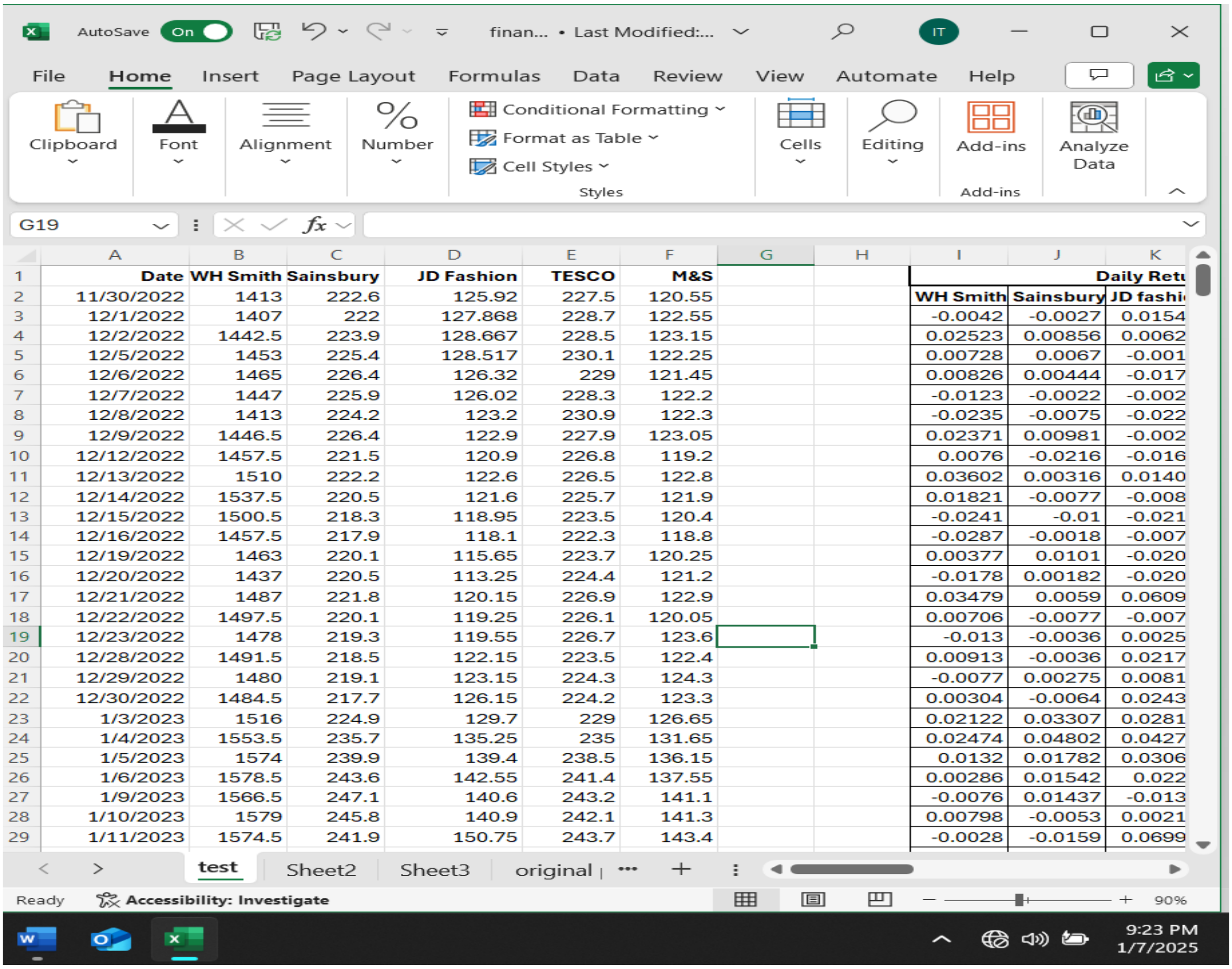
Introduction:

This report analyses the historical performance and risk metrics of five UK-based companies: Sainsbury, JD Fashion, Tesco, and Marks and Spencer(M&S). The purpose of this analysis is to provide key insight to investors about the market and to give them an idea of which company they should invest in to earn a good return. The selected companies are all retail and consumer-focused sectors providing varying levels of risk and return which offers opportunities for portfolio diversification. As these companies are familiar to most investors having a good reputation in the market makes it relevant to wider audiences and investors. The closing prices for all five companies were sourced from stooq.com for 2 years from 30th November 2022 to 30th November 2024. These data were used to find portfolio optimization techniques and risk management strategies.

Data set:

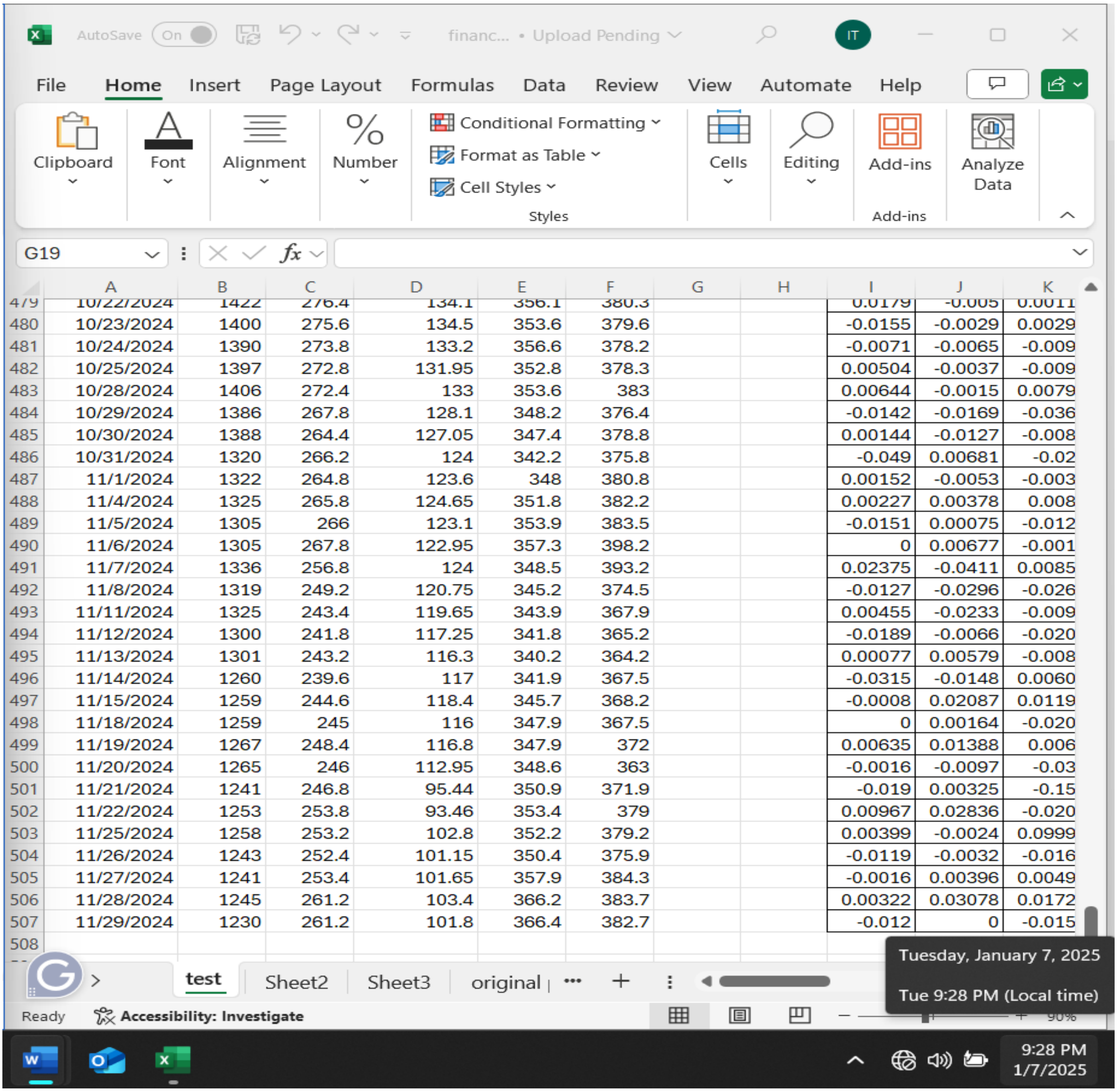
The data set has the closing values of all the firms for a period of 2 years and the data looks like Figure 1.1 in which the first column has all the dates starting from 30th November 2022 to 30th November 2024. The data are arranged in the order in which the oldest day comes first with the consecutive dates following it.



	A	B	C	D	E	F	I	J	K
1	Date	WH Smith	Sainsbury	JD Fashion	TESCO	M&S			Daily Retu
2	11/30/2022	1413	222.6	125.92	227.5	120.55	WH Smith	Sainsbury	JD fashi
3	12/1/2022	1407	222	127.868	228.7	122.55	-0.0042	-0.0027	0.0154
4	12/2/2022	1442.5	223.9	128.667	228.5	123.15	0.02523	0.00856	0.0062
5	12/5/2022	1453	225.4	128.517	230.1	122.25	0.00728	0.0067	-0.001
6	12/6/2022	1465	226.4	126.32	229	121.45	0.00826	0.00444	-0.017
7	12/7/2022	1447	225.9	126.02	228.3	122.2	-0.0123	-0.0022	-0.002
8	12/8/2022	1413	224.2	123.2	230.9	122.3	-0.0235	-0.0075	-0.022
9	12/9/2022	1446.5	226.4	122.9	227.9	123.05	0.02371	0.00981	-0.002
10	12/12/2022	1457.5	221.5	120.9	226.8	119.2	0.0076	-0.0216	-0.016
11	12/13/2022	1510	222.2	122.6	226.5	122.8	0.03602	0.00316	0.0140
12	12/14/2022	1537.5	220.5	121.6	225.7	121.9	0.01821	-0.0077	-0.008
13	12/15/2022	1500.5	218.3	118.95	223.5	120.4	-0.0241	-0.01	-0.021
14	12/16/2022	1457.5	217.9	118.1	222.3	118.8	-0.0287	-0.0018	-0.007
15	12/19/2022	1463	220.1	115.65	223.7	120.25	0.00377	0.0101	-0.020
16	12/20/2022	1437	220.5	113.25	224.4	121.2	-0.0178	0.00182	-0.020
17	12/21/2022	1487	221.8	120.15	226.9	122.9	0.03479	0.0059	0.0609
18	12/22/2022	1497.5	220.1	119.25	226.1	120.05	0.00706	-0.0077	-0.007
19	12/23/2022	1478	219.3	119.55	226.7	123.6	-0.013	-0.0036	0.0025
20	12/28/2022	1491.5	218.5	122.15	223.5	122.4	0.00913	-0.0036	0.0217
21	12/29/2022	1480	219.1	123.15	224.3	124.3	-0.0077	0.00275	0.0081
22	12/30/2022	1484.5	217.7	126.15	224.2	123.3	0.00304	-0.0064	0.0243
23	1/3/2023	1516	224.9	129.7	229	126.65	0.02122	0.03307	0.0281
24	1/4/2023	1553.5	235.7	135.25	235	131.65	0.02474	0.04802	0.0427
25	1/5/2023	1574	239.9	139.4	238.5	136.15	0.0132	0.01782	0.0306
26	1/6/2023	1578.5	243.6	142.55	241.4	137.55	0.00286	0.01542	0.022
27	1/9/2023	1566.5	247.1	140.6	243.2	141.1	-0.0076	0.01437	-0.013
28	1/10/2023	1579	245.8	140.9	242.1	141.3	0.00798	-0.0053	0.0021
29	1/11/2023	1574.5	241.9	150.75	243.7	143.4	-0.0028	-0.0159	0.0699

Figure 1.1

There are a total of 506 data to obtain the data to yield positive average returns. Figure 1.2



