

Financial Modeling

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■ Model

Abstraction towards some *Objectives*.

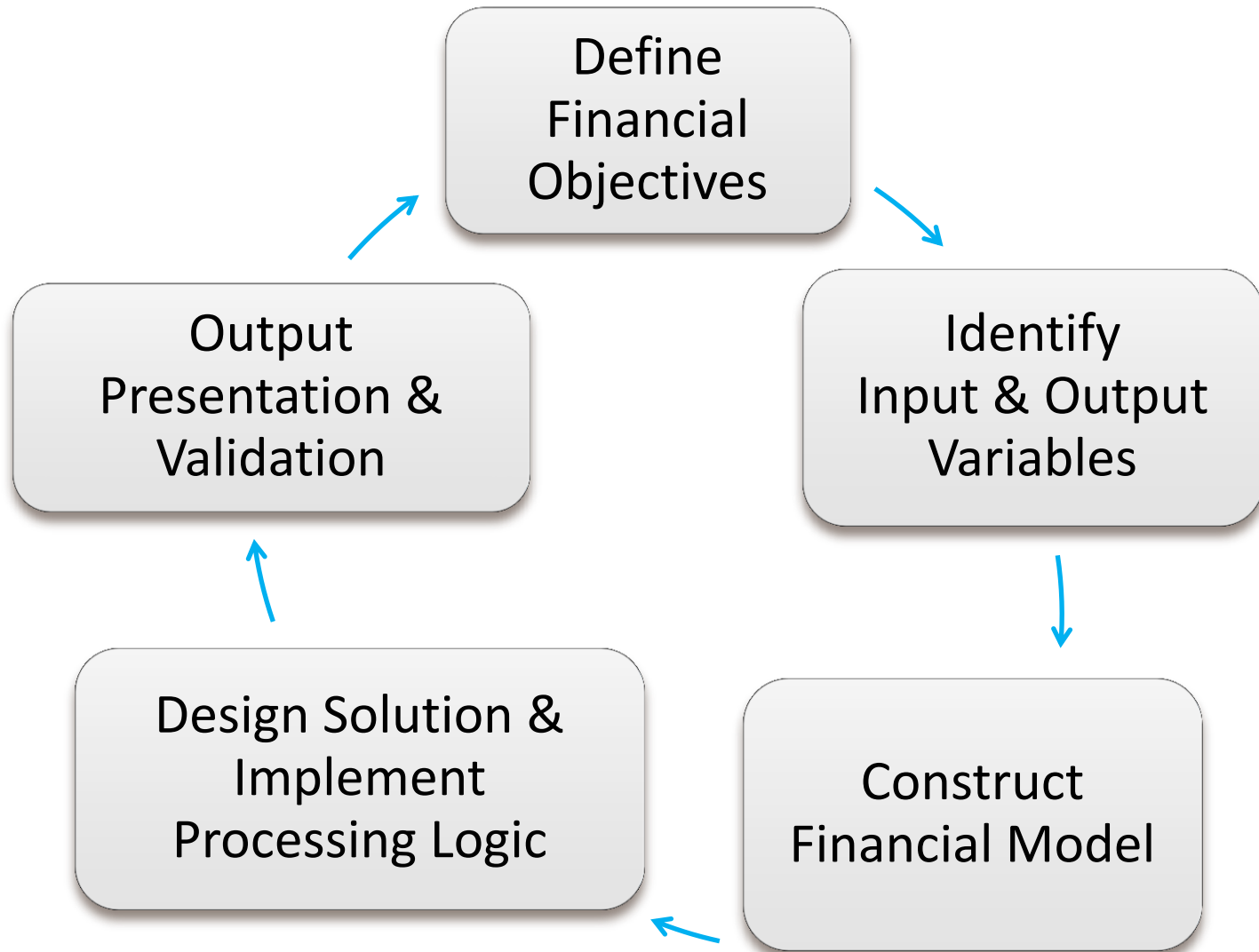
■ Financial Objectives

- 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

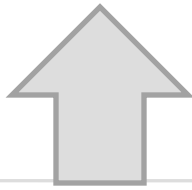
A contract between a buyer (holder) and a seller (writer), that gives the buyer the ***right*** but **not the obligation** to buy or sell a specified quantity of an underlying asset at a specific price (premium) within a specified period of time, regardless of the market price of the underlying asset.

