

Lecture Note #16: PivotTables Part #2

BUSI 201: Business Data Analysis

Fall 2023

Topic 1. PivotTables: Refreshing Data

One of the reasons that we may favor the use of functions over PivotTables is that functions will automatically update its values when information is edited in the original data. By default, PivotTables do not automatically update, as it does not draw directly from the original data. Instead, PivotTables refer to cached data, so we must manually update the PivotTable.¹

To learn how to refresh the data on our PivotTables, navigate to worksheet PIVOT-06 of the workbook BUSI201-LEC16-Workbook.xlsx. This worksheet contains a randomly generated gradebook for some class. Suppose that we are interested in analyzing the students' performance data based on their majors and class. Following the steps illustrated in Figure 1.

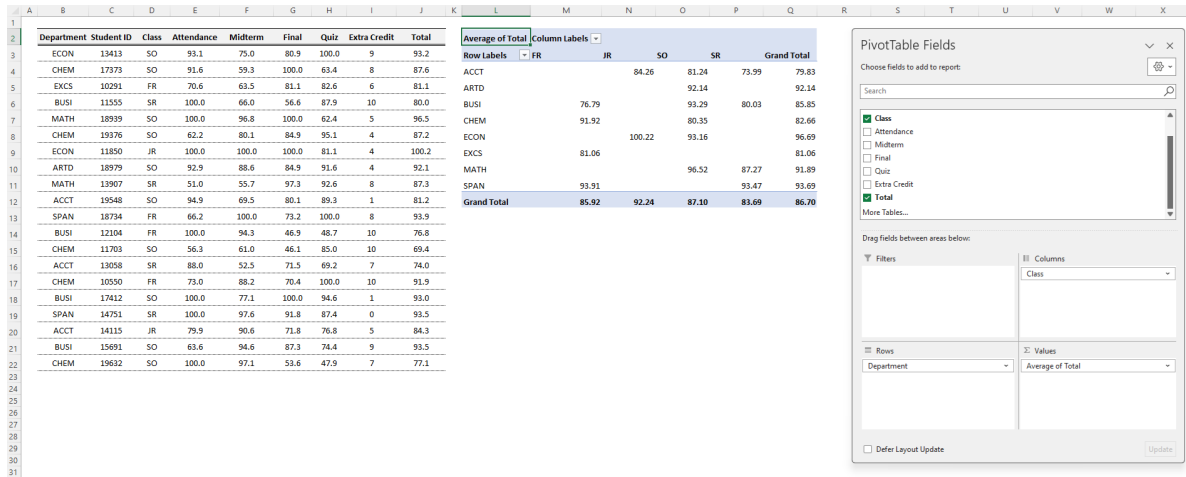


Figure 1: PIVOT-06

Suppose that there were some last minute changes where some students received extra credit after their final exams. Lets imagine that the student with 0 extra credit in row 19 has completed a task that earned them 10 points extra credit. There is only one senior majoring in Spanish in this dataset, so ideally speaking, the PivotTable should reflect this change.

¹There are macros that will allow us to automatically update the PivotTable, but this is not within the scope of this course.

Department	Student ID	Class	Attendance	Midterm	Final	Quiz	Extra Credit	Total
ECON	13413	SO	93.1	75.0	80.9	100.0	9	93.2
CHEM	17373	SO	91.6	59.3	100.0	63.4	8	87.6
EXCS	10291	FR	70.6	63.5	81.1	82.6	6	81.1
BUSI	11555	SR	100.0	66.0	56.6	87.9	10	80.0
MATH	18939	SO	100.0	96.8	100.0	62.4	5	96.5
CHEM	19376	SO	62.2	80.1	84.9	95.1	4	87.2
ECON	11850	JR	100.0	100.0	100.0	81.1	4	100.2
ARTD	18979	SO	92.9	88.6	84.9	91.6	4	92.1
MATH	13907	SR	51.0	55.7	97.3	92.6	8	87.3
ACCT	19548	SO	94.9	69.5	80.1	89.3	1	81.2
SPAN	18734	FR	66.2	100.0	73.2	100.0	8	93.9
BUSI	12104	FR	100.0	94.3	46.9	48.7	10	76.8
CHEM	11703	SO	56.3	61.0	46.1	85.0	10	69.4
ACCT	13058	SR	88.0	52.5	71.5	69.2	7	74.0
CHEM	10550	FR	73.0	88.2	70.4	100.0	10	91.9
BUSI	17412	SO	100.0	77.1	100.0	94.6	1	93.0
SPAN	14751	SR	100.0	97.6	91.8	87.4	10	103.5
ACCT	14115	JR	79.9	90.6	71.8	76.8	5	84.3
BUSI	15691	SO	63.6	94.6	87.3	74.4	9	93.5
CHEM	19632	SO	100.0	97.1	53.6	47.9	7	77.1

Average of Total	Column Labels	JR	SO	SR	Grand Total
ACCT		84.26	81.24	73.99	79.83
ARTD			92.14		92.14
BUSI	76.79		93.29	80.03	85.85
CHEM	91.92		80.35		82.66
ECON		100.22	93.16		96.69
EXCS	81.06				81.06
MATH			96.52	87.27	91.89
SPAN	93.91			93.47	93.69
Grand Total	85.92	92.24	87.10	83.69	86.70

Figure 2: PivotTable Not Synced

See Figure 2. Note that even after updating the original data, the PivotTable did not update accordingly. If we want the PivotTable data to be updated, we can manually initiate the process. While there are many ways to initiate this process, and we will be covering three methods.

