

INTRODUCTION TO ANALYTICS AND DECISION SUPPORT IN HEALTH CARE OPERATIONS MANAGEMENT

In today's highly complicated, technological, and competitive health care arena, the public's outcry is for administrators, physicians, and other health care professionals to provide high-quality care at a lower cost. While an aging population, increase in chronic conditions, and more insurance coverage create higher demand, mass access to social media and other mobile technologies bring higher expectations for care outcomes from patients and their families. Health care managers must therefore find ways to get excellent results from more limited resources. To cater to these new demands and adapt the technologies, health care managers must use a new strategic asset called big data. Big data may come from electronic medical records, social media, public health records, and so on. Hence, only those managers who can seek, organize, and analyze big data will survive as successful managers.

The goal of this book is to introduce aspiring health care managers to analytic and decision support models that allow decision makers to sort out complex issues and to make the best possible use of available resources. Such models are used, for example, to forecast patient demand, and to guide capital acquisition and capacity decisions, facility planning, personnel and patient scheduling, supply chain management, and quality

LEARNING OBJECTIVES

- **Recognize the analytical techniques for decisions about delivering health care of high quality.**
- **Describe the historical background and the development of decision techniques.**
- **Describe the health care manager's role and responsibilities in decision making.**
- **Review the scope of health services and follow recent trends in health care.**
- **Describe health services management and distinct characteristics of health services.**
- **Describe the data flow in health care organizations and how to organize data for analytics.**

control. They use mathematical and statistical techniques: multivariate statistical analysis, decision analysis, linear programming, project evaluation and review technique (PERT), queuing analysis, and simulation, to name a few. This book presents all these techniques from the perspective of health care organizations' delivery of care, rather than their traditional manufacturing applications. This chapter covers a brief historical background and the development of decision techniques and explains the importance of health care managers using these techniques. Finally, the scope, distinctive characteristics, and current trends of health services are emphasized. After reading this chapter, you should have a fair understanding of how important quantitative techniques are for decisions about delivering health care of high quality.

Historical Background and the Development of Decision Techniques

Beginning in the 1880s, the scientific management era brought about widespread changes in the management of the factories that had been created at an explosive rate during the Industrial Revolution. The movement was spearheaded by an efficiency engineer and inventor, Frederick Winslow Taylor, who is regarded as the father of modern scientific management. Taylor proposed a “science of management” based on observation, measurement, analysis, and improvement of work methods, along with economic incentives. He also believed that management's tasks are to plan, carefully select and train workers, find the best way to perform each job, achieve cooperation between management and workers, and separate management activities from work activities. Taylor's work was based on his idea that conflicts between labor and management occur because management has no idea how long jobs actually take. He therefore focused on time studies that evaluated work methods in great detail to identify the best way to do each job. Taylor's classic 1911 book, *The Principles of Scientific Management*, explained these guiding principles: (1) development of science for each element of work, (2) scientific selection and training of workers, (3) cooperation between management and employees, and (4) responsibility shared equally between workers and management (Taylor, 1911). Other early contributors to scientific methods of management were Frank and Lillian Gilbreth, who worked on standardization, and Henry Gantt, who emphasized the psychological effects that work conditions have on employees—he developed a time-based display chart to schedule work. Quantitative inventory management was developed by F. W. Harris in 1915. In the 1930s, W. Shewhart and associates developed statistical sampling techniques for quality control (Stevenson, 2015, pp. 23–24). World War II prompted the growth of operations research methods, and development of project management techniques; linear programming and queuing methods followed in the 1950s. After the 1970s, the development and wider use of computers and management information systems (MIS) reshaped all these techniques because large amounts of data could be analyzed

for decision making in organizations. Tools for quality improvement such as total quality management (TQM) and continuous quality improvement (CQI) became very popular in the 1980s and 1990s; then came supply chain management and productivity improvement techniques, in particular reengineering and lean management.

The Health Care Manager and Decision Making

A health care manager can be a chief executive officer (CEO) or chief operating officer (COO), or a middle-level manager to whom the duties are delegated. At the top management level, a health care manager's responsibilities include planning for capacity, location, services to be offered, and facility layout; those responsibilities are strategic. The health care manager also is ultimately responsible for overseeing service production through supply chain management, quality monitoring and improvement, and organizing health services to be either produced or outsourced. Finally, the health care manager is responsible for patient and personnel scheduling, and for optimally staffing the facility and directing job assignments and work orders. Regardless of whether health care managers are directly involved or delegate these responsibilities, their ultimate responsibility remains. Generally, operational decisions are delegated to midlevel and lower-level decision makers, while strategic decisions are evaluated at the organization's top levels. With the integrated delivery systems (IDS) movement, health care organizations are becoming larger and more complex, so health care managers are in dire need of the most recent, reliable information derived from quantitative data analysis in order to make informed decisions. Information technology (IT) has become integral to management decision processes.

Importance of Health Analytics: Information Technology (IT) and Decision Support Techniques

If they are to analyze their current situations and make appropriate changes to improve efficiency as well as the quality of care, health care managers need appropriate data. The data, from various sources, are collected by information technology (IT) embedded in systems either internal or external to the health care organization. For example, decisions about the location of a new health facility will require analysis of data on the communities under consideration (such as census, epidemiological data, and so on). Decisions about nurse staffing will require internal data on patient admissions and acuity that are collected routinely by the hospital. Later in this chapter under the heading of "Big Data and Data Flow in Health Care Organizations," this book identifies the sources of the data for various decision-making techniques and emphasizes the use of IT for informed decision support by health care managers. Furthermore, a supplemental data example using Excel pivot tables is presented at the end of the chapter.

The Scope of Health Care Services, and Recent Trends

According to the Organization for Economic Cooperation and Development (OECD) countries, their members' total expenditures on health services constituted 5.1 to 16.4 percent of gross domestic product (GDP) in 2013, making health services a very significant sector from a public policy perspective. Moreover, the statistics in Table 1.1 show an increasing trend in health care expenditures. The countries that spent an average of about 8 percent of their budgets on health care in the mid-2000s are now spending 12.5 percent more. The United States is the country spending the highest percentage of GDP on health care. However, its percentage share of GDP was stabilized from 2009 to 2013.

Health care, especially in the United States, is a labor-intensive industry with more than 19 million jobs and growing in 2016 (U.S. Department of Labor, 2016). The aging population—as well as the proliferation of medical technology and new treatments—contributes to this growth.

The health care industry seeks to match varying medical needs in the population. Its over half a million establishments vary in size, complexity, and organizational structure, ranging from small-town, private practice physicians with one medical assistant to urban hospitals that employ thousands of diverse health care professionals. Less than about 2 percent of health care establishments are hospitals, but they employ over one-third of all health care workers.

Advances in medical technologies, new procedures and methods of diagnosis and treatment, less invasive surgical techniques, gene therapy—all of these increase longevity and improve the quality of life. Similarly, advances in information technology can improve patient care. For example, handheld order-entry systems such as personal digital assistants (PDAs), radio frequency identification (RFID), and bar code scanners at bedside make health workers more efficient, and also minimize errors and thus improve the quality of care.

