testing_mortality_world

June 1, 2020

0.1 Covid case/mortality analysis for 173 countries

We use data from this site:

https://www.ecdc.europa.eu/en/publications-data/download-todays-data-geographic-distribution-covid-19-cases-worldwide

Download the csv data file and save it in the working directory with the file name "ecdpc.csv".

```
[1]: import numpy as np
     import statsmodels.api as sm
     import pandas as pd
     from datetime import datetime
```

Load the data

```
[2]: df = pd.read_csv("ecdpc.csv")
```

Simplify some variable names

```
[3]: df["country"] = df.countryterritoryCode
     df = df.loc[pd.notnull(df.country), :]
```

Clean up the dates

```
[4]: def f(x):
         u = x.split("/")
         return "%s-%s-%s" % tuple(u[::-1])
     df["date_rep"] = df.dateRep.apply(f)
     df["date"] = pd.to_datetime(df.date_rep)
```

Remove meaningless rows with future dates.

```
[5]: today = datetime.today().strftime('%Y-%m-%d')
     today = pd.to_datetime(today)
     df = df.loc[df.date <= today]
```

Only keep countries having at least one month of data

```
[6]: n = df.groupby("country").size()
     n = n[n > 30]
     df = df.loc[df.country.isin(n.index), :]
     print(df.country.unique().size)
```

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Sort first by country, then within country by date.

```
[7]: df = df.sort_values(["country", "date"])
```

Days is the number of calendar days in 2020 for each record.

```
[8]: df["days"] = (df.date - pd.to_datetime("2020-01-01")).dt.days
```

Create variables containing the number of new cases within a week, for each of the four weeks preceding the current day.

```
[9]: # Sum x from d2 days back in time to d1 days back in time, inclusive of
     # both endpoints.  d2 must be greater than d1.
     def wsum(x, d1, d2):
         w = np.ones(d2 + 1)
         if d1 > 0:
             w[-d1:] = 0
         y = np.zeros_like(x)
         y[d2:] = np.convolve(x.values, w[::-1], mode='valid')
         return y

     for j in range(4):
         xx = df.groupby("country").cases.transform(lambda x: wsum(x, 7*j, 7*j+6))
         df["cumpos%d" % j] = df.groupby("country").cases.transform(lambda x:␣
      ↪wsum(x, 7*j, 7*j+6))
         df["logcumpos%d" % j] = np.log(df["cumpos%d" % j] + 1)
```

```
/nfs/kshedden/python3/lib/python3.7/site-packages/pandas/core/series.py:853:
RuntimeWarning: invalid value encountered in log
  result = getattr(ufunc, method)(*inputs, **kwargs)
```

Calculate the date of the first death in each country, then remove data prior to 10 days after this date. rdays is the number of days in each country since its first reported Covid death.

```
[10]: def firstdeath(x):
          if (x.deaths == 0).all():
              return np.inf
          ii = np.flatnonzero(x.deaths > 0)[0]
          return x.date.iloc[ii]

      xx = df.groupby("country").apply(firstdeath)
      xx.name = "firstdeath"
      df = pd.merge(df, xx, left_on="country", right_index=True)

      df["rdays"] = (df.date - df.firstdeath).dt.days
      df = df.loc[df.rdays >= 10, :]
```