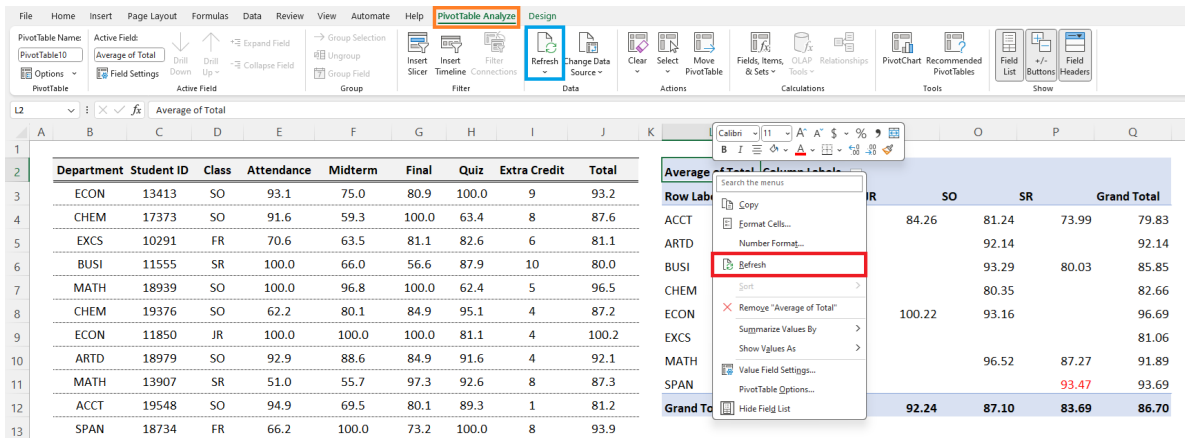


Figure 3: PivotTable Refreshing

First, select any cell on the PivotTable to pull up menu items on the ribbon on the top side of the Excel window. Then, select **PivotTable Analyze**, and then select **Refresh**. This should refresh the PivotTable so that the new extra credit score is reflected in the table. The second way of refreshing the PivotTable is also quite simple. Select any cell on the PivotTable, right click once, and select **Refresh**. The last method is using the hotkey **alt** + **F5** after selecting any cell in the PivotTable.

PivotTable Settings: Autofit Columns

Actually refreshing the table, you may have noticed that the width of each column changed to fit the data in each cell. Suppose you want to keep the width of each cell/column constant even after you refresh the PivotTable. We can change the settings so that they remain the same width after refreshing the data.

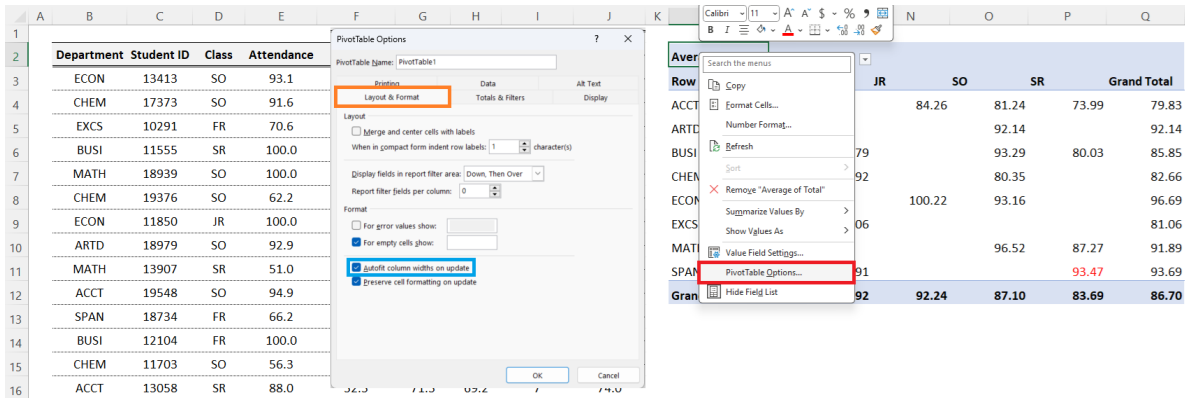


Figure 4: PivotTable Options: Autofit

Select any cell on the PivotTable, right click, and select **PivotTable Options**. Navigating to the **Layout&Format** tab in the new pop-up window, and deselect **Autofit column widths on update**. Following this process, the column widths will remain constant each time you update the PivotTable.

