Internet Users Worldwide

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1 Project: Internet Users Worldwide

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1.2 Introduction

The main idea behind studying the usage of internet around the world is simply to better understand distribution of access and possibly make some projections. Basically we have only three dimensions on this dataset: the Country name, the Year, and the total number of persons with internet access. Based on this data it is possible to calculate an extra field of growth rate, which can be expressed as a percentage. Having such variations on our hands, we can answer some questions like what was the biggest internet growth from one year to another in one country in total number of users, or even if there has ever been a decrease in the number of users in any country (maybe due to some war, the arab spring, crysis in Syria?) at any given point.

Data was taken from https://www.gapminder.org/data/

```
In [77]: # Use this cell to set up import statements for all of the packages that you
         #   plan to use.

         # Remember to include a 'magic word' so that your visualizations are plotted
         #   inline with the notebook. See this page for more:
         #   http://ipython.readthedocs.io/en/stable/interactive/magics.html

         import pandas as pd
         import numpy as np
         import matplotlib.pyplot as plt
         import seaborn as sns
         % matplotlib inline
```

## Data Wrangling
We will be using Pandas Dataframes for this analysis.

1.2.1 General Properties

```
In [78]: # Load your data and print out a few lines. Perform operations to inspect data
         #   types and look for instances of missing or possibly errant data.
         internet_users = pd.read_excel('Internet user total.xlsx')
         internet_users.head()
```

```
Out[78]:   Internet users, total number  1990  1991  1992  1993        1994  \
         0                  Afghanistan   0.0   NaN   NaN   NaN         NaN
         1                      Albania   0.0   NaN   NaN   NaN         NaN
         2                      Algeria   0.0   NaN   NaN   NaN  100.090832
         3               American Samoa   0.0   NaN   NaN   NaN         NaN
         4                      Andorra   0.0   NaN   NaN   NaN         NaN

                  1995         1996         1997         1998  ...           2002  \
         0         NaN          NaN          NaN          NaN  ...    1123.920517
         1  350.820117  1002.157509  1502.476346  2002.216783  ...   12052.645369
         2  500.465235   500.469039  3002.798156  6005.526744  ...  500441.425787
         3         NaN          NaN          NaN          NaN  ...            NaN
         4         NaN   995.756049  1979.716334  4424.113974  ...    7774.565416

                     2003          2004          2005          2006          2007  \
         0   22569.277533  2.824412e+04  3.380450e+05  5.988651e+05  5.537710e+05
         1   30194.039918  7.563375e+04  1.898870e+05  3.033497e+05  4.765945e+05
         2  700615.293472  1.501387e+06  1.921982e+06  2.462986e+06  3.204578e+06
         3            NaN           NaN           NaN           NaN           NaN
         4    9780.916489  2.020683e+04  2.929038e+04  3.908782e+04  5.768109e+04

                    2008          2009        2010  2011
         0  5.490559e+05  1.085510e+06  1256469.72   NaN
         1  7.590813e+05  1.315402e+06  1441927.80   NaN
         2  3.504773e+06  3.924904e+06  4433526.00   NaN
         3           NaN           NaN         NaN   NaN
         4  5.783693e+04  6.571155e+04    68739.84   NaN

         [5 rows x 23 columns]
```

We notice that some lines have only NaN values, which makes no sense. Those should be removed. Also, we notice that some nations do not have values for old dates, which makes sense since the internet started rising globally according to Wikipedia (not as a research tool between Universities) just since early 90s. For this reason, I will choose the year 2001 as a reference, and if the country has a NaN value the entire line will be removed. Afterward, all NaN values will be replaced by zeroes. We will also rename the index column to "Country".

```
In [79]: internet_users = internet_users[np.isfinite(internet_users['2001'])]
         internet_users.fillna(0,inplace=True)
         internet_users = internet_users.rename(columns={'Internet users, total number':'Count
         internet_users.head()
```

```
Out[79]:                 Country  1990  1991  1992  1993        1994        1995  \
         0           Afghanistan   0.0   0.0   0.0   0.0    0.000000    0.000000
         1               Albania   0.0   0.0   0.0   0.0    0.000000  350.820117
         2               Algeria   0.0   0.0   0.0   0.0  100.090832  500.465235
         5                Angola   0.0   0.0   0.0   0.0    0.000000    0.000000
         6   Antigua and Barbuda   0.0   0.0   0.0   0.0    0.000000 1510.651721

                   1996         1997         1998  ...           2002           2003  \
         0     0.000000     0.000000     0.000000  ...    1123.920517   22569.277533
         1  1002.157509  1502.476346  2002.216783  ...   12052.645369   30194.039918
         2   500.469039  3002.798156  6005.526744  ...  500441.425787  700615.293472
         5    96.624245   725.799034  2424.499171  ...   40260.379005   57158.963169
         6  2013.777727  2517.193852  3020.806471  ...   10063.375000   14078.562638

                    2004          2005          2006          2007          2008  \
         0  2.824412e+04  3.380450e+05  5.988651e+05  5.537710e+05  5.490559e+05
         1  7.563375e+04  1.898870e+05  3.033497e+05  4.765945e+05  7.590813e+05
         2  1.501387e+06  1.921982e+06  2.462986e+06  3.204578e+06  3.504773e+06
         5  7.417261e+04  1.885300e+05  3.244978e+05  5.608117e+05  8.297463e+05
         6  2.010192e+04  2.913262e+04  5.321297e+04  6.020606e+04  6.518681e+04

                    2009        2010  2011
         0  1.085510e+06  1256469.72   0.0
         1  1.315402e+06  1441927.80   0.0
         2  3.924904e+06  4433526.00   0.0
         5  1.113307e+06  1908191.20   0.0
         6  6.514908e+04    70968.00   0.0

         [5 rows x 23 columns]
```

Now, we can have a more general view of the whole dataset with the describe function:

```
In [80]: internet_users.describe()
```

```
Out[80]:                1990          1991          1992          1993          1994  \
         count  1.960000e+02  1.960000e+02  1.960000e+02  1.960000e+02  1.960000e+02
         mean   1.340288e+04  2.185336e+04  3.495840e+04  5.044544e+04  1.030947e+05
         std    1.424906e+05  2.137989e+05  3.205830e+05  4.275411e+05  9.213485e+05
         min    0.000000e+00  0.000000e+00  0.000000e+00  0.000000e+00  0.000000e+00
         25%    0.000000e+00  0.000000e+00  0.000000e+00  0.000000e+00  0.000000e+00
         50%    0.000000e+00  0.000000e+00  0.000000e+00  0.000000e+00  0.000000e+00
         75%    0.000000e+00  0.000000e+00  0.000000e+00  9.366564e+02  4.467333e+03
         max    1.988024e+06  2.975535e+06  4.453200e+06  5.924598e+06  1.281192e+07

                        1995          1996          1997          1998          1999  \
         count  1.960000e+02  1.960000e+02  1.960000e+02  1.960000e+02  1.960000e+02
         mean   1.984319e+05  3.694079e+05  5.921310e+05  9.231412e+05  1.388812e+06
         std    1.768884e+06  3.191477e+06  4.324240e+06  6.129312e+06  7.656223e+06
```

```
min    0.000000e+00  0.000000e+00  0.000000e+00  0.000000e+00  0.000000e+00
25%    0.000000e+00  1.532582e+02  7.825498e+02  1.988207e+03  4.968147e+03
50%    3.504101e+02  2.000100e+03  4.992679e+03  1.014368e+04  2.813967e+04
75%    1.952791e+04  4.411411e+04  8.699426e+04  1.501114e+05  2.450025e+05
max    2.460056e+07  4.423269e+07  5.893568e+07  8.305303e+07  1.001255e+08

       ...          2002          2003          2004          2005  \
count  ...  1.960000e+02  1.960000e+02  1.960000e+02  1.960000e+02
mean   ...  3.306814e+06  3.872760e+06  4.503447e+06  5.135800e+06
std    ...  1.421755e+07  1.562491e+07  1.728795e+07  1.872051e+07
min    ...  0.000000e+00  0.000000e+00  0.000000e+00  0.000000e+00
25%    ...  2.441795e+04  3.006752e+04  3.670026e+04  4.923302e+04
50%    ...  1.235731e+05  1.529147e+05  2.126868e+05  3.392482e+05
75%    ...  1.040248e+06  1.406971e+06  1.866206e+06  2.622681e+06
max    ...  1.695767e+08  1.797180e+08  1.904301e+08  2.017430e+08

               2006          2007          2008          2009          2010  \
count  1.960000e+02  1.960000e+02  1.960000e+02  1.960000e+02  1.960000e+02
mean   5.786826e+06  6.900786e+06  7.974482e+06  9.010653e+06  1.029808e+07
std    2.016719e+07  2.453651e+07  2.902002e+07  3.386430e+07  3.906940e+07
min    0.000000e+00  0.000000e+00  0.000000e+00  0.000000e+00  0.000000e+00
25%    6.745723e+04  8.333297e+04  1.026825e+05  1.123229e+05  1.481696e+05
50%    4.836016e+05  5.793525e+05  7.880628e+05  9.252343e+05  1.293429e+06
75%    3.076977e+06  3.391346e+06  4.237466e+06  4.594224e+06  5.170963e+06
max    2.064934e+08  2.267134e+08  3.001903e+08  3.857886e+08  4.600780e+08

        2011
count  196.0
mean     0.0
std      0.0
min      0.0
25%      0.0
50%      0.0
75%      0.0
max      0.0

[8 rows x 22 columns]
```

