Small Cap Value and Momentum

MGMT 638: Data-Driven Investments: Equity

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Small Cap Value and Growth

- small cap $\approx$ Russell 2000
- value usually measured by PB or PE
- some academic work (Fama-French) found PB is a better predictor of returns
- low PB = value, high PB = growth
- academics usually use BP instead of PB and call it book-to-market
- high BP = value, low BP = growth
- small-cap growth has historically had very poor returns

Value and Momentum Portfolios I

- get marketcap data in addition to prices
- calculate momentum
- keep stocks between 1,001 and 3,000 in market cap
- create 5x5 sort on value and momentum
- compute equally weighted portfolio returns

Value and Momentum Portfolios II

- rank each stock between 1,001 and 3,000 on value
    - low rank = best (low pb)
- rank each stock also on momentum
    - low rank = best (high momentum)
- add ranks to get a single combined rank
    - low combined rank = best
- go long best 50 and short worst 50

Value and Momentum Portfolios III

- For long only portfolio, choose best stocks in each sector and match sector weights to benchmark (e.g., Russell 2000).
- For long-short portfolio, match shorts and longs in each sector to get market-neutral and sector-neutral portfolio.

Value and Momentum Portfolios IV

- Use machine learning to find the optimal way to combine value and momentum
- And add other predictors (ROE, investment rate, short-term reversal, ...)

Data and Procedure

- Get sectors from tickers table
- Get marketcap and pb from weekly table
- Get closeadj and closeunadj from sep_weekly as before
- Calculate momentum as before
- Filter to 1,001-3,000 on marketcap each week
- Form portfolios

Create connection

Get data

Calculate momentum

Merge marketcap and pb

In [ ]:

Save this week’s data

In [199]:

```
today = df[df.date==df.date.max()]
today.head(3)
```

Out[199]:

	ticker	date	ret	mom	closeunadj	marketcap	pb	sector
668	A	2023-10-27	-0.059141	-0.188863	102.77	30069.2	5.4	Healthcare
981	AA	2023-10-27	-0.020825	-0.256682	23.51	4195.9	0.9	Basic Materials
1644	AADI	2023-10-27	0.039120	-0.626255	4.25	104.2	0.8	Healthcare

Shift predictors and filtering variables to backtest

In [200]:

```
df = df.set_index(["ticker", "date"])
df[["mom", "pb", "marketcap", "closeunadj"]] = df.groupby("ticker", group_keys
df = df.dropna()
df.head(3)
```

Out[200]:

		ret	mom	closeunadj	marketcap	pb	sector
ticker	**date**						
A	**2011-01-14**	0.008130	0.199287	41.88	14557.7	4.5	Healthcare
	2011-01-21	0.050456	0.270914	42.22	14675.8	4.5	Healthcare
	2011-01-28	-0.075973	0.337839	44.35	15416.2	4.8	Healthcare

In [201]:

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
MultiIndex: 2640984 entries, ('A', datetime.date(2011, 1, 14)) to ('Z
YXI', datetime.date(2023, 10, 27))
Data columns (total 6 columns):
 #   Column      Dtype  
---  ------      -----  
 0   ret         float64
 1   mom         float64
 2   closeunadj  float64
 3   marketcap   float64
 4   pb          float64
 5   sector      object 
dtypes: float64(5), object(1)
memory usage: 131.3+ MB
```

Filter out penny stocks and filter to small caps

In [202]:

```
df = df[df.closeunadj>5]
df["rnk"] = df.groupby("date").marketcap.rank(ascending=False, method="first")
df = df[(df.rnk>1000) & (df.rnk<=3000)]
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
MultiIndex: 1324775 entries, ('AA', datetime.date(2019, 9, 6)) to ('Z
YXI', datetime.date(2023, 10, 27))
Data columns (total 7 columns):
 #   Column      Non-Null Count    Dtype  
---  ------      --------------    -----  
 0   ret         1324775 non-null  float64
 1   mom         1324775 non-null  float64
 2   closeunadj  1324775 non-null  float64
 3   marketcap   1324775 non-null  float64
 4   pb          1324775 non-null  float64
 5   sector      1324775 non-null  object 
 6   rnk         1324775 non-null  float64
dtypes: float64(6), object(1)
memory usage: 76.1+ MB
```

```
In [203]: df.reset_index().groupby("date").ticker.count()
```

```
Out[203]:  date
           2011-01-14    2000
           2011-01-21    2000
           2011-01-28    2000
           2011-02-04    2000
           2011-02-11    2000
                         ... 
           2023-09-29    1865
           2023-10-06    1853
           2023-10-13    1837
           2023-10-20    1829
           2023-10-27    1802
           Name: ticker, Length: 668, dtype: int64
```

