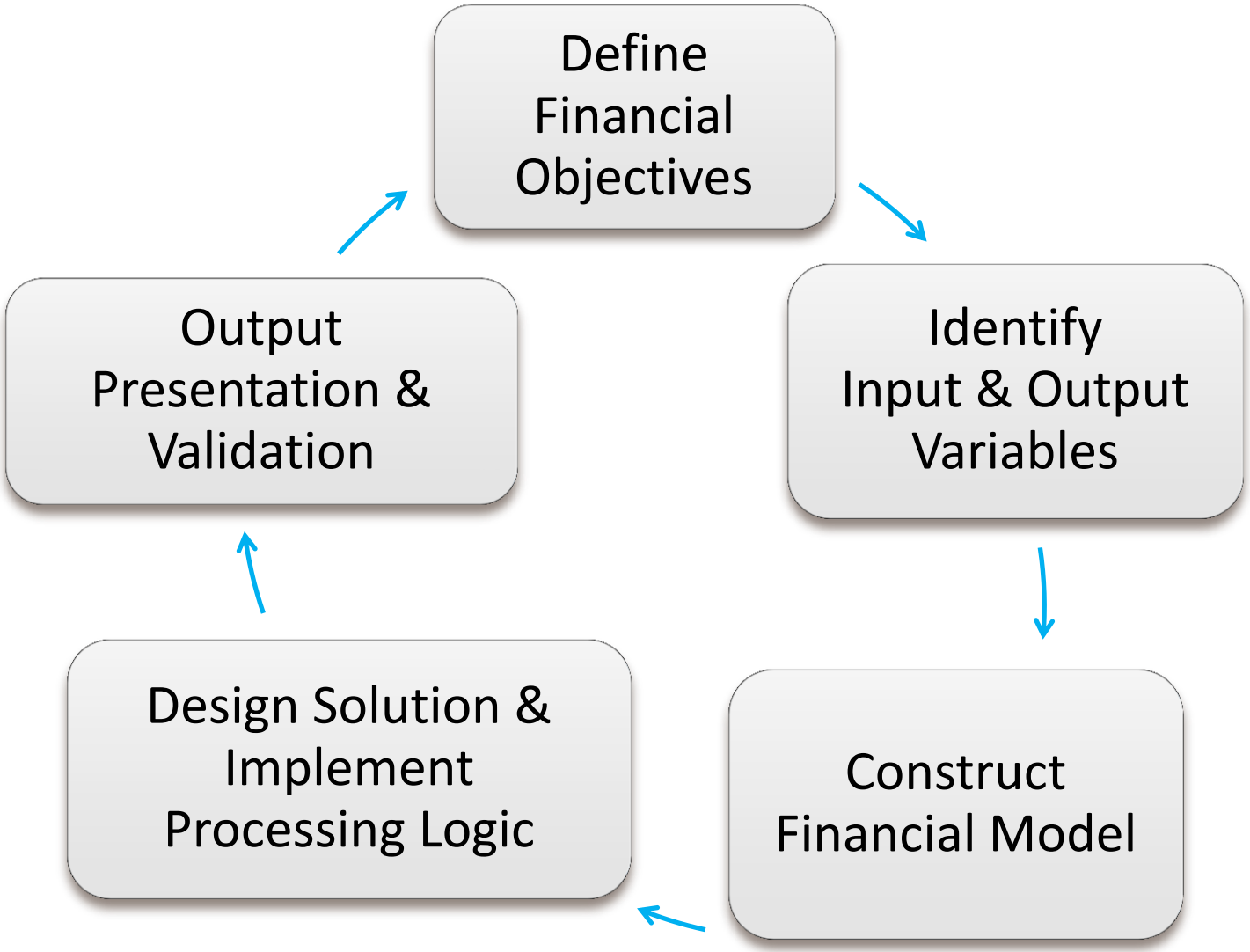
Financial Modeling

Financial Modeling

- Model
  Abstraction towards some *Objectives*.
- Financial Objectives
  - Business Valuation, Risk and Return of an Asset or a Portfolio, Derivatives Pricing, …
  - To resolve the “what if” questions or make projections
- Abstraction
  - Asset Price, Interest Rates, Volatilities, ...
  - To represent in mathematical terms for the relationships among variables (dependent and independent variables) of financial problems

