INTRODUCTION TO SPREADSHEETS & MODELS

Don Huesman

Module 1: Spreadsheets as a tool for thinking with numbers

Lecture 1 Objectives & a little spreadsheet history

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Course organization

- Module 1 – the spreadsheet as a tool for thinking with numbers, and a little history
- Module 2 – moving from spreadsheets to models
- Module 3 – statistical operations in Excel & Sheets
- Module 4 – linear programming in Excel & Sheets

Lecture 1 Learning objectives

- Understand the context in which spreadsheets and personal computers first emerged as tools for individuals
- Review the differences between ledgers & spreadsheets
- Identify the tools needed to complete the course, and where to find them

The spreadsheet as the original "killer app"

The spreadsheet as the original “killer app”

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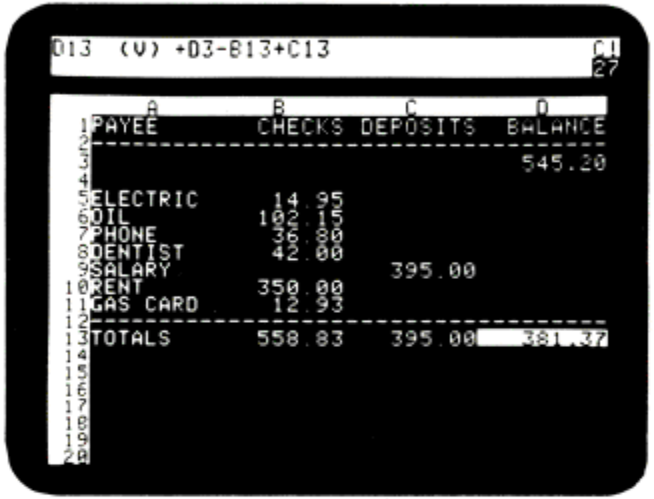

Dan Bricklin & Bob Frankston, circa 1979

From ledgers

To models


strategy & planning
analysis
develop
execute
idea
plan
training
innovate
process
materials
refresh
organize
roll out
2010
2020
2030
2040
return
risk
plan
do
check
search
business plan
business model
marketing plan
market research
quality
personal resources
trend analysis
development strategy
team building
cloud
business
risk
goal
target
$$$
35%
10%
26%
27%
50%
25%
strategy
teamwork
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Resources

- Software used in this Specialization
  - Excel
  - Google sheets
  - Data analysis toolpak for Excel
  - XLMiner Analysis Toolpak for Sheets

INTRODUCTION TO SPREADSHEETS & MODELS

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Module 1: Spreadsheets as a tool for thinking with numbers

Lecture 2 Navigating a spreadsheet and crafting formulas

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Lecture 2 Learning objectives

- Gain familiarity and comfort in navigating a spreadsheet,
- Identity the different types of data used in a spreadsheet and options for displaying them
- Use spreadsheet notation for mathematical operations on cells and arrays
- Understand and control the order of processing in formulas
- Use shortcuts for copying data and formulas

Exploring a new job opportunity by thinking through the numbers

INTRODUCTION TO SPREADSHEETS & MODELS

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Module 1: Spreadsheets as a tool for thinking with numbers

Lecture 3 Using functions

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Lecture 3 Learning objectives

- Learn to use built in functions, including those included in the Business & Financial Modeling specialization
- Understand the different uses of the sum and sumproduct functions
- Use basic statistical functions of average, min, max and standard deviation

Exploring a new business opportunity by thinking through the numbers

INTRODUCTION TO SPREADSHEETS & MODELS

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Module 1: Spreadsheets as a tool for thinking with numbers

Lecture 4 Using conditional expressions in formulas

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Lecture 4 Learning objectives

- Use conditional expressions within the logic of your formulas
- Understand some applications of conditional logic

INTRODUCTION TO SPREADSHEETS & MODELS

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Module 1: Spreadsheets as a tool for thinking with numbers

Lecture 5 Common errors in spreadsheets

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Lecture 5 Learning objectives

- Understand relative and absolute references in formulas
- Recognize errors in formulas
- Identify and correct circular references
- Audit formulas

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Module 1: Spreadsheets as a tool for thinking with numbers

Lecture 6 Differences between Sheets and Excel

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Excel & Sheets

- Differences between Excel & Sheets
- Creating a Google account to use Sheets
- Installing add-ins for statistical computation

DECISION MAKING AND SCENARIOS

MODULE 1.1 – Why Is Net Present Value Appropriate for Evaluating Projects?

Introduction

Professor Robert Holthausen
Professor Richard Lambert

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Many Potential Criteria for Selecting Investment Projects

- Methods for selecting investment projects

What are the alternatives?

Return on Investment

Earnings per Share or Sales Growth

Market Share

Internal Rate of Return

Payback

Customer satisfaction

Net Present Value

Objective Function

- What are you trying to accomplish with the projects you select?

Maximize firm value

- Which criterion meets that objective?

The Net Present Value Rule

- Maximizing EPS or EPS growth does not necessarily meet that objective, nor do the others like increasing market share or customer satisfaction, payback, etc.

Key Ingredients for Evaluating Projects Using Net Present Values

- **Time Value of Money**
  $1 today is worth more than $1 tomorrow

- **Incremental Analysis**
  Forecast the change in after-tax cash flows of the organization because of the project

- **Cost of Capital**
  Discount cash flows at the opportunity cost of capital

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DECISION MAKING AND SCENARIOS

MODULE 1.2 – Why is Net Present Value Appropriate for Evaluating Projects?

Time Value of Money

Professor Robert Holthausen
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Time Value of Money

$1 today is worth more than $1 tomorrow

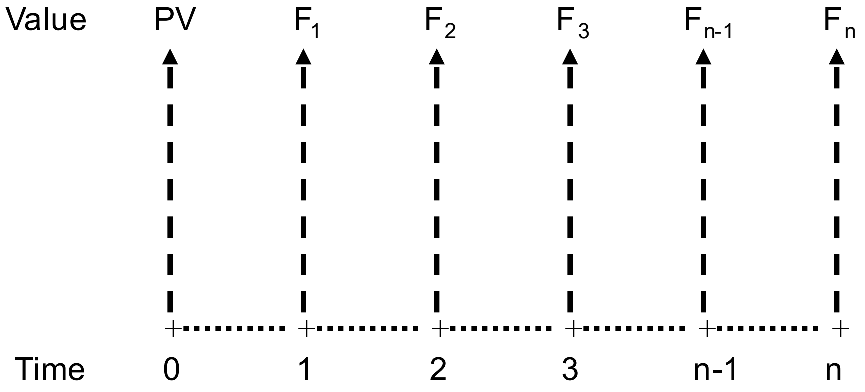
Timeline and Definitions

PV =present value

F_n =future value at period n

r =interest rate per period
(assumed constant through time)

n =number of periods



Future Value of Current Cash On Hand

$$F_n = PV * (1 + r)^n$$

Future Value – Example

- If the interest rate is 10% per year, what amount of money would you have in the bank at the end of one year if you deposited $1,000 in the bank today?

$$F_1 = \$1,000 * 1.10 = \$1,100.00$$

Future Value – Example

- If the interest rate is 10% per year, what amount of money would you have in the bank at the end of two years if you deposited $1,000 in the bank today?

$$F_2 = \$1{,}000 * 1.10^2 = \$1{,}210.00$$

Present Value of Future Cash flow

$$PV = F_n/(1 + r)^n$$

Present Value – Example

- If the interest rate is 10%, what amount of money must be put in the bank today to allow you to withdraw $1,000 a year from today?

$$PV = \$1{,}000 / 1.10 = \$909.09$$

Note: $\$909.09 \times 1.10 = \$1{,}000$

Present Value – Example

- If the interest rate is 10% per year, what amount of money must be put in the bank today to allow you to withdraw $1,000 two years from today?

$$PV = \$1{,}000 / (1.10)^2 = \$826.45$$

Note: $(\$826.45 \times 1.10) \times 1.10 = \$1{,}000$

Present Value – Annuity Example

- If the interest rate is 10% per year, what amount of money must be put in the bank today to allow you to withdraw $1,000 at the end of year 1 and the end of year 2?

$$PV = \$1{,}000 / 1.10 + \$1{,}000 / (1.10)^2 = \$1{,}735.54$$

Note: $(\$1{,}735.54 \times 1.10 - \$1{,}000) \times 1.10 = \$1{,}000$

Present Value – Varying cash flows

- If the interest rate is 10% per year, what amount of money must be put in the bank today to allow you to withdraw $1,000 at the end of year 1, $1,500 at the end of year 2 and $2,000 at the end of year 3.

$$PV = \$1{,}000/1.10 + \$1{,}500/(1.10)^2 + \$2{,}000/(1.10)^3$$

$$= \$909.09 + \$1{,}239.67 + \$1{,}502.63 = \$3{,}651.39$$

Present Value – Differing Interest Rates

- If the interest rate is different each year we can still do the calculation, but need a different r for each year

$$PV = F_n/[(1 + r_1)\ (1 + r_2) \ldots (1 + r_n)]$$

where $\mathbf{r_n}$ = interest rate for period n
(interest rate can vary from period to period)

Differing Interest Rates

- What amount of money must be put in the bank today to receive \$1000 two years from today if the interest rate for year 1 is 5% and the interest rate for year 2 is 15%?

$$PV = \$1000 / [(1.05)(1.15)] = \$828.16$$

Note: $(\$828.16 \times 1.05) \times 1.15 = \$1000$

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DECISION MAKING AND SCENARIOS
MODULE 1.3 – Why is Net Present Value Appropriate for Evaluating Projects?

NPV Analysis of Projects

Professor Robert Holthausen
Professor Richard Lambert

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Net Present Value Analysis

- Net present value (discounted cash flow) analysis allows comparisons among alternative investment projects when cash flows vary and occur at different times.
- Consider the two following projects – both require an initial investment and both are projects that last 3 years.

Compare Projects A & B

- Alternative A has the higher net income

(An accountant would conclude that because the sum of the cash flows over the three years is higher)

Alternative	Initial Investment	Annual Cash flows 1	2	3	Net Income for 3 Years
A	-2000	0	0	4500	2500
B	-2000	2000	2000	100	2100

But look at the difference in the timing of the cash flows - which has the higher present value?

Calculate the NPVs of the two projects

- Assume a **10%** interest rate.

  (AKA discount rate; hurdle rate; cost of capital)

$$NPV_A = -2000 + 4500 / 1.1^3$$

$$= -2000 + 3380.85 = \boxed{1380.85}$$

$$NPV_B = -2000 + 2000 / 1.1 + 2000 / 1.1^2 + 100 / 1.1^3$$

$$= -2000 + 1818 + 1653 + 75 = \boxed{1546.1}$$

NPV of a Project

- The NPV of the project is the point estimate of the value created by taking the project.
- If we take positive NPV projects, we are increasing the value of the firm.
  - Hence taking positive NPV projects relates directly to the objective of increasing the value of the firm
- If we take negative NPV projects, we are destroying firm value.
- In the case of Projects A and B, if we had to choose just one of the projects because we could not take both (maybe they are two solutions to the same problem or we only have $2,000 to invest), we would take Project B, because it creates the most value.

Compare Projects

- If we hold the cash flows of Projects A and B constant, what would we have to do to the discount rate to have Project A have a higher NPV than Project B?

- With a low enough discount rate, alternative A has the higher present value. (At an interest rate of **6.525%**, the present values of the two projects are equal = $1,722.7.)

$PV_A = 1380.85$

$PV_B = 1546.13$

NOTE: There are many financial functions in spreadsheet packages like Excel to help with these calculations – NPV function

Zero NPV Projects

- Consider a project with an initial investment of $2,000 at time 0, a single cash flow at year 1 of $2,200 and a discount rate of 10%. What is the NPV of this project?
- NPV = 0 = - 2,000 + 2,200/1.1
- So note that a project that earns a rate of return equal to the discount rate does not create any value - even though in this case the Return on Investment is10% ($200/$2000).
- **Thus, managers only create value when they earn a rate of return on invested capital in excess of the discount rate (their cost of capital).**

Cash Flow Perpetuity Model

- Here is how to calculate the present value of an infinite stream of cash flows when you can assume they will grow at constant rate and r is constant

$$V_t = \frac{F_{t+1}}{r - g}$$

Where : r = discount rate

g = constant percentage growth rate for all future periods

Present value of an infinite stream of cash flows

- Note that $r > g$ and F_{t+1} must be positive
- While this assumes an infinite stream of cash flows, in PV terms, we are really talking about 50 to 60 years.
- This shortcut will be useful in certain circumstances later

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DECISION MAKING AND SCENARIOS

MODULE 1.4 – Why Is Net Present Value Appropriate for Evaluating Projects?

Other Evaluation Techniques

Professor Robert Holthausen
Professor Richard Lambert

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Other Evaluation Techniques - IRR

- Definition:
  Discount rate that makes the NPV of the project exactly zero.

$$NPV = 0 = -C_0 + C_1/(1 + IRR) + C_2/(1 + IRR)^2 + \ldots + C_n/(1 + IRR)^n$$

where C_n represents the cash flow in period n

- Solve for the discount rate that makes the NPV exactly zero and that is the IRR

Other Evaluation Techniques - IRR

- An investment of $200 million today will yield $120 million in 1 year and $144 million in 2 years. Should we accept the project?

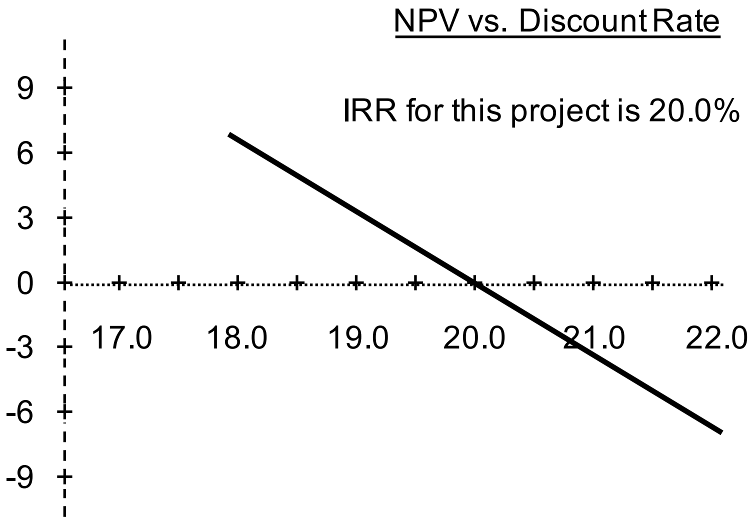
$$0 = -200 + 120/(1 + IRR) + 144/(1 + IRR)^2$$

IRR = 20% ← If our cost of capital is below 20%, the project has a positive NPV. If it is above 20%, the project has a negative NPV.

Other Evaluation Techniques - IRR

$$0 = -200 + 120/(1 + IRR) + 144/(1 + IRR)^2$$

IRR = 20%



IRR Criterion - Pitfalls

- IRR is often an appropriate technique for evaluating projects
- However, the IRR can lead you to select the wrong project in certain circumstances, such as mutually exclusive projects (can do one project but not the other because they are two solutions to the same thing or you are capital constrained) and variation in the cost of capital over the life of the project
- IRR sometimes fails to provide a definitive answer as to whether a project is worth taking
- Simple rule – If the IRR criterion does not provide a definitive answer regarding whether a project is good or not, OR if the NPV criterion and the IRR criterion do not agree on the appropriate project to select, use the NPV criterion

Other Evaluation Techniques - Payback

- **Definition:**
  How many years will it take for us to recover the initial outlay?
  (Payback is the number of years until the cumulative non-discounted after tax cash flows are equal to 0)

Other Techniques - Payback Pitfalls

- Gives equal weight to all cash flows before the payback by ignoring the opportunity cost of capital.
- Ignores cash flows after the payback
- No correct decision criteria. e.g., is three years too long?
- *Tends* to make firms accept too many projects which are short-lived and reject too many long-lived projects.

Other Evaluation Techniques - Payback Pitfalls

Project	Initial Investment	Annual Cash flows 1	2	3	Net Income for 3 years
A	-2000	0	0	4500	2500
B	-2000	2000	2000	100	2100

What is the payback?
The payback for project A is in year 3
The payback for project B is year 1

But of course, project B is not necessarily to be preferred over Project A. It depends on the discount rate as we saw. Firms which adopt “rules of thumb” based on how quickly payback must occur, often wind up focusing on projects with very short lives and eliminating projects with big cash flows in later years.

Other Evaluation Techniques - Return on Investment (ROI)

- Definition:

Companies sometimes calculate return on investment, return on assets, or return on invested capital. Most typically, this is some **accounting** measure of profitability divided by an accounting measure of investment.

The accounting profit measure is sometimes before tax and sometimes after tax, and is usually not a measure of cash flows.

Other Techniques - ROI Pitfalls

- Firms usually have some specified minimum required ROI before a project is accepted. Of course, the expected ROI usually varies from year to year and there is no correct procedure for aggregating varying ROI from year to year into a single ROI estimate for the project to compare against a cost of capital.

  Firms using ROI typically reject projects which are unprofitable in their early years.

Other Evaluation Techniques - ROI Pitfalls

Project	Initial Investment	Annual Cash flows 1	2	3	Net Income for 3 years
A	-2000	0	0	4500	2500
B	-2000	2000	2000	100	2100

What is the ROI based on the cash flows (not accounting profits)?
The ROI for Project A is 0%, 0% and 225% for Years 1 to 3
The ROI for Project B is 100%, 100% and 5% for Years 1 to 3

How do you aggregate those different ROIs? And despite the early ROI from Project B, it is not necessarily to be preferred over Project A. It depends on the discount rate as we saw. Firms which adopt "rules of thumb" based on ROI often reject projects that do not have a good ROI in the early years of the project.

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DECISION MAKING AND SCENARIOS

MODULE 1.5 – Why Is Net Present Value Appropriate for Evaluating Projects?

The Cost of Capital

Professor Robert Holthausen
Professor Richard Lambert

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Nominal Cost of Capital

- The discount rate represents the opportunity cost of capital
- A nominal cost of capital incorporates
  – The return investors would demand on a riskless asset without inflation
  – Compensation for expected inflation
  – A risk premium for the risk of the project
- It is a measure that incorporates the cost of financing across all the components of the company's capital structure – debt, common equity and preferred equity, etc.

Nominal Cost of Capital

- We must be consistent in our treatment of inflation
  - Cash flows and discount rates must both be in either nominal or real terms.
- Generally it is best to work in nominal terms. What does that mean?
  - The discount rate includes compensation for expected inflation (increases in expected inflation increase the discount rate).
  - The cash flow forecasts reflect the purchasing power of the currency in future years (in other words, for a company selling the same number of units of a product every year, we would expect revenues to generally increase because of the decline in the purchasing power of the currency which we would expect would cause the price per unit to increase).

Nominal Cost of Capital

- Who Estimates the Cost of Capital for a Company?
  - Generally the cost of capital is determined by someone in the finance function within a company, such as the CFO, a controller or someone in the treasury function
  - Line managers who advance projects for approval generally do not determine the cost of capital
- In companies where the finance function is reasonably sophisticated, different kinds of projects may have different costs of capital because of varying risks
  - Costs of capital may vary across divisions
  - Costs of capital may be a function of the risk due to the type of project – consider a machine replacement project with well known technology against a project where we are developing a new product

Summary

- We have discussed why net present value analysis is the appropriate criteria for choosing whether to accept or reject a project
  – We have also seen why other criterion, such as IRR, payback, ROI, etc. may not lead to decisions which maximize value
- We have discussed the time value of money and the cost of capital which are two key components of net present value
- In the second module, we discuss the details of how to evaluate a project with emphasis on analyzing the incremental after-tax cash flows associated with the project

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INTRODUCTION TO SPREADSHEETS & MODELS

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Module 2: From spreadsheet to model

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Module organization

- organization and layout of model elements
- types of objective functions and their use
- discrete vs. continuous time
- what if analysis and scenarios
- sensitivity analysis
- classic models

Module 2 Learning objectives

- Recognize assumptions and decision variables in business models, and the best ways to reference them in spreadsheet formulas
- Identify different types of metrics for evaluating outcomes of the business processes being modeled
- Design a spreadsheet with distinct locations for assumptions, decision variables, objectives and objective functions implemented through formulas
- Express logic in formulas using range names
- Create a basic cashflow model
- Conduct what-if analysis using spreadsheet tools
- Identify key variables using sensitivity analysis

Resources

- Software used in this Specialization
  - Excel
  - Google sheets
  - Data analysis toolpak for Excel
  - XLMiner Analysis Toolpak for Sheets

INTRODUCTION TO SPREADSHEETS & MODELS

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Module 2: From spreadsheet to model

Lecture 1 Using assumptions and decision variables in spreadsheet models

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Module 2 Lecture 1 Learning objectives

- Recognize assumptions and decision variables in business models, and the best ways to reference them in spreadsheet formulas
- Identify different types of metrics for evaluating outcomes of business processes being modeled
- Incorporate spreadsheet functions within models to identify and highlight outcome variables

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Module 2: From spreadsheet to model

Lecture 2 Structuring a spreadsheet to model variables, objectives and objective functions

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Module 2 Lecture 2 Learning objectives

- Design a spreadsheet with distinct locations for assumptions, decision variables, objectives and objective functions implemented through formulas
- Express logic in formulas using range names

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Module 2: From spreadsheet to model

Lecture 3 Constructing a simple cashflow model

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Module 2 Lecture 3 Learning objectives

- Create a basic cashflow model
- Use a cashflow model to evaluate a small business venture opportunity and think through some critical decisions

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Module 2: From spreadsheet to model

Lecture 4 What-if analysis & sensitivity analysis

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Module 2 Lecture 4 Learning objectives

- Conduct what-if analysis using spreadsheet tools
- Identify key variables using sensitivity analysis

INTRODUCTION TO SPREADSHEETS & MODELS

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Module 2: From spreadsheet to model

Lecture 5 Limits to simple, deterministic models

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Module 2 Lecture 5 Learning objectives

- Understand the characteristics and limitations of linear programming models
- Understand the characteristics and limitations of deterministic models

Module 2 Summary

- Recognize assumptions, decision variables and outcomes in business models, and the best ways to reference them in spreadsheet formulas
- Design a spreadsheet with distinct locations for assumptions, decision variables, objectives and objective functions implemented through formulas
- Express logic in formulas using range names
- Create a basic cashflow model
- Use a cashflow model to evaluate a small business venture opportunity and think through some critical decisions
- Conduct what-if analysis using spreadsheet tools
- Identify key variables using sensitivity analysis
- Understand the characteristics and limitations of linear programming models & deterministic models

DECISION MAKING AND SCENARIOS

MODULE 2.1 – Evaluating Projects

Introduction and Analyzing the Incremental After-Tax Cash Flows of a Project - Initial Investment Phase

Professor Robert Holthausen
Professor Richard Lambert

Introduction

- How do you compare the available projects?
- How do you decide which projects to select?