These advances usually add to costs, so cost containment is a major goal in the health care industry. To accomplish it, the health care industry has shifted the care of patients from hospital care to outpatient, ambulatory, and home health care. At the same time, managed care programs have stressed preventive care to reduce the eventual costs of undiagnosed, untreated medical conditions. Enrollment has grown in prepaid managed care programs: health

Table 1.1 Total Expenditures on Health as Percentage of GDP for 37 OECD Countries.

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Average	8.0	8.1	8.0	8.0	8.3	9.0	8.8	8.8	8.9	9.0
Minimum	4.7	5.0	4.9	5.0	5.5	5.8	5.3	5.0	5.0	5.1
Maximum	14.6	14.6	14.7	14.9	15.3	16.4	16.4	16.4	16.4	16.4

Source: OECD Health Data 2016

maintenance organizations (HMOs), preferred provider organizations (PPOs), and point-of-service (POS) programs.

The health care industry has turned to restructuring to improve financial and cost performance. Restructuring is accomplished by achieving an integrated delivery system (IDS). An IDS merges the segments of health care delivery, both vertically and horizontally, to increase efficiency by streamlining financial, managerial, and delivery functions.

The Patient Protection and Affordable Care Act, commonly referred to as the Affordable Care Act (ACA), brought significant reform to the health care industry, introducing various programs aimed at improving quality and controlling the rising costs of health care. Many of these programs offer financial incentives for providers to meet certain quality and efficiency benchmarks. The ACA also introduced accountable care organizations (ACOs) as a tool to control costs through improved coordination of care and increased emphasis on preventive care, continuing the shift toward rewarding providers for better outcomes rather than volume.

It is fair to conclude that the changes in the health care industry will continue and will affect the delivery of health services in terms of cost and efficiency as well as the quality of care.

Health Care Services Management

Given such complexity in both the nature and the environment of health care, managers of such establishments face challenging day-to-day decisions as well as long-term and strategic ones. Their discipline, the management and improvement of the systems and processes that provide health care, must rely on decision tools—namely, the specific methods that can help managers analyze, design, and implement organizational changes to achieve efficiency as well as high quality of care (effectiveness) for patients.

Clearly, then, management of health care establishments requires reasoned inquiry and judgment. Therefore, health care managers must use proven scientific methods drawn from such disciplines as industrial engineering, statistics, operations research, and management science. However, it must be remembered that such quantitative tools do not, alone, shape the final decision, which may have to include other, qualitative factors to arrive at the right course of action.

Future health care managers, whether in top administration or in administrative or clinical operations, will be heavy consumers of analytics, making informed decisions using state-of-the-art decision-making techniques incorporating the latest information from health information systems. To use those techniques successfully, however, they must also understand the distinctive characteristics of health care services.

Distinctive Characteristics of Health Care Services

Health care operations have five major distinctive characteristics: (1) patient participation in the service process, (2) simultaneity, (3) perishability, (4) intangibility, and (5) heterogeneity

(Fitzsimmons and Fitzsimmons, 2004, pp. 21–25). Let us examine each of these characteristics to better understand the decision platforms in health care.

Patient Participation

In health care, as in any service industry, to evaluate performance (efficiency and effectiveness) a distinction must be made between inputs and outputs. Patients (or their health conditions) who receive care are among the inputs into the service process. After diagnosis and treatment, the patient's condition constitutes the effectiveness of the health care organization—that is, output. Hence, the health care organization and the patient interact throughout the delivery of care—a profound distinction of health care as compared to manufacturing industries.

Simultaneous Production and Consumption

As a service industry, health care is produced and “consumed” simultaneously. This point reflects the fact that health is not a product to be created, stored, and sold later. (Will science achieve that via gene therapy?) One of the drawbacks of that simultaneity of “production” and “consumption” is the challenge it presents for quality control—that is, ensuring the effectiveness of the service. In manufacturing, a product can be inspected and, if found defective, not be offered for sale; meanwhile the process that is producing bad outputs is corrected. However, in health care, due to simultaneity, an instance of poor-quality care cannot be “recalled,” even though the process resulting in poor care can be corrected for future patients.

Perishable Capacity

Health care organizations design their services to serve with certain capacity over a given time. If the designed capacity is not used during that period, the opportunity to generate revenue from that capacity is lost. For example, consider a hospital with 15 operating rooms that are staffed and open for 12 hours each day. If the surgeries are not scheduled appropriately to fill the open slots, or if a large amount of time is wasted by the turnover of the cases, a portion of the available capacity, and thus of potential revenues for that day, perishes. Similarly, consider a physician's office with an available 10-hour schedule for patient visits. If the office does not receive appointments to fill all those time blocks, the practice's capacity for that day will be reduced, as will the revenues.

The Intangible Nature of Health Care Outputs

The output in health care does not comprise a tangible product on hand like food bought from your favorite fast-food restaurant, where you can judge the quality of the food as much as the promptness of the service. In health care, it is not so obvious what the patient has paid for. For one thing, since a healing process takes time, the opinions of patients about the service quality of their care are formed over time. Moreover, health care is not something that can be tested or handled before deciding on it. Although health care monitoring groups, as well as health care facilities in their marketing, may provide information about the quality of an organization's

services, one patient's experience may nevertheless not equal that of another receiving the same service, because patients' conditions and perceptions are never identical.

The High Levels of Judgment Called Upon, and the Heterogeneous Nature of Health Care

Although some routine health care tasks can be automated (recording patient history via IT), there remain a wide range of tasks that require a high level of judgment, personal interaction, and individual adaptations, even in a given service category. For example, a surgeon and an anesthetist must make specific decisions before operating, to plan the surgery for the particular condition of the patient. The heterogeneity of patients' conditions, already noted, often mandates considerable specialization in the delivery of care.

Even given these distinctive characteristics of health care, managers work together with clinicians to standardize health organizations' operations for both efficiency and effectiveness. Examples of such standardization are the diagnostic and treatment protocols developed for the care of various diseases.

Big Data and Data Flow in Health Care Organizations

Health analytics and decision support must deal with big data, which often flow through multiple systems before they are in a usable format for health care managers. An example data flow in a health care organization is depicted in Figure 1.1. The cornerstone system of health care organizations is typically the electronic health record (EHR) system. EHR systems such as Epic and Cerner integrate data from multiple sources. These sources include ancillary systems such as radiology and pharmacology, manual data entry, genomic data, and telemetry. Comprehensive EHR data are then integrated into an enterprise data warehouse (EDW), along with data from various billing and administrative systems (sometimes the data are integrated within the EHR system). The data include scheduling, human resources/payroll, and facility information. Real-time location systems, which are used to track medical equipment, supplies, and patients using radio frequency identification (RFID) technology, also feed into the EDW. Another key input into the EDW is external data sources, such as the Social Security Death Index. Other examples of external data sources are provided in Table 1.2. Such sources are often leveraged for strategic reasons such as quality improvement, site planning, and market analysis.

