MC² challenge in Risk

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HIPERFIT workshop

Agenda

MC price + MC Risk

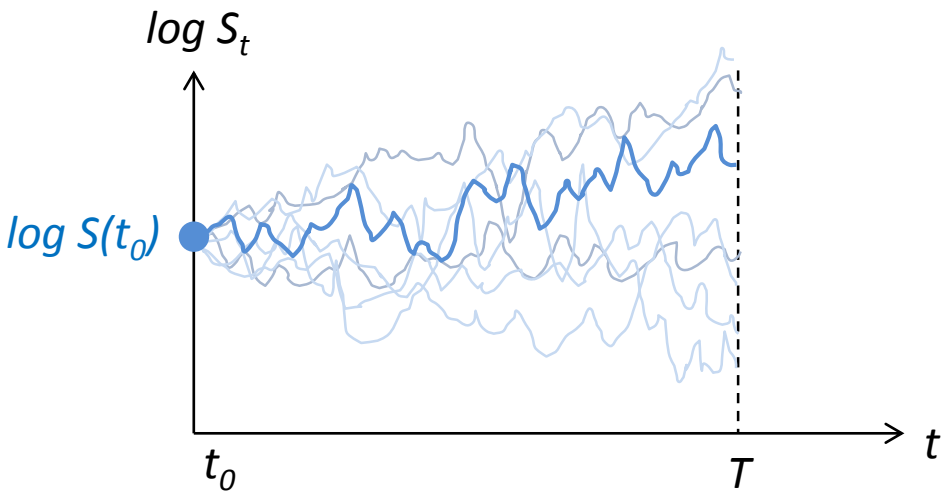
Horizon calculations

~~**CVA**~~

~~**CreditVaR**~~

Pricing with Monte Carlo

$$\pi_{t_0} = P(t_0, T) E^T \{ H(S_T) | \mathcal{F}_{t_0} \}$$

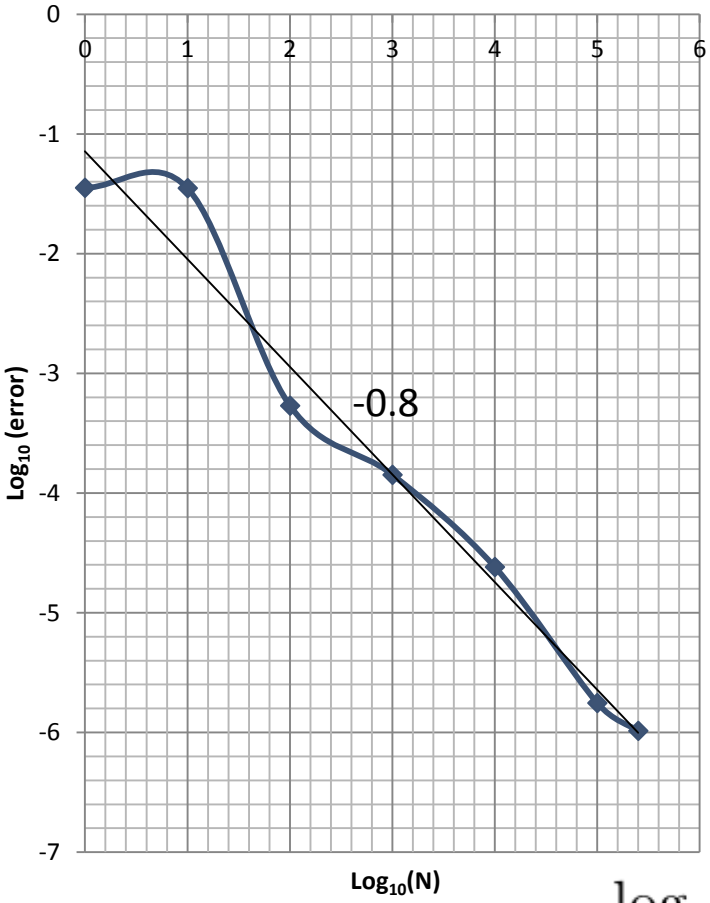


$$E^T\{H\} \sim \langle H \rangle_{MC}$$

