

ult scenarios where defaults can exceed the beginning  
ual the beginning balance.

```
o) = min (gp l DefaultRange (k, (i + gp lSeason Array (k,  
* gp lOrgBalArray (k, 0) , ActualBegBal (i, 0)  
= ActualNewDef (i, 0) + AggNewDef (i, 0)
```

```
Loop through each loan  
For k = 1 To TotalLoans1
```

```
Clear the notional amort arrays
```

```
For q = 0 To TotalPeriods  
NotionalBegBal (q, 0) = 0  
NotionalPMT (q, 0) = 0  
NotionalInt (q, 0)  
NotionalPrin (q, 0) = 0  
NotionalEndBal (q, 0)  
NotionalAmortFact (q, 0) = 0  
CurRateArray (q, 0) = 0  
Next q
```

# REVERSE ENGINEERING DEALS on Wall Street with Microsoft Excel **+CD** *A Step-by-Step Guide*

CD-ROM includes modeling exercises and a final version of the model discussed in the text



**Keith A. Allman**

```
Balances!$F 15,liab12_FxdRate*mezz_DayCountSys,0)*Balance!  
mezz_DayCountSys, mezz_DayCountSys,))*Balance!B014, liab12_FxdRate*OF  
($B10,0,MATCH(liab12_DayCtSys, mezz_DayCountSys,0))*Balance
```



# **Reverse Engineering Deals on Wall Street with Microsoft Excel**

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# **Reverse Engineering Deals on Wall Street with Microsoft Excel**

*A Step-by-Step Guide*

KEITH A. ALLMAN



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# Contents

<b>Preface</b>	<b>ix</b>
<b>Acknowledgments</b>	<b>xiii</b>
<b>About the Author</b>	<b>xv</b>
<b>CHAPTER 1</b>	
<b>Introduction</b>	<b>1</b>
The Transaction	2
The Documents	2
The Process	6
How This Book Works	12
<b>CHAPTER 2</b>	
<b>Determining Dates and Setting Up Timing</b>	<b>15</b>
Differences in Timing Approaches	15
A First Look at the Prospectus	16
Important Dates	17
Transforming Dates and Timing from Words to a Model	21
Model Builder 2.1: Reversing Dates and Timing	21
Conclusion of Dates and Timing	27
<b>CHAPTER 3</b>	
<b>Creating Asset Cash Flow from Prospectus Data</b>	<b>29</b>
It's All in the Prospectus Supplement	29
The Basics of Amortization	32
Performance and the Prospectus Supplement	33
Delinquency	34
Loss	35
Prepayment	36
Recovery	38
Creating Cash Flow	38

---

A Complex Implementation	39
Model Builder 3.1: Entering in the Raw Asset Information	40
Model Builder 3.2: Entering in the Default and Prepayment Assumptions	43
Model Builder 3.3: Interest Rates and Additional Asset Amortization Inputs	47
Model Builder 3.4: Introducing VBA and Moving Data In and Out of the Model	50
Model Builder 3.5: Loading Loan Performance Assumptions into VBA	57
Model Builder 3.6: Global Functions	60
Model Builder 3.7: Loan-Level Asset Amortization	61
<b>CHAPTER 4</b>	
<b>Setting Up Liability Assumptions, Paying Fees, and Distributing Interest</b>	<b>81</b>
Identifying the Offered Securities	81
Model Builder 4.1: Transferring the Liability Information to a Consolidated Sheet	84
The Liability Waterfall: A System of Priority	87
Model Builder 4.2: Starting the Waterfall with Fees	89
Interest: No Financing Is Free	91
Model Builder 4.3: Continuing the Waterfall with Interest Paid to the Certificate Holders	93
More on Waterfalls and Wall Street's Risk Parsing	106
Model Builder 4.4: Mezzanine Interest	106
Continuing the Waterfall: It Only Gets More Complicated	114
<b>CHAPTER 5</b>	
<b>Principal Repayment and the Shifting Nature of a Wall Street Deal</b>	<b>115</b>
Model Builder 5.1: The Deal State and Senior Principal	116
Mezzanine Principal Returns	142
Model Builder 5.2: The Mezzanine Certificates' Priority of Payments	142
Number Games or Risk Parsing?	147
<b>CHAPTER 6</b>	
<b>Credit Enhancement Mechanisms to Mitigate Loss</b>	<b>149</b>
Model Builder 6.1: Excess Spread, Overcollateralization, and Credit Enhancement	151
<b>CHAPTER 7</b>	
<b>Auditing the Model</b>	<b>173</b>
Model Builder 7.1	174



