2. Learning Objectives:

3. The candidate will demonstrate an understanding of important risk measurement techniques along with their uses and limitations, and be able to perform risk measurement calculations.

Learning Outcomes:

(3a) Analyze and evaluate risk measures & estimators (e.g., Value-At-Risk, Conditional Tail Expectations, etc.)

(3b) Apply and analyze scenario and stress testing in managing risk including the calibration and setting of assumptions

Sources:

C-25-07, An Introduction to Risk Measures for Actuarial Applications, Hardy

Chapter 14: Stress Testing, Jorion
Getting to Know CTE , Ingram

ERM - 102 - 12 Value-At-Risk: Evolution, Deficirencies and Alternatives - Vozian 2010 (also FE-C181-11)

Commentary on Question:

Commentary listed underneath question component.

Solution:

(a) Compare and contrast the following tail risk calculations:

(i) 95% VaR

(ii) 95% CTE

Commentary on Question:

Most of the candidate did well on this question

(i) α-VaR represents the loss that, with probability α will not be exceeded

(ii) the CTE is the expected loss given that the loss falls in the worst $(1 - \alpha)$ part of the loss distribution

(b) Calculate the 95% VaR and 95% CTE for X+Y, assuming X and Y are independent. Show all work.

Commentary on Question:

Most candidates did poorly on the calculation because they failed to develop the distribution of X+Y. Some even confused VAR with variance.

2. Continued

Values for X+Y:					
	X	5	80	500	0
Y		0.8	0.17	0.03	0
10	0.85	15	90	510	10
120	0.145	125	200	620	120
2000	0.005	2005	2080	2500	2000
0	0	5	80	500	0
Probabilities for X+Y:					
	X	5	80	500	0
Y		0.8	0.17	0.03	0
10	0.85	0.68000	0.14450	0.02550	0
120	0.145	0.11600	0.02465	0.00435	0
2000	0.005	0.00400	0.00085	0.00015	0
0	0	0	0	0	0

Rank	Value	Probability
1	2500	0.00015
2	2080	0.00085
3	2005	0.00400
4	620	0.00435
5	510	0.02550
6	200	0.02465
7	125	0.11600
8	90	0.14450
9	15	0.68000

The VaR is set at 200 which is the smallest number that gives the property that the loss will be smaller with at least 95% probability.

CTE95 = E[X+Y|X+Y>=200] = =(2500*0.00015 + 2080*0.00085 + 2005*0.004 + 620*0.00435 + 510*0.0255 + 200*0.01515)/0.05 = 577.9

(c) Explain the shortcomings of VaR and how stress testing can complement standard VaR models.

Commentary on Question:
Most candidates were able to identify and provide a brief explanation on one or more of the shortcomings of VAR. Some candidates just identified shortcomings without an explanation. As the questions asked to 'explain' shortcomings, no credit was awarded if no explanation was provided.

2. Continued

Shortcoming of VAR
1. VAR is not coherant – it fails the sub-additivity property and doesn't consider tail risk
2. VAR assumed normal distribution - the real distribution return is not normally distributed, no skew in tail
3. VAR calculation method is not prescribed - different companies use different methodologies to calculate VAR
4. Parametric risk - VAR Historical data and observation period, can be distorted by outliers and dependent on data used in parameter calibration
5. Agency problem – VAR can be manipulated by manager to hide risks
6. Regulatory disclosure - No standard VAR reporting template are enforced by the regulator which gives rise to risk of misrepresentation

How can stress testing be complement to VAR
VaR are based on recent historical data which fails to identify extreme unusual situations and stress testing can help manage situations that could cause extraordinary losses through the utilization of i) scenario analysis; ii) stressing models and iii) policy responses. It helps the managers paint a more realistic picture of tail risks.