

ISyE 6785 Final Project

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A New Anomaly: The Cross-Sectional Profitability of Technical Analysis

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Recap

Moving average timing strategy

Definition of Moving Average

- Moving Average (simple moving average)
The un-weighted mean of the previous n data

$$SMA = \frac{p_M + p_{M-1} + \dots + p_{M-(n-1)}}{n}$$



Moving Average Timing Strategy

- The idea of the Moving Average Timing Strategy

An investor should

- Hold an asset when the asset price is on an uninterrupted up trend
- Get out of the asset when the trend is broke



Mathematical Form of MA Time Strategy

- On each trading day, we will
 - invest in the decile portfolio j for the trading day t , if the last closing price P_{jt-1} is above the MA price $A_{jt-1,L}$.
 - Invest in the 30-day Treasury bill, otherwise
- The returns on the MA timing strategy

$$\tilde{R}_{jt,L} = \begin{cases} R_{jt}, & \text{if } P_{jt-1} > A_{jt-1,L} \\ r_{ft}, & \text{otherwise} \end{cases}$$

r_{ft} is the return on the risk-free asset, the 30-day Treasury bill

Python Implementation

Data

Key Data Structure and Algorithms

Data Source

- 1976 Nasdaq stocks, yahoo finance
- Jan 5st, 2010 to Dec 31st, 2014. Total: 5 years. Portfolios: 4 years (test)
- The paper use data before Dec 31st, 2009 (training period)
- Construct volatility decile portfolios and calculate the returns for these portfolios with moving average timing strategy.
- The data shall be **preprocessed** before we use them.

Data Preprocessing

1. Create a list of available stocks when downloading for future iteration.
2. Complete/Delete the stock with incomplete historical records.
 - 1301 business/trading days from Jan 5th, 2010 to Dec 31st, 2014.
 - Every stock has 1301 pieces of record, don't have to worry about the dates!
3. Number of shift days and business days for each year.
 - shifts = [251, 503, 753, 1005]
 - bdays = [252, 250, 252, 251]
 - Simple iteration

Data Handling Philosophy

- Read from file once
- Sequential/ordered access
- Get the all 'ingredients' ready before 'cooking'
 - Historical Price
 - Historical daily return
 - Historical moving average
 - Volatility of the stock
 - Volatility Decile Portfolios for each year
- The execution time is reduced from 40-50 minutes to 4-5 minutes

Key Data Structures

- Historical Price: price_db (dreturn_db, mvavr_db)

Key ▲	Type	Size	Value
AAL	TimeSeries	(1257,)	Date 2010-01-05 5.261844
AAME	TimeSeries	(1257,)	Date 2010-01-05 1.324163
AAON	TimeSeries	(1257,)	Date 2010-01-05 5.399662
AAPL	TimeSeries	(1257,)	Date 2010-01-05 28.767737
AAWW	TimeSeries	(1257,)	Date 2010-01-05 40.310001
AAXJ	TimeSeries	(1257,)	Date 2010-01-05 52.461069
ABAX	TimeSeries	(1257,)	Date 2010-01-05 24.023870
ABCB	TimeSeries	(1257,)	Date 2010-01-05 7.223898
ABCD	TimeSeries	(1257,)	Date 2010-01-05 4.01
ABCO	TimeSeries	(1257,)	Date 2010-01-05 15.830000

Index	Adj Close
2010-01-05	5.26
2010-01-06	5.04
2010-01-07	5.19
2010-01-08	5.09
2010-01-11	4.99
2010-01-12	5.03
2010-01-13	5.43
2010-01-14	5.54
2010-01-15	5.45
2010-01-19	5.59

Key Data Structures

- Volatility Decile Portfolios is calculated at the end of the previous year.
 1. Estimate the volatility of the stock using the daily returns before the new year.
 2. Sort the portfolios based on their volatility. The first 10% of stocks with the lowest volatility go to portfolio 1, and so on.
 3. Recalculated each year. Volatilities stored in vlt_tb

Index ▲	Type	Size	Value
0	list	5	['VGSH', 0.000841...308872521, 0.000816...994074642, 0.000719...112598488, 0.000 ...
1	list	5	['VCSH', 0.001381...127657993, 0.001414902452611475, 0.001258...405838237, 0.001 ...
2	list	5	['VGIT', 0.003466...916487925, 0.003355...802449957, 0.002976...558016987, 0.002 ...
3	list	5	['VMBS', 0.005194...014035524, 0.004047...020805696, 0.003366...446418579, 0.003 ...
4	list	5	['VCIT', 0.003753...358775803, 0.003630...056400203, 0.003233...613961433, 0.003 ...

Key Data Structures

- Volatility Decile Portfolio name list, vltDecsPorts_II

idx ▲	Type	Size	Value
0	list	10	['VGSH', 'VCSH', 'VGIT', 'VCIT', 'VMBS', 'CHSCP', 'ISHG', 'IGOV', 'VCLT', 'VGLT ...
1	list	10	['VGSH', 'VCSH', 'VGIT', 'VCIT', 'VMBS', 'ISHG', 'IGOV', 'VCLT', 'CHSCP', 'PVTB ...
2	list	10	['VGSH', 'VCSH', 'VGIT', 'VCIT', 'VMBS', 'ISHG', 'IGOV', 'VCLT', 'CHSCP', 'PVTB ...
3	list	10	['VGSH', 'VCSH', 'VGIT', 'VMBS', 'VCIT', 'ISHG', 'IGOV', 'VCLT', 'PVTBP', 'VGLT ...

idx ▲	Type	Size	Value
0	list	197	['VGSH', 'VCSH', 'VGIT', 'VCIT', 'VMBS', ...
1	list	197	['JBHT', 'COKE', 'MNST', 'SP', 'ENDP', '...
2	list	197	['ACIW', 'SMBC', 'BCPC', 'RDI', 'NEOG', ...
3	list	197	['HUBG', 'GUID', 'ABAX', 'PLCE', 'BWINB', ...
4	list	197	['SHEN', 'GABC', 'ISIG', 'SILC', 'ASMI', ...
5	list	197	['REXI', 'PBCP', 'RGEN', 'AIMC', 'ENG', ...
6	list	197	['CRZO', 'CTG', 'LONG', 'MLNX', 'SGI', '...
7	list	197	['NSEC', 'NEO', 'HDNG', 'SBGI', 'NFLX', ...
8	list	197	['TSYS', 'SNTA', 'TENX', 'MNKD', 'LIOX', ...
9	list	203	['VRML', 'LRAD', 'TUES', 'THLD', 'WGBS', ...

