SPRING 2014

QANT 300 – PRODUCTION & OPERATIONS MANAGEMENT

A2 & B1 Student Forecasting Project

S.No	Score	Poor	Fair	Good	Very Good	Excellent
1	Quality and appropriateness of the data					✓
2	Use of correct Excel formulas/tools to forecast and evaluate the measures of performance				✓	
3	Ability to present the data professionally in the report			✓		
4	Ability to support the usefulness of the project outcome in formulating organizational/business plans	✓				
5	Ability to justify relevant factors on why companies display different forecast trends				✓	

M201 - Access an information system to collect data and then conduct an analysis

M202 - Use technology to model and solve an operational model

M204 - Prepare reports and presentations using MS-Office products

M401 - Contribute an analysis in support of, or develop, a business plan.

M201 - see above

M202 - see above

M204 - see above

M401 - see above

G301 -

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0897346

A1

Section 1: Introduction Company

Microsoft : Microsoft is a multinational computer based on U.S. technology companies, to research and development, manufacture, authorization, and provide a wide range of computer software services business, the most famous and popular products is Microsoft Windows operating system and Microsoft Office software series. It is currently the world's biggest computer software provider.

Microsoft is the world's leading personal and commercial software developers, based in Redmond, Washington, the company aims to software and services to help users realize the information communication and digital life management, rich business applications and entertainment experience, give full play to the potential for individuals and companies. As software platform vendors, Microsoft Windows platform, server and tools, through the business solutions, help enterprises to improve their overall competitiveness, the development of new digital home technology and entertainment, promote the development of mobile computing and embedded devices. By Microsoft partners business model, efforts to promote information technology for the construction of the ecological system. Microsoft is committed to according to customer requirements for product research and development, to ensure that Microsoft is a leader in innovation. Microsoft for a variety of computer software for installing device drivers provide a series of product development, manufacturing, licensing and support. Microsoft also sells XBOX game, game consoles, and Zune digital music players, etc. Microsoft has five departments: the customer group, server and development tools group, online services division, Microsoft business division and Microsoft's entertainment and devices division.

Section 2: Prediction

Moving average: For forecast the fourth month's price; first calculate the sum of the first three months. Then got the average price by the sum prices divide by three. The result is the fourth month's price.

It used often for smoothing trend and provides overall impression of data over time.

(Moving average== $\sum$ demand in previous n periods/n)

Naïve: The last month's price equal to the previous month's price.

Assumes price in next period is the same as price in most recent period.

Exponential smoothing: Assume alpha is 0.3. Using actual price minus forecast price then multiply alpha. Finally, use last period forecast minus this number.

This method provides overall impression of data over time and smoothes the forecast price but makes it less sensitive to changes.

$(F_t = F_{t-1} + \alpha (A_{t-1} - F_{t-1}))$

Section 3: data

Date	High
6-Mar-09	21
1-Apr-09	19.93
1-May-09	18.88
1-Jun-09	21.2
1-Jul-09	20.94
3-Aug-09	24.34
1-Sep-09	25.72
1-Oct-09	25.49
2-Nov-09	26.25
1-Dec-09	29.35
4-Jan-10	30.14
1-Feb-10	31.5
1-Mar-10	31.24
1-Apr-10	29.03

3-May-10	30.57
1-Jun-10	31.58
1-Jul-10	31.06
2-Aug-10	26.93
1-Sep-10	26.41
1-Oct-10	26.38
1-Nov-10	25.53
1-Dec-10	27.2
3-Jan-11	28.87
1-Feb-11	28.4
1-Mar-11	29.46
1-Apr-11	28.34
2-May-11	26.78
1-Jun-11	26.87
1-Jul-11	26.25
1-Aug-11	26
1-Sep-11	28.15
3-Oct-11	27.69
1-Nov-11	27.5
1-Dec-11	27.5
2-Jan-12	27.2
1-Feb-12	26.19
1-Mar-12	29.95
2-Apr-12	32
1-May-12	32.95
1-Jun-12	32.89
2-Jul-12	32.34
1-Aug-12	31.14
3-Sep-12	31.05

1-Oct-12	30.96
1-Nov-12	31.61
3-Dec-12	30.25
1-Jan-13	30.2
1-Feb-13	27.73
1-Mar-13	28.23
1-Apr-13	28.2
1-May-13	28.66
3-Jun-13	33.11
1-Jul-13	35.28
1-Aug-13	35.78
2-Sep-13	36.43
1-Oct-13	35.2
1-Nov-13	33.75
2-Dec-13	36.29
1-Jan-14	38.29
3-Feb-14	38.98
3-Mar-14	37.4

Section 4: data analysis

Date	High	naive	3mma	exponential smoothing	|A-F|	|A-F|	|A-F|		|A-F|*|A-F|	|A-F|*|A-F|	|A-F|*|A-F|		|A-F|/A	|A-F|/A	|A-F|/A
6-Mar-09	21														
1-	19.9	21													

Apr-09	3														
1-May-09	18.88	19.93		20.679											
1-Jun-09	21.2	18.88	19.94	19.615	2.32	1.26	1.59		5.3824	1.596011	2.512225		0.109434	0.059591	0.074764
1-Jul-09	20.94	21.2	20.00	19.576	0.26	0.94	1.36		0.0676	0.877344	1.860496		0.012416	0.044731	0.065138
3-Aug-09	24.34	20.94	20.34	21.122	3.4	4.00	3.22		11.56	16	10.35552		0.139688	0.164339	0.13221
1-Sep-09	25.72	24.34	22.16	21.96	1.38	3.56	3.76		1.9044	12.6736	14.1376		0.053655	0.138414	0.14619
1-Oct-09	25.49	25.72	23.67	24.754	0.23	1.82	0.74		0.0529	3.324544	0.541696		0.009023	0.071531	0.028874
2-Nov-09	26.25	25.49	25.18	25.651	0.76	1.07	0.60		0.5776	1.137778	0.358801		0.028952	0.040635	0.022819
1-Dec-09	29.35	26.25	25.82	25.718	3.1	3.53	3.63		9.61	12.4609	13.19142		0.105622	0.120273	0.123748
4-Jan-10	30.14	29.35	27.03	27.18	0.79	3.11	2.96		0.6241	9.6721	8.7616		0.026211	0.103185	0.098208
1-Feb-10	31.5	30.14	28.58	29.587	1.36	2.92	1.91		1.8496	8.5264	3.659569		0.043175	0.092698	0.06073
1-	31.2	31.5	30.3	30.548	0.26	0.91	0.69		0.0676	0.8281	0.4788		0.0083	0.0291	0.0221

