THE FRANK J. FABOZZI SERIES

the global money markets

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frank j. fabozzi, steven v. mann & moorad choudhry

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The Global money markets

FRANK J. FABOZZI
STEVEN V. MANN
MOORAD CHOUDHRY

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FJF
To my wife, Donna,
and my children, Karly, Patricia, and Francesco

SVM
To my wife Mary and our daughters Meredith and Morgan.

MC
To Olga—like the wild cat of Scotland,
both elusive and exclusive…

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CHAPTER 1

Introduction

The money market is traditionally defined as the market for financial assets that have original maturities of one year or less. In essence, it is the market for short-term debt instruments. Financial assets traded in this market include such instruments as U.S. Treasury bills, commercial paper, some medium-term notes, bankers acceptances, federal agency discount paper, most certificates of deposit, repurchase agreements, floating-rate agreements, and federal funds. The scope of the money market has expanded in recent years to include securitized products such mortgage-backed and asset-backed securities with short average lives. These securities, along with the derivative contracts associated with them, are the subject of this book.

The workings of the money market are largely invisible to the average retail investor. The reason is that the money market is the province of relatively large financial institutions and corporations. Namely, large borrowers (e.g., U.S. Treasury, agencies, money center banks, etc.) seeking short-term funding as well as large institutional investors with excess cash willing to supply funds short-term. Typically, the only contact retail investors have with the money market is through *money market mutual funds*, known as *unit trusts* in the United Kingdom and Europe.

Money market mutual funds are mutual funds that invest only in money market instruments. There are three types of money market funds: (1) general money market funds, which invest in wide variety of short-term debt products; (2) U.S. government short-term funds, which invest only in U.S. Treasury bills or U.S. government agencies; and (3) short-term municipal funds. Money market mutual funds are a popular investment vehicle for retail investors seeking a safe place to park excess cash. In Europe, unit trusts are well-established investment vehicles for retail savers; a number of these invest in short-term assets and thus are termed money market unit

trusts. Placing funds in a unit trust is an effective means by which smaller investors can leverage off the market power of larger investors. In the UK money market, unit trusts typically invest in deposits, with a relatively small share of funds placed in money market paper such as government bills or certificates of deposit. Investors can invest in money market funds using one-off sums or save through a regular savings plan.

THE MONEY MARKET

The money market is a market in which the cash requirements of market participants who are *long* cash are met along with the requirements of those that are *short* cash. This is identical to any financial market; the distinguishing factor of the money market is that it provides for only short-term cash requirements. The market will always, without fail, be required because the needs of long cash and short cash market participants are never completely synchronized. The participants in the market are many and varied, and large numbers of them are both borrowers and lenders at the same time. They include:

- the sovereign authority, including the central government ("Treasury"), as well as government agencies and the central bank or *reserve bank*;
- financial institutions such as the large integrated investment banks, commercial banks, mortgage institutions, insurance companies, and finance companies;
- corporations of all types;
- individual private investors, such as high net-worth individuals and small savers;
- intermediaries such as money brokers, banking institutions, etc.;
- infrastructure of the marketplace, such as derivatives exchanges.

A money market exists in virtually every country in the world, and all such markets exhibit the characteristics we describe in this book to some extent. For instance, they provide a means by which the conflicting needs of borrowers and lenders can achieve equilibrium, they act as a conduit for financing of all maturities between one day and one year, and they can be accessed by individuals, corporations, and governments alike.

In addition to national domestic markets, there is the international cross-border market illustrated by the trade in *Eurocurrencies*.[1] Of

[1] A Eurocurrency is a currency that is traded outside of its national border, and can be any currency rather than just a European one.

course, there are distinctions between individual country markets, and financial market culture will differ. For instance, the prevailing financial culture in the United States and United Kingdom is based on a secondary market in tradable financial assets, so we have a developed and liquid bond and equity market in these economies. While such an arrangement also exists in virtually all other countries, the culture in certain economies such as Japan and (to a lesser extent) Germany is based more on banking relationships, with banks providing a large proportion of corporate finance. The differences across countries are not touched upon in this book; rather, it is the similarities in the type of instruments used that is highlighted.

