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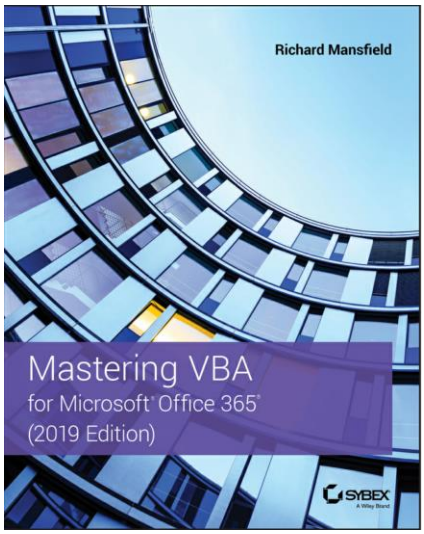

Unit 2 Homework: The VBA of Wall Street

Programming with Visual BASIC Application (VBA)
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Cover graphic from "*Mastering VBA for Microsoft Office 365,"* Richard Mansfield, Wiley Publishing (Sybex), 2019.

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Introduction

Visual Basic for Applications (VBA)was first distributed with Microsoft Excel in 1993 as a programming tool to automate tasks within Excel. With its history stemming from one of the first programming languages, Beginner's All-Purpose Symbolic Instruction Code (BASIC) and later Visual Basic, VBA adds significant capability and ease of use to Excel and subsequently the other Microsoft Office products. The current version of VBA for Microsoft Office 365 even allows for VBA scripts to run across the products to allow such tasks as automatic creation of Powerpoint presentations or Word Reports from analyses of Excel spreadsheets. VBA is a popular developers tool for Microsoft, but it is not a standalone version of Visual Basic and must be run within a host product.

Annual stock data from January, 2014 to December, 2016 are the basis for completing the Data Analytics Bootcamp Homework Assignment 2. Using these data, Excel and its Developer / VBA mode, the student is tasked to complete one or more "levels" of program complexity to automate the process for computing and displaying total annual volume for each year per ticker symbol ("easy"); add annual price and per cent changes ("moderate"); and, determine stock with greatest per cent increase and greatest total volume ("hard). The final challenge is to add the ability to automatically loop through each annual work sheet. A smaller, test data set was also provided To optimize the run time during development, but the submission must be on the complete data set.

Programming preparation tasks

Best Practice: Pseudocode for VBA

Figure 1 provides the "pseudocode" or written outline of the processes and algorithms needed to analyze the stock data set for all three task levels (easy, moderate, hard). Pseudocode is a frequently used methodology in software design since the concept only requires the developer to think through the logical sequence of steps needed to solve a problem and write them in natural language, rather than having to introduce explicit programming syntax at the first step. In the case of VBA, with its ease of readability, the words in the pseudocode can easily be modified with actual code once the flow and algorithms for the program are satisfactorily determined.

1. *'Compute run times for subroutine as an efficiency check*
    - 1.1.1. *Declare Start Time and get time from built-in function*