The EDW ultimately feeds multiple data marts, which serve as small, centralized data repositories that support specific business needs or areas. For example, a patient experience data mart would include nurse staffing; provider scheduling; facility, patient, and discharge information as well as data from external sources such as the Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) Patient Satisfaction Survey, all of which would be analyzed to identify opportunities for improvement. Once in a data mart, data are imported through various means (queries, extracts, etc.) into data analysis

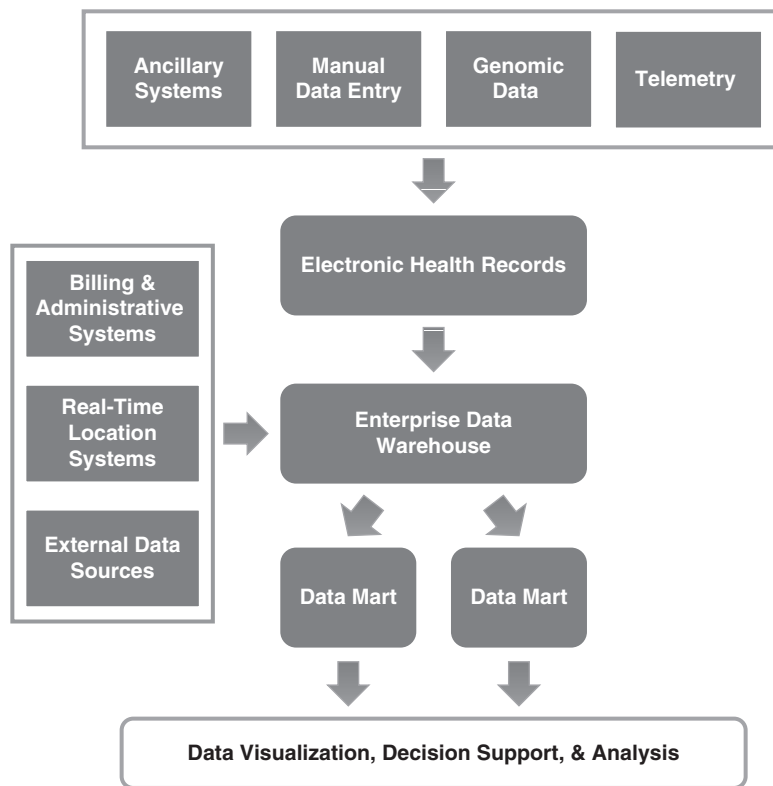


Figure 1.1 Data Flow in Health Care Organizations.

Table 1.2 Examples of External Data Sources.

Data Source	Description	How to Access
Healthcare Cost and Utilization Project (HCUP)	Publicly available family of all-payer inpatient health care databases which provides encounter-level information on inpatient stays, emergency department visits, and ambulatory surgery in U.S. hospitals	Certain HCUP data is available for free via HCUPnet, an online query system accessible at http://hcupnet.ahrq.gov/ . Individual databases can be accessed at https://www.hcup-us.ahrq.gov/databases.jsp . However, the cost and availability of data varies state to state.
Hospital Compare	The Hospital Compare data sets are part of the Centers for Medicare & Medicaid Services (CMS) Hospital Quality Initiative, providing information about the quality of care at Medicare-certified hospitals across the U.S.	Hospital Compare data sets can be downloaded for free at: https://data.medicare.gov/data/hospital-compare
Medical Expenditure Panel Survey (MEPS)	National surveys of individuals and families, as well as their health care providers, that provide data on health status, the use of medical services, charges, insurance coverage, and satisfaction with care	Data files can be downloaded at: http://meps.ahrq.gov/mepsweb/data_stats/download_data_files.jsp

and visualization tools such as Microsoft Excel and Tableau. Often when data are imported into a data analysis tool from a data mart, they require additional cleanup and manipulation. The PivotTable functionality in Excel is a helpful tool for transforming the data set into a workable format. Once the data are in a usable format, health care managers can perform their analyses to support various operational and strategic decisions. The end-of-chapter supplement illustrates the use of pivot tables in Excel and will provide the basis for predictive analytics examples in Chapter 2.

Summary

Contemporary health care managers must understand the distinctive characteristics of the health care services and use state-of-the-art decision-making techniques with the latest information available to plan and organize their facilities for best quality patient care. Additionally, to make informed decisions, they must understand the data sources and be able to organize the data in appropriate form for specific decision tools. The remaining chapters of this book will discuss and show the use of state-of-the-art decision-making techniques and their applications in health care.

KEY TERMS

Health Analytics

Health Care Manager

Decision Support

Health Care Providers

OECD

Perishable Capacity

Pivot Tables

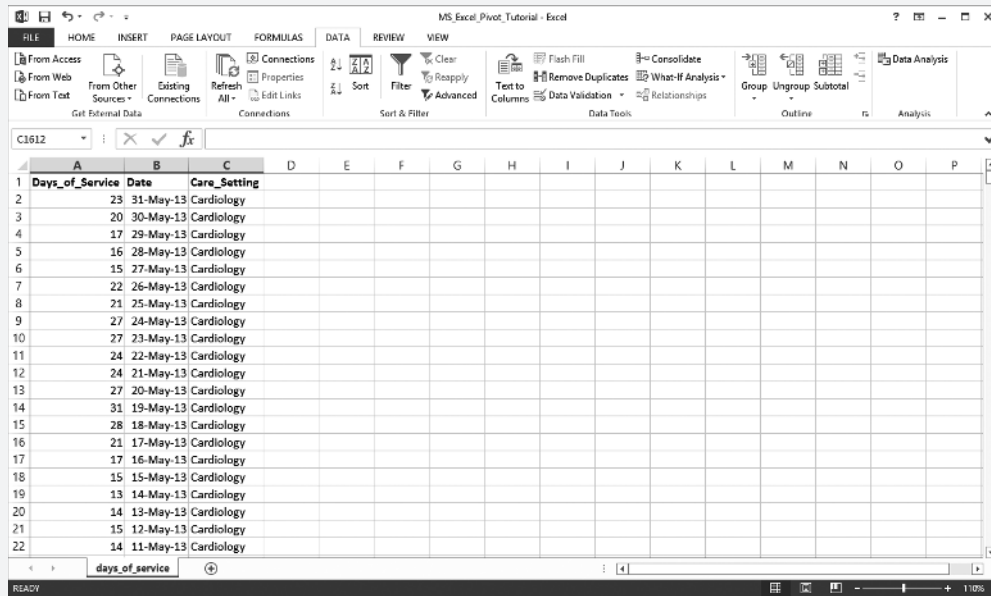
Big Data

CHAPTER 1 SUPPLEMENT

DATA ANALYTICS IN MS EXCEL: CREATING AND MANIPULATING PIVOT TABLES

The PivotTable functionality in Microsoft Excel is extremely useful for summarizing, grouping, and analyzing large data sets.

In this example, MS_Excel_Pivot_Tutorial.xls will be used. This file contains daily days of service data for a cardiology department from May 2010 through May 2013, as shown in Figure SE 1.1.



The screenshot shows the Microsoft Excel interface with the file 'MS_Excel_Pivot_Tutorial - Excel'. The ribbon is set to 'DATA'. The worksheet contains a PivotTable with the following data:

Days_of_Service	Date	Care_Setting
23	31-May-13	Cardiology
20	30-May-13	Cardiology
17	29-May-13	Cardiology
16	28-May-13	Cardiology
15	27-May-13	Cardiology
22	26-May-13	Cardiology
21	25-May-13	Cardiology
27	24-May-13	Cardiology
27	23-May-13	Cardiology
24	22-May-13	Cardiology
24	21-May-13	Cardiology
27	20-May-13	Cardiology
31	19-May-13	Cardiology
28	18-May-13	Cardiology
21	17-May-13	Cardiology
17	16-May-13	Cardiology
15	15-May-13	Cardiology
13	14-May-13	Cardiology
14	13-May-13	Cardiology
15	12-May-13	Cardiology
11	11-May-13	Cardiology

Figure SE 1.1 MS_Excel_Pivot_Tutorial.xls.

