

# CIS 1100

Jupyter Notebooks

Python

Fall 2024

University of Pennsylvania

# From `.py` to `.ipynb`

So far, when writing our Python programs, we:

- place code in a `.py` file
- run the program all the way through by writing `python my_file.py`

**Jupyter Notebooks** (or just Python Notebooks) provide an alternative scheme for writing & running code.

- place code in different **cells** inside of a `.ipynb` file
- run the program piece by piece by executing individual cells

# Notebooks and Cells

Jupyter Notebooks consist of several different cells.

- Cells can contain code or text
- Cells can be run individually
- The output of a cell is displayed underneath the cell
- Any effects of the cell are remembered & shared going forward

# Benefits & Drawbacks of Notebooks

Notebooks are extremely useful for data science and experimentation:

- Try small snippets and immediately see the results
- Save table outputs & figure drawings in the notebook to look at later

Notebooks are **not a good way to write all programs**:

- Running cells in different orders means that there's no single predictable output of your program
- Very easy to accidentally overwrite variables
- Get cluttered easily

# CIS 1100

Pandas & DataFrames

Python

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# Getting Started

- `pandas` is an extremely popular Python library used for managing tabular data
  - programmatic spreadsheets!
- It has so many tools and features, it's almost like learning an entirely new language
  - my role now: teach you a "starter kit"
  - your role later: learn what you need by building off of what you know.
- This material is adapted from the helpful `pandas` user guide

# Importing

```
import pandas as pd # !!!
```

# Importing

```
import pandas
```



# pandas Data Structures: Series

- A `Series` is a "one-dimensional labeled array holding data of any type"
  - Basically an indexed list
  - Usually only holds values of a single type at a time

# pandas Data Structures: DataFrame

- A `DataFrame` is a "two-dimensional data structure that holds data like a two-dimension array or a **table with rows and columns.**"
  - Basically a spreadsheet
  - Basically a bunch of `Series` grouped together

# Creating DataFrames

Technically, these can be built by combining a bunch of sequences together. Pretty rare to actually "build" the `DataFrame` yourself, though!

- More commonly: `pandas.read_csv()` to load a `DataFrame` from a CSV (comma separated values) file
- Others: `pandas.read_excel()`, `pandas.read_parquet()`, etc.

# Creating DataFrames from CSV

A CSV file contains several rows of data.

- Each row is broken up into several columns, usually separated by commas
- A row is an individual entry in a dataset
- A column is an individual dimension that each row shares

```
Territory;Bands;Population;Happiness
Afghanistan;2;37466414;2.404
Albania;7;3088385;5.199
Algeria;16;43576691;5.122
Andorra;2;85645;
Angola;8;33642646;
Argentina;1907;45864941;5.967
Armenia;19;3011609;5.399
...
```

# Creating DataFrames from CSV

A column in a CSV is like a `Series` or a column in a `DataFrame`

- sequence of values, (usually) all of the same type
- the first value in the column is the **header**, which gives a name to what the column exists to represent

```
Territory  
Afghanistan  
Albania  
Algeria  
Andorra  
Angola  
Argentina  
Armenia  
...
```

# Creating DataFrames from CSV

A row in a CSV is an individual data point in our larger set

- in this case, contains the name & statistics for a single country
- sometimes a row will have *missing data*

```
Algeria;16;43576691;5.122  
Andorra;2;85645;
```

# Creating DataFrames from CSV

`pandas.read_csv(filename)` turns a CSV file into a `DataFrame`. There are *a gazillion other options*, though.

Keyword Argument	Usage
<code>sep</code>	Specify the separator string between columns
<code>header</code>	Specify which row gives the column names, if any
<code>names</code>	Provide your own "header" by giving the columns your own names
<code>usecols</code>	Choose which columns you want to read from the CSV
<code>index_col</code>	Choose which column will be the index
<code>dtype</code>	Which data type to use for each column

# Creating Our DataFrame

```
df = pandas.read_csv("metal_bands.csv", sep=";")  
df
```

	Territory	Bands	Population	Happiness
0	Afghanistan	2.0	37466414.0	2.404
1	Albania	7.0	3088385.0	5.199
2	Algeria	16.0	43576691.0	5.122
3	Andorra	2.0	85645.0	NaN
4	Angola	8.0	33642646.0	NaN
...	...	...	...	...
169	Venezuela	343.0	29069153.0	4.925
170	Vietnam	21.0	102789598.0	5.485
171	Yemen	NaN	NaN	4.197
172	Zambia	NaN	NaN	3.760
173	Zimbabwe	2.0	14829988.0	2.995

174 rows x 4 columns



# Viewing DataFrames

```
df.head()
```

	<b>Territory</b>	<b>Bands</b>	<b>Population</b>	<b>Happiness</b>
<b>0</b>	Afghanistan	2.0	37466414.0	2.404
<b>1</b>	Albania	7.0	3088385.0	5.199
<b>2</b>	Algeria	16.0	43576691.0	5.122
<b>3</b>	Andorra	2.0	85645.0	NaN
<b>4</b>	Angola	8.0	33642646.0	NaN

`.head()` and `.tail()` return views of the top & bottom rows of a `DataFrame`

# Viewing DataFrames

`.columns` is a variable that shows the column names for a `DataFrame`

```
df.columns
```

```
Index(['Territory', 'Bands', 'Population', 'Happiness'], dtype='object')
```