```
In [204]: df.head(3)
```

Out[204]:

		ret	mom	closeunadj	marketcap	pb	sector	rnk
ticker	**date**							
AA	**2019-09-06**	0.025653	-0.477529	17.17	3186.0	0.7	Basic Materials	1006.0
	2020-01-31	-0.153060	-0.231754	17.12	3177.0	0.7	Basic Materials	1076.0
	2020-02-07	-0.017890	-0.237294	14.50	2759.5	0.6	Basic Materials	1162.0

Value and Momentum Portfolios I

In [205]:

```python
df["value_group"] = df.groupby("date", group_keys=False).pb.apply(
    lambda x: pd.qcut(x, 5, labels=range(1, 6))
)
df["mom_group"] = df.groupby("date", group_keys=False).mom.apply(
    lambda x: pd.qcut(x, 5, labels=range(1, 6))
)
rets = df.groupby(["date", "value_group", "mom_group"]).ret.mean()
rets = rets.unstack().unstack()
rets.head(3)
```

Out[205]:

```
  mom_group                                                    1
value_group          1          2          3          4          5          1
       date
 2011-01-14  -0.004985  -0.014070  -0.008452  -0.006321  -0.009538  -0.006124  -0.0
 2011-01-21   0.018622   0.018095   0.020878   0.013126   0.003709   0.013191   0.0
 2011-01-28  -0.026927  -0.021369  -0.030210  -0.027047  -0.030028  -0.010046  -0.0
```

3 rows × 25 columns

```
In [206]: (52*rets.mean()).unstack().round(3)
```

Out[206]:

value_group	1	2	3	4	5
mom_group					
1	0.040	0.038	0.060	0.052	-0.003
2	0.114	0.087	0.076	0.079	0.066
3	0.129	0.092	0.094	0.102	0.097
4	0.143	0.095	0.094	0.117	0.079
5	0.178	0.125	0.112	0.104	0.138

How many stocks are in the groups?

In [207]:

```
counts = df.groupby(["date", "value_group", "mom_group"]).ret.count()
counts = counts.unstack().unstack()
counts.tail(3)
```

Out[207]:

mom_group	**1**					**2**					**...**	**4**				
value_group	**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**	**...**	**1**	**2**	**3**	**4**	**5**
date																
2023-10-13	131	74	61	57	45	103	94	57	53	60	...	50	75	87	79	76
2023-10-20	138	75	57	50	46	108	94	59	47	58	...	58	71	80	66	91
2023-10-27	144	63	54	52	48	107	94	52	57	50	...	62	80	55	79	84

3 rows × 25 columns

Value and Momentum Portfolios II

- Rank stocks on momentum each week: 1=best, 2=next best, etc. (best=high momentum)
- Rank stocks on pb each week: 1=best, 2=next best, etc. (best=low pb)
- Add momentum and pb ranks: lowest combined ranks are best stocks
- Test A: sort into deciles on combined ranks and compute equally weighted returns
- Test B: go long best 50 stocks and short worst 50 stocks and compute returns

In [208]:

```
df["mom_rnk"] = df.groupby("date", group_keys=False).mom.rank(ascending=False
df["pb_rnk"] = df.groupby("date", group_keys=False).pb.rank(ascending=True, me
df["combined_rnk"] = df.mom_rnk + df.pb_rnk
```

Test A: Deciles

In [209]:

```
df["decile"] = df.groupby("date", group_keys=False).combined_rnk.apply(
    lambda x: pd.qcut(x, 10, labels=range(1, 11))
)
rets = df.groupby(["date", "decile"]).ret.mean()
rets = rets.unstack()
52*rets.mean()
```

Out[209]:

```
decile
1     0.140782
2     0.111245
3     0.110181
4     0.106055
5     0.096709
6     0.103076
7     0.092262
8     0.056943
9     0.074983
10    0.034706
dtype: float64
```

Test B: Top 50 and Bottom 50

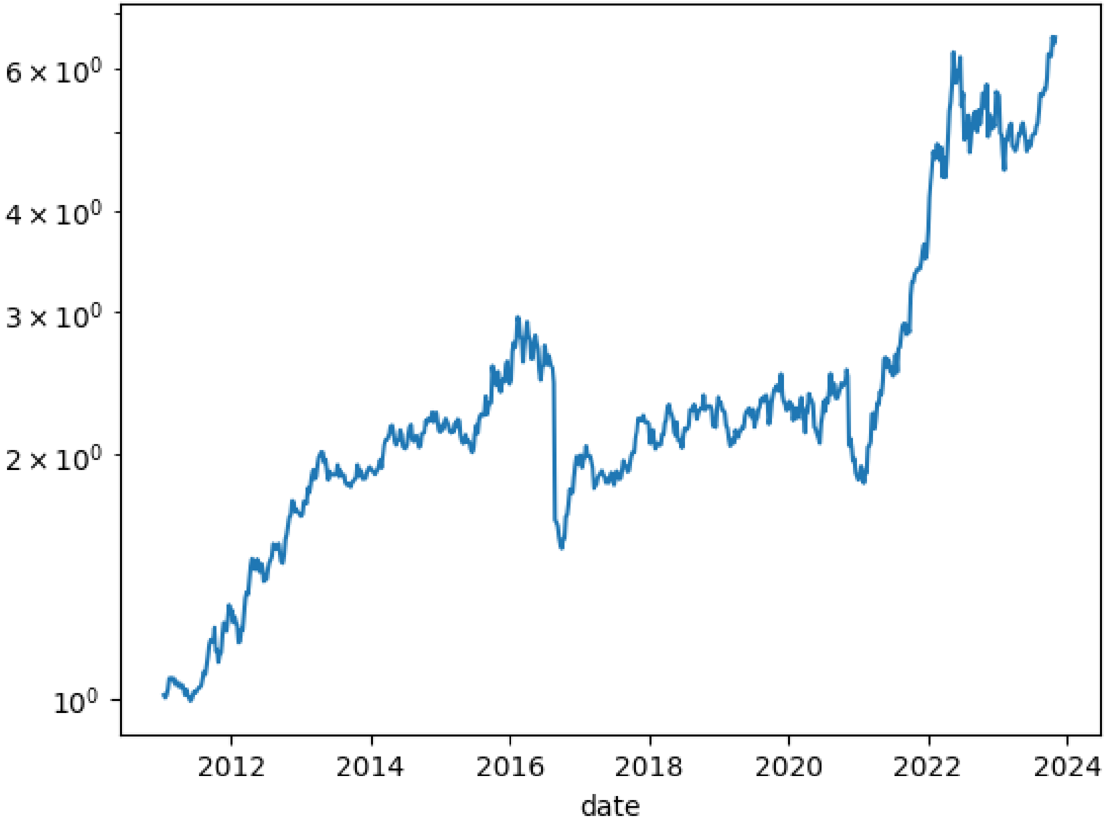
In [210]:

```
df["rnk_long"] = df.groupby("date", group_keys=False).combined_rnk.rank(methoc
df["rnk_short"] = df.groupby("date", group_keys=False).combined_rnk.rank(ascer
longs = df[df.rnk_long<=50]
shorts = df[df.rnk_short<=50]
long_rets = longs.groupby("date").ret.mean()
short_rets = shorts.groupby("date").ret.mean()
print(f"annualized mean long return is {52*long_rets.mean():.2%}")
print(f"annualized mean short return is {52*short_rets.mean():.2%}")
```

```
annualized mean long return is 17.82%
annualized mean short return is 0.23%
```

```
In [211]: (1+long_rets-short_rets).cumprod().plot(logy=True)