2. *'For each worksheet in the workbook,*
    - 2.1.1. *Activate the worksheet*
    - 2.1.2. *'Declare the variables needed for the new table entries*
    - 2.1.3. *'Declare the counter, row, column, and summing variables and initialize*
    - 2.1.4. *'Assign the column names to the new columns*
    - 2.1.5. *'Determine the length of the data set to use as the row counter*
    - 2.1.6. *Set beginning of year open price for first stock, then*
        - 2.1.6.1.1. *For all rows from 2 to the end*
            - 2.1.6.1.1.1.1. *Add volume to total volume*
        - 2.1.6.1.2. *Compare current stock ticker symbol with next row*
        - 2.1.6.1.3. *If ticker symbol is not the same*
            - 2.1.6.1.3.1.1. *Store ticker name and write total volume in summary row, column*
            - 2.1.6.1.3.1.2. *Reset total volume*
            - 2.1.6.1.3.1.3. *Increment the row number for the summary table*
            - 2.1.6.1.3.1.4. *Store location of new starting row*
    - 2.1.7. *"EASY" part iterates through all rows and stops here.*
    - 2.1.8. *"MODERATE" task includes the next steps before going to next start row .*
        - 2.1.8.1.1.1.1. *Compute yearly change as difference of closing from first of year open*
        - 2.1.8.1.1.1.2. *Compute per cent change as yearly change/open price*
        - 2.1.8.1.1.1.3. *Write values to summary table and color code as Green for positive change and red for negative change*
    - 2.1.9. *"HARD" task adds following steps*
        - 2.1.9.1.1. *Find last row of the summary table from previous steps*
        - 2.1.9.1.2. *For each row in summary table*
            - 2.1.9.1.2.1.1. *Compare each percentage to value in "greatest" box*
            - 2.1.9.1.2.1.2. *Compare total volume to value in "greatest" box*
            - 2.1.9.1.2.1.3. *Capture ticker symbol for greatest increase, greatest decrease, greatest volume*
            - 2.1.9.1.2.1.4. *Write to summary table*
    - 2.1.10. *Compute elapsed time for each sheet and add to table*
3. *Move to next Worksheet*
4. *End subroutine*

Figure 1 Pseudocode for developing VBA of Wallstreet analysis subroutine. The steps outlined here show what is needed to complete each of the three task levels from East to Hard, and include the Worksheet Challenge

Task Results

Tasks Easy-to-Hard and Worksheet Challenge

Following the pseudocode outline of Figure 1, the VBA code for processing through the 2014 to 2016 stock market spreadsheets was written in a sequence of "pieces" to first accomplish the "easy" task and then add the steps for "moderate" and "hard".

```
Sub WallstreetAnalysis()

' For interest, measure run time of program
Dim dtOpentime As Date, dtClosetime As Date
Dim strElapsedtime As String
dtOpentime = Time


' Do tasks for each worksheet in the given workbook using "Worksheets" object
' (Challenge task)
' ==================  START For Each Worksheet loop ======================================

For Each ws In Worksheets

    ' Label the new column headers for summary table
    ' (static locations in each worksheet determined by developer)

    ws.Range("I1").Value = "Ticker"
    ws.Range("J1").Value = "Annual Change"
    ws.Range("K1").Value = "Percentage Change"
    ws.Range("L1").Value = "Total Volume"

    ' Lable new columns for greatest change summary table
    ws.Range("O1").Value = "Ticker"
    ws.Range("P1").Value = "Value"
    ws.Range("N2").Value = "Greatest % Increase"
    ws.Range("N3").Value = "Greatest % Decrease"
    ws.Range("N4").Value = "Greatest Total Volume"

    ' Declare variable types, initialize counters, set start locations for "Easy" task
    Dim strTicker As String
    Dim lngLastrow As Long

    Dim dblTotalvolume As Double
    dblTotalvolume = 0

    ' Add these variables for Moderate code to compute annual changes
    Dim dblOpening As Double, dblClosing As Double
    Dim dblAnnualchange As Double, dblPercentchange As Double

    ' Add these variables for Hard code to compute greatest changes
    Dim dblGreatestup As Double, dblGreatestdown As Double, dblGreatestvolume As Double
    dblGreatestup = 0
    dblGreatestdown = 0
    dblGreatestvolume = 0
    '

    Dim irow As Long
    Dim lngPrevrow As Long
    lngPrevrow = 2

    ' Set row location for summary table
    Dim lngSumrow As Long
    lngSumrow = 2

    ' Find last row of each worksheet to set stopping point of "for" loop
    lngLastrow = ws.Cells(Rows.Count, 1).End(xlUp).Row
```

