

Week 1: FNCE10002 Principles of Finance



THE UNIVERSITY OF
MELBOURNE

Overview of Principles of Finance and Introduction to Financial Mathematics I

Asjeet S. Lamba, Ph.D., CFA
Associate Professor of Finance
Room 12.043, Faculty of Business and Economics
8344-7011

asjeet@unimelb.edu.au

Overview of Principles of Finance

- ❖ **Asjeet S. Lamba**

- ❖ *Phone:* 8344-7011

- ❖ *Email:* asjeet@unimelb.edu.au

- ❖ *Office:* Room 12.043, 198 Berkeley Street (The Spot)

- ❖ *Office Hours:* Wednesday, 11.15 am – 1.00 pm *or* by prior appointment

- ❖ **Jonathan Gauntlett**

- ❖ Tutor-in-charge

- ❖ *Email:* jonathan.gauntlett@unimelb.edu.au (only for urgent matters related to the tutorial program)

Subject Administration

- ❖ *Assessment 1*: Weekly tutorial participation which will contribute 10% to your overall grade
 - ❖ Tutorial participation consists of you handing in work assigned in each tutorial at the *beginning* of the tutorial
 - ❖ Answers must be handwritten on the Tutorial Hand-in Sheet (available on the LMS) and in original (photocopied/emailed answers are not acceptable)
 - ❖ Excluding the tutorial in which the mid semester exam will be discussed there are ten tutorials for which there will be assigned work
 - ❖ *For the full 10% credit you need to hand in at least eight of the ten items of assessment. That is, you may choose not to hand in at most two items of assessment and still receive the full 10% credit for this piece of assessment*

Subject Administration

FNCE10002 Principles of Finance

Semester 1, 2019

<i>Tutorial for Week:</i>		<i>Name:</i>	
<i>Tutorial Time:</i>		<i>Student ID:</i>	
<i>Date Submitted:</i>		<i>Tutor's Name:</i>	

Only answers to Part I questions are to be submitted at the **beginning** of your tutorial. Answers must be **handwritten** and in **original** (photocopies/emails will not be accepted). If needed, attach additional pages to this cover sheet. Make sure that you complete **all** the information above before submitting your work. Also, make sure that you keep a copy of your submission for your records as your submission will not be returned by your tutor.

--

Subject Administration

- ❖ *Assessment 2*: One individual online assignment which will contribute 10% to your overall grade
 - ❖ *Note that there are no extensions possible for this piece of assessment as it is implemented online with a reasonable lead-time to complete the assignment*
- ❖ *Assessment 3*: A mid semester exam which will contribute 20% to your overall grade. It will be closed-book and of 60 minutes duration with no reading time. The mid semester exam will be held during your class time in the week of April 8

Subject Administration

- ❖ *Assessment 4*: A final end-of-semester examination which will contribute 60% to your overall grade. It will be closed-book and of 120 minutes duration with a 15 minute reading time
 - ❖ *The final exam comprises a hurdle to passing this subject. That is, to pass this subject you need to score at least a 50% on the final exam. If you achieve an overall result greater than 50% but fail the final exam you will receive an overall result of NH (that is, fail by hurdle). The NH grade is always accompanied by a numerical mark of 49, regardless of your performance in other assessment components*
- ❖ Minimum time commitment: Around 4 times the in-class time, or around 144 hours
- ❖ Failure rates in this subject...
 - ❖ *Semester 1, 2017*: 8.6% (overall subject) and 10.1% (by hurdle), or 18.7% in total
 - ❖ *Semester 1, 2018*: 6.6% (overall subject) and 12.7% (by hurdle), or 19.3% in total

Subject Administration

- ❖ All lecture notes and additional readings are available on the subject's LMS page
- ❖ New policy on calculators in examinations
 - ❖ Only the [Casio FX82](#) (any suffix) is allowed in exams
 - ❖ “Any suffix” means that a Casio FX82 with any number/letter after FX82 is acceptable
- ❖ *Required Textbook*
 - ❖ Graham, J. R., Smart, S.B., Adam, C. and Gunasingham, B., Introduction to Corporate Finance: Asia-Pacific Edition, 2nd ed., Cengage Learning, 2017. [658.15 GRAH – Referred to as GRAH]
 - ❖ Link to the book's print and eBook versions:
<http://www.cengagebrain.com.au/shop/search/9780170364331>
 - ❖ There is a 10% discount on the eBook using the discount code **STUDYSMART**
- ❖ **Read the financial press on a regular (daily!) basis**

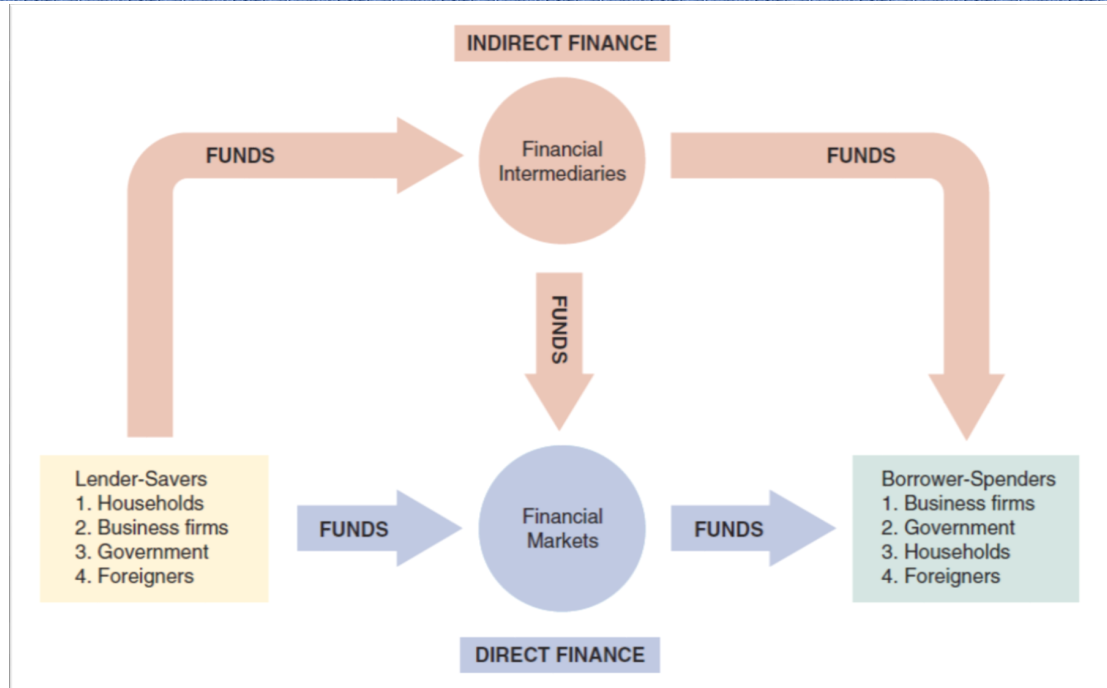
Subject Objectives

- ❖ Use financial mathematics to solve basic financial problems
- ❖ Explain the role of risk and return in the asset allocation decision and the pricing of risky assets
- ❖ Distinguish between the different sources of financing including short term debt, long term debt and equity
- ❖ Apply alternative capital budgeting techniques for project evaluation purposes
- ❖ Discuss the issues and choices involved in a firm's capital structure decision
- ❖ Discuss the issues and choices involved in a firm's distribution decision
- ❖ Explain how options can be used to manage basic financial risks

Subject Content and Focus

- ❖ Finance is the study of how individuals, businesses and institutions *acquire*, *spend* and *manage* financial resources (see next slide)
- ❖ Major areas of finance
 - ❖ Investment analysis and management
 - ❖ Corporate finance
 - ❖ Capital markets and financial institutions
 - ❖ International finance
 - ❖ Personal finance
 - ❖ Real estate finance
 - ❖ Financial intermediation
 - ❖ Behavioral and neurofinance
- ❖ This subject provides an introduction to investment analysis and corporate finance

Subject Content and Focus



Source: Mishkin, F. S. and Eakins, S. G., Financial Markets and Institutions, 8th ed., 2014