# Viewing

# DataFrames

`.describe()` produces summary statistics for each of the columns in your DataFrame

```
df.describe()
```

	<b>Bands</b>	<b>Population</b>	<b>Happiness</b>
<b>count</b>	145.000000	1.450000e+02	146.000000
<b>mean</b>	523.862069	4.681290e+07	5.553575
<b>std</b>	1673.237176	1.650167e+08	1.086843
<b>min</b>	1.000000	5.321000e+03	2.404000
<b>25%</b>	7.000000	2.711566e+06	4.888750
<b>50%</b>	38.000000	8.884864e+06	5.568500
<b>75%</b>	285.000000	3.364265e+07	6.305000
<b>max</b>	17557.000000	1.397898e+09	7.821000

# CIS 11000

Missing Values

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# Data is Messy

Every real-world dataset has imperfections in it:

- bias in collecting data (hard for us to fix)
- typos in data entry (might require manual fixes)
- missing or nonsensical values (require systematic fixes)

	Territory	Bands	Population	Happiness
0	Afghanistan	2.0	37466414.0	2.404
1	Albania	7.0	3088385.0	5.199
2	Algeria	16.0	43576691.0	5.122
3	Andorra	2.0	85645.0	NaN
4	Angola	8.0	33642646.0	NaN
...	...	...	...	...
169	Venezuela	343.0	29069153.0	4.925
170	Vietnam	21.0	102789598.0	5.485
171	Yemen	NaN	NaN	4.197
172	Zambia	NaN	NaN	3.760
173	Zimbabwe	2.0	14829988.0	2.995

# Missing or Nonsensical Values

There are some NaN values in rows 3, 4, 171, and 172...

- NaN → not a number
- Value may have been missing in original CSV or typed in an inscrutable way.

174 rows x 4 columns

# Sniffing out NaN

```
df.isna().sum()
```

- `.isna()` produces a new `DataFrame` with the same shape, but replacing all `NaN` with `True` and all other values with `False`.
- `.sum()` counts up all of the instances of `True` in a column

```
Territory      0  
Bands          29  
Population     29  
Happiness      28  
dtype: int64
```

i.e. 0 rows with `NaN` for `Territory`, 29 rows with `NaN` for `Bands`, etc.

# How to Solve NaN

There's no individual right answer for how to deal with missing data.

- `.dropna()` produces a new `DataFrame` by dropping all rows with at least one missing value.
- `.fillna(value=0)` produces a new `DataFrame` by replacing all values of `NaN` with `0`

On the one hand, losing all of the rows with any missing data can be quite wasteful.

But on the other hand, it's not clear how to interpret missing data. Do your best. 🙄



# CIS 11100

Selection

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# Choosing Columns

Three major ways:

1. When the column name is a valid Python identifier, you can use the `.` syntax to select a single column as a `Series`

```
df.Bands
```

```
0      2.0  
1      7.0  
2     16.0  
3      2.0  
4      8.0
```

```
...
```

```
169   343.0  
170    21.0  
171     NaN  
172     NaN  
173     2.0
```

```
Name: Bands, Length: 174, dtype: float64
```

# Choosing Columns

Three major ways:

1. When the column name is a valid Python identifier, you can use the `.` syntax to select a single column as a `Series`
2. No matter the column name, you can use indexing `[]` syntax to select a single column as a `Series`

```
df["Bands"]
```

```
0      2.0  
1      7.0  
2     16.0  
3      2.0  
4      8.0
```

```
...  
169    343.0  
170     21.0  
171     NaN  
172     NaN  
173      2.0
```

```
Name: Bands, Length: 174, dtype: float64
```

# Choosing Columns

Three major ways:

1. When the column name is a valid Python identifier, you can use the `.` syntax to select a single column as a `Series`
2. No matter the column name, you can use indexing `[]` syntax to select a single column as a `Series`
3. You can index with a list of column names to select several columns as a `DataFrame`

```
df[["Territory", "Bands"]]
```

	Territory	Bands
0	Afghanistan	2.0
1	Albania	7.0
2	Algeria	16.0
3	Andorra	2.0
4	Angola	8.0
...	...	...
169	Venezuela	343.0
170	Vietnam	21.0
171	Yemen	NaN
172	Zambia	NaN
173	Zimbabwe	2.0

174 rows x 2 columns

# Choosing Rows

You can select a *slice* of a DataFrame by indexing using range syntax.

```
df[10:20]
```

	<b>Territory</b>	<b>Bands</b>	<b>Population</b>	<b>Happiness</b>
<b>10</b>	Bahrain	6.0	1526929.0	6.647
<b>11</b>	Bangladesh	65.0	164098818.0	5.155
<b>12</b>	Barbados	3.0	301865.0	NaN
<b>13</b>	Belarus	293.0	9441842.0	5.821
<b>14</b>	Belgium	666.0	11778842.0	6.805

# Choosing Rows

You can select an individual row from a `DataFrame` as a `Series` by using `.iloc[index]`

```
df.iloc[13]
```

```
Territory      Belarus  
Bands          293.0  
Population     9441842.0  
Happiness      5.821  
Name: 13, dtype: object
```

