05a_Matplotlib_Notebook - VNM

February 21, 2019

```
In [ ]: # Data Source: https://www.kaggle.com/worldbank/world-development-indicators
        # Folder: 'world-development-indicators'
```

Matplotlib: Exploring Data Visualization
World Development Indicators
This week, we will be using an open dataset from Kaggle. It is The World Development Indicators dataset obtained from the World Bank containing over a thousand annual indicators of economic development from hundreds of countries around the world. This is a slightly modified version of the original dataset from The World Bank List of the available indicators and a list of the available countries.

1 Step 1: Initial exploration of the Dataset

```
In [1]: import pandas as pd
        import numpy as np
        import random
        import matplotlib.pyplot as plt
```

```
In [2]: data = pd.read_csv('./world-development-indicators/Indicators.csv')
        data.shape
```

```
Out[2]: (5656458, 6)
```

This is a really large dataset, at least in terms of the number of rows. But with 6 columns, what does this hold?

```
In [3]: data.head(10)
```

```
Out[3]:   CountryName CountryCode                                       IndicatorName  \
        0  Arab World         ARB  Adolescent fertility rate (births per 1,000 wo...
        1  Arab World         ARB  Age dependency ratio (% of working-age populat...
        2  Arab World         ARB  Age dependency ratio, old (% of working-age po...
        3  Arab World         ARB  Age dependency ratio, young (% of working-age ...
        4  Arab World         ARB        Arms exports (SIPRI trend indicator values)
        5  Arab World         ARB        Arms imports (SIPRI trend indicator values)
        6  Arab World         ARB               Birth rate, crude (per 1,000 people)
        7  Arab World         ARB                                    CO2 emissions (kt)
```

```
8  Arab World         ARB             CO2 emissions (metric tons per capita)
9  Arab World         ARB  CO2 emissions from gaseous fuel consumption (%...

       IndicatorCode  Year         Value
0         SP.ADO.TFRT  1960  1.335609e+02
1         SP.POP.DPND  1960  8.779760e+01
2      SP.POP.DPND.OL  1960  6.634579e+00
3      SP.POP.DPND.YG  1960  8.102333e+01
4      MS.MIL.XPRT.KD  1960  3.000000e+06
5      MS.MIL.MPRT.KD  1960  5.380000e+08
6      SP.DYN.CBRT.IN  1960  4.769789e+01
7      EN.ATM.CO2E.KT  1960  5.956399e+04
8      EN.ATM.CO2E.PC  1960  6.439635e-01
9  EN.ATM.CO2E.GF.ZS  1960  5.041292e+00
```

In [4]:
```
# Figure out what is the Country Code of Vietnam
data[data.CountryName.str.contains('Vietnam')].head()
```

Out[4]:
```
       CountryName CountryCode  \
22799     Vietnam         VNM
22800     Vietnam         VNM
22801     Vietnam         VNM
22802     Vietnam         VNM
22803     Vietnam         VNM

                                          IndicatorName   IndicatorCode  \
22799  Adolescent fertility rate (births per 1,000 wo...     SP.ADO.TFRT
22800  Age dependency ratio (% of working-age populat...     SP.POP.DPND
22801  Age dependency ratio, old (% of working-age po...  SP.POP.DPND.OL
22802  Age dependency ratio, young (% of working-age ...  SP.POP.DPND.YG
22803        Arms imports (SIPRI trend indicator values)  MS.MIL.MPRT.KD

       Year         Value
22799  1960  1.902520e+01
22800  1960  8.134621e+01
22801  1960  8.563223e+00
22802  1960  7.278299e+01
22803  1960  6.400000e+07
```

2 Step 2: Continue to explore the dataset

2.0.1 Lets pick a country and an indicator to explore: Arable land hectares per person and the Vietnam

In [28]:
```
# select Arable land for Vietnam
hist_indicator = 'Arable land \(hectares per person\)'
hist_country = 'VNM'
```

```
# Create filters
mask1 = data['IndicatorName'].str.contains(hist_indicator)
mask2 = data['CountryCode'].str.contains(hist_country)

# stage is just those indicators matching the VNM for country code and Arable land ov
stage = data[mask1 & mask2]
```