1.2.2 Data Cleaning (Replace this with more specific notes!)

There is something odd about the year 2011: all values are zeroes. It seems this whole column should be removed.

```
In [81]: internet_users = internet_users.drop(columns=['2011'])
         internet_users.head()
```

```
Out[81]:                Country  1990  1991  1992  1993      1994      1995  \
         0          Afghanistan   0.0   0.0   0.0   0.0  0.000000  0.000000
```

```
1               Albania   0.0   0.0   0.0   0.0    0.000000    350.820117
2               Algeria   0.0   0.0   0.0   0.0  100.090832    500.465235
5                Angola   0.0   0.0   0.0   0.0    0.000000      0.000000
6   Antigua and Barbuda   0.0   0.0   0.0   0.0    0.000000   1510.651721

          1996         1997         1998     ...              2001  \
0     0.000000     0.000000     0.000000     ...       1118.180665
1  1002.157509  1502.476346  2002.216783     ...      10026.047580
2   500.469039  3002.798156  6005.526744     ...     200180.427339
5    96.624245   725.799034  2424.499171     ...      19570.007120
6  2013.777727  2517.193852  3020.806471     ...       7045.119378

            2002          2003          2004          2005          2006  \
0    1123.920517  22569.277533  2.824412e+04  3.380450e+05  5.988651e+05
1   12052.645369  30194.039918  7.563375e+04  1.898870e+05  3.033497e+05
2  500441.425787 700615.293472  1.501387e+06  1.921982e+06  2.462986e+06
5   40260.379005  57158.963169  7.417261e+04  1.885300e+05  3.244978e+05
6   10063.375000  14078.562638  2.010192e+04  2.913262e+04  5.321297e+04

           2007          2008          2009        2010
0  5.537710e+05  5.490559e+05  1.085510e+06  1256469.72
1  4.765945e+05  7.590813e+05  1.315402e+06  1441927.80
2  3.204578e+06  3.504773e+06  3.924904e+06  4433526.00
5  5.608117e+05  8.297463e+05  1.113307e+06  1908191.20
6  6.020606e+04  6.518681e+04  6.514908e+04    70968.00

[5 rows x 22 columns]
```

It seems odd that the description of the dataset from the source says "Internet users, total number", but numbers do not have integer values. How is it possible to have a fraction of a human being? After looking at the original source (apparently, gapminder is a hub of data), it seems the total number of internet users per country is in fact the product of the percentage of internet users by the population of the country. So, in order to make more sense, it seems another function will have to be applied to round the number up.

```
In [82]: columns = []
         for year in range(1990,2011):
             columns.append(str(year))
         internet = internet_users[columns].applymap(np.int64)
         internet.insert(loc=0,column='Country',value=internet_users['Country'])
         internet.set_index('Country', inplace=True)
         internet_users = internet
         internet_users.head()
```

```
Out[82]:                      1990  1991  1992  1993  1994  1995  1996  1997  1998  \
         Country
         Afghanistan             0     0     0     0     0     0     0     0     0
         Albania                 0     0     0     0     0   350  1002  1502  2002
```

```
Algeria                 0     0     0     0   100   500   500  3002  6005
Angola                  0     0     0     0     0     0    96   725  2424
Antigua and Barbuda     0     0     0     0     0  1510  2013  2517  3020

                      1999  ...        2001    2002    2003     2004     2005  \
Country                     ...
Afghanistan              0  ...        1118    1123   22569    28244   338045
Albania               2502  ...       10026   12052   30194    75633   189886
Algeria              60054  ...      200180  500441  700615  1501386  1921981
Angola                9723  ...       19570   40260   57158    74172   188529
Antigua and Barbuda   4027  ...        7045   10063   14078    20101    29132

                        2006     2007     2008     2009     2010
Country
Afghanistan           598865   553770   549055  1085510  1256469
Albania               303349   476594   759081  1315401  1441927
Algeria              2462985  3204577  3504773  3924903  4433526
Angola                324497   560811   829746  1113306  1908191
Antigua and Barbuda    53212    60206    65186    65149    70968

[5 rows x 21 columns]
```

So now it seems we have nice data and we are ready to start our investigation!

## Exploratory Data Analysis

So, first thing we could do to analyze our data is to get a nice overview of maximum and minimuns. Let's start by getting a list of which country had the max and min values in each year.

```
In [83]: internet_users.apply(lambda x: x.idxmax(), axis=0)
```

```
Out[83]: 1990    United States
         1991    United States
         1992    United States
         1993    United States
         1994    United States
         1995    United States
         1996    United States
         1997    United States
         1998    United States
         1999    United States
         2000    United States
         2001    United States
         2002    United States
         2003    United States
         2004    United States
         2005    United States
         2006    United States
         2007    United States
         2008            China
```

```
2009            China
2010            China
dtype: object
```

So far we have our first interesting observation about the data: American leadership was taken out by China in 2008 in terms of absolute numbers, which is understandable considering the size of chinese poupulation.

```
In [84]: internet_users.apply(lambda x: x.idxmin(), axis=0)
```

```
Out[84]: 1990         Afghanistan
         1991         Afghanistan
         1992         Afghanistan
         1993         Afghanistan
         1994         Afghanistan
         1995         Afghanistan
         1996         Afghanistan
         1997         Afghanistan
         1998         Afghanistan
         1999         Afghanistan
         2000         Afghanistan
         2001    Korea, Dem. Rep.
         2002           Australia
         2003           Australia
         2004           Australia
         2005             Belarus
         2006              Guyana
         2007              Guyana
         2008    Korea, Dem. Rep.
         2009             Eritrea
         2010                Guam
         dtype: object
```

```
In [85]: internet_users.min(axis=0)
```

```
Out[85]: 1990    0
         1991    0
         1992    0
         1993    0
         1994    0
         1995    0
         1996    0
         1997    0
         1998    0
         1999    0
         2000    0
         2001    0
         2002    0
         2003    0
```

