FIN3080 Assignment1 Report

Problem1

Data processing

Downloading data

First, I downloaded 6 different csv files, they separately contain:

1. Monthly Closing Price, Market Value of Tradable Shares, Monthly Return with Cash Dividend Reinvested

2. Return on Assets – B, Return on Equity – B

3. R&D Expenses

4. Total Assets, Total Liabilities

5. Establishment Date, Market Type

6. Earnings per Share - TTM1, Net Assets per Share

Reasons for choosing

1. ROA-B, ROE-B

   Since the assets and equity are constantly changing, to avoid the periodical change, I decide to use the B-type of these two indices. B-type version is the average of the beginning and the ending, it will be more precise to describe the average level of the indices.

2. Earnings per Share - TTM1

   For the 1-type, I think that the non-operating part is also very import on measuring a company's earning ability, so I choose the total net profit. Then for TTM, we know that the common EPS is earning till now this year divided by shares (e.g., EPS of Q2 = (earningQ1+earningQ2) / number of shares). If we use this index to calculate the P/E Ratio, it will change violently. But the TTM-type will keep using 12-month level earning, which will keep in a steady level.

Data processing

1. For data that contains two types (A, B), I always chose A-type to exclude parent statements.

2. For data that is recorded quarterly, I transfer the date to 'xxxxQy'. 'xxxx' means the year it represents; y means the quarter it represents. (e.g., 2010/6/30 will be transferred to 2010Q2.)

3. Some of the quarterly data contains the beginning of the year (xxxx/1/1). To simplify, I choose to delete the row with date 1/1.

4. To easily calculate the P/E and P/B ratio, I delayed the EPS and the Net asset per share by 1 quarter to satisfy the equation given in the hint.

5. For the monthly data, I transferred each month to the corresponding quarter.

6. For market type column, I transferred 32 and 16 to 2 (meaning the GEM board) and the other numbers to 1 (meaning the main board).

7. Use 'the code of each stock' and 'the quarter' to merge all the csv files.

(detailed code and the corresponding results are shown in the code.pdf I uploaded together)

Stock Code	Monthly Closing	Market Value	Monthly Return	quarter	Return on Assets	Return on Equity	Total Assets	Total Liabilities	RD Expenses	Current Date	Earnings per Share	Net Assets per Share	Establish Date	Market Type
2	27.7	269110210	0.044101	2019Q4	0.018053	0.11901	1.6388E+12	1.3939E+12	1066676029	2019/12/31	4.960556	21.664201	1988/11/1	1
2	32.18	312634172	0.161733	2019Q4	0.018053	0.11901	1.6388E+12	1.3939E+12	1066676029	2019/12/31	4.960556	21.664201	1988/11/1	1
2	28.98	281545628	-0.099441	2020Q1	0.033839	0.217825	1.7299E+12	1.4594E+12	915033708	2020/3/31	4.877979	23.940514	1988/11/1	1
