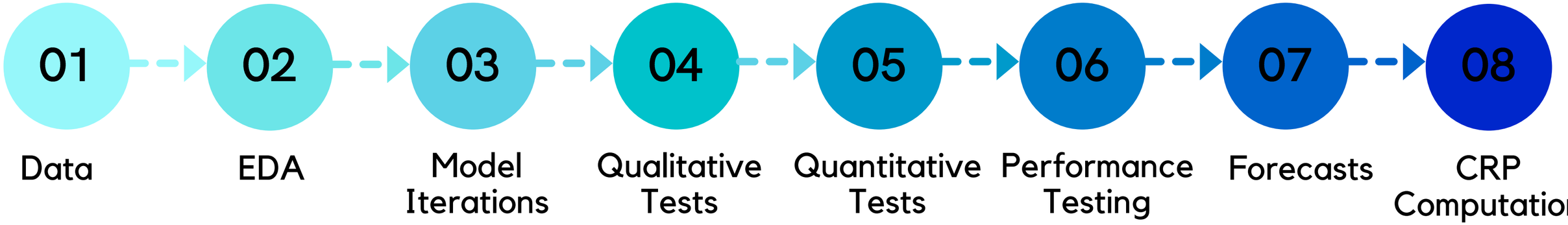
Econometric Models in The Banking Industry

Presented by Darshan Lodha (Roll No 433)

Contents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mirror_mod.use_y = True
mirror_mod.use_z = False
elif _operation == "MIRROR_Z":
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mirror_mod.use_y = False
mirror_mod.use_z = True
Data

Bank's Equity Portfolio

	Quarter	Portfolio Values
1	Q1 2005	1180.59
2	Q2 2005	1191.33
3	Q3 2005	1228.81
4	Q4 2005	1248.29
5	Q1 2006	1294.83
6	Q2 2006	1270.20
7	Q3 2006	1335.85
8	Q4 2006	1418.30
9	Q1 2007	1420.86
10	Q2 2007	1503.35
11	Q3 2007	1526.75
12	Q4 2007	1468.36
13	Q1 2008	1322.70
14	Q2 2008	1280.00
15	Q3 2008	1166.36
16	Q4 2008	903.25
17	Q1 2009	797.87
18	Q2 2009	919.32
19	Q3 2009	1057.08

Showing 1 to 19 of 52 entries, 2 total columns

	Quarter	Portfolio Values
20	Q4 2009	-
21	Q1 2010	1169.43
22	Q2 2010	1030.71
23	Q3 2010	1141.2
24	Q4 2010	1257.64
25	Q1 2011	1325.83
26	Q2 2011	1320.64
27	Q3 2011	1131.42
28	Q4 2011	1257.6
29	Q1 2012	1408.47
30	Q2 2012	1362.16
31	Q3 2012	1440.67
32	Q4 2012	1426.19
33	Q1 2013	1569.19
34	Q2 2013	1606.28
35	Q3 2013	16815.5
36	Q4 2013	18483.6
37	Q1 2014	1872.34
38	Q2 2014	1960.23

Showing 20 to 38 of 52 entries, 2 total columns

	Date	Real GDP Growth	Nominal GDP growth	Real Disposable Income Growth	Nominal Disposable Income	Unemployment Rate	CPI Inflation Rate	3-month Treasury Rate	5-year Treasury Yield	10-year Treasury Yield	BBB Corporate Yeild	Mortgage Rate	Prime Rate
1	Q1 2000	1.2	4.3	8.1	11.8	4.0	4.0	5.5	6.6	6.7	8.2	8.3	8.7
2	Q2 2000	7.8	10.2	4.2	6.1	3.9	3.2	5.7	6.5	6.4	8.5	8.3	9.2
3	Q3 2000	0.5	3.1	4.8	7.4	4.0	3.7	6.0	6.1	6.1	8.1	8.0	9.5
4	Q4 2000	2.3	4.5	1.4	3.6	3.9	2.9	6.0	5.6	5.8	7.9	7.6	9.5
5	Q1 2001	-1.1	1.4	3.5	6.3	4.2	3.9	4.8	4.9	5.3	7.4	7.0	8.6
6	Q2 2001	2.1	5.1	-0.3	1.6	4.4	2.8	3.7	4.9	5.5	7.5	7.1	7.3
7	Q3 2001	-1.3	0.0	9.8	10.1	4.8	1.1	3.2	4.6	5.3	7.3	7.0	6.6
8	Q4 2001	1.1	2.3	-4.9	-4.6	5.5	-0.3	1.9	4.2	5.1	7.2	6.8	5.2
9	Q1 2002	3.7	5.1	10.1	10.9	5.7	1.3	1.7	4.5	5.4	7.6	7.0	4.8
10	Q2 2002	2.2	3.8	2.0	5.2	5.8	3.2	1.7	4.5	5.4	7.6	6.8	4.8
11	Q3 2002	2.0	3.8	-0.5	1.5	5.7	2.2	1.6	3.4	4.5	7.3	6.3	4.8
12	Q4 2002	0.3	2.4	1.9	3.8	5.9	2.4	1.3	3.1	4.3	7.0	6.1	4.5
13	Q1 2003	2.1	4.6	1.1	4.0	5.9	4.2	1.2	2.9	4.2	6.5	5.8	4.3
14	Q2 2003	3.8	5.1	5.9	6.3	6.1	-0.7	1.0	2.6	3.8	5.7	5.5	4.2
15	Q3 2003	6.9	9.3	6.7	9.3	6.1	3.0	0.9	3.1	4.4	6.0	6.0	4.0
16	Q4 2003	4.8	6.8	1.6	3.3	5.8	1.5	0.9	3.2	4.4	5.8	5.9	4.0
17	Q1 2004	2.3	5.9	2.9	6.1	5.7	3.4	0.9	3.0	4.1	5.5	5.6	4.0

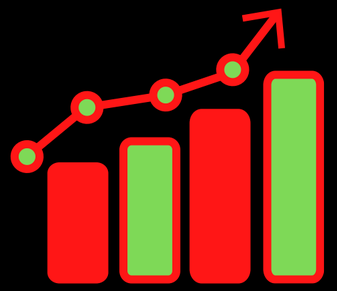
Showing 1 to 17 of 72 entries, 26 total columns

me te	House Price Index	Commercial Real Estate Price Index	Market Volatility Index	Money Supply	FED Funds Rate	VIX CLS	TED Spread	Composite Leader Indicator	consumer confidence index	Business Confidence Index	(USD/euro)	(yen/USD)	(USD/pound)
8.7	102	127	27.0	4654.900	5.85	24.92397	0.9200000	99.98411	100.10150	101.34550	0.957	102.7	1.592
9.2	105	125	33.5	4753.800	6.53	19.16905	0.6811290	99.56741	99.92783	101.52950	0.955	106.1	1.513
9.5	107	139	21.9	4809.700	6.52	26.01667	0.6696721	99.79356	99.89449	101.62280	0.884	107.9	1.479
9.5	110	144	31.7	4880.933	6.40	25.72645	0.5203226	100.21420	100.34910	101.31510	0.939	114.4	1.496
8.6	112	143	32.8	5009.767	5.31	23.92381	0.5213115	100.32080	100.84700	100.45550	0.879	125.5	1.419
7.3	114	142	34.7	5136.300	3.97	25.38034	0.2555000	100.15700	101.12480	100.15440	0.847	124.7	1.408
6.6	116	143	43.7	5251.467	3.07	27.91000	0.2367213	99.75716	101.27160	99.74064	0.910	119.2	1.469
5.2	118	139	35.3	5369.700	1.82	21.36083	0.1820000	99.86518	101.42080	99.48149	0.890	131.0	1.454
4.8	120	140	26.1	5463.733	1.73	21.64313	0.2061667	100.47300	102.37300	99.51858	0.872	132.7	1.425
4.8	123	140	28.4	5507.000	1.75	35.06844	0.1666667	100.48340	102.99570	99.32779	0.986	119.9	1.525
4.8	127	142	45.1	5611.300	1.75	30.72672	0.2147541	99.95801	102.85180	98.81992	0.988	121.7	1.570
4.5	129	144	42.6	5726.667	1.24	30.02262	0.1768852	99.20563	101.89360	98.29375	1.049	118.8	1.610
4.3	132	151	34.7	5821.467	1.25	21.53127	0.1981967	98.72200	101.05210	98.25281	1.090	118.1	1.579
4.2	135	151	29.1	5937.233	1.22	19.32016	0.2015873	99.12431	100.98560	98.86729	1.150	119.9	1.653
4.0	139	149	22.7	6057.733	1.01	17.42719	0.2498361	99.82661	100.23610	99.30354	1.165	111.4	1.662
4.0	143	147	21.1	6052.167	0.98	16.65806	0.2050000	100.47250	99.96880	99.36362	1.260	107.1	1.784
4.0	148	153	21.6	6099.133	1.00	16.23016	0.2230000	100.77840	99.86436	99.71673	1.229	104.2	1.840