Mar-10	4		3								64		23	29	51
1-Apr-10	29.03	31.24	30.96	31.422	2.21	1.93	2.39		4.8841	3.7249	5.721664		0.076128	0.066483	0.082398
3-May-10	30.57	29.03	30.59	30.577	1.54	0.02	0.01		2.3716	0.0004	4.9E-05		0.050376	0.000654	0.000229
1-Jun-10	31.58	30.57	30.28	29.492	1.01	1.30	2.09		1.0201	1.69	4.359744		0.031982	0.041165	0.066118
1-Jul-10	31.06	31.58	30.39	30.873	0.52	0.67	0.19		0.2704	0.444444	0.034969		0.016742	0.021464	0.006021
2-Aug-10	26.93	31.06	31.07	31.424	4.13	4.14	4.49		17.0569	17.1396	20.19604		0.153361	0.153732	0.166877
1-Sep-10	26.41	26.93	29.86	29.821	0.52	3.45	3.41		0.2704	11.87951	11.63492		0.01969	0.130506	0.129156
1-Oct-10	26.38	26.41	28.13	26.774	0.03	1.75	0.39		0.0009	3.074178	0.155236		0.001137	0.066464	0.014936
1-Nov-10	25.53	26.38	26.57	26.401	0.85	1.04	0.87		0.7225	1.088544	0.758641		0.033294	0.040867	0.034117
1-Dec-10	27.2	25.53	26.11	26.125	1.67	1.09	1.08		2.7889	1.195378	1.155625		0.061397	0.040196	0.039522
3-Jan-11	28.87	27.2	26.37	26.031	1.67	2.50	2.84		2.7889	6.25	8.059921		0.057846	0.086595	0.098337
1-	28.4	28.8	27.2	27.701	0.47	1.20	0.70		0.2209	1.44	0.4886		0.0165	0.0422	0.0246

Feb-11		7	0								01		49	54	13
1-Mar-11	29.46	28.4	28.16	28.729	1.06	1.30	0.73		1.1236	1.698678	0.534361		0.035981	0.044241	0.024813
1-Apr-11	28.34	29.46	28.91	28.718	1.12	0.57	0.38		1.2544	0.3249	0.142884		0.03952	0.020113	0.013338
2-May-11	26.78	28.34	28.73	29.124	1.56	1.95	2.34		2.4336	3.815511	5.494336		0.058252	0.07294	0.087528
1-Jun-11	26.87	26.78	28.19	27.872	0.09	1.32	1.00		0.0081	1.751211	1.004004		0.003349	0.049249	0.037291
1-Jul-11	26.25	26.87	27.33	26.807	0.62	1.08	0.56		0.3844	1.1664	0.310249		0.023619	0.041143	0.021219
1-Aug-11	26	26.25	26.63	26.684	0.25	0.63	0.68		0.0625	0.401111	0.467856		0.009615	0.024359	0.026308
1-Sep-11	28.15	26	26.37	26.175	2.15	1.78	1.98		4.6225	3.156544	3.900625		0.076377	0.063114	0.07016
3-Oct-11	27.69	28.15	26.80	26.645	0.46	0.89	1.05		0.2116	0.7921	1.092025		0.016612	0.032142	0.037739
1-Nov-11	27.5	27.69	27.28	28.012	0.19	0.22	0.51		0.0361	0.0484	0.262144		0.006909	0.008	0.018618
1-Dec-11	27.5	27.5	27.78	27.633	0	0.28	0.13		0	0.0784	0.017689		0	0.010182	0.004836
2-	27.2	27.5	27.5	27.5	0.3	0.36	0.30		0.09	0.1320	0.09		0.0110	0.0133	0.0110

Jan-12			6							11			29	58	29
1-Feb-12	26.19	27.2	27.40	27.41	1.01	1.21	1.22		1.0201	1.4641	1.4884		0.038564	0.046201	0.046583
1-Mar-12	29.95	26.19	26.96	26.897	3.76	2.99	3.05		14.1376	8.920178	9.320809		0.125543	0.099722	0.101937
2-Apr-12	32	29.95	27.78	27.318	2.05	4.22	4.68		4.2025	17.8084	21.92112		0.064063	0.131875	0.146313
1-May-12	32.95	32	29.38	30.565	0.95	3.57	2.39		0.9025	12.7449	5.688225		0.028832	0.108346	0.072382
1-Jun-12	32.89	32.95	31.63	32.285	0.06	1.26	0.60		0.0036	1.579211	0.366025		0.001824	0.038208	0.018395
2-Jul-12	32.34	32.89	32.61	32.932	0.55	0.27	0.59		0.3025	0.074711	0.350464		0.017007	0.008452	0.018306
1-Aug-12	31.14	32.34	32.73	32.725	1.2	1.59	1.59		1.44	2.517511	2.512225		0.038536	0.050953	0.050899
3-Sep-12	31.05	31.14	32.12	31.98	0.09	1.07	0.93		0.0081	1.152044	0.8649		0.002899	0.034568	0.029952
1-Oct-12	30.96	31.05	31.51	31.113	0.09	0.55	0.15		0.0081	0.3025	0.023409		0.002907	0.017765	0.004942
1-Nov-12	31.61	30.96	31.05	31.023	0.65	0.56	0.59		0.4225	0.3136	0.344569		0.020563	0.017716	0.01857
3-	30.2	31.6	31.2	31.155	1.36	0.96	0.91		1.8496	0.9152	0.8190		0.0449	0.0316	0.0299

Dec-12	5	1	1							11	25		59	25	17
1-Jan-13	30.2	30.25	30.94	31.202	0.05	0.74	1.00		0.0025	0.5476	1.004004		0.001656	0.024503	0.033179
1-Feb-13	27.73	30.2	30.69	30.235	2.47	2.96	2.51		6.1009	8.741878	6.275025		0.089073	0.106623	0.090335
1-Mar-13	28.23	27.73	29.39	29.459	0.5	1.16	1.23		0.25	1.353344	1.510441		0.017712	0.041209	0.043535
1-Apr-13	28.2	28.23	28.72	27.88	0.03	0.52	0.32		0.0009	0.2704	0.1024		0.001064	0.01844	0.011348
1-May-13	28.66	28.2	28.05	28.221	0.46	0.61	0.44		0.2116	0.368044	0.192721		0.01605	0.021168	0.015318
3-Jun-13	33.11	28.66	28.36	28.338	4.45	4.75	4.77		19.8025	22.53084	22.77198		0.1344	0.143361	0.144126
1-Jul-13	35.28	33.11	29.99	29.995	2.17	5.29	5.29		4.7089	27.9841	27.93123		0.061508	0.149943	0.149802
1-Aug-13	35.78	35.28	32.35	33.761	0.5	3.43	2.02		0.25	11.7649	4.076361		0.013974	0.095864	0.056428
2-Sep-13	36.43	35.78	34.72	35.43	0.65	1.71	1.00		0.4225	2.912711	1		0.017842	0.046848	0.02745
1-Oct-13	35.2	36.43	35.83	35.975	1.23	0.63	0.77		1.5129	0.3969	0.600625		0.034943	0.017898	0.022017
1-	33.7	35.2	35.8	36.061	1.45	2.05	2.31		2.1025	4.2161	5.3407		0.0429	0.0608	0.0684