# CIS 11000

Finer Points about  
the DataFrame

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# The Index

Like any sequence, a `Series` and `DataFrame` will always have an `index`

- `Index` is actually a special type in Pandas
- By default, a `DataFrame` read from a CSV is indexed by row number
- Unlike lists, Pandas data doesn't have to be indexed by numbers

	Territory	Bands	Population	Happiness
0	Afghanistan	2.0	37466414.0	2.404
1	Albania	7.0	3088385.0	5.199
2	Algeria	16.0	43576691.0	5.122
3	Andorra	2.0	85645.0	NaN
4	Angola	8.0	33642646.0	NaN
...	...	...	...	...
169	Venezuela	343.0	29069153.0	4.925
170	Vietnam	21.0	102789598.0	5.485
171	Yemen	NaN	NaN	4.197
172	Zambia	NaN	NaN	3.760
173	Zimbabwe	2.0	14829988.0	2.995

174 rows x 4 columns



# Choosing the Index

- Choose the index by: `df = df.set_index(keys)`
  - `keys` can be a single column name (as `str`) or a list of columns
- `Territory` is no longer a column and so cannot be easily modified 🙄

```
df2 = df.copy()
df2 = df2.set_index("Territory")
df2.head()
```

	<b>Bands</b>	<b>Population</b>	<b>Happiness</b>	<b>Bands Per Capita</b>
<b>Territory</b>				
<b>Afghanistan</b>	2.0	37.466414	2.404	0.053381
<b>Albania</b>	7.0	3.088385	5.199	2.266557
<b>Algeria</b>	16.0	43.576691	5.122	0.367169
<b>Andorra</b>	2.0	0.085645	NaN	23.352210
<b>Angola</b>	8.0	33.642646	NaN	0.237793

# Queries over the Index

```
df2["Belarus":"Botswana"]
```

	<b>Bands</b>	<b>Population</b>	<b>Happiness</b>	<b>Bands Per Capita</b>
<b>Territory</b>				
<b>Belarus</b>	293.0	9.441842	5.821	31.032080
<b>Belgium</b>	666.0	11.778842	6.805	56.542061
<b>Belize</b>	1.0	0.405633	NaN	2.465283
<b>Benin</b>	NaN	NaN	4.623	NaN
<b>Bolivia</b>	243.0	11.758869	5.600	20.665253
<b>Bosnia and Herzegovina</b>	86.0	3.824782	5.768	22.484942
<b>Botswana</b>	7.0	2.350667	3.471	2.977878

If our index is now the **Territory**,  
we can select ranges of territory  
names using **[start:stop]**

# Operations Create New DataFrames

```
df.rename(columns={"Territory" : "Name"})
```

	Name	Bands	Population	Happiness	Bands Per Capita
0	Afghanistan	2.0	37.466414	2.404	0.053381
1	Albania	7.0	3.088385	5.199	2.266557
2	Algeria	16.0	43.576691	5.122	0.367169
3	Andorra	2.0	0.085645	NaN	23.352210
4	Angola	8.0	33.642646	NaN	0.237793
...	...	...	...	...	...

Suppose we want to rename a column.

`.rename(columns=name_mapping)`  
comes in handy!

# Operations Create New DataFrames

OK. Then, let's just remind ourselves what the DataFrame looks like with `df.columns`...

```
Index(['Territory', 'Bands', 'Population', 'Happiness', 'Bands Per Capita'], dtype='object')
```

Where did our `Name` column go? Why is `Territory` still there? 😡😡😡😡

# Operations Create New DataFrames

Operations that seem to modify a DataFrame actually create **new** tables.

- The DataFrame that a function was called on is totally unchanged
- If we want the modification to apply to the DataFrame we're working with, we have to save it back into the variable:

```
df = df.rename(columns={"Territory" : "Name"})
```

- If you just want to see what an operation does without modifying the DataFrame, then you can perform the operation without saving it back:

```
df.rename(columns={"Territory" : "Name"}) # not "permanent"
```

# CIS 11000

Filtering

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# Boolean Indexing

```
df["Bands"] > 50
```

```
0      False
1      False
2      False
3      False
4      False
...
169    True
170    False
171    False
172    False
173    False
```

```
Name: Bands, Length: 174, dtype: bool
```

Pandas allows you to write boolean expressions over a `Series/DataFrame` that we typically do on individual values:

- (assuming `x` is a number) `x > 50` is an expression that produces either `True` or `False`
- `df["Bands"]` is a `Series` of numbers, and `df["Bands"] > 50` is a `Series` of booleans.

```
df[df["Bands"] > 50]
```

	Territory	Bands	Population	Happiness
5	Argentina	1907.0	45864941.0	5.967
7	Australia	1545.0	25809973.0	7.162
8	Austria	664.0	8884864.0	7.163
11	Bangladesh	65.0	164098818.0	5.155
13	Belarus	293.0	9441842.0	5.821
...	...	...	...	...
163	Ukraine	715.0	43745640.0	5.084
165	United Kingdom	3244.0	66052076.0	6.943
166	United States	17557.0	334998398.0	6.977
167	Uruguay	121.0	3398239.0	6.474
169	Venezuela	343.0	29069153.0	4.925

70 rows x 4 columns

# Boolean Indexing & Filtering

- Alone, a `Series` of booleans may not be so interesting.
- Used as an index into another `DataFrame`, this `Series` allows us to **select only those rows that meet a condition.**

*"Show me the rows of `df` where the number of bands is greater than 50!"*



# More Complex Filtering

Same as logical `and` / `or`, we can combine filtering expressions in Pandas.