Figure 2a. Screenshot of VBA script displaying specific code. The primary coding tools used in this effort was the use of the Worksheet "object" as a means to access attributes of the spreadsheets both as input and output.

```
'************************ START For Row loop for EASY and MODERATE*************************************

    For irow = 2 To lngLastrow

    ' Add to total volume until ticker symbol changes
    dblTotalvolume = dblTotalvolume + ws.Cells(irow, 7)

'++++++++++++++++++++++++ START line by line checks and computations +++++++++++++++

    ' Check for ticker symbol change in next row
        If (ws.Cells(irow + 1, 1) <> ws.Cells(irow, 1).Value) Then

    ' The outer If/Endif clause constitutes the "Easy" task: output ticker and total volume

    'Put current ticker name in summary table and its total volume
            strTicker = ws.Cells(irow, 1).Value
            ws.Range("I" & lngSumrow).Value = strTicker
            ws.Range("L" & lngSumrow).Value = dblTotalvolume

    'Reset volume tally.  Add to summary table row and store location of end row
            dblTotalvolume = 0

    'For Moderate task, now compute the changes for each symbol and
    ' color as red for negative and green for positive
            dblOpening = ws.Range("C" & lngPrevrow)
            dblClosing = ws.Range("F" & irow)
            dblAnnualchange = dblClosing - dblOpening
            ws.Range("J" & lngSumrow) = dblAnnualchange
            If (dblAnnualchange >= 0) Then
                ws.Range("J" & lngSumrow).Interior.ColorIndex = 4
            Else
                ws.Range("J" & lngSumrow).Interior.ColorIndex = 3
            End If

    'Compute percentage change, error trap for divide by zero first
           If (dblOpening <> 0) Then
               dblPercentchange = dblAnnualchange / dblOpening
            Else
               dblPercentchange = 0
            End If
    'Write percentage in table
            ws.Range("K" & lngSumrow).NumberFormat = "0.00%"
            ws.Range("K" & lngSumrow).Value = dblPercentchange

        lngSumrow = lngSumrow + 1
        lngPrevrow = irow + 1

        End If

'++++++++++++++++++++++++  END line by line checks and computations +++++++++++++++++
    Next irow
' ************************ END For Row loop for EASY and MODERATE ***************************************
```

Figure 2b..Code for easy and moderate tasks.

```
' ********************** START of Row Loop for HARD ************************************************

' Find last row in summary table columns
    lngLastrow = ws.Cells(Rows.Count, 11).End(xlUp).Row

    For i = 2 To lngLastrow
    ' Look for largest % increase
    If ws.Range("K" & i) > ws.Range("P2") Then
        ws.Range("P2").Value = ws.Range("K" & i).Value
        ws.Range("P2").NumberFormat = "0.00%"
        ws.Range("O2").Value = ws.Range("I" & i).Value
    End If

    ' Look for largest % decrease
    If ws.Range("K" & i) < ws.Range("P3") Then
        ws.Range("P3").NumberFormat = "0.00%"
        ws.Range("P3").Value = ws.Range("K" & i).Value
        ws.Range("O3").Value = ws.Range("I" & i).Value
    End If

    ' Look for largest total volume
    If ws.Range("L" & i) > ws.Range("P4") Then
        ws.Range("P4").Value = ws.Range("L" & i).Value
        ws.Range("O4").Value = ws.Range("I" & i).Value
    End If

    Next i
 '********************** END of Row Loop for HARD ************************************************


' Size the columns for flexible fit

ws.Columns("I:Q").AutoFit

' Show elapsed time per sheet

dtClosetime = Time
t = Format(dtClosetime - dtOpentime, "hh:mm:ss")

strElapsedtime = "Worksheet " & ws.Name & "  Opened at " & Format(dtOpentime, "hh:mm:ss") _
& "    Closed at " & Format(dtClosetime, "hh:mm:ss")


ws.Range("N9").Value = strElapsedtime

' ====================== END Worksheet loop ======================================

Next ws

End Sub
```

Figure 2c..Code for "hard"task that identifies stocks with greatest percent changes in price and total volume.

Annual stock analysis results for years 2014 to 2016

Tables 1 to 3 include screen shots of the first page of the analyzed spreadsheets for each of the three years.