Nov-13	5		0							78	21		63	4	74
2-Dec-13	36.29	33.75	35.13	34.765	2.54	1.16	1.53		6.4516	1.353344	2.325625		0.069992	0.032057	0.042023
1-Jan-14	38.29	36.29	35.08	34.512	2	3.21	3.78		4	10.3041	14.27328		0.052233	0.083834	0.098668
3-Feb-14	38.98	38.29	36.11	36.89	0.69	2.87	2.09		0.4761	8.2369	4.3681		0.017701	0.073628	0.053617
3-Mar-14	37.4	38.98	37.85	38.497	1.58	0.45	1.10		2.4964	0.205511	1.203409		0.042246	0.012121	0.029332
				MAD	1.207368	1.796316	1.674053	MSE	2.541466	4.782209	4.455422	MAPE	0.040264	0.05944	0.055412

In order to measure the accuracy of the prediction, there are 3 Common Measures of Error.

Mean Absolute Deviation (MAD)

MAD=∑ |Actual - Forecast|/N

The Mean Absolute Deviation is all individual observations and the arithmetic mean deviation of the absolute value of the average.Compared with the mean error, mean absolute error due to the deviation is absolute value, won't appear the situation of the positive and negative offset, therefore, the average absolute error can better reflect the actual situation of the prediction error.

Mean Absolute Percentage Error (MAPE)

MAPE is a measure of accuracy of a method for constructing fitted time series values in statistics, specifically in trend estimation. It usually expresses accuracy as a percentage, and is defined by the formula:

MAPE=∑ (|A-F|/A)/N

Mean Squared Error (MSE)

Mean square error (MSE) refers to parameters of the expected value of the difference between the true value of square。

MSE=∑ (*Forecast Errors*) ^2/N

	NAÏVE	3MMA	exponential smoothing
MAD	1.207368	1.796316	1.674053
MSE	2.541466	4.782209	4.455422
MAPE	0.040264	0.05944	0.055412

Section 5: conclusion

In this case, the method of Naïve gets the lowest number in MAD, MSE and MAPE, that means the method of naive has the lowest measurement error compare with 3 mouths moving average and exponential smoothing. So naive is the best method for predicting Microsoft stock price.

Section 6: B1

Introduction Company

Google: It is an American multinational technology companies. Google the company was established in September 1998, is engaged in site index of content, and other related business, through the Internet, anyone can get this information for free. Through Google index of network, the company's automatic search technology can help users search the relevant information immediately. Through Google adwords business to promote their products and services, in addition, as an integral part of the Google network, thousands of third party sites can use Google's adsense business publishing their own advertising. Google's revenue mainly comes from publishing online advertising. Some of Google's specific operations include: Google web search, Google image search, Google finance, Google documents, Google users, Google desktop, Google toolbar, Google earth, Google, Google mobile, Google LABS, Google adwords, Google adsense, Google enterprise, Google apps, etc.

Apple: It is a high-tech company in the United States, is famous for its innovation in high-tech enterprises. Apple was founded in 1977 on January 3, design, production and sales of personal computers, portable digital music players and mobile communication tools, a variety of related software, auxiliary facilities, peripherals, and network products. Sales way is varied, including online stores, retail stores, direct sales, wholesale resale and the third party, etc. In addition; apple also sells third-party products, iPod and iPhone compatible products, including application software, printers, storage devices, audio, headphones and all kinds of accessories and peripherals. The company's products are mainly oriented education, entrepreneurs, consumers and businesses, and government users. Apple's products include personal computer desktop computers and laptops, servers, storage products, related equipment and peripheral equipment, and various third-party hardware products. Apple's software products including the operating system and computer technology, professional application software, application software for users, education and business. Music products and services including iPod series of products, and online offering third-party music, video, books, music, video, television shows and movies, etc. Apple's Internet software and services is committed to using and use the Internet to promote the company's products and services. Apple's wireless networking products allows you to almost any corner of the surf the Internet at home or company.

Data Google:

Date	High
1/20/2009	352.33
2/2/2009	381
3/2/2009	359.16
4/1/2009	403.75
5/1/2009	417.23
6/1/2009	447.34
7/1/2009	452.7
8/3/2009	474.35
9/1/2009	507
10/1/2009	561.64
11/2/2009	587.06
12/1/2009	625.99
1/4/2010	629.51
2/1/2010	547.5
3/1/2010	588.28
4/1/2010	597.84
5/3/2010	532.92
6/1/2010	509.25
7/1/2010	497.5
8/2/2010	508.6
9/1/2010	536.85
10/1/2010	624.74
11/1/2010	630.85
12/1/2010	607
1/3/2011	642.96
2/1/2011	631.18
3/1/2011	619.22
4/1/2011	595.19

5/2/2011	545.73
6/1/2011	533.2
7/1/2011	627.5
8/1/2011	615.5
9/1/2011	558.52
10/3/2011	602.7
11/1/2011	618.3
12/1/2011	646.76
1/3/2012	670.25
2/1/2012	625.6
3/1/2012	658.59
4/2/2012	653.14
5/1/2012	637.85
6/1/2012	587.89
7/2/2012	642.6
8/1/2012	688.99
9/4/2012	764.89
10/1/2012	774.38
11/1/2012	699.22
12/3/2012	729.1
1/2/2013	760.95
2/1/2013	808.97
3/1/2013	844
4/1/2013	827.64
5/1/2013	920.6
6/3/2013	910.84
7/1/2013	928
8/1/2013	909.71
9/3/2013	905.99

10/1/2013	1041.52
11/1/2013	1068
12/2/2013	1121
1/2/2014	1160.63

Data apple:

Date	High
1/7/2009	95
2/2/2009	103
3/2/2009	109.98
4/1/2009	127.2
5/1/2009	135.9
6/1/2009	146.4
7/1/2009	165
8/3/2009	172.49
9/1/2009	188.9
10/1/2009	208.71
11/2/2009	208
12/1/2009	213.95
1/4/2010	215.59
2/1/2010	205.17
3/1/2010	237.48
4/1/2010	272.46
5/3/2010	267.88
6/1/2010	279.01
7/1/2010	265.99
8/2/2010	264.28
9/1/2010	294.73

10/1/2010	319
11/1/2010	321.3
12/1/2010	326.66
1/3/2011	348.6
2/1/2011	364.9
3/1/2011	361.67
4/1/2011	355.13
5/2/2011	351.83
6/1/2011	352.13
7/1/2011	404.5
8/1/2011	399.5
9/1/2011	422.86
10/3/2011	426.7
11/1/2011	408
12/1/2011	409.09
1/3/2012	458.24
2/1/2012	547.61
3/1/2012	621.45
4/2/2012	644
5/1/2012	596.76
6/1/2012	590
7/2/2012	619.87
8/1/2012	680.87
9/4/2012	705.07
10/1/2012	676.75
11/1/2012	603
12/3/2012	594.59
1/2/2013	555
2/1/2013	484.94

3/1/2013	469.95
4/1/2013	445.25
5/1/2013	465.75
6/3/2013	454.43
7/1/2013	457.34
8/1/2013	513.74
9/3/2013	507.92
10/1/2013	539.25
11/1/2013	558.33
12/2/2013	575.14
1/2/2014	557.03

Data analysis:

Google

<table>
<tr><th>Date</th><th>High</th><th>naive</th><th>3mma</th><th>es</th><th>|A-F|/A</th><th>|A-F|/A</th><th>|A-F|/A</th><th></th><th>|A-F|</th><th>|A-F|</th><th>|A-F|</th><th></th><th>|A-F|*|A-F|</th><th>|A-F|*|A-F|</th><th>|A-F|*|A-F|</th></tr>
<tr><td>1/20/2009</td><td>352.33</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>2/2/2009</td><td>381</td><td>352.33</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>3/2/2009</td><td>359.16</td><td>381</td><td></td><td>360.931</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>4/1/2009</td><td>403.75</td><td>359.16</td><td>364.16</td><td>374.448</td><td>0.11</td><td>0.10</td><td>0.07</td><td></td><td>44.59</td><td>39.587</td><td>29.302</td><td></td><td>1988.268</td><td>1567.104</td><td>858.6072</td></tr>
<tr><td>5/1/2009</td><td>417.23</td><td>403.75</td><td>381.30</td><td>372.537</td><td>0.03</td><td>0.09</td><td>0.11</td><td></td><td>13.48</td><td>35.927</td><td>44.693</td><td></td><td>181.7104</td><td>1290.725</td><td>1997.464</td></tr>
<tr><td>6/1/2</td><td>447.</td><td>417.</td><td>393.</td><td>407.7</td><td>0.07</td><td>0.12</td><td>0.09</td><td></td><td>30.11</td><td>53.9</td><td>39.54</td><td></td><td>906.612</td><td>2911.68</td><td>1563.88</td></tr>
</table>

009	34	23	38	94						60	6		1	2	6
7/1/2 009	452. 7	447. 34	422. 77	426.2 63	0.01	0.07	0.06		5.36	29.9 27	26.43 7		28.7296	895.605 4	698.915
8/3/2 009	474. 35	452. 7	439. 09	448.9 48	0.05	0.07	0.05		21.65	35.2 60	25.40 2		468.722 5	1243.26 8	645.261 6
9/1/2 009	507	474. 35	458. 13	459.1 95	0.06	0.10	0.09		32.65	48.8 70	47.80 5		1066.02 3	2388.27 7	2285.31 8
10/1/ 2009	561. 64	507	478. 02	484.1 45	0.10	0.15	0.14		54.64	83.6 23	77.49 5		2985.53	6992.86 2	6005.47 5
11/2/ 2009	587. 06	561. 64	514. 33	523.3 92	0.04	0.12	0.11		25.42	72.7 30	63.66 8		646.176 4	5289.65 3	4053.61 4
12/1/ 2009	625. 99	587. 06	551. 90	569.2 66	0.06	0.12	0.09		38.93	74.0 90	56.72 4		1515.54 5	5489.32 8	3217.61 2
1/4/2 010	629. 51	625. 99	591. 56	598.7 39	0.01	0.06	0.05		3.52	37.9 47	30.77 1		12.3904	1439.95	946.854 4
2/1/2 010	547. 5	629. 51	614. 19	627.0 46	0.15	0.12	0.15		82.01	66.6 87	79.54 6		6725.64	4447.11 2	6327.56 6
3/1/2 010	588. 28	547. 5	601. 00	604.9 07	0.07	0.02	0.03		40.78	12.7 20	16.62 7		1663.00 8	161.798 4	276.457 1
4/1/2 010	597. 84	588. 28	588. 43	559.7 34	0.02	0.02	0.06		9.56	9.41 0	38.10 6		91.3936	88.5481	1452.06 7
5/3/2 010	532. 92	597. 84	577. 87	591.1 48	0.12	0.08	0.11		64.92	44.9 53	58.22 8		4214.60 6	2020.80 2	3390.5
6/1/2 010	509. 25	532. 92	573. 01	578.3 64	0.05	0.13	0.14		23.67	63.7 63	69.11 4		560.268 9	4065.76 3	4776.74 5
7/1/2 010	497. 5	509. 25	546. 67	525.8 19	0.02	0.10	0.06		11.75	49.1 70	28.31 9		138.062 5	2417.68 9	801.965 8
8/2/2 010	508. 6	497. 5	513. 22	505.7 25	0.02	0.01	0.01		11.10	4.62 3	2.875		123.21	21.3752 1	8.26562 5