- Need to use `&` for "and", `|` for "or"
- Annoyingly, terms usually need to be wrapped in parentheses

```
# "Many bands AND lower happiness"  
df[(df["Bands"] > 50) & (df["Happiness"] < 4.0)]  
  
# "Few bands OR low population"  
df[(df["Bands"] < 10) | (df["Population"] < 5000000)]
```

```
df[df["Bands"] > 50]
```

	Territory	Bands	Population	Happiness
5	Argentina	1907.0	45864941.0	5.967
7	Australia	1545.0	25809973.0	7.162
8	Austria	664.0	8884864.0	7.163
11	Bangladesh	65.0	164098818.0	5.155
13	Belarus	293.0	9441842.0	5.821
...	...	...	...	...
163	Ukraine	715.0	43745640.0	5.084
165	United Kingdom	3244.0	66052076.0	6.943
166	United States	17557.0	334998398.0	6.977
167	Uruguay	121.0	3398239.0	6.474
169	Venezuela	343.0	29069153.0	4.925

70 rows x 4 columns

# Boolean Indexing & Filtering

*"Show me the rows of `df` where the number of bands is greater than 50 and the happiness is less than 4.0."*

```
df[(df["Bands"] > 50) & (df["Happiness"] < 4.0)]
```

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Setting

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# Systematically Modifying a Column

Suppose "true" population numbers are too unwieldy—  
would like to work with population as number of millions

- A little easier to filter:
  - `df["Population"] < 4` instead of `df["Population"] < 4000000`
- Can set replace a column's values by setting that column equal to a new `Series` with a compatible index.

# Scaling Population

```
df["Population"] = df["Population"] / 1000000  
df
```

	Territory	Bands	Population	Happiness
0	Afghanistan	2.0	37.466414	2.404
1	Albania	7.0	3.088385	5.199
2	Algeria	16.0	43.576691	5.122
3	Andorra	2.0	0.085645	NaN
4	Angola	8.0	33.642646	NaN
...	...	...	...	...
169	Venezuela	343.0	29.069153	4.925
170	Vietnam	21.0	102.789598	5.485
171	Yemen	NaN	NaN	4.197
172	Zambia	NaN	NaN	3.760
173	Zimbabwe	2.0	14.829988	2.995

```
df["Population"] = df["Population"] / 1000000
```

- RHS: create a new `Series` with all of the values of `df["Population"]` but scaled down by a factor of a million
- LHS: replace the `df["Population"]` column with the RHS
- **This modifies the `DataFrame`!**

	Territory	Bands Per Capita
0	Afghanistan	0.053381
1	Albania	2.266557
2	Algeria	0.367169
3	Andorra	23.352210
4	Angola	0.237793
...	...	...
169	Venezuela	11.799449
170	Vietnam	0.204301
171	Yemen	NaN
172	Zambia	NaN
173	Zimbabwe	0.134862

# Creating a New Column

Suppose we want a notion of "bands per capita", or number of heavy metal bands per one million citizens.

```
df["Bands Per Capita"] = df["Bands"] / df["Population"]
df[["Territory", "Bands Per Capita"]]
```

# Setting is Permanent!

- If you overwrite a column, that data is lost unless you "reload" from the source data
- If you add a new column, it's stuck in the data frame unless you remove it manually
  - Remove Columns: `df = df.drop(columns=["Bands Per Capita"])`

# CIS 1100

Strings & Dealing with Types

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# Syntax for String Operations

When performing operations on string-valued columns, you need to insert `str` into the function call.

Operation	Call
Getting the length of country names	<code>df["Territory"].str.len()</code>
Converting country names to all lowercase	<code>df["Territory"].str.lower()</code>
Removing any whitespace around a country's name	<code>df["Territory"].str.strip()</code>
Replacing spaces within names with <code>_</code>	<code>df["Territory"].str.replace(" ", "_")</code>

*All of these still need to be "saved back" to be permanent.*

# Concatenating Strings

Suppose I have a `DataFrame` with first names and last names. I might want to use/store full names as well!

```
roster = pandas.DataFrame([{"first" : "Harry", "last" : "Smith"},  
                           {"first" : "Henry", "last" : "Gifford"},  
                           {"first" : "Travis", "last" : "McGaha"}])
```

roster

	<b>first</b>	<b>last</b>
<b>0</b>	Harry	Smith
<b>1</b>	Henry	Gifford
<b>2</b>	Travis	McGaha

# Concatenating Strings

`this_col.str.cat(other_col)` allows you to join the contents of one string `Series` with another:

```
roster["full"] = roster["first"].str.cat(roster["last"])
roster
```

	<b>first</b>	<b>last</b>	<b>full</b>
<b>0</b>	Harry	Smith	HarrySmith
<b>1</b>	Henry	Gifford	HenryGifford
<b>2</b>	Travis	McGaha	TravisMcGaha

... we probably need a space.

