Exercise 2

Calculate total crime per month and plot the time series of crime.

	Group.1 <chr>	x <int>
1	2002-01-01	38405
2	2002-02-01	33909
3	2002-03-01	38583
4	2002-04-01	40032
5	2002-05-01	42913
6	2002-06-01	42834

Description: df[,2] [6 x 2]

6 rows
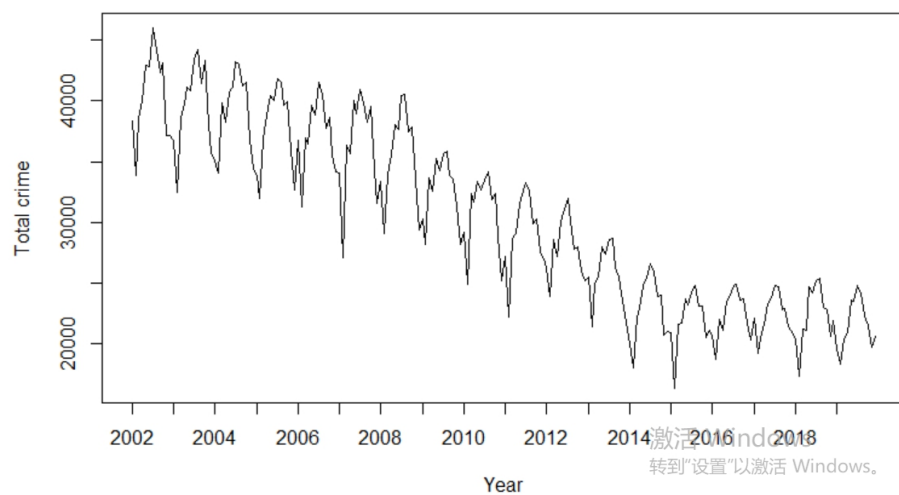
Merge the two datasets by districts-units and period.

	mu <chr>	month <date>	unit <chr>	period <int>	tot_pop <int>	tot_white <int>	tot_black <int>	tot_hisp <int>
1	2005-01-01sss1	2005-01-01	1	1	38472	22608	4953	2543
2	2005-01-01sss1	2005-01-01	1	1	38472	22608	4953	2543
3	2005-01-01sss1	2005-01-01	1	1	38472	22608	4953	2543
4	2005-01-01sss1	2005-01-01	1	1	38472	22608	4953	2543
5	2005-01-01sss10	2005-01-01	10	1	117209	4204	39545	72559
6	2005-01-01sss10	2005-01-01	10	1	117209	4204	39545	72559

Description: df[,11] [6 x 11]

6 rows | 1-9 of 11 columns

Construct a panel data of unit over time

Description: df[,10] [6 x 10]

mu <chr>	month <date>	unit <chr>	tc <dbl>	vc <dbl>	pc <dbl>	inc <dbl>	white <dbl>	black <dbl>	hisp <dbl>
2005-01-01sss1	2005-01-01	1	0.040263048	0.005510501	0.020378457	91084.91	0.58764816	0.1287430	0.06610002
2005-01-01sss10	2005-01-01	10	0.011901816	0.003762510	0.003924613	29147.49	0.03586755	0.3373888	0.61905656
2005-01-01sss11	2005-01-01	11	0.031884018	0.008651667	0.007711869	26337.89	0.02479407	0.8434408	0.11737796
2005-01-01sss12	2005-01-01	12	0.018846924	0.004912072	0.008636937	52560.59	0.31138978	0.1741782	0.41249536
2005-01-01sss13	2005-01-01	13	0.007464259	0.001931926	0.004057045	61949.53	0.51589448	0.1838842	0.24804173
2005-01-01sss14	2005-01-01	14	0.010347193	0.002504153	0.005578559	61849.46	0.41737535	0.0722320	0.46087158

6 rows | 2-11 of 10 columns

Exercise 3

```
Coefficients:
(Intercept)      tenure        crime       p50_inc        black        white         hisp
  5.067e-01   -4.161e-06    2.230e-07    1.618e-08   -8.102e-03   -1.207e-02   -5.363e-03
```

Exercise 4

Call:

lm(formula = "arrest ~ tenure + crime + p50_inc + black + white + hisp + factor(unit) + factor(month)",

    data = officer_pop_crime)