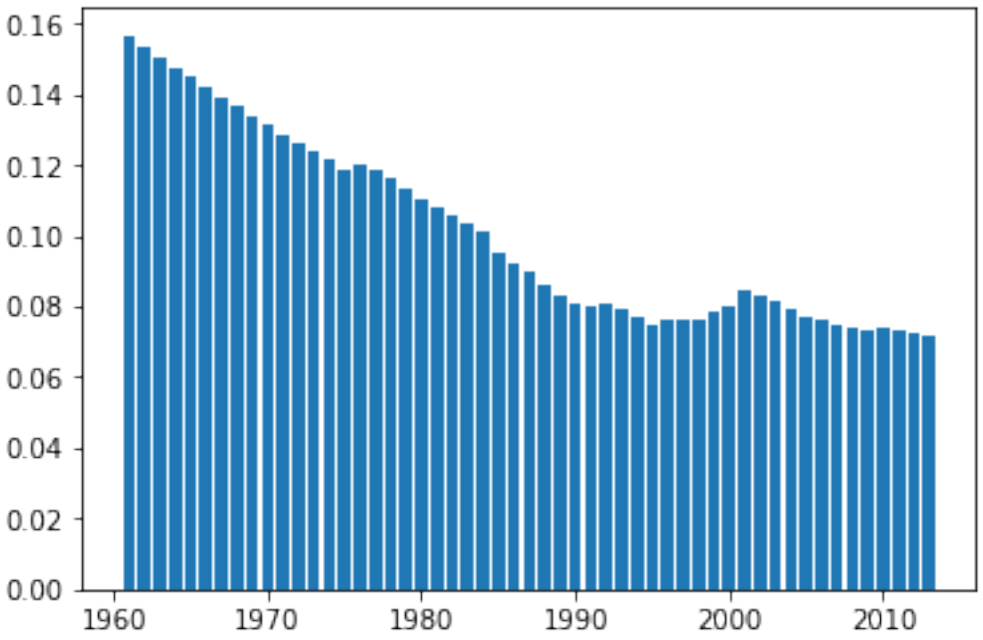
```
In [29]: stage.head()
```

Out[29]:

	CountryName	CountryCode	IndicatorName	IndicatorCode	Year	Value
49343	Vietnam	VNM	Arable land (hectares per person)	AG.LND.ARBL.HA.PC	1961	0.156656
77766	Vietnam	VNM	Arable land (hectares per person)	AG.LND.ARBL.HA.PC	1962	0.153642
106386	Vietnam	VNM	Arable land (hectares per person)	AG.LND.ARBL.HA.PC	1963	0.150668
135441	Vietnam	VNM	Arable land (hectares per person)	AG.LND.ARBL.HA.PC	1964	0.147709
167408	Vietnam	VNM	Arable land (hectares per person)	AG.LND.ARBL.HA.PC	1965	0.144754

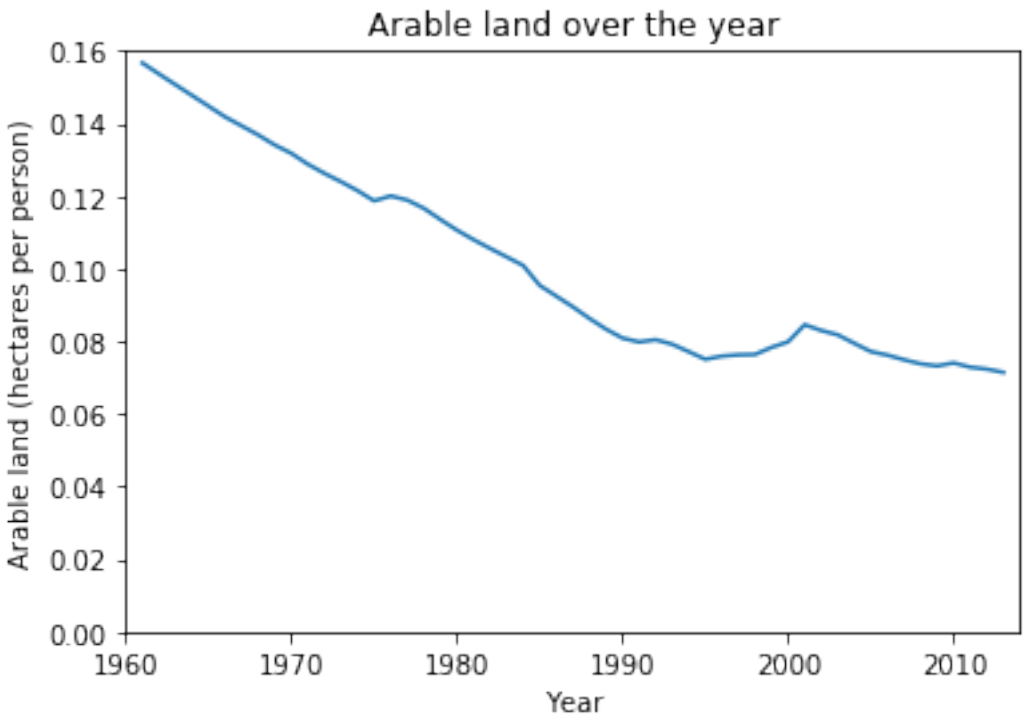
2.0.2 Let's see how arable land have changed over time using MatplotLib

```
In [52]: # get the years
years = stage['Year'].values # return numpy array
# get the values
arable_land = stage['Value'].values

# Get the last year
# print(years)

# create
plt.bar(years,arable_land)
plt.show()
```