Financial Modeling Process



Example - Define Financial Objective

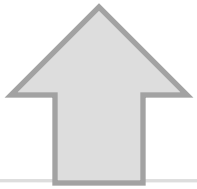
Option 期權

A contract between a buyer (holder) and a seller (writer), that gives the buyer the ***right*** but not the obligation to buy or sell a specified quantity of an underlying asset at a specific price (premium) within a specified period of time, regardless of the market price of the underlying asset.

Objective

What is the premium?

Option Pricing Example
Identify Input and Output Variables



Input Variables

- Spot price : Current price of underlying
- Dividend : Dividend of underlying
- Rate : Market interest rate
- Volatility: Standard deviation of underlying
- Strike price / Exercise price : Price at which the option buyer has the right to buy or sell the underlying
- Expiration : Date on which the holder/buyer of the option loses the right to buy or sell
- Call/Put option : Option buyer has the right to buy/sell the underlying

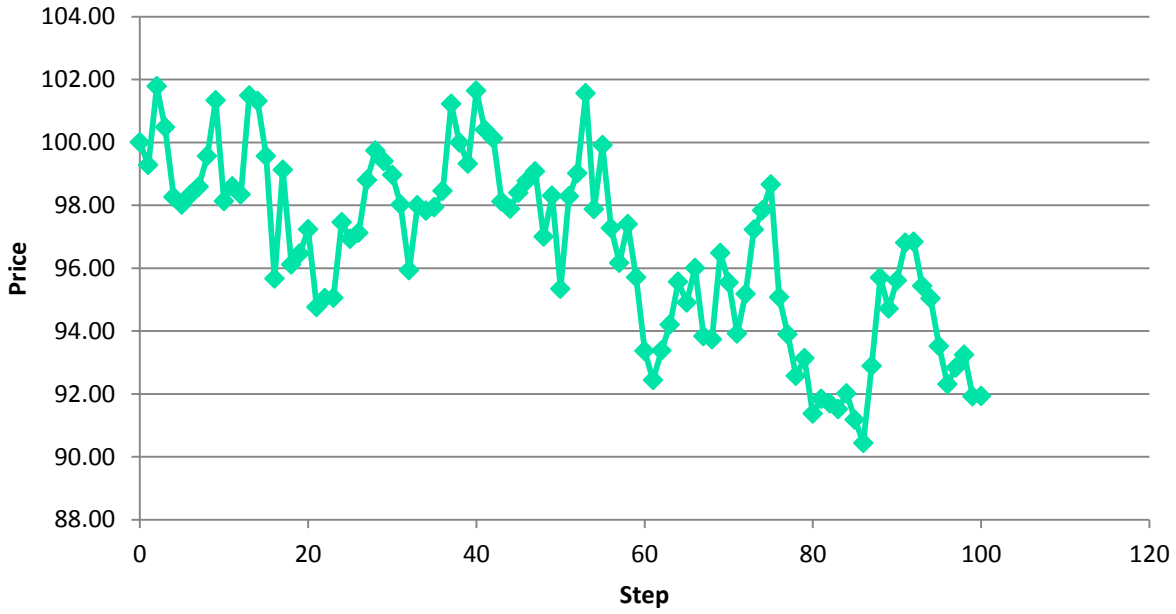
Output Variables

- Premium : The amount paid by the option buyer to the option writer for the right

Example – Option Pricing
Construct Financial Model

$$S(t+\Delta t) = S(t)e^{\left(\left(r-q-\frac{\sigma^2}{2}\right)\Delta t+\sigma\varepsilon\sqrt{\Delta t}\right)}$$

where ε is drawn from a standard normal distribution



Example – Black-Sholes
Design Solution & Implement Processing Logic

$$dC = \left(\frac{\partial C}{\partial S} \mu S + \frac{\partial C}{\partial t} + \frac{1}{2} \sigma^2 S^2 \frac{\partial^2 C}{\partial S^2} \right) dt + \frac{\partial C}{\partial S} \sigma S \sqrt{dt}$$