9/1/2010	536.85	508.6	505.12	500.83	0.05	0.06	0.07		28.25	31.733	36.020		798.0625	1007.004	1297.44
10/1/2010	624.74	536.85	514.32	517.075	0.14	0.18	0.17		87.89	110.423	107.665		7724.652	12193.31	11591.75
11/1/2010	630.85	624.74	556.73	563.217	0.01	0.12	0.11		6.11	74.120	67.633		37.3321	5493.774	4574.223
12/1/2010	607	630.85	597.48	626.573	0.04	0.02	0.03		23.85	9.520	19.573		568.8225	90.6304	383.1023
1/3/2011	642.96	607	620.86	623.695	0.06	0.03	0.03		35.96	22.097	19.265		1293.122	488.2627	371.1402
2/1/2011	631.18	642.96	626.94	617.788	0.02	0.01	0.02		11.78	4.243	13.392		138.7684	18.00588	179.3457
3/1/2011	619.22	631.18	627.05	639.426	0.02	0.01	0.03		11.96	7.827	20.206		143.0416	61.25671	408.2824
4/1/2011	595.19	619.22	631.12	627.592	0.04	0.06	0.05		24.03	35.930	32.402		577.4409	1290.965	1049.89
5/2/2011	545.73	595.19	615.20	612.011	0.09	0.13	0.12		49.46	69.467	66.281		2446.292	4825.618	4393.171
6/1/2011	533.2	545.73	586.71	580.352	0.02	0.10	0.09		12.53	53.513	47.152		157.0009	2863.677	2223.311
7/1/2011	627.5	533.2	558.04	541.971	0.15	0.11	0.14		94.30	69.460	85.529		8892.49	4824.692	7315.21
8/1/2011	615.5	627.5	568.81	561.49	0.02	0.08	0.09		12.00	46.690	54.010		144	2179.956	2917.08
9/1/2011	558.52	615.5	592.07	623.9	0.10	0.06	0.12		56.98	33.547	65.380		3246.72	1125.379	4274.544
10/3/2011	602.7	558.52	600.51	598.406	0.07	0.00	0.01		44.18	2.193	4.294		1951.872	4.810711	18.43844
11/1/	618.	602.	592.	571.7	0.03	0.04	0.08		15.60	26.0	46.52		243.36	679.123	2164.66

2011	3	7	24	74						60	6			6	9
12/1/2011	646.76	618.3	593.17	607.38	0.04	0.08	0.06		28.46	53.587	39.380		809.9716	2871.531	1550.784
1/3/2012	670.25	646.76	622.59	626.838	0.04	0.07	0.06		23.49	47.663	43.412		551.7801	2271.793	1884.602
2/1/2012	625.6	670.25	645.10	653.807	0.07	0.03	0.05		44.65	19.503	28.207		1993.623	380.38	795.6348
3/1/2012	658.59	625.6	647.54	656.855	0.05	0.02	0.00		32.99	11.053	1.735		1088.34	122.1762	3.010225
4/2/2012	653.14	658.59	651.48	635.497	0.01	0.00	0.03		5.45	1.660	17.643		29.7025	2.7556	311.2754
5/1/2012	637.85	653.14	645.78	656.955	0.02	0.01	0.03		15.29	7.927	19.105		233.7841	62.83204	365.001
6/1/2012	587.89	637.85	649.86	648.553	0.08	0.11	0.10		49.96	61.970	60.663		2496.002	3840.281	3680
7/2/2012	642.6	587.89	626.29	622.862	0.09	0.03	0.03		54.71	16.307	19.738		2993.184	265.9074	389.5886
8/1/2012	688.99	642.6	622.78	604.303	0.07	0.10	0.12		46.39	66.210	84.687		2152.032	4383.764	7171.888
9/4/2012	764.89	688.99	639.83	656.517	0.10	0.16	0.14		75.90	125.063	108.373		5760.81	15640.84	11744.71
10/1/2012	774.38	764.89	698.83	711.76	0.01	0.10	0.08		9.49	75.553	62.620		90.0601	5708.306	3921.264
11/1/2012	699.22	774.38	742.75	767.737	0.11	0.06	0.10		75.16	43.533	68.517		5649.026	1895.151	4694.579
12/3/2012	729.1	699.22	746.16	751.832	0.04	0.02	0.03		29.88	17.063	22.732		892.8144	291.1573	516.7438
1/2/2013	760.95	729.1	734.23	708.184	0.04	0.04	0.07		31.85	26.717	52.766		1014.423	713.7803	2784.251

2/1/2013	808.97	760.95	729.76	738.655	0.06	0.10	0.09		48.02	79.213	70.315		2305.92	6274.752	4944.199
3/1/2013	844	808.97	766.34	775.356	0.04	0.09	0.08		35.03	77.660	68.644		1227.101	6031.076	4711.999
4/1/2013	827.64	844	804.64	819.479	0.02	0.03	0.01		16.36	23.000	8.161		267.6496	529	66.60192
5/1/2013	920.6	827.64	826.87	839.092	0.10	0.10	0.09		92.96	93.730	81.508		8641.562	8785.313	6643.554
6/3/2013	910.84	920.6	864.08	855.528	0.01	0.05	0.06		9.76	46.760	55.312		95.2576	2186.498	3059.417
7/1/2013	928	910.84	886.36	917.672	0.02	0.04	0.01		17.16	41.640	10.328		294.4656	1733.89	106.6676
8/1/2013	909.71	928	919.81	915.988	0.02	0.01	0.01		18.29	10.103	6.278		334.5241	102.0773	39.41328
9/3/2013	905.99	909.71	916.18	922.513	0.00	0.01	0.02		3.72	10.193	16.523		13.8384	103.904	273.0095
10/1/2013	1041.52	905.99	914.57	908.594	0.13	0.12	0.13		135.53	126.953	132.926		18368.38	16117.15	17669.32
11/1/2013	1068	1041.52	952.41	946.649	0.02	0.11	0.11		26.48	115.593	121.351		701.1904	13361.82	14726.07
12/2/2013	1121	1068	1005.17	1049.464	0.05	0.10	0.06		53.00	115.830	71.536		2809	13416.59	5117.399
1/2/2014	1160.63	1121	1076.84	1083.9	0.03	0.07	0.07		39.63	83.790	76.730		1570.537	7020.764	5887.493
				MAPE	0.054028	0.071418	0.072391	MAD	35.32121	47.5577	47.74441	MSE	1966.618	3344.681	3198.735

Apple:

Date	High	naive	3mma	es	|A-F|/A	|A-F|/A	|A-F|/A		|A-F|	|A-F|	|A-F|		|A-F|*|A-F|	|A-F|*|A-F|	|A-F|*|A-F|
1/7/2009	95														
2/2/2009	103	95													
3/2/2009	109.98	103		97.40											
4/1/2009	127.2	109.98	102.66	105.09	0.14	0.19	0.17		17.22	24.540	22.106		296.5284	602.2116	488.6752
5/1/2009	135.9	127.2	113.39	115.15	0.06	0.17	0.15		8.70	22.507	20.754		75.69	506.55	430.7285
6/1/2009	146.4	135.9	124.36	129.81	0.07	0.15	0.11		10.50	22.040	16.590		110.25	485.7616	275.2281
7/1/2009	165	146.4	136.50	139.05	0.11	0.17	0.16		18.60	28.500	25.950		345.96	812.25	673.4025
8/3/2009	172.49	165	149.10	151.98	0.04	0.14	0.12		7.49	23.390	20.510		56.1001	547.0921	420.6601
9/1/2009	188.9	172.49	161.30	167.25	0.09	0.15	0.11		16.41	27.603	21.653		269.2881	761.944	468.8524
10/1/2009	208.71	188.9	175.46	177.41	0.09	0.16	0.15		19.81	33.247	31.297		392.4361	1105.341	979.5022
11/2/2009	208	208.71	190.03	194.84	0.00	0.09	0.06		0.71	17.967	13.157		0.5041	322.8011	173.1066

12/1/2009	213.95	208	201.87	208.50	0.03	0.06	0.03		5.95	12.080	5.453		35.4025	145.9264	29.73521
1/4/2010	215.59	213.95	210.22	209.79	0.01	0.02	0.03		1.64	5.370	5.805		2.6896	28.8369	33.69803
2/1/2010	205.17	215.59	212.51	214.44	0.05	0.04	0.05		10.42	7.343	9.272		108.5764	53.92454	85.96998
3/1/2010	237.48	205.17	211.57	212.46	0.14	0.11	0.11		32.31	25.910	25.016		1043.936	671.3281	625.8003
4/1/2010	272.46	237.48	219.41	214.86	0.13	0.19	0.21		34.98	53.047	57.597		1223.6	2813.949	3317.414
5/3/2010	267.88	272.46	238.37	247.97	0.02	0.11	0.07		4.58	29.510	19.906		20.9764	870.8401	396.2488
6/1/2010	279.01	267.88	259.27	271.09	0.04	0.07	0.03		11.13	19.737	7.924		123.8769	389.536	62.78978
7/1/2010	265.99	279.01	273.12	271.22	0.05	0.03	0.02		13.02	7.127	5.229		169.5204	50.78938	27.34244
8/2/2010	264.28	265.99	270.96	275.10	0.01	0.03	0.04		1.71	6.680	10.824		2.9241	44.6224	117.159
9/1/2010	294.73	264.28	269.76	265.48	0.10	0.08	0.10		30.45	24.970	29.253		927.2025	623.5009	855.738
10/1/2010	319	294.73	275.00	273.42	0.08	0.14	0.14		24.27	44.000	45.585		589.0329	1936	2077.992
11/1/2010	321.3	319	292.67	302.01	0.01	0.09	0.06		2.30	28.630	19.289		5.29	819.6769	372.0655
12/1/2010	326.66	321.3	311.68	319.69	0.02	0.05	0.02		5.36	14.983	6.970		28.7296	224.5003	48.5809
1/3/2011	348.6	326.66	322.32	322.91	0.06	0.08	0.07		21.94	26.280	25.692		481.3636	690.6384	660.0789
2/1/20	364.	348.	332.	333.	0.04	0.09	0.09		16.30	32.71	31.65		265.69	1070.16	1002.22

11	9	6	19	24						3	8			2	9
3/1/2011	361.67	364.9	346.72	353.49	0.01	0.04	0.02		3.23	14.950	8.180		10.4329	223.5025	66.9124
4/1/2011	355.13	361.67	358.39	363.93	0.02	0.01	0.02		6.54	3.260	8.801		42.7716	10.6276	77.4576
5/2/2011	351.83	355.13	360.57	359.71	0.01	0.02	0.02		3.30	8.737	7.878		10.89	76.32934	62.06288
6/1/2011	352.13	351.83	356.21	354.14	0.00	0.01	0.01		0.30	4.080	2.010		0.09	16.6464	4.0401
7/1/2011	404.5	352.13	353.03	351.92	0.13	0.13	0.13		52.37	51.470	52.580		2742.617	2649.161	2764.656
8/1/2011	399.5	404.5	369.49	367.84	0.01	0.08	0.08		5.00	30.013	31.659		25	900.8002	1002.292
9/1/2011	422.86	399.5	385.38	403.00	0.06	0.09	0.05		23.36	37.483	19.860		545.6896	1405	394.4196
10/3/2011	426.7	422.86	408.95	406.51	0.01	0.04	0.05		3.84	17.747	20.192		14.7456	314.9442	407.7169
11/1/2011	408	426.7	416.35	424.01	0.05	0.02	0.04		18.70	8.353	16.012		349.69	69.77818	256.3841
12/1/2011	409.09	408	419.19	421.09	0.00	0.02	0.03		1.09	10.097	12.000		1.1881	101.9427	144
1/3/2012	458.24	409.09	414.60	408.33	0.11	0.10	0.11		49.15	43.643	49.913		2415.723	1904.741	2491.308
2/1/2012	547.61	458.24	425.11	423.84	0.16	0.22	0.23		89.37	122.500	123.775		7986.997	15006.25	15320.25
3/1/2012	621.45	547.61	471.65	485.05	0.12	0.24	0.22		73.84	149.803	136.399		5452.346	22441.04	18604.69
4/2/2012	644	621.45	542.43	569.76	0.04	0.16	0.12		22.55	101.567	74.238		508.5025	10315.79	5511.281

5/1/2012	596.76	644	604.35	628.22	0.08	0.01	0.05		47.24	7.593	31.455		2231.618	57.65871	989.417
6/1/2012	590	596.76	620.74	629.83	0.01	0.05	0.07		6.76	30.737	39.828		45.6976	944.7427	1586.27
7/2/2012	619.87	590	610.25	594.73	0.05	0.02	0.04		29.87	9.617	25.138		892.2169	92.48028	631.919
8/1/2012	680.87	619.87	602.21	598.96	0.09	0.12	0.12		61.00	78.660	81.909		3721	6187.396	6709.084
9/4/2012	705.07	680.87	630.25	638.17	0.03	0.11	0.09		24.20	74.823	66.900		585.64	5598.531	4475.61
10/1/2012	676.75	705.07	668.60	688.13	0.04	0.01	0.02		28.32	8.147	11.380		802.0224	66.36818	129.5044
11/1/2012	603	676.75	687.56	696.57	0.12	0.14	0.16		73.75	84.563	93.574		5439.063	7150.957	8756.093
12/3/2012	594.59	603	661.61	654.63	0.01	0.11	0.10		8.41	67.017	60.035		70.7281	4491.234	3604.201
1/2/2013	555	594.59	624.78	600.48	0.07	0.13	0.08		39.59	69.780	45.477		1567.368	4869.248	2068.158
2/1/2013	484.94	555	584.20	582.71	0.14	0.20	0.20		70.06	99.257	97.773		4908.404	9851.886	9559.56
3/1/2013	469.95	484.94	544.84	533.98	0.03	0.16	0.14		14.99	74.893	64.032		224.7001	5609.011	4100.097
4/1/2013	445.25	469.95	503.30	480.44	0.06	0.13	0.08		24.70	58.047	35.193		610.09	3369.416	1238.547
5/1/2013	465.75	445.25	466.71	462.54	0.04	0.00	0.01		20.50	0.963	3.210		420.25	0.928011	10.3041
6/3/2013	454.43	465.75	460.32	451.40	0.02	0.01	0.01		11.32	5.887	3.030		128.1424	34.65284	9.1809
7/1/20	457.	454.	455.	462.	0.01	0.00	0.01		2.91	2.197	5.014		8.4681	4.82534	25.1402

