CIS100 Test 3 Review
CIS100 Test 3 Content

Chapter 6: Business Networks and Telecommunications
Chapter 7: Databases and Data Warehouses
Chapter 8: Web-Enabled Enterprises

Videos:
The Machine is Us/ing Us
UPS Worldport / PLD

Chapter 2: Solving Problems with Statistical Analysis Tools
Chapter 4: Applying Logic in Decision Making
Chapter 7: Organizing Data for Effective Analysis

Cumulative concepts, features and functions, as well as nested IF statements plus new functions

Includes all Homework and Lab Assignments to date
### CIS100 Cumulative Microsoft® Excel® Functions

- **Mathematical Functions**
  - INT
  - ROUND
  - SUM

- **Statistical Functions**
  - AVERAGE
  - COUNT
  - COUNTA
  - LARGE
  - MAX
  - MEDIAN
  - MIN
  - SMALL

- **Logical Functions**
  - AND
  - OR
  - NOT
  - IF
CIS100 Test 3 New Microsoft® Excel ® Functions

• **Date Functions**
  - DATEDIF
  - YEARFRAC
  - NOW
  - TODAY

• **Mathematical Functions**
  - SUMIF

• **Statistical Functions**
  - AVERAGEIF
  - COUNTIF
Microsoft® Excel® Date Functions

**DATEDIF**

\[ \text{DATEDIF}(\text{startdate}, \text{enddate}, \text{interval}) \]

**YEARFRAC**

\[ \text{YEARFRAC} (\text{start\_date}, \text{end\_date}, [\text{basis}]) \]
The **DATEDIF** function

Syntax:

=DATEDIF(startdate,enddate,interval)

Arguments:

- **startdate** Required
  - A date that represents the start date.

- **enddate** Required
  - A date that represents the end date.

- **interval** Required
  - The type of day count basis to use.
The **DATEDIF** function

**Syntax:**

`=DATEDIF(startdate,enddate,interval)`

**Arguments:**

- **interval**  Required
  - The type of day count basis to use.

<table>
<thead>
<tr>
<th>Interval</th>
<th>Meaning</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>m</td>
<td>Months</td>
<td>Complete calendar months between the dates.</td>
</tr>
<tr>
<td>d</td>
<td>Days</td>
<td>Number of days between the dates.</td>
</tr>
<tr>
<td>y</td>
<td>Years</td>
<td>Complete calendar years between the dates.</td>
</tr>
<tr>
<td>ym</td>
<td>Months excluding years</td>
<td>Complete calendar months between the dates as if they were of the same year.</td>
</tr>
<tr>
<td>yd</td>
<td>Days excluding years</td>
<td>Complete calendar days between the dates as if they were of the same year.</td>
</tr>
<tr>
<td>md</td>
<td>Days excluding years and months</td>
<td>Complete calendar days between the dates as if they were of the same month and same year.</td>
</tr>
</tbody>
</table>
The **DATEDIF** function

**Description:**

- Computes the difference between two dates in a variety of different intervals.

**Remarks:**

- If you have the interval in another cell referenced by the formula, that cell should not have quotes around the interval string.
- When calculating date intervals, DATEDIF uses the year of `startdate`, not `enddate` when calculating the `yd`, `ym` and `md` intervals.

**Errors:**

- **#VALUE** – If `startdate` or `enddate` are not valid dates
- **#NUM!** – If `startdate` is greater than or equal to `enddate`
- **#NUM!** – If interval is not a valid parameter (m, d, y, ym, yd, md)
The **DATEDIF** function

What is the difference in days between the two dates?

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Data</td>
</tr>
<tr>
<td>2</td>
<td>1/1/2007</td>
</tr>
<tr>
<td>3</td>
<td>7/30/2007</td>
</tr>
<tr>
<td></td>
<td>Description</td>
</tr>
<tr>
<td></td>
<td>Start date</td>
</tr>
<tr>
<td></td>
<td>End date</td>
</tr>
</tbody>
</table>

=DATEDIF(A2,A3,”d”)
The **DATEDIF** function

What is the difference in days between the two dates?

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data</td>
<td>Description</td>
</tr>
<tr>
<td>1/1/2007</td>
<td>Start date</td>
</tr>
<tr>
<td>7/30/2007</td>
<td>End date</td>
</tr>
</tbody>
</table>

=DATEDIF(A2,A3,"d")
=210
The **TODAY** function

**Description:**

- Returns the serial number of the current date.

**Remarks:**

- If the cell format was General before the function was entered, Excel changes the cell format to Date.
- If you want to view the serial number, you must change the cell format to General or Number.
- The TODAY function is useful when you need to have the current date displayed on a worksheet, regardless of when you open the workbook.
- The TODAY function is dependent on your computer’s system clock being correct.

**Errors:**

*None*
The **TODAY** function

= TODAY()
The **TODAY** function

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>12/11/2008</td>
</tr>
</tbody>
</table>

=\text{TODAY}()
The **NOW** function

**Syntax:**

```
=NOW()
```

**Arguments:**

None
The **NOW** function

**Description:**

• Returns the serial number of the current date and time.