idx ▲	Type	Size	Value
0	str	1	VGSH
1	str	1	VCSH
2	str	1	VGIT
3	str	1	VCIT
4	str	1	VMBS
5	str	1	CHSCP
6	str	1	ISHG

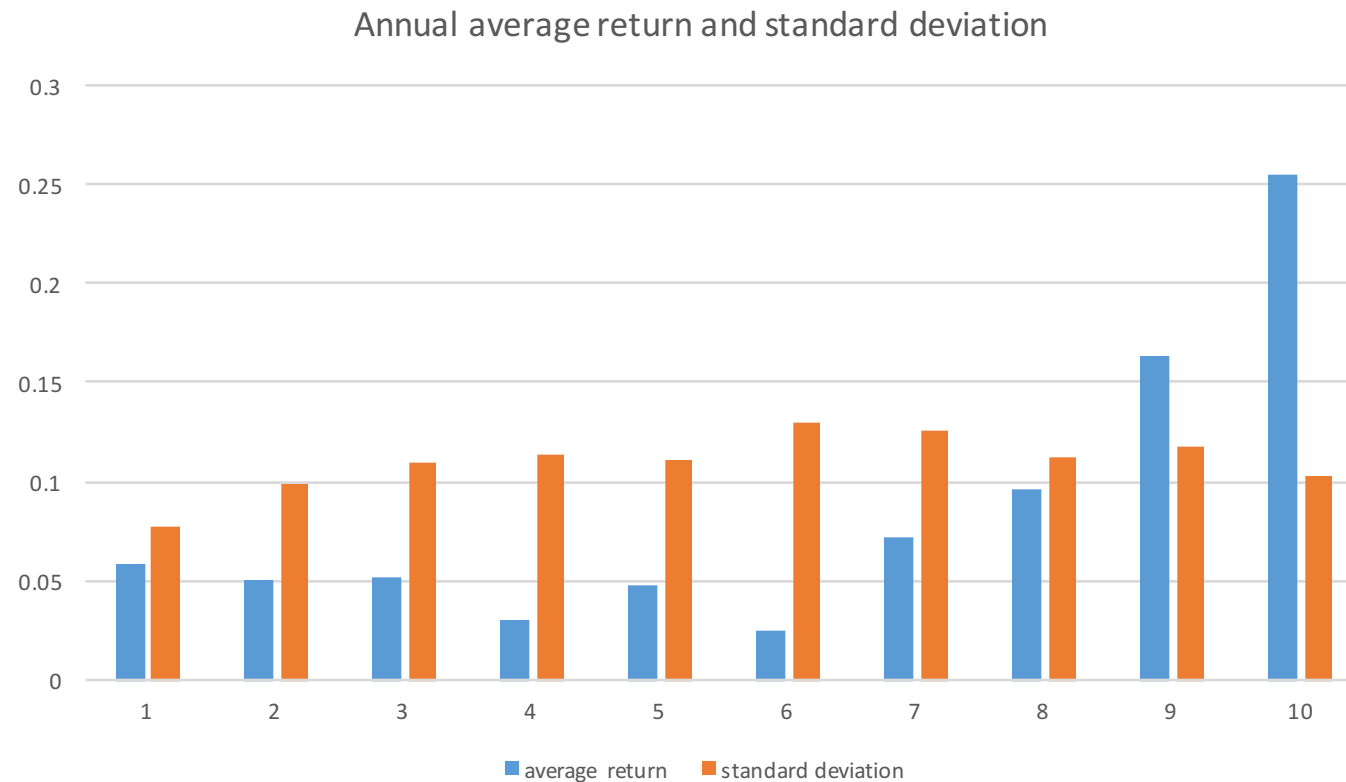
Key Algorithm

- Key function: `def calPortRet(portstock_l, year, price_db, mvavr_db, dreturn_db)`
- Input:
 - `portstock_l`: name list of stocks in that portfolio
 - `year`: which year
 - `price_db`, `mvavr_db`, `dreturn_db` are database we calculated before
- Output:
 - Average daily return of the portfolio for that year
- Two versions:
 - Operation based on single stock
 - Operation based on whole portfolio (equal-weighted)

