FOUNDATIONS OF
REAL ESTATE FINANCIAL MODELLING

ROGER STAIGER

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Foundations of Real Estate Financial Modelling is specifically designed to provide an overview of pro forma modelling for real estate projects. The book introduces students and professionals to the basics of real estate finance theory before providing a step-by-step guide for financial model construction using Excel. The idea that real estate is an asset with unique characteristics which can be transformed, both physically and financially, forms the basis of discussion.

Individual chapters are separated by functional unit and build upon themselves to include information on:

- Amortization
- Single-Family Unit
- Multifamily Unit
- Development/Construction Addition(s)
- Waterfall (Equity Bifurcation)
- Accounting Statements
- Additional Asset Classes.

Further chapters are dedicated to risk quantification and include scenario, stochastic, and Monte Carlo simulations, waterfalls, and securitized products. This book is the ideal companion to core real estate finance textbooks and will boost students' Excel modelling skills before they enter the workplace. The book provides individuals with step-by-step instruction on how to construct a real estate financial model that is both scalable and modular.

A companion website provides the pro forma models to give readers a basic financial model for each asset class as well as methods to quantify performance and understand how and why each model is constructed and the best practices for repositioning these assets.

Roger Staiger (FRICS) is Managing Director for Stage Capital, LLC, a global advisory firm in real estate financial modelling, portfolio management and asset repositioning. He holds faculty positions at George Washington University, Georgetown University and Johns Hopkins University. He has held many senior positions including Managing Director for Constellation Energy's Retail Commodity Division and CFO for America's Best Builder 2006.

Foundations of Real Estate Financial Modelling provides the reader with a clear path towards appropriate methods and processes used to properly model various types of real estate investments. In addition, the book provides the "why" behind the models by introducing practical explanations of valuation, capital stack formation and assessment of risk. The book also defines key terms, which are especially important in today's real estate industry where jargon and undefined "rule of thumb" benchmarks proliferate.

What is noteworthy is Professor Staiger's use of visual enhancements (graphs and actual pro-formas) throughout the book that bring clarity and meaning to the content. This is effective because many adult learners are visual in their comprehension of new material.

In summary, students will appreciate the thoughtfulness of the book that provides a roadmap to a clear and concise explanation of the process and practical application of real estate models for financial forecasting and risk assessment.

Bob Rajewski, Adjunct Professor, John Hopkins University

The book is aptly named. The author does an excellent job of providing the context in which real estate modelling should be viewed in. Rather than being a step-by-step instruction manual, Staiger reviews the appropriate supporting theory that must be understood before diving headlong into real estate financial modelling. As real estate is not a commodity, there is no "one size fits all" financial model. Given the extreme variations in assumptions, risk profiles, and deal structures, real estate financial models are as diverse as the assets they attempt to quantify. Failure to understand these concepts along with the industry standard metrics will almost guarantee the construction of flawed models.

In general terms, pro forma modelling is fairly straightforward with a basic understanding of finance. However, many seasoned analysts struggle with modelling waterfalls. As the waterfall is designed to separate risk and associated returns by tranches, it therefore requires the adjustment of payment streams. Done incorrectly the outcome can be disastrous causing potential investors to lose faith in the integrity of the model and possibly the entire project. The author devotes a substantial amount of time covering this topic and incorporates a variety of diagrams to simplify the concepts.

I recommend this book to anyone attempting to build a defensible real estate financial model. This book will inspire confidence to both beginner and advanced model builders.

Keith A. Hopkins, MBA, Managing Director, Stage Capital Group, LLC

Foundations of Real Estate Financial Modelling was created as part of Professor Staiger's curriculum within the School of Real Estate at Georgetown University's School of Continuing Studies. It is a superb step-by-step process of how to build various models which are both scalable and modular. The textbook will be an excellent resource for students, as well as non-finance faculty, to understand the mechanics of building a real estate pro forma.

Roger's disciplined and purposeful approach to pro forma modelling has been so well received by the students that we regularly offer workshops, free to students, to ensure the skill is gained and focused upon in the program. This textbook is an excellent resource for the students to supplement the workshops and explain the basic theory of real estate finance coupled with technical skills.

We are proud that we will be incorporating this textbook within our curriculum at Georgetown University. This textbook could well be required reading for all students.

William H. Hudnut III, Executive Director, Georgetown University

Acknowledgements

Preface

Foundations of Real Estate Financial Modelling is a book designed to assist individuals in developing real estate pro forma models beginning with a fresh spreadsheet. Although the first three chapters cover theory and provide background for real estate, the book is actually a "how-to" book on pro forma construction.

