# full_potential

January 27, 2023

[59]:
```
import nasdaqdatalink
import pandas as pd
import datetime
import matplotlib.pyplot as plt
from data_loader import get_data, get_data_multiple
```

[60]:
```
api_key = "4582031f930830a9e531b95f4f79f677"
```

[61]:
```
target = get_data(api_key, "USREC")
target['USREC'] = target['USREC'].astype(float)
target.reset_index(inplace = True)
target = target.rename(columns = {'date': 'DATE'})
```

[62]:
```
target
```

[62]:

| | DATE | USREC |
|---|---|---|
| 0 | 1854-12-01 | 1.0 |
| 1 | 1855-01-01 | 0.0 |
| 2 | 1855-02-01 | 0.0 |
| 3 | 1855-03-01 | 0.0 |
| 4 | 1855-04-01 | 0.0 |
| … | … | … |
| 2012 | 2022-08-01 | 0.0 |
| 2013 | 2022-09-01 | 0.0 |
| 2014 | 2022-10-01 | 0.0 |
| 2015 | 2022-11-01 | 0.0 |
| 2016 | 2022-12-01 | 0.0 |

[2017 rows x 2 columns]

[63]:
```
ten_year_treas = get_data(api_key, "DGS10")
ten_year_treas = ten_year_treas.rename(columns = {'DGS10': 'Value'})
three_month_treas = get_data(api_key, "DTB3")
three_month_treas = three_month_treas.rename(columns = {'DTB3': 'Value'})
combined = three_month_treas.join(ten_year_treas, how='left', lsuffix='_3mon',␣
↪rsuffix='_10yr')
combined = combined.dropna()
```

```
# drop all rows where the value is just "."
combined = combined[combined.Value_3mon != "."]
combined = combined[combined.Value_10yr != "."]
# export combined to csv
combined.to_csv('combined.csv')
# convert columns to float64
combined['Value_3mon'] = combined['Value_3mon'].astype('float64')
combined['Value_10yr'] = combined['Value_10yr'].astype('float64')
# create new column for spread
combined['spread'] = combined['Value_10yr'] - combined['Value_3mon']
```

[64]:
```
combined
```

[64]:

| date | Value_3mon | Value_10yr | spread |
|---|---|---|---|
| 1962-01-02 | 2.70 | 4.06 | 1.36 |
| 1962-01-03 | 2.73 | 4.03 | 1.30 |
| 1962-01-04 | 2.72 | 3.99 | 1.27 |
| 1962-01-05 | 2.74 | 4.02 | 1.28 |
| 1962-01-08 | 2.78 | 4.03 | 1.25 |
| … | … | … | … |
| 2023-01-18 | 4.54 | 3.37 | -1.17 |
| 2023-01-19 | 4.55 | 3.39 | -1.16 |
| 2023-01-20 | 4.57 | 3.48 | -1.09 |
| 2023-01-23 | 4.58 | 3.52 | -1.06 |
| 2023-01-24 | 4.57 | 3.46 | -1.11 |

[15250 rows x 3 columns]