Showing 1 to 17 of 72 entries, 26 total columns

Historical Macroeconomic Variables

Forecasted Macroeconomic Variables - Base Scenario



	Date	Real GDP Growth	Nominal GDP growth	Real Disposable Income Growth	Nominal Disposable Income	Unemployment Rate	CPI Inflation Rate	3-month Treasury Rate	5-year Treasury Yield	10-year Treasury Yield	BBB Corporate Yeild	Mortgage Rate	Prime Rate
1	Q1 2018	2.5	4.6	4.0	6.1	4.0	2.1	1.4	2.2	2.6	4.1	4.1	4.6
2	Q2 2018	2.8	4.8	2.9	4.8	4.0	1.9	1.7	2.4	2.7	4.3	4.3	4.8
3	Q3 2018	2.6	4.7	2.9	4.9	3.9	2.1	1.9	2.5	2.8	4.4	4.4	5.0
4	Q4 2018	2.5	4.6	2.8	4.8	3.8	2.1	2.1	2.7	2.9	4.5	4.5	5.2
5	Q1 2019	2.3	4.5	2.9	5.0	3.8	2.2	2.2	2.8	3.1	4.6	4.7	5.3
6	Q2 2019	2.3	4.4	2.5	4.5	3.8	2.2	2.4	2.8	3.1	4.7	4.8	5.5
7	Q3 2019	2.1	4.3	2.4	4.4	3.8	2.2	2.5	2.9	3.2	4.8	4.9	5.6
8	Q4 2019	2.0	4.2	2.3	4.4	3.7	2.4	2.6	2.9	3.3	4.9	4.9	5.7
9	Q1 2020	2.1	4.2	2.2	4.3	3.8	2.3	2.7	3.0	3.5	5.1	5.1	5.7
10	Q2 2020	2.1	4.2	2.3	4.4	3.9	2.3	2.7	3.0	3.5	5.1	5.2	5.7
11	Q3 2020	2.1	4.2	2.3	4.4	4.0	2.3	2.7	3.1	3.5	5.2	5.2	5.7
12	Q4 2020	2.1	4.2	2.3	4.4	4.0	2.3	2.7	3.1	3.6	5.2	5.2	5.8
13	Q1 2021	2.1	4.2	2.3	4.4	4.1	2.3	2.7	3.1	3.6	5.2	5.3	5.8

Showing 1 to 13 of 13 entries, 26 total columns

House Price Index	Commercial Real Estate Price Index	Market Volatility Index	Money Supply	FED Funds Rate	VIX CLS	TED Spread	Composite Leader Indicator	Consumer Confidence Index	Business Confidence Index	(USD/euro)	(yen/USD)	(USD/pound)
196	282	15.3	13986.35	1.516667	20.26929	0.3531085	99.24496	104.0279	101.4908	1.201	112.7	1.350
197	286	17.5	14158.45	1.841667	23.18383	0.3484497	99.15998	103.8751	101.5046	1.199	112.8	1.347
198	289	18.7	14330.64	2.058333	24.77358	0.3438756	99.05617	103.9473	101.5226	1.198	112.8	1.344
199	293	20.0	14505.78	2.275000	26.49581	0.3393789	98.50858	104.0219	101.5426	1.197	112.8	1.341
201	297	20.9	14677.53	2.383333	27.68812	0.3349530	98.57602	104.0964	101.5625	1.202	112.6	1.344
202	300	21.5	14849.59	2.600000	28.48299	0.3305921	100.50641	104.1720	101.5842	1.208	112.3	1.347
203	304	22.1	15022.56	2.708333	29.27787	0.3262908	101.21521	104.2486	101.6073	1.213	112.0	1.351
204	308	22.1	15195.52	2.816667	29.27787	0.3220446	101.55621	104.3261	101.6319	1.219	111.8	1.354
206	310	23.5	15368.99	2.925000	31.13257	0.3178489	101.57415	104.4045	101.6578	1.219	111.8	1.354
207	313	23.6	15542.47	2.925000	31.26505	0.3137002	102.75322	104.4837	101.6849	1.219	111.8	1.354
209	315	23.8	15715.95	2.925000	31.53001	0.3095947	103.15304	104.5275	101.7143	1.219	111.8	1.354
211	317	23.8	15889.43	2.925000	31.53001	0.3055295	103.05138	104.6101	101.7444	1.219	111.8	1.354
212	320	23.9	16062.90	2.925000	31.66249	0.3015015	102.94768	104.6933	101.7754	1.219	111.8	1.354

1 to 13 of 13 entries, 26 total columns

Forecasted Macroeconomic Variables - Adverse Scenario

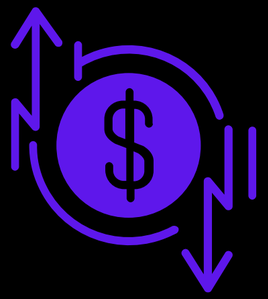
	Date	Real GDP Growth	Nominal GDP growth	Real Disposable Income Growth	Nominal Disposable Income	Unemployment Rate	CPI Inflation Rate	3-month Treasury Rate	5-year Treasury Yield	10-year Treasury Yield	BBB Corporate Yeild	Mortgage Rate	Prime Rate
1	Q1 2018	-1.3	1.2	2.4	4.2	4.5	1.7	0.6	0.0	0.7	3.8	3.2	3.8
2	Q2 2018	-3.5	-1.4	-1.2	0.2	5.3	1.3	0.1	0.1	0.8	4.2	3.4	3.3
3	Q3 2018	-2.4	-0.4	-1.8	-0.2	5.8	1.6	0.1	0.2	0.9	4.4	3.6	3.3
4	Q4 2018	-1.3	0.6	-1.1	0.6	6.3	1.7	0.1	0.3	1.0	4.6	3.7	3.3
5	Q1 2019	-0.7	1.3	-0.3	1.5	6.6	1.8	0.1	0.4	1.1	4.8	3.9	3.2
6	Q2 2019	0.4	2.3	-0.1	1.6	6.9	1.9	0.1	0.5	1.2	4.8	3.9	3.2
7	Q3 2019	1.0	2.9	0.5	2.2	7.0	1.9	0.1	0.6	1.3	4.7	3.9	3.2
8	Q4 2019	2.5	4.3	1.0	2.9	7.0	2.1	0.1	0.6	1.4	4.6	3.9	3.2
9	Q1 2020	2.8	4.5	2.3	4.2	6.9	2.1	0.1	0.7	1.6	4.6	4.0	3.2
10	Q2 2020	3.0	4.7	2.4	4.2	6.8	2.0	0.1	0.7	1.7	4.4	4.0	3.2
11	Q3 2020	3.2	4.8	2.6	4.4	6.6	2.0	0.1	0.8	1.8	4.3	4.0	3.2
12	Q4 2020	3.3	4.9	2.8	4.5	6.5	2.0	0.1	0.9	1.8	4.2	3.9	3.2
13	Q1 2021	3.3	4.8	2.9	4.6	6.3	1.9	0.1	0.9	1.9	4.0	3.9	3.2

Showing 1 to 13 of 13 entries, 26 total columns

ne	House Price Index	Commercial Real Estate Price Index	Market Volatility Index	Money Supply	FED Funds Rate	VIX CLS	TED Spread	Composite Leader Indicator	Consumer Confidence Index	Business Confidence Index	(USD/euro)	(yen/USD)	(USD/pound)
3.8	191	272	28.0	11322.28	0.53316114	28.46249	0.3272713	96.21942	100.85654	98.39681	1.133	110.7	1.319
3.3	185	262	33.1	9687.36	0.07004090	29.28727	0.3403462	91.97932	96.35300	94.15412	1.113	109.6	1.304
3.3	180	254	33.7	10918.58	0.05998471	27.77898	0.3438756	88.55540	92.92800	90.76041	1.115	109.6	1.296
3.3	177	247	32.8	11742.78	0.05194590	25.16344	0.3469207	85.33063	90.10637	87.95878	1.118	109.1	1.287
3.2	174	242	31.7	12008.89	0.04745278	23.16365	0.3495162	82.82784	87.46628	85.33724	1.146	108.6	1.295
3.2	172	239	28.8	12824.65	0.04161769	20.29324	0.3376260	82.82491	85.84560	83.71307	1.155	108.1	1.301
3.2	171	237	25.7	12974.03	0.03821185	17.53731	0.3194931	82.08401	84.54401	82.40202	1.163	107.7	1.307
3.2	171	237	23.1	13296.08	0.03512439	15.68516	0.3023275	81.63676	83.86337	81.69764	1.171	107.3	1.312
3.2	171	237	21.3	14032.56	0.03231523	13.53336	0.2866873	80.98574	83.24241	81.05245	1.174	107.3	1.313
3.2	172	238	20.1	13515.19	0.03085230	12.65199	0.2706433	81.75566	83.13252	80.90564	1.178	107.4	1.313
3.2	172	239	19.3	13666.04	0.02943089	11.98413	0.2560110	81.57841	82.66542	80.44056	1.181	107.5	1.314
3.2	173	240	18.7	13816.89	0.02804752	11.55083	0.2467738	81.25617	82.48521	80.22563	1.185	107.7	1.314
3.2	174	242	18.3	13269.35	0.02669908	11.19688	0.2319243	81.17449	82.55088	80.25016	1.188	107.8	1.315