Net Present Value Rule

Net Present Value Rule

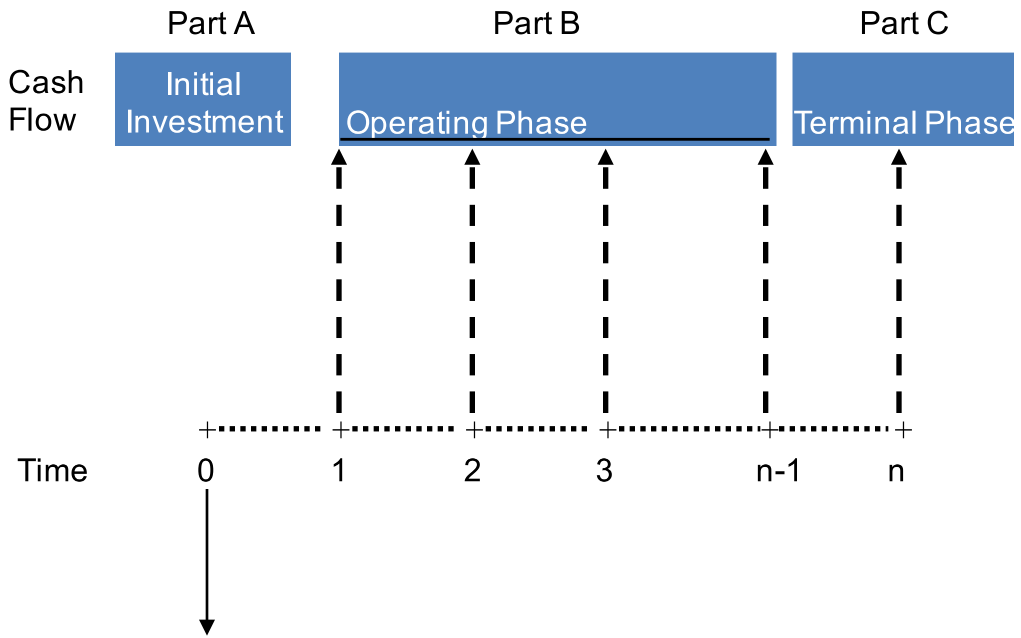
- If a project has a positive NPV, it is worth more than it costs – it creates value.
- Therefore, maximizing the value of the firm is equivalent to taking all projects with positive NPVs.
- If you cannot take all the positive NPV projects available, you take the combination of projects with the highest combined NPV

ANALYZING THE INCREMENTAL AFTER-TAX CASH FLOWS

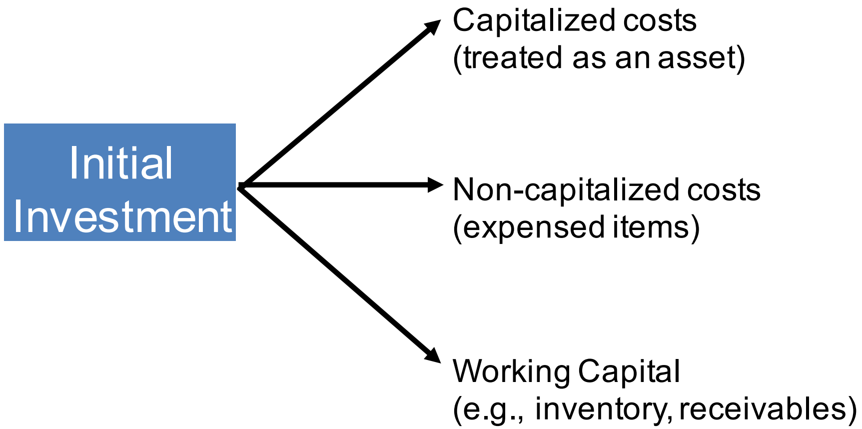
Analyzing the Incremental After-Tax Cash Flows

- We must forecast the incremental cash flows of the project to determine the NPV.
  – What exactly does that mean?
- Basically, we ask how do the *after-tax* cash flows of the *organization* change because of the project!
- Three different phases of a project:
  – Initial Investment Phase
  – Operating Phase
  – Terminal Phase

Incremental After-Tax Cash Flows



Part A - Initial Investment



Initial Investment - Capitalized Costs

- **Capitalized costs**

Capitalized costs are recorded as an asset and then that amount is generally written off as an expense – depreciated - over the asset's life

No immediate tax benefit unless there is some type of special credit (For example, the government might give a credit for expenditures on pollution control devices or solar energy.)

So capitalized costs are already after-tax cash outflows unless there is some credit (e.g., if you buy a machine whose purchase price is $1,000,000, the after-tax cash outflow is $1,000,000.

Initial Investment - Non-capitalized costs

- **Non-Capitalized costs**:
  Items that are expensed like R&D, training, etc.

After-tax Outlay = Before tax outlay x (1-T)

where T = Corporate Tax Rate

Initial Investment - Working Capital

Working Capital = Current Assets - Current Liabilities

- For many projects the working capital investment is often related to how the inventory and accounts receivable change net of the change in accounts payable.
- Inventory build-up is a common initial investment
  - Building up inventory requires a cash outflow unless it is funded by an increase in accounts payable
  - Accounts receivable increases also require a cash outflow – though more likely in the operating phase
- No tax benefit for increases in working capital

Remember: Working capital expansion consumes cash.

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DECISION MAKING AND SCENARIOS

MODULE 2.2 – Evaluating Projects

Analyzing the Incremental After-Tax Cash Flows – Operating Phase

Professor Robert Holthausen
Professor Richard Lambert

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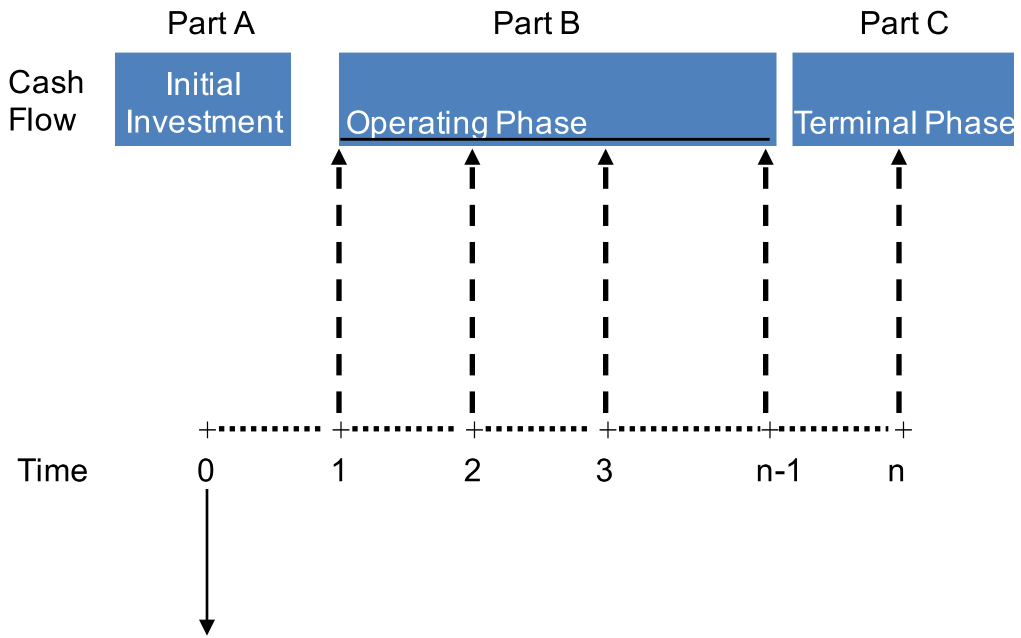
Incremental After-Tax Cash Flows – Operating Phase



Cash Flows during the operating phase

- Want to measure how the relevant cash flows of the organization change because of the project.
- To do that, we measure $\Delta\text{Cash Flow} = \Delta\text{CR} - \Delta\text{CE} - \Delta\text{T}$
  - Where CR is cash receipts, CE is cash expenditures and T is taxes and Δ is the change in the company's CR, CE and T because of the project
  - Suppose the project increases the company's sales by $1,400 and the company collects all of that money this period. What is the change in cash receipts because of the project? $1,400
  - Suppose the cost of the products that the company sold above for $1,400 was $500 and they made only what they sold. What are cash expenditures for production? $500

Cash Flows during the operating phase

- Note that the cash flows with the project so far would be $900 = $1400 - $500. But at this point we haven't figured out the taxes?
- What would the taxes be assuming that we had $300 of depreciation expense associated with the project and a tax rate of 40%?
- The taxable income would be equal to Revenues – Cost of Goods Sold – Depreciation = $1,400 - $500 - $300 = $600 and taxes would be 40% of $600 or $240. Assume we pay taxes at year end.
- The cash flow for the year would be the cash receipts – cash expenditures – taxes associated with the project = $1400 – $500 – $240 = $660

Cash Flows during the operating phase

- Must include any additional working capital investment required such as receivables and inventories, net of increases in accounts payables
- The ongoing working capital investments would typically affect CR and CE.
- Let’s augment our prior example to see that

Cash Flows during the operating phase

- As indicated, we measure how the relevant cash flows of the organization changed because of the project.
- To do that, we measure $\Delta \text{Cash Flow} = \Delta CR - \Delta CE - \Delta T$
- Let's add some working capital to the prior problem.
  - Suppose the project increases the company's sales by $1,400, but accounts receivable associated with those sales (amounts owed by customers) increase by $200. What is the change in cash receipts because of the project? $1,200 = $1,400 - $200
  - Suppose the cost of the products that the company sold above was $500. In addition, suppose the company felt that it needed to increase its inventory level $200 during the period to accommodate future sales. What are cash expenditures? $700 = $500 + $200

Cash flows during the operating phase

- Note that the cash flows with the project so far would be \$500 = \$1200 - \$700. But at this point we haven't figured out the taxes?
- What would the taxes be assuming that we had \$300 of depreciation expense associated with the project and a tax rate of 40%? Taxes are based on measure of income, not cash flows.
- The taxable income would be equal to Revenues – Cost of Goods Sold – Depreciation = \$1,400 - \$500 - \$300 = \$600 and taxes would be 40% of \$600 or \$240. This is the same as before!!!
- The operating cash flow for the year would be the cash receipts – cash expenditures – taxes associated with the project = \$1200 – \$700 – \$240 = \$260

Cash Flows during the operating phase - Note on Depreciation

- Depreciation is not a cash flow in the years it is taken, but it does affect a company's cash flows indirectly by reducing the amount of taxes that the company pays because it reduces the company's net income.
- In many countries, corporations can use an accelerated form of depreciation (faster write-off of the asset) for tax purposes than they do for their non-tax records
- The relevant depreciation for this calculation is whatever method is used for tax purposes, not the depreciation used for financial reporting purposes (which can be different).

Cash Flows during the operating phase - Note on Depreciation

- The simplest form of depreciation is straight-line which calculates annual depreciation as

  Annual depreciation = (cost – estimated salvage) / life
- So a machine costing $1000 with an estimated salvage value of $250 and a 5 year life would have $150 of depreciation per year ($150 = ($1,000 - $250) / 5)
- Accelerated forms of depreciation would write the asset off over the same time frame, but the depreciation would be higher in the early years and lower in the later years than straight-line depreciation
  - Corporations often use accelerated depreciation because it typically reduces the PV of the taxes paid

Cash Flows during the operating phase

- Make sure to include any additional investments in property, plant and equipment required in future years associated with the project.
- For example, if you had to add say another production line for a product in the third year, you would reduce the cash flows for that capital investment in that year.

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DECISION MAKING AND SCENARIOS
MODULE 2.3 – Evaluating Projects

Analyzing the Incremental After-Tax Cash Flows – Terminal Phase

Professor Robert Holthausen
Professor Richard Lambert

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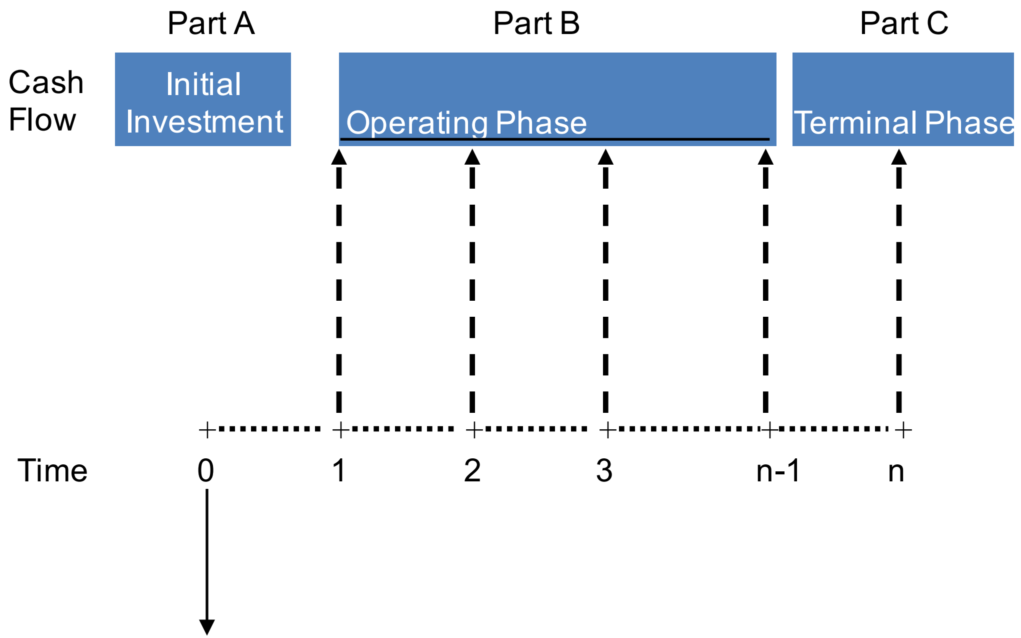
Incremental After-Tax Cash Flows – Terminal Phase



Terminal or Salvage Value in Last Year

Terminal Value

- Include final cash flow from operating the project
- Salvage value on project
  - Include tax on any gain/loss at the end of the life.
  - NOTE: Salvage value sometimes can be a big negative number.
- Include any working capital released in terminal year
- Cash Flow Perpetuity model
  - (If project will be infinitely long lived)

Terminal Value - Cash Flow Perpetuity Model

- If you believe a project will be infinitely long lived, then use a cash flow perpetuity model to value the project, once you have forecasted out to a low or zero constant rate of growth in cash flows. Terminal value at year n, TV_n:

$$TV_n = \frac{NCF_{n+1}}{r - g}$$

Where : r = discount rate
g = constant percentage growth rate for future periods

Present value of an infinite stream of payments

Terminal Value - Cash Flow Perpetuity Model

- How would you use this? Suppose you forecasted cash flows for a new product for 10 years during which time the growth of the new product rose, but by the end of year 10 the growth rate was close to inflation, say 3%.
- Take the year 11 cash flow and apply the perpetuity model which gives you the value of the cash flow from year 11 to infinity at year 10

$$TV_{10} = \frac{F_{11}}{r - g}$$

Where : r = discount rate

g = constant percentage growth rate, in this case, 3%

- You now add $TV_{10} / (1+r)^{10}$ (which discounts the TV back to time 0) to the present value of the first ten years of cash flows
- Do not assume that all projects have an infinite life - rare

Net Present Value

NPV = - initial investment (discounted over time if multiple years)

+ discounted value of cash flows during the operating phase

+ discounted value of terminal value

If NPV > 0 accept project

If NPV < 0 reject project

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DECISION MAKING AND SCENARIOS

MODULE 2.4 – Evaluating Projects

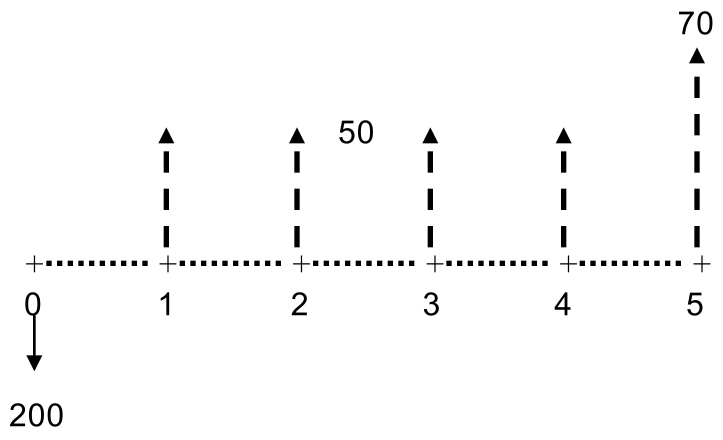
Example: New Production Machine

Professor Robert Holthausen
Professor Richard Lambert

Example - New Production Machine

- A company is considering purchasing a new machine that saves costs on the production of a product they sell. The machine costs $200 million and it would save $50 million in production costs in each of the next 5 years. The division manager expects to be able to sell the machine after 5 years for $20 million. Assume, for simplicity that there are no working capital effects associated with the new machine and that revenues are unaffected.
- Ignoring taxes, should the machine be purchased if the discount rate is 10%

New Production Machine



NPV = $-200 + (50/1.1 + 50/1.1^2 + 50/1.1^3 + 50/1.1^4 + 50/1.1^5) + (20/1.1^5) =$ **1.96 million**

Accept the project

What if the tax rate is 40%.
Then what happens?

New Production Machine

- How does the initial investment change with taxes?

  It doesn't. The initial investment is still -$200. Remember, in this case the initial investment is a capitalized cost and the after-tax outflow remains the same.

New Production Machine

- What are the annual cash flows for years 1 through 5 with taxes? (Assume depreciation is on a straight-line basis with a zero estimated salvage value.)

	Tax Return	Cash Flows
Annual cash savings	$ 50	$ 50
Annual depreciation ($200/5)	(40)	
Annual effect on taxable income	10	
Tax rate	40%	
Net effect of taxes	4	(4)
Annual Cash Flows		$46

New Production Machine

- What is the salvage value at the end of Year 5 with taxes?

	Tax Return	Cash Flows
Original cost of project	$ 200	
Accumulated depreciation	(200)	
Tax basis (book value for tax purposes)	-0-	
Proceeds from sale	20	$ 20
Gain on sale	20	
Tax rate	40%	
Net effect of taxes	8	(8)
Net Salvage Value		$ 12

Therefore...

$$NPV = -\$200 + (\$46/1.1 + 46/1.1^2 + 46/1.1^3 + 46/1.1^4 + 46/1.1^5) + (\$12/1.1^5)$$

$$= -\$18.17 \text{ million}$$

New Production Machine – Alternative Scenario

- Let us suppose that the accumulated depreciation was only $150 at the end of year 5?

	Tax Return	Cash Flows
Original cost of project	$ 200	
Accumulated depreciation	(150)	
Tax basis (book value for tax purposes)	-50-	
Proceeds from sale	20	$ 20
Loss on sale	(30)	
Tax rate	40%	
Net effect of taxes	(12)	12
Net Salvage Value		$ 32

New Production Machine – Alternative Scenario

- But if you change the accumulated depreciation by year 5, that has to change the annual cash flows for years 1 through 5 because of the different amount of depreciation

	Tax Return	Cash Flows
Net annual cash savings	$ 50	$ 50
Annual depreciation	(30)	
Annual effect on taxable income	20	
Tax rate	40%	
Net effect of taxes	8 →	(8)
Net Annual Cash Flows		$42

What will happen to the NPV? Will it go up or down?

$$NPV = -\$200 + (\$42/1.1 + 42/1.1^2 + 42/1.1^3 + 42/1.1^4 + 42/1.1^5) + (\$32/1.1^5)$$

$$= -\$20.92 \text{ million}$$

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DECISION MAKING AND SCENARIOS

MODULE 2.5 – Evaluating Projects

Key Considerations in Evaluations

Professor Robert Holthausen
Professor Richard Lambert

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Things to Keep in Mind

- Only the change in after-tax cash flows of the organization is relevant. Estimate cash flows on an incremental basis.

How will the after-tax cash flows of the organization change?

Things to Keep in Mind

- Remember we are asking how the cash flows of the organization change – we are not analyzing the project in isolation.

Suppose a project loses money in the first few years.
The company will get a tax benefit from that loss as long as the company is profitable and paying taxes

Things to Keep in Mind

- Only future cash flows are relevant.

  Do not reinvest in a project just because it has been profitable in the past. Future potential is the only thing that matters. History is a guide to the future – it is not the future

Things to Keep in Mind

- Consider only investment-related cash flows. (i.e., ignore financial costs)

  The cost of financing is embedded in the discount rate used. Therefore, cash flows are typically created assuming that the investment is derived from all-equity financing or cash the company has available. If you subtract interest payments from your incremental cash flows, you will be charging the project twice for financing since that is part of the cost of capital calculation.

Things to Keep in Mind

- Include all incidental effects

  It is important to include all incidental effects on the remainder of the business. Will a new product cannibalize sales of existing products? Will it increase sales of other products or services? Remember we are not analyzing the project in isolation!!!

  Some incidental effects are hard to quantify. Quantify everything you can and weigh the non-quantified issues against the NPV of the quantified costs and benefits.

Things to Keep in Mind

- Do not forget working capital requirements

  Working capital is the difference between a company's current assets and current liabilities. Many projects require an additional investment in working capital before the operating phase and that investment may further increase during the operating phase. Those working capital investments should be recognized in the cash flow forecasts. Working capital is usually recovered at the end of the project when it is released (inventory is sold and receivables are collected and payables are paid).

Things to Keep in Mind

- Don't forget taxes

  Consider the effect of taxes on any decision. That is, make sure to calculate the incremental cash flows **after taxes**. Note that this means you need to have some understanding of the company's tax situation

  – What is their tax rate?
  – What form of depreciation do they use?
  – Do they pay tax in multiple jurisdictions?

Things to Keep in Mind

- Forget sunk costs - they are **never** relevant

  Sunk costs are past and irreversible outflows. They cannot affect a decision made today. Therefore they should be ignored.

- Suppose a company had spent $100 million developing a new product, but had not finished development yet. It is now deciding whether to continue development, which the company estimates will cost $50 million more. Should the company factor the $100 million into the decision?

- More specifically would your NPV analysis include the $100 million in its analysis in deciding today whether to continue development as well as the $50 million?

Things to Keep in Mind – Sunk Costs (Continued)

- No – the $100 million is a sunk cost and is irrelevant for deciding whether to proceed with development at this stage.
- What is relevant is what is the present value of the additional amounts the company needs to spend, weighed against the present value of the benefits from continuing development
- Sunk costs are not relevant

Things to Keep in Mind

- Don't forget opportunity costs

The opportunity cost of a resource (the value of the resource in its next most highly valued use) may be relevant to the investment decision even when no cash changes hands.

For example, suppose a company is contemplating building a new manufacturing operation on land the company already owns. Assume the land cost the company $10,000 five years ago, but could now be sold for $100,000. In analyzing whether to build the manufacturing facility, should the net present value analysis consider the cost of the land to be $10,000 or $100,000?