13	34	43	14	35										4	
8/1/2013	513.74	457.34	459.17	455.30	0.11	0.11	0.11		56.40	54.567	58.437		3180.96	2977.521	3414.883
9/3/2013	507.92	513.74	475.17	474.26	0.01	0.06	0.07		5.82	32.750	33.660		33.8724	1072.563	1132.996
10/1/2013	539.25	507.92	493.00	511.99	0.06	0.09	0.05		31.33	46.250	27.256		981.5689	2139.063	742.8895
11/1/2013	558.33	539.25	520.30	517.32	0.03	0.07	0.07		19.08	38.027	41.011		364.0464	1446.027	1681.902
12/2/2013	575.14	558.33	535.17	544.97	0.03	0.07	0.05		16.81	39.973	30.166		282.5761	1597.867	909.9876
1/2/2014	557.03	575.14	557.57	563.37	0.03	0.00	0.01		18.11	0.543	6.343		327.9721	0.295211	40.23365
				mape	0.055128	0.089141	0.08212	MAD	22.06224	34.93391	32.78979	MSE	922.563	2216.852	1940.456

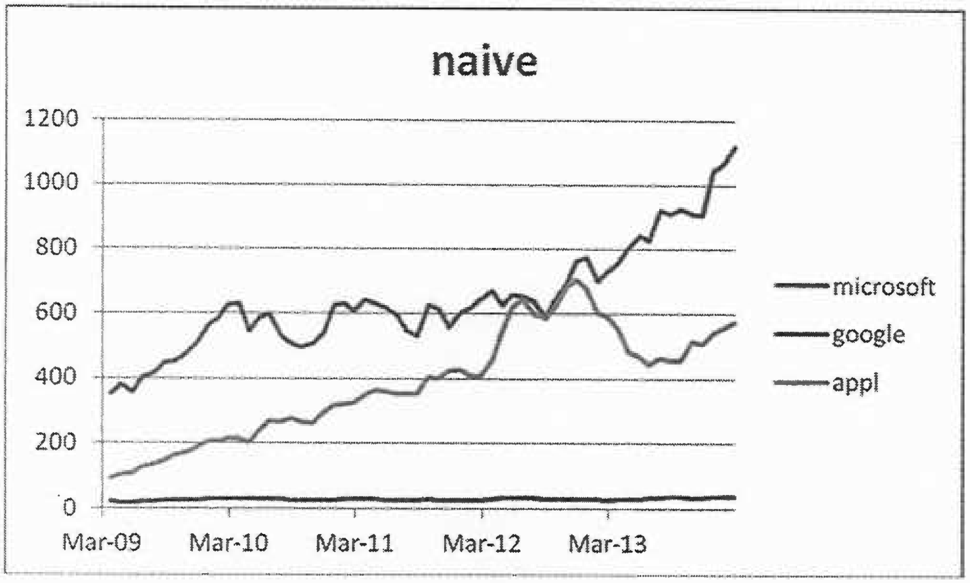
GOOGLE:

	NAÏVE	3MMA	exponential smoothing
MAD	0.054976	0.072671	0.073661
MSE	35.32121	47.5577	47.74441
MAPE	1966.618	3344.681	3198.735

Apple:

	NAÏVE	3MMA	exponential smoothing
MAD	0. 056095	0. 090705	0. 08356
MSE	22. 06224	34. 93391	32. 78979
MAPE	922. 563	2216. 852	1940. 456