<b>CHAPTER 8</b>	
<b>Conclusion of Example Transaction and Final Thoughts on Reverse Engineering</b>	<b>187</b>
Mortgage Insurance and Servicer Advances	187
Reverse Engineering in the Current and Future Market	188
<b>Appendix</b>	<b>189</b>
Automatic Range Naming	189
<b>About the CD-ROM</b>	<b>193</b>
<b>Index</b>	<b>197</b>



# Preface

**Y**ears after starting my career in financial modeling at a bond insurer, I decided it was time to move on to Citigroup's conduit to advance my knowledge of the securitization industry. I was no longer a newbie analyst with the lurking fear of not knowing enough about modeling or structured finance to justify my employment. Instead, I joined as a semiseasoned associate, questioning if the skills and knowledge I had thus far accumulated justified the lateral hiring. Luckily I was presented with a task my first week of work at Citigroup that would provide the answer to such a question, and given my place on the corporate food chain at the time, I would have to accept that answer whether I liked it or not.

The task at hand was to validate the conduit's mortgage model to ensure that all calculation processes were correct and that the model essentially returned accurate durations, yields, and, ultimately, rating assessments of a transaction. "No problem," I thought. "Enter data, push a few buttons, determine some durations and yields, and I complete my first task." Like any great underestimation in life those were the thoughts of grandeur prior to the fall. I quickly learned that the process was going to be much more intense.

To validate the model I had to have one of the top four auditing firms provide a letter stating that the conduit's model returned the same results as the auditing firm's model. To obtain such a letter I had to select a deal with the auditor that was publicly rated and would cover many mortgage modeling concepts. The auditor and I would have to model the deals on our systems and tie durations and yields to the fifth decimal place. Still, it was my first week and I thought, "Well, that's a bit more complicated than I thought, but they have a mortgage model, so how difficult could it be?"

Let's just say, it was difficult. Opening the existing mortgage model, I found that it was a standard amortization engine. For those new to structured finance, this means that only the asset amortization was mostly done. There was essentially no liability structure in place and the deal we selected had nine tranches of debt, ratio-stripped classes, prepayment lockouts, and a host of other complexities. At this realization I took a breath, peered above my cube to see if somehow my boss had sensed the fear emanating from outside his office, and sat down again to refocus. How would I accomplish this task in a relatively short period of time? I stared at the 273-page document on my desk that would be my savior: the deal prospectus.

I got to know the deal prospectus for that transaction very well. I took it with me everywhere. I read it at home, on the subway, in my cube, on planes, and any other imaginable place. I realized that the prospectus was a very large map to proving my

competence. I navigated through dates, timing issues, special amortization assumptions, complex liabilities, and advanced structuring concepts. Each page represented a section in my model. After a few weeks, I transformed legal jargon into functions, formulas, and code. The end result was, in my mind, a beautiful, harmonic merger of words and numbers. I use the words “in my mind” because as readers of finance material, you probably know the looks you get when trying to convey any excitement about this topic. Regardless of my enthusiasm level, I did tie to the fifth decimal place with the auditor’s output sheets and successfully completed my first task.

I often compare that model audit experience to when I first started in the finance industry and had to build a more basic model from scratch. I was overwhelmed by the task and worked incredibly hard to get a simple senior subordinated structure to work correctly. Similarly, reverse engineering the prospectus to be able to tie to the auditor’s model took hours of reading and rereading lawyers’ prose. Testing amortization scenarios and checking the resulting yields and durations consumed entire days. I had to constantly flip between reading sections of the prospectus to understand the details, working on my model to implement them, and then jumping back to the prospectus and the auditor’s printouts to check if I was correct.

Luckily, I already had a background in understanding deal documentation from my prior work in the financial guarantee business. As a third party to transactions providing financial guarantees, the company I worked for rarely wrote the bulk of the documents. Instead, we had to adapt a large amount of other bankers’ and lawyers’ writing into our analyses. Reading literally hundreds of term sheets and indentures made me relatively fluent in legal terminology and conventions.

Even with my prior experience, the task of reverse engineering a deal was not simple. It required many hours spent coming to a solution that could have easily been explained to me by a more senior professional. Unfortunately, given division budgets, such a senior professional on hand to answer modeling questions is a fantasy. Obtaining that knowledge in a text is much more of a reality, which was the logic for writing my first book on building a basic structured finance model from a blank spreadsheet.

However, reverse engineering a complete Wall Street transaction is much more complicated than just building a basic model. These complications have been highlighted by the subprime crisis that started in mid-2007. Some investors, risk managers, and many financial professionals responsible for structuring, purchasing, and trading Wall Street products only took rudimentary approaches to analyzing these complex securities, often relying on credit ratings alone. Whereas the collateral posed a major problem, with underwriters offering risky products to poor credit quality borrowers, the structures of these transactions became so complicated that, as the markets deteriorated, people with exposure became unsure of how the transactions would perform. Ultimately, investors were not clear if the deteriorated assets would produce enough cash to pay their tranches of debt. Complicated triggers and alterations in cash priority further exacerbated the problem. With sometimes hundreds of securities having similar collateral and virtually meaningless ratings, investors did not know how to price their securities, and chaos reigned in the market.

