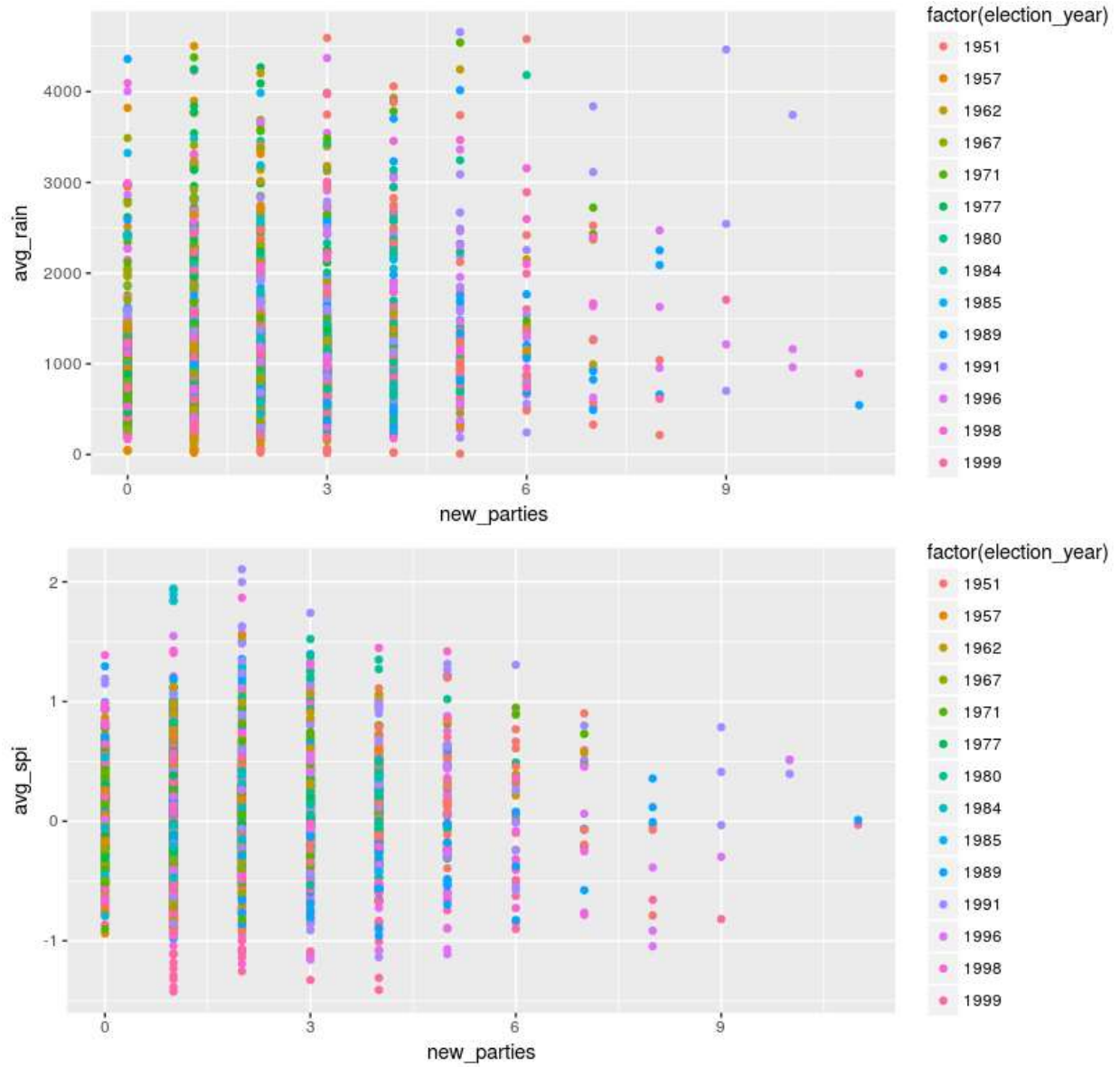


## Assignment 3 Answers

### Question 1A



## Question 1B

```
> model1b_spi <- plm(avg_spi ~ lag_avg_spi + lag_neighbor_avg_spi + factor(years_onto_election) + factor(election_year),
+                    cleanDT, eff .... [TRUNCATED])

> summary(model1b_spi)
Twoways effects Within Model

Call:
plm(formula = avg_spi ~ lag_avg_spi + lag_neighbor_avg_spi +
     factor(years_onto_election) + factor(election_year), data = cleanDT,
     effect = "twoways", model = "within", index = "district")

Unbalanced Panel: n = 212, T = 1-12, N = 2193

Residuals:
    Min.    1st Qu.    Median    3rd Qu.     Max.
-1.246669 -0.292647 -0.024628  0.262729  1.776808

Coefficients: (2 dropped because of singularities)
              Estimate Std. Error t-value Pr(>|t|)
lag_avg_spi      0.264521   0.041910   6.3116 3.411e-10 ***
lag_neighbor_avg_spi -0.117426   0.049538  -2.3704 0.0178637 *
factor(years_onto_election)2  1.671038   0.598731   2.7910 0.0053064 **
factor(years_onto_election)3  1.360200   0.334206   4.0699 4.891e-05 ***
factor(years_onto_election)4  1.938107   0.962880   2.0128 0.0442709 *
factor(years_onto_election)5  1.943122   0.962622   2.0186 0.0436687 *
factor(years_onto_election)6  2.188617   0.630872   3.4692 0.0005334 ***
factor(years_onto_election)7  2.377925   0.995664   2.3883 0.0170223 *