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
<ticker>	<date>	<open>	<high>	<low>	<close>	<vol>		Ticker	Annual Change	Percentage Change	Total Volume			Ticker	Value	
A	20140101	57.19	57.19	57.19	57.19	0		A	-16.25	-28.41%	572978100		Greatest % Increase	DM	5581.16%	
A	20140102	57.1	57.1	56.15	56.21	1916100		AA	15.48	48.54%	5161412000		Greatest % Decrease	CBO	-95.73%	
A	20140103	56.39	57.35	56.26	56.92	1866600		AA-B	1.34	2.73%	21618200		Greatest Total Volume	BAC	21595474700	
A	20140106	57.4	57.7	56.56	56.64	1777400		AAC	10.92	54.60%	9789700					
A	20140107	56.95	57.63	56.93	57.45	1463200		AAN	1.17	3.98%	237929300					
A	20140108	57.33	58.54	57.17	58.39	2659400		AAP	48.6	43.91%	200376400					
A	20140109	58.4	58.68	57.87	58.41	1757600		AAT	8.38	26.66%	40207800					
A	20140110	58.51	59.01	58.14	58.93	1623300		AAV	0.45	10.37%	86658700		Worksheet 2014 Opened at 16:21:07 Closed at 16:21:48			
A	20140113	58.77	59.1	58.6	58.93	2946700		AB	4.49	21.04%	83051600					
A	20140114	59.16	59.95	59.02	59.88	2562200		ABB	-5.41	-20.37%	466820000					
A	20140115	59.82	60.37	59.59	60.34	2335100		ABBV	12.63	23.92%	2303237600					
A	20140116	60.24	60.5	60.04	60.5	1835900		ABC	19.85	28.23%	428969000					
A	20140117	60.83	60.83	60.33	60.71	1699500		ABEV	-1.13	-15.37%	3208014300					
A	20140120	60.71	60.71	60.71	60.71	0		ABG	22.18	41.27%	81065600					
A	20140121	60.69	60.88	59.86	60.85	3008400		ABM	0.06	0.21%	52403000					
A	20140122	60.82	61.22	60.71	60.93	2769300		ABR	0.11	1.65%	28348400					
A	20140123	60.48	60.51	59.4	59.47	3063500		ABR-A	0.77	3.18%	1798500					
A	20140124	59.46	59.46	57.71	57.87	2656300		ABR-B	2.09	9.24%	1722000					
A	20140127	57.9	58.37	56.98	58.3	4669000		ABR-C	0.94	3.86%	1758200					
A	20140128	58.5	58.88	57.91	58.1	2536200		ABRN	0.49	2.04%	3451100					
A	20140129	57.67	58.22	57.41	57.65	2163000		ABT	6.69	17.45%	1516024700					
A	20140130	58.42	60.11	58.42	59.51	3743100		ABX	-6.88	-39.02%	3085372400					
A	20140131	58.61	59.15	58.05	58.15	3529000		ACC	9.15	28.41%	180543400					
A	20140203	58.15	58.48	56.08	56.15	2929200		ACCO	2.29	34.08%	223248000					
A	20140204	56.32	57.88	56.09	57.81	2911800		ACH	2.82	32.41%	34117500					
A	20140205	57.58	57.7	56.96	57.43	2283800		ACM	0.94	3.19%	303393900					
A	20140206	57.51	58.35	57.46	58.29	1609400		ACN	7.09	8.62%	705479100					
A	20140207	58.46	59.47	58.13	59.42	1975200		ACP	-2.47	-14.05%	14206700					
A	20140210	59.27	59.44	58.29	59.01	1760400		ACRE	-1.62	-12.37%	44197000					

Table 1. Screenshot of 30 lines and summary tables from the 2014 Stock market analysis.

