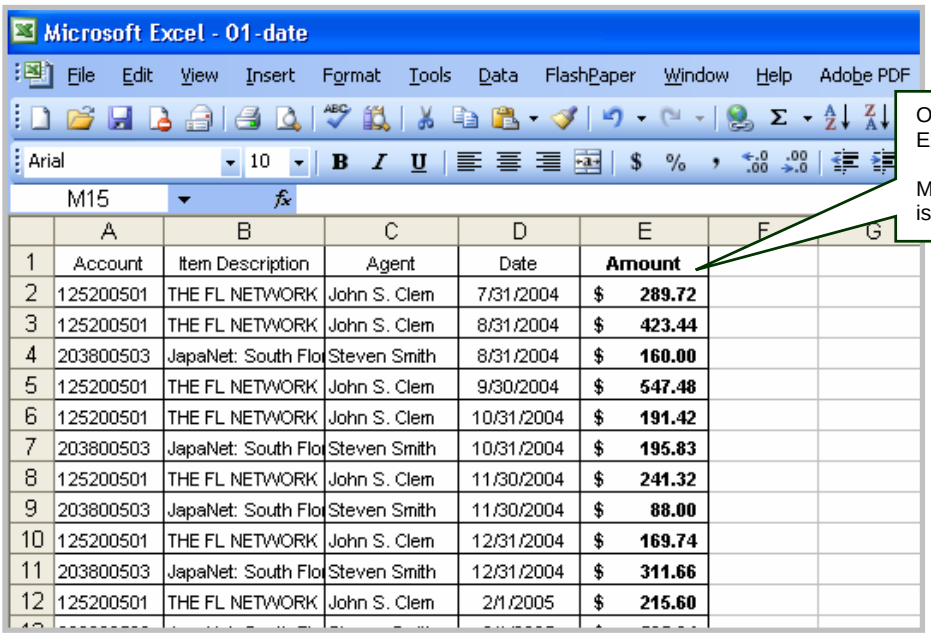
APPLYING BENFORD'S LAW

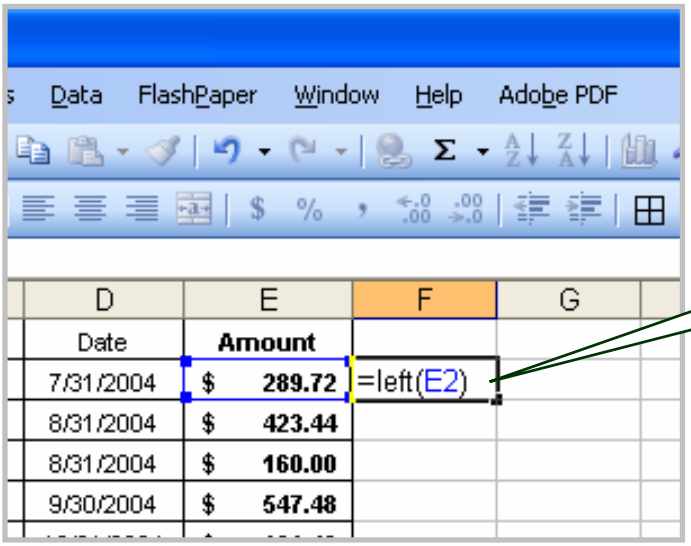
This PDF contains step-by-step instructions on how to apply Benford's law using Microsoft Excel, which is commonly used by internal auditors around the world in their day-to-day work. The technique is explained in the context of a realistic example and should enable auditors to easily and effectively apply Benford's law to their company's data when identifying unusual data patterns that may signal the presence of errors or fraud.



	A	B	C	D	E	F	G
1	Account	Item Description	Agent	Date	Amount		
2	125200501	THE FL NETWORK	John S. Clem	7/31/2004	$ 289.72		
3	125200501	THE FL NETWORK	John S. Clem	8/31/2004	$ 423.44		
4	203800503	JapaNet: South Flo	Steven Smith	8/31/2004	$ 160.00		
5	125200501	THE FL NETWORK	John S. Clem	9/30/2004	$ 547.48		
6	125200501	THE FL NETWORK	John S. Clem	10/31/2004	$ 191.42		
7	203800503	JapaNet: South Flo	Steven Smith	10/31/2004	$ 195.83		
8	125200501	THE FL NETWORK	John S. Clem	11/30/2004	$ 241.32		
9	203800503	JapaNet: South Flo	Steven Smith	11/30/2004	$ 88.00		
10	125200501	THE FL NETWORK	John S. Clem	12/31/2004	$ 169.74		
11	203800503	JapaNet: South Flo	Steven Smith	12/31/2004	$ 311.66		
12	125200501	THE FL NETWORK	John S. Clem	2/1/2005	$ 215.60		

Open financial transitions in an Excel spreadsheet.

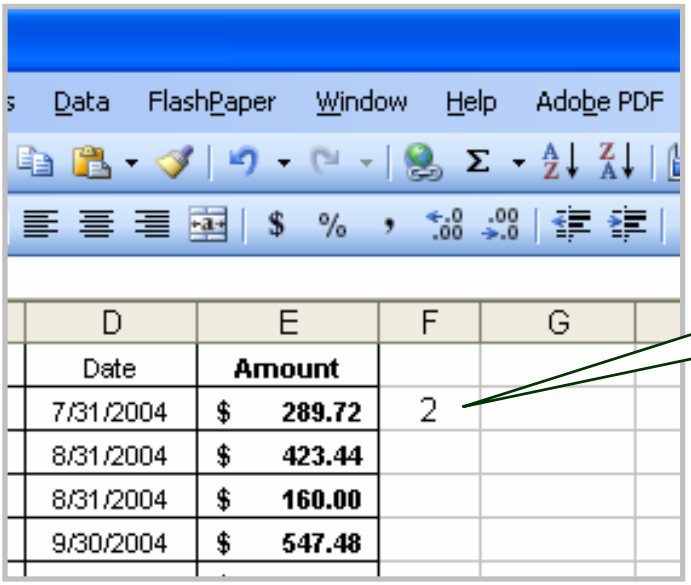
Make sure the **transaction amount** column is the right-most column of the table.