Subject Content and Focus

- ❖ **Investment analysis** is mainly concerned with **where** and **how** to invest and how to **finance** these investments (first half of this subject)
 - ❖ Valuation of bonds, equities and derivatives
 - ❖ Modern portfolio theory
 - ❖ Asset pricing and market efficiency
 - ❖ Extended in [FNCE30001 Investments](#) and [FNCE30007 Derivative Securities](#)
- ❖ **Corporate finance** is mainly concerned with the **decisions of companies and their management** (second half of this subject)
 - ❖ Capital budgeting – what investments to make
 - ❖ Capital structure – how to finance these investments
 - ❖ Payout policy – what to payout to shareholders
 - ❖ Extended in [FNCE20005 Corporate Financial Decision Making](#)

Subject Content and Focus

- ❖ Weeks 1 – 2 Introduction to Financial Mathematics
- ❖ Weeks 3 – 4 Valuation of Debt and Equity Securities
- ❖ Week 5 Modern Portfolio Theory and Asset Pricing I
- ❖ Week 6 Mid Semester Exam (No lecture)
- ❖ Week 7 Modern Portfolio Theory and Asset Pricing II
- ❖ Weeks 8 – 9 Capital Budgeting
- ❖ Weeks 10 – 11 Capital Structure and Payout Policy
- ❖ Week 12 Introduction to Options

Subject Philosophy

*“Everything should be made
as simple as possible,
but not simpler.”*

Albert Einstein

Subject Philosophy

“Any fool can know. The point is to understand.”

Albert Einstein

Student Feedback – Semester 1, 2018

- ❖ The lectures were great and provided a lot of real-world analysis, and the tutorials were clear and provided good understanding of the concepts discussed in lectures.
- ❖ The content was really insightful and linked well with all aspects. I felt that topics built on prior knowledge well as the semester progressed.
- ❖ The content was interesting and provided a great foundation for people with no prior knowledge of finance. The tutorial and lectures were very well structured and helped with the understanding of the subject. I would recommend this course to anyone.
- ❖ The different types of questions in the pre-tutorial work forced us to think deeply about the material and ensure that we could both explain it and apply it in different ways.
- ❖ Weekly assignments were a good way to consolidate and apply the concepts learnt in lectures each week. Tutorials allowed students to discuss the concepts in small groups and gain a better understanding of the content each week.
- ❖ This subject has challenged my analytical and logical as well as mathematical skills in solving problems which are relevant to world economics. As well as the case studies involved on lectures, which are relevant to the concepts discussed.
- ❖ The content was interesting and the real-life applications were evident and stimulating. The content and LMS page were organised to a high standard which assisted learning very well.

Student Feedback – Semester 1, 2018

- ❖ I enjoyed the case studies in lectures that were relevant to our current economic and financial climate which made the content we were learning both interesting and relevant.
- ❖ It was interesting to learn the new concepts and skills as I have never been exposed to them before.
- ❖ Really well organized, the content is helpful and some is challenging, you need to understand the knowledge to solve problems.
- ❖ Asjeet as a lecturer was a very methodical lecturer. He gave time to do assignments and gave time to do past papers and provided solutions. This was an aspect I was very happy about the lecturer.
- ❖ It is definitely a challenging and interesting subject, love the incorporation of different companies.
- ❖ The fact that it was relevant to what actually happens in the workplace. Looking at case studies was helpful and gave good context to what we were learning. Lecture capture was incredibly useful, as after attending each lecture, I watched the whole thing again to take more detailed notes and fully understand the theory.
- ❖ Overall framework of different topics is presented clearly. Presentation of content in lecture slides are simple and easy to understand as well!
- ❖ The willingness of the lecturer to engage with us helped engender a sense of understanding and stimulate our minds during the 2-hour weekly lectures.
- ❖ Asjeet is so fun and has a great sense of humour that I like. He really loves Finance and it definitely makes students like me who are interested in Finance want to go further within this subject.

Student Feedback – Semester 1, 2018

- ❖ Professor Lamba provides content in a fun, easy-to-understand presentation each week. The tutorials help back up what we learn in the lectures. The subject is very well structured ... all students were kept up-to-date with everything they were expected to accomplish for this subject.
- ❖ The materials such as sample exams and formula sheet are always provided in advance. The materials given (lecture notes, formula sheet, tutorials questions and answers) are provided with good quality... The professor is very helpful and when I raised doubt regarding the tutorial feedback, he was really friendly and efficient in checking with my tutor. The best subject I have had in the University of Melbourne for my first semester here.
- ❖ The lecturer was great. Despite it being a two-hour lecture, Asjeet was excellent at explaining the content, going through examples and maintaining engagement with his humour.
- ❖ I liked that we had the pre-tutorial and in-tutorial questions because these ensured we really understood the concepts each week.
- ❖ Asjeet is able to share his enthusiasms of equity markets which makes the subject more memorable and engaging. I particularly enjoy his personal anecdotes of trading Billabong, Telstra shares, etc.
- ❖ The lecturer is so engaging in his lectures and shows a lot of enthusiasm by bringing in current events and issues in the financial world. Content is very well explained in lectures with great support from tutorials and pre-tutorial tasks.

Note: The comments have been corrected for grammar and spelling errors

Code of Conduct During Lectures

- ❖ Be attentive to the lecturer
- ❖ Do not talk
- ❖ Arrive on time and stay for the full lecture
- ❖ Turn off mobile phones and other electronic devices
- ❖ Bring required materials to the lecture

About Me

- ❖ Associate Professor, University of Melbourne
- ❖ Teaching Associate/Lecturer, University of Washington, Seattle
- ❖ Visiting appointments: ANU (MBA program) and Monash University (MBA program)

- ❖ PhD in Finance, University of Washington, Seattle
- ❖ MBA in Finance, University of Michigan, Ann Arbor
- ❖ BA (Honors) in Economics, University of Delhi, Delhi
- ❖ Chartered Financial Analyst (CFA) charterholder

Introduction to Financial Mathematics I

1. Examine the main goal of the firm
2. Examine the time value of money and interest rates
3. Compare simple interest with compounded interest
4. Calculate present and future values of cash flows
5. Calculate present and future values of a series of cash flows

These notes have been prepared by Asjeet S. Lamba, Department of Finance, University of Melbourne for use by students enrolled in FNCE10002 Principles of Finance. Please let me know if you find any typos or errors. This material is copyrighted by Asjeet S. Lamba and reproduced under license by the University of Melbourne (© 2017-19)

Required Readings: Weeks 1 – 2

❖ *Week 1*

- ❖ GRAH, Ch. 1 and Ch. 3 (Sec. 3.1 – 3.5a and 3.6a)
- ❖ Varian, H., 1993, A Portfolio of Nobel Laureates: Markowitz, Miller and Sharpe, *Journal of Economic Perspectives* 7(1), pp. 159-169