European call price $C = S_0 N(d_1) - X e^{-rT} N(d_2)$

European put price $P = X e^{-rT} N(-d_2) - S_0 N(-d_1)$

where :

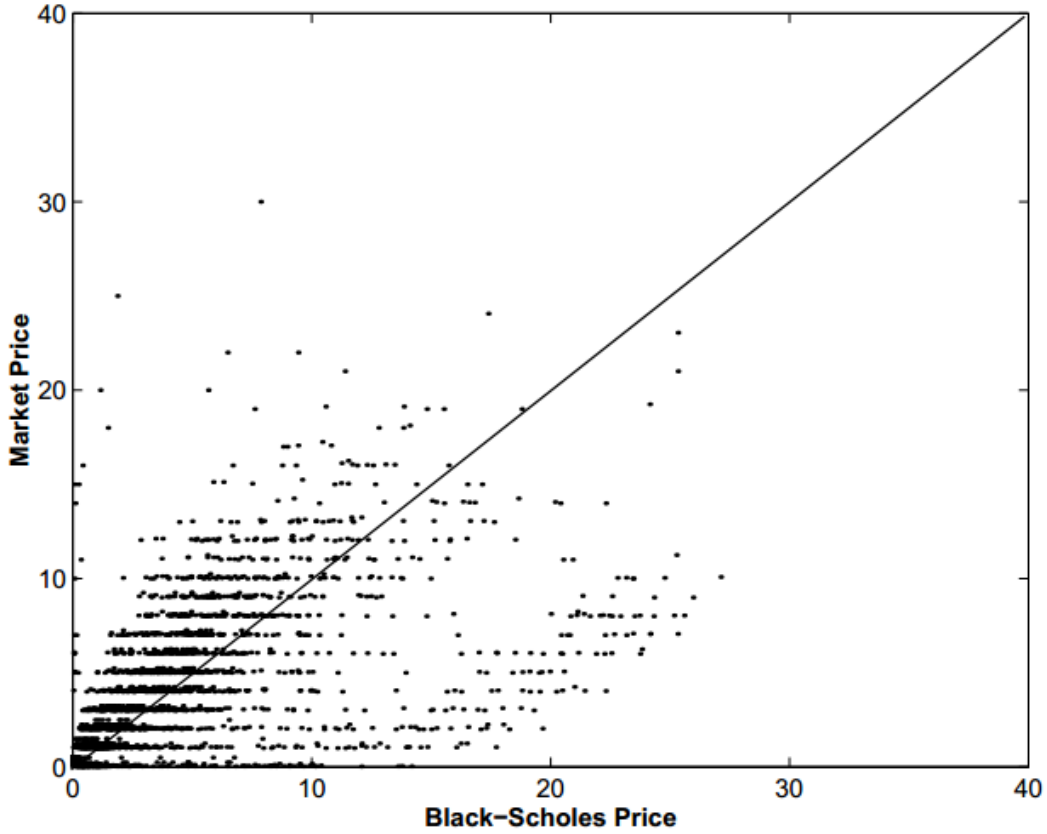
$$d_1 = \frac{LN\left(\frac{S_0}{X}\right) + (r + \frac{\sigma^2}{2})T}{\sigma\sqrt{T}}$$

$$d_2 = \frac{LN\left(\frac{S_0}{X}\right) + (r - \frac{\sigma^2}{2})T}{\sigma\sqrt{T}} = d_1 - \sigma\sqrt{T}$$