Out[211]: <Axes: xlabel='date'>
```



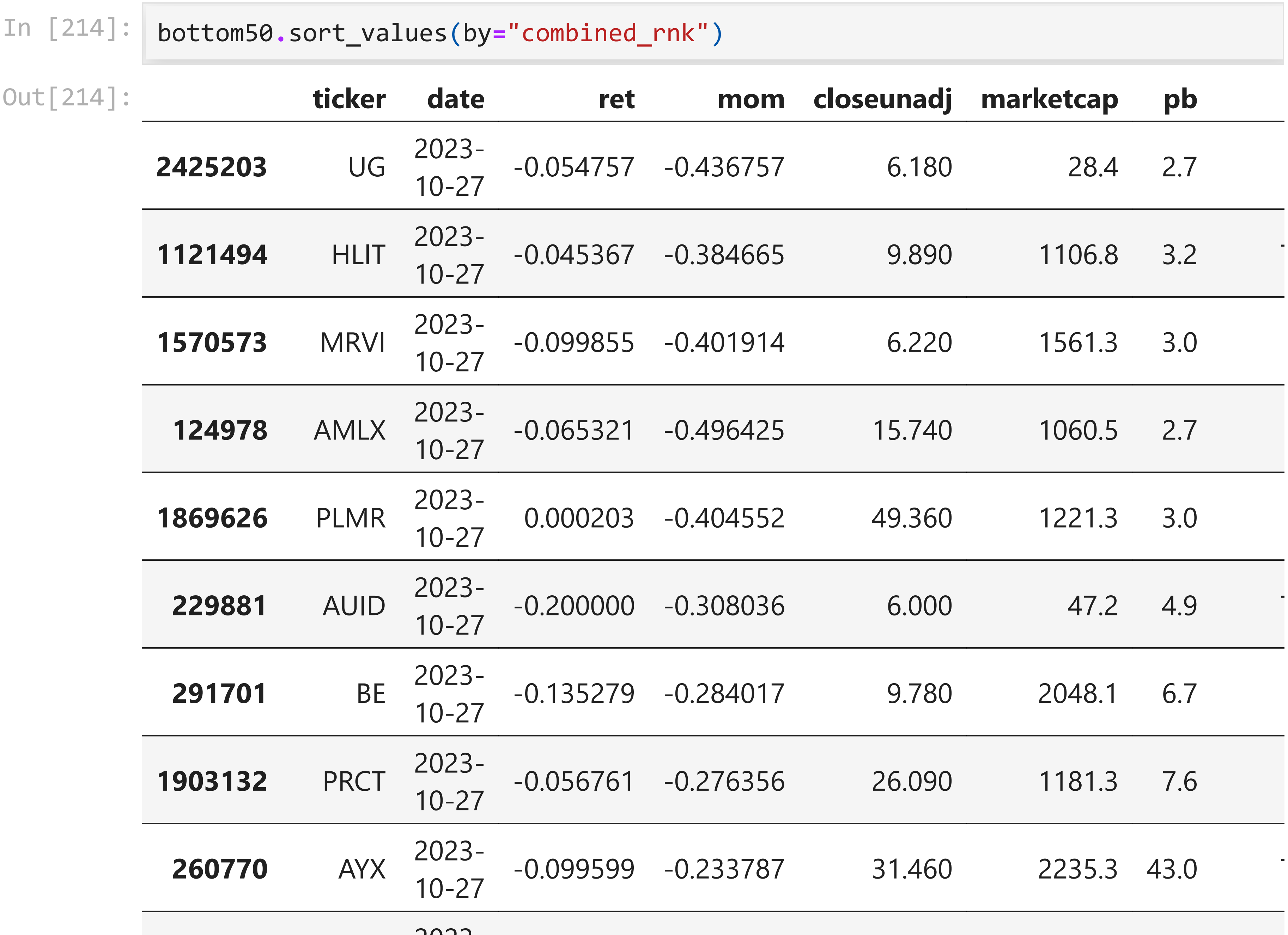
What are the top 50 and bottom 50 today?

In [213]:

```
top50.sort_values(by="combined_rnk")
```

Out[213]:

	ticker	date	ret	mom	closeunadj	marketcap	pb	
772871	EHTH	2023-10-27	-0.040293	1.587413	7.860	220.8	0.4	
427948	CBUS	2023-10-27	-0.453433	1.501030	10.270	218.6	0.5	He
2367118	TRML	2023-10-27	0.284404	0.906040	14.000	59.9	0.4	He
1429651	LSEA	2023-10-27	-0.001379	0.798000	7.240	279.4	0.4	Re
2197648	SPHR	2023-10-27	-0.009177	0.784908	33.470	1160.7	0.4	Commu
387833	BZH	2023-10-27	0.045982	1.177448	23.430	734.3	0.7	C
2449388	USAP	2023-10-27	0.158678	0.771622	14.020	127.4	0.6	Basic
1761051	OPRT	2023-10-27	-0.066102	0.377863	5.510	187.6	0.4	
1597522	MUX	2023-10-27	-0.083979	0.785714	7.090	336.6	0.7	Basic



```
In [214]: bottom50.sort_values(by="combined_rnk")
```

Out[214]:

	ticker	date	ret	mom	closeunadj	marketcap	pb
2425203	UG	2023-10-27	-0.054757	-0.436757	6.180	28.4	2.7
1121494	HLIT	2023-10-27	-0.045367	-0.384665	9.890	1106.8	3.2
1570573	MRVI	2023-10-27	-0.099855	-0.401914	6.220	1561.3	3.0
124978	AMLX	2023-10-27	-0.065321	-0.496425	15.740	1060.5	2.7
1869626	PLMR	2023-10-27	0.000203	-0.404552	49.360	1221.3	3.0
229881	AUID	2023-10-27	-0.200000	-0.308036	6.000	47.2	4.9
291701	BE	2023-10-27	-0.135279	-0.284017	9.780	2048.1	6.7
1903132	PRCT	2023-10-27	-0.056761	-0.276356	26.090	1181.3	7.6
260770	AYX	2023-10-27	-0.099599	-0.233787	31.460	2235.3	43.0

Sector weights