The Basics: Inserting a Pivot Table

1. To insert a pivot table, first highlight the data set.

Tip: Selecting the entire worksheet will lead to blank categories being displayed in the pivot table. Instead, highlight the column headers (Days_of_Service, Date, and Care_Setting) and then press “Ctrl+Shift+Down” to capture only rows containing data.

2. Once the data set has been selected, click on the **Insert** tab. **PivotTable** will be the first option on the left side of the toolbar under the **Tables** group (see Figure SE 1.2).

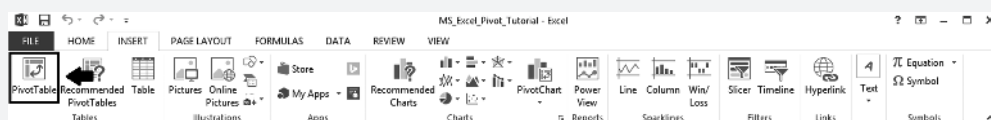


Figure SE 1.2 PivotTable Button.

Click on the **PivotTable** button. A **Create PivotTable** message box (Figure SE 1.3) will appear. This provides the option to place the PivotTable on a new worksheet or on an existing worksheet within the Excel file.

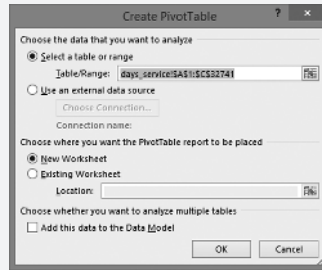


Figure SE 1.3 Create PivotTable Message Box.

Click **OK** to place the PivotTable on a new worksheet.

3. Sheet2 has now been created. As shown in Figure SE 1.4, a **PivotTable Fields** section will be located on the right-hand side of the sheet. This contains the names of the data columns from the Days_of_Service data set. To build a PivotTable, drag and drop these data columns into the **Filters**, **Columns**, **Rows**, and **Values** sections found below the **PivotTable Fields** section.

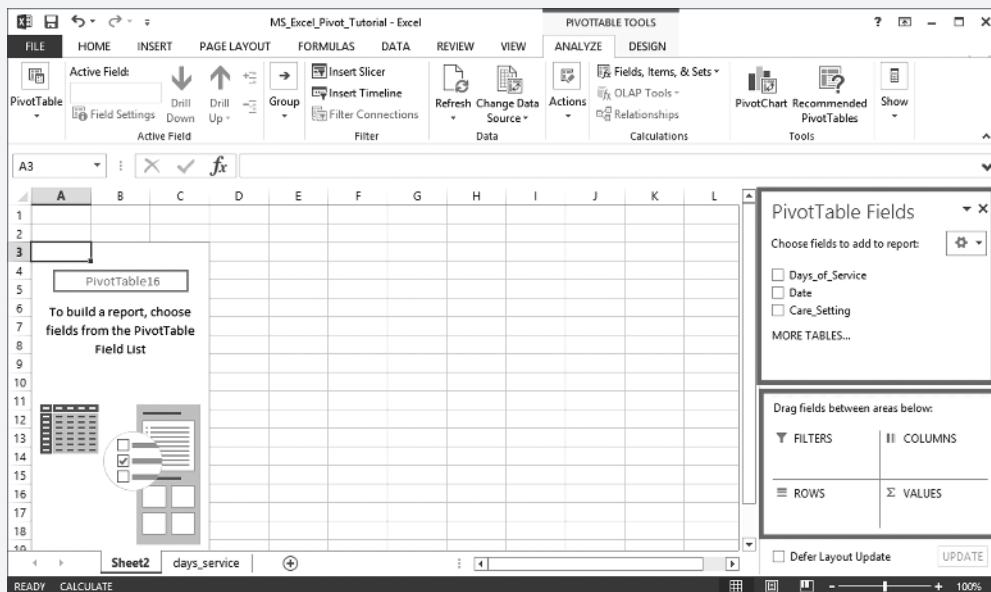


Figure SE 1.4 PivotTable Fields.

Building a Basic PivotTable Report

- To create a basic pivot table containing the total days of service for each date, drag and drop the **Date** field into the **Rows** section. Next, drag and drop **Days_of_Service** into the **Values** section, as shown in Figure SE 1.5.

Notice that by default, the pivot table provides a *count* of Days_of_Service by date.

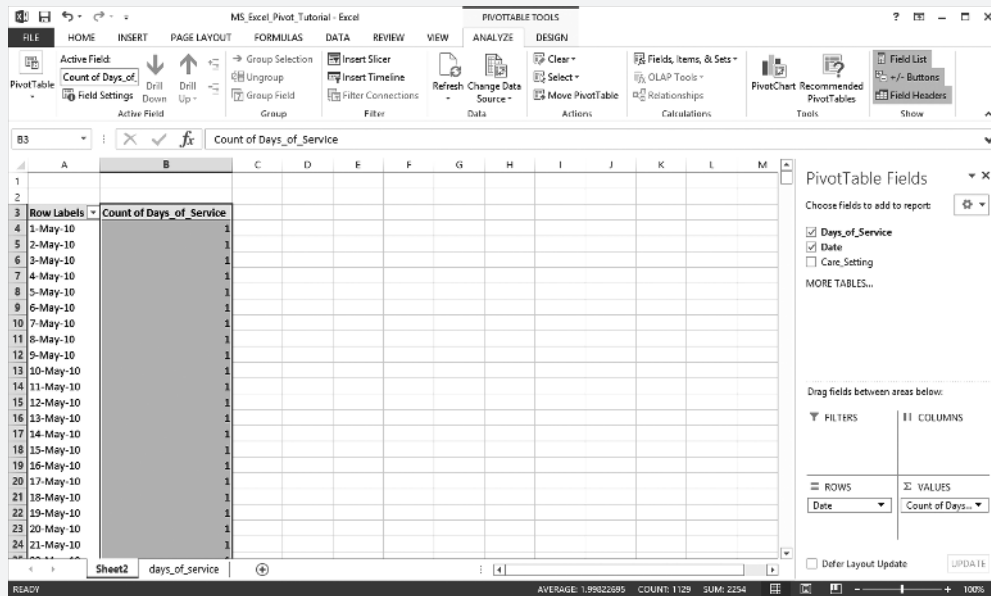


Figure SE 1.5 Rows and Values Sections.

To display the total, or sum of, **Days_of_Service** by date, click the down arrow for the **Count of Days_of_Service** under the **Values** section, and then select **Value Field Settings** (see Figure SE 1.6).

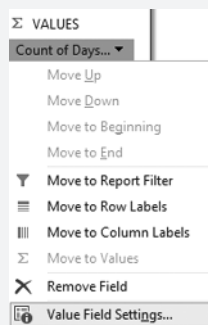


Figure SE 1.6 Value Field Settings.

In the **Value Field Settings** window (Figure SE 1.7) on the **Summarize Values By** tab, select **Sum** and then click **OK**.