Turns out arable land reduced over time, but let's make this graphic a bit more appealing before we continue to explore it.

```
In [53]: # switch to a line plot
         plt.plot(stage['Year'].values, stage['Value'].values)

         # Label the axes
         plt.xlabel('Year')
         plt.ylabel(stage['IndicatorName'].iloc[0])

         #label the figure
         plt.title('Arable land over the year')

         # to make more honest, start they y axis at 0
         plt.axis([1960, 2014, 0, 0.16])

         plt.show()
```



3 Step 3: Research Question

3.1 How does GDP affect the arable land per person?

3.1.1 Relationship between GDP and Arable land in Vietnam

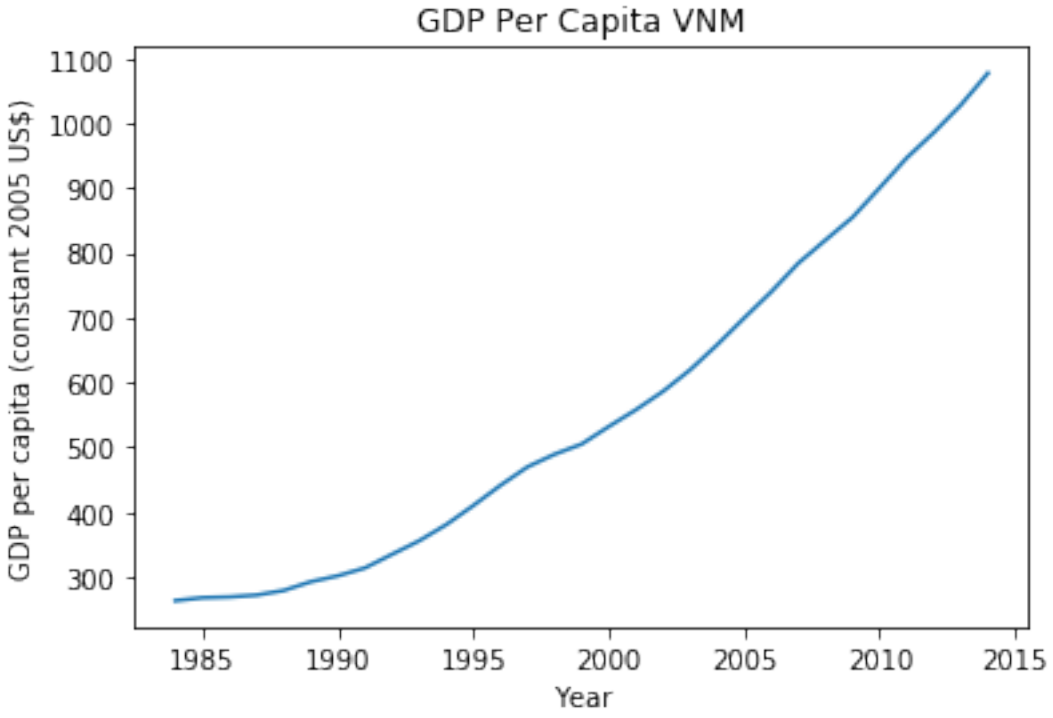
```
In [54]: # select GDP Per capita emissions for the United States
         hist_indicator = 'GDP per capita \(constant 2005'
         hist_country = 'VNM'

         mask1 = data['IndicatorName'].str.contains(hist_indicator)
         mask2 = data['CountryCode'].str.contains(hist_country)

         # stage is just those indicators matching the VNM for country code and Arable land ov

         gdp_stage = data[mask1 & mask2]

         #plot gdp_stage vs stage

In [55]: gdp_stage.head(2)

Out[55]:         CountryName CountryCode                      IndicatorName  \
         1431540     Vietnam         VNM  GDP per capita (constant 2005 US$)
         1519020     Vietnam         VNM  GDP per capita (constant 2005 US$)
```

```
             IndicatorCode  Year       Value
1431540  NY.GDP.PCAP.KD  1984  262.954377
1519020  NY.GDP.PCAP.KD  1985  267.509107
```

In [56]:
```
stage.head(2)
```

Out[56]:
```
      CountryName CountryCode                      IndicatorName  \
49343     Vietnam         VNM  Arable land (hectares per person)
77766     Vietnam         VNM  Arable land (hectares per person)

            IndicatorCode  Year     Value
49343  AG.LND.ARBL.HA.PC  1961  0.156656
77766  AG.LND.ARBL.HA.PC  1962  0.153642
```

In [57]:
```
# switch to a line plot
plt.plot(gdp_stage['Year'].values, gdp_stage['Value'].values)

# Label the axes
plt.xlabel('Year')
plt.ylabel(gdp_stage['IndicatorName'].iloc[0])

#label the figure
plt.title('GDP Per Capita VNM')

# to make more honest, start they y axis at 0
#plt.axis([1959, 2011,0,25])

plt.show()
```



Although arable land reduces over time, GDP increased.