In developed economies, the money market is large and liquid. Exhibit 1.1 illustrates the market growth in the United States during the 1990s. Exhibit 1.2 illustrates the breakdown of the United Kingdom money market by different types of instrument, each of which we cover in detail in this book.

OVERVIEW OF THE BOOK

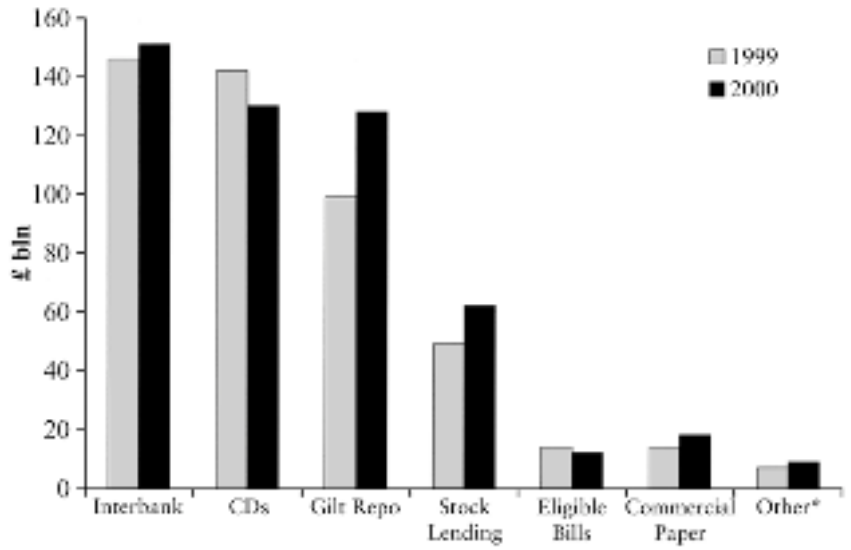
In Chapter 2 we cover money market calculations. The intent of this chapter is to introduce some of the fundamental money market calculations and conventions that will be used throughout this book, including day count conventions, as well as the basic formulae for price and yield. It is essential to understand these calculations since some market instruments are interest bearing while others are discount instruments. Moreover, some instruments calculate interest based on a 360-day year and some money market securities use a 365-day year.

EXHIBIT 1.1 US Money Market Volumes, $ Billion at Year-End

Instrument	1990	1995	1999
Treasury bills	527	748	723
Federal agency securities	435	845	1,284
Commercial paper	561	675	1,213
Bankers' acceptances	55	29	21
Fed funds borrowers and repo	409	569	762
Eurodollar borrowings	37	94	167
CDs (min size $100,000)	432	345	634

Source: Federal Reserve Bulletin, 2000, 2001

EXHIBIT 1.2 **Composition of Sterling Money Markets, £ Billion Volume Outstanding**



* Includes Treasury bills, sell/buy-backs and local authority bills
Source: Bank of England *Quarterly Bulletin*, Autumn 2001

Chapters 3 and 4 cover short-term debt instruments issued by some of the largest borrowers in the world—the U.S. Treasury and U.S. federal agencies. U.S. Treasury bills are considered among the safest and most liquid securities in the money market. Treasury bill yields serve as benchmark short-term interest rates for markets around the world. Agency securities are *not* typically backed by the full faith and credit of the U.S. government, as is the case with Treasury bills. However, short-term agency securities are considered safer than other money market instruments except U.S. Treasury bills.

Another large borrower of short-term funds is a corporation using instruments such as commercial paper or short-term medium term notes. These instruments are the subject of Chapter 5. Commercial paper is a short-term unsecured promissory note that is issued in the open market and represents the obligation of the issuing corporation. An important innovation in this market is asset-backed commercial paper. Asset-backed commercial paper is commercial paper issued by either corporations or large financial institutions through a bankruptcy-remote special purpose corporation and is usually issued to finance the purchase of receivables and other similar assets. In contrast, a medium-

term note is a corporate debt instrument with the unique characteristic that notes are offered continuously to investors by an agent of the issuer. The maturities of medium-term notes range from 9 months to 30 years or longer. Our focus will be on medium-term notes with original maturities of one year or less.

The largest group of players in the global money markets are financial institutions that include depository institutions, investment banks, and insurance companies. These institutions are simultaneously the biggest investors in and issuers of money market instruments. There are specialized instruments that are unique to this group of borrowers which include certificates of deposits, bankers acceptances, federal funds, and funding agreements. Chapter 6 details these instruments.