# Concatenating Strings

`this_col.str.cat(other_col, sep=" ")` allows you to join the contents of one string `Series` with another, adding a space in between:

```
roster["full"] = roster["first"].str.cat(roster["last"], sep=" ")
roster
```

	<b>first</b>	<b>last</b>	<b>full</b>
<b>0</b>	Harry	Smith	Harry Smith
<b>1</b>	Henry	Gifford	Henry Gifford
<b>2</b>	Travis	McGaha	Travis McGaha

# Checking for Patterns

`str.contains(pattern)` allows you to check if a column contains a certain pattern.

- `pattern` can be a string specifying a pattern literally or a *regular expression* 🙄
- returns a boolean series, so can be used for Boolean Indexing (filtering)

```
df[df["Territory"].str.contains("New")]
```

	Territory	Bands	Population	Happiness	Bands Per Capita
113	New Caledonia	5.0	0.293608	NaN	17.029509
114	New Zealand	288.0	4.991442	7.2	57.698757

# Splitting Strings

```
df["split_names"] = df["Territory"].str.split(" ")  
df
```

	Territory	Bands	Population	Happiness	Bands Per Capita	split_names
0	Afghanistan	2.0	37.466414	2.404	0.053381	[Afghanistan]
1	Albania	7.0	3.088385	5.199	2.266557	[Albania]
2	Algeria	16.0	43.576691	5.122	0.367169	[Algeria]
3	Andorra	2.0	0.085645	NaN	23.352210	[Andorra]
4	Angola	8.0	33.642646	NaN	0.237793	[Angola]
...	...	...	...	...	...	...
169	Venezuela	343.0	29.069153	4.925	11.799449	[Venezuela]
170	Vietnam	21.0	102.789598	5.485	0.204301	[Vietnam]
171	Yemen	NaN	NaN	4.197	NaN	[Yemen]
172	Zambia	NaN	NaN	3.760	NaN	[Zambia]
173	Zimbabwe	2.0	14.829988	2.995	0.134862	[Zimbabwe]

`str.split(sep)` splits a column of strings into lists of strings

- This is a little weird: the value stored in a cell of the `DataFrame` is now a list...

# Splitting Strings

```
df["split_names"].str.get(0)
```

```
0      Afghanistan
1         Albania
2         Algeria
3         Andorra
4         Angola
...
169    Venezuela
170     Vietnam
171      Yemen
172     Zambia
173    Zimbabwe
Name: split_names, Length: 174, dtype: object
```

`str.split(sep)` splits a column of strings into lists of strings

- To get the value at a given index of a list in a `DataFrame`, use `.str.get()`

# Splitting Strings

```
df["split_names"].str.len()
```

```
0      1
1      1
2      1
3      1
4      1
...
169    1
170    1
171    1
172    1
173    1
Name: split_names, Length: 174, dtype: int64
```

`str.split(sep)` splits a column of strings into lists of strings

- To get the length a list in a DataFrame, use `.str.len()`



# Splitting Strings

Can use string splitting & length checking to ask more complex questions:

*"Show me the countries that have more than one-word names."*

```
df[df["split_names"].str.len() > 1]
```

	<b>Territory</b>	<b>Bands</b>	<b>Population</b>	<b>Happiness</b>	<b>Bands Per Capita</b>	<b>split_names</b>
<b>18</b>	Bosnia and Herzegovina	86.0	3.824782	5.768	22.484942	[Bosnia, and, Herzegovina]
<b>23</b>	Burkina Faso	NaN	NaN	4.670	NaN	[Burkina, Faso]
<b>33</b>	Costa Rica	235.0	5.151140	6.582	45.620969	[Costa, Rica]
<b>37</b>	Czech Republic	964.0	10.702596	6.920	90.071605	[Czech, Republic]
<b>39</b>	Dominican Republic	31.0	10.597348	5.737	2.925260	[Dominican, Republic]
<b>40</b>	East Timor	1.0	1.413958	NaN	0.707235	[East, Timor]
<b>43</b>	El Salvador	96.0	6.528135	6.120	14.705578	[El, Salvador]

# CIS 1100

Plotting

Python

Fall 2024

University of Pennsylvania

# Plotting with `.plot()`

`DataFrame.plot()` is an extremely powerful function. On its own, it can do:

- line plots
- bar plots
- horizontal bar plots
- histograms
- box plots
- Kernel Density Estimation plots
- area plots
- pie plots
- scatter plots
- hexbin plots