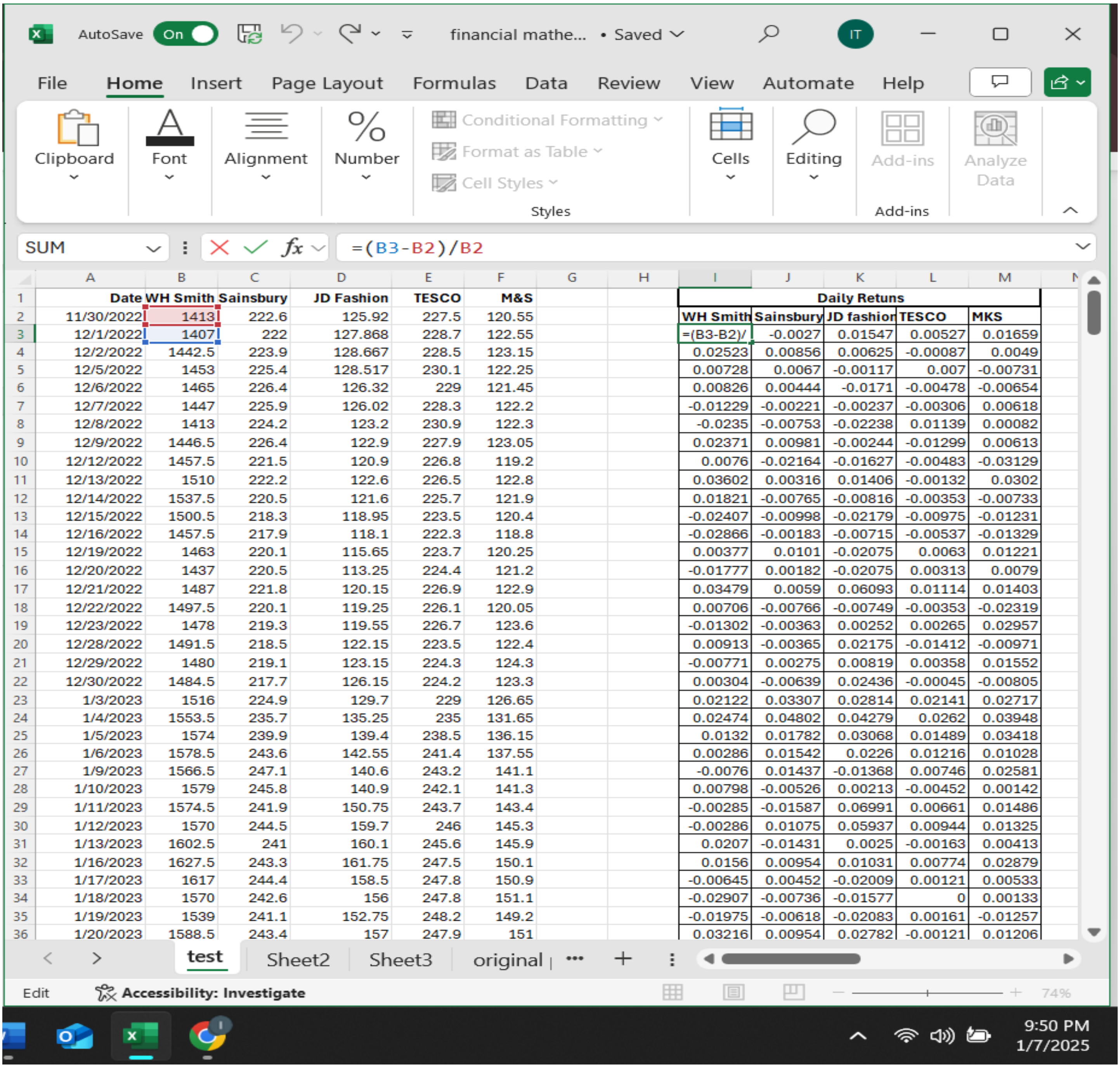
	A	B	C	D	E	F	G	H	I	J	K
479	10/22/2024	1422	276.4	134.1	356.1	380.3			0.0179	-0.005	0.0011
480	10/23/2024	1400	275.6	134.5	353.6	379.6			-0.0155	-0.0029	0.0029
481	10/24/2024	1390	273.8	133.2	356.6	378.2			-0.0071	-0.0065	-0.009
482	10/25/2024	1397	272.8	131.95	352.8	378.3			0.00504	-0.0037	-0.009
483	10/28/2024	1406	272.4	133	353.6	383			0.00644	-0.0015	0.0079
484	10/29/2024	1386	267.8	128.1	348.2	376.4			-0.0142	-0.0169	-0.036
485	10/30/2024	1388	264.4	127.05	347.4	378.8			0.00144	-0.0127	-0.008
486	10/31/2024	1320	266.2	124	342.2	375.8			-0.049	0.00681	-0.02
487	11/1/2024	1322	264.8	123.6	348	380.8			0.00152	-0.0053	-0.003
488	11/4/2024	1325	265.8	124.65	351.8	382.2			0.00227	0.00378	0.008
489	11/5/2024	1305	266	123.1	353.9	383.5			-0.0151	0.00075	-0.012
490	11/6/2024	1305	267.8	122.95	357.3	398.2			0	0.00677	-0.001
491	11/7/2024	1336	256.8	124	348.5	393.2			0.02375	-0.0411	0.0085
492	11/8/2024	1319	249.2	120.75	345.2	374.5			-0.0127	-0.0296	-0.026
493	11/11/2024	1325	243.4	119.65	343.9	367.9			0.00455	-0.0233	-0.009
494	11/12/2024	1300	241.8	117.25	341.8	365.2			-0.0189	-0.0066	-0.020
495	11/13/2024	1301	243.2	116.3	340.2	364.2			0.00077	0.00579	-0.008
496	11/14/2024	1260	239.6	117	341.9	367.5			-0.0315	-0.0148	0.0060
497	11/15/2024	1259	244.6	118.4	345.7	368.2			-0.0008	0.02087	0.0119
498	11/18/2024	1259	245	116	347.9	367.5			0	0.00164	-0.020
499	11/19/2024	1267	248.4	116.8	347.9	372			0.00635	0.01388	0.006
500	11/20/2024	1265	246	112.95	348.6	363			-0.0016	-0.0097	-0.03
501	11/21/2024	1241	246.8	95.44	350.9	371.9			-0.019	0.00325	-0.15
502	11/22/2024	1253	253.8	93.46	353.4	379			0.00967	0.02836	-0.020
503	11/25/2024	1258	253.2	102.8	352.2	379.2			0.00399	-0.0024	0.0999
504	11/26/2024	1243	252.4	101.15	350.4	375.9			-0.0119	-0.0032	-0.016
505	11/27/2024	1241	253.4	101.65	357.9	384.3			-0.0016	0.00396	0.0049
506	11/28/2024	1245	261.2	103.4	366.2	383.7			0.00322	0.03078	0.0172
507	11/29/2024	1230	261.2	101.8	366.4	382.7			-0.012	0	-0.015
508											

Figure 1.2

Average Daily Returns: After uploading the data into Excel, the next step is to find each day's returns using the formula

Daily Returns= (Present value = Future Value)/Future Value

from the original data shown in Figure 1.3. In this picture, the B3 represents the Present Value and the B2 is the future value. The same must be done for each day and separately for each company. This step will be used in calculating the Average Daily Returns and the Standard Deviation for all the companies.



=(B3-B2)/B2

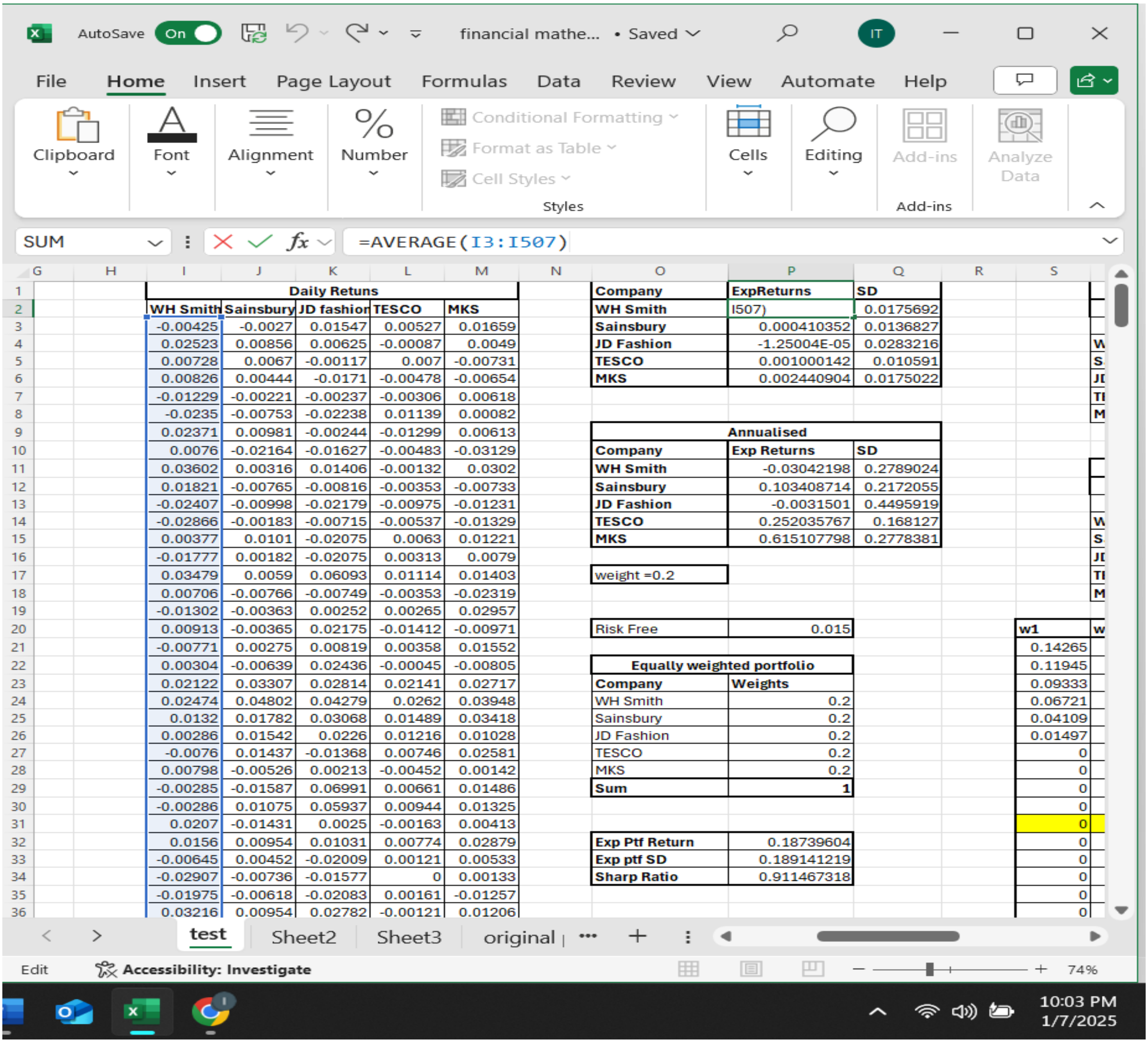
	A	B	C	D	E	F	I	J	K	L	M
1	Date	WH Smith	Sainsbury	JD Fashion	TESCO	M&S	Daily Retuns				
2	11/30/2022	1413	222.6	125.92	227.5	120.55	WH Smith	Sainsbury	JD fashion	TESCO	MKS
3	12/1/2022	1407	222	127.868	228.7	122.55	=(B3-B2)/	-0.0027	0.01547	0.00527	0.01659
4	12/2/2022	1442.5	223.9	128.667	228.5	123.15	0.02523	0.00856	0.00625	-0.00087	0.0049
5	12/5/2022	1453	225.4	128.517	230.1	122.25	0.00728	0.0067	-0.00117	0.007	-0.00731
6	12/6/2022	1465	226.4	126.32	229	121.45	0.00826	0.00444	-0.0171	-0.00478	-0.00654
7	12/7/2022	1447	225.9	126.02	228.3	122.2	-0.01229	-0.00221	-0.00237	-0.00306	0.00618
8	12/8/2022	1413	224.2	123.2	230.9	122.3	-0.0235	-0.00753	-0.02238	0.01139	0.00082
9	12/9/2022	1446.5	226.4	122.9	227.9	123.05	0.02371	0.00981	-0.00244	-0.01299	0.00613
10	12/12/2022	1457.5	221.5	120.9	226.8	119.2	0.0076	-0.02164	-0.01627	-0.00483	-0.03129
11	12/13/2022	1510	222.2	122.6	226.5	122.8	0.03602	0.00316	0.01406	-0.00132	0.0302
12	12/14/2022	1537.5	220.5	121.6	225.7	121.9	0.01821	-0.00765	-0.00816	-0.00353	-0.00733
13	12/15/2022	1500.5	218.3	118.95	223.5	120.4	-0.02407	-0.00998	-0.02179	-0.00975	-0.01231
14	12/16/2022	1457.5	217.9	118.1	222.3	118.8	-0.02866	-0.00183	-0.00715	-0.00537	-0.01329
15	12/19/2022	1463	220.1	115.65	223.7	120.25	0.00377	0.0101	-0.02075	0.0063	0.01221
16	12/20/2022	1437	220.5	113.25	224.4	121.2	-0.01777	0.00182	-0.02075	0.00313	0.0079
17	12/21/2022	1487	221.8	120.15	226.9	122.9	0.03479	0.0059	0.06093	0.01114	0.01403
18	12/22/2022	1497.5	220.1	119.25	226.1	120.05	0.00706	-0.00766	-0.00749	-0.00353	-0.02319
19	12/23/2022	1478	219.3	119.55	226.7	123.6	-0.01302	-0.00363	0.00252	0.00265	0.02957
20	12/28/2022	1491.5	218.5	122.15	223.5	122.4	0.00913	-0.00365	0.02175	-0.01412	-0.00971
21	12/29/2022	1480	219.1	123.15	224.3	124.3	-0.00771	0.00275	0.00819	0.00358	0.01552
22	12/30/2022	1484.5	217.7	126.15	224.2	123.3	0.00304	-0.00639	0.02436	-0.00045	-0.00805
23	1/3/2023	1516	224.9	129.7	229	126.65	0.02122	0.03307	0.02814	0.02141	0.02717
24	1/4/2023	1553.5	235.7	135.25	235	131.65	0.02474	0.04802	0.04279	0.0262	0.03948
25	1/5/2023	1574	239.9	139.4	238.5	136.15	0.0132	0.01782	0.03068	0.01489	0.03418
26	1/6/2023	1578.5	243.6	142.55	241.4	137.55	0.00286	0.01542	0.0226	0.01216	0.01028
27	1/9/2023	1566.5	247.1	140.6	243.2	141.1	-0.0076	0.01437	-0.01368	0.00746	0.02581
28	1/10/2023	1579	245.8	140.9	242.1	141.3	0.00798	-0.00526	0.00213	-0.00452	0.00142
29	1/11/2023	1574.5	241.9	150.75	243.7	143.4	-0.00285	-0.01587	0.06991	0.00661	0.01486
30	1/12/2023	1570	244.5	159.7	246	145.3	-0.00286	0.01075	0.05937	0.00944	0.01325
31	1/13/2023	1602.5	241	160.1	245.6	145.9	0.0207	-0.01431	0.0025	-0.00163	0.00413
32	1/16/2023	1627.5	243.3	161.75	247.5	150.1	0.0156	0.00954	0.01031	0.00774	0.02879
33	1/17/2023	1617	244.4	158.5	247.8	150.9	-0.00645	0.00452	-0.02009	0.00121	0.00533
34	1/18/2023	1570	242.6	156	247.8	151.1	-0.02907	-0.00736	-0.01577	0	0.00133
35	1/19/2023	1539	241.1	152.75	248.2	149.2	-0.01975	-0.00618	-0.02083	0.00161	-0.01257
36	1/20/2023	1588.5	243.4	157	247.9	151	0.03216	0.00954	0.02782	-0.00121	0.01206

Figure 1.2

Average Expected Return:

After calculating the daily returns for all the companies, the next step is to find the Average Expected Returns, which is the average of the daily returns of each company. The formula used to calculate the Average expected return is by using the **AVERAGE** function from the Excel. The next step would be to select the daily returns, and it will give an output with the Average Expected Return. Figure 1.3. The same process has to be repeated with each company to obtain the average expected return of each company, which then has to be annualized. To annualize data it has to be multiplied by 252 which is the total number of working days in a year excluding all the bank holidays. The formula for annualized expected return would be