Things to Keep in Mind

- Use expected values of cash flows

- Future cash flows are forecasts of the future. As such, there is uncertainty associated with these numbers. Base case for the analysis is the expected value of the future cash flows (the mean estimate of the future.)
- We sometimes approximate expected values by looking at different scenarios weighting them probabilistically

Things to Keep in Mind

- Perform Sensitivity Analysis

1 To estimates of future cash flows
2 To estimates of the discount rate
3 To timing and length of project

Sensitivity analysis allows us to see the key drivers of value in a project. Once you understand the key sensitivities (key value drivers), you can expend extra effort on those areas to solidify your knowledge and make sure your forecasts are reasonable. You can also manage the project knowing what the key determinants of value creation are and hold the personnel responsible for managing the project appropriately.

Summary

- In the first two modules, we have:
  - Discussed how to calculate present values and why that is the relevant criterion for evaluating projects
  - Discussed how to evaluate projects with emphasis on how we model the change in the company's after-tax cash flows because of the project
- In the next two modules, we will:
  - Discuss how to model a project's cash flows using basic financial statements
  - Discuss a detailed example of a new product venture, complete with a valuation and scenario analysis

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INTRODUCTION TO SPREADSHEETS & MODELS

Don Huesman

Module 3: Addressing uncertainty and probability in models

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Module topics

- Random variables
- Probability distributions in spreadsheets
- Power, exponential and log functions in model formulas
- Models for calculating probability trees and decision trees
- Correlations between variables and spreadsheet statistical functions
- Regression tools in spreadsheets for making predictions
- Multiple regression

Resources

- Software used in this Specialization
  - Excel
  - Google sheets
  - Data analysis toolpak for Excel
  - XLMiner Analysis Toolpak for Sheets

INTRODUCTION TO SPREADSHEETS & MODELS

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Module 3: Addressing uncertainty and probability in models

Lecture 1 Random variables and probability distributions in spreadsheet models

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Module 3 Lecture 1 Learning objectives

- Implementing random variables using the functions rand() and randbetween()
- Developing forecasts using historical data to project future events
- Understanding probability distributions as they affect models
- Using built-in spreadsheet statistical functions

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Module 3: Addressing uncertainty and probability in models

Lecture 2 Changes in discrete and continuous time

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Module 3 Lecture 2 Learning objectives

- Calculating change in variables in discrete and continuous time
- Redesigning model objective functions to accommodate continuous time.

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Module 4: Addressing uncertainty and probability in models

Lecture 3 Power, exponential and log functions in model formulas

Module 3 Learning objectives

- Using power, exponential and log functions in model formulas
- Applications of non-linear functions

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Module 3: Addressing uncertainty and probability in models

Lecture 4 Models for calculating probability trees and decision trees

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Module 4 Learning objectives

- Designing models for calculating probability trees
- Implementing decision trees

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Module 3: Addressing uncertainty and probability in models

Lecture 5 Using spreadsheet statistical functions for correlation and regression

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Module 5 Learning objectives

- Using spreadsheet statistical functions to measure correlations between model variables
- Understanding the meaning of the results of spreadsheet functions for calculating correlations
- Using regression tools in spreadsheets for making predictions
- Improving forecasts with multiple regression

Module 5 Summary

- Random variables
- Probability distributions in spreadsheets
- Power, exponential and log functions in model formulas
- Models for calculating probability trees and decision trees
- Correlations between variables and spreadsheet statistical functions
- Regression tools in spreadsheets for making predictions

FUNDAMENTALS OF QUANTITATIVE MODELING

Richard Waterman

Module 3: Probabilistic models

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Module 3 content

- What are probabilistic models?
- Random variables and probability distributions -- the building blocks
- Examples of probabilistic models
- Summaries of probability distributions: means, variances and standard deviation
- Special random variables: Bernoulli, Binomial and Normal
- The Empirical Rule

Probabilistic models

- These are models that incorporate ***random variables*** and ***probability distributions***
- Random variables represent the potential outcomes of an uncertain event
- Probability distributions assign probabilities to the various potential outcomes
- We use probabilistic models in practice because realistic decision making often necessitates recognizing uncertainty (in the inputs and outputs of a process)

Key features of a probabilistic model

- By incorporating ***uncertainty*** explicitly in the model we can measure the uncertainty associated with the outputs, for example by giving a range to a forecast, which is a more realistic goal
- In a business setting incorporating ***uncertainty*** is synonymous with understanding and quantifying the ***risk*** in a business process, and ideally leads to better management decisions

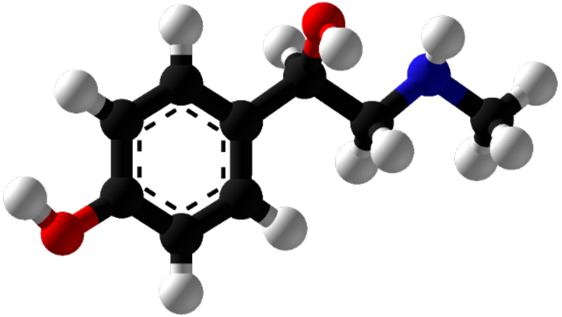
Oil prices

If you run an energy intensive business, an airline for example, then the price of oil is a key determinant of your profitability

For medium or long-term investment planning (buying new planes) the future price of oil is an important consideration

But who knows the price of oil in ten years? No-one. But we may be able to put a probability distribution around the future price and incorporate the uncertainty into the decision making process

Valuing a drug development company



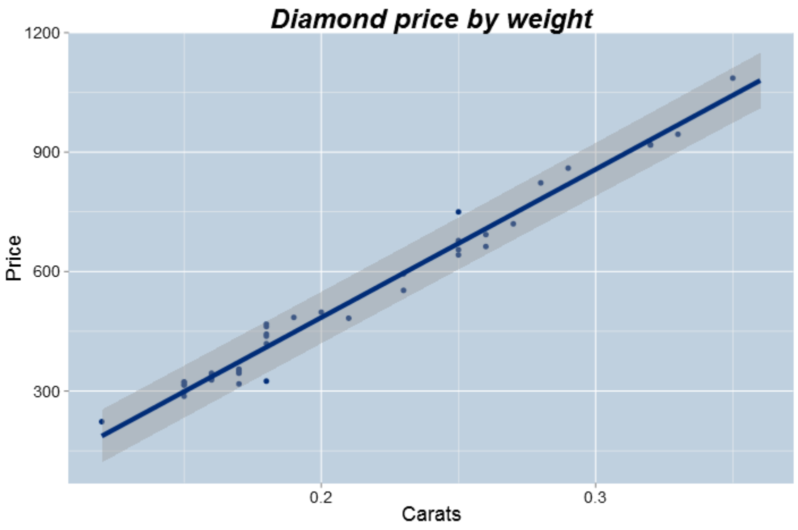
- A company has 10 drugs in a development portfolio
- Given a drug has been approved, you have predicted its revenue
- But whether a drug is approved or not is an uncertain future event (a random variable). You have estimated the probability of approval
- You only wish to invest in the company if the company's expected total revenue for the portfolio is over $10B in 5 years time
- You need to calculate the ***probability distribution*** of the total revenue to understand the investment risk

Some examples of probabilistic models

- ***Regression models*** (module 4)
- ***Probability trees***
- ***Monte Carlo*** simulation
- ***Markov models***

Regression models

- $E(Price\,|Carats) = -259.6 + 3721\ \times Carats$
- The gray band gives a prediction interval for the price of a diamond taken from this population

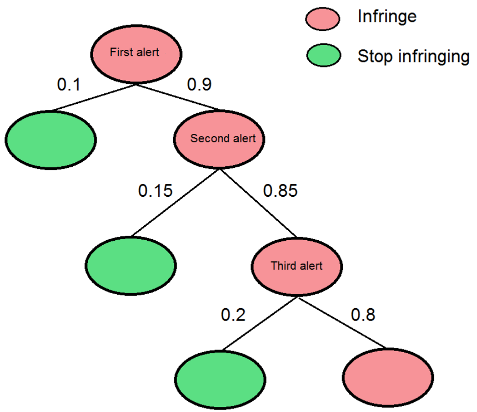


Regression models

- Regression models use data to estimate the relationship between the mean value of the outcome(Y) and a predictor variable(X)
- The intrinsic variation in the raw data is incorporated into forecasts from the regression model
- The less noise in the underlying data the more precise the forecasts from the regression model will be

Probability trees

- Probability trees allow you to propagate probabilities through a sequence of events



- P(Stop infringing) = $0.1 + 0.9 \times 0.15 + 0.9 \times 0.85 \times 0.2 = 0.388$.

Monte Carlo simulation

- From the demand model:

  $$\text{Quantity} = 60{,}000\ \text{Price}^{-2.5}$$

- The optimal price was $p_{opt} = \frac{c\,b}{1+b}$, where b = -2.5, c is the cost, c = 2, and $p_{opt} \approx 3.33$
- But what if b is not known exactly?
- Monte Carlo simulation replaces the number -2.5 with a random variable, and recalculates p_{opt} using different realizations of this random variable from some stated probability distribution

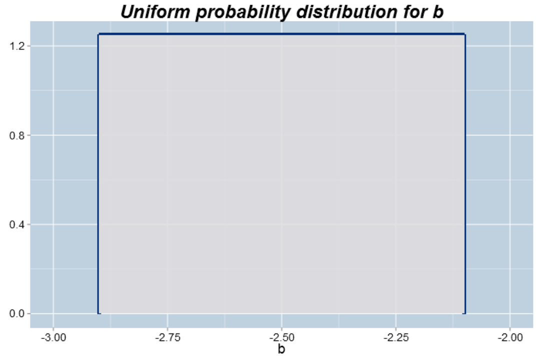
Input and output from a MC simulation

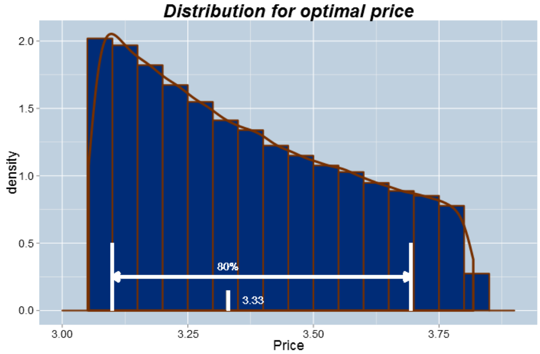
- Input: b from a uniform distribution between -2.9 and -2.1

- Output: $p_{opt} = \frac{c\,b}{1+b}$

- 100,000 replications

- Interval = (3.1,3.7)



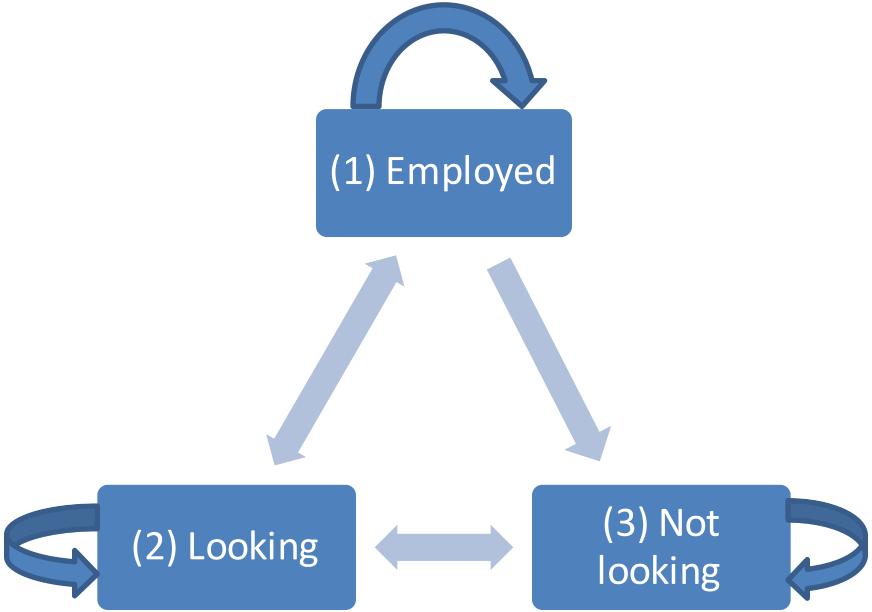


Markov chain models

- Dynamic models for discrete time state space transitions
- Example: employment status (the state of the chain)
- Treat time in 6 month blocks
- Model states:
  1. Employed
  2. Unemployed and looking
  3. Unemployed and not looking

Probability transition matrix

$$\begin{array}{rc} & \text{Next state} \\ & \begin{pmatrix} 1 & 2 & 3 \end{pmatrix} \\ \text{Current state} \begin{pmatrix} 1 \\ 2 \\ 3 \end{pmatrix} & \begin{pmatrix} 0.8 & 0.1 & 0.1 \\ 0.2 & 0.7 & 0.1 \\ 0 & 0.3 & 0.7 \end{pmatrix} \end{array}$$



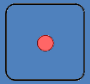
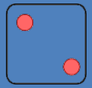
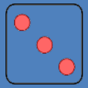
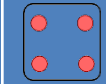
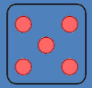
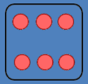
Markov property (lack of memory): transition probabilities only depend on the current state, not on prior states. Given the present, the future does not depend on the past

Building blocks of probability models

- Random variables (discrete and continuous)
- Probability distributions
- Random variables represent the potential outcomes of an uncertain event
- Probability distributions assign probabilities to the various potential outcomes

A discrete random variable

- Roll a fair die

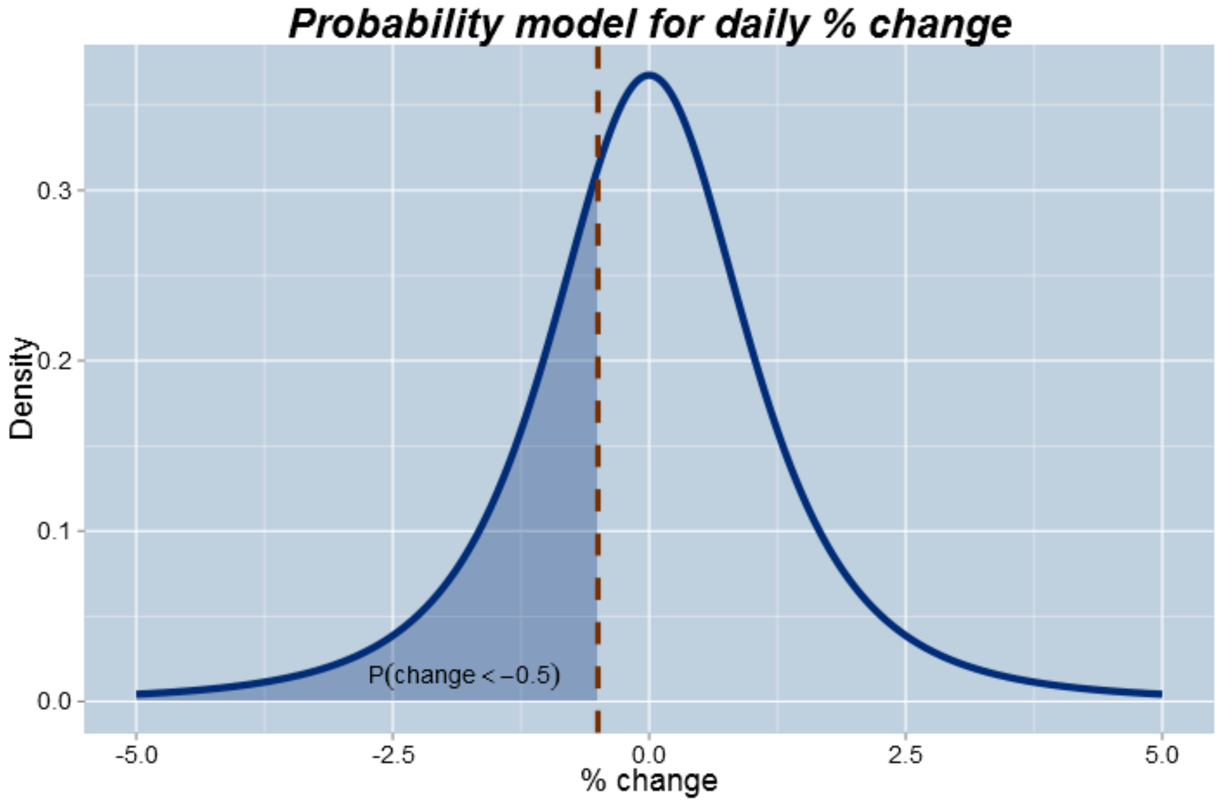
X						
P(X = x)	1/6	1/6	1/6	1/6	1/6	1/6

- Probabilities lie between 0 and 1 inclusive
- Probabilities add to 1

A continuous random variable

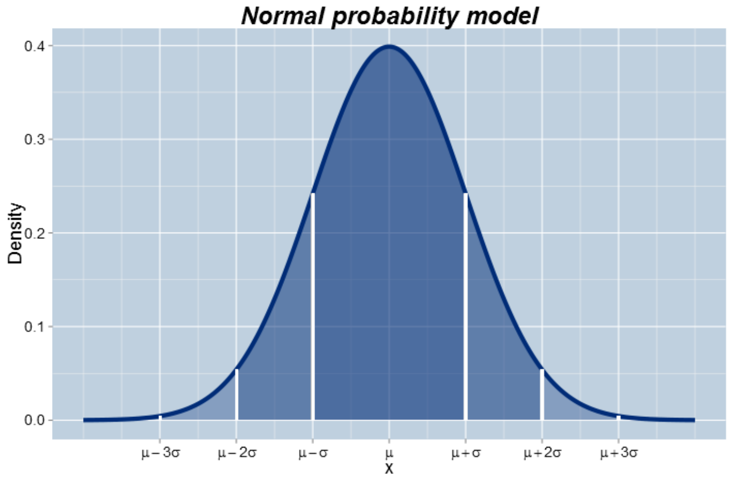
- The ***percent change*** in the S&P500 stock index tomorrow: $100 \times \frac{p_{t+1} - p_t}{p_t}$ where p_t is the closing price on day t
- It can potentially take on **any** number between -100% and infinity
- For a continuous random variable probabilities are computed from areas under the ***probability density function***

Probability distribution of S&P500 daily % change



Key summaries of probability distributions

- Mean (μ) measures centrality
- Two measures of spread:
  - Variance (σ^2)
  - Standard deviation (σ)



The Bernoulli distribution

- The random variable X takes on one of two values:
  - P(X = 1) = p
  - P(X = 0) = 1-p
- Often viewed as an experiment that takes on two outcomes, success/failure. Success = 1 and failure = 0
- $\mu = E(X) = 1 \times p + 0 \times (1-p) = p$
- $\sigma^2 = E(X-\mu)^2 = (1-p)^2\,p + (0-p)^2\,(1-p) = p(1-p)$
- $\sigma = \sqrt{p(1-p)}$
- For p = 0.5, $\mu = 0.5$, $\sigma^2 = 0.25$ and $\sigma = 0.5$

Example: drug development

- Will a drug under development be approved?
- X = $\begin{cases} Yes = 1 \\ No = 0 \end{cases}$
- P(X = Yes) = 0.65
- P(X = No) = 0.35
- If drug is approved then the projected revenue is $500m, 0 otherwise
- Expected(Revenue) = $500m × 0.65 + $0 ×0.35 = $325m

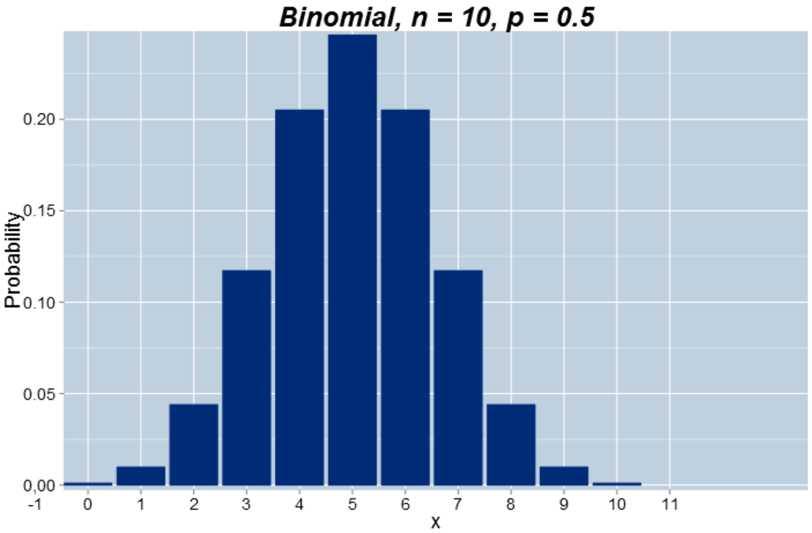
The Binomial distribution

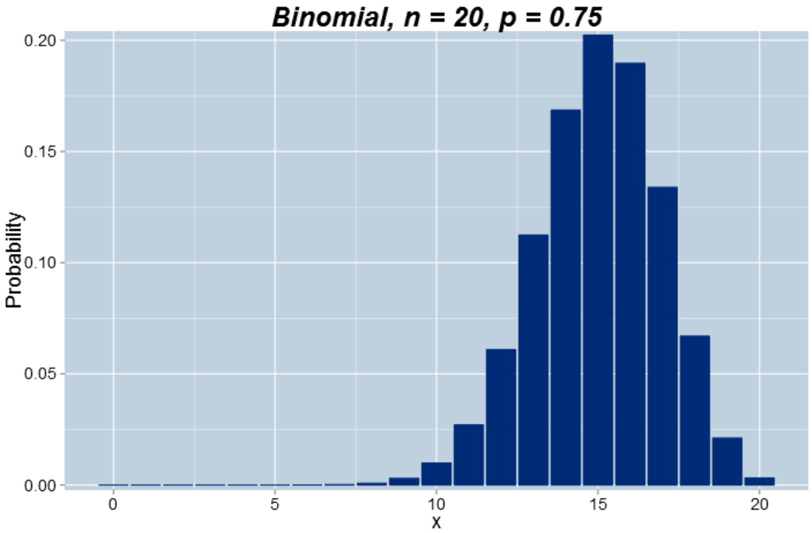
- A Binomial random variable is the number of success in *n* ***independent*** Bernoulli trials
- Independent means that P(A and B) = P(A) × P(B)
- Independence means that knowing that A has occurred provides no information about the occurrence of B
- Independence is a common simplifying assumption in many probability models and makes their construction and subsequent calculations much easier

The Binomial distribution

- Example: toss a fair coin 10 times and count the number of heads (call this X)
- Then X has a Binomial distribution with parameters n = 10 and p = 0.5.
- In general: $P(X = x) = \binom{n}{x} p^x (1-p)^{n-x}$, where $\binom{n}{x}$ is the ***binomial coefficient:*** $\frac{n!}{x!(n-x)!}$
- $\mu = E(X) = np, \sigma^2 = E(X - \mu)^2 = np(1-p)$