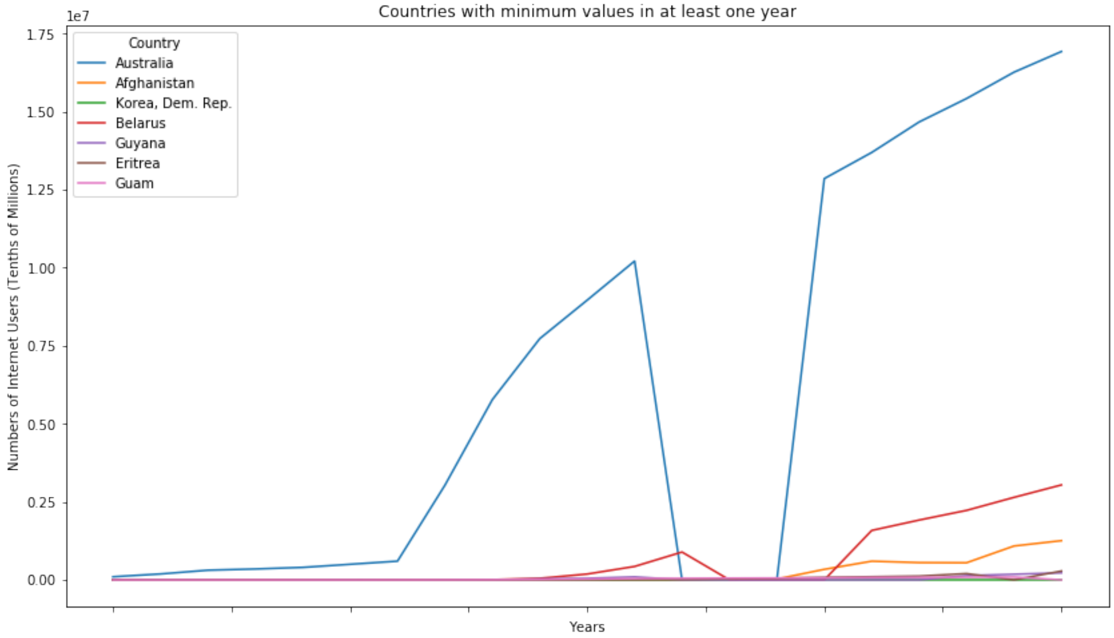
```
2004    0
2005    0
2006    0
2007    0
2008    0
2009    0
2010    0
dtype: int64
```

It is weird to see Australia in the list with lowest internet access, but what seems to be happening is that the country apparently is missing data for those years. The same must be happening to all countries that had internet internet access in any previous year and had a zero value in any subsequent time.

```
In [86]: internet_users.loc[list_countries_min_values_to_check]
```

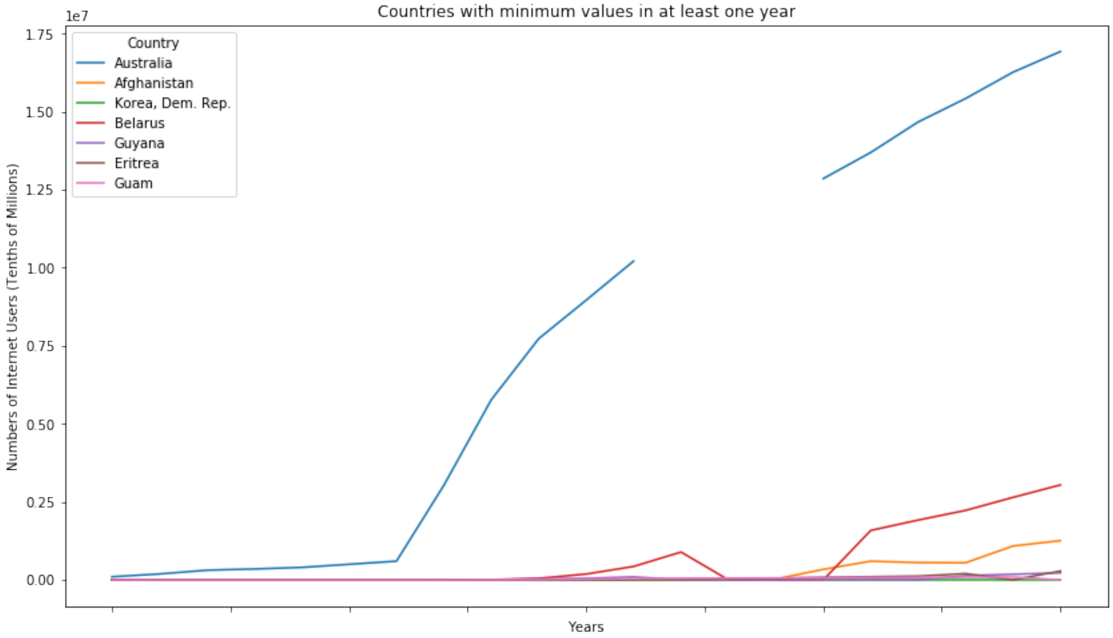
```
Out[86]:            1990  1991  1992  1993  1994  1995  1996  1997  1998  1999  ...     \
         Country                                                                ...
         Kiribati      0     0     0     0     0     0     0     0   499   999  ...
         Tonga         0     0     0     0     0   118   157   493   741   991  ...
         Samoa         0     0     0     0     0     0     0   299   399   499  ...
         Gibraltar     0     0     0     0     0     0     0   725  1137  1615  ...
         Vanuatu       0     0     0     0     0     0    97   244   487   975  ...

                    2001  2002  2003  2004   2005   2006   2007   2008   2009   2010
         Country
         Kiribati   1999  2178  2663  3163   3679   4209   5702   6757   7842   8959
         Tonga      2782  2879  2975  3963   4953   5946   7341   8346  10351  12486
         Samoa      3002  4006  5015  5526   6042   8078   8610   9147  10944  12815
         Gibraltar  5846  6625  8047  9468  11359  13243  15119  16986  19037  19008
         Vanuatu    5365  6828  7805  9757  10732  12681  15121  16576  17534  19172

         [5 rows x 21 columns]
```

```
In [87]: list_countries_min_values_to_check = ['Australia','Afghanistan','Korea, Dem. Rep.','Bo
         transposed_internet_users = internet_users.loc[list_countries_min_values_to_check].tra
         transposed_internet_users.set(xlabel='Years', ylabel='Numbers of Internet Users (Tent
         plt.show()
```



So it seems we might have two possible alternatives. First is to fill those missing gaps with some sort of approximation of the value expected. For this we probably would have to make a function to calculate those values. Second would be to try to remove the 0 values for those specific points and try to force matplot to smooth the graph.

```
In [88]: internet_users.at['Australia','2002']=None
         internet_users.at['Australia','2003']=None
         internet_users.at['Australia','2004']=None
         transposed_internet_users = internet_users.loc[list_countries_min_values_to_check].tra
         transposed_internet_users.set(xlabel='Years', ylabel='Numbers of Internet Users (Tent
         plt.show()
```