	D	E	F	G
	Date	Amount		
	7/31/2004	$ 289.72	=left(E2)	
	8/31/2004	$ 423.44		
	8/31/2004	$ 160.00		
	9/30/2004	$ 547.48		

On the cell next to the first transaction amount, perform the following actions:

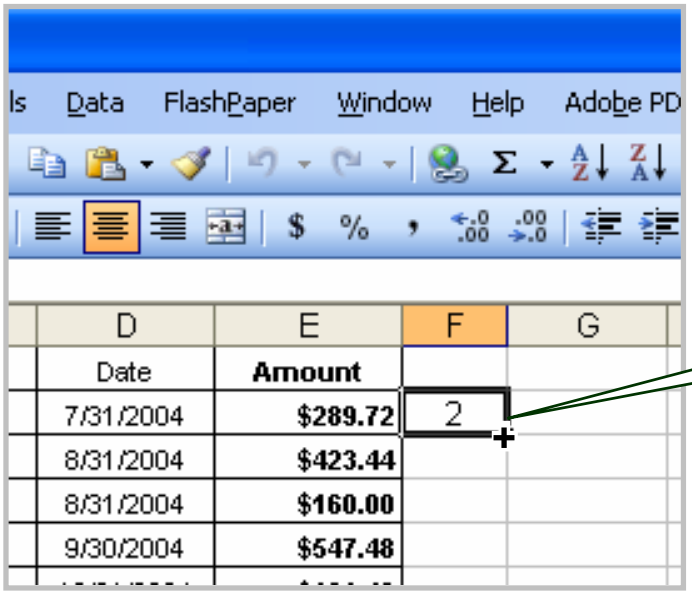
1. Type in: **=LEFT(**
2. Press the left arrow key once: ←
3. Type in: **)**
4. Press the **Enter** key once



	D	E	F	G
	Date	Amount		
	7/31/2004	$ 289.72	2	
	8/31/2004	$ 423.44		
	8/31/2004	$ 160.00		
	9/30/2004	$ 547.48		

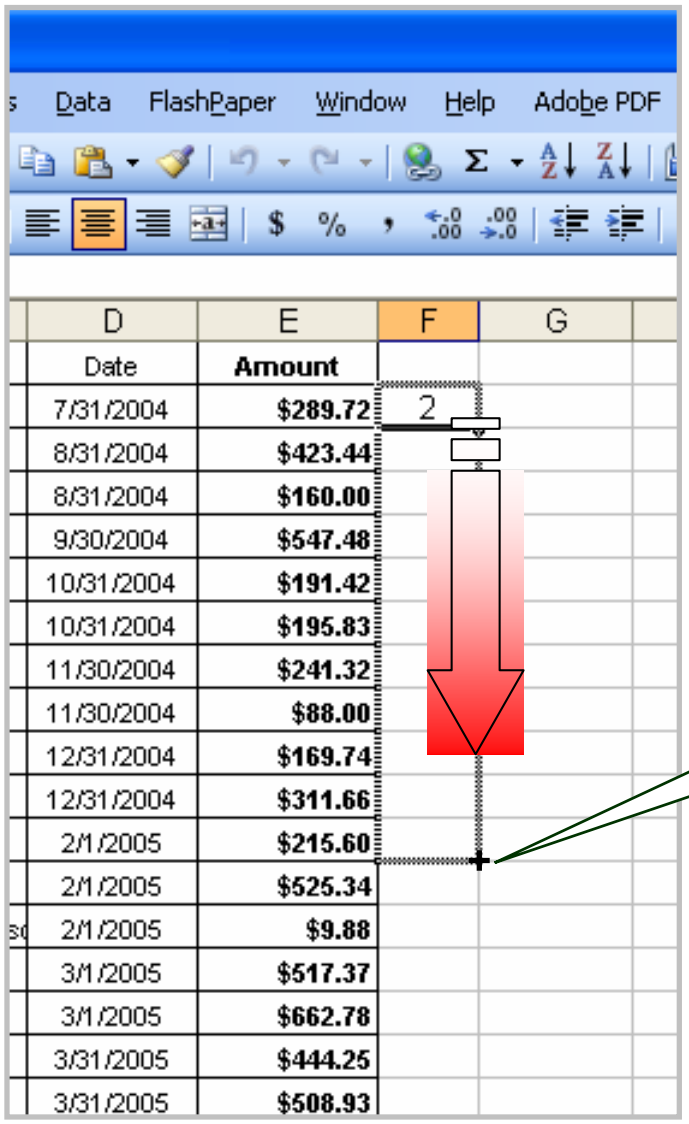
Upon completion, the **first digit** of the transaction amount should appear in the cell.

Next, apply the same formula to the rest of the spreadsheet.



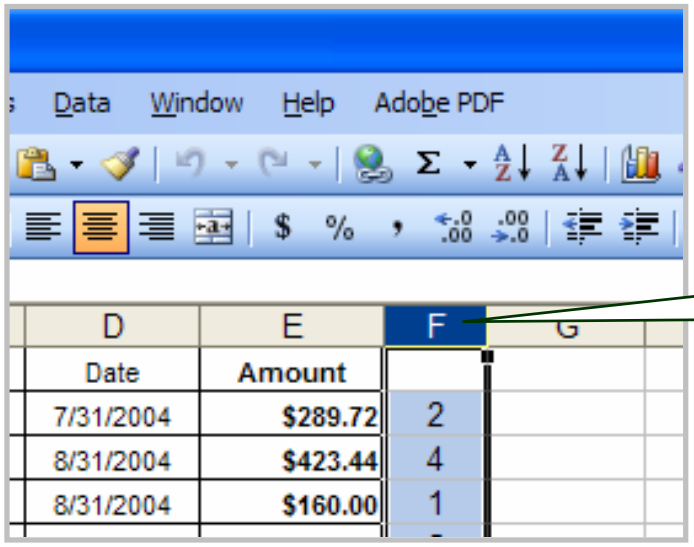
Select the cell that contains the first digit and move the cursor to the bottom-right corner of the cell.