PivotTable Settings: Manually Sorting Columns

One thing that bothers me is that the Class is not sorted properly. We as humans understand that the correct order should be FR>SO>JR>SR, but Excel does not. We can manually sort the columns by following a few steps. First move your mouse cursor to the upper border of cell N3 so that the mouse cursor changes to a downward pointing arrow. Left click once, and then move the cursor slightly upward until the cursor changes to a “move” cursor (looks like a + sign with arrows pointing outward). Then, you can click and drag the entire column.

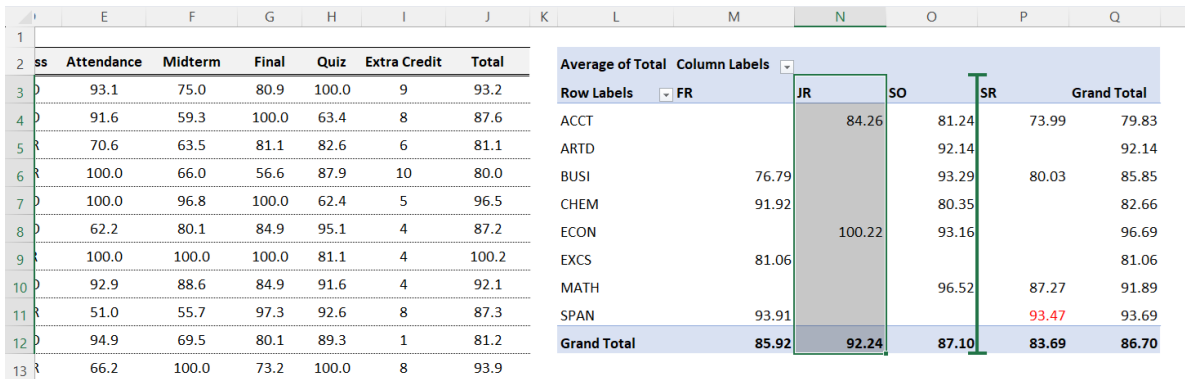


Figure 5: Manually Sorting PivotTable Columns

Topic 2. PivotTables: Declaring “Tables”

Recall how we started off building PivotTables. We selected the range that contained the data, and then selected the location where the PivotTable should show up, and we set up the PivotTable using the new menu that pops up. One problem with this approach occurs when we want to add entries to the original data.

Suppose you add a new student to the list in worksheet PIVOT-06, where you already have a PivotTable, and then try to update the PivotTable. This new line of data will not be automatically added to the PivotTable, since the range that we selected when setting up the PivotTable does not include the final row. We will learn how to declare tables so that we can fix this problem.

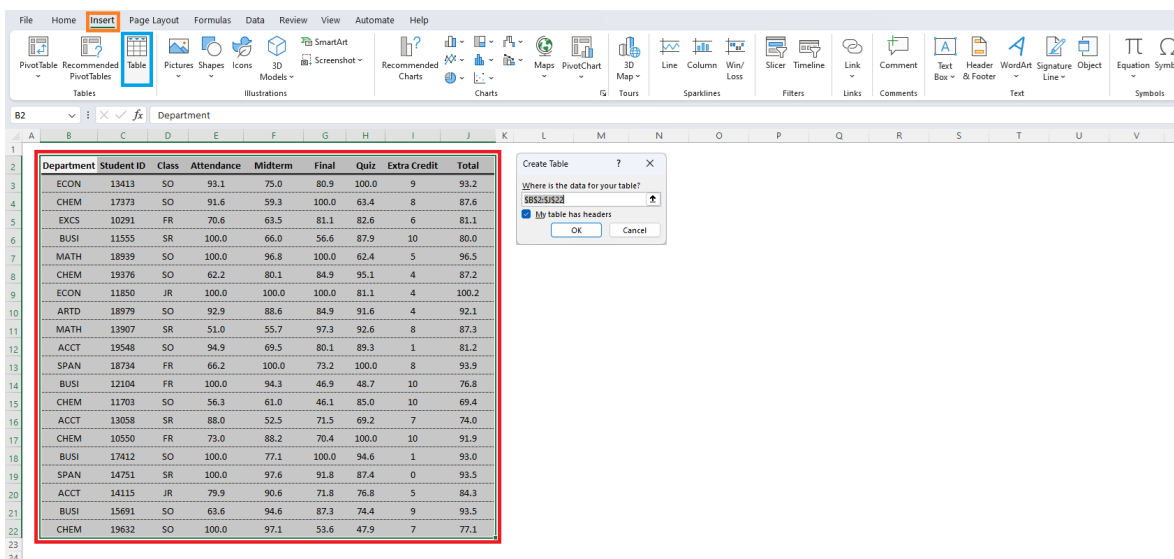


Figure 6: Declaring the Data as a Table

Navigate to the worksheet PIVOT-07, which is a duplicate of the previous worksheet. We will be selecting the dataset we will be working with, and declare it as a table. Select the entire dataset including the variable names at the top row as shown in the **red box** of Figure 6. Then, navigate to **Insert**, and then select **Table**. There are some conditions that should be satisfied for this process to work out:

1. No merged cells should be included in the selected dataset.
2. There can be no duplicate variable names in the first row.
3. All variable names must be included in a single row.

