AUG 19–SEPT 19

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Project Summary

#0: GENERAL OVERVIEW/LOGISTICS

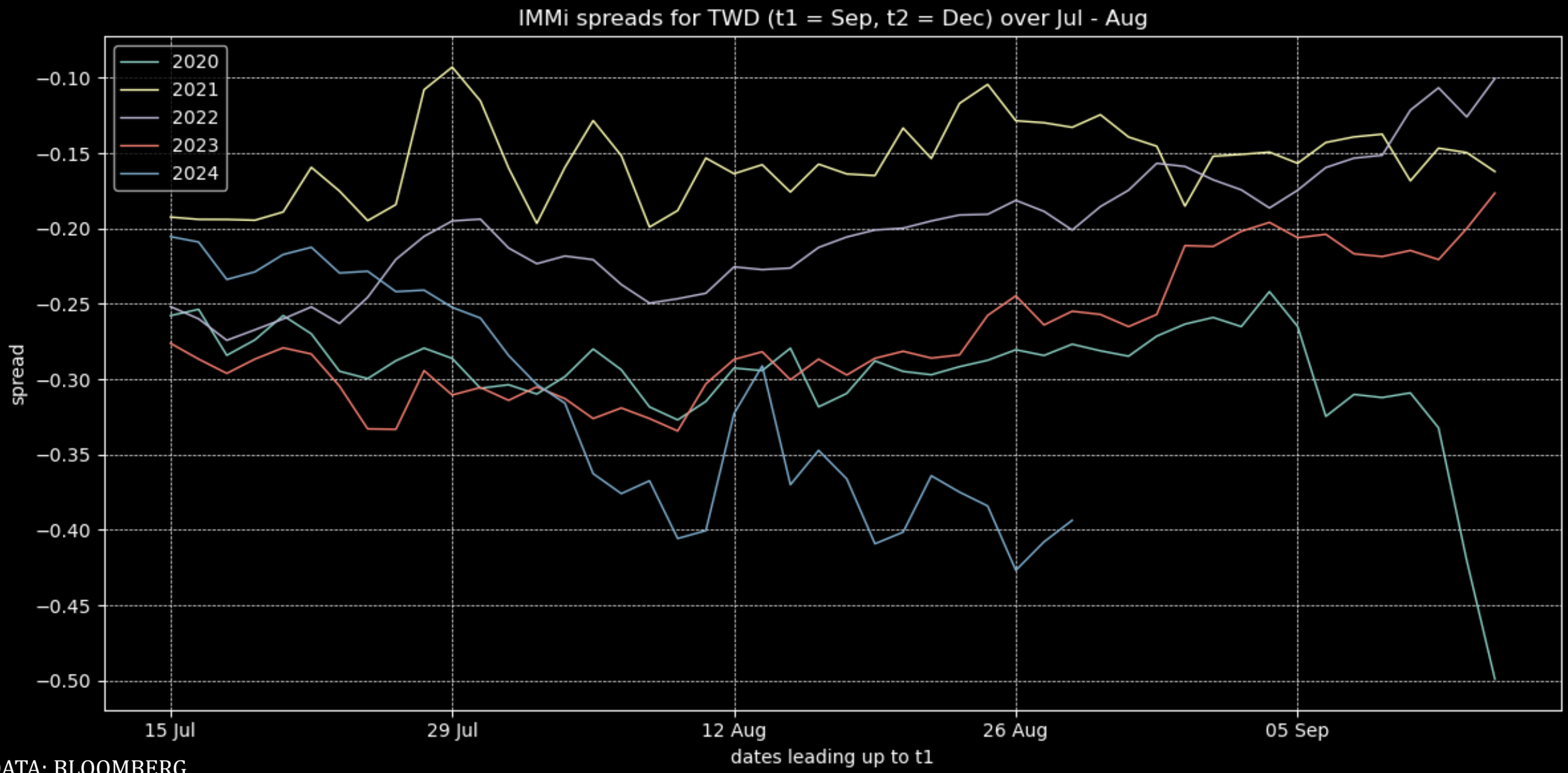
- Language: python script or interactive notebook. Runnable from command line or executable. 5000+ lines of code
- Data: Bloomberg & 360T. Runnable anytime without Bloomberg sign-in. Sources can be easily modified (rates, FX).
- Aims: testing fundamental/technical strategies/hypotheses.
- Implementation: either one-time historical analysis or live systematic signals

IMMi Study

Are there seasonal patterns in IMMi rolls close to expiry?

#1: IMMi SEASONAL STUDY: TWD SEP/DEC

◊ For 2022/2023 the spread compressed a fair amount leading up to Sep, may be a post-covid pattern. Esp in 26 Aug to 5 Sept period



DATA: BLOOMBERG

#1: IMMi STUDY: RESULTS FOR TWD SEP/DEC SPREAD – START/END PnL

- Change: spread at 45, 30, 20d… prior to spread at t1 (in bps)
- Pattern of compression in post covid Sep/Dec
- Tool can be used for any pairs/dates (e.g. some pattern in INR, opposite in TWD dec/mar

PnL (S/B)	*45d*	*30d*	*20d*	*15d*	*10d*	*5d*	*2d*
2011	0.67	0.99	1.03	1.04	0.55	1.07	0.16
2012	0.06	-0.02	-0.07	-0.05	-0.03	0.09	-0.06
2013	-0.42	-0.41	-0.33	-0.17	-0.19	-0.21	-0.04
2014	0.11	0.15	0.18	0.15	0.20	0.16	-0.02
2015	0.09	-0.08	0.05	0.02	-0.09	-0.02	-0.04
2016	-0.50	-0.36	-0.31	-0.17	-0.23	-0.23	0.00
2017	-0.36	-0.33	-0.22	-0.11	0.02	-0.07	0.01
2018	0.05	0.04	0.08	0.02	0.03	0.02	-0.08
2019	-0.52	-0.42	-0.34	-0.29	-0.27	-0.01	-0.04
2020	-0.68	-0.72	-0.74	-0.80	-0.87	-0.65	-0.57
2021	-0.01	0.01	-0.14	0.08	-0.05	0.02	-0.06
2022	0.39	0.33	0.28	0.19	0.28	0.07	0.02
2023	0.43	0.34	0.25	0.11	0.06	0.12	0.14
2024	NaN	NaN	NaN	NaN	NaN	NaN	NaN