# Plotting with `.plot()`

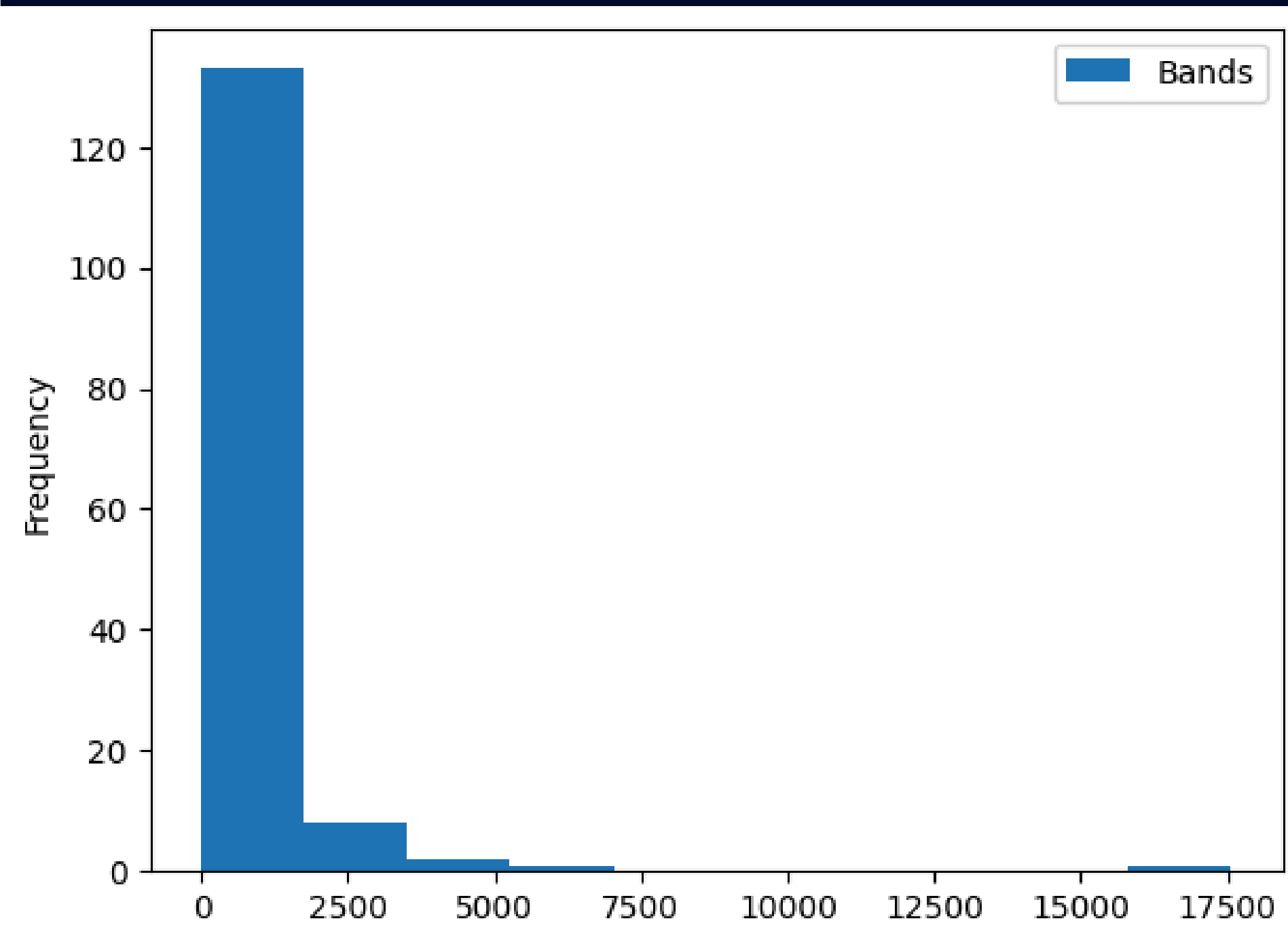
`DataFrame.plot()` is an extremely powerful function.

- In later lectures, we'll talk about all the finer points of data visualization
- For now, just READ THE DOCUMENTATION!

