# Pandas: An overview

# Pandas Data Types

| Pandas dtype | Python type | Usage |
|---|---|---|
| object | str | Text |
| int64 | int | Integer numbers |
| float64 | float | Floating point numbers |
| bool | bool | True/False values |
| datetime64 | NA | Date and time values |
| timedelta[ns] | NA | Differences between two datetimes |
| category | NA | Finite list of text values |

# Pandas Data Structure: Series

One-dimensional labeled array

## Pandas Data Structure: Series

One-dimensional labeled array

In [5]:
```
pd.Series([1.0, 2.4, 3.7])
```

Out[5]:
```
0    1.0
1    2.4
2    3.7
dtype: float64
```

## Pandas Data Structure: Series

One-dimensional labeled array

In [5]:
```
pd.Series([1.0, 2.4, 3.7])
```

Out[5]:
```
0    1.0
1    2.4
2    3.7
dtype: float64
```

In [6]:
```
pd.Series({'a' : 1.0, 'b' : 2.4, 'c' : 3.7}, dtype="int64")
```

Out[6]:
```
a    1
b    2
c    3
dtype: int64
```

## Pandas Data Structure: DataFrame

- Two-dimensional, like a spreadsheet or SQL table
- Rows have an *index*
- Columns have a *label* and a *data type*
- Commonly used variable name: `df`

## Pandas Data Structure: DataFrame

- Two-dimensional, like a spreadsheet or SQL table
- Rows have an *index*
- Columns have a *label* and a *data type*
- Commonly used variable name: `df`

In [2]:
```
df = pd.DataFrame({'somecat' : ['a', 'b', 'b', 'a'],
  'somedate': [pd.datetime.utcnow(), pd.datetime(2000,1,1), None, None],
  'somefloat' : [1.4, 1.23456789e-5, None, np.pi],
  'someint' : [-1, 0, 42, 1000],
  'sometext': ['foo', 'bar', 'baz', None]})
df
```

Out[2]:

| | somecat | somedate | somefloat | someint | sometext |
|---|---|---|---|---|---|
| **0** | a | 2018-08-27 11:07:08.906312 | 1.400000 | -1 | foo |
| **1** | b | 2000-01-01 00:00:00.000000 | 0.000012 | 0 | bar |
| **2** | b | NaT | NaN | 42 | baz |
| **3** | a | NaT | 3.141593 | 1000 | None |

# DataFrame: data types

## DataFrame: data types

In [15]:
```
df.dtypes
```

Out[15]:
```
somecat              object
somedate     datetime64[ns]
somefloat           float64
someint               int64
sometext             object
dtype: object
```

# DataFrame: head, tail, sample

## DataFrame: head, tail, sample

In [17]:
```
df.head(2)
```

Out[17]:

| | somecat | somedate | somefloat | someint | sometext |
|---|---|---|---|---|---|
| **0** | a | 2018-08-15 06:43:48.751782 | 1.400000 | -1 | foo |
| **1** | b | 2000-01-01 00:00:00.000000 | 0.000012 | 0 | bar |

## DataFrame: head, tail, sample

In [17]:
```
df.head(2)
```

Out[17]:

| | somecat | somedate | somefloat | someint | sometext |
|---|---|---|---|---|---|
| **0** | a | 2018-08-15 06:43:48.751782 | 1.400000 | -1 | foo |
| **1** | b | 2000-01-01 00:00:00.000000 | 0.000012 | 0 | bar |

In [56]:
```
df.tail(2)
```

Out[56]:

| | somecat | somedate | somefloat | someint | sometext |
|---|---|---|---|---|---|
| **2** | b | NaT | NaN | 42 | baz |
| **3** | a | NaT | 3.141593 | 1000 | None |

## DataFrame: head, tail, sample

In [17]:
```
df.head(2)
```

Out[17]:

| | somecat | somedate | somefloat | someint | sometext |
|---|---|---|---|---|---|
| **0** | a | 2018-08-15 06:43:48.751782 | 1.400000 | -1 | foo |
| **1** | b | 2000-01-01 00:00:00.000000 | 0.000012 | 0 | bar |