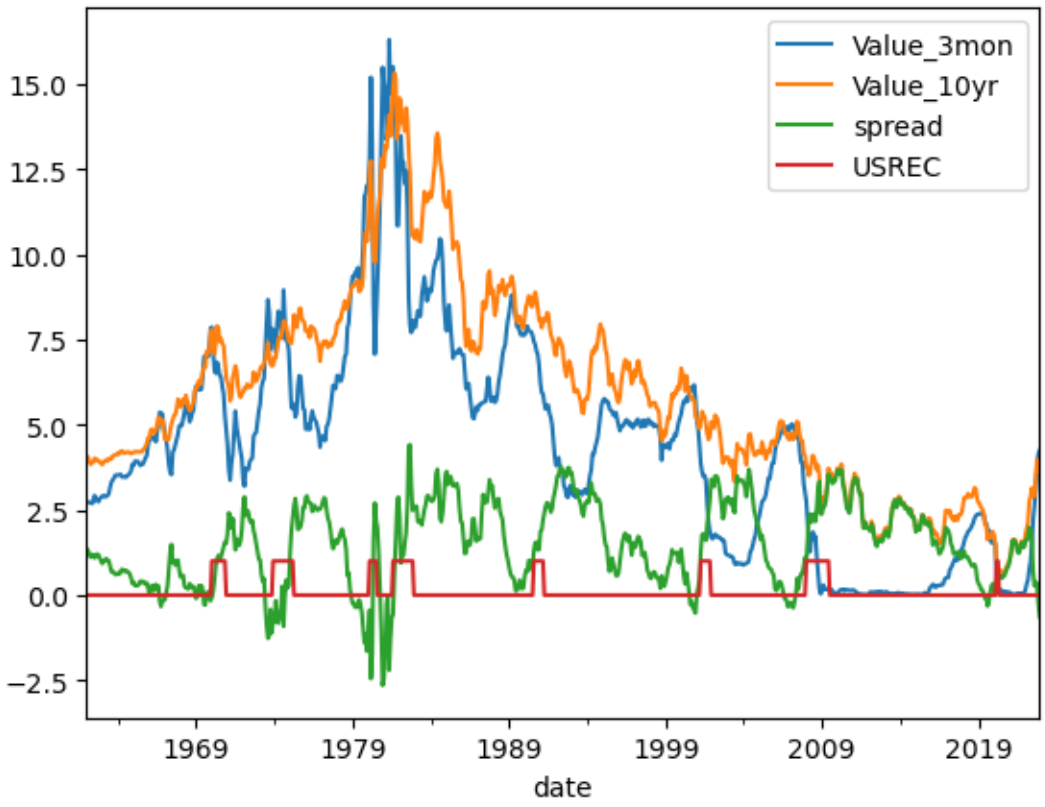
[65]:
```
# take average by month in yield
yield_by_month_mean = combined.resample('M').mean()
# format yield into monthly datetime
yield_by_month_mean.index = yield_by_month_mean.index.strftime('%Y-%m')
```

[66]:
```
#Take average by month in yield
yield_by_month_mean = combined.groupby(pd.Grouper(freq='M')).mean()

#Format yield into monthly datetime
yield_by_month_mean = yield_by_month_mean.set_index(yield_by_month_mean.index.
 ↪strftime('%Y-%m'))

#Format target into YYYY-MM
target['DATE'] = target['DATE'].apply(lambda x: x.strftime('%Y-%m'))
target = target.set_index(target['DATE']).drop(columns = ['DATE'])
```

[67]:
```
recession_vs_yield = yield_by_month_mean.join(target, how = 'left').dropna()
```

```
recession_vs_yield = recession_vs_yield.set_index(pd.
  ↪DatetimeIndex(recession_vs_yield.index))
recession_vs_yield.plot()
```

[67]: <AxesSubplot:xlabel='date'>




[68]:
```
recession_vs_yield.dtypes
```

[68]:
```
Value_3mon    float64
Value_10yr    float64
spread        float64
USREC         float64
dtype: object
```

[69]:
```
nasdaqdatalink.read_key("/data/.apikey")
SOC35 = nasdaqdatalink.get('UMICH/SOC35')
#Include michigan state university data on current levels of fear WRT the␣
  ↪economy
SOC35 = SOC35.set_index(SOC35.index.strftime('%Y-%m'))
date_index = recession_vs_yield.index.strftime('%Y-%m')
recession_vs_yield = recession_vs_yield.set_index(date_index)
```

```
recession_vs_yield = SOC35.join(recession_vs_yield, how = 'right')
```

[70]:
```
recession_vs_yield
```

[70]:
```
          Good time to buy  Uncertain - depends  Bad time to buy  Relative  \
date
1962-01               NaN                  NaN              NaN       NaN
1962-02               NaN                  NaN              NaN       NaN
1962-03               NaN                  NaN              NaN       NaN
1962-04               NaN                  NaN              NaN       NaN
1962-05               NaN                  NaN              NaN       NaN
…                     …                    …                …         …
2022-08              32.0                  5.0             63.0      69.0
2022-09              34.0                  5.0             61.0      73.0
2022-10              42.0                  6.0             52.0      90.0
2022-11              34.0                  5.0             61.0      73.0
2022-12              36.0                  5.0             59.0      77.0

          Value_3mon  Value_10yr    spread  USREC
date
1962-01     2.719545    4.083182  1.363636    0.0
1962-02     2.732778    4.039444  1.306667    0.0
1962-03     2.723182    3.930455  1.207273    0.0
1962-04     2.729500    3.843000  1.113500    0.0
1962-05     2.685000    3.873636  1.188636    0.0
…              …           …         …         …
2022-08     2.630870    2.897826  0.266957    0.0
2022-09     3.126667    3.519048  0.392381    0.0
2022-10     3.717000    3.983500  0.266500    0.0
2022-11     4.151500    3.891000 -0.260500    0.0
2022-12     4.252381    3.616190 -0.636190    0.0

[732 rows x 8 columns]
```

