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ДЕРЖАВНИЙ ВИЩИЙ НАВЧАЛЬНИЙ ЗАКЛАД
«ДОНЕЦЬКИЙ НАЦІОНАЛЬНИЙ ТЕХНІЧНИЙ УНІВЕРСИТЕТ»

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БАНКІВСЬКІ ІНФОРМАЦІЙНІ СИСТЕМИ

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У навчальному посібнику розкриваються питання щодо основ банківської діяльності і розробки інформаційних систем для обслуговування потреб банку, його клієнтів і кореспондентів. Автор прагнув не лише показати особливості та специфіку основних банківських задач, а й допомогти майбутнім фахівцям адаптуватись до роботи в умовах нових інформаційних технологій та англомовного середовища.

Для студентів вищих навчальних закладів, що спеціалізуються за фахом економічна кібернетика. Ця книжка буде корисною як практичний посібник для фахівців, що збираються проходити стажування або працювати у фінансово-кредитних установах англомовних країн.

ЗМІСТ

ПЕРЕДМОВА

Інформаційні технології відкривають нові ринки, нові продукти, нові послуги та ефективні канали доставки для банківської галузі. Електронний банкінг у режимі он лайн, мобільний банкінг та інтернет-банкінг – це тільки кілька прикладів.

Інформаційні технології були наріжним каменем останніх реформ у фінансовому секторі, спрямованих на підвищення швидкості та надійності фінансових операцій та ініціатив, спрямованих на зміцнення банківського сектору. IT-революція підготувала грунт для безпрецедентного зростання у фінансовій активності по всьому світу. Технічний прогрес і розвиток в усьому світі мереж істотно знизив вартість глобального переказу коштів.

Саме інформаційні технології дозволяють банкам задовольняти такі високі очікування клієнтів, які є сьогодні більш вимогливими і також більше технічно підкованими в порівнянні з їх попередниками з минулих років.

Стрімкий розвиток інформаційних банківських технологій потребує відповідних спеціалістів, здатних розробляти і впроваджувати сучасні інформаційні системи. На ринку спеціалістів щороку зростає потреба в розробниках інформаційних банківських систем, які були б добре обізнаними в предметній області, розумілись на принципах її функціонування, могли б сформулювати адекватні бізнес-правила.

Мета навчального посібника «Банківські інформаційні системи» — надати допомогу в оволодінні знаннями у сфері розробки автоматизованих банківських систем, а також допомогти підготуватися до можливості професійного спілкування у англомовному просторі.

У запропонованому навчальному посібнику враховані основні положення документів Болонського процесу, теми розбиті на два модулі. У першому модулі розкриті базові банківські операції, що є основою предметної області проектування інформаційних систем у банках. У другому модулі розкриті безпосередньо особливості розробки та аудиту безпеки банківських інформаційних систем.

Кожний розділ посібника завершується контрольними питаннями, які дадуть змогу студентам перевірити ступінь опанування матеріалу та краще зорієнтуватись в основних ключових моментах даної теми.

UNIT I. MEASURING INTEREST RATES

The concept of **present value** (or **present discounted value**) is based on the commonsense notion that a dollar paid to you one year from now is less valuable to you than a dollar paid to you today: This notion is true because you can deposit a dollar in a savings account that earns interest and have more than a dollar in one year. Economists use a more formal definition, as explained in this section.

Let's look at the simplest kind of debt instrument, which we will call a **simple loan**. In this loan, the lender provides the borrower with an amount of funds (called the *principal*) that must be repaid to the lender at the *maturity date*, along with an additional payment for the interest. For example, if you made your friend, Jane, a simple loan of $100 for one year, you would require her to repay the principal of $100 in one year's time along with an additional payment for interest; say, $10. In the case of a simple loan like this one, the interest payment divided by the amount of the loan is a natural and sensible way to measure the interest rate. This measure of the so called *simple interest rate*, *i*, is:

$$i = \frac{\$10}{\$100} = 0.10 = 10\%$$

If you make this $100 loan, at the end of the year you would have $110, which can be rewritten as:

$$\$100 \times (1 + 0.10) = \$110$$

If you then lent out the $110, at the end of the second year you would have:

$$\$110 \times (1 + 0.10) = \$121$$

or, equivalently,

$$\$100 \times (1 + 0.10) \times (1 + 0.10) = \$100 \times (1 + 0.10)^2 = \$121$$

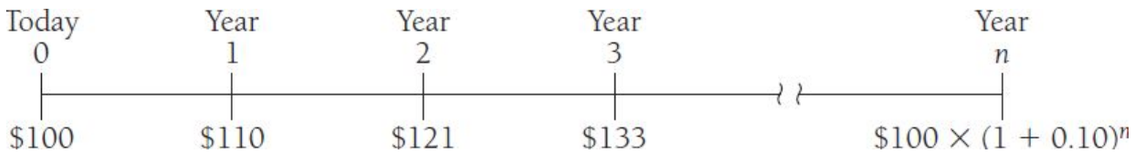
Continuing with the loan again, you would have at the end of the third year:

$$\$121 \times (1 + 0.10) = \$100 \times (1 + 0.10)^3 = \$133$$

Generalizing, we can see that at the end of *n* years, your $100 would turn into:

$$\$100 \times (1 + i)^n$$

The amounts you would have at the end of each year by making the $100 loan today can be seen in the following timeline:



This timeline immediately tells you that you are just as happy having $100 today as having $110 a year from now (of course, as long as you are sure that Jane will pay you back). Or that you are just as happy having $100 today as having $121 two years from now, or $133 three years from now or $\$100 \times (1 + i)^n$, *n* years from now. The timeline tells us that we can also work backward from future amounts to the present: for example, $\$133 = \$100 \times (1 + 0.10)^3$ three years from now is worth $100 today, so that:

$$\$100 = \frac{\$133}{(1 + 0.10)^3}$$

The process of calculating today's value of dollars received in the future, as we have done above, is called *discounting the future*. We can generalize this process by writing today's (present) value of $100 as *PV*, the future value of $133 as *FV*, and replacing 0.10 (the 10% interest rate) by *i*. This leads to the following formula:

$$PV = \frac{FV}{(1 + i)^n} \qquad (1)$$

Intuitively, what Equation 1 tells us is that if you are promised $1 for certain ten years from now, this dollar would not be as valuable to you as $1 is today because if you had the $1 today, you could invest it and end up with more than $1 in ten years.

The concept of present value is extremely useful, because it allows us to figure out today's value (price) of a credit market instrument at a given simple interest rate *i* by just adding up the individual present values of all the future payments received. This information allows us to compare the value of two instruments with very different timing of their payments.

As an example of how the present value concept can be used, let's assume that you just hit the $20 million jackpot in the New York State Lottery, which promises you a payment of $1 million for the next twenty years. You are clearly excited, but have you really won $20 million? No, not in the present value sense. In today's dollars, that $20 million is worth a lot less. If we assume an interest rate of 10% as in the earlier examples, the first payment of $1 million is clearly worth $1 million today, but the next payment next year is only worth $1 million/(1 + 0.10) = $909,090, a lot less than $1 million. The following year the payment is worth $1 million/$(1 + 0.10)^2$ = $826,446 in today's dollars, and so on. When you add all these up, they come to $9.4 million. You are still pretty excited (who wouldn't be?), but because you understand the concept of present value, you recognize that you are the victim of false advertising.

You didn't really win $20 million, but instead won less than half as much. In terms of the timing of their payments, there are four basic types of credit market instruments.

1. A simple loan, which we have already discussed, in which the lender provides the borrower with an amount of funds, which must be repaid to the lender at the maturity date along with an additional payment for the interest. Many money market instruments are of this type: for example, commercial loans to businesses.

2. A **fixed-payment loan** (which is also called a **fully amortized loan**) in which the lender provides the borrower with an amount of funds, which must be repaid by making the same payment every period (such as a month), consisting of part of the principal and interest for a set number of years. For example, if you borrowed $1,000, a fixed-payment loan might require you to pay $126 every year for 25 years. Installment loans (such as auto loans) and mortgages are frequently of the fixed-payment type.

3. A **coupon bond** pays the owner of the bond a fixed interest payment (coupon payment) every year until the maturity date, when a specified final amount (**face value** or **par value**) is repaid. The coupon payment is so named because the bondholder used to obtain payment by clipping a coupon off the bond and sending it to the bond issuer, who then sent the payment to the holder. Nowadays, it is no longer necessary to send in coupons to receive these payments. A coupon bond with $1,000 face value, for example, might pay you a coupon payment of $100 per year for ten years, and at the maturity date repay you the face value amount of $1,000. (The face value of a bond is usually in

$1,000 increments.)

A coupon bond is identified by three pieces of information. First is the corporation or government agency that issues the bond. Second is the maturity date of the bond. Third is the bond's **coupon rate**, the dollar amount of the yearly coupon payment expressed as a percentage of the face value of the bond. In our example, the coupon bond has a yearly coupon payment of $100 and a face value of $1,000. The coupon rate is then $100/$1,000 = 0.10, or 10%. Capital market instruments such as U.S. Treasury bonds and notes and corporate bonds are examples of coupon bonds.

4. A **discount bond** (also called a **zero-coupon bond**) is bought at a price below its face value (at a discount), and the face value is repaid at the maturity date. Unlike a coupon bond, a discount bond does not make any interest payments; it just pays off the face value. For example, a discount bond with a face value of $1,000 might be bought for $900; in a year's time the owner would be repaid the face value of $1,000. U.S. Treasury bills, U.S. savings bonds, and long-term zero-coupon bonds are examples of discount bonds.

These four types of instruments require payments at different times: Simple loans and discount bonds make payment only at their maturity dates, whereas fixed-payment loans and coupon bonds have payments periodically until maturity. How would you decide which of these instruments provides you with more income? They all seem so different because they make payments at different times. To solve this problem, we use the concept of present value, explained earlier, to provide us with a procedure for measuring interest rates on these different types of instruments. Of the several common ways of calculating interest rates, the most important is the **yield to maturity**, the interest rate that equates the present value of payments received from a debt instrument with its value today.1 Because the concept behind the calculation of the yield to maturity makes good economic sense, economists consider it the most accurate measure of interest rates.

To understand the yield to maturity better, we now look at how it is calculated for the four types of credit market instruments.

Simple Loan. Using the concept of present value, the yield to maturity on a simple loan is easy to calculate. For the one-year loan we discussed, today's value is $100, and the payments in one year's time would be $110 (the repayment of $100 plus the interest payment of $10). We can use this information to solve for the yield to maturity i by recognizing that the present value of the future payments must equal today's value of a loan. Making today's value of the loan ($100) equal to the present value of the $110 payment in a year (using Equation 1) gives us:

$$\$100 = \frac{\$110}{1+i}$$

Solving for i,

$$i = \frac{\$110 - \$100}{\$100} = \frac{\$10}{\$100} = 0.10 = 10\%$$

This calculation of the yield to maturity should look familiar, because it equals the interest payment of $10 divided by the loan amount of $100; that is, it equals the simple interest rate on the loan. An important point to recognize is that *for simple loans, the simple interest rate equals the yield to maturity*. Hence the same term i is used to denote both the yield to maturity and the simple interest rate.

Fixed-Payment Loan. Recall that this type of loan has the same payment every period throughout the life of the loan. On a fixed-rate mortgage, for example, the borrower makes the same payment to the bank every month until the maturity date, when the loan will be completely paid off. To calculate the yield to maturity for a

fixed-payment loan, we follow the same strategy we used for the simple loan - we equate today's value of the loan with its present value. Because the fixed-payment loan involves more than one payment, the present value of the fixed-payment loan is calculated as the sum of the present values of all payments (using Equation 1). In the case of our earlier example, the loan is $1,000 and the yearly payment is $126 for the next 25 years. The present value is calculated as follows: At the end of one year, there is a $126 payment with a *PV* of $126/(1 + *i*); at the end of two years, there is another $126 payment with a *PV* of $126/(1 + *i*)^2; and so on until at the end of the twenty-fifth year, the last payment of $126 with a *PV* of $126/(1 + *i*)^{25} is made. Making today's value of the loan ($1,000) equal to the sum of the present values of all the yearly payments gives us:

$$\$1{,}000 = \frac{\$126}{1+i} + \frac{\$126}{(1+i)^2} + \frac{\$126}{(1+i)^3} + \cdots + \frac{\$126}{(1+i)^{25}}$$

More generally, for any fixed-payment loan,

$$LV = \frac{FP}{1+i} + \frac{FP}{(1+i)^2} + \frac{FP}{(1+i)^3} + \cdots + \frac{FP}{(1+i)^n} \qquad (2)$$

where *LV* - loan value
FP - fixed yearly payment
n - number of years until maturity

For a fixed-payment loan amount, the fixed yearly payment and the number of years until maturity are known quantities, and only the yield to maturity is not. So we can solve this equation for the yield to maturity *i.* Because this calculation is not easy, many pocket calculators have programs that allow you to find *i* given the loan's numbers for *LV*, *FP*, and *n.* For example, in the case of the 25-year loan with yearly payments of $126, the yield to maturity that solves Equation 2 is 12%. Real estate brokers always have a pocket calculator that can solve such equations so that they can immediately tell the prospective house buyer exactly what the yearly (or monthly) payments will be if the house purchase is financed by taking out a mortgage.

Coupon Bond. To calculate the yield to maturity for a coupon bond, follow the same strategy used for the fixed-payment loan: Equate today's value of the bond with its present value. Because coupon bonds also have more than one payment, the present value of the bond is calculated as the sum of the present values of all the coupon payments plus the present value of the final payment of the face value of the bond.

The present value of a $1,000-face-value bond with ten years to maturity and yearly coupon payments of $100 (a 10% coupon rate) can be calculated as follows: At the end of one year, there is a $100 coupon payment with a *PV* of $100/(1 + *i*); at the end of the second year, there is another $100 coupon payment with a *PV* of $100/(1 + *i*)^2; and so on until at maturity, there is a $100 coupon payment with a *PV* of $100/(1 + *i*)^{10} plus the repayment of the $1,000 face value with a *PV* of $1,000/(1 + *i*)^{10}. Setting today's value of the bond (its current price, denoted by *P*) equal to the sum of the present values of all the payments for this bond gives:

$$P = \frac{\$100}{1+i} + \frac{\$100}{(1+i)^2} + \frac{\$100}{(1+i)^3} + \cdots + \frac{\$100}{(1+i)^{10}} + \frac{\$1{,}000}{(1+i)^{10}}$$

More generally, for any coupon bond,

$$P = \frac{C}{1+i} + \frac{C}{(1+i)^2} + \frac{C}{(1+i)^3} + \cdots + \frac{C}{(1+i)^n} + \frac{F}{(1+i)^n} \quad (3)$$

where P - price of coupon bond
C - yearly coupon payment
F - face value of the bond
n - years to maturity date

In Equation 3, the coupon payment, the face value, the years to maturity, and the price of the bond are known quantities, and only the yield to maturity is not. Hence we can solve this equation for the yield to maturity i. Just as in the case of the fixed payment loan, this calculation is not easy, so business-oriented pocket calculators have built-in programs that solve this equation for you. Let's look at some examples of the solution for the yield to maturity on our 10%-coupon-rate bond that matures in ten years. If the purchase price of the bond is $1,000, then either using a pocket calculator with the built-in program or looking at a bond table, we will find that the yield to maturity is 10 percent. If the price is $900, we find that the yield to maturity is 11.75%. Table 1 shows the yields to maturity calculated for several bond prices.

Table 1 Yields to Maturity on a 10%-Coupon-Rate Bond Maturing in Ten Years (Face Value = $1,000)

Price of Bond ($)	Yield to Maturity (%)
1,200	7.13
1,100	8.48
1,000	10.00
900	11.75
800	13.81

Three interesting facts are illustrated by Table 1:

1. When the coupon bond is priced at its face value, the yield to maturity equals the coupon rate.

2. The price of a coupon bond and the yield to maturity are negatively related; that is, as the yield to maturity rises, the price of the bond falls. As the yield to maturity falls, the price of the bond rises.

3. The yield to maturity is greater than the coupon rate when the bond price is below its face value.

These three facts are true for any coupon bond and are really not surprising if you think about the reasoning behind the calculation of the yield to maturity. When you put $1,000 in a bank account with an interest rate of 10%, you can take out $100 every year and you will be left with the $1,000 at the end of ten years. This is similar to buying the $1,000 bond with a 10% coupon rate analyzed in Table 1, which pays a $100 coupon payment every year and then repays $1,000 at the end of ten years. If the bond is purchased at the par value of $1,000, its yield to maturity must equal 10%, which is also equal to the coupon rate of 10%. The same reasoning applied to any coupon bond demonstrates that if the coupon bond is purchased at its par value, the yield to maturity and the coupon rate must be equal.

It is straightforward to show that the bond price and the yield to maturity are negatively related. As i, the yield to maturity, rises, all denominators in the bond price

formula must necessarily rise. Hence a rise in the interest rate as measured by the yield to maturity means that the price of the bond must fall. Another way to explain why the bond price falls when the interest rises is that a higher interest rate implies that the future coupon payments and final payment are worth less when discounted back to the present; hence the price of the bond must be lower.

There is one special case of a coupon bond that is worth discussing because its yield to maturity is particularly easy to calculate. This bond is called a **consol** or a **perpetuity**; it is a perpetual bond with no maturity date and no repayment of principal that makes fixed coupon payments of $\$C$ forever. Consols were first sold by the British Treasury during the Napoleonic Wars and are still traded today; they are quite rare, however, in American capital markets. The formula in Equation 3 for the price of the consol P simplifies to the following:

$$P = \frac{C}{i} \tag{4}$$

The bond price formula for a consol is:

$$P = \frac{C}{1+i} + \frac{C}{(1+i)^2} + \frac{C}{(1+i)^3} + \cdots$$

which can be written as:

$$P = C\,(x + x^2 + x^3 + \cdots)$$

in which $x = 1/(1 + i)$. The formula for an infinite sum is:

$$1 + x + x^2 + x^3 + \cdots = \frac{1}{1-x} \quad \text{for} \quad x < 1$$

and so:

$$P = C\left(\frac{1}{1-x} - 1\right) = C\left[\frac{1}{1 - 1/(1+i)} - 1\right]$$

which by suitable algebraic manipulation becomes:

$$P = C\left(\frac{1+i}{i} - \frac{i}{i}\right) = \frac{C}{i}$$

where P - price of the consol
C - yearly payment

One nice feature of consols is that you can immediately see that as i goes up, the price of the bond falls. For example, if a consol pays \$100 per year forever and the interest rate is 10%, its price will be \$1,000 = \$100/0.10. If the interest rate rises to 20%, its price will fall to \$500 = \$100/0.20. We can also rewrite this formula as

$$i = \frac{C}{P} \tag{5}$$

We see then that it is also easy to calculate the yield to maturity for the consol (despite the fact that it never matures). For example, with a consol that pays \$100 yearly and has a price of \$2,000, the yield to maturity is easily calculated to be 5% (= \$100/\$2,000).

Discount Bond. The yield-to-maturity calculation for a discount bond is similar to hat for the simple loan. Let us consider a discount bond such as a one-year U.S. Treasury bill, which pays off a face value of \$1,000 in one year's time. If the current purchase price of this bill is \$900, then equating this price to the present value of the \$1,000

received in one year, using Equation 1, gives:

$$\$900 = \frac{\$1{,}000}{1 + i}$$

and solving for i,

$$\begin{aligned}(1 + i) \times \$900 &= \$1{,}000 \\ \$900 + \$900i &= \$1{,}000 \\ \$900i &= \$1{,}000 - \$900 \\ i &= \frac{\$1{,}000 - \$900}{\$900} = 0.111 = 11.1\%\end{aligned}$$

More generally, for any one-year discount bond, the yield to maturity can be written as:

$$i = \frac{F - P}{P} \tag{6}$$

where F - face value of the discount bond
P - current price of the discount bond

In other words, the yield to maturity equals the increase in price over the year $F - P$ divided by the initial price P. In normal circumstances, investors earn positive returns from holding these securities and so they sell at a discount, meaning that the current price of the bond is below the face value. Therefore, $F - P$ should be positive, and the yield to maturity should be positive as well. However, this is not always the case, as recent extraordinary events in Japan indicate.

An important feature of this equation is that it indicates that for a discount bond, the yield to maturity is negatively related to the current bond price. This is the same conclusion that we reached for a coupon bond. For example, Equation 6 shows that a rise in the bond price from \$900 to \$950 means that the bond will have a smaller increase in its price at maturity, and the yield to maturity falls from 11.1 to 5.3%. Similarly, a fall in the yield to maturity means that the price of the discount bond has risen.

Summary. The concept of present value tells you that a dollar in the future is not as valuable to you as a dollar today because you can earn interest on this dollar. Specifically, a dollar received n years from now is worth only $\$1/(1 + i)^n$ today. The present value of a set of future payments on a debt instrument equals the sum of the present values of each of the future payments. The yield to maturity for an instrument is the interest rate that equates the present value of the future payments on that instrument to its value today. Because the procedure for calculating the yield to maturity is based on sound economic principles, this is the measure that economists think most accurately describes the interest rate.

Our calculations of the yield to maturity for a variety of bonds reveal the important fact that ***current bond prices and interest rates are negatively related: When the interest rate rises, the price of the bond falls, and vice versa***.

QUESTIONS AND TASKS

1. Would a dollar tomorrow be worth more to you today when the interest rate is 20% or when it is 10%?

2. You have just won $20 million in the state lottery, which promises to pay you $1 million (tax free) every year for the next 20 years. Have you really won $20 million?

3. If the interest rate is 10%, what is the present value of a security that pays you $1,100 next year, $1,210 the year after, and $1,331 the year after that?

4. If the security in Problem 3 sold for $3,500, is the yield to maturity greater or less than 10%? Why?

5. Write down the formula that is used to calculate the yield to maturity on a 20-year 10% coupon bond with $1,000 face value that sells for $2,000.

6. What is the yield to maturity on a $1,000-face-value discount bond maturing in one year that sells for $800?

7. What is the yield to maturity on a simple loan for $1 million that requires a repayment of $2 million in five years' time?

8. To pay for college, you have just taken out a $1,000 government loan that makes you pay $126 per year for 25 years. However, you don't have to start making these payments until you graduate from college two years from now. Why is the yield to maturity necessarily less than 12%, the yield to maturity on a normal $1,000 fixed-payment loan in which you pay $126 per year for 25 years?

9. Which $1,000 bond has the higher yield to maturity, a 20-year bond selling for $800 with a current yield of 15% or a one-year bond selling for $800 with a current yield of 5%?

10. Pick five U.S. Treasury bonds from the bond page of the newspaper, and calculate the current yield. Note when the current yield is a good approximation of the yield to maturity.

11. You are offered two bonds, a one-year U.S. Treasury bond with a yield to maturity of 9% and a one-year U.S. Treasury bill with a yield on a discount basis of 8.9%. Which would you rather own?

12. If there is a decline in interest rates, which would you rather be holding, long-term bonds or short-term bonds? Why? Which type of bond has the greater interest-rate risk?

13. Francine the Financial Adviser has just given you the following advice: "Long-term bonds are a great investment because their interest rate is over 20%." Is Francine necessarily right?

14. If mortgage rates rise from 5% to 10% but the expected rate of increase in housing prices rises from 2% to 9%, are people more or less likely to buy houses?

15. Interest rates were lower in the mid-1980s than they were in the late 1970s, yet many economists have commented that real interest rates were actually much higher in the mid-1980s than in the late 1970s. Does this make sense? Do you think that these economists are right?

UNIT 2 THE BANK BALANCE SHEET

To understand how banking works, first we need to examine the bank **balance sheet**, a list of the bank's assets and liabilities. As the name implies, this list balances; that is, it has the characteristic that:

$$\text{total assets} = \text{total liabilities} + \text{capital}$$

Furthermore, a bank's balance sheet lists *sources* of bank funds (liabilities) and *uses* to which they are put (assets). Banks obtain funds by borrowing and by issuing other liabilities such as deposits. They then use these funds to acquire assets such as securities and loans. Banks make profits by charging an interest rate on their holdings of securities and loans that is higher than the expenses on their liabilities. The balance sheet of all commercial banks as of January 2003 appears in Table 1.

Table 1 Balance Sheet of All Commercial Banks (items as a percentage of the total, January 2003)

Assets (Uses of Funds)*		Liabilities (Sources of Funds)	
Reserves and cash items	5	Checkable deposits	9
Securities		Nontransaction deposits	
U.S. government and agency	15	Small-denomination time deposits (< $100,000) + savings deposits	42
State and local government and other securities	10	Large-denomination time deposits	14
Loans		Borrowings	28
Commercial and industrial	14	Bank capital	7
Real estate	29		
Consumer	9		
Interbank	4		
Other	8		
Other assets (for example, physical capital)	6		
Total	100	Total	100

*In order of decreasing liquidity.
Source: www.federalreserve.gov/releases/h8/current/.

A bank acquires funds by issuing (selling) liabilities, which are consequently also referred to as *sources of funds.* The funds obtained from issuing liabilities are used to purchase income-earning assets.

Checkable Deposits. Checkable deposits are bank accounts that allow the owner of the account to write checks to third parties. Checkable deposits include all accounts on which checks can be drawn: non-interest-bearing checking accounts (demand deposits), interest-bearing NOW (negotiable order of withdrawal) accounts, and money market deposit accounts (MMDAs). Introduced with the Depository Institutions Act in 1982, MMDAs have features similar to those of money market mutual funds and are included in the checkable deposits category. However, MMDAs differ from checkable deposits in that they are not subject to reserve requirements as checkable deposits are and are not included in the M1 definition of money.

Table 1 shows that the category of checkable deposits is an important source of bank funds, making up 9% of bank liabilities. Once checkable deposits were the most important source of bank funds (over 60% of bank liabilities in 1960), but with the

appearance of new, more attractive financial instruments, such as money market mutual funds, the share of checkable deposits in total bank liabilities has shrunk over time.

Checkable deposits and money market deposit accounts are payable on demand; that is, if a depositor shows up at the bank and requests payment by making a withdrawal, the bank must pay the depositor immediately. Similarly, if a person who receives a check written on an account from a bank, presents that check at the bank, it must pay the funds out immediately (or credit them to that person's account).

A checkable deposit is an asset for the depositor because it is part of his or her wealth. Conversely, because the depositor can withdraw from an account funds that the bank is obligated to pay, checkable deposits are a liability for the bank. They are usually the lowest-cost source of bank funds because depositors are willing to forgo some interest in order to have access to a liquid asset that can be used to make purchases. The bank's costs of maintaining checkable deposits include interest payments and the costs incurred in servicing these accounts—processing and storing cancelled checks, preparing and sending out monthly statements, providing efficient tellers (human or otherwise), maintaining an impressive building and conveniently located branches, and advertising and marketing to entice customers to deposit their funds with a given bank. In recent years, interest paid on deposits (checkable and time) has accounted for around 25% of total bank operating expenses, while the costs involved in servicing accounts (employee salaries, building rent, and so on) have been approximately 50% of operating expenses.

Nontransaction Deposits. Nontransaction deposits are the primary source of bank funds (56% of bank liabilities in Table 1). Owners cannot write checks on nontransaction deposits, but the interest rates are usually higher than those on checkable deposits. There are two basic types of nontransaction deposits: savings accounts and time deposits (also called certificates of deposit, or CDs).

Savings accounts were once the most common type of nontransaction deposit. In these accounts, to which funds can be added or from which funds can be withdrawn at any time, transactions and interest payments are recorded in a monthly statement or in a small book (the passbook) held by the owner of the account. Time deposits have a fixed maturity length, ranging from several months to over five years, and have substantial penalties for early withdrawal (the forfeiture of several months' interest). Small-denomination time deposits (deposits of less than $100,000) are less liquid for the depositor than passbook savings, earn higher interest rates, and are a more costly source of funds for the banks.

Large-denomination time deposits (CDs) are available in denominations of $100,000 or over and are typically bought by corporations or other banks. Large-denomination CDs are negotiable; like bonds, they can be resold in a secondary market before they mature. For this reason, negotiable CDs are held by corporations, money market mutual funds, and other financial institutions as alternative assets to Treasury bills and other short-term bonds. Since 1961, when they first appeared, negotiable CDs have become an important source of bank funds (14%).

Borrowings. Banks obtain funds by borrowing from the Federal Reserve System, the Federal Home Loan banks, other banks, and corporations. Borrowings from the Fed are called **discount loans** (also known as *advances*). Banks also borrow reserves overnight in the federal (fed) funds market from other U.S. banks and financial institutions.

Banks borrow funds overnight in order to have enough deposits at the Federal Reserve to meet the amount required by the Fed. (The *federal funds* designation is somewhat confusing, because these loans are not made by the federal government or by the Federal Reserve, but rather by banks to other banks.) Other sources of borrowed

funds are loans made to banks by their parent companies (bank holding companies), loan arrangements with corporations (such as repurchase agreements), and borrowings of Eurodollars (deposits denominated in U.S. dollars residing in foreign banks or foreign branches of U.S. banks). Borrowings have become a more important source of bank funds over time: In 1960, they made up only 2% of bank liabilities; currently, they are 28% of bank liabilities.

Bank Capital. The final category on the liabilities side of the balance sheet is bank capital, the bank's net worth, which equals the difference between total assets and liabilities (7% of total bank assets in Table 1). The funds are raised by selling new equity (stock) or from retained earnings. Bank capital is a cushion against a drop in the value of its assets, which could force the bank into insolvency (having liabilities in excess of assets, meaning that the bank can be forced into liquidation). A bank uses the funds that it has acquired by issuing liabilities to purchase income earning assets. Bank assets are thus naturally referred to as *uses of funds*, and the interest payments earned on them are what enable banks to make profits.

Reserves. All banks hold some of the funds they acquire as deposits in an account at the Fed. **Reserves** are these deposits plus currency that is physically held by banks (called **vault cash** because it is stored in bank vaults overnight). Although reserves currently do not pay any interest, banks hold them for two reasons. First, some reserves, called **required reserves**, are held because of **reserve requirements**, the regulation that for every dollar of checkable deposits at a bank, a certain fraction (10 cents, for example) must be kept as reserves. This fraction (10 percent in the example) is called the **required reserve ratio**. Banks hold additional reserves, called **excess reserves**, because they are the most liquid of all bank assets and can be used by a bank to meet its obligations when funds are withdrawn, either directly by a depositor or indirectly when a check is written on an account.

Cash Items in Process of Collection. Suppose that a check written on an account at another bank is deposited in your bank and the funds for this check have not yet been received (collected) from the other bank. The check is classified as a cash item in process of collection, and it is an asset for your bank because it is a claim on another bank for funds that will be paid within a few days.

Deposits at Other Banks. Many small banks hold deposits in larger banks in exchange for a variety of services, including check collection, foreign exchange transactions, and help with securities purchases. This is an aspect of a system called *correspondent banking.*

Collectively, reserves, cash items in process of collection, and deposits at other banks are often referred to as *cash items.* In Table 1, they constitute only 5% of total assets, and their importance has been shrinking over time: In 1960, for example, they accounted for 20% of total assets.

Securities. A bank's holdings of securities are an important income-earning asset: Securities (made up entirely of debt instruments for commercial banks, because banks are not allowed to hold stock) account for 25% of bank assets in Table 1, and they provide commercial banks with about 10% of their revenue. These securities can be classified into three categories: U.S. government and agency securities, state and local government securities, and other securities. The United States government and agency securities are the most liquid because they can be easily traded and converted into cash with low transaction costs. Because of their high liquidity, short-term U.S. government securities are called **secondary reserves**.

State and local government securities are desirable for banks to hold, primarily

because state and local governments are more likely to do business with banks that hold their securities. State and local government and other securities are less marketable (hence less liquid) and are also riskier than U.S. government securities, primarily because of default risk: There is some possibility that the issuer of the securities may not be able to make its interest payments or pay back the face value of the securities when they mature.

Loans. Banks make their profits primarily by issuing loans. In Table 1, some 64% of bank assets are in the form of loans, and in recent years they have generally produced more than half of bank revenues. A loan is a liability for the individual or corporation receiving it, but an asset for a bank, because it provides income to the bank. Loans are typically less liquid than other assets, because they cannot be turned into cash until the loan matures. If the bank makes a one-year loan, for example, it cannot get its funds back until the loan comes due in one year. Loans also have a higher probability of default than other assets. Because of the lack of liquidity and higher default risk, the bank earns its highest return on loans.

As you saw in Table 1, the largest categories of loans for commercial banks are commercial and industrial loans made to businesses and real estate loans. Commercial banks also make consumer loans and lend to each other. The bulk of these interbank loans are overnight loans lent in the federal funds market. The major difference in the balance sheets of the various depository institutions is primarily in the type of loan in which they specialize. Savings and loans and mutual savings banks, for example, specialize in residential mortgages, while credit unions tend to make consumer loans.

Other Assets. The physical capital (bank buildings, computers, and other equipment) owned by the banks is included in this category.

QUESTIONS AND TASKS

1. Why might a bank be willing to borrow funds from other banks at a higher rate than it can borrow from the Fed?
2. Expand meaning of the term loan.
3. Expand meaning of the term securities.
4. Expand meaning of the term vault cash.
5. Expand meaning of the term bank capital.