```
In [215]: top50.groupby("sector").rnk.count()
```

```
Out[215]: sector
          Basic Materials            3
          Communication Services     2
          Consumer Cyclical         11
          Energy                     1
          Financial Services        19
          Healthcare                 4
          Industrials                5
          Real Estate                5
          Name: rnk, dtype: int64
```

```
In [216]: bottom50.groupby("sector").rnk.count()
```

```
Out[216]: sector
          Basic Materials            1
          Communication Services     1
          Consumer Cyclical          3
          Consumer Defensive         2
          Energy                     2
          Financial Services         3
          Healthcare                19
          Industrials                3
          Technology                15
          Utilities                  1
          Name: rnk, dtype: int64
```

Value and Momentum Portfolios III

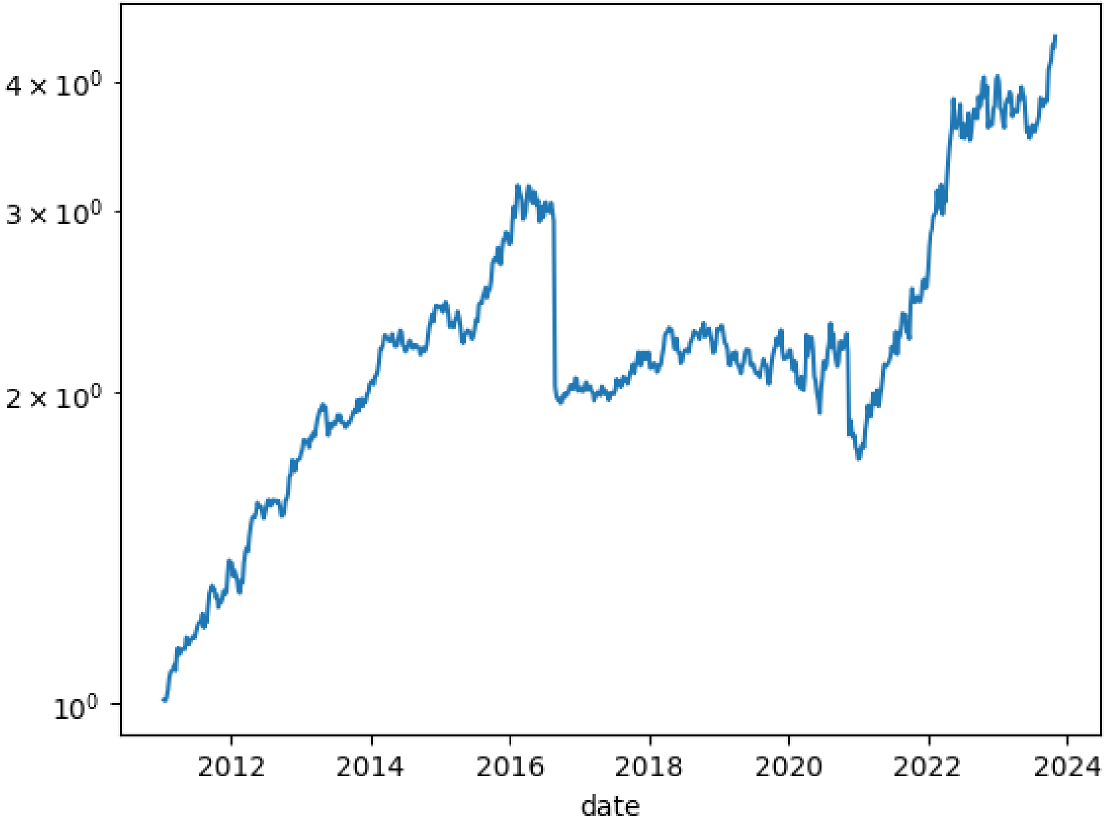
- Rank on combined rank separately in each sector
- Do that by grouping by date and sector instead of just date
- Choose top 5 and bottom 5 in each sector to get sector neutrality

```
In [217]: df["rnk_long"] = df.groupby(["date", "sector"], group_keys=False).combined_rnk
          df["rnk_short"] = df.groupby(["date", "sector"], group_keys=False).combined_rr
          longs = df[df.rnk_long<=5]
          shorts = df[df.rnk_short<=5]
          long_rets = longs.groupby("date").ret.mean()
          short_rets = shorts.groupby("date").ret.mean()
          print(f"annualized mean long return is {52*long_rets.mean():.2%}")
          print(f"annualized mean short return is {52*short_rets.mean():.2%}")
```

```
annualized mean long return is 15.07%
annualized mean short return is 1.82%
```