It seems it does not perform such task automatically, so we have to force it somehow. After some Google research, found out that in fact my mistake was to manually set all those values to zero in the beginning. Instead, I should have removed the NaN values with the dropna() function. So let's start it over.

```
In [89]: internet_users = pd.read_excel('Internet user total.xlsx')
         internet_users = internet_users[np.isfinite(internet_users['2001'])]
         internet_users = internet_users.rename(columns={'Internet users, total number':'Count
         internet_users = internet_users.drop(columns=['2011'])
         internet = internet_users.fillna(value=0)
         internet = internet.round(0)
         internet_users = internet[internet_users.notna()]
         #internet_users = internet_users.fillna(value='')
         internet_users.set_index('Country',drop=True, inplace=True)
         internet_users
```

```
Out[89]:                            1990       1991       1992       1993  \
         Country
         Afghanistan                 0.0        NaN        NaN        NaN
         Albania                     0.0        NaN        NaN        NaN
         Algeria                     0.0        NaN        NaN        NaN
         Angola                      0.0        NaN        NaN        NaN
         Antigua and Barbuda         0.0        NaN        NaN        NaN
         Argentina                   0.0        NaN     1004.0    10034.0
         Armenia                     0.0        NaN        NaN        NaN
         Aruba                       0.0        NaN        NaN        NaN
         Australia              100029.0   190043.0   310055.0   350047.0
```

```
Austria                   10000.0    20000.0    50000.0    60000.0
Azerbaijan                    0.0        NaN        NaN        NaN
Bahamas                       0.0        NaN        NaN        NaN
Bahrain                       0.0        NaN        NaN        NaN
Bangladesh                    0.0        NaN        NaN        NaN
Barbados                      0.0        NaN        NaN        NaN
Belarus                       0.0        NaN        NaN        NaN
Belgium                     100.0     2003.0    10009.0    20009.0
Benin                         0.0        NaN        NaN        NaN
Bermuda                       0.0        NaN        NaN        NaN
Bhutan                        0.0        NaN        NaN        NaN
Bolivia                       0.0        NaN        NaN        NaN
Bosnia and Herzegovina        0.0        NaN        NaN        NaN
Botswana                      0.0        0.0        NaN        NaN
Brazil                        0.0     5003.0    20013.0    40029.0
Brunei                        0.0        NaN        NaN        NaN
Bulgaria                      0.0        NaN        NaN      200.0
Burkina Faso                  0.0        NaN        NaN        NaN
Burundi                       0.0        0.0        0.0        0.0
Cambodia                      0.0        NaN        NaN        NaN
Cameroon                      0.0        NaN        NaN        NaN
...                           ...        ...        ...        ...
Sudan                         0.0        NaN        NaN        NaN
Suriname                      0.0        NaN        NaN        NaN
Swaziland                     0.0        NaN        NaN        NaN
Sweden                    50000.0    99999.0   129995.0   149991.0
Switzerland               39756.0    79530.0   119374.0   149352.0
Syria                         0.0        0.0        0.0        0.0
Tajikistan                    0.0        NaN        NaN        NaN
Tanzania                      0.0        NaN        NaN        NaN
Thailand                      0.0       30.0      200.0     7968.0
Togo                          0.0        0.0        0.0        0.0
Tonga                         0.0        NaN        NaN        NaN
Trinidad and Tobago           0.0        NaN        NaN        NaN
Tunisia                       0.0        NaN        NaN        NaN
Turkey                        0.0        NaN        NaN     4818.0
Turkmenistan                  0.0        NaN        NaN        NaN
Uganda                        0.0        NaN        NaN        NaN
Ukraine                       0.0        NaN        NaN      401.0
United Arab Emirates          0.0        NaN        NaN        NaN
United Kingdom            49980.0    99956.0   149920.0   299807.0
United States           1988024.0  2975535.0  4453200.0  5924598.0
Uruguay                       0.0        NaN        NaN        NaN
Uzbekistan                    0.0        NaN        NaN        NaN
Vanuatu                       0.0        NaN        NaN        NaN
Venezuela                     0.0        NaN     2493.0     8776.0
Vietnam                       0.0        NaN        NaN        NaN
Virgin Islands (U.S.)         0.0        NaN        NaN        NaN
```

```
West Bank and Gaza            0.0        NaN        NaN        NaN
Yemen, Rep.                   0.0        NaN        NaN        NaN
Zambia                        0.0        NaN        NaN        NaN
Zimbabwe                      0.0        NaN        NaN        NaN

                              1994        1995        1996        1997  \
Country
Afghanistan                    NaN         NaN         NaN         NaN
Albania                        NaN       351.0      1002.0      1502.0
Algeria                      100.0       500.0       500.0      3003.0
Angola                         NaN         NaN        97.0       726.0
Antigua and Barbuda            NaN      1511.0      2014.0      2517.0
Argentina                  15044.0     30072.0     50092.0    100123.0
Armenia                      300.0      1700.0      3000.0      3500.0
Aruba                          NaN         NaN      2300.0         NaN
Australia                 400033.0    500006.0    600014.0   3032449.0
Austria                   110000.0    150000.0    550001.0    760006.0
Azerbaijan                   110.0       160.0       499.0      1993.0
Bahamas                        NaN      2686.0      4956.0      3915.0
Bahrain                        NaN      1936.0      4848.0      9762.0
Bangladesh                     NaN         NaN         NaN       919.0
Barbados                       NaN        20.0      1029.0      2077.0
Belarus                       50.0       300.0      3001.0      5002.0
Belgium                    70000.0     99958.0    299756.0    499407.0
Benin                          NaN         NaN        99.0      1476.0
Bermuda                        NaN      4199.0      9997.0     14995.0
Bhutan                         NaN         NaN         NaN         NaN
Bolivia                        NaN      4991.0     14976.0     34951.0
Bosnia and Herzegovina         NaN         NaN       500.0      2000.0
Botswana                       NaN      1023.0      2557.0      5110.0
Brazil                     60050.0    170164.0    740838.0   1311724.0
Brunei                         NaN      2946.0      9817.0     14721.0
Bulgaria                    1650.0     10000.0     60000.0    100000.0
Burkina Faso                   NaN         NaN       106.0      2112.0
Burundi                        0.0         0.0        49.0       493.0
Cambodia                       NaN         NaN         NaN       686.0
Cameroon                       NaN         NaN         NaN       990.0
...                            ...         ...         ...         ...
Sudan                          0.0         0.0         0.0       391.0
Suriname                       NaN       500.0      1000.0      4493.0
Swaziland                      NaN        10.0       496.0       892.0
Sweden                    299985.0    450000.0    800125.0   2100857.0
Switzerland               189346.0    249305.0    321250.0   1070663.0
Syria                          0.0         0.0         0.0      4844.0
Tajikistan                     NaN         NaN         NaN         NaN
Tanzania                       NaN         NaN       499.0      2496.0
Thailand                   22831.0     44633.0     69581.0    219680.0
Togo                           0.0         0.0       460.0      9183.0
```

```
Tonga                          NaN       118.0       158.0       493.0
Trinidad and Tobago            NaN      1995.0      4988.0     14963.0
Tunisia                      650.0      1000.0      2500.0      4000.0
Turkey                     28880.0     48087.0    115292.0    287927.0
Turkmenistan                   NaN         NaN         NaN         NaN
Uganda                         NaN       596.0       993.0      2283.0
Ukraine                     7009.0     22025.0     50053.0    100093.0
United Arab Emirates           NaN      2418.0      9287.0     86068.0
United Kingdom            599560.0   1099145.0   2398186.0   4307074.0
United States           12811919.0  24600557.0  44232691.0  58935678.0
Uruguay                     1999.0      9997.0     59978.0    109954.0
Uzbekistan                     NaN       350.0      1000.0      2503.0
Vanuatu                        NaN         NaN        98.0       244.0
Venezuela                  11968.0     26930.0     55857.0     89773.0
Vietnam                        NaN         NaN       101.0      3031.0
Virgin Islands (U.S.)       1000.0      2999.0      4998.0      7497.0
West Bank and Gaza             NaN         NaN         NaN         NaN
Yemen, Rep.                    NaN         NaN        98.0      2438.0
Zambia                       589.0       783.0       831.0       879.0
Zimbabwe                     199.0       898.0      1997.0      3998.0

                              1998         1999     ...              2001  \
Country                                             ...
Afghanistan                    NaN          NaN     ...            1118.0
Albania                     2002.0       2502.0     ...           10026.0
Algeria                     6006.0      60055.0     ...          200180.0
Angola                      2424.0       9723.0     ...           19570.0
Antigua and Barbuda         3021.0       4028.0     ...            7045.0
Argentina                 300195.0    1200184.0     ...         3648448.0
Armenia                     4000.0      30002.0     ...           50006.0
Aruba                          NaN       3985.0     ...           15794.0
Australia                5772823.0    7727668.0     ...        10212333.0
Austria                  1230014.0    1840018.0     ...         3149915.0
Azerbaijan                  2990.0       7977.0     ...           25030.0
Bahamas                     6787.0      11067.0     ...           35590.0
Bahrain                    19671.0      29586.0     ...           96625.0
Bangladesh                  4599.0      46014.0     ...          171275.0
Barbados                    5240.0       6339.0     ...           32013.0
Belarus                     7503.0      50020.0     ...          430483.0
Belgium                   798809.0    1397655.0     ...         3194941.0
Benin                       2947.0       9805.0     ...           24427.0
Bermuda                    19993.0      24989.0     ...           29984.0
Bhutan                         NaN        764.0     ...            5084.0
Bolivia                    49939.0      79908.0     ...          179745.0
Bosnia and Herzegovina      5000.0       7000.0     ...           45000.0
Botswana                   10214.0      19397.0     ...           61222.0
Brazil                   2503664.0    3505320.0     ...         8009872.0
Brunei                     19622.0      24521.0     ...           43190.0
```

```
Bulgaria                  150001.0     234602.0     ...          605007.0
Burkina Faso                5279.0       7384.0     ...           19951.0
Burundi                      986.0       2463.0     ...            6890.0
Cambodia                    1957.0       3908.0     ...            9738.0
Cameroon                    1979.0      19778.0     ...           44438.0
...                            ...          ...     ...               ...
Sudan                       1564.0       2935.0     ...           49068.0
Suriname                    7585.0       8711.0     ...           14508.0
Swaziland                    989.0       4934.0     ...           13778.0