Result Analysis

Average returns and standard deviations

- Operation based on portfolio, 5-day moving average



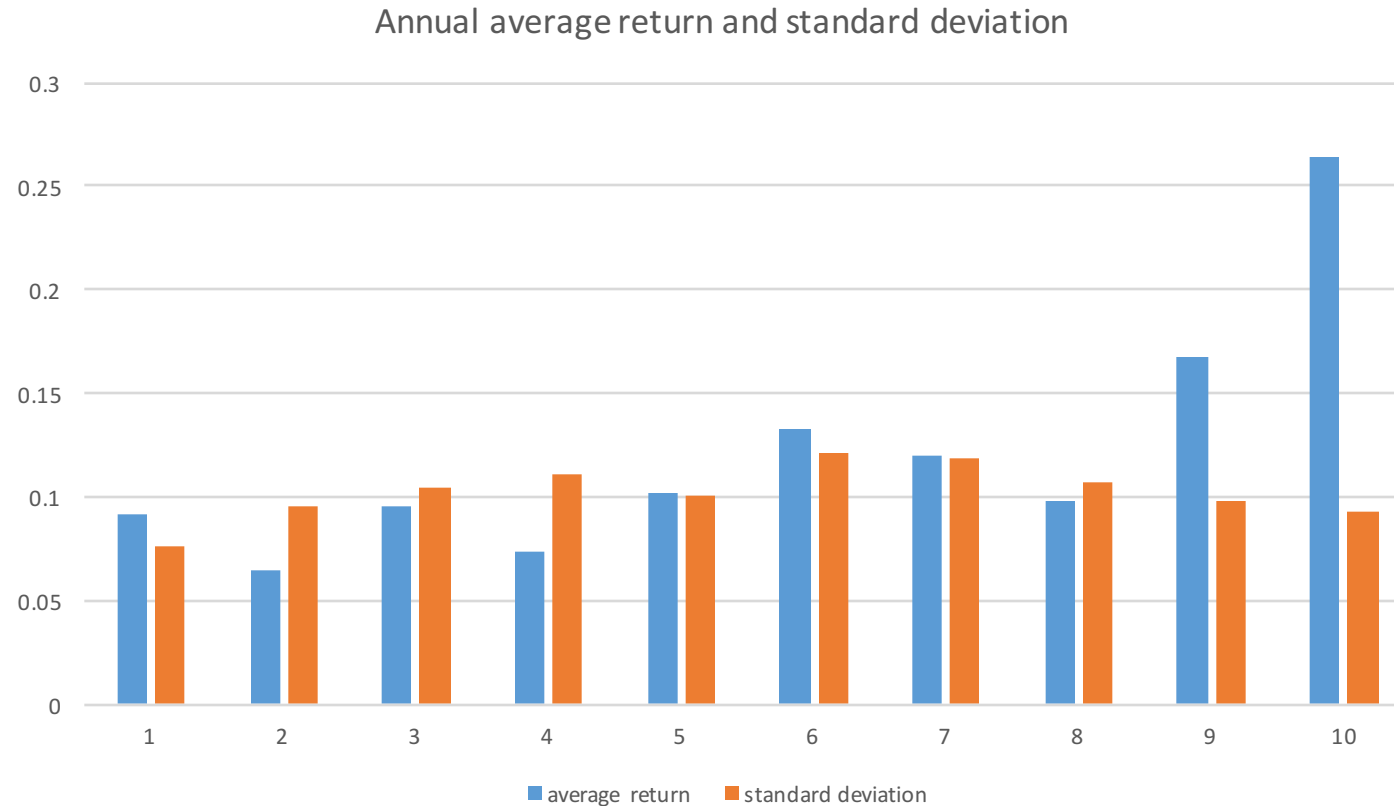
Average returns and standard deviations

- Operation based on portfolio, 10-day moving average



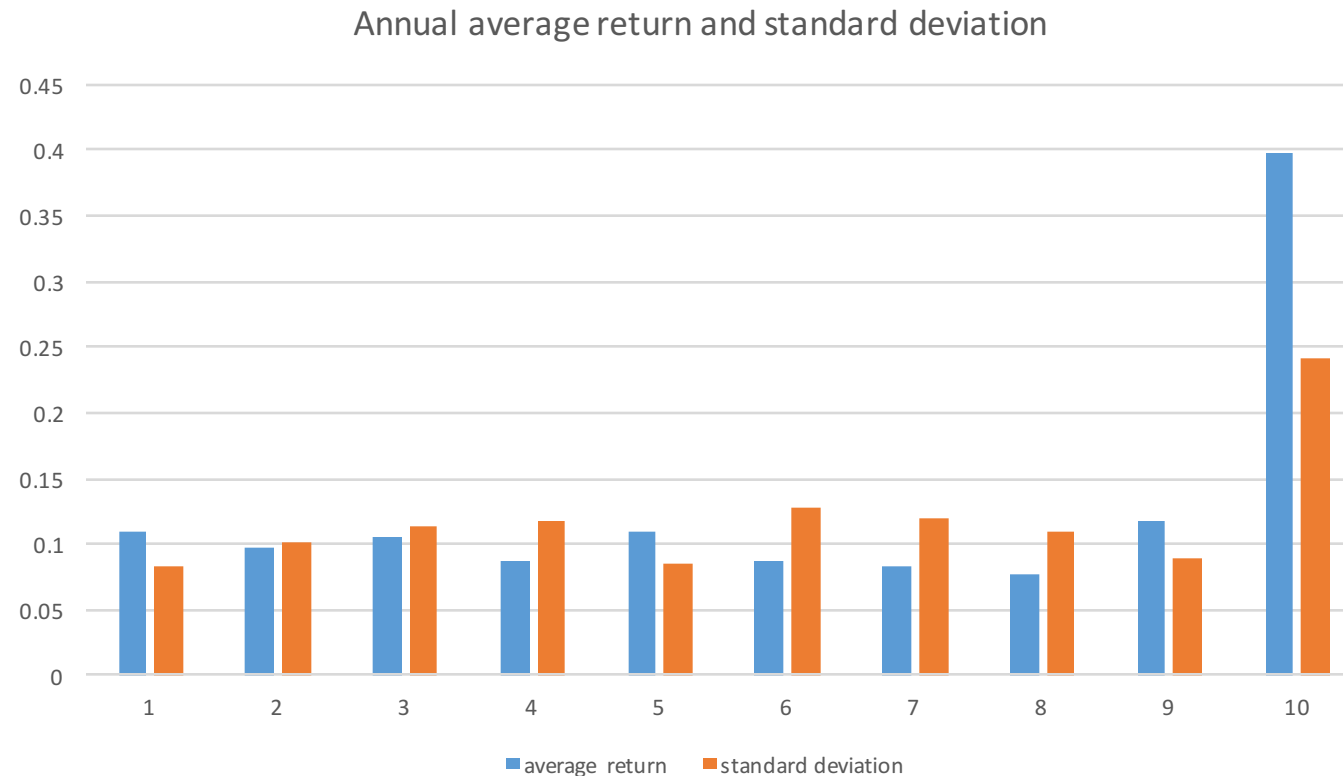
Average returns and standard deviations