**Remarks:**

• If the cell format was General before the function was entered, Excel changes the cell format to the same date and time format that is specified in the regional date and time settings in Control Panel.
• The NOW function is useful when you need to display the current date and time on a worksheet or calculate a value based on the current date and time, and have that value updated each time you open the worksheet.
• Numbers to the right of the decimal point in the serial number represent the time; numbers to the left represent the date.
• The results of the NOW function change only when the worksheet is calculated or when a macro that contains the function is run. It is not updated continuously.

**Errors:**

*None*
The **NOW** function

=NOW()
The **NOW** function

=NOW()
The **YEARFRAC** function

Syntax:

```excel
=YEARFRAC(start_date,end_date,[basis])
```

Arguments:

• **start_date**  Required
  - A date that represents the start date.

• **end_date**  Required
  - A date that represents the end date.

• **basis**  Optional
  - The type of day count basis to use.

<table>
<thead>
<tr>
<th>Basis</th>
<th>Day count basis</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 or omitted</td>
<td>US (NASD) 30/360</td>
</tr>
<tr>
<td>1</td>
<td>Actual/actual</td>
</tr>
<tr>
<td>2</td>
<td>Actual/360</td>
</tr>
<tr>
<td>3</td>
<td>Actual/365</td>
</tr>
<tr>
<td>4</td>
<td>European 30/360</td>
</tr>
</tbody>
</table>
The **YEARFRAC** function

**Description:**

- Calculates the fraction of the year represented by the number of whole days between two dates (the start_date and the end_date).

**Remarks:**

- Use the YEARFRAC worksheet function to identify the proportion of a whole year's benefits or obligations to assign to a specific term.
- Dates should be entered by using the DATE function, or as results of other formulas or functions.
- All arguments are truncated to integers.

**Errors:**

- #VALUE – If start_date or end_date are not valid dates
- #NUM! – If basis < 0
- #NUM! – If basis > 4
The **YEARFRAC** function

What is the fraction of the year between the two dates?

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Data</td>
<td>Description</td>
</tr>
<tr>
<td>2</td>
<td>1/1/2007</td>
<td>Start date</td>
</tr>
<tr>
<td>3</td>
<td>7/30/2007</td>
<td>End date</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>Actual/360</td>
</tr>
</tbody>
</table>

\[=\text{YEARFRAC}(A2, A3, A4)\]
The **YEARFRAC** function

What is the fraction of the year between the two dates?

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><img src="image.png" alt="Image of spreadsheet" /></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>1/1/2007</td>
<td>Start date</td>
</tr>
<tr>
<td>3</td>
<td>7/30/2007</td>
<td>End date</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>Actual/360</td>
</tr>
</tbody>
</table>

=YEARFRAC(A2,A3,A4)
=0.5833333333

Microsoft® Excel® Date Functions
Age Calculation in Excel

- [http://www.fontstuff.com/excel/exltut01.htm](http://www.fontstuff.com/excel/exltut01.htm)

Uses nested IF statements:

- `=IF(MONTH(TODAY())>MONTH(A1),YEAR(TODAY())-YEAR(A1),IF(AND(MONTH(TODAY())=MONTH(A1),DAY(TODAY())>=DAY(A1)), YEAR(TODAY())-YEAR(A1),(YEAR(TODAY())-YEAR(A1))-1))`

• Most precise way to calculate a person’s age given that you have the requisite information about the person’s birth date.
Microsoft® Excel®
Mathematical Functions

**SUMIF**

=SUMIF(range,criteria,[sum_range])
The **SUMIF** function

Syntax:

```
=SUMIF(range, criteria, [sum_range])
```

Arguments:

- **range** *Required*
  - The range of cells that you want evaluated by criteria.
    - Cells in each range must be numbers or names, arrays, or references that contain numbers.
    - Blank and text values are ignored.
- **criteria** *Required*
  - The criteria in the form of a number, expression, a cell reference, text, or a function that defines which cells will be added.
    - Criteria can be expressed as 32, ">32", B5, "32", "apples", or TODAY().
- **sum_range** *Optional*
  - The actual cells to add, if you want to add cells other than those specified in the range argument.
    - Excel adds the cells that are specified in the range argument (the same cells to which the criteria is applied).
The **SUMIF** function

**Description:**
- Sums the values in a range that meet criteria that you specify.

**Remarks:**
- See the Microsoft® Excel® help for additional remarks.

**Errors:**

*None*
The **SUMIF** function

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Property Value</td>
<td>Commission</td>
<td>Formula</td>
<td>Description</td>
<td>Result</td>
</tr>
<tr>
<td>2</td>
<td>100,000</td>
<td>7,000</td>
<td>=SUMIF(A2:A5,&quot;&gt;160000&quot;,B2:B5)</td>
<td>Sum of the commissions for property values over 160000</td>
<td>63000</td>
</tr>
<tr>
<td>3</td>
<td>200,000</td>
<td>14,000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>300,000</td>
<td>21,000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>400,000</td>
<td>28,000</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Microsoft® Excel®
Statistical Functions