Showing 1 to 13 of 13 entries, 26 total columns

Forecasted Macroeconomic Variables - Severly Adverse Scenario



	Date	Real GDP Growth	Nominal GDP growth	Real Disposable Income Growth	Nominal Disposable Income	Unemployment Rate	CPI Inflation Rate	3-month Treasury Rate	5-year Treasury Yield	10-year Treasury Yield	BBB Corporate Yeild	Mortgage Rate	Prime Rate
1	Q1 2018	-4.7	-2.3	1.4	3.0	5.0	1.4	0.1	1.9	2.4	7.1	5.3	3.3
2	Q2 2018	-8.9	-7.1	-4.2	-3.1	6.5	0.9	0.1	1.9	2.4	7.7	5.7	3.3
3	Q3 2018	-6.8	-5.1	-5.1	-3.8	7.6	1.2	0.1	1.9	2.4	7.9	5.8	3.3
4	Q4 2018	-4.7	-3.0	-3.9	-2.5	8.5	1.3	0.1	1.9	2.4	8.0	5.9	3.3
5	Q1 2019	-3.6	-1.8	-2.9	-1.5	9.3	1.5	0.1	1.9	2.4	8.1	6.0	3.2
6	Q2 2019	-1.3	0.3	-2.4	-1.0	9.7	1.5	0.1	1.9	2.4	7.9	6.0	3.2
7	Q3 2019	-0.2	1.4	-1.4	-0.1	10.0	1.5	0.1	1.9	2.4	7.5	5.8	3.2
8	Q4 2019	2.8	4.3	-0.1	1.5	9.9	1.8	0.1	1.9	2.4	7.1	5.7	3.2
9	Q1 2020	3.5	4.8	1.9	3.4	9.7	1.8	0.1	1.9	2.4	6.7	5.5	3.2
10	Q2 2020	4.0	5.2	2.3	3.7	9.5	1.7	0.1	1.9	2.4	6.3	5.3	3.2
11	Q3 2020	4.2	5.3	2.7	4.1	9.2	1.6	0.1	1.9	2.4	5.9	5.1	3.2
12	Q4 2020	4.5	5.5	3.1	4.3	8.9	1.6	0.1	1.9	2.4	5.5	4.9	3.2
13	Q1 2021	4.5	5.4	3.3	4.5	8.6	1.5	0.1	1.9	2.4	5.0	4.7	3.2

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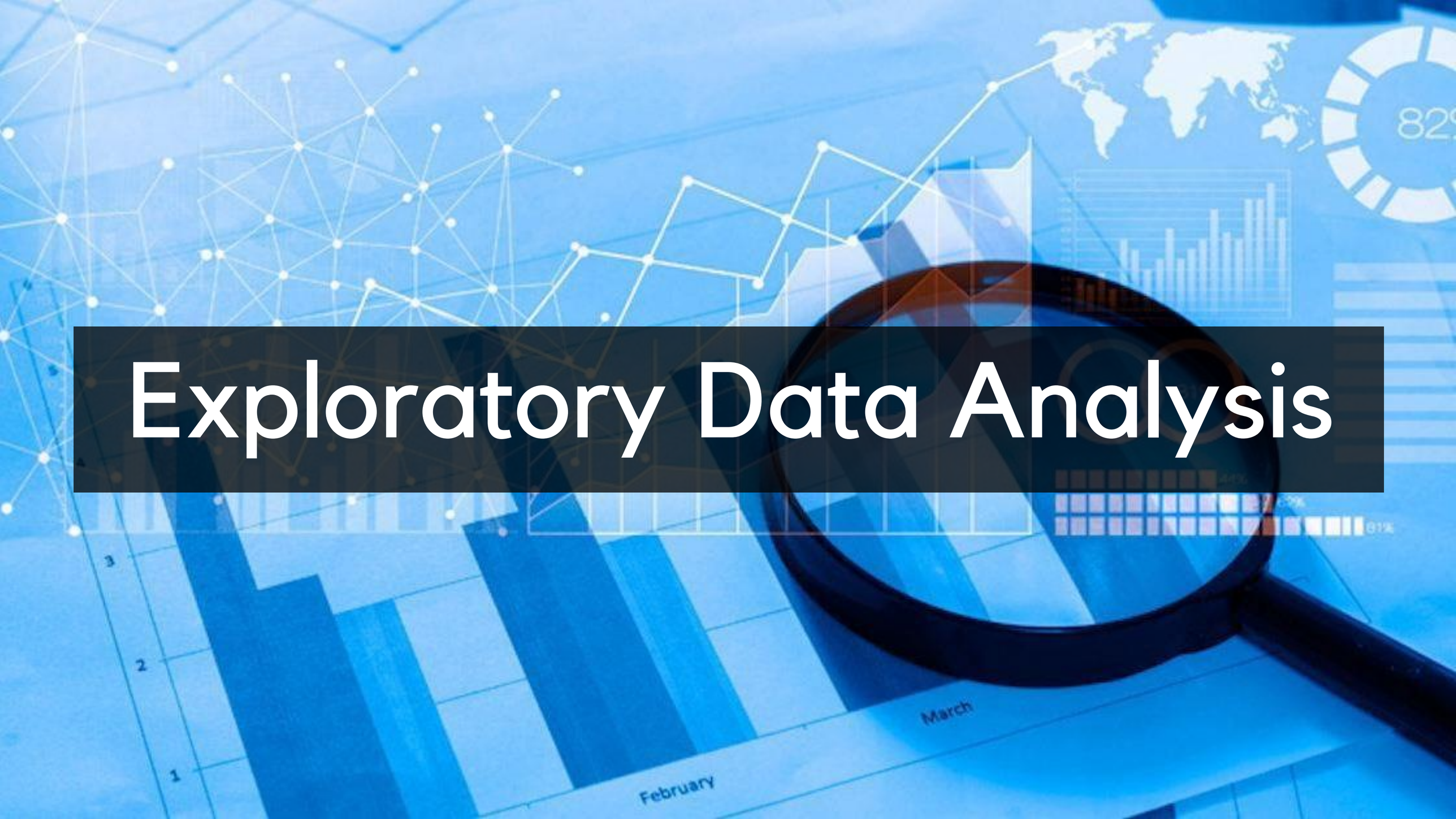
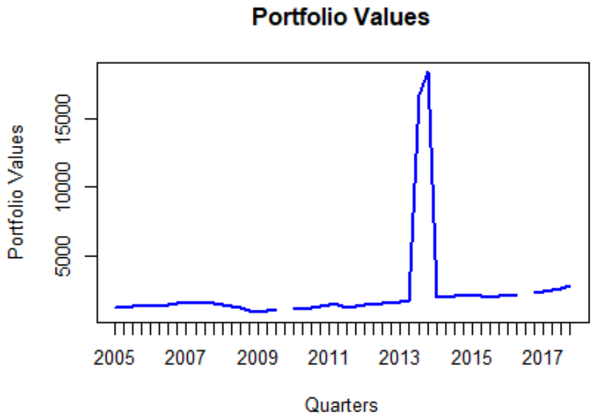
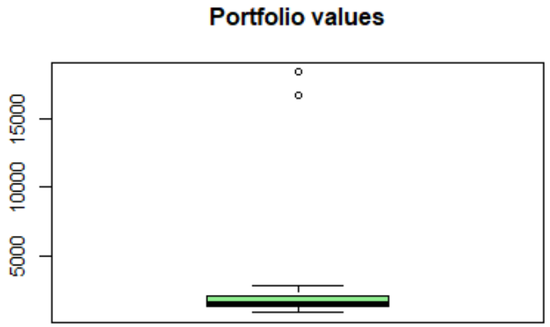
	House Price Index	Commercial Real Estate Price Index	Market Volatility Index	Money Supply	FED Funds Rate	VIX CLS	TED Spread	Composite Leader Indicator	Consumer Confidence Index	Business Confidence Index	(USD/euro)	(yen/USD)	(USD/pound)
3.3	186	262	50.7	9324.232	0.08886019	51.537429	0.6114806	93.19388	220.68494	202.08357	1.123	99.5	1.316
3.3	171	234	62.4	6706.634	0.07004090	55.212263	0.6239681	83.60189	227.68884	214.89993	1.097	103.5	1.296
3.3	159	212	59.5	8188.939	0.05998471	49.045980	0.6174131	76.10457	203.49663	195.45113	1.084	105.9	1.284
3.3	151	195	52.8	8979.771	0.05194590	40.507000	0.6033403	70.15402	171.92365	167.98077	1.071	107.5	1.271
3.2	143	181	47.4	10007.404	0.04745278	34.635871	0.5898086	65.10308	149.76191	149.12018	1.081	106.3	1.278
3.2	139	173	37.9	10124.723	0.04161769	26.705336	0.5556761	63.55952	121.85292	123.49422	1.091	105.0	1.284
3.2	136	167	29.7	10242.652	0.03821185	20.266848	0.5098295	61.70549	98.68344	102.24078	1.101	103.7	1.290
3.2	136	167	23.5	11396.637	0.03512439	15.956760	0.4666360	61.38435	83.75072	88.00946	1.111	102.5	1.295
3.2	136	167	19.8	12027.908	0.03231523	12.580303	0.4175663	60.88882	72.10504	76.80909	1.116	101.1	1.295
3.2	137	170	17.5	11487.913	0.03085230	11.015414	0.3875120	61.90710	67.11283	71.69304	1.121	100.0	1.294
3.2	139	172	16.0	10932.833	0.02943089	9.935027	0.3512709	62.46450	63.67298	68.19157	1.127	98.9	1.294
3.2	141	176	15.0	11053.513	0.02804752	9.265375	0.3231562	63.03918	62.00539	66.07430	1.132	98.1	1.293
3.2	143	180	14.4	10475.806	0.02669908	8.810660	0.2899053	63.67460	60.98437	64.68272	1.136	97.4	1.293