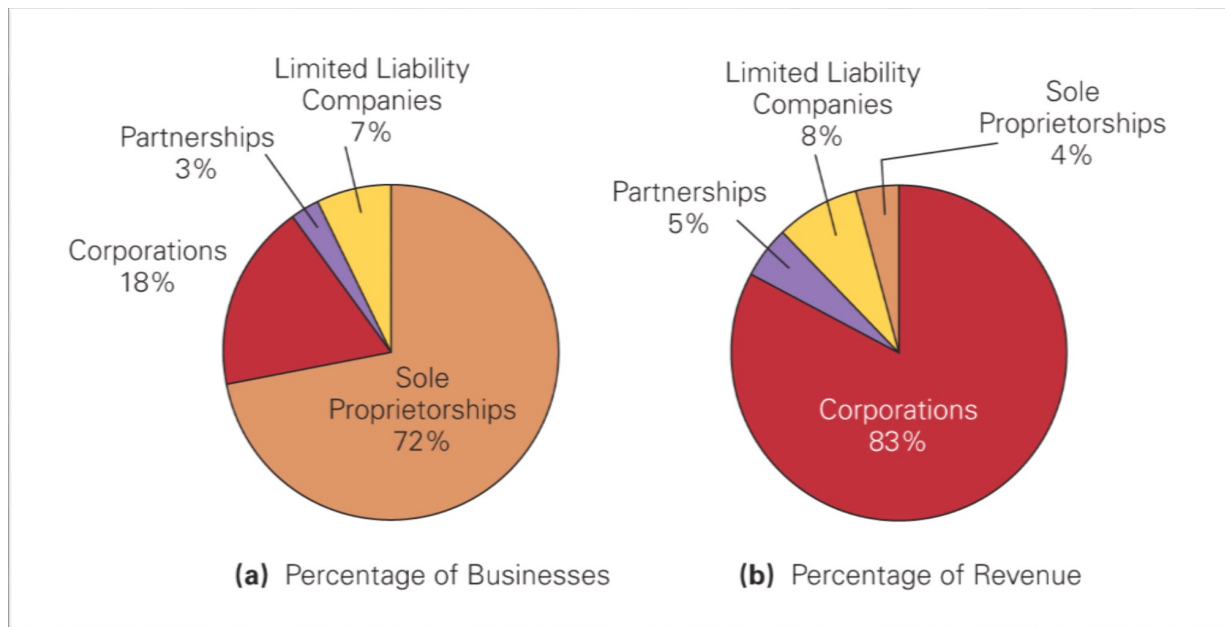
❖ *Week 2*

- ❖ GRAH, Ch. 3 (Sec. 3.5b – 3.6)
- ❖ Lamba, A. S., 2019, Teaching Note 1: Introduction to Financial Mathematics (focus on sections 3.2, 3.6 and 3.7 of the teaching note as this material is not covered in detail in the text)

1.1 The Main Goal of Firms and Managers

- ❖ In this subject, our focus is on listed and publicly-traded corporations
- ❖ Other types of business structures in Australia (and elsewhere)...
 - ❖ Sole proprietorship
 - ❖ Partnership/Limited partnership
 - ❖ Proprietary limited company
 - ❖ Limited liability company (US and Europe mainly)
 - ❖ See Chapter 1 for more details on these business structures

Why Focus On Corporations?

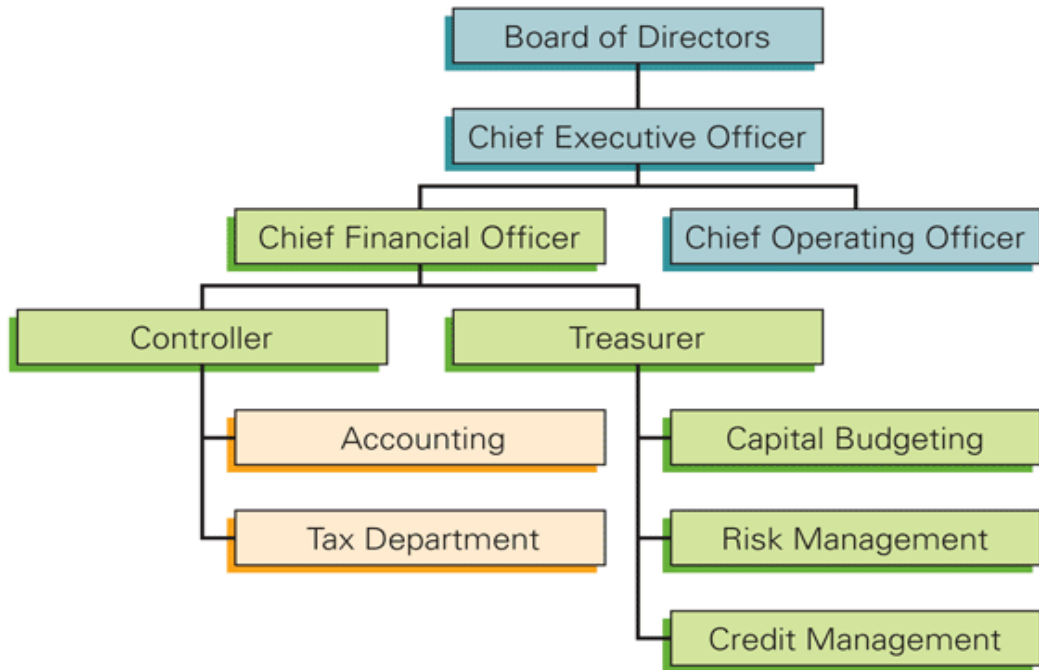


Source: Berk and DeMarzo, Figure 1.1. The data are for the US market.

Listed, Publicly-Traded Corporations

- ❖ A corporation is a legal entity separate from its owners
- ❖ Ownership is represented by shares of stock. An owner of these shares is referred to as a shareholder, stockholder or equity holder
 - ❖ There is no limit to the number of shareholders and the amount of funds a company can raise by selling shares
 - ❖ Shareholders are entitled to (discretionary) dividend payments
- ❖ Direct control is via an elected Board of Directors and day-to-day control via the senior management led by the Chief Executive Officer (CEO)
 - ❖ The finance manager (CFO) is typically responsible for the firm's investment, financing and cash management decisions
- ❖ Note that this separation of *ownership* and *control* can lead to *agency problems* (more on this in future lectures)

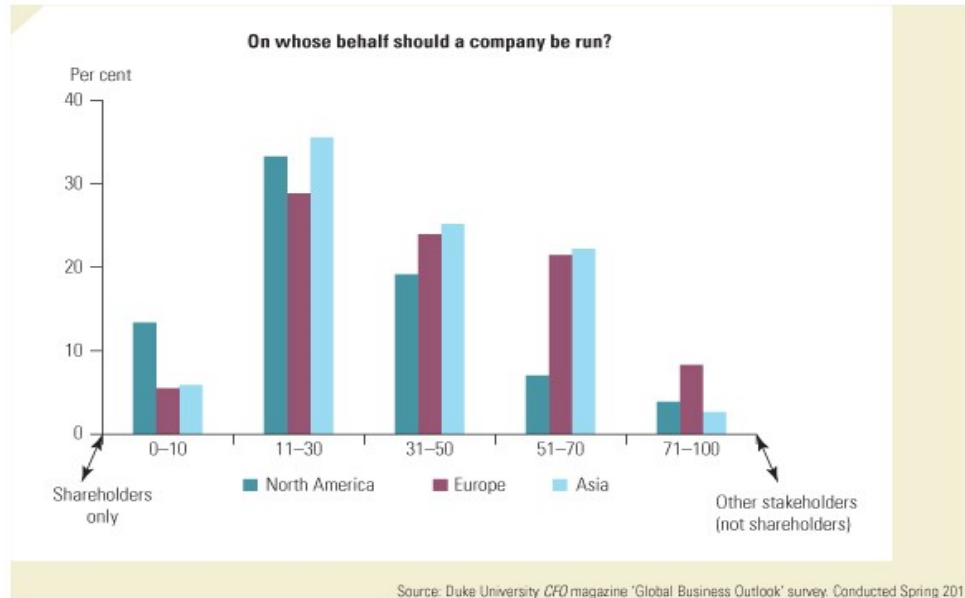
Listed, Publicly-Traded Corporations



Firm Value Maximization

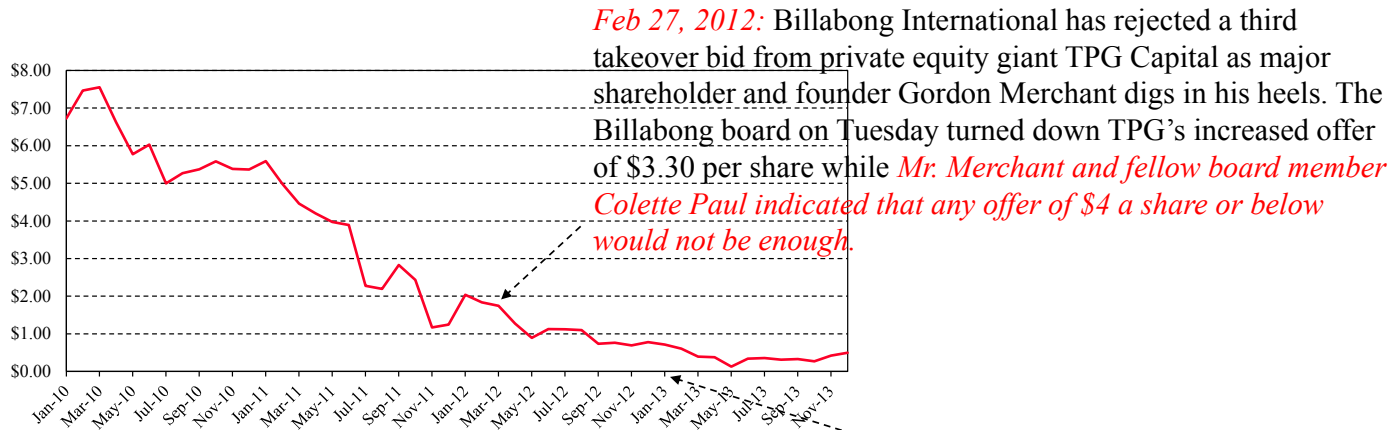
- ❖ The *main* goal of management is to maximize the firm's market value of equity
 - ❖ Equity value = Present value of future expected cash flows
- ❖ Market value of equity = Share price \times Number of shares
 - ❖ Maximizing the market value of equity is the same as maximizing the share price
- ❖ This maximizes the wealth of shareholders
 - ❖ Shareholder wealth = Present value of shareholders' future expected cash flows
- ❖ *What do managers claim they do?*
- ❖ *Do managers always maximize equity value?*
- ❖ *What happens when managers do not maximize equity value?*