**AVERAGEIF**
= AVERAGEIF(range, criteria, [average_range])

**COUNTIF**
= COUNTIF(range, criteria)
The **AVERAGEIF** function

**Syntax:**

\[ = \text{AVERAGEIF} (\text{range}, \text{criteria}, [\text{average\_range}]) \]

**Arguments:**

- **range**  Required
  - One or more cells to average, including numbers or names, arrays, or references that contain numbers.
- **criteria**  Required
  - The criteria in the form of a number, expression, cell reference, or text that defines which cells are averaged.
- **average\_range**  Optional
  - The actual set of cells to average.
The **AVERAGEIF** function

**Description:**

• Returns the average (arithmetic mean) of all the cells in a range that meet a given criteria.

**Remarks:**

• If `average_range` is omitted, `range` is used.
• Cells in range that contain TRUE or FALSE are ignored.
• If a cell in `average_range` is an empty cell, AVERAGEIF ignores it.
• If a cell in criteria is empty, AVERAGEIF treats it as a 0 value.

**Errors:**

#DIV/0 – If range is a blank or text value.

#DIV/0 – If no cells in the range meet the criteria.
The **AVERAGEIF** function

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Property Value</td>
<td>Commission</td>
</tr>
<tr>
<td>2</td>
<td>100,000</td>
<td>7,000</td>
</tr>
<tr>
<td>3</td>
<td>200,000</td>
<td>14,000</td>
</tr>
<tr>
<td>4</td>
<td>300,000</td>
<td>21,000</td>
</tr>
<tr>
<td>5</td>
<td>400,000</td>
<td>28,000</td>
</tr>
</tbody>
</table>

=AVERAGEIF(B2:B5,"<23000")
The **AVGAGEIF** function

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><strong>Property Value</strong></td>
<td><strong>Commission</strong></td>
</tr>
<tr>
<td>2</td>
<td>100,000</td>
<td>7,000</td>
</tr>
<tr>
<td>3</td>
<td>200,000</td>
<td>14,000</td>
</tr>
<tr>
<td>4</td>
<td>300,000</td>
<td>21,000</td>
</tr>
<tr>
<td>5</td>
<td>400,000</td>
<td>28,000</td>
</tr>
</tbody>
</table>

=AVGAGEIF(B2:B5,"<23000")

=14000
The **AVERAGEIF** function

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><strong>Property Value</strong></td>
<td><strong>Commission</strong></td>
</tr>
<tr>
<td>2</td>
<td>100,000</td>
<td>7,000</td>
</tr>
<tr>
<td>3</td>
<td>200,000</td>
<td>14,000</td>
</tr>
<tr>
<td>4</td>
<td>300,000</td>
<td>21,000</td>
</tr>
<tr>
<td>5</td>
<td>400,000</td>
<td>28,000</td>
</tr>
</tbody>
</table>

=SUMIF(A2:A5,">95000",B2:B5)
The **AVERAGEIF** function

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Property Value</td>
<td>Commission</td>
</tr>
<tr>
<td>2</td>
<td>100,000</td>
<td>7,000</td>
</tr>
<tr>
<td>3</td>
<td>200,000</td>
<td>14,000</td>
</tr>
<tr>
<td>4</td>
<td>300,000</td>
<td>21,000</td>
</tr>
<tr>
<td>5</td>
<td>400,000</td>
<td>28,000</td>
</tr>
</tbody>
</table>

=AVERAGEIF(A2:A5,"<95000")

=#DIV/0
### The AVERAGEIF function

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Property Value, Commission</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>100,000</td>
<td>7,000</td>
</tr>
<tr>
<td>3</td>
<td>200,000</td>
<td>14,000</td>
</tr>
<tr>
<td>4</td>
<td>300,000</td>
<td>21,000</td>
</tr>
<tr>
<td>5</td>
<td>400,000</td>
<td>28,000</td>
</tr>
</tbody>
</table>

=AVERAGEIF(A2:A5,">250000",B2:B5)
The **AVERAGEIF** function

<table>
<thead>
<tr>
<th></th>
<th>Property Value</th>
<th>Commission</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>100,000</td>
<td>7,000</td>
</tr>
<tr>
<td>3</td>
<td>200,000</td>
<td>14,000</td>
</tr>
<tr>
<td>4</td>
<td>300,000</td>
<td>21,000</td>
</tr>
<tr>
<td>5</td>
<td>400,000</td>
<td>28,000</td>
</tr>
</tbody>
</table>

=AVGAREIF(A2:A5,">250000",B2:B5)

=24500
The **COUNTIF** function

**Syntax:**

```
=COUNTIF(range, criteria)
```

**Arguments:**

- **range** Required
  - One or more cells to count, including numbers or names, arrays, or references that contain numbers.
    - Blank and text values are ignored.
- **criteria** Required
  - A number, expression, cell reference, or text string that defines which cells will be counted.
    - Criteria can be expressed as 32, "&gt;32", B4, "apples", or "32".
The **COUNTIF** function

**Description:**

- Counts the number of cells within a range that meet a single criterion that you specify.

