples from the population,

2. For each sample, find the maximum,

3. Then the distribution of these maximum values will follow a Generalized Extreme Value distribution.

(In some ways, it is parallel to the central limit theorem which says that the the mean of a large number of random samples pulled from any population follows a normal distribution, regardless of the distribution of the underlying population.)

Generalized Extreme Value (GEV) distributions have three parameters: (shape parameter), (location parameter) and (scale parameter). Based upon the value of , a GEV distribution may either be a Frechet, Weibull or a Gumbel. These are the only three types of extreme value distributions.

Question 9

Question Type: **MultipleChoice**

The 99% 10-day VaR for a bank is $200mm. The average VaR for the past 60 days is $250mm, and the bank specific regulatory multiplier is 3. What is the bank's basic VaR based market risk capital charge?

Options:

A- $250mm

B- $200mm

C- $750mm

D- $600mm

Answer:

C

Explanation:

The current Basel rules for the basic VaR based charge for market risk capital set market risk capital requirements as the maximum of the following two amounts:

1. 99%/10-day VaR,

2. Regulatory Multiplier x Average 99%/10-day VaR of the past 60 days

The 'regulatory multiplier' is a number between 3 and 4 (inclusive) calculated based on the number of 1% VaR exceedances in the previous 250 days, as determined by backtesting.

- If the number of exceedances is <= 4, then the regulatory multiplier is 3.

- If the number of exceedances is between 5 and 9, then the multiplier = 3 + 0.2*(N-4), where N is the number of exceedances.

- If the number of exceedances is >=10, then the multiplier is 4.

So you can see that in most normal situations the risk capital requirement will be dictated by the multiplier and the prior 60-day average VaR, because the product of these two will almost often be greater than the current 99% VaR.

The correct answer therefore is = max(200mm, 3*250mm) = $750mm.

Interestingly, also note that a 99% VaR should statistically be exceeded 1%*250 days = 2.5 times, which means if the bank's VaR model is performing as it should, it will still need to use a reg multiplier of 3.