01_sample_selection

September 29, 2021

1 Data Prep

[1]:
```
import warnings
warnings.filterwarnings('ignore')
```

[2]:
```
%matplotlib inline

from pathlib import Path
import numpy as np
import pandas as pd

import matplotlib.pyplot as plt
import seaborn as sns
```

[3]:
```
sns.set_style('whitegrid')
idx = pd.IndexSlice
deciles = np.arange(.1, 1, .1).round(1)
```

1.1 Load Data

[4]:
```
DATA_STORE = Path('..', 'data', 'assets.h5')
```

[5]:
```
with pd.HDFStore(DATA_STORE) as store:
    data = (store['quandl/wiki/prices']
            .loc[idx['2007':'2016', :],
                 ['adj_open', 'adj_high', 'adj_low', 'adj_close', 'adj_volume']]
            .dropna()
            .swaplevel()
            .sort_index()
            .rename(columns=lambda x: x.replace('adj_', '')))
    metadata = store['us_equities/stocks'].loc[:, ['marketcap', 'sector']]
```

[6]:
```
data.info(null_counts=True)
```

```
<class 'pandas.core.frame.DataFrame'>
MultiIndex: 6951874 entries, ('A', Timestamp('2007-01-03 00:00:00')) to ('ZUMZ',
Timestamp('2016-12-30 00:00:00'))
```

```
Data columns (total 5 columns):
 #   Column  Non-Null Count    Dtype
---  ------  --------------    -----
 0   open    6951874 non-null  float64
 1   high    6951874 non-null  float64
 2   low     6951874 non-null  float64
 3   close   6951874 non-null  float64
 4   volume  6951874 non-null  float64
dtypes: float64(5)
memory usage: 292.5+ MB
```

[7]:
```
metadata.sector = pd.factorize(metadata.sector)[0]
metadata.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Index: 6834 entries, PIH to ZYME
Data columns (total 2 columns):
 #   Column     Non-Null Count  Dtype
---  ------     --------------  -----
 0   marketcap  5766 non-null   float64
 1   sector     6834 non-null   int64
dtypes: float64(1), int64(1)
memory usage: 160.2+ KB
```

[8]:
```
data = data.join(metadata).dropna(subset=['sector'])
```

[9]:
```
data.info(null_counts=True)
```

```
<class 'pandas.core.frame.DataFrame'>
MultiIndex: 5395695 entries, ('A', Timestamp('2007-01-03 00:00:00')) to ('ZUMZ',
Timestamp('2016-12-30 00:00:00'))
Data columns (total 7 columns):
 #   Column     Non-Null Count    Dtype
---  ------     --------------    -----
 0   open       5395695 non-null  float64
 1   high       5395695 non-null  float64
 2   low        5395695 non-null  float64
 3   close      5395695 non-null  float64
 4   volume     5395695 non-null  float64
 5   marketcap  5385154 non-null  float64
 6   sector     5395695 non-null  float64
dtypes: float64(7)
memory usage: 309.5+ MB
```

[10]:
```
print(f"# Tickers: {len(data.index.unique('ticker')):,.0f} | # Dates: {len(data.
↪index.unique('date')):,.0f}")
```

```
# Tickers: 2,399 | # Dates: 2,547
```

1.2 Select 500 most-traded stocks

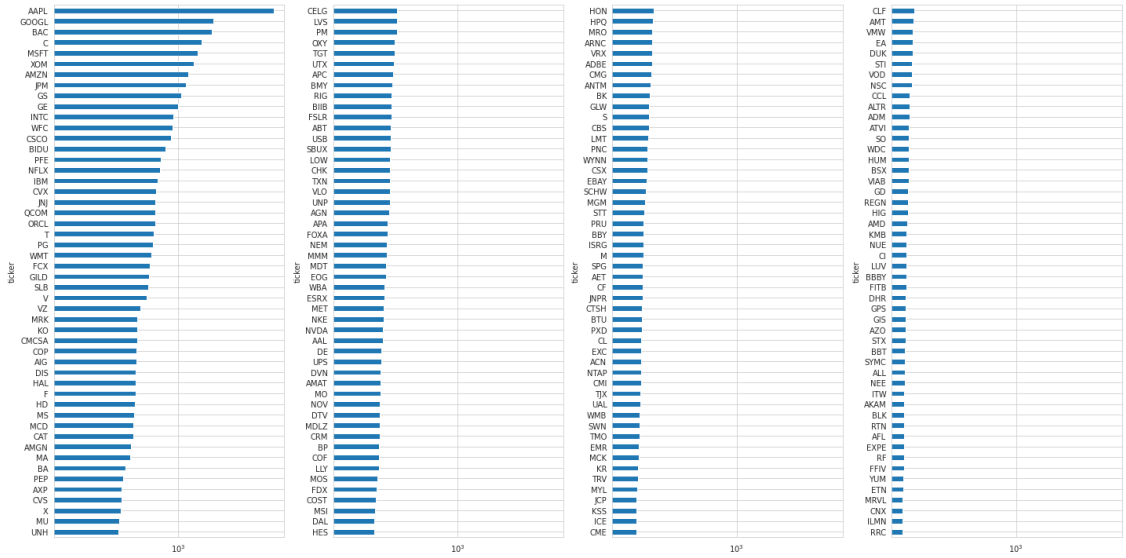
[11]:
```
dv = data.close.mul(data.volume)
```

[12]:
```
top500 = (dv.groupby(level='date')
            .rank(ascending=False)
            .unstack('ticker')
            .dropna(thresh=8*252, axis=1)
            .mean()
            .nsmallest(500))
```