The mouse pointer should turn into a **solid black cross.**



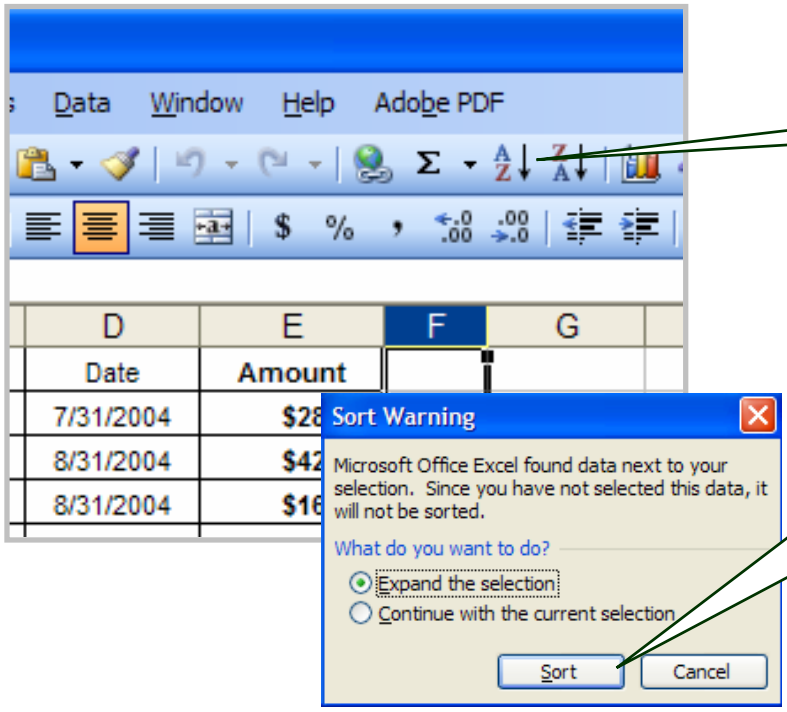
Click and hold the left mouse button and **drag it downward** until you reach the end of the transactions.

Keep holding the left button while dragging it until you reach the last record and then release it.



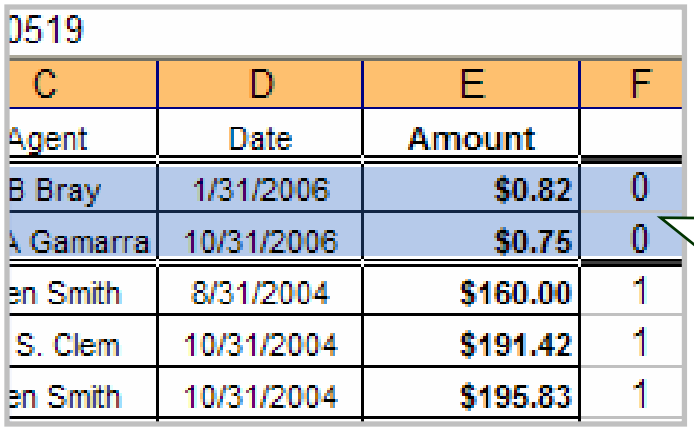
If done correctly, the first digit of each transaction amount should appear next to its original number.

Click on the letter on top of the column to select the first digit column.



Click on the **A-Z** button on the top menu.

When the **Sort Warning** window appears, make sure the **Expand the selection** option is checked and click **Sort.**



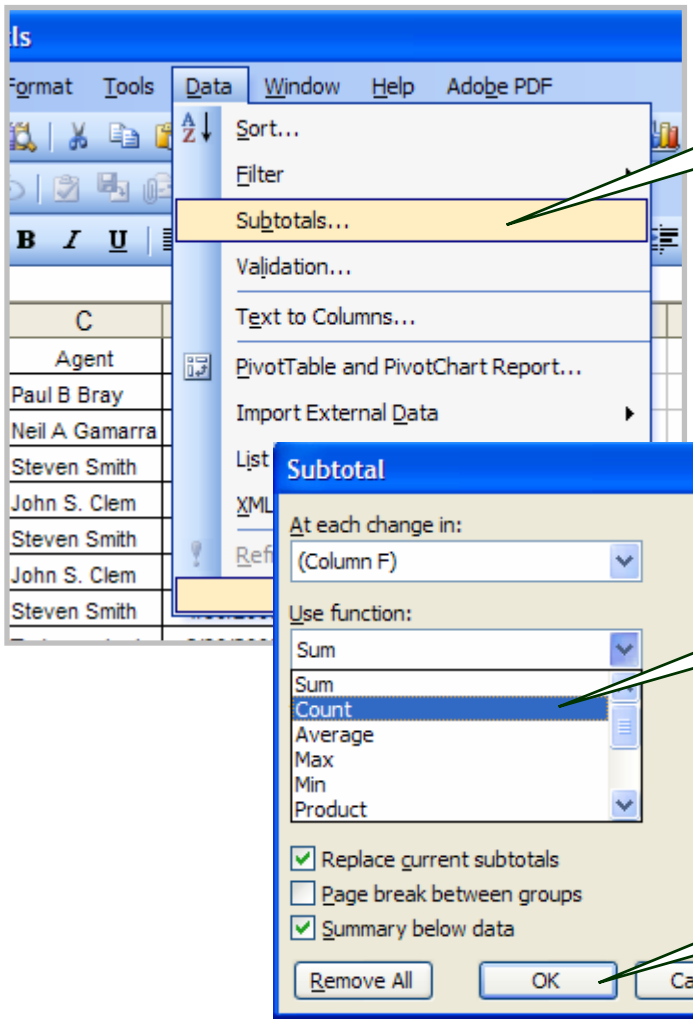
All the transactions now will be arranged by the first digit. Some amounts may start with zero because their values are smaller than 1.

However, according to Benford's law zero cannot be a leading digit. Therefore, we will need to modify the amount so the next available non-zero digit will become the leading digit.

For example, if the number is 0.82, the next available non-zero digit is 8. You may simply modify the number by removing the fraction and changing the number to 82.

Benford's law tests only the frequencies of the digits. Therefore, the size of the number is irrelevant to the test — that is, 0.82, 82, or 8200 is essentially the same number in terms of its non-zero digits. However, it is recommended to write down the original number so that you can keep track of the real transaction amount.

After the modification, you may again use the sort function as instructed in the previous step. This time all the numbers will be arranged by their true leading digit.