**Remarks:**

- See the Microsoft® Excel® help for additional remarks.
- Criteria are case insensitive

**Errors:**

None
The **COUNTIF** function

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Data</td>
<td>Data</td>
<td><strong>Formula</strong></td>
<td><strong>Description</strong></td>
<td>Result</td>
</tr>
<tr>
<td>2</td>
<td>apples</td>
<td>32</td>
<td>=COUNTIF(A2:A5,&quot;apples&quot;)</td>
<td>Number of cells with apples in column A</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>oranges</td>
<td>54</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>peaches</td>
<td>75</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>apples</td>
<td>86</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Microsoft® Excel® Statistical Functions
Extra Material

DATABASES & DATA WAREHOUSES
Database Approach

Entity – any object about which an organization chooses to collect data. Ex. Types of people: employees, students, contractors, etc.

Character – the smallest piece of data

Field – one piece of information about an entity Ex. First Name or Last Name. Multiple characters make up a field

Record – the fields related to the same entity make up a record

File – A collection of related records Ex. All the records of a colleges’ students

Database – a collection of one or more files

Ref. p 235
The Traditional File Approach

- **Traditional file approach**: no mechanism for tagging, retrieving, or manipulating data
- **Database approach**: provides powerful mechanism for managing and manipulating data
- Traditional approach is inconvenient:
  - Program-data dependency
  - High data redundancy
  - Low data integrity
- **Data redundancy**: duplication of data
- **Data integrity**: accuracy of data
The Database Approach

- **Database approach**: data organized as **entities**
- **Entity**: an object about which an organization chooses to collect data, such as:
  - People
  - Events
  - Products
- **Character**: smallest piece of data
  - A single letter or a digit
- **Field**: single piece of information about entity
The Database Approach (continued)

• **Record**: collection of related fields
• **File**: collection of related records
• Database fields can hold images, sounds, video clips, etc.
• Field name allows easy access to the data
• **Database management system (DBMS)**: program used to:
  – Build databases
  – Populate a database with data
  – Manipulate data in a database
**Figure 7.2**
Data hierarchy

<table>
<thead>
<tr>
<th>Data Level</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Character</td>
<td>223287695 Doe John 1987</td>
</tr>
<tr>
<td>Field</td>
<td>223287695 Doe John 1987</td>
</tr>
<tr>
<td>Record</td>
<td>200987845 Jewel Mark 1987</td>
</tr>
<tr>
<td></td>
<td>223287695 Doe John 1987</td>
</tr>
<tr>
<td></td>
<td>249876587 Smith Justin 1987</td>
</tr>
<tr>
<td>File</td>
<td>200987845 Jewel Mark 1987</td>
</tr>
<tr>
<td></td>
<td>223287695 Doe John 1987</td>
</tr>
<tr>
<td></td>
<td>349876587 Smith Justin 1986</td>
</tr>
<tr>
<td></td>
<td>410098456 Jones Jose 1985</td>
</tr>
<tr>
<td>Database</td>
<td>200987845 Jewel Mark 1987</td>
</tr>
<tr>
<td></td>
<td>223287695 Doe John 1987</td>
</tr>
<tr>
<td></td>
<td>349876587 Smith Justin 1986</td>
</tr>
<tr>
<td></td>
<td>410098456 Jones Jose 1985</td>
</tr>
<tr>
<td></td>
<td>ACC Dor Avi 9-8776</td>
</tr>
<tr>
<td></td>
<td>MKT Jenings Rich 9-8776</td>
</tr>
<tr>
<td></td>
<td>FIN Dor Jim 9-8776</td>
</tr>
</tbody>
</table>

- SSN: Student File
- Last Name: Student File
- First Name: Student File
- Campus Phone Number: Professor File
- Department: Professor File
The Database Approach (continued)

- **Database administrator (DBA):** the person responsible for managing the database
  - Sets user limits for access to data in the database
- DBMS is usually bundled with a programming language
The Relational Model

- **Relational Model**: consists of tables
- Based on relational algebra
  - **Tuple**: record (or row)
  - **Attribute**: field (or column)
  - **Relation**: table of records
- To design a relational database, you must understand the entities to be stored in the database and how they relate
- Tables are independent of each other, but can be related to each other
The Relational Model (continued)

• **Key**: a field whose values identify records
  – Used to retrieve records

• **Primary key**: a field by which records are uniquely identified
  – Each record in the table must have a unique key value

• **Composite key**: combination of fields that serve as a primary key
The Database Approach (continued)

• **Query**: a message to the database requesting data from specific records and/or fields

• Database must be properly secured
  – Not everyone should have access to all data
  – Users will have different views of the database, based on the data they are allowed to see
The Relational Model (continued)

- **Foreign key**: a field that is common to two tables
  - Used to link the tables
  - This field is a primary key in one table and a foreign key in the other

- **Join table**: composite of tables

- Two types of table relationships:
  - **One-to-many relationship**: one item in a table is linked to many items in the other table
  - **Many-to-many relationship**: many items in a table are linked to many items of the other table
The Object-Oriented Model