- Operation based on portfolio, 20-day moving average



Average returns and standard deviations

- Operation based on portfolio, 50-day moving average



Average returns and standard deviations

- Operation based on portfolio, 100-day moving average



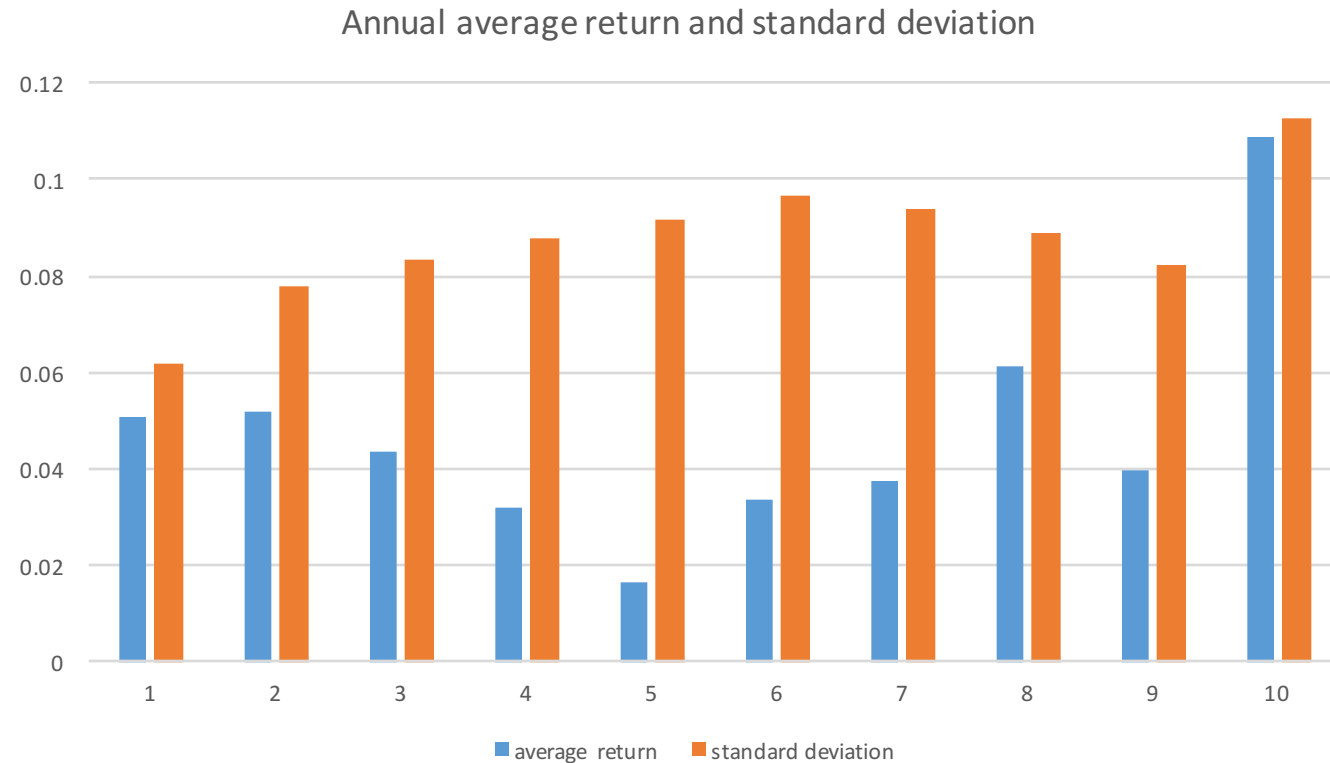