Chapter 7 describes short-term floating-rate securities. The term "floating-rate security" covers several different types of instruments with one common feature: the security's coupon rate will vary over the life of the instrument. Approximately, 10% of publicly traded debt issued worldwide possesses a floating coupon. Floating-rate securities are the investment of choice for financial institutions whose funding costs are based on a short-term floating rate.

One of the largest segments of the global money markets is the market for repurchase agreements. The repurchase agreement on one hand is an efficient mechanism used by security dealers to finance bond positions, and on the other a relatively safe investment opportunity for investors such as money market funds and corporations. In Chapter 8, we review repurchase agreements as well as their major uses.

Chapters 9 and 10 cover short-term mortgage-backed and asset-backed securities. Mortgage-backed securities are securities backed by a pool of mortgage loans. The pool of loans is referred to as the collateral. While residential mortgages are by far the largest type of asset that has been securitized, other assets such as consumer loans, business loans and receivables have also been securitized. Securities backed by collateral other the mortgage loans are called asset-backed securities. The largest sectors of the asset-backed securities market in the United States are securities backed by credit card receivables, auto loans, home equity loans, manufactured housing loans, and student loans.

Derivatives are financial instruments that derive their value from some underlying price, index, or interest rate. Money market practitioners use derivatives to control their exposure to risk by taking positions to either diminish or enhance this exposure. In Chapters 11 and 12, we describe these derivative instruments and how they are employed to create advantageous risk and return patterns. Chapter 11 describes forward contracts, futures contracts, and forward rate agreements. Chapter focuses on swap contracts and caps/floors.

The activity of financial institutions in the money market involves an activity known as asset and liability management. Asset and liability management is the term covering tools and techniques used by financial institutions to manage various types of risk while achieving its profit objectives by holding the optimal combination of assets and liabilities. We introduce the fundamental principles of asset and liability management in Chapter 13. An appreciation of these concepts and tools is essential to an understanding of the functioning of the global money markets.

The final chapter of the book, Chapter 14, describes bank regulatory capital issues. As noted, the primary players in the global money markets are large financial institutions, in particular depository institutions. These entities are subject to risk-based capital requirement. The asset allocation decisions by managers of depository institutions are largely influenced by how much capital they are compelled to hold and the capital costs incurred. As a result, these money market participants must risk-based capital issues regardless of the products they trade or else they will not fully understand the cost of their own capital or the return on its use.

CHAPTER 2

Money Market Calculations

The intent of this chapter is to introduce some of the fundamental money market calculations that will be used throughout this book. We will cover such topics as day count conventions, as well as the basic formulas for price and yield.

DAY COUNT CONVENTIONS

To those unfamiliar with the workings of financial markets, it may come as a shock that there is no widespread agreement as to how many days there are in a year. The procedures used for calculating the number of days between two dates (e.g., the number of days between the settlement date and the maturity date) are called *day count conventions*. Day count conventions vary across different types of securities and across countries. In this section, we will introduce the day count conventions relevant to the money markets.

Day Count Basis

The *day count basis* specifies the convention used to determine the number of days in a month and in a year. According to the *Securities Industry Association Standard Securities Calculation Methods* book, Volume 2, the notation used to identify the day count basis is:[1]

(number of days in a month)/(number of days in a year)

[1] See, Jan Mayle, *Standard Securities Calculation Methods, Volume 2* (New York; Securities Industry Association, 1994).

Although there are numerous day count conventions used in the fixed-income markets around the world, there are three basic types.[2] All day count conventions used worldwide are variations of these three types. The first type specifies that each month has the actual number of calendar days in that month and each year has the actual number of calendar days in that year or in a coupon period (e.g., Actual/Actual). The second type specifies that each month has the actual number of calendar days in that month but restricts the number of days in each year to a certain number of days regardless of the actual number of days in that year (e.g., Actual/360). Finally, the third types restricts both the number of days in a month and in a year to a certain number of days regardless of the actual number of days in that month/year (e.g., 30/360). Below we will define and illustrate the three types of day count conventions.