Firm Value Maximization – What Managers Say



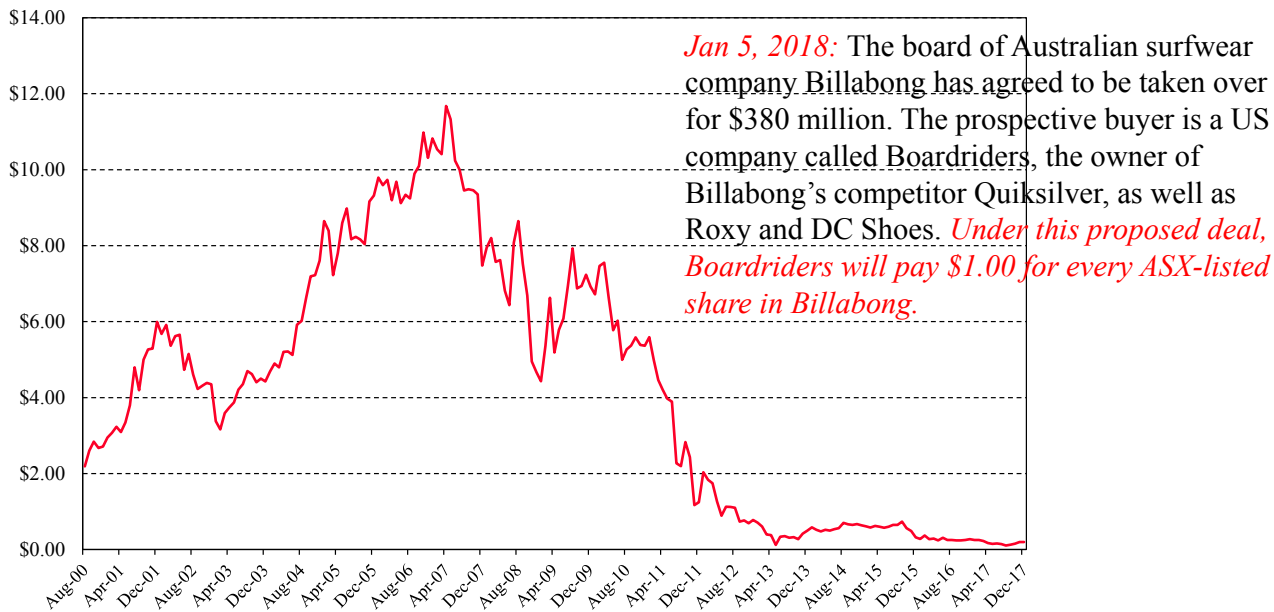
Source: Graham, et al, Finance in Practice, Ch 1. Survey of CFOs conducted following the 2007-08 Global Financial Crisis.

Case Study 1: Surf's Up No More for Billabong



Jan 15, 2013: A second \$1.10 offer has been made for Billabong, the sixth since the struggling surfwear company hit financial headwinds. The Gold Coast-based company late yesterday revealed it had received the \$1.10 a share offer from San Francisco private equity firm Altamont Capital Partners and US apparel company VF Corporation, whose brands include Lee and Wrangler. The offer matches the bid put forward by Paul Naude, the boss of Billabong's Americas division, who heads a consortium backed by US private equity firm Sycamore Partners and Bank of America Merrill Lynch. The two offers value the surfwear retailer at \$527 million.

Case Study 1: Surf's Up No More for Billabong



Price history of Billabong since its IPO in August 2000 at \$2.30 per share. *The price was around \$0.20 by end-Dec 2017, or over 98% lower compared to its all time high price of \$11.33!* (Note that Billabong conducted a 1-5 reverse share split in Nov 2015 but these prices are not adjusted for this reverse split.)

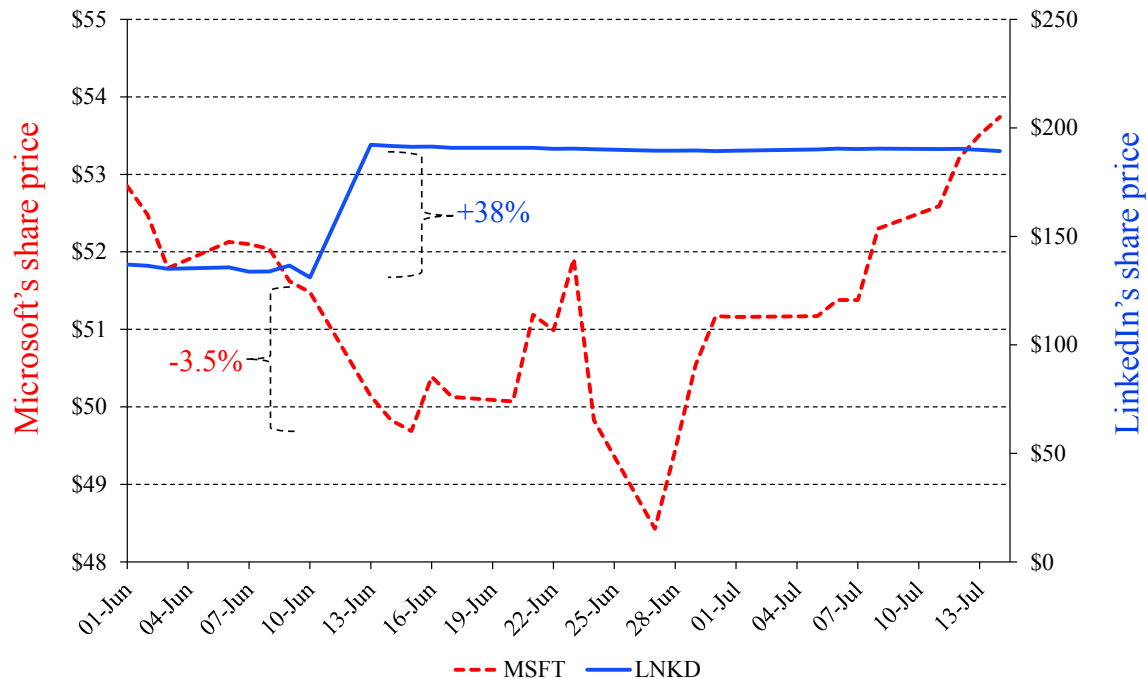
Case Study 2: Microsoft's Takeover of LinkedIn

- ❖ *Microsoft Pays \$26 Billion for LinkedIn in Biggest Deal Yet*
- ❖ *June 13, 2016:* Microsoft Corp. (Nasdaq: [MSFT](#)) announced a US\$26.2 billion takeover of the professional social network LinkedIn Corp. *Microsoft will pay \$196 per share in an all-cash transaction, including LinkedIn's net cash, a 49.5 percent premium to LinkedIn's closing price Friday. The price relative to LinkedIn's earnings makes the transaction the most expensive of any major deal this year,* according to data compiled by Bloomberg. *"This is about the coming together of the leading professional cloud and the leading professional network,"* Nadella said in an interview. "This is the logical next step to take. We believe we can accelerate that by making LinkedIn the social fabric for all of Office."