These three companies either have the lowest MAD, MSE and MAPE by naive method. Because 3 mouths moving average method often for smoothing trend and exponential smoothing method smoothes the forecast price but makes it less sensitive to changes, but these 3 companies are high technology and internet companies. These industry stock prices usually are very changeful and steeper trends. So, naive method is better than 3 mouths moving average method and exponential smoothing method.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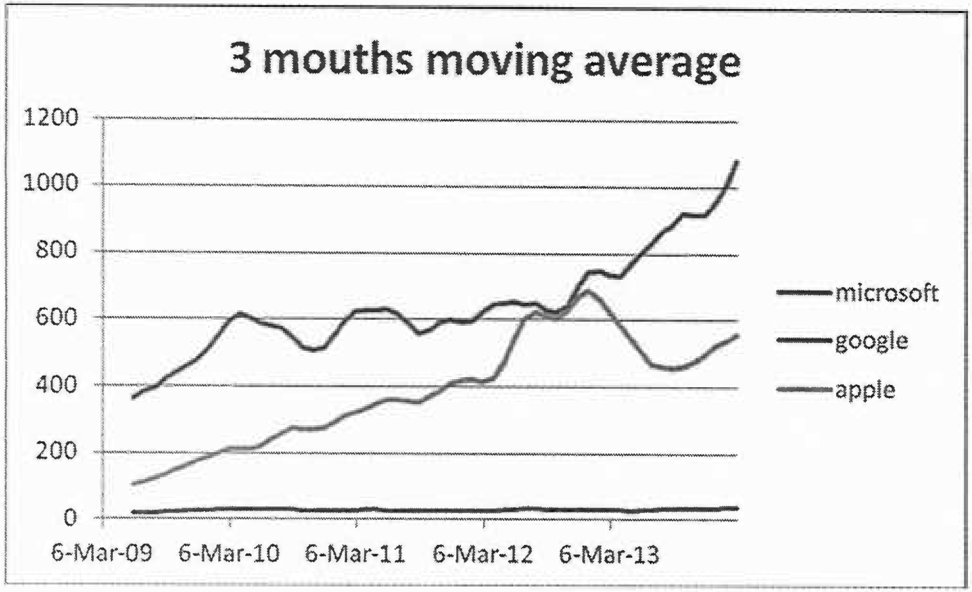
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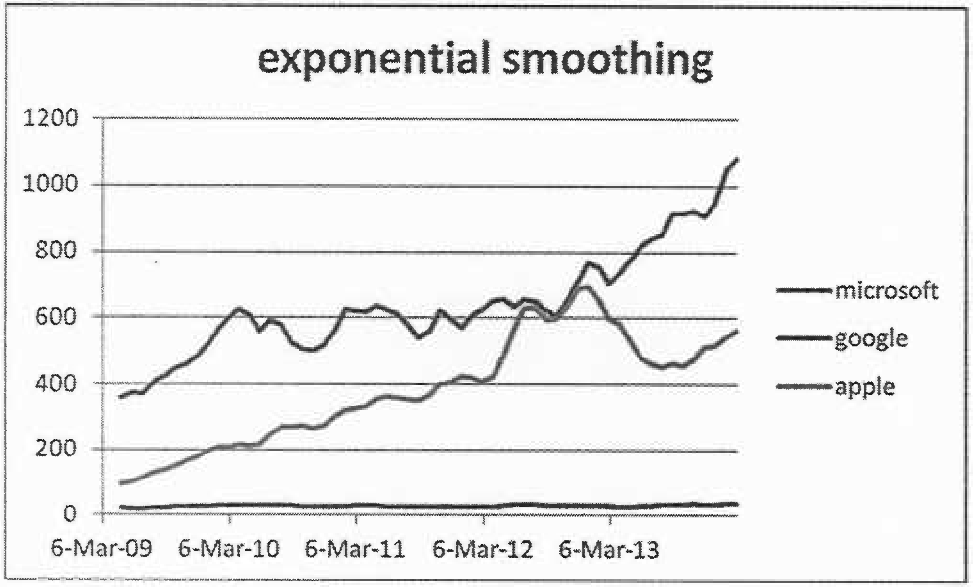
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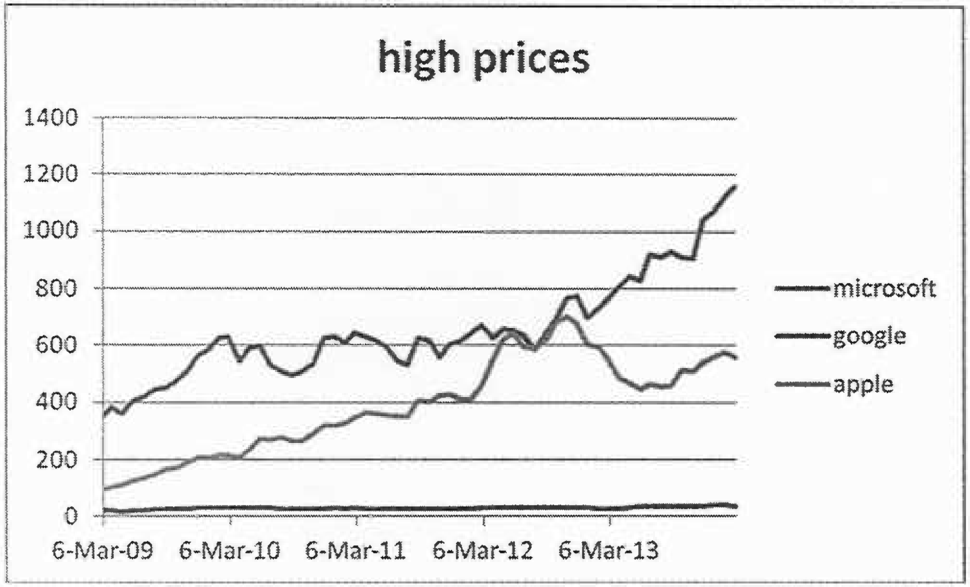

Analysis for B1:

These 3 method almost have the same trend on each company.

On the whole, Apple and Google have similar trend their price of the stock had been rapid growth between years 2009 to years 2013. So, Apple and Google have common factors. They both gained great progress and many of the successful products on mobile products and network products. On the other hand, Microsoft had a stable trend compare with others. This is because Microsoft already have very huge market share by software market and it didn't have a very successful new product to attract new users except software. So it was hard to make an observably development during the year 2009 to 2013.

According to the above table we can know Google grow significantly than Apple between the year 2009 to March at the year 2010. This is because Google successful operate two new products, Gmail and Google document. Gmail is Google and development of a free E-mail service, on April 1, 2004 to enter the Beta phase, February 7, 2007, will be open for the public. Until July 7, 2009, Gmail to end its long Beta phase. Gmail is the first E-mail with 1 GB of storage space network. Google also launched a product in same year - Google document. Different with Microsoft Word, it allows the user to create, edit, and in the online environment collaborative editing files. On July 7, 2009, including three functions, Google docs and Gmail, Google calendar with Google Apps work package.

And at the end of the year 2010 to March at the year 2011 Google also grow rapidly than Apple. The reason is Android acquired by Google in 2005, at the same time, Google provides a software development kit to developers to develop applications running on Android phones, and attracted the various mobile phone manufacturers in the world, telecom operators and software developers, and set up the open handset alliance to jointly develop the Android system. In the fourth quarter of 2010 Canalys analysis report, Android is listed as the world's best-selling smart phone operating system.

According to the above table we know that Apple grow significantly between March 2012 to September 2012. There are two reasons can explain that. The first reason is more iPhone sales channels, for example, in the Chinese market, apple through cooperation with China Unicom sale new iPhone. There are already 10 million China mobile users in the use of the iPhone. In 2012, the Chinese market will become one of the main markets of iPhone sales continue to rise. The market expects that the iPhone sales will reach 135.8 million units in 2012, and the data will still be very conservative. The second reason is that new the ipad to market will be in March next year. The new device will use the iPhone 4 s the current configuration of the A5 processor, using higher pixel screen, camera, and voice assistant Siri. Also, apple will be launched in the second half of 2012 the next iPhone. The new iPhone will adopt the new design, support long-term evolution, the faster processors, more large display, better camera, and including (NFC), a new technology.

But between September 2012 and March 2013, its share price fell sharply compare with Google. The cause of the start is, on September 21, 2012, apple released the iPhone 5, and launch their own map software. The new iPhone to booking volume reached two million units, and because of a lack of supply, it delayed the shipment date to October. Although our sales volume is awesome, the map software is criticized because of mass and insufficient data.