In the first three chapters readers review the basics of real estate, valuation, and cash flow distinctions between asset types (i.e. hotel, multifamily, retail, etc.). In addition, readers are introduced to a new metric, P(Loss), developed by the author. P(Loss) quantifies the probability of not returning 100.0% of invested capital, that is, the most important question for an investment. It is innovative in its simplicity and requirement of risk quantification.

In later chapters, beginning with Chapter 4, readers follow the chapters to construct evermore complex real estate financial models. The finished versions can be found on the companion website for use after the reader has personally completed the model. What the book does not do is analyze the use of these models, though real case studies are included on the companion website. The book focuses on construction rather than use. This book is best used as a classroom tool or by the novice to intermediate financial analyst who has a background in real estate.

Later books will include more analysis of case studies using the base models constructed within this text. For now the focus is on model construction rather than case study analysis.

Contents

1   What is real estate?

When considering the question "What is real estate?" more questions are produced than answers. Real estate is considered to be real property. This translates the question to what is "property"? For the purposes of this book, real estate is defined as investment(s) in physical buildings and land, in both combined, or in financial products backed by physical buildings and land, such as mortgage-backed securities (MBS). Therefore, the mental image of real estate is generally a building, home, or farm – i.e. a physical structure residing on land. However, the picture of real estate should actually be a return distribution which includes both return and risk. Real estate is tangible, it can be seen, touched, felt, and at times of distress, kicked. Real estate is also intangible as it is a financial instrument which can be transformed physically and financially. Finally, the value of real estate, in reality, is the cash flow it produces, which is a direct result of the tenants and leases and the risks associated with these cash flows. Conceptually, the physical real estate is an expense item while the tenants produce the cash flows for a real estate project. The characteristics of these cash flows depend on the type of real estate (i.e. asset class) and the current economic environment.

To consider real estate in a broader context, it is an asset class which attracts investment funds. In fact, real estate is the second largest asset class in the US and was actually the largest asset class in 2006, prior to the bubble bursting. To provide some context, in 2010 the US GDP was approximately $14,500bn, with total US asset values (aggregation of Fixed Income, Equity, and Real Estate) of approximately $69,000bn. In 2010, the asset split was Fixed Income ($32,500bn), Equity ($18,000bn), and Real Estate ($18,500bn). Therefore, real estate, in 2010, was approximately 27% greater than US GDP and the same percentage of US asset value.

Real estate in the context as an asset class must be bifurcated further into residential and commercial components. Residential is four times the size of the commercial asset class and is actually a leading indicator by 7 months (based on historic analysis of the Case-Shiller index versus RCA's commercial index in 2014). Residential real estate is therefore approximately $14,800bn while commercial real estate is $3,700bn (note: commercial real estate in 2007 was $6,000bn).

Although the differences between residential and commercial may appear to be obvious, it is important to reclassify each to best describe their financial characteristics – i.e. residential is non-income producing and commercial is income producing. Classifying commercial as income producing is the conventional methodology. However, the rhetorical question remains, "Are both real estate asset classes not both non-income producing?" The difference is that the commercial asset class has historically been purchased for investment purposes (i.e. an investment-type asset), while traditionally residential real estate purchased as a primary home is considered for personal consumption (i.e. residential home). To further

extrapolate, residential is also quasi-income producing when one considers the rental expense that would be incurred if individuals were not in their own homes. MBAs call this deference of rental expense "opportunity cost" and model it as if it were an expense to determine price.

At the core, all real estate has the same cash flow diagram (Figure 1.1).

Specifically, real estate is unique as an asset class because, unlike equity and fixed-income securities, the purchase is rewarded not with income (e.g. dividends and/or coupon payments) but rather with invoices. These invoices are maintenance, in the case of a physical structure, property taxes, etc. Basically the 'rewards' for owning real estate, in its purest form, are expenses which are both timely and constant. Of course the owner also has use of the property and owner's rights to the property, but it is the tenants that provide the income for the asset. Further, these expenses are known and can be accurately forecast given historic depreciation tables and tax forecasts. Therefore, the value of real estate, in purity, is negative.

Then why does real estate trade with positive pricing? The answer: the ability of real estate to attract cash flows, realized or not. Of course there are other reasons as well – for example the ability to absorb large amounts of capital in singular transactions, community investment and presence, and so forth – but in summary, it is the ability to actively manage the asset to produce positive cash flows (i.e. income over maintenance, taxes, and debt service). Therefore, the value of real estate is not the physical structure itself but rather the rents, the leases, the asset can attract.