2	29.59	287471882	0.021049	2020Q1	0.033839	0.217825	1.7299E+12	1.4594E+12	915033708	2020/3/31	4.877979	23.940514	1988/11/1	1
2	25.65	249194112	-0.133153	2020Q1	0.033839	0.217825	1.7299E+12	1.4594E+12	915033708	2020/3/31	4.877979	23.940514	1988/11/1	1
2	26.8	260366557	0.044834	2020Q2	0.001401	0.008924	1.7398E+12	1.4657E+12	276948704	2020/6/30	4.809349	24.253022	1988/11/1	1
2	25.7	249679870	-0.041045	2020Q2	0.001401	0.008924	1.7398E+12	1.4657E+12	276948704	2020/6/30	4.809349	24.253022	1988/11/1	1
2	26.14	253932192	0.017121	2020Q2	0.001401	0.008924	1.7398E+12	1.4657E+12	276948704	2020/6/30	4.809349	24.253022	1988/11/1	1
2	26.84	260732213	0.026779	2020Q3	0.010537	0.066316	1.8062E+12	1.5149E+12	394374362	2020/9/30	4.688964	25.069962	1988/11/1	1
2	27.27	264909368	0.053335	2020Q3	0.010537	0.066316	1.8062E+12	1.5149E+12	394374362	2020/9/30	4.688964	25.069962	1988/11/1	1
2	28.02	272195104	0.027503	2020Q3	0.010537	0.066316	1.8062E+12	1.5149E+12	394374362	2020/9/30	4.688964	25.069962	1988/11/1	1
2	27.55	267629376	-0.016774	2020Q4	0.016969	0.104921	1.8145E+12	1.5118E+12	665687473	2020/12/31	4.87296	26.050042	1988/11/1	1
2	30.7	298229469	0.114338	2020Q4	0.016969	0.104921	1.8145E+12	1.5118E+12	665687473	2020/12/31	4.87296	26.050042	1988/11/1	1
2	28.7	278893779	-0.065147	2020Q4	0.016969	0.104921	1.8145E+12	1.5118E+12	665687473	2020/12/31	4.87296	26.050042	1988/11/1	1
2	27.79	270050805	-0.031707	2021Q1	0.032952	0.191154	1.8692E+12	1.5193E+12	127449412	2021/3/31	5.104104	30.112974	1988/11/1	1
2	33.1	321651013	0.191076	2021Q1	0.032952	0.191154	1.8692E+12	1.5193E+12	127449412	2021/3/31	5.104104	30.112974	1988/11/1	1
2	30	291526598	-0.093656	2021Q1	0.032952	0.191154	1.8692E+12	1.5193E+12	127449412	2021/3/31	5.104104	30.112974	1988/11/1	1
2	28.17	273743475	-0.061	2021Q2	0.001328	0.007109	1.9079E+12	1.5524E+12	252777749	2021/6/30	5.110713	30.593923	1988/11/1	1
2	26.7	259458672	-0.052183	2021Q2	0.001328	0.007109	1.9079E+12	1.5524E+12	252777749	2021/6/30	5.110713	30.593923	1988/11/1	1
2	23.81	231374943	-0.10824	2021Q2	0.001328	0.007109	1.9079E+12	1.5524E+12	252777749	2021/6/30	5.110713	30.593923	1988/11/1	1
2	20.66	200764650	-0.132297	2021Q3	0.008458	0.045332	1.955E+12	1.5913E+12	370464654	2021/9/30	4.892731	31.30738	1988/11/1	1
2	19.8	192407555	0.014775	2021Q3	0.008458	0.045332	1.955E+12	1.5913E+12	370464654	2021/9/30	4.892731	31.30738	1988/11/1	1
2	21.31	207081060	0.076263	2021Q3	0.008458	0.045332	1.955E+12	1.5913E+12	370464654	2021/9/30	4.892731	31.30738	1988/11/1	1
2	18.21	176956645	-0.145472	2021Q4	0.012826	0.067895	1.9674E+12	1.5925E+12	642366252	2021/12/31	4.630464	32.251018	1988/11/1	1
2	18.26	177442523	0.002746	2021Q4	0.012826	0.067895	1.9674E+12	1.5925E+12	642366252	2021/12/31	4.630464	32.251018	1988/11/1	1
2	19.76	192018853	0.082147	2021Q4	0.012826	0.067895	1.9674E+12	1.5925E+12	642366252	2021/12/31	4.630464	32.251018	1988/11/1	1