$$\sim \frac{1}{\sqrt{N_Q}}$$

SimCorp

Pricing with Monte Carlo



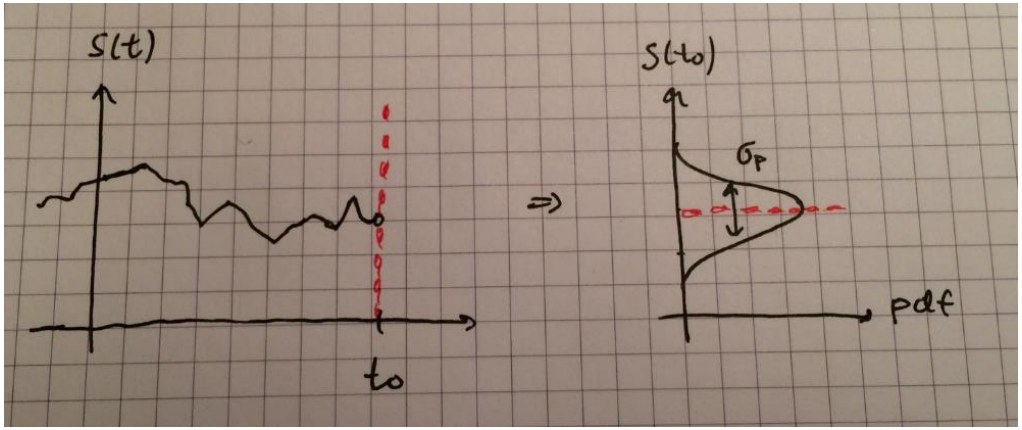
$\log_{10}(N_Q)$

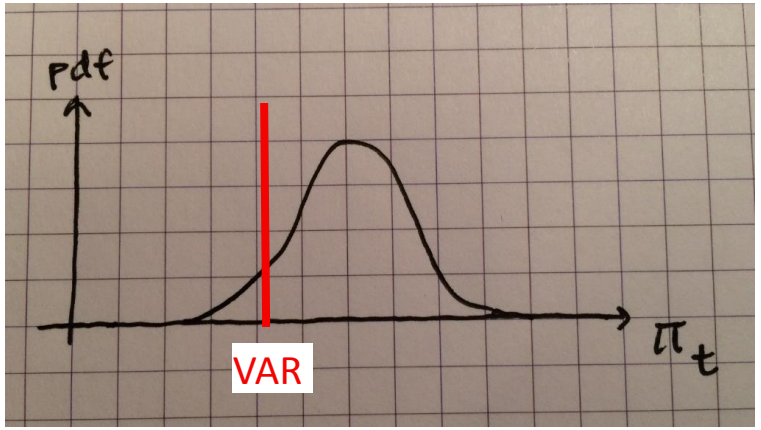
SimCorp

VAR with Monte Carlo

- Let $S(t_0)$ be a risk factor:
  - From historical observations, define distribution …

…. Draw N_P samples from $S(t_0)$ distribution and calculate distribution of Q price