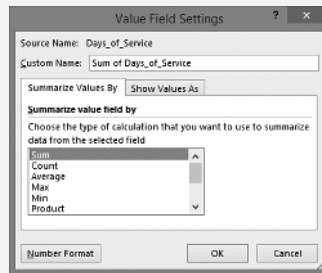


Figure SE 1.7 Summarize Values By.

Now the pivot table will display the total **Days_of_Service** by date, as shown in Figure SE 1.8.

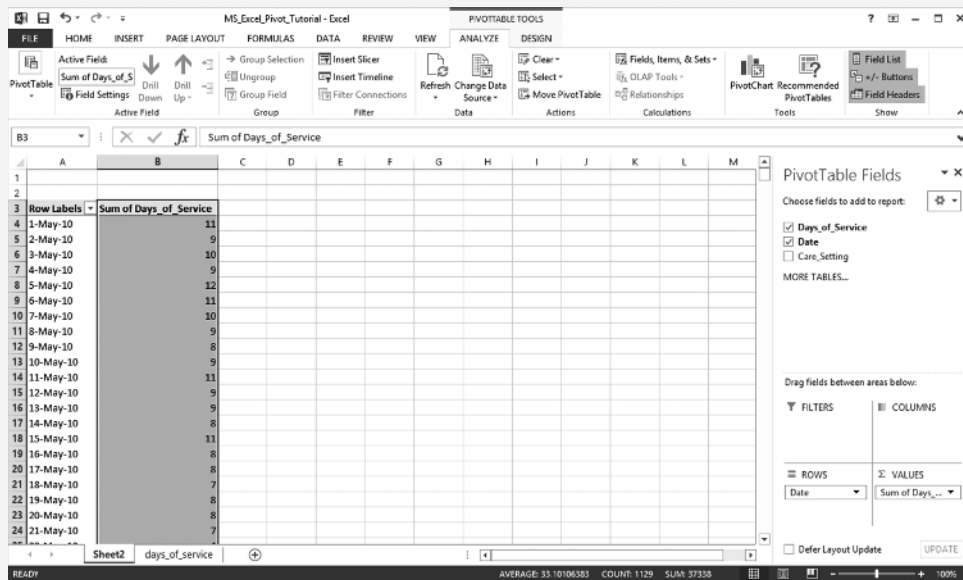


Figure SE 1.8 Days of Service by Date.

Grouping and Filtering

Excel's PivotTable Reports provide several different tools to group and filter data sets. In this section, the **Group** and **Insert Timeline** functions will be highlighted.

- To display the total **Days_of_Service** by year, right-click on any date in the pivot table and select **Group**, as shown in Figure SE 1.9.

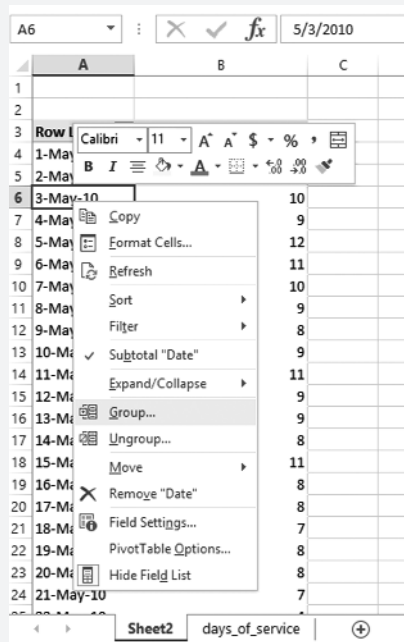


Figure SE 1.9 Select Group.

A **Grouping** window will appear (Figure SE 1.10). Select **Years** and click **OK**.

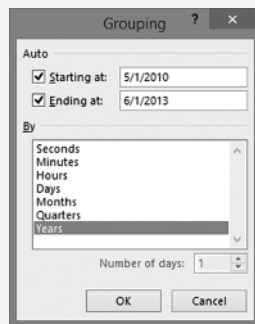


Figure SE 1.10 Grouping Window.

Total **Days_of_Service** by year is now displayed (see Figure SE 1.11).

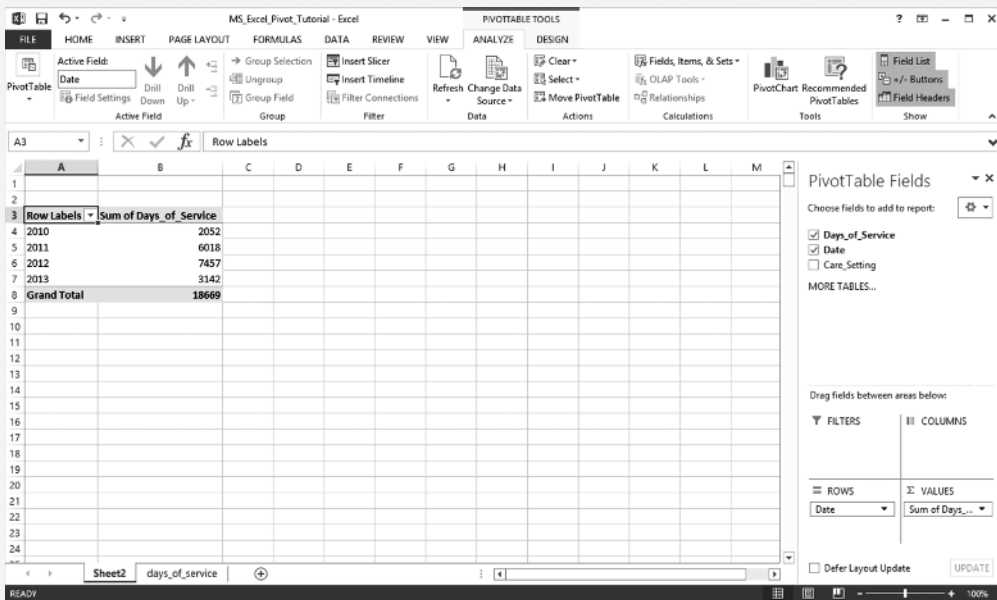


Figure SE 1.11 Total Days of Service.

6. To display the total **Days_of_Service** by year and month, repeat these same steps, selecting **Month** and **Year** in the **Grouping** window.
7. To ungroup items, right-click on any date and click **Ungroup**, as shown in Figure SE 1.12.

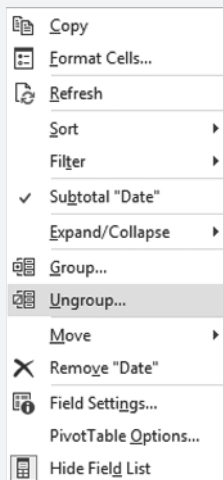


Figure SE 1.12 Ungroup.

8. **Insert Timeline** also allows users to filter the data set by a particular time period (years, quarters, months, or days). For instance, filtering by year would display the total **Days_of_Service** for each day in the selected year, rather than displaying the total **Days_of_Service** for the year as in the Grouping function.

To use the **Timeline** functionality, select the **Analyze** tab and click the **Insert Timeline** button in the **Filter** section (see Figure SE 1.13).

Tip: The **Analyze** and **Design** tabs display only when a cell in the PivotTable has been selected.



Figure SE 1.13 Insert Timeline.

An **Insert Timelines** window will appear (Figure SE 1.14). Select **Date** and click **OK**.