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A properly trained staff of reverse engineers can solve this problem for any company. Most of the information required to model individual deals is available from multiple public sources. Understanding how to translate that information into an intelligible form is a challenge that this book addresses. I firmly believe that whether you are an investor, banker, auditor, or a student learning the business, thoroughly understanding the documentation and how it is translated into a computer-based model ultimately provides a complete understanding of deal mechanics and gives you the power to make confident, well-informed decisions.

KEITH A. ALLMAN

*New York, New York*  
*October 2008*



# Acknowledgments

The idea for this book started right after a training session I facilitated through my financial training company Enstruct. It was a three-day course on financial modeling for a large bank that wanted to focus on understanding the calculations behind the complex terminology in deal documentation. I cannot divulge the bank's name, but I thank them for helping stimulate the idea. From that point on, a number of people have helped me along the way. Primarily, Ralph Armenta provided a great recommendation in using the example deal that is reversed in this book and assisted with materials collection. Another excellent resource was Permjit Singh, who reviewed material that I sent and offered corrections and detail verification. Permjit is extremely detail oriented and incredible at finding even the smallest discrepancy. Finally, I would like to thank all of the staff at John Wiley & Sons who work on my books: Emilie Herman, Laura Walsh, Mary Daniello, and Bill Falloon.

K. A. A.





## About the Author

**K**eith Allman is the founder and principal trainer of Enstruct, a financial training company that specializes in quantitative finance and modeling instruction. He began Enstruct as a structured finance-focused training company, but has expanded the core curriculum to cover other topics such as corporate modeling, valuation, programming for finance, and using applications outside of Excel for more robust financial analysis. Mr. Allman also leads the consultancy work that Enstruct has been engaged in, which has largely been structured finance-related, such as mortgage and auto securitizations. His particular area of expertise is international in scope, with training and transaction work in most of Latin America, the Caribbean, the Middle East, South East Asia, Australia, Russia, and parts of Southern and Western Africa.

Prior to his current position, he was a Vice President in the Global Special Situations Group at Citigroup, where he focused on principal finance in emerging markets. Previously, he worked in Citigroup's Global Securitized Markets division modeling conduit transactions and in MBIA Corporation's Quantitative Analytics group. Mr. Allman is also the author of *Modeling Structured Finance Cash Flows with Excel: A Step-by-Step Guide* (Wiley & Sons 2007). His education includes a master's degree in international affairs with a concentration in finance and banking from Columbia University and dual bachelor degrees from UCLA.



# **Reverse Engineering Deals on Wall Street with Microsoft Excel**



# Introduction

In my first book, *Modeling Structured Finance Cash Flows with Microsoft Excel: A Step-by-Step Guide*, I took readers through building a basic structured finance model from a blank worksheet. The text is a practical guide to transforming the concepts of a structured finance deal into an Excel-based model. However, in the finance industry, few people rely on a concept to close a deal. Instead, they rely on strict legal documentation that dictates the precise mechanics of the transaction. The difference between a deal based on general concepts and one based on well-defined rules can be substantial. This is why documentation exists for every concept in a deal. Attorneys spend hours writing terms sheets and indentures, banking associates review every word and integrate documents into a deal prospectus, and finally junior analysts lose sleep formatting and making charts to enhance the final prospectus.

Unfortunately, even with all this effort, reading through deal documentation can be arduous and difficult to interpret. However, well-written documentation provides a wealth of valuable information for those who want to know exactly how the deal works. Parties to the deal want to make sure every part of the transaction is well defined and published for understanding. Investors are the primary third-party readers who need to understand all the risks and rewards prior to investing in the deal. Savvy financial institutions read their competition's prospectuses to keep track of developments in structures. Auditors can use a public prospectus as a basis for evaluating a client's model. In general, anyone interested in understanding industries, asset classes, or even specific deals can gain valuable insights from deal documentation.

Reading through documentation allows for a strong understanding of the details, but the real value of documentation is that a reader can actually use the documents to reverse engineer a computer-based model of the transaction. Public prospectuses alone provide all or nearly all the information necessary to build a model that is representative of the deal. The resulting model will allow investors to see precise investment returns and the scenarios where their yields or durations are stressed. Financial institutions can model transactions to see the quantitative results of certain structures under differing stresses. They can also select a prospectus, use an internal model to reverse engineer the prospectus, hire an auditor to reverse engineer the same deal, and check both models' outputs to calibrate and audit the financial institution's model.