Annualised Expected Return = Average Expected Return * 252



	WH Smith	Sainsbury	JD fashion	TESCO	MKS
3	-0.00425	-0.0027	0.01547	0.00527	0.01659
4	0.02523	0.00856	0.00625	-0.00087	0.0049
5	0.00728	0.0067	-0.00117	0.007	-0.00731
6	0.00826	0.00444	-0.0171	-0.00478	-0.00654
7	-0.01229	-0.00221	-0.00237	-0.00306	0.00618
8	-0.0235	-0.00753	-0.02238	0.01139	0.00082
9	0.02371	0.00981	-0.00244	-0.01299	0.00613
10	0.0076	-0.02164	-0.01627	-0.00483	-0.03129
11	0.03602	0.00316	0.01406	-0.00132	0.0302
12	0.01821	-0.00765	-0.00816	-0.00353	-0.00733
13	-0.02407	-0.00998	-0.02179	-0.00975	-0.01231
14	-0.02866	-0.00183	-0.00715	-0.00537	-0.01329
15	0.00377	0.0101	-0.02075	0.0063	0.01221
16	-0.01777	0.00182	-0.02075	0.00313	0.0079
17	0.03479	0.0059	0.06093	0.01114	0.01403
18	0.00706	-0.00766	-0.00749	-0.00353	-0.02319
19	-0.01302	-0.00363	0.00252	0.00265	0.02957
20	0.00913	-0.00365	0.02175	-0.01412	-0.00971
21	-0.00771	0.00275	0.00819	0.00358	0.01552
22	0.00304	-0.00639	0.02436	-0.00045	-0.00805
23	0.02122	0.03307	0.02814	0.02141	0.02717
24	0.02474	0.04802	0.04279	0.0262	0.03948
25	0.0132	0.01782	0.03068	0.01489	0.03418
26	0.00286	0.01542	0.0226	0.01216	0.01028
27	-0.0076	0.01437	-0.01368	0.00746	0.02581
28	0.00798	-0.00526	0.00213	-0.00452	0.00142
29	-0.00285	-0.01587	0.06991	0.00661	0.01486
30	-0.00286	0.01075	0.05937	0.00944	0.01325
31	0.0207	-0.01431	0.0025	-0.00163	0.00413
32	0.0156	0.00954	0.01031	0.00774	0.02879
33	-0.00645	0.00452	-0.02009	0.00121	0.00533
34	-0.02907	-0.00736	-0.01577	0	0.00133
35	-0.01975	-0.00618	-0.02083	0.00161	-0.01257
36	0.03216	0.00954	0.02782	-0.00121	0.01206

Company	ExpReturns	SD
WH Smith	I507)	0.0175692
Sainsbury	0.000410352	0.0136827
JD Fashion	-1.25004E-05	0.0283216
TESCO	0.001000142	0.010591
MKS	0.002440904	0.0175022

Annualised		
Company	Exp Returns	SD
WH Smith	-0.03042198	0.2789024
Sainsbury	0.103408714	0.2172055
JD Fashion	-0.0031501	0.4495919
TESCO	0.252035767	0.168127
MKS	0.615107798	0.2778381

weight =0.2

Risk Free	0.015

Equally weighted portfolio	
Company	Weights
WH Smith	0.2
Sainsbury	0.2
JD Fashion	0.2
TESCO	0.2
MKS	0.2
Sum	1

Exp Ptf Return	0.18739604
Exp ptf SD	0.189141219
Sharp Ratio	0.911467318

w1
0.14265
0.11945
0.09333
0.06721
0.04109
0.01497
0
0
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0
0
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0

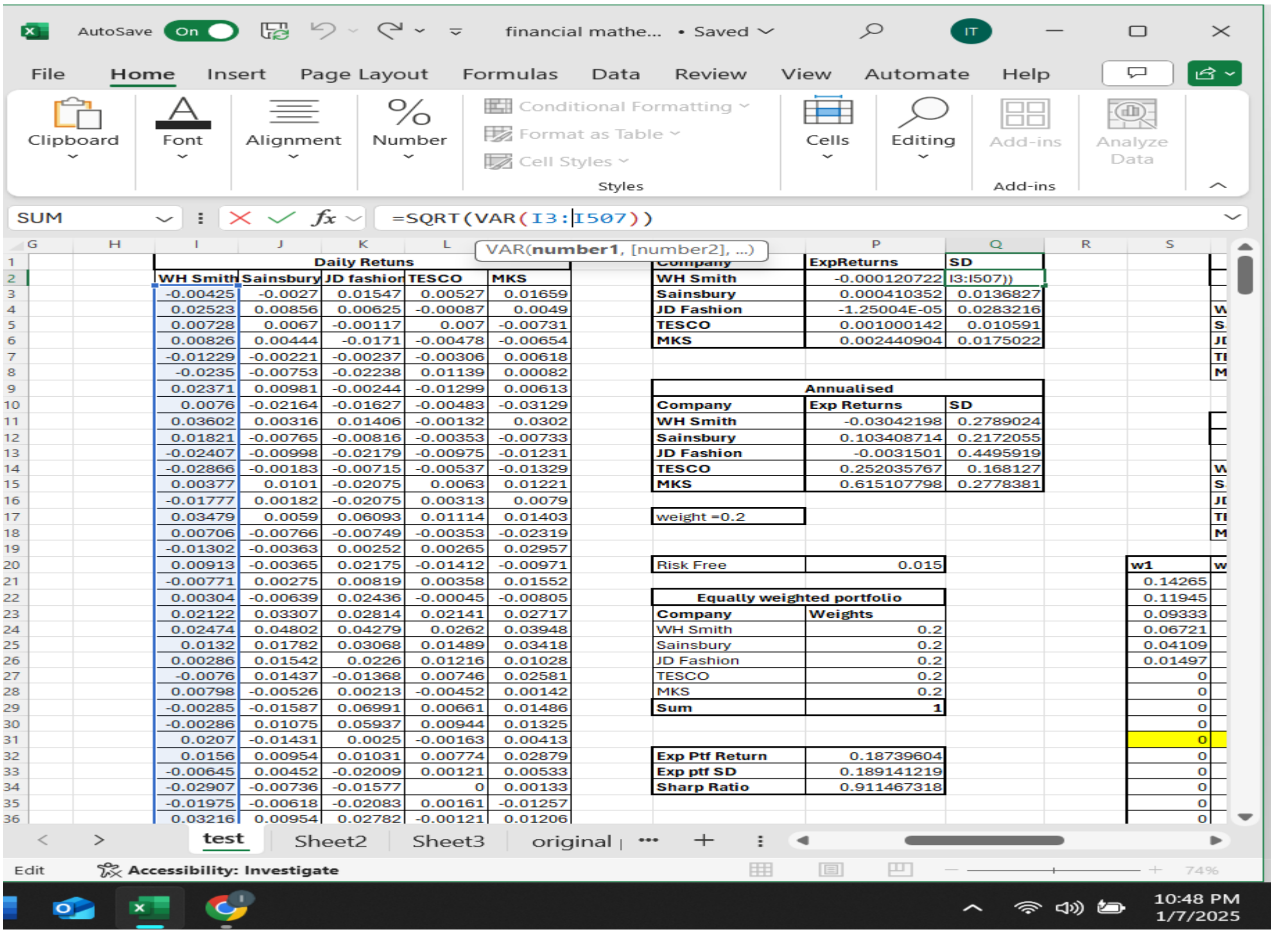
Figure 1.3

Standard Deviation:

The next step would be to calculate the Standard deviation which is the squared root of the variance. For calculating first, we have to find the variance in Excel by using the function VAR with the values of the respective daily returns of the company. After finding the variance the next step would be to calculate the standard deviation by square rooting the variance by using SQRT of the variance. Figure 1.5. The final formula for finding the standard deviation would be

Standard Deviation (SD) = SQRT (VAR(Daily Returns)

After calculating the SD we have to annualize the results to get the Annualised Standard Deviation by multiplying the SD with the squared root of 252.Figure 1.6



	Daily Retuns				
2	WH Smith	Sainsbury	JD fashion	TESCO	MKS
3	-0.00425	-0.0027	0.01547	0.00527	0.01659
4	0.02523	0.00856	0.00625	-0.00087	0.0049
5	0.00728	0.0067	-0.00117	0.007	-0.00731
6	0.00826	0.00444	-0.0171	-0.00478	-0.00654
7	-0.01229	-0.00221	-0.00237	-0.00306	0.00618
8	-0.0235	-0.00753	-0.02238	0.01139	0.00082
9	0.02371	0.00981	-0.00244	-0.01299	0.00613
10	0.0076	-0.02164	-0.01627	-0.00483	-0.03129
11	0.03602	0.00316	0.01406	-0.00132	0.0302
12	0.01821	-0.00765	-0.00816	-0.00353	-0.00733
13	-0.02407	-0.00998	-0.02179	-0.00975	-0.01231
14	-0.02866	-0.00183	-0.00715	-0.00537	-0.01329
15	0.00377	0.0101	-0.02075	0.0063	0.01221
16	-0.01777	0.00182	-0.02075	0.00313	0.0079
17	0.03479	0.0059	0.06093	0.01114	0.01403
18	0.00706	-0.00766	-0.00749	-0.00353	-0.02319
19	-0.01302	-0.00363	0.00252	0.00265	0.02957
20	0.00913	-0.00365	0.02175	-0.01412	-0.00971
21	-0.00771	0.00275	0.00819	0.00358	0.01552
22	0.00304	-0.00639	0.02436	-0.00045	-0.00805
23	0.02122	0.03307	0.02814	0.02141	0.02717
24	0.02474	0.04802	0.04279	0.0262	0.03948
25	0.0132	0.01782	0.03068	0.01489	0.03418
26	0.00286	0.01542	0.0226	0.01216	0.01028
27	-0.0076	0.01437	-0.01368	0.00746	0.02581
28	0.00798	-0.00526	0.00213	-0.00452	0.00142
29	-0.00285	-0.01587	0.06991	0.00661	0.01486
30	-0.00286	0.01075	0.05937	0.00944	0.01325
31	0.0207	-0.01431	0.0025	-0.00163	0.00413
32	0.0156	0.00954	0.01031	0.00774	0.02879
33	-0.00645	0.00452	-0.02009	0.00121	0.00533
34	-0.02907	-0.00736	-0.01577	0	0.00133
35	-0.01975	-0.00618	-0.02083	0.00161	-0.01257
36	0.03216	0.00954	0.02782	-0.00121	0.01206

Company	ExpReturns	SD
WH Smith	-0.000120722	I3:I507))
Sainsbury	0.000410352	0.0136827
JD Fashion	-1.25004E-05	0.0283216
TESCO	0.001000142	0.010591
MKS	0.002440904	0.0175022

Annualised		
Company	Exp Returns	SD
WH Smith	-0.03042198	0.2789024
Sainsbury	0.103408714	0.2172055
JD Fashion	-0.0031501	0.4495919
TESCO	0.252035767	0.168127
MKS	0.615107798	0.2778381

weight =0.2

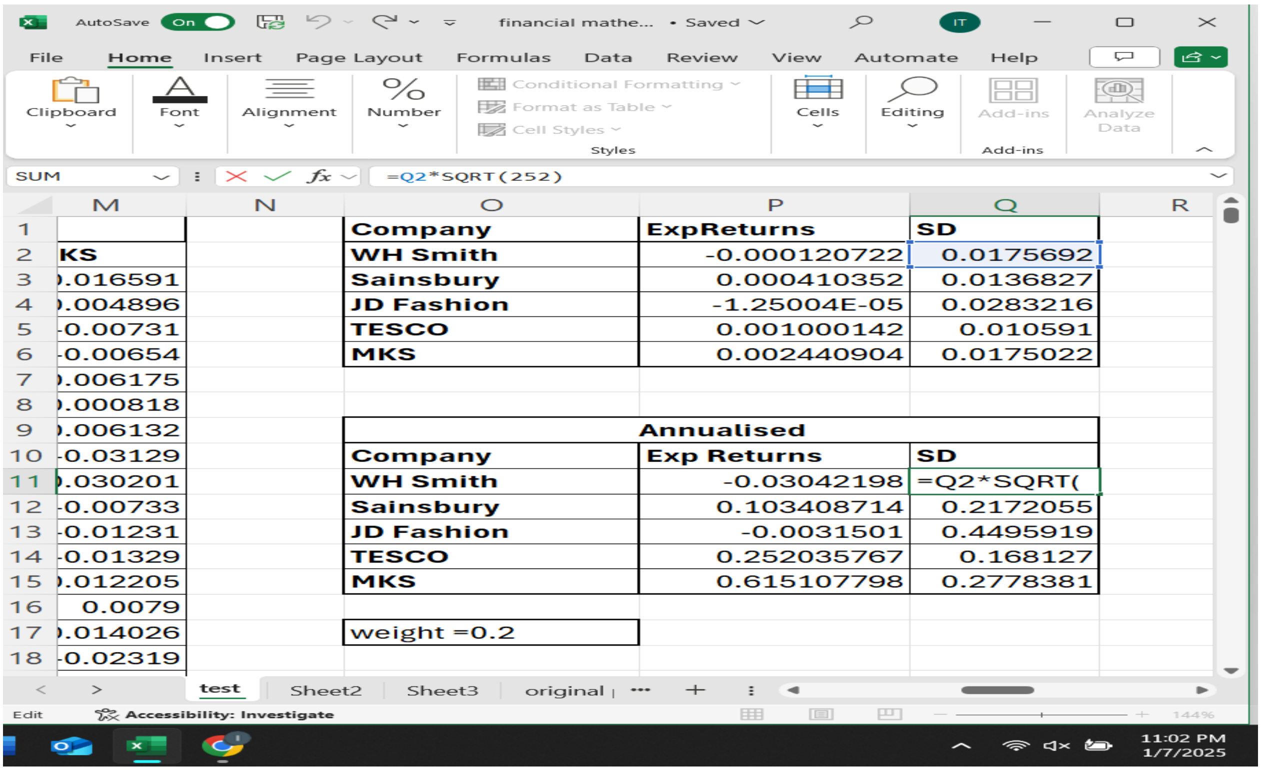
Risk Free	0.015

Equally weighted portfolio	
Company	Weights
WH Smith	0.2
Sainsbury	0.2
JD Fashion	0.2
TESCO	0.2
MKS	0.2
Sum	1

Exp Ptf Return	0.18739604
Exp ptf SD	0.189141219
Sharp Ratio	0.911467318

w1
0.14265
0.11945
0.09333
0.06721
0.04109
0.01497
0
0
0
0
0
0
0
0
0
0

Figure 1.5



Company	ExpReturns	SD
WH Smith	-0.000120722	0.0175692
Sainsbury	0.000410352	0.0136827
JD Fashion	-1.25004E-05	0.0283216
TESCO	0.001000142	0.010591
MKS	0.002440904	0.0175022

Annualised		
Company	Exp Returns	SD
WH Smith	-0.03042198	=Q2*SQRT(
Sainsbury	0.103408714	0.2172055
JD Fashion	-0.0031501	0.4495919
TESCO	0.252035767	0.168127
MKS	0.615107798	0.2778381

weight =0.2

Figure 1.6

Correlation Matrix:

The correlation matrix has been calculated to find the correlation that the different assets have with each other. This was calculated using the **data analysis** function from the **data** section in Excel. After the selection of the **correlation** function the input should be the daily return of all the companies together will automatically give output in a matrix format. Figure 1.7 The 1s in the matrix format indicated a perfect correlation(where a stock correlates with itself). Since all the values have a positive value this means that all the assets have a positive correlation with each other, this also means that all the assets are moving in the same direction. High positive correlations (0.6) suggest that including both stocks in a portfolio may not provide much diversification benefit, as they are likely to move together. Low or negative correlations can improve diversification, as they indicate that the stocks do not move together, potentially reducing overall portfolio risk.