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Stock Code                       int64
Monthly Closing Price            float64
Market Value of Tradable Shares  float64
Monthly Return                   float64
quarter                          object
Return on Assets                 float64
Return on Equity                 float64
Total Assets                     float64
Total Liabilities                float64
RD Expenses                      float64
Current Date                     object
Earnings per Share               float64
Net Assets per Share             float64
Establish Date                   object
Market Type                      int64
dtype: object
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(a)

I use python to calculate the P/E and P/B ratio, quarterly R&D expense/total asset ratios, firm ages (measured by days) and create new columns to save these data.

(detailed data are shown in the csv file)

Stock Code	Monthly Clo	Market Valu	Monthly Ret	quarter	Return on A	Return on E	Total Assets	Total Liabiliti	RD Expense	Current Date	Earnings per	Net Assets p	Establish Dat	Market Type	PE Ratio	PB Ratio	quarterly RD	Quarterly Fir
2	27.7	269110210	0.044101	2019Q4	0.018053	0.11901	1.639E+12	1.394E+12	1.067E+09	2019/12/31	4.960556	21.664201	1988/11/1	1	5.5840515	1.278607	0.0006509	11382
2	32.18	312634172	0.161733	2019Q4	0.018053	0.11901	1.639E+12	1.394E+12	1.067E+09	2019/12/31	4.960556	21.664201	1988/11/1	1	6.487176	1.4853998	0.0006509	11382
2	28.98	281545628	-0.099441	2020Q1	0.033839	0.217825	1.73E+12	1.459E+12	915033371	2020/3/31	4.877979	23.940514	1988/11/1	1	5.940985	1.21005003	5.29E-05	11473
2	29.59	287471882	0.021049	2020Q1	0.033839	0.217825	1.73E+12	1.459E+12	915033371	2020/3/31	4.877979	23.940514	1988/11/1	1	6.0660368	1.2359801	5.29E-05	11473
2	25.65	249194112	-0.133153	2020Q1	0.033839	0.217825	1.73E+12	1.459E+12	915033371	2020/3/31	4.877979	23.940514	1988/11/1	1	5.2583252	1.0714056	5.29E-05	11473
2	26.8	260366557	0.044834	2020Q2	0.001401	0.008924	1.74E+12	1.466E+12	276948704	2020/6/30	4.809349	24.253022	1988/11/1	1	5.5724798	1.1050169	0.0001592	11564
2	25.7	249679870	-0.041045	2020Q2	0.001401	0.008924	1.74E+12	1.466E+12	276948704	2020/6/30	4.809349	24.253022	1988/11/1	1	5.3437586	1.0596618	0.0001592	11564
2	26.14	253932192	0.017121	2020Q2	0.001401	0.008924	1.74E+12	1.466E+12	276948704	2020/6/30	4.809349	24.253022	1988/11/1	1	5.4352471	1.0778038	0.0001592	11564
2	26.84	260732213	0.026779	2020Q3	0.010537	0.066316	1.806E+12	1.515E+12	394374362	2020/9/30	4.688964	25.069962	1988/11/1	1	5.7240789	1.0706039	0.0002183	11656
2	27.27	264909368	0.053335	2020Q3	0.010537	0.066316	1.806E+12	1.515E+12	394374362	2020/9/30	4.688964	25.069962	1988/11/1	1	5.8157836	1.0877559	0.0002183	11656
2	28.02	272195104	0.027503	2020Q3	0.010537	0.066316	1.806E+12	1.515E+12	394374362	2020/9/30	4.688964	25.069962	1988/11/1	1	5.9757337	1.1176722	0.0002183	11656
2	27.55	267629376	-0.016774	2020Q4	0.016969	0.104921	1.814E+12	1.512E+12	665687473	2020/12/31	4.87296	26.050042	1988/11/1	1	5.6536479	1.0575799	0.0003669	11748
2	30.7	298229469	0.114338	2020Q4	0.016969	0.104921	1.814E+12	1.512E+12	665687473	2020/12/31	4.87296	26.050042	1988/11/1	1	6.3000722	1.178501	0.0003669	11748
2	28.7	278893779	-0.065147	2020Q4	0.016969	0.104921	1.814E+12	1.512E+12	665687473	2020/12/31	4.87296	26.050042	1988/11/1	1	5.8896441	1.10117257	0.0003669	11748
2	27.79	270050805	-0.031707	2021Q1	0.032952	0.191154	1.869E+12	1.519E+12	127449412	2021/3/31	5.104104	30.112974	1988/11/1	1	5.4446383	0.922858	6.82E-05	11838
2	33.1	321651013	0.191076	2021Q1	0.032952	0.191154	1.869E+12	1.519E+12	127449412	2021/3/31	5.104104	30.112974	1988/11/1	1	6.4849776	1.099194	6.82E-05	11838
2	30	291526598	-0.093656	2021Q1	0.032952	0.191154	1.869E+12	1.519E+12	127449412	2021/3/31	5.104104	30.112974	1988/11/1	1	5.8776232	0.9962483	6.82E-05	11838
2	28.17	273743475	-0.061	2021Q2	0.001328	0.007109	1.908E+12	1.552E+12	252777749	2021/6/30	5.110713	30.593923	1988/11/1	1	5.5119511	0.9207711	0.0001325	11929
2	26.7	259458672	-0.052183	2021Q2	0.001328	0.007109	1.908E+12	1.552E+12	252777749	2021/6/30	5.110713	30.593923	1988/11/1	1	5.22432	0.87727223	0.0001325	11929
2	23.81	231374943	-0.10824	2021Q2	0.001328	0.007109	1.908E+12	1.552E+12	252777749	2021/6/30	5.110713	30.593923	1988/11/1	1	4.6588411	0.7782591	0.0001325	11929
2	20.66	200764650	-0.132297	2021Q3	0.008458	0.045332	1.955E+12	1.591E+12	370464654	2021/9/30	4.892731	31.30738	1988/11/1	1	4.2225906	0.6599083	0.0001895	12021

(b)

I use the market type to divide the whole data into two and describe the data.

Main Board

	Monthly Return	P/E Ratio	P/B Ratio	Return on Assets	Return on Equity	quarterly R&D / asset ratio	Quarterly Firm Ages
number	590685	552256	573956	547109	540602	167959	578641
mean	0.012345	41.09662	inf	0.022267	0.022137	0.012881	6293.525
standard deviation	0.157611	6156.217	---	0.257124	1.246348	0.017488	2590.473
min	-0.89183	-1288000	-282500	-64.8192	-276.269	-0.00223	30
25%	-0.0677	11.11444	1.508724	0.004182	0.009971	0.002589	4347
median	0	26.53375	2.461719	0.016782	0.035428	0.008052	6219
75%	0.074545	54.29686	4.069699	0.040683	0.078482	0.017775	8124
max	22.05263	1279000	inf	20.78764	36.49243	1.290456	24013