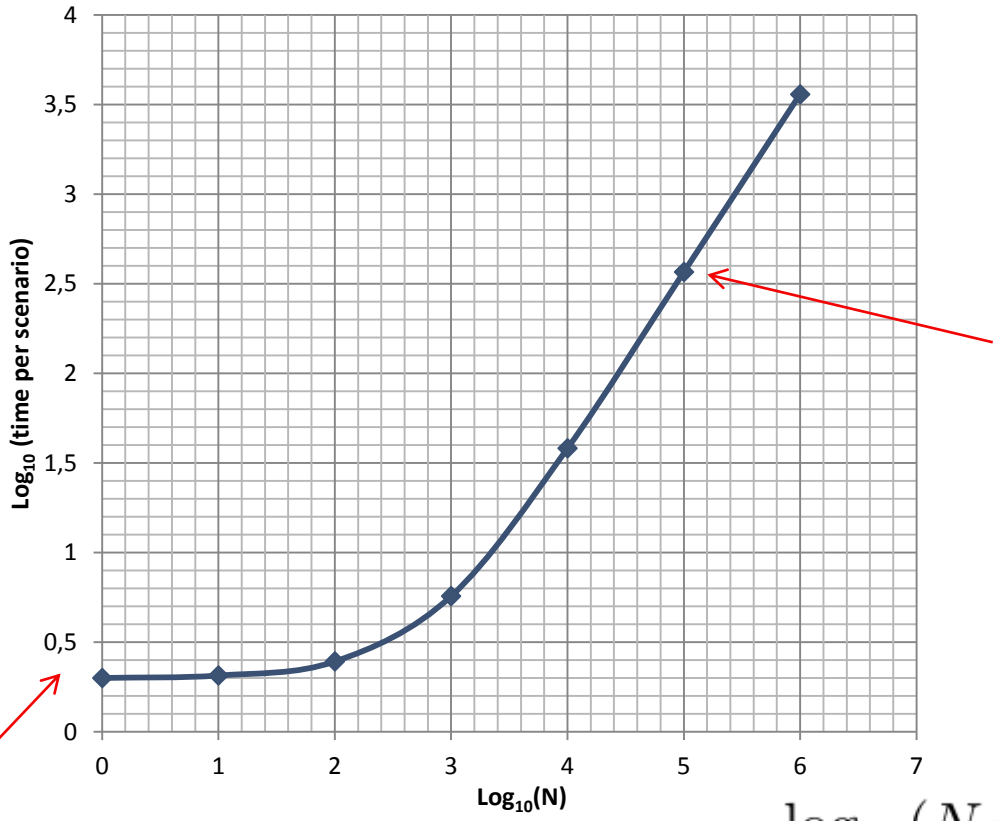




MC on MC

MC VAR execution time

Execution time versus Q paths



> 3 hours @ 40k

< 2 minutes @ 40k

$\log_{10}(N_Q)$

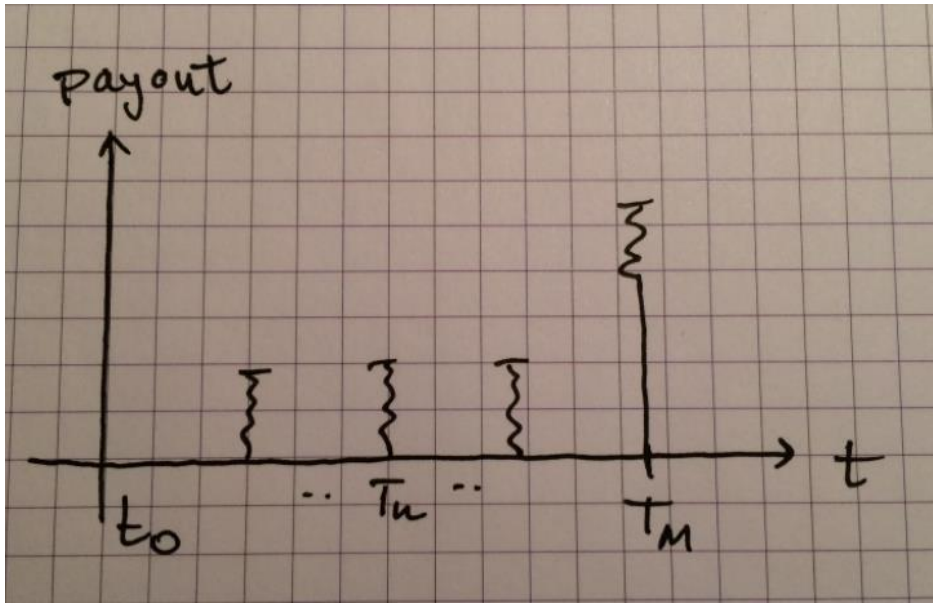
SimCorp

MC²: Portfolio of callable bonds

Structured note:
- Underlying is CMS rate
- Issuer calls
- Caps and floors
- Maturity up to 50Y

Price models:
- Libor Market Model
- Hull White 2F
- Hull White 1F
- … all are calibrated …

Portfolio:
2500 contracts



Risk factors:
Swaptions (90 RF)
Yield curves (22 RF)
⇒ 6328 covariances

MC VAR paths (NP) = 40.000

Overnight calculation: 5h

MC²: Portfolio of callable bonds

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- Underlying is CMS rate
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Portfolio:
2500 contracts

Paths:
contracts x NP x NQ =
2.500 x 40.000 x 10.000 = 1000 B

Time:
2.500 x 40.000 x 5ms = 139 hours
60 load-balanced servers => 2.3 hours

without calibration …

sk factors:
vaptions (90 RF)
eld curves (22 RF)
⇒ 6328 covariances

MC VAR paths (NP) = 40.000

Overnight calculation: 5h

(Re-) Calibration

- do n = 1:NP (Risk)
  - do m = 1:NQ (Price)
    - price_q(m) = path (RF_set(n))
  - enddo
  - price_p(n) = average (price_q)
- enddo

