

# Business Modeling

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First Data

# Outline

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# Business & Financial modeling

**Business modelling** ... In theory and practice the term business model is used for a broad range of informal and formal descriptions to represent core aspects of a business, including purpose, offerings, strategies, infrastructure, organizational structures, trading practices, and operational processes and policies. The literature has provided very diverse interpretations and definitions of a business model. A systematic review and analysis of manager responses to a survey defines business models as the design of organizational structures to enact a commercial opportunity. Further extensions to this design logic emphasize the use of narrative or coherence in business model descriptions as mechanisms by which entrepreneurs create extraordinarily successful growth firms. ... *Wikipedia*

# Business & Financial modeling

Financial modeling is the task of building an abstract representation (a model) of a financial decision making situation. This is a mathematical model designed to represent (a simplified version of) the performance of a financial asset or portfolio of a business, project, or any other investment. Financial modeling is a general term that means different things to different users; the reference usually relates either to accounting and corporate finance applications, or to quantitative finance applications. While there has been some debate in the industry as to the nature of financial modeling - whether it is a tradecraft, such as welding, or a science - the task of financial modeling has been gaining acceptance and rigor over the years. Typically, financial modelling is understood to mean an exercise in either asset pricing or corporate finance, of a quantitative nature. In other words, financial modelling is about translating a set of hypotheses about the behavior of markets or agents into numerical predictions; for example, a firm's decisions about investments (the firm will invest 20% of assets), or investment returns (returns on "stock A" will, on average, be 10% higher than the market's returns)

*Wikipedia*

# Use cases

- Financial calculation
- Financial statement modeling
- Initial Public Offering (IPO) modeling
- Valuation - corporation financial model
- Portfolio models
- Option-pricing models
- Prediction of electricity consumption in regions based on a local weather history

# Tools

- Excel, Excel with VBA
- statistical software SPSS (IBM), or free GNU PSPP
- programming languages
- Oracle CrystalBall
- analytical packages gretl, OCTAVE or R project
- data mining TANAGRA, WEKA

# Time Value of Money

**Rule 1** Only values at the same point in time can be compared or combined

**Rule 2** A cash flow must be **compounded** to move it forward in time. Future value of a cash flow is computed as:

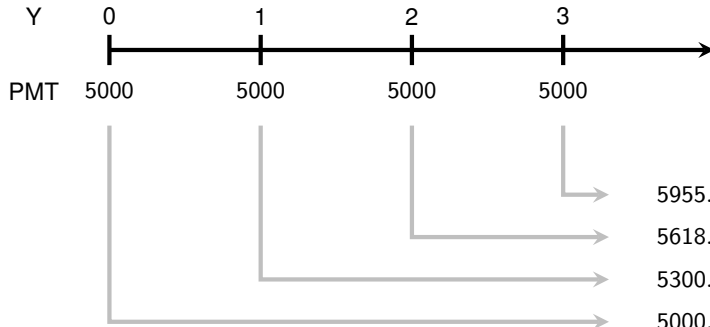
$$FV_n = C \times (1 + r)^n$$

**Rule 3** A cash flow must be **discounted** to move it back in time. Present value of a cash flow is computed as:

$$PV = \frac{C}{(1 + r)^n}$$

# Cash flow timeline

What is the future value and the present value of a cash flow at a given interest rate  $r = 6\%$ ?



$$5955.08 = 5000 \times (1.06)^3$$

$$5618.00 = 5000 \times (1.06)^2$$

$$5300.00 = 5000 \times (1.06)^1$$

$$5000.00 = 5000 \times (1.06)^0$$

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$$FV = 21\,873.08$$

And,  $PV = 18365.0597$ .



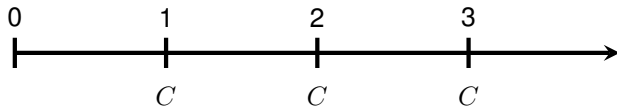
# Perpetuity

A **perpetuity** is a stream of equal cash flows that occur at regular intervals and last forever.

$$PV = \frac{C}{(1+r)} + \frac{C}{(1+r)^2} + \frac{C}{(1+r)^3} + \dots = \sum_{n=1}^{\infty} \frac{C}{(1+r)^n} \quad (1)$$

What is the present value of the perpetuity paid annually  $C$  at the interest rate  $r$ ?

Timeline of the perpetuity is:



# Perpetuity ... continued

We model the perpetuity as an investment to a bank account:

- Invest amount  $P$  to an account at the interest rate  $r$
- Every year withdraw the earned interest  $C = r \times P$  and keep the principal  $P$
- Present value of receiving  $C$  in perpetuity is the upfront cost  $P = C/r$ .

$$PV(C \text{ in perpetuity}) = \frac{C}{r}$$

# Annuity

An **annuity** is a series of payments made at fixed intervals of time. What is the present value of a cash-flow of  $N$  payments  $C$ .

$$PV = \frac{C}{(1+r)} + \frac{C}{(1+r)^2} + \frac{C}{(1+r)^3} + \dots + \frac{C}{(1+r)^N} = \sum_{n=1}^N \frac{C}{(1+r)^n}$$

Let us invest  $P$  in the bank, and we withdraw only interest  $C = r \times P$  each period. After  $N$  periods we withdraw also  $P$ .  $P$  is the present value of two cash flows:

$$P = PV(\text{annuity of } C \text{ for } N \text{ periods}) + PV(P \text{ in period } N)$$

# Annuity

Rearranging terms:

$$\begin{aligned} PV(\text{annuity of } C \text{ for } N \text{ periods}) &= P - PV(P \text{ in period } N) \\ &= P - \frac{P}{(1+r)^N} = P \left( 1 - \frac{1}{(1+r)^N} \right) \end{aligned}$$

As  $C = r \times P$ , we substitute for  $P$  to get the formula for the present value of an annuity  $C$  for  $N$  periods:

$$PV(\text{annuity of } C \text{ for } N \text{ periods with interest rate } r) = C \times \frac{1}{r} \left( 1 - \frac{1}{(1+r)^N} \right)$$

# Mortgage model in Excel

- We want a loan  $L$  from a Bank
- What is a monthly payment  $PMT$ ?
- What is the split in the interest rate payment and principal payment?

$PMT$  ... is an annuity for a bank

$L$  ... is the initial deposit (present value) that need to equal creation of the annuity  $PMT$

$$L = PMT \times \frac{1}{r} \left( 1 - \frac{1}{(1+r)^N} \right)$$

Re-ordering the equation

$$PMT = \frac{L \times r}{1 - \frac{1}{(1+r)^N}}$$

Excel offers function  $PMT(rate, nper, pv, fv, type)$

# Changes to the mortgage

- How much will the payments decrease if the advanced payment  $P_1$  to the principal  $P$  happens?
- How shortens the number of payments if the advance payment  $L_1$  to the principal  $P$  happens?

See the excel spreadsheet.

# References

- Jonathan Berk, Peter DeMarzo: Corporate Finance, 2007, Pearson International Edition
- Simon Benninga: Financial Modeling, 3rd edition, 2008, The MIT Press

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