Coefficients:

(Intercept)	tenure	crime
6.362e-01	-3.810e-06	-6.320e-06
p50_inc	black	white
-4.910e-07	-9.201e-02	-1.013e-01
hisp	factor(unit)2	factor(unit)3
-1.398e-01	-2.438e-02	-2.001e-02
factor(unit)4	factor(unit)5	factor(unit)6
-3.633e-05	-1.580e-02	-1.386e-02
factor(unit)7	factor(unit)8	factor(unit)9
-2.109e-02	2.343e-02	3.110e-03
factor(unit)10	factor(unit)11	factor(unit)12
7.682e-03	-1.134e-02	4.412e-04
factor(unit)13	factor(unit)14	factor(unit)15
-3.064e-03	2.441e-02	-2.027e-02
factor(unit)16	factor(unit)17	factor(unit)18
7.288e-03	1.080e-03	4.017e-03
factor(unit)19	factor(unit)20	factor(unit)21
8.935e-03	-1.545e-02	-3.672e-02

	factor(unit)22	factor(unit)23	factor(unit)24
	-6.345e-04	-1.097e-02	-1.540e-02

	factor(unit)25	factor(month)2007-02-01	factor(month)2007-03-01
	2.203e-02	2.747e-03	5.425e-03

factor(month)2007-04-01	factor(month)2007-05-01	factor(month)2007-06-01
-4.433e-03	9.642e-03	-1.518e-02

factor(month)2007-07-01	factor(month)2007-08-01	factor(month)2007-09-01
-2.476e-03	-9.283e-03	2.832e-03

factor(month)2007-10-01	factor(month)2007-11-01	factor(month)2007-12-01
5.532e-03	3.270e-03	-8.522e-03

factor(month)2008-01-01	factor(month)2008-02-01	factor(month)2008-03-01
-1.580e-02	-7.936e-03	-7.042e-03

factor(month)2008-04-01	factor(month)2008-05-01	factor(month)2008-06-01
7.880e-03	1.890e-02	1.043e-03

factor(month)2008-07-01	factor(month)2008-08-01	factor(month)2008-09-01
-1.992e-05	1.040e-03	9.368e-03

factor(month)2008-10-01	factor(month)2008-11-01	factor(month)2008-12-01
-3.356e-03	-1.542e-03	1.093e-02

factor(month)2009-01-01	factor(month)2009-02-01	factor(month)2009-03-01
-6.007e-03	-5.783e-03	-8.894e-03

factor(month)2009-04-01	factor(month)2009-05-01	factor(month)2009-06-01
-4.911e-03	-1.545e-03	4.206e-03

factor(month)2009-07-01	factor(month)2009-08-01	factor(month)2009-09-01
5.471e-03	-4.667e-03	-4.795e-03

factor(month)2009-10-01	factor(month)2009-11-01	factor(month)2009-12-01
-1.586e-03	-5.210e-03	-9.886e-03

factor(month)2010-01-01	factor(month)2010-02-01	factor(month)2010-03-01
1.815e-03	3.620e-03	-8.878e-03

factor(month)2010-04-01	factor(month)2010-05-01	factor(month)2010-06-01
7.082e-03	-3.414e-03	-5.868e-03

factor(month)2010-07-01	factor(month)2010-08-01	factor(month)2010-09-01
-1.353e-02	9.875e-03	2.215e-03

factor(month)2010-10-01	factor(month)2010-11-01	factor(month)2010-12-01
-2.548e-03	-9.175e-03	-4.759e-03

factor(month)2011-01-01	factor(month)2011-02-01	factor(month)2011-03-01
-8.207e-03	-5.389e-03	-4.549e-03

factor(month)2011-04-01	factor(month)2011-05-01	factor(month)2011-06-01
-1.189e-03	-5.307e-04	1.207e-04

factor(month)2011-07-01	factor(month)2011-08-01	factor(month)2011-09-01
4.004e-03	-1.043e-04	-1.135e-02

factor(month)2011-10-01	factor(month)2011-11-01	factor(month)2011-12-01
1.049e-02	-6.974e-03	2.879e-04

factor(month)2012-01-01	factor(month)2012-02-01	factor(month)2012-03-01
-1.045e-02	2.973e-03	1.820e-03