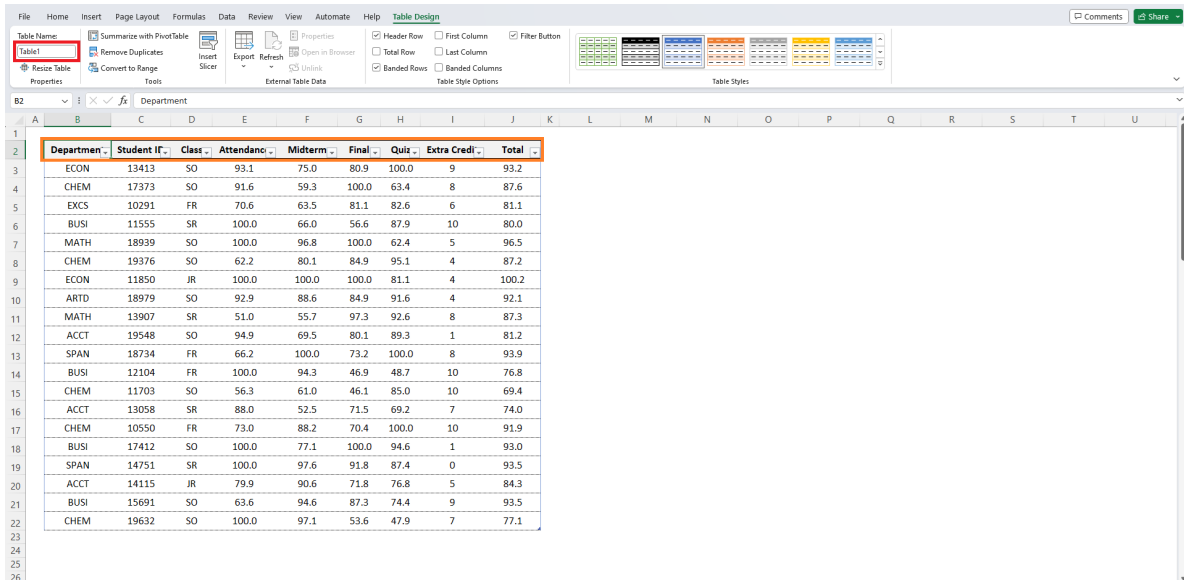


Figure 7: Declaring the Data as a Table

We can name the table by changing the terms in the **red box** in Figure 7. We should keep track of this name, as we will be referencing this when we create the PivotTable. If the dataset is correctly declared as a table, you will see filters being automatically added as shown in the **orange box** in Figure 7.