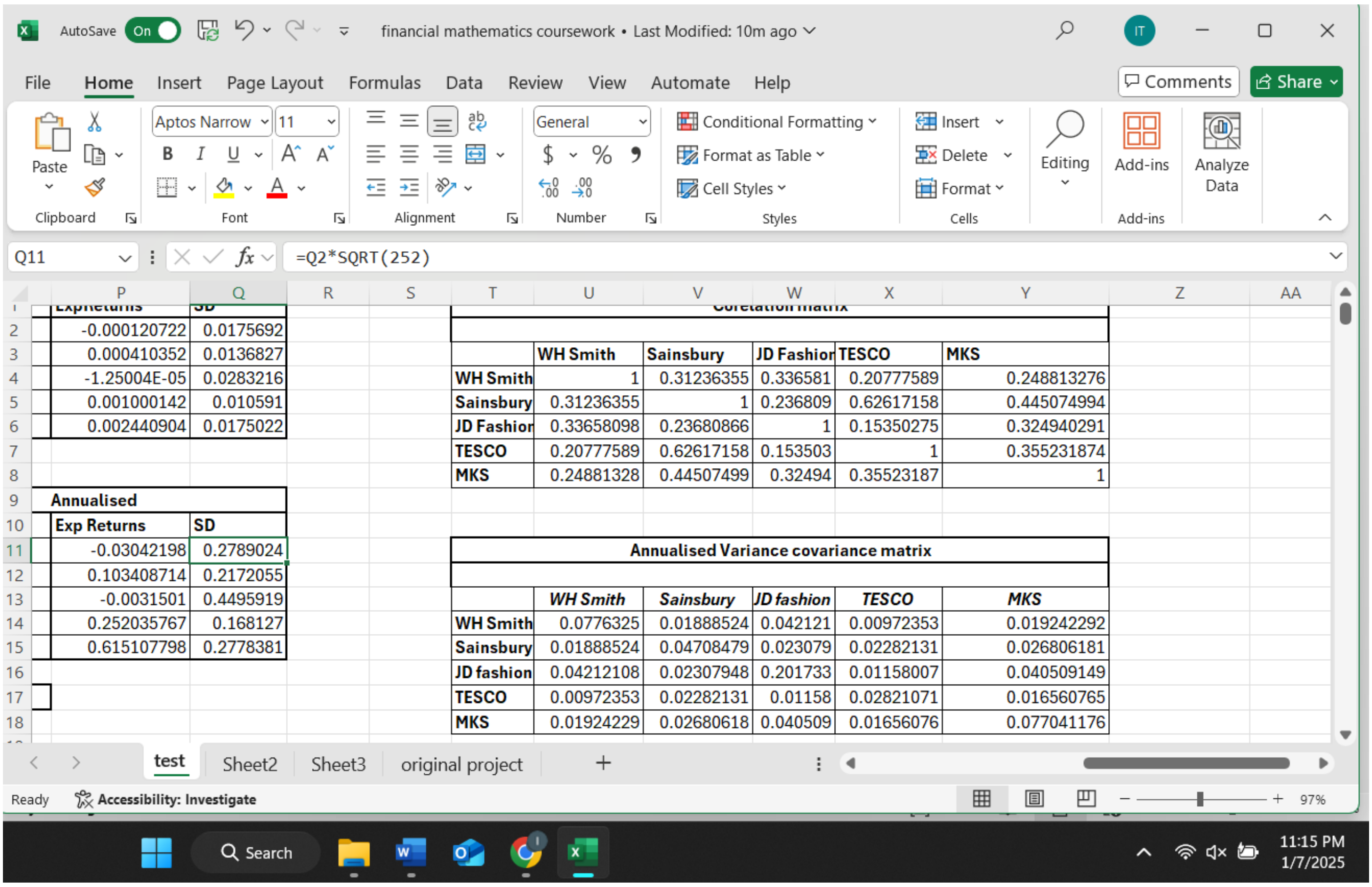


Figure 1.7

Covariance variance matrix: The covariance variance matrix is calculated to find the stock movement and the risk or volatility of each asset over the given period. The values tell how each stock deviates from its mean over time. Figure 1.8 By analysing the covariance variance matrix it can be observed that the variance (diagonal elements) of JD Fashion has shown very high volatility (0.2017) indicating that it is very risky followed by WH Smith (0.0776), MKS(0.0770), and Sainsbury and Tesco showed lower volatility which means lower risk. While the covariance of the assets (off-diagonal elements) shows that WH Smith and Sainsbury(0.0189) have positive covariance which means they are likely to move in the same direction,Covariance between JD fashion and Tesco(0.0116) shows less positive covariance which means they will move together but they will not have a strong relationship. Next would be the Sainsbury and MKS(0.0268) suggests that they have a moderate relationship, while

JD Fashion and WH Smith(0.0421) have more positive covariance and have higher chances of moving together. Thus through the covariance variance matrix, it can be said that JD Fashion & WH Smith and Sainsbury & MKS have higher positive covariance and are more likely to move together in the same direction while Tesco& JD Fashion and Tesco and WH Smith have lower positive covariance which suggests that they are less likely to follow each other's movements.

Annualised Variance covariance matrix

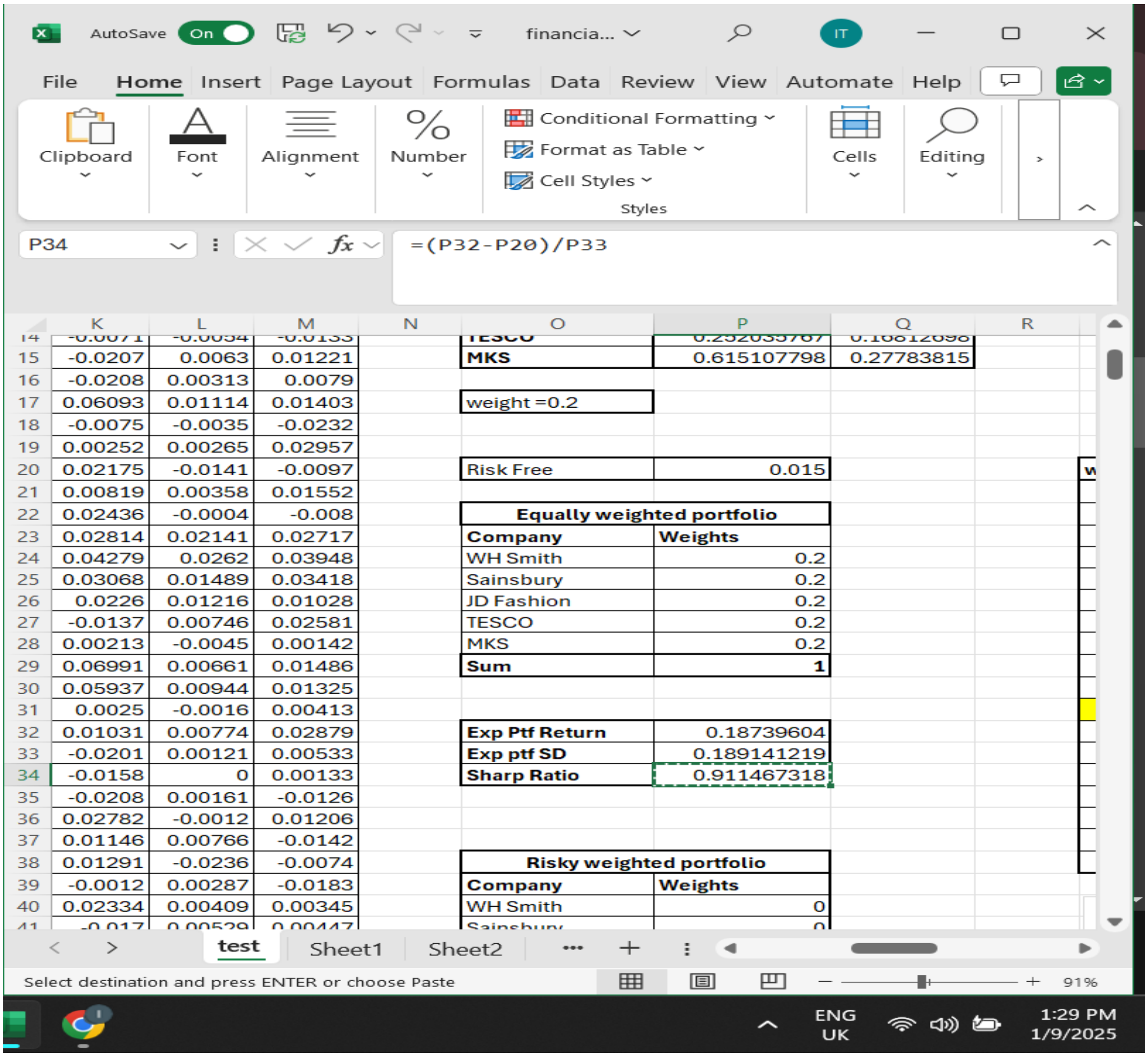
	WH Smith	Sainsbury	JD fashion	TESCO	MKS
WH Smith	0.077632501	0.018885237	0.0421211	0.00972353	0.01924229
Sainsbury	0.018885237	0.047084787	0.0230795	0.022821315	0.02680618
JD fashion	0.042121076	0.023079479	0.2017327	0.011580072	0.04050914
TESCO	0.00972353	0.022821315	0.0115801	0.028210709	0.01656076
MKS	0.019242292	0.026806181	0.0405091	0.016560765	0.07704117

w1	w2	w3	w4	w5	SD	Returns
0.14265	0	0.003528662	0.690884083	0.1629362	0.154201796	0.2
0.11945	0	0	0.683054408	0.1974936	0.15568356	0.2
0.09333	0	0	0.674408573	0.2322589	0.157827633	0.3
0.06721	0	0	0.665762964	0.2670242	0.160614774	0.3
0.04109	0	0	0.657117296	0.3017895	0.164012202	0.3
0.01497	0	0	0.648471681	0.3365548	0.16798289	0.3
0	0	0	0.620008638	0.3799914	0.172545943	0.3
0	0	0	0.564923149	0.4350768	0.178121185	0.4
0	0	0	0.509837671	0.4901623	0.18471588	0.4

Figure 1.8

To find the portfolio risk the first step would be to find the risk-free rate which here is 1.5% as given is the question, which would lead to distributing weights equally to fir find the equally weighted portfolio moving forward with the Risky weighted portfolio which will give the weights on each assets for a target return

<u>Equally weighted Portfolio:</u> To find the equally weighted portfolio, each company should be assigned with equal weights which should sum up to 1 so that the portfolio is equally diversified. Figure 1.8. The weight for each asset is 0.2.



. Figure 1.8.

The expected portfolio return would be calculated with the formulae

Expected portfolio Return= MMULT(transpose(Weights),Annualised expected return)

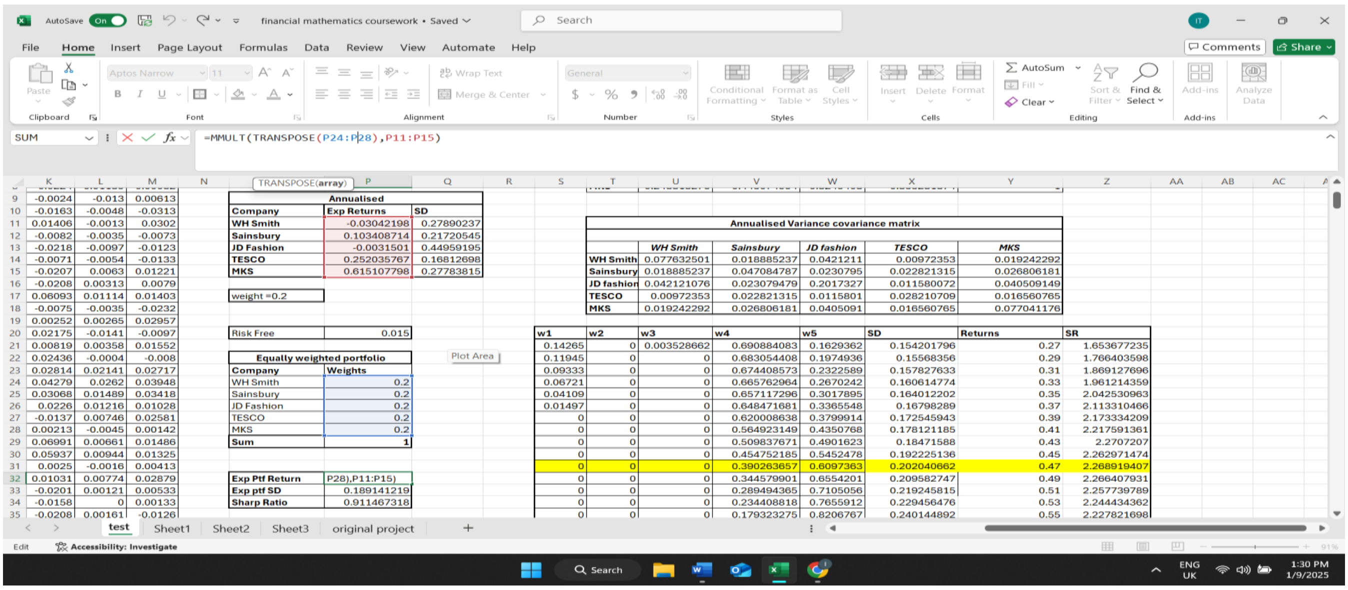


Figure 1.9

This would give us the expected portfolio return which is 0.18739604, (Figure 1.8,)then the SD for the portfolio is calculated using the formula

SD for the portfolio= Sqrt(MMULT(MMULT(TRANSPOSE(Weights),Covariance variance matrix), Weights))

