Appendix B: Advanced Filters, Database Functions, and Summary IFS Functions

Filtering and Summarizing Database Information

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## B-1 Using Advanced Filters

Advanced filtering displays a subset of the rows in an Excel table or a range of data that match the criteria you specify. With advanced filtering, you specify the filter criteria in a separate range. Advanced filtering enables you to perform Or conditions across multiple fields, such as the criteria Patricia wants you to use to find eligible equipment for replacement within E-Quip Tools. You can also use advanced filtering to create complex criteria using functions and formulas. For example, Patricia could use advanced filtering to find all equipment with no service agreement at the end of life.

Patricia created a workbook that contains an Excel table named Equipment to store the data for all of the equipment. For each piece of equipment, Patricia has listed the Date Acquired, Life (Years), and End of Life, which is calculated using the Date Acquired and Life data. You will open Patricia's workbook and filter the inventory data to identify equipment eligible for replacement.

### To open and review Patricia's workbook:

1. **Open the** Tools **workbook located in the ExcelB ▸ Tutorial folder included with your Data Files, and then save the workbook as** E-Quip **in the location specified by your instructor.**

2. **B-1a Understanding the Criteria Range**

The criteria range is an area in a worksheet, separate from a range of data or an Excel table, used to specify the criteria for the data to be displayed after the filter is applied to the range or Excel table. The criteria range consists of a header row that lists field names from the table's header row, and at least one row with the specific filtering criteria for each field. The criteria range specifies which records from the data range will be included in the filtered data.
Criteria placed on the same row are considered to be connected with the logical operator And. That means all criteria in the same row must be met before a record is included in the filtered data. Figure B-2 shows an And criteria range filter to retrieve all equipment not under service agreements at end of life on or before December 31, 2016.

Figure B-2 And filter specified in a criteria range

Creating a Criteria Range

Typically, you place a criteria range above the data range to keep it separate from the data. If you place a criteria range next to the data range, the criteria might be hidden when the advanced filtering causes rows to be hidden. You can also place a criteria range in a separate worksheet, particularly if you need to use several criteria ranges in different cells to perform calculations based on various sets of filtered records.

You will place the criteria range in rows 1 through 4 of the Equipment Inventory worksheet to make it easier to locate. Because the field names in the criteria range must exactly match the field names in the Excel table or range except for capitalization, you should copy and paste the field names instead of retyping them. In row 2, you will enter an And criteria range with the criteria for equipment with no service agreement at end of life. In row 3, you will enter the criteria for equipment under service agreement with a value of less than $600 and an end of life one year before today's date.

To create the criteria range to find equipment with or without service agreements:

1. Point to the left side of cell A6 until the pointer changes to ➡, and then click the mouse button. The column headers in row 6 are selected.
2. Copy the field names to the Clipboard.

3. Select cell A1, and then paste the field names. The field names for the criteria range appear in row 1.

4. Press the Esc key to remove the copied data from the Clipboard.

Now, you will enter the first set of criteria.

5. In cell E2, enter <=12/31/2016. This condition retrieves all equipment with an end of life equivalent to today's date (12/31/2016).

6. In cell H2, enter N. This condition retrieves equipment with no service agreement.

Next, you will enter the second set of criteria.

7. In cell E3, enter <=12/31/2017. The condition retrieves all equipment with an end of life that is one year after today's date (12/31/2016).

8. In cell H3, enter Y. This condition retrieves all equipment with a service agreement.

9. In cell I3, enter <600. This condition retrieves all equipment with a value of less than $600. The criteria in row 3 retrieve equipment with a service agreement that has a value of less than $600 and is within a year of its end of life. See Figure B-5.
Now that the criteria range is established, you can use the Advanced Filter command to filter the Equipment table. You can filter the records in their current location by hiding rows that don't match your criteria, as you have done with the Filter command. Or, you can copy the records that match your criteria to another location in the worksheet. Patricia wants you to filter the records in their current location.

**To filter the Equipment table in its current location:**

1. 1.
   Select any cell in the Equipment table to make the table active.

2. 2.
   On the ribbon, click the **DATA** tab.

3. 3.
   In the Sort & Filter group, click the **Advanced** button. The Advanced Filter dialog box opens.