- **Object-oriented database model**: uses object-oriented approach for the database structure
- **Encapsulation**: combined storage of data and relevant procedures to process it
  - Allows object to be “planted” in different data sets
- **Inheritance**: the ability to create a new object by replicating the characteristics of an existing (parent) object
- Object-oriented databases (ODBs) store data objects, not records
Relational Operations

• **Relational operation**: creates a temporary subset of a table or tables
• Used to create a limited list or a joined table list
• **Three important relational operations**:
  – *Select*: a selection of records based on conditions
  – *Project*: a selection of certain columns from a table
  – *Join*: join data from multiple tables to create a temporary table
Structured Query Language

- **Structured Query Language (SQL):** query language of choice for DBMSs

- **Advantages of SQL:**
  - It is an international standard
  - It is provided with most relational DBMSs
  - It has easy-to-remember, intuitive commands
The Schema and Metadata

- **Schema**: a plan that describes the structure of the database, including:
  - Names and sizes of fields
  - Identification of primary keys
  - Relationships

- **Data dictionary**: a repository of information about the data and its organization
  - Also called **metadata**: the data about the data
Data Warehousing

• Most data collections are used for transactions
• Accumulation of transaction data is useful
• **Data warehouse**: a large repository database that supports management decision making
  – Typically relational
  – Data is collected from transactional databases
• **Data mart**: a smaller collection of data focusing on a particular subject or department
From Database to Data Warehouse

• Transactional databases are not suitable for business analysis
  – Contain only current, not historical data

• Data warehouse requires large storage capacity:
  – Mainframe computers are often used
  – Scalability is an issue
  – Data warehouses grow continually
Phases in Data Warehousing

• Three phases in transferring data from a transactional database to a data warehouse:
  – **Extraction phase**: create files from transactional database
  – **Transformation phase**: cleanse and modify the data format
  – **Loading phase**: transfer files to data warehouse

• A properly built data warehouse becomes a single source for all data required for analysis

• Data mining and online analytical processing (OLAP) use data in data warehouses
Business Networks and Telecommunications

CH. 6
Objectives

- Describe business and home applications of digital telecommunications
- Identify the major media and devices used in telecommunications
- Explain the concept of protocols
- Compare and contrast various networking and Internet services
- List networking technologies and trends that are likely to have an impact on businesses and information management in the near future
- Discuss the pros and cons of telecommuting
Telecommunications in Business

- **Telecommunications**: the transmittal of data and information from one point to another
  - Allows communications over large distances
- Telephone, e-mail, and the Web rely on fast, reliable telecommunications
- Networking technologies have brought about several improvements to the business process
Telecommunications in Business (continued)

• Improvements made possible by telecommunications:
  – Better business communication, including e-mail, voice mail, instant messaging, faxing, file transfer, mobile telephony, and teleconferencing
  – Greater efficiency: information delivery is immediate and not constrained by geographical distance
  – Better distribution of data: central storage with both local and remote access
Telecommunications in Business (continued)

• Improvements made possible by telecommunications (continued):
  – Instant transactions, using Web and wireless technologies
  – Flexible and mobile workforce: telecommuting and wireless connectivity for remote workers
  – Alternative channels: voice, radio, television now available via the Web also

• Network security is a challenge
Telecommunications in Daily Use

- Cellular phones
- Videoconferencing
- Wireless payments and warehousing
- Peer-to-peer file sharing
- Web-empowered commerce
Cellular Phones

- Name is derived from areas of service, called cells
- Each cell has a computerized transceiver
  - Transmits and receives signals
- Can transmit and receive calls almost anywhere
- Cell phones provide other capabilities, including:
  - E-mail and faxing
  - GPS
  - Digital cameras
- Major advantage is mobility
Videoconferencing

- **Videoconferencing**: transmitted images and speech
- Brings together conference rooms that are thousands of miles apart
- Produces savings in multiple areas, including:
  - Travel
  - Lodging
  - Transportation
  - Time
Wireless Payments and Warehousing

- **Radio frequency identification (RFID):**
  - Enables rapid transactions and payments
  - Used at gas stations for payment at pump
  - Used in vehicles for automatic road toll payment
  - Used to track and locate items in warehouses
Peer-to-Peer File Sharing

- **Peer-to-peer (P2P) file sharing**: used to locate and download files from any online computer through Internet using applications such as:
  - LimeWire
  - BearShare
  - KaZaa
  - Morpheus

- Used extensively to download music and video files, often in violation of copyright laws
Web-Empowered Commerce

• Increasingly fast communication allows organizations and individuals to:
  – Conduct business
  – Research
  – Market
  – Educate and train
  – Shop, purchase, and pay

• Entire industries have been created by the Web, such as online exchanges and auctions
Bandwidth

• **Bandwidth**: speed at which data is communicated
  – Also called **transmission rate** or **bit rate**

• **Bits per second (bps)**: unit of measure for bandwidth

• **Baseband**: communications medium that can carry only one transmission at a time

• **Broadband**: communications medium that can carry multiple transmissions simultaneously
Media