DATA: BLOOMBERG

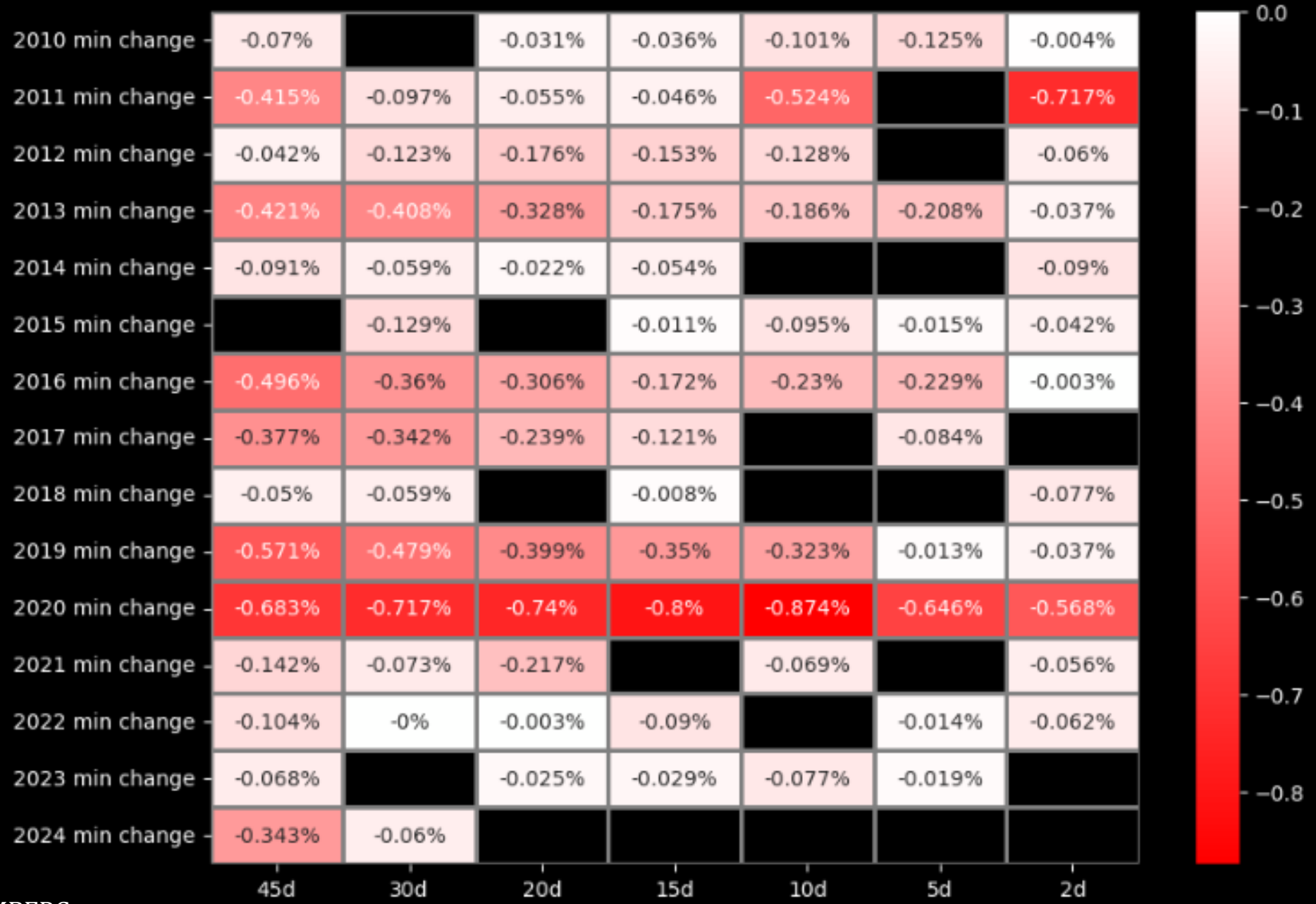
SIMULATED PnL SCENARIOS , NOT ACTUAL TRADING PnL

#1: IMMi STUDY: RESULTS FOR TWD SEP/DEC SPREAD – MAX PnL MOVEMENT (BPS)

DATA: BLOOMBERG

SIMULATED PnL SCENARIOS , NOT ACTUAL TRADING PnL

#1: IMMi STUDY: RESULTS FOR TWD SEP/DEC SPREAD – MIN PnL MOVEMENT (BPS)



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SIMULATED PnL SCENARIOS , NOT ACTUAL TRADING PnL

#1: IMMi STUDY: RESULTS FOR TWD SEP/DEC SPREAD – TRADE IMPROVEMENTS

- strategy improvement: TWD1M – PPM1M (implied points per month) as a metric to indicate buy/sell.
- If this was high (e.g. > 60), it may indicate spread compression--successful at predicting compressions 5/7 times

1M-Imp	*45d*	*30d*	*20d*	*15d*	*10d*	*5d*	*2d*
2011	171.95	-55.14	-23.22	-27.63	126.46	-86.81	149.38
2012	35.40	52.15	18.16	-24.36	-43.00	-41.70	11.37
2013	60.10	-21.00	-24.52	-61.44	-35.58	-31.01	-71.28
2014	63.03	-10.67	-21.36	-2.60	-16.45	3.30	11.54
2015	44.64	123.73	-34.33	-10.36	28.14	4.78	9.92
2016	-125.15	31.18	-15.41	-84.45	27.99	-17.50	-100.43
2017	4.44	-12.68	-40.87	-85.26	-92.99	-75.22	-81.03
2018	68.53	-2.83	-16.69	-18.27	-31.34	-59.07	-48.71
2019	55.07	-37.13	-51.60	-49.44	-78.35	-153.95	-128.94
2020	49.04	20.59	-4.71	-16.58	-16.61	-85.52	-109.70
2021	68.02	18.16	17.96	-36.28	-18.51	-60.95	-39.58
2022	92.92	57.06	-4.24	-27.92	-26.72	14.97	14.74
2023	116.10	31.83	11.48	4.84	19.34	-15.71	-48.15
2024	6.17	-89.91	NaN	NaN	NaN	NaN	NaN

DATA: BLOOMBERG

SIMULATED PnL SCENARIOS, NOT ACTUAL TRADING PnL

#1: IMMI STUDY: NOTES/FUTURE ANALYSIS

- Made small (75k) PnL testing the strategy (TWD, INR Sep/Dec)
- Included Excel integration of tables for easier analysis
- Future analyses to test, changing:
  - Currency
  - IMM dates
  - How far back to enter (from t1)
  - Backtesting period (all history or recent years)