This is the subject of Chapter 12, but the value of real estate can be modelled using Portfolio Theory. In the case of an office project where multiple tenants occupy the asset, the value is determined as the portfolio of leases rather than as a single project, or office asset. This addresses repositioning given that a single-tenanted building provides no diversification of industry and risk while a multi-tenanted building provides diversification, provided the tenant's industries are not highly correlated. Extrapolating further, a multi-tenanted real estate asset can be modelled as and considered a portfolio of forward rate agreements (FRAs) rather than a single asset. Again, this is the subject of later chapters.

An actively managed real estate investment with tenants will have the more traditional cash flow diagram associated with equity and fixed-income securities (Figure 1.2).

Note that the previous diagram assumes a terminal value at the end of the period. There are two methods of valuing a real estate asset: (1) assume cash flows continue into perpetuity and (2) assume cash flows end upon sale, or terminal value. For the purposes of this text, a terminal value will be assumed in calculating yield; however, it should be understood that

Figure 1.1 Real Estate Cash Flow Diagram

Figure 1.2 Real Estate Cash Flow Diagram with Tenants, i.e. Leased

$$\text{Sales Price}_n = \frac{\text{NOI}_{n+1}}{\text{Capitalization Rate}}$$

Figure 1.3 Sales Price/Capitalization Rate Equation

the terminal value can be removed if the property is considered held (i.e. valued) into perpetuity (note: terminal value in this text will be quantified using the traditional capitalization rate method). See Figure 1.3.

Note that sales price is calculated as a function of net operating income (NOI) rather than net income. Net income is NOI less debt service, that is, cost of financing. This is consistent with Modigliani and Miller's propositions from corporate finance, which state the value of an entity is independent of financing concerns.

Yield

Yield is a valuation method used for Western finance – i.e. Europe, North and South America. It is the solved discount rate for the series of cash flows when setting the Net Present Value (NPV) equal to zero, in other words, the Internal Rate of Return (IRR). This is more simply viewed in Figure 1.4 and Figure 1.5.

The NPV equation is a polynomial. Therefore, it is important, to avoid multiple IRR possibilities, that there be only a single cash flow change – i.e. cash flows change from negative to positive once. If there are multiple changes in cash flow signs, as in the following example, there is the possibility of multiple IRR solutions.

Note: there are other pitfalls when completing an IRR; however, they are not all covered in this text. Some of these pitfalls include type of project consideration (i.e. financing versus investment) and using IRR to compare multiple projects with different initial capital and varying time lines.
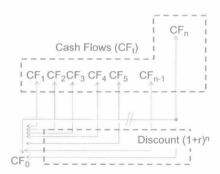

Figure 1.4 Cash Flow Diagram

$$NPV = CF_0 + \sum_{t=1}^{n} \frac{CF_t}{\left(1+r\right)^t}$$

Figure 1.5 Net Present Value Equation

Net Present Value (NPV)/Internal Rate of Return (IRR) in detail

Net Present Value (NPV) is the Present Value (PV) of all future cash flows, discounted at the appropriate market rate or the rate of alternative investments, minus the initial cash outlay. The Net Present Value rule is that an investment is worth considering when the NPV is a positive. It is calculated using the formula in Figure 1.6:

$$NPV = C_o + \sum_{i=1}^{N} \frac{C_t}{(1+rate)^i}$$

Figure 1.6 Net Present Value Equation (Rearranged)

where
$C_o = -$ Initial Cash Outflow
$i =$ period or timing of cash flow
rate = discount rate used to evaluate the cash flows

Without exception, NPV can be used to determine value of projects to the equity holders. Accepting projects with a positive NPV always benefits the equity holders, assuming an appropriate discount rate has been applied.

Internal Rate of Return is the rate calculated by setting the NPV equation to zero for a series of cash flows. It is the premier method for evaluating capital expenditures. It provides an intrinsic value of a project, expressing the realized rate of return for future cash flows. However, unlike NPV, IRR has pitfalls and does not always determine which cash flows offer positive value to equity holders unless it is completely understood.

The following is a list of some, but not all, of the pitfalls to using IRR for cash flow evaluation.

- Multiple IRRs
- Investment versus financing
- Scaling (specific to mutually exclusive projects).

The first, multiple IRRs, is important since the NPV formula is a polynomial when solving for the rate. Therefore, for specific cash flows, those flipping from negative to positive or positive to negative more than once, multiple IRRs may be found. The following example illustrates a series of cash flows, with six flips in sign, in which two IRRs exist. Neither is correct and neither is incorrect. It is impossible to evaluate these cash flows using the IRR method. See Figure 1.7.