In [56]:
```
df.tail(2)
```

Out[56]:

| | somecat | somedate | somefloat | someint | sometext |
|---|---|---|---|---|---|
| **2** | b | NaT | NaN | 42 | baz |
| **3** | a | NaT | 3.141593 | 1000 | None |

In [57]:
```
df.sample(2)
```

Out[57]:

| | somecat | somedate | somefloat | someint | sometext |
|---|---|---|---|---|---|
| **3** | a | NaT | 3.141593 | 1000 | None |
| **0** | a | 2018-05-06 17:58:40.283808 | 1.400000 | -1 | foo |

## DataFrame: dimensions

- `shape`: number of rows and columns
- `count()`: number of values per column (excluding `None`)

## DataFrame: dimensions

- `shape`: number of rows and columns
- `count()`: number of values per column (excluding `None`)

In [58]:
```
df.shape
```

Out[58]:
```
(4, 5)
```

## DataFrame: dimensions

- `shape`: number of rows and columns
- `count()`: number of values per column (excluding `None`)

In [58]:
```
df.shape
```

Out[58]:
```
(4, 5)
```

In [59]:
```
df.count()
```

Out[59]:
```
somecat      4
somedate     2
somefloat    3
someint      4
sometext     3
dtype: int64
```

# Data Import and Export

## Data Export

- Pandas DataFrame has many `to_*` functions for exporting data
- Writes to file if path is provided
- Many options to specify format:
  - JSON: orient, date formatting, ...
  - CSV: separator, column order, ...
  - SQL: replace, append, data type mapping, ...

## Data Export

- Pandas DataFrame has many `to_*` functions for exporting data
- Writes to file if path is provided
- Many options to specify format:
  - JSON: orient, date formatting, ...
  - CSV: separator, column order, ...
  - SQL: replace, append, data type mapping, ...

In [11]:
```
df.to_json('data/demo.json', orient='columns')
df.to_json()
```

Out[11]:
```
'{"somecat":{"0":"a","1":"b","2":"b","3":"a"},"somedate":{"0":153457254481
1,"1":946684800000,"2":null,"3":null},"somefloat":{"0":1.4,"1":0.000012345
7,"2":null,"3":3.1415926536},"someint":{"0":-1,"1":0,"2":42,"3":1000},"sometex
t":{"0":"foo","1":"bar","2":"baz","3":null}}'
```

## Data Export

- Pandas DataFrame has many `to_*` functions for exporting data
- Writes to file if path is provided
- Many options to specify format:
  - JSON: orient, date formatting, ...
  - CSV: separator, column order, ...
  - SQL: replace, append, data type mapping, ...

In [11]:
```
df.to_json('data/demo.json', orient='columns')
df.to_json()
```

Out[11]:
```
'{"somecat":{"0":"a","1":"b","2":"b","3":"a"},"somedate":{"0":153457254481
1,"1":946684800000,"2":null,"3":null},"somefloat":{"0":1.4,"1":0.000012345
7,"2":null,"3":3.1415926536},"someint":{"0":-1,"1":0,"2":42,"3":1000},"sometex
t":{"0":"foo","1":"bar","2":"baz","3":null}}'
```

In [30]:
```
df.to_csv('data/demo.csv', index=False)
df.to_csv()
```

Out[30]:
```
',somecat,somedate,somefloat,someint,sometext\n0,a,2018-08-15 06:43:48.751782,
1.4,-1,foo\n1,b,2000-01-01 00:00:00.000000,1.23456789e-05,0,bar\n2,b,,,42,baz
\n3,a,,3.141592653589793,1000,\n'
```

## Data Import

- Pandas has many `read_*` functions for importing data into a DataFrame
  - CSV, SQL (query or table), JSON, XML
- CSV:
  - Tries to automagically detect: separators, column names, data types
  - Fails sometimes, but can be defined explicitely
  - Parsing of dates needs to be defined explicitely
- SQL:
  - Requires connection to database

## Data Import

- Pandas has many `read_*` functions for importing data into a DataFrame
  - CSV, SQL (query or table), JSON, XML
- CSV:
  - Tries to automagically detect: separators, column names, data types
  - Fails sometimes, but can be defined explicitely
  - Parsing of dates needs to be defined explicitely
- SQL:
  - Requires connection to database