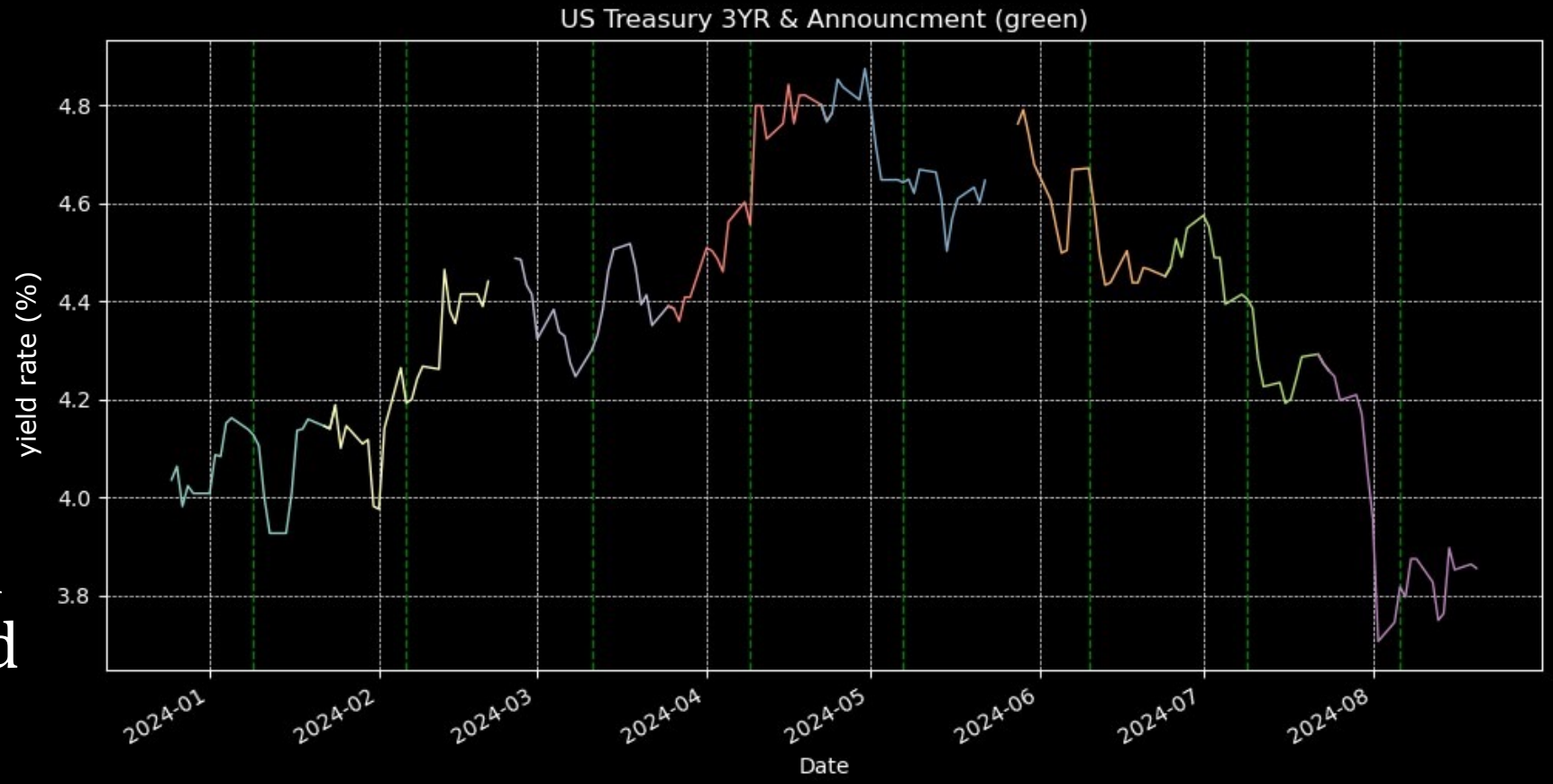
```
yr_to_start = 2024
years_back = 4
start_month = 9 #3, 6, 9, 12
res_days = [60, 45, 30, 20, 15, 10, 5, 2] # days before t1 to enter trade for
simulation
curncy = 'TWD'
exp = ['1W', '1M', '2M', '3M', '6M', '9M', '1Y'] # expiry dates for
interpolation
```

UST Auctions & Yields

How do yields move on auction days?

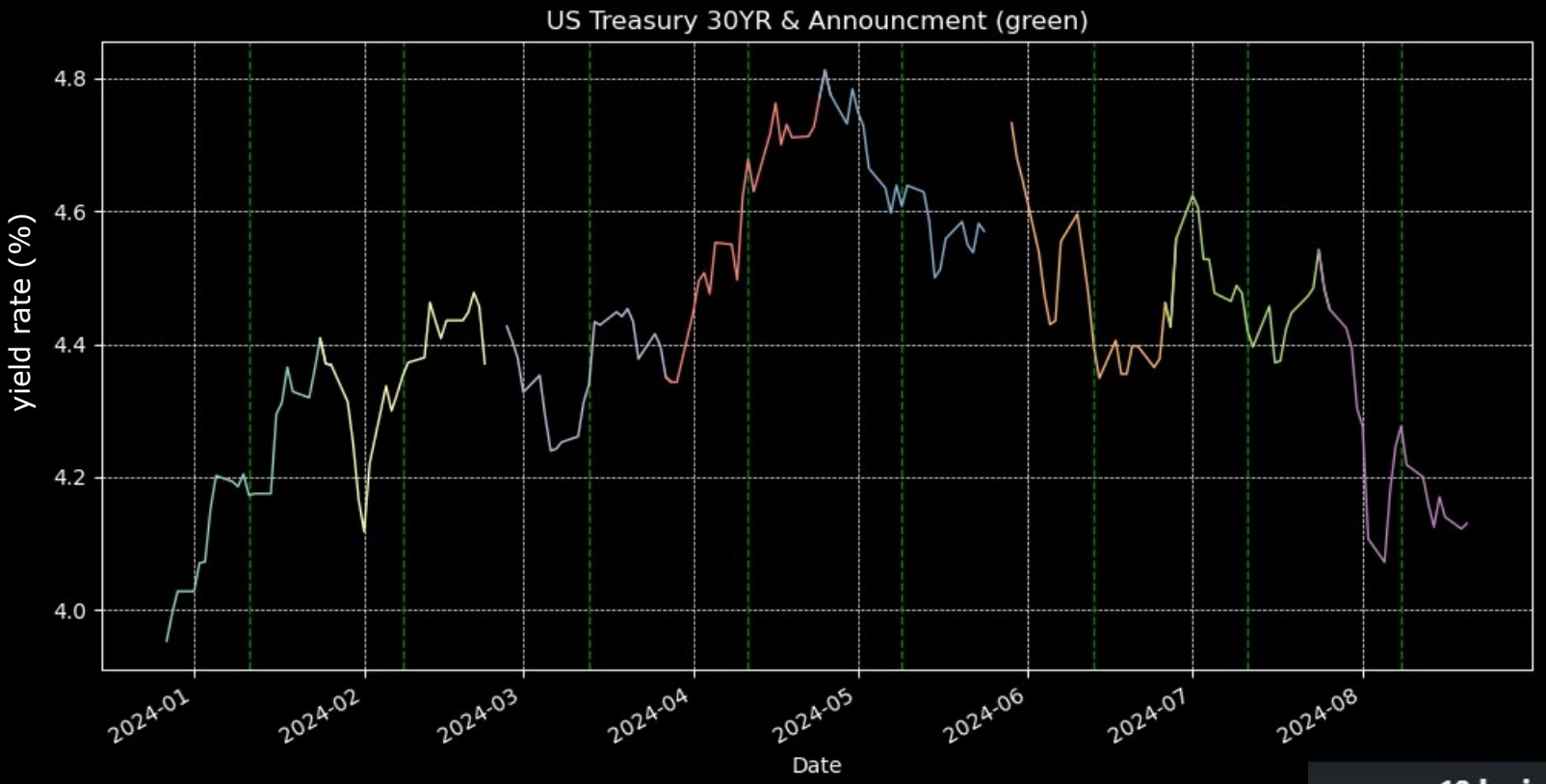
#2: UST AUCTIONS & YIELDS

- ◊ No particular movement/analysis seen on or around auction dates
- ◊ Next analysis: more details could be studied—e.g. use the details of the auction (yield values, allotted amt), how they correlate with the changes in Yields



DATA: BLOOMBERG

#2: UST AUCTIONS & YIELDS: AVG YIELD MOVEMENTS BEFORE/AFTER ANNOUNCEMENT



◊ Nothing distinctive, wide range of change

	10d prior	5d prior	1d prior	1d post	5d post	10d post
count	20.000000	20.00000	20.000000	20.000000	20.000000	20.000000
mean	2.022000	2.05300	0.512000	-1.646500	-1.130500	-0.520500
std	18.415897	16.42762	5.025948	8.362702	23.144275	25.615743
min	-28.000000	-22.26000	-10.500000	-16.570000	-62.100000	-73.560000
25%	-9.795000	-8.50750	-0.645000	-5.092500	-13.195000	-12.830000
50%	3.895000	-4.41000	0.290000	-1.555000	-0.620000	2.515000
75%	12.947500	15.54000	2.427500	1.145000	19.985000	16.857500
max	45.480000	35.20000	13.030000	24.270000	28.580000	34.010000

DATA: BLOOMBERG

Indx & Yields

How does PMI/ESI data correlate w/ market yields?