Figure SE 1.14 Insert Timelines Window.

A **Date** timeline tool (Figure SE 1.15) will now appear to the right of the PivotTable. Note that the default filter is set to **Months**.

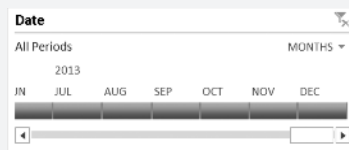


Figure SE 1.15 Date Timeline Tool.

Use the scroll bar to scroll to 2011, and then select the bar below January. This displays only the dates and total **Days_of_Service** data for January 2011, as shown in Figure SE 1.16.

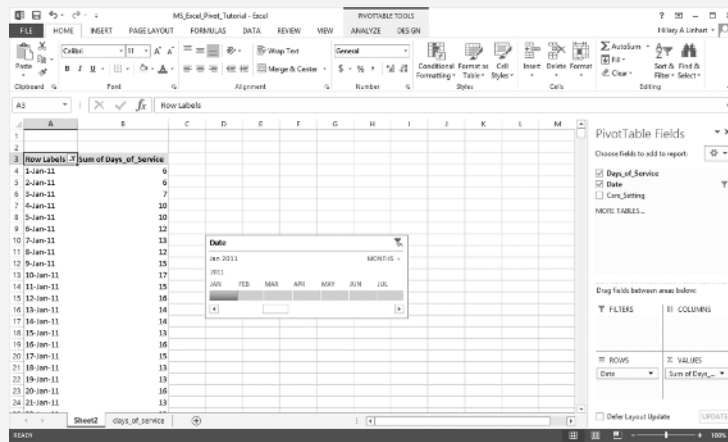


Figure SE 1.16 January 2011 Data.

9. To display the Days_of_Service by year using the **Timeline** tool, click the drop-down arrow next to **Months**, and then select **Years** (see Figure SE 1.17).



Figure SE 1.17 Display by Years.

Click on the bar below 2012. This will display all of the dates and total Days_of_Service for 2012, as shown in Figure SE 1.18.

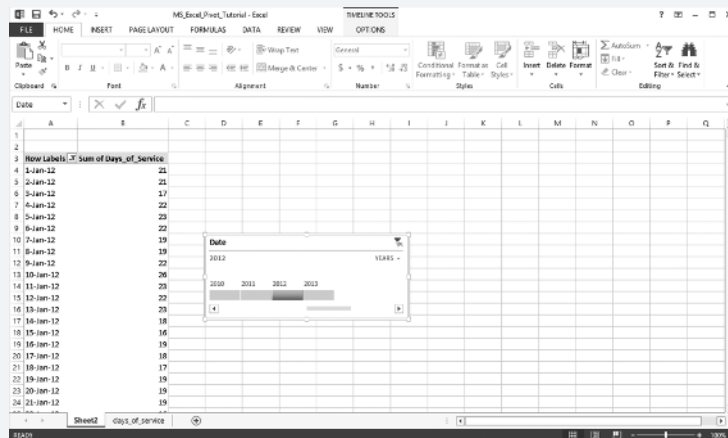


Figure SE 1.18 Days of Service for 2012.

10. Repeat these same steps to filter by quarter and day.
11. To remove the **Timeline** tool, simply select the **Date** window and press the **Delete** button.

Building an Advanced PivotTable Report: Using Columns and Filters

While the **Grouping** and **Timeline** functions are useful, it is often more helpful to insert additional columns into the data set containing the year, month, weekday, and so on, and then leveraging the **Columns** and **Filter** sections of the pivot table.

In this next section, the goal is to build a pivot table that displays total Days_of_Service per weekday for each month. A filter will also be created to view this data on an annual basis.

12. Create three new columns on the **Days_of_Service** worksheet entitled **Year**, **Month**, and **Weekday**, as shown in Figure SE 1.19.

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	Days_of_Service	Date	Care_Setting	Year	Month	Weekday									
2		23	31-May-13												
3		20	30-May-13												
4		17	29-May-13												
5		16	28-May-13												
6		15	27-May-13												
7		22	26-May-13												
8		21	25-May-13												
9		27	24-May-13												
10		27	23-May-13												
11		24	22-May-13												
12		24	21-May-13												
13		27	20-May-13												
14		31	19-May-13												
15		28	18-May-13												
16		21	17-May-13												
17		17	16-May-13												
18		15	15-May-13												
19		15	14-May-13												
20		14	13-May-13												
21		15	12-May-13												

Figure SE 1.19 Year, Month, and Weekday Columns.

13. The **TEXT** function will be used to convert the Date column values into Year, Month, and Weekday text values. In cell D2, input the following formula, as shown in Figure SE 1.20:

=TEXT(B2, "YYYY")

This takes the date in cell B2 (May 31, 2013) and returns the four-digit year.

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	Days_of_Service	Date	Care_Setting	Year	Month	Weekday									
2		23	31-May-13	2013											
3		20	30-May-13												
4		17	29-May-13												

Figure SE 1.20 Year TEXT Formula.

- 14.** In cell E2, type the following formula. This will take the date in cell B2 and return the month.

=TEXT(B2, "MMMM")

- 15.** Last, in cell F2, type the following formula. This takes the date in cell B2 and returns the day of the week.

=TEXT(B2, "DDDD")

- 16.** To quickly copy these formulas down to all rows, highlight cells D2 through F2 then double-click on the small square in the bottom right-hand corner of cell F2, as shown in Figures SE 1.21 and 1.22.

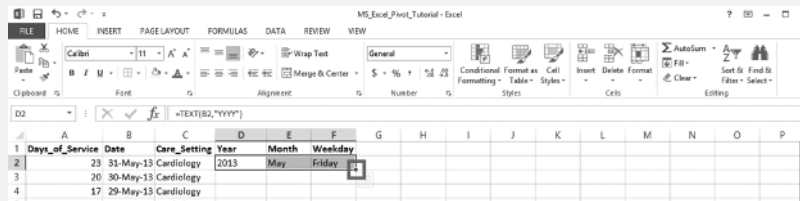


Figure SE 1.21 Copy Formulas Down.

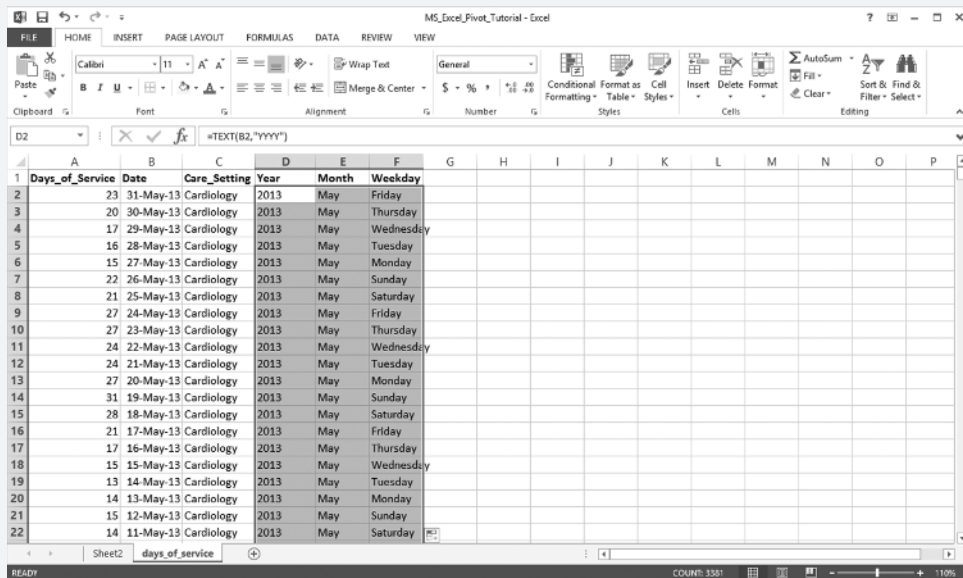


Figure SE 1.22 Formulas Copied Down.