In [36]:
```
df = pd.read_csv('data/demo.csv', parse_dates=['somedate'])
```

# Exercise 4 - Pandas overview & Basic functions

Goals:

- Be able to read data from into a Pandas DataFrame
- Get a brief overview about the data

Tasks:

- Open and inspect the Rossmann sample data with the Jupyter web interface
- Import store.csv and sales.csv data as Data Frame
  - Observe the warning when reading *sales* data
- Explore the data briefly:
  - Print the ten first/last/random stores and sales
  - What are the data types of the columns?
  - How many rows and colums are in the data sets?
  - How many null/NaN values are in the data sets?
- Write *store* data to a JSON file

## Exercise 4 - Bonus Tasks

- Fix the warning when reading *sales* data
- Write to and read from SQL (sqlite)
- Why are some numeric values converted to int64 while others are converted to float64?

# Explore Data

## Selecting columns

If only some columns are required for further processing.

## Selecting columns

If only some columns are required for further processing.

In [15]:
```
df[['somecat','someint']]
```

Out[15]:

| | somecat | someint |
|---|---|---|
| **0** | a | -1 |
| **1** | b | 0 |

## Selecting columns

If only some columns are required for further processing.

In [15]:
```
df[['somecat','someint']]
```

Out[15]:

| | somecat | someint |
|---|---|---|
| **0** | a | -1 |
| **1** | b | 0 |

In [16]:
```
df[df.columns[2:4]].head(2)
```

Out[16]:

| | somefloat | someint |
|---|---|---|
| **0** | 1.400000 | -1 |
| **1** | 0.000012 | 0 |

## Filter Rows by Boolean Indexing

https://pandas.pydata.org/pandas-docs/stable/indexing.html#boolean-indexing (https://pandas.pydata.org/pandas-docs/stable/indexing.html#boolean-indexing)

## Filter Rows by Boolean Indexing

https://pandas.pydata.org/pandas-docs/stable/indexing.html#boolean-indexing (https://pandas.pydata.org/pandas-docs/stable/indexing.html#boolean-indexing)

In [64]:
```
df.loc[(df.somecat == 'b') | (df.someint > 100)]
```

Out[64]:

| | somecat | somedate | somefloat | someint | sometext |
|---|---|---|---|---|---|
| **1** | b | 2000-01-01 | 0.000012 | 0 | bar |
| **2** | b | NaT | NaN | 42 | baz |
| **3** | a | NaT | 3.141593 | 1000 | NaN |

## Filter Rows by Query

https://pandas.pydata.org/pandas-docs/stable/indexing.html#the-query-method
(https://pandas.pydata.org/pandas-docs/stable/indexing.html#the-query-method)

## Filter Rows by Query

https://pandas.pydata.org/pandas-docs/stable/indexing.html#the-query-method (https://pandas.pydata.org/pandas-docs/stable/indexing.html#the-query-method)

In [65]:
```
df.query('somecat == "b" or someint > 100')
```

Out[65]:

| | somecat | somedate | somefloat | someint | sometext |
|---|---|---|---|---|---|
| **1** | b | 2000-01-01 | 0.000012 | 0 | bar |
| **2** | b | NaT | NaN | 42 | baz |
| **3** | a | NaT | 3.141593 | 1000 | NaN |

## N largest / smallest

- Get the rows with the **n** largest or smallest values of a column.

## N largest / smallest

- Get the rows with the **n** largest or smallest values of a column.

In [66]:
```
df.nlargest(2, 'someint')
```

Out[66]:

| | somecat | somedate | somefloat | someint | sometext |
|---|---|---|---|---|---|
| **3** | a | NaT | 3.141593 | 1000 | NaN |
| **2** | b | NaT | NaN | 42 | baz |

## N largest / smallest

- Get the rows with the **n** largest or smallest values of a column.