[71]:
```
unemployment = get_data(api_key, "UNRATE")
```

[72]:
```
if unemployment.index.dtype == 'datetime64[ns]':
    unemployment.index = unemployment.index.strftime('%Y-%m')
combined2 = recession_vs_yield.join(unemployment, how = 'left')
```

[73]:
```
combined2
```

[73]:
```
          Good time to buy  Uncertain - depends  Bad time to buy  Relative  \
date
1962-01               NaN                  NaN              NaN       NaN
1962-02               NaN                  NaN              NaN       NaN
1962-03               NaN                  NaN              NaN       NaN
```

```
1962-04                NaN                    NaN              NaN        NaN
1962-05                NaN                    NaN              NaN        NaN
…                      …                      …                …          …
2022-08               32.0                    5.0             63.0       69.0
2022-09               34.0                    5.0             61.0       73.0
2022-10               42.0                    6.0             52.0       90.0
2022-11               34.0                    5.0             61.0       73.0
2022-12               36.0                    5.0             59.0       77.0

          Value_3mon  Value_10yr    spread  USREC UNRATE
date
1962-01    2.719545    4.083182  1.363636    0.0    5.8
1962-02    2.732778    4.039444  1.306667    0.0    5.5
1962-03    2.723182    3.930455  1.207273    0.0    5.6
1962-04    2.729500    3.843000  1.113500    0.0    5.6
1962-05    2.685000    3.873636  1.188636    0.0    5.5
…               …           …         …      …      …
2022-08    2.630870    2.897826  0.266957    0.0    3.7
2022-09    3.126667    3.519048  0.392381    0.0    3.5
2022-10    3.717000    3.983500  0.266500    0.0    3.7
2022-11    4.151500    3.891000 -0.260500    0.0    3.6
2022-12    4.252381    3.616190 -0.636190    0.0    3.5

[732 rows x 9 columns]
```

[74]:
```
housing_market_data = nasdaqdatalink.get('YALE/RHPI')
housing_market_data = housing_market_data.rename(columns = {'Index':␣
 ↪'Yale_Housing'})
```

[75]:
```
fred_housing = get_data(api_key, "CSUSHPINSA")
fred_housing = fred_housing[fred_housing.CSUSHPINSA != "."]
fred_housing['CSUSHPINSA'] = fred_housing['CSUSHPINSA'].astype(float)
fred_housing = fred_housing.rename(columns = {'CSUSHPINSA': 'FRED_Housing'})
```

[76]:
```
# adjust index to match other data
fred_housing.index = fred_housing.index.strftime('%Y-%m')
housing_market_data.index = housing_market_data.index.strftime('%Y-%m')
combined_housing = fred_housing.join(housing_market_data, how = 'left')
```