• Several types of communications media

• **Tangible media** includes:
  – Twisted pair cable
  – Coaxial cable
  – Optical fiber

• **Intangible media** includes:
  – Microwave radio technologies
Media (continued)

- **Twisted pair cable**: pairs of insulated copper wires twisted together
  - Twisting reduces **electromagnetic interference (EMI)**
  - Flexible, reliable, and low cost
  - Connects devices with RJ-45 connector plug
- **Coaxial cable**: for cable television transmission
  - Used for Internet connections via cable
- **Optical fiber**: uses light to represent bits
  - Not susceptible to interference
  - Can carry signals for longer distances
Media (continued)

- **Radio frequency (RF) technologies**: use radio waves to carry bits
  - Popular examples: Wi-Fi and Bluetooth
- **Microwaves**: high-frequency radio waves that can carry signals with high accuracy over long distances
  - For outside transmission, weather conditions may degrade the quality
- Microwave signals can be transmitted by satellite links
• **Electrical power lines**: electrical power grid can be used for telecommunication
• **Broadband over Power Lines (BPL) or Power Line Communication (PLC)**: telecommunications through power lines
• When choosing a network media, you should consider availability, current and potential bandwidth, vulnerability to electromagnetic interference (EMI), or radio frequency interference (RFI)
Networks

- **Network**: combination of devices (or **nodes**) connected through a communication media
- Any compatible device that can transmit and receive on a network can be part of a network
Types of Networks

• Computer networks are classified by reach and complexity

• Three basic types of networks: LANs, MANs, and WANs

• **Local area network (LAN):** established by a single organization and shared among employees
  – **Server-based LAN:** a single computer controls the network
  – **Peer-to-peer LAN:** no central device controls communications
Types of Networks (continued)

• **Wireless LANs (WLANs)** offer advantages:
  – Easier installation
  – More scalable
  – More flexible: equipment is easily moved

• **Scalability**: ease of expanding a system

• **WLAN drawback**: wireless networks are less secure
Types of Networks (continued)

• **Metropolitan area network (MAN):**
  – Links multiple LANs within a large city
  – Typically uses fiber optic or wireless broadband connections between LANs

• **Wide area network (WAN):**
  – Far-reaching system of networks composed of LANs or MANs
  – May be public or private
Types of Networks (continued)

- **Value-added networks (VANs):**
  - Networks with enhanced services offered by outside vendors
  - Provide reliability, management, and maintenance of networks for an organization

- **Internet service providers (ISPs):**
  - Preferred method of conducting e-commerce
  - Less costly than VANs
PANs

- **Personal area network (PAN):** wireless network designed for handheld and portable devices
  - Used by one or two people
  - Transmission speed is slower
  - Maximum distance is about 10 meters
Networking Hardware

- Networks use a variety of devices to connect computers and peripheral devices
- **Network interface card (NIC):** connects a device to a hub, switch, bridge, or router, which connects to a LAN or WAN
- **Hub:** central location to connect devices to LAN; broadcasts all communications to all devices
- **Switch:** a hub that sends communications only to designated devices on the network
Networking Hardware (continued)

- **Bridge**: connects two networks
- **Router**: routes data packets to the next node on the path to the final destination
- **Repeater**: amplifies or regenerates signals
- **Modem**: translates communication signals from analog to digital and vice versa
- **Dial-up connection**: slower type of connection through modem, usually no faster than 56 Kbps
Virtual Private Networks

- **Virtual private network (VPN):** can be an alternative to creating a LAN
  - Does not require leasing of lines
  - Utilizes the Internet, a public network, to simulate a private network that only authorized users can access
  - Enables the use of intranets and extranets
Switching Techniques

• Specify how messages travel to their destinations

• **Circuit switching**: dedicated channel (circuit) is established for the duration of the transmission

• **Packet switching**: message broken into packets
  – **Packet**: group of bits transmitted together
  – Packets are transmitted independently, and may be routed through different paths
  – Packet numbers are used to reassemble the packets at the destination
Switching Techniques (continued)

- **Frame relay**: high-speed packet-switching protocol used in WANs
  - Variable-sized packets routed quickly
- Circuit switching is ideal for real-time communications when no delay is desired
- Packet switching is more efficient, but introduces some delay
- **Multi-Protocol Label Switching (MPLS)**: uses packets, but all packets are routed on the same path; used for VoIP
Switching Techniques (continued)

![Diagram showing a packet structure with fields: Destination Address, Source Address, Packet Number, Data, Error Detection Bits.]

