

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.

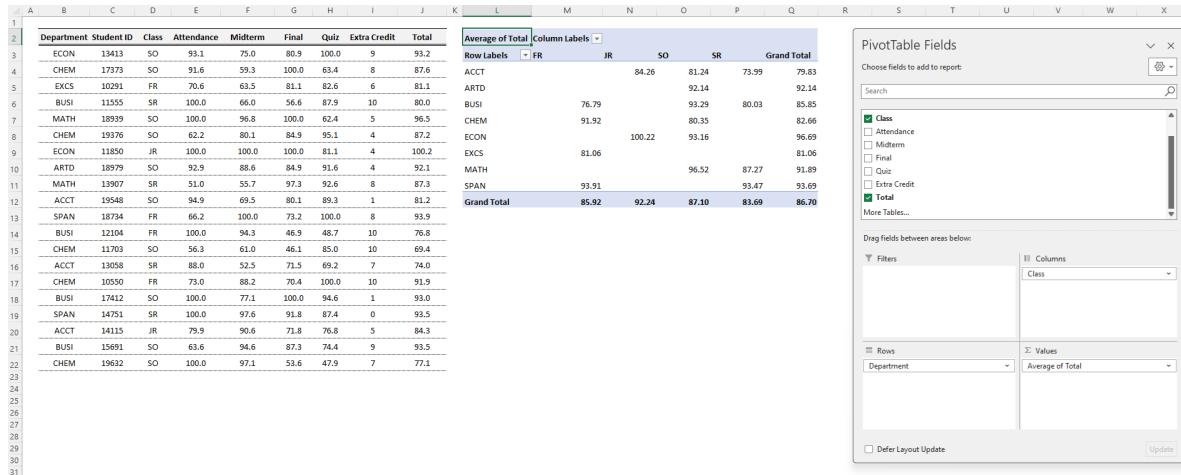


Figure 1: PIVOT-06

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.

The screenshot shows an Excel spreadsheet with two main sections: a data table and a PivotTable.

Data Table:

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

PivotTable:

	Average of Total	Column Labels								
Row Labels	FR	JR	SO	SR	Grand Total					
ACCT			84.26	81.24	73.99	79.83				
ARTD				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.

The screenshot shows an Excel spreadsheet with the same data and PivotTable as Figure 2, but with the ribbon menu open on the top bar.

Ribbon Menu:

- PivotTable Name: PivotTable10
- Active Field: Average of Total
- Options: PivotTable
- Design: Active Field, Group Selection, Insert Slicer, Refresh, Change Data Source, Filter, Actions, Fields, Items & Sets, PivotTable Calculations, Tools
- PivotChart: Recommended PivotTables
- Field List: Field Headers

PivotTable Contextual Menu:

- Copy
- Format Cell...
- Number Format...
- Refresh** (highlighted with a red box)
- Print...
- Remove "Average of Total"
- Summarize Values By...
- Show Values As...
- Value Field Settings...
- PivotTable Options...
- Hide Field List

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.

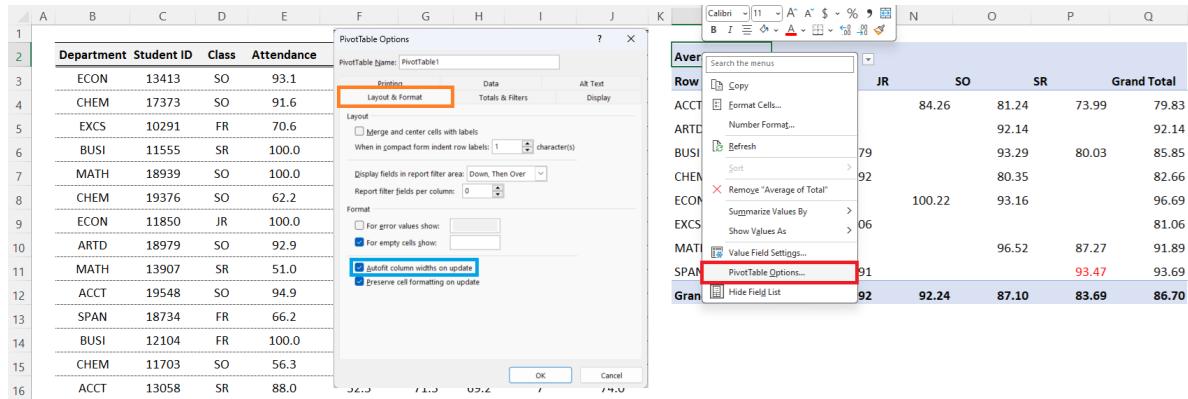


Figure 4: PivotTable Options: Autofit

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.