Sweden                   2962762.0    3667832.0     ...         4595249.0
Switzerland              1764011.0    2426492.0     ...         3971601.0
Syria                       9681.0      19356.0     ...           58211.0
Tajikistan                     NaN       2002.0     ...            3195.0
Tanzania                    2994.0      24941.0     ...           59813.0
Thailand                  672850.0    1514185.0     ...         3550430.0
Togo                       13752.0      27456.0     ...          136739.0
Tonga                        742.0        992.0     ...            2782.0
Trinidad and Tobago        34916.0      74822.0     ...          199533.0
Tunisia                    10001.0     150033.0     ...          410303.0
Turkey                    431461.0    1436989.0     ...         3349546.0
Turkmenistan                   NaN       2003.0     ...            7975.0
Uganda                     14879.0      24784.0     ...           59449.0
Ukraine                   150117.0     200123.0     ...          600158.0
United Arab Emirates      190358.0     432896.0     ...          827413.0
United Kingdom           7995303.0   12493278.0     ...        19786366.0
United States           83053031.0  100125498.0     ...       140147752.0
Uruguay                   229893.0     329828.0     ...          369767.0
Uzbekistan                  5008.0       7509.0     ...          149646.0
Vanuatu                      488.0        976.0     ...            5365.0
Venezuela                 324191.0     678327.0     ...         1150224.0
Vietnam                    10073.0     100422.0     ...         1007834.0
Virgin Islands (U.S.)       9997.0      11996.0     ...           19979.0
West Bank and Gaza             NaN          NaN     ...           60339.0
Yemen, Rep.                 3899.0       9745.0     ...           16586.0
Zambia                      2927.0      14625.0     ...           24362.0
Zimbabwe                   10012.0      20056.0     ...          100581.0

                               2002         2003         2004         2005  \
Country
Afghanistan                  1124.0      22569.0      28244.0     338045.0
Albania                     12053.0      30194.0      75634.0     189887.0
Algeria                    500441.0     700615.0    1501387.0    1921982.0
Angola                      40260.0      57159.0      74173.0     188530.0
Antigua and Barbuda         10063.0      14079.0      20102.0      29133.0
Argentina                 4097919.0    4527354.0    6148589.0    6854530.0
Armenia                     60009.0     140027.0     150038.0     161054.0
Aruba                       17784.0      20150.0      22781.0      25653.0
Australia                       NaN          NaN          NaN   12854218.0
```

```
Austria                   2955166.0    3473318.0    4443118.0    4774674.0
Azerbaijan                 413989.0          NaN          NaN     689641.0
Bahamas                     55044.0      62040.0      69243.0      79840.0
Bahrain                    115898.0     139496.0     144151.0     154411.0
Bangladesh                 187866.0     223717.0     275931.0     339713.0
Barbados                    74828.0     106919.0     134434.0     151673.0
Belarus                    891820.0          NaN          NaN          NaN
Belgium                   4750690.0    5148463.0    5578276.0    6228738.0
Benin                       48770.0      68162.0      87484.0      97027.0
Bermuda                     32982.0      35979.0      38976.0      41971.0
Bhutan                      10156.0      15217.0      20280.0      25364.0
Bolivia                    269533.0     309315.0     398835.0     478149.0
Bosnia and Herzegovina      99995.0     149986.0     584937.0     806363.0
Botswana                    61221.0      61221.0      61215.0      61195.0
Brazil                   16403934.0   23989345.0   35071405.0   39099569.0
Brunei                      52365.0      68342.0     105771.0     132418.0
Bulgaria                   716654.0     943950.0    1412178.0    1545501.0
Burkina Faso                26160.0      50025.0      55200.0      66721.0
Burundi                      7869.0      13765.0      24572.0      39313.0
Cambodia                    29157.0      33937.0      39639.0      42386.0
Cameroon                    59212.0      98623.0     167546.0     246216.0
...                             ...          ...          ...          ...
Sudan                      157404.0     197315.0     296864.0     496277.0
Suriname                    19981.0      22976.0      29969.0      31970.0
Swaziland                   19665.0      26533.0      35370.0      40848.0
Sweden                    6282022.0    7070576.0    7531615.0    7659593.0
Switzerland               4454555.0    4756908.0    4990915.0    5197920.0
Syria                      355051.0     594309.0     778094.0    1044003.0
Tajikistan                   3486.0       4092.0       4952.0      19275.0
Tanzania                    79722.0     249043.0     331609.0    1669734.0
Thailand                  4868421.0    6078800.0    7053467.0   10022117.0
Togo                       181911.0     190546.0     200009.0     216322.0
Tonga                        2880.0       2976.0       3964.0       4953.0
Trinidad and Tobago        286329.0     339208.0     354186.0     381156.0
Tunisia                    506073.0     631052.0     837019.0     957023.0
Turkey                    7447774.0    8179652.0    9802998.0   10534937.0
Turkmenistan                13898.0      19762.0      35416.0      47348.0
Uganda                      99075.0     123844.0     198148.0     495330.0
Ukraine                    900071.0    1499871.0    1649659.0    1759537.0
United Arab Emirates       921614.0    1002533.0    1102215.0    1627740.0
United Kingdom           33515216.0   38635538.0   39295002.0   42141909.0
United States           169576672.0  179718040.0  190430149.0  201742976.0
Uruguay                    379741.0     529611.0     566728.0     667436.0
Uzbekistan                 273461.0     487511.0     666800.0     867554.0
Vanuatu                      6829.0       7805.0       9757.0      10732.0
Venezuela                 1241034.0    1930220.0    2201971.0    3347147.0
Vietnam                   1493286.0    3076281.0    6286874.0   10594671.0
Virgin Islands (U.S.)       29951.0      29931.0      29915.0      29905.0
```

```
West Bank and Gaza         104051.0     141243.0     153305.0     569071.0
Yemen, Rep.                 97699.0     117438.0     176475.0     216521.0
Zambia                      51088.0     107248.0     225365.0     326878.0
Zimbabwe                   503600.0     806572.0     826930.0    1007663.0

                               2006         2007         2008         2009  \
Country
Afghanistan                598865.0     553771.0     549056.0    1085510.0
Albania                    303350.0     476594.0     759081.0    1315402.0
Algeria                   2462986.0    3204578.0    3504773.0    3924904.0
Angola                     324498.0     560812.0     829746.0    1113307.0
Antigua and Barbuda         53213.0      60206.0      65187.0      65149.0
Argentina                 8166600.0   10214688.0   11164731.0   13621240.0
Armenia                    172887.0     185104.0     191211.0     472002.0
Aruba                       28759.0      32206.0      36090.0      40193.0
Australia                13691235.0   14667832.0   15418953.0   16262458.0
Austria                   5261760.0    5764496.0    6078674.0    6147500.0
Azerbaijan                1043526.0    1282575.0    1527567.0    2484249.0
Bahamas                     84257.0      88792.0     105237.0     114636.0
Bahrain                    229174.0     304659.0     546701.0     619876.0
Bangladesh                1423535.0    2591222.0    3636958.0    4557934.0
Barbados                   170769.0     175737.0     181000.0     187379.0
Belarus                   1583845.0    1916461.0    2226559.0    2643159.0
Belgium                   6722851.0    7300198.0    6997430.0    7462657.0
Benin                      121055.0     145215.0     154586.0     192680.0
Bermuda                     44965.0      47958.0      53213.0      53948.0
Bhutan                      30484.0      40764.0      45939.0      51170.0
Bolivia                    577075.0     993596.0    1041680.0    1397602.0
Bosnia and Herzegovina     950025.0    1055106.0    1308125.0    1421924.0
Botswana                    81548.0     101774.0     122176.0     121867.0
Brazil                   52963579.0   58609644.0   64799077.0   75791320.0
Brunei                     156223.0     168673.0     176960.0     192000.0
Bulgaria                  2083091.0    2570191.0    3011477.0    3394203.0
Burkina Faso                92516.0     112958.0     142740.0     180625.0
Burundi                     49151.0      53954.0      64341.0     155246.0
Cambodia                    63303.0      66982.0      70495.0      74083.0
Cameroon                   364127.0     537656.0     637798.0     736321.0
...                             ...          ...          ...          ...
Sudan                     3185731.0    3496357.0    4207779.0          NaN
Suriname                    47965.0      71980.0     108473.0     163028.0
Swaziland                   41313.0      46453.0      78799.0      88794.0
Sweden                    7978004.0    7513243.0    8313185.0    8473110.0
Switzerland               5653541.0    5806685.0    5997978.0    6196045.0
Syria                     1481976.0          NaN    2757196.0    3469298.0
Tajikistan                 246136.0     475361.0     587506.0     683087.0
Tanzania                  2315569.0    2956909.0    3804090.0    4352474.0
Thailand                 11545108.0   13579629.0   12424773.0   13809931.0
Togo                       237786.0     254376.0     277288.0     300995.0
```

```
Tonga                        5947.0       7342.0       8347.0      10352.0
Trinidad and Tobago        396175.0     428192.0     463202.0     592003.0
Tunisia                   1300957.0    1732293.0    2821089.0    3531386.0
Turkey                   12597189.0   20038925.0   24376486.0   26152021.0
Turkmenistan                63364.0      68333.0      86072.0      97104.0
Uganda                     742880.0    1114070.0    2475812.0    3165582.0
Ukraine                   2099484.0    3031481.0   10315912.0   15154526.0
United Arab Emirates      2424619.0    3297380.0    4468769.0    5204111.0
United Kingdom           41662350.0   45726882.0   48029802.0   51516674.0
United States           206493364.0  226713423.0  225691907.0  218457578.0
Uruguay                    978271.0    1134080.0    1314965.0    1403389.0
Uzbekistan                1674617.0    1985297.0    2434558.0    4627564.0
Vanuatu                     12682.0      15122.0      16577.0      17534.0
Venezuela                 4130269.0    5747711.0    7261277.0    8898213.0
Vietnam                  14506873.0   17643674.0   20559697.0   23072261.0
Virgin Islands (U.S.)       29902.0      29906.0      29914.0      29921.0
West Bank and Gaza         669699.0     789496.0     932070.0    1266856.0
Yemen, Rep.                265638.0    1099544.0    1558972.0    2323490.0
Zambia                     488794.0     587097.0     687068.0     802868.0
Zimbabwe                  1226884.0    1354215.0    1419476.0    1417045.0

                               2010
Country
Afghanistan               1256470.0
Albania                   1441928.0
Algeria                   4433526.0
Angola                    1908191.0
Antigua and Barbuda         70968.0
Argentina                14548455.0
Armenia                   1360512.0
Aruba                       45145.0
Australia                16923972.0
Austria                   6102179.0
Azerbaijan                4226380.0
Bahamas                    147437.0
Bahrain                    694009.0
Bangladesh                5501609.0
Barbados                   191878.0
Belarus                   3041748.0
Belgium                   8034050.0
Benin                      277002.0
Bermuda                     54687.0
Bhutan                      98728.0
Bolivia                   1985970.0
Bosnia and Herzegovina    1955277.0
Botswana                   120417.0
Brazil                   79245740.0
Brunei                     199460.0
```