**Figure 6.3**
A packet

- Destination Address
- Source Address
- Packet Number
- Data
- Error Detection Bits
Protocols

- **Protocol**: set of rules governing communication between computers
- Some protocols are designed for WANs, LANs, and wireless communications
- Most important set of protocols for telecommunications and networks is called TCP/IP
TCP/IP

- **TCP/IP (Transmission Control Protocol/Internet Protocol):** a set of related protocols
  - TCP ensures packets arrive accurately and in proper order
  - IP ensures efficient delivery of packets from node to node
- **Internet backbone:** highest speed channels
- **Host:** a computer connected directly to a backbone
- **IP number:** unique numerical identification for a network device
TCP/IP (continued)

- **DNS (Domain Name Service)**: associates a character-based name with an IP address
- **Static IP address**: a permanent address assigned to a device
- **Dynamic IP address**: temporary IP number assigned to a device for the duration of the connection
  - Provides flexibility when the number of IP addresses is limited
Ethernet

- **Ethernet**: LAN protocol using coaxial or Cat 5 or 6 twisted pair cable
- **Gigabit Ethernet**: faster Ethernet connection of one Gbps or greater
- Devices on network contend with other devices for transmission time
- **CSMA/CD** (Carrier Sense Multiple Access with Collision Detection) protocol ensures there are no collisions in transmission
Wireless Protocols

- **IEEE 802.11**: a family of wireless protocols known as Wi-Fi (Wireless Fidelity)
  - Supports wireless communication within 100 meters of router
  - 802.11 subtypes support various distances and speeds up to 248 Mbps

- **Access point (hotspot)**: connection between wireless device and a wired network
  - Allows Internet access within range of equipment
Wireless Protocols (continued)

- **Encryption**: ability to scramble and encode messages
  - Uses encryption keys shared only between sender and receiver
- **Bluetooth**: allows devices to communicate within 10 meters
  - Transmits voice and data
  - Considered a PAN technology
Wireless Protocols (continued)

- **Worldwide Interoperability for Microwave Access (WiMAX):** increases range and speed of wireless communication
  - Works with metropolitan area networks (MANs)
  - Would enable Internet connection while in a moving vehicle

- **Mobile Broadband Wireless Access (MBWA):** similar to cell phone communications
  - Compatible with IP services, WiFi, and Bluetooth
  - Would support WiFi routers on cell towers to allow use of VoIP by cell phones
Figure 6.5
How WiMAX works

WiMAX Subscriber Station
Wi-Fi
Access Point
Ethernet
Wi-Fi
Ethernet Wire
WiMAX
WiMAX Base Station
Internet

(Home, Business or Public Hotspot)
Generations in Mobile Communications

• Networking professionals refer to generations of mobile communication technologies
  
  – First generation (1G): analog
  – Second generation (2G): used digital voice encoding
  – Third generation (3G): increased speeds that support video, videoconferencing, Internet access
  – Fourth Generation (4G): digital only, with packet switching and tighter security
Internet Networking Services

- Variety of options to choose from when subscribing to network services
- **Downstream**: speed of receiving from network
- **Upstream**: speed of transmitting to network
- Services with lower rates for upstream than downstream are suitable for most individuals and businesses
Cable

- Internet links provided by television cable firms
- Cable connected to Internet server
- At residence, cable is split into TV set and computer via a bridge called a cable modem
- Cable shared by all subscribers connected to the node
  - Communication speeds may slow during peak times and as more subscribers join the service
Digital Subscriber Line (DSL)

- **Digital subscriber line (DSL):** data remains digital through entire transmission
- Uses telephone lines connected to DSL bridge (DSL modem)
- Several types of DSL:
  - Asymmetric allows different upstream and downstream rates
  - Symmetric provides high speed in both directions for short-distance communications
- Transmission bit rates closely related to distance from telephone company’s central office
T1 and T3 Lines

• **T1 and T3 lines**: point-to-point dedicated digital circuits provided by telephone companies
  – T1 line is made up of 24 channels of 64 Kbps
  – T3 line is made up of 672 channels of 64 Kbps
• T1 and T3 service is expensive
• Used by universities and large companies for backbone and Internet connections
Satellite

- **Satellite services use microwave radio transmission**
- Service provider installs dish antenna that is tuned to a communications satellite
- Speeds up to 45 Mbps
- Used for private homes and for mobile uses such as shipping and trucking
- **Global positioning system (GPS):** a free satellite service that provides location information
Fixed Wireless

- **Fixed wireless**: point-to-point transmission between two stationary devices, typically between buildings
- Wireless Internet service provider (WISP)
  - Specializes in fixed wireless service
- Highly modular and scalable
- Suitable for both rural and urban areas
Fiber to the Premises

- Connects a building to the Internet via optical fibers
- **Fiber to the Home (FTTH):** when the optical fiber reaches the subscriber’s living or work space
- Subscribers connect computers or LAN routers to an optical fiber socket
Optical Carrier

• **Optical carrier (OC):** provides services through optical fiber lines
  – Expensive
  – Very high connection speeds

• Provides speeds in multiples of 51.84 Mbps (the base rate bandwidth)

• Typically used by:
  – ISPs
  – Providers of search engines
  – Content-rich or high-traffic Web sites
Broadband over Power Lines (BPL)

- **Broadband over Power Lines (BPL)**: uses electric power lines to carry digital signals
- Used by utility companies to:
  - Monitor power consumption down to household
  - Detect power failure in real time
  - Track power outages by region
  - Automate some customer services
  - Remotely control substations
- **Speeds are similar to those of DSL**
The Future of Networking Technologies