4. 4.
   Make sure the **Filter the list, in-place** option button is selected and the range **$A$6:$I$79** appears in the List range box. The range **$A$6:$I$79** is the current location of the Equipment table, which is the table you want to filter.

5. 5.
Make sure the Criteria range box displays $A$1:$I$3. This range references the criteria range, which includes the field names.

6. Make sure the **Unique records only** option box is unchecked. Every record in the Equipment table is unique. You would check this option if the table contained duplicate records that you did not want to display. See Figure B-6.

Figure B-6 Advanced Filter dialog box

7. Click the **OK** button, and then scroll through the worksheet. The list is filtered in its current location, and 15 equipment records (as shown in the status bar) match the criteria. See Figure B-7.

Figure B-7 Filtered equipment inventory data
Trouble? If all of the data in the table is filtered, the list range or criteria range might be incorrect. Click the Clear button in the Sort & Filter group on the DATA tab, and then repeat Steps 1 through 6, making sure the list range is $A$6:$I$79 and the criteria range is $A$1:$I$3 in the Advanced Filter dialog box.

After providing the list of eligible equipment to Patricia, she asks you to remove the filter to display all of the records in the Equipment table.

To show all of the records in the table:

1. On the DATA tab, in the Sort & Filter group, click the Clear button. All of the records in the Equipment table are redisplayed.

Patricia needs to know the average value of the equipment by location and by status. The status of the equipment indicates whether or not it is in use (active), or whether it is not in use but available if needed (reserve). To generate this information, you must set up a criteria range to retrieve the appropriate records for each calculation. Consequently, a Database function is a good approach.

Database functions use a criteria range to specify the records to summarize. In a Database function, the criteria range is used as one of the arguments of the function. The general syntax for any Database function is

\[
\text{DatabaseFunctionName}(\text{table range, column to summarize, criteria range})
\]
where *table range* refers to the cells where the data to summarize is located, including the column header; *column to summarize* is the column name of the field to summarize entered within quotation marks; and *criteria range* is the range where the criteria that determine which records are used in the calculation are specified.

You will use Database functions to summarize the average inventory for each location by status. First, you will set up a criteria range. Although the criteria range often includes all fields from the table, even those not needed to select records, you do not have to include all field names from the table when setting up a criteria range. In this case, you will use only the fields needed to specify the criteria.

You will create two criteria ranges to complete the Average Inventory section in the Inventory Summary sheet.

To create criteria ranges for the active and reserve equipment for the Tundra and Hoffman locations:

1. 1. Go to the **Inventory Summary** worksheet. The column headers for the criteria range have already been copied from the Equipment Inventory worksheet.

2. 2. In cell **G6**, enter **Tundra** and then in cell **H6**, enter **A**. These are the criteria to find all active equipment at the Tundra location.

3. 3. In cell **J6**, enter **Tundra** and then in cell **K6**, enter **R**. These are the criteria to find all reserve equipment at the Tundra location.

4. 4. In cell **G10**, enter **Hoffman** and then in cell **H10**, enter **A**. These are the criteria to find all active equipment at the Hoffman location.

5. 5. In cell **J10**, enter **Hoffman** and then in cell **K10**, enter **R**. These are the criteria to find all reserve equipment at the Hoffman location. See [Figure B-9](#).

Figure B-9 Criteria ranges for the active and reserve equipment in both locations
The criteria ranges are complete, so you can use the DAVERAGE function to calculate the average value of active equipment by location. The first two arguments are the same for each location. The third argument, the criteria range, is different for each location so you can average a different subset of each location inventory.

To find the average value of the active equipment for the Tundra and Hoffman locations:

1. Select cell C5, and then click the Insert Function button next to the formula bar. The Insert Function dialog box opens.

2. Click the Or select a category arrow, and then click Database in the list of functions.

3. In the Select a function box, select DAVERAGE, if necessary, and then click the OK button. The Function Arguments dialog box opens.

4. In the Database box, type ‘Equipment Inventory’!$A$6:$I$79 to enter the range to search, and then press the Tab key. In this case, ‘Equipment Inventory’!$A$6:$I$79 refers to all data values in the range A6:I79 of the Equipment Inventory worksheet.