17. Now that Year, Month, and Weekday fields have been created, return to **Sheet2** and reset the pivot table by unchecking the **Days_of_Service** and **Date** pivot table fields, as shown in Figure SE 1.23. This will remove the fields from the **Rows** and **Values** areas.

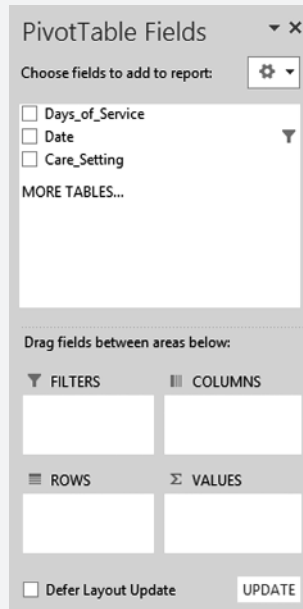


Figure SE 1.23 Uncheck PivotTable Fields.

18. Notice that the Year, Month, and Weekday columns do not appear under the PivotTable Fields. To update the pivot table with these columns, select the **Analyze** tab. Click the **Change Data Source** button, found in the **Data** section (see Figure SE 1.24).



Figure SE 1.24 Change Data Source.

A **Change PivotTable Data Source** window will appear (Figure SE 1.25). Update the **Table/Range** to include the Year, Month, and Weekday columns, and then click **OK**.

Tip: Simply press the **Shift** key and tap the → key three times to extend the range.

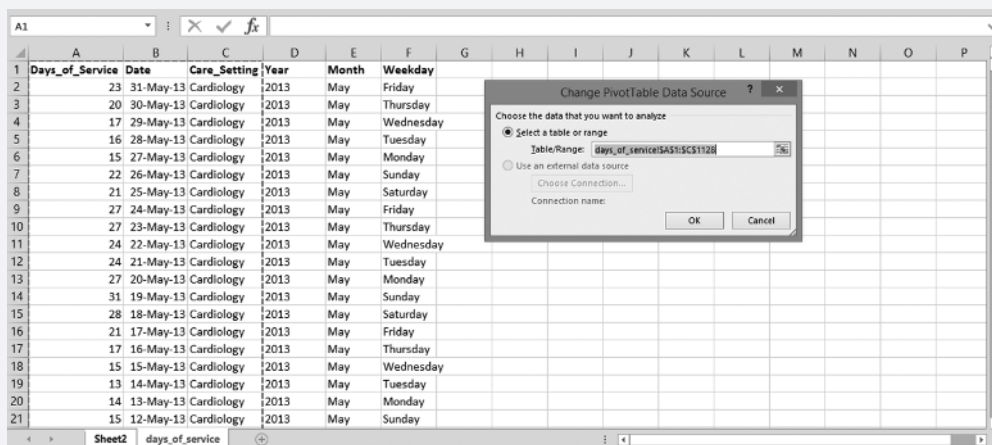


Figure SE 1.25 Change PivotTable Data Source Window.

19. The **PivotTable Fields** now include the **Year**, **Month**, and **Weekday** columns.

20. To begin building the pivot table, drag and drop the **Days_of_Service** field into the **Values** section, as shown in Figure SE 1.26.

Note: Repeat Step 4 if the **Values** field does not default to the **Sum of Days_of_Service**.

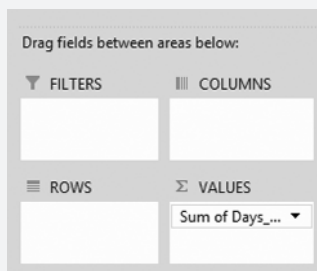


Figure SE 1.26 Days_of_Service in Values Section.

21. Drag and drop the **Month** field into the **Rows** section.

22. Drag and drop the **Weekday** field into the **Columns** section.

As shown in Figure SE 1.27, the pivot table should now display the total days of service for each weekday by month across the entire data set (May 2010 to May 2013).

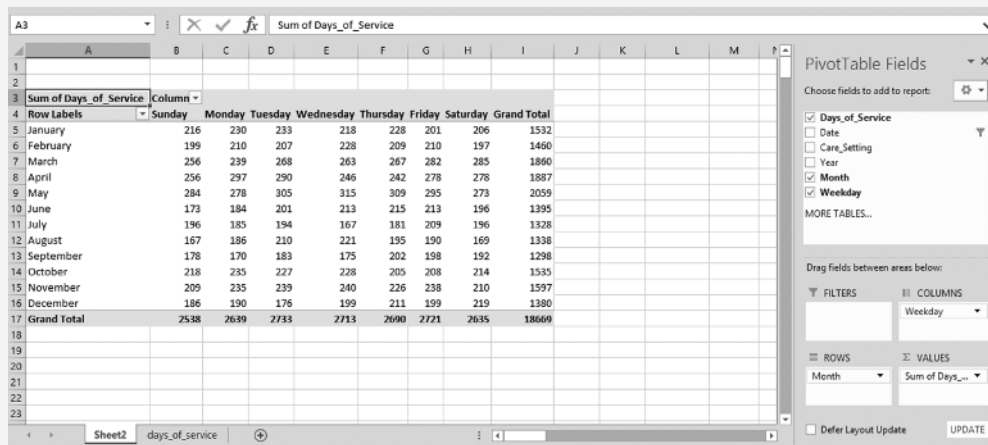


Figure SE 1.27 Total Days of Service by Day and Month.

23. To filter by year, drag and drop the **Year** field into the **Filters** section. A **Year** filter will then appear in the first row (see Figure SE 1.28).

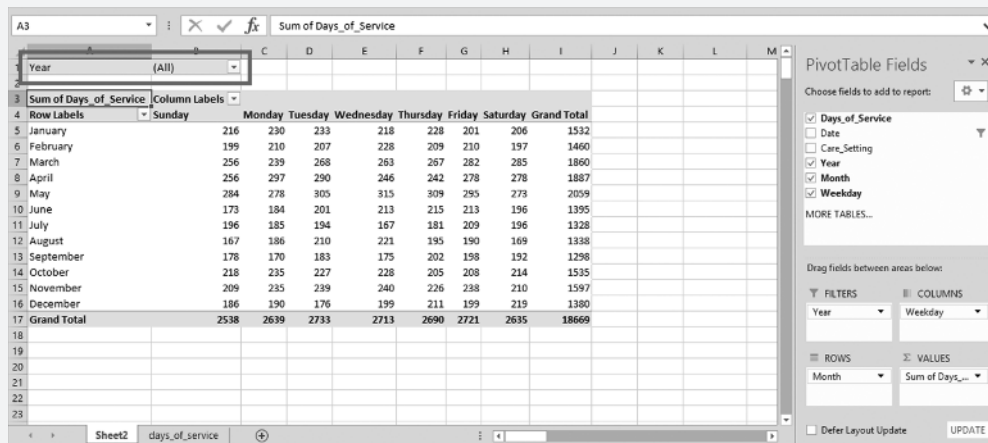


Figure SE 1.28 Filter by Year.