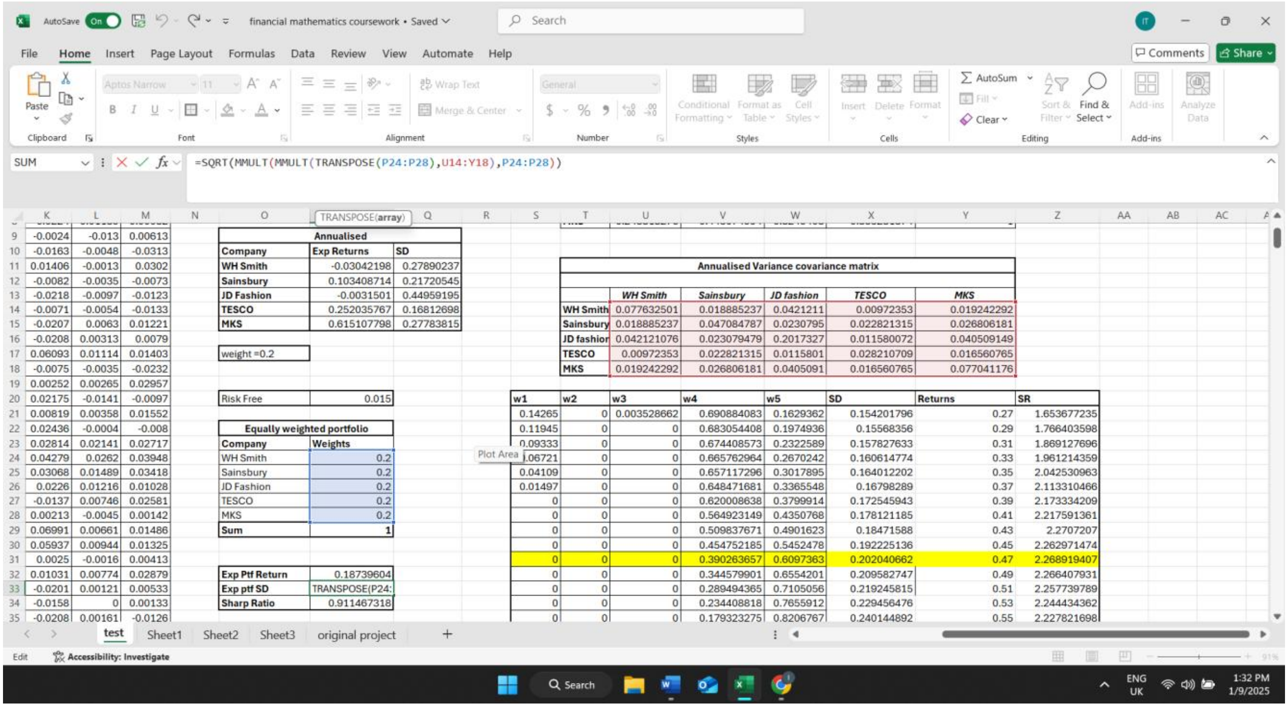


Figure 2.1

This will give the SD for the equally weighted portfolio which would be 0.189141219.(Figure 2.1) Finally, the sharp ratio is calculated by using the formula to give 0.911467318

Sharp Ratio= (Expected Return-Risk Free Rate)/SD

This will give the Sharp Ratio for the equally weighted portfolio which is 0.911467318(Figure 2.2)

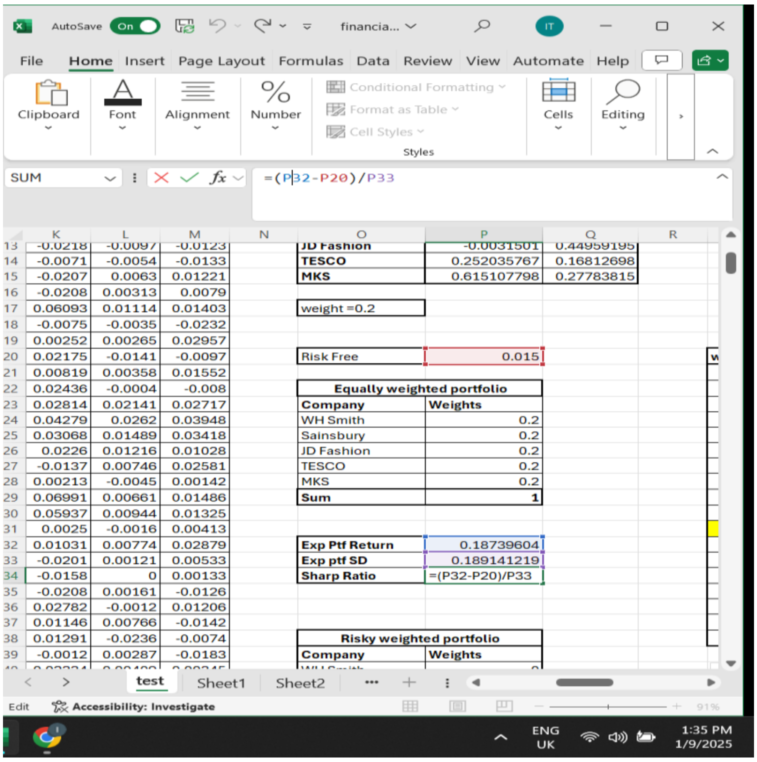


Figure 2.2

Risky Weighted portfolio: At first same steps as the equally weighted portfolio should be followed, after calculating the SR then we go ahead to use the solver function in the EXCEL to determine the portfolio risk and the percentage of investment in each asset by updating or increasing the expected return of the risky weighted portfolio. After doing if a couple of times, we get a series of instances with different weights and Sharp ratios. Among the series of instances, the one with the highest sharp ratio is highlighted and is used as the optimal market portfolio risk. So the optimal portfolio risk would be(Figure 2.3):

WH Smith:0

Sainsbury: 0

JD Fashion:0

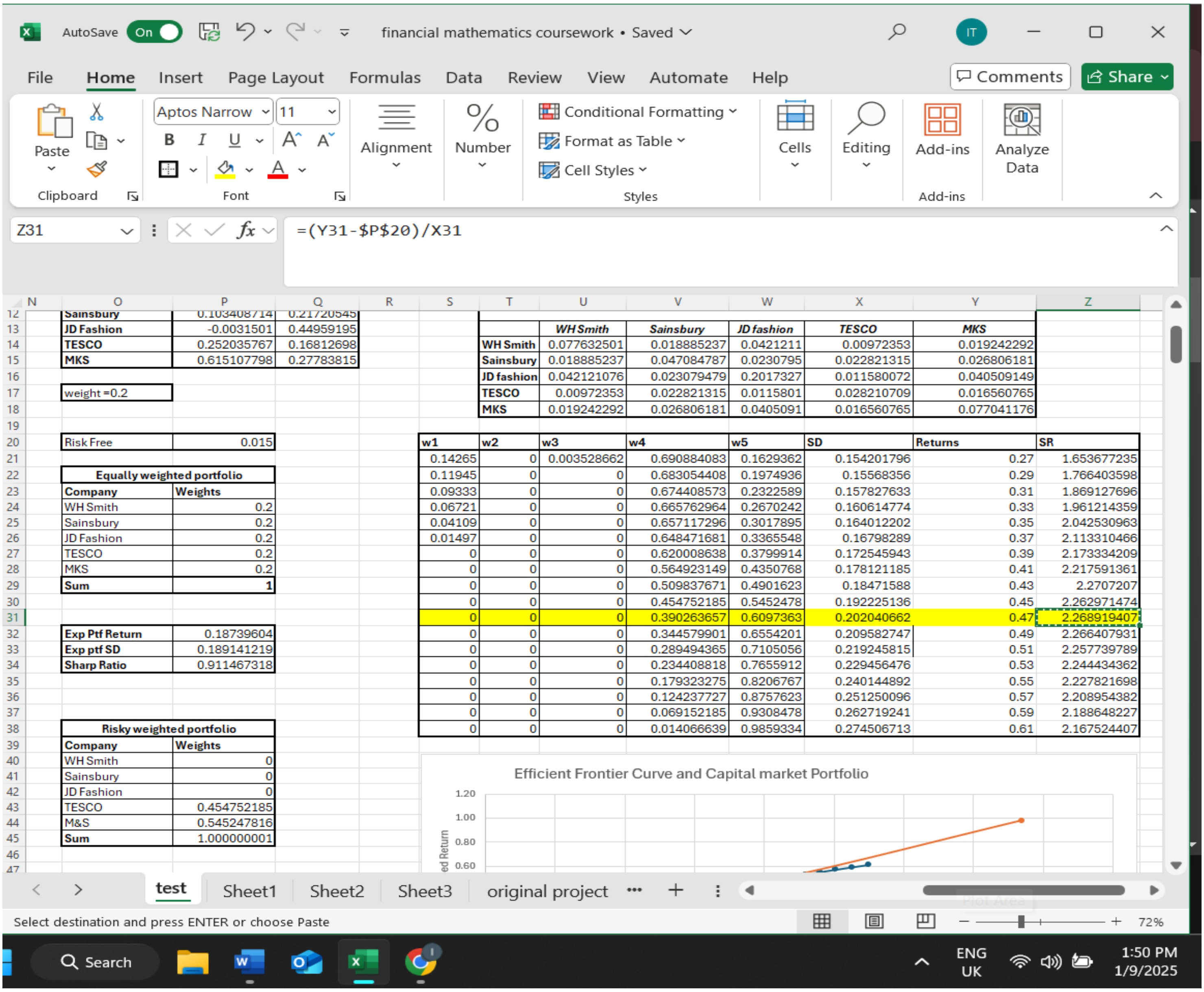
Tesco:0.39

MKS:0.61

Expected Return: 0.47

SD:0.202040662

Sharp ratio:2.268919407



Z31 =(Y31-P20)/X31

Sainsbury	0.103408714	0.21720545
JD Fashion	-0.0031501	0.44959195
TESCO	0.252035767	0.16812698
MKS	0.615107798	0.27783815

weight =0.2

Risk Free	0.015

Equally weighted portfolio	
Company	Weights
WH Smith	0.2
Sainsbury	0.2
JD Fashion	0.2
TESCO	0.2
MKS	0.2
Sum	1

Exp Ptf Return	0.18739604
Exp ptf SD	0.189141219
Sharp Ratio	0.911467318

Risky weighted portfolio	
Company	Weights
WH Smith	0
Sainsbury	0
JD Fashion	0
TESCO	0.454752185
M&S	0.545247816
Sum	1.000000001

	WH Smith	Sainsbury	JD fashion	TESCO	MKS
WH Smith	0.077632501	0.018885237	0.0421211	0.00972353	0.019242292
Sainsbury	0.018885237	0.047084787	0.0230795	0.022821315	0.026806181
JD fashion	0.042121076	0.023079479	0.2017327	0.011580072	0.040509149
TESCO	0.00972353	0.022821315	0.0115801	0.028210709	0.016560765
MKS	0.019242292	0.026806181	0.0405091	0.016560765	0.077041176

w1	w2	w3	w4	w5	SD	Returns	SR
0.14265	0	0.003528662	0.690884083	0.1629362	0.154201796	0.27	1.653677235
0.11945	0	0	0.683054408	0.1974936	0.15568356	0.29	1.766403598
0.09333	0	0	0.674408573	0.2322589	0.157827633	0.31	1.869127696
0.06721	0	0	0.665762964	0.2670242	0.160614774	0.33	1.961214359
0.04109	0	0	0.657117296	0.3017895	0.164012202	0.35	2.042530963
0.01497	0	0	0.648471681	0.3365548	0.16798289	0.37	2.113310466
0	0	0	0.620008638	0.3799914	0.172545943	0.39	2.173334209
0	0	0	0.564923149	0.4350768	0.178121185	0.41	2.217591361
0	0	0	0.509837671	0.4901623	0.18471588	0.43	2.2707207
0	0	0	0.454752185	0.5452478	0.192225136	0.45	2.262971474
0	0	0	0.390263657	0.6097363	0.202040662	0.47	2.268919407
0	0	0	0.344579901	0.6554201	0.209582747	0.49	2.266407931
0	0	0	0.289494365	0.7105056	0.219245815	0.51	2.257739789
0	0	0	0.234408818	0.7655912	0.229456476	0.53	2.244434362
0	0	0	0.179323275	0.8206767	0.240144892	0.55	2.227821698
0	0	0	0.124237727	0.8757623	0.251250096	0.57	2.208954382
0	0	0	0.069152185	0.9308478	0.262719241	0.59	2.188648227
0	0	0	0.014066639	0.9859334	0.274506713	0.61	2.167524407

Figure 2.3

Efficient Frontier Curve: The efficient frontier curve that has been obtained by using the SD and the expected returns into a graph and choosing a scatter plot to mark the points. It shows the portfolio of assets that give the highest return for a given level of risk. The curve with the blue dots starts steep but flattens as the risk increases. The curve shows the best possible portfolios of assets which means any portfolio below the curve would not be good. The x axis shows the Standard Deviation and the Y axis shows the Expected return from the instances created by the solver. (Figure 2.4)

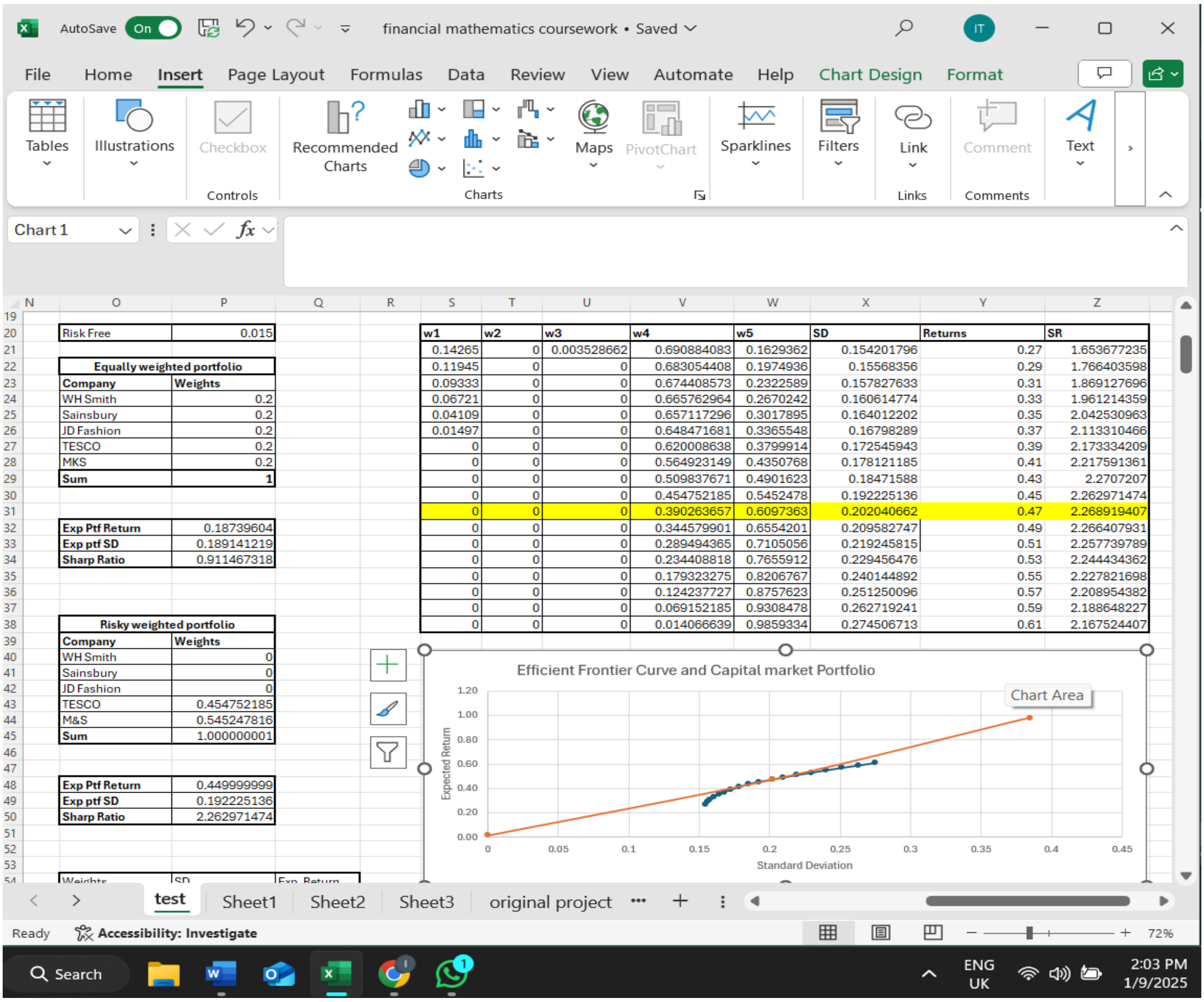


Figure2.4

Capital Market Line: The capital market line is calculated to allow investors to combine risk-free investments with their risky portfolio. Here the CML starts with risk-free rate which is 0.015. The orange line represents the CML. Any portfolio on the orange line is better than those on the blue curve because it gives a higher return for the same level of risk.(Figure 2.5). The points for CML are obtained by creating a table of weights starting from 0 to 3 with Standard Deviation and Expected Returns.