factor(month)2012-04-01	factor(month)2012-05-01	factor(month)2012-06-01
4.576e-03	4.361e-03	-2.065e-03
factor(month)2012-07-01	factor(month)2012-08-01	factor(month)2012-09-01
6.781e-04	-5.126e-03	2.322e-03
factor(month)2012-10-01	factor(month)2012-11-01	factor(month)2012-12-01
-1.458e-02	3.463e-03	-1.687e-02
factor(month)2013-01-01	factor(month)2013-02-01	factor(month)2013-03-01
3.795e-03	-8.078e-03	-1.585e-02
factor(month)2013-04-01	factor(month)2013-05-01	factor(month)2013-06-01
3.512e-03	1.411e-02	7.059e-03
factor(month)2013-07-01	factor(month)2013-08-01	factor(month)2013-09-01
1.753e-02	-2.732e-03	3.037e-03
factor(month)2013-10-01	factor(month)2013-11-01	factor(month)2013-12-01
-8.699e-03	-5.810e-03	3.319e-03
factor(month)2014-01-01	factor(month)2014-02-01	factor(month)2014-03-01
-1.496e-02	2.499e-03	-4.441e-03
factor(month)2014-04-01	factor(month)2014-05-01	factor(month)2014-06-01
-1.862e-02	-5.901e-03	-1.761e-03
factor(month)2014-07-01	factor(month)2014-08-01	factor(month)2014-09-01
5.575e-03	-1.113e-03	1.055e-03
factor(month)2014-10-01	factor(month)2014-11-01	factor(month)2014-12-01
-1.730e-03	-8.539e-03	-7.021e-03
factor(month)2015-01-01	factor(month)2015-02-01	factor(month)2015-03-01
-4.922e-03	-9.308e-03	4.154e-03
factor(month)2015-04-01	factor(month)2015-05-01	factor(month)2015-06-01
-3.524e-03	-6.722e-03	-7.111e-03
factor(month)2015-07-01	factor(month)2015-08-01	factor(month)2015-09-01
-8.631e-03	-5.341e-03	-1.012e-03
factor(month)2015-10-01	factor(month)2015-11-01	factor(month)2015-12-01
-8.335e-03	2.320e-03	-7.373e-03
factor(month)2016-01-01	factor(month)2016-02-01	factor(month)2016-03-01
-5.344e-03	-7.099e-03	-1.453e-02
factor(month)2016-04-01	factor(month)2016-05-01	factor(month)2016-06-01
9.818e-03	9.858e-03	-5.147e-03
factor(month)2016-07-01	factor(month)2016-08-01	factor(month)2016-09-01
-1.082e-02	-1.921e-02	-1.542e-03
factor(month)2016-10-01	factor(month)2016-11-01	factor(month)2016-12-01
3.118e-03	-1.398e-02	-1.290e-02
factor(month)2017-01-01	factor(month)2017-02-01	factor(month)2017-03-01
8.784e-05	-5.838e-03	6.054e-03
factor(month)2017-04-01	factor(month)2017-05-01	factor(month)2017-06-01
-5.738e-03	8.410e-03	-1.219e-02
factor(month)2017-07-01	factor(month)2017-08-01	factor(month)2017-09-01
-6.123e-03	-2.664e-03	-8.493e-03

factor(month)2017-10-01   factor(month)2017-11-01   factor(month)2017-12-01
      -9.683e-03   -1.685e-02   -8.924e-03

Exercise 5

Within estimator

```
Coefficients:
                        Estimate
tenure_within          1.088e-04
tc_within              4.847e-01
inc_within            -3.845e-07
black_within          -6.888e-02
hisp within           -5 333e-02
```

Between estimator

```
Coefficients:
                Estimate
(Intercept)     9.361e-01
tenure          1.064e-05
tc             -1.197e+00
inc             1.470e-06
black          -3.028e-01
hisp           -4.093e-01
white          -8.167e-01
```

first diffference estimator

```
Coefficients:
                 Estimate
(Intercept)      1.252e-02
tenure           1.355e-04
tc               2.745e-01
inc             -7.910e-07
black           -2.565e-02
hisp            -3.495e-02
white            2.325e-02
```

compare the estimated values

within:1.088e-04
between:1.064e-05
first difference:1.355e-04
The between estimator is the smallest. The first difference estimator is the largest.