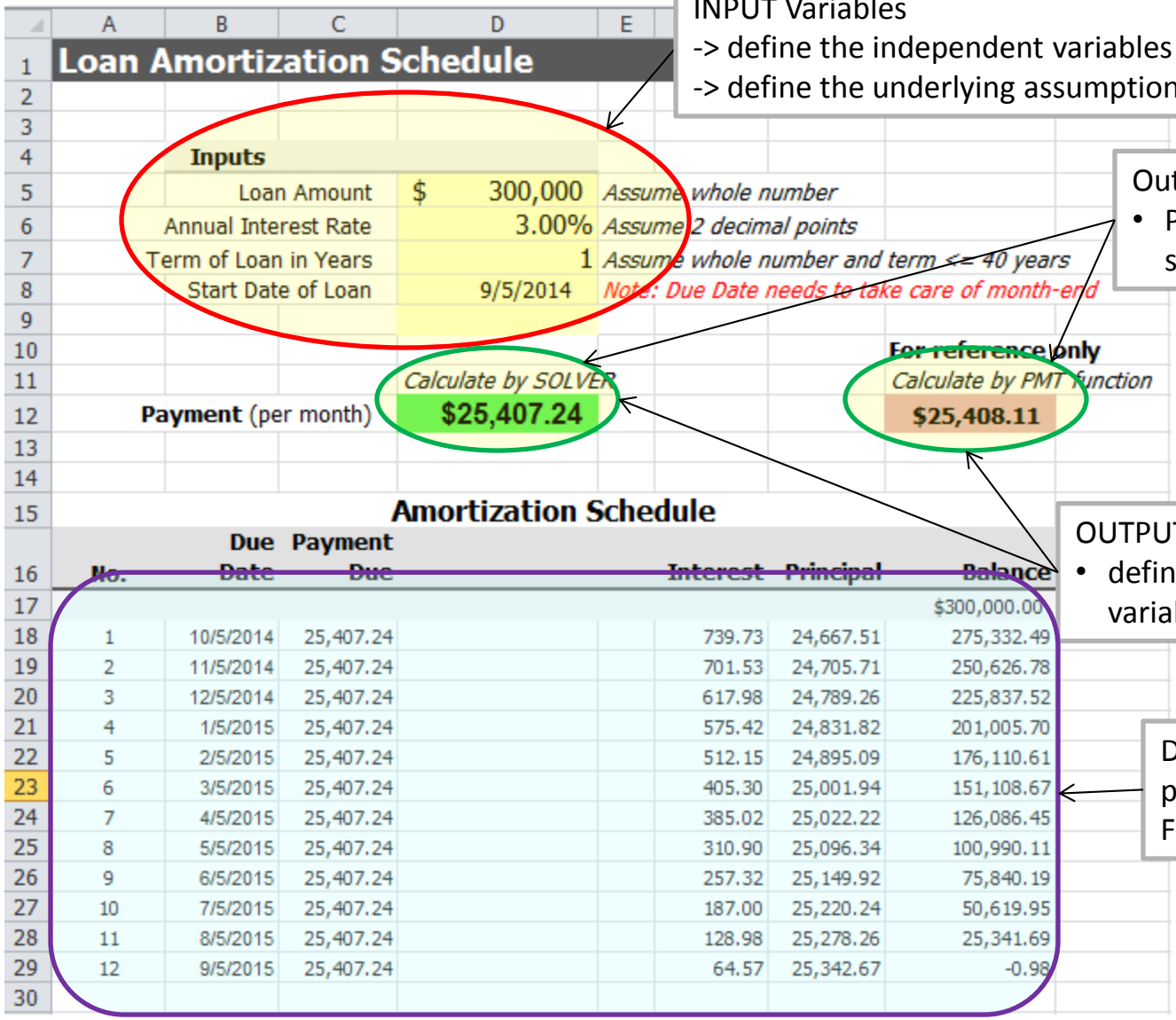
$N(d) =$ standard normal cumulative probability distribution function

Example – Black-Sholes Validation

S&P 500 Call Prices versus Black-Scholes Call Price



Example – Loan Amortization



INPUT Variables
-> define the independent variables
-> define the underlying assumption

Output Presentation & Validation
- Present the OUTPUT Result in a systematic manner

OUTPUT Variables
- define the Output dependent variables (Mortgage Payment)

Design and structure the processing logic using Financial Modeling Tools (Excel)