GEM Board

|	Monthly Return	P/E Ratio	P/B Ratio	Return on Assets	Return on Equity	quarterly R&D / asset ratio	Quarterly Firm Ages
number	113574	105499	115333	113622	113346	74190	115382
mean	0.012296	95.72106	4.847628	0.031006	-0.01017	0.021634	6126.663
standard deviation	0.181764	10732.74	19.01698	0.063812	9.037973	0.023772	1993.519
min	-0.86352	-692857	-733.511	-1.87851	-1756.04	0	441
25%	-0.08444	24.27946	2.399521	0.007107	0.01088	0.007569	4714
median	-0.00485	41.86074	3.567484	0.023855	0.035254	0.015271	6049
75%	0.081081	72.0427	5.651034	0.053166	0.076682	0.027398	7397
max	6.399758	2087500	3484.119	0.96864	1.319279	0.792735	15538

Findings

1. There are some companies in the main board that their net asset per share is too low, which makes their P/B Ratio become a truly large number. So, the maximum of the P/B Ratio is infinity, and the mean is also infinity.

2. The p25, median, p75 of the P/E Ratio of the SME Board are all larger than those of the

Main Board, so it is likely to be more companies that are undervalued in the Main Board.

3. The p25, median, p75 of the quarterly R&D expense / total asset ratio of the SME Board are all larger than those of the Main Board. So, the companies in the SME Board are tend to put more money into R&D part.

4. The p25 of the monthly return of SME Board is smaller than the Main board, while the median and the p75 very close, so it will be better for a conservative investor to invest in the Main Board.

Problem2

Time-series figure
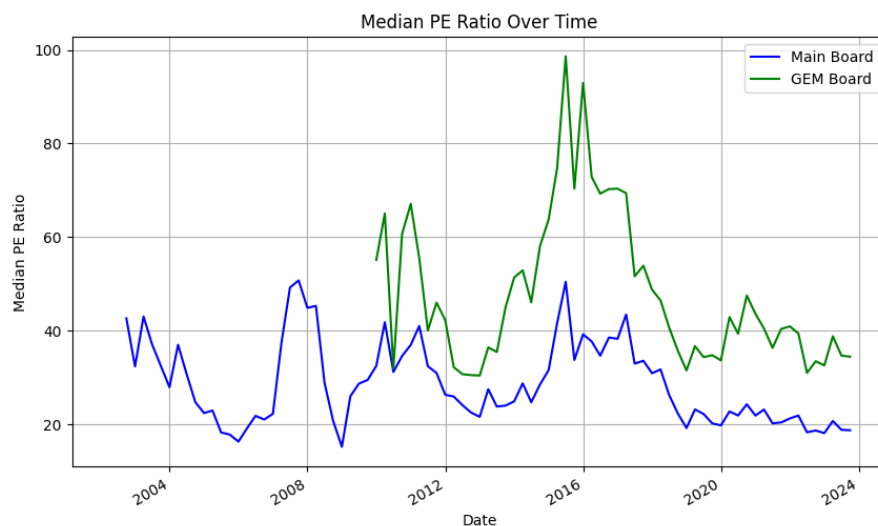
(i)

Yes, it is advisable to consider new investments. Since we can see from the figure that the median P/E Ratio of both two boards are in a historic low level. Every time in the history, when the median P/E Ratio of the Main Board have reached a level lower than 20, it will increase soon, same as the GEM Board. So, when we are in Sep. 2023, the stocks are very likely to be undervalued. It would be wise to invest in the market now. Although the P/E Ratio may become lower in the short run, it will go back to its real value in the long run.

(ii)

First, invest part of your money into the index ETF and wait to see the trend.

If the index increases, keep buying the index ETF but the quantity you buy should be less and less as the index increases. After the index reach a certain point, gradually sell the ETF.

If the index begins to decrease, you can keep investing more money into the index ETF, and wait until it returns to its normal value and sell them.

Problem3

Data Processing

1. Divide the data by companies ('Symbol'), calculate the total revenue growth rate separately and save the data in the new column.
2. Delete the rows whose 'EndDate' is not in 2011-2020.
3. Delete the rows whose 'ROEC' or 'GrowthRate' is missing.
4. Delete the companies that don't contain 10 year's data.
5. Divide data by date ('EndDate'), calculate the median ROE and Growth rate for each year.
6. Check whether the company matches the condition, and calculate the probability.

Result (larger than or equal to)

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
ROE	50.03%	38.98%	32.74%	28.70%	24.71%	21.64%	19.18%	16.42%	14.48%	12.12%
Growth Rate	50.03%	28.64%	17.44%	12.84%	9.31%	6.65%	4.04%	2.81%	1.69%	1.33%

Companies Over Median