The formula to find the Standard Deviation is **Standard Deviation= Weight*SD of the optimal market portfolio,** then the Expected return for the capital market line is calculated with the formula **Expected Return= Weights * Expected Return of optimal market portfolio (1-weights) *risk-free rate.** This has to be done for all the weights used to calculate the Capital market line which will give us the points for plotting it on the efficient frontier graph. (Figure 2.5). The point at which the CML and the efficient frontier curve meet is called the market portfolio, The CML shows the best combinations of risky assets and risk-free investments, offering higher returns for the same risk than the efficient frontier.

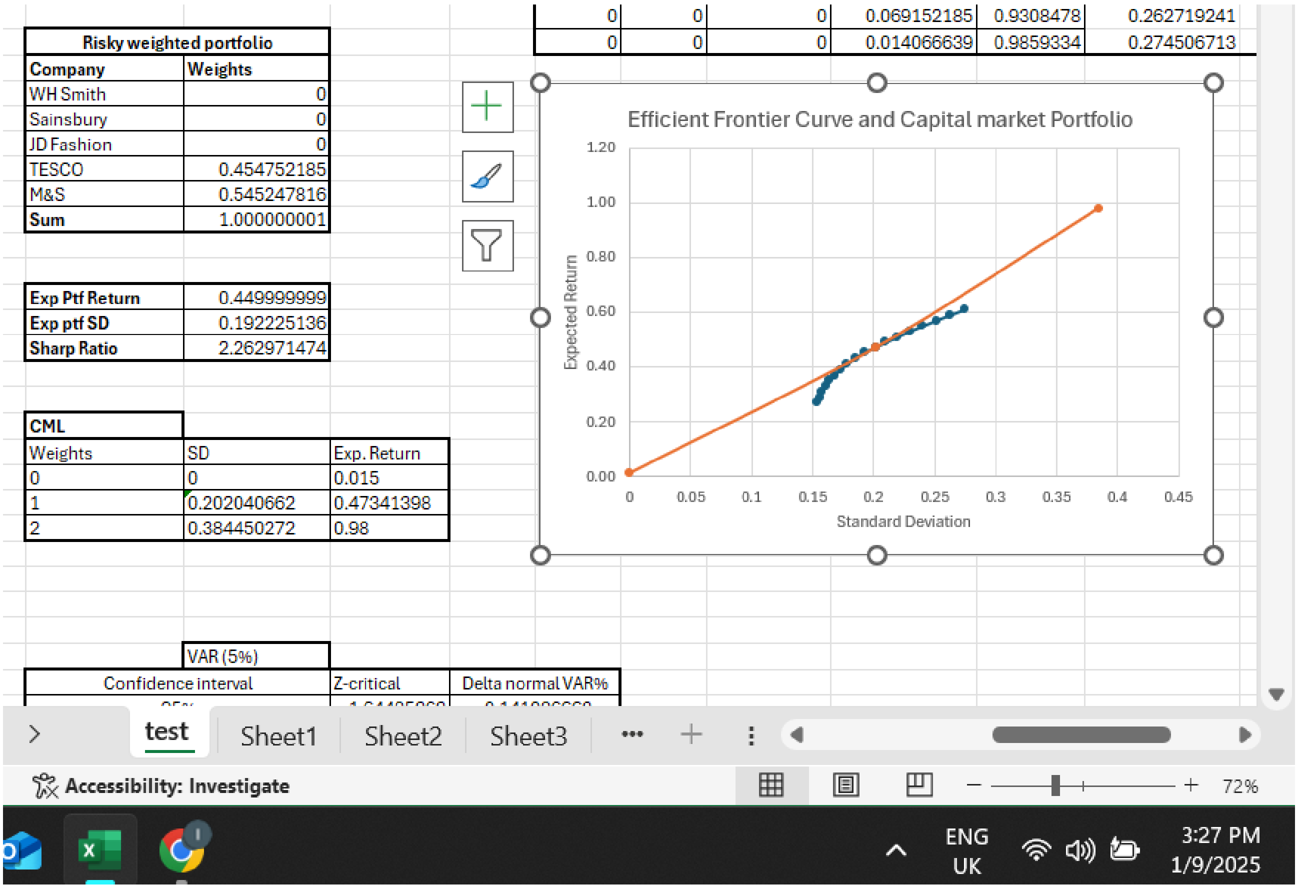


Figure 2.5

Beta using linear regression: To calculate the beta first step would be to download the data for the same date range of FTSE 100 to provide as a benchmark to represent the overall market . The daily returns for FTSE 100 has to be calculated in the same way as for others and then use the data analysis function to calculate the beta for each assts individually. The fuction asks for x and y input where the y input would be the daily returns of the Benchmark i.e., FTSE 100 and the x input would be the daily return of a individual asset.The output will have a range of data including the regression statistics, Anova and many more but the beta is found under the co-efficient section marked under X variable 1.Below are the beta for some of the assets used in this coursework.

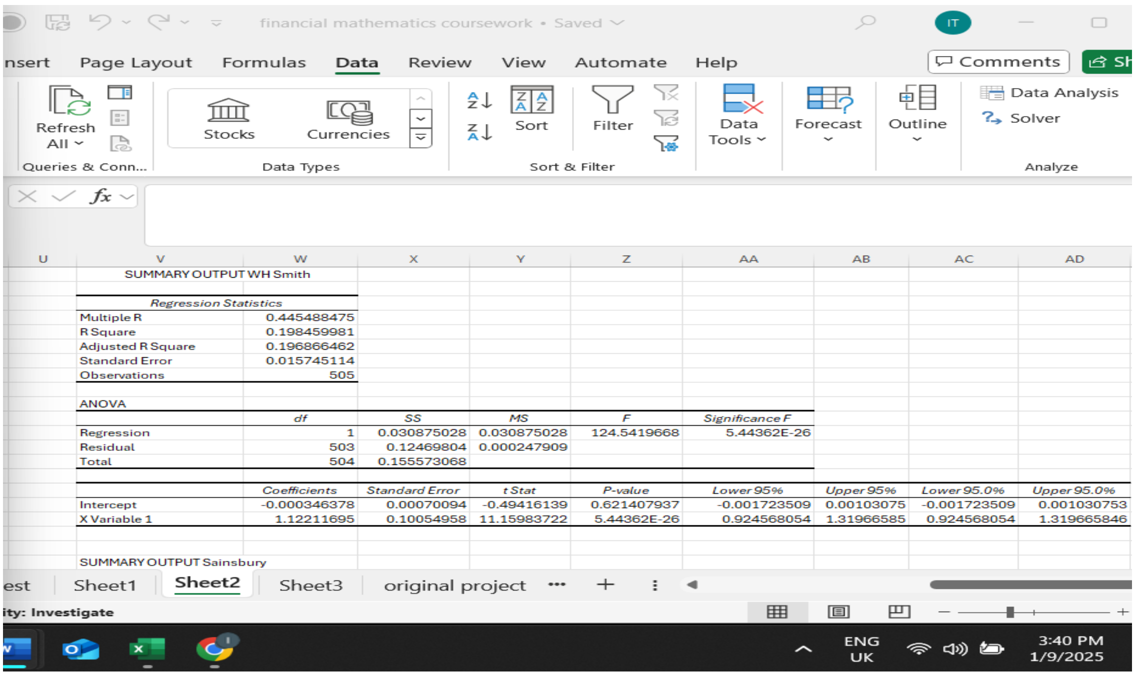
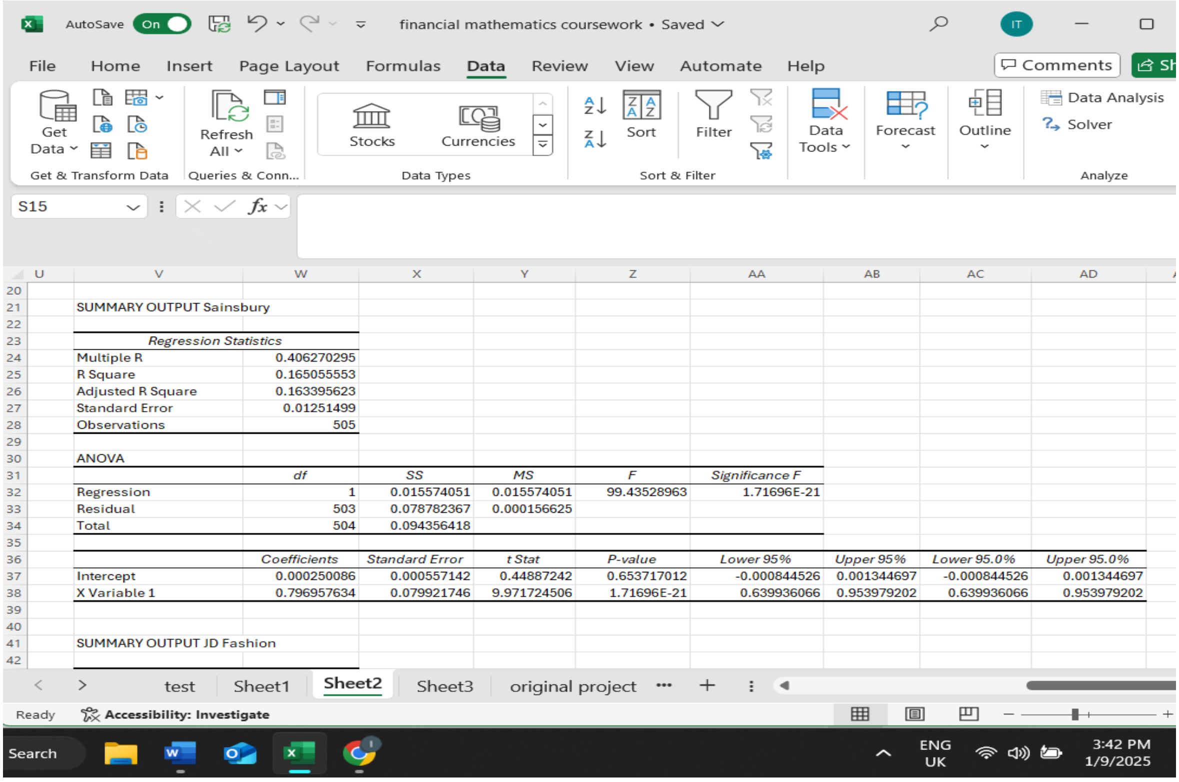


Figure 2.6-Beta for WH Smith



SUMMARY OUTPUT Sainsbury

Regression Statistics	
Multiple R	0.406270295
R Square	0.165055553
Adjusted R Square	0.163395623
Standard Error	0.01251499
Observations	505

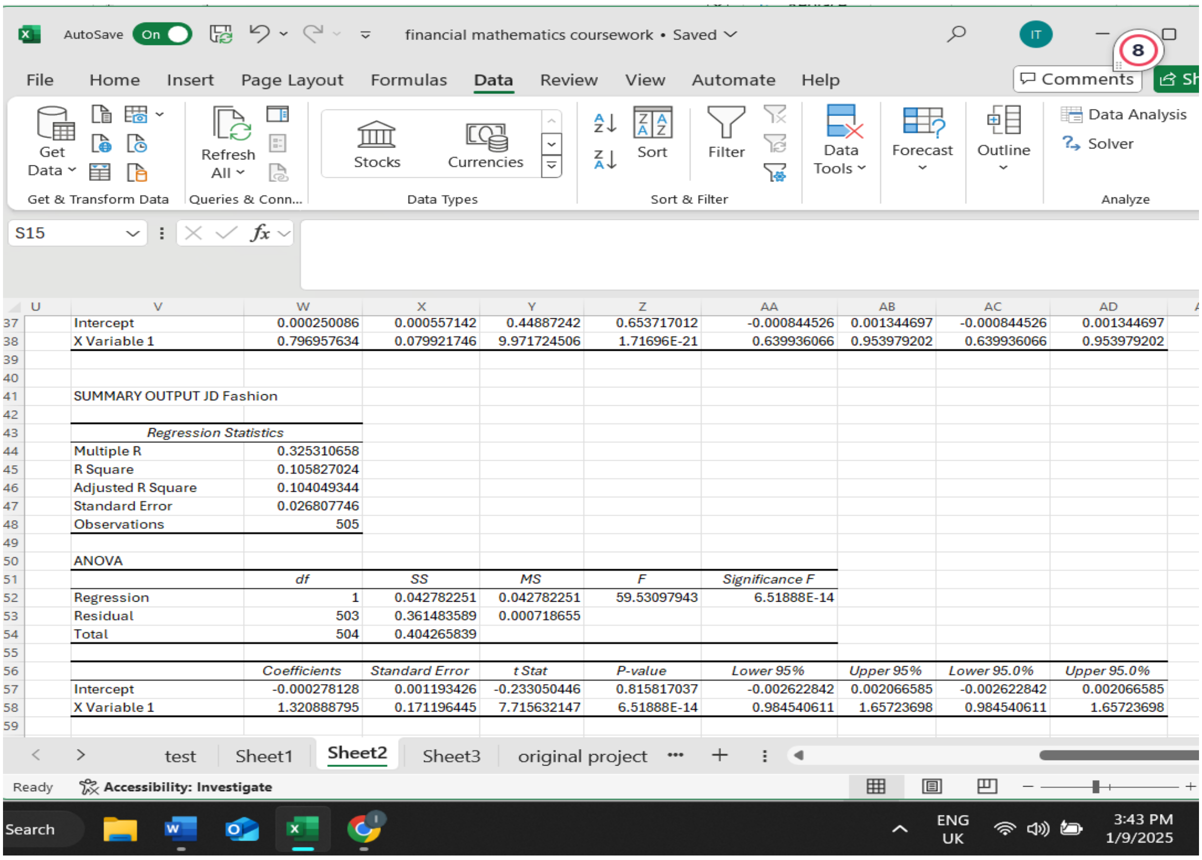
ANOVA

	df	SS	MS	F	Significance F
Regression	1	0.015574051	0.015574051	99.43528963	1.71696E-21
Residual	503	0.078782367	0.000156625		
Total	504	0.094356418			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	0.000250086	0.000557142	0.44887242	0.653717012	-0.000844526	0.001344697	-0.000844526	0.001344697
X Variable 1	0.796957634	0.079921746	9.971724506	1.71696E-21	0.639936066	0.953979202	0.639936066	0.953979202