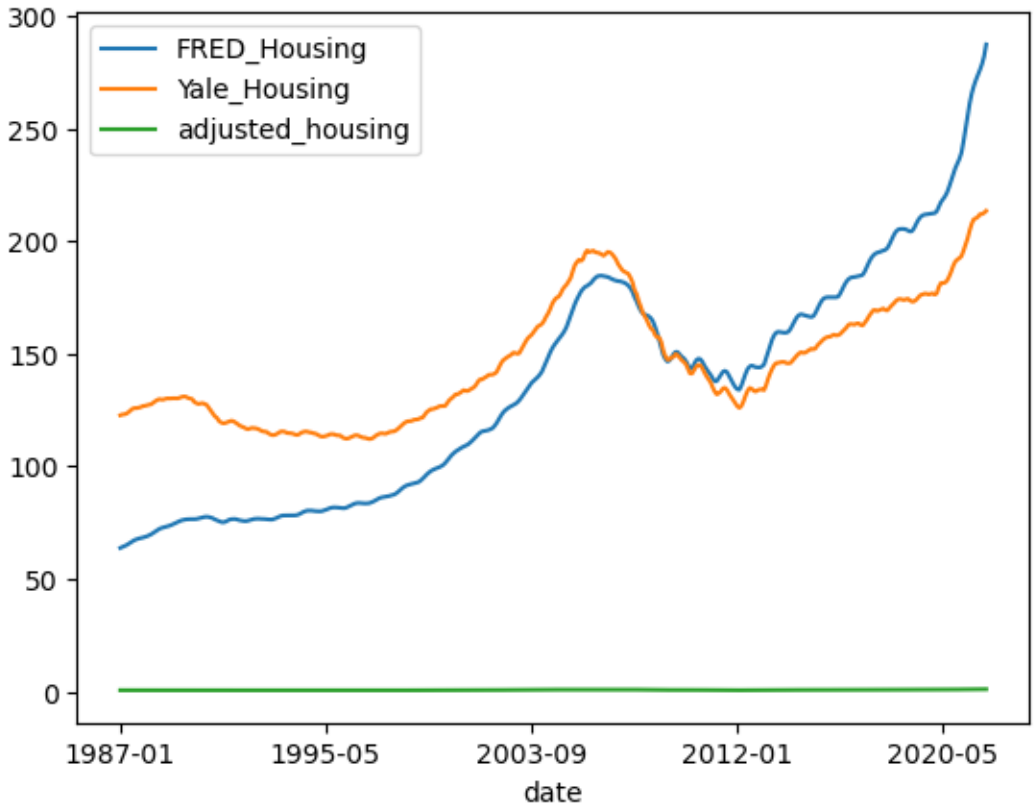
[77]:
```
combined_housing
```

[77]:
```
         FRED_Housing  Yale_Housing
date
1987-01        63.734    122.638054
1987-02        64.134    122.963501
1987-03        64.469    123.056393
1987-04        64.973    123.360053
```

```
1987-05        65.547     124.009712
…                …              …
2022-06       308.371            NaN
2022-07       307.177            NaN
2022-08       303.706            NaN
2022-09       300.588            NaN
2022-10       298.990            NaN

[430 rows x 2 columns]
```

[78]:
```
#adjust fred housing with cpi
cpi = get_data(api_key, "CPIAUCSL")
cpi = cpi.rename(columns = {'CPIAUCSL': 'Value'})
cpi = cpi.set_index(cpi.index.strftime('%Y-%m'))
cpi = cpi.join(combined_housing, how = 'left')
cpi = cpi.dropna()
cpi['Value'] = cpi['Value'].astype(float)
cpi['FRED_Housing'] = cpi['FRED_Housing'].astype(float)
cpi['adjusted_housing'] = (cpi['FRED_Housing']/ cpi['Value'])
cpi = cpi.drop(columns = ['Value'])
cpi.plot()
```

[78]:
```
<AxesSubplot:xlabel='date'>
```



[79]:
```
from sklearn.linear_model import LinearRegression

# do linear regression to get scaling factor between fred and yale
X = cpi['adjusted_housing'].values.reshape(-1, 1)
y = cpi['Yale_Housing'].values.reshape(-1, 1)
reg = LinearRegression().fit(X, y)
reg.score(X, y)
reg.coef_[0][0]
```

[79]:
```
213.0298949761555
```

[80]:
```
cpi_series = get_data(api_key, "CPIAUCSL")
cpi_series = cpi_series.set_index(cpi_series.index.strftime('%Y-%m'))
#adjusted_housing = fred_housing * reg.coef_[0][0] / cpi_series
```

[81]:
```
adjusted_housing = fred_housing.join(cpi_series, how='left')
adjusted_housing['CPIAUCSL'] = adjusted_housing['CPIAUCSL'].astype(float)
adjusted_housing['FRED_Housing'] = adjusted_housing['FRED_Housing'].
 ↪astype(float)
# remove all rows where CPIAUCSL is NaN or FRED_Housing is '.'ArithmeticError
#adjusted_housing = adjusted_housing[adjusted_housing.CPIAUCSL.notna()]
adjusted_housing = adjusted_housing[adjusted_housing.FRED_Housing != "."]
adjusted_housing.dtypes
adjusted_housing['adjusted_housing'] = (adjusted_housing['FRED_Housing'] * reg.
 ↪coef_[0][0] / adjusted_housing['CPIAUCSL']).astype(float)
adjusted_housing
```