Trouble? If the error “Invalid” appears to the right of the Database box, you probably mistyped the range to search. Make sure you typed apostrophes (’) and not quotation marks (”) around the Equipment Inventory worksheet name, included a space in the Equipment Inventory worksheet name, and typed ! (an exclamation mark) before the criteria range.

5. In the Field box, type “Value” and then press the Tab key. The field specifies the table column that contains the data to be averaged.

6. In the Criteria box, type G5:H6 to specify the criteria for active equipment in the Tundra location. See Figure B-10.

Figure B-10DAVERAGE Function Arguments dialog box
7. Click the **OK** button. The formula `=DAVERAGE('Equipment Inventory'!$A$6:$I$79,"Value",G5:H6)` appears in the formula bar, and $1,065 appears in cell C5, indicating the average value of the active equipment in the Tundra location. See **Figure B-11**.

**Figure B-11** Average value of the active equipment in the Tundra location

8. Select cell **C6**, and then click the **Insert Function** button next to the formula bar.

9. Repeat Step 3 to open the DAVERAGE Function Arguments dialog box, and then repeat Steps 4 and 5 to enter the first two arguments for the DAVERAGE function, specifying all data values in the Equipment table and the field name.

10. In the Criteria box, type **G9:H10** to specify the active equipment in the Hoffman location.
Click the **OK** button. The formula =DAVERAGE (‘Equipment Inventory’!$A$6:$I$79,”Value”,G9:H10) appears in the formula bar, and $827 appears in cell C6, indicating the average value of the active equipment in the Hoffman location.

To calculate the average inventory value for the reserve equipment in the Tundra and Hoffman locations, you will copy the formulas in the range C5:C6 to cells D5 and D6, and then edit the third argument.

To find the average inventory value for reserve equipment for the Tundra and Hoffman locations:

1. 1. Copy the formula in cell C5 to cell D5.

2. 2. Select cell D5, and then change the criteria range (the third argument) from H5:I6 to J5:K6. The formula =DAVERAGE (‘Equipment Inventory’!$A$6:$I$79,”Value”,J5:K6) appears in the formula bar, and $2,816 appears in cell D5, indicating the average value of the reserve equipment in the Tundra location.

3. 3. Copy the formula from cell C6 to cell D6.

4. 4. Select cell D6, and then change the criteria range (the third argument) from K5:L6 to J9:K10. The formula =DAVERAGE (‘Equipment Inventory’!$A$6:$I$79,”Value”,J9:K10) appears in the formula bar, and $2,151 appears in cell D6, indicating the average value of the reserve equipment in the Hoffman location. See [Figure B-12](#).

Figure B-12 Average inventory values

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**Summarizing Data Using the COUNTIFS, SUMIFS, and AVERAGEIFS Functions**
Patricia wants you to summarize the years of service for the company's inventory. She needs to know the total and average values of the active equipment based on the life of the equipment.

The COUNTIFS, SUMIFS, and AVERAGEIFS functions are similar to the COUNTIF, SUMIF, and AVERAGEIF functions except the latter functions enable you to specify only one condition to summarize the data, whereas the former functions enable you to summarize the data using several conditions.

The COUNTIFS function counts the number of cells within a range that meet multiple criteria. Its syntax is

\[
\text{COUNTIFS}(\text{criteria\_range}_{1},\text{criteria}_{1},\text{criteria\_range}_{2},\text{criteria}_{2},\ldots)
\]

where criteria\_range\_1, criteria\_range\_2, and so on represent up to 127 ranges (columns of data) in which to evaluate the associated criteria; and criteria\_1, criteria\_2, and so on represent up to 127 criteria in the form of a number, an expression, a cell reference, or text that define which cells will be counted. Criteria can be expressed as a number such as 50 to find a number equal to 50; an expression such as “>10000” to find an amount greater than 10,000; text such as “A” to find a text value equal to A; or a cell reference such as B4 to find the value equal to the value stored in cell B4. Each cell in a range is counted only if all of the corresponding criteria specified in the COUNTIFS function are true.