UNIT 3 BASIC BANKING

Before proceeding to a more detailed study of how a bank manages its assets and liabilities in order to make the highest profit, you should understand the basic operation of a bank.

In general terms, banks make profits by selling liabilities with one set of characteristics (a particular combination of liquidity, risk, size, and return) and using the proceeds to buy assets with a different set of characteristics. This process is often referred to as *asset transformation.* For example, a savings deposit held by one person can provide the funds that enable the bank to make a mortgage loan to another person. The bank has, in effect, transformed the savings deposit (an asset held by the depositor) into a mortgage loan (an asset held by the bank). Another way this process of asset transformation is described is to say that the bank "borrows short and lends long" because it makes long-term loans and funds them by issuing short-dated deposits.

The process of transforming assets and providing a set of services (check clearing, record keeping, credit analysis, and so forth) is like any other production process in a firm. If the bank produces desirable services at low cost and earns substantial income on its assets, it earns profits; if not, the bank suffers losses. To make our analysis of the operation of a bank more concrete, we use a tool called a **T-account**. A T-account is a simplified balance sheet, with lines in the form of a T, that lists only the changes that occur in balance sheet items starting from some initial balance sheet position. Let's say that Jane Brown has heard that the First National Bank provides excellent service, so she opens a checking account with a $100 bill. She now has a $100 checkable deposit at the bank, which shows up as a $100 liability on the bank's balance sheet. The bank now puts her $100 bill into its vault so that the bank's assets rise by the $100 increase in vault cash. The T-account for the bank looks like this:

FIRST NATIONAL BANK

Assets		Liabilities	
Vault cash	+$100	Checkable deposits	+$100

Since vault cash is also part of the bank's reserves, we can rewrite the T-account as follows:

Assets		Liabilities	
Reserves	+$100	Checkable deposits	+$100

Note that Jane Brown's opening of a checking account leads to *an increase in the bank's reserves equal to the increase in checkable deposits.*

If Jane had opened her account with a $100 check written on an account at another bank, say, the Second National Bank, we would get the same result. The initial effect on the T-account of the First National Bank is as follows:

Assets		Liabilities	
Cash items in process of collection	+$100	Checkable deposits	+$100

Checkable deposits increase by $100 as before, but now the First National Bank is owed $100 by the Second National Bank. This asset for the First National Bank is entered in the T-account as $100 of cash items in process of collection because the First National Bank will now try to collect the funds that it is owed. It could go directly to the Second National Bank and ask for payment of the funds, but if the two banks are in separate states, that would be a time-consuming and costly process.

Instead, the First National Bank deposits the check in its account at the Fed, and the Fed collects the funds from the Second National Bank. The result is that the Fed transfers $100 of reserves from the Second National Bank to the First National Bank, and the final balance sheet positions of the two banks are as follows:

FIRST NATIONAL BANK

Assets		Liabilities	
Reserves	+$100	Checkable deposits	+$100

SECOND NATIONAL BANK

Assets		Liabilities	
Reserves	−$100	Checkable deposits	−$100

The process initiated by Jane Brown can be summarized as follows: When a check written on an account at one bank is deposited in another, the bank receiving the deposit gains reserves equal to the amount of the check, while the bank on which the check is written sees its reserves fall by the same amount. Therefore, ***when a bank receives additional deposits, it gains an equal +amount of reserves; when it loses deposits, it loses an equal amount of reserves.***

Now that you understand how banks gain and lose reserves, we can examine how a bank rearranges its balance sheet to make a profit when it experiences a change in its deposits. Let's return to the situation when the First National Bank has just received the extra $100 of checkable deposits. As you know, the bank is obliged to keep a certain fraction of its checkable deposits as required reserves. If the fraction (the required reserve ratio) is 10%, the First National Bank's required reserves have increased by $10, and we can rewrite its T-account as follows:

FIRST NATIONAL BANK

Assets		Liabilities	
Required reserves	+$10	Checkable deposits	+$100
Excess reserves	+$90		

Let's see how well the bank is doing as a result of the additional checkable deposits. Because reserves pay no interest, it has no income from the additional $100 of assets. But servicing the extra $100 of checkable deposits is costly, because the bank must keep records, pay tellers, return canceled checks, pay for check clearing, and so forth. The bank is taking a loss! The situation is even worse if the bank makes interest payments on the deposits, as with NOW accounts. If it is to make a profit, the bank must put to productive use all or part of the $90 of excess reserves it has available. Let us assume that the bank chooses not to hold any excess reserves but to make loans instead. The T-account then looks like this:

Assets		Liabilities	
Required reserves	+$10	Checkable deposits	+$100
Loans	+$90		

The bank is now making a profit because it holds short-term liabilities such as checkable deposits and uses the proceeds to buy longer-term assets such as loans with higher interest rates. As mentioned earlier, this process of asset transformation is frequently described by saying that banks are in the business of "borrowing short and lending long." For example, if the loans have an interest rate of 10% per year, the bank earns $9 in income from its loans over the year. If the $100 of checkable deposits is in a NOW account with a 5% interest rate and it costs another $3 per year to service the account, the cost per year of these deposits is $8. The bank's profit on the new deposits is then $1 per year (a 1% return on assets).

QUESTIONS AND TASKS

1. Using the T-accounts of the First National Bank and the Second National Bank, describe what happens when Jane Brown writes a $50 check on her accountant the First National Bank to pay her friend Joe Green, who in turn deposits the check in his account at the Second National Bank.

2. What happens to reserves at the First National Bank if one person withdraws $1,000 of cash and another person deposits $500 of cash? Use T-accounts to explain your answer.

UNIT 4. LIQUIDITY MANAGEMENT AND THE ROLE OF RESERVES

Now that you have some idea of how a bank operates, let's look at how a bank manages its assets and liabilities in order to earn the highest possible profit. The bank manager has four primary concerns. The first is to make sure that the bank has enough ready cash to pay its depositors when there are **deposit outflows**, that is, when deposits are lost because depositors make withdrawals and demand payment. To keep enough cash on hand, the bank must engage in **liquidity management**, the acquisition of sufficiently liquid assets to meet the bank's obligations to depositors.

Let us see how a typical bank, the First National Bank, can deal with deposit outflows that occur when its depositors withdraw cash from checking or savings accounts or write checks that are deposited in other banks. In the example that follows, we assume that the bank has ample excess reserves and that all deposits have the same required reserve ratio of 10% (the bank is required to keep 10% of its time and checkable deposits as reserves). Suppose that the First National Bank's initial balance sheet is as follows:

Assets		Liabilities	
Reserves	$20 million	Deposits	$100 million
Loans	$80 million	Bank capital	$ 10 million
Securities	$10 million		

The bank's required reserves are 10% of $100 million, or $10 million. Since it holds $20 million of reserves, the First National Bank has excess reserves of $10 million. If a deposit outflow of $10 million occurs, the bank's balance sheet becomes:

Assets		Liabilities	
Reserves	$10 million	Deposits	$90 million
Loans	$80 million	Bank capital	$10 million
Securities	$10 million		

The bank loses $10 million of deposits *and* $10 million of reserves, but since its required reserves are now 10% of only $90 million ($9 million), its reserves still exceed this amount by $1 million. In short, ***if a bank has ample reserves, a deposit outflow does not necessitate changes in other parts of its balance sheet.***

The situation is quite different when a bank holds insufficient excess reserves. Let's assume that instead of initially holding $10 million in excess reserves, the First National Bank makes loans of $10 million, so that it holds no excess reserves. Its initial balance sheet would be:

Assets		Liabilities	
Reserves	$10 million	Deposits	$100 million
Loans	$90 million	Bank capital	$ 10 million
Securities	$10 million		

When it suffers the $10 million deposit outflow, its balance sheet becomes:

Assets		Liabilities	
Reserves	$ 0	Deposits	$90 million
Loans	$90 million	Bank capital	$10 million
Securities	$10 million		

After $10 million has been withdrawn from deposits and hence reserves, the bank has a problem: It has a reserve requirement of 10% of $90 million, or $9 million, but it has no reserves! To eliminate this shortfall, the bank has four basic options. One is to acquire reserves to meet a deposit outflow by borrowing them from other banks in the federal funds market or by borrowing from corporations.1 If the First National Bank acquires the $9 million shortfall in reserves by borrowing it from other banks or corporations, its balance sheet becomes:

Assets		Liabilities	
Reserves	$ 9 million	Deposits	$90 million
Loans	$90 million	Borrowings from other	
Securities	$10 million	banks or corporations	$ 9 million
		Bank capital	$10 million

The cost of this activity is the interest rate on these borrowings, such as the federal funds rate. A second alternative is for the bank to sell some of its securities to help cover the deposit outflow. For example, it might sell $9 million of its securities and deposit the proceeds with the Fed, resulting in the following balance sheet:

Assets		Liabilities	
Reserves	$ 9 million	Deposits	$90 million
Loans	$90 million	Bank capital	$10 million
Securities	$ 1 million		

The bank incurs some brokerage and other transaction costs when it sells these securities. The U.S. government securities that are classified as secondary reserves are very liquid, so the transaction costs of selling them are quite modest. However, the other securities the bank holds are less liquid, and the transaction cost can be appreciably higher. A third way that the bank can meet a deposit outflow is to acquire reserves by borrowing from the Fed. In our example, the First National Bank could leave its security and loan holdings the same and borrow $9 million in discount loans from the Fed. Its balance sheet would be:

Assets		Liabilities	
Reserves	$ 9 million	Deposits	$90 million
Loans	$90 million	Discount loans	
Securities	$10 million	from the Fed	$ 9 million
		Bank capital	$10 million

The cost associated with discount loans is the interest rate that must be paid to the Fed (called the **discount rate**). Finally, a bank can acquire the $9 million of reserves to meet the deposit outflow by reducing its loans by this amount and depositing the $9 million it then receives with the Fed, thereby increasing its reserves by $9 million. This transaction changes the balance sheet as follows:

Assets		Liabilities	
Reserves	$ 9 million	Deposits	$90 million
Loans	$81 million	Bank capital	$10 million
Securities	$10 million		

The First National Bank is once again in good shape because its $9 million of reserves satisfies the reserve requirement. However, this process of reducing its loans is the bank's costliest way of acquiring reserves when there is a deposit outflow. If the First National Bank has numerous short-term loans renewed at fairly short intervals, it can reduce its total amount of loans outstanding fairly quickly by *calling in* loans - that is, by not renewing some loans when they come due. Unfortunately for the bank, this is likely to antagonize the customers whose loans are not being renewed because they have not done anything to deserve such treatment. Indeed, they are likely to take their business elsewhere in the future, a very costly consequence for the bank.

A second method for reducing its loans is for the bank to sell them off to other banks. Again, this is very costly because other banks do not personally know the customers who have taken out the loans and so may not be willing to buy the loans at their full value.

The foregoing discussion explains why banks hold excess reserves even though loans or securities earn a higher return. When a deposit outflow occurs, holding excess reserves allows the bank to escape the costs of (1) borrowing from other banks or corporations, (2) selling securities, (3) borrowing from the Fed, or (4) calling in or selling off loans. ***Excess reserves are insurance against the costs associated with deposit outflows. The higher the costs associated with deposit outflows, the more excess reserves banks will want to hold.***

Just as you and I would be willing to pay an insurance company to insure us against a casualty loss such as the theft of a car, a bank is willing to pay the cost of holding excess reserves (the opportunity cost, which is the earnings forgone by not holding income-earning assets such as loans or securities) in order to insure against losses due to deposit outflows. Because excess reserves, like insurance, have a cost, banks also take other steps to protect themselves; for example, they might shift their holdings of assets to more liquid securities (secondary reserves).

Liquidity Risk Strategy:

The liquidity risk strategy defined by board should enunciate specific policies on particular aspects of liquidity risk management, such as:

a. **Composition of Assets and Liabilities**. The strategy should outline the mix of assets and liabilities to maintain liquidity. Liquidity risk management and asset/liability management should be integrated to avoid steep costs associated with having to rapidly reconfigure the asset liability profile from maximum profitability to increased liquidity.

b. **Diversification and Stability of Liabilities**. A funding concentration exists when a single decision or a single factor has the potential to result in a significant and

sudden withdrawal of funds. Since such a situation could lead to an increased risk, the Board of Directors and senior management should specify guidance relating to funding sources and ensure that the bank have a diversified sources of funding day-to-day liquidity requirements. An institution would be more resilient to tight market liquidity conditions if its liabilities were derived from more stable sources. To comprehensively analyze the stability of liabilities/funding sources the bank need to identify:

– Liabilities that would stay with the institution under any circumstances;

– Liabilities that run-off gradually if problems arise; and

– That run-off immediately at the first sign of problems.

c. **Access to Inter-bank Market**. The inter-bank market can be important source of liquidity. However, the strategies should take into account the fact that in crisis situations access to inter bank market could be difficult as well as costly.

The liquidity strategy must be documented in a liquidity policy, and communicated throughout the institution. The strategy should be evaluated periodically to ensure that it remains valid.

The institutions should formulate liquidity policies, which are recommended by senior management/ALCO and approved by the Board of Directors (or head office). While specific details vary across institutions according to the nature of their business, the key elements of any liquidity policy include:

– General liquidity strategy (short- and long-term), specific goals and objectives in relation to liquidity risk management, process for strategy formulation and the level within the institution it is approved;

– Roles and responsibilities of individuals performing liquidity risk management functions, including structural balance sheet management, pricing, marketing, contingency planning, management reporting, lines of authority and responsibility for liquidity decisions;

– Liquidity risk management structure for monitoring, reporting and reviewing liquidity;

– Liquidity risk management tools for identifying, measuring, monitoring and controlling liquidity risk (including the types of liquidity limits and ratios in place and rationale for establishing limits and ratios);

– Contingency plan for handling liquidity crises.

To be effective the liquidity policy must be communicated down the line throughout in the organization. It is important that the Board and senior management/ALCO review these policies at least annually and when there are any material changes in the institution's current and prospective liquidity risk profile. Such changes could stem from internal circumstances (e.g. changes in business focus) or external circumstances (e.g. changes in economic conditions).

Reviews provide the opportunity to fine tune the institution's liquidity policies in light of the institution's liquidity management experience and development of its business. Any significant or frequent exception to the policy is an important barometer to gauge its effectiveness and any potential impact on banks liquidity risk profile.

Institutions should establish appropriate procedures and processes to implement their liquidity policies. The procedural manual should explicitly narrate the necessary operational steps and processes to execute the relevant liquidity risk controls. The manual should be periodically reviewed and updated to take into account new activities, changes in risk management approaches and systems.

Cash Flow Projections

At the basic level banks may utilize flow measures to determine their cash position. A cash flow projection estimates a bank's inflows and outflows and thus net

deficit or surplus (GAP) over a time horizon. The contingency funding plan discussed previously is one example of a cash flow projection. Not to be confused with the re-pricing gap report that measures interest rate risk, a behavioral gap report takes into account bank's funding requirement arising out of distinct sources on different time frames. A maturity ladder is a useful device to compare cash inflows and outflows both on a day-to-day basis and over a series of specified time periods. The number of time frames in such maturity ladder is of significant importance and up to some extent depends upon nature of bank's liability or sources of funds. Banks, which rely on short term funding, will concentrate primarily on managing liquidity on very short term. Whereas, other banks might actively manage their net funding requirement over a slightly longer period. In the short term, bank's flow of funds could be estimated more accurately and also such estimates are of more importance as these provide an indication of actions to be taken immediately. Further, such an analysis for distant periods will maximize the opportunity for the bank to manage the GAP well in advance before it crystallizes. Consequently banks should use short time frames to measure near term exposures and longer time frames thereafter. It is suggested that banks calculate daily GAP for next one or two weeks, monthly Gap for next six month or a year and quarterly thereafter. While making an estimate of cash flows, following aspect needs attention

a) The funding requirement arising out of off- Balance sheet commitments also need to be accounted for.

b) Many cash flows associated with various products are influenced by interest rates or customer behavior. Banks need to take into account behavioral aspects instead of contractual maturity. In this respect past experiences could give important guidance to make any assumption.

c) Some cash flows may be seasonal or cyclical.

d) Management should also consider increases or decreases in liquidity that typically occur during various phases of an economic cycle.

While the banks should have liquidity sufficient enough to meet fluctuations in loans and deposits, as a safety measure banks should maintain a margin of excess liquidity. To ensure that this level of liquidity is maintained, management should estimate liquidity needs in a variety of scenarios.

Management Information System.

An effective management information system (MIS) is essential for sound liquidity management decisions. Information should be readily available for day-to-day liquidity management and risk control, as well as during times of stress.

Data should be appropriately consolidated, comprehensive yet succinct, focused, and available in a timely manner. Ideally, the regular reports a bank generates will enable it to monitor liquidity during a crisis; managers would simply have to prepare the reports more frequently. Managers should keep crisis monitoring in mind when developing liquidity MIS. There is usually a trade -off between accuracy and timeliness. Liquidity problems can arise very quickly, and effective liquidity management may require daily internal reporting. Since bank liquidity is primarily affected by large, aggregate principal cash flows, detailed information on every transaction may not improve analysis.

Management should develop systems that can capture significant information. The content and format of reports depend on a bank's liquidity management practices, risks, and other characteristics. However, certain information can be effectively presented through standard reports such as "Funds Flow Analysis," and "Contingency Funding Plan Summary". These reports should be tailored to the bank's needs. Other routine reports may include a list of large funds providers, a cash flow or funding gap report, a funding maturity schedule, and a limit monitoring and exception report. Day-to-day management

may require more detailed information, depending on the complexity of the bank and the risks it undertakes. Management should regularly consider how best to summarize complex or detailed issues for senior management or the board.

Beside s other types of information important for managing day-to-day activities and for understanding the bank's inherent liquidity risk profile include:

a) Asset quality and its trends.

b) Earnings projections.

c) The bank's general reputation in the market and the condition of the market itself.

d) The type and composition of the overall balance sheet structure.

e) The type of new deposits being obtained, as well as its source, maturity, and price.

As far as information system is concerned, various units related to treasury activities, the dealing, the treasury operation & risk management cell/department should be integrated. Furthermore, management should ensure proper and timely flow of information among front office, back office and middle office in an integrated manner; however, their reporting lines should be kept separate to ensure independence of these functions.

QUESTIONS AND TASKS

1**.** Rank the following bank assets from most to least liquid:

a. Commercial loans

b. Securities

c. Reserves

d. Physical capital

2. The bank you own has the following balance sheet:

Assets		Liabilities	
Reserves	$ 75 million	Deposits	$500 million
Loans	$525 million	Bank capital	$100 million

If the bank suffers a deposit outflow of $50 million with a required reserve ratio on deposits of 10%, what actions must you take to keep your bank from failing?

3. If a deposit outflow of $50 million occurs, which balance sheet would a bank rather have initially, the balance sheet in Problem 2 or the following balance sheet? Why?

Assets		Liabilities	
Reserves	$100 million	Deposits	$500 million
Loans	$500 million	Bank capital	$100 million

4. Why has the development of overnight loan markets made it more likely that banks will hold fewer excess reserves?

5**.** If the bank you own has no excess reserves and a sound customer comes in asking for a loan, should you automatically turn the customer down, explaining that you don’t have any excess reserves to lend out? Why or why not? What options are available for you to provide the funds your customer needs?

UNIT 5. ASSET AND LIABILITY MANAGEMENT

The bank manager must pursue an acceptably low level of risk by acquiring assets that have a low rate of default and by diversifying asset holdings (**asset management**). The second concern is to acquire funds at low cost (**liability management**). Finally, the manager must decide the amount of capital the bank should maintain and then acquire the needed capital (**capital adequacy management**).

To understand bank and other financial institution management fully, we must go beyond the general principles of bank asset and liability management described next and look in more detail at how a financial institution manages its assets.

Asset management. Now that you understand why a bank has a need for liquidity, we can examine the basic strategy a bank pursues in managing its assets. To maximize its profits, a bank must simultaneously seek the highest returns possible on loans and securities, reduce risk, and make adequate provisions for liquidity by holding liquid assets. Banks try to accomplish these three goals in four basic ways.

First, banks try to find borrowers who will pay high interest rates and are unlikely to default on their loans. They seek out loan business by advertising their borrowing rates and by approaching corporations directly to solicit loans. It is up to the bank's loan officer to decide if potential borrowers are good credit risks who will make interest and principal payments on time (i.e., engage in screening to reduce the adverse selection problem). Typically, banks are conservative in their loan policies; the default rate is usually less than 1%. It is important, however, that banks not be so conservative that they miss out on attractive lending opportunities that earn high interest rates.

Second, banks try to purchase securities with high returns and low risk. Third, in managing their assets, banks must attempt to lower risk by diversifying. They accomplish this by purchasing many different types of assets (short- and long-term, U.S. Treasury, and municipal bonds) and approving many types of loans to a number of customers. Banks that have not sufficiently sought the benefits of diversification often come to regret it later. For example, banks that had overspecialized in making loans to energy companies, real estate developers, or farmers suffered huge losses in the 1980s with the slump in energy, property, and farm prices. Indeed, many of these banks went broke because they had "put too many eggs in one basket."

Finally, the bank must manage the liquidity of its assets so that it can satisfy its reserve requirements without bearing huge costs. This means that it will hold liquid securities even if they earn a somewhat lower return than other assets. The bank must decide, for example, how much in excess reserves must be held to avoid costs from a deposit outflow. In addition, it will want to hold U.S. government securities as secondary reserves so that even if a deposit outflow forces some costs on the bank, these will not be terribly high. Again, it is not wise for a bank to be too conservative. If it avoids all costs associated with deposit outflows by holding only excess reserves, losses are suffered because reserves earn no interest, while the bank's liabilities are costly to maintain. The bank must balance its desire for liquidity against the increased earnings that can be obtained from less liquid assets such as loans.

Liability Management. Before the 1960s, liability management was a staid affair: For the most part, banks took their liabilities as fixed and spent their time trying to achieve an optimal mix of assets. There were two main reasons for the emphasis on asset management. First, over 60% of the sources of bank funds were obtained through checkable (demand) deposits that by law could not pay any interest. Thus banks could

not actively compete with one another for these deposits by paying interest on them, and so their amount was effectively a given for an individual bank. Second, because the markets for making overnight loans between banks were not well developed, banks rarely borrowed from other banks to meet their reserve needs.

Starting in the 1960s, however, large banks (called **money center banks**) in key financial centers, such as New York, Chicago, and San Francisco, began to explore ways in which the liabilities on their balance sheets could provide them with reserves and liquidity. This led to an expansion of overnight loan markets, such as the federal funds market, and the development of new financial instruments such as negotiable CDs (first developed in 1961), which enabled money center banks to acquire funds quickly.

This new flexibility in liability management meant that banks could take a different approach to bank management. They no longer needed to depend on checkable deposits as the primary source of bank funds and as a result no longer treated their sources of funds (liabilities) as given. Instead, they aggressively set target goals for their asset growth and tried to acquire funds (by issuing liabilities) as they were needed. For example, today, when a money center bank finds an attractive loan opportunity, it can acquire funds by selling a negotiable CD. Or, if it has a reserve shortfall, funds can be borrowed from another bank in the federal funds market without incurring high transaction costs. The federal funds market can also be used to finance loans. Because of the increased importance of liability management, most banks now manage both sides of the balance sheet together in a so-called asset–liability management (ALM) committee.

The emphasis on liability management explains some of the important changes over the past three decades in the composition of banks' balance sheets. While negotiable CDs and bank borrowings have greatly increased in importance as a source of bank funds in recent years (rising from 2% of bank liabilities in 1960 to 42% by the end of 2002), checkable deposits have decreased in importance (from 61% of bank liabilities in 1960 to 9% in 2002). Newfound flexibility in liability management and the search for higher profits have also stimulated banks to increase the proportion of their assets held in loans, which earn higher income (from 46% of bank assets in 1960 to 64% in 2002).

Capital Adequacy Management. Banks have to make decisions about the amount of capital they need to hold for three reasons. First, bank capital helps prevents *bank failure*, a situation in which the bank cannot satisfy its obligations to pay its depositors and other creditors and so goes out of business. Second, the amount of capital affects returns for the owners (equity holders) of the bank. And third, a minimum amount of bank capital (bank capital requirements) is required by regulatory authorities.

How Bank Capital Helps Prevent Bank Failure. Let's consider two banks with identical balance sheets, except that the High Capital Bank has a ratio of capital to assets of 10% while the Low Capital Bank has a ratio of 4%.

HIGH CAPITAL BANK

Assets		Liabilities	
Reserves	$10 million	Deposits	$90 million
Loans	$90 million	Bank capital	$10 million

LOW CAPITAL BANK

Assets		Liabilities	
Reserves	$10 million	Deposits	$96 million
Loans	$90 million	Bank capital	$ 4 million

Suppose that both banks get caught up in the euphoria of the telecom market, only to find that $5 million of their telecom loans became worthless later. When these bad loans are written off (valued at zero), the total value of assets declines by $5 million, and so bank capital, which equals total assets minus liabilities, also declines by $5 million. The balance sheets of the two banks now look like this:

HIGH CAPITAL BANK

Assets		Liabilities	
Reserves	$10 million	Deposits	$90 million
Loans	$85 million	Bank capital	$ 5 million

LOW CAPITAL BANK

Assets		Liabilities	
Reserves	$10 million	Deposits	$96 million
Loans	$85 million	Bank capital	−$ 1 million

The High Capital Bank takes the $5 million loss in stride because its initial cushion of $10 million in capital means that it still has a positive net worth (bank capital) of $5 million after the loss. The Low Capital Bank, however, is in big trouble. Now the value of its assets has fallen below its liabilities, and its net worth is now - $1 million.

Because the bank has a negative net worth, it is insolvent: It does not have sufficient assets to pay off all holders of its liabilities (creditors). When a bank becomes insolvent, government regulators close the bank, its assets are sold off, and its managers are fired. Since the owners of the Low Capital Bank will find their investment wiped out, they would clearly have preferred the bank to have had a large enough cushion of bank capital to absorb the losses, as was the case for the High Capital Bank. We therefore see an important rationale for a bank to maintain a high level of capital: ***A bank maintains bank capital to lessen the chance that it will become insolvent.***

How the Amount of Bank Capital Affects Returns to Equity Holders. Because owners of a bank must know whether their bank is being managed well, they need good measures of bank profitability. A basic measure of bank profitability is the **return on assets (ROA)**, the net profit after taxes per dollar of assets:

$$\text{ROA} = \frac{\text{net profit after taxes}}{\text{assets}}$$

The return on assets provides information on how efficiently a bank is being run, because it indicates how much profits are generated on average by each dollar of assets. However, what the bank's owners (equity holders) care about most is how much the bank is earning on their equity investment. This information is provided by the other basic measure of bank profitability, the **return on equity (ROE)**, the net profit after taxes per dollar of equity (bank) capital:

$$\text{ROE} = \frac{\text{net profit after taxes}}{\text{equity capital}}$$

There is a direct relationship between the return on assets (which measures how efficiently the bank is run) and the return on equity (which measures how well the owners are doing on their investment). This relationship is determined by the so-called **equity multiplier (EM)**, which is the amount of assets per dollar of equity capital:

$$\text{EM} = \frac{\text{assets}}{\text{equity capital}}$$

To see this, we note that:

$$\frac{\text{net profit after taxes}}{\text{equity capital}} = \frac{\text{net profit after taxes}}{\text{assets}} \times \frac{\text{assets}}{\text{equity capital}}$$

which, using our definitions, yields:

$$\text{ROE} = \text{ROA} \times \text{EM} \qquad (1)$$

The formula in Equation 1 tells us what happens to the return on equity when a bank holds a smaller amount of capital (equity) for a given amount of assets. As we have seen, the High Capital Bank initially has $100 million of assets and $10 million of equity, which gives it an equity multiplier of 10 (= $100 million/$10 million). The Low Capital Bank, by contrast, has only $4 million of equity, so its equity multiplier is higher, equaling 25 (= $100 million/$4 million). Suppose that these banks have been equally well run so that they both have the same return on assets, 1%. The return on equity for the High Capital Bank equals 1% * 10 = 10%, while the return on equity for the Low Capital Bank equals 1% * 25 = 25%. The equity holders in the Low Capital Bank are clearly a lot happier than the equity holders in the High Capital Bank because they are earning more than twice as high a return. We now see why owners of a bank may not want it to hold too much capital. ***Given the return on assets, the lower the bank capital, the higher the return for the owners of the bank.***

Trade-off Between Safety and Returns to Equity Holders. We now see that bank capital has benefits and costs. Bank capital benefits the owners of a bank in that it makes their investment safer by reducing the likelihood of bankruptcy. But bank capital is costly because the higher it is, the lower will be the return on equity for a given return on assets. In determining the amount of bank capital, managers must decide how much of

the increased safety that comes with higher capital (the benefit) they are willing to trade off against the lower return on equity that comes with higher capital (the cost). In more uncertain times, when the possibility of large losses on loans increases, bank managers might want to hold more capital to protect the equity holders. Conversely, if they have confidence that loan losses won't occur, they might want to reduce the amount of bank capital, have a high equity multiplier, and thereby increase the return on equity.

Bank Capital Requirements. Banks also hold capital because they are required to do so by regulatory authorities. Because of the high costs of holding capital for the reasons just described, bank managers often want to hold less bank capital relative to assets than is required by the regulatory authorities. In this case, the amount of bank capital is determined by the bank capital requirements.

QUESTIONS AND TASKS

1. If a bank finds that its ROE is too low because it has too much bank capital, what can it do to raise its ROE?
2. If a bank is falling short of meeting its capital requirements by $1 million, what three things can it do to rectify the situation?
3. Expand meaning of the term equity multiplier.
4. Expand meaning of the term return on equity.
5. Expand meaning of the term return on assets.

UNIT 6. MANAGING CREDIT RISK

The two sections following this one provide an in-depth discussion of how a financial institution manages **credit risk**, the risk arising because borrowers may default, and how it manages **interest-rate risk**, the riskiness of earnings and returns on bank assets that results from interest-rate changes.

Screening and Monitoring. Asymmetric information is present in loan markets because lenders have less information about the investment opportunities and activities of borrowers than borrowers do. This situation leads to two information-producing activities by banks and other financial institutions—screening and monitoring. Indeed, Walter Wriston, a former head of Citicorp, the largest bank corporation in the United States, was often quoted as stating that the business of banking is the production of information.

Screening. Adverse selection in loan markets requires that lenders screen out the bad credit risks from the good ones so that loans are profitable to them. To accomplish effective screening, lenders must collect reliable information from prospective borrowers. Effective screening and information collection together form an important principle of credit risk management.

When you apply for a consumer loan (such as a car loan or a mortgage to purchase a house), the first thing you are asked to do is fill out forms that elicit a great deal of information about your personal finances. You are asked about your salary, your bank accounts and other assets (such as cars, insurance policies, and furnishings), and your outstanding loans; your record of loan, credit card, and charge account repayments; the number of years you've worked and who your employers have been. You also are asked personal questions such as your age, marital status, and number of children. The lender uses this information to evaluate how good a credit risk you are by calculating your "credit score," a statistical measure derived from your answers that predicts whether you are likely to have trouble making your loan payments.

Deciding on how good a risk you are cannot be entirely scientific, so the lender must also use judgment. The loan officer, whose job is to decide whether you should be given the loan, might call your employer or talk to some of the personal references you supplied. The officer might even make a judgment based on your demeanor or your appearance. (This is why most people dress neatly and conservatively when they go to a bank to apply for a loan.)

The process of screening and collecting information is similar when a financial institution makes a business loan. It collects information about the company's profits and losses (income) and about its assets and liabilities. The lender also has to evaluate the likely future success of the business. So in addition to obtaining information on such items as sales figures, a loan officer might ask questions about the company's future plans, how the loan will be used, and the competition in the industry. The officer may even visit the company to obtain a firsthand look at its operations. The bottom line is that, whether for personal or business loans, bankers and other financial institutions need to be nosy.

Specialization in Lending. One puzzling feature of bank lending is that a bank often specializes in lending to local firms or to firms in particular industries, such as energy. In one sense, this behavior seems surprising, because it means that the bank is not diversifying its portfolio of loans and thus is exposing itself to more risk. But from another perspective, such specialization makes perfect sense. The adverse selection

problem requires that the bank screen out bad credit risks. It is easier for the bank to collect information about local firms and determine their creditworthiness than to collect comparable information on firms that are far away. Similarly, by concentrating its lending on firms in specific industries, the bank becomes more knowledgeable about these industries and is therefore better able to predict which firms will be able to make timely payments on their debt.

Monitoring and Enforcement of Restrictive Covenants. Once a loan has been made, the borrower has an incentive to engage in risky activities that make it less likely that the loan will be paid off. To reduce this moral hazard, financial institutions must adhere to the principle for managing credit risk that a lender should write provisions (restrictive covenants) into loan contracts that restrict borrowers from engaging in risky activities. By monitoring borrowers' activities to see whether they are complying with the restrictive covenants and by enforcing the covenants if they are not, lenders can make sure that borrowers are not taking on risks at their expense. The need for banks and other financial institutions to engage in screening and monitoring explains why they spend so much money on auditing and information-collecting activities.

An additional way for banks and other financial institutions to obtain information about their borrowers is through long-term customer relationships, another important principle of credit risk management.