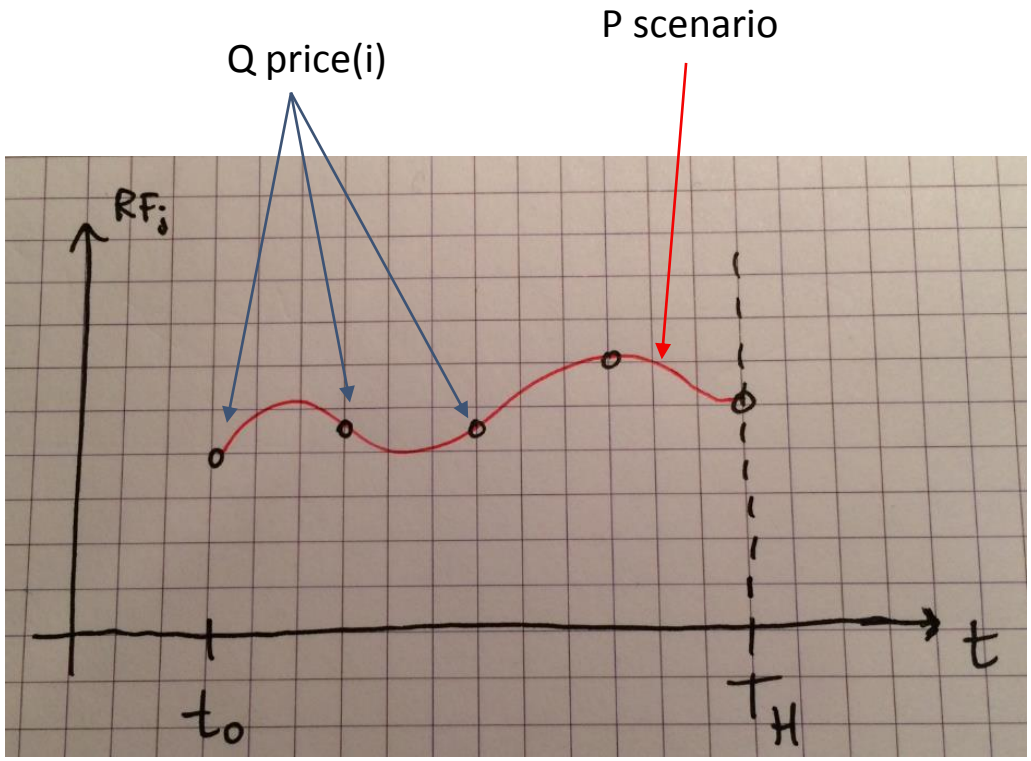
- do n = 1:NP (Risk)
  - model_pars = calibrate(RF_set(n))
  - do m = 1:NQ (Price)
    - price_q(m) = path (model_pars)
  - enddo
  - price_p(n) = average (price_q)
- enddo

Calibration of price models:
- Libor Market Model (1-10 seconds)
- Hull White 2F (1-10 seconds)
- Hull White 1F (0.1 seconds)

Calibrations:
models x NP =
10 x 40.000 = 400 k

Time:
10 x 40.000 x 1s = 111 hours
60 load-balanced servers => 1.9 hours

Horizon calculations



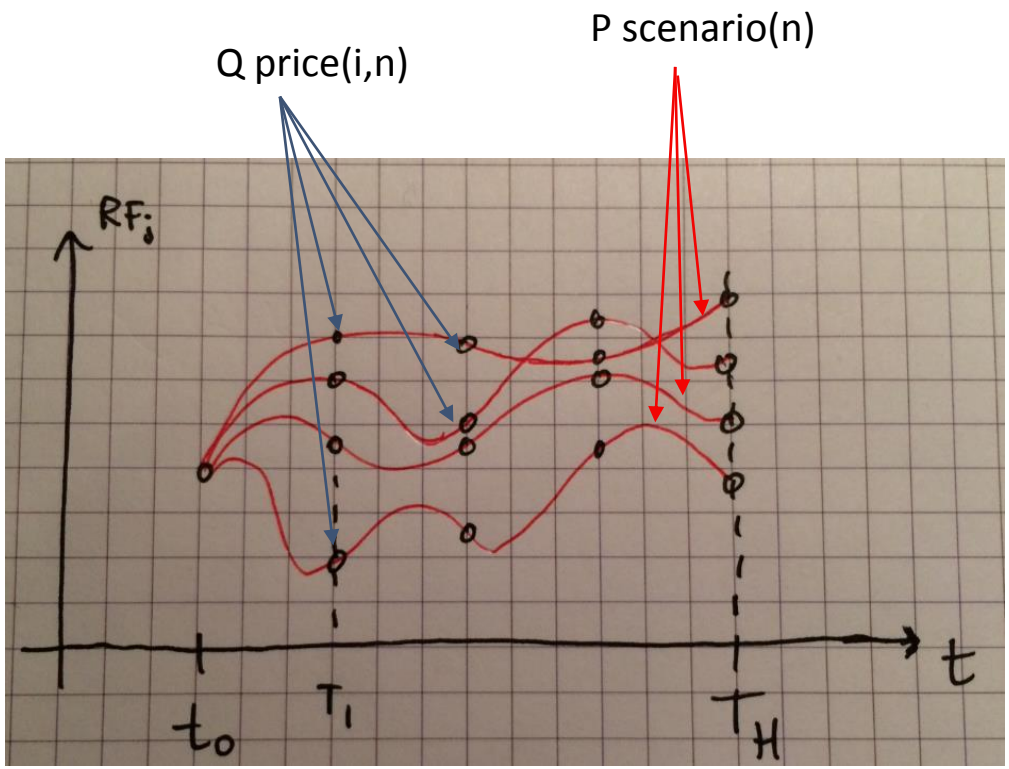
Horizon T_H

Horizon calculations

Propagation:
- Re-investment rules
- (Daily) Q pricing

Purpose:
- Future Exposure
  - Limits
- Liability matching
  - Legal

$MC^2 \times N$



Horizon T_H