3.1.2 ScatterPlot for comparing GDP against Arable land (hectares per person)

First, we'll need to make sure we're looking at the same time frames

```
In [61]: print("GDP Min Year = ", gdp_stage['Year'].min(), "max: ", gdp_stage['Year'].max())
         print("Arable land Min Year = ", stage['Year'].min(), "max: ", stage['Year'].max())
```

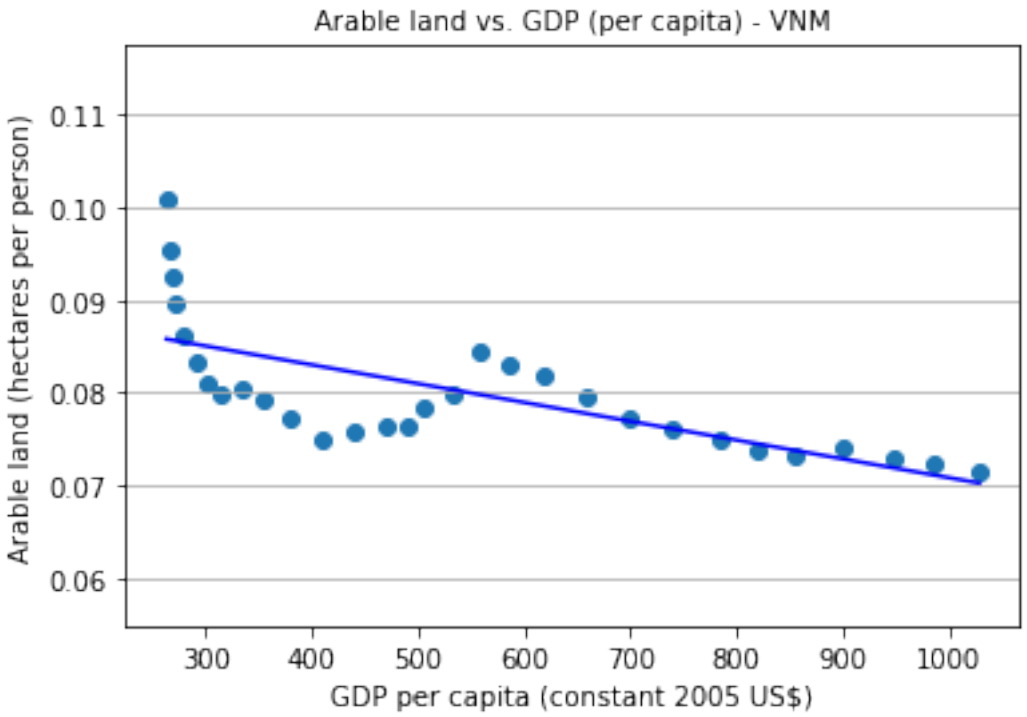
```
GDP Min Year =  1984 max:  2014
Arable land Min Year =  1961 max:  2013
```

Let's pick the data from 1984 to 2013.

```
In [59]: gdp_stage_trunc = gdp_stage[gdp_stage['Year'] < 2014]
         stage_trunc = stage[stage['Year'] > 1983]
         print(len(gdp_stage_trunc))
         print(len(stage_trunc))
```

```
30
30
```

```
In [60]: %matplotlib inline
         import matplotlib.pyplot as plt

         fig, axis = plt.subplots()
         # Grid lines, Xticks, Xlabel, Ylabel

         axis.yaxis.grid(True)
         axis.set_title('Arable land vs. GDP (per capita) - VNM',fontsize=10)
         axis.set_xlabel(gdp_stage_trunc['IndicatorName'].iloc[0],fontsize=10)
         axis.set_ylabel(stage_trunc['IndicatorName'].iloc[0],fontsize=10)

         X = gdp_stage_trunc['Value']
         Y = stage_trunc['Value']

         axis.scatter(X, Y)

         # Find the slope and intercept of the best fit line
         slope, intercept = np.polyfit(X, Y, 1)
         # Create a list of values in the best fit line
         abline_values = [slope * i + intercept for i in X]
         plt.plot(X, abline_values, 'b')

         plt.show()
```



This looks like a opposite relationship. We will test this by looking at correlation.

```
In [51]: np.corrcoef(gdp_stage_trunc['Value'],stage_trunc['Value'])

Out[51]: array([[ 1.        , -0.70609641],
                [-0.70609641,  1.        ]])
```

A correlation of -0.70 is a strong negative correlation. With the increase of GDP the arable land reduced.