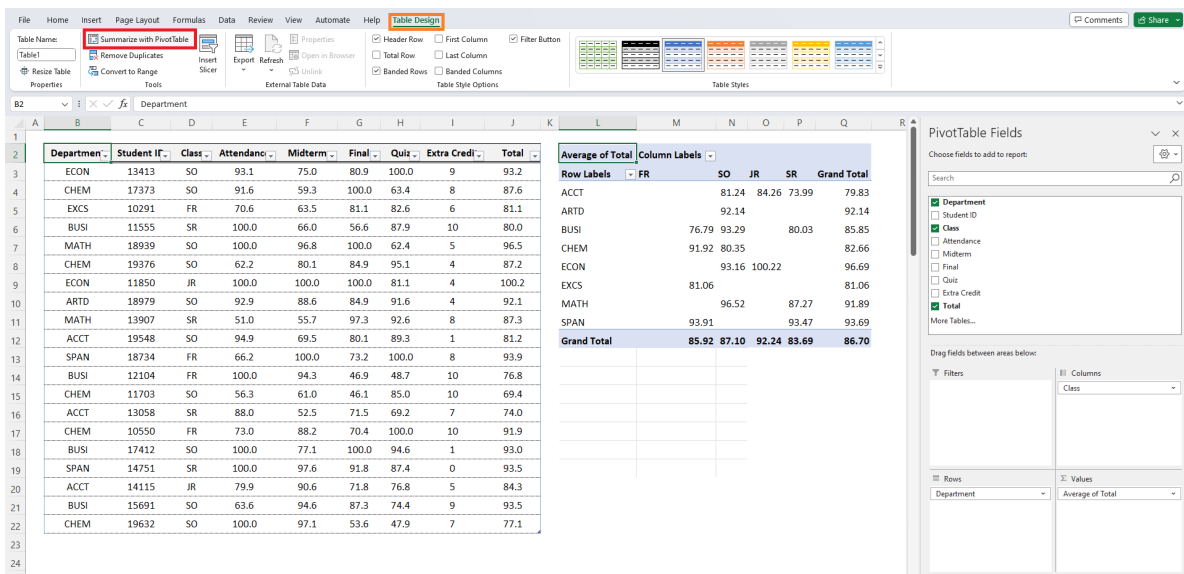


Figure 8: Generating PivotTables with a Table

Select the table that we just declared, and then select **Table Design** in the ribbon menu. Then, select **Summarize with PivotTable**. Following all procedures to generate the PivotTable, we can reach the state illustrated in Figure 8. Now let's see what happens when we add a new entry.

Department	Student ID	Class	Attendance	Midterm	Final	Quiz	Extra Credit	Total
ECON	13413	SO	93.1	75.0	80.9	100.0	9	93.2
CHEM	17373	SO	91.6	59.3	100.0	63.4	8	87.6
EXCS	10291	FR	70.6	63.5	81.1	82.6	6	81.1
BUSI	11555	SR	100.0	66.0	56.6	87.9	10	80.0
MATH	18939	SO	100.0	96.8	100.0	62.4	5	96.5
CHEM	19376	SO	62.2	80.1	84.9	95.1	4	87.2
ECON	11850	JR	100.0	100.0	100.0	81.1	4	100.2
ARTD	18979	SO	92.9	88.6	84.9	91.6	4	92.1
MATH	13907	SR	51.0	55.7	97.3	92.6	8	87.3
ACCT	19548	SO	94.9	69.5	80.1	89.3	1	81.2
SPAN	18734	FR	66.2	100.0	73.2	100.0	8	93.9
BUSI	12104	FR	100.0	94.3	46.9	48.7	10	76.8
CHEM	11703	SO	56.3	61.0	46.1	85.0	10	69.4
ACCT	13058	SR	88.0	52.5	71.5	69.2	7	74.0
CHEM	10550	FR	73.0	88.2	70.4	100.0	10	91.9
BUSI	17412	SO	100.0	77.1	100.0	94.6	1	93.0
SPAN	14751	SR	100.0	97.6	91.8	87.4	0	93.5
ACCT	14115	JR	79.9	90.6	71.8	76.8	5	84.3
BUSI	15691	SO	63.6	94.6	87.3	74.4	9	93.5
CHEM	19632	SO	100.0	97.1	53.6	47.9	7	77.1
ECON	19999	FR	100.0	100.0	100.0	100.0	10	110.0

Average of Total	Column Labels	SO	JR	SR	Grand Total
Row Labels	FR				
ACCT		81.24	84.26	73.99	79.83
ARTD		92.14			92.14
BUSI		76.79	93.29	80.03	85.85
CHEM		91.92	80.35		82.66
ECON		93.16	100.22		96.69
EXCS		81.06			81.06
MATH		96.52	87.27		91.89
SPAN		93.91	93.47		93.69
Grand Total		85.92	87.10	92.24	83.69

Figure 9: Adding Data to a Table

Suppose that we add a student below the very last row of the data. See the entry generated in the red box in Figure 9. Notice that the PivotTable does not automatically update, since the cell that should now have data is empty as shown in the orange box in Figure 9. However, you may have noticed that the table itself has been expanded to include the newest entry, as evidenced by the blue outline expanding to surround the new row.

Department	Student ID	Class	Attendance	Midterm	Final	Quiz	Extra Credit	Total
ECON	13413	SO	93.1	75.0	80.9	100.0	9	93.2
CHEM	17373	SO	91.6	59.3	100.0	63.4	8	87.6
EXCS	10291	FR	70.6	63.5	81.1	82.6	6	81.1
BUSI	11555	SR	100.0	66.0	56.6	87.9	10	80.0
MATH	18939	SO	100.0	96.8	100.0	62.4	5	96.5
CHEM	19376	SO	62.2	80.1	84.9	95.1	4	87.2
ECON	11850	JR	100.0	100.0	100.0	81.1	4	100.2
ARTD	18979	SO	92.9	88.6	84.9	91.6	4	92.1
MATH	13907	SR	51.0	55.7	97.3	92.6	8	87.3
ACCT	19548	SO	94.9	69.5	80.1	89.3	1	81.2
SPAN	18734	FR	66.2	100.0	73.2	100.0	8	93.9
BUSI	12104	FR	100.0	94.3	46.9	48.7	10	76.8
CHEM	11703	SO	56.3	61.0	46.1	85.0	10	69.4
ACCT	13058	SR	88.0	52.5	71.5	69.2	7	74.0
CHEM	10550	FR	73.0	88.2	70.4	100.0	10	91.9
BUSI	17412	SO	100.0	77.1	100.0	94.6	1	93.0
SPAN	14751	SR	100.0	97.6	91.8	87.4	0	93.5
ACCT	14115	JR	79.9	90.6	71.8	76.8	5	84.3
BUSI	15691	SO	63.6	94.6	87.3	74.4	9	93.5
CHEM	19632	SO	100.0	97.1	53.6	47.9	7	77.1
ECON	19999	FR	100.0	100.0	100.0	100.0	10	110.0