To count the number of pieces of Active (A) equipment in the Tundra location (Tundra) and with a value more than $500, you can use the COUNTIFS function.

\[
=\text{COUNTIFS(Equipment[Status],"A",Equipment[Location],"Tundra", Equipment[Value],">500")}
\]

The criteria are treated as if they are connected by an AND function, so all conditions must be true for a record to be counted.

The SUMIFS and AVERAGEIFS functions have a slightly different syntax. The SUMIFS function adds values in a range that meet multiple criteria using the syntax

\[
\text{SUMIFS}(\text{sum\_range},\text{criteria\_range}_{1},\text{criteria}_{1},\text{criteria\_range}_{2},\text{criteria}_{2},\ldots)
\]

where sum\_range is the range you want to add; criteria\_range\_1, criteria\_range\_2, and so on represent up to 127 ranges (columns of data) in which to evaluate the associated criteria; and criteria\_1, criteria\_2, and so on represent up to 127 criteria in the form of a number, an expression, a cell reference, or text that define which cells will be added.

To calculate the total value of active equipment acquired after 2016 in the Tundra location, you can use the following SUMIFS function to add the values (Equipment[Value]) of the equipment located in Tundra (Equipment[Location], “Tundra”) that was acquired on or later than 1/1/2016 (Equipment[Date Acquired], “>=1/1/2016”) and has an active status (Equipment[Status], “A”):

\[
=\text{SUMIFS(Equipment[Value],Equipment[Location],"Tundra", Equipment[Date Acquired],">=1/1/2016",Equipment[Status],"A")}
\]

The AVERAGEIFS function calculates the average of values within a range of cells that meet multiple conditions. Its syntax is

\[
\text{AVERAGEIFS}(\text{average\_range},\text{criteria\_range}_{1},\text{criteria}_{1},\text{criteria\_range}_{2},\text{criteria}_{2},\ldots)
\]
where average_range is the range to average; criteria_range1, criteria_range2, and so on represent up to 127 ranges in which to evaluate the associated criteria; and criteria1, criteria2, and so on represent up to 127 criteria in the form of a number, an expression, a cell reference, or text that define which cells will be averaged.

To calculate the value of active equipment that has a two-year lifetime, you can use the following AVERAGEIFS function to average the values (Equipment[Value]) of active equipment (Equipment[Status],“A”) having two years of life (Equipment[Life],“2”):

\[
=\text{AVERAGEIFS}(\text{Equipment[Value]},\text{Equipment[Status]},"A",\text{Equipment[Life]},"2")
\]

One of the first items you need for the Years' Service Summary report is a count of equipment with a two-year lifetime. You will use the COUNTIFS function to compute statistical information for the active equipment in both locations.

To calculate the total amount of active equipment with lifetimes of two, five, and greater than five years:

1. Select cell C16, and then click the Insert Function button next to the formula bar. The Insert Function dialog box opens.

2. Click the Or select a category arrow, and then click Statistical.

3. In the Select a function box, click COUNTIFS, and then click the OK button. The Function Arguments dialog box opens.

4. In the Criteria_range1 box, enter Equipment[Status] and then press the Tab key. This criterion selects all of the equipment in the Equipment table that is in active use.

5. In the Criteria1 box, type “A” to specify active equipment, and then press the Tab key. The first condition is complete, and 60 appears as the total count in the middle of the Function Arguments dialog box.

6. In the Criteria_range2 box, enter Equipment[Life] and then press the Tab key. This criterion selects equipment that will have a lifetime of two years.

7. In the Criteria2 box, type “2” to select equipment with a lifetime of two years, and then press the Tab key. The second condition is complete, and 17 appears as the total count. See Figure B-13.
8. Click the **OK** button. The formula `=COUNTIFS(Equipment[Status],“A”,Equipment[Life],“2”)` appears in the formula bar, and the value 17 appears in cell C16. See Figure B-14.

Figure B-14 Summary of the equipment with a two-year lifetime

9. Copy the formula from cell C16 to the range C17:C18.

10. In cell C17, change the second criteria argument from “2” to “5”. The criteria specify a lifetime of five years. The formula `=COUNTIFS(Equipment[Status],“A”,Equipment[Life],“5”)` appears in the formula bar, and 40 appears in cell C17.
11. In cell C18, change the second criteria argument from 2 to “>5”. The criteria specify a lifetime of greater than five years. The formula =COUNTIFS(Equipment[Status],“A”,Equipment[Life],“>5”) appears in the formula bar, and 3 appears in cell C18.