• Trends likely to have a significant impact on businesses and management of information
  – Broadband telephony
  – Radio frequency identification
  – Convergence of digital technologies
Broadband Telephony

• **Voice over Internet Protocol (VoIP):** uses Internet connection to conduct telephone conversations
• Flat monthly charge instead of per call charge
• Different quality of sound from traditional telephone services
• May not allow direct calls to emergency numbers such as 911
• When Internet link or power is down, no phone service
Radio Frequency Identification

- RFID tags are tiny and need little power
- Objects are embedded with tags that contain a transponder (a radio transceiver activated by a signal transmitted to it)
- Tags are encoded with electronic product code
- Readers decode data stored in tag’s memory and pass the data to a host computer
- Efficient for large companies, but expensive for smaller companies
<table>
<thead>
<tr>
<th>Use</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access Control</td>
<td>Cards used to replace door keys.</td>
</tr>
<tr>
<td>People Tracking</td>
<td>Keep children within school. Track prisoners on probation and prevent fleeing.</td>
</tr>
<tr>
<td>Animal Tracking</td>
<td>Track pets.</td>
</tr>
<tr>
<td>Livestock Management</td>
<td>Track life cycle of farm animals (e.g., feeding and immunization). Equip each cow with a unique ID to track diseases.</td>
</tr>
<tr>
<td>Antitheft Measures</td>
<td>Transponders integrated into car keys. Only a legal key can start the engine.</td>
</tr>
<tr>
<td>Transportation</td>
<td>At airport, safety inspection of tagged luggage.</td>
</tr>
<tr>
<td>Retail</td>
<td>Tracking products in pallets and on shelves. Contactless payment.</td>
</tr>
<tr>
<td>Pharmaceuticals</td>
<td>Reduce drug counterfeiting.</td>
</tr>
<tr>
<td>Health Care</td>
<td>Tag people who enter and leave an epidemic zone.</td>
</tr>
</tbody>
</table>
### Figure 6.9
Future Uses of RFID

<table>
<thead>
<tr>
<th>Use in...</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shopping</td>
<td>Identify dresses in your size, if you hold or wear a personal tag.</td>
</tr>
<tr>
<td></td>
<td>Enhanced product information on your PDA/cell phone.</td>
</tr>
<tr>
<td></td>
<td>Personalized customer service.</td>
</tr>
<tr>
<td></td>
<td>Passive self-checkout.</td>
</tr>
<tr>
<td></td>
<td>Dynamic pricing by demand.</td>
</tr>
<tr>
<td></td>
<td>Return RFID tagged items without receipt.</td>
</tr>
<tr>
<td>Product Information</td>
<td>Scan an RFID tag of an item and download additional information about it</td>
</tr>
<tr>
<td></td>
<td>from an Internet site to your cell phone.</td>
</tr>
<tr>
<td></td>
<td>Use your cell phone to check the price of an item while in a competitor’s store.</td>
</tr>
<tr>
<td>Manufacturer Serving</td>
<td>Send recall message to customer cell phone or e-mail address.</td>
</tr>
<tr>
<td>Customers</td>
<td>Send warranty and recall messages to customer.</td>
</tr>
<tr>
<td>Appliances</td>
<td>Washing machine automatically sets proper wash cycle based on information on tags attached to clothes.</td>
</tr>
<tr>
<td></td>
<td>Refrigerator alerts you about expired or recalled foods, notifies you about items consumed, and prepares shopping lists. It can also log on to the Internet and search for recipes of dishes you can prepare with refrigerated items.</td>
</tr>
<tr>
<td>Agriculture</td>
<td>Tags attached to crops can transmit information about weather and soil conditions and trigger automatic irrigation.</td>
</tr>
<tr>
<td>Waste Management</td>
<td>Track hazardous materials to ensure proper disposal.</td>
</tr>
<tr>
<td></td>
<td>Sort recyclable items.</td>
</tr>
</tbody>
</table>
Converging Technologies

- Convergence occurs in networking technology
- Cell phones can act as Web phones using VoIP
- Television sets will connect to Internet, cable, and satellites concurrently
- PDAs function as televisions sets and phones
- Portable music/video players will communicate with PCs to download files and transmit to wireless earphones
- Cell phones will read RFID on products to compare prices and make purchases
Summary

- Telecommunications is communication over distance
- Telecommunications technology has changed the business environment
- Different media have different bandwidths
- Networks are classified according to reach and complexity
- Public network can be turned into a virtual private network (VPN)
Summary (continued)

- Two ways to switch a communication line: packet switching and circuit switching
- Network protocols are sets of rules to which all devices on a network must adhere
  - The Internet adheres to the TCP/IP protocol
- Wireless technologies make it easy and affordable to create wireless LANs and hotspots
- Organizations and individuals have variety of choices when subscribing to networking services
Summary (continued)

• As Internet links become faster, Internet telephony (VoIP) is gaining in popularity
• Wireless technologies support the increasingly popular RFID technologies
• Much like hardware, telecommunications technologies are merging
• Increasing numbers of employees now telecommute