Average of Total	Column Labels	SO	JR	SR	Grand Total
Row Labels	FR				
ACCT		81.24	84.26	73.99	79.83
ARTD		92.14			92.14
BUSI		76.79	93.29	80.03	85.85
CHEM		91.92	80.35		82.66
ECON		110.00	93.16	100.22	101.13
EXCS		81.06			81.06
MATH		96.52	87.27		91.89
SPAN		93.91	93.47		93.69
Grand Total		90.74	87.10	92.24	83.69

PivotTable Fields

Choose fields to add to report:

Search

- Department
- Student ID
- Class
- Attendance
- Midterm
- Final
- Quiz
- Extra Credit
- Total
- More Tables...

Drag fields between areas below:

<p>Filters</p>	<p>Columns</p> <p>Class</p>
<p>Rows</p> <p>Department</p>	<p>Values</p> <p>Average of Total</p>

Figure 10: Updated Pivot Table

Refresh the PivotTable using any of the three methods we learned in the previous section. You should notice that the newly added row is now added in the PivotTable, as the entry shows up in the orange box in Figure 10.

Topic 3. PivotTables: Formatting

While there are many formatting options available for PivotTables, we will be covering some of the basic ones that will be useful in real-world scenarios in this chapter. Navigate to worksheet PIVOT-08 for an expanded version of the gradebook from the previous worksheets.

Department	Student ID	Class	Attendance	Midterm	Final	Quiz	Extra Credit	HasCredit	Total
ECON	13413	SO	93.1	75.0	80.9	100.0	9	1	93.2
CHEM	17373	SO	91.6	59.3	100.0	63.4	8	1	87.6
EXCS	10291	FR	70.6	63.5	81.1	82.6	6	1	81.1
BUSI	11555	SR	100.0	66.0	56.6	87.9	10	1	80.0
MATH	18939	SO	100.0	96.8	100.0	62.4	5	1	96.5
CHEM	19376	SO	62.2	80.1	84.9	95.1	4	1	87.2
ECON	11850	JR	100.0	100.0	100.0	81.1	4	1	100.2
ARTD	18979	SO	92.9	88.6	84.9	91.6	4	1	92.1
MATH	13967	SR	51.0	55.7	97.3	92.6	8	1	87.3
ACCT	19548	SO	94.9	69.5	80.1	89.3	1	1	81.2
SPAN	18734	FR	66.2	100.0	73.2	100.0	8	1	93.9
BUSI	12104	FR	100.0	94.3	46.9	48.7	10	1	76.8
CHEM	11703	SO	56.3	61.0	46.1	85.0	10	1	69.4
ACCT	13058	SR	88.0	52.5	71.5	69.2	7	1	74.0
CHEM	10550	FR	73.0	88.2	70.4	100.0	10	1	91.9
BUSI	17412	SO	100.0	77.1	100.0	94.6	1	1	93.0
SPAN	14751	SR	100.0	97.6	91.8	87.4	0	0	93.5
ACCT	14115	JR	79.9	90.6	71.8	76.8	5	1	84.3
BUSI	15691	SO	63.6	94.6	87.3	74.4	9	1	93.5
CHEM	19632	SO	100.0	97.1	53.6	47.9	7	1	77.1
ECON	14076	JR	100.0	71.8	87.6	64.2	1	1	80.4
CHEM	19184	SO	62.1	90.5	100.0	100.0	7	1	100.4
SPAN	19612	FR	100.0	76.4	79.1	100.0	9	1	93.6
ECON	15230	JR	100.0	59.4	57.7	56.1	7	1	69.1
CHEM	15412	FR	100.0	49.6	74.7	100.0	7	1	81.7
EXCS	14608	SR	100.0	100.0	52.5	100.0	6	1	87.0
Grand Total			83.42784885	84.67021979	86.01199578	81.04270365	81.04270365	83.87598766	

Figure 11: Default PivotTable

Number Formats

For most purposes, we do not need any more than 2 decimal points. We can change the formatting of the cells in the PivotTable to make the table more readable. Simply select any cell on the PivotTable, right click, and select **Value Field Settings**. Then, click on **Number Format** to call up the formatting window in the **orange box**. You can change the format of the numbers in this window, and apply the effect to the entire PivotTable.