If a prospective borrower has had a checking or savings account or other loans with a bank over a long period of time, a loan officer can look at past activity on the accounts and learn quite a bit about the borrower. The balances in the checking and savings accounts tell the banker how liquid the potential borrower is and at what time of year the borrower has a strong need for cash. A review of the checks the borrower has written reveals the borrower's suppliers. If the borrower has borrowed previously from the bank, the bank has a record of the loan payments. Thus long-term customer relationships reduce the costs of information collection and make it easier to screen out bad credit risks.

The need for monitoring by lenders adds to the importance of long-term customer relationships. If the borrower has borrowed from the bank before, the bank has already established procedures for monitoring that customer. Therefore, the costs of monitoring long-term customers are lower than those for new customers.

Long-term relationships benefit the customers as well as the bank. A firm with a previous relationship will find it easier to obtain a loan at a low interest rate because the bank has an easier time determining if the prospective borrower is a good credit risk and incurs fewer costs in monitoring the borrower.

A long-term customer relationship has another advantage for the bank. No bank can think of every contingency when it writes a restrictive covenant into a loan contract; there will always be risky borrower activities that are not ruled out. However, what if a borrower wants to preserve a long-term relationship with a bank because it will be easier to get future loans at low interest rates? The borrower then has the incentive to avoid risky activities that would upset the bank, even if restrictions on these risky activities are not specified in the loan contract. Indeed, if a bank doesn't like what a borrower is doing even when the borrower isn't violating any restrictive covenants, it has some power to discourage the borrower from such activity: The bank can threaten not to let the borrower have new loans in the future. Long-term customer relationships therefore enable banks to deal with even unanticipated moral hazard contingencies.

Loan Commitments. Banks also create long-term relationships and gather information by issuing **loan commitments** to commercial customers. A loan commitment is a bank's commitment (for a specified future period of time) to provide a firm with

loans up to a given amount at an interest rate that is tied to some market interest rate. The majority of commercial and industrial loans are made under the loan commitment arrangement.

The advantage for the firm is that it has a source of credit when it needs it. The advantage for the bank is that the loan commitment promotes a long-term relationship, which in turn facilitates information collection. In addition, provisions in the loan commitment agreement require that the firm continually supply the bank with information about the firm's income, asset and liability position, business activities, and soon. A loan commitment arrangement is a powerful method for reducing the bank's costs for screening and information collection.

Collateral and Compensating Balances. Collateral requirements for loans are important credit risk management tools. Collateral, which is property promised to the lender as compensation if the borrower defaults, lessens the consequences of adverse selection because it reduces the lender's losses in the case of a loan default. If a borrower defaults on a loan, the lender can sell the collateral and use the proceeds to make up for its losses on the loan. One particular form of collateral required when a bank makes commercial loans is called **compensating balances**: A firm receiving a loan must keep a required minimum amount of funds in a checking account at the bank. For example, a business getting a $10 million loan may be required to keep compensating balances of at least $1 million in its checking account at the bank. This $1 million in compensating balances can then be taken by the bank to make up some of the losses on the loan if the borrower defaults. Besides serving as collateral, compensating balances help increase the likelihood that a loan will be paid off. They do this by helping the bank monitor the borrower and consequently reduce moral hazard. Specifically, by requiring the borrower to use a checking account at the bank, the bank can observe the firm's check payment practices, which may yield a great deal of information about the borrower's financial condition.

For example, a sustained drop in the borrower's checking account balance may signal that the borrower is having financial trouble, or account activity may suggest that the borrower is engaging in risky activities; perhaps a change in suppliers means that the borrower is pursuing new lines of business. Any significant change in the borrower's payment procedures is a signal to the bank that it should make inquiries. Compensating balances therefore make it easier for banks to monitor borrowers more effectively and are another important credit risk management tool.

Credit Rationing. Another way in which financial institutions deal with adverse selection and moral hazard is through **credit rationing**: refusing to make loans even though borrowers are willing to pay the stated interest rate or even a higher rate. Credit rationing takes two forms. The first occurs when a lender refuses to make a loan *of any amount* to a borrower, even if the borrower is willing to pay a higher interest rate. The second occurs when a lender is willing to make a loan but restricts the size of the loan to less than the borrower would like.

At first you might be puzzled by the first type of credit rationing. After all, even if the potential borrower is a credit risk, why doesn't the lender just extend the loan but at a higher interest rate? The answer is that adverse selection prevents this solution. Individuals and firms with the riskiest investment projects are exactly those that are willing to pay the highest interest rates. If a borrower took on a high-risk investment and succeeded, the borrower would become extremely rich. But a lender wouldn't want to make such a loan precisely because the investment risk is high; the likely outcome is that the borrower will *not* succeed and the lender will not be paid back.

Charging a higher interest rate just makes adverse selection worse for the lender;

that is, it increases the likelihood that the lender is lending to a bad credit risk. The lender would therefore rather not make any loans at a higher interest rate; instead, it would engage in the first type of credit rationing and would turn down loans. Financial institutions engage in the second type of credit rationing to guard against moral hazard: They grant loans to borrowers, but not loans as large as the borrowers want. Such credit rationing is necessary because the larger the loan, the greater the benefits from moral hazard. If a bank gives you a $1,000 loan, for example, you are likely to take actions that enable you to pay it back because you don't want to hurt your credit rating for the future. However, if the bank lends you $10 million, you are more likely to fly down to Rio to celebrate. The larger your loan, the greater your incentives to engage in activities that make it less likely that you will repay the loan. Since more borrowers repay their loans if the loan amounts are small, financial institutions ration credit by providing borrowers with smaller loans than they seek.

Measuring credit risk.

The measurement of credit risk is of vital importance in credit risk management. A number of qualitative and quantitative techniques to measure risk inherent in credit portfolio are evolving. To start with, banks should establish a credit risk rating framework across all type of credit activities. Among other things, the rating framework may, incorporate:

Business Risk
– Industry Characteristics
– Competitive Position (e.g. marketing/technological edge)
– Management
Financial Risk
– Financial condition
– Profitability
– Capital Structure
– Present and future Cash flows

Internal Risk Rating.

Credit risk rating is summary indicator of a bank's individual credit exposure. An internal rating system categorizes all credits into various classes on the basis of underlying credit quality. A well-structured credit rating framework is an important tool for monitoring and controlling risk inherent in individual credits as well as in credit portfolios of a bank or a business line. The importance of internal credit rating framework becomes more eminent due to the fact that historically major losses to banks stemmed from default in loan portfolios. While a number of banks already have a system for rating individual credits in addition to the risk categories prescribed by SBP, all banks are encouraged to devise an internal rating framework. An internal rating framework would facilitate banks in a number of ways such as

a) Credit selection
b) Amount of exposure
c) Tenure and price of facility
d) Frequency or intensity of monitoring
e) Analysis of migration of deteriorating credits and more accurate computation of future loan loss provision
f) Deciding the level of Approving authority of loan.

Managing credit risk

The Architecture of internal rating system.

The decision to deploy any risk rating architecture for credits depends upon two basic aspects

a) The Loss Concept and the number and meaning of grades on the rating continuum corresponding to each loss concept.

b) Whether to rate a borrower on the basis of 'point in time philosophy' or 'through the cycle approach.

Besides there are other issues such as whether to include statutory grades in the scale, the type of rating scale i.e. alphabetical numerical or alpha-numeric etc. SBP does not advocate any particular credit risk rating system; it should be banks own choice. However the system should commensurate with the size, nature and complexity of their business as well as possess flexibility to accommodate present and future risk profile of the bank, the anticipated level of diversification and sophistication in lending activities.

A rating system with large number of grades on rating scale becomes more expensive due to the fact that the cost of obtaining and analyzing additional information for fine gradation increase sharply. However, it is important that there should be sufficient gradations to permit accurate characterization of the under lying risk profile of a loan or a portfolio of loans.

The operating Design of Rating System.

As with the decision to grant credit, the assignment of ratings always involve element of human judgment. Even sophisticated rating models do not replicate experience and judgment rather these techniques help and reinforce subjective judgment. Banks thus design the operating flow of the rating process in a way that is aimed promoting the accuracy and consistency of the rating system while not unduly restricting the exercise of judgment. Key issues relating to the operating design of a rating system include what exposures to rate; the organization's division of responsibility for grading; the nature of ratings review; the formality of the process and specificity of formal rating definitions.

What Exposures are rated?

Ideally all the credit exposures of the bank should be assigned a risk rating. However given the element of cost, it might not be feasible for all banks to follow. The banks may decide on their own which exposure needs to be rated. The decision to rate a particular loan could be based on factors such as exposure amount, business line or both. Generally corporate and commercial exposures are subject to internal ratings and banks use scoring models for consumer/retail loans.

The rating process in relation to credit approval and review.

Ratings are generally assigned /reaffirmed at the time of origination of a loan or its renewal /enhancement. The analysis supporting the ratings is inseparable from that required for credit appraisal. In addition the rating and loan analysis process while being separate are intertwined. The process of assigning a rating and its approval / confirmation goes along with the initiation of a credit proposal and its approval. Generally loan origination function (whether a relationship manager or credit staff) initiates a loan proposal and also allocates a specific rating. This proposal passes through the credit approval process and the rating is also approved or recalibrated simultaneously by approving authority. The revision in the ratings can be used to upgrade the rating system and related guidelines.

How to arrive at ratings

The assignment of a particular rating to an exposure is basically an abbreviation of its overall risk profile. Theoretically ratings are based upon the major risk factors and their intensity inherent in the business of the borrower as well as key parameters and their intensity to those risk factors. Major risk factors include borrowers financial condition, size, industry and position in the industry; the reliability of financial statements of the borrower; quality of management; elements of transaction structure

such as covenants etc. A more detail on the subject would be beyond the scope of these guidelines, however a few important aspects are

a) Banks may vary somewhat in the particular factors they consider and the weight they give to each factor.

b) Since the rater and reviewer of rating should be following the same basic thought, to ensure uniformity in the assignment and review of risk grades, the credit policy should explicitly define each risk grade; lay down criteria to be fulfilled while assigning a particular grade, as well as the circumstances under which deviations from criteria can take place.

c) The credit policy should also explicitly narrate the roles of different parties involved in the rating process.

d) The institution must ensure that adequate training is imparted to staff to ensure uniform ratings

e) Assigning a Rating is basically a judgmental exercise and the models, external ratings and written guidelines/benchmarks serve as input.

f) Institutions should take adequate measures to test and develop a risk rating system prior to adopting one. Adequate validation testing should be conducted during the design phase as well as over the life of the system to ascertain the applicability of the system to the institution's portfolio.

Institutions that use sophisticated statistical models to assign ratings or to calculate probabilities of default, must ascertain the applicability of these models to their portfolios. Even when such statistical models are found to be satisfactory, institutions should not use the output of such models as the sole criteria for assigning ratings or determining the probabilities of default. It would be advisable to consider other relevant inputs as well.

Ratings review. The rating review can be two-fold:

a) Continuous monitoring by those who assigned the rating. The Relationship Managers (RMs) generally have a close contact with the borrower and are expected to keep an eye on the financial stability of the borrower. In the event of any deterioration the ratings are immediately revised /reviewed.

b) Secondly the risk review functions of the bank or business lines also conduct periodical review of ratings at the time of risk review of credit portfolio.

Risk ratings should be assigned at the inception of lending, and updated at least annually. Institutions should, however, review ratings as and when adverse events occur. A separate function independent of loan origination should review Risk ratings. As part of portfolio monitoring, institutions should generate reports on credit exposure by risk grade. Adequate trend and migration analysis should also be conducted to identify any deterioration in credit quality. Institutions may establish limits for risk grades to highlight concentration in particular rating bands. It is important that the consistency and accuracy of ratings is examined periodically by a function such as an independent credit review group

For consumer lending, institutions may adopt credit-scoring models for processing loan applications and monitoring credit quality. Institutions should apply the above principles in the management of scoring models. Where the model is relatively new, institutions should continue to subject credit applications to rigorous review until the model has stabilized.

QUESTIONS AND TASKS

1. Why is being nosy a desirable trait for a banker?
2. A bank almost always insists that the firms it lends to keep compensating

balances at the bank. Why?

3. “Because diversification is a desirable strategy for avoiding risk, it never makes sense for a bank to specialize in making specific types of loans.” Is this statement true, false, or uncertain? Explain your answer.

UNIT 7 MANAGING INTEREST-RATE RISK

With the increased volatility of interest rates that occurred in the 1980s, banks and other financial institutions became more concerned about their exposure to interestrate risk, the riskiness of earnings and returns that is associated with changes in interest rates. To see what interest-rate risk is all about, let's again take a look at the First National Bank, which has the following balance sheet:

Assets		Liabilities	
Rate-sensitive assets	$20 million	Rate-sensitive liabilities	$50 million
Variable-rate and short-term loans		Variable-rate CDs	
Short-term securities		Money market deposit accounts	
Fixed-rate assets	$80 million	Fixed-rate liabilities	$50 million
Reserves		Checkable deposits	
Long-term loans		Savings deposits	
Long-term securities		Long-term CDs	
		Equity capital	

A total of $20 million of its assets are rate-sensitive, with interest rates that change frequently (at least once a year), and $80 million of its assets are fixed-rate, with interest rates that remain unchanged for a long period (over a year). On the liabilities side, the First National Bank has $50 million of rate-sensitive liabilities and $50 million of fixed-rate liabilities. Suppose that interest rates rise by 5 percentage points on average, from 10% to 15%. The income on the assets rises by $1 million (= 5% * $20 million of rate-sensitive assets), while the payments on the liabilities rise by $2.5 million (= 5% * $50 million of rate-sensitive liabilities). The First National Bank's profits now decline by $1.5 million (= $1 million - $2.5 million). Conversely, if interest rates fall by 5 percentage points, similar reasoning tells us that the First National Bank's profits rise by $1.5 million. This example illustrates the following point: ***If a bank has more rate-sensitive liabilities than assets, a rise in interest rates will reduce bank profits and a decline in interest rates will raise bank profits.***

Gap and Duration Analysis. The sensitivity of bank profits to changes in interest rates can be measured more directly using **gap analysis**, in which the amount of rate-sensitive liabilities is subtracted from the amount of rate-sensitive assets. In our example, this calculation (called the "gap") is -$30 million (= $20 million - $50 million). By multiplying the gap times the change in the interest rate, we can immediately obtain the effect on bank profits. For example, when interest rates rise by 5 percentage points, the change in profits is 5% * (-$30) million, which equals -$1.5 million, as we saw.

The analysis we just conducted is known as *basic gap analysis*, and it can be refined in two ways. Clearly, not all assets and liabilities in the fixed-rate category have the same maturity. One refinement, the *maturity bucket approach*, is to measure the gap for several maturity subintervals, called *maturity buckets*, so that effects of interest-rate changes over a multiyear period can be calculated. The second refinement, called *standardized gap analysis*, accounts for the differing degrees of rate sensitivity for different rate-sensitive assets and liabilities.

An alternative method for measuring interest-rate risk, called **duration analysis**, examines the sensitivity of the market value of the bank's total assets and liabilities to changes in interest rates. Duration analysis is based on what is known as Macaulay's concept of *duration*, which measures the average lifetime of a security's stream of

payments. Duration is a useful concept because it provides a good approximation of the sensitivity of a security's market value to a change in its interest rate:

percent change in market value of security ≈
- percentage-point change in interest rate Ч duration in years

where ≈ denotes "approximately equals."

Duration analysis involves using the average (weighted) duration of a financial institution's assets and of its liabilities to see how its net worth responds to a change in interest rates. Going back to our example of the First National Bank, suppose that the average duration of its assets is three years (that is, the average lifetime of the stream of payments is three years), while the average duration of its liabilities is two years. In addition, the First National Bank has $100 million of assets and $90 million of liabilities, so its bank capital is 10% of assets. With a 5-percentage-point increase in interest rates, the market value of the bank's assets falls by 15% (= (-5)% * 3 years), a decline of $15 million on the $100 million of assets. However, the market value of the liabilities falls by 10% (= 5% * 2 years), a decline of $9 million on the $90 million of liabilities. The net result is that the net worth (the market value of the assets minus the liabilities) has declined by $6 million, or 6% of the total original asset value. Similarly, a 5-percentage-point decline in interest rates increases the net worth of the First National Bank by 6% of the total asset value.

As our example makes clear, both duration analysis and gap analysis indicate that the First National Bank will suffer if interest rates rise but will gain if they fall. Duration analysis and gap analysis are thus useful tools for telling a manager of a financial institution its degree of exposure to interest-rate risk.

Strategies for Managing Interest-Rate Risk. Suppose that as the manager of the First National Bank, you have done a duration and gap analysis for the bank as discussed in the text. Now you need to decide what alternative strategies you should pursue to manage the interest-rate risk.

If you firmly believe that interest rates will fall in the future, you may be willing to take no action because you know that the bank has more rate sensitive liabilities than rate-sensitive assets and so will benefit from the expected interest-rate decline. However, you also realize that the First National Bank is subject to substantial interest-rate risk because there is always a possibility that interest rates will rise rather than fall. What should you do to eliminate this interest-rate risk? One thing you could do is to shorten the duration of the bank's assets to increase their rate sensitivity.

Alternatively, you could lengthen the duration of the liabilities. By this adjustment of the bank's assets and liabilities, the bank's income will be less affected by interest-rate swings.

One problem with eliminating the First National Bank's interest-rate risk by altering the balance sheet is that doing so might be very costly in the short run. The bank may be locked in to assets and liabilities of particular durations because of where its expertise lies. Fortunately, recently developed financial instruments known as financial derivatives - financial forwards and futures, options, and swaps - can help the bank reduce its interest-rate risk exposure but do not require that the bank rearrange its balance sheet.

Off-Balance-Sheet Activities. Although asset and liability management has traditionally been the major concern of banks, in the more competitive environment of recent years banks have been aggressively seeking out profits by engaging in off-balance-sheet activities.

Off-balancesheet activities involve trading financial instruments and generating income from fees and loan sales, activities that affect bank profits but do not appear on bank balance sheets. Indeed, off-balance-sheet activities have been growing in importance for banks: The income from these activities as a percentage of assets has nearly doubled since 1980.

Loan Sales. One type of off-balance-sheet activity that has grown in importance in recent years involves income generated by loan sales. A **loan sale**, also called a *secondary loan participation*, involves a contract that sells all or part of the cash stream from a specific loan and thereby removes the loan from the bank's balance sheet. Banks earn profits by selling loans for an amount slightly greater than the amount of the original loan. Because the high interest rate on these loans makes them attractive, institutions are willing to buy them, even though the higher price means that they earn a slightly lower interest rate than the original interest rate on the loan, usually on the order of 0.15 percentage point.

Generation of Fee Income. Another type of off-balance-sheet activity involves the generation of income from fees that banks receive for providing specialized services to their customers, such as making foreign exchange trades on a customer's behalf, servicing a mortgage-backed security by collecting interest and principal payments and then paying them out, guaranteeing debt securities such as banker's acceptances (by which the bank promisesto make interest and principal payments if the party issuing the security cannot), and providing backup lines of credit. There are several types of backup lines of credit. We have already mentioned the most important, the loan commitment, under which for a fee the bank agrees to provide a loan at the customer's request, up to a given dollar amount, over a specified period of time. Credit lines are also now available to bank depositors with "overdraft privileges"—these bank customers can write checks in excess of their deposit balances and, in effect, write themselves a loan. Other lines of credit for which banks get fees include standby letters of credit to back up issues of commercial paper and other securities and credit lines (called *note issuance facilities*, NIFs, and *revolving underwriting facilities*, RUFs) for underwriting Euronotes, which are medium-term Eurobonds.

Off-balance-sheet activities involving guarantees of securities and backup credit lines increase the risk a bank faces. Even though a guaranteed security does not appear on a bank balance sheet, it still exposes the bank to default risk: If the issuer of the security defaults, the bank is left holding the bag and must pay off the security's owner. Backup credit lines also expose the bank to risk because the bank may be forced to provide loans when it does not have sufficient liquidity or when the borrower is a very poor credit risk.

Trading Activities and Risk Management Techniques. We have already mentioned that banks' attempts to manage interest-rate risk led them to trading in financial futures, options for debt instruments, and interest-rate swaps.

Banks engaged in international banking also conduct transactions in the foreign exchange market. All transactions in these markets are off-balance-sheet activities because they do not have a direct effect on the bank's balance sheet. Although bank trading in these markets is often directed toward reducing risk or facilitating other bank business, banks also try to outguess the markets and engage in speculation. This speculation can be a very risky business and indeed has led to bank insolvencies, the most dramatic being the failure of Barings, a British bank, in 1995.

Trading activities, although often highly profitable, are dangerous because they make it easy for financial institutions and their employees to make huge bets quickly.

A particular problem for management of trading activities is that the

principal-agent problem, discussed in Chapter 8, is especially severe. Given the ability to place large bets, a trader (the agent), whether she trades in bond markets, in foreign exchange markets or in financial derivatives, has an incentive to take on excessive risks: If her trading strategy leads to large profits, she is likely to receive a high salary and bonuses, but if she takes large losses, the financial institution (the principal) will have to cover them. As the Barings Bank failure in 1995 so forcefully demonstrated, a trader subject to the principal–agent problem can take an institution that is quite healthy and drive it into insolvency very fast.

To reduce the principal–agent problem, managers of financial institutions must set up internal controls to prevent debacles like the one at Barings. Such controls include the complete separation of the people in charge of trading activities from those in charge of the bookkeeping for trades. In addition, managers must set limits on the total amount of traders' transactions and on the institution's risk exposure.

Managers must also scrutinize risk assessment procedures using the latest computer technology. One such method involves the so-called value-at-risk approach. In this approach, the institution develops a statistical model with which it can calculate the maximum loss that its portfolio is likely to sustain over a given time interval, dubbed

the value at risk, or VAR. For example, a bank might estimate that the maximum loss it would be likely to sustain over one day with a probability of 1 in 100 is $1 million; the $1 million figure is the bank's calculated value at risk. Another approach is called "stress testing." In this approach, a manager asks models what would happen if a doomsday scenario occurs; that is, she looks at the losses the institution would sustain if an unusual combination of bad events occurred. With the value-at-risk approach and stress testing, a financial institution can assess its risk exposure and take steps to reduce it.

Because of the increased risk that banks are facing from their off-balance-sheet activities, U.S. bank regulators have become concerned about increased risk from banks' off-balance-sheet activities and, as we will see in Chapter 11, are encouraging banks to pay increased attention to risk management. In addition, the Bank for International Settlements is developing additional bank capital requirements based on value-at-risk calculations for a bank's trading activities.

QUESTIONS AND TASKS

1. Suppose that you are the manager of a bank whose $100 billion of assets have an average duration of four years and whose $90 billion of liabilities have an average duration of six years. Conduct a duration analysis for the bank, and show what will happen to the net worth of the bank if interest rates rise by 2 percentage points. What actions could you take to reduce the bank's interest-rate risk?

2. Suppose that you are the manager of a bank that has $15 million of fixed-rate assets, $30 million of rate-sensitive assets, $25 million of fixed-rate liabilities, and $20 million of rate-sensitive liabilities. Conduct a gap analysis for the bank, and show what will happen to bank profits if interest rates rise by 5 percentage points. What actions could you take to reduce the bank's interest-rate risk?

UNIT 8 INFORMATION TECHNOLOGY IN THE BANKING SECTOR: OPPORTUNITIES, THREATS AND STRATEGIES

The New Era

The 21st century will bring about an all-embracing convergence of computing, communications, information and knowledge. This will radically change the way we live, work, and think. The growth of high speed networks, coupled with the falling cost of computing power, is making possible applications undreamed of in the past. Voice, data, images, and video may now be transferred around the world in micro-seconds. This explosion of technology is changing the banking industry from paper and branch banks to' digitized and networked banking services. It has already changed the internal accounting and management systems of banks. It is now fundamentally changing the delivery systems banks use to interact with their customers. All over the world, banks are still struggling to find a technological solution to meet the challenges of a rapidly-changing environment. It is clear that this new technology is changing the banking industry forever. Banks with the ability to invest and integrate information technology will become dominate in the highly competitive global market. Bankers are convinced that investing in IT is critical. Its potential and consequences on the banking industry future is enormous.

Technology and Banks Transformation

Computers are getting more sophisticated. They have given banks a potential they could only dream about and have given bank customers high expectations. The changes that new technologies have brought to banking are enormous in their impact on officers, employees, and customers of banks. Advances in technology are allowing for delivery of banking products and services more conveniently and effectively than ever before - thus creating new bases of competition. Rapid access to critical information and the ability to act quickly and effectively will distinguish the successful banks of the future. The bank gains a vital competitive advantage by having a direct marketing and accountable customer service environment and new, streamlined business processes. Consistent management and decision support systems provide the bank that competitive edge to forge ahead in the banking marketplace.

Major applications. The advantages accruing from computerization are three-directional - to the customer, to the bank and to the employee.

For the customer. Banks are aware of customer's need for new services and plan to make them available. IT has increased the level of competition and forced them to integrate the new technologies in order to satisfy their customers. They have already developed and implemented a certain number of solutions among them:

- *Self-inquiry facility:* Facility for logging into specified self-inquiry terminals at the branch to inquire and view the transactions in the account.
- *Remote banking:* Remote terminals at the customer site connected to the respective branch through a modem, enabling the customer to make inquiries regarding his accounts, on-line, without having to move from his office.
- *Anytime banking-Anywhere banking:* Installation of ATMs which offer non-stop cash withdrawal, remittances and inquiry facilities. Networking of computerized branches inter-city and intra-city, will permit customers of these branches, when interconnected, to transact from any of these branches.
- *Telebanking:* A 24-hour service through which inquiries regarding balances and transactions in the account can be made over the phone.
- *Electronic Banking:* This enables the bank to provide corporate or high

value customers with a Graphical User Interface (GUI) software on a PC, to inquire about their financial transactions and accounts, cash transfers, cheque book issue and inquiry on rates without visiting the bank. Moreover, LC text and details on bills can be sent by the customer, and the bank can download the same. The technology used to provide this service is called electronic data interchange (EDI). It is used to transmit business transactions in computer-readble form between organizations and individuals in a standard format.

- As information is centralized and updates are available simultaneously at all places, single-window service becomes possible, leading to effective reduction in waiting time.

For the bank. During the last decade, banks applied IT to a wide range of back and front office tasks in addition to a great number of new products. The major advantages for the bank to implement IT are:

- Availability of a wide range of inquiry facilities, assisting the bank in business development and follow-up.
- Immediate replies to customer queries without reference to ledger-keeper as terminals are provided to Managers and Chief Managers.
- Automatic and prompt carrying out of standing instructions on due date and generation of reports.
- Generation of various MIS reports and periodical returns on due dates.
- Fast and up-to-date information transfer enabling speedier decisions, by interconnecting computerized branches and controlling offices.

For the employees. IT has increased their productivity through the followings:

- Accurate computing of cumbersome and time-consuming jobs such as balancing and interest calculations on due dates.
- Automatic printing of covering schedules, deposit receipts, pass book / pass sheet, freeing the staff from performing these time-consuming jobs, and enabling them to give more attention to the needs of the customer.
- Signature retrieval facility, assisting in verification of transactions, sitting at their own terminal.
- Avoidance of duplication of entries due to existence of single-point data entry.

A search of the banking literature reveals that banks are moving rapidly to take advantage of recent and new customer service and cost reduction opportunities that new technologies offer. A sampling is in the table below:

Technology	1998	2001
Infrastructure		
PC Networks: Tellers	48%	80%
Sales Tracking Software	44%	80%
Relational Data Base	36%	76%
Automate Credit Scoring	8%	48%
E-mail	60%	95%
Equipment Management Software	33%	57%
Imaging Checks / Statements	12%	72%
Imaging Documents	7%	45%
Delivery Systems		

Internet Banking Home Page	3%	25%
Internet Electronic Office	1%	15%
Telebanking	56%	88%
Smart Cards Debit Cards	35%	70%
Electronic Banking	12%	76%

Internet: Riding the tiger. The Internet is rapidly becoming the information superhighway of a global electronic marketplace. The rising commercial interests in the Internet are especially evident in "frontend" applications such as electronic catalogs, yellow pages, storefronts, malls, and customer support centers. All these applications are based on the World Wide Web (WWW) - the fastest growing segment of the Internet. Although "back-end" applications such as electronic data interchange (EDI) are equally important, their adoption has not been as rapid. One major concern is security: the Internet is generally perceived as not secure enough for transmitting sensitive data such as payments. Upon a closer look, however, this view is not warranted, since technologies such as public key encryption and firewalls address essential security concerns. Moreover, such technologies are already available. The only remaining barrier is the lack of real world users of those technologies.

The pilot project between Bank of America (BofA) and one of its large corporate customers involves transporting financial EDI transactions over the Internet. If successful, BofA expects that this new EDI option will lead to a reduction in telecommunications costs, an improved position with respect to its value-added network (VAN), and valuable learning experience with the Internet environment, which is becoming increasingly important to the bank. The project is also significant beyond BofA: because it is one of the first large-scale, real-world trials, its outcome will help dispel many uncertainties surrounding Internet-based EDI, and encourage more companies to move in this direction.

Investing in technology. According to a survey conducted by the American Bankers Association, US banks expenditure on information technology grew from $16.3 billion in 1994 to $18.7 billion in 1995-an increase of 14.7%, and $1 billion more than the same bankers forecasted they would spend in last year's survey. By 1998, the banks expect to spend $21.2 billion (an increase of 7. 1 %).

How to survive. The key to survival is customer service. Customer loyalty will be determined by convenient and innovative delivery of products and personalized services. In the '70's and '80's, banks were marketing to a generation raised on old style banking: personal interaction at a banking office. That generation was disdainful of "impersonal" service and afraid of computers. Convenience was having a "branch" in one's neighbourhood. Today, personal service and convenience are still the critical factors in the banking relationship, but they are defined differently. Consumers still want to bank with a financial institution they "know," and one who "knows" them, but they do not necessarily want to go to the bank. They are not afraid of computers and technology; they embrace them. Convenience is doing their banking when they want, and where they want. They are now comfortable with personal computers and other electronic devices. They expect fast, efficient, and accurate service And the only way to cost effectively provide the instant, quality service that customers demand, and that the competition provides, is through intensive use of the most advanced information technologies and through good people trained in the use of these technologies. For all these reasons, the banks delivery systems are completely changing.

The new Delivery Systems. The increasing cost of building brick-and-mortar

branches, decreasing cost of computers, high delivery costs and slow revenue growth force a relook at the conventional delivery systems. Moreover, growing comfort of technology usage by the customer is rapidly fostering usage of non-branch channels for routine transactions.

The new strategy changes the focus of the branch from being a high cost transaction center to a provider of a wide range of services like telebanking, customer service kiosks, ATMs, and remote electronic banking.

New Marketing Opportunities. As the new technology is so expensive banks need to use the new systems to do more than deliver information and basic services. Banks need the ability to also sell insurance and investment products to get a better return on this investment. Telephone banking can bring financial services to the home or office, especially if they are affordable screen phones. By noticing how much interest the customer expresses, the bank can market stock quotes and insurance quotes. Interactive videos are new technology that banks can make available to the customer to maintain personal contact while still lowering the expense of delivery service. With an interactive video an expert employee is not needed in each branch. Complex life insurance products, open brokerage accounts, customized product illustrations can be widely available where needed. The interactive videos will be cost effective expertise. The internet is a medium to allow banks to offer products to customers outside the normal customer base of a branch. Banks are aware of the customer's need for these services and plan to make them available before other sources do.

Drawbacks. Early experiences with electronic commerce in the banking industry, which has been a pioneer in the use of electronic systems, can be used to learn of some potential dangers and issues to be taken into account. The use of Automated Teller Machines and electronic home banking systems has increasingly allowed customers to bank outside of traditional bank facilities, for most of their usual transactions. This was consistent with the cost-savings strategy of most banks, which discovered that electronic transactions were about seven times less costly compared to the manual handling of these transactions by a bank teller. Nevertheless, the fact that customers' only contact with their banks was through (rather unsophisticated) electronic interfaces, and the major difficulties in integrating the legacy systems of a typical bank, prevented banks in many cases from selling additional products to customers (cross-selling). In some European markets, the insurance companies took opportunity of that to grab business from banks, selling savings products to customers through their extensive distribution network. Similarly, the decrease in human interaction with customers could also lead to a less sophisticated understanding of their needs, as they're not always able to express comments, criticisms or requests for new products while interacting with machines. This should lead to a design of electronic commerce systems which incorporate capabilities for customer understanding and for proactive selling of new products. Electronic business transactions can only be successful if financial exchanges between buyers and sellers can occur in a simple, universally accepted, safe and cheap way. Various systems have been proposed, some of them based on traditional mechanisms (e.g. credit cards accounts) while others rely on new designs, such as electronic money. The key here will be to find a few widely accepted mechanisms, which can be used by most actors. The recent agreement between Mastercard and Visa on one security standard for credit card transactions over the Internet, and its backing by most major software vendors is one step in the right direction. This doesn't diminish the need for more specialized systems, for instance to allow microtransactions, the exchange of very small amounts of money (a few cents) in exchange for information or services. These new payment mechanisms will in turn enable new business models such as pay-per-article newspapers.

QUESTIONS AND TASKS

1. What do you see opportunities for development IT in banking?
2. What do you see threats for development IT in banking?
3. What do you see strategies for development IT in banking?