Binomial probability distributions

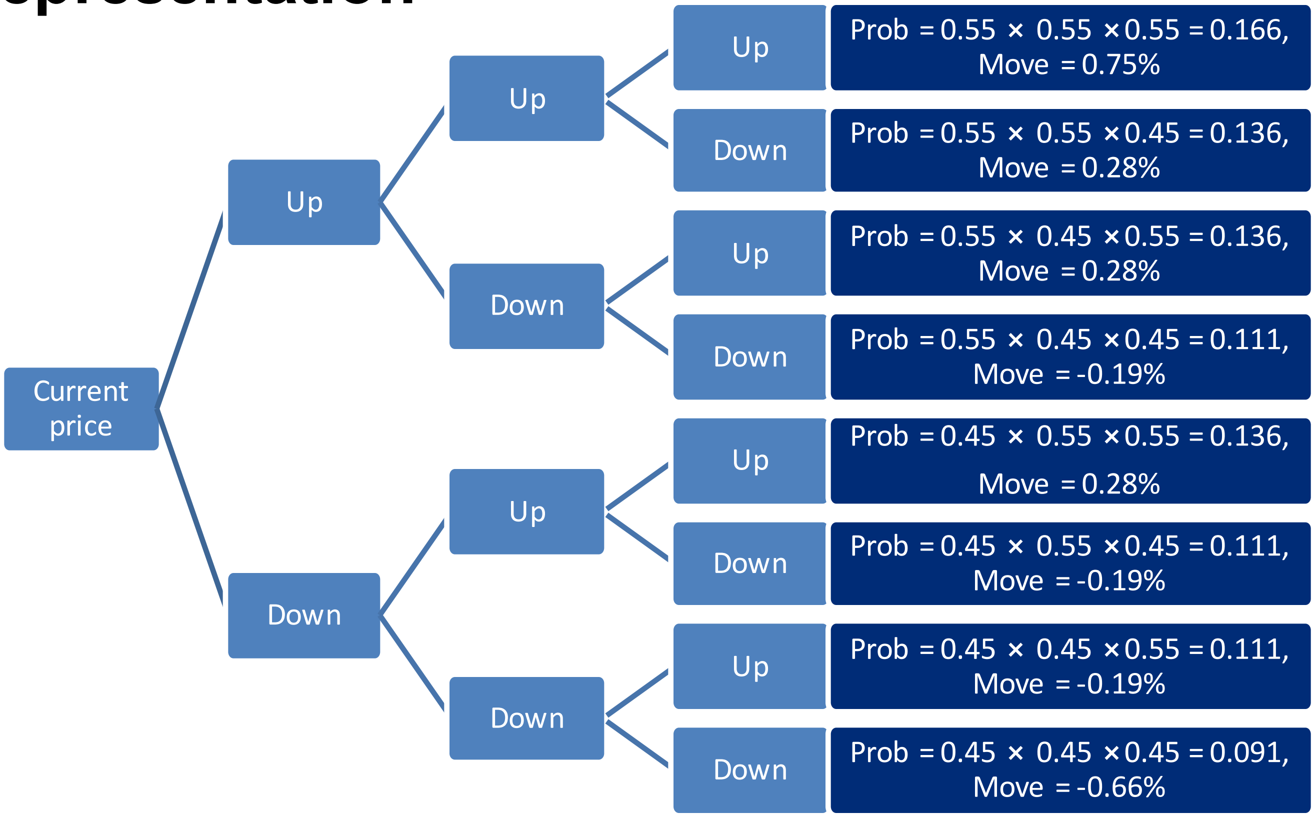




Example: Binomial models for markets (oil for example)

- Assume that the market either goes up or down each day
- It goes up u% with probability p and down d% with probability 1-p
- Assume days are ***independent***
- Example: p = 0.55, 1 – p = 0.45, u = 0.25%, d = 0.22%
- Take a time horizon of 3 days
- There are 8 possible outcomes:
  – {UUU},{UUD},{UDU},{UDD},{DUU},{DUD},{DDU},{DDD}
- For each outcome there will be an associated market move. For example, if we see (U,U,U) then the market goes up by a factor of $1.0025 \times 1.0025 \times 1.0025 = 1.007519$, that is a little over ¾ of a percent.

Tree representation



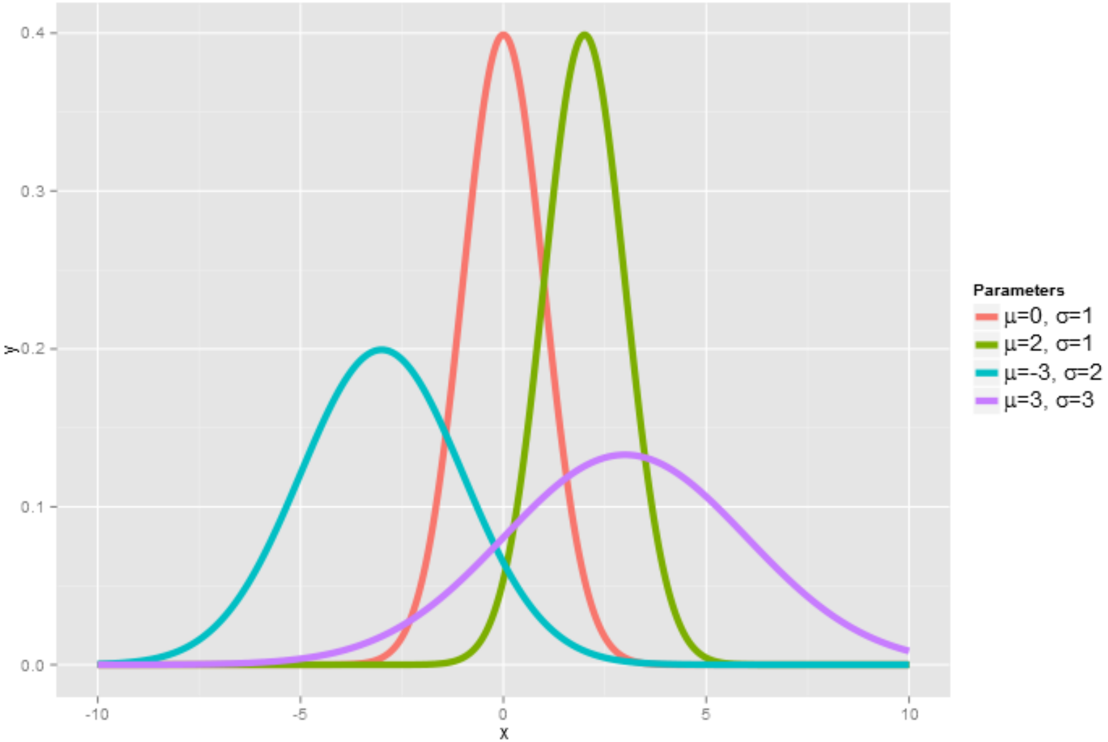
The Normal distribution

- The Normal distribution, colloquially known as the *Bell Curve,* is the most important modeling distribution
- Many disparate processes can be well ***approximated*** by Normal distributions
- There are mathematical theorems (the Central Limit Theorem) that tell us Normal distributions should be expected in many situations
- A Normal distribution is characterized by its mean μ and standard deviation σ. It is symmetric about its mean

Examples

- There is a ***universality*** to the Normal distribution
  - Biological: heights and weights
  - Financial: stock returns
  - Educational: exam scores
  - Manufacturing: the length of an automotive component
- It is therefore often used as a distributional assumption in Monte Carlo simulations (knowing the mean and standard deviation is enough to define a Normal distribution)

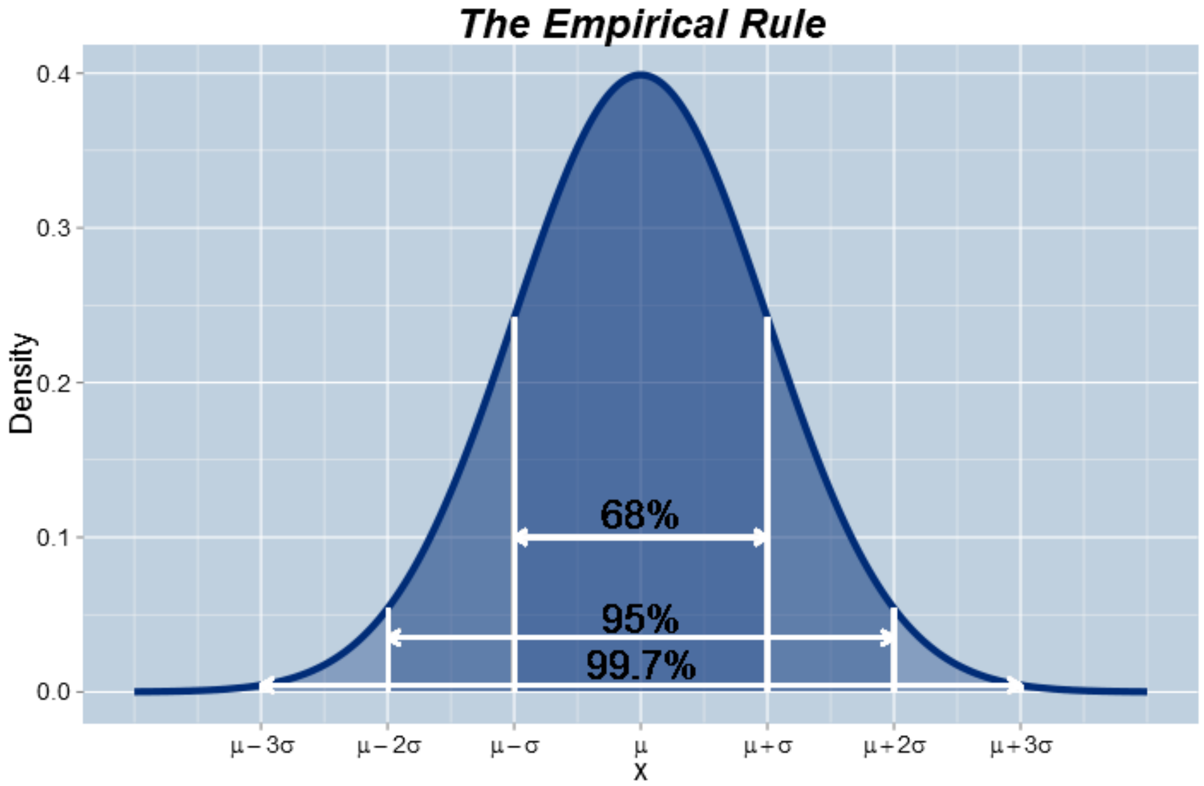
Plots of various Normal distributions



The Empirical Rule

- The Empirical Rule is a rule for calculating probabilities of events when the underlying distribution or observed data is approximately Normally distributed
- It states
  - There is an approximate **68%** chance that an observation falls within **one** standard deviation from the mean
  - There is an approximate **95%** chance that an observation falls within **two** standard deviations from the mean
  - There is an approximate **99.7%** chance that an observation falls within **three** standard deviations from the mean

The Empirical Rule illustrated



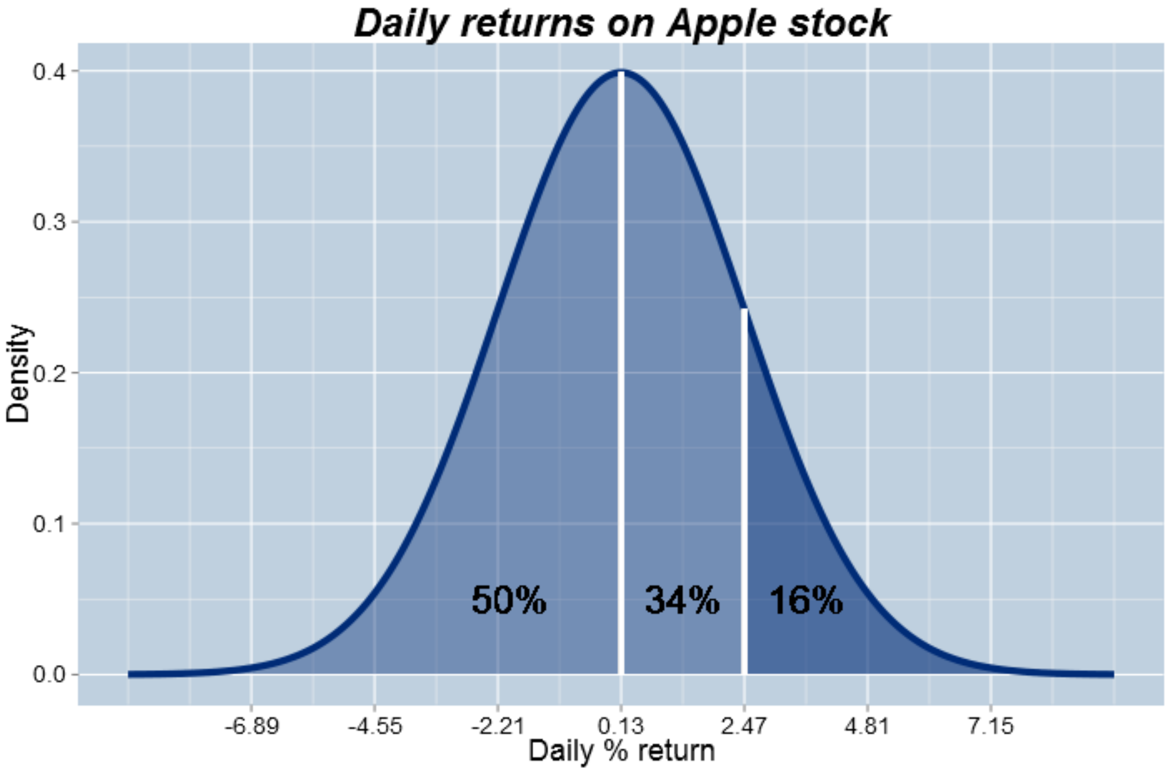
Empirical Rule example

- Assume that the daily **return** on Apple's stock is approximately Normally distributed with mean μ = 0.13% and σ = 2.34%
- What is the probability that tomorrow Apple's stock price increases by more than 2.47%?
- Technique: count how many standard deviations 2.47% is away from the mean, 0.13%. Call this ***counter*** the ***z-score***

$$Z = \frac{2.47 - 0.13}{2.34} = 1$$

- So, from the Empirical Rule the probability equals approximately 16%

Illustrating the answer



Module 3 Summary

- What are probabilistic models?
- Random variables and probability distributions -- the building blocks
- Examples of probabilistic models
- Summaries of probability distributions: means, variances and standard deviation
- Special random variables: Bernoulli, Binomial and Normal
- The Empirical Rule

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DECISION MAKING AND SCENARIOS

MODULE 3.1 - Expressing Business Strategies In Financial Terms

Introduction

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Agenda – This Module

- We'll show
  - How Business Activities, Transactions and Events are translated into Financial Statements
    - Balance Sheets,
    - Income Statements, and
    - Cash Flow Statements
  - How these three statements are linked to each other
  - How Balance Sheets and Income Statements can help to forecast the future Cash Flow Statements,
    - Recall from the prior two modules that future cash flows are the things we want to put into our Net Present Value calculations

Agenda – The Next Module

- We'll apply What We've Been Learning to an Analysis of a New Product Venture
  - We'll map out a plan of the business activities, transactions and events that need to happen to implement our new venture, including their timing
  - We'll show how to set up a spreadsheet to
    - help us with our forecasts, and
    - give us the ability to re-calculate things automatically as we re-think our plans.
  - We'll forecast out the implied financial statements
  - Calculate the Net Present Value (NPV)
  - And we'll use our spreadsheets to explore different risks our venture may face, and analyze the implications of these scenarios for NPV

Introduction

- To Apply Present Value Techniques, we have to be able to express a project in terms of the time pattern of cash inflows and outflows that the project will generate
- To forecast these cash flows, we have to plan the sequence of business activities and transactions that give rise to the cash flows
- Accounting systems that compile Balance Sheets and Income Statements in addition to Cash Flow Statements are helpful in keeping track of all these activities, especially their timing and coordination
- Our Objectives in this Module are to
  - Explain how accounting systems translate Business Activities into Financial Terms
  - How we can use this to better forecast future cash flows

Where Do Future Cash Flows Come From?

- From Transactions with Other Parties
  - Customers, Suppliers, Employees, Governments, Investors, and Creditors
- These Receipts and Payments Result from Business Activities
  - Raising Capital – Equity and Debt
  - Acquiring Resources – Buildings, Equipment, Technology, People
  - Developing Products and Services
  - Selling to Customers

For Simple Enough Projects

- Putting together “full blown” financial statements is overkill
- The rough magnitude of future cash flows can be estimated
- A “back of the envelope” present value calculation can often clearly reveal that the project is profitable – or not

But for More Complicated Projects

- The direct cash flow consequences of the project are not readily apparent; they come from a combination of the activities we just mentioned
- We need a plan for the timing of all those activities and also a prediction for the timing of their cash consequences – there's often a timing difference between when the activity occurs and when the cash payment is paid or received
  - How big will sales be, when will sales be collected?
  - What combination of labor and materials will we need to deliver the product or service at the forecasted time?
  - What resources will we need to acquire?
  - How do we co-ordinate all of the above?

Putting Together Forecasted Financial Statements Will Help Us Do That

- Constructing forecasted balance sheets and income statements that "mesh" with the cash flow statements forces you to
  - Make sure you don't leave things out of your calculations
  - Think more carefully about what needs to happen to implement your project idea
- **Articulating all the activities helps you spot problems and allows you to re-think your strategy for implementation so that you can improve it**
  - This also helps later on when evaluating results as they come in
    - to be able to compare them to what was expected
    - To spot deviations and take corrective action or revise your strategy as new information becomes available

Credibility with Others

- Having a more fully thought out plan will enhance your ability to
  - Get the project approved by others
  - Get the project funded

One More Benefit – Calculating Taxes

- Taxes are likely to be one of the relevant cash flows associated with your project
- Taxes are usually based on income (not cash flow)
- So to calculate the taxes you need to calculate income

Three Main Financial Statements

- **Balance Sheet**
  - Financial position (listing of resources and obligations) on a specific date
  - Assets = Liabilities + Owners' Equity
- **Income Statement**
  - Profitability of operations over a period of time
  - Net Income = Revenues – Expenses
- **Statement of Cash Flows**
  - Sources and uses of cash during a period of time
  - Operating, Investing, and Financing Activities
- While Each Conveys something different – they're all linked together

Financial Statements for Projects

- Often we think of financial statements (especially balance sheets) as being for FIRMS
- But you can also do this for projects
- For example, you can think of the project’s balance sheet as how its adoption would impact (or change) the balance sheet of the firm as a whole

Balance Sheet – a list (in dollars) at a point in time of

- **Assets** - The **resources** that we've acquired that are going to help generate future cash flows
- **Liabilities** - The **obligations** we've made to pay (or pay back) cash to others
- **Owners' Equity** - The **capital** that **owners** have put into the firm (or re-invested)

- **Think of a Balance Sheet as a SNAPSHOT**

Balance Sheet Equation

- Virtually everything in accounting is driven by this (seemingly simple) relation

  Assets = Liabilities + Owners' Equity

  Resources = Claims on Resources by

  Outsiders + Owners

- Equivalently,

  Owners' Equity = Assets – Liabilities

  Everything that's not claimed by anyone else belongs to the owners

Common Assets Appearing on Balance Sheets

- Cash
- Accounts Receivable
- Inventory
- Property Plant and Equipment
- Intangible Assets
- Investments in Financial Assets
- Other

Limitations to Balance Sheets

- Not All Resources are on the Balance Sheet
  - People
  - “Softer” investments like Research and Development, Advertising, Marketing
- Balance Sheet Assets are generally NOT measured at the Present Value of the future cash flows they will generate
  - Instead they are measured at the cost to acquire them (Historical Cost)
- Nevertheless, Keeping track of the balance sheet (and how it will evolve over time) is extremely helpful in Forecasting the Amounts and Timing of Future Cash Flows

Examples of Liabilities on Balance Sheets

- Accounts Payable (to suppliers)
- Other Payables (wages, interest, income taxes)
- Receipt of payment in advance of providing service
- Short term-debt
- Long-term debt
- Product warranties
- Employee pensions

Owners' Equity (or Shareholders' Equity)

- **OWNERS' EQUITY** is the residual claim on assets after settling claims of creditors (i.e. assets – liabilities)
- Types of Owners' Equity
  - Contributed capital – amounts from investments by owners or by issuing new shares of stock
  - Retained Earnings = profits earned by the firm that have been re-invested back into the firm as opposed to paid out to the owners (in the form of dividends)
    - **THIS IS THE LINK BETWEEN INCOME STATEMENTS AND BALANCE SHEETS**

Forecasting How The Balance Sheet Will Change Over Time Helps Us Keep Track of the Amounts and Timing of …

- Resources we’ll be adding (new assets) and resources we’ll be using up
- New obligations we’ll be adding and old obligations we’ll be paying off
- New investments that will be made by owners and distributions made back to owners

What Makes the Balance Sheet Change Over Time?

- These are the business activities and economic events that take place **during** the period
- Two important summaries of these activities are
  - Income Statement = Revenues – Expenses
  - Cash Flow Statement = Cash Inflows – Cash Outflow

Relation Between Financial Statements

Balance Sheet at 12/31/00

Assets = Liabilities + Owners' Equity

Cash + Noncash assets = Liabilities + Contributed Capital + Retained Earnings

Statement of Cash Flows
for year ended 12/31/01

Income Statement
for year ended 12/31/01
(minus dividends)

Cash + Noncash assets = Liabilities + Contributed Capital + Retained Earnings

Balance Sheet at 12/31/01

Relation Between Financial Statements

- The Balance Sheet shows the resources and claims on the resources AT A POINT IN TIME
- The Income Statement and Cash Flow statement provide information about how the balance sheet changes OVER A PERIOD OF TIME
  - The Cash Flow Statement tells you how the CASH account on the balance sheet changes over time
  - The Income Statement tells you about how the RETAINED EARNINGS account on the balance sheet changes over time

Income

- Income (profits) is a measure of the performance of the company during a period of time
- Income is Not the Same as Cash Flow
- On the Income Statement, the recognition of revenues and expenses are tied to business activities, not necessarily to when the associated cash flow occurs
  - Income measures the increase in economic value from a transaction or event
  - Cash Flow measures the receipt of that value in the form of cash
  - The difference is one of TIMING

Example – Income Vs Cash Flow

- Income will match the cost of products you sell to the price you sell them at to calculate the profit on the sale
- Cash flow will match the cost of a product to the period you paid for it and the receipt of cash from the customer to the period it was received – even if these are different periods

- This is where the balance sheet comes in – to help link the timing difference between the two statements
  - Inventory = products we've acquired not yet sold
  - Receivables = sales we've made but not yet collected

Revenue

- Revenue is an increase in shareholders' equity (not necessarily cash) from providing goods or services.