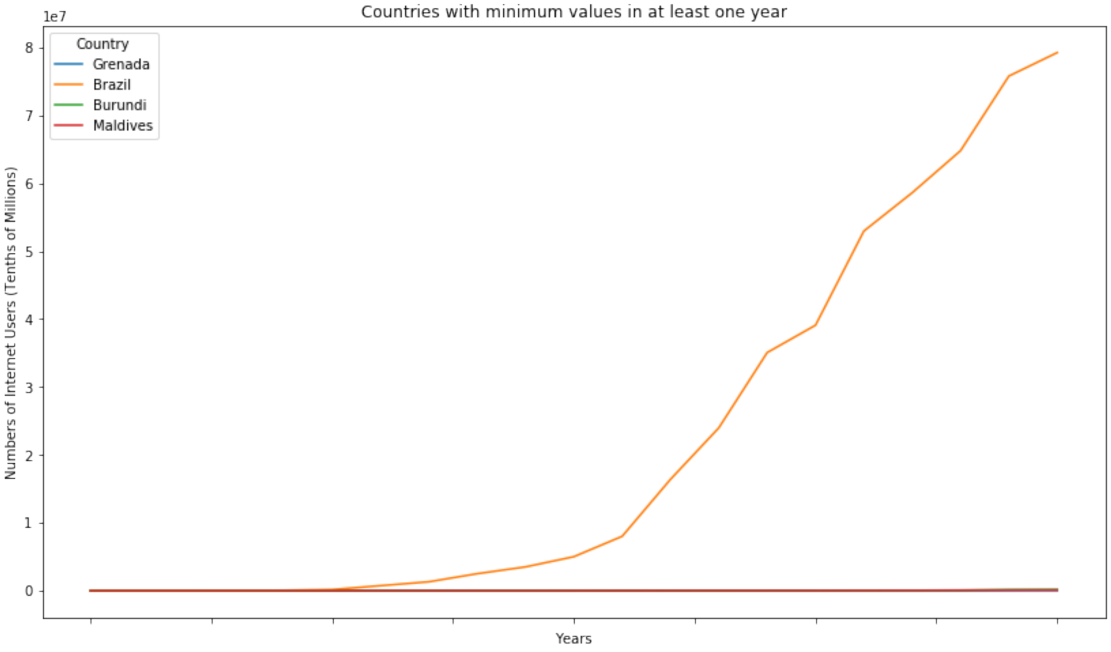
```
         Bulgaria                  3464630.0
         Burkina Faso               230562.0
         Burundi                    176040.0
         Cambodia                   178142.0
         Cameroon                   783956.0
         ...                             ...
         Sudan                           NaN
         Suriname                   165733.0
         Swaziland                   95122.0
         Sweden                    8441718.0
         Switzerland               6430363.0
         Syria                     4224995.0
         Tajikistan                 794483.0
         Tanzania                  4932535.0
         Thailand                 14653914.0
         Togo                       324296.0
         Tonga                       12487.0
         Trinidad and Tobago        650611.0
         Tunisia                   3856984.0
         Turkey                   28969976.0
         Turkmenistan               110924.0
         Uganda                    4178085.0
         Ukraine                  20451748.0
         United Arab Emirates      5859118.0
         United Kingdom           52730234.0
         United States           229684122.0
         Uruguay                   1606911.0
         Uzbekistan                5488940.0
         Vanuatu                     19172.0
         Venezuela                10337115.0
         Vietnam                  24211031.0
         Virgin Islands (U.S.)           NaN
         West Bank and Gaza        1512273.0
         Yemen, Rep.               2970485.0
         Zambia                    1308857.0
         Zimbabwe                  1445717.0

         [196 rows x 21 columns]
```

```
In [90]: internet_users.min(axis=0)
```

```
Out[90]: 1990       0.0
         1991       0.0
         1992       0.0
         1993       0.0
         1994       0.0
         1995       0.0
         1996       0.0
```

```
1997       0.0
1998       0.0
1999       0.0
2000       0.0
2001       0.0
2002       0.0
2003       0.0
2004       0.0
2005       0.0
2006       0.0
2007       0.0
2008       0.0
2009       0.0
2010    8959.0
dtype: float64
```

```
In [91]: list_countries_min_values_to_check = ['Grenada','Brazil','Burundi','Maldives']
         min_values_internet_users = internet_users.loc[list_countries_min_values_to_check].T.p
         min_values_internet_users.set(xlabel='Years', ylabel='Numbers of Internet Users (Tenth
         plt.show()
```