#3: ESI & YIELDS

- Tried using Economic Surprise Index (ESI) only as a predictor
- E.g. if higher than previous announcement, or high surprise
- Wasn’t that good of an indicator
- Tried with different lag periods also, to see if yields were affect later, not much correlation seen

#3: PMI (MANUFACTURING) & YIELDS: PRELINARY ANALYSIS/HYPOTHESIS

- ◊ correlation b/w change in Purchasing Manager's Index (PMI) and market yields was higher than ESI (60-80% most cases)

- ◊ but required further research (as only 12 data points to correlate for each year)

```
PMI correlation with ust 3M in 2024: 0.7811317499797503
--- statistics for 2YR - 2016 - 2017 ---
PMI correlation with ust 2YR in 2016: 0.7043412408547101
--- statistics for 2YR - 2017 - 2018 ---
PMI correlation with ust 2YR in 2017: 0.7278963186260535
--- statistics for 2YR - 2018 - 2019 ---
PMI correlation with ust 2YR in 2018: -0.18532693865404093
```

DATA: BLOOMBERG

#3: PMI & YIELDS

- strategy: buy signal if PMI higher than previous announcement's value else sell
- a 1d holding period between PMI announcement day & day to exit trade was optimal
- Hold for 1 day after announcement (10 AM CT announcement, hold position till close)