The screenshot shows a Microsoft Excel spreadsheet with a PivotTable in the range A1:J16. The PivotTable contains data for various students across different departments and classes. The columns are manually sorted: N (Class) is at the top, followed by O (Attendance), P (Midterm), Q (Final), R (Quiz), S (Extra Credit), and T (Total). A red box highlights the 'Column Labels' dropdown menu, which shows 'Average of Total' and 'Column Labels'. Another red box highlights the 'Row Labels' dropdown menu, which shows 'FR', 'SO', 'JR', and 'SR'. The data rows are sorted by Class (FR, SO, JR, SR) and then by Attendance (93.1, 91.6, 70.6, 66.2).

ss	Attendance	Midterm	Final	Quiz	Extra Credit	Total	Average of Total	Column Labels	Row Labels	FR	JR	SO	SR	Grand Total
0	93.1	75.0	80.9	100.0	9	93.2			ACCT		84.26	81.24	73.99	79.83
0	91.6	59.3	100.0	63.4	8	87.6			ARTD		92.14			92.14
R	70.6	63.5	81.1	82.6	6	81.1			BUSI		76.79	93.29	80.03	85.85
R	100.0	66.0	56.6	87.9	10	80.0			CHEM		91.92	80.35		82.66
R	100.0	96.8	100.0	62.4	5	96.5			ECON		100.22	93.16		96.69
R	62.2	80.1	84.9	95.1	4	87.2			EXCS		81.06			81.06
R	100.0	100.0	100.0	81.1	4	100.2			MATH			96.52	87.27	91.89
R	92.9	88.6	84.9	91.6	4	92.1			SPAN		93.91		93.47	93.69
R	51.0	55.7	97.3	92.6	8	87.3			Grand Total		85.92	92.24	87.10	83.69
R	94.9	69.5	80.1	89.3	1	81.2								86.70
R	66.2	100.0	73.2	100.0	8	93.9								

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.

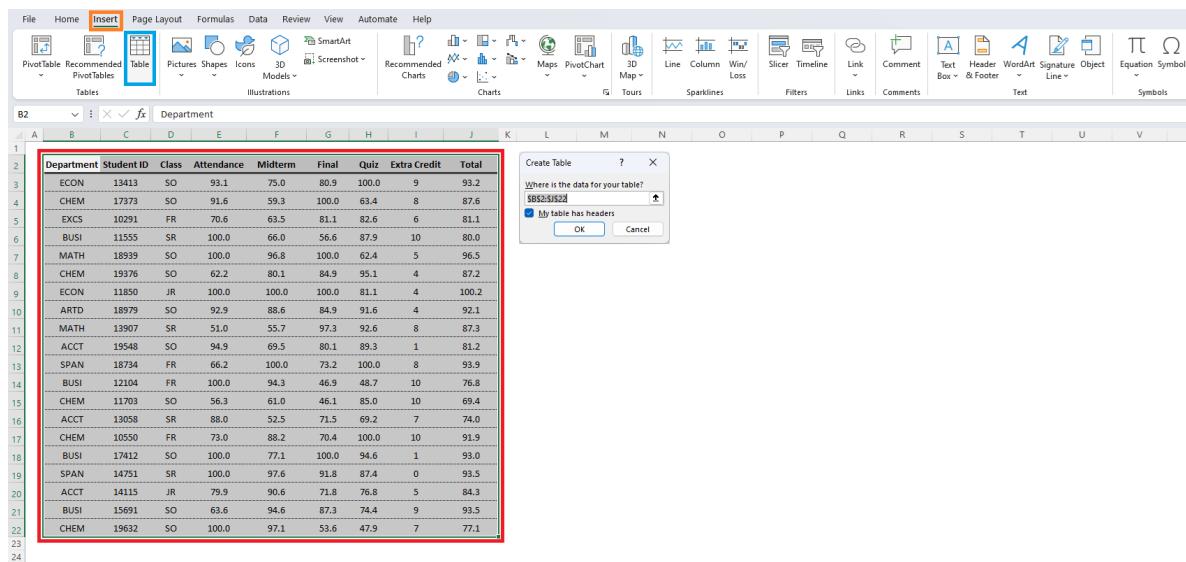


Figure 6: Declaring the Data as a Table

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.