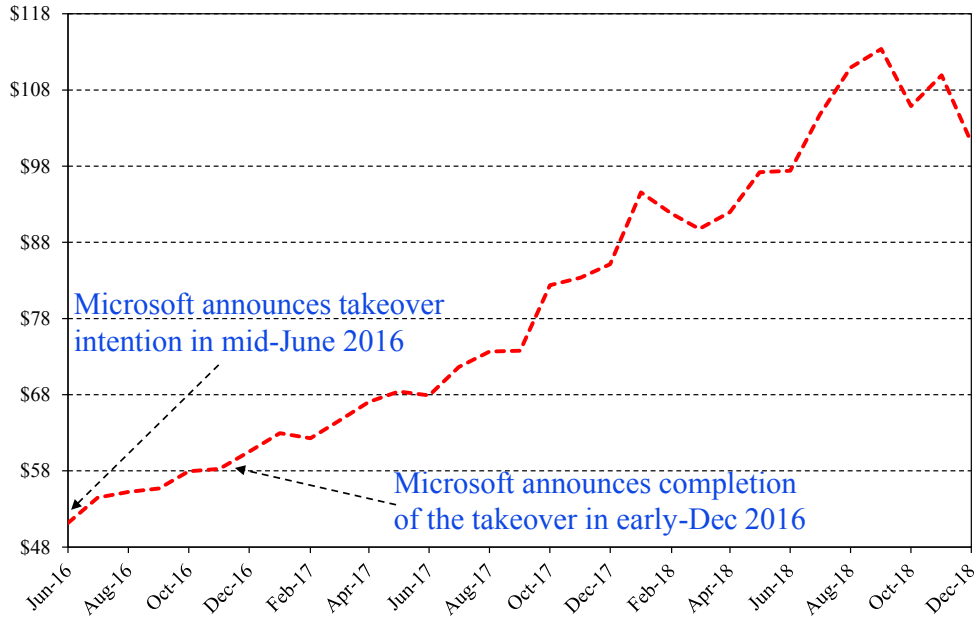
Source: <http://www.bloomberg.com/news/articles/2016-06-13/microsoft-to-buy-linkedin-in-deal-valued-at-26-2-billion>

- ❖ *How did the market react to the announcement?*
- ❖ *What does this tell us about what the market's expectations?*
- ❖ *What has happened since then?*

Case Study 2: Microsoft's Takeover of LinkedIn



Case Study 2: Microsoft's Takeover of LinkedIn



Price history of Microsoft from Jun 2016 – Dec 2018. The total return (excluding dividends paid) was almost 98% during this period. The total return (excluding dividends paid) during Dec 2016 – Dec 2018 was over 67%.

“Inputs” to Firm Value Maximization

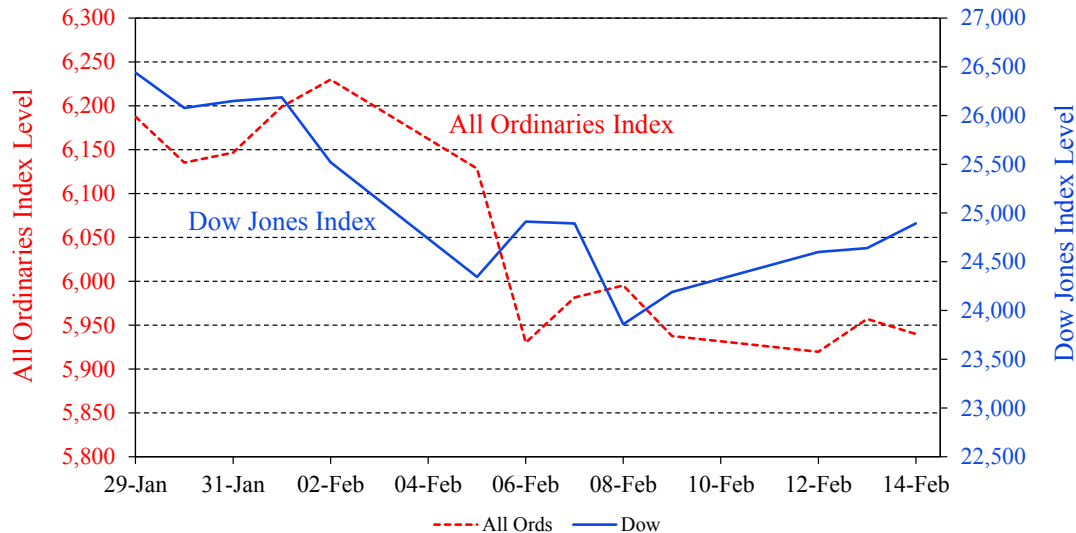
- ❖ In order to examine the goal of maximizing the market value of a firm's equity we need to understand three important concepts in Finance...
 - ❖ The role of information and capital market efficiency
 - ❖ The time value of money and interest rates
 - ❖ Riskless arbitrage and the law of one price (more on this in future lectures)
- ❖ *Capital market efficiency* refers to the idea that the market prices we observe reflect *all relevant* information available at that point in time
- ❖ *What do we mean by “relevant” information?*
- ❖ *What role do market expectations play in determining market prices?*

Case Study 3A: That's Not a Market Crash...

- ❖ On Feb 5 and then Feb 8 of 2018 the Dow Jones Industrial Average (or “The Dow”) experienced its two largest point drops of over 1,000 points which translated to percent drops of over 4.6% and 4.1% respectively. The sell-off wiped out more than \$2 trillion dollars of the total US equity markets’ value. *The drops were sparked by concerns related to an overheated economy driving inflation higher and resulting in the US Fed raising interest rates earlier than expected.* Commenting on the market drops, President Trump tweeted: “In the ‘old days,’ when good news was reported, the Stock Market would go up. Today, when good news is reported, the Stock Market goes down. Big mistake, and we have so much good (great) news about the economy!”

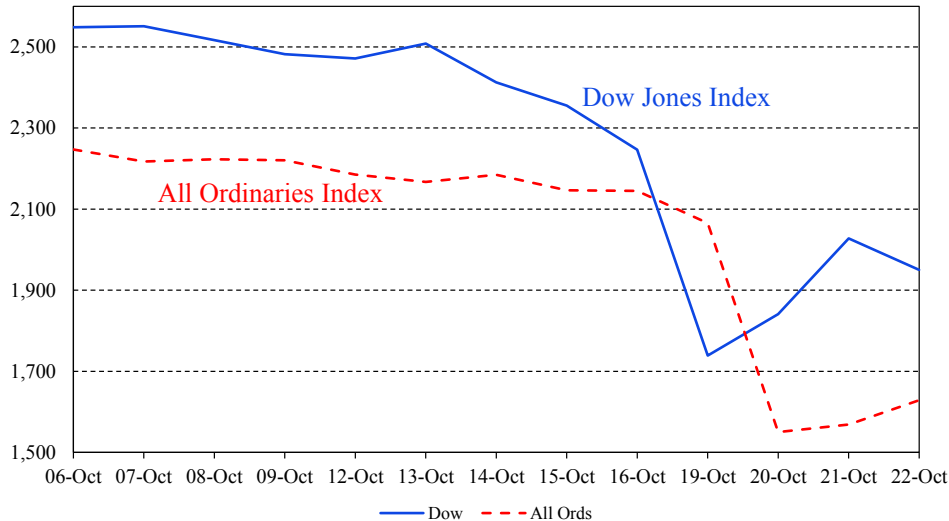
Source: <https://www.businessinsider.com.au/trump-stock-market-tweet-shows-lack-of-understanding-2018-2>

Case Study 3A: That's Not a Market Crash...



On Feb 5 and then Feb 8 of 2018 the Dow Jones Industrial Average experienced its two largest point drops of over 1,000 points which translated to percent drops of over 4.6% and 4.1% respectively. The Australian market index (All Ords) had already fallen by 1.6% on Feb 5 and fell a further 3.2% on Feb 6 and around 1% on Feb 9.

Case Study 3B: That's a Market Crash!