SUMMARY OUTPUT JD Fashion

Figure 2.7 Beta for Sainsbury



Intercept	0.000250086	0.000557142	0.44887242	0.653717012	-0.000844526	0.001344697	-0.000844526	0.001344697
X Variable 1	0.796957634	0.079921746	9.971724506	1.71696E-21	0.639936066	0.953979202	0.639936066	0.953979202

SUMMARY OUTPUT JD Fashion

Regression Statistics	
Multiple R	0.325310658
R Square	0.105827024
Adjusted R Square	0.104049344
Standard Error	0.026807746
Observations	505

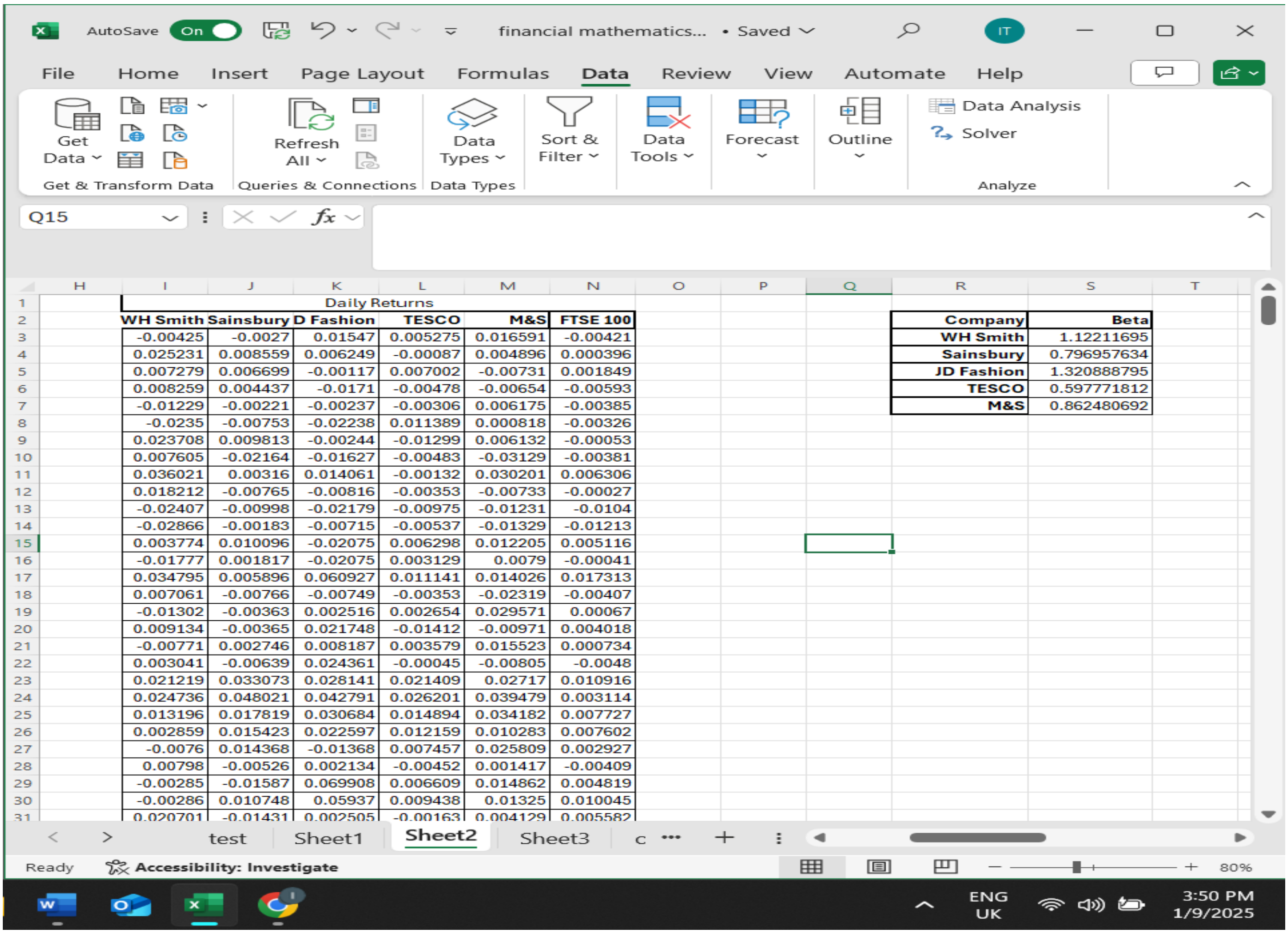
ANOVA

	df	SS	MS	F	Significance F
Regression	1	0.042782251	0.042782251	59.53097943	6.51888E-14
Residual	503	0.361483589	0.000718655		
Total	504	0.404265839			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	-0.000278128	0.001193426	-0.233050446	0.815817037	-0.002622842	0.002066585	-0.002622842	0.002066585
X Variable 1	1.320888795	0.171196445	7.715632147	6.51888E-14	0.984540611	1.65723698	0.984540611	1.65723698

Figure 2.8

After calculating the beta for all 5 assets a table is made to store all the betas together. The assets like WH Smith and JD Fashion are growth-oriented (Beta >1) stocks which shows that it is highly sensitive to the market while Sainsbury, Tesco and M&S are less sensitive(Beta < 0) to the market fluctuations. Figure 2.9



Daily Returns

WH Smith	Sainsbury	D Fashion	TESCO	M&S	FTSE 100
-0.00425	-0.0027	0.01547	0.005275	0.016591	-0.00421
0.025231	0.008559	0.006249	-0.00087	0.004896	0.000396
0.007279	0.006699	-0.00117	0.007002	-0.00731	0.001849
0.008259	0.004437	-0.0171	-0.00478	-0.00654	-0.00593
-0.01229	-0.00221	-0.00237	-0.00306	0.006175	-0.00385
-0.0235	-0.00753	-0.02238	0.011389	0.000818	-0.00326
0.023708	0.009813	-0.00244	-0.01299	0.006132	-0.00053
0.007605	-0.02164	-0.01627	-0.00483	-0.03129	-0.00381
0.036021	0.00316	0.014061	-0.00132	0.030201	0.006306
0.018212	-0.00765	-0.00816	-0.00353	-0.00733	-0.00027
-0.02407	-0.00998	-0.02179	-0.00975	-0.01231	-0.0104
-0.02866	-0.00183	-0.00715	-0.00537	-0.01329	-0.01213
0.003774	0.010096	-0.02075	0.006298	0.012205	0.005116
-0.01777	0.001817	-0.02075	0.003129	0.0079	-0.00041
0.034795	0.005896	0.060927	0.011141	0.014026	0.017313
0.007061	-0.00766	-0.00749	-0.00353	-0.02319	-0.00407
-0.01302	-0.00363	0.002516	0.002654	0.029571	0.00067
0.009134	-0.00365	0.021748	-0.01412	-0.00971	0.004018
-0.00771	0.002746	0.008187	0.003579	0.015523	0.000734
0.003041	-0.00639	0.024361	-0.00045	-0.00805	-0.0048
0.021219	0.033073	0.028141	0.021409	0.02717	0.010916
0.024736	0.048021	0.042791	0.026201	0.039479	0.003114
0.013196	0.017819	0.030684	0.014894	0.034182	0.007727
0.002859	0.015423	0.022597	0.012159	0.010283	0.007602
-0.0076	0.014368	-0.01368	0.007457	0.025809	0.002927
0.00798	-0.00526	0.002134	-0.00452	0.001417	-0.00409
-0.00285	-0.01587	0.069908	0.006609	0.014862	0.004819
-0.00286	0.010748	0.05937	0.009438	0.01325	0.010045
0.020701	-0.01431	0.002505	-0.00163	0.004129	0.005582

Company	Beta
WH Smith	1.12211695
Sainsbury	0.796957634
JD Fashion	1.320888795
TESCO	0.597771812
M&S	0.862480692

Figure 2.9

VAR 5% and Asset Contribution: VAR 5 % means that there is a 95% confidence that the losses will not exceed the value of VAR over a given period under normal market conditions. The formula to find the VAR5% is **VAR(5%)=Expected Return + Z-critical * SD.**(Figure 3.0) The Z-critical is calculated by using the function **NORM.S.INV** and the formula is **Z- critical = NORM.S.INV(1-Confidence interval)** which gives **-1.6448536. (Figure 3.1)** The value after calculating with this formula is -0.141086 . The negative value shows that at a 5% probability, the portfolio is expected to lose up to 14.11% of its value over time.

After calculating the VAR for the portfolio the next step would be to find the contribution that each assent have on the VAR 5% . To calculate this we need the optimal portfolio SD and expected return and the weights along with the annualised weights of each asset. So the formula to calculate each asset contribution would be

Contribution of individual asset=Optimal Weight of individual asset*(SD of individual asset/Optimal Portfolio SD)*Optimal portfolio Expected return