UNIT 9 DATABASE SYSTEM IMPLEMENTATION IN BANKING

The first databases implemented during the 1960s and 1970s were based upon either flat data files or the hierarchical or networked data models. These methods of storing data were relatively inflexible due to their rigid structure and heavy reliance on applications programs to perform even the most routine processing.

In the late 1970s, the *relational database model* which originated in the academic research community became available in commercial implementations such as IBM DB2 and Oracle. The relational data model specifies data stored in *relations* that have some *relationships* among them (hence the name *relational*).

In relational databases such as Sybase, mySQL, Oracle, IBM DB2, MS SQL Server and MS Access, data is stored in *tables* made up of one or more *columns* (Access calls a column a *field*). The data stored in each column must be of a single *data type* such as Character (sometimes called a "string"), Number or Date. A collection of values from each column of a table is called a *record* or a *row* in the table.

Different tables can have the same column in common. This feature is used to explicitly specify a relationship between two tables. Values appearing in column A in one table are shared with another table.

Below are two examples of tables in a relational database for a local bank:

Customer Table

CustomerID	Name	Address	City	State	Zip
Number	***Character***	***Character***	***Character***	***Character***	***Character***
1001	Mr. Smith	123 Lexington	Smithville	KY	91232
1002	Mrs. Jones	12 Davis Ave.	Smithville	KY	91232
1003	Mr. Axe	443 Grinder Ln.	Broadville	GA	81992
1004	Mr. & Mrs. Builder	661 Parker Rd.	Streetville	GA	81990

The Customer table has 6 columns (CustomerID, Name, Address, City, State and Zip) and 4 rows (or records) of data. The Accounts table has 5 columns (CustomerID, AccountNumber, AccountType, DateOpened and Balance) with 7 rows of data.

Each of the columns conforms to one of three basic *data types*: Character, Number or Date. The data type for a column indicates the type of data values that may be stored in that column.

Number - may only store numbers, possibly with a decimal point.

Character - may store numbers, letters and punctuation. Access calls this data type **Text**.

Date - may only store date and time data.

In some database implementations other data types exist such as Images (for pictures or other data). However, the above three data types are most commonly used.

Accounts Table

CustomerID	AccountNumber	AccountType	DateOpened	Balance
Number	***Number***	***Character***	***Date***	***Number***
1001	9987	Checking	10/12/1989	4000.00
1001	9980	Savings	10/12/1989	2000.00

1002	8811	Savings	01/05/1992	1000.00
1003	4422	Checking	12/01/1994	6000.00
1003	4433	Savings	12/01/1994	9000.00
1004	3322	Savings	08/22/1994	500.00
1004	1122	Checking	11/13/1988	800.00

Notice that the two tables share the column CustomerID and that the values of the CustomerID column in the Customer table are the same the values in the CustomerID column in the Accounts table. This *relationship* allows us to specify that the Customer **Mr. Axe** has both a Checking and a Savings account that were both opened on the same day: December 1, 1994.

Another name given to such a relationship is *Master/Detail*. In a master/detail relationship, a single master record (such as Customer 1003, Mr. Axe) can have many details records (the two accounts) associated with it.

In a Master/Detail relationship, it is possible for a Master record to exist without any Details. However, it is impossible to have a Detail record without a matching Master record. For example, a Customer may not necessarily have any account information at all. However, any account information *must* be associated with a single Customer.

Each table also must have a special column called the **Key** that is used to uniquely identify rows or records in the table. Values in a key column (or columns) may never be duplicated. In the above tables, the CustomerID is the key for the Customer table while the AccountNumber is the key for the Accounts table.

A Business Example

In this section, we will outline a business example that will be used as a basis for the examples throughout the tutorial. In organizations, the job of analyzing the business and determining the appropriate database structure (tables and columns) is typically carried out by *Systems Analysts*. A Systems Analyst will gather information about how the business operates and will form a *model* of the data storage requirements. From this model, a database programmer will create the database tables and then work with the application developers to develop the rest of the database application.

For this tutorial, we will consider a simple banking business. The bank has many customers who open and maintain one or more accounts. For each Customer, we keep a record of their name and address. We also assign them a unique CustomerID. We assign this unique identifier both for convenience and for accuracy. It is much easier to identify a single customer using their CustomerID rather than by looking up their full name and address. In addition, it is possible for the bank to have two customers with the same name (e.g., Bill Smith). In such cases, the unique CustomerID can always be used to tell them apart.

In a similar fashion, all accounts are assigned a unique account number. An account can be either a checking account or a savings account. Savings accounts earn interest but the only transactions allowed are deposits and withdrawals. Checking accounts do not earn interest. We maintain the date that the account was opened. This helps us track our customers and can be useful for marketing purposes. Finally, we maintain the current balance of an account.

In the previous section, we gave the structure and some sample data for the Customer table and the Accounts table. These will be used to support the data storage part of our Banking application.

In any database application, each of the tables requires a means to get data into them and retrieve the data at a later time. The primary way to get data into tables is to use

data entry forms. The primary ways to get data back out of tables or to display data in tables are to use queries or reports.

For this tutorial, we will create a data entry form for each table, a query for each table and a report for each table.

In the following sections, we will first introduce how to start Access and how to create a new database.

Starting Microsoft Access

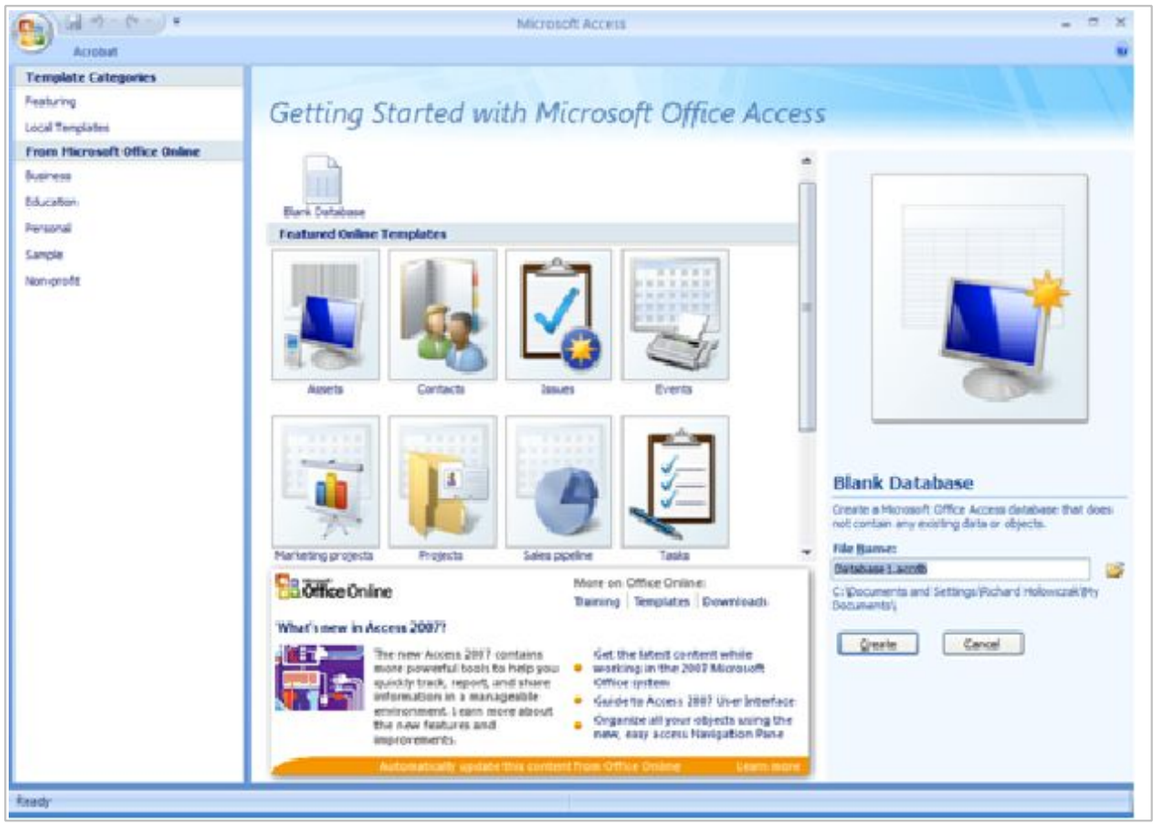
As with most Windows programs, Access can be executed by navigating the Start menu in the lower left-hand corner of the Windows Desktop.

To start Access, click on the Start button, then the Programs menu, then move to the MS Office menu and finally click on the Microsoft Access menu item. The MS Office Professional menu is shown below.

Microsoft Office Menu for Office 2007

Note that this arrangement of menus may vary depending on how MS Office was installed on the PC you are using.

Once Access is running, an initial screen will be displayed:



From this initial screen, the user can create a new database (either blank or with some tables created with the database wizard), or open up an existing database.

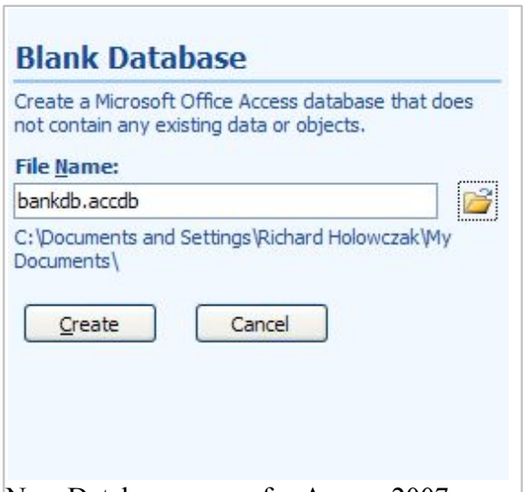
In general, the first time one begins a project, a new, blank database should be created. After that point, use the *Open existing database* option to re-open the database created previously.

Warning - If you have previously created a database, and then create it again using the same name, you will overwrite any work you have done.

For the purposes of this tutorial, if you are going through these steps for the first time, choose the option to create a new, blank database as shown in the above figure.

In Access 2007, click on the round Office button in the upper left corner and choose New from the drop down menu. Fill in *File Name* as bankdb.accdb and click on the Create button to create the database as in the figure below.

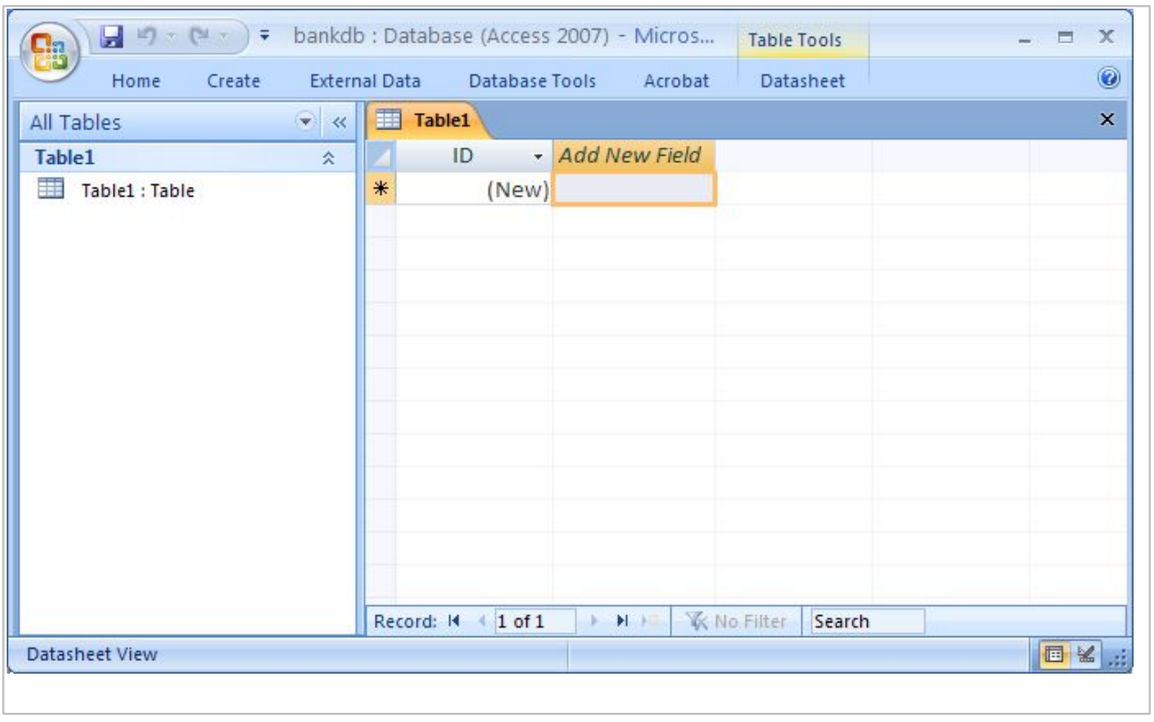
It is advisable to keep the name of the database (bankdb in the above example) relatively short and do not use spaces or other punctuation in the name of the database. Also, the name of the database should reflect the database's contents.



New Database screen for Access 2007
In the above file name, bankdb is the name chosen for this particular database and .accdb is the file name extension given for *Microsoft DataBase 2007* files.

Once the new database is created, the following main Access screen will appear:

MS Access 2007



The screen layout for MS Access 2007 is significantly different from past versions. Most of the tabs along the top of the screen have been rearranged. In addition, the default main screen after creating a new database automatically switches to the Design view to create a new table.

The following tabs will appear at the top of the screen:

- **Home tab** - Controls for changing fonts, performing queries, copy/paste/cut data, etc.
- **Create tab** - Controls for creating tables, forms, reports, etc.
- **External Data tab** - Controls for loading data from other data sources into MS Access.
- **Database Tools tab** - Controls for managing databases (security, switchboard, etc.)
- **Design tab** - This will appear when designing a new table, form, report, etc.

Review of Starting Microsoft Access

To start Microsoft Access:

1. Use the Start button on the task bar to open: Programs -> MS Office -> Microsoft Access
2. To create a new database, choose **Blank Database** and specify a new file name for the database. Be sure to use a descriptive name for the new database. Click on the OK button to create the new database.
3. To open an existing database, choose **Open an Existing Database**, highlight *More Files...* and click on the OK button. Then navigate to the drive, highlight the existing database file on the floppy disk and click the OK button again to open the database.

To exit Access, pull down the File menu (or Office menu) and select the Exit menu item.

QUESTIONS AND TASKS

1. Expand meaning of the term database.
2. Expand meaning of the term data type.
3. Expand meaning of the terms tables, field, record.
4. Expand meaning of the term relational database model.
5. Expand meaning of the term key.

UNIT 10 DATABASE MANAGEMENT SYSTEM: CREATING TABLES

Creating and Viewing Tables

Tables are the main units of data storage in Access. Recall that a table is made up of one or more *columns* (or *fields*) and that a given column may appear in more than one table in order to indicate a relationship between the tables.

From the business example discussed earlier, we concluded that two tables would be sufficient to store the data about **Customers** and their bank **Accounts**. We now give the step-by-step instructions for creating these two tables in Access.

There are a number of ways to create a table in Access. Access provides *wizards* that guide the user through creating a table by suggesting names for tables and columns. The other main way to create a table is by using the *Design View* to manually define the columns (fields) and their data types.

While using the wizards is a fast way to create tables, the user has less control over the column names (fields) and data types. In this tutorial, we will describe the steps to create a table using the *Design View*. Students are encouraged to experiment on their own with using the Create Table wizard.

Creating a Table Using the Design View

To create a table in Access using the Design View, perform the following steps:

1. In Access 2007, the Create New Table tab should already be highlighted and a new table named table1 created. If this is not the case, click on the *Create* tab and click on the *Table* icon. Then pull down the *View* menu and choose *Design View*.

2. The Table Design View will appear. Fill in the **Field Name**, **Data Type** and **Description** for each column/field in the table. The CustomerID field is filled in below:

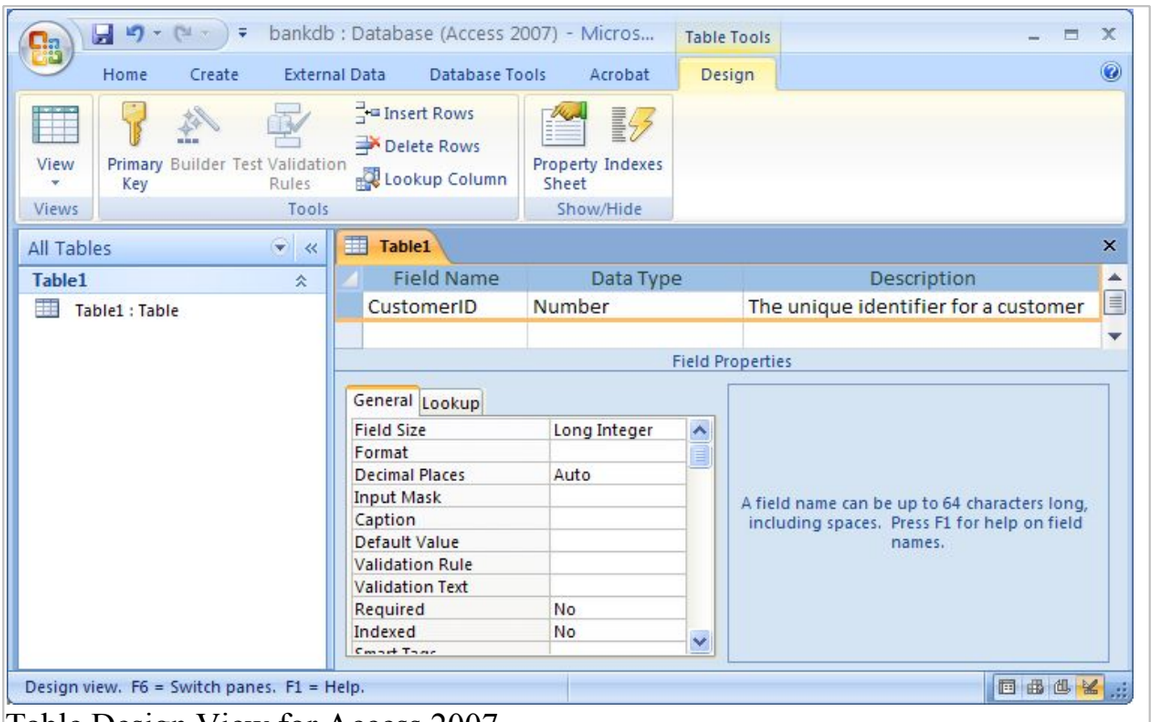


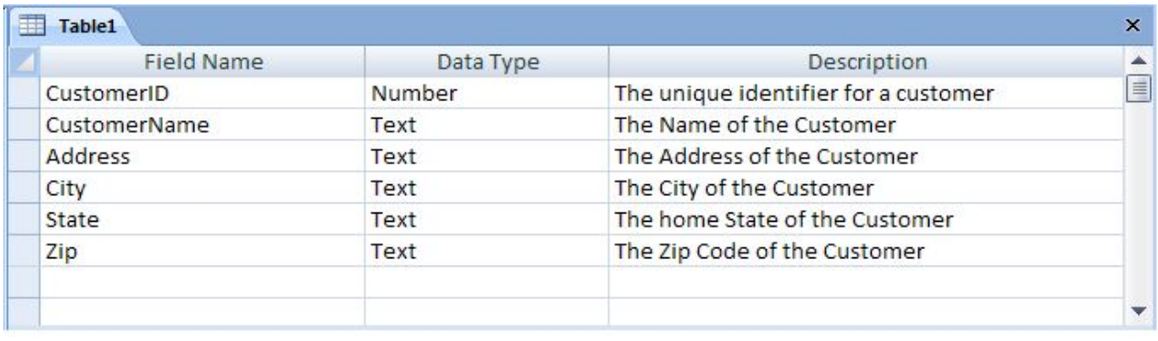
Table Design View for Access 2007

Note that the default name given for the table is Table1. In a later step, we will assign an appropriate name for this table.

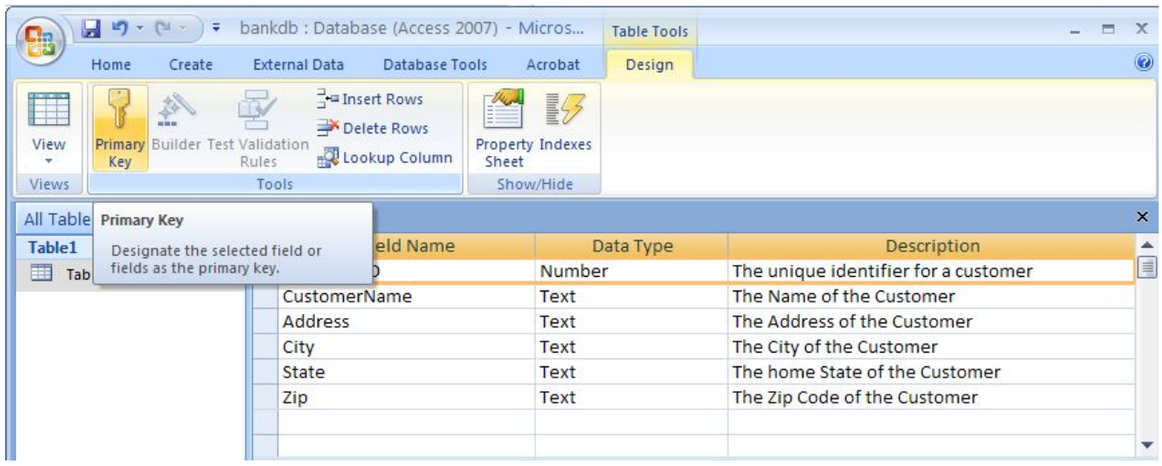
3. Fill in the information for the fields as follows:

Field Name	**Data Type**	**Description**
CustomerID	Number	The Unique Identifier for a Customer
CustomerName	Text	The Name of the Customer
Address	Text	The Address of the Customer
City	Text	The City of the Customer
State	Text	The home State of the Customer
Zip	Text	The Zip Code of the Customer

4. A figure showing the design view with the new table definition filled in is given below:

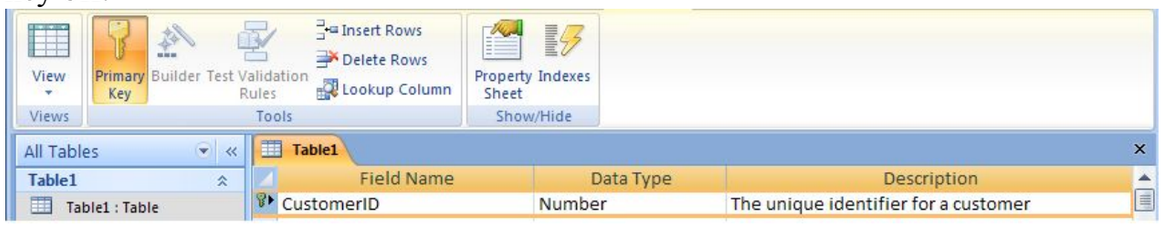


Now that all of the fields have been defined for the table, a Primary Key should be defined. Recall that the Primary Key will be used to uniquely identify a record in the table (in this case a Customer). Highlight the **CustomerID** field and click on the Primary Key button on the button bar

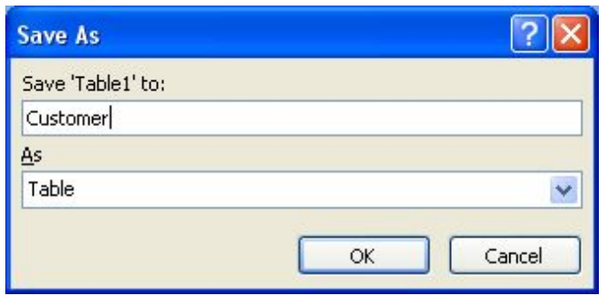


Notice that a small key appears next to the field name on the left side.

Note: To remove a primary key, simply repeat this procedure to toggle the primary key off.



5. As a final step, the table must be saved. Pull down the Office menu and choose the Save As menu item. A dialog box will appear where the name of the new table should be specified. Note that Access gives a default name such as **Table1** or **Table2**. Simply type over this default name with the name of the table. For this example, name the table: **Customer** Then click on the OK button.



At this point, the new Customer table has been created and saved.

Note about naming fields in MS Access

When defining the fields (columns) for a table, it is important to use field names that give a clear understanding of the data contents of the column. For example, does the field CNO indicate a Customer Number or a Container Number?

Field names in Access can be up to 64 characters long and may contain spaces. **However, *the use of spaces in field names and table names is strongly discouraged***. If you wish to make field names easier to read, consider using an underscore character to separate words. However be certain no spaces appear before or after the underscore.

The following table summarizes some different ways to give field names:

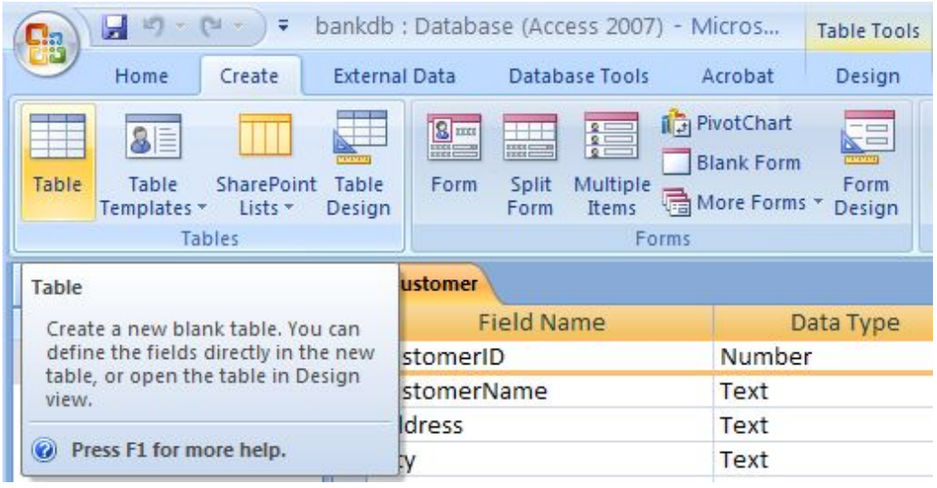
Description	Bad	Good

Unique identifier for a customer	CID	CustomerID or Customer_ID
Description for a product	PDESC	ProductDescription
Employee's home telephone number	Employee_home_telephone_number	HomePhone
Bank account number	BA#	AccountNumber

Creating a Table

Create the *Accounts* table by following the same steps used to create the Customer table.

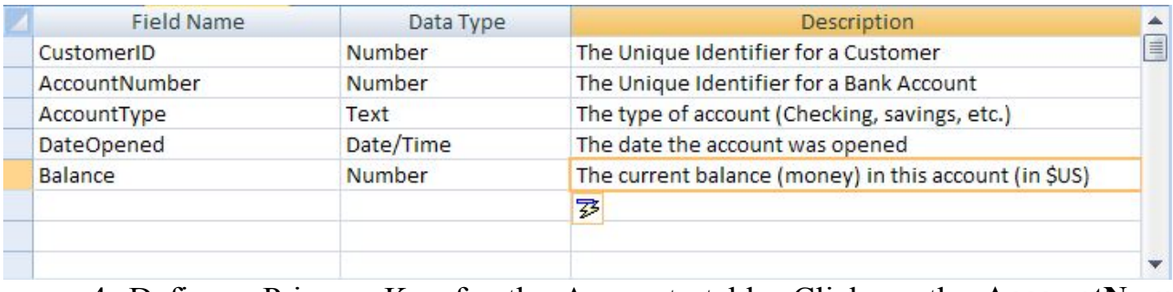
1. Click on the Create tab and then click on the *Table* button.



2. Pull down the View menu and choose Design. The Table Design View will appear. Fill in the **Field Name**, **Data Type** and **Description** for each column/field in the Accounts table.

Field Name	**Data Type**	**Description**
CustomerID	Number	The Unique Identifier for a Customer
AccountNumber	Number	The Unique Identifier for a Bank Account
AccountType	Text	The type of account (Checking, savings, etc.)
DateOpened	Date	The date the account was opened
Balance	Number	The current balance (money) in this account (in $US)

3. A figure showing the design view with the new table definition filled in is given below:



4. Define a Primary Key for the Accounts table. Click on the **AccountNumber** field with the *Right* mouse button and choose Primary Key from the pop-up menu.

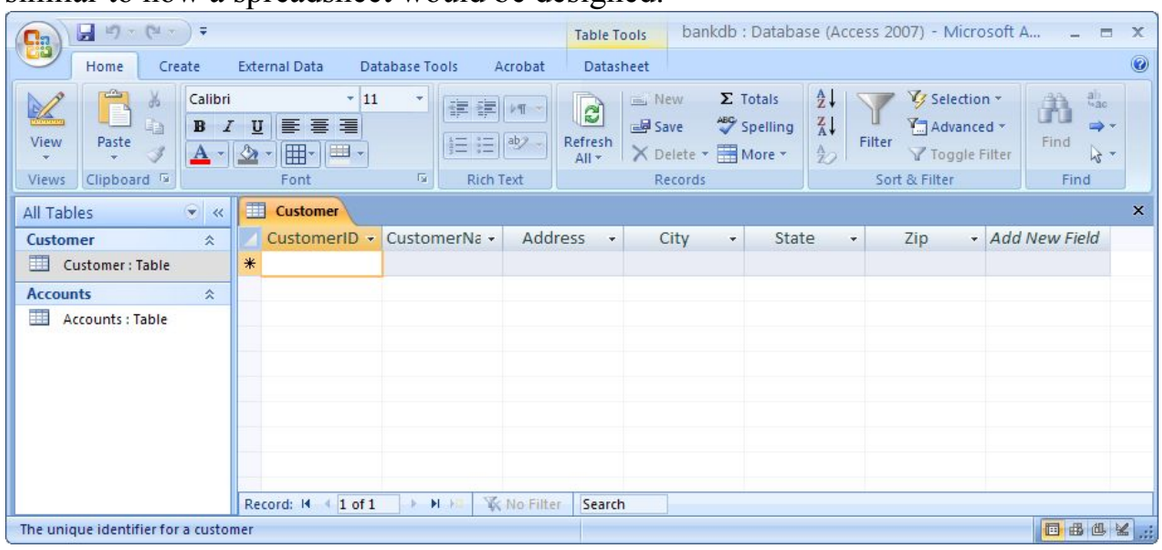
5. Save the new Accounts table by pulling down the File menu and choosing the

Save menu item. Fill in the name of the table: **Accounts** Then click on the OK button.

Viewing and Adding Data to a Table

Data can be added, deleted or modified in tables using a simple spreadsheet-like display. To bring up this view of a single table's data, highlight the name of the table and then double-click on the name of the table.

In this view of the Customer table, shown in the figure below, the fields (columns) appear across the top of the window and the rows or records appear below. This view is similar to how a spreadsheet would be designed.



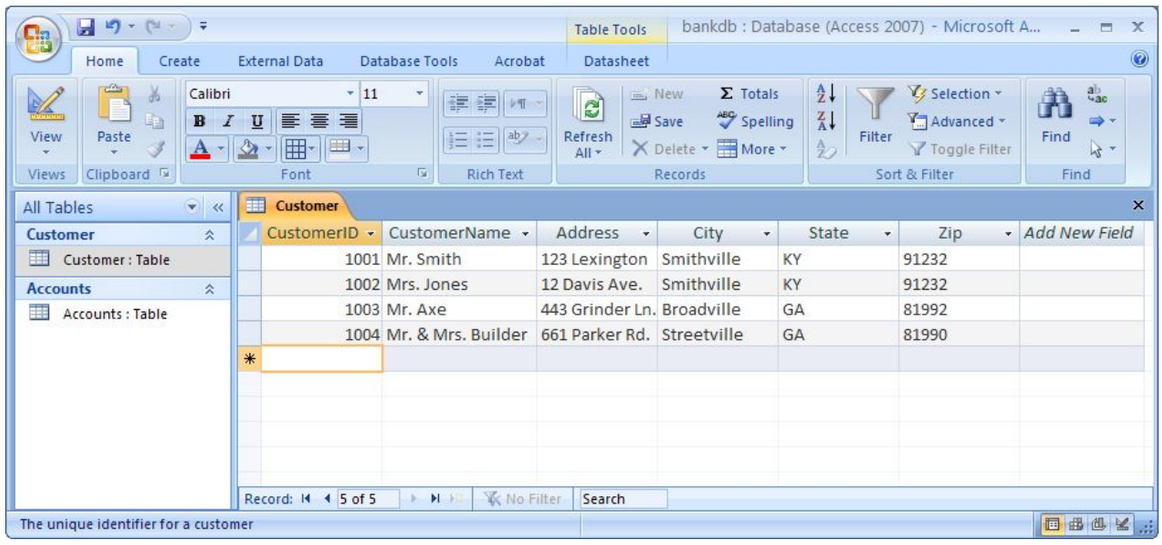
Note at the bottom of the window the number of records is displayed. In this case, since the table was just created, only one blank record appears.

To add data to the table, simply type in values for each of the fields (columns). Press the Tab key to move between fields within a record. Use the up and down arrow keys to move between records. Enter the data as given below:

CustomerID	Name	Address	City	State	Zip
1001	Mr. Smith	123 Lexington	Smithville	KY	91232
1002	Mrs. Jones	12 Davis Ave.	Smithville	KY	91232
1003	Mr. Axe	443 Grinder Ln.	Broadville	GA	81992
1004	Mr. & Mrs. Builder	661 Parker Rd.	Streetville	GA	81990

To save the new data, pull down the Office menu and choose Save.