factor(years_onto_election)8  1.257603   1.007547   1.2482 0.2121140
factor(years_onto_election)10  2.634676   0.827711   3.1831 0.0014802 **
factor(years_onto_election)11  1.985328   0.978752   2.0284 0.0426525 *
factor(years_onto_election)15  2.095467   0.721517   2.9043 0.0037228 **
factor(years_onto_election)16  2.392751   1.000561   2.3914 0.0168782 *
factor(election_year)1962      0.067805   0.723733   0.0937 0.9253663
factor(election_year)1967     -0.548558   0.730709  -0.7507 0.4529120
factor(election_year)1971     -0.341845   0.759762  -0.4499 0.6528057
factor(election_year)1977     -0.673778   0.257231  -2.6193 0.0088783 **
factor(election_year)1984     -0.790792   0.818634  -0.9660 0.3341696
factor(election_year)1985     -0.376341   0.832121  -0.4523 0.6511270
factor(election_year)1989     -1.285207   0.839647  -1.5307 0.1260180
factor(election_year)1991     -0.673315   0.450643  -1.4941 0.1353059
factor(election_year)1996     -1.375846   0.898305  -1.5316 0.1257831
factor(election_year)1998     -1.074358   0.548739  -1.9579 0.0503885 .
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Total Sum of Squares:    514.23
Residual Sum of Squares: 443.12
R-Squared:               0.13828
Adj. R-Squared:          0.029342
F-statistic: 13.5766 on 23 and 1946 DF, p-value: < 2.22e-16
```