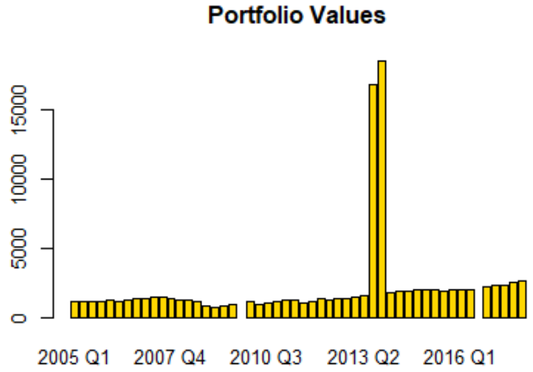
Showing 1 to 13 of 13 entries, 26 total columns

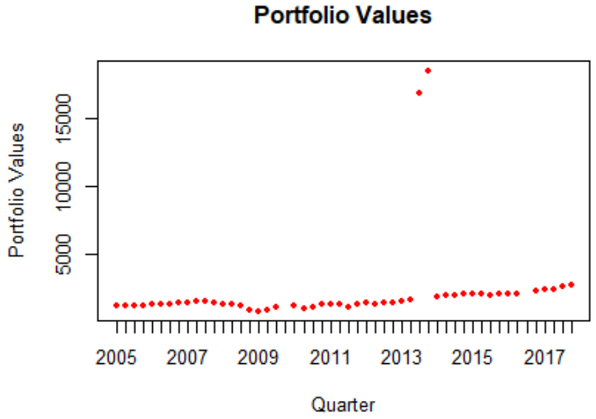

Exploratory Data Analysis
February
March

Missing Values & Outliers- Portfolio Values







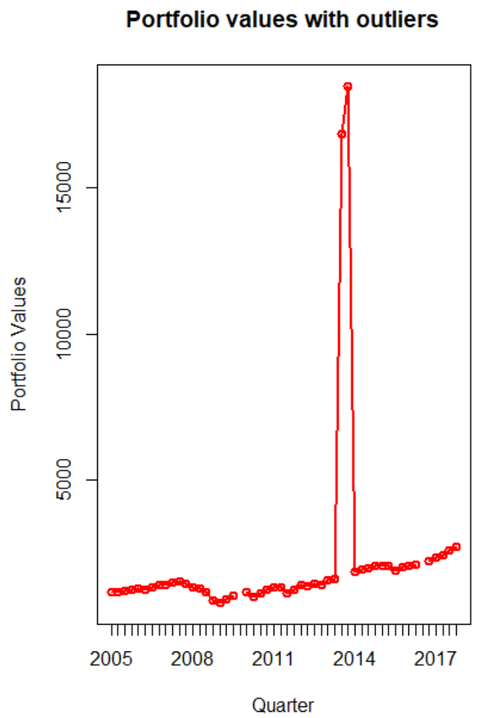


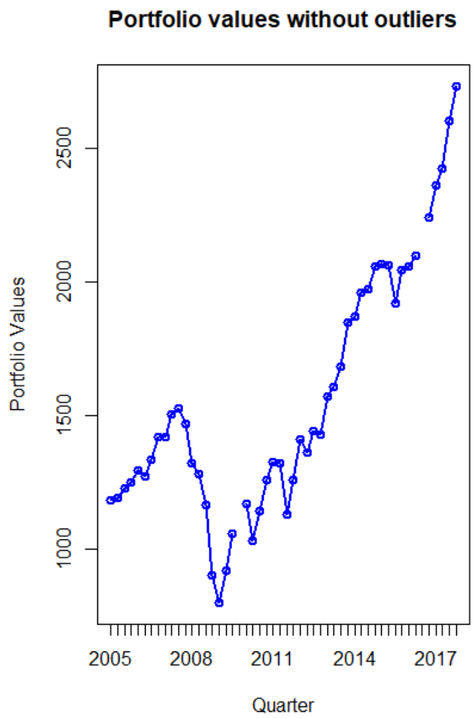
- 2 missing values in the dataset which are shown as discontinuities.
- The missing values are present at Q4 2009 and Q3 2016.
- Two sudden high peaks in values (line chart) and the same are displayed as outliers in the box plot.
- The outlier values are observed at Q3 2013 and Q4 2013.

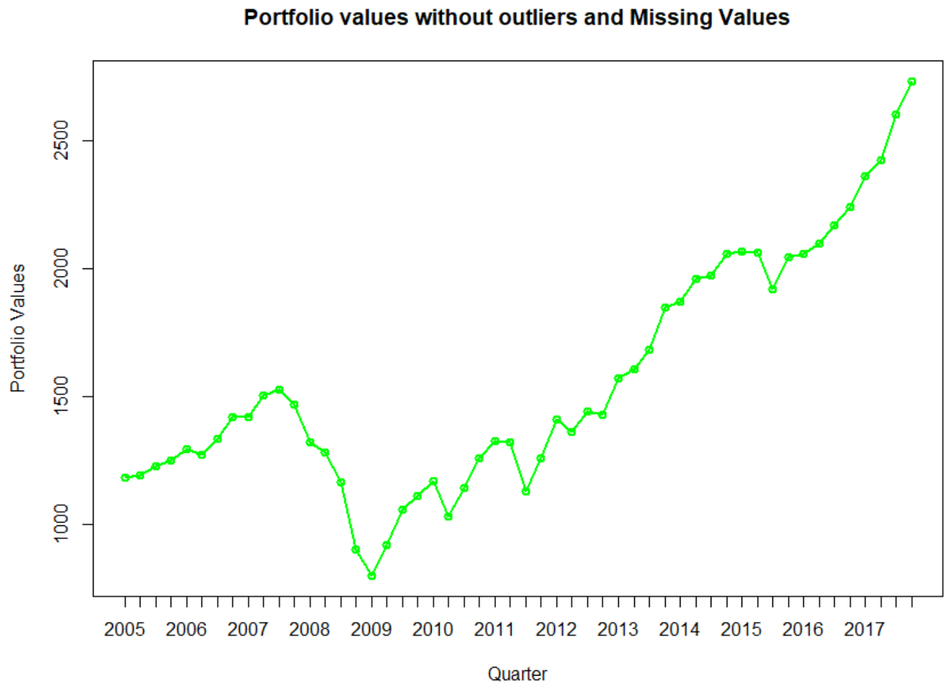
Handling Missing Values & Outliers- Portfolio Values

- Outliers - 16815.5 and 18483.6
- Reason for the presence of outliers

- Reason for the presence of missing values
- Using interpolation to remove the missing values