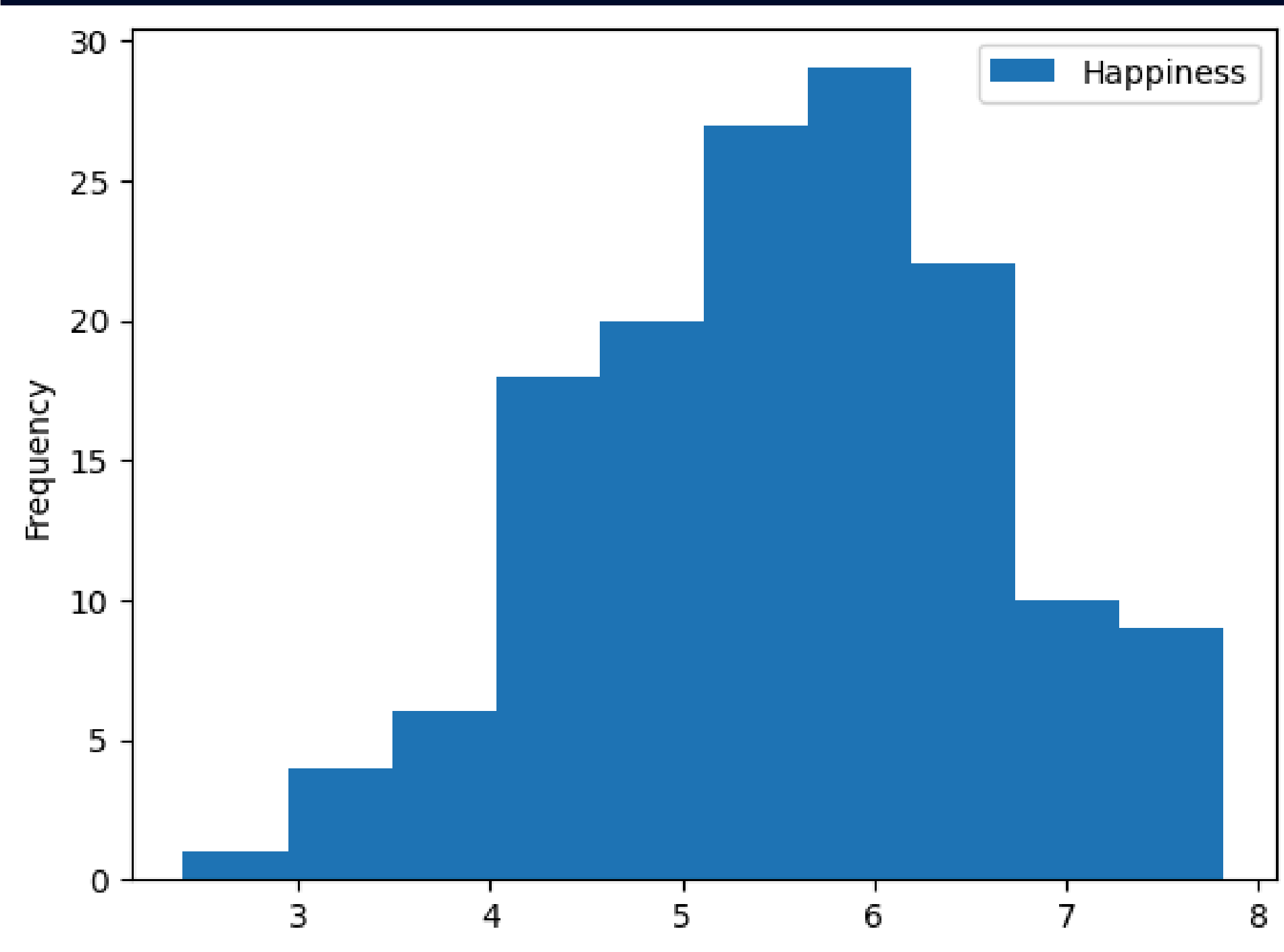
# Histograms

*What's the overall distribution of a given column in my DataFrame?*

```
df.plot(kind="hist", y="Bands")
```



# Histograms



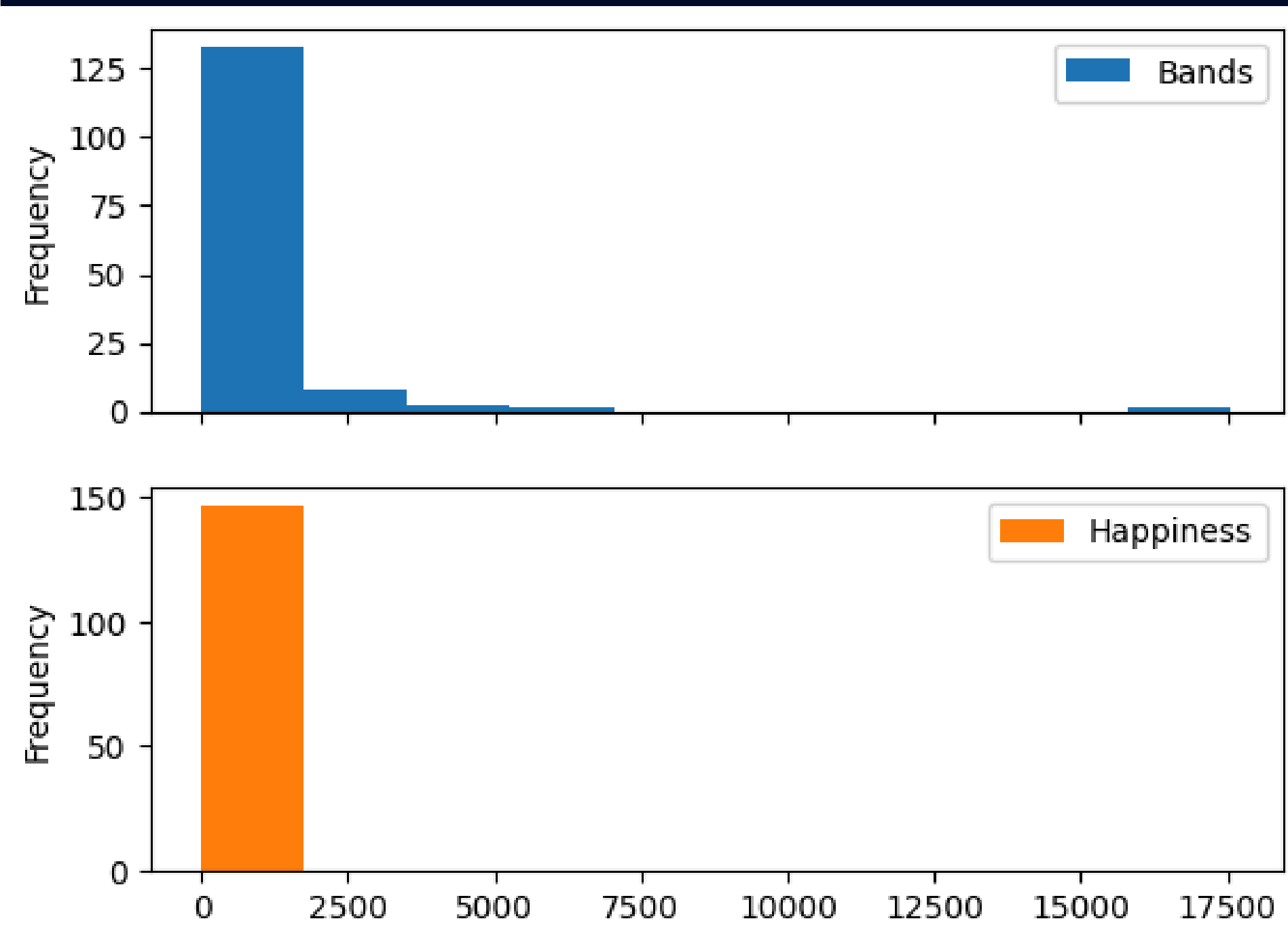
Change `y` to pick a different column to map out:

```
df.plot(kind="hist", y="Happiness")
```