To navigate to other records in the table, use the navigation bar at the bottom of the screen: 



To modify existing data, simply navigate to the record of interest and tab to the appropriate field. Use the arrow keys and the delete or backspace keys to change the existing data.

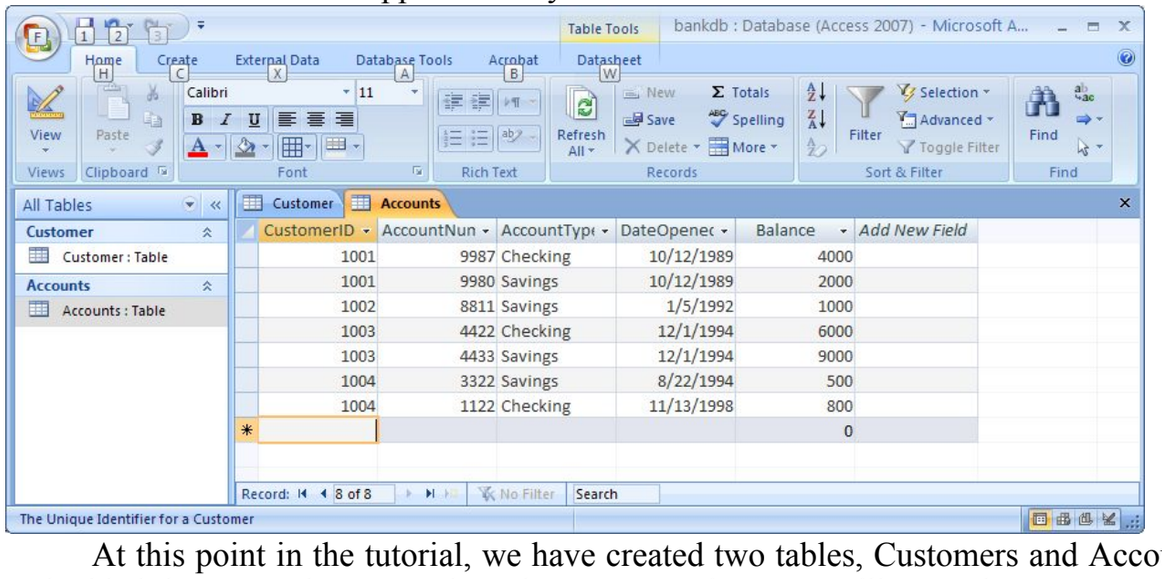
To delete a record, first navigate to the record of interest. Then pull down the Edit menu and choose the Delete menu item.

To close the table and return to the Access main screen, pull down the File menu and choose the Close menu item.

Adding Data to a Table

Be sure to enter the data exactly as shown including the capitalization of the data in the AccountType field. e.g., type Savings instead of savings or SAVINGS. Note that when entering the dates, type in the full four digits for the year. By default, Access displays all 4 digits of the year (older version of Access only displayed two digits).

Be sure to save the data when you are done. The figure below shows the Accounts table and data as it should appear when you are done with this exercise.



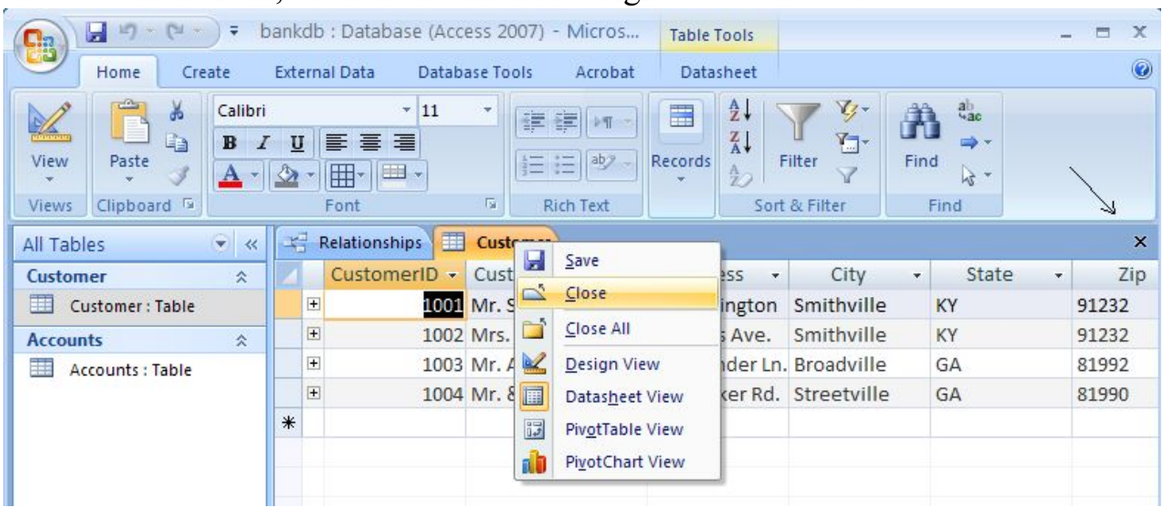
At this point in the tutorial, we have created two tables, Customers and Accounts, and added data to each one. In the subsequent sections, we will cover how to query and report on the data in the tables and how to create a user-friendly data entry form using the Access wizards.

Creating Relationships Between tables

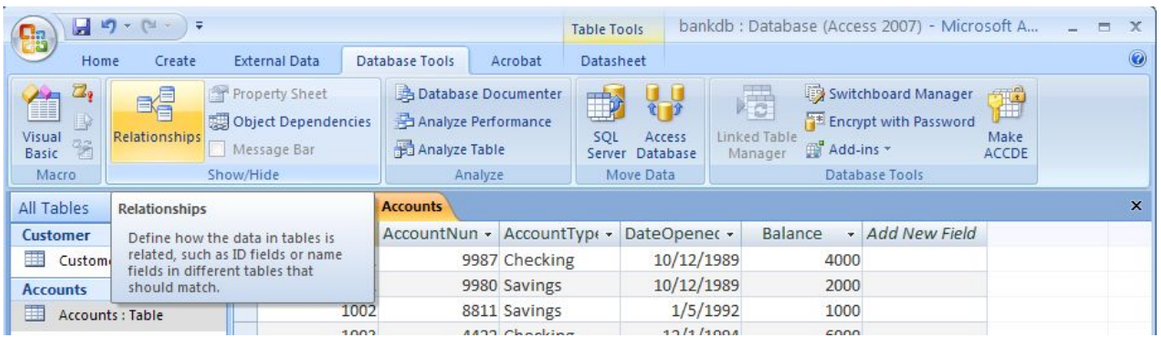
Recall that one of the main characteristics of relational databases is the fact that all tables are related to one another. In the Bank database thus far, the Customers table is related to the Accounts table by virtue of the CustomerID field appearing in both tables.

Access has a means to make this relationship explicit using the Relationships screen. Access uses this information when designing reports, forms and queries that require more than one table to be displayed.

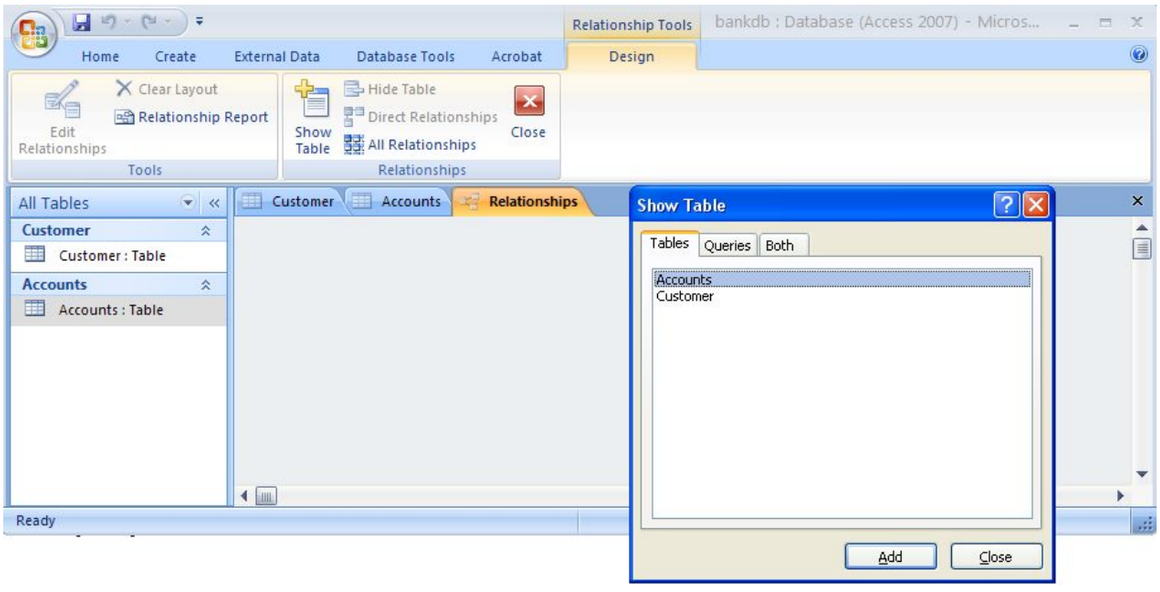
To get started, make sure the Accounts table and the Customer table are both closed. Access will halt creation of any relationships if the table are currently opened. To close a table, either right-click on the table name in the tab above the table and choose the close menu item, or click the small X to right above the table.



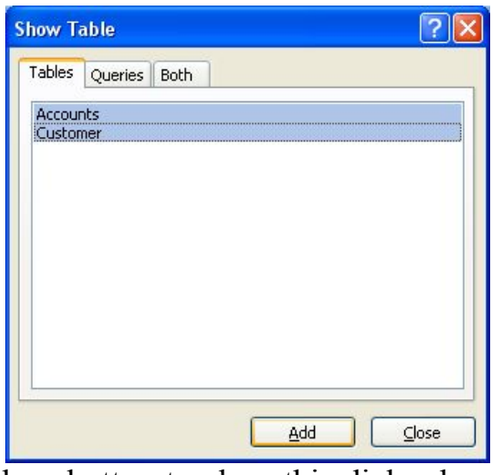
Next, display the Relationships screen by clicking on the Database Tools tab and then click on the Database Tools button as shown below.



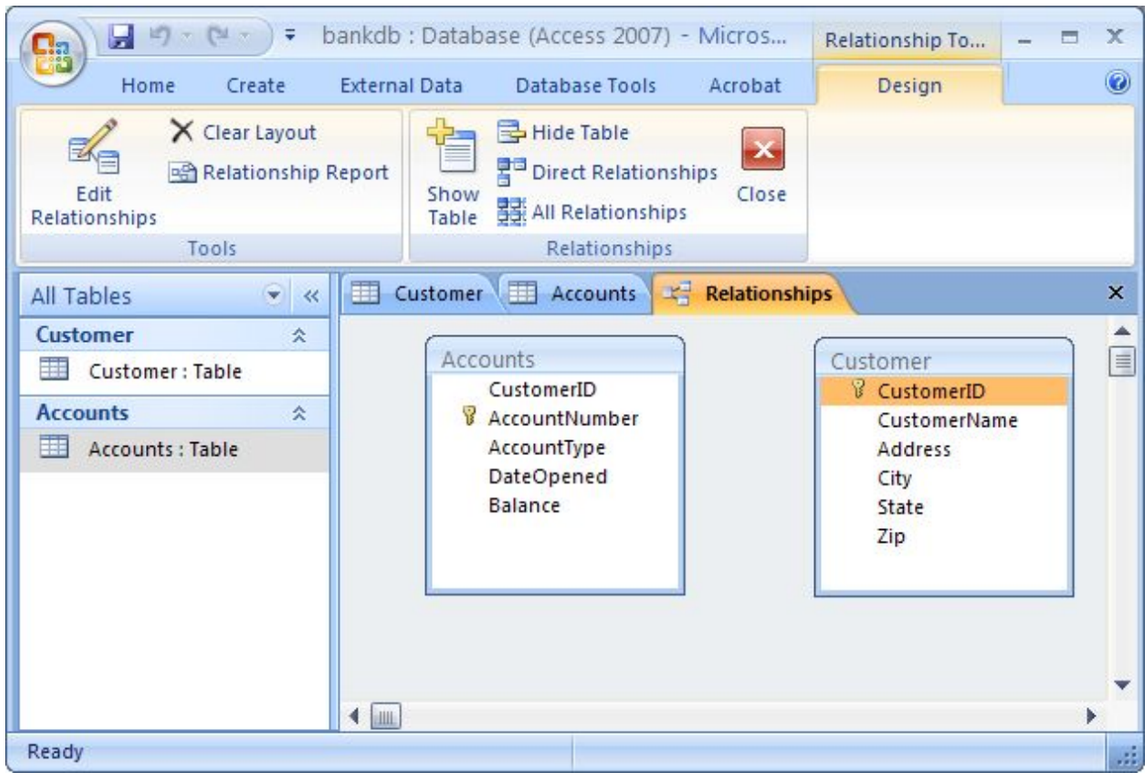
The blank Relationships screen will appear as follows:



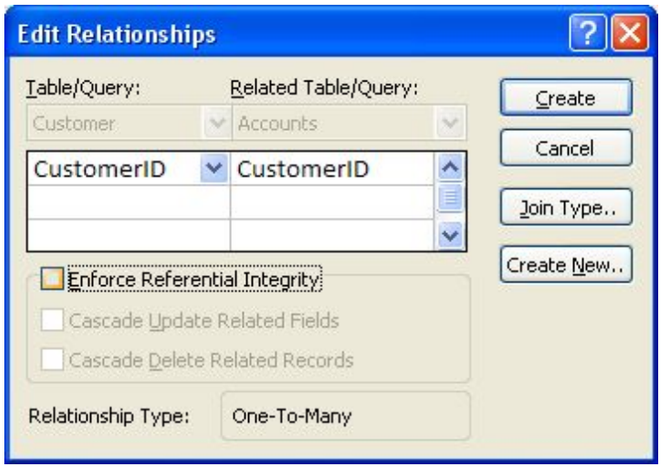
The Show Table dialog box will appear by default. Highlight both the Customers table and the Accounts table as shown below and then click on the Add button.



Then click on the Close button to close this dialog box. The Relationships screen will now reappear with the two tables displayed as below:

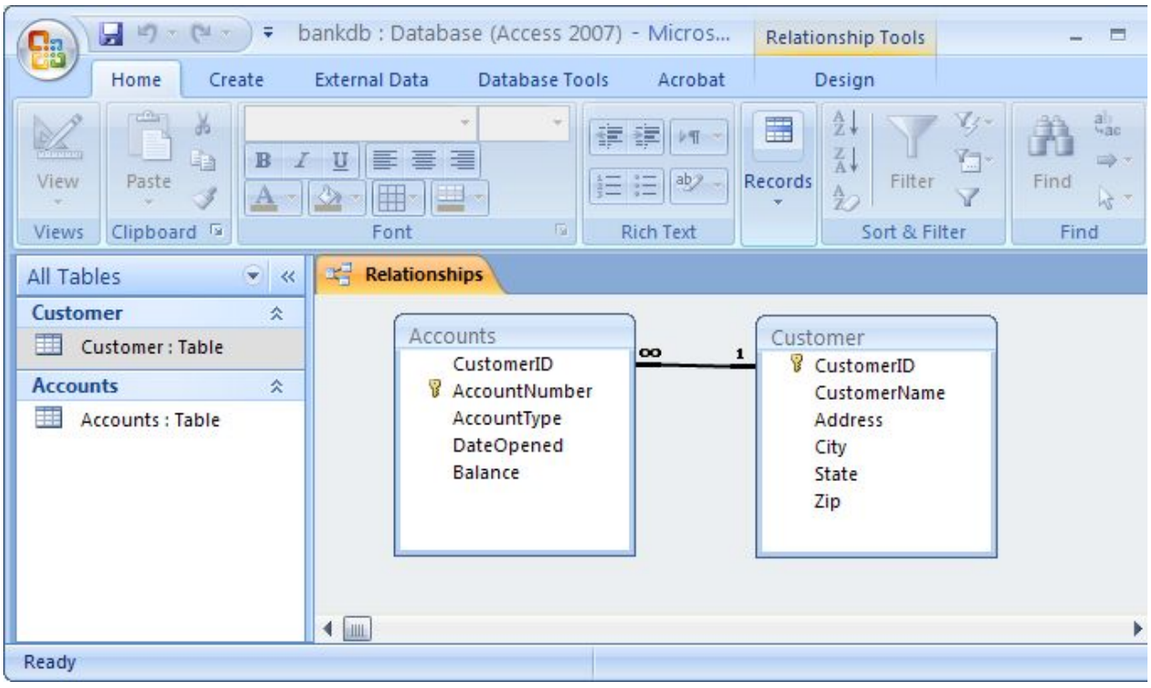


To connect the Customers table with the Accounts table to form a relationship, click on the CustomerID field in the Customers table and drag it over on top of the CustomerID field on the Accounts table. Upon releasing the mouse button, the Edit Relationships dialog box will appear as below:



Access will do its best to determine the Relationship Type (almost always it will select *One-to-Many*). For this example, Access knows that CustomerID is a key of the Customer table so it chooses this field as the "One" side. This makes the Accounts table the "Many" side as *One* customer may have *Many* accounts.

One additional step to be taken is the check off the box labeled "Enforce Referential Integrity". This option puts constraints into effect such that an Accounts record can not be created without a valid Customer record, and Access will also prevent a user from deleting a Customer record if a related Accounts record exists. At this point, click on the Create button to create the relationship. The Relationships screen should reappear with the new relationship in place as follows:



Note the symbols "1" (indicating the "One" side) and the infinity symbol (indicating the "Many" side) on the relationship. Close the relationships screen and select Yes to save the changes to the Relationships layout.

If the relationship does not appear in the above fashion, highlight it and press the delete key to delete it. Then go back to the table design view and make certain that the CustomerID field is designated as the key of the Customers table. Then go back to the Relationships screen and try to recreate the relationship.

Review of Creating and Viewing Tables

Creating a new table requires the following steps:

1. Click on the **Tables** tab on the Access main screen
2. Click on the New button.
3. Choose the **Design View** and click the OK button.
4. Fill in the name, data type and description of each of the fields in the table.
5. Designate a primary key by clicking on one of the fields with the right mouse button and then choose Primary Key from the pop-up menu.
6. Save the table by pulling down the File menu and choosing Save.
7. Close the new table by pulling down the File menu and choosing Close.

To change the design of an existing table (e.g., to add, change or delete a field):

1. Click on the **Tables** tab on the Access main screen
2. Highlight the name of the table to be modified and click on the Design button.
3. Make the necessary changes.
4. Save the table by pulling down the File menu and choosing Save.
5. Close the table by pulling down the File menu and choosing Close.

To add, delete or change data in an existing table:

1. Click on the **Tables** tab on the Access main screen
2. Highlight the name of the table to be modified and click on the Open button.
3. Make the necessary changes to the data.
4. Save the table data by pulling down the File menu and choosing Save.

5. Close the table by pulling down the File menu and choosing Close.

To create or edit relationships between tables:

1. Pull down the Tools menu and select the Relationships menu item.
2. To display tables, right click and choose Add Tables
3. To create new relationships, drag a key field from one table and drop it on the associated field in another table
4. To edit an existing relationship, double click on the relationship line.
5. To delete an existing relationship, click on the relationship line and press the delete key.

QUESTIONS AND TASKS

1. What do you know the steps for creating table?
2. What data types do you know?
3. Expand meaning of the term relationship type.
4. Expand meaning of the term field description.
5. Expand meaning of the term primary key.

UNIT 11 DATABASE MANAGEMENT SYSTEM: CREATING QUERIES

Creating and Running Queries

Queries are a fundamental means of accessing and displaying data from tables. Queries can access a single table or multiple tables. Examples of queries for our bank database might include:

- Which Customers live in Georgia?
- Which Accounts have less than a $500 balance ?

In this section, we show how to use the Access Wizards to create queries for a single table and for multiple tables.

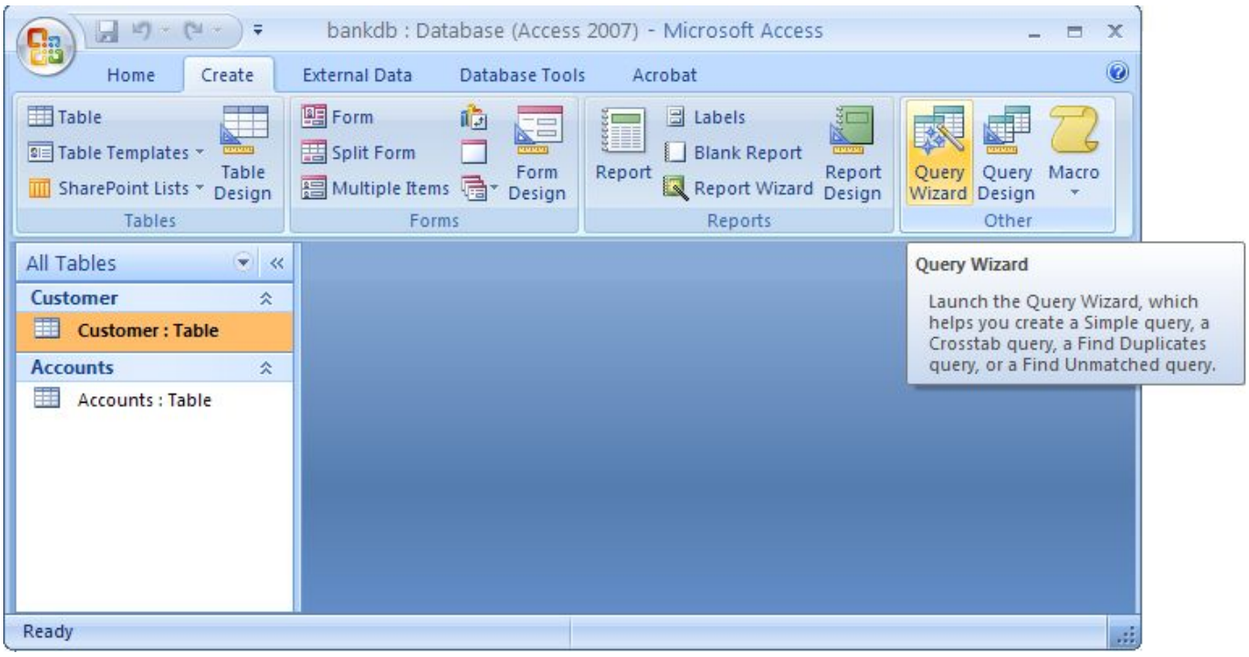
Single Table Queries

In this section, we demonstrate how to query a single table. Single table queries are useful to gain a view of the data in a table that:

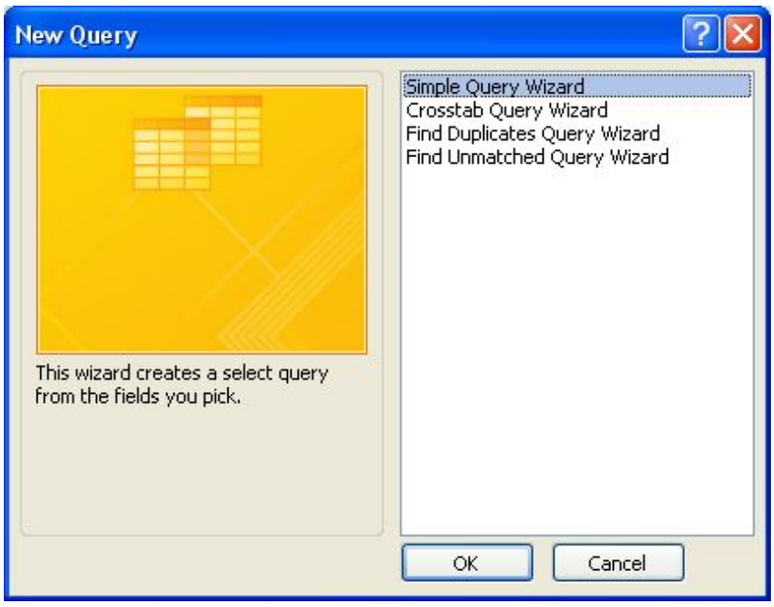
- only displays certain fields (columns) in the output
- sorts the records in a particular order
- performs some statistics on the records such as calculating the sum of data values in a column or counting the number of records, or
- filters the records by showing only those records that match some criteria. For example, show only those bank customers living in GA.

Creating a query can be accomplished by using either the query design view or the Query wizard. In the following example, we will use the query wizard to create a query.

To create a new query, click on the Create tab. Then click on the the Query wizard button.



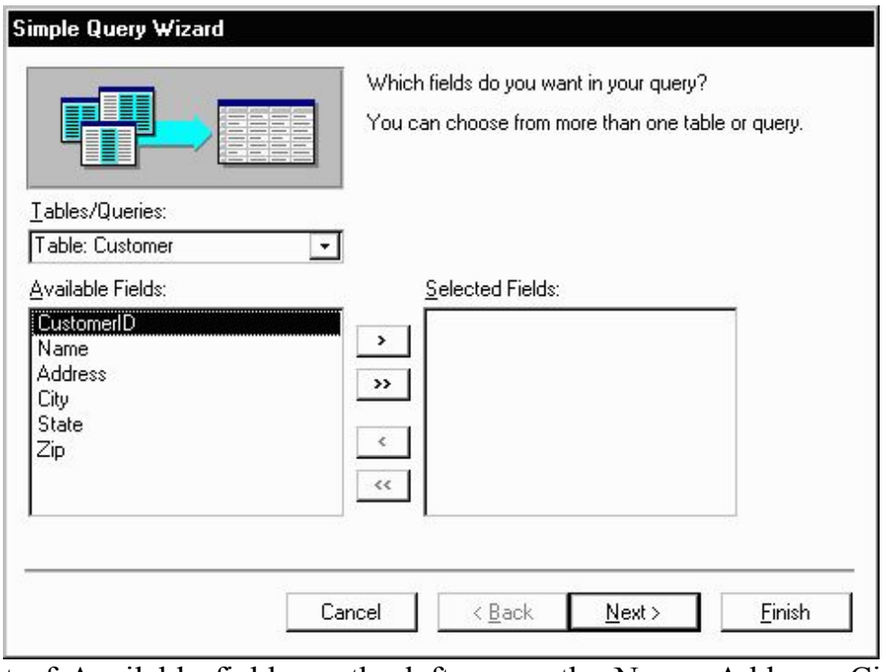
When the Query wizard appears, highlight the Simple Query Wizard selection and OK button.



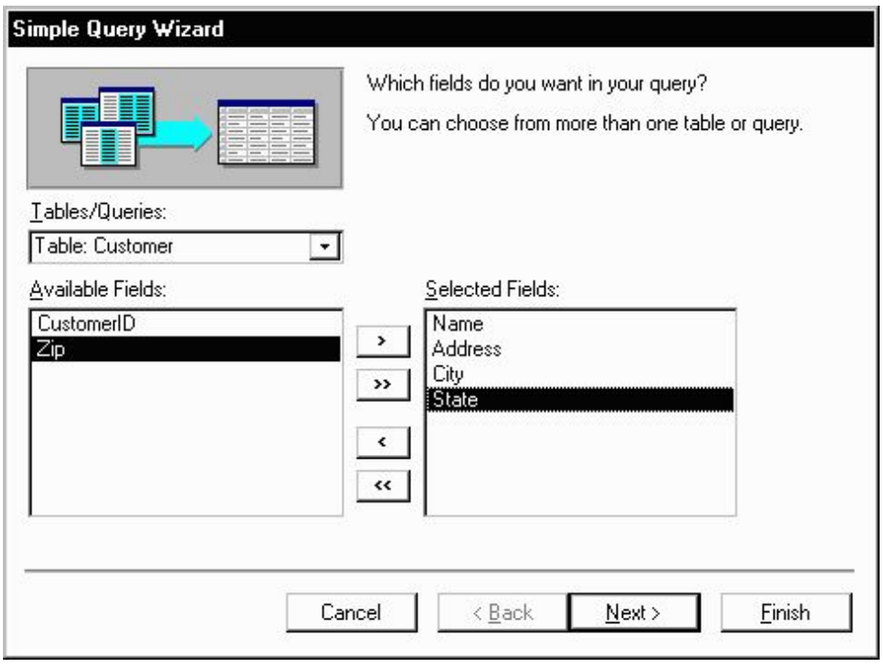
The first step in the Simple Query wizard is to specify the table for the query and which fields (columns) should be displayed in the query output. Three main sections of this step are:

1. Tables/Queries - A pick list of tables or queries you have created.
2. Available Fields - Those fields from the table that can be displayed.
3. Selected Fields - Those fields from the table that *will* be displayed.

For this example, pull down the Tables/Queries list and choose the Customer table. Notice that the available fields change to list only those fields in the Customer table. This step is shown below:

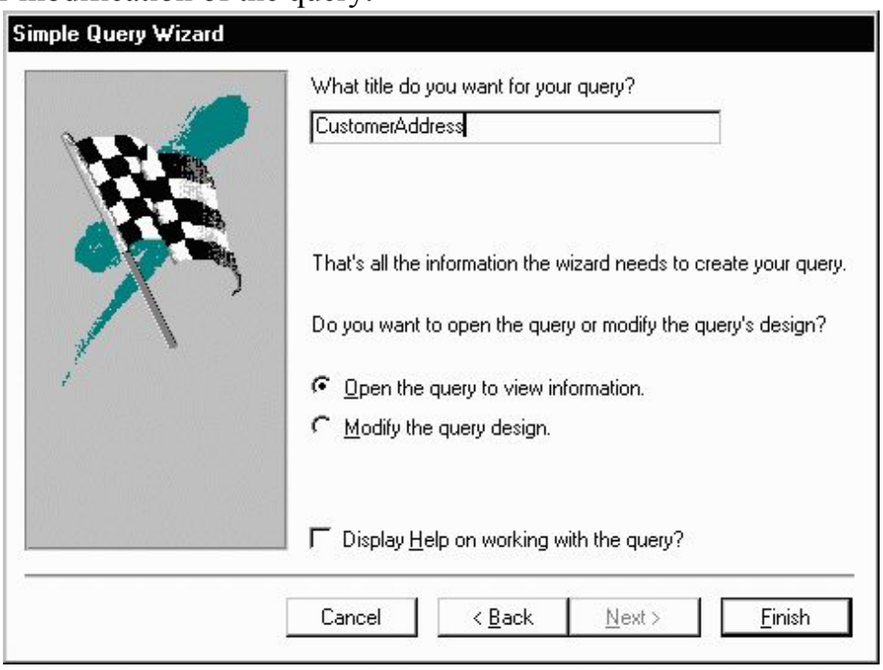


From the list of Available fields on the left, move the Name, Address, City and State fields over to the Selected Fields area on the right. Highlight one of the fields and then click on the right arrow button  in the center between the two areas. Repeat this for each of the four fields to be displayed. When done with this step, the wizard should appear as below:

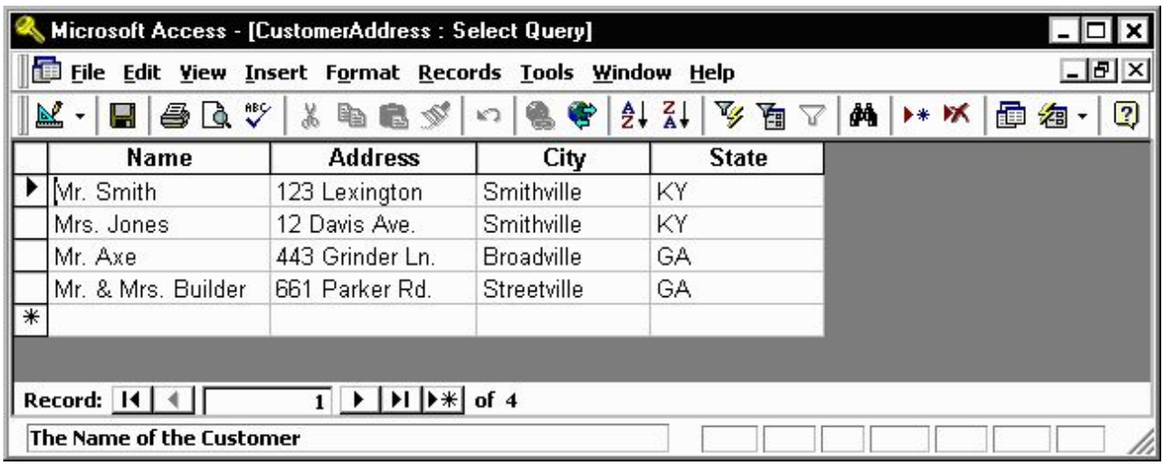


Click on the Next button to move to the next and final step in the Simple Query wizard.
In the final step, give your new query a name. For this example, name the query: Customer Address
At this point, the wizard will create the new query with the option to either:

- Open the query to view information - that is, the wizard will execute the query and show the data.
- Modify the query design - the wizard will switch to the Design View to allow further modification of the query.