Average returns and standard deviations

- Operation based on portfolio, 200-day moving average



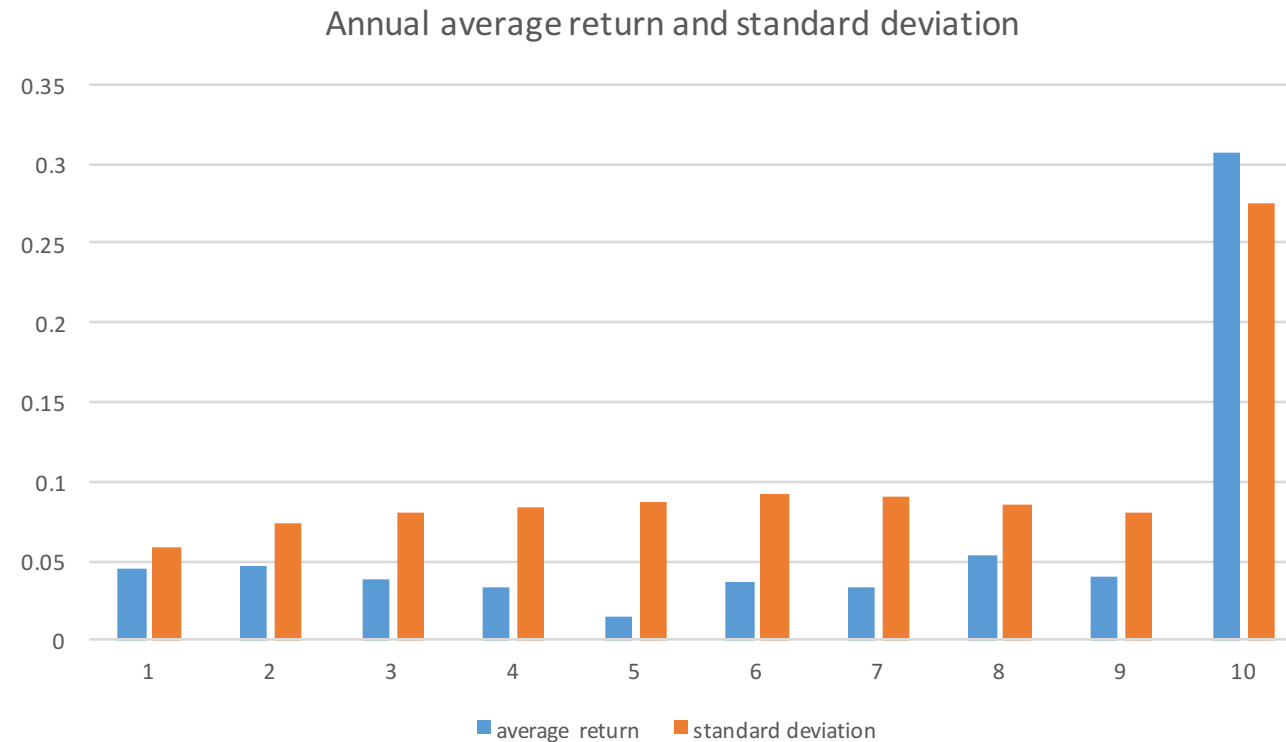
Average returns and standard deviations

- Operation based on single stock, 5-day moving average



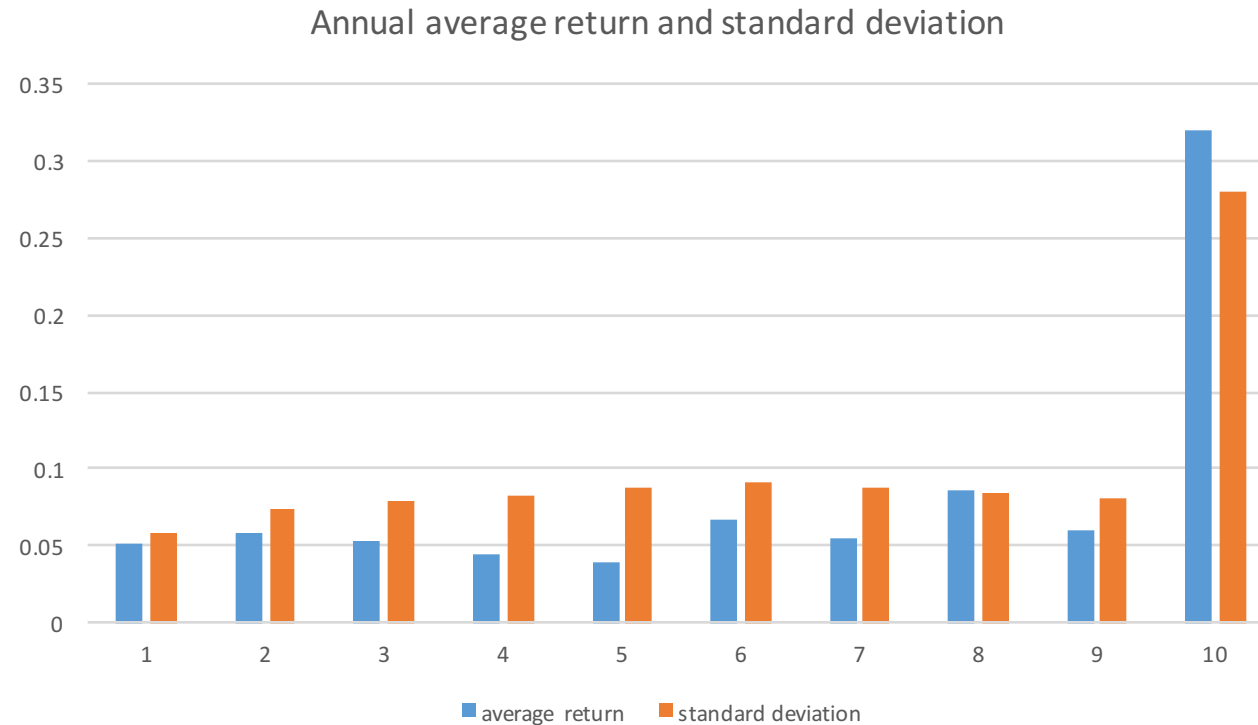
Average returns and standard deviations