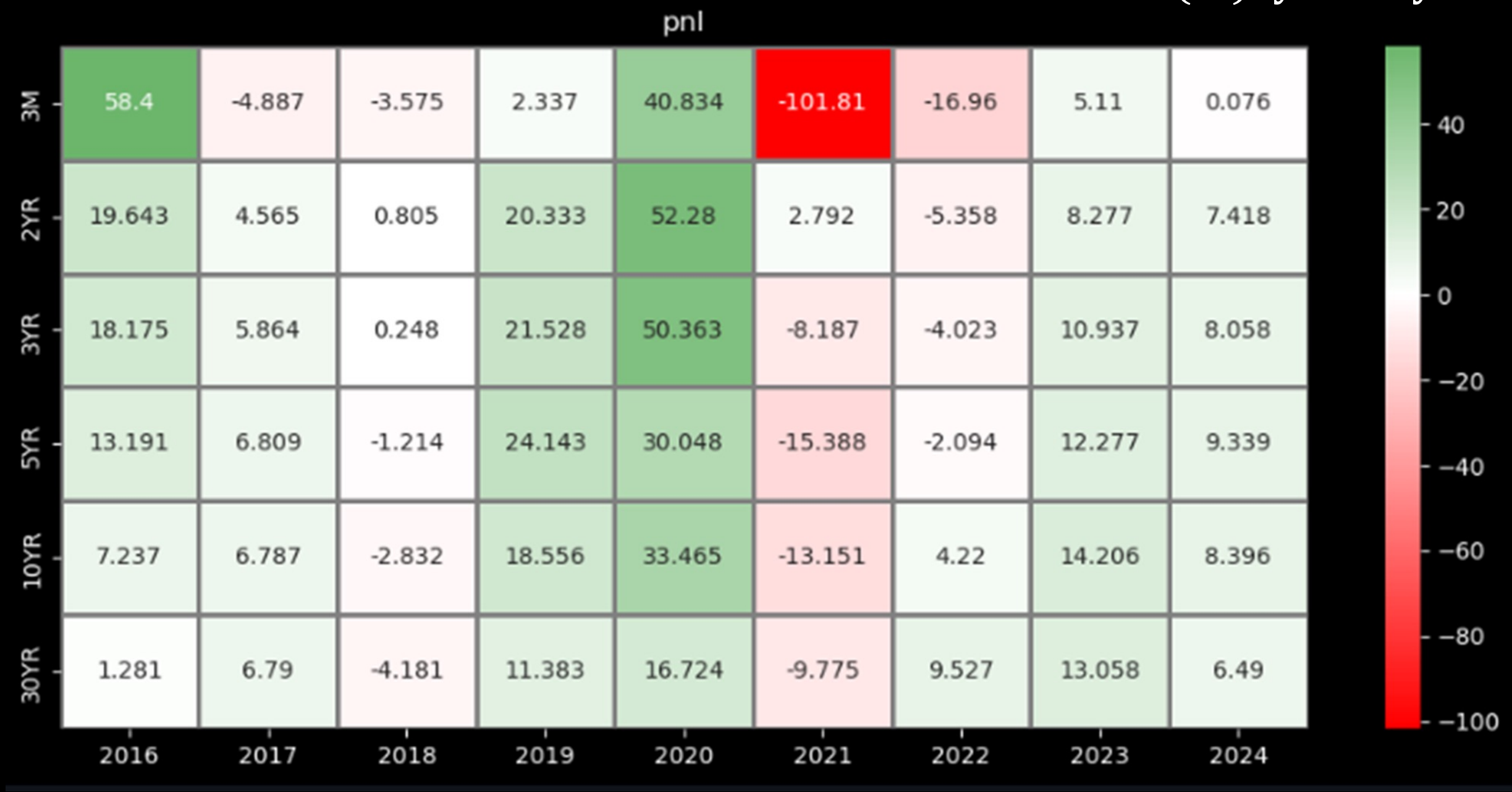
#3: PMI & YIELDS: HIT RATIO

strat hit ratio: year *x* yield

SIMULATED PnL SCENARIOS , NOT ACTUAL TRADING PnL

#3: PMI & YIELDS: PnL BASED ON STRATEGY

PnL (%): year *x* yield

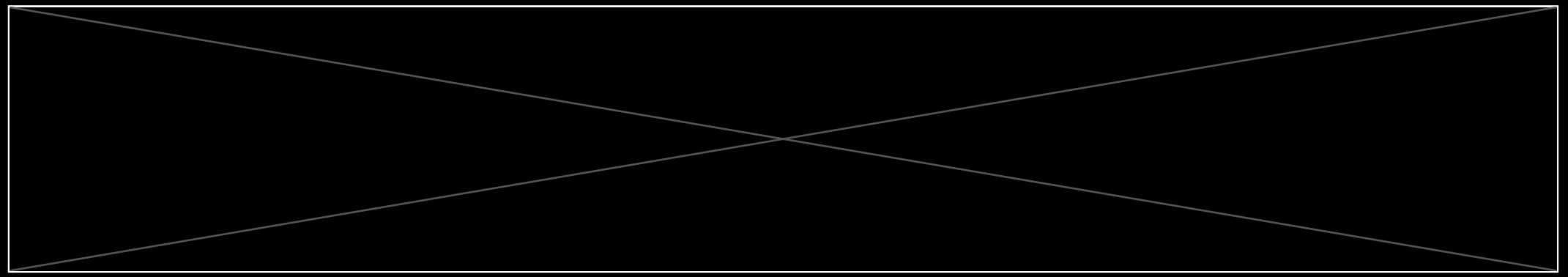
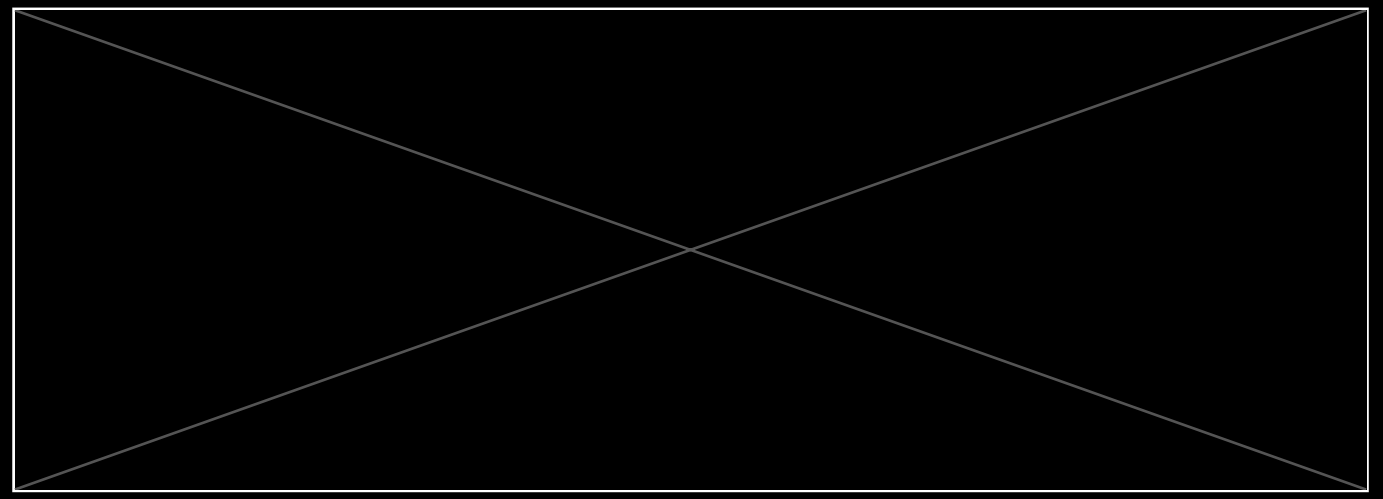


SIMULATED PnL SCENARIOS , NOT ACTUAL TRADING PnL

Syst. Strat

Can systematic strategies such as CTA-inspired ones or MA/BB improve PnL?

#4: DYNAMIC MA STRATEGY: METHODOLOGY

- Created trading logic based on CTA papers and testing (for balance of feasible manual execution and CTA-style positioning), e.g:
  - 
- Then used genetic algorithms to optimize the parameters of the strategy, using a training set from 3 months prior to present. For CTA/MA strat:
  - 

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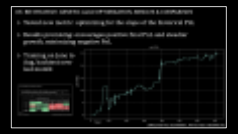
#4: DYNAMIC MA STRATEGY: RESULTS

- Have different variations of the strategy (e.g. conservative/aggressive) based on fitness function (what metrics to optimize)
- An e.g. of an aggressive (high vol/drawdown, but reducing absolute loss):

high risk-reward. linear						
	total pnl %	*hit ratio %*	*stdev/vol %*	*max draw %*	*max loss %*	*@ 100 hr %*
3	13.94	71.15	3.20	-0.78	-0.06	1.17
4	17.72	63.32	6.89	-17.42	-7.21	7.28
5	-11.43	38.92	4.41	-27.92	-10.48	-0.33
6	7.07	58.00	6.91	-37.52	-7.71	-3.37
7	13.17	50.14	8.45	-22.89	-6.19	-1.64
ANN	97.14		12.28			



DATA: 360T

SIMULATED PnL SCENARIOS , NOT ACTUAL TRADING PnL

#4: DYNAMIC MA STRATEGY: GENETIC ALGO OPTIMIZATION, RESULTS & COMPARISON

- An example of safer, more stable returns (optimzed for ↓loss).
- Also tried limiting strat to run for 100 hrs each month and re-train afterwards (hypothesis: strat becomes outdated)

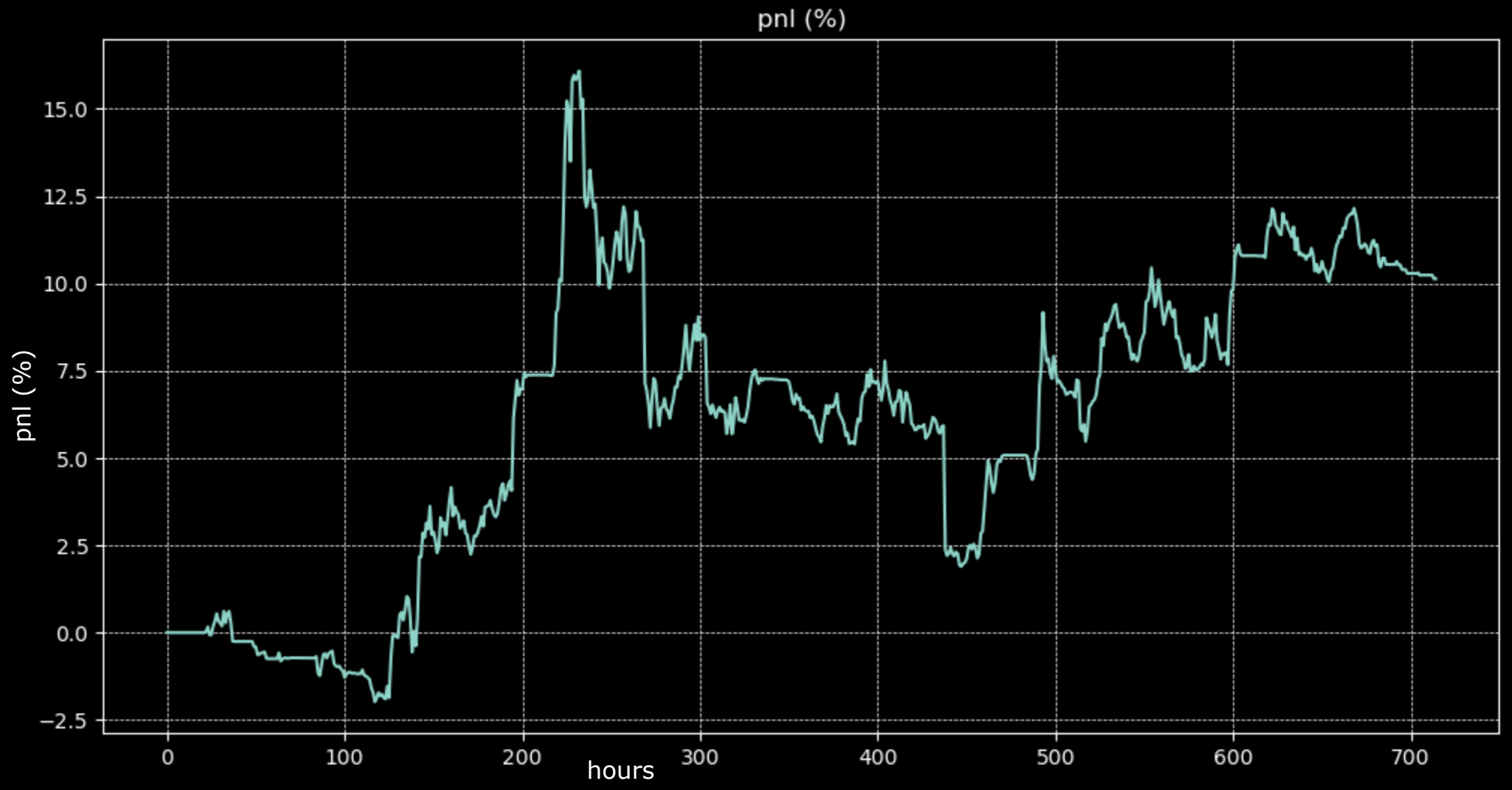
3	-0.15	63.98	0.83	-0.09	-0.07
4	0.52	62.76	1.15	-0.45	-0.45
5	0.29	60.54	0.92	-0.04	0.00
6	0.12	59.46	0.64	-0.16	-0.04
7	0.07	55.13	0.77	-0.64	-0.64
ANN	10.73		3.42		