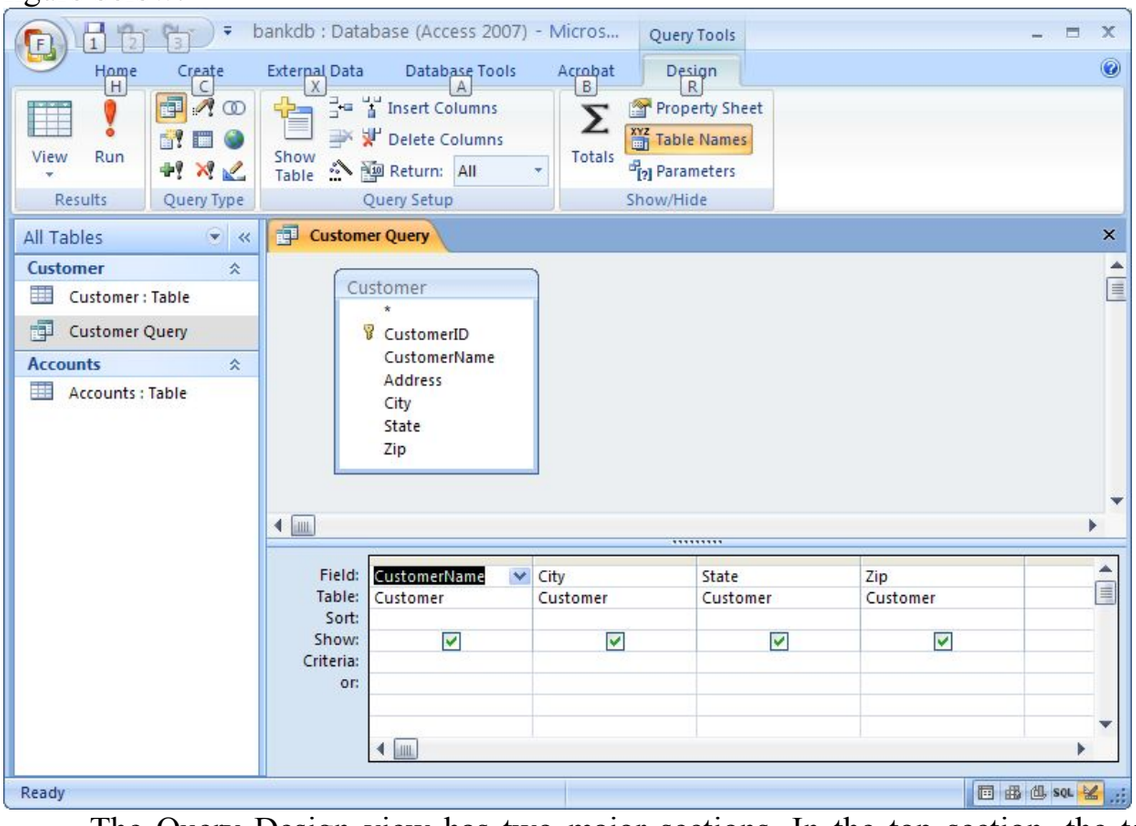
Choose Open the query to view information and click on the Finish button. When this query executes, only the customer's name, address, city and state fields appear, however, all of the rows appear as shown in the figure below:



Close this query by pulling down the Office menu and choosing the Close menu item. The Access main screen showing the Queries tab should appear. Note the new query CustomerAddress appears under the Queries tab.

In the following example, we will modify the CustomerAddress query to only display customers in a certain state. To accomplish this, we will make use of the Query Design View.

Open up the CustomerAddress query in the design view by highlighting the name of the query and clicking on the Design button. The design view will appear as in the figure below:



The Query Design view has two major sections. In the top section, the table(s) used for the query are displayed along with the available fields. In the bottom section, those fields that have been selected for use in the query are displayed.

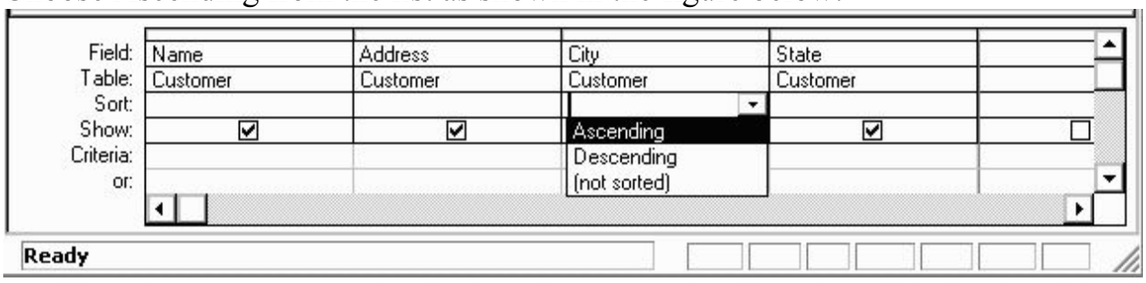
Each field has several options associated with it:

- Field - The name of the field from the table
- Table - The table the field comes from
- Sort - The order in which to sort on this field (Ascending, Descending or Not Sorted)

- Show - Whether or not to display this field in the query output
- Criteria - Indicates how to filter the records in the query output.

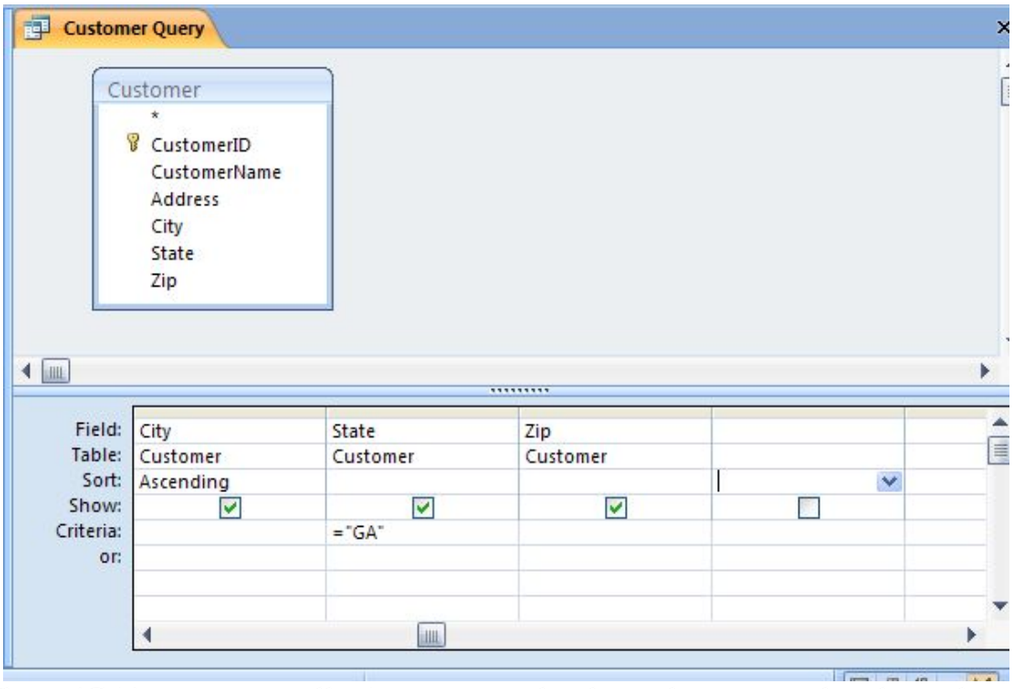
For this example, we will filter the records to only display those customers living in the State of Georgia (GA). We will also sort the records on the City field.

To sort the records on the **City** field, click in the Sort area beneath the **City** field. Choose Ascending from the list as shown in the figure below:



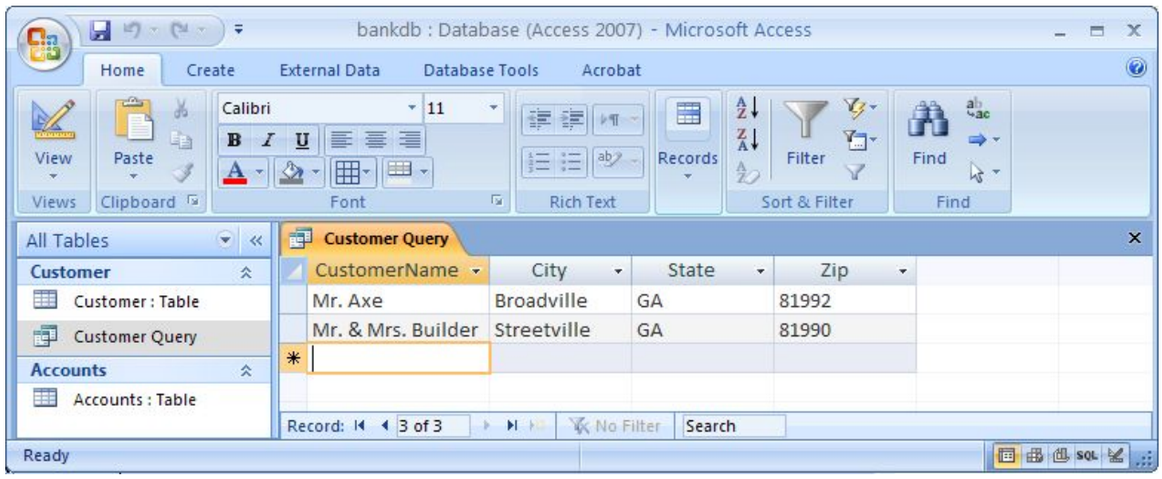
To filter the output to only display Customers in Georgia, click in the Criteria area beneath the **State** field and type the following statement:

= 'GA'



The = 'GA' statement tells Access to only show those records where the value of the **State** field is equal to 'GA'. Note the use of single quotes to surround the characters.

Run the query by clicking on the Run button (with the large red exclaimation point). The output is shown in the figure below:



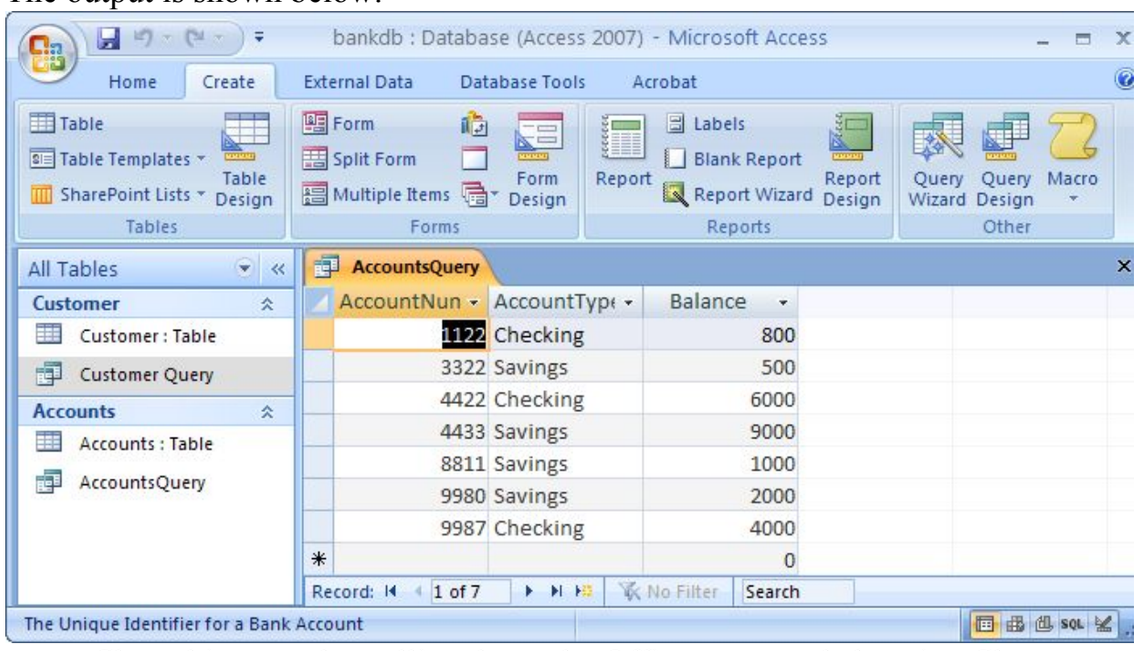
Finally, save and close this query to return to the Access main screen.

Single Table Queries

Use the Simple Query wizard to create a query on the Accounts table showing just the AccountNumber, AccountType and Balance fields.

1. From the Access main screen, click on the Queries tab. Then click on the New button.
2. Choose the Simple Query wizard option and click on the OK button.
3. Under Table/Queries: choose the Accounts table. Then move the AccountNumber, AccountType and Balance fields over to the Selected fields area. Then click the Next button.
4. In the next panel, you will be asked to choose between a detail or summary query. Choose detailed query and click on the Next button.
5. Name the new Query : AccountsQuery and click on the Finish button.

The output is shown below:

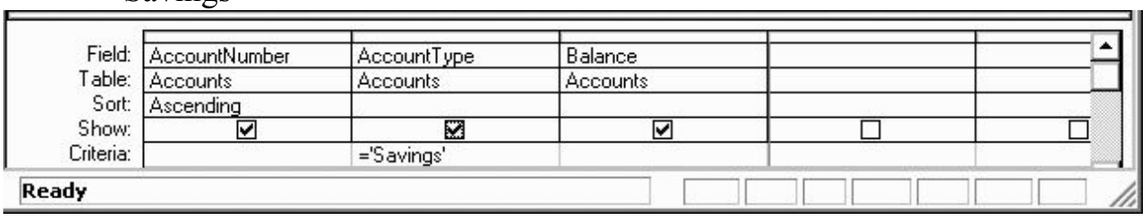


Close this query by pulling down the Office menu and choosing Close.

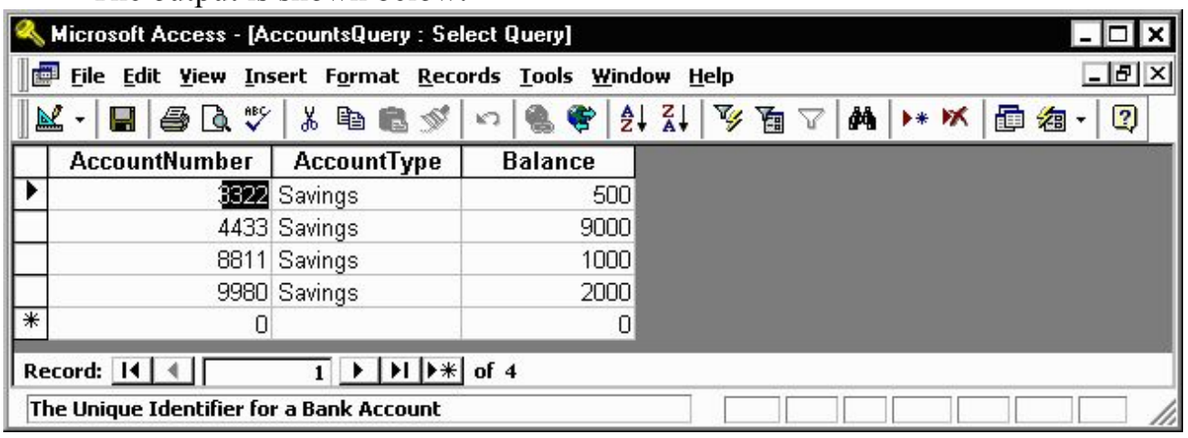
In the next part of the exercise, we will modify the query to sort the output on the account number and only display the Savings accounts.

1. From the Queries tab on the Access main screen, highlight the AccountsQuery and click on the Design button.
2. Change the Sort order for the **AccountNumber** field to Ascending.
   Add the following statement to the Criteria: are under the **AccountType** field:

= 'Savings'



3. Run the query by pulling down the Query menu and choosing the Run menu item. The output is shown below:

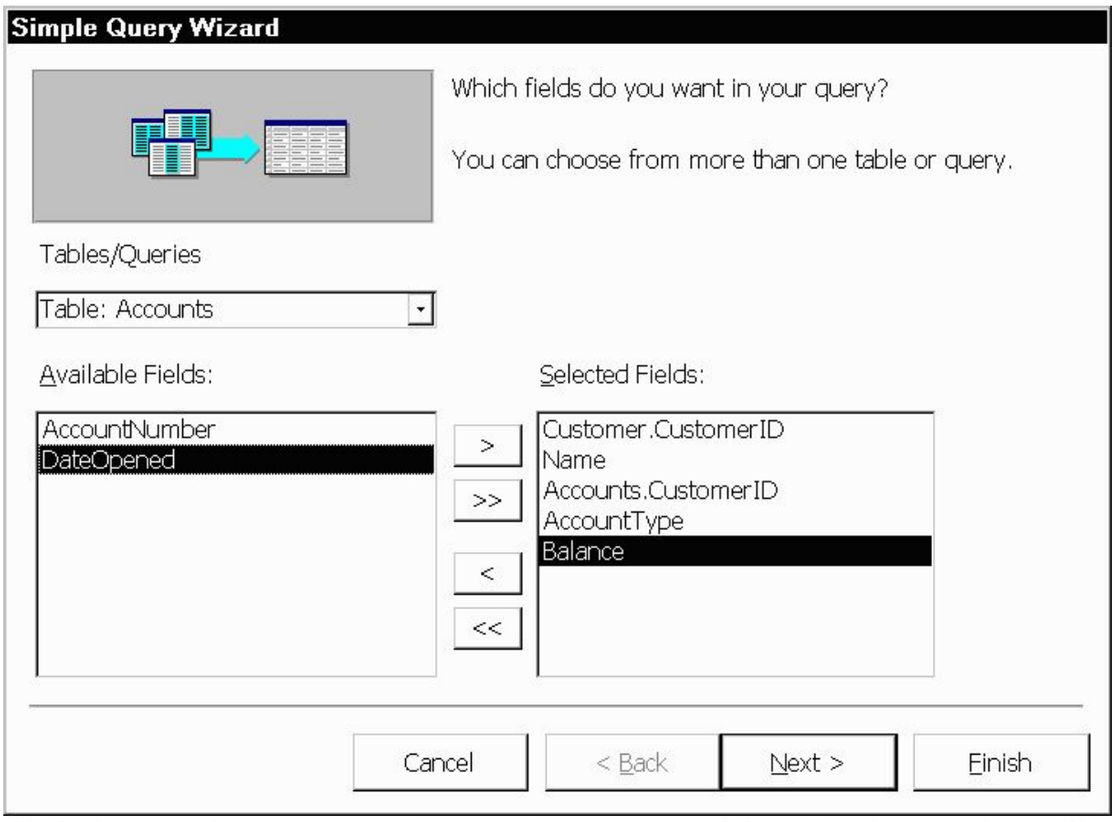


4. Finally, save and close the query to return to the Access main screen.

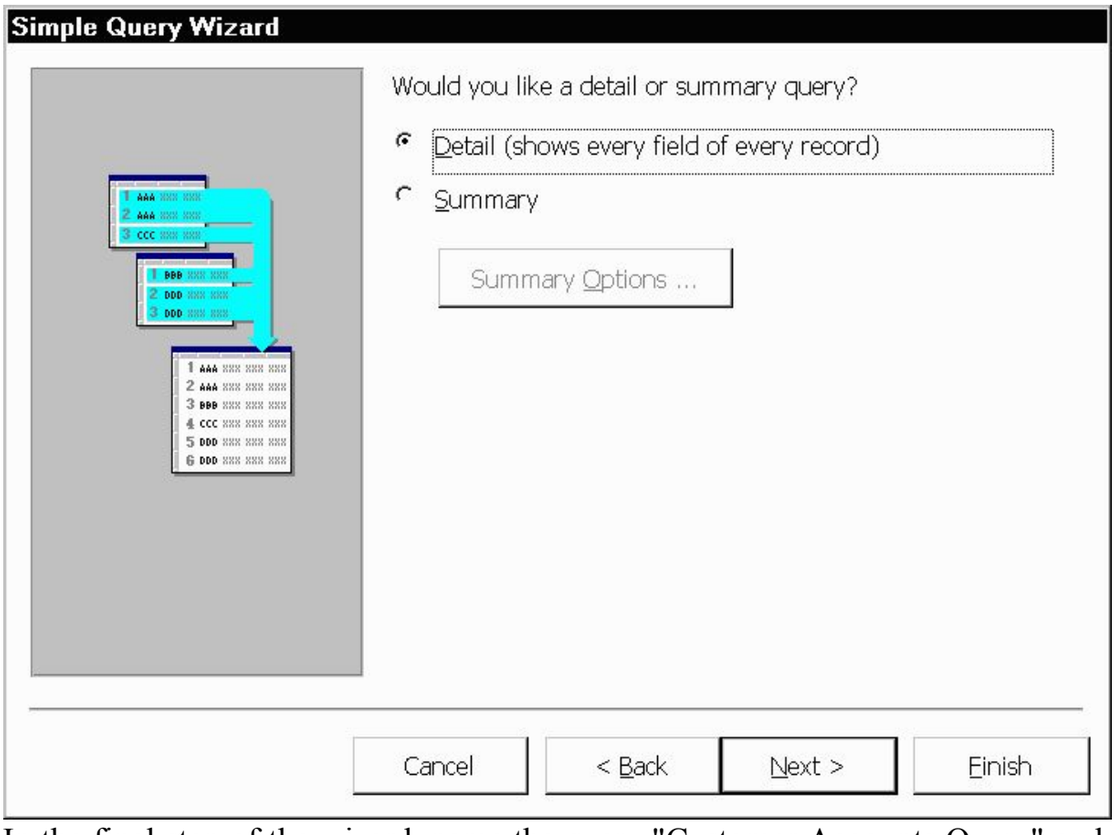
Multiple Table Queries

Up to this point, queries involving only one table have been demonstrated. It is almost a given that queries will need to involve more than one table. For this example, assume that a manager would like to see a list of all of the customers and the type of account(s) that each one maintains at the bank. Such a query requires data from both the Customers table as well as the Accounts table. In such queries, Access will rely on the Relationships established between tables to guide how the data will be assembled to satisfy the query.

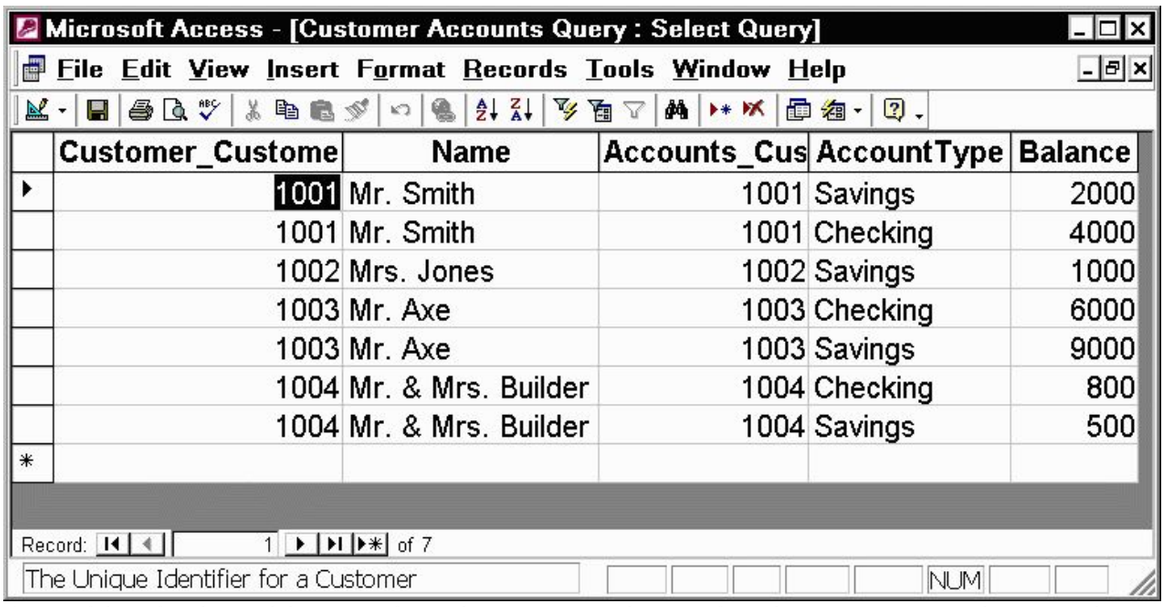
To start the process of creating a multiple table query, highlight the Query tab (Access '97) and click on the New button to create a new query. Select the "Simple Query Wizard" option as was done previously. When the simple query wizard appears, select the CustomerID and Name fields from the Customers table, then switch the Tables/Queries selection to the Accounts table and select the CustomerID, AccountType and Balance fields from the Accounts table. The result from this step is down below:



Click the Next button to continue. In the next step of the wizard, an option will appear to provide some level of Summary. For this example, leave the default at "Detail ..." as shown below and then click on the Next button.



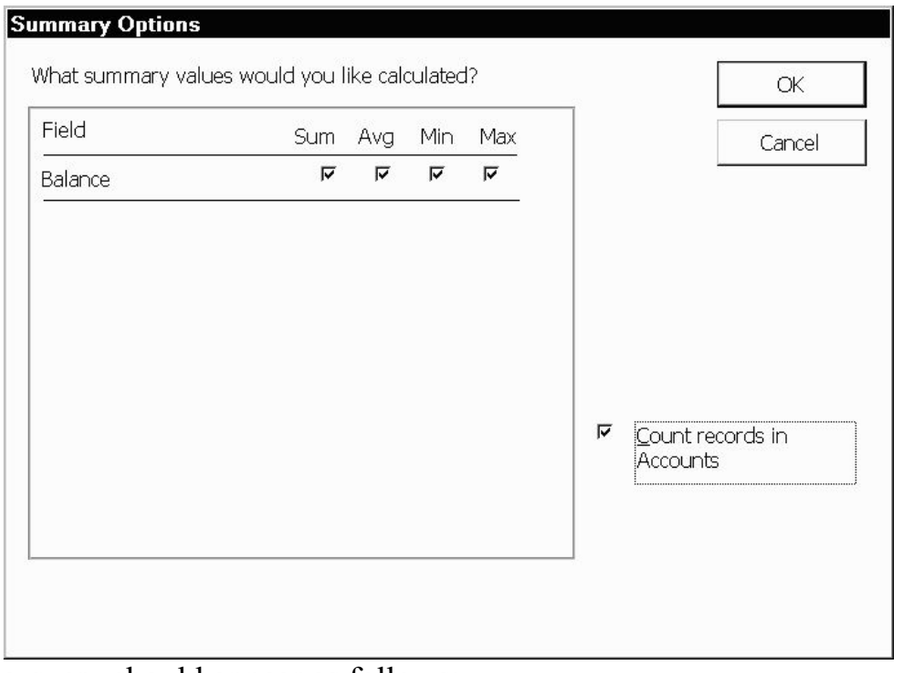
In the final step of the wizard, name the query "Customer Accounts Query" and click on the Finish button. The multiple table query results should appear as follows:



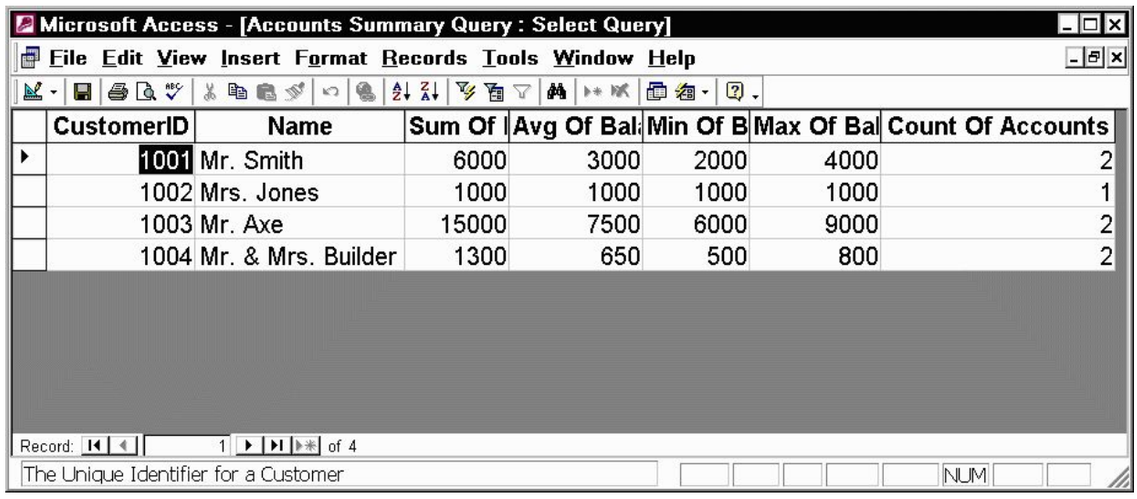
As with single table queries demonstrated previously, one can change the query definition in design view by adding filters (e.g., show account information for all customers in 'GA').

Multiple Table Queries

For this exercise, create a new query called "Accounts Summary Query" that joins the Cusomers table (include the CustomerID and Name fields) with the Accounts table (include the Balance field only). In the second step of the wizard, click on the Summary choice (instead of Details) and then click on the Summary Options... button. Check off all of the Summary option boxes such as **Sum**, **AVG**, **Min** and **Max** as shown in the figure below:



The resulting query should appear as follows:



Review of Creating and Running Queries

In this section, the basic steps for creating and running queries were introduced. The query wizard can be used to create simple queries that access a single table. It is also possible to then modify the query to sort or filter the records.

Creating a query using the query wizard:

1. From the Access main screen, click on the Queries tab. Then click on the New button.
2. From the Queries tab on the main Access screen, click on the New button and choose the Simple Query wizard option.
3. Under Table/Queries: choose the appropriate table for the query and then indicate which fields in the table will appear in the query output.
   If querying more than one table, change the Table/Queries: selection to display additional tables and select the necessary fields.
4. If the table contains numeric fields, either detailed or summary information may be specified for the query.
5. Finally, name the new query and click on the Finish button.
   As a final note, Forms and Reports can be created based on existing queries.

QUESTIONS AND TASKS

1. What do you know the steps for creating queries?
2. What query types do you know?
3. Expand meaning of the term query.
4. Expand meaning of the term multiple table query.
5. Expand meaning of the term simple query.

UNIT 12 CUSTOMER RELATIONSHIP MANAGEMENT IN BANKING SECTOR

Today, many businesses such as banks, insurance companies, and other service providers realize the importance of Customer Relationship Management (CRM) and its potential to help them acquire new customers, retain existing ones and maximize their lifetime value. At this point, close relationship with customers will require a strong coordination between IT and marketing departments to provide a long-term retention of selected customers. This paper deals with the role of Customer Relationship Management in banking sector and the need for Customer Relationship Management to increase customer value by using some analytical methods in CRM applications.

CRM is a sound business strategy to identify the bank's most profitable customers and prospects, and devotes time and attention to expanding account relationships with those customers through individualized marketing, repricing, discretionary decision making, and customized service-all delivered through the various sales channels that the bank uses. Under this case study, a campaign management in a bank is conducted using data mining tasks such as dependency analysis, cluster profile analysis, concept description, deviation detection, and data visualization. Crucial business decisions with this campaign are made by extracting valid, previously unknown and ultimately comprehensible and actionable knowledge from large databases. The model developed here answers what the different customer segments are, who more likely to respond to a given offer is, which customers are the bank likely to lose, who most likely to default on credit cards is, what the risk associated with this loan applicant is.

Finally, a cluster profile analysis is used for revealing the distinct characteristics of each cluster, and for modeling product propensity, which should be implemented in order to increase the sales.

Customer Relationship Management

In literature, many definitions were given to describe CRM. The main difference among these definitions is technological and relationship aspects of CRM. Some authors from marketing background emphasize technological side of CRM while the others considers IT perspective of CRM. From marketing aspect, CRM is defined by [Couldwell 1998] as ".. a combination of business process and technology that seeks to understand a company's customers from the perspective of who they are, what they do, and what they are like". Technological definition of CRM was given as ".. the market place of the future is undergoing a technology-driven metamorphosis" [Peppers and Rogers 1995]. Consequently, IT and marketing departments must work closely to implement CRM efficiently. Meanwhile, implementation of CRM in banking sector was considered by [Mihelis et al. 2001]. They focused on the evaluation of the critical satisfaction dimensions and the determination of customer groups with distinctive preferences and expectations in the private bank sector. The methodological approach is based on the principles of multi-criteria modeling and preference disaggregation modeling used for data analysis and interpretation. [Yli-Renko et al. 2001] have focused on the management of the exchange relationships and the implications of such management for the performance and development of technology-based firms and their customers. Spesifically the customer relationships of new technology-based firms has been studied. [Cook and Hababou, 2001] was interested in total sales activities, both volume-related and non-volume related. They also developed a modification of the standard data envelope analysis (DEA) structure using goal programming concepts that yields both a sales and service measures.

[Beckett-Camarata et al. 1998] have noted that managing relationships with their customers (especially with employees, channel partners and strategic alliance partners) was critical to the firm's long-term success. It was also emphasized that customer relationship management based on social exchange and equity significantly assists the firm in developing collaborative, cooperative and profitable long-term relationships. [Yuan and Chang 2001] have presented a mixed-initiative synthesized learning approach for better understanding of customers and the provision of clues for improving customer relationships based on different sources of web customer data. They have also hierarchically segmented data sources into clusters, automatically labeled the features of the clusters, discovered the characteristics of normal, defected and possibly defected clusters of customers, and provided clues for gaining customer retention. [Peppers 2000] has also presented a framework, which is based on incorporating e-business activities, channel management, relationship management and back-office/front-office integration within a customer centric strategy. He has developed four concepts, namely Enterprise, Channel management, Relationships and Management of the total enterprise, in the context of a CRM initiative. [Ryals and Knox 2001] have identified the three main issues that can enable the development of Customer Relationship Management in the service sector; the organizational issues of culture and communication, management metrics and cross-functional integration especially between marketing and information technology.