- Operation based on single stock, 10-day moving average



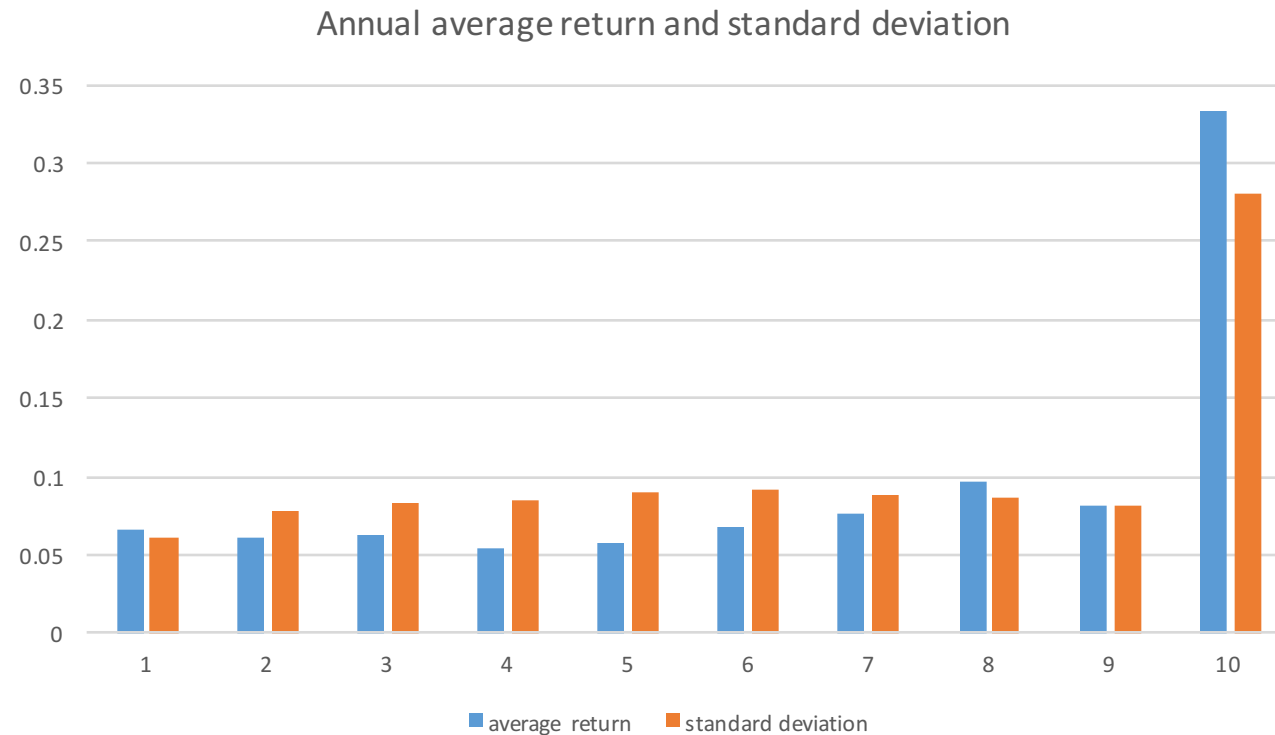
Average returns and standard deviations

- Operation based on single stock, 20-day moving average



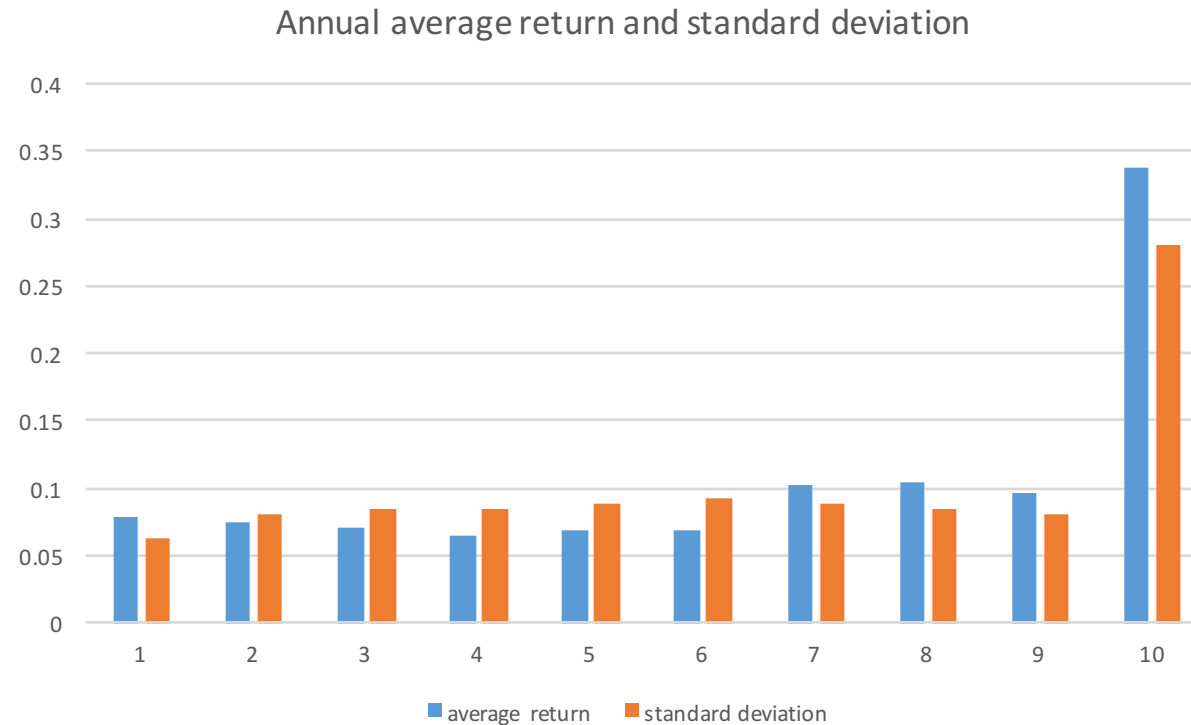
Average returns and standard deviations

- Operation based on single stock, 50-day moving average