In [66]:
```
df.nlargest(2, 'someint')
```

Out[66]:

| | somecat | somedate | somefloat | someint | sometext |
|---|---|---|---|---|---|
| **3** | a | NaT | 3.141593 | 1000 | NaN |
| **2** | b | NaT | NaN | 42 | baz |

In [67]:
```
df.nsmallest(2, 'somefloat')
```

Out[67]:

| | somecat | somedate | somefloat | someint | sometext |
|---|---|---|---|---|---|
| **1** | b | 2000-01-01 00:00:00.000000 | 0.000012 | 0 | bar |
| **0** | a | 2018-05-06 17:58:40.283808 | 1.400000 | -1 | foo |

# Descriptive Statistics

## Measures

- Location
  - Mean: Sum up all values and divide them by the number of values, $\bar{x} = 1/n \sum_{i=1}^{n} x_i$
  - Median: Order values and take the one from the middle
- Variability
  - Variance: $\frac{\sum (x-\bar{x})^2}{n-1}$
  - Standard Deviation: $\sqrt{variance}$
- Example: [1,2,3,10,100]
  - mean: (1+2+3+10+100)/5=23.2, median: 3
  - variance: $\frac{(1-23.2)^2+(2-23.2)^2+(3-23.2)^2+(10-23.2)^2+(100-23.2)^2}{4}$, std: 43

$$= \frac{493+449+408+174+5898}{4} = \frac{7422}{4} = 1855,5$$

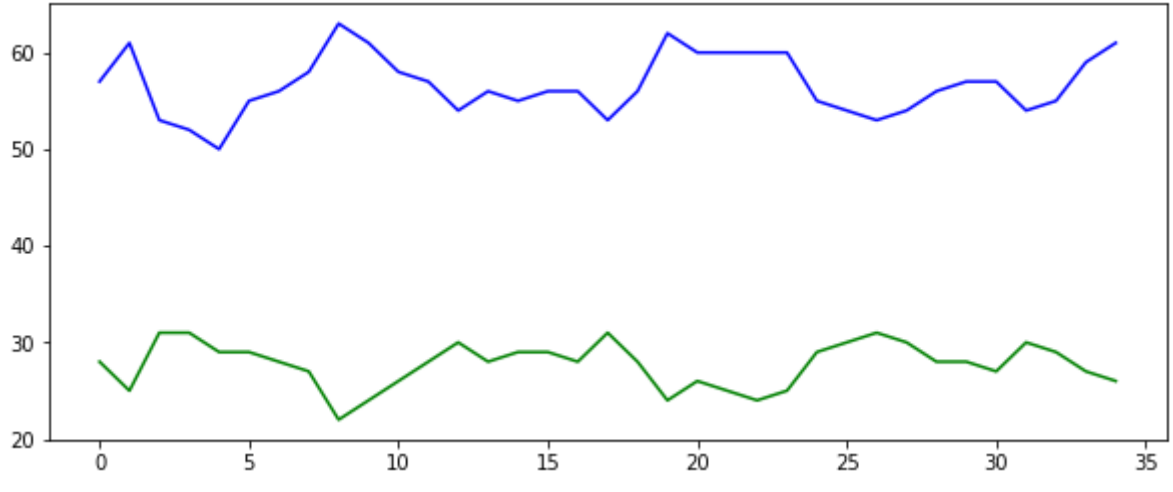
## Correlation

- A correlation coefficient ist a measure for how strong two variables are related to each other
- Calculation: $r_{xy} = \frac{\sum_{i=1}^{n}(x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum_{i=1}^{n}(x_i - \bar{x})^2 \sum_{i=1}^{n}(y_i - \bar{y})^2}}$
- Possible Values: $-1 \leqslant r \leqslant 1$
  - the bigger $|r|$, the stronger the linear relation
  - $r = 0$ no linear relation
- Example:
  - x = [1,2,3,10,100], $\bar{x} = 23.2,$
  - y = [2,4,6,20,200], $\bar{y} = 46.4,$
  - $r_{xy} = \frac{\sum_{i=1}^{n}(x_i - \bar{x})(y_i - \bar{y})}{\sqrt{7422 * 29629}} \approx \frac{14830}{14829} \approx 1$

# Example

## Example

In [10]:
```
cafe_df = pd.read_csv('data/cafe.csv')
plt.plot(cafe_df['sold_cups_coffee'], color='blue', label='coffee')
plt.plot(cafe_df['temperature'], color='green', label='temperature');
```