Objective

What is the premium?

Option Pricing Example

Identify Input and Output Variables



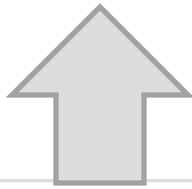
Input Variables

- **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

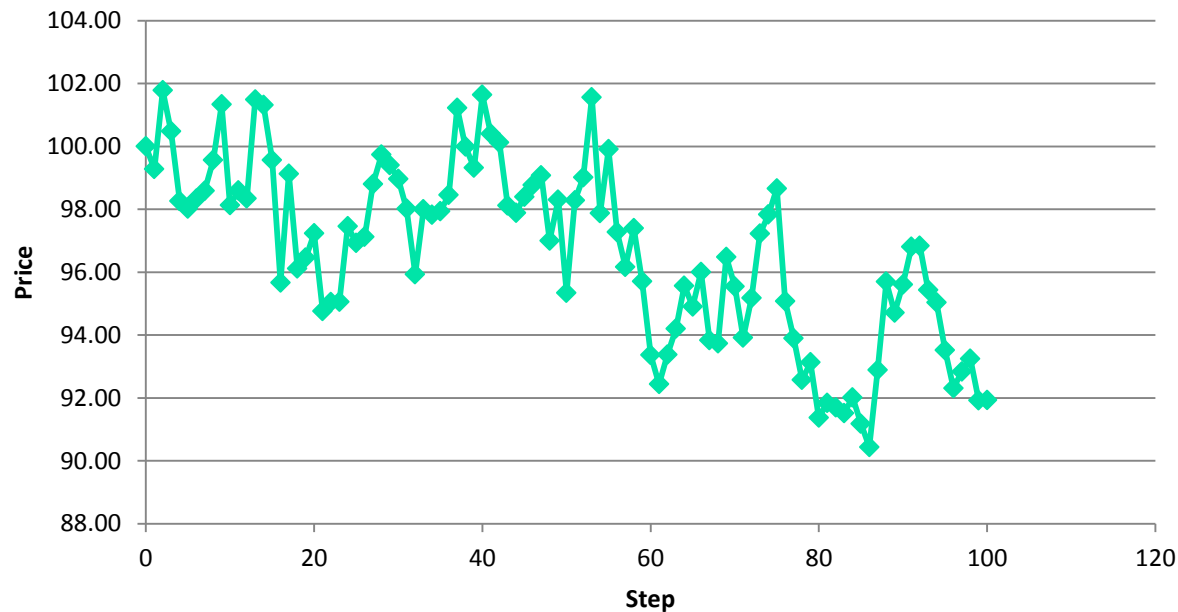
- Premium : The amount paid by the option buyer to the option writer for the right

Example – Option Pricing Construct Financial Model



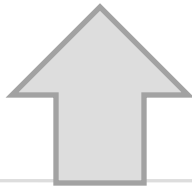
$$S(t + \Delta t) = S(t)e^{\left(\left(r - q - \frac{\sigma^2}{2}\right)\Delta t + \sigma\varepsilon\sqrt{\Delta t}\right)}$$

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

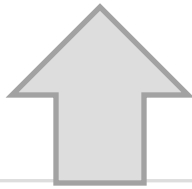
where :