## THE TRANSACTION

---

Many types of Wall Street deals can be reverse engineered. No doubt my background in structured finance influenced my decision to choose a mortgage-backed security as the example that will run through this book. However, structured finance transactions are ideal examples for reverse engineers to learn from because they are heavily documented. The deal chosen for this book is the Citigroup Mortgage Loan Trust 2006-WF2, serviced by Wells Fargo.

You do not need to be a structured finance professional to gain knowledge from this book. The focus will be on how legal documentation transforms into modeling. For those unfamiliar with structured finance transactions, specifically mortgage-backed securities, entire books are available that can help explain the concepts. For those who have an understanding of structured finance transactions, this book will reveal the inner workings of all the complex challenges presented in understanding and modeling a modern mortgage-backed security. For the benefit of the unfamiliar reader, and as a basic review for the seasoned professional, I will briefly explain the basics of this type of transaction.

Citigroup Mortgage Loan Trust 2006-WF2 is a mortgage-backed security issuance with seven senior tranches and five mezzanine tranches of debt. In general, a mortgage-backed transaction is composed of these *tranches* or “slices” of debt, which have each been funded by investors. The investors receive principal and interest that are primarily generated from assets. In this case, the assets are thousands of mortgages that have been pooled together. The interest and principal that mortgage obligors are paying are aggregated and passed through to the transaction. Depending on the tranche invested in, investors will receive certain allocations of this interest and principal. The basic transaction structure is shown in Figure 1.1.

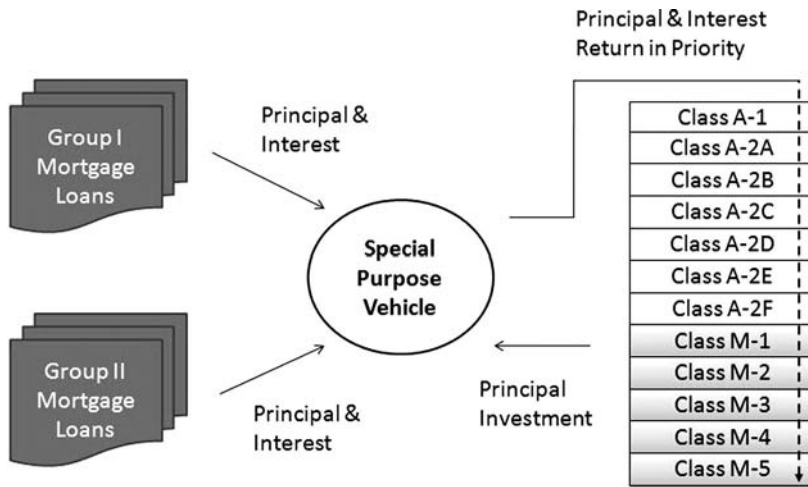
## THE DOCUMENTS

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So where do you begin? First we should clarify what each document is, what it does, and what information we can procure from it. For this review, we turn to the Securities Act of 1933, the origin of securities registration. This act requires issuers to provide information about their transaction in the form of a registration statement. The exact information required by the Securities Act is detailed in Schedules A and B of the act. Other key documents that will be reviewed are shown in Figure 1.2.

### Prospectus

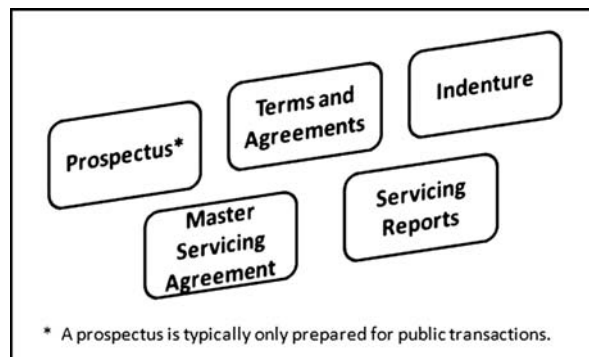
The Securities Act requires a prospectus that discloses important facts regarding the company and the proposed transaction. The prospectus must provide full



**FIGURE 1.1** The flow of a standard structured finance transaction.

disclosure of all relevant facts about the securities being issued. The most important information includes:

- Information about the parties to the transaction such as the issuer, underwriter, and any entity owning greater than a 10% share.
- The amount of the issuer's securities owned by the parties to the transaction.
- The amount of debt created by the offered security, along with descriptions of the debt in terms of date, maturity, character, rate of interest, amortization style, and any terms of substitution.
- A balance sheet of the issuer.
- A profit-and-loss statement of the issuer.



**FIGURE 1.2** The core documents of a transaction.