Actual/Actual

Treasury notes, bonds and STRIPS use an Actual/Actual (in period) day count convention. When calculating the number of days between two dates, the Actual/Actual day count convention uses the actual number of calendar days as the name implies. Let's illustrate the Actual/Actual day count convention with a 3.625% coupon, 2-year U.S. Treasury note with a maturity date of August 31, 2003. The Bloomberg Security Display (DES) screen for this security is presented in Exhibit 2.1. In the "Security Information" box on the left-hand side of the screen, we see that the day count is specified as "ACT/ACT." From the "Issuance Info" box on the right-hand side of the screen, we see that interest starts accruing on August 31, 2001 (the issuance date) and the first coupon date is February 28, 2002. Suppose this bond is traded with a settlement date of September 11, 2001. How many days are there between August 31, 2001 and September 11, 2001 using the Actual/Actual day count convention?

To answer this question, we simply count the actual number of days between these two dates.[3] To do this, we utilize Bloomberg's DCX (Days Between Dates) function presented in Exhibit 2.2. The function tells us there are 11 actual days between August 31, 2001 and September 11, 2001.[4] In the same manner, we can also determine the actual number of calendar days in the full coupon period. A full 6-month coupon period can only have 181, 182, 183 or 184 calendar days. For example, the actual number of days between August 31, 2001 and February 28, 2002 is 184.

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[2] Bloomberg identifies 24 different day count conventions.

[3] This is easy to accomplish using software that can convert a Gregorian date (MM/DD/YY) into a Julian date (the number of days since some base date).

[4] Note that the settlement date (September 11) is not counted.

EXHIBIT 2.1 Bloomberg Security Description Screen for a 2-Year U.S. Treasury Note

Source: Bloomberg Financial Markets

EXHIBIT 2.2 Bloomberg DCX (Days Between Dates) Screen

Source: Bloomberg Financial Markets

EXHIBIT 2.3 **Bloomberg Security Description Screen of a 26-Week U.S. Treasury Bill**

Source: Bloomberg Financial Markets

Actual/360

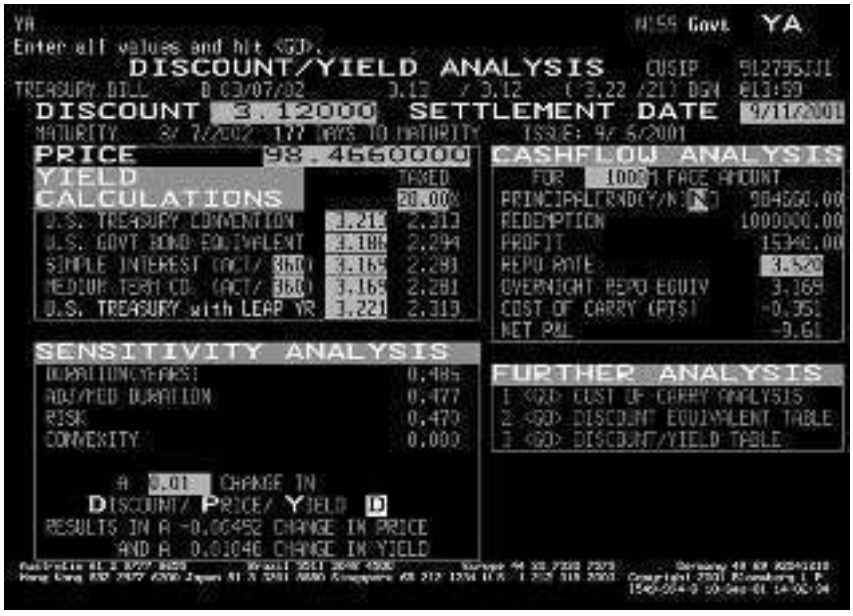
Actual/360 is the second type of day count convention. Specifically, Actual/360 specifies that each month has the same number of days as indicated by the calendar. However, each year is assumed to have 360 days regardless of the actual number of days in a year. Actual/360 is the day count convention used in U.S. money markets. Let's illustrate the Actual/360 day count with a 26-week U.S. Treasury bill which matures on March 7, 2002. The Bloomberg Security Display (DES) screen for this security is presented in Exhibit 2.3. From the "Security Information" box on the left-hand side of the screen, we see that the day count is specified as "ACT/360." Suppose this Treasury bill is purchased with a settlement date on September 11, 2001 at a price of 98.466. How many days does this bill have until maturity using the Actual/360 day count convention?