CRM Objectives in Banking Sector

The idea of CRM is that it helps businesses use technology and human resources gain insight into the behaviour of customers and the value of those customers. If it works as hoped, a business can: provide better customer service, make call centres more efficient, cross sell products more effectively, help sales staff close deals faster, simplify marketing and sales processes, discover new customers, and increase customer revenues. It doesn't happen by simply buying software and installing it. For CRM to be truly effective, an organization must first decide what kind of customer information it is looking for and it must decide what it intends to do with that information. For example, many financial institutions keep track of customers' life stages in order to market appropriate banking products like mortgages or IRAs to them at the right time to fit their needs. Next, the organization must look into all of the different ways information about customers comes into a business, where and how this data is stored and how it is currently used. One company, for instance, may interact with customers in a myriad of different ways including mail campaigns, Web sites, brick-and-mortar stores, call centers, mobile sales force staff and marketing and advertising efforts. Solid CRM systems link up each of these points. This collected data flows between operational systems (like sales and inventory systems) and analytical systems that can help sort through these records for patterns. Company analysts can then comb through the data to obtain a holistic view of each customer and pinpoint areas where better services are needed. In CRM projects, following data should be collected to run process engine: 1) Responses to campaigns, 2) Shipping and fulfillment dates, 3)Sales and purchase data, 4) Account information, 5) Web registration data, 6) Service and support records, 7) Demographic data, 8) Web sales data.

A Model Design for CRM At Bank

Garanti Bank, one of the leading banks in Turkey were looking at new ways to enhance its customer potential and service quality. Electronic means of banking have proved a success in acquiring new customer groups until the end of 2001. After then, a strategic decision was made to re-engineer their core business process in order to enhance the bank's performance by developing strategic lines. Strategic lines were given in order to meet the needs of large Turkish and multinational corporate customers, to

expand commercial banking business, to focus expansion in retail banking and small business banking, to use different delivery channels while growing, and to enhance operating efficiency though investments in technology and human resources

To support this strategy Garanti Bank has implemented a number of projects since 1992 regarding branch organization, processes and information systems. The administration burden in the branches has been greatly reduced and centralized as much as possible in order to leave a larger room to marketing and sales. The BPR projects have been followed by rationalizing and modernizing the operational systems and subsequently by the introduction of innovative channels: internet banking, call centre and self-servicing. In parallel, usage of technology for internal communication: intranet, e-mail, workflow and management reporting have become widespread.

CRM Development

To be prepared to the changing economic conditions and, in particular, to a rapidly decreasing inflation rate scenario Garanti Bank has started timely to focus on developing a customer relationship management (CRM) system. The total number of customers is presently around two millions, but an increase to roughly three millions is foreseen as merging with Osmanli Bank and Koferzbank are achieved and the present growth targets are reached.

The importance for the bank of managing the relationships with their customers has been the drive of the joint projects that have been developed with IBM in the last three years. During the projects a number of crucial technological and architecture choices have been made to implement the entire process. Realizing the importance of customer information availability the first of these projects has focussed on the problem of routinely collecting and cleansing data. The project has been undertaken by the bank with the spirit that has characterized the whole CRM development. The project has promoted a massive involvement of the branches, namely of the portfolio managers and campaigns have been launched for popularizing among branch staff the importance of gathering and maintaining reliable customer data. Another set of methods have been tested for customer not included in portfolios (pool customers), such as mailing or distributing questionnaires in the branches or using automatic teller machines (ATM) and the call center. Methods for data checking and testing have been developed to be routinely employed by the bank's staff. Results obtained are very good: for portfolio customers data available are respectively 98% for the commercial ones and 85% for the retail ones. For pool customers availability goes down to 65%: this is a well-known phenomenon due to the loose relationship with the latter customers.

Data Warehouse and Data Mining

The Data warehouse is the core of any decision support system and hence of the CRM. In implementing its Data Warehouse Garanti Bank has selected an incremental approach, where the development of information systems is integrated with the business strategy. Instead of developing a complete design of a corporate Data Warehouse before implementing it, the bank has decided to develop a portion of the Data Warehouse to be used for customer relationship management and for the production of accurate and consistent management reports. Here we are not concerned with the latter goal, but are concentrating on the former.

The Data Warehouse has been designed according to the IBM BDW (Banking Data Warehouse) model, that has been developed as a consequence of the collaboration between IBM and many banking customers. The model is currently being used by 400 banks worldwide. The Garanti Bank Data Warehouse is regularly populated both from operational systems and from intermediate sources obtained by partial pre-processing of the same raw data.

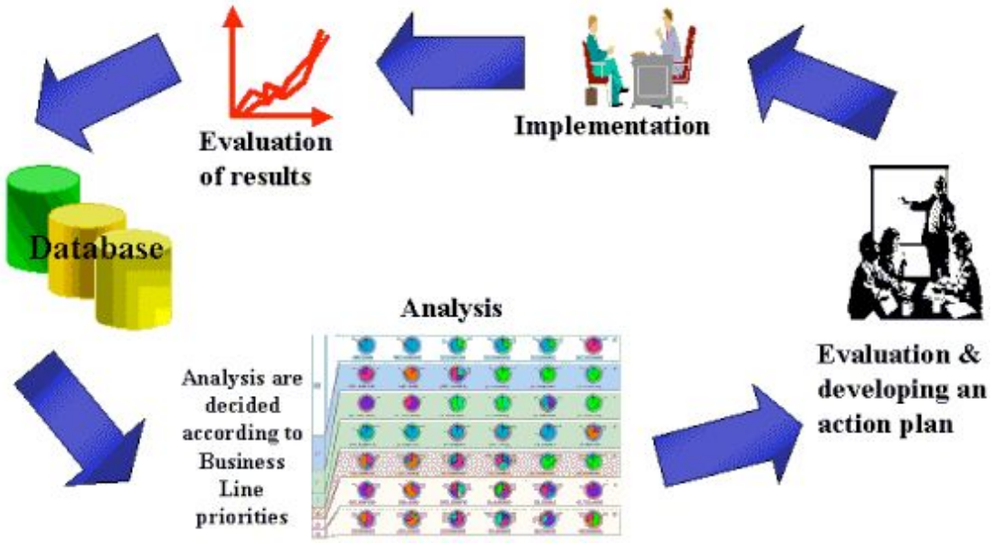


Figure 1. The process of Relational Marketing

It includes customers' demographic data, product ownership data and transaction data or, more generally product usage data as well as risk and profitability data. Most data are monthly averages and today's historical depth is 36 months starting from 1/1/1999 to 12/31/2001. As new data are produced they are placed temporarily in an intermediate, from which they are pre-processed and transferred to the warehouse. The importance of the Data Warehouse stems from the analysis of Figure 1. As a result of strategic decisions customer analysis is carried out by using data continuously updated as well the analytical methods and tools to be described later on. The CRM group analyzes results obtained and designs action plans, such as campaigns, promotions, special marketing initiatives, etc. Plans developed are then implemented by means of the several channels used by the bank to reach customers. Evaluation or results completes the cycle. The results become an integral part of the description of the bank-customer relationship in the warehouse. The learning cycle is thus complete and results obtained can be reused in future analyses and in future marketing plans. It’s easy to understand that the Data Warehouse cannot actually be built 'once for all' but is a kind of living structure continuously enriched and updated as the Relational Marketing activity developers. OLAP (On Line Application Programming) analyses are developed by means of Business Object in its web version. CRM analysts use this tool to issue complex SQL queries on the Data Warehouse or on the Analytical Datamart and carry out mono and bivariate statistics on the whole customers' population or on selected groups. Figure 2 shows general structure of Relational Marketing Activity.

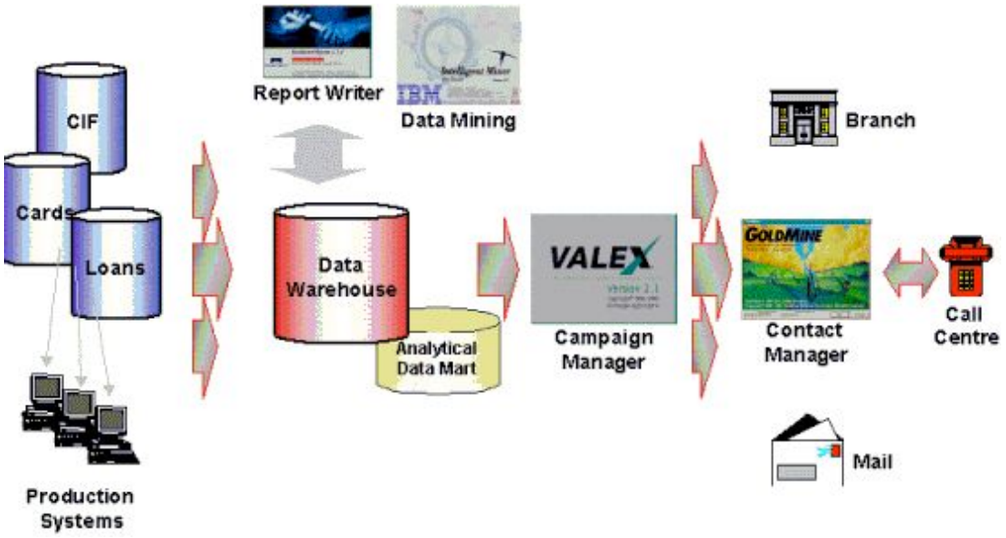


Figure 2.The Relational Marketing process is supported by a computing infrastructure where many software packages are integrated with the bank's information system.

Data Mining analyses are not carried out directly on the Data Warehouse, but on the Analytical Datamart by means of the software package IBM Intelligent Miner [Cabena et.al. 1999], using as a computing and data server the same mainframe where the Data Warehouse resides. Garanti Bank believes these tools and methodologies are a powerful competitive weapon and is investing heavily in the human resources needed to develop these analyses.

The Analytical Datamart is derived from the Data Warehouse through the following steps: 1) *Raw data processing:* data selection, data extraction, and data verification and rectification *2) Data modelling and variable pre-processing:* variable selection, new variable creation, variable statistics, variable discretization. The above processing, based on traditional data analysis, is strictly dependent on the investigated process; new variable creation, for instance, is intended to aggregate information contained in the raw data into more expressive variables. A simple example is the number of credit transaction on current account, that contains much of the information contained in the individual transactions, but is easier to analyze and represent. Variable discretization, based on the distribution of the original variables, is intended to generate categorical variables that better express the *physical reality* of the problem under investigation. The Analytical Datamart is customer centric and contains the following data:

1. demographic (age, sex, cultural level, marital status, etc.)
2. ownership of bank's product/services
3. product/services usage (balance, transactions, etc.)
4. global variables : profit, cost, risk, assets, liabilities
5. relationship with the bank: segment, portfolio, etc.

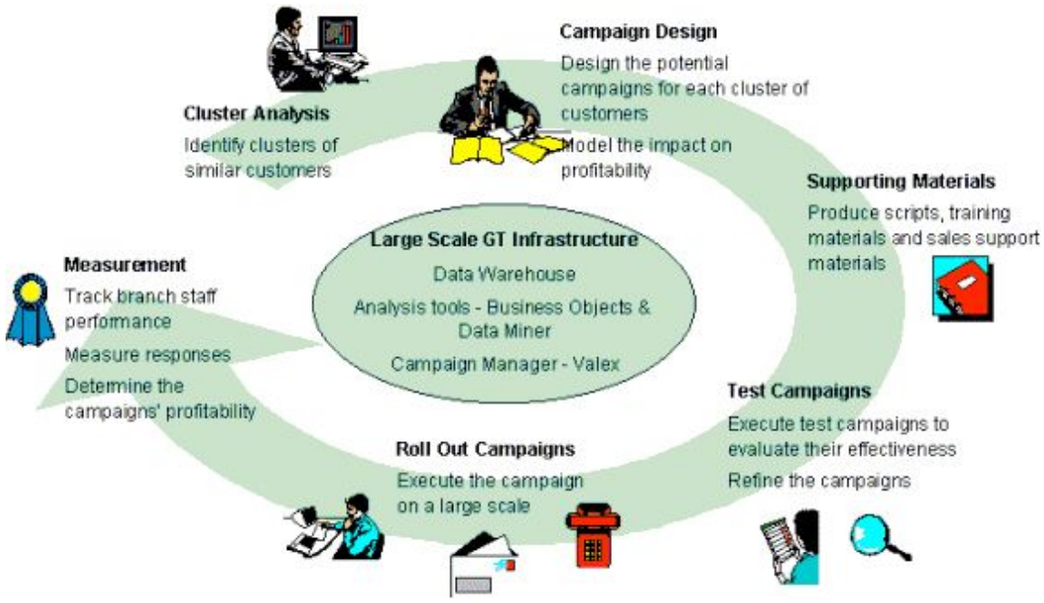


Figure 3. The marketing campaign process and the software supporting it.

Marketing Campaigns

After analyzing strategic and analytical CRM we concentrate here on the equally important operational aspects. Marketing Campaigns is the first method that Garanti Bank has used to test the above described analyses and techniques. The overall campaign process is reported in Figure 3, that shows that propensity determination and targeting are the first step of the whole activity.

A number of experimental campaigns have been designed and carried out to test the soundness of the approach before attempting a large scale roll-out. Experimental campaigns have addressed about 900 customers selected within six branch offices in Instanbul. An education process has been started by meeting sales forces in the branch offices, by distribution of an explanation booklet and by publishing on the Intranet a note explaining the whole process.

System interfaces have been modified in order to track the customers under promotion, as well as to enable salespeople in the branch office to complete the sales on promoted customers as well as to record the fact that the sale was a consequence of the promotion. The bank has so far used for promotion two channels: the salespeople in the branches and the call center. Each channel was used in four different campaigns.

RETAIL	CHANNEL	SALES (%)
1st Mutual Fund Campaign with 4 branches	BRANCH	26
2nd Mutual Fund Campaign with 6 branches	BRANCH	44
Credit Card Campaign with 4 branches	BRANCH	61
E.L.M.A Campaign with Gayrettepe branch	BRANCH	47
Mutual Fund Campaign with 6 branches	TELE-MARKETING	6
Home Insurance Campaign	TELE-MARKETING	21
COMMERCIAL		
Alternative Delivery Channels	TELE-MARKETING	22
Internet Branch Activation Campaign	TELE-MARKETING	67

Figure 4. Summary table of experimental promotions deployed by Garanti Bank.

The activity of the call centre was supported by the Goldmine software package, while the overall campaign management was achieved through Valex. This product used customer data stored in the Data Warehouse and at the same time manages itself a smaller local database, where campaign data are temporarily stored (list of customers, date of promotion, responses, etc.). These data must be *copied* manually into the Data Warehouse when the campaign has been completed.

Table in Figure 4 reports a summary of the campaigns deployed and the results thereof. By considering that the maximum response rate obtained by campaigns run by using traditional methods is normally around 1-2%, we see that the benefit of using targeted campaigns is very remarkable. As precise measurements on results obtained by the bank by using traditional methods are not available, we cannot accurately quantify the improvement. An indirect measurement of this improvement comes from the observation that in the timeframe where investment funds campaign were run, the branch offices included in the promotion record an increase in product purchase of about 214%, against an average 6 % throughout the Bank.

Table in Figure 4 shows also that the results obtained by using the call center as a promotion channel are equally satisfactory, with the single exception of a low result obtained on the first campaign on investment funds.

Results obtained by extensive usage of customer data to develop and apply Relational Marketing have convinced the Garanti Bank to proceed along the line undertaken. As lists of customers eligible for four very important banking product/services are available, as above described, the following actions are now being deployed:

1. extension of promotions to a larger customer population by having sales people in the branches contacting progressively 15,000 customers

2. targeted campaigns through Internet and the call centre for customers actively using one or both of these innovative channels for their banking operations.

The same approach is now being extended to small and medium businesses and to commercial customers. Moreover the analytical and strategic CRM cycle is being completed by developing an application analyzing customers' attrition and deploying strategies to reduce it.

QUESTIONS AND TASKS

1. Expand meaning of the term CRM.
2. Expand meaning of the term SQL.
3. Expand meaning of the term OLAP.
4. Expand meaning of the term ATM.
5. Expand meaning of the term Data Warehouse.

UNIT 13 DISTRIBUTED ONLINE BANKING

In today's world of emerging technologies, enterprises are moving towards the Internet for businesses. People are rushing towards the e-commerce applications for their day-today needs, which in turn are making the Internet very popular. Online Banking has given both an opportunity and a challenge to traditional banking. In the fast growing world, banking is a necessity, which in turn takes a lot of time from our busy schedule. Going to a branch or ATM or paying bills by paper check and mailing them out, and balancing checkbooks are all time-consuming tasks. Banking online automates many of these processes, saving time and money. For all banks, online banking is a powerful tool to gain new customers while it helps to eliminates costly paper handling and manual teller interactions in an increasingly competitive banking environment. Banks have spent generations gaining trust of their customers, and the goal for this project is to develop a user friendly, secure Online Banking Application. The application will be built using Java Server Pages (JSP), tomcat as the application server, and Microsoft Access / SQL Server as a database.

Architecture of Online Banking:

The Online Banking Application is based on 3-tiered model. The Enterprise architecture for Online Banking Application is shown below.

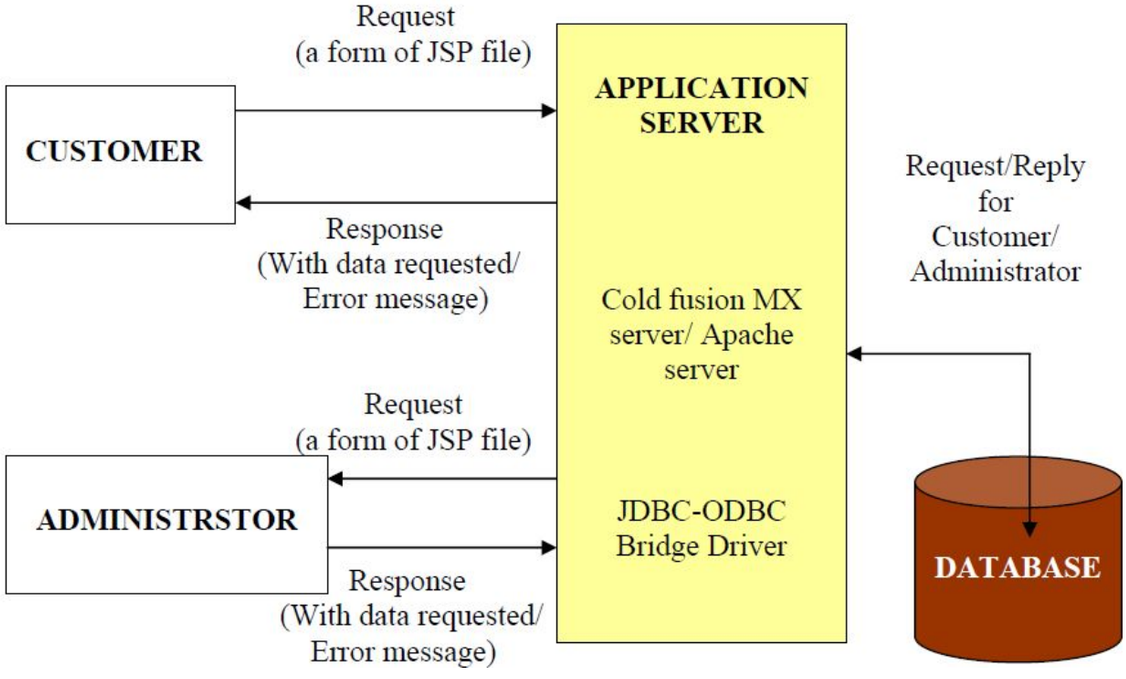


Figure 1: Architecture of Online Banking Application

The 3-tiered architecture shown above has the following major components:

1. **Client:** There will be two clients for the application. One will be a web-based user-friendly client called bank customers. The other will be for administration purposes.

2. **Application Server:** It takes care of the server script, takes care of JDBC-ODBC driver, and checks for the ODBC connectivity for mapping to the database in order to fulfill client and administrator's request.

3. **Database:** Database Servers will stores customer's and bank data.

Simply stated, the application works based on a request/response protocol. A client initiates a request to the server. The server responds by executing the business logic hosted inside the JSP program and if required, communicates with the Database Server to fulfil a client's request.

The Online banking Application project will be divided into 4 modules namely:

1. Bank Account
2. Bank Account Administrator
3. Credit Card Customer
4. Credit Card Account Administrator

Each module is discussed in more detail under design phase.

Similar banking applications available in the market

A considerable amount of research has been done in the past few months on this project. Many banks had migrated from paper based banking system to electronic / online banking. Each bank had its own, user friendly interface, which helps its customers to interact with their account at their ease. A wide variety of online banking applications are available in the market, which in turn help the bank to function smoothly without reducing the quality of service. All banks which are using online banking application use the same basic principle.

National City Bank has excellent features, which allows customers to check their accounts and view their statements. The best thing about this bank's system allows us to schedule payments and do online transactions. The security feature is the best; it gains the trust of the customer and allows them to do their transitions in an efficient and secure manner. However, the interface is very complicated for novice users. The interface for credit card customer is confusing.

Bank One is the fastest growing bank in United States with millions of customers, who perform their transactions online. The security issues are wonderful, and it allows the customer to view their transactions, pay bills online, ATM/branch locator and provide calculators and educators that will help customers to determine savings, mortgages and loan amounts. Educators are learning materials covering several financial topics which help the customer to learn more about the facilities that the bank has for them. The user interface is not as useful for the novice customers.

TCF bank Online banking is a safe, fast and convenient way to access the accounts. It has all functionality but was lacking in user interface.

Comparison between JSP and other technologies

• ***JSP vs. Active Server Pages (ASP)***. ASP is a similar technology from Microsoft. The advantages of JSP are Saturday, March 13, 2004two fold. First, the dynamic part is written in Java, not Visual Basic or other MS-specific language, so it is more powerful and easier to use. Second, it is portable to other operating systems and non-Microsoft Web servers.

• ***JSP vs. Pure Servlets***. JSP doesn't give you anything that you couldn't in principle do with a servlet. But it is more convenient to write and to modify regular HTML than to have a million println statements that generate the HTML, by separating the look from the content, you can put different people on different tasks. Your Web page design experts can build the HTML, leaving places for your servlet programmers to insert the dynamic content.

• ***JSP vs. JavaScript.*** JavaScript can generate HTML dynamically on the client. This is a useful capability, but only handles situations where the dynamic information is based on the client's environment. With the exception of cookies, HTTP and form submission data is not available to JavaScript. And, since it runs on the client, JavaScript

can't access server-side resources like databases, catalogs and pricing information, to understand the distinction between Java Script and Java Server Pages. *Java Script code is generally executed by the web client (browser)* after the web server sends the HTTP response. *Java Server Pages are executed by the web server* before the web server sends the HTTP response. In fact, JSP is what creates the HTTP response. Thus, Java Script is said to be a "Client Side" technology. Its underlying code can be viewed by the web user, while Java Server Pages are a "Server Side" technology and its underlying code is not exposed to web users. JSP is processed by the web server before result reaches the client.

• ***JSP vs. Static HTML.*** Regular HTML, of course, cannot contain dynamic information. JSP is so easy and convenient that it is quite feasible to augment HTML pages that only benefit marginally by the insertion of small amounts of dynamic data. Previously, the cost of using dynamic data would prevent its use in all but the most valuable instances.

Software Development Methodology

Analysis. The table below lists the functionalities to be included in the Online Banking Application, as well as certain features that will not be supported. This list is a tentative, since it may be discovered during development that additional features are required or some existing features may prove to be unworkable or impractical due to time limitations. The application will be written Java Server Pages (JSP), as it is easier to write and maintain pages. All the necessary hardware and software requirement for the complete application are included in this paper. Table 1 represents the features supported by Online Banking Application.

Design. Dataflow diagrams are depictured below to give the clear understanding of Online Banking Application. The Online banking Application project will be divided into 4 modules namely:

1. Bank Account
2. Bank Account Administrator
3. Credit Card Customer
4. Credit Card Account Administrator

Table 1: Functionalities for an Online Banking Application

Feature Support

Feature	Support
Support 3-tier architecture(Client, Server, Database)	yes
Creation of design for all common components	yes
Creation of design for all Server Side Components	yes
Support session tracking	yes
Easy means of navigation through pages containing proper session tracking.	yes
Support Application Servers	Tomcat
Support Secure Socket Layer (SSL)	yes
Easy means of navigation through different pages, which are secured using SSL	yes
Support the ODBC connections and JDBC-ODBC as well	yes
Database	MS-SQL Server or MS-Access
Establish database connection	yes
Generation of Use case and Data flow diagrams	yes
Programming Language support	JSP
Operating System support	Windows'2000 or higher

Module 1

In this module the customer is allowed to logon to the website and can access his/her account by getting user name and password which will be verified with the server and the database. Once he/she gets verified then they are allowed to view their personal account and perform operations such as change of address, paying bills online, viewing transactions and transferring money into other accounts. The data will be highly secured using Secure Socket Layer (SSL) technology. Once the customer finishes the task the update information instantly gets stored into the database. The customer is then allowed to sign out from his/her account.

Module 2

In this module the administrator is allowed to log on to the website and can access his/her administrative account by using the user name and password which will then be verified with the database. Once he/she gets verified the administrative interface will be displayed, where the administrator can perform operations for both new customers and existing customers. Administrator will help a new customer in opening their account by taking complete information from them. Administrator provides services like withdrawal, deposit, transfer and deleting customer during the time of closing the account. In this module administrator provides great customer service to the customers who want to do phone banking or teller banking. The data will be highly secured using Secure Socket Layer (SSL) technology. The interface for administrator will be both very user friendly and efficient. The data gets stored in the database instantly when the administrator hits the submit button.

Module 3

In this module, the customer is allowed to apply for the credit cards (Student, Premium and Basic) or for the loan (home, auto and education). Depending upon their selection the corresponding page will be shown when they will be asked to fill out the form. Depending on the credit rating the customer will be either accepted or rejected. Usually the credit rating will be checked with national credit bureau, which will be internally connected to INS and Social Security office database. Once the customer gets approved for the credit card or loan, their credit card will be sent to them by postal service. Once they decided to register themselves to an online credit card banking they enroll by using the enroll form, where they will be asked to enter their credit card number, their Social Security Number and user defined password(Numbers only).

To access the account, customers should visit the credit card website and get verified with the database by entering the user name and the password they have created. If the verification is successful then they will be allowed to view their credit card account which will display information about their credit limit and balance. They are also allowed to make online bill payments using their credit card account. As this module contains allimportant data like credit card numbers, account user name and password and online bill payments, it needs to be secure, therefore Secure Socket Layer (SSL) will be used. It encrypts the data before it is sent and gets decrypted at the server and vise-versa. This will prevent the hackers to view the data, which is being transferred through any media.

Module 4

In this module the administrator is allowed to log on to the website and will be allowed to access his/her administrative account by using its user name and password which will then gets verified with the database. Depending upon their authentication, the administrative page will be displayed, where administrator is allowed to assign credit limits for the customer depending upon what kind of request the customer has made. The administrator will be allowed to put a hold on the credit card account for security reasons, like lost/stolen credit card and this facility will protect customer information

from getting misused by others. Once the administrator selects the type of card or loan requested and the social security number from the database on a single click the credit limit will be assigned. There will be a special field in the database, which will allow the administrator to keep track of the customers who have already been issued their cards.

The application will be having other functionalities such as:

- Password retrieval for existing customer.
- Locator [in case of teller banking]
- Career at the bank.
- Enrollment for online banking.

The application will be using a backend as MS- Access database, all the front-end will be written in Java Server Pages (JSP) and Jakarta Tomcat application server will be used as a middle ware which will take care of the connection between front-end and backend.

Database Design:

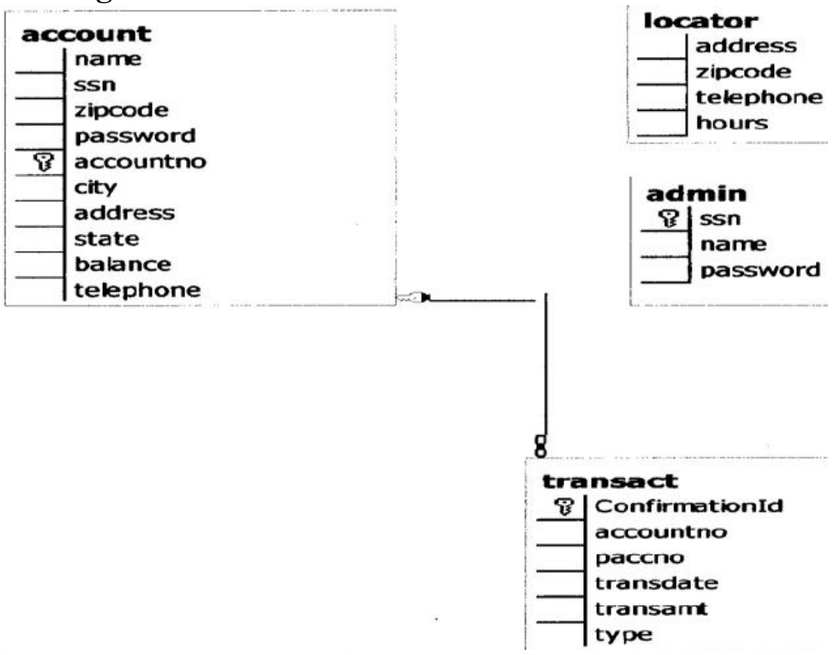


Figure 2: Entity- Relationship diagram for Online Bank account customer and Administrator

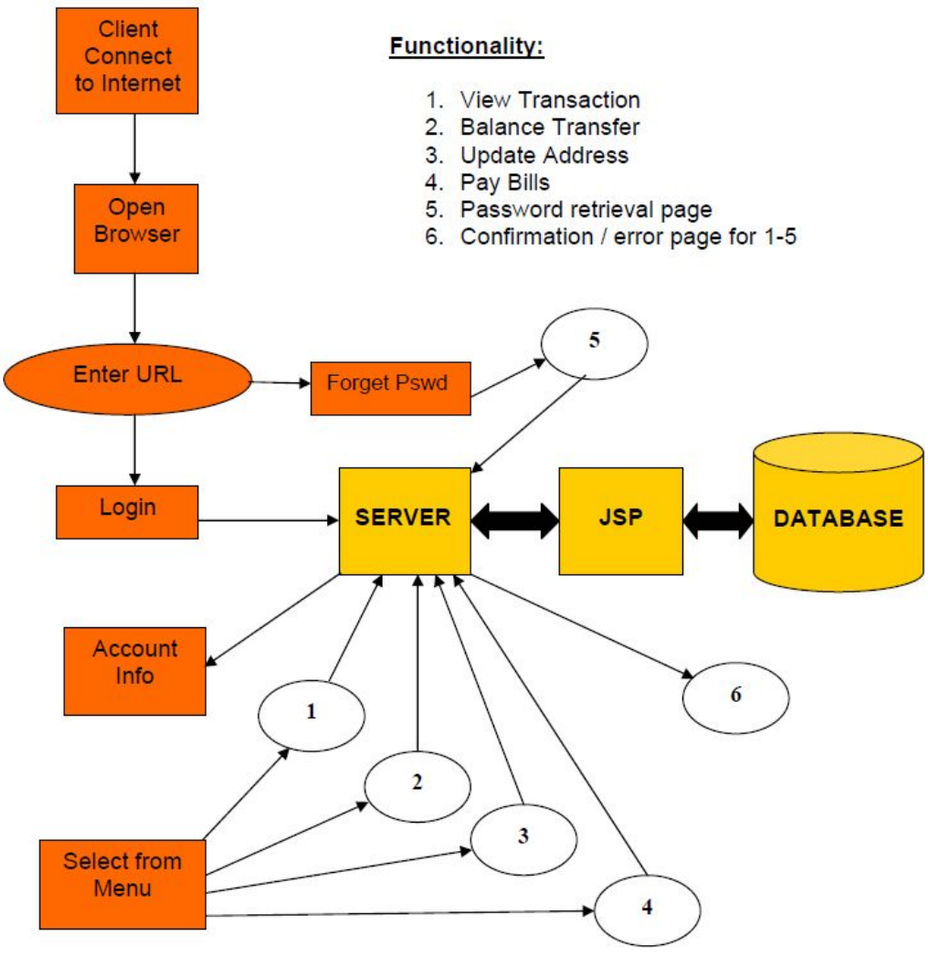


Figure 3: Dataflow diagram for bank account customer

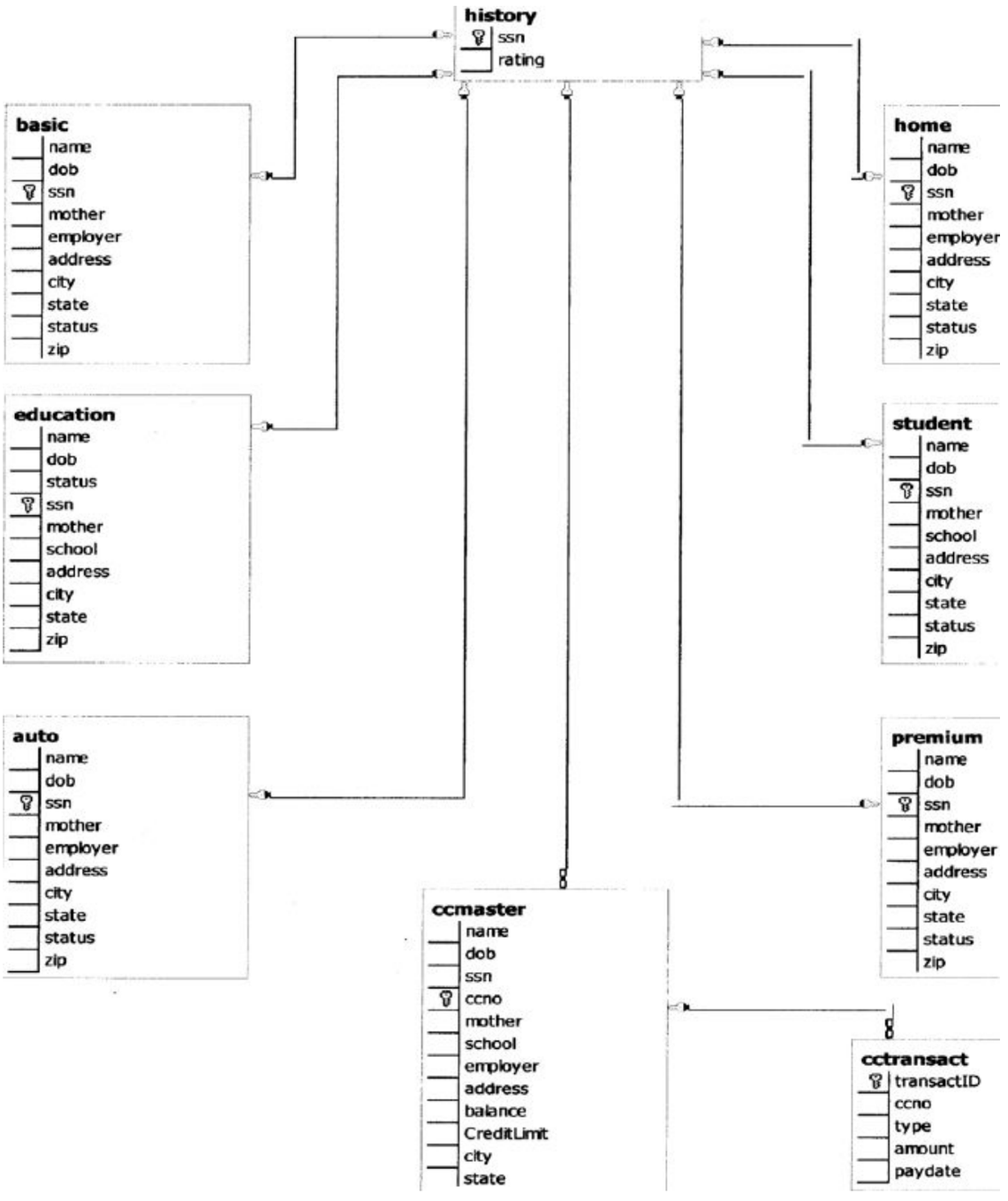


Figure 4: Entity-Relationship diagram for Online Credit Card Customer and Administrator

Implementation

As the Online Banking Application is develop in increments, features will be coded as soon as the designs for that feature have been completed. If design changes are required due to requirements changes of flaws that are discovered, work on this phase will be suspended and the analysis and design phases will be reinitiated to make the necessary design changes. After those changes have been made, the implementation phase will continue. A new design version is created every time that a design change is required.