- Revenue is recognized when both:
  - It is earned (i.e. goods or services are provided) and
  - It is realized (i.e. payment for goods or services received in cash or something that can be converted to a known amount of cash)
- Revenue can be recognized before we get cash
  - A credit sale
- Or Revenue can be recognized after we get cash
  - A deposit received in advance of delivery

Expenses

- Expenses are decreases in shareholders' equity (not necessarily cash) that arise in the process of generating revenues
- Expenses are recognized when either:
  - Related revenues are recognized (product costs) (MATCHING) or
  - Incurred, if difficult to match with revenues
    - Examples: Selling, General, Administrative Expenses
- Expenses are often recognized as assets get used up
  - Cost of Goods Sold
  - Depreciation Expense

Income Statement Format – Expenses Are Grouped into Categories

Revenue (or Sales)
- Cost of Goods Sold

Gross Profit
- Operating (SG&A) Expense

Operating Income
- Interest, Other Gains and Losses

Pre-tax Income
- Income Tax Expense

Net Income

Next

- Recording Transactions and Compiling them into Balance Sheets, Income Statements and Cash Flow Statements
- Showing how we can Construct a Cash Flow Statement from the Balance Sheet and Income Statement

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DECISION-MAKING AND SCENARIOS
MODULE 3.2 – Expressing Business Strategies In Financial Terms

Balance Sheets and Income Statements

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Agenda

- We're going to look at a series of common transactions and events and see how they impact the financial statements
- We'll focus on the Balance Sheet and Income Statement first
- Then do the Cash Flow Statement and how it relates back to the other two

What Makes Balance Sheet Accounts Change Over Time?

Beginning Balance	Business Activities, Transactions and Events During the Period		Ending Balance
Cash_{Beg}	+ Receipts - Payments	=	Cash_{End}
$\text{Accts Rec}_{\text{Beg}}$	+ Sales - Collection	=	$\text{Accts Rec}_{\text{End}}$
$\text{Inventory}_{\text{Beg}}$	+ Purchases – Cost of Goods Sold	=	$\text{Inventory}_{\text{End}}$
PPE_{Beg}	+ Purchases – Deprec - Disposals	=	PPE_{End}
$\text{Accts Pay}_{\text{Beg}}$	+ Purchases – Payments to Suppliers	=	$\text{Accts Pay}_{\text{End}}$
$\text{Wages Pay}_{\text{Beg}}$	+ Wage Expense – Wages Paid	=	$\text{Wages Pay}_{\text{End}}$
Contributed $\text{Capital}_{\text{Beg}}$	+ Stock Issuance – Stock Repurchases	=	Contributed $\text{Capital}_{\text{End}}$
$\text{Retained Earn}_{\text{Beg}}$	+ Net Income - Dividends	=	$\text{Retained Earn}_{\text{End}}$

We Could Analyze Each Account Independently, But

- We can learn even more if we understand how the changes in accounts are related to each other
- This is governed by the Balance Sheet Equation
  - Assets = Liabilities + Owners' Equity
- This equation is going to impose a discipline and consistency across accounts that is going to
  - Help us make fewer mistakes and
  - Help us Identify the Relation between the Cash Flow Statement and the other two statements

Implications of Balance Sheet Equation

- **Assets = Liabilities + Owners' Equity**
- Any transaction or event that is recorded in the financial statements must preserve the balance sheet equation
- This means each transaction itself must balance
- If one account is impacted, at least one other must be as well
- Example: Suppose an asset account goes UP, then at least one of the following also happens
  - Another asset account has to go DOWN, or
  - A liability account goes UP, or
  - An owners' equity account goes UP

Financial Statement Impact of Transactions and Events

- For each transaction or event, we will
  - Determine which "accounts" (if any) are affected
  - Make sure that the balance sheet still balances

    Assets = Liabilities + Owners' Equity

- Most of these transactions and events are part of the New Product Venture example we will be analyzing in Module 4.
- Any transaction or event that impacts the Income Statement will flow into Retained Earnings
  - A real accounting system would keep a more detailed record of the types of revenues and expense

Issue Shares (A Financing Transaction)

a) **Raise $240,000 of cash in exchange for shares of common stock.**

ASSETS = LIABILITIES + OWNERS' EQUITY

	Cash				Contributed Capital
Issue Shares	+$240,000				+$240,000

Cash Goes Up, but there is no Impact on Income

We want to distinguish between Owners' Equity going up because of profits and Owners' Equity going up because of new contributions.

This is a financing transaction; It is not a measure of how well the project is performing

Long Term Assets - PPE

a) **Purchase PPE for $70,000 Cash**

b) PPE expected to last 7 years and be worth $0 at that time

ASSETS = LIABILITIES + OWNERS' EQUITY

	Cash	PPE				Retained Earnings
Purchase	**-$70,000**	**+$70,000**				
Depreciation Expense (each year)		-$10,000				-$10,000

PPE is not charged entirely to income immediately because it will benefit many periods.

Purchasing PPE

- Even though it uses up cash, it’s not all charged to that period’s income statement
- This is because we can use it for many periods
- PPE is an asset because it has future benefits
- If instead PPE was leased or rented, no asset would be recorded. Instead there would be a (smaller) recurring cash outflow that was charged to that period’s income statement.

Long Term Assets - PPE

a) Purchase PPE for $70,000 Cash

b) PPE expected to last 7 years and be worth $0 at that time

ASSETS = LIABILITIES + OWNERS' EQUITY

	Cash	PPE				Retained Earnings
Purchase	-$70,000	+$70,000				
Depreciation Expense (each year)		**-$10,000**				**-$10,000**

Depreciation Expense = $70,000 / 7 years = $10,000 per year. This reduces our income in those years. Hopefully the benefits from using the asset outweigh this expense.

Depreciation of PPE

- Straight line Depreciation – a common way to spread the purchase price over the useful life
- Depreciation per Year =

$$\frac{\text{(Purchase Price – Expected Salvage Value)}}{\text{Expected Useful Life}}$$

- The book value of the PPE generally does not match what you could sell it for
- At the end of the asset's life, we sell it (or dispose of it) and record that cash inflow or outflow in that period.

Inventory Transactions

a) **Buy $99,000 of inventory on credit**
b) Make a payment of $94,000 to the supplier
c) Sell Inventory that Cost $90,000

ASSETS = LIABILITIES + OWNERS' EQUITY

	Cash	Inventory		Accounts Payable		Retained Earnings
Purchase		**+$99,000**		**+$99,000**		
Payment	-$94,000			-$94,000		
Sale		-$90,000				-$90,000

If we purchase more inventory than we sell, Inventory goes up

If we purchase more inventory than we pay for, Accounts Payable goes up

Inventory Transactions

a) Buy $99,000 of inventory on credit

b) Make a payment of $94,000 to the supplier

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Purchase		+$99,000		+$99,000		
Payment	-$94,000			-$94,000		
Sale		**-$90,000**				**-$90,000**

If we purchase more inventory than we sell, Inventory goes up

If we purchase more inventory than we pay for, Accounts Payable goes up

Inventory

- Inventory is carried on the books at what you paid for it, not what you expect to sell it for
- When you sell inventory, you take the inventory off the books (at cost) and replace it on the books with the cash (or receivable) you get when you sell it
- The difference is the profit on the sale

Sales and Collection

a) **Sell $200,000 of products on credit**

b) Collect $180,000 from Customers

ASSETS = LIABILITIES + OWNERS' EQUITY

	Cash	Accounts Receivable				Retained Earnings
Sale		**+$200,000**				**+$200,000**
Collection	+$180,000	-$180,000				

Sales make Income go up; Collections make Cash go up

If Sales exceed Collections, then Receivables have a net increase

Sales and Collection

a) Sell $200,000 of products on credit

b) Collect $180,000 from Customers

ASSETS = LIABILITIES + OWNERS' EQUITY

	Cash	Accounts Receivable				Retained Earnings
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Collection	**+$180,000**	**-$180,000**				

Sales make Income go up; Collections make Cash go up

If Sales exceed Collections, then Receivables have a net increase

Wages and Benefits

a) **Employees Earn $55,000 of Wages and Benefits**

b) Of this, $46,000 is paid and the rest is deferred

ASSETS = LIABILITIES + OWNERS' EQUITY

	Cash		Wages Payable		Retained Earnings
Wages Earned			**+55,000**		**-$55,000**
Wages Paid	-$45,000		-$45,000		

Earning the benefits lowers income, paying the benefits lowers cash

If more benefits are earned than paid, the Wages Payable account goes up

Wages and Benefits

a) Employees Earn $55,000 of Wages and Benefits

b) Of this, $46,000 is paid and the rest is deferred

ASSETS = LIABILITIES + OWNERS' EQUITY

	Cash		Wages Payable		Retained Earnings
Wages Earned			+55,000		-$55,000
Wages Paid	**-$46,000**		**-$46,000**		

Earning the benefits reduces income, paying the benefits reduces cash

If more benefits are earned than paid, the Wages Payable account goes up

Pay Dividend – A Financing Transaction

a) Pay Cash Dividend of $5000

ASSETS = LIABILITIES + OWNERS' EQUITY

	Cash				Retained Earnings
Dividend Paid	-$5,000				-$5,000

Retained Earnings Go Down, because some of our earnings are no longer retained!

But Dividends are not an expense; they're not a cost needed to generate revenues.

We want to distinguish between how much the project generates in profits and what the firm does with those profits (pay out a dividend or re-invest them in the firm)

Summary of All Transactions (so far)

	Assets				Liabilities		Owners' Equity	
Transaction or Event	**Cash**	**Accounts Receivable**	**Inventory**	**PPE**	**Accounts Payable**	**Wages Payable**	**Contributed Capital**	**Retained Earnings**
Beginning Balance	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
Investment By Owners	$240,000						$240,000	
Purchase of PPE	-$70,000			$70,000				
Depreciation of PPE				-$10,000				-$10,000
Purchase Of Inventory on Credit			$99,000		$99,000			
Payment for Inventory Purchases	-$94,000				-$94,000			
Sale of Inventory			-$90,000					-$90,000
Sales Revenue		$200,000						$200,000
Collects from Customers	$180,000	-$180,000						
Wages and Benefits Expense						$55,000		-$55,000
Payment for Wages and Benefits	-$46,000					-$46,000		
Payment of Dividend	-$5,000							-$5,000
Payment of Taxes (see Below)								
Ending Balance	**$205,000**	**$20,000**	**$9,000**	**$60,000**	**$5,000**	**$9,000**	**$240,000**	**$40,000**
Totals for			**Assets**	**$294,000**	**Liabilities**	**$14,000**	**Owners' Equity**	**$280,000**

Income Statement (so far)

Sales Revenue	$200,000
Cost of Goods Sold	($90,000)
Gross Profit	$110,000
Depreciation Expense	($10,000)
Wage Expense	($55,000)
Pre-tax Income	$45,000

Now we need to calculated Income Tax Expense!

Taxes

- Calculation of Taxes can be complicated – when in doubt, consult a tax professional
- There is usually a different set of rules for calculating taxable income than for calculating income on the firm’s “regular” accounting books
- We’ll examine one of those differences – Depreciation

Depreciation – Book Purposes

- For accounting purposes (called BOOK purposes), firms generally use Straight Line Depreciation
- For our $70,000 purchase of PPE and a 7 year useful life, Book Depreciation is $70,000 / 7 = $10,000 a year
- If this was also used for tax purposes, this would lower taxable income by $10,000.
  - If the tax rate is 40%, this would lower our taxes by $4,000

Depreciation – Tax Purposes

- But for tax purposes, firms are often allowed to use **ACCELERATED DEPRECIATION**
- The purpose of this feature of the tax code is to help stimulate investment
- Accelerated Depreciation means that more depreciation than $7,000 is allowed in the early years and less than $7,000 in the later years
- This means that you get more of your tax deduction early.
- Given the time value of money, the PV of your tax payments is lower, so this makes the after-tax cost of purchasing the PPE lower!

Back To Our Example

- Suppose that for tax purposes, instead of depreciating 1/7th of the cost of \$70,000, we're allowed to deduct 29% of \$70,000 in the first year
- This means Tax Depreciation = .29 x 70,000 = \$20,300 (about double the straight-line amount)
- Assuming everything else on the tax return is the same as on our book income statement, our tax return would be as follows:

Taxable Income	
Sales Revenue	$200,000
Cost of Goods Sold	-$90,000
Depreciation Expense	-$20,300
Wages and Benefits	-$55,000
Taxable Income	$34,700
Tax at 40%	**$13,880**

- Let's assume that the tax of \$13,800 is paid in cash

Summary of All Transactions (including taxes)

	Assets				Liabilities		Owners' Equity	
Transaction or Event	**Cash**	**Accounts Receivable**	**Inventory**	**PPE**	**Accounts Payable**	**Wages Payable**	**Contributed Capital**	**Retained Earnings**
Beginning Balance	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
Investment By Owners	$240,000						$240,000	
Purchase of PPE	-$70,000			$70,000				
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Purchase Of Inventory on Credit			$99,000		$99,000			
Payment for Inventory Purchases	-$94,000				-$94,000			
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Sales Revenue		$200,000						$200,000
Collects from Customers	$180,000	-$180,000						
Wages and Benefits Expense						$55,000		-$55,000
Payment for Wages and Benefits	-$46,000					-$46,000		
Payment of Dividend	-$5,000							-$5,000
Payment of Taxes	-$13,880							-$13,880
Ending Balance	**$191,120**	**$20,000**	**$9,000**	**$60,000**	**$5,000**	**$9,000**	**$240,000**	**$26,120**
Totals for			**Assets**	**$280,120**	**Liabilities**	**$14,000**	**Owners' Equity**	**$266,120**

Balance Sheet

Assets		Liabilities and Owners' Equity	
Cash	$191,120	Accounts Payable	$5,000
Accounts Receivable	$20,000	Wages Payable	$9,000
Inventory	$9,000	Total Liabilities	$14,000
Current Assets	$220,120		
Property Plant and Equipment, Net	$60,000	Contributed Capital	$240,000
		Retained Earnings	$26,120
		Total Owners' Equity	$266,120
Total Assets	$280,120	Total Liabilities Plus Owners' Equity	$280,120

Income Statement (Including Taxes)

Sales Revenue	$200,000
Cost of Goods Sold	($90,000)
Gross Profit	$110,000
Depreciation Expense	($10,000)
Wage Expense	($55,000)
Pre-tax Income	$45,000
Tax Expense	$13,880
Net Income	**$31,120**

Next – The Cash Flow Statement

- And How it Relates to the Income Statement and Change in Balance Sheet accounts

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DECISION MAKING AND SCENARIOS MODULE 3.3 – Expressing Business Strategies In Financial Terms

Cash Flow Statements

Professor Robert Holthausen
Professor Richard Lambert

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Objective

- To learn how business activities, transactions and events impact the cash flow statement
- To learn how to derive cash flows by analyzing the income statement and the change in the balance sheet

Cash Flow Statement – Inflows and Outflows of Cash

- Operating activities:
  - Transactions related to providing goods and services to customers and to paying expenses related to the revenue generating activities (i.e. "income statement" transactions)
- Investing activities:
  - Transactions related to acquisition or disposal of long-term assets
- Financing activities:
  - Transactions related to owners or creditors (issuing debt or equity, paying back loans, paying dividends)

From Earlier - Summary of All Transactions

		Assets					Liabilities			Owners' Equity	
Transaction or Event		**Cash**	**Accounts Receivable**	**Inventory**	**PPE**		**Accounts Payable**	**Wages Payable**		**Contributed Capital**	**Retained Earnings**
Beginning Balance		**$0**	**$0**	**$0**	**$0**		**$0**	**$0**		**$0**	**$0**
Investment By Owners		$240,000								$240,000	
Purchase of PPE		-$70,000			$70,000						
Depreciation of PPE					-$10,000						-$10,000
Purchase Of Inventory on Credit				$99,000			$99,000				
Payment for Inventory Purchases		-$94,000					-$94,000				
Sale of Inventory				-$90,000							-$90,000
Sales Revenue			$200,000								$200,000
Collects from Customers		$180,000	-$180,000								
Wages and Benefits Expense								$55,000			-$55,000
Payment for Wages and Benefits		-$46,000						-$46,000			
Payment of Dividend		-$5,000									-$5,000
Payment of Taxes		-$13,880									-$13,880
Ending Balance		**$191,120**	**$20,000**	**$9,000**	**$60,000**		**$5,000**	**$9,000**		**$240,000**	**$26,120**
Totals for				**Assets**	**$280,120**		**Liabilities**	**$14,000**		**Owners' Equity**	**$266,120**

To Construct the Cash Flow Statement Directly

- Look at the transactions that impact the cash account
- Classify them into the three categories
- While straight-forward in concept, for complex firms this becomes difficult to do

Cash Flow Statement - Direct Method

Cash From Operations	
Cash Collected From Customers	$180,000
Cash Paid to Suppliers	($94,000)
Cash Paid to Employees	($46,000)
Cash Paid For Taxes	(13,880)
Total Cash From Operations	$26,120
Cash From Investing	
Cash Paid for PPE	($70,000)
Total Cash From Investing	($70,000)
Cash From Financing	
Cash From Issuing Shares	$240,000
Cash Paid for Dividends	($5,000)
Total Cash From Financing	$235,000
TOTAL CHANGE IN CASH	$191,120

Interpretation – So Far Our Cash is Coming Primarily From Financing Activities

- Our Cash Balance is up $191,120, BUT
  - This is not because the firm's projects generated a lot of cash
  - Instead, cash has increased because of financing activities
    - Specifically, from Issuing Shares of Stock
- For our purposes (project valuation and evaluation), we want to focus on the other two categories
  - OPERATIONS AND INVESTING
  - This is how our projects are performing

Operations and Investing

- Overall, our projects have caused cash to go DOWN by $43,880
- But this is a misleading measure of our performance because
  - Most of the decline is because of the investment in PPE, which should have additional benefits beyond this first year
  - This is also why Accounting Income spreads this cash flow out over time in the form of depreciation
- This is also why we want to forecast financial statements for future years – to see how much benefits we still expect to be realized

Understanding Our Operating Cash Flows

- Note that Cash from Operations is +$26,120
- But Net Income was +$31,120
- These are close (in this case) but not exactly the same
- Why are they different?
  - Not all sales in the income statement are cash
  - Not all expenses in the income statement are cash
  - Anything else?

- Understanding why they're different requires looking to the Balance Sheet

Comparing Net Income To Cash From Operations

Net Income		Cash From Operations
Sales Revenue		Cash Collected From Customers
(Cost of Goods Sold)		(Purchases From Suppliers)
(Wage Expense)		(Wages Paid)
(Depreciation Expense)		
(Taxes Paid)		(Taxes Paid)
Net Income		**Cash From Operations**

Comparing Net Income To Cash From Operations

Net Income	Different Because	Cash From Operations
Sales Revenue	Not all Sales Were Collected	Cash Collected From Customers
(Cost of Goods Sold)	Not all Inventory was sold Not all Purchases were paid for	(Purchases From Suppliers)
(Wage Expense)	Not all Wages were Paid	(Wages Paid)
(Depreciation Expense)	This is not a Cash Flow	
(Taxes Paid)	No Difference	(Taxes Paid)
Net Income		**Cash From Operations**

The Items that Reconcile Cash and Net income

- Are all in the CHANGES in the Other Balance Sheet Accounts
- This Follows from the Balance Sheet Equation
- Any difference between
  - How Cash Changed and
  - How Retained Earnings Changed
  - Has to be reflected in some other Balance Sheet account

Relation Between Financial Statements

Balance Sheet at 12/31/00

Assets = Liabilities + Owners' Equity

Cash + Noncash assets = Liabilities + Contributed Capital + Retained Earnings

Statement of Cash Flows
for year ended 12/31/01

Income Statement
for year ended 12/31/01
(minus dividends)

Cash + Noncash assets = Liabilities + Contributed Capital + Retained Earnings

Balance Sheet at 12/31/01

In Equation Form -- Changes in Balance Sheets Have to Balance

Δ Assets = Δ Liabilities + Δ Owners' Equity

Δ Cash + Δ Noncash Assets = Δ Liabilities + Δ Contributed Capital + Δ Retained Earnings

Substitute Δ Retained Earnings = Net Income – Dividends

And move everything but Change in Cash to the right side:

Cash = Net Income - Δ Noncash Assets + Δ Liabilities + Δ Contributed Capital - Dividends

This Gives Us an Alternative (More Common) Way To Present The Cash Flow Statement

- Start with the Income Statement and use the
- CHANGE in Balance Sheet Accounts
- To “infer” the implied Cash Flow Statement
- Even though it looks more complicated at first, it’s easier to forecast

The Relation Between Cash, Income, and Other Balance Sheet Items

Cash = Net Income - Δ Noncash Assets + Δ Liabilities + Δ Contributed Capital - Dividends

- **For a Given Level of Income**
- If Assets Go UP, Cash Goes DOWN
  - An increase in assets uses up cash
  - An increase in assets means some of our income was invested in those assets instead of cash
- If Liabilities Go UP, Cash Goes UP
  - An increase in liabilities means we haven't paid them yet
- If Owners' Equity goes UP, Cash Goes UP
  - An increase in owners' equity means we've gotten new funding from investors

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- **If Owners' Equity goes UP, Cash Goes UP**
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Putting Specific Balance Sheet Accounts into Categories

Change in Cash =

Net Income + Depreciation – Change in Working Capital

- Investments in LT Assets + Disposal of LT Assets

+ Changes in LT Liabilities

+ Changes in Contributed Capital – Dividends

Cash From Operations

Cash From Investing

Cash From Financing

Where Working Capital = ST Assets other than Cash minus ST Liabilities

Working Capital Accounts

- Receivables = Sales that weren't cash (yet)
- Inventory = Production that wasn't sold (yet)
- Accounts Payable = Purchases that weren't paid (yet)
- Wages Payable = Work done that wasn't paid for (yet)

- Each of these items is (often) easier to forecast than forecasting cash flow directly
- Working Capital Accounts are often closely related to the Sales and Expense accounts in Net Income

Cash Flow Statement – More Common Presentation

Cash From Operations	
Net Income = 200,000 – 90,000 – 10,000 – 55,000 – 13,880	$31,120
Add: Depreciation	10,000
Subtract: Change in Accounts Receivable	($20,000)
Subtract: Change in Inventory	($9,000)
Add: Change in Accounts Payable	$5,000
Add: Change in Wages Payable	$9,000
Total Cash From Operations	$26,120
Cash From Investing (same as before)	($70,000)
Cash From Financing (same as before)	$235,000
TOTAL CHANGE IN CASH	$191,120

Cash Flow Statement – More Common Presentation

Cash From Operations	
Net Income = 200,000 – 90,000 – 10,000 – 55,000 – 13,880	**$31,120**
Add: Depreciation	10,000
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Subtract: Change in Inventory	($9,000)
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Add: Change in Wages Payable	$9,000
Total Cash From Operations	$26,120
Cash From Investing (same as before)	($70,000)
Cash From Financing (same as before)	$235,000
TOTAL CHANGE IN CASH	$191,120

Start with Net Income -- Income was $31,120 but this is not all cash

Cash Flow Statement – Addback of Depreciation

Cash From Operations	
Net Income = 200,000 – 90,000 – 10,000 – 55,000 – 13,880	$31,120
Add: Depreciation	10,000
Subtract: Change in Accounts Receivable	($20,000)
Subtract: Change in Inventory	($9,000)
Add: Change in Accounts Payable	$5,000
Add: Change in Wages Payable	$9,000
Total Cash From Operations	$26,120
Cash From Investing (same as before)	($70,000)
Cash From Financing (same as before)	$235,000
TOTAL CHANGE IN CASH	$191,120