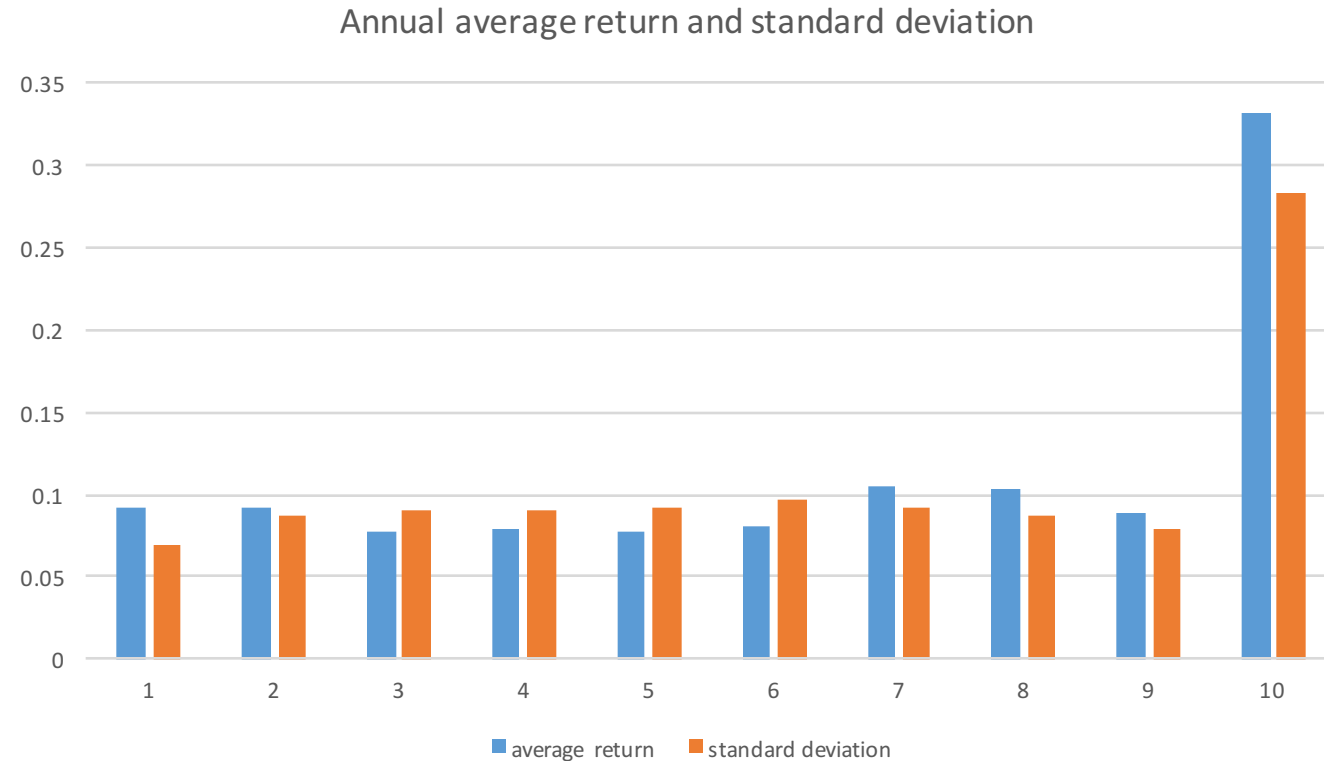
Average returns and standard deviations

- Operation based on single stock, 100-day moving average

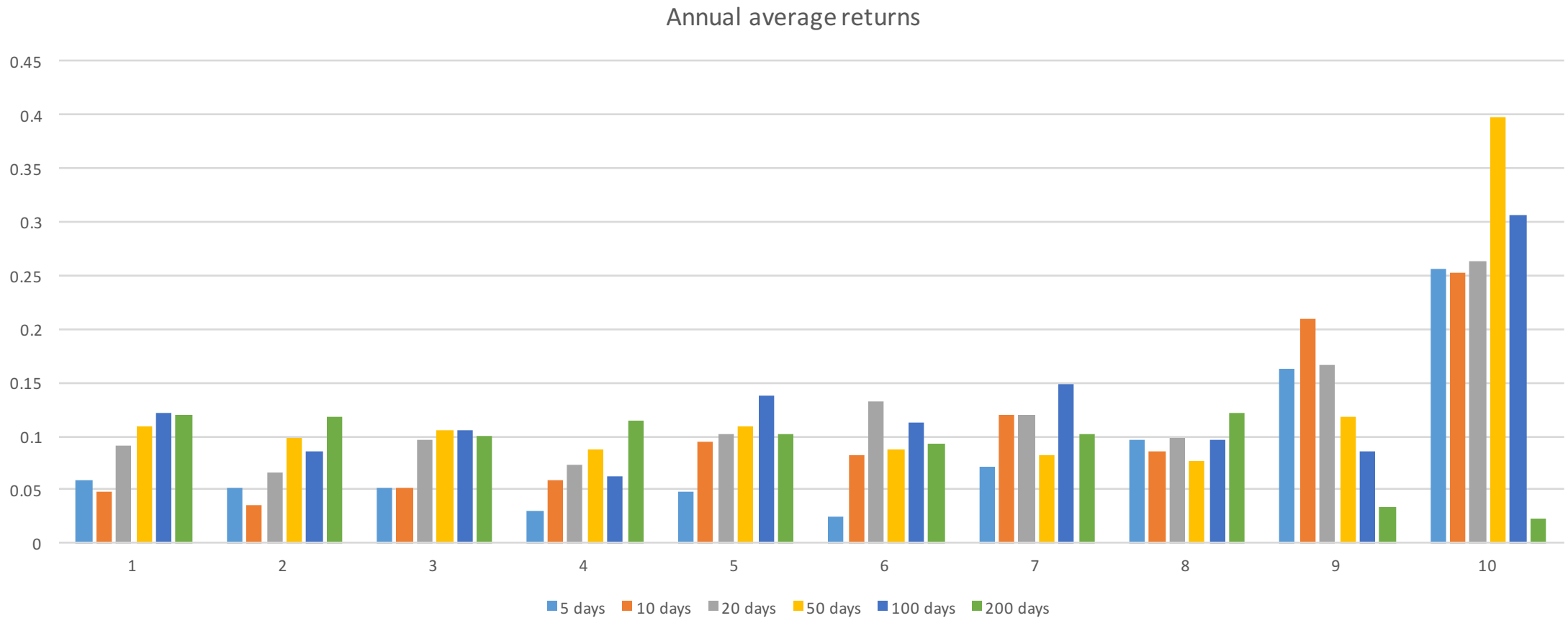


Average returns and standard deviations

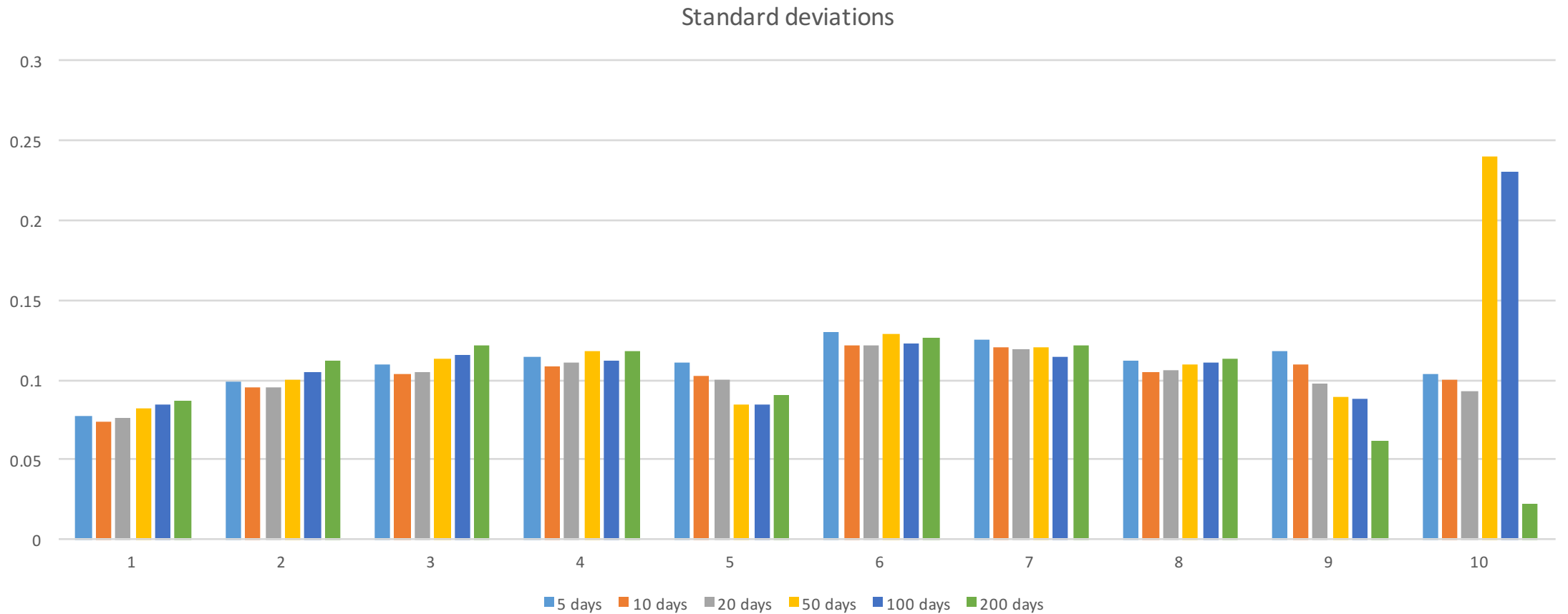
- Operation based on single stock, 200-day moving average