## Corrleation does not imply causation

http://tylervigen.com/spurious-correlations (http://tylervigen.com/spurious-correlations)

## Describe

- Generates various summary statistics, excluding NaN.
- By default numeric columns only
- Can be changed by defining `include`

## Describe

- Generates various summary statistics, excluding NaN.
- By default numeric columns only
- Can be changed by defining `include`

In [68]:
```
df.describe()
```

Out[68]:

| | somefloat | someint |
|---|---|---|
| **count** | 3.000000 | 4.000000 |
| **mean** | 1.513868 | 260.250000 |
| **std** | 1.573883 | 493.573618 |
| **min** | 0.000012 | -1.000000 |
| **25%** | 0.700006 | -0.250000 |
| **50%** | 1.400000 | 21.000000 |
| **75%** | 2.270796 | 281.500000 |
| **max** | 3.141593 | 1000.000000 |

## Describe

- Generates various summary statistics, excluding NaN.
- By default numeric columns only
- Can be changed by defining `include`

## Describe

- Generates various summary statistics, excluding NaN.
- By default numeric columns only
- Can be changed by defining `include`

In [69]:
```
df.describe(include=[np.object,np.bool,np.datetime64])
```

Out[69]:

| | somecat | somedate | sometext |
|---|---|---|---|
| **count** | 4 | 2 | 3 |
| **unique** | 2 | 2 | 3 |
| **top** | a | 2018-05-06 17:58:40.283808 | bar |
| **freq** | 2 | 1 | 1 |
| **first** | NaN | 2000-01-01 00:00:00 | NaN |
| **last** | NaN | 2018-05-06 17:58:40.283808 | NaN |

## Single Summaries

- Many functions to calculate summaries
- mean, min, max, median, quantiles, std, var, count, sum, ...

## Single Summaries

- Many functions to calculate summaries
- mean, min, max, median, quantiles, std, var, count, sum, ...

In [70]:
```
df.sum()
```

Out[70]:
```
somefloat       4.541605
someint      1041.000000
dtype: float64
```

## Grouped Summaries

- Works also for grouped data
- mean, min, max, median, quantiles, std, var, count, sum, ...

## Grouped Summaries

- Works also for grouped data
- mean, min, max, median, quantiles, std, var, count, sum, ...

In [71]:
```
df.groupby('somecat').sum()
```

Out[71]:

| | somefloat | someint |
|---|---|---|
| **somecat** | | |
| **a** | 4.541593 | 999 |
| **b** | 0.000012 | 42 |

# Correlation

## Correlation

In [4]:
```
df.corr ()
```

Out[4]:

| | somefloat | someint |
|---|---|---|
| **somefloat** | 1.000000 | 0.895266 |
| **someint** | 0.895266 | 1.000000 |