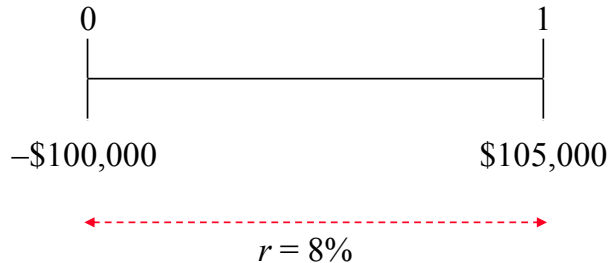
In sharp contrast, on Oct 19 (in the US) and Oct 20 (in Australia) of 1987 the Dow Jones Industrial Average experienced its largest *percent* drop of 22.6% (which translated to a drop of over 500 points). The drop in the All Ords was an even more dramatic 25.0% the following day. Here's a [link](#) to a retrospective on those events.

1.3 Time Value of Money and Interest Rates

- ❖ Most finance problems deal with analyzing the costs and benefits of decisions involving cash flows at different points in time
- ❖ The basic *valuation principle* states that if the value of benefits exceed the value of costs then the decision will increase the value of the firm
- ❖ Some questions...
 - ❖ *How are benefits defined?*
 - ❖ *How are costs defined?*
 - ❖ *Does it matter if the benefits and costs occur at different points in time?*

Time Value of Money and Interest Rates

- ❖ *Illustration:* An investment opportunity will cost you \$100,000 today (that is, year 0) with a benefit of \$105,000 in one year's time. Assume that the cash flow in year 1 is riskfree (that is, it is certain to occur). You also have the opportunity to put money in a bank and earn a riskfree interest rate (r) of 8% per annum. What should you do and why?



Time Value of Money and Interest Rates

- ❖ The naïve (and **incorrect!**) approach...
 - ❖ Benefits – Costs = $105000 - 100000 = \$5,000 > 0$
- ❖ This ignores the opportunity of putting \$100,000 in a bank account and earning a (riskfree) interest rate of 8%...
 - ❖ Value of \$100,000 in one year = $100000(1 + 0.08) = \$108,000$
- ❖ The difference between the value of money today and money in the future is called the *time value of money*
 - ❖ The riskfree interest rate measures the *rate of exchange over time*
 - ❖ By depositing money in a bank account (that is, *lending* money to the bank) one can convert money today into money in the future
 - ❖ By *borrowing* money from a bank one can exchange money in the future for money today

Time Value of Money and Interest Rates

- ❖ The correct approach *always* takes the time value of money into account
- ❖ We can value the investment in year 1 (that is, its *future* value)...
 - ❖ Future value of the benefit (year 1) = \$105,000
 - ❖ Future value of the cost (year 1) = $100000(1 + 0.08) = \$108,000$
 - ❖ Future value of net benefits = $105000 - 108000 = -\$3,000 < 0$
- ❖ We can also value of the investment today (that is, its *present* value)...
 - ❖ Present value of the benefit (year 0) = $105000/(1 + 0.08) = \$97,222.22$
 - ❖ Present value of the cost (year 0) = \$100,000
 - ❖ Present value of net benefits = $97222.22 - 100000 = -\$2,777.78 < 0$
 - ❖ *Note:* The net benefit above is referred to as the *net present value*
- ❖ *How are the present and future values of the investment related to each other?*

1.4 Simple Versus Compounded Interest

❖ Simple interest

- ❖ The value of a cash flow is calculated *without* including any accrued (that is, earned) interest to the principal
- ❖ *Example:* If you invest \$1,000 at 8% p.a. earning simple interest for 5 years what amount will you have in your bank account at the end of that time period?
 - ❖ Interest earned in each of the five years = $1000 \times 0.08 = \$80$
 - ❖ Interest earned over five years = $(1000 \times 0.08) \times 5 = \400
 - ❖ Future value at the end of year 5 = $1000 + 400 = \$1,400$
- ❖ We can do the calculation in a single step as...
 - ❖ Future value at the end of year 5 = $1000(1 + 5 \times 0.08) = \$1,400$
- ❖ Future value using *simple* interest, $FV_n = PV_0(1 + n \times r)$

Simple Versus Compounded Interest

- ❖ *Example (continued)*: If your goal was to accumulate \$1,400 at the end of 5 years and you could earn simple interest at 8% p.a. what amount would you need to save today?
- ❖ We know that the future value using simple interest is...
 - ❖ $FV_n = PV_0(1 + n \times r)$
- ❖ So, the present value today of a given future amount using **simple** interest is...
 - ❖ $PV_0 = FV_n / (1 + n \times r)$
 - ❖ $PV_0 = 1400 / (1 + 5 \times 0.08) = \$1,000$
- ❖ Note that in virtually every other situation we will be concerned with *compounded* interest rather than simple interest

Simple Versus Compounded Interest

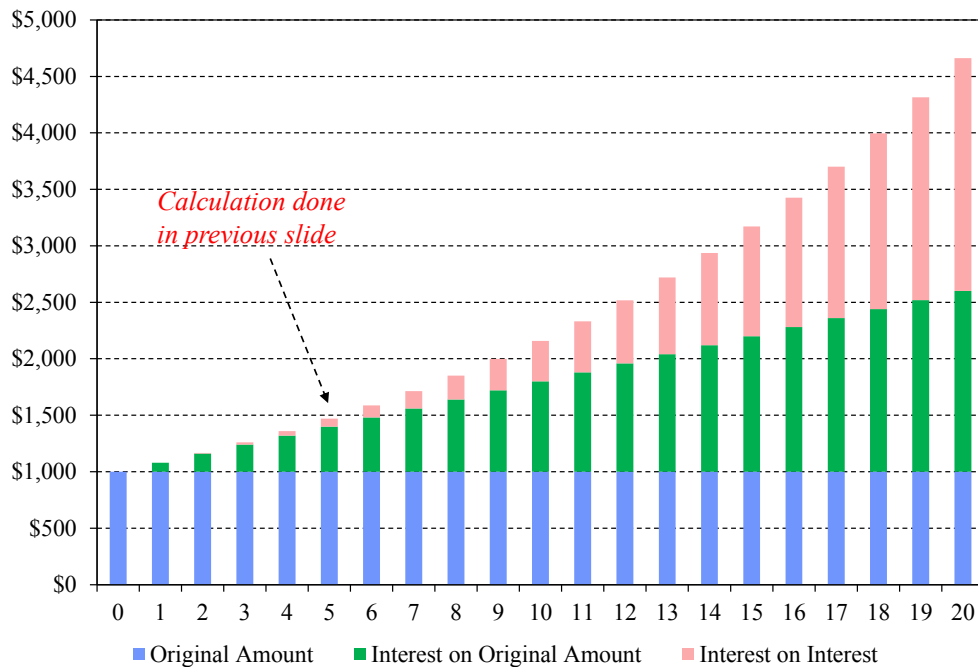
- ❖ **Compounded interest**

- ❖ Interest accrued (that is, earned) is added to the principal and reinvested
 - ❖ The (future) value of a cash flow is calculated based on the principal *and* interest accrued
 - ❖ This compounding of interest over time is referred to as *interest on interest*
- ❖ Here's what Albert Einstein said about compound interest...
- ❖ *"Compound interest is the eighth wonder of the world. He who understands it, earns it ... he who doesn't ... pays it."*

Simple Versus Compounded Interest

- ❖ *Example:* If you invest \$1,000 at 8% p.a. earning compounded interest for 5 years what amount will you have in your account at the end of that time period?
 - ❖ Future value at the end of year 1 = $1000.00(1.08) = \$1,080.00$
 - ❖ Future value at the end of year 2 = $1080.00(1.08) = \$1,166.40$
 - ❖ Future value at the end of year 3 = $1166.40(1.08) = \$1,259.71$
 - ❖ Future value at the end of year 4 = $1259.71(1.08) = \$1,360.49$
 - ❖ Future value at the end of year 5 = $1360.49(1.08) = \$1,469.33$
- ❖ Alternatively, we can do the calculation in a single step...
 - ❖ Future value at the end of year 5 = $1000(1.08)^5 = \$1,469.33$
 - ❖ *Note:* $\$1,469.33 = \$1,000 + \$400 + \69.33 (see next slide)
 - ❖ The amount of \$69.33 is due to the compounding of interest (“interest on interest”)

Simple Versus Compounded Interest



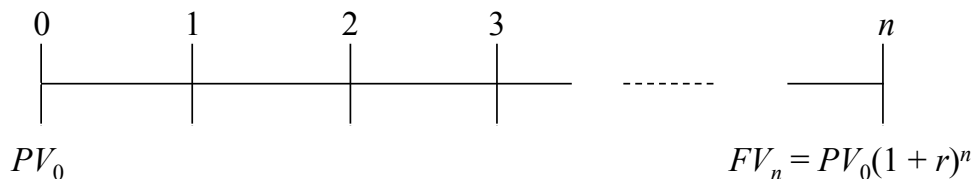
Simple Versus Compounded Interest

So, what's the big deal?