The screenshot shows a Microsoft Excel spreadsheet with a table named 'Table1'. The table has columns labeled: Department, Student ID, Class, Attendance, Midterm, Final, Quiz, Extra Credit, and Total. The 'Table Design' tab is selected in the ribbon. A red box highlights the 'Table Name' dropdown where 'Table1' is selected. An orange box highlights the 'Summarize with PivotTable' button in the ribbon.

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.

The screenshot shows a Microsoft Excel spreadsheet with a PivotTable generated from the declared table. The PivotTable Fields pane on the right shows fields like Department, Student ID, Class, Attendance, Midterm, Final, Quiz, Extra Credit, and Total. The 'Summarize with PivotTable' button is highlighted with a red box in the ribbon. The PivotTable Fields pane is highlighted with an orange box.

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 lets see what happens when we add a new entry.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
2	Department	Student ID	Class	Attendance	Midterm	Final	Quiz	Extra Credit	Total													
3	ECON	13413	SO	93.1	75.0	80.9	100.0	9	93.2													
4	CHEM	17373	SO	91.6	59.3	100.0	63.4	8	87.6													
5	EXCS	10291	FR	70.6	63.5	81.1	82.6	6	81.1													
6	BUSI	11555	SR	100.0	66.0	56.6	87.9	10	80.0													
7	MATH	18939	SO	100.0	96.8	100.0	62.4	5	96.5													
8	CHEM	19376	SO	62.2	80.1	84.9	95.1	4	87.2													
9	ECON	11850	JR	100.0	100.0	81.0	81.1	4	100.2													
10	ARTD	18979	SO	92.9	88.6	84.9	91.6	4	92.1													
11	MATH	13907	SR	51.0	55.7	97.3	92.6	8	87.3													
12	ACCT	19548	SO	94.9	69.5	80.1	89.3	1	81.2													
13	SPAN	18734	FR	66.2	100.0	73.2	100.0	8	93.9													
14	BUSI	12104	FR	100.0	94.3	46.9	48.7	10	76.8													
15	CHEM	11703	SO	56.3	61.0	46.1	85.0	10	69.4													
16	ACCT	13058	SR	88.0	52.5	71.5	69.2	7	74.0													
17	CHEM	10550	FR	73.0	88.2	70.4	100.0	10	91.9													
18	BUSI	17412	SO	100.0	77.1	100.0	94.6	1	93.0													
19	SPAN	14751	SR	100.0	97.6	91.8	87.4	0	93.5													
20	ACCT	14115	JR	79.9	90.6	71.8	76.8	5	84.3													
21	BUSI	15691	SO	63.6	94.6	87.3	74.4	9	93.5													
22	CHEM	19632	SO	100.0	97.1	53.6	47.9	7	77.1													
23	ECON	19999	FR	100.0	100.0	100.0	100.0	10	110.0													

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.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R			
2	Department	Student ID	Class	Attendance	Midterm	Final	Quiz	Extra Credit	Total												
3	ECON	13413	SO	93.1	75.0	80.9	100.0	9	93.2												
4	CHEM	17373	SO	91.6	59.3	100.0	63.4	8	87.6												
5	EXCS	10291	FR	70.6	63.5	81.1	82.6	6	81.1												
6	BUSI	11555	SR	100.0	66.0	56.6	87.9	10	80.0												
7	MATH	18939	SO	100.0	96.8	100.0	62.4	5	96.5												
8	CHEM	19376	SO	62.2	80.1	84.9	95.1	4	87.2												
9	ECON	11850	JR	100.0	100.0	81.0	81.1	4	100.2												
10	ARTD	18979	SO	92.9	88.6	84.9	91.6	4	92.1												
11	MATH	13907	SR	51.0	55.7	97.3	92.6	8	87.3												
12	ACCT	19548	SO	94.9	69.5	80.1	89.3	1	81.2												
13	SPAN	18734	FR	66.2	100.0	73.2	100.0	8	93.9												
14	BUSI	12104	FR	100.0	94.3	46.9	48.7	10	76.8												
15	CHEM	11703	SO	56.3	61.0	46.1	85.0	10	69.4												
16	ACCT	13058	SR	88.0	52.5	71.5	69.2	7	74.0												
17	CHEM	10550	FR	73.0	88.2	70.4	100.0	10	91.9												
18	BUSI	17412	SO	100.0	77.1	100.0	94.6	1	93.0												
19	SPAN	14751	SR	100.0	97.6	91.8	87.4	0	93.5												
20	ACCT	14115	JR	79.9	90.6	71.8	76.8	5	84.3												
21	BUSI	15691	SO	63.6	94.6	87.3	74.4	9	93.5												
22	CHEM	19632	SO	100.0	97.1	53.6	47.9	7	77.1												
23	ECON	19999	FR	100.0	100.0	100.0	100.0	10	110.0												

Figure 10: Updated PivotTable

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.