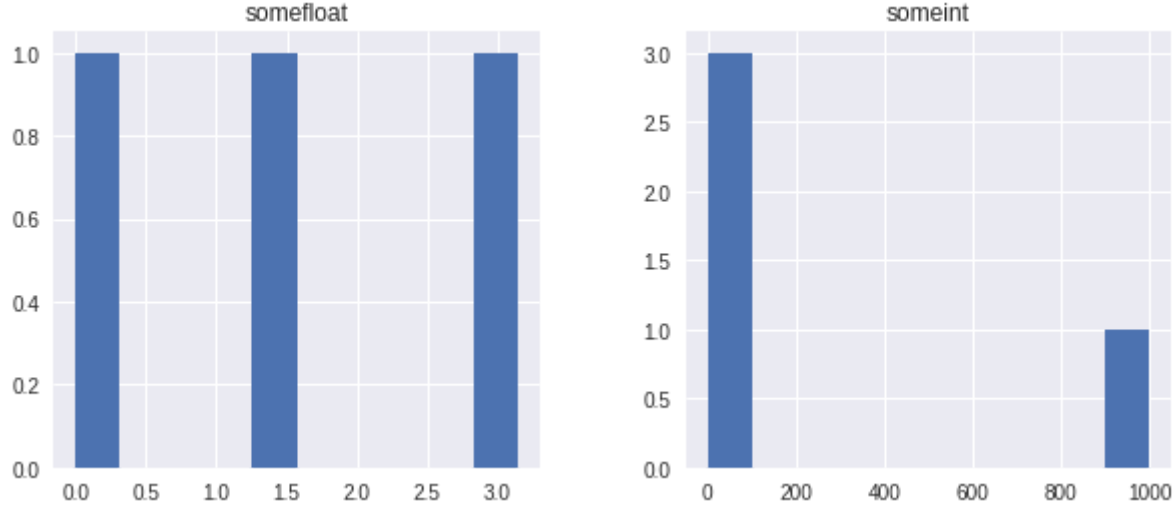
## Histograms

- Draw histogram of the DataFrame's series using matplotlib / pylab.
- By default 10 bins.
- Frequency of values within the dataset
- Hint: trailing semicolon supresses output

## Histograms

- Draw histogram of the DataFrame's series using matplotlib / pylab.
- By default 10 bins.
- Frequency of values within the dataset
- Hint: trailing semicolon supresses output

In [72]:
```
df.hist();
```



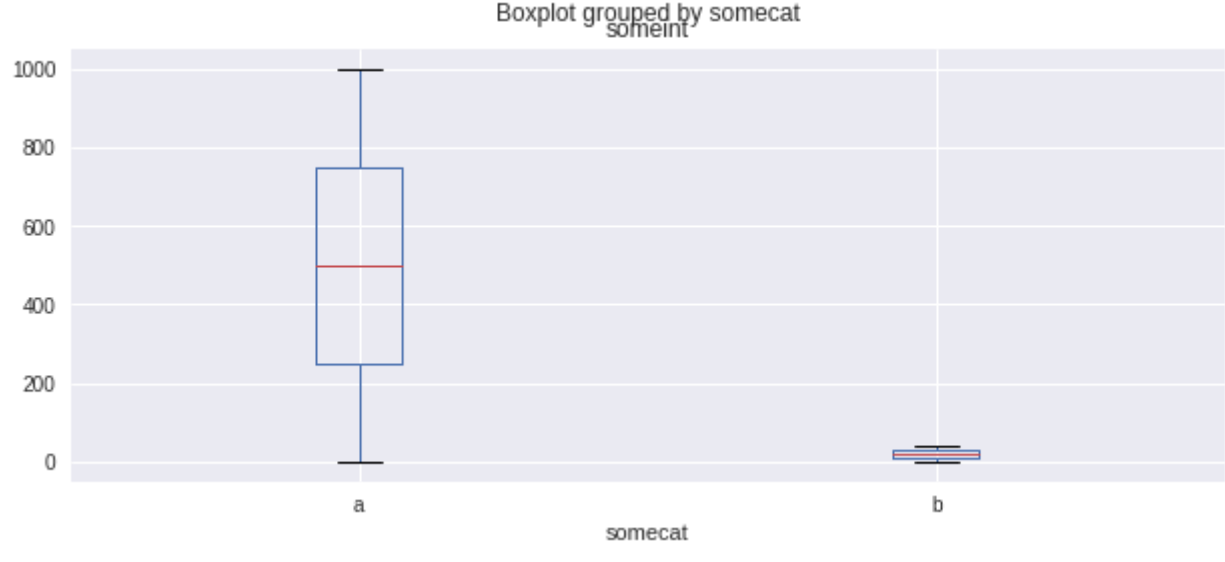
## Boxplot

- Visualizes the distribution of values
- Median and first and third quantile

## Boxplot

- Visualizes the distribution of values
- Median and first and third quantile

In [73]:
```
df.boxplot(column='someint', by='somecat');
```



# Exercise 5 - Descriptive Statistics

Goals:

- Explore a data set
- Determine descritive statistics

Tasks:

- Get the number of stores per store type
- Get the number of stores per assortment
- Determine the number of stores which have a competitor within 5 km
- Calculate min, max, and mean distance to the nearest competitor
- Plot a histogram of the distance to competitors
- Plot sales and number of customers per weekday
- Boxplot with sales per weekday

# Exercise 5 - Bonus Tasks

- Sales per store: min, avg, max, median
- Plot a histogram with sales per store, using 50 bins
- Play with the describe() function