1.2.1 Visualize the 200 most liquid stocks

[13]:
```
top200 = (data.close
            .mul(data.volume)
            .unstack('ticker')
            .dropna(thresh=8*252, axis=1)
            .mean()
            .div(1e6)
            .nlargest(200))
cutoffs = [0, 50, 100, 150, 200]
fig, axes = plt.subplots(ncols=4, figsize=(20, 10), sharex=True)
axes = axes.flatten()

for i, cutoff in enumerate(cutoffs[1:], 1):
    top200.iloc[cutoffs[i-1]:cutoffs[i]
                ].sort_values().plot.barh(logx=True, ax=axes[i-1])
fig.tight_layout()
```



[14]:
```
to_drop = data.index.unique('ticker').difference(top500.index)
```

[15]:
```
len(to_drop)
```

[15]: 1899

[16]:
```
data = data.drop(to_drop, level='ticker')
```

[17]:
```
data.info(null_counts=True)
```

```
<class 'pandas.core.frame.DataFrame'>
MultiIndex: 1256095 entries, ('A', Timestamp('2007-01-03 00:00:00')) to ('ZION',
Timestamp('2016-12-30 00:00:00'))
Data columns (total 7 columns):
 #   Column     Non-Null Count    Dtype
---  ------     --------------    -----
 0   open       1256095 non-null  float64
 1   high       1256095 non-null  float64
 2   low        1256095 non-null  float64
 3   close      1256095 non-null  float64
 4   volume     1256095 non-null  float64
 5   marketcap  1253855 non-null  float64
 6   sector     1256095 non-null  float64
dtypes: float64(7)
memory usage: 72.6+ MB
```

[18]:
```
print(f"# Tickers: {len(data.index.unique('ticker')):,.0f} | # Dates: {len(data.
 ↪index.unique('date')):,.0f}")
```

```
# Tickers: 500 | # Dates: 2,518
```

1.2.2 Remove outlier observations based on daily returns

[19]:
```
before = len(data)
data['ret'] = data.groupby('ticker').close.pct_change()
data = data[data.ret.between(-1, 1)].drop('ret', axis=1)
print(f'Dropped {before-len(data):,.0f}')
```

```
Dropped 502
```

[20]:
```
tickers = data.index.unique('ticker')
print(f"# Tickers: {len(tickers):,.0f} | # Dates: {len(data.index.
 ↪unique('date')):,.0f}")
```

```
# Tickers: 500 | # Dates: 2,517
```

1.2.3 Sample price data for illustration

[21]:
```
ticker = 'AAPL'
# alternative
# ticker = np.random.choice(tickers)
price_sample = data.loc[idx[ticker, :], :].reset_index('ticker', drop=True)
```

[22]:
```
price_sample.info()
```

```
<class 'pandas.core.frame.DataFrame'>
DatetimeIndex: 2517 entries, 2007-01-04 to 2016-12-30
Data columns (total 7 columns):
 #   Column     Non-Null Count  Dtype
---  ------     --------------  -----
 0   open       2517 non-null   float64
 1   high       2517 non-null   float64
 2   low        2517 non-null   float64
 3   close      2517 non-null   float64
 4   volume     2517 non-null   float64
 5   marketcap  2517 non-null   float64
 6   sector     2517 non-null   float64
dtypes: float64(7)
memory usage: 157.3 KB
```

[23]:
```
price_sample.to_hdf('data.h5', 'data/sample')
```

1.3 Compute returns

Group data by ticker

[24]:
```
by_ticker = data.groupby(level='ticker')
```

1.3.1 Historical returns

[25]:
```
T = [1, 2, 3, 4, 5, 10, 21, 42, 63, 126, 252]
```

[26]:
```
for t in T:
    data[f'ret_{t:02}'] = by_ticker.close.pct_change(t)
```

1.3.2 Forward returns

[27]:
```
data['ret_fwd'] = by_ticker.ret_01.shift(-1)
data = data.dropna(subset=['ret_fwd'])
```

1.4 Persist results

[28]:
```
data.info(null_counts=True)
```

```
<class 'pandas.core.frame.DataFrame'>
MultiIndex: 1255093 entries, ('A', Timestamp('2007-01-04 00:00:00')) to ('ZION',
Timestamp('2016-12-29 00:00:00'))
Data columns (total 19 columns):
 #   Column     Non-Null Count    Dtype
---  ------     --------------    -----
 0   open       1255093 non-null  float64
 1   high       1255093 non-null  float64
 2   low        1255093 non-null  float64
 3   close      1255093 non-null  float64
 4   volume     1255093 non-null  float64
 5   marketcap  1252855 non-null  float64
 6   sector     1255093 non-null  float64
 7   ret_01     1254593 non-null  float64
 8   ret_02     1254093 non-null  float64
 9   ret_03     1253593 non-null  float64
 10  ret_04     1253093 non-null  float64
 11  ret_05     1252593 non-null  float64
 12  ret_10     1250093 non-null  float64
 13  ret_21     1244593 non-null  float64
 14  ret_42     1234093 non-null  float64
 15  ret_63     1223593 non-null  float64
 16  ret_126    1192093 non-null  float64
 17  ret_252    1129093 non-null  float64
 18  ret_fwd    1255093 non-null  float64
dtypes: float64(19)
memory usage: 187.5+ MB
```

[29]:
```
data.to_hdf('data.h5', 'data/top500')
```