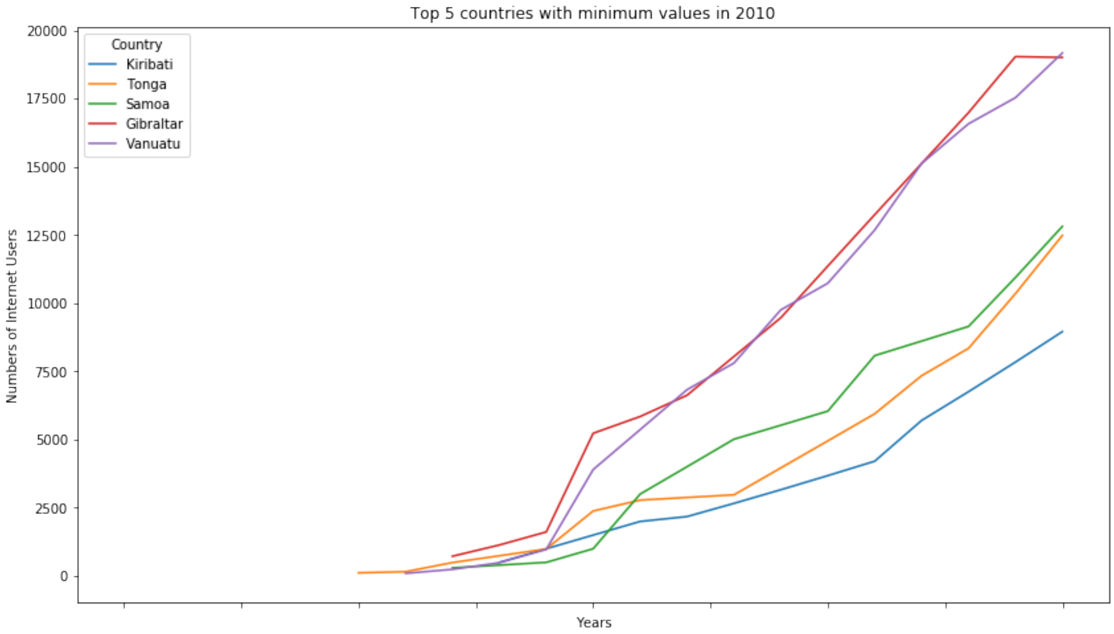


We can also see the 5 smallest values in 2010 and see how they behaved over the years:

```
In [92]: internet_users['2010'].sort_values().head(5)
```

```
Out[92]: Country
         Kiribati      8959.0
         Tonga        12487.0
         Samoa        12816.0
         Gibraltar    19009.0
         Vanuatu      19172.0
         Name: 2010, dtype: float64
```

```
In [93]: list_countries_min_values_to_check = ['Kiribati','Tonga','Samoa','Gibraltar','Vanuatu
         min_values_internet_users = internet_users.loc[list_countries_min_values_to_check].tra
         min_values_internet_users.set(xlabel='Years', ylabel='Numbers of Internet Users')
         plt.show()
```

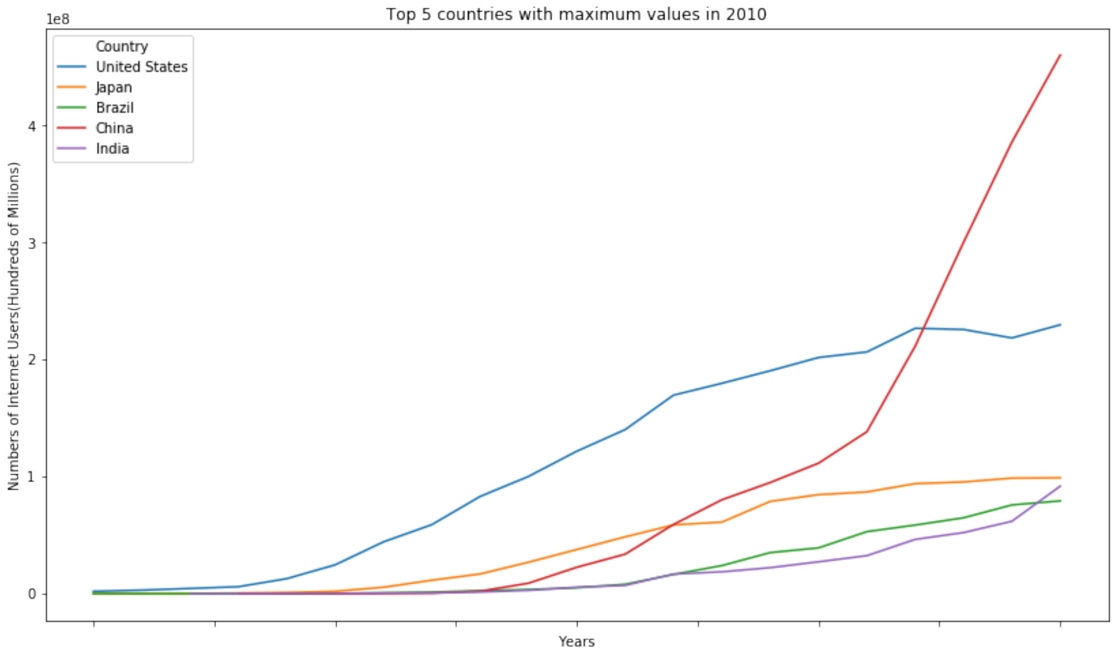


Also, we can check the top 5 in absolute numbers:

```
In [94]: internet_users['2010'].sort_values(ascending=False).head(5)
```

```
Out[94]: Country
         China            460077957.0
         United States    229684122.0
         Japan             98951089.0
         India             91846075.0
         Brazil            79245740.0
         Name: 2010, dtype: float64
```

```
In [95]: list_countries_max_values_to_check = ['United States','Japan','Brazil','China','India
         max_values_internet_users = internet_users.loc[list_countries_max_values_to_check].tra
         max_values_internet_users.set(xlabel='Years', ylabel='Numbers of Internet Users(Hundre
         plt.show()
```



1.2.3 Which country had the largest internet boom?

To answer this question we should calculate something like the derivate of the graph for each country (Newton and Leibniz say hello) and then find the largest value overall. To do this, unfortunatelly, we will have to deal with some unpleasant NaN mess which will prevent us from dealing with this "pandas style": we will have to use loops and ifs.

```
In [96]: #first will remove all values that are None in 2010
         internet_users = internet_users[np.isfinite(internet_users['2010'])]
         year_list = []
         year_diff_list = []
         for year in range(1990,2011):
             year_list.append(str(year))
         for year in range(1990,2010):
             year_diff_list.append(str(year)+'-'+str(year+1))
         internet_users_variation = pd.DataFrame(columns=year_diff_list)
         for index,row in internet_users.iterrows():
             next_row = []
             i = 0
             while i < len(year_list)-1:
                 if np.isnan(row[year_list[i+1]]) and not np.isnan(row[year_list[i]]) and i !=
                     k=2
                     stop = False
                     #print('Entered in '+index+' with an i of ' + str(i))
                     while k+i < len(year_list) and not stop:
                         #print('First loop in '+index+' with an k of '+str(k))
```

```
                if not np.isnan(row[year_list[i+k]]):
                    #print('Found non None in '+index+' in column number '+str(i+k))
                    stop = True
                    diff = (row[year_list[i+k]] - row[year_list[i]])/k
                    j=1
                    while j<=k:
                        #print('Second loop in '+index+' with an j of '+str(j)+' appe
                        next_row.append(j*diff)
                        j+=1
                else:
                    k += 1
            i += k
            #print('Value of i at the end of the first loop is '+ str(i))

        else:
            #print('Adding simple difference with i of '+str(i))
            next_row.append(row[year_list[i+1]]-row[year_list[i]])
            i += 1
    #print(len(next_row))
    #print(index)
    #print(len(year_diff_list))
    #print(len(next_row))
    #print('Appending row to '+index)
    internet_users_variation.loc[index] = next_row
internet_users_variation.head(10)
```