Next, you will calculate the total value of the active equipment based on the life of the equipment. To do this, you will use the SUMIFS function.

To calculate the total value of active equipment based on the life of the equipment:

1. Select cell D16, and then click the Insert Function button next to the formula bar. The Insert Function dialog box opens.

2. Click the Or select a category arrow, and then click Math & Trig.

3. In the Select a function box, click SUMIFS, and then click the OK button. The Function Arguments dialog box opens.

4. In the Sum_range box, type Equipment[Value] to enter the range of data to sum, and then press the Tab key.

5. In the Criteria_range1 box, enter Equipment[Status] and then press the Tab key.

6. In the Criteria box, type “A” to specify active equipment, and then press the Tab key. The first condition is complete. See Figure B-15.

Figure B-15: SUMIFS Function Arguments dialog box
7. In the Criteria_range2 box, enter **Equipment[Life]** for the range referencing the life of the equipment, and then press the **Tab** key.

8. In the Criteria2 box, type “2” to specify the lifetime of the equipment, and then press the **Tab** key.

9. Click the **OK** button. The formula
   \[=\text{SUMIFS}(\text{Equipment[Value]}, \text{Equipment[Status]}, "A", \text{Equipment[Life]}, "2")\]
   appears in the formula bar, and $1,325 appears in cell D16.

10. Copy the formula from cell **D16** to the range **D17:D18**.

11. In cell **D17**, change the second criteria argument from “2” to “5”. The formula
    \[=\text{SUMIFS}(\text{Equipment[Value]}, \text{Equipment[Status]}, "A", \text{Equipment[Life]}, "5")\]
    appears in the formula bar, and $25,560 appears in cell D17.

12. In cell **D18**, change the second criteria argument to “>5”. The formula
    \[=\text{SUMIFS}(\text{Equipment[Value]}, \text{Equipment[Status]}, "A", \text{Equipment[Life]}, ">5")\]
    appears in the formula bar, and $32,000 appears in cell D18.
Next, you will calculate the average value of active equipment based on the life of the equipment. You will use the AVERAGEIFS function to do this.

To calculate the average value of active equipment based on the life of the equipment:

1. Select cell E16, and then click the Insert Function button next to the formula bar. The Insert Function dialog box opens.

2. Click the Or select a category arrow, and then click Statistical.

3. In the Select a function box, click AVERAGEIFS, and then click the OK button. The Function Arguments dialog box opens.

4. In the Average_range box, type Equipment[Value] to enter the range to be averaged, and then press the Tab key.

5. In the Criteria_range1 box, enter Equipment[Status] and then press the Tab key.

6. In the Criteria1 box, type “A” to specify active equipment, and then press the Tab key. The first condition is complete.

7. In the Criteria_range2 box, enter Equipment[Life] for the range referencing the life of the equipment, and then press the Tab key.

8. In the Criteria2 box, type “2” to specify a lifetime of two years for the equipment, and then press the Tab key.

9. Click the OK button. The formula =AVERAGEIFS(Equipment[Value],Equipment[Status],“A”,Equipment[Life],“2”) appears in the formula bar, and $78 appears in cell E16.
Copy the formula from cell E16 to the range E17:E18.

11. In cell E17, change the second criteria argument from “2” to “5”. The formula =AVERAGEIFS(Equipment[Value],Equipment[Status],“A”,Equipment[Life],“<5”) appears in the formula bar, and $639 appears in cell E17.

12. In cell E18, change the second criteria argument to “>5”. The formula =AVERAGEIFS(Equipment[Value],Equipment[Status],“A”,Equipment[Life],“>5”) appears in the formula bar, and $10,667 appears in cell E18.

13. Select cell E18. See Figure B-16.

Figure B-16Equipment Life Summary report

14. Save the workbook, and then close it.

The Inventory Summary worksheet is complete. In this appendix, you used advanced filtering techniques to evaluate the equipment inventory. You also used the DAVERAGE and AVERAGEIFS functions to calculate the average value of inventory broken down by location and status.