DATA: 360T

SIMULATED PnL SCENARIOS , NOT ACTUAL TRADING PnL

#4: DYNAMIC MA STRATEGY: ACTUAL TRADES: OTHER EXAMPLES (LAST MONTH)

USDJPY, cta-style positioning + moving average strategy, genetic algo **max PnL, min drawd**, systematically traded hourly over last M



SIMULATED PnL SCENARIOS , NOT ACTUAL TRADING PnL

#4: SYSTEMATIC STRATEGY: PRACTICAL CONSIDERATIONS

- ◊ Developed simple interface (if don't want full systematic control)
- ◊ E.g. suggested position, when to trade, technical reason for trade
- ◊ Will need to be retrained monthly to keep parameters relevant, though even this parameter (the retraining period) can be tuned
- ◊ Currently testing across diff securities (rates/FX) and time periods (1 hour ticks seem to be most feasible for both PnL and execution frequency ease)

#4: SYSTEMATIC STRATEGY: PRACTICAL CONSIDERATIONS, TRADING INTERFACE

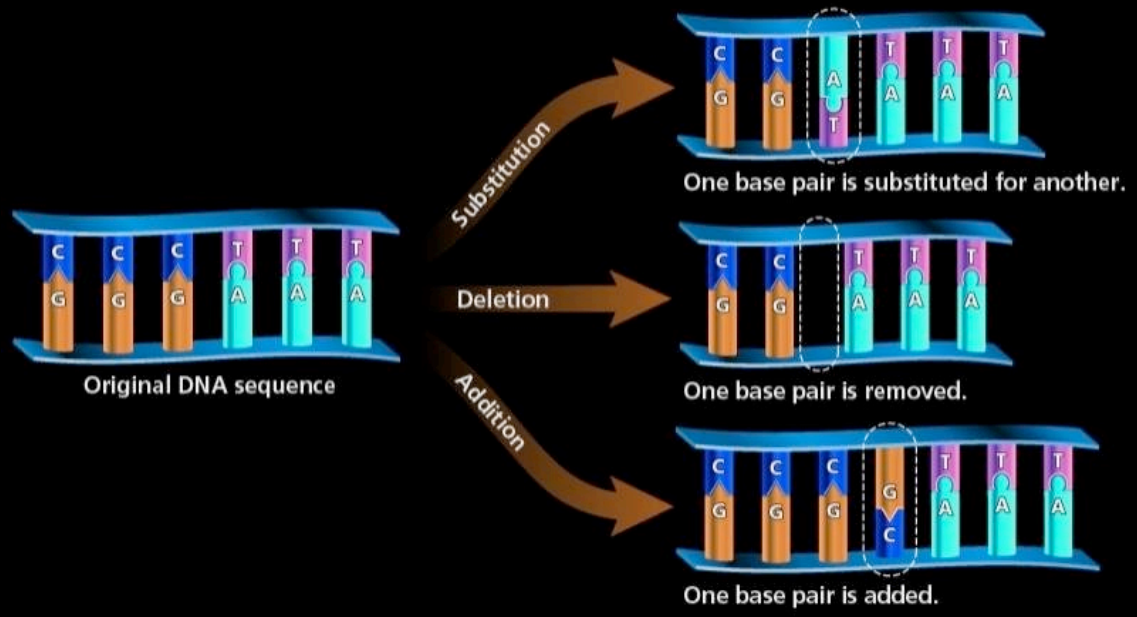
- Lightweight command-line tool. Suggests trades to make at the next open, quick plot of strategy, current PnL etc.
- Easily modifiable for more statistics if needed
- May be used in conjunction with user's fundamental analysis