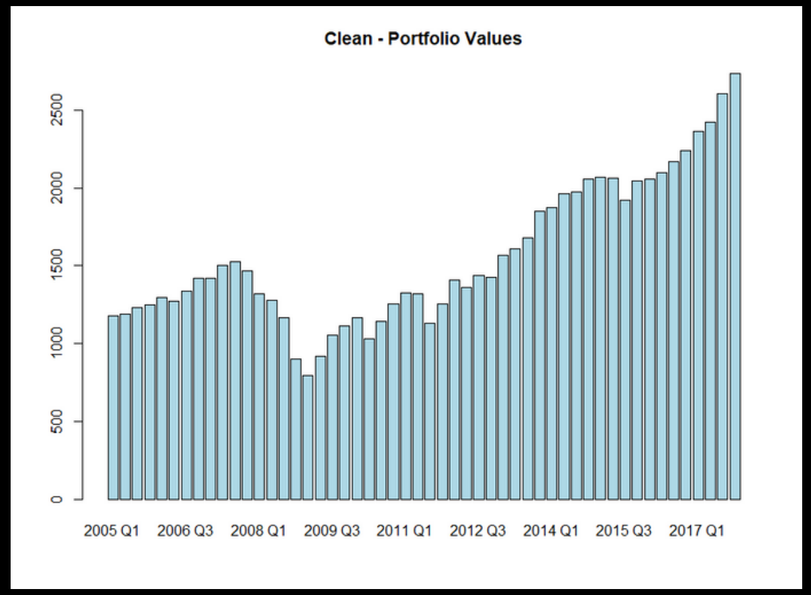


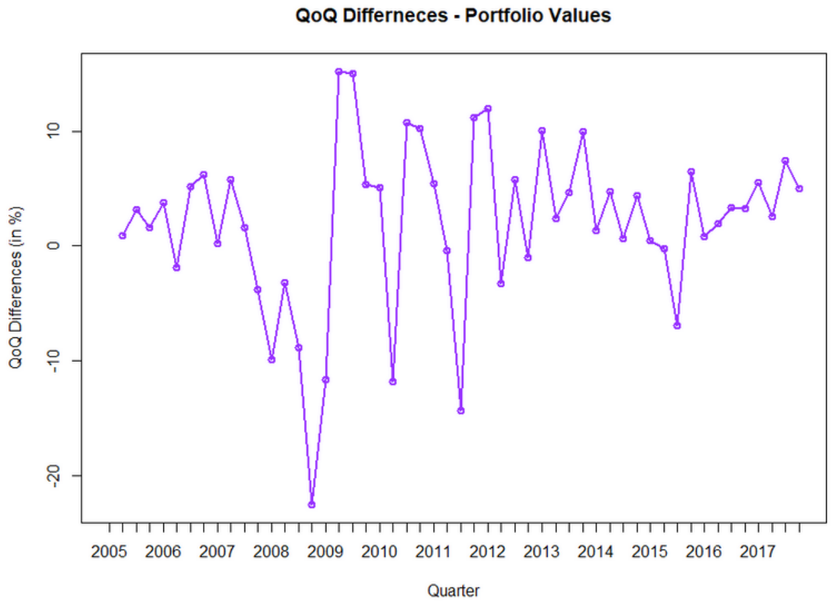


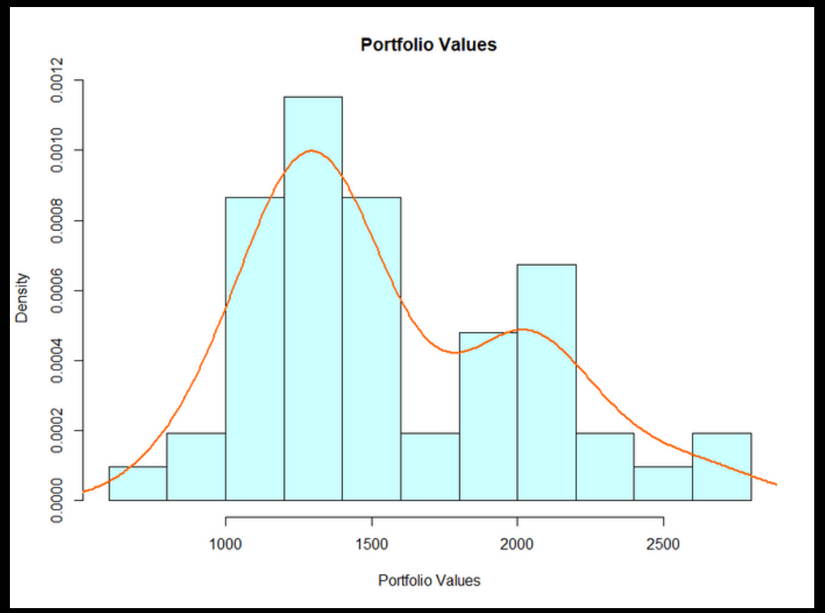


Analysing clean portfolio values dataset

```
> describe(df_portfolioval2$`Portfolio Values`)
   vars  n    mean     sd  median trimmed    mad    min     max   range skew kurtosis    se
X1    1 52 1562.93 463.73 1419.58 1528.63 381.91 797.87 2733.48 1935.61 0.65    -0.53 64.31
```





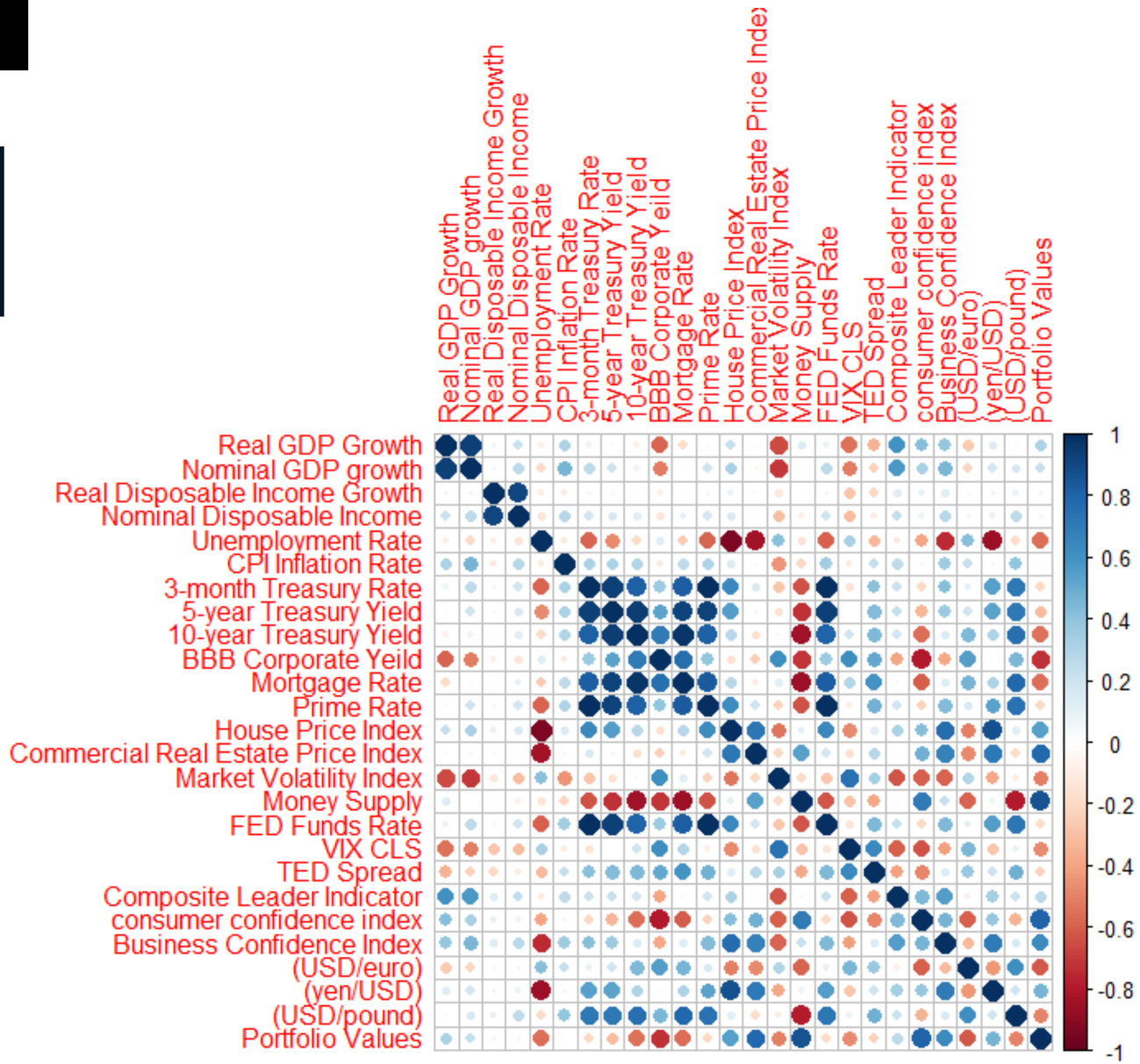


Initial Variable Selection

Correlation Analysis

Considering the threshold as absolute value of 0.6

	Correlation.With.Portfolio.Values
BBB Corporate Yeild	-0.7249939
Commercial Real Estate Price Index	0.7827077
Money Supply	0.8603835
consumer confidence index	0.8082416
Business Confidence Index	0.6348337
(USD/euro)	-0.6154111
Portfolio Values	1.0000000




Model Iterations

Iteration 1

```
Call:
lm(formula = `Portfolio Values` ~ `BBB Corporate Yeild` + `Commercial Real Estate Price Index` +
    `Money Supply` + `consumer confidence index` + `Business Confidence Index` +
    `(USD/euro)`, data = df_hismac_port_clean)

Residuals:
    Min      1Q  Median      3Q     Max
-206.69  -49.21   18.25   48.52  230.20

Coefficients:
                                  Estimate Std. Error t value Pr(>|t|)
(Intercept)                     -1.104e+04  2.030e+03  -5.437 2.12e-06 ***
`BBB Corporate Yeild`           -3.820e+01  2.399e+01  -1.593 0.118269
`Commercial Real Estate Price Index`  3.414e+00  8.209e-01   4.159 0.000142 ***
`Money Supply`                   1.007e-01  1.256e-02   8.016 3.27e-10 ***
`consumer confidence index`      3.290e+01  1.106e+01   2.974 0.004705 **
`Business Confidence Index`      7.734e+01  1.652e+01   4.680 2.64e-05 ***
`(USD/euro)`                     7.098e+01  1.312e+02   0.541 0.591272
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 86.69 on 45 degrees of freedom
Multiple R-squared:  0.9692,    Adjusted R-squared:  0.9651
F-statistic: 235.7 on 6 and 45 DF,  p-value: < 2.2e-16
```

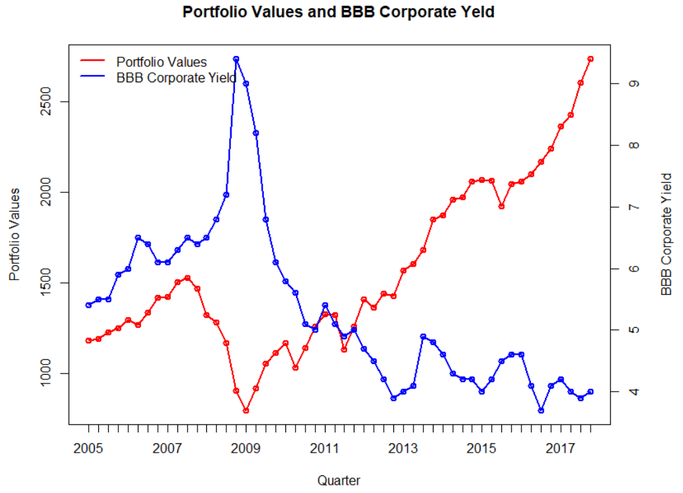
Multicollinearity

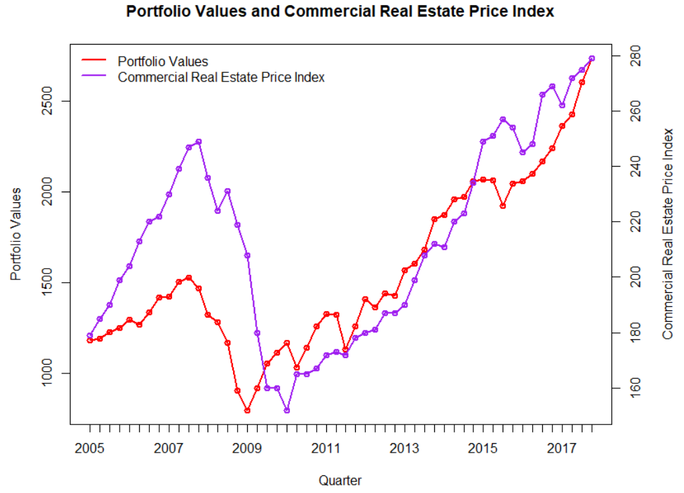
	BBB Corporate Yeild	Commercial Real Estate Price Index	Money Supply	consumer confidence index	Business Confidence Index	(USD/euro)
BBB Corporate Yeild	1.0000000	-0.2420809	-0.7127515	-0.7992596	-0.3892171	0.5569278
Commercial Real Estate Price Index	-0.2420809	1.0000000	0.5471087	0.4815387	0.6720498	-0.4735007
Money Supply	-0.7127515	0.5471087	1.0000000	0.7028015	0.2258533	-0.5804776
consumer confidence index	-0.7992596	0.4815387	0.7028015	1.0000000	0.4622329	-0.5960608
Business Confidence Index	-0.3892171	0.6720498	0.2258533	0.4622329	1.0000000	-0.3139783
(USD/euro)	0.5569278	-0.4735007	-0.5804776	-0.5960608	-0.3139783	1.0000000