```
In [218]: (1+long_rets-short_rets).cumprod().plot(logy=True)
```

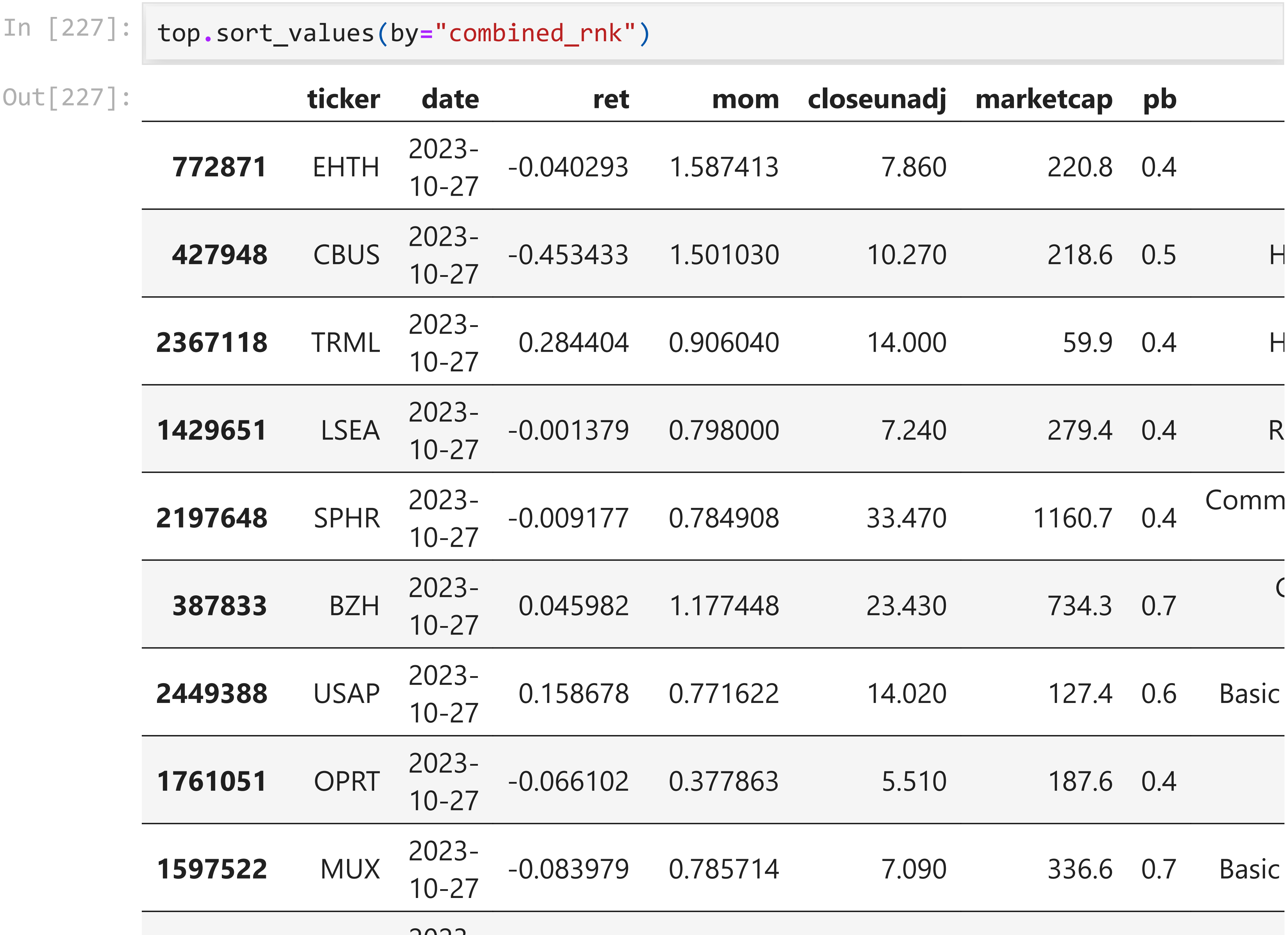
```
Out[218]: <Axes: xlabel='date'>
```



Best and worst stocks today in sector-neutral strategy

- Just group by sector when ranking
- Choose top 5 and bottom 5 in each sector