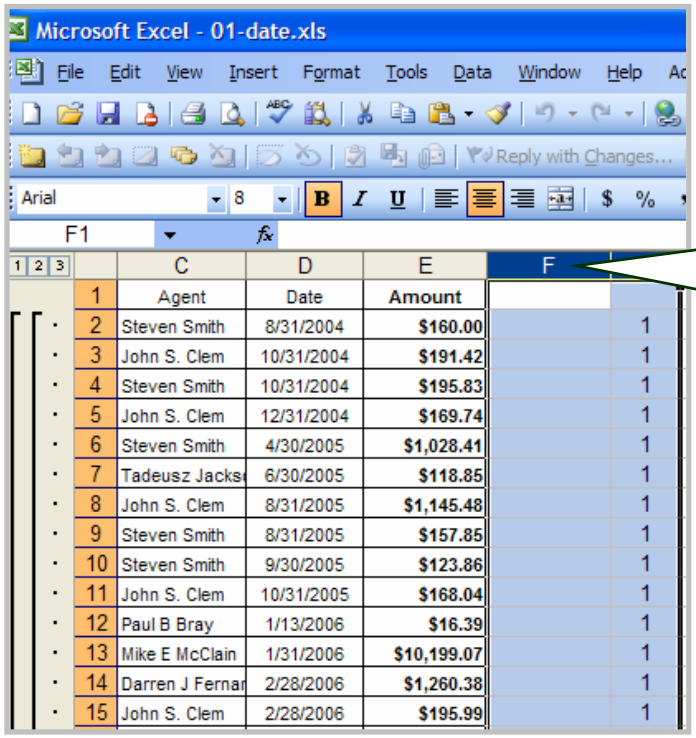
Make sure the column containing all the first digits is selected.

Click on **Data** on the top menu and then choose **Subtotals.**

In the next **Subtotal** window, you will see a box labeled **Use Function.**

Click on the drop down menu and change the option to **Count.**

Keep all other options unchanged and click **OK.**

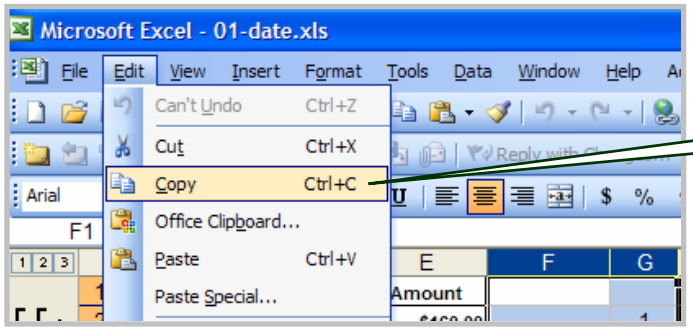


A new column will be inserted between the transaction amount and the first digit column.

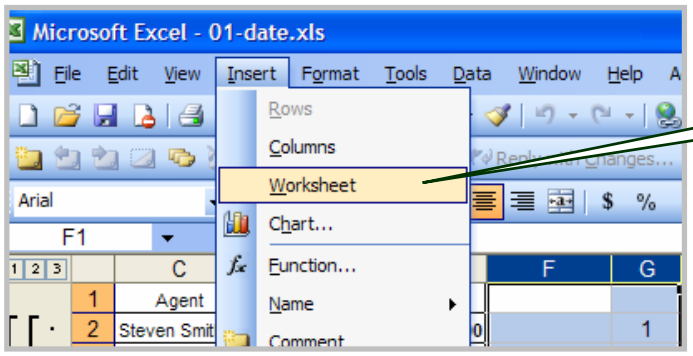
Now you need to copy the counting result to a new spreadsheet and create a summary table.

Click and hold the left mouse button on the letter on top of the new column that was just created. While holding the left button, **drag** it slightly right to the column that contains all the first digits and release it.

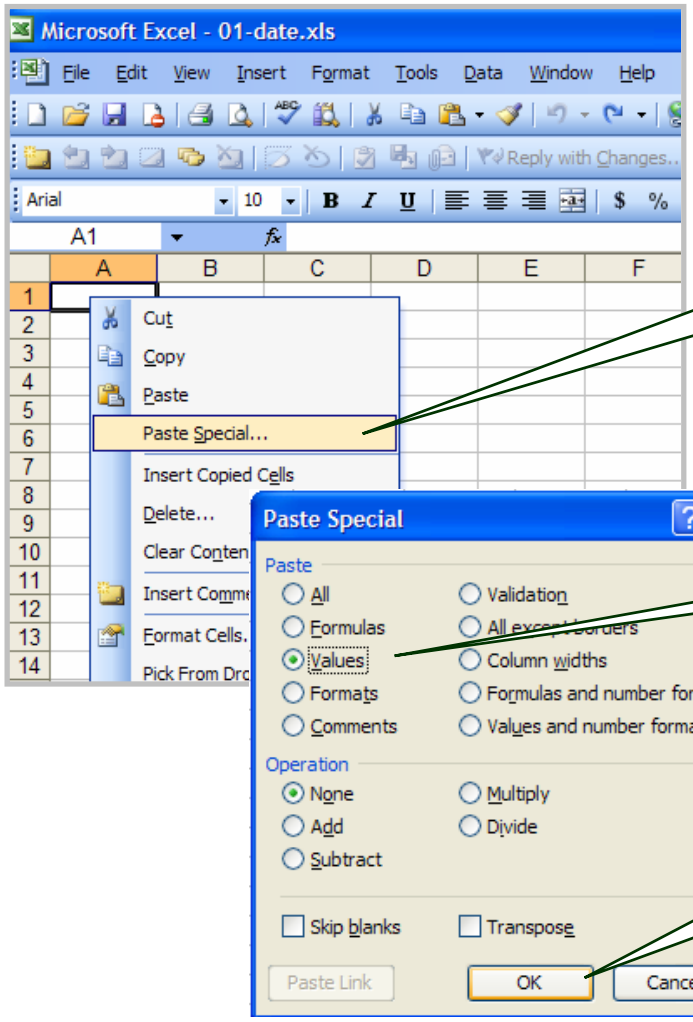
Two columns should now be highlighted.



Click on **Edit** on the top menu and choose **Copy.**



Click on **Insert** on the top menu and select **Worksheet.**

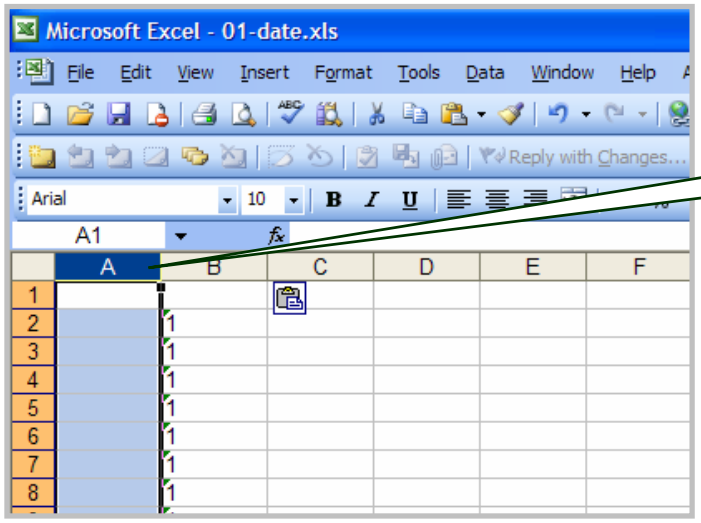


A new blank worksheet will be created.