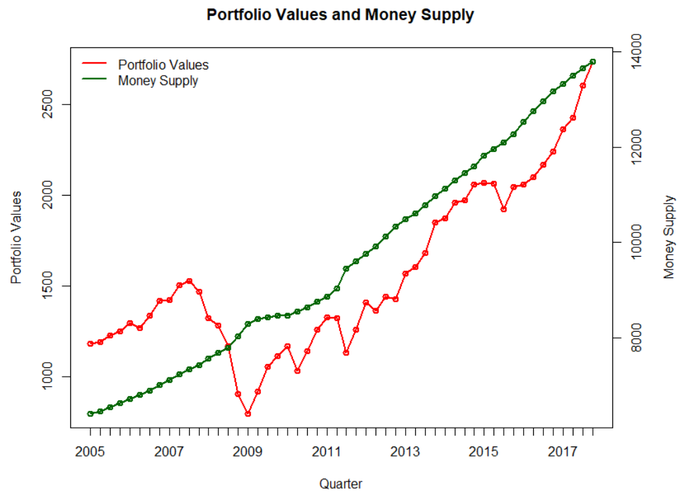
Multicollinearity between:

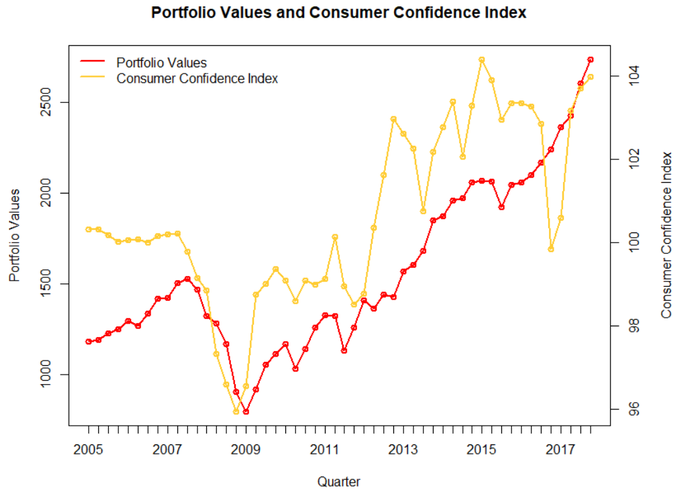
- BBB Corporate Yield and Money Supply
- BBB Corporate Yield and Consumer Confidence Index
- Commercial Real Estate Index and Business Confidence Index
- Money Supply and Consumer Confidence Index

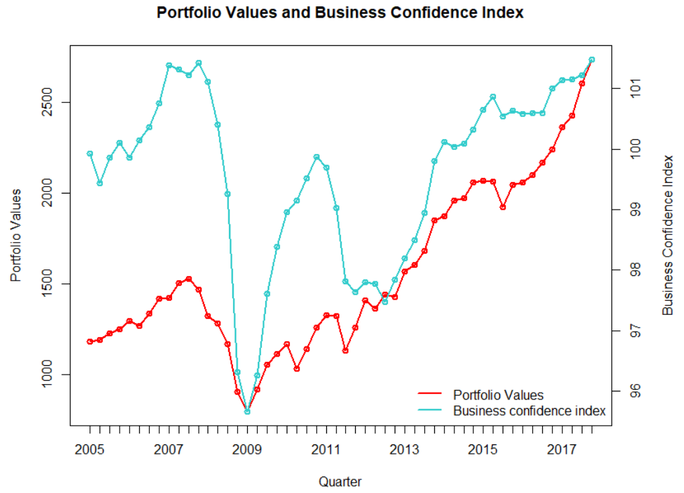
Graphical Analysis

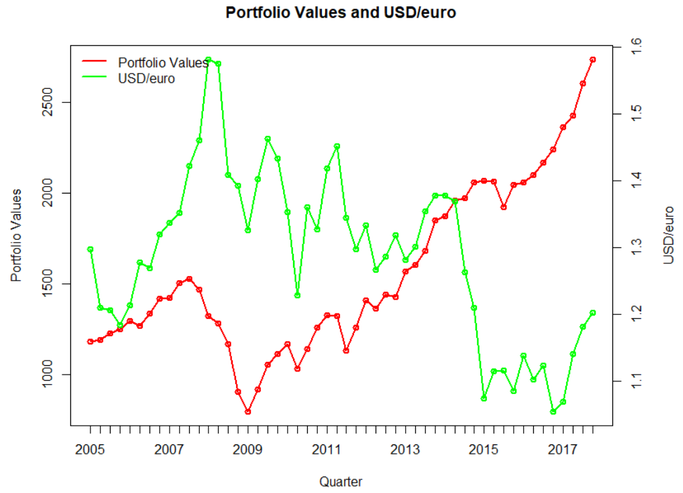












Iteration 2

```
Call:
lm(formula = `Portfolio Values` ~ `BBB Corporate Yeild` + `Commercial Real Estate Price Index` +
    `consumer confidence index` + `Business Confidence Index` +
    `(USD/euro)`, data = df_hismac_port_clean)

Residuals:
    Min      1Q  Median      3Q     Max
-267.75  -84.32  -23.11   85.98  320.50

Coefficients:
                                  Estimate Std. Error t value Pr(>|t|)
(Intercept)                     -1707.4132  2563.7383  -0.666   0.5087
`BBB Corporate Yeild`            -170.3159    26.8638  -6.340 8.94e-08 ***
`Commercial Real Estate Price Index`    8.2727     0.8534   9.694 1.08e-12 ***
`consumer confidence index`          34.9014    17.0428   2.048   0.0463 *
`Business Confidence Index`         -12.6256    18.6890  -0.676   0.5027
`(USD/euro)`                        121.0510   202.0077   0.599   0.5520
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 133.6 on 46 degrees of freedom
Multiple R-squared:  0.9251,    Adjusted R-squared:  0.917
F-statistic: 113.7 on 5 and 46 DF,  p-value: < 2.2e-16
```

Iteration 3

```
Call:
lm(formula = `Portfolio Values` ~ `BBB Corporate Yeild` + `Commercial Real Estate Price Index` +
    `consumer confidence index`, data = df_hismac_port_clean)

Residuals:
    Min      1Q  Median      3Q     Max
-241.11  -90.60  -32.22   92.43  329.48

Coefficients:
                                    Estimate Std. Error t value Pr(>|t|)
(Intercept)                      -2710.5448  1724.1416  -1.572   0.1225
`BBB Corporate Yeild`             -161.9066    24.4895  -6.611  2.9e-08 ***
`Commercial Real Estate Price Index`    7.8067     0.6169  12.656  < 2e-16 ***
`consumer confidence index`            34.4669    16.6673   2.068   0.0441 *
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 131.8 on 48 degrees of freedom
Multiple R-squared:  0.924,     Adjusted R-squared:  0.9193
F-statistic: 194.6 on 3 and 48 DF,  p-value: < 2.2e-16
```

Iteration 4

```
Call:
lm(formula = `Portfolio Values` ~ `BBB Corporate Yeild` + `Commercial Real Estate Price Index`,
    data = df_hismac_port_clean)

Residuals:
    Min      1Q  Median      3Q     Max
-202.08  -81.48  -51.12   98.96  349.28

Coefficients:
                                 Estimate Std. Error t value Pr(>|t|)
(Intercept)                       840.582    159.295   5.277 2.97e-06 ***
`BBB Corporate Yeild`            -202.564     15.081 -13.432  < 2e-16 ***
`Commercial Real Estate Price Index`    8.437      0.554  15.230  < 2e-16 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 136.1 on 49 degrees of freedom
Multiple R-squared:  0.9173,    Adjusted R-squared:  0.9139
F-statistic: 271.6 on 2 and 49 DF,  p-value: < 2.2e-16
```

```
        RESET test

data:  reg_model4
RESET = 12.574, df1 = 2, df2 = 47, p-value = 4.228e-05
```