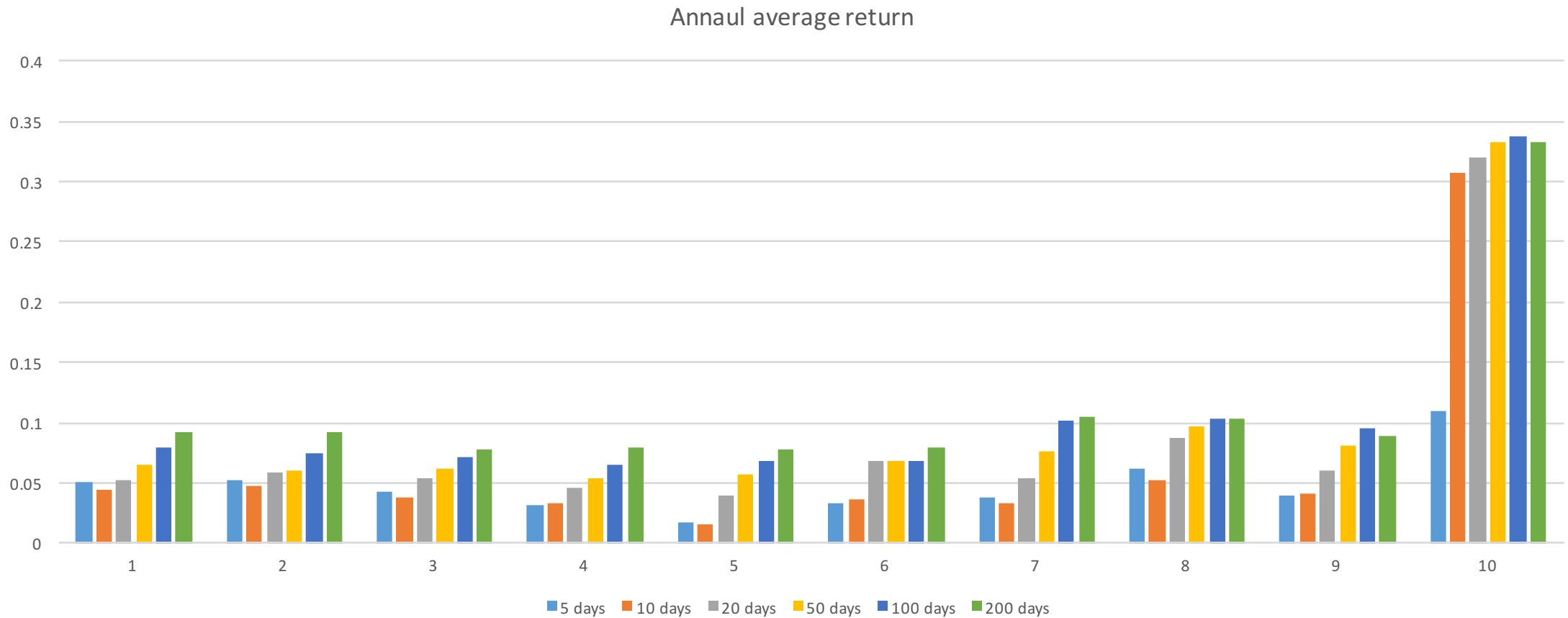
Average returns with different MA length, operation based on portfolios



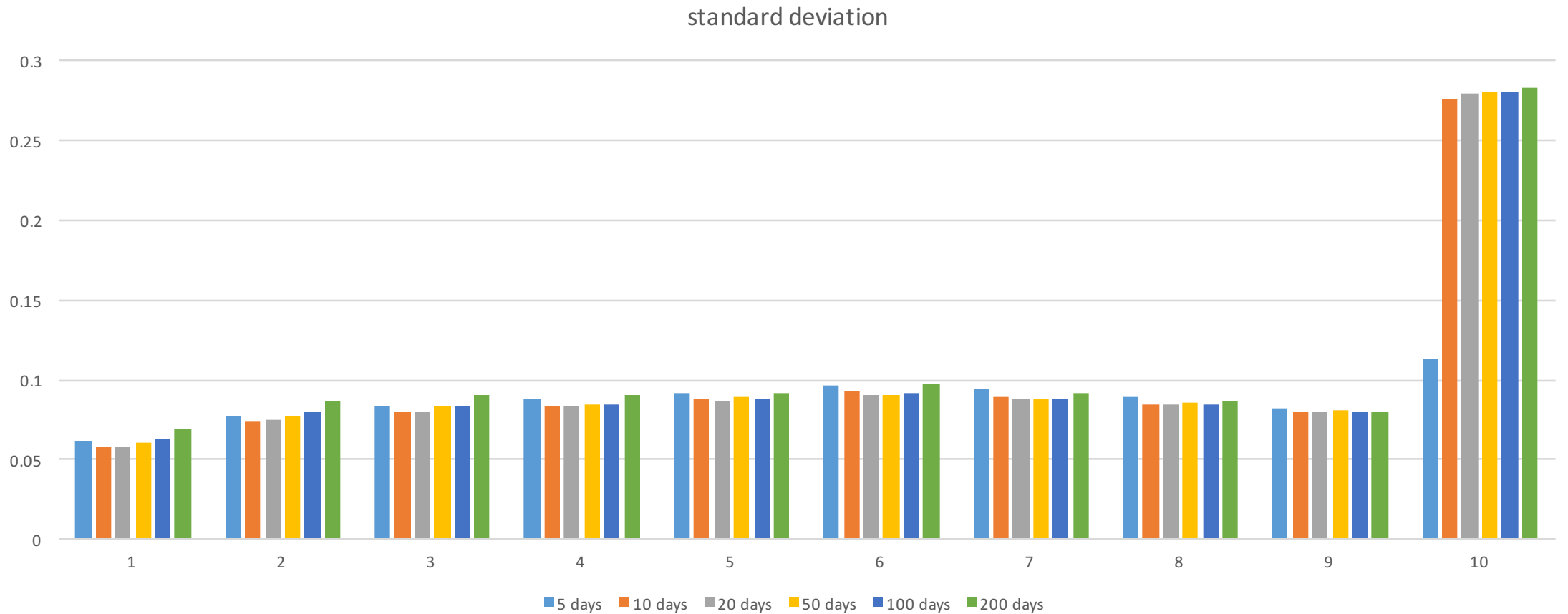
Standard deviations with different MA length, operation based on portfolios



Average returns with different MA length, operation based on single stock



Standard deviations with different MA length, operation based on single stock



Observations

- Roughly speaking, decile portfolios with high volatility can take more advantage on moving average timing strategy, especially for the highest volatility decile portfolio.
- As the moving average length gets larger, the difference between the returns of portfolios gets smaller.
- When operation is based on single stock, average return is slightly higher for longer MA period.

Performance of the Test Period

- The performance during test period is not exceptionally well as that during the training period, when average return grows almost linearly with volatility.
- The profitability still holds for the test period. The highest volatility decile portfolio still gets the highest return.

Thank you!

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