## Question 1C

```
> model1c_spi <- plm(extreme_weather ~ lag_avg_spi + lag_neighbor_avg_spi + factor(years_onto_election) + factor(election_year),
+                    .... [TRUNCATED])

> summary(model1c_spi)
Twoways effects Within Model

Call:
plm(formula = extreme_weather ~ lag_avg_spi + lag_neighbor_avg_spi +
    factor(years_onto_election) + factor(election_year), data = cleanDT,
    effect = "twoways", model = "within", index = "district")

Unbalanced Panel: n = 212, T = 1-12, N = 2193

Residuals:
    Min.    1st Qu.    Median    3rd Qu.     Max.
-2.07493 -0.58835 -0.06047  0.51312  3.47138

Coefficients: (2 dropped because of singularities)
              Estimate Std. Error t-value Pr(>|t|)
lag_avg_spi      0.461773    0.075321   6.1307 1.056e-09 ***
lag_neighbor_avg_spi -0.440122    0.089028  -4.9436 8.326e-07 ***
factor(years_onto_election)2  0.075910    1.076032   0.0705  0.94377
factor(years_onto_election)3  0.408862    0.600631   0.6807  0.49613
factor(years_onto_election)4  1.644381    1.730476   0.9502  0.34210
factor(years_onto_election)5  2.340212    1.730012   1.3527  0.17630
factor(years_onto_election)6  0.951392    1.133795   0.8391  0.40150
factor(years_onto_election)7  2.654512    1.789395   1.4835  0.13811
factor(years_onto_election)8  3.409937    1.810750   1.8832  0.05983 .
factor(years_onto_election)10 3.236272    1.487552   2.1756  0.02971 *
factor(years_onto_election)11 4.459258    1.759000   2.5351  0.01132 *
factor(years_onto_election)15 1.473249    1.296701   1.1362  0.25603
factor(years_onto_election)16 5.605971    1.798194   3.1176  0.00185 **
factor(election_year)1962    -1.900049    1.300684  -1.4608  0.14423
factor(election_year)1967    -1.739131    1.313220  -1.3243  0.18555
factor(election_year)1971    -1.486976    1.365435  -1.0890  0.27628
factor(election_year)1977     0.263236    0.462293   0.5694  0.56914
factor(election_year)1984    -1.021074    1.471238  -0.6940  0.48775
factor(election_year)1985    -1.528829    1.495477  -1.0223  0.30677
factor(election_year)1989    -1.367784    1.509003  -0.9064  0.36483
factor(election_year)1991     0.356062    0.809889   0.4396  0.66024
factor(election_year)1996    -1.295132    1.614421  -0.8022  0.42252
factor(election_year)1998     0.056469    0.986187   0.0573  0.95434
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Total Sum of Squares:    1754.6
Residual Sum of Squares: 1431.2
R-Squared:              0.18428
Adj. R-Squared:         0.081168
F-statistic: 19.1146 on 23 and 1946 DF, p-value: < 2.22e-16
```

```

> model1c_rain <- plm(extreme_weather ~ lag_avg_rain + lag_neighbor_avg_rain + factor(years_onto_election) + factor(election_year),
+ .... [TRUNCATED]

> summary(model1c_rain)
Twoways effects Within Model

Call:
plm(formula = extreme_weather ~ lag_avg_rain + lag_neighbor_avg_rain +
    factor(years_onto_election) + factor(election_year), data = cleanDT,
    effect = "twoways", model = "within", index = "district")

Unbalanced Panel: n = 212, T = 1-12, N = 2193

Residuals:
    Min.    1st Qu.    Median    3rd Qu.     Max.
-2.113025 -0.568188 -0.058554  0.510106  3.443358

Coefficients: (2 dropped because of singularities)
              Estimate Std. Error t-value Pr(>|t|)
lag_avg_rain      0.00105034  0.00011729  8.9548 < 2.2e-16 ***
lag_neighbor_avg_rain -0.00065447  0.00013252 -4.9387 8.538e-07 ***
factor(years_onto_election)2  0.07079476  1.06322553  0.0666  0.94692
factor(years_onto_election)3  0.35594722  0.59388846  0.5994  0.54901
factor(years_onto_election)4  1.48468350  1.71178117  0.8673  0.38587
factor(years_onto_election)5  2.25687596  1.71039768  1.3195  0.18716
factor(years_onto_election)6  0.92223193  1.12064295  0.8229  0.41064
factor(years_onto_election)7  2.60530711  1.76861600  1.4731  0.14089
factor(years_onto_election)8  3.19722143  1.78953171  1.7866  0.07415 .
factor(years_onto_election)10 3.23372812  1.46992101  2.1999  0.02793 *
factor(years_onto_election)11 4.31827307  1.73877970  2.4835  0.01309 *
factor(years_onto_election)15 1.35505774  1.28243437  1.0566  0.29081
factor(years_onto_election)16 5.48801454  1.77777995  3.0870  0.00205 **
factor(election_year)1962    -1.85329442  1.28669899 -1.4403  0.14993
factor(election_year)1967    -1.70623462  1.29900403 -1.3135  0.18917
factor(election_year)1971    -1.35646595  1.35099897 -1.0040  0.31548
factor(election_year)1977     0.25033850  0.45706559  0.5477  0.58396
factor(election_year)1984    -0.90891315  1.45584959 -0.6243  0.53249
factor(election_year)1985    -1.42800264  1.47762827 -0.9664  0.33396
factor(election_year)1989    -1.30366490  1.49224080 -0.8736  0.38243
factor(election_year)1991     0.37286500  0.80074804  0.4656  0.64152
factor(election_year)1996    -1.23103604  1.59610785 -0.7713  0.44064
factor(election_year)1998     0.06196664  0.97452782  0.0636  0.94931
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Total Sum of Squares: 1754.6
Residual Sum of Squares: 1400.8
R-Squared: 0.20163
Adj. R-Squared: 0.10071
F-statistic: 21.3687 on 23 and 1946 DF, p-value: < 2.22e-16

```

## Question 2

```
> # Question 2 -----
> library(pglm)

> model2 <- pglm(new_parties ~ extreme_weather + factor(years_onto_election),
+               cleanDT, effect = "twoways", model = "within", index = .... [TRUNCATED]

> summary(model2)
-----
Maximum Likelihood estimation
Newton-Raphson maximisation, 3 iterations
Return code 1: gradient close to zero
Log-Likelihood: -3589.45
16 free parameters
Estimates:

```

	Estimate	Std. error	t value	Pr(>  t )
extreme_weather	0.007877	0.015556	0.506	0.612598
factor(years_onto_election)2	0.170410	0.059926	2.844	0.004460 **
factor(years_onto_election)3	0.500151	0.064409	7.765	8.15e-15 ***
factor(years_onto_election)4	-0.237080	0.065057	-3.644	0.000268 ***
factor(years_onto_election)5	0.063458	0.058629	1.082	0.279087
factor(years_onto_election)6	0.010490	0.063968	0.164	0.869736
factor(years_onto_election)7	0.220055	0.176093	1.250	0.211429
factor(years_onto_election)8	0.161677	0.239083	0.676	0.498889
factor(years_onto_election)10	-0.164774	0.603312	-0.273	0.784764
factor(years_onto_election)11	-0.287326	0.332484	-0.864	0.387489
factor(years_onto_election)12	0.463121	0.117403	3.945	7.99e-05 ***
factor(years_onto_election)15	-0.781524	0.592811	-1.318	0.187391
factor(years_onto_election)16	0.150546	0.343109	0.439	0.660828
factor(years_onto_election)17	0.741067	0.156981	4.721	2.35e-06 ***
factor(years_onto_election)22	0.445690	0.182348	2.444	0.014519 *
factor(years_onto_election)32	0.372872	0.229447	1.625	0.104143

```
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
-----
```

### Question 3

```
> # Question 3 -----
> cleanDT <- cleanDT[, neighbor_extreme_weather := (neighbor_flood_cnt + neighbor_drought_cnt)]

> library(pglm)

> model3 <- pglm(new_parties ~ extreme_weather + neighbor_extreme_weather + factor(years_onto_election),
+               cleanDT, effect = "twoways" .... [TRUNCATED]

> summary(model3)
-----
Maximum Likelihood estimation
Newton-Raphson maximisation, 3 iterations
Return code 1: gradient close to zero
Log-Likelihood: -3444.172
17 free parameters
Estimates:

              Estimate Std. error t value Pr(> t)
extreme_weather      0.021759   0.020318    1.071 0.284218
neighbor_extreme_weather -0.009173   0.005582   -1.643 0.100341
factor(years_onto_election)2  0.156077   0.061074    2.556 0.010602 *
factor(years_onto_election)3  0.502467   0.065662    7.652 1.97e-14 ***
factor(years_onto_election)4 -0.223484   0.066575   -3.357 0.000788 ***
factor(years_onto_election)5  0.087208   0.061444    1.419 0.155809
factor(years_onto_election)6  0.027272   0.067284    0.405 0.685236
factor(years_onto_election)7  0.242643   0.180469    1.345 0.178783
factor(years_onto_election)8  0.215452   0.253110    0.851 0.394648
factor(years_onto_election)10 -0.135513   0.603712   -0.224 0.822395
factor(years_onto_election)11 -0.251315   0.333224   -0.754 0.450734
factor(years_onto_election)12  0.480768   0.118721    4.050 5.13e-05 ***
factor(years_onto_election)15 -0.783765   0.592871   -1.322 0.186174
factor(years_onto_election)16  0.153445   0.343751    0.446 0.655319
factor(years_onto_election)17  0.741178   0.159485    4.647 3.36e-06 ***
factor(years_onto_election)22  0.458004   0.190682    2.402 0.016309 *
factor(years_onto_election)32  0.381056   0.256904    1.483 0.138005
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
-----
```