Iteration 5

```
Call:
lm(formula = `Portfolio Values` ~ log(`BBB Corporate Yeild`) +
    `Commercial Real Estate Price Index`, data = df_hismac_port_clean)

Residuals:
    Min      1Q  Median      3Q     Max
-262.55  -77.52  -31.70   85.73  336.42

Coefficients:
                                      Estimate Std. Error t value Pr(>|t|)
(Intercept)                         1803.2424   208.6873   8.641 2.03e-11 ***
log(`BBB Corporate Yeild`)         -1186.8737    85.7050 -13.848  < 2e-16 ***
`Commercial Real Estate Price Index`     8.0257     0.5484  14.634  < 2e-16 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 132.8 on 49 degrees of freedom
Multiple R-squared:  0.9212,    Adjusted R-squared:  0.9179
F-statistic: 286.3 on 2 and 49 DF,  p-value: < 2.2e-16
```

```
        RESET test

data:  reg_model5
RESET = 6.132, df1 = 2, df2 = 47, p-value = 0.004302
```

Iteration 6

```
Call:
lm(formula = `Portfolio Values` ~ log(`BBB Corporate Yeild`) +
    log(`Commercial Real Estate Price Index`), data = df_hismac_port_clean)

Residuals:
    Min      1Q  Median      3Q     Max
-288.21  -89.63  -34.46   76.25  387.82

Coefficients:
                                        Estimate Std. Error t value Pr(>|t|)
(Intercept)                            -5281.59     715.15  -7.385 1.68e-09 ***
log(`BBB Corporate Yeild`)             -1220.71      91.25 -13.378  < 2e-16 ***
log(`Commercial Real Estate Price Index`)  1654.97     123.28  13.425  < 2e-16 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 142.3 on 49 degrees of freedom
Multiple R-squared:  0.9095,    Adjusted R-squared:  0.9058
F-statistic: 246.2 on 2 and 49 DF,  p-value: < 2.2e-16
```

```
        RESET test

data:  reg_model6
RESET = 9.5636, df1 = 2, df2 = 47, p-value = 0.0003276
```

Iteration 7 - Final Model

```
Call:
lm(formula = log(`Portfolio Values`) ~ log(`BBB Corporate Yeild`) +
    log(`Commercial Real Estate Price Index`), data = df_hismac_port_clean)

Residuals:
      Min        1Q    Median        3Q       Max
-0.168414 -0.054587  0.003137  0.048034  0.160566

Coefficients:
                                          Estimate Std. Error t value Pr(>|t|)
(Intercept)                                3.44342    0.39744   8.664 1.88e-11 ***
log(`BBB Corporate Yeild`)                -0.81726    0.05071 -16.116  < 2e-16 ***
log(`Commercial Real Estate Price Index`)  0.97473    0.06851  14.228  < 2e-16 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.07909 on 49 degrees of freedom
Multiple R-squared:  0.9281,    Adjusted R-squared:  0.9252
F-statistic: 316.3 on 2 and 49 DF,  p-value: < 2.2e-16
```

```
        RESET test

data:  reg_model7
RESET = 0.66685, df1 = 2, df2 = 47, p-value = 0.5181
```

Quantitative Tests

Quantitative Tests

Ramsey Reset Test

```
        RESET test

data:  reg_model7
RESET = 0.66685, df1 = 2, df2 = 47, p-value = 0.5181
```

VIF

```
log(`BBB Corporate Yeild`) log(`Commercial Real Estate Price Index`)
                  1.079015                           1.079015
```

Shapiro Wilk Test

```
        Shapiro-Wilk normality test

data:  reg_model7$residuals
W = 0.98387, p-value = 0.7
```

Jarque-Bera Test

```
        Jarque Bera Test

data:  reg_model7$residuals
X-squared = 0.35066, df = 2, p-value = 0.8392
```

Kolmogorov-Smirnov Test

```
        One-sample Kolmogorov-Smirnov test

data:  res_standard
D = 0.077007, p-value = 0.894
alternative hypothesis: two-sided
```

Breusch Pagan Test

```
        studentized Breusch-Pagan test

data:  reg_model7
BP = 4.3599, df = 2, p-value = 0.113
```

Durbin Watson Test

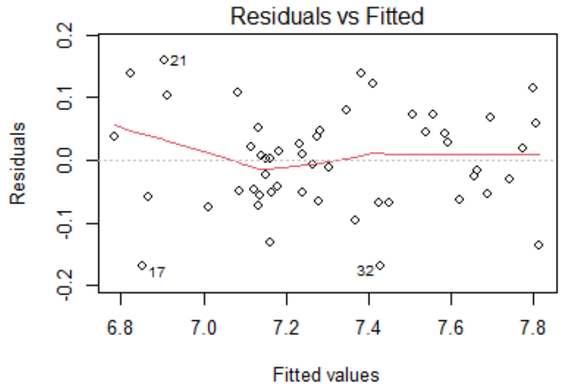
```
 lag Autocorrelation D-W Statistic p-value
   1       0.4429308      1.064331       0
 Alternative hypothesis: rho != 0
```

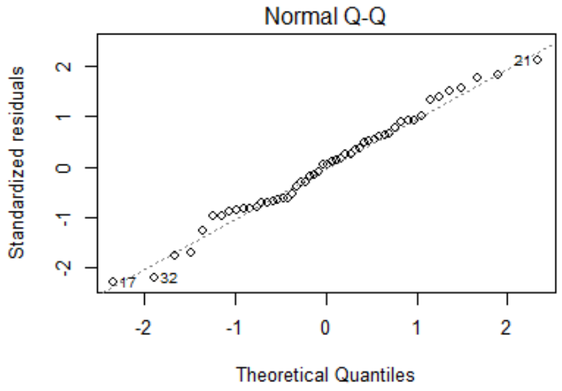
Breusch Godfrey Test

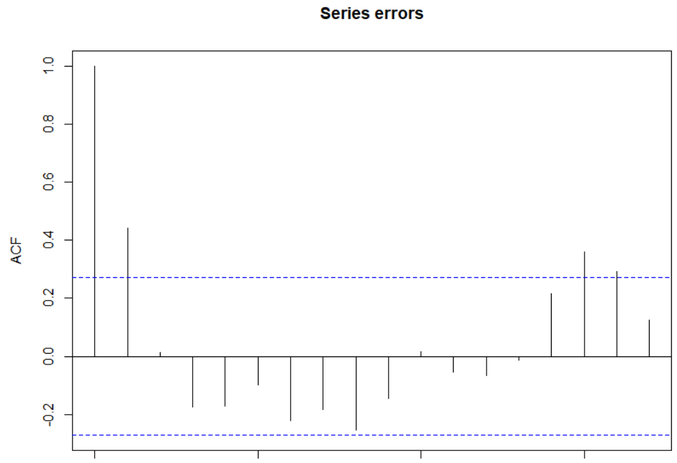
```
        Breusch-Godfrey test for serial correlation of order up to 1

data:  reg_model7
LM test = 10.729, df = 1, p-value = 0.001055
```