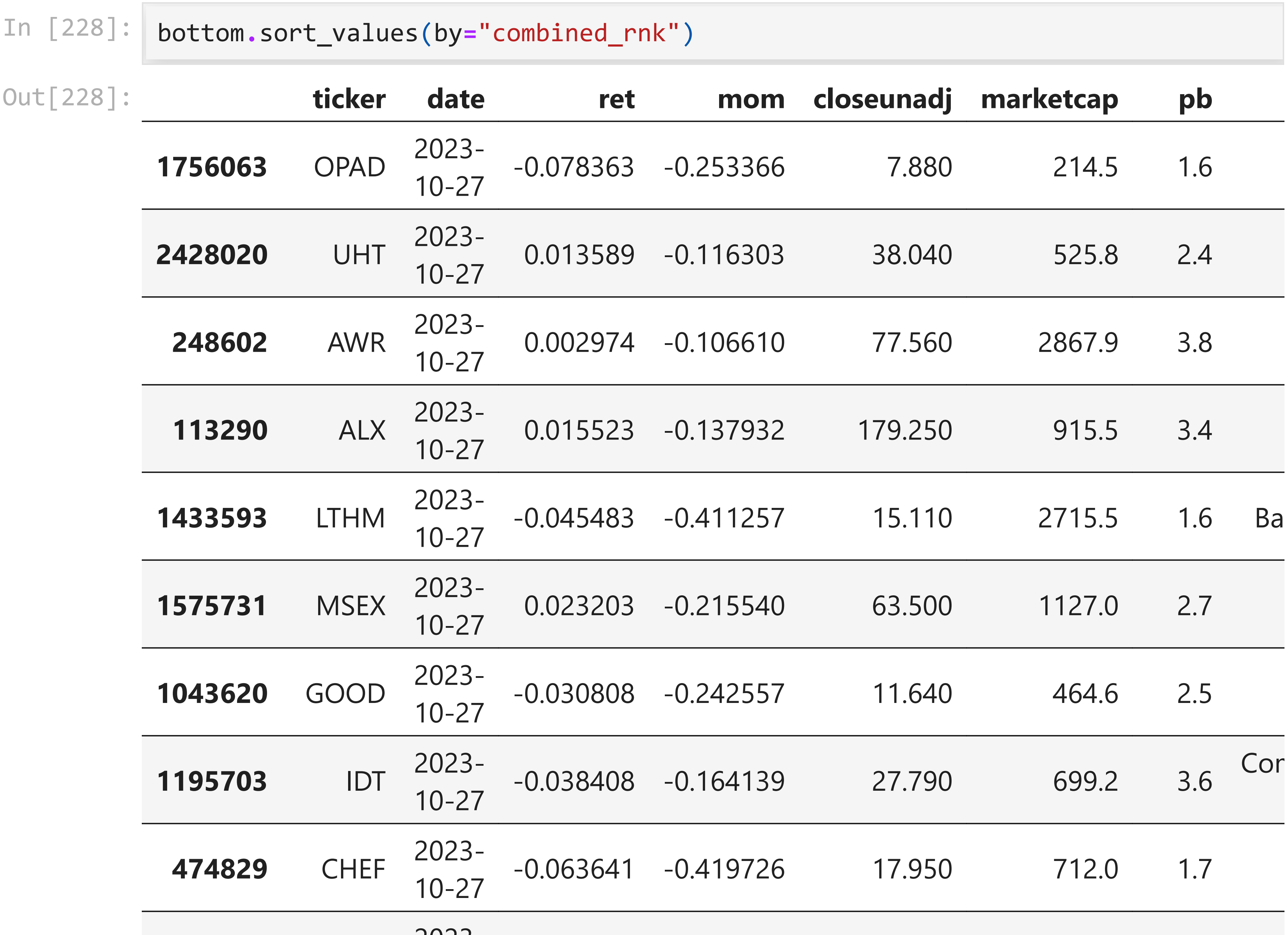
```
In [226]: today["rnk_long"] = today.groupby("sector").combined_rnk.rank(method="first")
          today["rnk_short"] = today.groupby("sector").combined_rnk.rank(ascending=False
          top = today[today.rnk_long<=5].copy()
          bottom = today[today.rnk_short<=5].copy()
```