[81]:

| date | FRED_Housing | CPIAUCSL | adjusted_housing |
|---|---|---|---|
| 1987-01 | 63.734 | 111.400 | 121.878342 |
| 1987-02 | 64.134 | 111.800 | 122.204466 |
| 1987-03 | 64.469 | 112.200 | 122.404851 |
| 1987-04 | 64.973 | 112.700 | 122.814475 |
| 1987-05 | 65.547 | 113.000 | 123.570536 |
| … | … | … | … |
| 2022-06 | 308.371 | 295.328 | 222.438244 |
| 2022-07 | 307.177 | 295.271 | 221.619746 |
| 2022-08 | 303.706 | 295.620 | 218.856834 |
| 2022-09 | 300.588 | 296.761 | 215.777107 |
| 2022-10 | 298.990 | 298.062 | 213.693152 |

[430 rows x 3 columns]

[82]:
```
combined_housing
```

[82]:
```
            FRED_Housing  Yale_Housing
date
1987-01           63.734    122.638054
1987-02           64.134    122.963501
1987-03           64.469    123.056393
1987-04           64.973    123.360053
1987-05           65.547    124.009712
…                    …           …
2022-06          308.371           NaN
2022-07          307.177           NaN
2022-08          303.706           NaN
2022-09          300.588           NaN
2022-10          298.990           NaN

[430 rows x 2 columns]
```

[83]:
```
# drop everything after 1987-01
housing_market_data = housing_market_data[housing_market_data.index < '1987-01']
# concat with adjusted housing
adjusted_housing = pd.concat([housing_market_data['Yale_Housing'],␣
 ↪adjusted_housing['adjusted_housing']], axis = 0)
adjusted_housing = adjusted_housing.to_frame(name='adjusted_housing')
adjusted_housing = adjusted_housing.set_index(pd.to_datetime(adjusted_housing.
 ↪index).strftime('%Y-%m'))
adjusted_housing
```

[83]:
```
            adjusted_housing
1890-12           100.000000
1891-12            88.011791
1892-12            95.421736
1893-12            92.297385
1894-12           123.980483
…                        …
2022-06           222.438244
2022-07           221.619746
2022-08           218.856834
2022-09           215.777107
2022-10           213.693152

[901 rows x 1 columns]
```

[101]:
```
combined3 = combined2.join(adjusted_housing, how = 'left')
combined3 = combined3.rename(columns = {'adjusted_housing': 'housing market',␣
 ↪'UNRATE': 'Value'})
# rename the date index column to Date
combined3 = combined3.rename_axis('Date')
```

[102]:
```
combined3.isna().sum()
```

[102]:
```
Good time to buy       192
Uncertain - depends    192
Bad time to buy        192
Relative               192
Value_3mon               0
Value_10yr               0
spread                   0
USREC                    0
Value                    0
housing market           2
dtype: int64
```

[103]:
```
combined3
```

[103]:
```
            Good time to buy  Uncertain - depends  Bad time to buy  Relative  \
Date
1962-01                  NaN                  NaN              NaN       NaN
1962-02                  NaN                  NaN              NaN       NaN
1962-03                  NaN                  NaN              NaN       NaN
1962-04                  NaN                  NaN              NaN       NaN
1962-05                  NaN                  NaN              NaN       NaN
…                        …                    …                …         …
2022-08                 32.0                  5.0             63.0      69.0
2022-09                 34.0                  5.0             61.0      73.0
2022-10                 42.0                  6.0             52.0      90.0
2022-11                 34.0                  5.0             61.0      73.0
2022-12                 36.0                  5.0             59.0      77.0

            Value_3mon  Value_10yr    spread  USREC Value  housing market
Date
1962-01       2.719545    4.083182  1.363636    0.0   5.8      109.981774
1962-02       2.732778    4.039444  1.306667    0.0   5.5      109.380905
1962-03       2.723182    3.930455  1.207273    0.0   5.6      109.380905
1962-04       2.729500    3.843000  1.113500    0.0   5.6      109.018717
1962-05       2.685000    3.873636  1.188636    0.0   5.5      109.605470
…                …           …         …     …     …   …              …
2022-08       2.630870    2.897826  0.266957    0.0   3.7      218.856834
2022-09       3.126667    3.519048  0.392381    0.0   3.5      215.777107
2022-10       3.717000    3.983500  0.266500    0.0   3.7      213.693152
2022-11       4.151500    3.891000 -0.260500    0.0   3.6             NaN
2022-12       4.252381    3.616190 -0.636190    0.0   3.5             NaN

[732 rows x 10 columns]
```

[104]:
```
combined3.to_csv('preprocessed_data.csv')
```