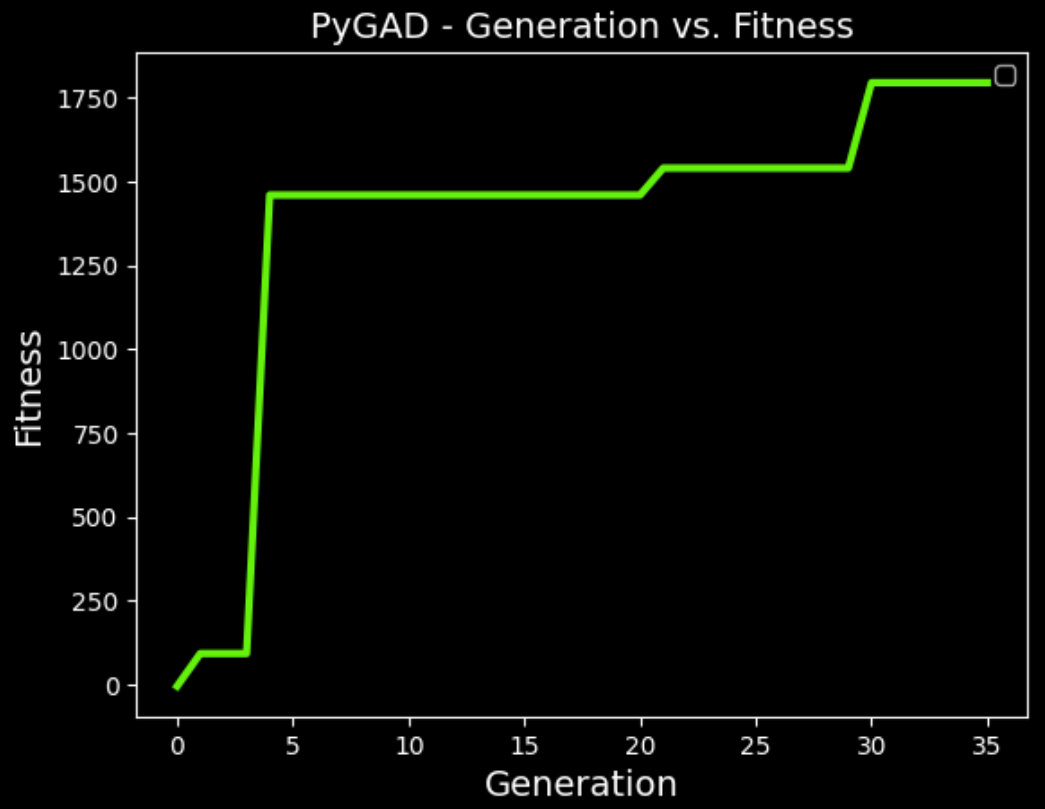
Other Strats

Genetic Algorithm Opt. + BBands

#5: GENERAL STRATEGIES: GENETIC ALGORITHMS & OPTIMIZATION

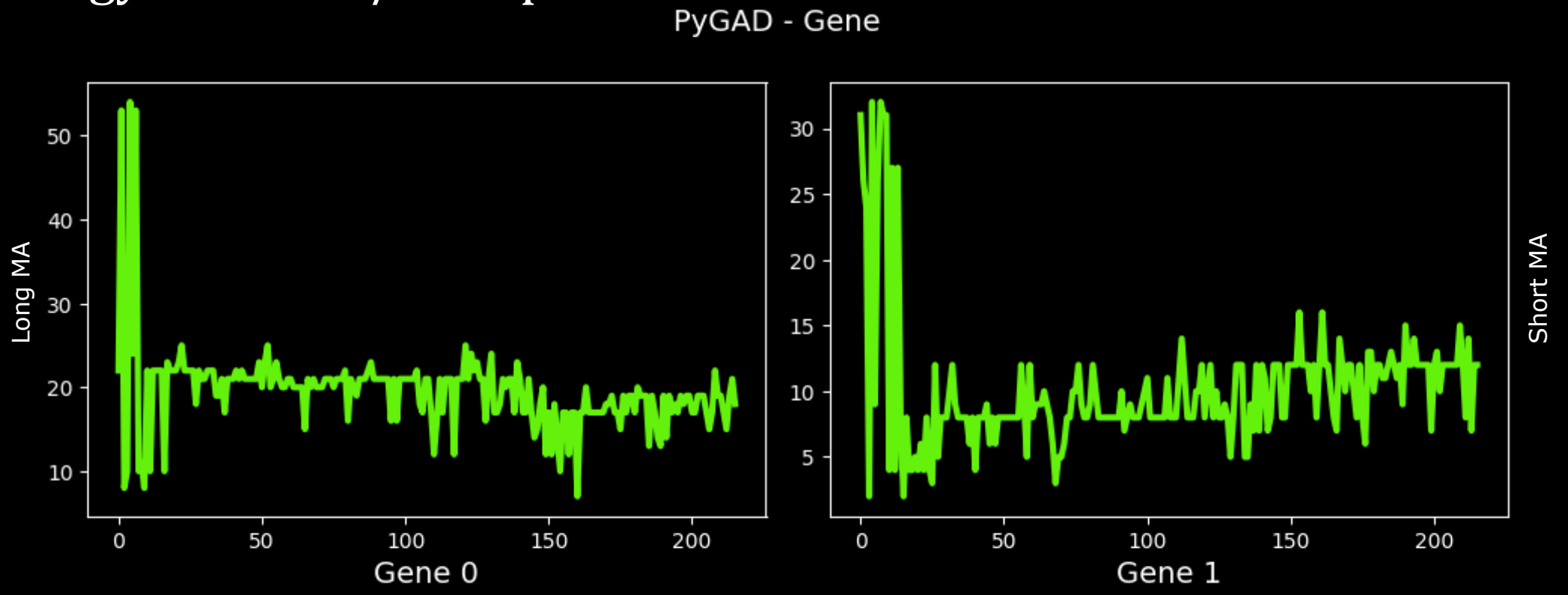
- A way of finding optimal parameters inspired by evolution and natural selection based on a 'fitness' metric (can be modified, e.g. PnL + max drawd)
- Inspired by evolution/natural selection ('individuals' are parameter sets)





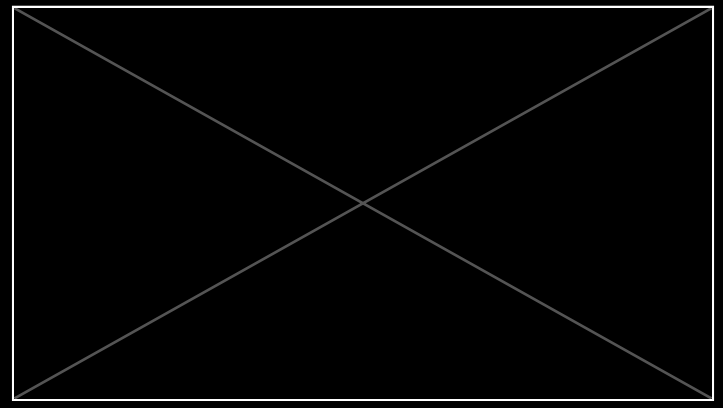
#5: GENERAL STRATEGIES: GENETIC ALGORITHMS & OPTIMIZATION

- [redacted] "training" period to find optimal solutions for recent mont s
- Then use these optimized parameters for strategy in following month
- Using the optimized parameters more than a month seems to make the strategy outdated/not optimal



#5: BB STRATEGY: GENETIC ALGO OPTIMIZATION, RESULTS & COMPARISON

- Basic BBands



vs

- BBands w genetic algo, optimized for max PnL, min drawdown (riskier)

JPY, BBands Standard (20, 2)					
	total pnl %	*hit ratio %*	*stdev/vol %*	*max draw %*	*avg ret %*
3	-0.35	52.50	1.93	-13.97	-0.25
4	-5.95	43.24	2.71	-12.58	-5.37
5	14.54	61.11	4.96	-6.48	1.67
6	-9.54	50.00	4.11	-11.53	-4.65
7	-14.24	45.95	4.27	-14.99	-7.76
ANN	-37.29		12.46		

JPY, BBands + Genetic Algo Optimization, Hourly, Opt: PnL, Drawd					
month (2024)	*total pnl %*	*hit ratio %*	*stdev/vol %*	*max draw %*	*avg ret %*
3	3.81	52.43	4.63	-30.82	0.38
4	6.93	61.54	3.46	-12.94	0.68
5	17.39	55.41	5.96	-7.84	2.62
6	14.87	53.97	4.65	-8.55	1.85
7	2.68	49.38	1.65	-7.63	1.26
8	2.12	50.93	0.93	-3.95	-0.23
ANN	95.62		12.28		

DATA: 360T

SIMULATED PnL SCENARIOS , NOT ACTUAL TRADING PnL

#5: BB STRATEGY: GENETIC ALGO OPTIMIZATION, RESULTS & COMPARISON

- Can optimize for different risk levels willing to take (modify objective)
- Example of a more balanced strategy (medium risk):