One reason for this is because Income contains a $10,000 subtraction for depreciation, But this isn't cash so we add it back

Start With Net Income -- Income was $31,120 but this is not all cash

Cash Flow Statement – Addback of Depreciation

Cash From Operations	
Net Income = 200,000 – 90,000 – 10,000 – 55,000 – 13,880	$31,120
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TOTAL CHANGE IN CASH	$191,120

One reason for this is because Income contains a $10,000 subtraction for depreciation, **But this isn't cash so we add it back**

Income was $31,120 but this is not all cash

Cash Flow Statement – Investment in Working Capital

Cash From Operations	
Net Income = 200,000 – 90,000 – 10,000 – 55,000 – 13,880	$31,120
Add: Depreciation	10,000
Subtract: Change in Accounts Receivable	($20,000)
Subtract: Change in Inventory	($9,000)
Add: Change in Accounts Payable	$5,000
Add: Change in Wages Payable	$9,000
Total Cash From Operations	$26,120
Cash From Investing (same as before)	($70,000)
Cash From Financing (same as before)	$235,000
TOTAL CHANGE IN CASH	$191,120

A second reason is because we invested $15,000 in Working Capital

Cash Flow Statement – Investment in Working Capital

Cash From Operations	
Net Income = 200,000 – 90,000 – 10,000 – 55,000 – 13,880	$31,120
Add: Depreciation	10,000
Subtract: Change in Accounts Receivable	($20,000)
Subtract: Change in Inventory	($9,000)
Add: Change in Accounts Payable	$5,000
Add: Change in Wages Payable	$9,000
Total Cash From Operations	$26,120
Cash From Investing (same as before)	($70,000)
Cash From Financing (same as before)	$235,000
TOTAL CHANGE IN CASH	$191,120

= -$15,000

A second reason is because we invested $15,000 in Working Capital

Firms are often INVESTING in Working Capital during Growth Phases
And RELEASING Working Capital during Contraction Phases

The Individual Lines in the Operating Section Provide More Details about the Components of Working Capital

- Sales of $200,000 weren't all cash – $20,000 is still invested in receivables
- The Cost of Goods Sold of $90,000 wasn't the cash paid to suppliers because
  - We purchased $9,000 more than we sold
  - We haven't yet paid for $5,000 of what we purchased
- The Wage Expense of $55,000 wasn't all paid yet - $9,000 is still in the liability account Wages Payable

Summary

- We've learned how to represent business transactions and events into Balance Sheets, Income Statements, and Cash Flow Statements
- We've learned to be able to express Cash Flow Statements in terms of Balance Sheets and Income Statements
- Cash From Operations =

  Net Income + Depreciation – Change in Working Capital

Next Module

- We're going to apply these skills to Evaluating a Potential New Product Venture
  - We're going to add multiple periods – the balance sheet at the end of one period is the balance sheet for the start of the next period
  - Lay out a strategic plan and what this implies about future business activities, transactions and events
  - Then take what we learned in this module and translate those into forecasted financial statements – ultimately into forecasts of future cash flows
  - Then take what we learned in Modules 1 and 2 to use Net Present Value Techniques to calculate the Value of adopting this strategy
  - Re-think the strategy along several dimensions and examine what these imply for the present value

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INTRODUCTION TO SPREADSHEETS & MODELS

Don Huesman

Module 4: Using spreadsheets to implement Monte Carlo simulations and linear programs for optimization

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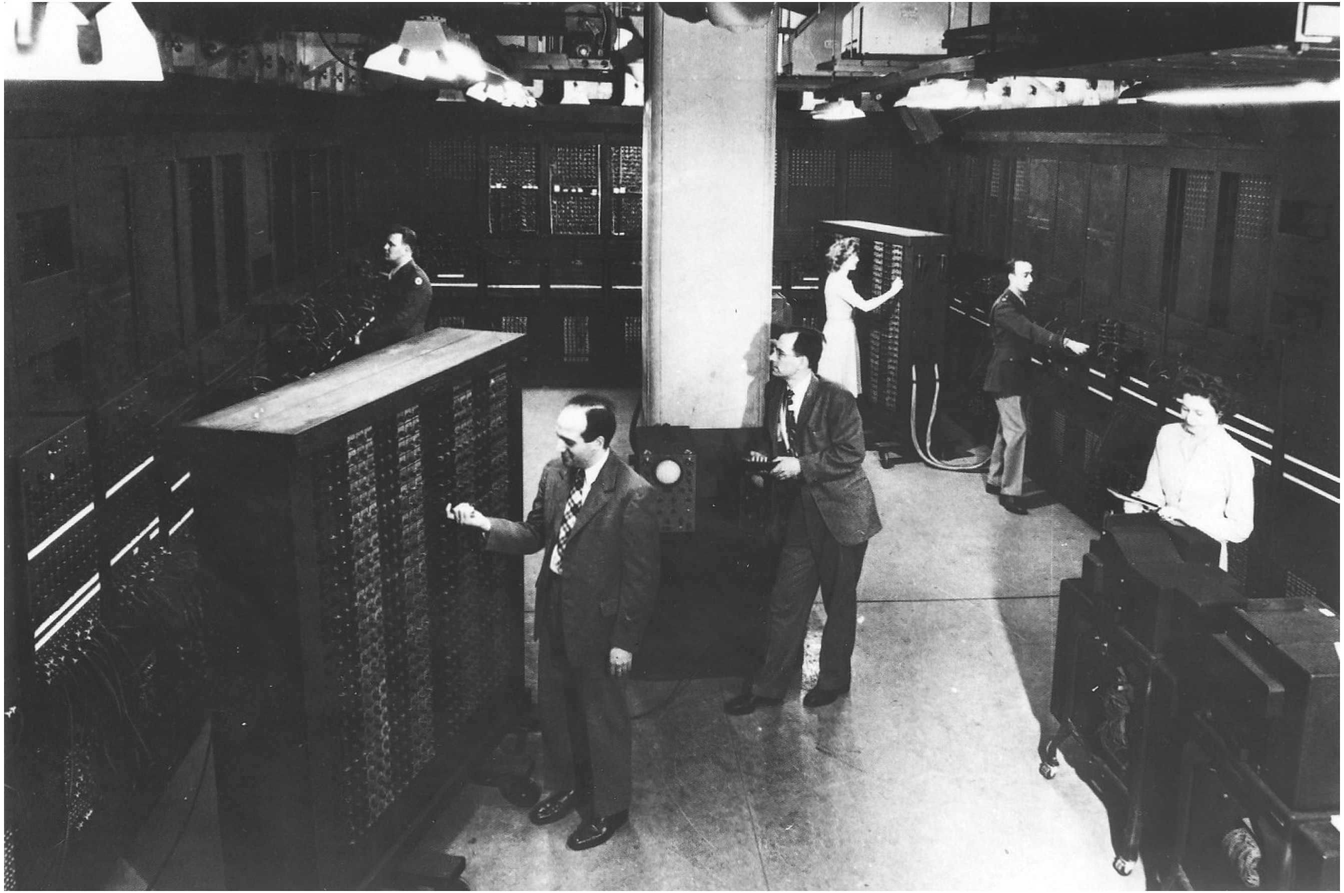

Module topics

- Purpose of Monte Carlo simulations
- Implementing Monte Carlo simulations in spreadsheets
- Types of problems addressed by linear programs
- Implementing linear programs in spreadsheets
- Summarizing course modules

Resources

- Software used in this Specialization
  - Excel
  - Google sheets
  - Data analysis toolpak for Excel
  - XLMiner Analysis Toolpak for Sheets

INTRODUCTION TO SPREADSHEETS & MODELS

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Module 4: Using spreadsheets to implement Monte Carlo simulations and linear programs for optimization

Lecture 1 Monte Carlo simulations

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Module 2 Lecture 1 Learning objectives

- Purpose of Monte Carlo simulations
- Implementing Monte Carlo simulations in spreadsheets

Module 2 Lecture 1 Learning objectives

- Problems addressed by Monte Carlo simulations
  - Uncertainty in assumptions about environment
  - Complex interactions among variables
  - High levels of accuracy important in assessing risk
- Implementing Monte Carlo simulations in spreadsheets
  - Identify type of probability distribution for key variables
  - Apply distribution to random number generation
  - Run simulation model a large number of times
  - Assess probable outcomes & compare to risk
- Available add-ins to simplify and add-value (no endorsements!)

INTRODUCTION TO SPREADSHEETS & MODELS

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Module 4: Using spreadsheets to implement Monte Carlo simulations and linear programs for optimization

Lecture 2 Linear programming

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Module 2 Lecture 2 Learning objectives

- Types of problems addressed by linear programs
- Implementing linear programs in spreadsheets
- Incorporating constraints
- Using the Solver plug in to achieve an optimal solution

INTRODUCTION TO SPREADSHEETS & MODELS

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Module 4: Using spreadsheets to implement Monte Carlo simulations and linear programs for optimization

Lecture 3 Next steps, Differences between Excel and Sheets

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Module 3 Learning objectives

- Other courses in the Business and Financial Modeling Specialization
- Reviewing differences between Excel and Sheets

Module 4 Summary

- Using simulations to model uncertainty and risk in spreadsheets
- As an example of linear programs, using Excel's solver to identify optimal allocations of resources to reach a desired outcome
- Identifying similarities and differences between Excel and Sheets
- Other courses in the Business and Financial Modeling Specialization

FUNDAMENTALS OF QUANTITATIVE MODELING

Richard Waterman

Module 4: Regression models

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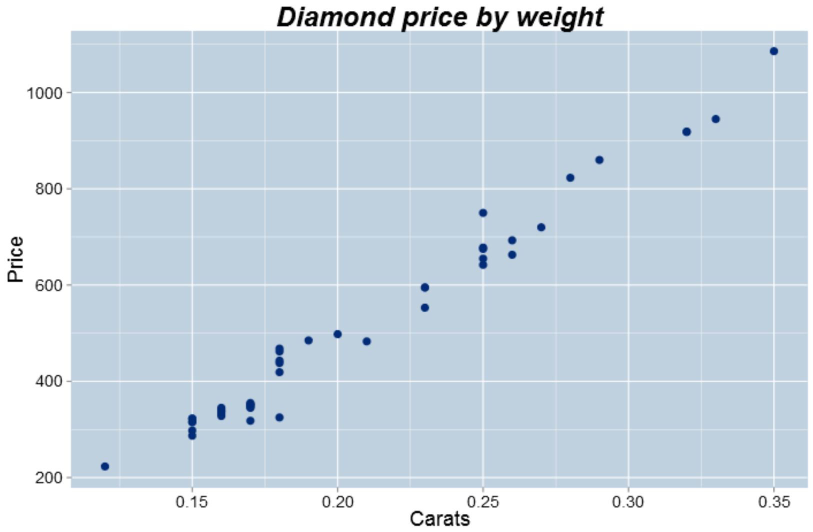
Module 4 content

- What is a regression model?
- Questions that a regression can answer
- Correlation and linear association
- Fitting a line to data
- Interpretation of the regression coefficients
- Prediction intervals in regression
- Multiple regression – many predictor variables
- Logistic regression -- what to do when the outcome variable is dichotomous

Regression models

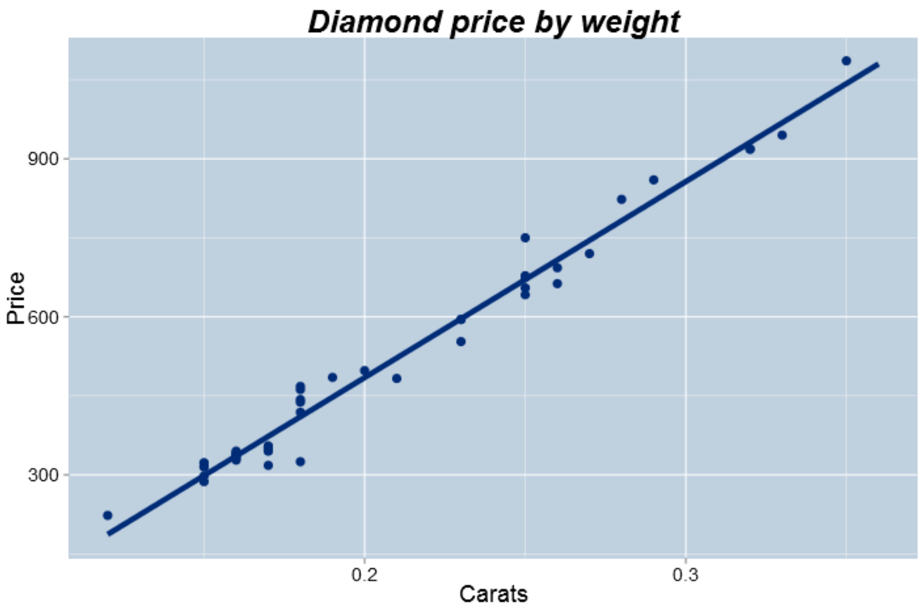
- A ***simple regression*** model uses a single predictor variable X to estimate the **mean** of an outcome variable Y, as a function of X



Example

- Using the diamonds data: the predictor variable is the diamond's weight in carats and the outcome variable is the price of the diamond
- Heavier stones tend to cost more money (positive association) but a regression formalizes this idea into a model that reveals how the expected price varies with weight
- If the relationship is modeled with a straight line we call it a ***linear*** regression: $E(Y|X) = b_0 + b_1 X$

A linear regression model for the diamonds data



$$E(Price \mid Weight) = -260 + 3721 \times Weight$$

Correlation

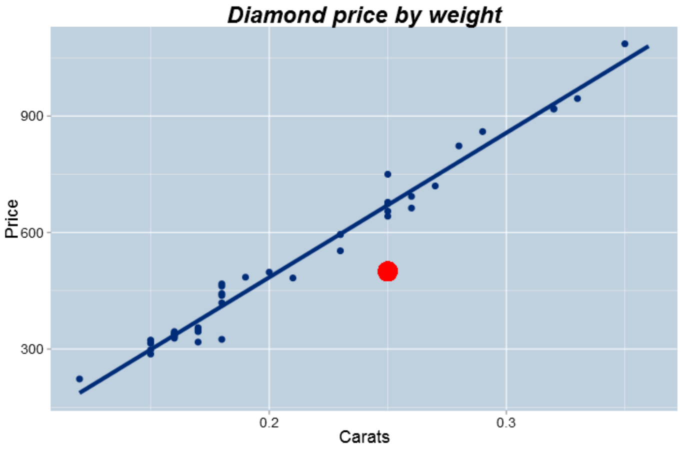
- ***Correlation*** is a measure of the strength of ***linear association*** between two variables
- It is denoted by the letter *r*. Fact: $-1 \leq r \leq +1$
- Negative values of the correlation indicate negative association and positive values indicate positive association
- A correlation of 0 means no linear association between the variables
- For the diamonds data, r = 0.989 which is an extremely strong positive correlation

Questions that can be answered with a regression

- In a business setting regression is most often used as a ***prediction*** tool. It is a core ***predictive analytics*** methodology
  - What price do you expect to pay for a diamond that weighs 0.3 carats?
  - Give me a ***prediction interval*** in which the price is likely to fall
- Interpreting coefficients from the model
  - How much on average do you expect to pay for diamonds that weigh 0.3 carats v. diamonds that weigh 0.2 carats? (ans. = 372)
- How much of the variability in price is accounted for by the weight of the diamond?

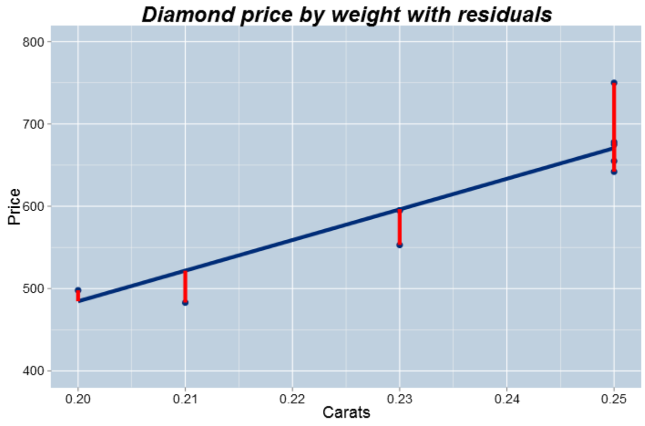
Questions that can be answered with a regression

- Prospecting for opportunities (new customers, investments etc.)
- If you found a diamond for sale that weighed 0.25 carats but cost only $500, would you be interested?
- The key idea is that this point is below the regression line
- Maybe it is mispriced and a great opportunity or maybe it is a flawed diamond, but it is certainly worth a look!



Fitting a model to data using least squares

- Fitting a model requires an optimality criteria
- Most regression models are fit using ***least squares***
  – Find the line that minimizes the sum of the squares of the vertical distance from the points to the line

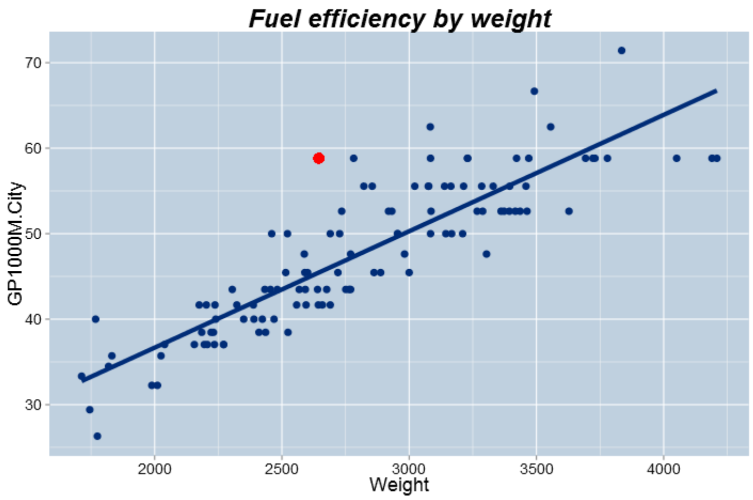


Residuals and fitted values

- Key insight:
  - The regression line decomposes the observed data into two components
    1. The fitted values (the predictions)
    2. The residuals (the vertical distance from point to line)
- Both are useful:
  - The fitted values are the forecasts
  - The residuals allow us to assess the quality of the fit. If a point has a large residual it is not well fit by the regression. If we can explain why, we have learnt something new

Example: fuel economy v. weight

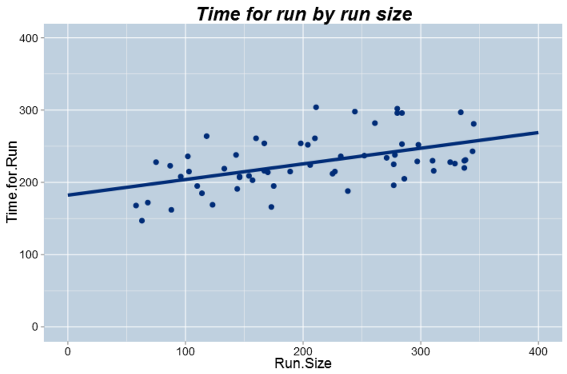
- Y = GP1000M (City), X = weight
- The point with the biggest residual is identified in red



Mazda RX-7 with rotary engine

Interpretation of regression coefficients

- $E(Y|X) = 182 + 0.22\ X$
- Equate units on each side
- Intercept is measured in units of Y
- Slope is measured in units of Y/X
- Intercept = Setup time in minutes
- Slope = Work rate in minutes per additional item



R^2 and Root Mean Squared Error (RMSE)

- R^2 measures the proportion of variability in Y explained by the regression model. It is the square of the correlation, r
- RMSE measures the standard deviation of the residuals (the spread of the points about the fitted regression line)

Example	R^2	RMSE
Diamonds	98%	31.84
Fuel economy	77%	4.23
Production time	26%	32.11

Using Root Mean Squared Error

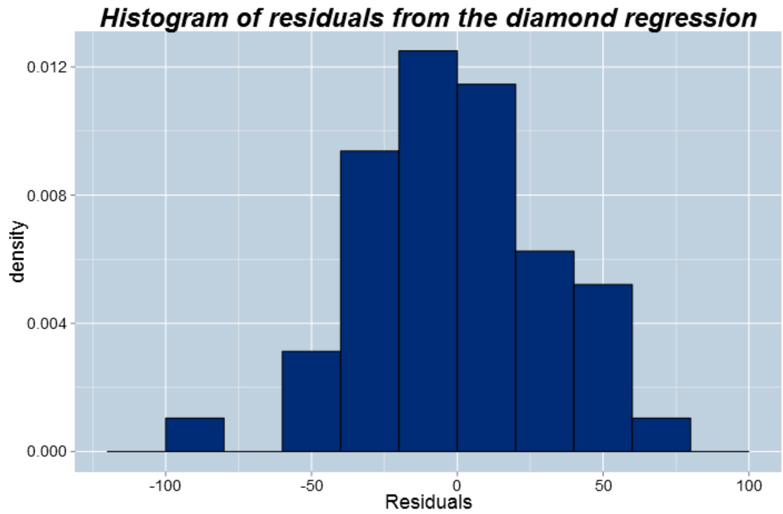
- Assumption: at a fixed value of X, the distribution of points about the true regression line follows a Normal distribution, centered on the regression line
- These normal distributions all have the same standard deviation σ, which is estimated by RMSE

An approximate 95% prediction interval for a new observation

- Using the Normality assumption and the Empirical Rule, (within the range of the observed data) an approximate 95% prediction interval for a new observation is given by:
  - $Forecast \pm 2 \times RMSE$
- For the diamonds data the RMSE is approximately 32
- Therefore under the Normality assumption the width of the approximate 95% prediction interval is $\pm$ \$64
- An approximate 95% PI for the price of a diamond that weighs 0.25 carats is $-260 + 3721 \times 0.25 \pm 64 = (606, 734)$

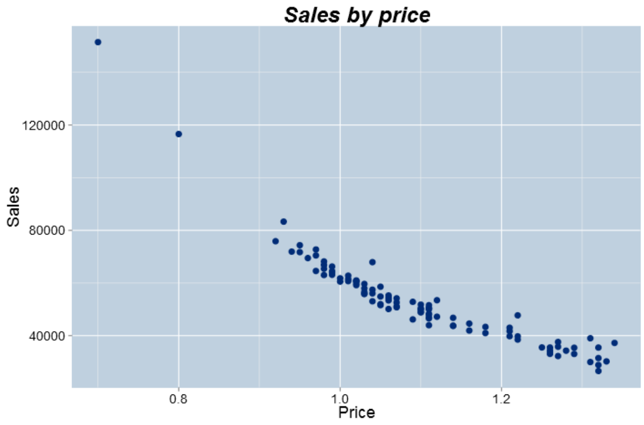
Residual diagnostics – checking the Normality assumption