When graphing the NPV versus rate, two IRRs are located at each point of an X-intercept (3% and 58%). Both are correct and neither offers a true representation of the worth of the cash flows to equity holders. See Figure 1.8.

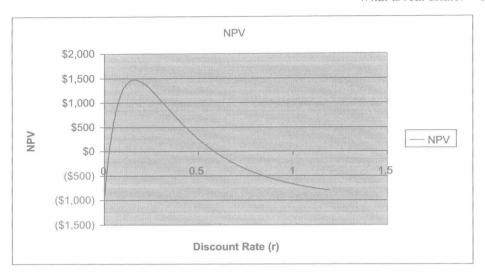| Date	1/1/90	1/1/91	1/1/92	1/1/93	1/1/94	1/1/95	1/1/96	1/1/97	1/1/98	1/1/99
Cash Flow	−4,500	4,000	3,000	4,000	−3,000	4,000	−1,000	3,000	−4,000	−6,500

Figure 1.7 Cash Flow Example

Figure 1.8 Two IRR Examples

The Net Present Value, discounted at 10%, yields a positive value of $1,408. Since the NPV is positive, the cash flows yield value to the equity holders. This would not be the conclusion if the IRR approach were used since it could yield a value of 3%, which is below the discount rate of 10%. Therefore, an NPV analysis yields the correct conclusion.

The second problem with IRR analysis is the altering valuation criteria for investment versus financing projects. Consider the following two projects, A and B, and their respective cash flows:

Project	A	B
Initial Cash	–$100	$100
Cash @ T = 1	$130	–$130

The Internal Rate of Return for each project is 30%; however, the NPVs for projects A and B are positive ($18.20) and negative (–$18.20), respectively, at a 10% discount rate. The IRR analysis would seem to state that both projects are of equal value but the NPV analysis clearly demonstrates that only project A adds value to the equity holders.

The difference is that project A is an investment project whereas project B is a financing project. An example of a financing project is a seminar where the money is received months in advance of the outlays, which occur at the time of the seminar. The rule for acceptance under the IRR criteria is to accept if the IRR is greater than the discount rate for investment-type projects and accept if the IRR is less than the discount rate for financing-type projects. See the graphs in Figures 1.9 and 1.10. This rule change for type of project is confusing and nonexistent in the NPV analysis.

A third pitfall for IRR analysis concerns mutually exclusive projects. Scaling is a critical issue when two opportunities are available but only one can be executed. An example is the
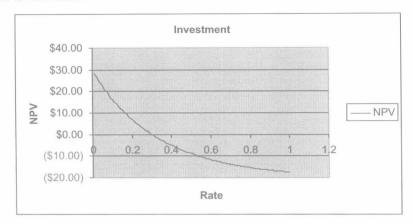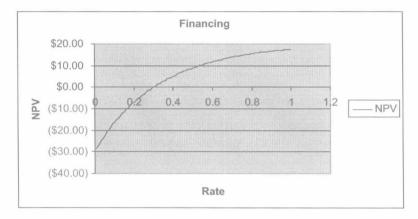
Figure 1.9 Investment-Type Project

Figure 1.10 Financing-Type Project

ability to earn $50 on one investment and $100 on another. Consider the following two projects, A and B, and their respective cash flows:

Project	A	B
Initial Cash	−$50	−$1000
Cash @ T = 1	$100	$1100

For this example, assume the period for the investment to be short, virtually instantaneous, so that timing effects can be ignored. The NPV for project A is $50 and for project B is $100. The IRR for project A is 100% and for project B is 10%. Using IRR analysis project A should be pursued since it yields the highest return to equity holders; however, NPV analysis shows that project B yields the highest value to equity holders. The IRR analysis is flawed because it neglects to account for the scaling issue that $100 is worth more to the equity holders than $50. This can be adjusted using an incremental IRR analysis but that is beyond the scope of this book.

The three pitfalls mentioned here demonstrate the limitations of using the IRR analysis to evaluate cash flows to equity holders. IRR is beneficial in stating the intrinsic value of future cash flows but it must be completely understood. NPV analysis always yields correct

conclusions but does not state the intrinsic value. Both methods should be used together to ensure accurate valuation of cash flows.

Modified Internal Rate of Return (MIRR)

Modified Internal Rate of Return (MIRR) adjusts for the pitfall of traditional IRR analysis which assumes all cash flows are reinvested at the calculated IRR rate. Therefore, traditional IRR analysis may misstate the implicit return for a project by failing to quantify the effect that earned cash flows during the project are not reinvested at a project's IRR but rather at a corporate reinvestment rate (estimated at the corporate weighted average cost of capital, or WACC).