# Modifying a DataFrame

## Modifying a DataFrame

- Selection often return a *view*
  - When modifying such a *view* a warning is printed
  - Explicit `copy()` possible
- Functions that modify data don't modify the DataFrame but return a copy
  - Many functions have an `inplace` parameter which is `False` by default

## Data Cleaning

- Fill gaps:
  - Interpolate
  - Padding or backfill
  - Fill with default vlaue
  - Drop row
- Drop duplicates

In [5]:
```
df = pd.DataFrame({'somecat' : ['a', 'b', 'b', 'a'],
  'somedate': [pd.datetime.utcnow(), pd.datetime(2000,1,1), None, None],
  'somefloat' : [1.4, 1.23456789e-5, None, np.pi],
  'someint' : [-1, 0, 42, 1000], 'sometext': ['foo', 'bar', 'baz', None]})
df
```

Out[5]:

| | somecat | somedate | somefloat | someint | sometext |
|---|---|---|---|---|---|
| **0** | a | 2018-08-27 11:17:50.387794 | 1.400000 | -1 | foo |
| **1** | b | 2000-01-01 00:00:00.000000 | 0.000012 | 0 | bar |
| **2** | b | NaT | NaN | 42 | baz |
| **3** | a | NaT | 3.141593 | 1000 | None |

In [5]:
```
df = pd.DataFrame({'somecat' : ['a', 'b', 'b', 'a'],
  'somedate': [pd.datetime.utcnow(), pd.datetime(2000,1,1), None, None],
  'somefloat' : [1.4, 1.23456789e-5, None, np.pi],
  'someint' : [-1, 0, 42, 1000], 'sometext': ['foo', 'bar', 'baz', None]})
df
```

Out[5]:

| | somecat | somedate | somefloat | someint | sometext |
|---|---|---|---|---|---|
| **0** | a | 2018-08-27 11:17:50.387794 | 1.400000 | -1 | foo |
| **1** | b | 2000-01-01 00:00:00.000000 | 0.000012 | 0 | bar |
| **2** | b | NaT | NaN | 42 | baz |
| **3** | a | NaT | 3.141593 | 1000 | None |

In [6]:
```
df2 = df.copy()
df2.somefloat.interpolate(inplace=True)
df2.sometext.fillna(method='ffill', inplace=True)
df2
```

Out[6]:

| | somecat | somedate | somefloat | someint | sometext |
|---|---|---|---|---|---|
| **0** | a | 2018-08-27 11:17:50.387794 | 1.400000 | -1 | foo |
| **1** | b | 2000-01-01 00:00:00.000000 | 0.000012 | 0 | bar |
| **2** | b | NaT | 1.570802 | 42 | baz |
| **3** | a | NaT | 3.141593 | 1000 | baz |

# Data Cleaning

## Data Cleaning

In [7]:
```
df2
```

Out[7]:

| | somecat | somedate | somefloat | someint | sometext |
|---|---|---|---|---|---|
| **0** | a | 2018-08-27 11:17:50.387794 | 1.400000 | -1 | foo |
| **1** | b | 2000-01-01 00:00:00.000000 | 0.000012 | 0 | bar |
| **2** | b | NaT | 1.570802 | 42 | baz |
| **3** | a | NaT | 3.141593 | 1000 | baz |

## Data Cleaning

In [7]:
```
df2
```

Out[7]:

| | somecat | somedate | somefloat | someint | sometext |
|---|---|---|---|---|---|
| **0** | a | 2018-08-27 11:17:50.387794 | 1.400000 | -1 | foo |
| **1** | b | 2000-01-01 00:00:00.000000 | 0.000012 | 0 | bar |
| **2** | b | NaT | 1.570802 | 42 | baz |
| **3** | a | NaT | 3.141593 | 1000 | baz |

In [8]:
```
df2.fillna(0, inplace=True)
df2.drop_duplicates('somedate', inplace=True)
df2
```

Out[8]:

| | somecat | somedate | somefloat | someint | sometext |
|---|---|---|---|---|---|
| **0** | a | 2018-08-27 11:17:50.387794 | 1.400000 | -1 | foo |
| **1** | b | 2000-01-01 00:00:00 | 0.000012 | 0 | bar |
| **2** | b | 0 | 1.570802 | 42 | baz |