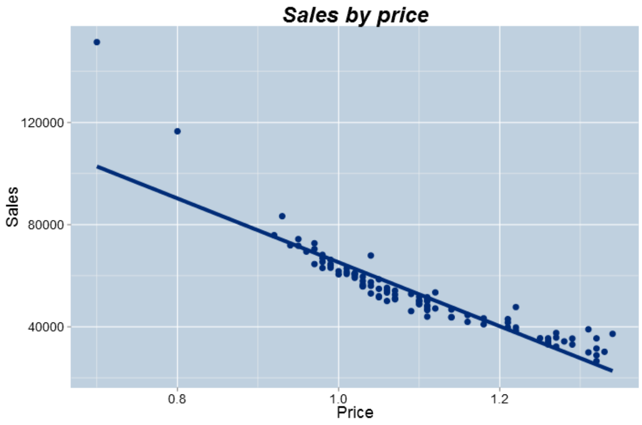
- The histogram of residuals from the diamonds regression is approximately Normally distributed, providing no strong evidence ***against*** the Normality assumption



Fitting curves to data

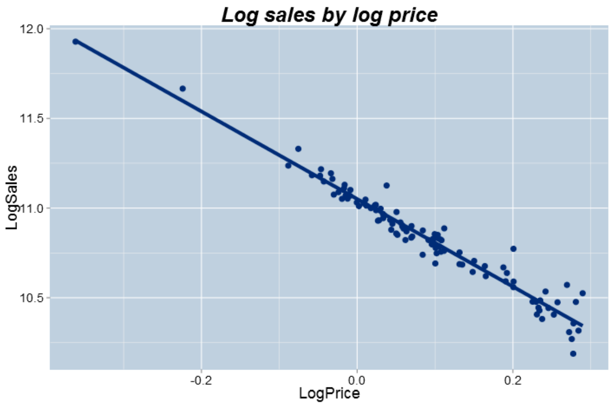
- Often relationships are non-linear
- Demand for a pet food (measured in cases sold) against average price. A line is a bad fit to the data





On observing curvature, transform

- This is where the basic math functions discussed in module 1 come in very useful
- Look at the pet food data after having taken the log transform



The regression equation for the log-log model

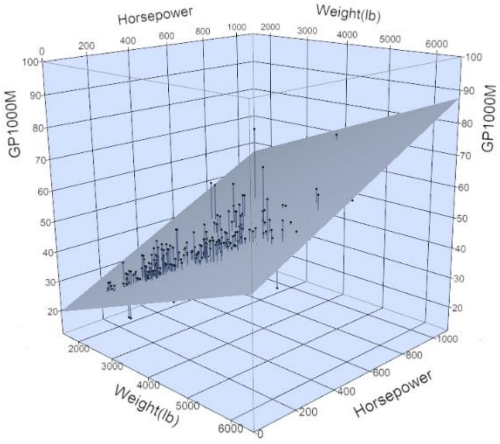
- The regression equation is now
  - $E(\log(Sales) \mid Price)) = b_0 + b_1 \log(Price)$
- In this instance we have:
  - $E(\log(Sales) \mid Price)) = 11.015 \; - 2.442 \log(Price)$
- This process shows how we could actually estimate the demand model that was the subject of the optimization in module 2

Multiple regression

- ***Multiple regression*** models allow for the inclusion of many predictor variables
  - In the fuel economy dataset we might add the horsepower of a car as an additional predictor
  - In the diamonds data set we might add in the color of the diamond to improve the model
- With two predictors, X_1 and X_2 the regression model becomes
  - $E(Y|X_1, X_2) = b_0 + b_1X_1 + b_2X_2$

Weight and horsepower as predictors of fuel economy

- Fitting a multiple regression model of fuel economy as a function of weight and horsepower gives:
  - $E(GP1000M|Weight, Horsepower)$ = 11.68+0.0089 $Weight$ + 0.0884 $Horsepower$
- The model is now a plane rather than a line
- For this model R^2 = 84% and RMSE= 3.45, an improvement over the simple regression model with only weight included



Logistic regression

- Linear regression is most appropriate when the outcome variable Y is continuous
- In many business problems, the outcome variable is **not** continuous but rather, ***discrete***
  – Purchase a product: Yes/No
  – Medical outcome: Live/Die
  – Website activity: Sign up/Don't sign up
- These outcomes can be viewed as Bernoulli random variables

Logistic regression

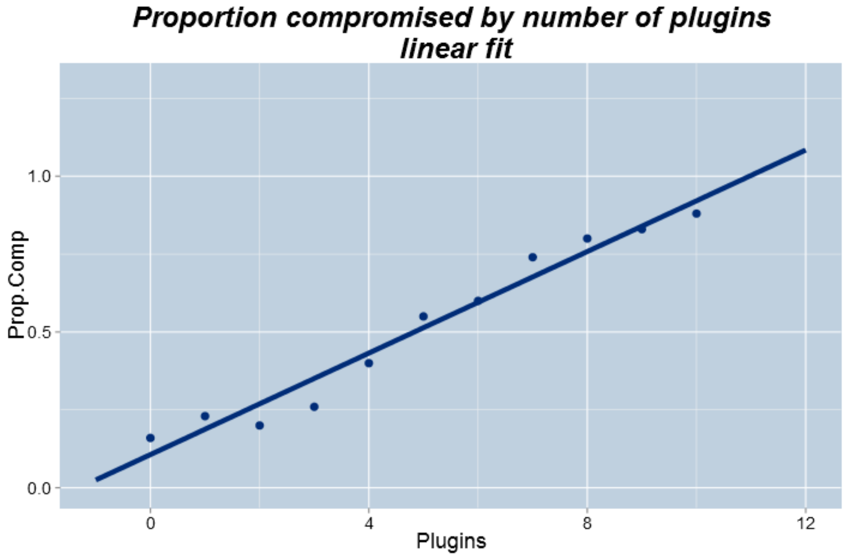
- Logistic regression is used to estimate the probability that a Bernoulli random variable is a *success*, as a function of predictor variables
- For example, how does the probability that a website is compromised vary as a function of the number of plugins that the site has installed?

Website compromise study

#Plugins	0	1	2	3	4	5	6	7	8	9	10
Compromised	16	23	20	26	40	55	60	74	80	83	88
Not compromised	84	77	80	74	60	45	40	26	20	17	12
Proportion compromised	0.16	0.23	0.20	0.26	0.40	0.55	0.60	0.74	0.80	0.83	0.88

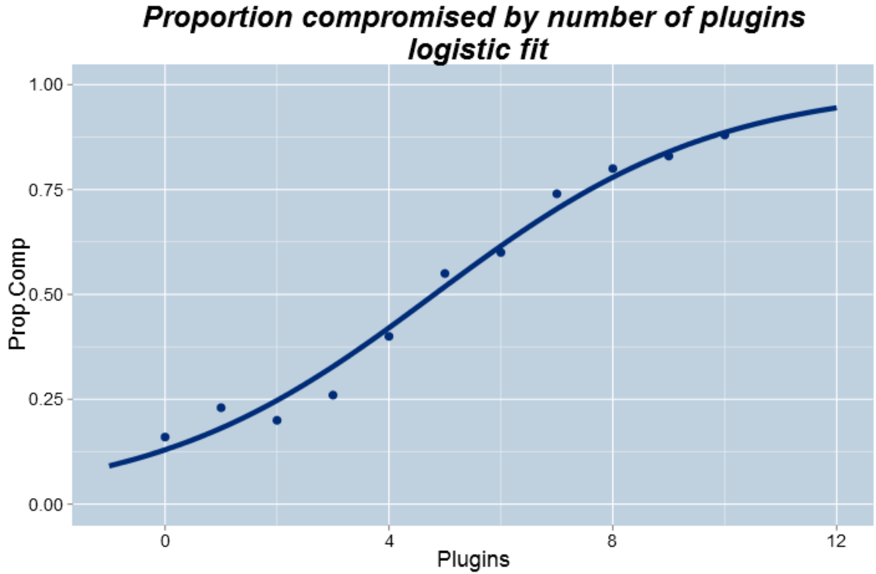
Linear fit

- The linear fit does not extrapolate well, predicting proportions greater than 1



Logistic regression fit

- The logistic regression fit is more appropriate, always predicting probabilities between 0 and 1



Module summary

- What is a regression model?
- Questions that a regression can answer
- Correlation and linear association
- Fitting a line to data
- Interpretation of the regression coefficients
- Prediction intervals in regression
- Multiple regression – many predictor variables
- Logistic regression – what to do when the outcome variable is dichotomous

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DECISION MAKING AND SCENARIOS
MODULE 4.1 – New Product Venture

Introduction And Setup

Professor Robert Holthausen
Professor Richard Lambert

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Agenda – Valuation of a Proposed New Product Venture and Evaluation of Alternative Scenarios

- **Introduction and Spreadsheet Set up**
- Forecasting of Future Cash Flows
- Valuation (NPV and IRR)
- Formulation and Evaluation of Alternative Scenarios
- Expanding the Time Horizon

Iterative Process

- Translate your project idea into the future economic actions, transactions, events needed to carry out the project and your best estimate of the outcomes
- Map those predictions into forecasted financial statements.
- Calculate the NPV of the forecasted cash flows
- Rethink your strategy
  – Consider Alternative Courses of Action
  – Alternative Scenarios

We can’t know the future for certain

- But if we plan carefully we improve our chances for success
- Many ideas prove to be unprofitable when you initially put numbers to them
- But forcing yourself to lay out your strategy can help expose the weaknesses and help identify where you need to rethink your idea and strategy for execution

Spreadsheet Set Up – Open the Spreadsheet and Follow Along!

- Assumptions Section
  - So you can identify and change them
- Intermediate Calculations Section
- Forecasted Financial Statements
  - Income Statement
  - Tax Return
  - Balance Sheet
  - Cash Flow Statement
- Calculation of NPV and IRR

- Using Color Codes in the Spreadsheet can be Helpful!
- Keep the Spreadsheet simple at first, make sure it works, and then add complexity

New Product Venture

	Initial Investment			Operating Phase					Terminal Phase
Time:	0	1	2	3	4	5	6	7	8
Cash Flow	C_0	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8

ASSUMPTIONS	
Discount Rate	6.00%
Tax rate	40.00%

Investment / Start Up Phase -- Years 1 and 2

- Investment In PPE at the start
- Research & Development over two years
- Marketing and Administrative Costs over two years

Startup Phase	
Iniital Investment in PPE (paid in cash)	$70,000.00
Residual Value for Depreciation Purposes	$0.00
Useful Life in Years	7
R&D per year During Startup Phase (in cash and expensed)	$20,000.00

Operating Phase -- Years 3 though 7

- Production and Sales
  - Working Capital - Some payments and some collections occur with a lag
- Continued S,G & A Activities (that ramp up relative to the start up phase)
- Allows for Sales Growth over the period
- Allows for Inflation in prices over the period

Operating Phase – Initial Assumptions

Operating Phase - Sales		
Iniitial Sales Volume (in units) - Starts in Year 3		2000
Sales Growth Rate per year		0.00%
Sales Price Per Unit		$100.00
Product Gross Margin Pct		55.00%
Inflation Rate for Sales and COGS		0.00%
SG&A - Fixed Costs per year (not subject to inflation) - Starts in Year 1	$	25,000.00
SG&A - Variable Cost Per Unit (not subject to inflation) Starts in Year 3 because there are no sales until then	$	15.00

Working Capital Timing Issues	
Collections	
In year of sale	90.00%
Following year	10.00%
Desired Units of Inventory as a Percent of that year's sales	10.00%
Payments on Purchases Made This year	
Percent Paid this year	95.00%
Percent Paid next year	5.00%
Payments to Employees for Compensaton and Benefits Earned this year	
Percent Paid this year	70.00%
Percent Paid Next year	30.00%

Termination / Shut Down / Disposal Phase -- Year 8

- Remaining Inventory Liquidated (at a lower price)
- Remaining Receivables Collected
- Remaining Payables Paid
- Remaining Long Term Assets Sold
- Other Disposal Costs

Termination / Shut Down Phase	
Proceeds from Disposal of PPE	$5,000.00
Other Disposal or Cleanup Costs	$2,000.00
Markup Over Cost for Sale of Ending Inventory	0.00%
Fixed SG&A Costs During This Phase	$0.00
Variable SG&A During This Phase	$0.00

Our Focus is on the Cash Inflows and Outflows of the New Venture

- Not looking at how the New Venture is **Financed**
- The discount rate (6%) represents the opportunity cost of the capital we're employing in the project (regardless of the source)

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DECISION MAKING AND SCENARIOS
MODULE 4.2 – New Product Venture

Forecasting Future Cash Flows

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Professor Richard Lambert

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Agenda – Valuation of a Proposed New Product Venture and Evaluation of Alternative Scenarios

- Introduction and Spreadsheet Set up
- **Forecasting of Future Cash Flows**
- Valuation (NPV and IRR)
- Formulation and Evaluation of Alternative Scenarios
- Expanding the Time Horizon

- **OPEN THE SPREADSHEET AND FOLLOW ALONG!**

Forecasting Financial Statements

- Forecasts often start with sales (and sales growth)
- Use the projected sales figures to estimate the remaining income statement lines (which are often at least partially a function of sales volume)
- Use the forecasted Sales numbers to construct a schedule for producing the product or service (production volume, inventory levels)
- Use the forecasted sales and production schedules to estimate
  - The resources needed to accomplish the plans (assets)
  - The timing of resource acquisition and use
- Use the income statement and balance sheets to construct the statement of cash flows.
- We'll focus on the cash flows from project itself and not worry about the specifics as to how it is financed

Forecasting Revenues

- Try to Assess Consumer Demand
- Forecast Industry Sales and Firm Market Share
  - Management Estimates
  - Analysts Forecasts
- Production/ Technology Constraints
- Demand will also depend on the Sales Price
- For Newer Ventures
  - How long until we can get to market?
  - How long will the "high growth" phase last?
  - What will steady state and "phase out/decline" phases look like?

Forecasting The Other Income Statement Lines

- Cost of Goods (or Services) Sold
  - What combination of material, labor and overhead is required?
  - What Profit Margin is expected?
  - How much of the Costs are Fixed vs Variable?
- Selling General and Administrative:
  - What are the marketing and advertising plans?
  - How do they Vary Over Time?
  - How much do these costs go up when sales go up?
- Prior (or Competitor) Income Statements can be helpful

Income Statement - Depreciation Expense

- Based on acquisitions of property, plant, and equipment up through that year
- Estimates of Useful Lives and Salvage Value

Income Statement – Income Tax Expense

- Where will the income be (what tax jurisdiction)?
- What are our tax rates?
- Income for tax purposes is generally different than financial statement income
  - Accelerated depreciation for tax purposes vs straight line depreciation for book purposes
- We'll assume that this venture is part of a bigger company that has plenty of taxable income
  - So if this venture incurs losses early on, we're able to utilize those losses to reduce our taxes
  - If that's not the case, you have to worry about more complicated features of the tax law involving Loss Carryforwards and Carrybacks

Income Statement -- Disposal Year

- In the “Other” line on the Income Statement
- There is a Gain on Sale of the PPE (its book value is $0 at the time of sale, but we sold it for $5000)
- There are Other Disposal costs of $2000

Forecasted Income Statements

INCOME STATEMENT	1	2	3	4	5	6	7	8
Sales Revenue	$0	$0	$200,000	$200,000	$200,000	$200,000	$200,000	$9,000
Cost of Goods Sold	$0	$0	$90,000	$90,000	$90,000	$90,000	$90,000	$9,000
Gross Margin	$0	$0	$110,000	$110,000	$110,000	$110,000	$110,000	$0
Depreciation Expense	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$0
Research & Development	$20,000	$20,000	$0	$0	$0	$0	$0	$0
SG&A	$25,000	$25,000	$55,000	$55,000	$55,000	$55,000	$55,000	$0
Other Losses (Gains)	$0	$0	$0	$0	$0	$0	$0	($3,000)
Pre-tax Income (Loss(	($55,000)	($55,000)	$45,000	$45,000	$45,000	$45,000	$45,000	$3,000
Tax Expense (Benefit)	($26,120)	($23,600)	$17,800	$19,200	$19,760	$20,320	$20,600	$1,200
Net Income (Loss)	**($28,880)**	**($31,400)**	**$27,200**	**$25,800**	**$25,240**	**$24,680**	**$24,400**	**$1,800**

- No Growth In Sales Volume During Operating Phase (by assumption)
- Big Drop in Sales (and Sale Price) During the Termination Phase
- Decline in Income During Operating Phase is because of the tax expense (and the declining tax shield provided by depreciation)

Forecasted Income Statements

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Depreciation Expense	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$0
Research & Development	$20,000	$20,000	$0	$0	$0	$0	$0	$0
SG&A	$25,000	$25,000	$55,000	$55,000	$55,000	$55,000	$55,000	$0
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Depreciation Expense	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$0
Research & Development	$20,000	$20,000	$0	$0	$0	$0	$0	$0
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Depreciation Expense	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$0
Research & Development	$20,000	$20,000	$0	$0	$0	$0	$0	$0
SG&A	$25,000	$25,000	$55,000	$55,000	$55,000	$55,000	$55,000	$0
Other Losses (Gains)	$0	$0	$0	$0	$0	$0	$0	($3,000)
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Balance Sheet -- Working Capital

- Accounts Receivable
  - What will be our credit policy?
  - How much of sales will be cash vs credit?
  - How quickly will we get paid?
- Inventory – What are production plans?
  - Strategy: Make to Order / Make to Stock ?
  - How long does production take?
  - How much inventory do we want to hold?
- Accounts Payables – when do we pay for
  - Inventory
  - Wages and Benefits
- Others

Balance Sheet - Long Term Assets

- What are our Production / Capital Expenditure Plans?
- Will we need to add capacity later?
- Disposal Cost or Resale Value
- Tangible vs Intangible Assets
  - Intangible Assets Like R&D aren't Capitalized
- Depreciation and Amortization Policies
  - Book vs Tax

Forecasted Balance Sheets

Assets	0	1	2	3	4	5	6	7	8
Current Assets									
Cash	($70,000)	($81,380)	($102,780)	($80,630)	($45,280)	($10,040)	$24,640	$59,040	$68,840
Accounts Receivable	$0	$0	$0	$20,000	$20,000	$20,000	$20,000	$20,000	$0
Inventory	$0	$0	$0	$9,000	$9,000	$9,000	$9,000	$9,000	$0
Total Current Assets	($70,000)	($81,380)	($102,780)	($51,630)	($16,280)	$18,960	$53,640	$88,040	$68,840
Property Plant and Equipment	$70,000	$70,000	$70,000	$70,000	$70,000	$70,000	$70,000	$70,000	$0
Less Accumulated Depreciation	$0	$10,000	$20,000	$30,000	$40,000	$50,000	$60,000	$70,000	$0
Long Term Assets	$70,000	$60,000	$50,000	$40,000	$30,000	$20,000	$10,000	$0	$0
Total Assets	$0	($21,380)	($52,780)	($11,630)	$13,720	$38,960	$63,640	$88,040	$68,840
Liabilities									
Current Liabilities									
Accounts Payable	$0	$0	$0	$4,950	$4,500	$4,500	$4,500	$4,500	$0
Wages and Benefits Payable	$0	$7,500	$7,500	$16,500	$16,500	$16,500	$16,500	$16,500	$0
Other Liabilties	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total Liabilites	$0	$7,500	$7,500	$21,450	$21,000	$21,000	$21,000	$21,000	$0
Owners Equity									
Contributed Capital	$0	$0	$0	$0	$0	$0	$0	$0	$0
Retained Earnings	$0	($28,880)	($60,280)	($33,080)	($7,280)	$17,960	$42,640	$67,040	$68,840
Total Owners Equity	$0	($28,880)	($60,280)	($33,080)	($7,280)	$17,960	$42,640	$67,040	$68,840

- Jump in Working Capital in Period 3, Released in Period

Forecasted Balance Sheets

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Property Plant and Equipment	$70,000	$70,000	$70,000	$70,000	$70,000	$70,000	$70,000	$70,000	$0
Less Accumulated Depreciation	$0	$10,000	$20,000	$30,000	$40,000	$50,000	$60,000	$70,000	$0
Long Term Assets	$70,000	$60,000	$50,000	$40,000	$30,000	$20,000	$10,000	$0	$0
Total Assets	$0	($21,380)	($52,780)	($11,630)	$13,720	$38,960	$63,640	$88,040	$68,840
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Current Liabilities									
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Wages and Benefits Payable	$0	$7,500	$7,500	$16,500	$16,500	$16,500	$16,500	$16,500	$0
Other Liabilties	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total Liabilites	$0	$7,500	$7,500	$21,450	$21,000	$21,000	$21,000	$21,000	$0
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Less Accumulated Depreciation	$0	$10,000	$20,000	$30,000	$40,000	$50,000	$60,000	$70,000	$0
Long Term Assets	$70,000	$60,000	$50,000	$40,000	$30,000	$20,000	$10,000	$0	$0
Total Assets	$0	($21,380)	($52,780)	($11,630)	$13,720	$38,960	$63,640	$88,040	$68,840
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Current Liabilities									
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Wages and Benefits Payable	$0	$7,500	$7,500	$16,500	$16,500	$16,500	$16,500	$16,500	$0
Other Liabilties	$0	$0	$0	$0	$0	$0	$0	$0	$0
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- Jump in Working Capital in Period 3, Released in Period 8

Forecasting The Cash Flow Statement

- Use the forecasted Balance Sheets and Income Statements to forecast the Cash Flow Statements
- Operating Cash Flow =

  Net Income + Depreciation – Change in Working Capital
- Investing Cash Flows
  - During the Start up Period
    - Purchase of PPE
  - During the Disposal Period
    - Sale of PPE

* Note that in the Terminal Period, there is a gain on sale of PPE in Net Income. We moved that out of the operating section to be part of the investing cash flows. This doesn't change the overall cash flow, just its classification

Forecasted Cash Flow Statements

CASH FLOW STATEMENT			0	1	2	3	4	5	6	7	8
Net Income				($28,880)	($31,400)	$27,200	$25,800	$25,240	$24,680	$24,400	$1,800
Add Depreciation				$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$0
Minus Change in Accts Rec				$0	$0	($20,000)	$0	$0	$0	$0	$20,000
Minus Change in Inventory				$0	$0	($9,000)	$0	$0	$0	$0	$9,000
Plus Change in Accts Payable				$0	$0	$4,950	($450)	$0	$0	$0	($4,500)
Plus Change in Wages Payable				$7,500	$0	$9,000	$0	$0	$0	$0	($16,500)
Other				$0	$0	$0	$0	$0	$0	$0	($5,000)
Cash From Operations				($11,380)	($21,400)	$22,150	$35,350	$35,240	$34,680	$34,400	$4,800
Investment in PPE			($70,000)	$0	$0	$0	$0	$0	$0	$0	$0
Disposal of PPE			$0	$0	$0	$0	$0	$0	$0	$0	$5,000
Net Cash Inflow (Outflow)			**($70,000)**	**($11,380)**	**($21,400)**	**$22,150**	**$35,350**	**$35,240**	**$34,680**	**$34,400**	**$9,800**

- Negative Cash Flows during the start-up period
- Positive Cash Flows during Operating Period
  - Cash Lags Income Because of the investment in working capital
- Termination phase has a positive cash flow in this case (collection of receivables)

Forecasted Cash Flow Statements

CASH FLOW STATEMENT			0	1	2	3	4	5	6	7	8
Net Income				($28,880)	($31,400)	$27,200	$25,800	$25,240	$24,680	$24,400	$1,800
Add Depreciation				$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$0
Minus Change in Accts Rec				$0	$0	($20,000)	$0	$0	$0	$0	$20,000
Minus Change in Inventory				$0	$0	($9,000)	$0	$0	$0	$0	$9,000
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Minus Change in Accts Rec		$0	$0	($20,000)	$0	$0	$0	$0	$20,000
Minus Change in Inventory		$0	$0	($9,000)	$0	$0	$0	$0	$9,000
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Minus Change in Accts Rec		$0	$0	($20,000)	$0	$0	$0	$0	$20,000
Minus Change in Inventory		$0	$0	($9,000)	$0	$0	$0	$0	$9,000
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Forecasted Cash Flow Statements

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Add Depreciation		$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$0
Minus Change in Accts Rec		$0	$0	($20,000)	$0	$0	$0	$0	$20,000
Minus Change in Inventory		$0	$0	($9,000)	$0	$0	$0	$0	$9,000
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Plus Change in Wages Payable		$7,500	$0	$9,000	$0	$0	$0	$0	($16,500)
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Cash From Operations		($11,380)	($21,400)	$22,150	$35,350	$35,240	$34,680	$34,400	$4,800
Investment in PPE	($70,000)	$0	$0	$0	$0	$0	$0	$0	$0
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- Negative Cash Flows during the Start-Up Phase
- Positive Cash Flows during Operating Phase
  - Cash Lags Income Because of the investment in working capital
- Termination phase has a positive cash flow in this case (collection of receivables)

Look at the Numbers Again

- Do They Make Sense?
- Are the Sales Levels achievable?
- Is the Production Schedule achievable?
- Are there Cleanup or Disposal Costs at the end we've forgotten?