Modified IRR corrects this misstatement by converting a project's cash flows to a zero coupon security. The project's future cash flows are compounded to the final period at the reinvestment (WACC) rate. Using the initial cash outflow, the yield on the zero coupon security is then calculated (MIRR). The equation for MIRR is in Figure 1.11.

$$MIRR = \left[\frac{\sum_{s=1}^{n}(CF_S)(1+r)^{n-s}}{CF_0}\right]^{1/n} - 1$$

where

CF_S = Cash Flows in period S

CF_0 = Initial Cash Flow (Cost)

n = Number of periods

r = Reinvestment rate

S = Current period

Figure 1.11 Modified Internal Rate of Return

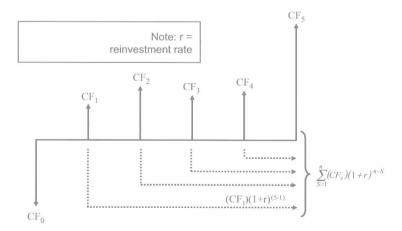An example of the Modified Internal Rate of Return for a series of cash flows follows in Figure 1.12:

Figure 1.12 Future Valuing Cash Flows for MIRR

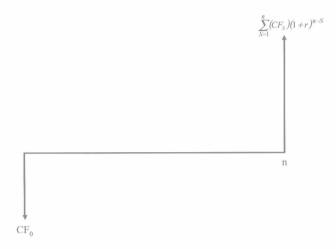The compounding of the cash flows creates a zero coupon security maturing at time period *n* (Figure 1.13).

$$\sum_{S=1}^{n}(CF_S)(1+r)^{n-S}$$

n

CF_0

Figure 1.13 MIRR Zero Coupon Bond

Note the Price (CF_0) for the zero coupon security is as follows in Figure 1.14:

$$P = \frac{M}{(1+yield)^n}$$

where

$$M = \sum_{S=1}^{n}(CF_S)(1+r)^{n-S}$$

$yield = \text{MIRR}$

$n = \text{Periods}$

Figure 1.14 Price for MIRR

Solving for MIRR yields the equation in Figure 1.15:

$$MIRR = \left[\frac{M}{P}\right]^{1/n} - 1$$

Figure 1.15 MIRR Equation

Risk

'Risk' is understood largely by everyone but the true definition seems to be elusive. Before a discussion of risk commences, risk must be bifurcated into project risk (i.e. single entity) and portfolio risk (i.e. multiple assets held together). Single entity risk, which will be discussed here, quantifies deviation of an expected return for a single project; for example

project A had an expected return of 18% with a standard deviation of 5%. Single entity risk assumes a project is held in a vacuum and does not consider additional assets held together. Project risk assumes assets are held together and viewed in their entirety. Portfolio risk therefore not only considers individual project return and risk but also the correlation (i.e. linear association of projects), as well as the respective weights of each asset held in the portfolio. For discussion purposes, project risk will be discussed early in this book whereas portfolio risk will be discussed in later chapters. Therefore, the discussion that follows is for single entities only.

The actual definition of risk is simple: the deviation or variation from an expected outcome. Basically risk is the range of outcomes from the expected value. If one assumes the distribution type is normal, risk, in its most basic form, is the deviation (standard deviation) of a normal curve (Figure 1.16).

Figure 1.16 Normal Distribution Graphic

It is essential to understand that while this drawing of risk is a representation, it does *not* depict *all* representations of risk. Fundamentally, risk is simply deviation from an expected return. This deviation is often represented by a normal distribution, as humanistic and nature data are best represented as normal distributions. However, risk can be modelled using a myriad of distribution types to include hypergeometric, uniform, triangular, Poisson, etc. The family of distributions includes those both continuous and discrete. The actual characteristics of each should be understood; if they are not, please reference a basic statistics text. For the purpose of this text about asset reposition, the normal distribution, which is a continuous distribution, will be used as a proxy for risk deviation and quantification. Note: there are two general types of distributions, continuous and discrete. Continuous distributions have no probability associated with a singular point but only within a range of points, such as between two points.

There are three main methods to quantify a project's risk: (1) variance, (2) standard deviation, and (3) range. Understanding that the three are all related is essential. Further, each can be used as an approximation for another quantitative measure through the use and understanding of the relationship in Figure 1.17:

$$\sigma = \sqrt{\sigma^2} \approx \frac{Range}{6}$$

Figure 1.17 Risk Relationships

The approximation assumes the distribution is best described by a normal distribution and assumes no outliers in the distribution (Figure 1.18); that is, the empirical rule states $+/- 3\sigma$ represents approximately 99.7% of the data. Outliers are defined as data values falling outside this range.