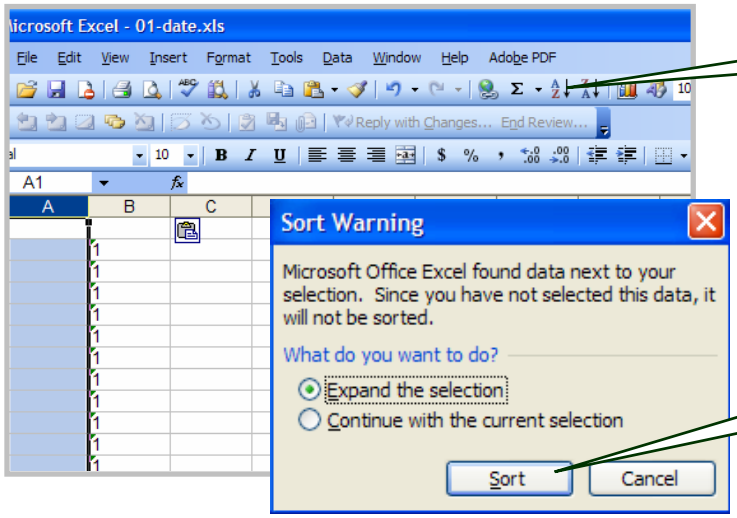
Right click on the first cell (A1) on the upper-left corner, and choose **Paste Special.**

When the **Paste Special** window opens, check the **Values** option.

Keep all other options unchanged and click **OK.**



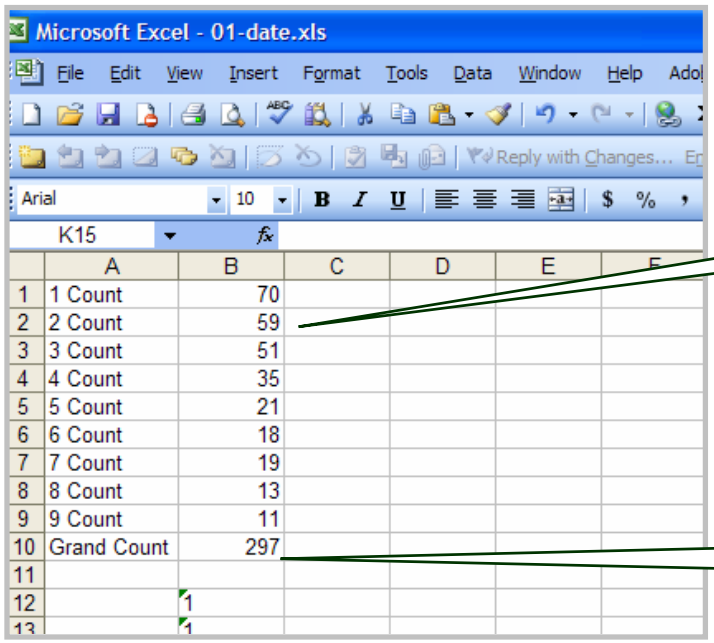
Click on the letter on top of the first column. The first column — which might appear to be empty — will be selected.



Click on the A-Z button on the top menu.

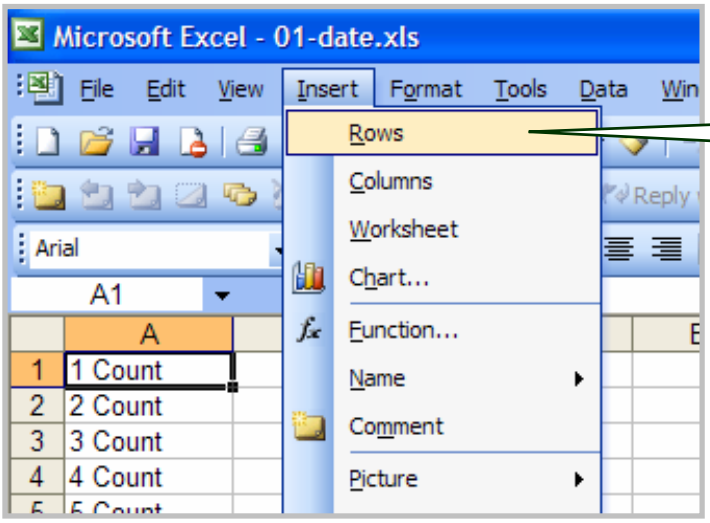
When the **Sort Warning** window appears, make sure the **Expand the selection** option is checked.

Click **Sort.**



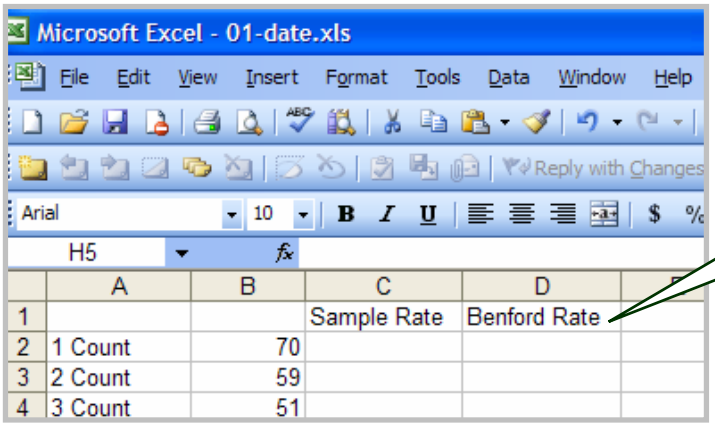
You have successfully created a table that counts transaction amounts that start with digits 1 through 9.

You may choose to delete all the rows below the **Grand Count** line; they are no longer needed in this summary sheet.

