How to use models in Finance?

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Agenda

- Models in Science and Finance
- Simple example: Forward
- Practical and Theoretical limits of Black-Scholes framework
- Digital Options
- Volatility Target Indices

Models in Science vs Finance

Nat Sciences

- Predict
- Imperfect knowledge BUT
- Rules of nature not supposed to change

Finance

- No prediction
- Consistent prices
- Risk management recipes
- Imperfect knowledge BUT
- Rules change
  - LIBOR, RFR

How to create a Forward?

- Contract: agree on the price of 1 Apple share in 1 yrs time

Static replication:

- Buy 1 Stock: Cost: S
- Need to finance the position: interest
- Total cost: $S*e^{r*t}$
- Earn divindend

What is missing

- What is the correct rate?
- Ability to borrow 1y, 2y …15 y?
- Borrow and roll – exposed to future interest rates – what if cannot be replicated
- Non-trivial factors come in…
- Do we model or not?

Option Trading

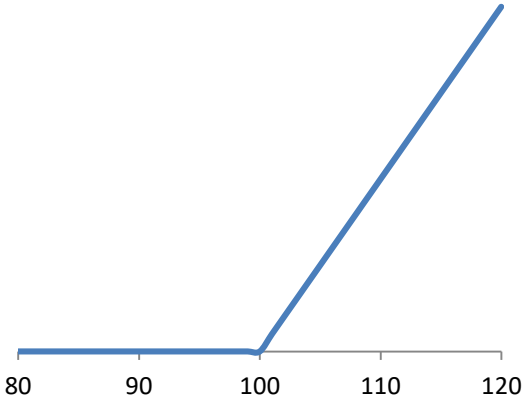
- Black-Scholes model
  Forward+Volatility+Discount+Deal Terms
- Infinite Liquidity
- Stock tradeable
- No transaction Cost
- Theoretical replication is doable

Option Trading

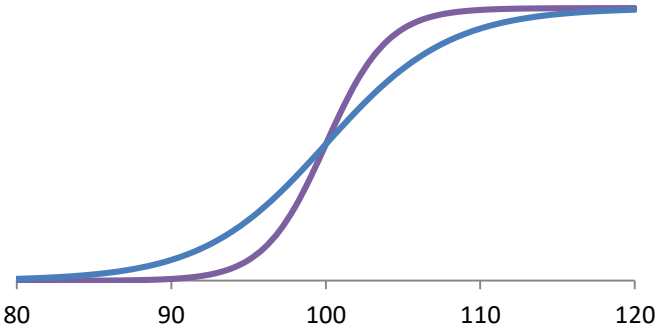
- Market – trade long dated options
- Do we adjust forward model?
- Adjust option volatility
  - Same BS framework
  - Simpler model

Vanilla options

t→maturity; S → K



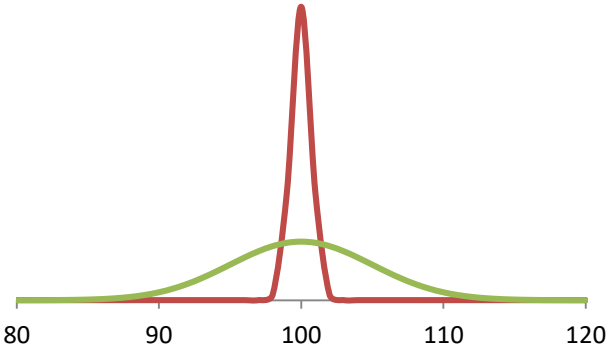
Δ



γ infinite

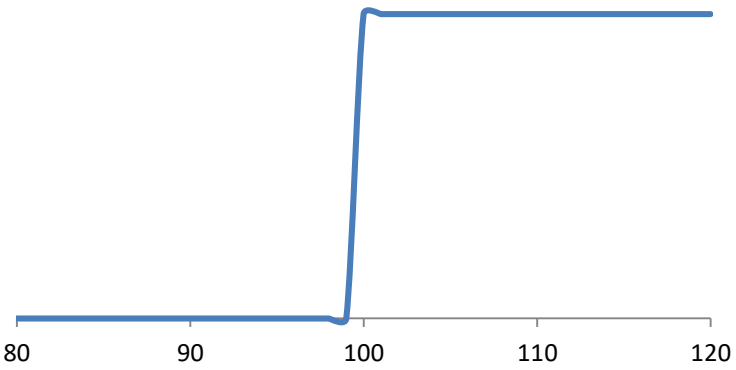
Cash Gamma Finite

γ



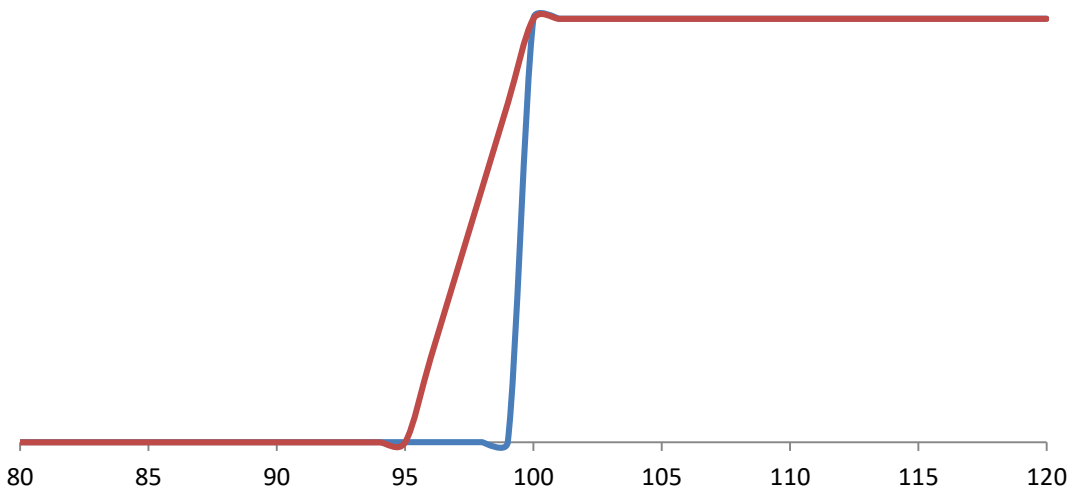
Digital Option

- Δ,γ diverges
- Closed form under BS
- Transaction costs



- No model gives hedging at maturity!

Use of Ramps



- Conservative
- Reserve which cover losses – over hedge

Volatility Targets

- Dynamic allocation
  - Risky (Stock)
  - Risk free (Cash, Treasuries)
- Keep target vol
  - Exposure = min(Cap, $\sigma_{target}/\sigma_{realised}$
- Rebalance weekly, monthly (transaction costs)
- Not directlz tradeable

Volatility Target Options

Full Simulation

- Expensive
- Assumes full replication
- Full risk decomposed

Quick mode BS

- Fast
- No details
- No detail/No component risk

Really Volatility Target?

- Limit of exposure/market volatility
- Low volatility → No Vol Target
  - Index option?
- High Volatility → Cash, or partial exposure

Summary

- No model perfect in practice
- What is tradeable important
- More important to model tradeable factors than all factors
- Danger of overconfidence