The weights of each asset on the VaR would be

weights	Contribution
0	0
0	0
0	0
0.390263657	0.035818695
0.609736343	0.118299017

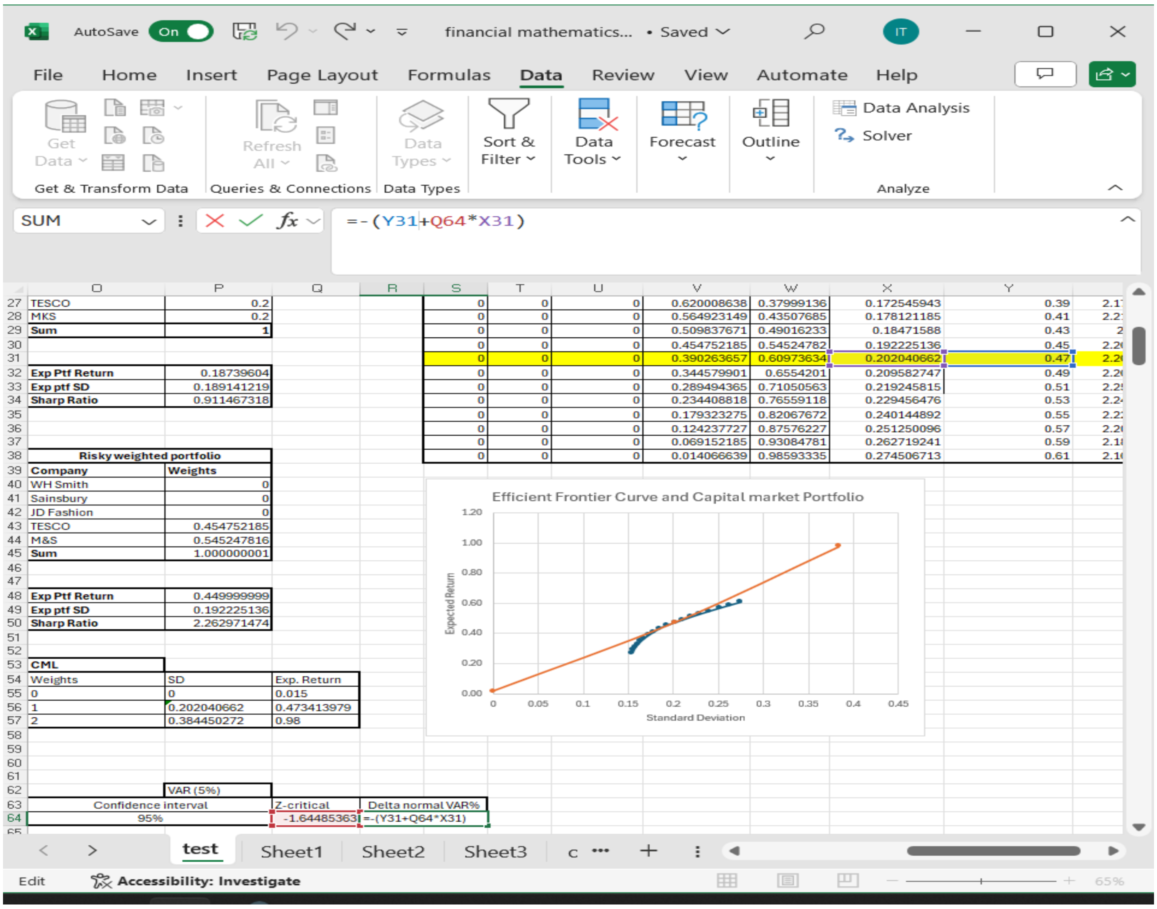


Figure 3.0

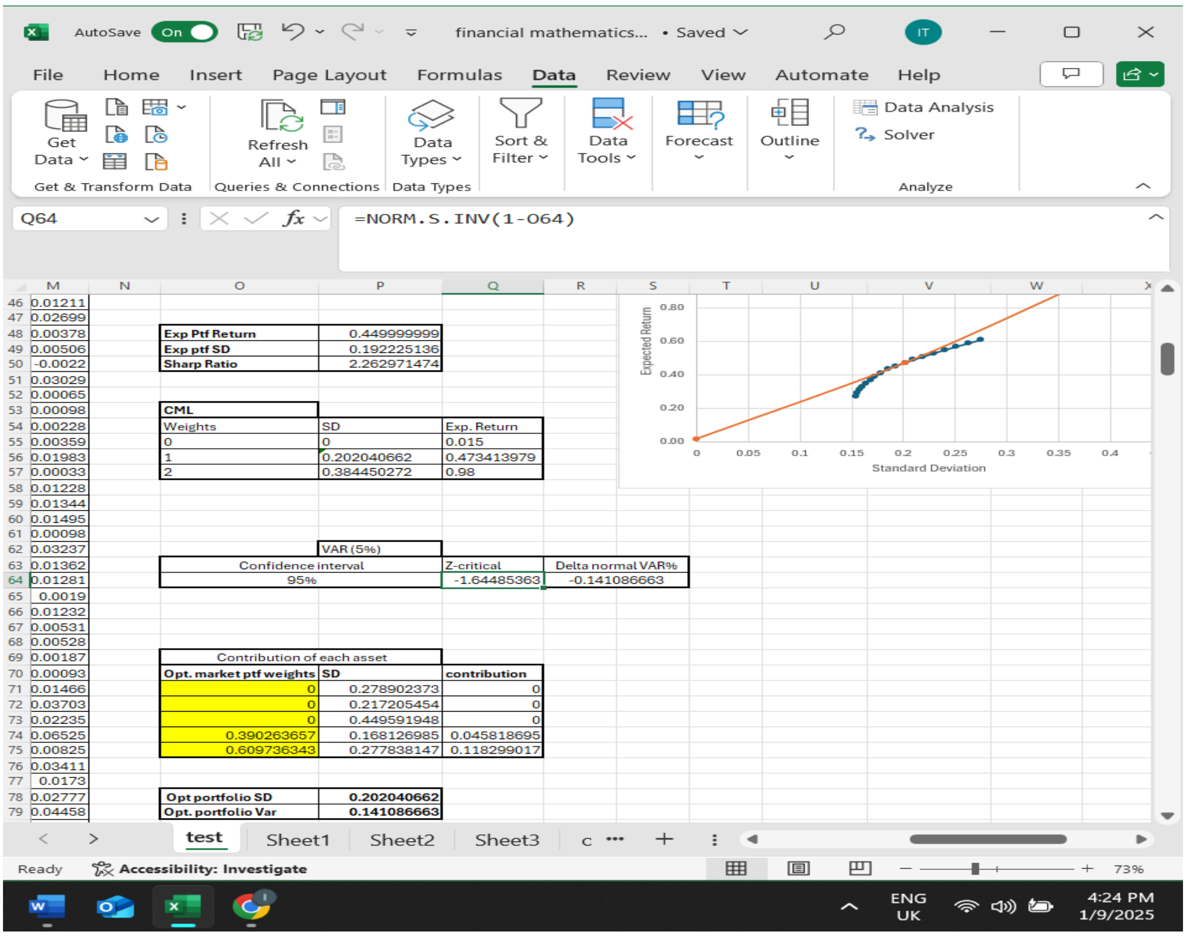


Figure 3.1

Estimating the volatility:

In this we analyse the volatility of one of the assets which is WH Smith using various ARCH/GARCH models.The data used to analyse this was the daily return of the WH smith .R codes are written to clean the data with missing values, (Figure 3.2)To fit the model the into Garch model the code in Figure 3.3 was passed to return data including:

- GARCH(1,0)
- GARCH(0,1)
- GARCH(1,1)
- GARCH(2,0)
- GARCH(2,1)
- GARCH(2,2)
- GARCH(0,2)
- GARCH(1,2)

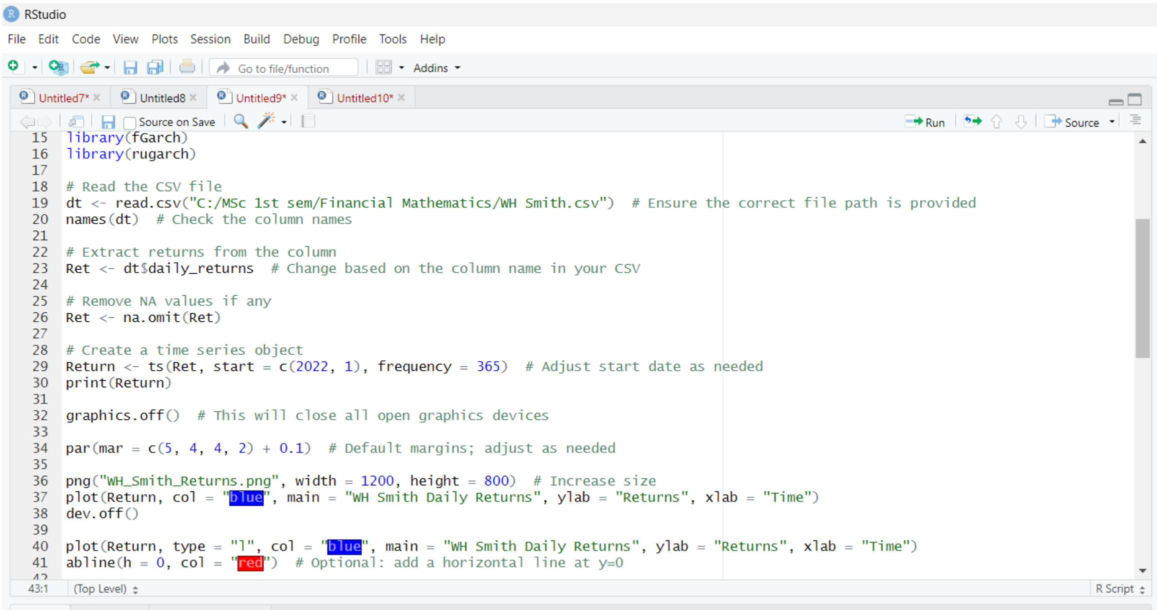


Figure 3.2

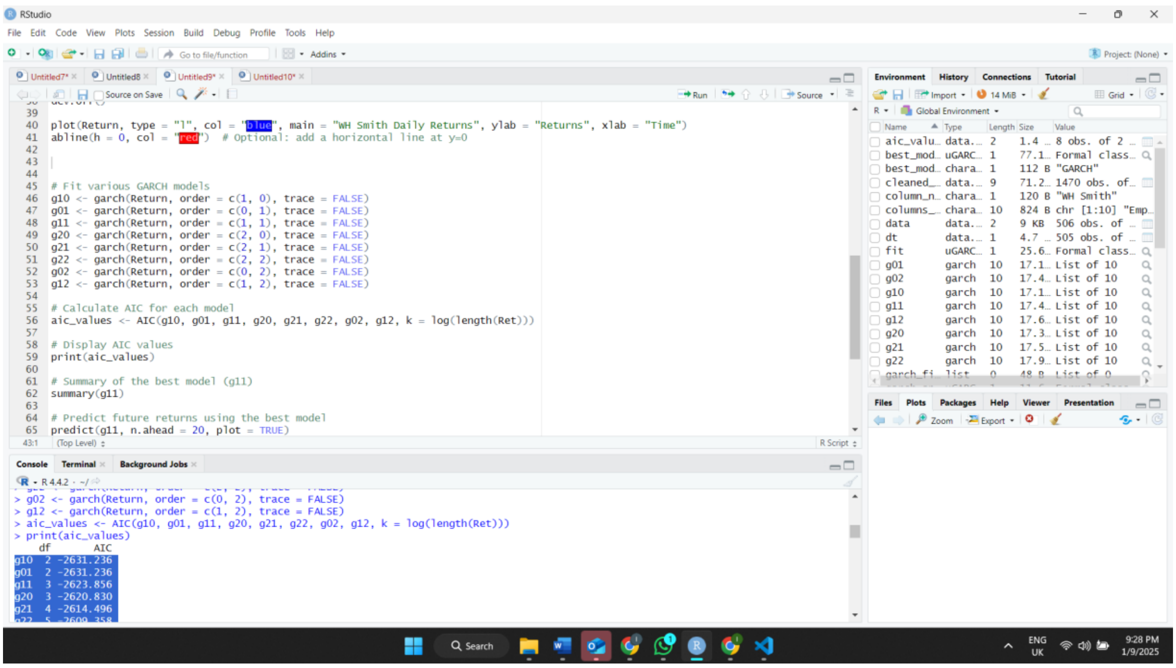


Figure 3.3

After that the AIC results will prove that which model suits the best. The Model with the lowest AIC will be considered the best fit among the model tested. By seeing the output we can say that the GARCH(2,1) with an AIC value of -2614.496.Figre 3.4The best reason to have chose this model GARCH is :

1. After fitting the model it was significant that there are not much leftover patterns on errors which indicated that the GARCH(2,1) model dose a good job of explaining the SD of WH Smith's returns.
2. This model helps to understand and predict the volatility of the assets will be. The Garch(2,1) looks at the volatility based on the past two days of price changes and the last day's volatility.
3. This model is good at recognizing patterns where high volatility tends to come in clusters. For example, if the asset has had a few days of big price changes, it's likely to continue being volatile for a while. This is common in financial markets.

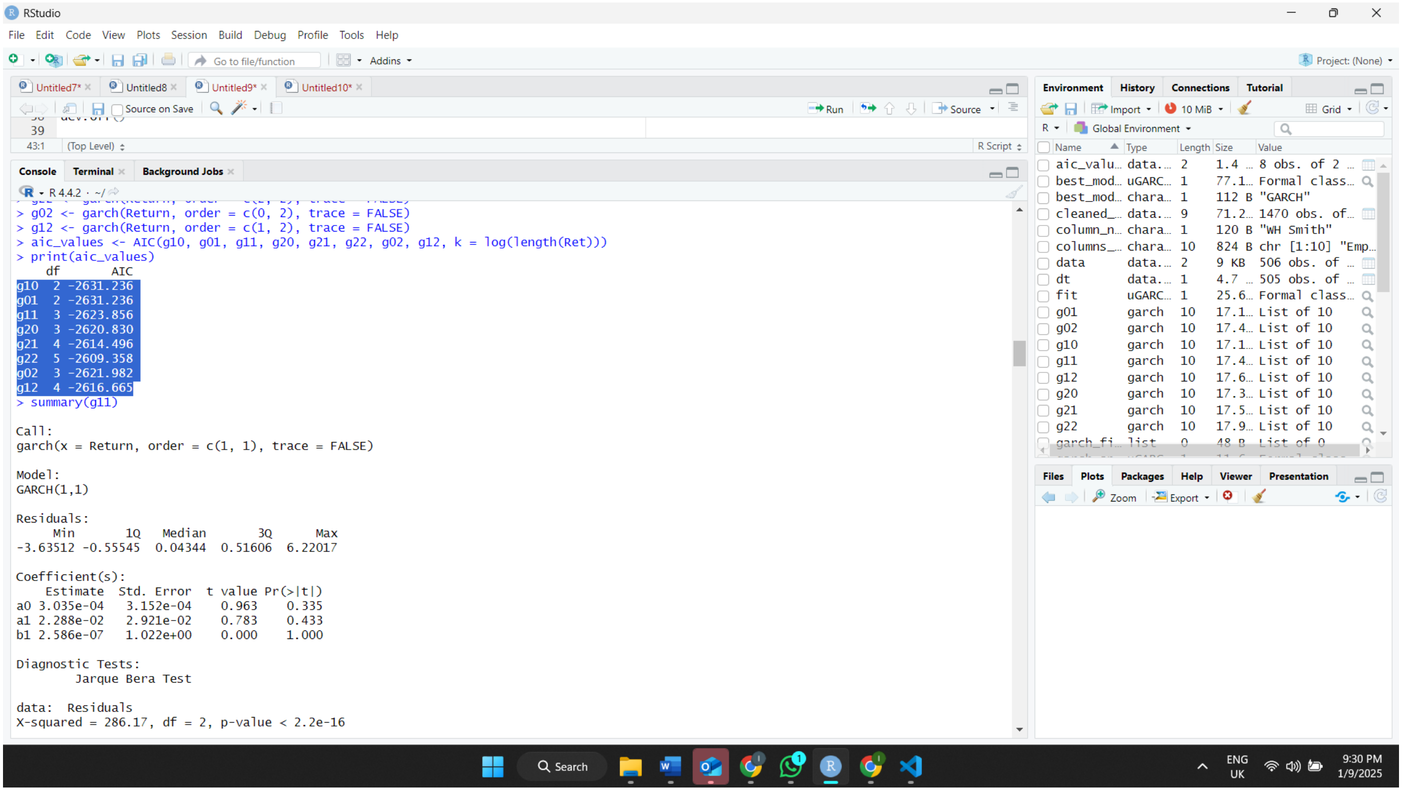


Figure 3.5

Summary of Findings:

The analysis evaluated the performance of five well-known UK retail companies (Sainsbury, JD Fashion, Tesco, Marks & Spencer, and WH Smith) over two years to guide investment decisions. The goal was to determine which portfolios provide the best balance of risk and return.

1. Efficient Portfolio Selection:

    - A combination of stocks was tested to maximize returns while managing risk effectively.

    - The most efficient portfolio consisted of 39% Tesco and 61% Marks & Spencer, offering the highest return relative to risk. This portfolio is optimal for investors seeking a favorable balance between potential gains and risk exposure.

2. Risk and Return Insights:

    - Each company's risk (measured by volatility) and potential return were carefully evaluated.

- JD Fashion exhibited higher risk, making it suitable for high-reward seekers. Conversely, companies like Tesco and Sainsbury demonstrated more stability, appealing to cautious investors.

3. Correlation:

    - Companies with lower correlations provided diversification benefits, reducing overall portfolio risk. For example, Tesco and JD Fashion exhibited lower correlation, enhancing portfolio stability when combined.

4. Performance Metrics:

    - The Sharpe Ratio was used to measure how well the investment compensates for risk. The optimal portfolio achieved a high Sharpe Ratio, indicating excellent risk-adjusted returns.
    - The Capital Market Line highlighted the best combinations of risk-free and risky assets. This provides a clear visual guide to balancing risk and return for potential investors.

5. Market Sensitivity:

    - Beta analysis showed WH Smith and JD Fashion are more sensitive to market fluctuations, while Tesco and Sainsbury are less affected. This allows investors to tailor portfolios based on market sentiment and risk tolerance.

6. Potential Losses:

    - A value at risk (VaR) evaluation predicted that under everyday market situations, losses are not going to exceed 14.11% for the optimized portfolio.

Therefore this analysis suggests that the quality funding approach relies upon on the investor's desires and threat appetite. The efficient portfolio gives a great choice for balanced returns. Riskier investments like JD fashion may want to appeal to aggressive traders in search of higher potential gains, while strong shares like Tesco fit conservative traders. The findings make stronger the importance of diversification to control risks correctly and align investments with marketplace traits and individual goals.