Financing Cash Flows

- Remember that we're ignoring the specifics how the project is financed and concentrating on the **project's** cash flows
- The discount rate (6%) reflects whatever the opportunity cost of capital is
- If you're worried that our Cash Balance (not just the cash flow) is Negative during the early periods, assume that **whatever cash is needed for the project comes from another part of the firm on an as needed basis**

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DECISION MAKING AND SCENARIOS
MODULE 4.3 – New Product Venture

NPV and IRR Calculations

Professor Robert Holthausen
Richard Lambert

Wharton UNIVERSITY of PENNSYLVANIA ONLINE

Agenda – Valuation of a Proposed New Product Venture and Evaluation of Alternative Scenarios

- Introduction and Spreadsheet Set up
- Forecasting of Future Cash Flows
- **Valuation (NPV and IRR)**
- Formulation and Evaluation of Alternative Scenarios
- Expanding Beyond the Time Horizon

Take The Forecasted Cash Flows

CASH FLOW STATEMENT	0	1	2	3	4	5	6	7	8
Net Income		($28,880)	($31,400)	$27,200	$25,800	$25,240	$24,680	$24,400	$1,800
Add Depreciation		$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$0
Minus Change in Accts Rec		$0	$0	($20,000)	$0	$0	$0	$0	$20,000
Minus Change in Inventory		$0	$0	($9,000)	$0	$0	$0	$0	$9,000
Plus Change in Accts Payable		$0	$0	$4,950	($450)	$0	$0	$0	($4,500)
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- Negative Cash Flows During the Startup / Investing Phase
- Positive Cash Flows During the Operating Phase
- Positive Cash Flows (in this case) During the Termination Phase

And Feed them Into the Net Present Value Calculations

CASH FLOW STATEMENT	0	1	2	3	4	5	6	7	8
Net Income		($28,880)	($31,400)	$27,200	$25,800	$25,240	$24,680	$24,400	$1,800
Add Depreciation		$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$0
Minus Change in Accts Rec		$0	$0	($20,000)	$0	$0	$0	$0	$20,000
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- Negative Cash Flows During the Startup / Investing Phase
- Positive Cash Flows During the Operating Phase
- Positive Cash Flows (in this case) During the Termination Phase

Calculate Net Present Value (NPV) and IRR

- Use the after-tax Cost of Capital (6%) to calculate NPV
- Recall that this represents the opportunity cost of our capital
  - The rate we could earn on our next best use (of equivalent risk) of capital
- Remember that the NPV function in Excel assumes the first cash flow is one period away

Initial Cash Flow	-$70,000
Present Value of Future Cash Flows	+$96,624
Total Present Value of Cash Flows	**$26,624**
Internal Rate of Return	**11.5%**

Interpretation of Net Present Value (NPV)

- NPV = $26,624
- This is the economic value that the New Product Venture will add to the firm.
- This considers both the timing and magnitude of the inflows and outflows of cash
- It should also reflect the riskiness associated with the cash flows. (the discount rate is supposed to reflect this)

Interpretation of Internal Rate of Return (IRR)

- IRR = 11.5%
- This means that the money we invest in the New Product Venture earns a rate of return of 11.5%
- Again, this takes the timing as well as the magnitudes of the inflows and outflows of cash into consideration
- Since 11.5% is considerably above the cost of capital (6%), this is additional evidence that this is a profitable product venture
  - If the cost of capital was 11.5%, this venture would have an NPV of zero
  - If the cost of capital was above 11.5%, this venture would have a negative NPV. It would be destroying value; not creating it.

How believable are those numbers?

- The NPV and IRR numbers look “precise”
- But they’re only as credible as the quality of the inputs that went into our spreadsheet
  - These are the parameters we put into the Assumptions Section of the Spreadsheet
- But these are all judgments or estimates (or guesses) about the future and how our business strategy will play out over time
- We know that this can’t possibly be 100% accurate
- So let’s think about alternative scenarios for how things might turn out

WE’RE NOT FINISHED!

- In fact, we’re just starting
- Now we want to ask some hard questions
  - What can go wrong?
  - How wrong can it go?
- And to try to think “outside the box”
  - Re-think all our assumptions
  - How can we do this better?

  - Ideally we’ve set up the spreadsheet in a way that allows the series of future financial statements and the Net Present Value to be easily re-calculated under alternative scenarios

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DECISION MAKING AND SCENARIOS
MODULE 4.4 – New Product Venture

Formulation and Evaluation of Alternative Scenarios

Professor Robert Holthausen
Professor Richard Lambert

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ONLINE

Agenda – Valuation of a Proposed New Product Venture and Evaluation of Alternative Scenarios

- Introduction and Spreadsheet Set up
- Forecasting of Future Cash Flows
- Valuation (NPV and IRR)
- **Formulation and Evaluation of Alternative Scenarios**
- Expanding Beyond the Time Horizon

Iterative Process

- Translate your project idea into the future economic actions, transactions, events needed to carry out the project and your best estimate of the outcomes
- Map those predictions into forecasted financial statements.
- Calculate the NPV of the forecasted cash flows
- **Rethink your strategy**
  - **Consider Alternative Courses of Action**
  - **Alternative Scenarios**

Reality Checks

- Do the statements make sense?
- Is our forecasted sales price realistic?
- Can we reasonably expect to sell that many?
- Do we have the capability of producing that many?
- Are the balances of receivables, inventory and liabilities reasonable?

Let's Start with Sales

- This is the source of all our inflows.
- Remember that we assumed the following in our spreadsheet

Operating Phase - Sales	
Iniitial Sales Volume (in units) - Starts in Year 3	2000
Sales Growth Rate per year	0.00%
Sales Price Per Unit	$100.00
Product Gross Margin Pct	55.00%
Inflation Rate for Sales and COGS	0.00%

- These assumptions (at this point) partly reflect
  - our best estimate of what we think will happen
  - Simplifications to make it easier to check if our spreadsheet was working

What If Analysis? – Sales Volume

- Our calculations assumed that Volume will be 2,000 units per year
  - What if Sales Volume is different?
- How big are profits (in present value terms) at different sales levels?
- Go back to the spreadsheet and change the "INITIAL SALES VOLUME" cell
  - All the calculations will automatically update

Operating Phase - Sales	
Iniitial Sales Volume (in units) - Starts in Year 3	**2000**
Sales Growth Rate per year	0.00%
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What If Analysis? – Sales Volume

- Our calculations assumed that Sale Volume is 2,000 units per year
  - What if they're not?
- How big are profits (in present value terms) at different sales levels?
- Go back to the spreadsheet and change the "INITIAL SALES VOLUME" cell
  - All the calculations will automatically update

Operating Phase - Sales		
Iniitial Sales Volume (in units) - Starts in Year 3	~~2000~~	2400
Sales Growth Rate per year	0.00%	
Sales Price Per Unit	$100.00	
Product Gross Margin Pct	55.00%	
Inflation Rate for Sales and COGS	0.00%	

Re-calculation of NPV if Sales Volume is 20% Higher or 20% Lower than our Base-Line Forecasted Case

Sales Volume in Units Per Year	NPV	IRR
2,400 (20% higher)	$61,961	17.7%
2,000 (original forecast)	$26,624	11.5%
1,600 (20% lower)	-$8,712	4.0%

Note that if Sales Falls Short of our Forecast by 20%, we'll lose money!

At What Sales Volume Does our New Venture "Break Even?"

- Breakeven means earns a Net Present Value of Zero
- Equivalently, it means that the Venture Earns an IRR of 6%
- We could try to figure this out by **trial and error** by putting in different volume levels
  - we know from the prior slide that the Breakeven Volume will be slightly above 1,600 units a year
- Or we can use a built in function in Excel called **GOALSEEK** to do this for us

GOALSEEK – an Excel Function to solve this

- We have set up the spreadsheet such that
  - There is a cell that contains the Sales Volume per year (We can put in an arbitrary number. Goalseek will change the number)
  - There is a cell that contains the results of the NPV calculation
- Under the Data Tab, choose “What If Analysis” and “Goalseek”.
- Choose to Set the Cell with the NPV formula in it Equal to 0.0 by changing the Cell with the Volume in it.
- This asks Excel to find the Sales Volume per year that results in the Overall NPV of the project (discounted at 6%) to equal 0.0
- Equivalently, this finds the Sales Volume such that the project earns a 6% rate of return (after tax)

GOALSEEK Calculation of Break-Even Volume

Sales Volume in Units Per Year	NPV	IRR
2,000 (Original Forecast)	$26,624	11.5%
1,698 (Breakeven Volume)	$0	6.0%

- This is an Important Calculation to make
- In our case, we have a “margin of safety” of approximately 300 units of sales per year (relative to our forecast) before we start to lose money

- In many proposed new ventures, the breakeven point will turn out to be well ABOVE your forecasted sales volume
  - THIS MEANS YOU NEED TO RETHINK YOUR PLANS AND SEE IF THERE IS A WAY TO MODIFY YOUR STRATEGY OR PLANS FOR EXECUTING IT

Another Concern – Costs of Providing the Product or Service

- Our calculations assume we have a product gross margin of 55%.
  - This means that if our sales price is $100, it will cost $45 to make each unit, leaving a margin of $55 to cover the rest of our costs
- But how much margin of safety do we have there?

Operating Phase - Sales	
Iniitial Sales Volume (in units) - Starts in Year 3	2000
Sales Growth Rate per year	0.00%
Sales Price Per Unit	$100.00
Product Gross Margin Pct	**55.00%**
Inflation Rate for Sales and COGS	0.00%

Scenarios – How does NPV change with Profit Margin (As a Percent of Sales Price); Sales Volume = 2,000 units per year

Profit Margin Percentage	NPV	IRR
65%	$71,820	19.5%
55% (original forecast)	$26,624	11.5%
45%	-$18,571	1.7%

- If the Margin is only 45%, we lose money!
  - We can use GoalSeek to fine tune this
- **Are there other ways to produce and deliver the product or provide the service that will cost less?**

Scenario – How Much will Sales Grow?

- This is one of the most important considerations in new ventures
- Sales often grow during initial part of the Operating Phase
- We've assumed NO GROWTH – let's change that!
- Assume (for simplicity) that sales grows at a constant rate during the operating phase

Operating Phase - Sales	
Iniitial Sales Volume (in units) - Starts in Year 3	2000
Sales Growth Rate per year	**0.00%**
Sales Price Per Unit	$100.00
Product Gross Margin Pct	55.00%
Inflation Rate for Sales and COGS	0.00%

Growth In Sales -- What if Sales Volume Starts at 2,000 but Grows by 25% Year?

INCOME STATEMENT								
	1	2	3	4	5	6	7	8
Sales Revenue	$0	$0	$200,000	$250,000	$312,500	$390,625	$488,281	$21,973
Cost of Goods Sold	$0	$0	$90,000	$112,500	$140,625	$175,781	$219,727	$21,973
Gross Margin	$0	$0	$110,000	$137,500	$171,875	$214,844	$268,555	$0
Depreciation Expense	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$0
Research & Development	$20,000	$20,000	$0	$0	$0	$0	$0	$0
SG&A	$25,000	$25,000	$55,000	$62,500	$71,875	$83,594	$98,242	$0
Other Losses (Gains)	$0	$0	$0	$0	$0	$0	$0	($3,000)
Pre-tax Income (Loss(	($55,000)	($55,000)	$45,000	$65,000	$90,000	$121,250	$160,313	$3,000
Tax Expense (Benefit)	($26,120)	($23,600)	$17,800	$27,200	$37,760	$50,820	$66,725	$1,200
Net Income (Loss)	($28,880)	($31,400)	$27,200	$37,800	$52,240	$70,430	$93,588	$1,800

- Note the Increase in Sales!
- Sales Goes up Faster than Total Costs
  - Because some of the costs are fixed!

With 25% Growth in Sales – More Working Capital

CASH FLOW STATEMENT	0	1	2	3	4	5	6	7	8
Net Income		($28,880)	($31,400)	$27,200	$37,800	$52,240	$70,430	$93,588	$1,800
Add Depreciation		$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$0
Minus Change in Accts Rec		$0	$0	($20,000)	($5,000)	($6,250)	($7,813)	($9,766)	$48,828
Minus Change in Inventory		$0	$0	($9,000)	($2,250)	($2,813)	($3,516)	($4,395)	$21,973
Plus Change in Accts Payable		$0	$0	$4,950	$788	$1,434	$1,793	$2,241	($11,206)
Plus Change in Wages Payable		$7,500	$0	$9,000	$2,250	$2,813	$3,516	$4,395	($29,473)
Other		$0	$0	$0	$0	$0	$0	$0	($5,000)
Cash From Operations		($11,380)	($21,400)	$22,150	$43,588	$57,424	$74,410	$96,063	$26,922
Investment in PPE	($70,000)	$0	$0	$0	$0	$0	$0	$0	$0
Disposal of PPE	$0	$0	$0	$0	$0	$0	$0	$0	$5,000
Net Cash Inflow (Outflow)	**($70,000)**	**($11,380)**	**($21,400)**	**$22,150**	**$43,588**	**$57,424**	**$74,410**	**$96,063**	**$31,922**

Unlike the Constant Sales Case, Note that there is **continued additional investment in Working Capital**, with it all released in the last period

Net Present Value as a Function of Sales Growth

Growth In Sales Volume	NPV	IRR
0% (Original Forecast)	$26,624	11.5%
25% Per Year	$132,624	25.1%

- Growth Makes a HUGE difference in Profitability!
- Note that Sales Volume goes from 2,000 units to 4,883 units per year
- Do we have the **PRODUCTIVE CAPACITY** to handle this much volume?
- If not, we'll need to add more productive capacity. When? How much? How much will it cost? Will it be worth it?

Inflation

- A common mistake in doing these calculations is using the same initial period prices will persist for all future periods.
  - But prices often change over time, especially in periods of inflation
- We can incorporate this by building anticipated inflation into the future prices
- Be careful – not all prices go up at the same rate
  - Example: The tax shield from depreciation is usually set based on the original purchase price of the assets
- In some sectors of the economy, prices go DOWN over time, not up

Exploration of Scenarios – Inflation Rate

- Suppose the Inflation Rate in our New Product Venture applies Only to Sales and Cost of Goods

Inflation Rate Per Year	NPV	IRR
0% (original)	$26,624	11.5%
10%	$77,298	19.2%
50%	$398,227	42.5%

- But if the Inflation Rate is that high, shouldn't the discount rate be higher than 6%?
- Keep track of whether Sales Revenue is increasing because of
  – Higher Sales Prices
  – Higher Sales Volume (if this is the reason, this might require more capacity)

Other Scenarios To Explore – Discount Rate

- Discount Rate
  - Higher expectations about inflation should imply higher discount rates
  - Higher risk should imply higher discount rates
- Higher discount rates will result in lower present values

Other Scenarios To Explore - Time Related Factors

- Credit Policy – Suppose we allow people to pay later
  - Collecting later is bad
  - But will it Allow us to Sell to more customers?
  - Do we think Sales will increase enough to offset the cost of later collections?
  - Will we run into customer defaults?
- Different Patterns of Growth and Decline for Sales
- Length of Time the Operating Phase lasts
  - How quickly will competitors come in and take away sales?
- Time to Market (sales start in year 3)
  - Faster time to market will result in higher present values

Interactions with Our Other Products and Activities

- Do the revenues from this new product cannibalize the **revenues** from our other products?
  - Or will they make our other products more attractive to customers?
- Does this product venture cannibalize **scarce resources** that our other products use?
- Will we **learn** things in doing this product venture that we can apply to other products?

Tentative Summary

- Our baseline case (no growth) has a positive NPV
- But it doesn’t take much to go wrong to change that
- If Sales are expected to grow, things look much better
- There are many things that are difficult to quantify – this is where the ART mixes with the SCIENCE in business strategy discussions

Next

- We have one more thing we want to take another look at – and that's what happens at the end of the project
- Or whether this is, in fact, the end.

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DECISION MAKING AND SCENARIOS
MODULE 4.5 – New Product Venture

Expanding Beyond The Time Horizon

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Agenda – Valuation of a Proposed New Product Venture and Evaluation of Alternative Scenarios

- Introduction and Spreadsheet Set up
- Forecasting of Future Cash Flows
- Valuation (NPV and IRR)
- Formulation and Evaluation of Alternative Scenarios
- **Expanding Beyond the Time Horizon**

Disposal Value

- In our example, we assume we **Terminated** the New Product Venture in Period 8
- This resulted in a set of one-time cash flows
  - Sale of PPE
  - Sale of Remaining Inventory at a reduced price
  - Collection of Remaining Receivables
  - Payment of Remaining Payables
  - Other Disposal Costs
    - **This is an easy one to overlook or underestimate**
- As these are all ONE-TIME costs that occur 8 periods out, it's easy to calculate their impact on the overall NPV of the project

But What if We Continue Beyond the Forecast Horizon?

- By Continuing the Project Itself
- Or by Rolling it over into a New Project
- This is especially relevant if we're trying to value the FIRM as a whole (which has an indefinite life)

Valuing a Firm

- We can think of a firm as a set of projects
  - Some are operating simultaneously
  - But new ones arise to take the place of old ones that get phased out
- A Firm has an Indefinite life
- We can't keep forecasting all the way out to infinity

Two Part Approach to Forecasting and Valuation

- Individual yearly forecasts are usually made for a finite horizon (typically 3 to 7 years).
- Then a more ad hoc (simplified) assumption is made regarding what will happen beyond that time (often called the Terminal Value)

What Happens Beyond the Forecast Horizon?

- Usually we assume that the firm goes into "steady state" beyond the forecast horizon
- Common Assumptions about Steady State
  - Cash Flows are Constant beyond the Forecast Horizon
    - Say, equal to the Cash Flow from Period 7
    - This is called a perpetuity
  - Cash Flows **grow at a constant rate** beyond the forecast Horizon
    - This is called a constant growth perpetuity
- While often a good "approximation," the main virtue of these assumptions is that the math is easy

Valuation of a Constant Growth Perpetuity

- Suppose the discount rate is r
- If the cash flows start at C and grow at g percent per year, the present value is

$$\text{PV of growing perpetuity} = \frac{C}{r - g}$$

- The growth rate g has to be less than the discount rate r
  – You can't grow at too a high a rate forever!
- No growth is just a special case of this
- In our case, this constant growth perpetuity doesn't start until year 8, so we have to further discount the above formula

The Terminal Value Assumption Has a Big Impact on Valuation!

- Discount Rate = 6%

What Happens Beyond Year 7?	Present Value of Cash Flows Beyond Year 7		Present Value of Cash Flows During Years 0-7	Total Present Value of Cash Flows
Terminate – One Cash Flow of $9,800 in Period 8	$6,148		$20,476	$26,624
Perpetuity – 0% Growth Over Period 7 Cash Flow	$381,299		$20,476	$401,775
Perpetuity – 2% Growth Over Period 7 Cash Flow	$583,388		$20,476	$603,864

- Most of the Value of the Firm is from Cash Flows Beyond Year 7, even with no growth

Course Conclusions

- In this course, we’ve developed a framework for evaluating business decisions and strategies
- We stressed the importance of thinking of business strategies in terms of the financial consequences these strategies will have
- To do this requires thinking about the business activities that will occur, the resources that will be employed, and the obligations that will be incurred
- We stressed the value of accounting systems for keeping track of all these things in a systematic way
  – How balance sheets and income statements and cash flow statements are linked together

Conclusions Continued

- Balance Sheets list the resources and obligations associated with a business strategy
- Income Statements calculate the profits associated with the business activities and events that occur during a period
- Cash Flow Statements calculate the inflows and outflows of cash that derive from the business activities and events
- Ultimately it's the future cash flows that the strategy or project will affect that is relevant
  - Balance Sheets and Income Statements help you calculate this
  - Cash Flows can be expressed in terms of the Income Statement and Balance Sheets

How do You Compare Different Streams of Future Cash Flows?

- We showed that NET PRESENT VALUE is the most economically sensible way to do this
  - Done properly, it reflects
    - the opportunity cost of capital
    - the riskiness of the strategy
- Net Present Value Calculations allow you to look at an investment that will generate an uncertain return in the future and allow you to answer
  - How big does that return need to be for the investment to be worthwhile?
  - How does the answer depend on how far into the future it is before the return occurs?
  - How does the answer depend on how risky the return is?

Spreadsheet Setup and Scenario Analysis

- We talked about the value of spreadsheets in
  - Making assumptions clear cut
  - Making calculations and re-calculations easier
  - Allowing easier exploration of risks and alternative scenarios

After You've Initiated the Project

- The same forecasts we had developed can now be used to help monitor the progress of the project
  - To allow us to spot if things are going "off course" and help us decide what to do about it
- What you learn on one project can be very helpful in structuring your thinking for the next project
- Business Success involves an Ongoing Iterative Process of Valuation, Evaluation and Learning,
- Our course has developed important tools to help you do this better

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