# Histograms

Create a list of columns for `y` and use `subplots=True` to generate multiple plots at once. Needs refinement... 😊

```
df.plot(kind="hist", y=["Bands", "Happiness"],  
        subplots=True)
```



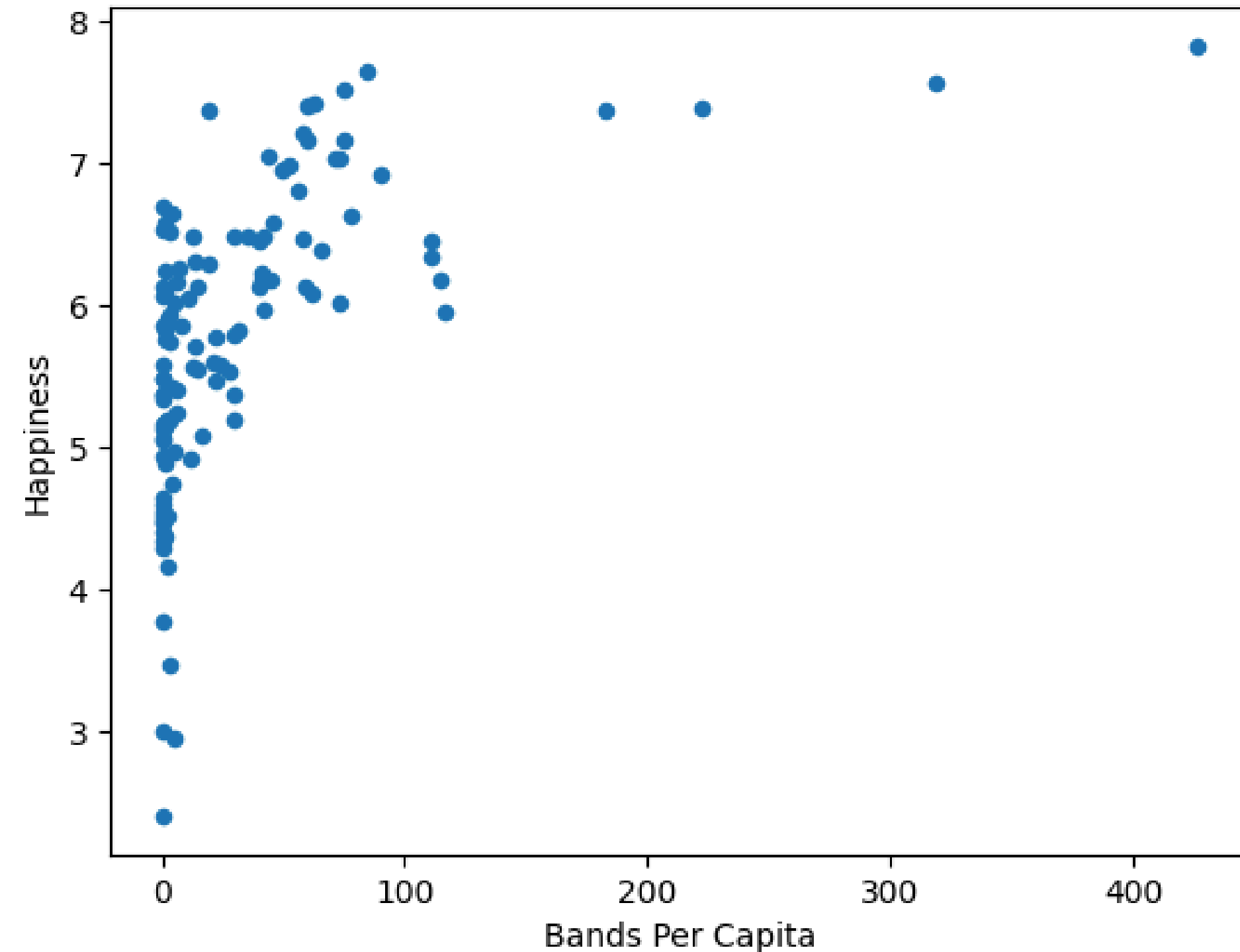
# Scatter Plots

Not an excellent plot, but...

```
df.plot(kind="scatter", x="Bands Per Capita", y="Happiness",  
        title="How Do Metal Bands Influence a Country's Happiness?")
```

- `x`: the column to show on the x axis
- `y`: the column to show on the y axis
- `title`: add a title to the figure

How Do Metal Bands Influence a Country's Happiness?





# Plotting

- Best learned by trying things with different data sets
- You can read about all of the kinds of plots that come with Pandas and their options by reading the documentation
- Will talk in later modules about best practices for picking & designing plots
- Will work in class to make different kinds of plots with different datasets.