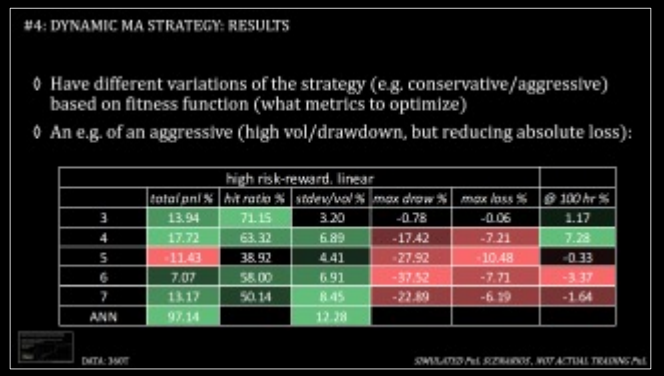
BB, JPY, opt: PnL + max_loss + max_draw					
	total pnl %	*hit ratio %*	*stdev/vol %*	*max draw %*	*max loss %*
4	0.99	52.78	0.50	-1.92	-1.43
5	5.99	51.61	1.99	-1.90	0.00
6	3.40	69.35	1.19	-1.20	-0.71
7	2.01	68.75	0.83	-0.87	-0.21
8	-1.67	41.18	0.61	-2.21	-2.19
ANN	25.73		3.55		

DATA: 360T

SIMULATED PnL SCENARIOS , NOT ACTUAL TRADING PnL

#5: BB STRATEGY: GENETIC ALGO OPTIMIZATION, RESULTS & COMPARISON

- ◊ Tested new metric: optimizing for the slope of the historical PnL
- ◊ Results promising: encourages positive final PnL and steadier growth, minimizing negative PnL
- ◊ Training on June to Aug, backtest over last month:



#4: DYNAMIC MA STRATEGY: RESULTS

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◊ An e.g. of an aggressive (high vol/drawdown, but reducing absolute loss):

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	total pnl %	*hit ratio %*	*stdev/vol %*	*max draw %*	*max loss %*	*@ 100 hr %*
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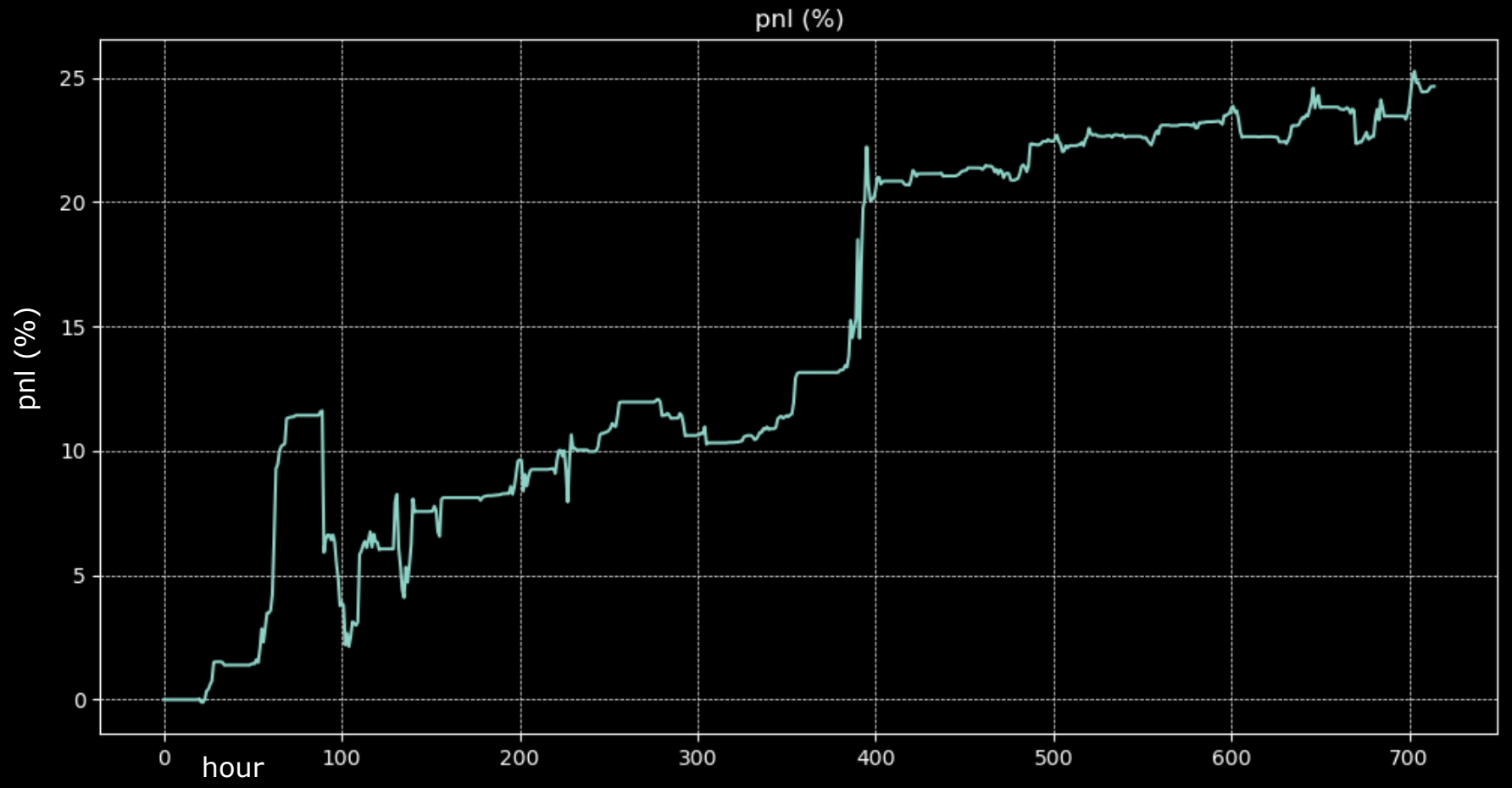

SIMULATED PnL SCENARIOS , NOT ACTUAL TRADING PnL

#5: SYSTEMATIC STRATEGY: NOTES/FUTURE WORK

- Made a python module (integrated with Millennium API for easier future back testing), has genetic algorithm optimization for fine-tuning strategies
- Tried grid search (brute force) to find best params. Doable but too computational expensive/time and may lead to overfitting, so out-of-sample testing not that good sometimes
- To test further: variable re-training periods, e.g. 100, 200 hrs etc.
- Also some months, other strategies entirely may be optimal, can use the strategy type as a parameter
- Strat could be aided with human inputs of event risk/management

#5: SYSTEMATIC STRATEGY: NOTES/FUTURE WORK, GENETIC ALGORITHMS

- Other statistics to optimize (right)
  - Optimizing for certain parameters (e.g. solely PnL) may cause overfitting/vol → not applicable to next month's movements
- 100 hr, seems promising for even 'safer' strategy
- A lot to be explored/optimized/PnL to be generated, many combinations

```
class obj_func:
    def __init__(self, results):
        self.results = results

    def pnl_draw(self):
        if not self.results['draw']:
            return self.results['pnl'] / 0.01 # reward 0
loss w multiplier
        else:
            return self.results['pnl'] /
(self.results['draw'] * self.results['max_loss'])

    def pnl_draw_sum(self):
        return self.results['pnl'] + self.results['draw']

    def pnl_draw_loss(self):
        if self.results['draw'] == 0 or
self.results['max_loss'] == 0:
            return self.results['pnl'] / 0.01
        else:
            return self.results['pnl'] / (-1 *
self.results['max_loss'])

    def pnl_draw_loss_sum(self):
        if self.results['pnl'] == 0:
            return -1 # no trades made, penalize
        return self.results['pnl'] + self.results['draw']
+ self.results['max_loss']
```

Q&A

Much more to find!