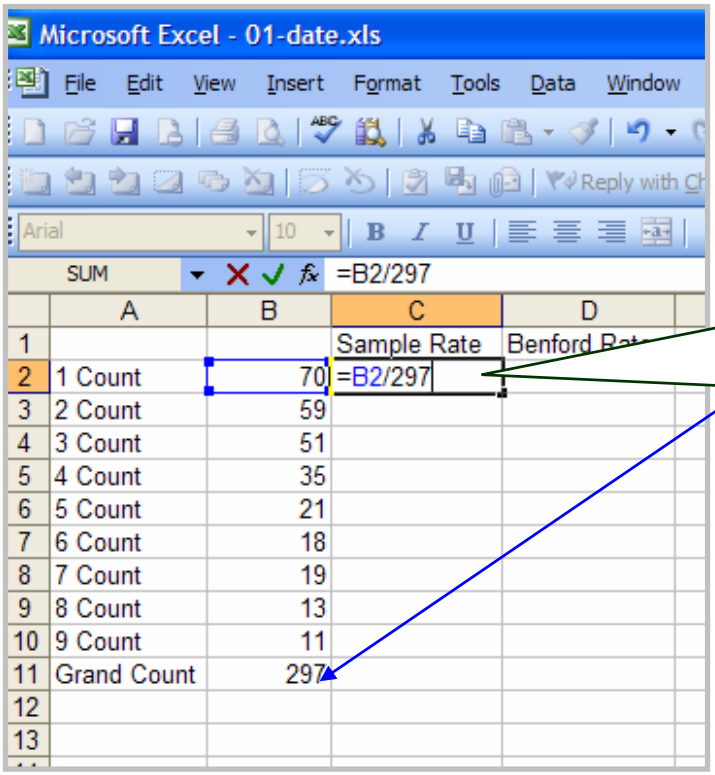


Select the first cell (A1) on the upper-left corner.

Click on **Insert** on the top menu and choose **Rows.**



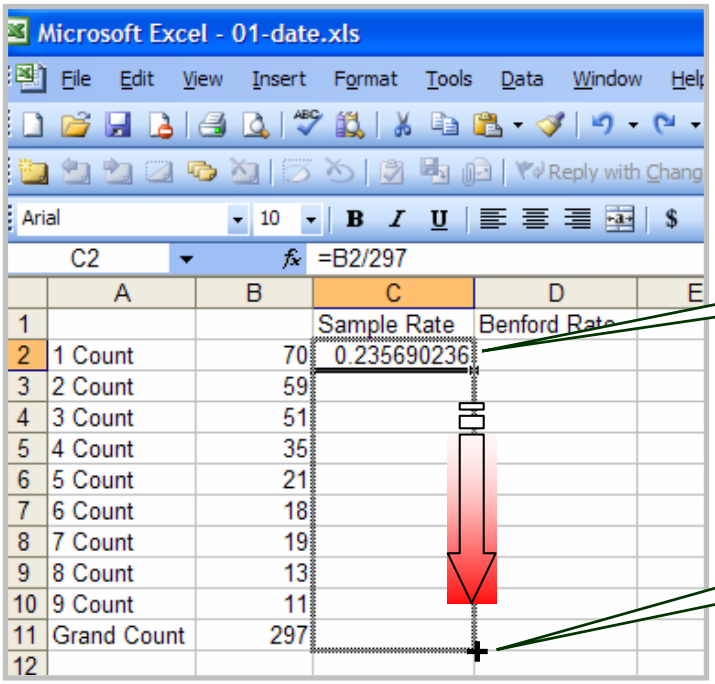
On the new row just created, type in **Sample Rate** in the CI space and **Benford Rate** in the D1 space.



On the first cell under **Sample Rate**, do the following using your **keyboard**:

1. Type in: **=**
2. Press Left arrow key once: ←
3. Type in: **/**
4. **Type** in the number next to the **Grand Count**. In this example, the number is **297** (you will have a different number).

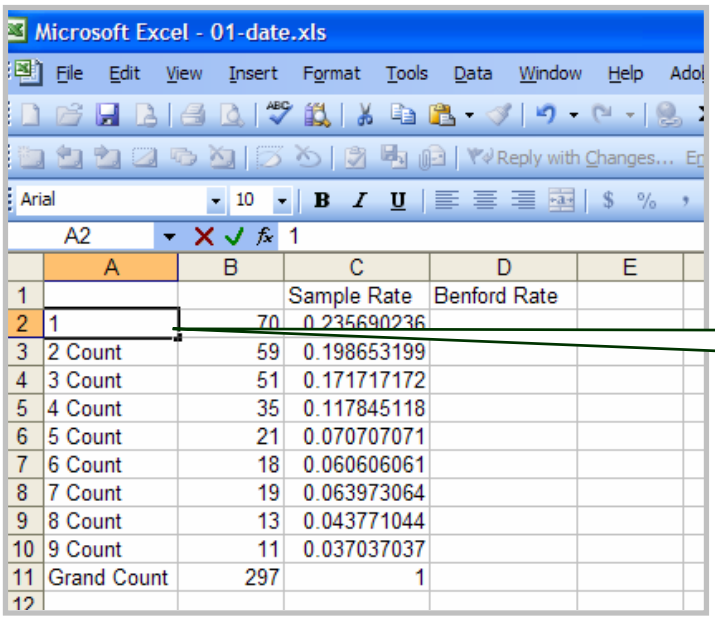
5. Press the **Enter** key once.



Move the cursor to the bottom-right corner of the cell.

The mouse pointer will turn into a **solid black cross.**

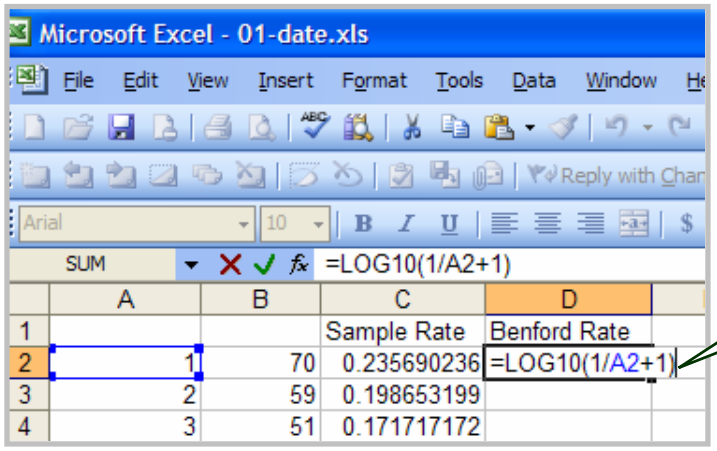
Click and hold the left mouse button and **drag it downward** until you reach the end of the **Grand Count** line; release the mouse button.



We will need to remove the word **Count** from the row label. To do so, simply click on the label **1 Count**, then type **1** on the keyboard and hit **Enter**.