Department	Student ID	Class	Attendance	Midterm	Final	Quiz	Extra Credit	HasCredit	Total
ECON	14076	JR	100.0	71.8	87.6	64.2	1	1	80.4
CHEM	19184	SO	62.1	90.5	100.0	100.0	7	1	100.4
SPAN	19612	FR	100.0	76.4	79.1	100.0	9	1	93.6
ECON	15230	JR	100.0	59.4	57.7	56.1	7	1	69.1
CHEM	15412	FR	100.0	49.6	74.7	100.0	7	1	81.7
EXCS	14608	SR	100.0	100.0	52.5	100.0	6	1	87.0

Figure 12: Number Formats

Report Layout

The default layout of the table is Compact, which minimizes the number of columns by stacking variables in a single column. Although it has its advantages, it is often better to experiment with other layouts. Lets edit the PivotTable to be a bit more complex for our future analysis.

The screenshot shows the Excel interface with the PivotTable in Compact layout. The PivotTable Fields task pane on the right shows the following fields:

- Department (checked)
- Student ID (unchecked)
- Class (checked)
- Attendance (unchecked)
- Midterm (unchecked)
- Final (unchecked)
- Quiz (unchecked)
- Extra Credit (unchecked)
- HasCredit (checked)
- Total (checked)

The PivotTable data is as follows:

Department	Class	Average of Total	HasCredit	Grand Total
ACCT	FR	81.97180831	81.97180831	
ACCT	JR	84.25503722	84.25503722	
ACCT	SO	80.49997159	80.49997159	
ACCT	SR	76.28255876	76.28255876	
ACCT Total		81.97180831	81.97180831	
ARTD	FR	83.77962563	88.58207904	86.18085234
ARTD	JR	82.38811311	82.38811311	
ARTD	SO	74.82377554	91.8038321	86.14381325
ARTD Total		79.30170059	88.6446364	85.53020929
BUSI	FR	81.64118281	81.64118281	
BUSI	JR	88.19664436	86.81477805	87.27540015
BUSI	SO	93.29143588	93.29143588	
BUSI	SR	62.71228186	78.20443844	75.04038625
BUSI Total		75.45446311	84.9879588	83.08125966
CHEM	FR	77.19110851	77.19110851	
CHEM	JR	86.49057939	86.49057939	
CHEM	SO	85.47927373	85.47927373	
CHEM	SR	80.45724209	86.94005859	84.77911976
CHEM Total		80.46724209	83.99841709	83.80168515
ECON	FR	77.8171997	77.8171997	
ECON	JR	82.63920561	82.63920561	
ECON	SO	82.12111888	82.12111888	
ECON	SR	78.1064632	78.1064632	
ECON Total		80.34720899	80.34720899	
EXCS	FR	84.86577408	84.86577408	

Figure 13: Layouts

The default layout of PivotTables is the Compact layout, which minimizes the number of columns by placing all row variables in one column. This format takes up less space, but it is not optimal for data analysis purposes. We want each row variable to populate its own column, since we may have to set up conditions based on these variables. Select **Design**, and then **Report Layout**, and select **Show in Tabular Form**.

The screenshot shows the Excel interface with the PivotTable in Tabular layout. The PivotTable Fields task pane on the right shows the following fields:

- Department (checked)
- Student ID (unchecked)
- Class (checked)
- Attendance (unchecked)
- Midterm (unchecked)
- Final (unchecked)
- Quiz (unchecked)
- Extra Credit (unchecked)
- HasCredit (checked)
- Total (checked)

The PivotTable data is as follows:

Department	Student ID	Class	Attendance	Midterm	Final	Quiz	Extra Credit	HasCredit	Total
ECON	13413	SO	93.1	75.0	80.9	100.0	9	1	93.2
CHEM	17373	SO	91.6	59.3	100.0	63.4	8	1	87.6
EXCS	10291	FR	70.6	63.5	81.1	82.6	6	1	81.1
BUSI	11555	SR	100.0	66.0	56.6	87.9	10	1	80.0
MATH	18939	SO	100.0	96.8	100.0	62.4	5	1	96.5
CHEM	19376	SO	62.2	80.1	84.9	95.1	4	1	87.2
ECON	11850	JR	100.0	100.0	100.0	81.1	4	1	100.2
ARTD	18979	SO	92.9	88.6	84.9	91.6	4	1	92.1
MATH	13907	SR	51.0	55.7	97.3	92.6	8	1	87.3
ACCT	19548	SO	94.9	69.5	80.1	89.3	1	1	81.2
SPAN	18734	FR	66.2	100.0	73.2	100.0	8	1	93.9
BUSI	12104	FR	100.0	94.3	46.9	48.7	10	1	76.8
CHEM	11703	SO	56.3	61.0	46.1	85.0	10	1	69.4
ACCT	13058	SR	88.0	52.5	71.5	69.2	7	1	74.0
CHEM	10550	FR	73.0	88.2	70.4	100.0	10	1	91.9
BUSI	17412	SO	100.0	77.1	100.0	94.6	1	1	93.0
SPAN	14751	SR	100.0	97.6	91.8	87.4	0	0	93.5
ACCT	14115	JR	79.9	90.6	71.8	76.8	5	1	84.3
BUSI	15691	SO	63.6	94.6	87.3	74.4	9	1	93.5
CHEM	19632	SO	100.0	97.1	53.6	47.9	7	1	77.1
ECON	14076	JR	100.0	71.8	87.6	64.2	1	1	80.4
CHEM	19184	SO	62.1	90.5	100.0	100.0	7	1	100.4
SPAN	19612	FR	100.0	76.4	79.1	100.0	9	1	93.6
ECON	15230	JR	100.0	59.4	57.7	56.1	7	1	69.1
CHEM	15412	FR	100.0	49.6	74.7	100.0	7	1	81.7
EXCS	14608	SR	100.0	100.0	52.5	100.0	6	1	87.0