Once again, the question is easily answered using Bloomberg's DCX (Days Between Dates) function and specifying the two dates of interest. This screen is presented in Exhibit 2.4. We see that with a settlement date of September 11, 2001 there are 177 calendar days until maturity on March 7, 2002. This can be confirmed by examining the Bloomberg's YA (Yield Analysis) screen in Exhibit 2.5. We see that with a settlement date of September 11, 2001 this Treasury bill has 177 days to maturity. This information is located just above the "Price" box in the center of the screen.

EXHIBIT 2.4 Bloomberg DCX (Days Between Dates) Screen

Source: Bloomberg Financial Markets

EXHIBIT 2.5 Bloomberg Yield Analysis for a 26-Week U.S. Treasury Bill



Source: Bloomberg Financial Markets

When computing the number of days between two dates, Actual/360 and Actual/Actual will give the same answer. What then is the importance of the 360-day year in the Actual/360 day count? The difference is apparent when we want to compare, say, the yield on 26-week Treasury bill with a coupon Treasury which has six months remaining to maturity. U.S. Treasury bills, like many money market instruments, are discount instruments. As such, their yields are quoted on a bank discount basis which determine the bill's price (which we explain in detail in Chapter 3). The quoted yield on a bank discount basis for a Treasury bill is not directly comparable to the yield on a coupon Treasury using an Actual/Actual day count for two reasons. First, the Treasury bill's yield is based on a face-value investment rather than on the price. Second, the Treasury bill yield is annualized according to a 360-day year while a coupon Treasury's yield is annualized using the actual number of days in a calendar year (365 or 366). These factors make it difficult to compare Treasury bill yields with yields on Treasury notes and bonds. We demonstrate how these yields can be adjusted to make them comparable shortly.

Another variant of this second day count type is the Actual/365. Actual/365 specifies that each month has the same number of days as indicated by the calendar and each year is assumed to have 365 days regardless of the actual number of days in a year. Actual/365 does not consider the extra day in a leap year. This day count convention is used in the UK money markets.

30/360

The 30/360 day count is the most prominent example of the third type of day count convention which restricts both the number of days in a month and in a year to a certain number of days regardless of the actual number of days in that month/year. With the 30/360 day count all months are assumed to have 30 days and all years are assumed to have 360 days. The number of days between two dates using a 30/360 day will usually differ from the actual number of days between the two dates.

To determine the number of days between two dates, we will adopt the following notation:

$Y1$ = year of the earlier date
$M1$ = month of the earlier date
$D1$ = day of the earlier date
$Y2$ = year of the later date
$M2$ = month of the later date
$D2$ = day of the later date

Since the 30/360 day count assumes that all months have 30 days, some adjustments must be made for months having 31 days and Febru-

ary which has 28 days (29 days in a leap year). The following adjustments accomplish this task:[5]

1. If the bond follows the End-of-Month rule[6] and $D2$ is the last day of February (the 28th in a non-leap year and the 29th in a leap year) and $D1$ is the last day of February, change $D2$ to 30.
2. If the bond follows the End-of-Month rule and $D1$ is the last day of February, change $D1$ to 30.
3. If $D2$ is 31 and $D1$ is 30 or 31, change $D2$ to 30.
4. If $D1$ is 31, change $D1$ to 30.

Once these adjustments are made, the formula for calculating the number of days between two dates is as follows:

$$\text{Number of days} = [(Y2 - Y1) \times 360] + [(M2 - M1) \times 30] + (D2 - D1)$$

To illustrate the 30/360 day count convention, let's use a 4% coupon bond which matures on August 15, 2003, issued by Fannie Mae. The Bloomberg Security Description (DES) screen for this bond is presented in Exhibit 2.6. We see that in the "Security Information" box that the bond has a 30/360 day count. Suppose the bond is purchased with a settlement date of September 11, 2001. We see from the lower left-hand corner of the screen that the first coupon date is February 15, 2002 and the first interest accrual date is August 27, 2001. How many days have elapsed in the first coupon period from August 27, 2001 until the settlement date of September 11, 2001 using the 30/360 day count convention?