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
<ticker>	<date>	<open>	<high>	<low>	<close>	<vol>		Ticker	Annual Change	Percentage Change	Total Volume			Ticker	Value	
A	20150101	40.94	40.94	40.94	40.94	0		A	0.87	2.13%	645319200		Greatest % Increase	ARR	491.30%	
A	20150102	41.18	41.31	40.37	40.56	1530700		AA	-17.76	-37.49%	6449104200		Greatest % Decrease	KMI.W	-98.59%	
A	20150105	40.32	40.46	39.7	39.8	2042200		AA-B	-17.14	-33.97%	40441700		Greatest Total Volume	BAC	21277761900	
A	20150106	39.81	40.02	39.02	39.18	2084500		AAC	-11.86	-38.36%	78122300					
A	20150107	39.52	39.81	39.29	39.7	3359600		AAN	-8.18	-26.76%	179606700					
A	20150108	40.24	40.98	40.18	40.89	2116300		AAP	-8.77	-5.51%	266930500					
A	20150109	41	41	40.29	40.59	1644900		AAT	-1.46	-3.67%	48158100					
A	20150112	40.61	40.72	39.95	40.11	2771100		AAV	0.29	6.05%	30229400		Worksheet 2015 Opened at 16:21:07 Closed at 16:21:35			
A	20150113	40.47	40.7	39.33	39.55	2013400		AB	-1.98	-7.67%	71403800					
A	20150114	39.03	39.1	38.21	39.06	5134000		ABB	-3.42	-16.17%	532805500					
A	20150115	39.33	39.41	37.99	38.01	2630200		ABBV	-6.2	-9.47%	2643021600					
A	20150116	37.86	38.46	37.76	38.25	3003900		ABC	13.55	15.03%	516218400					
A	20150119	38.25	38.25	38.25	38.25	0		ABEV	-1.76	-28.30%	3915345800					
A	20150120	38.43	38.66	37.76	37.93	5033600		ABG	-8.48	-11.17%	82930400					
A	20150121	37.75	38.41	37.68	38.16	2721600		ABM	-0.18	-0.63%	72539400					
A	20150122	38.51	39.86	38.12	39.65	4856500		ABR	0.38	5.61%	37916900					
A	20150123	39.6	39.6	38.76	38.81	1519200		ABR-A	-0.49	-1.96%	1243100					
A	20150126	38.79	39.17	38.47	39.15	1511200		ABR-B	-2.14	-8.66%	1022000					
A	20150127	38.7	39.25	38.58	38.75	1703500		ABR-C	-0.12	-0.47%	634000					
A	20150128	39.01	39.05	37.96	38	2033500		ABRN	0.1	0.41%	2109900					
A	20150129	38	38.47	37.69	38.46	2329900		ABT	-0.11	-0.24%	1469310700					
A	20150130	38.01	38.32	37.71	37.77	3054300		ABX	-3.37	-31.35%	4289215100					
A	20150202	37.9	38.76	37.71	38.69	2508400		AC	1	3.39%	437700					
A	20150203	39.04	39.63	38.92	39.62	2950300		ACC	-0.02	-0.05%	228980000					
A	20150204	39.33	39.46	38.82	39.11	2567400		ACCO	-1.88	-20.87%	167330800					
A	20150205	39.22	39.82	39.22	39.53	1826300		ACH	-3.28	-28.47%	35801000					
A	20150206	39.54	39.81	39.23	39.34	2697200		ACM	-0.34	-1.12%	362299600					
A	20150209	39.23	39.43	38.95	39.04	3586100		ACN	15.19	17.01%	625655000					
A	20150210	39.31	39.76	38.78	39.67	1408700		ACP	-3.76	-24.88%	14348400					

Table 2. Screenshot of 30 lines and summary tables from the 2015 Stock market analysis.