The following technologies are used in this project:

1. Java Server Pages (JSP)
2. Database (MS-SQL Server2000)

3. Tomcat-apache server.
4. Secure Socket Layer (SSL)
5. Java Database Connectivity (JDBC)

Java Server Pages (JSP) is use create dynamic web content even easier, Java has introduced Java Server Pages (also called JSPs). While to write Servlets can require some pretty extensive knowledge of Java, a newbie to Java can learn how to do some pretty neat things with JSPs in a hurry.

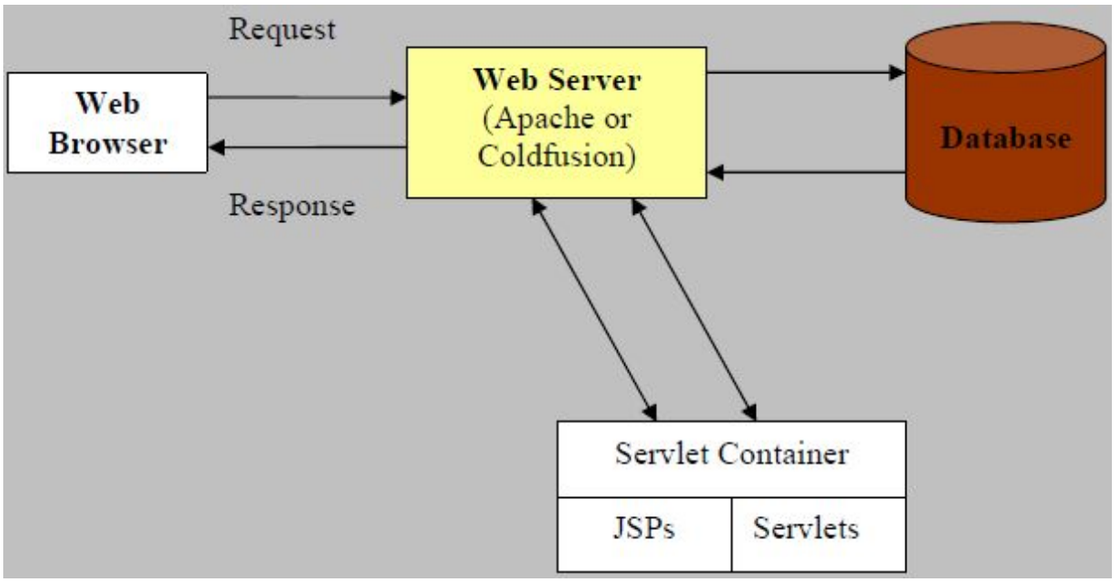


Figure 5: Architectures of JSP

Advantages of Java Server Pages

1. Easier to use JSP technology without needing to learn the Java language
2. Easier to extend the JSP language
3. Easier to write and maintain pages

Database

A collection of programs that enables you to store, modify, and extract information from a database. Information of the users gets stored in a relational database. The application works well with MS- Access as database, it also works well with SQL Server 2000 and Oracle.

Data Manipulation Language (DML) is used to modify the data present in database:

– SELECT - extracts data from a database table
– UPDATE - updates data in a database table
– DELETE - deletes data from a database table
– INSERT INTO - inserts new data into a database table

The Data Definition Language (DDL) is used to define the data:

– CREATE TABLE - creates a new database table
– ALTER TABLE - alters (changes) a database table
– DROP TABLE - deletes a database table
– CREATE INDEX - creates an index (search key)
– DROP INDEX - deletes an index

The relationship diagram for the application is shown under Database Design. It contains tables, relationship present in the table are one-to-many and one-to-one. The database design is fully normalized in third normal form 3NF to maximum extent.

Java Database connectivity (JDBC)

JDBC technology is an API that lets us access virtually any tabular data source from the Java programming language. It provides cross-DBMS connectivity to a wide range of SQL databases, and now, with the new JDBC API, it also provides access to other tabular data sources, such as spreadsheets or flat files.

Secure Socket Layer (SSL)

SSL, or Secure Socket Layer, is a technology, which allows web browsers and web servers to communicate over a secured connection. This means that the data being sent is encrypted by one side, transmitted, and then decrypted by the other side before processing. This is a two-way process, meaning that both the server AND the browser encrypt all traffic before sending out data.

Another important aspect of the SSL protocol is Authentication. This means that during your initial attempt to communicate with a web server over a secure connection, that server will present your web browser with a set of credentials, in the form of a "Certificate", as proof that site is who and what it claims to be. In certain cases, the server may also request a Certificate from your web browser, asking for proof that *you* are who you claim to be. This is known as "Client Authentication," SSL uses public key encryption for encrypting data. The figure below will give a better understanding about public key encryption.

System Requirement

Minimum system requirements are listed below:

Table 4: Hardware and Software Requirements

Processor	Pentium III 550 MHz or Athlon AMD 1GHz
RAM:	256 MB or more
Operating System:	Windows 2000 Server, Windows XP with Java Virtual Machine enabled
Database	Oracle/MS Access/SQL Server 2000
Hard Disk space:	20 MB
Web Server	Cold fusion Server or Tomcat-Apache
Web Browser	Internet Explorer 5.0 or higher
Software	Macromedia Dream waver MX, SSL, MS-Access

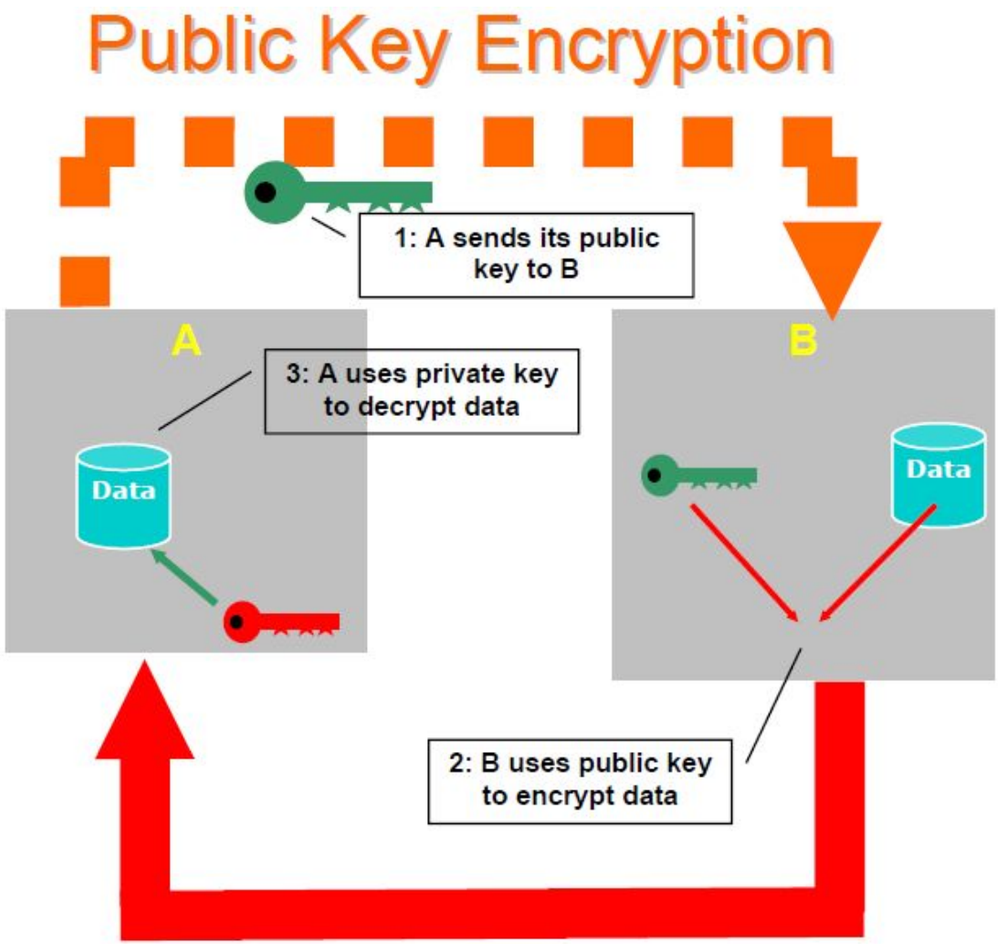


Figure 6: Public key encryption

QUESTIONS AND TASKS

1. Expand meaning of the term online banking.
2. Expand meaning of the term architecture of online banking.
3. Expand meaning of the term Dataflow diagram.
4. Expand meaning of the term Entity-Relationship diagram.
5. Expand meaning of the term key encryption.

UNIT 14 BANKING INFORMATION SYSTEMS SECURITY AUDIT

The business operations in the banking and financial sector have been increasingly dependent on the computerised information systems over the years. It has now become impossible to separate Information Technology (IT) from the business of the banks and the financial institutions. There is a need for focussed attention on the issues of the corporate governance of the information systems in computerized environment and the security controls to safeguard information and information systems.

The application of Information Technology has brought about significant changes in the way the institutions in the banking and financial sector process and store data and this sector is now poised to countenance various developments such as Internet banking, e-money, e-cheque, e-commerce etc., as the most modern methods of delivery of services to the customers. The telecommunication networks have played a catalytic role in the expansion and integration of the Information Systems (IS), within and between the institutions, facilitating data accessibility to different users. In view of the critical importance of IS, there is a need to exercise constant vigilance for the safety of the financial systems. Structured, well defined and documented security policies, standards and guidelines lay the foundation for good IS security and each institution is required to define, document, communicate, implement and audit IS Security to ensure the confidentiality, integrity, authenticity and timely availability of information, which is of paramount importance to business operations.

The text discusses IS Security Controls relating to computer hardware, software, network, Telecommuting/Teleworking, Mobile Computing, Computer Media Handling, Voice, Telephone and related equipment and Internet and the procedures/methodologies to be adopted to safeguard information and information systems. It discusses issues such as Change Control Mechanism, Separation of Development and (Production) Operational Facilities, Information Handling and Back-up, Electronic Mail and Financial Services/Products. It emphasises the use/implementation of Firewall, Digital Signature, Cryptographic Controls, Business Continuity Planning (BCP), Framework/Disaster Recovery Planning (DRP) including Cryptographic Disasters. It also discusses various other issues relating to Certification Authorities (CAs)/Trusted Third Parties (TTPs), Compliance with Legal Requirements, Intellectual Property Rights (IPR), Review of IS Security Policy and Human Resources.

The developments in Information Technology have a tremendous impact on auditing. Information Technology has facilitated re-engineering of the traditional business processes to ensure efficient operations and improved communication within the organisation and between the organisations and its customers. Auditing in a computerized and networked environment is still at its nascent stage in India and established practices and procedures are evolving. Well planned and structured audit is essential for risk management and monitoring and control of Information Systems in any organisation.

Information Systems (IS) auditing is a systematic independent examination of the information systems and the environment to ascertain whether the objectives, set out to be met, have been achieved. Auditing is also described as a continuous search for compliance.

The Auditors may not necessarily examine the entire system. They may examine a part or parts of it only. Auditing covers primarily the following broad major areas of activity :

a) gathering of information

b) comparison of information and

c) asking why

Types of Audit: Various methods are adopted for categorizing Audit . One such method of categorization divides audit into two types e.g. **Adequacy Audit** (also called **Systems Audit**) and **Compliance Audit**. Another method categorizes Audit by levels – **Internal Audit**, **External Audit** and **Extrinsic Audit**. Yet another method of categorization is by parties – First Party, Second Party and Third Party audits. The most common types of audit are **Financial Audit, Compliance Audit, Information Systems Audit and Operations Audit.**

Banking & Financial Activities and Risks: The deployment of Information Technology in banks and financial institutions, both in the front and back office operations, has facilitated greater systemic efficiency in the banking and financial sector. It has, at the same time, introduced new areas of risk. Risk is inherent in the traditional banking and financial activities. However, risk in a computerized and networked environment is multifarious such as **operational risk, reputational risk, legal risk, credit risk, liquidity risk, interest rate risk, foreign exchange risk** etc., as briefly discussed hereunder :

Operational risk arises out of the problems concerning the reliability and integrity of the Information Systems. The extent of such risks depends on the security features, design and implementation of security policies and procedures, adopted in an electronic banking system. Network security, database security, data integrity, appropriateness of the security policies and practices and the likely misuse of the information and information resources by the employees, customers and third parties are some of the factors, which require to be addressed for risk measurement in a computerized and networked environment in the banking and financial sector.

Reputational risk is very closely intertwined with the other kinds of risks. Failures, frauds, lack of proper delivery or non-delivery of information to customers, monetary loss to customers, lack of personal touch and litigation are some of the factors which cause loss of reputation to an organisation. Lack of reputation is a very serious problem for any business and the banking/ financial institution is no exception. Lack of reputation is usually due to serious security loopholes and lapses in the information systems, lack of fast and efficient delivery channels for retail banking and financial services and the market's general lack of trust in electronic banking/financial channel, say credit cards, which constitutes one type of electronic money or e-cash or plastic money. The occurrence of external and internal attacks on an organisation's information and Information Systems may cause serious damage to public confidence in the organisation.

Legal risk emanates from various factors such as the lack of adequate legal framework, inappropriate, ineffective, irrelevant and inapplicable Information Technology Act, inappropriate customer secrecy obligations on the part of the banks and financial institutions, inadequate privacy policy for the customers, Certification Authority risk, Trans-border financial transactions with very little or no legal backing or international law for the same, lack of legal provisions for public trans-border communication network such as Internet, other private networks etc.

Credit risk arises when the parties default in repayment of loans and advances. In computerized environment, credit risk gets enhanced because credit is channelised through electronic channels, which transgress the barriers of time and space. Credit appraisal in order to ascertain the credit worthiness of a prospective customer is difficult to verify as multiple remote customers may access the bank round the clock for credit

through non-traditional channels of communication with little or no ways and means being available with the banks to completely ascertain the veracity of their claims within the set limits of response time, as per the guidelines for Customer Relationship Management. In cases of credit flow through trusted third parties like the operators of electronic interbank/ institutional payment gateways, any default on the part of the third party operators in assessing the credit worthiness of the final customers would boomerang on the bank and has to be considered as another factor contributing to credit risk. Credit risk assumes great importance in an electronic banking environment.

Liquidity risk arises when an entity fails to meet its payment obligations in a timely manner. Banks, which may provide the facility of electronic money, shall be liable to arrange for adequate funds in case of redemption or settlement on electronic money. Any default could lead to legal wrangles and loss of liquidity.

Interest Rate risk arises due to variation in the interest rates. In case of banks offering electronic money, any fluctuation in the interest rate, which affects the value of the assets, created by electronic money, are liable to create interest rate risk liability on the bank.

Cross-border Transactions Risks: Electronic banking envisages a borderless world of financial services and therefore, risks, arising out of variation in the exchange rate, are likely to create additional risks for a bank. Different exchange rates, existing in different countries, mean that the banks need to analyse not only the exchange rate fluctuations with respect to the currencies of their respective countries, but exchange rate fluctuations between two or more (other) countries also. This kind of risk is likely to arise in case the bank has to cover losses due to unfavourable exchange rate fluctuations or in case, the third country participants in an electronic payment system are unable to fulfil their financial obligations due to social, economic and political factors in their respective countries.

Risks accentuate the need for comprehensive audit, as under, in a computerised environment.

Financial Audit:

A financial audit is an examination of an organization's financial statements. A financial audit like other types of audit has to be conducted by an independent auditor. Auditors must not only be independent, but have to also appear to be independent. The term audit here describes the investigation, which the auditors undertake to provide the basis for their analysis and opinion/suggestion. As a part of financial audit, auditors consider and evaluate the internal controls, put in place by an organization, in regard to the preparation of the financial statements. This evaluation gives them a feel of the accuracy and reliability of the information in the organization's accounting system. The auditors gather evidence/information to substantiate every material item appearing in the financial statements. Auditors also build up procedures, designed to determine that the financial statements and the accompanying notes are complete in all respects.

After completing the audit, the auditors express their expert opinion as to the fairness of the financial statements. These opinions are expressed in the form of audit reports. Audit reports, however, do not guarantee the accuracy of the financial statements, but provide the auditor's professional opinion only on the overall fairness and accuracy of the financial statements, based on the information made available to the Auditors.

The primary purpose of financial audit is to determine the overall accuracy and fairness of the financial statements and not to detect any or all acts of fraud. Most audit procedures are based on samples and therefore, it may not be possible for the auditors to verify all the transactions. However, frauds, which render the financial statements

misleading, require to be brought under the scope of any form of audit. Auditors design their investigation to detect errors and omissions that are material to the financial statements. With respect to the financial statements, an item is material, if knowledge of the item might reasonably be expected to influence the decisions of the users of the financial statements.

Financial Audit in Computerized Environment for the Banking & Financial Sector.

The use of Information Technology has revolutionised the banking and financial sector. The manner in which the financial services are being offered by the banks and the financial institutions is undergoing a sea change. A set of new financial services such as Electronic Banking, Tele-banking, Electronic Clearing Systems, Electronic Funds Transfer, Electronic Money, Smart Cards, Credit Cards etc. is fast gaining ground. Information Technology has helped the banks and the financial institutions to build up more efficient back-office systems together with automated management information systems for asset-liability management and risk analysis.

In a computerized environment, the financial statements could be generated from diverse database systems, operating on different operating systems. The financial transactions, on the basis of which the financial statements are generated, could be fully automated and there may or may not be proper audit trails, time stamps like log reports and the like to monitor and trace these transactions. Further, these transactions may not be bound by the traditional boundaries of time, space and even organizations. Various legs of a transaction could have been effected not only at different points of time, but at geographically different locations and between different banks or financial institutions. Needless to say that such transactions become very complex.

An organisation's financial statements reflect a set of management assertions about its financial health. The task of an auditor is to determine whether the financial statements have been fairly presented. To accomplish this, the auditor has to establish the audit objectives, design procedures and gather evidence/ information, which may corroborate or refute the management's assertions.

In a computerized environment, financial audit requires to be carried out in three phases, as under:

In the first phase, an audit plan has to be drawn up. This will require to be done by reviewing the organisation's policies and practices, regulatory and legal controls as applicable, trade practices and conventions and internal control mechanism. The financially significant applications and the controls over the primary transactions, which are processed by these applications are also studied in this phase of audit. The techniques for gathering the desired information at this phase include questionnaires, interviewing management/concerned authorities and reviewing the systems documentation.

In the second phase, the internal controls, which have been set up, are tested. Various tests are conducted to test the ruggedness of the internal controls.

In the third phase, detailed drill-down tests are conducted by scrutiny of the individual transactions, selected from a fairly large sample of the business transactions.

Information Systems (IS) Audit.

IS audit is a systematic process of objectively obtaining and evaluating evidence/information regarding the proper implementation, operation and control of information and the Information System resources. IS audit could be considered a part of Financial Audit. The lack of physical procedures, which can be easily verified and evaluated, injects a high degree of complexity into IS audit. Therefore, a logical framework for conducting an audit in the IT environment is critical to help the auditor

identify all important processes and data files.

IS audit follows a three-phase process, as applicable to Financial Audit and Compliance Audit. The first phase is the audit planning phase, followed by the test of controls phase and finally, the substantive testing phase.

In the planning or first phase, an IS auditor must identify the various risks and exposures and the security controls, which provide safeguards against these exposures. The tests, which need to be conducted to make the second phase of the audit effective, are also planned in detail in the first phase.

In the second phase, the security controls are tested. Control activities in an organization are the policies and procedures used to ensure that appropriate actions are taken to deal with the organisation's identified risks. One of the primary areas of IS audit is to check the effectiveness of these security controls. Control activities, in turn, are divided into two major areas – **Computer Controls and Physical Controls.**

Within Computer Controls and the security controls are the general controls and the application controls. General controls pertain to area-wise concerns such as controls over the data centre, organizational databases, systems development and program maintenance.

Application controls ensure the integrity of specific application software. Physical Controls include access control, transaction authorization, segregation of duties, supervision, accounting records and independent verification.

In the third or the Substantive Testing Phase, individual transactions are tested. The IS audit substantive tests extensively use computer assisted audit tools and techniques. Audit of Information Systems is a very challenging job, specially in the light of the fast changing pace of Information Technology including Communication Systems.

Information Systems Audit for the Banking & Financial Sector.

Audit is one of the major controls for monitoring management activities in the banks and financial institutions. In a computerized environment, IS audit is a very effective and necessary activity. Usually the IT implementation in the banking and financial organizations is done by adopting a mix of different methodologies – **internal development and deployment and third party product development and deployment.**

In case of internally developed and deployed IT systems, IS audit will require to be done by a team of specially trained internal or external auditors. However, it is preferable to have the IS audit conducted with the help of suitable external agencies with the required skills and expertise to ensure independent nature of audit.

In case of development and deployment of the IT systems by third parties, the IS audit requires to be conducted by trusted auditor/s with skills and expertise, required for the purpose. IS audit assumes greater significance because a large number of critical and strategic financial operations in the banking and financial sector are wholly or partly being handled by the computerized systems.

Information Systems Audit & Computer Aided Audit Tools & Techniques.

With the help of computer aided audit tools and techniques, an IS audit becomes more scientific and meaningful. There are five basic approaches, as under, for testing the application controls using CAATT (Computer Aided Audit Tools and Techniques).

a) Test Data Method – This method is used to establish application integrity by processing specially prepared sets of input data. The results of each test are compared with the predetermined expected results. The auditor first obtains the current version of the application and then generates the test transaction files and test master files. Thereafter, the test transaction files are input into the program and the result in the form

of routine output reports, transaction listing and error reports are collected. Further, updated master files are also checked for correct/expected outputs. The test results are compared with the expected results, either manually or again through a computer program.

b) Base Case System Evaluation – Under this method, a base test set of transactions is prepared along with the expected results. This set of transactions is comprehensive and all possible transaction types are included. Whenever testing is done, the results are compared with the results of the base test data results, which were obtained initially.

c) Tracing – Under this method, the test data does a virtual walk through the application logic. The application under review must undergo a special compilation to activate a trace option. The test data, prepared for tracing, is run and the result shows the exact listing of the programmed instructions, executed while the test data was processed.

d) Integrated Test Facility – This is an automated test technique, where the audit module is designed in the application program itself to be run in the normal course of operations by the application program with a specific choice of test data and where the application program distinguishes between the actual transactional data and test transactional data for simultaneous integrated audit and normal operations.

e) Parallel Simulation – This requires the auditor to write a program that simulates the key features and processes of the application. The program is run on the pre-processed actual transactional data and the results obtained are compared with the actual results obtained.

For the purpose of **Concurrent Audit or Real Time Audit**, sometimes an embedded audit module is used to identify important transactions, while they are being processed and copies of such transactions are extracted in real time. Threshold levels and pre-defined conditions are set and all transactions, which cross the threshold or meet the conditions, are segregated and copies thereof audited in real time.

Database Auditing is another area of interest for the IS auditors. Data structures vary from flat files to relational database structures. In order to effectively audit databases, a process of data normalization is essential. Database normalization is a technical matter and is usually the responsibility of the Systems Professionals. However, technical knowledge of the same is essential for the IS auditors also. The IS auditors, while performing the software audit, should ensure from the system documents that the database is properly normalized and there is not much redundancies and dependencies, as poorly normalized database could affect the integrity of data. The database constraints will also require to properly examined.

With the advent of Corporate Networks, Payment Gateways and new products like Internet Banking, Anywhere Anytime Banking etc., which primarily rely on various public and private networks for their operation, Network Audit forms a key area of IS audit. Network Audit covers all aspects of the network, right from the communication channels, network equipment like switches, bridges, routers, firewalls to internetworking issues and security controls. To ensure continuous adequacy of security controls in networked environment, each organisation will require to regularly conduct penetration testing in respect of the Information Systems with the help of third parties under well specified terms and conditions, agreed therefor with such third parties.

Operations Audit: Operations Audit is mostly considered part and parcel of the other types of audit.

Audit for the Banking & Financial Sector in Computerised Environment and Regulator's Role: A number of regulators regulate the activities in the banking and

financial sector. In an ideal situation, each financial market like the call money market, term money market, securities/debt market, capital market, foreign exchange market, derivatives market and commodities market should have independent statutory regulators. However, in most of the countries, more often than not, both the regulatory and supervisory powers rest with the same independent statutory regulatory authority.

The job of the regulator is to ensure the soundness of the financial markets and the financial systems and to work towards their growth. As a part of the regulator's mandate, various regulations in the form of guidelines, circulars and instructions are issued to the participants in the financial markets from time to time. These guidelines relate to the macro and micro levels. The mandate of the regulator for supervision encompasses the functions of audit.

The audit is done to ensure systemic efficiency, efficacy, speed and to prevent frauds. In case of various kinds of audit in a computerized environment, the regulator will require to issue from time to time, the guidelines, concerning the level of transparency and access to the financial statements, information and information systems. For the specific purpose of audit, the entities in the banking and financial sector will require to adhere to standard practices and policies regarding the development and deployment of computer resources.

These guidelines will specify not only the key areas of statutory audit, but will also include the areas of operation, where concurrent audit may be necessary. Further, areas will require to be identified for off-site and on-site inspection and audit by the regulator.

For this purpose, a set of standards, practices and procedures will require to be worked out for adoption by each organization in the banking and financial sector regarding each and every aspect of computerization including, among others, networking, applications, databases, security features, audit and accounting features. The standards will require to be generic, open and minimal. These standards, practices and procedures will ensure that the banks and financial institutions can be inspected and audited in a more comprehensive and elaborate manner, keeping in view the basic principles in which the computers, networks, databases, applications and security provisions operate in a computerized environment.

It will require to provide for sufficient safeguards to be built in the Information Systems to ensure systemic ruggedness to reduce the risk of cyber and digital crimes like hacking, spamming, unauthorised access and destruction or manipulation of the information and the information systems.

The regulator may have to initially take the help of trusted and independent third party Information Systems Auditors, with suitable skills and expertise for the purpose, along with its personnel, for auditing inter-institutional applications. The regulator will require to develop a team of expert Information System Auditors in-house for the purpose. Adequate importance will require to be given to security features in the Information Systems such as the use of digital certificates, digital signature, encryption, time stamping and audit trails.

These security controls will require to be implemented by the entities in the banking and financial sector only after careful selection and regular audit by trusted independent third party/ies, well-versed in the latest technology for the same. The regulator has also to ensure that all kinds of financial risks like operational risks, credit risks, interest rate risks etc. are managed by the banks and the financial institutions through comprehensive and effective means of off-site, on-site and concurrent audit and inspection.

This assumes much more significance in an environment, where the speed of financial transactions is very high with much larger ramifications. Better accounting

norms, income recognition norms, stricter capital adequacy measures etc. will require to be devised and implemented.

QUESTIONS AND TASKS

1. Expand meaning of the term operations audit.
2. Expand meaning of the term information systems audit.
3. Expand meaning of the term financial audit.
4. Expand meaning of the term types of audit.
5. Russian Hacker Case. In June 1994, a Russian crime ring managed to get inside the Citibank computer system and transfer $140,000 from the Philippine National Bank to a bank in Finland. The bank in the Philippines called to complain that the transaction had not been authorized. Citibank realized something was amiss and set up a special team to start looking into transactions of similar circumstance. However, it was not given that the unauthorized transfer was the first discovery of a chain of illegal activity. By the middle of July, the team identified a similar transfer had taken place and yet a third by the end of the month.

By this time, Citibank had called in the Federal Bureau of Investigation (FBI) and the investigation was in full swing. Transactions were being illegally transferred from cities as far away as Djakarta and Buenos Aries to banks in San Francisco and Israel. In total, fraudulent transactions amounted to more than $3 million; though in the end, the gang of thieves managed to abscond with only $400,000. The system breached was called the Citibank Cash Management system. This system allowed corporate customers to transfer money automatically from their accounts to whoever they are paying. And it handled approximately 100,000 transactions a day, totalling $500 billion. The Citibank system relied on static passwords, which they intend for users to memorize. The passwords remain the same each time a user enters the system, and although they are encrypted, the crime ring was somehow able to get a password and identification numbers of some of these corporate customers. The investigation team realized that the passwords traversed through many network links that were not necessarily fully owned and operated by the bank, but many were leased from telecommunication companies in various countries which provided the bank with network links between its offices. The question the investigators faced was did the perpetrator have an insider in Citibank or was he able to get them using conventional “network-sniffing” software.

On August 5, a fraudster transferred $218,000 from a Citibank account in Djakarta and another $304,000 from a bank in Argentina to Bank of America accounts in San Francisco that had been set up by a Russian couple. They would go to the bank after the money was transferred and attempt to withdraw it. At that point, investigators identified the perpetrators. They were kept under observation by both the public and private sector through October, transferring money from and to more accounts. The idea of computer control of funds was new to the media at that time. It was a new idea to reporters that a person could be sitting at a computer in Russia in the middle of the night keying in passwords and watching money move across a screen.

The Internet was still young at the time and largely unused commercially. The transfers were done through a proprietary network managed by Citibank. But, like the Internet, these proprietary networks cross over other proprietary networks and it is at these points that passwords become most vulnerable. Yet cooperation between the bank investigators, telecommunications administrators, and law enforcement led eventually to

Vladimir Levin, a young Russian hacker. He was trapped through a traced telecommunications line performing a fraudulent transaction and was imprisoned. In the course of the investigation, several people were arrested (including half a dozen Russian citizens, which this story is known as the “Russian Hacker Case”). Immediately after, Citibank ended the use of static passwords over its Funds Transfer networks and started issuing One Time Password tokens to customers using those networks (these tokens were a form of two factor authentication from a small company named RSA from its founders, Rivest, Shamir, and Adelman, then infrequently encountered).

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