Referring back to the 30/360 day count rule, we see that adjustments 1 through 4 do not apply in this example so no adjustments to $D1$ and $D2$ are required. Accordingly, in this example,

$Y1 = 2001$
$M1 = 8$
$D1 = 27$
$Y2 = 2001$
$M2 = 9$
D2 = 11

Inserting these numbers into the formula, we find that the number of days between these two dates is 14, which is calculated as follows:

[5] See, Mayle, *Standard Securities Calculation Methods, Volume 2*.
[6] This is the standard convention for bonds in the U.S. and it states that if a bond's maturity date falls on the last day of the month so do the bond's coupon payments.

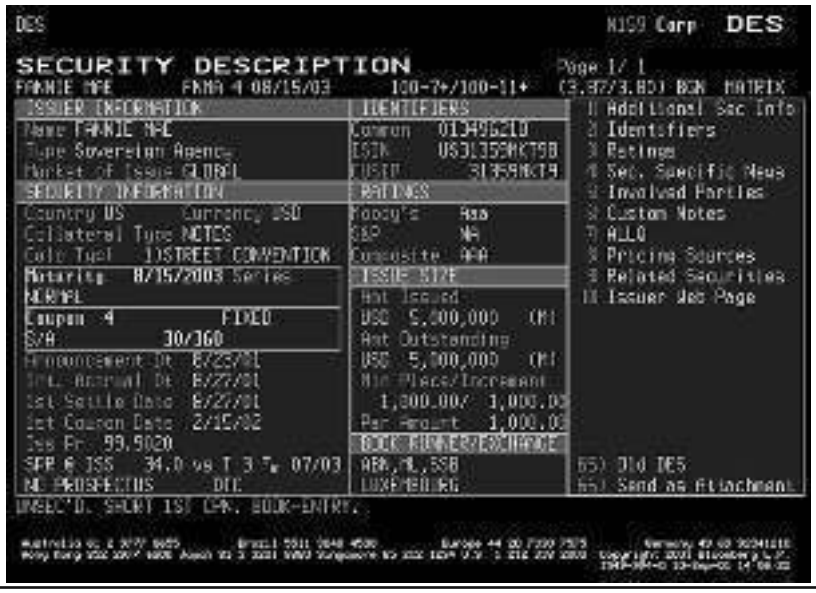
$$\text{Number of days} = [(2000 - 2000) \times 360] + [(9 - 8) \times 30] + (11 - 27)$$
$$= 0 + 30 + (-16) = 14$$

To check this, let's employ Bloomberg's DCX (Days Between Dates) function presented in Exhibit 2.7. The function tells us there are 14 days between August 27, 2001 and September 11, 2001 using a 30/360 day count. Note that the actual number of days between these two dates is 15.

DISCOUNT INSTRUMENTS

Many money market instruments are discount securities (e.g. U.S. Treasury bills, agency discount notes, and commercial paper). Unlike bonds that pay coupon interest, discount securities are like zero-coupon bonds in that they are sold at a discount from their face value and are redeemed for full face value at maturity. Further, most discount securities use an ACT/360 day count convention. In this section, we discuss how yields on discount securities are quoted, how discount securities are priced, and how the yields on discount securities can be adjusted so that they can be compared to the yields on interest-bearing securities.

EXHIBIT 2.6 **Bloomberg Security Description Screen for a Fannie Mae 2-Year Benchmark Note**



Source: Bloomberg Financial Markets

EXHIBIT 2.7 Bloomberg DCX (Days Between Dates) Screen

Source: Bloomberg Financial Markets

Yield on a Bank Discount Basis

The convention for quoting bids and offers is different for discount securities from that of coupon-paying bonds. Prices of discount securities are quoted in a special way. Bids and offers of these securities are quoted on a *bank discount basis*, not on a price basis. The *yield on a bank discount basis* is computed as follows:

$$Y_d = \frac{D}{F} \times \frac{360}{t}$$

where

Y_d = annualized yield on a bank discount basis (expressed as a decimal)
D = dollar discount, which is equal to the difference between the face value and the price
F = face value
t = actual number of days remaining to maturity

As an example, suppose a Treasury bill with 91 days to maturity and a face value of $100 trading at a price of $98.5846. The dollar discount, D, is computed as follows: