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# Chapter 8

## Testing VaR Results to Ensure Proper Risk Measurement

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# VaR-Testing Methodologies

- Testing is required to connect the result back to reality and give confidence that VaR is a true measure of the risks
- Three types of tests:
  - Software-installation test
  - Profit-and-Loss (P&L) reconciliation Test
  - Back-testing (the modeled probability distribution)

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- Software-installation Test

To ensure that the results coming from the software are in accordance with what the risk management group thinks the software embodies.

- 用不同的投資組合，用軟體系統算出VaR，再與手算(或用別的軟體算，如Excel)的比較
- 測試一系列之壓力測試，改變所有之變數(參數)，看軟體系統算出的結果是否符合人的預期

## ● P&L Reconciliation Test

- 每天將VaR calculator算出的sensitivity乘上真正的市場變化與會計系統中的P&L來比較，照理應要接近，若有差距，可能的原因：
  - ◆ VaR calculator有些部位未考慮進去 (比較可能)
  - ◆ VaR calculator是一天天算，所以無法補捉intraday changes (例如， VaR 預期收盤價，但若盤中就將部位處理掉，會計系統中紀錄的P&L，會與VaR的預期不同)
  - ◆ VaR calculator看收盤價，accounting system在mid-day做記帳
  - ◆ 複雜之金融商品評價模型有誤 (比較可能)
- 但VaR calculator不只看sensitivity，還包括了可能的機率分配，而P&L test無法分辨機率問題

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- Back-testing (the modeled probability distribution)
    - Make sure that the probability distribution derived by VaR is consistent with actual losses
    - 例如：比較100天之 $VaR_{99}$ 與actual loss, if  $VaR_{99}$ 是對的，應該只有大約1次之loss會超過 $VaR_{99}$ ，p.147, figure8-1
    - 如多過或少於應出現之次數都不好，但有時很難分辨是VaR model 不好還是銀行的運氣太差

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- 實際上，無論VaR模型有多好，也未必能每次都能剛好fit次數，所以假設the number of exceptions 是random variable
  - 用Bernoulli distribution describes the probability of having a given number of outcomes that are equal to one if a binomial variable (the outcome is either 0 or 1) is sampled multiple times

- The Exceptions in 250 Days is assumed to follow a Bernoulli distribution

Exceptions	Probability	Cumulative Pr.	Zone	Market-risk capital Multiplier
0	8.1%	8.1%	Green	1
1	20.5%	28.6%		1
2	25.7%	54.3%		1
3	21.5%	75.8%		1
4	13.4%	89.2%		1
5	6.7%	95.9%	Yellow	1.13
6	2.7%	98.6%		1.17
7	1.0%	99.6%		1.22
8	0.3%	99.9%		1.25
9	0.1%	99.98%		1.28
10	0.01%	99.99%	Red	1.33

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- Market-risk capital Multiplier is suggested by the Basel Committee in the Capital Accord, which is used to compensate for the possible unreliability of the bank's VaR calculator
  - Not only the whole portfolio, the back-testing also can be applied to subportfolios