```
In [227]: top.sort_values(by="combined_rnk")
```

Out[227]:

	ticker	date	ret	mom	closeunadj	marketcap	pb	
772871	EHTH	2023-10-27	-0.040293	1.587413	7.860	220.8	0.4	
427948	CBUS	2023-10-27	-0.453433	1.501030	10.270	218.6	0.5	H
2367118	TRML	2023-10-27	0.284404	0.906040	14.000	59.9	0.4	H
1429651	LSEA	2023-10-27	-0.001379	0.798000	7.240	279.4	0.4	R
2197648	SPHR	2023-10-27	-0.009177	0.784908	33.470	1160.7	0.4	Comm
387833	BZH	2023-10-27	0.045982	1.177448	23.430	734.3	0.7	C
2449388	USAP	2023-10-27	0.158678	0.771622	14.020	127.4	0.6	Basic
1761051	OPRT	2023-10-27	-0.066102	0.377863	5.510	187.6	0.4	
1597522	MUX	2023-10-27	-0.083979	0.785714	7.090	336.6	0.7	Basic



In [228]:

```
bottom.sort_values(by="combined_rnk")
```

Out[228]:

	ticker	date	ret	mom	closeunadj	marketcap	pb	
1756063	OPAD	2023-10-27	-0.078363	-0.253366	7.880	214.5	1.6	
2428020	UHT	2023-10-27	0.013589	-0.116303	38.040	525.8	2.4	
248602	AWR	2023-10-27	0.002974	-0.106610	77.560	2867.9	3.8	
113290	ALX	2023-10-27	0.015523	-0.137932	179.250	915.5	3.4	
1433593	LTHM	2023-10-27	-0.045483	-0.411257	15.110	2715.5	1.6	Ba
1575731	MSEX	2023-10-27	0.023203	-0.215540	63.500	1127.0	2.7	
1043620	GOOD	2023-10-27	-0.030808	-0.242557	11.640	464.6	2.5	
1195703	IDT	2023-10-27	-0.038408	-0.164139	27.790	699.2	3.6	Cor
474829	CHEF	2023-10-27	-0.063641	-0.419726	17.950	712.0	1.7	

```
In [229]: top.groupby("sector").rnk.count()
```

```
Out[229]: sector
          Basic Materials           5
          Communication Services    5
          Consumer Cyclical         5
          Consumer Defensive        5
          Energy                    5
          Financial Services        5
          Healthcare                5
          Industrials               5
          Real Estate               5
          Technology                5
          Utilities                 5
          Name: rnk, dtype: int64
```

```
In [230]: bottom.groupby("sector").rnk.count()
```

```
Out[230]: sector
          Basic Materials           5
          Communication Services    5
          Consumer Cyclical         5
          Consumer Defensive        5
          Energy                    5
          Financial Services        5
          Healthcare                5
          Industrials               5
          Real Estate               5
          Technology                5
          Utilities                 5
          Name: rnk, dtype: int64
```

How many shares to buy/sell?

- Can do this either for top50 and bottom50 or top and bottom (sector-neutral)
- $1,000,000 to invest long and short
- Divide by number of stocks to get $ per stock
- Divide by price to get shares per stock

Long side

In [231]:

```
top["shares"] = (1000000 / 55) / top.closeunadj
top["shares"] = top.shares.round(0).astype(int)
top[["sector", "combined_rnk", "ticker", "shares"]].sort_values(by=["sector",
```

Out[231]:

	sector	combined_rnk	ticker	shares
2449388	Basic Materials	299	USAP	1297
1597522	Basic Materials	366	MUX	2564
950535	Basic Materials	423	FRD	1872
2638060	Basic Materials	683	ZEUS	368
986128	Basic Materials	761	GATO	3629
2197648	Communication Services	151	SPHR	543
2300744	Communication Services	528	TDS	1021
2455127	Communication Services	704	USM	439
1177442	Communication Services	863	IAC	435
2116089	Communication Services	946	SGA	949
387833	Consumer Cyclical	269	BZH	776
1139786	Consumer Cyclical	391	HOV	274
925188	Consumer Cyclical	480	FLXS	921
306996	Consumer Cyclical	507	BH	126
438831	Consumer Cyclical	523	CCS	299

Short side

In [232]:

```python
bottom["shares"] = (1000000 / 55) / bottom.closeunadj
bottom["shares"] = bottom.shares.round(0).astype(int)
bottom[["sector", "combined_rnk", "ticker", "shares"]].sort_values(by=["secto
```

Out[232]:

	sector	combined_rnk	ticker	shares
1433593	Basic Materials	2619	LTHM	1203
1573351	Basic Materials	2675	MSB	901
2165284	Basic Materials	2689	SMID	939
1555752	Basic Materials	2779	MP	1102
2379344	Basic Materials	3443	TSE	3035
1195703	Communication Services	2660	IDT	654
1755960	Communication Services	2738	OOMA	1693
934187	Communication Services	2768	FNGR	3218
1042555	Communication Services	2889	GOGO	1707
2388282	Communication Services	3229	TTGT	720
425453	Consumer Cyclical	3029	CBRL	281
1492207	Consumer Cyclical	3041	MED	261
350200	Consumer Cyclical	3236	BOWL	1758
1374556	Consumer Cyclical	3236	LEE	2029
2514031	Consumer Cyclical	3352	VSCO	982

In [237]:

```
with pd.ExcelWriter("portfolios 2023-11-01.xlsx") as writer:
    top.drop(columns="date").to_excel(writer, "top", index=False)
    bottom.drop(columns="date").to_excel(writer, "bottom", index=False)
    top50.drop(columns="date").to_excel(writer, "top50", index=False)
    bottom50.drop(columns="date").to_excel(writer, "bottom50", index=False)
    today.drop(columns="date").to_excel(writer, "today", index=False)
```