<i>End of year, n</i>	<i>Simple interest</i>	<i>Compounded interest</i>	<i>Difference</i>
1	\$1,080.00	\$1,080.00	\$0.00
2	\$1,160.00	\$1,166.40	\$6.40
3	\$1,240.00	\$1,259.71	\$19.71
4	\$1,320.00	\$1,360.49	\$40.49
5	\$1,400.00	\$1,469.33	\$69.33
20	\$2,600.00	\$4,660.96	\$2,060.96
50	\$5,000.00	\$46,901.61	\$41,901.61
100	\$9,000.00	\$2,199,761.26	\$2,190,761.26

1.5 Future and Present Value of a Single Cash Flow

- ❖ The future value (FV_n) at $r\%$ p.a. of an amount (PV_0) today is the dollar value to which it grows at the end of time period n
- ❖ $FV_n = PV_0(1 + r)^n$



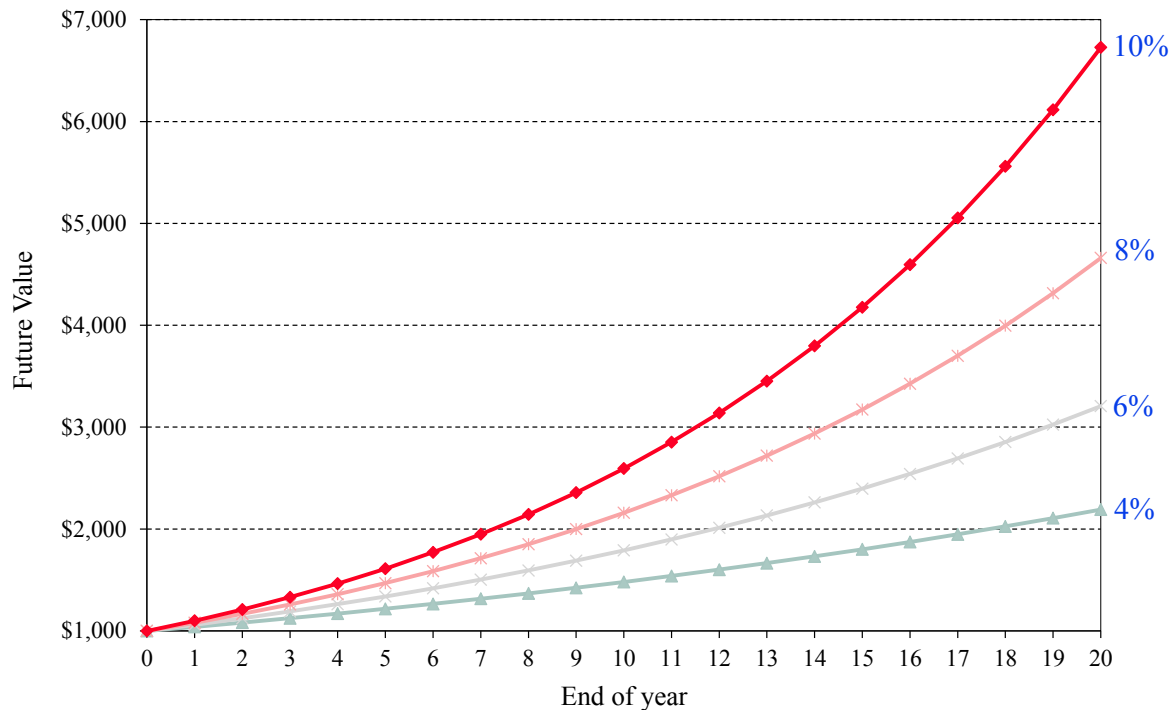
Cash flows occur at the end of the period

End of the year	End of the quarter	End of the month
31 Dec 2015	31 Mar 2018	31 Aug 2018
31 Dec 2016	30 Jun 2018	30 Sep 2018
31 Dec 2017	30 Sep 2018	31 Oct 2018
31 Dec 2018	31 Dec 2018	30 Nov 2018

Future Value of a Single Cash Flow

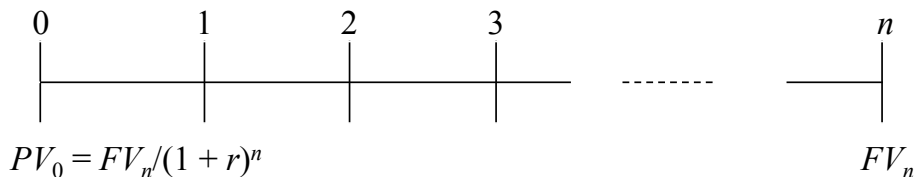
- ❖ *Example:* You decide to invest \$1,000 for different time periods. What is the future value of this \$1,000 in 5, 20 and 100 years at an interest rate of (a) 6% and (b) 8%?
- ❖ *At $r = 6\%$ p.a.*
 - ❖ $FV_5 = 1000(1 + 0.06)^5 = \$1,338.23$
 - ❖ $FV_{20} = 1000(1 + 0.06)^{20} = \$3,207.14$
 - ❖ $FV_{100} = 1000(1 + 0.06)^{100} = \$339,302.08$
- ❖ *At $r = 8\%$ p.a.*
 - ❖ $FV_5 = 1000(1 + 0.08)^5 = \$1,469.33$
 - ❖ $FV_{20} = 1000(1 + 0.08)^{20} = \$4,660.96$
 - ❖ $FV_{100} = 1000(1 + 0.08)^{100} = \$2,199,761.26$

Future Value of a Single Cash Flow



Present Value of a Single Cash Flow

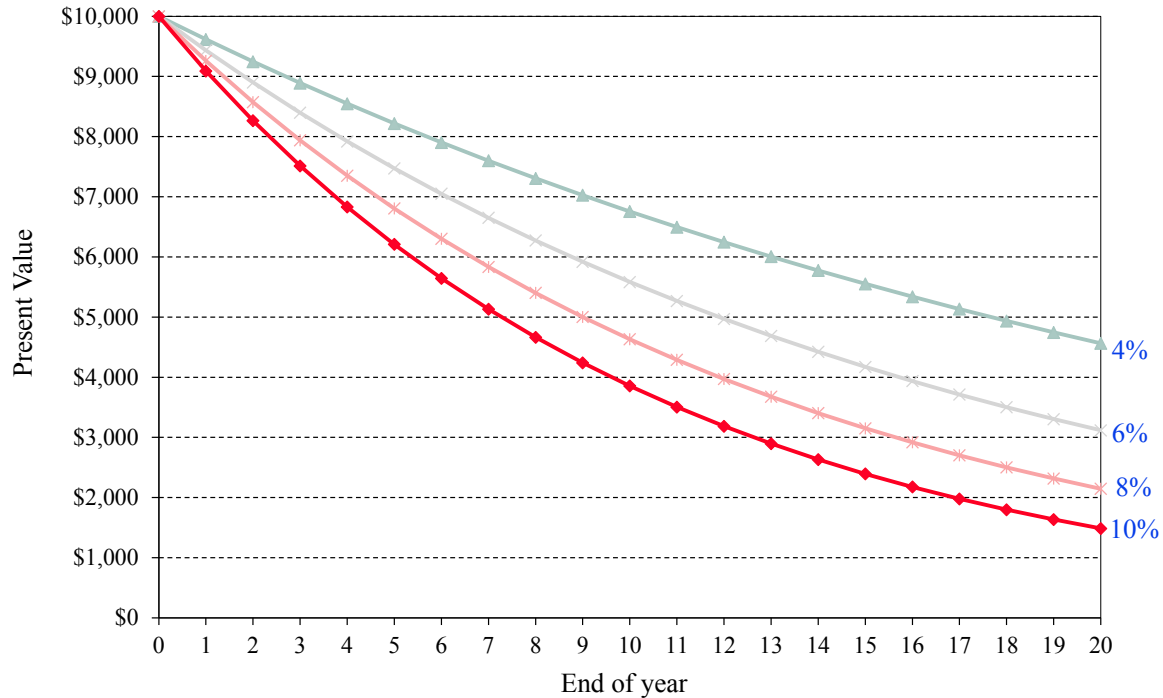
- ❖ The present value (PV_0) at $r\%$ p.a. of an amount (FV_n) at the end of time n is the amount which invested today would grow to FV_n in time n
- ❖ $PV_0 = FV_n / (1 + r)^n$
 - ❖ *Note:* The amount $1/(1 + r)$ is referred to as the one-year *discount factor*