### Question 4

```
> # Question 4 -----
> library(pglm)

> model4 <- pglm(political_concentration ~ extreme_weather + neighbor_extreme_weather + factor(years_onto_election),
+               cleanDT, effect .... [TRUNCATED]

> summary(model4)
-----
Maximum Likelihood estimation
Newton-Raphson maximisation, 3 iterations
Return code 2: successive function values within tolerance limit
Log-Likelihood: -472745.8
17 free parameters
Estimates:

              Estimate Std. error t value Pr(> t)
extreme_weather      -0.0288962   0.0006944  -41.61 <2e-16 ***
neighbor_extreme_weather -0.0035885   0.0001873  -19.16 <2e-16 ***
factor(years_onto_election)2 -0.4091406   0.0025014 -163.57 <2e-16 ***
factor(years_onto_election)3 -0.0719923   0.0027500  -26.18 <2e-16 ***
factor(years_onto_election)4  0.0964889   0.0023029   41.90 <2e-16 ***
factor(years_onto_election)5  0.0946316   0.0022259   42.52 <2e-16 ***
factor(years_onto_election)6  0.6153091   0.0023383  263.14 <2e-16 ***
factor(years_onto_election)7 -0.8196872   0.0113772  -72.05 <2e-16 ***
factor(years_onto_election)8 -0.1214957   0.0100928  -12.04 <2e-16 ***
factor(years_onto_election)10  0.3650913   0.0177092   20.62 <2e-16 ***
factor(years_onto_election)11  0.5944881   0.0068126   87.26 <2e-16 ***
factor(years_onto_election)12  0.6171954   0.0040983  150.60 <2e-16 ***
factor(years_onto_election)15  1.2800851   0.0110860  115.47 <2e-16 ***
factor(years_onto_election)16  0.5459597   0.0124105   43.99 <2e-16 ***
factor(years_onto_election)17  0.6691637   0.0057687  116.00 <2e-16 ***
factor(years_onto_election)22  0.8305019   0.0064113  129.54 <2e-16 ***
factor(years_onto_election)32  0.9642177   0.0092025  104.78 <2e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
-----
```

## Question 5

```
> summary(model5_a)
-----
Maximum Likelihood estimation
Newton-Raphson maximisation, 3 iterations
Return code 1: gradient close to zero
Log-Likelihood: -1257.81
13 free parameters
Estimates:

```

	Estimate	Std. error	t value	Pr(> t)
extreme_weather	8.578e-02	4.212e-02	2.036	0.041723 *
factor(years_onto_election)2	7.272e-01	1.437e-01	5.061	4.17e-07 ***
factor(years_onto_election)3	-1.209e+00	2.661e-01	-4.543	5.54e-06 ***
factor(years_onto_election)4	-7.899e-01	1.823e-01	-4.332	1.48e-05 ***
factor(years_onto_election)5	5.118e-01	1.460e-01	3.505	0.000457 ***
factor(years_onto_election)6	-7.648e-01	1.984e-01	-3.855	0.000116 ***
factor(years_onto_election)7	6.782e-01	3.457e-01	1.962	0.049751 *
factor(years_onto_election)8	-1.536e+01	1.188e+03	-0.013	0.989682
factor(years_onto_election)10	-1.400e-01	1.066e+00	-0.131	0.895493
factor(years_onto_election)11	-3.160e-01	7.546e-01	-0.419	0.675412
factor(years_onto_election)15	-1.519e+01	1.500e+03	-0.010	0.991924
factor(years_onto_election)16	-2.421e-02	7.905e-01	-0.031	0.975570
lag_neighbor_extreme_weather	-6.738e-03	1.007e-02	-0.669	0.503428

```
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
-----

> model5_b <- pglm(not_from_neighbor ~ extreme_weather + factor(years_onto_election) + lag_neighbor_extreme_weather,
+                  cleanDT, effe .... [TRUNCATED])

> summary(model5_b)
-----
Maximum Likelihood estimation
Newton-Raphson maximisation, 3 iterations
Return code 2: successive function values within tolerance limit
Log-Likelihood: -2623.333
13 free parameters
Estimates:

```

	Estimate	Std. error	t value	Pr(> t)
extreme_weather	0.007656	0.021378	0.358	0.7202
factor(years_onto_election)2	-0.013093	0.073098	-0.179	0.8578
factor(years_onto_election)3	0.680571	0.078315	8.690	< 2e-16 ***
factor(years_onto_election)4	-0.148084	0.074349	-1.992	0.0464 *
factor(years_onto_election)5	-0.083263	0.070673	-1.178	0.2387
factor(years_onto_election)6	-0.426388	0.085547	-4.984	6.22e-07 ***
factor(years_onto_election)7	0.043331	0.221248	0.196	0.8447
factor(years_onto_election)8	0.259428	0.264411	0.981	0.3265
factor(years_onto_election)10	-0.140365	0.747219	-0.188	0.8510
factor(years_onto_election)11	-0.084025	0.380092	-0.221	0.8250
factor(years_onto_election)15	-0.420074	0.605502	-0.694	0.4878
factor(years_onto_election)16	0.188729	0.391683	0.482	0.6299
lag_neighbor_extreme_weather	-0.005446	0.004693	-1.161	0.2458

```
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
-----
```

Note : The code submitted runs without any errors. Env variables are cleaned to keep only the useful ones in the environment. 1<sup>st</sup> line of the code, change the directory to downloaded dir and place the datasets in the directory same as the R file. Approx. running time on 16GB machine ~2 Mins.