Figure 14: Tabular Layout

Other Options

The readers are encouraged to try out other formatting options in the Design tab. There are options that allow you to enable/disable the subtotals for each category in the red box. You can also generate or remove grand totals which take up the very last row/column of each PivotTable in the blue box.

The screenshot displays the Excel PivotTable Design tab. The 'Layout' group contains 'Subtotals' (red box), 'Grand Totals' (blue box), 'Report Layout' (orange box), and 'Blank Rows' (orange box). The 'PivotTable Style Options' group includes 'Row Headers' (checked, green box), 'Column Headers' (checked, green box), 'Banded Rows' (unchecked, green box), and 'Banded Columns' (unchecked, green box). The 'PivotTable Styles' group shows various style thumbnails (purple box). Below, a PivotTable is shown with columns: Department, Student ID, Class, Attendance, Midterm, Final, Quiz, Extra Credit, HasCredit, Total. The PivotTable is filtered by Department (ACCT, ARTD, BUSI, CHEM) and shows a Grand Total for each department. The Grand Total values are highlighted in a blue box.

Department	Student ID	Class	Attendance	Midterm	Final	Quiz	Extra Credit	HasCredit	Total
ECON	13413	SO	93.1	75.0	80.9	100.0	9	1	93.2
CHEM	17373	SO	91.6	59.3	100.0	63.4	8	1	87.6
EXCS	10291	FR	70.6	63.5	81.1	82.6	6	1	81.1
BUSI	11555	SR	100.0	66.0	56.6	87.9	10	1	80.0
MATH	18939	SO	100.0	96.8	100.0	62.4	5	1	96.5
CHEM	19376	SO	62.2	80.1	84.9	95.1	4	1	87.2
ECON	11850	JR	100.0	100.0	100.0	81.1	4	1	100.2
ARTD	18979	SO	92.9	88.6	84.9	91.6	4	1	92.1
MATH	13907	SR	51.0	55.7	97.3	92.6	8	1	87.3
ACCT	19548	SO	94.9	69.5	80.1	89.3	1	1	81.2
SPAN	18734	FR	66.2	100.0	73.2	100.0	8	1	93.9
BUSI	12104	FR	100.0	94.3	46.9	48.7	10	1	76.8
CHEM	11703	SO	56.3	61.0	46.1	85.0	10	1	69.4
ACCT	13058	SR	88.0	52.5	71.5	69.2	7	1	74.0
CHEM	10550	FR	73.0	88.2	70.4	100.0	10	1	91.9
BUSI	17412	SO	100.0	77.1	100.0	94.6	1	1	93.0
SPAN	14751	SR	100.0	97.6	91.8	87.4	0	0	93.5
ACCT	14115	JR	79.9	90.6	71.8	76.8	5	1	84.3

The PivotTable is filtered by Department (ACCT, ARTD, BUSI, CHEM) and shows a Grand Total for each department. The Grand Total values are highlighted in a blue box.

Average of Total	Column Labels	0	1	Grand Total
ACCT		81.97180831		81.97180831
	FR	90.19903521		90.19903521
	JR	84.25503722		84.25503722
	SO	80.49997159		80.49997159
	SR	76.28255876		76.28255876
ARTD		79.30170059	88.64446364	85.53020929
	FR	83.77962563	88.58207904	86.18085234
	JR	82.38811131		82.38811131
	SO	74.82377554	91.8038321	86.14381325
BUSI		75.45446311	84.9879588	83.08125966
	FR		81.64118281	81.64118281
	JR	88.19664436	86.81477805	87.27540015
	SO		93.29143588	93.29143588
	SR	62.71228186	78.20443844	73.04038625
CHEM		80.45724209	83.99841709	83.80168515
	FR		77.19110851	77.19110851
	JR		86.49057939	86.49057939

Figure 15: Other Options

The options in the orange box allows you to add an empty row between categories, and the options in the green box automatically shades alternating rows/columns which assist on reading tables. To change the colors or borders of the PivotTable, you should look into the options in the purple box.