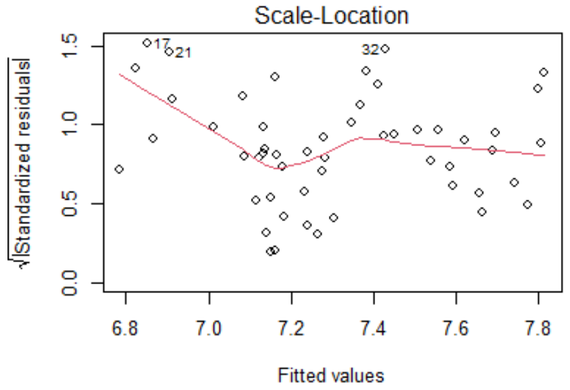

Qualitative Tests

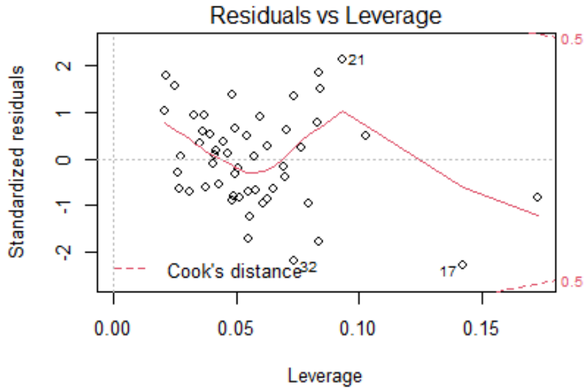
Qualitative Tests

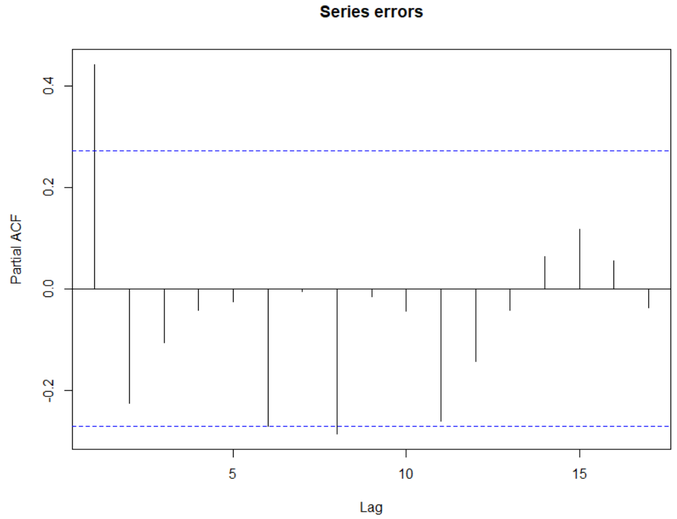






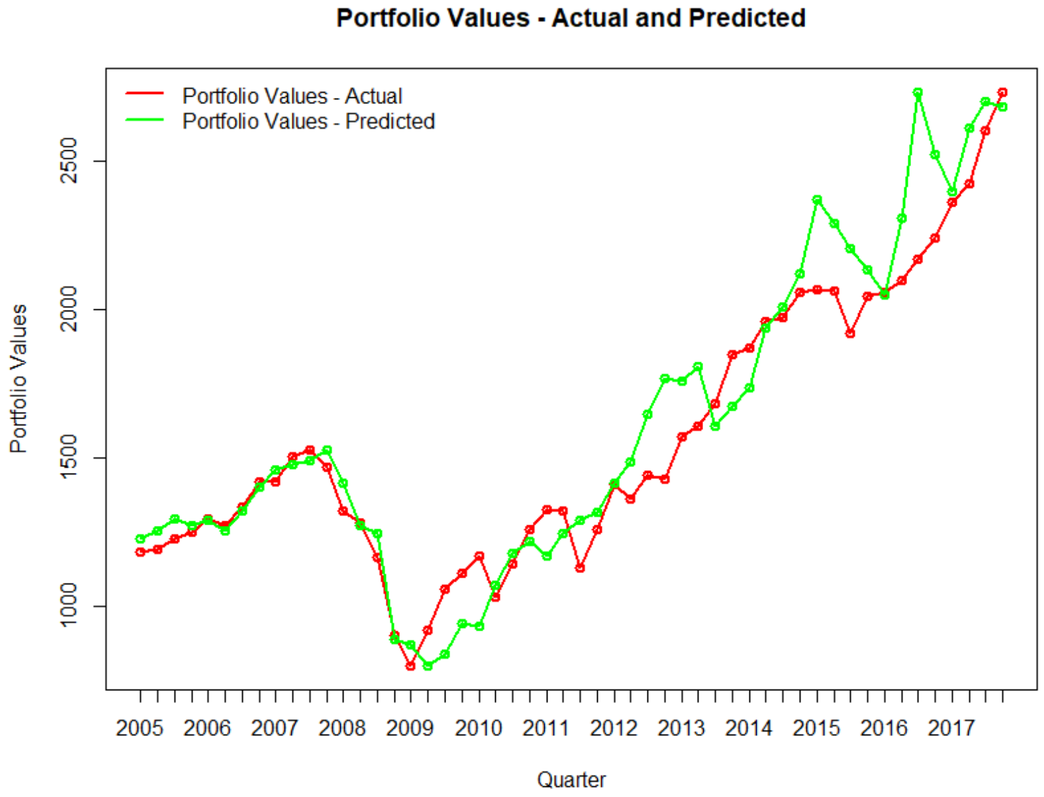




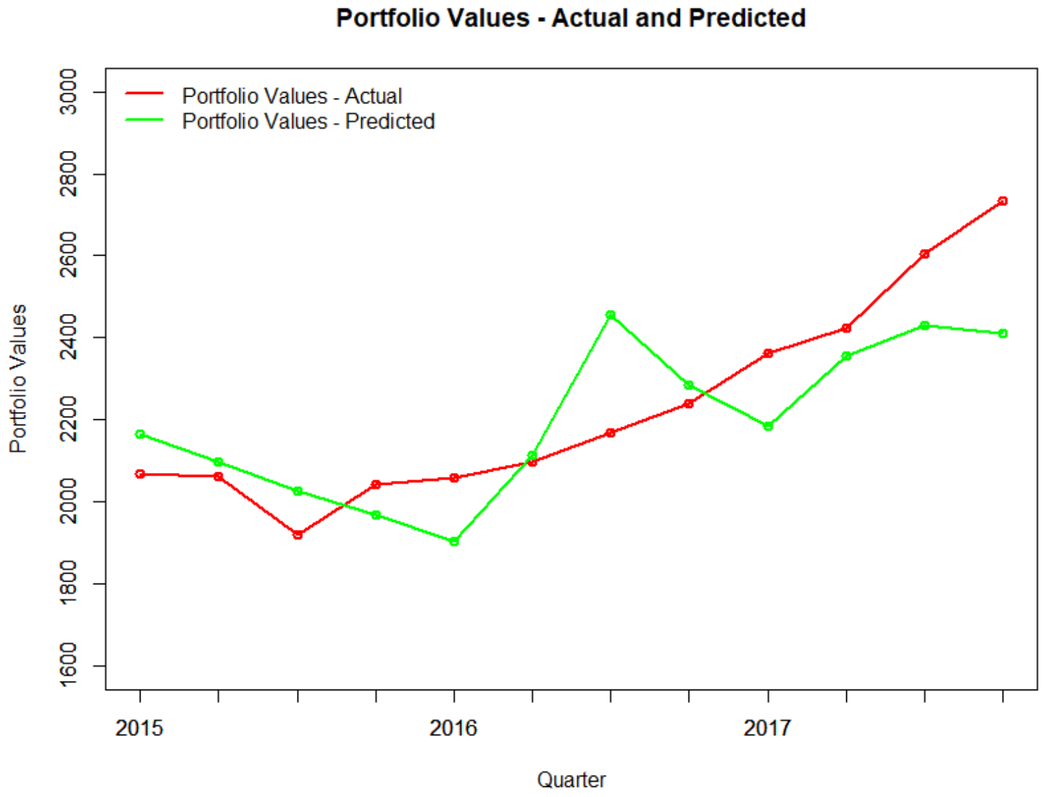


Performance Testing

In sample Analysis



Out of sample Analysis



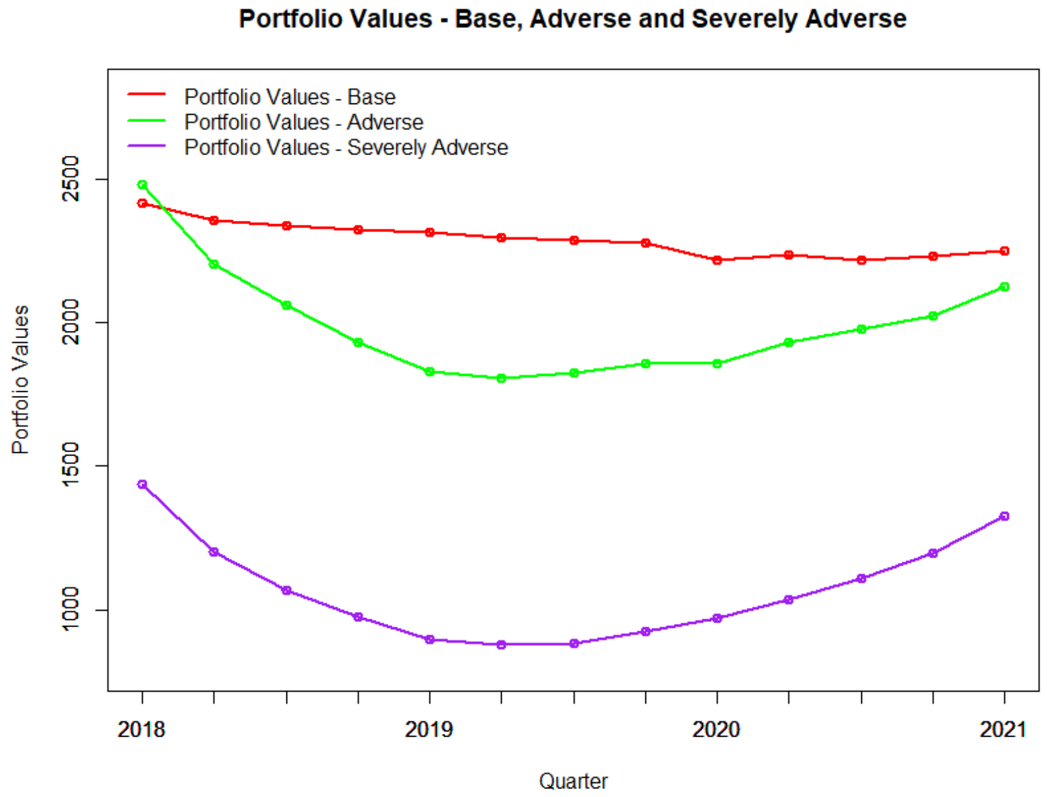

Forecasts

Forecasts

	Base_Portfolio_Values
1	2415.343
2	2355.247
3	2335.038
4	2323.467
5	2312.467
6	2294.546
7	2284.711
8	2275.341
9	2216.089
10	2236.991
11	2215.483
12	2229.193
13	2249.753

	Adverse_Portfolio_Values
1	2481.216
2	2204.375
3	2058.955
4	1932.144
5	1829.265
6	1807.157
7	1823.523
8	1855.857
9	1855.857
10	1932.432
11	1977.146
12	2023.755
13	2123.187

	SevAdve_Portfolio_Values
1	1435.3002
2	1203.1059
3	1070.0554
4	976.2429
5	898.6911
6	877.7037
7	884.8056
8	925.3393
9	970.2475
10	1038.1698
11	1107.9039
12	1199.9182
13	1325.8470



CRP Computation

CRP Computation

CRP = 20% * [(0.5*E9Q(Baseline Scenario) + 0.35*E9Q(Adverse Scenario) +0.15*E9Q(Severely Adverse Scenario)

$166.07

E9Q(Scenario) = Base value of the portfolio - Expected value of the portfolio after 9 quarters in each scenario

Base Value of the portfolio = 2733.48
E9Q(Base) = 517.39
E9Q(Adverse) = 877.6234
E9Q(Severely Adverse) = 1763.23

THANK YOU