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
<ticker>	<date>	<open>	<high>	<low>	<close>	<vol>		Ticker	Annual Change	Percentage Change	Total Volume			Ticker	Value	
A	20160101	41.81	41.81	41.81	41.81	0		A	3.75	8.97%	528576200		Greatest % Increase	SD	11675.00%	
A	20160104	41.06	41.19	40.34	40.69	3287300		AA	-1.53	-5.17%	5208239000		Greatest % Decrease	DYN.W	-91.49%	
A	20160105	40.73	40.95	40.34	40.55	2587200		AAC	-11.82	-62.01%	57179800		Greatest Total Volume	BAC	27428529600	
A	20160106	40.24	40.99	40.05	40.73	2103600		AAN	9.6	42.88%	184809000					
A	20160107	40.14	40.15	38.81	39	3504300		AAP	18.61	12.36%	262665300					
A	20160108	39.22	39.71	38.47	38.59	3736700		AAT	4.73	12.33%	49026400					
A	20160111	38.71	38.9	37.41	37.94	2818600		AAV	1.67	32.87%	27358200					
A	20160112	38.43	38.58	37.65	38.19	1989300		AB	-0.4	-1.68%	64736300		Worksheet 2016 Opened at 16:21:07 Closed at 16:21:23			
A	20160113	38.35	38.47	36.72	36.86	4206600		ABB	3.34	18.84%	503779400					
A	20160114	36.94	37.88	36.55	37.61	2893300		ABBV	3.38	5.71%	2034231800					
A	20160115	36.67	37.56	36.55	37.11	2994300		ABC	-25.52	-24.61%	647239900					
A	20160118	37.11	37.11	37.11	37.11	0		ABEV	0.45	10.09%	4199335100					
A	20160119	37.64	37.92	36.79	37.2	2506500		ABG	-5.74	-8.51%	89828200					
A	20160120	36.68	37.61	36.13	37.26	2469000		ABM	12.37	43.45%	79787400					
A	20160121	37.35	37.83	36.81	37.23	2298300		ABR	0.31	4.34%	27556100					
A	20160122	37.91	38.18	37.58	37.98	1834400		ABR-A	0.57	2.33%	792500					
A	20160125	37.4	38.03	37.4	37.61	1831200		ABR-B	2.02	8.95%	795300					
A	20160126	37.89	37.96	37.36	37.51	1755000		ABR-C	0.18	0.72%	521300					
A	20160127	37.39	37.92	36.81	37.05	1479400		ABRN	0.7	2.85%	1759800					
A	20160128	37.27	37.27	36.01	36.11	3479400		ABT	-6.5	-14.47%	2298099600					
A	20160129	36.44	37.69	36.31	37.65	2959800		ABX	8.6	116.53%	4996990800					
A	20160201	37.37	37.95	37	37.69	2666500		AC	2.35	7.70%	6530000					
A	20160202	37.18	37.55	36.95	37.07	1742300		ACC	8.43	20.39%	258457600					
A	20160203	37.27	37.36	36.29	37.19	2128400		ACCO	5.92	83.03%	163653100					
A	20160204	37.15	37.79	36.97	37.42	2833400		ACH	1.97	23.91%	11563400					
A	20160205	37.26	37.31	35.83	36.04	4424600		ACM	6.33	21.08%	296759000					
A	20160208	35.61	35.78	34.39	34.8	3888600		ACN	12.63	12.09%	650155300					
A	20160209	34.21	35.77	34.15	35.37	3464400		ACP	2.08	18.33%	21179200					
A	20160210	35.63	36.73	35.53	35.85	3169900		ACRE	2.29	20.02%	35062000					

Table 3. Screenshot of 30 lines and summary tables from the 2016 Stock market analysis.

Data Analysis

In this second Data Analytics Homework Assignment, the student considered a three-year set of stock market values spread over three individual Excel worksheets. Using these data, a VBA programming analysis was completed that determined the best and worst performing stocks in the three years based on greatest share price increase or decrease, add greatest total volume of stocks purchased. The data show significant ranges of performance not easily seen from just the raw data, particularly in the per cent increase in share prices in just three years of trading. For example, the stock DM increased from $0.69 to $39.2 for a per increase of %5581.16. Per cent decreases have a lower bound of 100%, and several stocks unfortunately experience such near complete loss. Trading volumes for large corporations are extremely large, for example, 21595474700 shares of Bank of America (BAC) in 2014.

Summary

Visual Basic for Applications is an important software product for business and finance as well other technical sectors. In this example, a timer was set to measure elapsed time for the computations across the three spreadsheets. The analyses of all spreadsheets, nearly 2.25 million row entries, was completed in about 40 seconds, showing how VBA is a powerful tool for analysis of large data sets.