Out[96]:

```
                       1990-1991      1991-1992     1992-1993     1993-1994  \
Afghanistan           101.636364     203.272727    304.909091    406.545455
Albania                70.200000     140.400000    210.600000    280.800000
Algeria                25.000000      50.000000     75.000000    100.000000
Angola                 16.166667      32.333333     48.500000     64.666667
Antigua and Barbuda   302.200000     604.400000    906.600000   1208.800000
Argentina             502.000000    1004.000000   9030.000000   5010.000000
Armenia                75.000000     150.000000    225.000000    300.000000
Aruba                 383.333333     766.666667   1150.000000   1533.333333
Australia           90014.000000  120012.000000  39992.000000  49986.000000
Austria             10000.000000   30000.000000  10000.000000  50000.000000

                       1994-1995      1995-1996     1996-1997     1997-1998  \
Afghanistan           508.181818     609.818182  7.114545e+02  8.130909e+02
Albania               351.000000     651.000000  5.000000e+02  5.000000e+02
Algeria               400.000000       0.000000  2.503000e+03  3.003000e+03
Angola                 80.833333      97.000000  6.290000e+02  1.698000e+03
Antigua and Barbuda  1511.000000     503.000000  5.030000e+02  5.040000e+02
Argentina           15028.000000   20020.000000  5.003100e+04  2.000720e+05
Armenia              1400.000000    1300.000000  5.000000e+02  5.000000e+02
Aruba                1916.666667    2300.000000  5.616667e+02  1.123333e+03
Australia           99973.000000  100008.000000  2.432435e+06  2.740374e+06
```

```
Austria              40000.000000  400001.000000  2.100050e+05  4.700080e+05

                        1998-1999     1999-2000  2000-2001  2001-2002  \
Afghanistan          9.147273e+02  1.016364e+03     1118.0       6.00
Albania              5.000000e+02  1.003000e+03     6521.0    2027.00
Algeria              5.404900e+04  9.008200e+04    50043.0  300261.00
Angola               7.299000e+03  4.906000e+03     4941.0   20690.00
Antigua and Barbuda  1.007000e+03  1.006000e+03     2011.0    3018.00
Argentina            8.999890e+05  1.399252e+06  1049012.0  449471.00
Armenia              2.600200e+04  1.000200e+04    10002.0   10003.00
Aruba                1.685000e+03  9.955000e+03     1854.0    1990.00
Australia            1.954845e+06  1.232838e+06  1251827.0  660471.25
Austria              6.100040e+05  8.599820e+05   449915.0 -194749.00

                     2002-2003   2003-2004  2004-2005  2005-2006  2006-2007  \
Afghanistan            21445.0     5675.00   309801.0   260820.0   -45094.0
Albania                18141.0    45440.00   114253.0   113463.0   173244.0
Algeria               200174.0   800772.00   420595.0   541004.0   741592.0
Angola                 16899.0    17014.00   114357.0   135968.0   236314.0
Antigua and Barbuda     4016.0     6023.00     9031.0    24080.0     6993.0
Argentina             429435.0  1621235.00   705941.0  1312070.0  2048088.0
Armenia                80018.0    10011.00    11016.0    11833.0    12217.0
Aruba                   2366.0     2631.00     2872.0     3106.0     3447.0
Australia            1320942.5  1981413.75  2641885.0   837017.0   976597.0
Austria               518152.0   969800.00   331556.0   487086.0   502736.0

                     2007-2008  2008-2009  2009-2010
Afghanistan            -4715.0   536454.0   170960.0
Albania               282487.0   556321.0   126526.0
Algeria               300195.0   420131.0   508622.0
Angola                268934.0   283561.0   794884.0
Antigua and Barbuda     4981.0      -38.0     5819.0
Argentina             950043.0  2456509.0   927215.0
Armenia                 6107.0   280791.0   888510.0
Aruba                   3884.0     4103.0     4952.0
Australia             751121.0   843505.0   661514.0
Austria               314178.0    68826.0   -45321.0
```

To answer our question we simply perform a max_value search in the whole dataset.

```
In [97]: internet_users_variation.loc['China']
```

```
Out[97]: 1990-1991    6.683333e+02
         1991-1992    1.336667e+03
         1992-1993    2.005000e+03
         1993-1994    1.203000e+04
         1994-1995    4.611500e+04
         1995-1996    1.002490e+05
         1996-1997    2.406010e+05
         1997-1998    1.704102e+06
         1998-1999    6.814362e+06
         1999-2000    1.361895e+07
         2000-2001    1.119377e+07
         2001-2002    2.536553e+07
         2002-2003    2.109288e+07
         2003-2004    1.474971e+07
         2004-2005    1.650925e+07
         2005-2006    2.688585e+07
         2006-2007    7.310170e+07
         2007-2008    8.875316e+07
         2008-2009    8.559838e+07
         2009-2010    7.428931e+07
         Name: China, dtype: float64
```

```
In [98]: internet_users_variation.max().idxmax()
```

```
Out[98]: '2007-2008'
```

```
In [99]: internet_users_variation.idxmax(axis=0)
```

```
Out[99]: 1990-1991    United States
         1991-1992    United States
         1992-1993    United States
         1993-1994    United States
         1994-1995    United States
         1995-1996    United States
         1996-1997    United States
         1997-1998    United States
         1998-1999    United States
         1999-2000    United States
         2000-2001    United States
         2001-2002    United States
         2002-2003            China
         2003-2004            Japan
         2004-2005            China
         2005-2006            China
         2006-2007            China
         2007-2008            China
         2008-2009            China
         2009-2010            China
         dtype: object
```

So China from 2007-2008 had the largest internet user growth of our dataset!

1.2.4 Did internet users got smaller in any country?

In order to answer this question, we list all minimum values of our table.

```
In [100]: internet_users_variation.min()

Out[100]: 1990-1991          0.0
          1991-1992          0.0
          1992-1993          0.0
          1993-1994          0.0
          1994-1995         -6.0
          1995-1996          0.0
          1996-1997      -1041.0
          1997-1998         -2.0
          1998-1999         -7.0
          1999-2000         -6.0
          2000-2001    -190011.0
          2001-2002    -194749.0
          2002-2003        -12.0
          2003-2004      -8744.0
          2004-2005    -399920.0
          2005-2006    -479559.0
          2006-2007    -464761.0
          2007-2008   -1154856.0
          2008-2009   -7234329.0
          2009-2010     -45321.0
          dtype: float64

In [101]: internet_users_variation.idxmin(axis=0)

Out[101]: 1990-1991          Botswana
          1991-1992           Burundi
          1992-1993           Burundi
          1993-1994           Burundi
          1994-1995         Greenland
          1995-1996           Algeria
          1996-1997           Bahamas
          1997-1998           Liberia
          1998-1999          Dominica
          1999-2000            Rwanda
          2000-2001            Israel
          2001-2002           Austria
          2002-2003           Liberia
          2003-2004              Oman
          2004-2005      South Africa
          2005-2006    United Kingdom
          2006-2007            Sweden
          2007-2008          Thailand
          2008-2009     United States
          2009-2010           Austria
          dtype: object
```

So, answering the question, yes, there are many occasions in which the number of internet users got smaller in a country, and in fact it happened even in developed countries such as

USA,UK, Sweden and Austria! We do not have enough info on the dataset however to know if this covers mobile internet usage or just cable/home internet plans.

## Conclusions

We observe that overall internet users are growing worldwide, but there are some cases in which the number has decreased. One huge example is in USA during 2008 and 2009, probably because of the economic crisis, but we cannot asser it for sure because we could not determine if this database consolidates all internet users or only cable/home internet plans.

One noticeable country is China: if plotted against USA it is incredible to see the huge explosion of internet users and how it seems to never stop growing.