Present Value of a Single Cash Flow

- ❖ *Example:* If you needed \$10,000 in (a) five years and (b) twenty years how much would you need to save and invest today if the interest rates were (a) 6% and (b) 8%?
- ❖ The present value today of \$10,000 in five years...
 - ❖ At 6% p.a.: $PV_0 = 10000/(1 + 0.06)^5 = \$7,472.58$
 - ❖ At 8% p.a.: $PV_0 = 10000/(1 + 0.08)^5 = \$6,805.83$
- ❖ The present value today of \$10,000 in twenty years...
 - ❖ At 6% p.a.: $PV_0 = 10000/(1 + 0.06)^{20} = \$3,118.05$
 - ❖ At 8% p.a.: $PV_0 = 10000/(1 + 0.08)^{20} = \$2,145.48$
- ❖ What is the interpretation of the one-year *discount factors*, $1/1.06 = 0.9434$ and $1/1.08 = 0.9259$?

Present Value of a Single Cash Flow



Factors Influencing Present and Future Values

- ❖ The present and future values of a cash flow depend on the following factors
- ❖ **The time period, n**
 - ❖ Future value increases as n increases
 - ❖ Present value decreases as n increases
- ❖ **The interest rate, r**
 - ❖ Future value increases as r increases
 - ❖ Present value decreases as r increases
- ❖ **The method of computing interest (examined in later lectures)**
 - ❖ Future value increases as the compounding frequency increases
 - ❖ Present value decreases as the compounding frequency increases

Four Rules to Remember

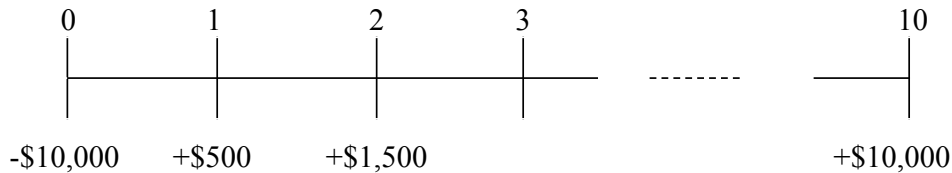
- ❖ *Rule 1:* You can *only* compare or combine cash flows at the same point in time
- ❖ *Rule 2:* To move cash flows *forward* in time you must *compound* them
- ❖ *Rule 3:* To move cash flows *back* in time you must *discount* them
- ❖ *Rule 4:* The interest rate used to compound or discount cash flows *must* match the periodicity of those cash flows (more on this in week 3)

1.6 Present and Future Values of a Series of Cash Flows

- ❖ A series of cash flows can be valued using the value additivity principle which states...
 - ❖ The present (future) value of a series of cash flows is equal to the sum of the present (future) values of each cash flow
- ❖ The net present value of an investment resulting in a series of cash flows is defined as the present value of the cash inflows (benefits) *minus* the present value of the cash outflows (costs)
 - ❖ $NPV = PV(\text{Cash inflows}) - PV(\text{Cash outflows})$
 - ❖ Note that the typical cash outflow is the initial investment
 - ❖ Decision rule: Accept the investment if the *NPV* is positive and reject it if it is negative
 - ❖ We will discuss the net present value in much greater detail in future weeks

Present Value of a Series of Cash Flows

- ❖ *Example:* You have been offered an investment opportunity which involves investing \$10,000 today to receive \$500 at the end of year 1, \$1,500 at the end of year 2 and \$10,000 at the end of ten years. What is the present value and the net present value of the investment if the interest rate is 6% p.a.? Should you accept the investment opportunity? How does your answer change if the interest rate is 2% p.a.? What about if the interest rate is 2.16%? What is the future value of the cash inflows at the end of year 10 at 6% p.a.? Recalculate the investment's *NPV* using this future value



Cash flows occur at the end of each period

Present Value of a Series of Cash Flows

❖ At 6%, the net present value of the investment is...

$$NPV = \frac{500}{(1+0.06)} + \frac{1500}{(1+0.06)^2} + \frac{10000}{(1+0.06)^{10}} - 10000 = -\$2,609.36 < 0$$

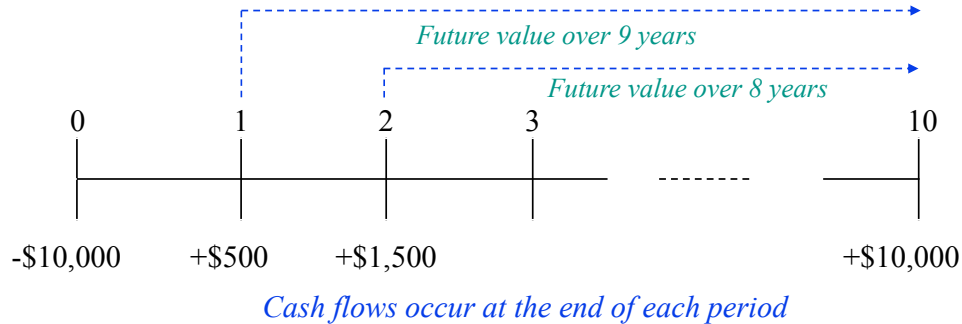
❖ At 2%, the net present value of the investment is...

$$NPV = \frac{500}{(1+0.02)} + \frac{1500}{(1+0.02)^2} + \frac{10000}{(1+0.02)^{10}} - 10000 = \$135.43 > 0$$

❖ At 2.16%, the net present value of the investment is...

$$NPV = \frac{500}{(1+0.0216)} + \frac{1500}{(1+0.0216)^2} + \frac{10000}{(1+0.0216)^{10}} - 10000 = \$2.57 \approx \$0.00$$

Future Value of a Series of Cash Flows



- ❖ Using the value additivity principle we can get the future value of the cash inflows as...

$$FV_{10} = 500(1 + 0.06)^9 + 1500(1 + 0.06)^8 + 10000 = \$13,235.51$$

- ❖ At 6% the net present value of the investment is the same as before...

$$NPV = \frac{13235.51}{(1 + 0.06)^{10}} - 10000 = -\$2,609.36 < 0$$

Key Concepts

- ❖ Managers should aim to maximize the value of the firm by taking on profitable investments. This results in maximum shareholder wealth
- ❖ Using simple interest, the value of a cash flow is calculated without including any accrued interest to the principal
- ❖ Using compounded interest, the value of a cash flow is calculated based on the principal and interest accrued
- ❖ The present and future values of a cash flow depend on the time period, the interest rate and the method of computing interest
- ❖ The net present value of an investment is present value of the cash inflows minus the present value of the cash outflows

Formula Sheet

- ❖ Future value of a single cash flow using simple interest

- ❖ $FV_n = PV_0(1 + n \times r)$

- ❖ Present value of a single cash flow using simple interest

- ❖ $PV_0 = FV_n / (1 + n \times r)$

- ❖ Future value of a single cash flow

- ❖ $FV_n = PV_0(1 + r)^n$

- ❖ Present value of a single cash flow

- ❖ $PV_0 = FV_n / (1 + r)^n$

(*Note*: The formula sheets on the mid semester and final exams will contain all the formulas covered in lectures but *without* the descriptions)