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

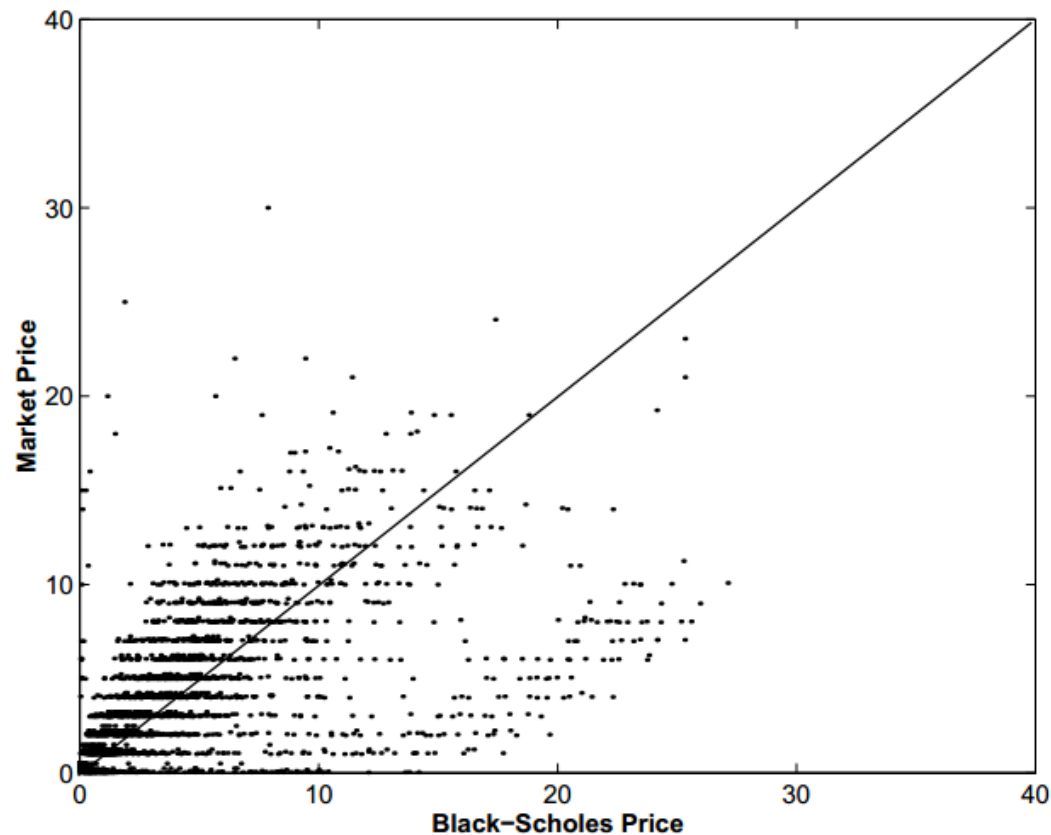
$$d_2 = \frac{LN\left(\frac{S_0}{X}\right) + (r - \frac{\sigma^2}{2})T}{\sigma\sqrt{T}} = d_1 - \sigma\sqrt{T}$$

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

Example – Black-Sholes Validation



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



Example – Loan Amortization

	A	B	C	D	E
1	Loan Amortization Schedule				
2					
3					
4		Inputs			
5		Loan Amount	\$ 300,000	Assume whole number	
6		Annual Interest Rate	3.00%	Assume 2 decimal points	
7		Term of Loan in Years	1	Assume whole number and term <= 40 years	
8		Start Date of Loan	9/5/2014	Note: Due Date needs to take care of month-end	
9					
10					
11					
12		Payment (per month)	\$25,407.24	Calculate by SOLVER	
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					
25					
26					
27					
28					
29					
30					

Amortization Schedule						
No.	Due Date	Due Payment	Interest	Principal	Balance	
					\$300,000.00	
1	10/5/2014	25,407.24	739.73	24,667.51	275,332.49	
2	11/5/2014	25,407.24	701.53	24,705.71	250,626.78	
3	12/5/2014	25,407.24	617.98	24,789.26	225,837.52	
4	1/5/2015	25,407.24	575.42	24,831.82	201,005.70	
5	2/5/2015	25,407.24	512.15	24,895.09	176,110.61	
6	3/5/2015	25,407.24	405.30	25,001.94	151,108.67	
7	4/5/2015	25,407.24	385.02	25,022.22	126,086.45	
8	5/5/2015	25,407.24	310.90	25,096.34	100,990.11	
9	6/5/2015	25,407.24	257.32	25,149.92	75,840.19	
10	7/5/2015	25,407.24	187.00	25,220.24	50,619.95	
11	8/5/2015	25,407.24	128.98	25,278.26	25,341.69	
12	9/5/2015	25,407.24	64.57	25,342.67	-0.98	

INPUT Variables

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

Output Presentation & Validation

- Present the OUTPUT Result in a systematic manner

For reference only

Calculate by PMT function

\$25,408.11

OUTPUT Variables

- define the Output dependent variables (Mortgage Payment)

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