24. Select the down arrow next to **(All)** to filter down to a specific year. Select **2012**, and then click **OK** (see Figure SE 1.29).

Note: Multiple years can be viewed at once by checking the **Select Multiple Items** check box.



Figure SE 1.29 Filter to 2012.

- 25.** The PivotTable has now been constructed, displaying total days of service per weekday for each month in 2012.

Exercises

- 1.1** Access the *Days_of_Service_Surgical.xlsx* data set containing days of service data for a surgical department over a 16-month period. Using the Chapter 1 Supplement as a guide, reorganize the data set using Excel's PivotTable functionality so that the *average* days of service per weekday per month over this 16-month period are displayed.
- 1.2** Access the *Visits.xlsx* data set containing daily visit data for an urgent care clinic over a 24-month period. The clinic manager would like to determine the average number of visits per week during this time frame.

Create a new column entitled "Week." In the first cell of this column, type the formula `=WEEKNUM(B2)`. This will take the date in cell B2 and return the week number (e.g., "1" for the first week of January and "52" for the last week of December). Copy this formula down to all rows.

Use Excel's PivotTable functionality to reorganize the data set so that the average number of clinic visits per weekday per week over this time period is displayed, and include a filter for year.

- 1.3** Access the *Admissions.xlsx* data set containing daily patient admissions data for an intensive care unit over a 36-month period. Use Excel's PivotTable functionality to reorganize the data set so that the average number of admissions per weekday per quarter is displayed, and include a filter for year.

Note: To capture the quarter, create a new column entitled "Quarter." In the first cell of this column, input the formula `"Q"&ROUNDUP(MONTH(B2)/3,0)`.

This will take the date in cell B2 and return the quarter (e.g., “Q1” for dates in January, February, and March).

- 1.4** A director of outpatient services is developing a presentation discussing the growth of outpatient visits in hospital settings. Access the Hospital.xlsx data set containing hospital data over a five-year period. Use Excel’s PivotTable functionality to create an insert for the director’s presentation that displays the average number of outpatient visits for each of the five years.
- 1.5** A health care executive is interested in whether readmission rates for heart attack, heart failure, and pneumonia differ across small, medium, and large hospitals. Assume that the researcher defines small hospitals as those with fewer than 50 beds, medium hospitals as those with 50 to 99 beds, and large hospitals as those with 100 or more beds.
- Access the Hospital.xlsx data set containing hospital data over a five-year period.
 - Insert a new column next to the ipbeds_5 column entitled “Hospital Size.” In the first cell of this new column, input the following formula (known as a nested IF statement) and copy down to the remaining cells:

`=IF(B2<50,“small”,IF(B2<100,“medium”,“large”))`

This will classify each hospital as small, medium, or large according to its inpatient bed size in year 5.

- Create a pivot table that displays the average risk-adjusted readmission rate for heart attack, heart failure, and pneumonia in year 5 by hospital size. Does there appear to be a difference in readmission rates across hospitals of different sizes?
- 1.6** Navigate to the Hospital Compare website at <https://data.medicare.gov/data/hospital-compare> and then filter the category to “General Information.”
- Locate and download the Hospital General Information file. This file contains a list of all hospitals that have been registered with Medicare and includes addresses, phone numbers, and hospital type.
To download the file, select the link for “Hospital General Information.” This will display the report on the web page. Locate and click on the “Export” button at the top right of the report. Download the report as “CSV for Excel.”
 - Use Excel’s PivotTable functionality to reorganize the data set to display the total number of hospitals for each type of hospital ownership (i.e., Government—State, Proprietary, etc.). (Hint: You will only need to use one field—hospital ownership.)
 - Modify the PivotTable in part (b) to include a breakdown of hospital ownership by hospital type (i.e., acute care, children’s, etc.). The resulting PivotTable should look similar to the format shown in Figure EX 1.6.

- d. Using the PivotTable in part (c), determine the following:
 - i. The percentage of hospitals that are physician owned
 - ii. The total number of acute care hospitals owned by state governments
 - iii. The total number of private nonprofit children's hospitals
- e. Modify the PivotTable in part (c) to obtain the total number of critical access hospitals in the United States. (Note: A simple modification eliminates the need to add up columns or rows.)

	A	B	C
1			
2			
3	Row Labels	Count of Hospital Ownership	
4	Government - Federal	46	
5	Acute Care Hospitals	41	
6	Critical Access Hospitals	5	
7	Government - Hospital District or Authority	558	
8	Acute Care Hospitals	292	
9	Critical Access Hospitals	266	
10	Government - Local	417	
11	Acute Care Hospitals	192	
12	Critical Access Hospitals	225	
13	Government - State	61	
14	Acute Care Hospitals	53	
15	Childrens	1	
16	Critical Access Hospitals	7	
17	Government Federal	129	
18	ACUTE CARE - VETERANS ADMINISTRATION	129	
19	Physician	61	
20	Acute Care Hospitals	61	
21	Proprietary	779	
22	Acute Care Hospitals	720	
23	Childrens	1	

Figure EX 1.6 Pivot Table By Hospital Ownership and Hospital Type.

1.7 A health care manager is interested in determining the number of ACOs with 25,000 or more assigned beneficiaries.

- a. Navigate to <https://data.cms.gov/>. Select the ACO category and locate the Medicare Shared Savings Program Accountable Care Organizations Performance Year 1 Results data set. Click “Export” and download the file into MS Excel format.
- b. Insert a new column entitled “Beneficiary Grouping” to the right of the “Total Assigned Beneficiaries Column”. In the first cell of this new column, input the following formula:

=IF(F2<25000,“< 25000”,“25000+”)

This will assign a value of “<25000” for all ACOs with fewer than 25,000 beneficiaries and “25000+” to ACOs with 25,000 or more assigned beneficiaries. Copy the formula down to all rows.

Note that if the “Total Assigned Beneficiaries” column were in column C instead of E, the formula would read =IF(C1<25000,...).

- c. Create a pivot table that compares the total counts of ACOs with fewer than 25,000 beneficiaries and ACOs with 25,000 or more assigned beneficiaries. Include a filter for the beneficiaries’ state of residence. What is the total number of ACOs with 25,000 or more assigned beneficiaries?
- d. Suppose the manager is interested in the total expenditure per assigned beneficiary for ACOs with fewer than 25,000 beneficiaries compared to those with 25,000 or more beneficiaries. Modify the pivot table in part (b) to display the sum of assigned beneficiaries and the sum of total expenditures for ACOs with fewer than 25,000 beneficiaries versus those with 25,000 or more beneficiaries.
- e. Calculate the average expenditure per beneficiary for each beneficiary grouping by dividing the sum of expenditures by the sum of assigned beneficiaries.

(Note: Consider the potential implications of these findings in terms of the effectiveness of ACOs in reducing costs of care. This topic will be addressed again in Chapter 2.)