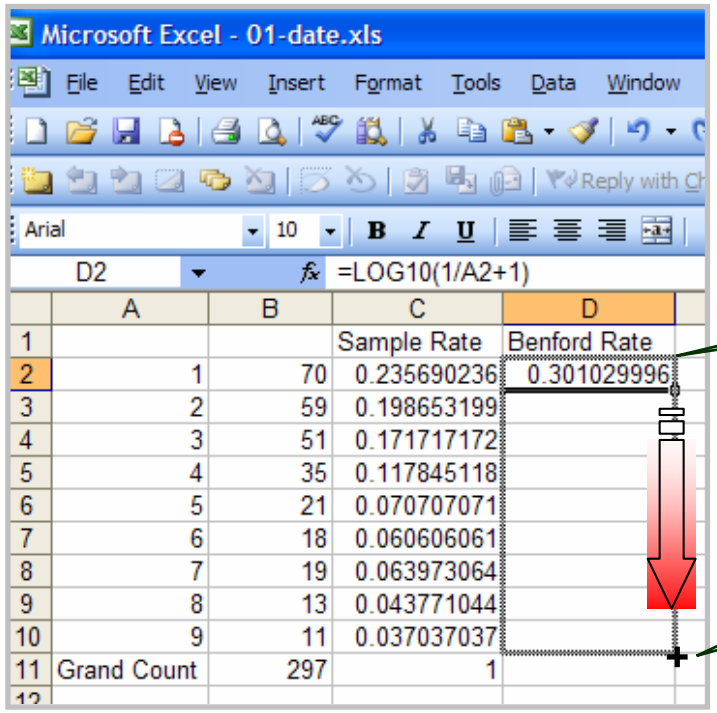
	A	B	C	D	E
1			Sample Rate	Benford Rate	
2	1	70	0.235690236		
3	2	59	0.198653199		
4	3	51	0.171717172		
5	4	35	0.117845118		
6	5	21	0.070707071		
7	6	18	0.060606061		
8	7	19	0.063973064		
9	8	13	0.043771044		
10	9	11	0.037037037		
11	Grand Count	297	1		

Repeat the last step by replacing **2 Count** with **2**, **3 Count** with **3**, and so on until all 9 counts are replaced by numbers.



In the first cell under **Benford Rate** type in **=LOG10(1/A2+1)**

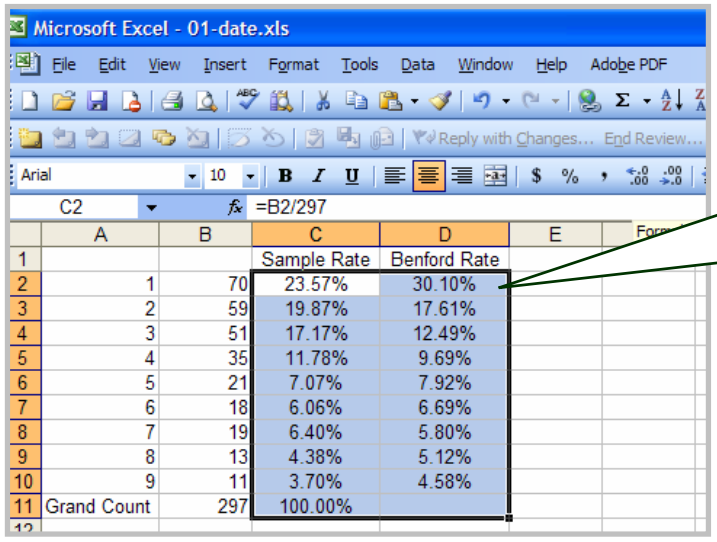
Note: If you use a different cell to store digit 1, please replace **A2** with the correct cell number. If you follow this guide entirely, you should have the same **A2** cell number.



Move the mouse cursor to the bottom-right corner of the cell.

You should see the mouse pointer turn into a **solid black cross.**

Click and hold the left mouse button, **drag it downward** until you reach the end of the **Digit 9** line, and release the mouse button.

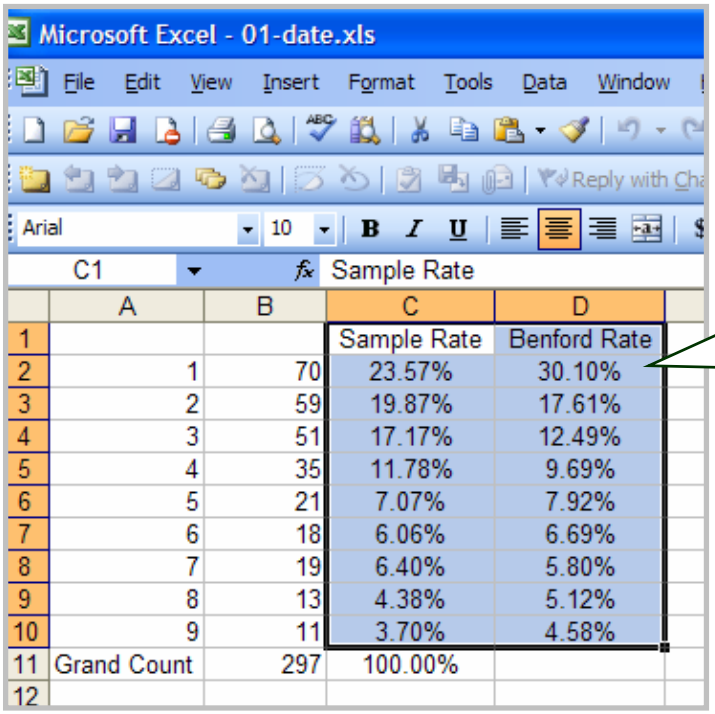


To increase readability, you can convert the rates to percentages.

To do this, highlight all the cells under **Sample Rate** and **Benford Rate**, then on the top menu:

Click the % button **once**.

Click the ←.0 .00 button **twice**.