# Add columns

## Add columns

In [9]:
```
df3 = df2.copy()
df3['newtext'] = 'abc'
df3['newint'] = df3['somefloat'].pow(df3.someint).astype(np.int64)
df3
```

Out[9]:

| | somecat | somedate | somefloat | someint | sometext | newtext | |
|---|---|---|---|---|---|---|---|
| **0** | a | 2018-08-27 11:17:50.387794 | 1.400000 | -1 | foo | abc | 0 |
| **1** | b | 2000-01-01 00:00:00 | 0.000012 | 0 | bar | abc | 1 |
| **2** | b | 0 | 1.570802 | 42 | baz | abc | 1726 |

# Combine DataFrames

## Combine DataFrames

In [10]:
```
df3
```

Out[10]:

| | somecat | somedate | somefloat | someint | sometext | newtext | |
|---|---|---|---|---|---|---|---|
| **0** | a | 2018-08-27 11:17:50.387794 | 1.400000 | -1 | foo | abc | 0 |
| **1** | b | 2000-01-01 00:00:00 | 0.000012 | 0 | bar | abc | 1 |
| **2** | b | 0 | 1.570802 | 42 | baz | abc | 1726 |

## Combine DataFrames

In [10]:
```
df3
```

Out[10]:

| | somecat | somedate | somefloat | someint | sometext | newtext | |
|---|---|---|---|---|---|---|---|
| **0** | a | 2018-08-27 11:17:50.387794 | 1.400000 | -1 | foo | abc | 0 |
| **1** | b | 2000-01-01 00:00:00 | 0.000012 | 0 | bar | abc | 1 |
| **2** | b | 0 | 1.570802 | 42 | baz | abc | 1726 |

In [11]:
```
other_df = pd.DataFrame({
  'date': [pd.datetime(2000,1,1), pd.datetime(2000,1,2), pd.datetime(2000,1,3),
    pd.datetime(2000,1,1), pd.datetime(2000,1,2), pd.datetime(2000,1,3),
    pd.datetime(2000,1,1), pd.datetime(2000,1,2), pd.datetime(2000,1,3),],
  'key' : ['foo', 'foo', 'foo', 'bar', 'bar', 'bar', 'baz', 'baz', 'baz']})
other_df
```

Out[11]:

| | date | key |
|---|---|---|
| **0** | 2000-01-01 | foo |
| **1** | 2000-01-02 | foo |
| **2** | 2000-01-03 | foo |
| **3** | 2000-01-01 | bar |
| **4** | 2000-01-02 | bar |
| **5** | 2000-01-03 | bar |
| **6** | 2000-01-01 | baz |
| **7** | 2000-01-02 | baz |
| **8** | 2000-01-03 | baz |

# Combine Data Frames

## Combine Data Frames

In [13]:
```
merged_df = pd.merge(left=other_df, right=df3[['somecat','sometext']], left_on=
'key', right_on='sometext')
merged_df
```

Out[13]:

| | date | key | somecat | sometext |
|---|---|---|---|---|
| **0** | 2000-01-01 | foo | a | foo |
| **1** | 2000-01-02 | foo | a | foo |
| **2** | 2000-01-03 | foo | a | foo |
| **3** | 2000-01-01 | bar | b | bar |
| **4** | 2000-01-02 | bar | b | bar |
| **5** | 2000-01-03 | bar | b | bar |
| **6** | 2000-01-01 | baz | b | baz |
| **7** | 2000-01-02 | baz | b | baz |
| **8** | 2000-01-03 | baz | b | baz |

# Exercise 6 - Modifying a DataFrame

Goals:

- Data cleaning
- Add columns
- Combine data frames

Tasks:

- Read `date` column in *sales* data as date (datetime64)
- Calculate CompetitionOpenSince date from month and year columns (datetime64)
- Fill missing CompetitionDistance with average value of all distances
- Fill missing Competition date with today's date
- Replace StateHoliday categories a, b, c with 1 and convert to int32
- Join store type, assortment, distance and open since from store df to sales df
- Plot average sales and number of customers per store type

# Exercise 6 - Bonus Task

- Find correlations and plot a heat map