The screenshot shows a PivotTable in the main area and its corresponding PivotTable Fields pane on the right. The PivotTable displays student grades across various departments and fields. The PivotTable Fields pane lists all fields used in the table, including Department, Student ID, Class, Attendance, Midterm, Final, Quiz, Extra Credit, HasCredit, Total, and Grand Total. The 'Total' field is currently selected. The pane also includes sections for Filters, Columns, Rows, and Values.

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	11553	SR	100.0	66.0	56.6	87.9	10	1	100.0
MATH	18399	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	IR	100.0	100.0	100.0	81.1	4	1	100.2
ARTD	18397	SO	92.9	88.6	84.9	91.6	4	1	92.1
MATH	19067	SR	51.0	55.7	97.3	92.6	8	1	87.5
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	16550	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	IR	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	19012	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 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.

The screenshot shows the 'Value Field Settings' dialog box open in the PivotTable Fields pane. The 'Number' tab is selected, showing a preview of the 'Sample' value 90.20. The 'Decimal places' dropdown is set to 2. The 'Format Cells...' button is highlighted with a red box. Other tabs like 'Currency', 'Text', 'Percentage', 'Fraction', 'Scientific', 'Special', and 'Custom' are visible but not selected. The main pane shows the PivotTable with various fields and their values.

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.

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	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 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**.

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	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.

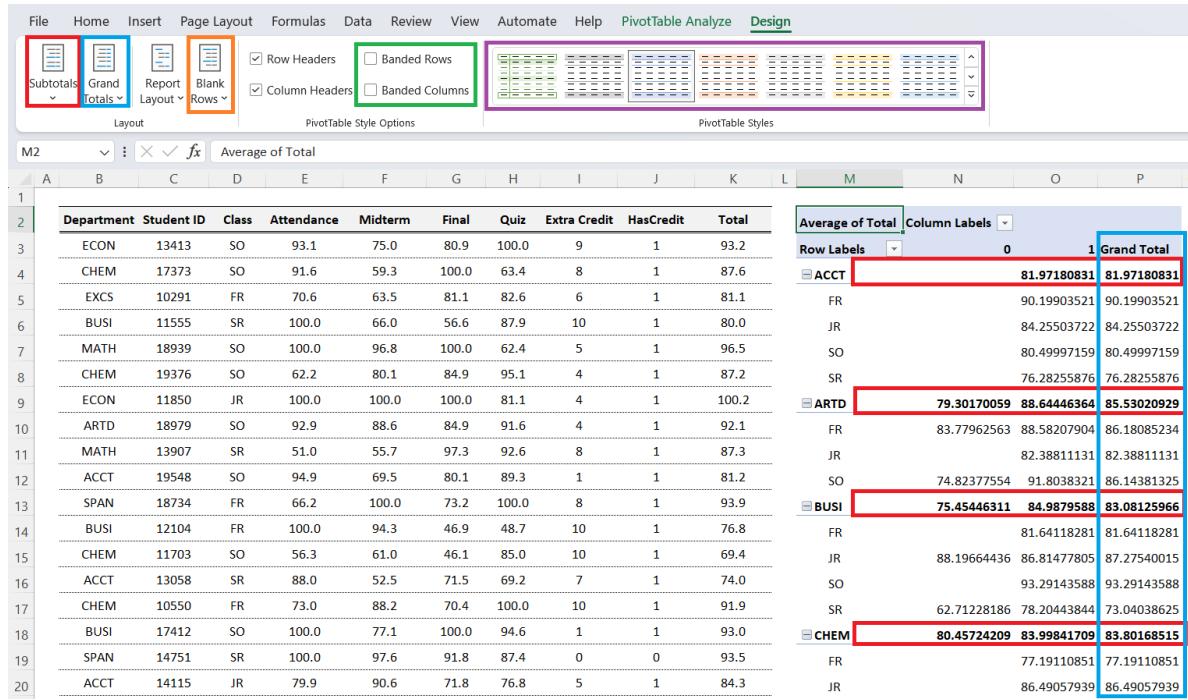


Figure 15: Other Options

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.