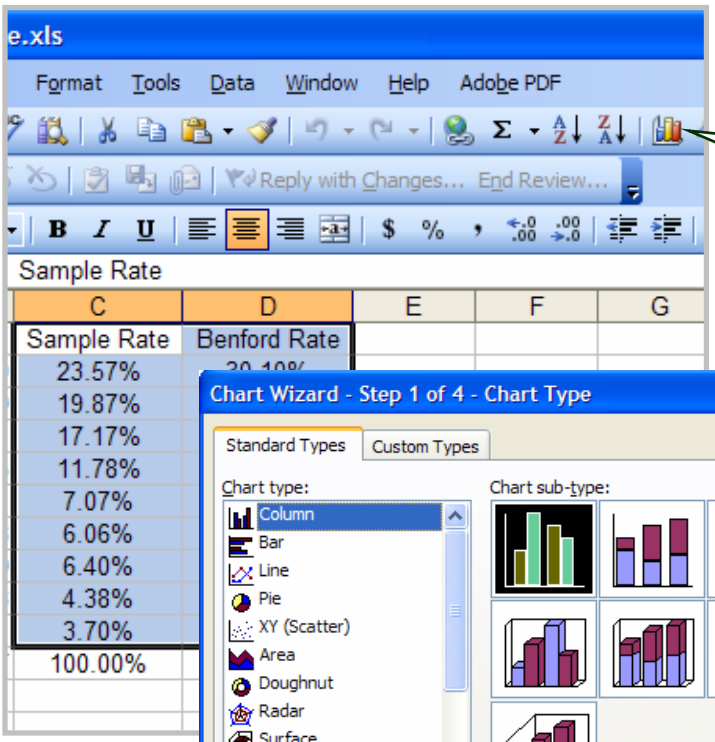


	A	B	C	D
1			Sample Rate	Benford Rate
2	1	70	23.57%	30.10%
3	2	59	19.87%	17.61%
4	3	51	17.17%	12.49%
5	4	35	11.78%	9.69%
6	5	21	7.07%	7.92%
7	6	18	6.06%	6.69%
8	7	19	6.40%	5.80%
9	8	13	4.38%	5.12%
10	9	11	3.70%	4.58%
11	Grand Count	297	100.00%	
12				

Now we will create a chart to visualize the difference.

First, highlight the data under **Sample Rate** and **Benford Rate**. Please make sure:

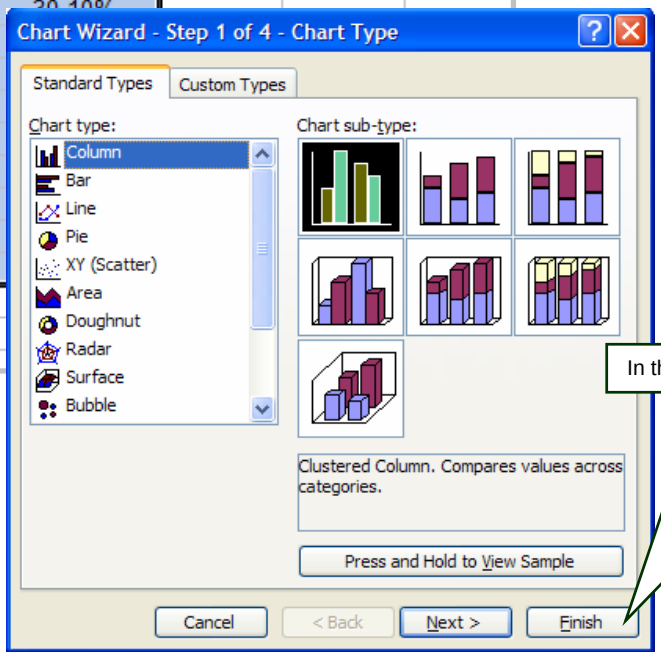
1. The labels are included.
2. Rates for 1 through 9 are included.
3. Rate for **Grand Count** (100%) is **NOT** included.



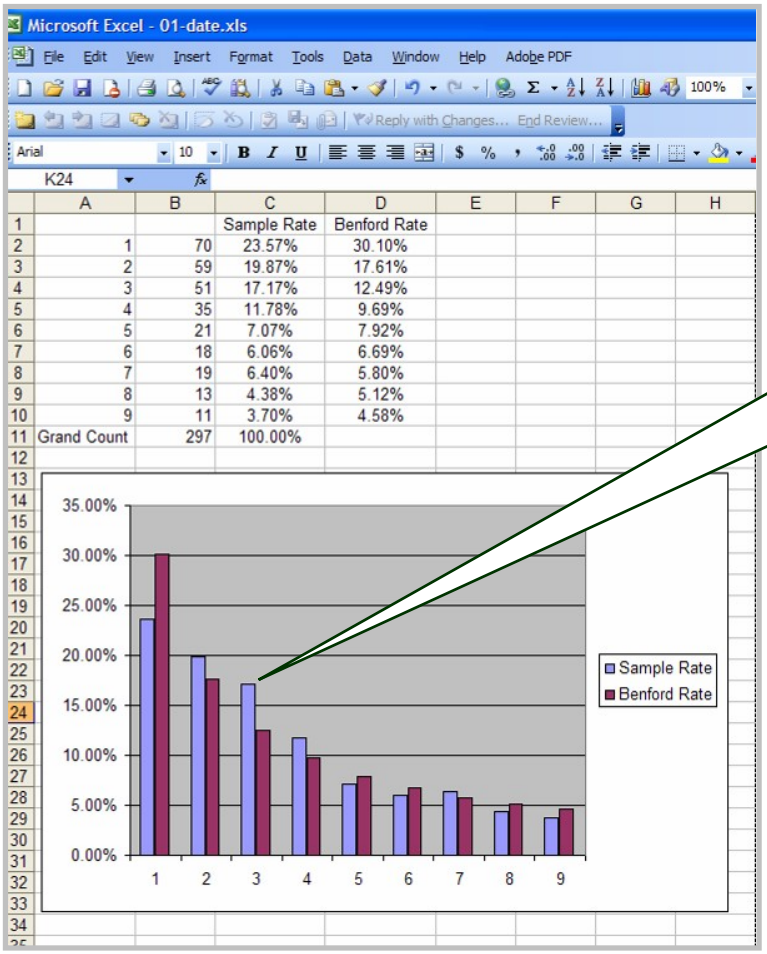
C	D	E	F	G
Sample Rate	Benford Rate			
23.57%				
19.87%				
17.17%				
11.78%				
7.07%				
6.06%				
6.40%				
4.38%				
3.70%				
100.00%				

On the top menu click on the  button.

If you cannot find this button, click **Insert** and choose **Chart**.



In the **Chart Wizard** window, click the **Finish** button.



The blue bars represent the sample rates from the financial transactions you have opened.

When a blue bar is significantly higher than the red bar next to it, this indicates that an unusual higher amount of transaction numbers is beginning that particular number.