Here is a basic regression analysis looking at all the countries, with data filtered as described above.

```
[11]: fml = "deaths ~ 0 + C(country) + "
      fml += "logcumpos0 + logcumpos1 + logcumpos2 + logcumpos3"
      m1 = sm.GEE.from_formula(fml, groups="country", data=df, family=sm.families.
       ↪Poisson())
```

```
r1 = m1.fit(scale="X2")
print(r1.summary())
```

```
                        GEE Regression Results
================================================================================
===
Dep. Variable:                      deaths   No. Observations:
8586
Model:                                 GEE   No. clusters:
173
Method:                        Generalized   Min. cluster size:
12
                      Estimating Equations   Max. cluster size:
123
Family:                            Poisson   Mean cluster size:
49.6
Dependence structure:         Independence   Num. iterations:
2
Date:                     Mon, 01 Jun 2020   Scale:
33.046
Covariance type:                    robust   Time:
13:29:26
================================================================================
===
                    coef    std err          z      P>|z|      [0.025
0.975]
--------------------------------------------------------------------------------
---
C(country)[ABW]   -3.9114      0.063    -61.801      0.000      -4.035
-3.787
C(country)[AFG]   -4.3143      0.447     -9.650      0.000      -5.191
-3.438
C(country)[AGO]   -5.3809      0.132    -40.838      0.000      -5.639
-5.123
C(country)[ALB]   -4.6574      0.304    -15.335      0.000      -5.253
-4.062
C(country)[AND]   -3.9173      0.327    -11.968      0.000      -4.559
-3.276
C(country)[ARE]   -5.2399      0.517    -10.127      0.000      -6.254
-4.226
C(country)[ARG]   -3.7832      0.437     -8.662      0.000      -4.639
-2.927
C(country)[ARM]   -5.0287      0.407    -12.343      0.000      -5.827
-4.230
C(country)[ATG]   -4.0133      0.067    -59.777      0.000      -4.145
-3.882
C(country)[AUS]   -5.1046      0.459    -11.131      0.000      -6.003
```

3

	coef	std err	z	P>|z|	[0.025	0.975]
						-4.206
C(country)[AUT]	-3.9337	0.510	-7.712	0.000	-4.933	-2.934
C(country)[AZE]	-5.2982	0.387	-13.708	0.000	-6.056	-4.541
C(country)[BDI]	-29.5319	1.007	-29.334	0.000	-31.505	-27.559
C(country)[BEL]	-2.3761	0.566	-4.197	0.000	-3.486	-1.266
C(country)[BEN]	-6.5777	0.263	-25.006	0.000	-7.093	-6.062
C(country)[BFA]	-3.9405	0.311	-12.684	0.000	-4.549	-3.332
C(country)[BGD]	-4.5830	0.536	-8.552	0.000	-5.633	-3.533
C(country)[BGR]	-3.9504	0.361	-10.934	0.000	-4.658	-3.242
C(country)[BHR]	-7.3884	0.433	-17.081	0.000	-8.236	-6.541
C(country)[BHS]	-4.7405	0.170	-27.816	0.000	-5.075	-4.406
C(country)[BIH]	-3.8793	0.371	-10.469	0.000	-4.606	-3.153
C(country)[BLR]	-5.7638	0.551	-10.466	0.000	-6.843	-4.684
C(country)[BLZ]	-28.6173	1.005	-28.465	0.000	-30.588	-26.647
C(country)[BMU]	-4.4305	0.181	-24.540	0.000	-4.784	-4.077
C(country)[BOL]	-3.7885	0.419	-9.035	0.000	-4.610	-2.967
C(country)[BRA]	-2.7184	0.670	-4.056	0.000	-4.032	-1.405
C(country)[BRB]	-4.3322	0.116	-37.306	0.000	-4.560	-4.105
C(country)[BRN]	-28.8326	1.005	-28.701	0.000	-30.802	-26.864
C(country)[BWA]	-29.1140	1.005	-28.958	0.000	-31.084	-27.143
C(country)[CAN]	-3.0492	0.585	-5.210	0.000	-4.196	-1.902
C(country)[CHE]	-3.5989	0.540	-6.661	0.000	-4.658	-2.540
C(country)[CHL]	-4.7959	0.557	-8.617	0.000	-5.887	-3.705
C(country)[CHN]	-3.3751	0.629	-5.369	0.000	-4.607	-2.143
C(country)[CIV]	-5.3142	0.361	-14.726	0.000	-6.021	

```
                                             -4.607
C(country)[CMR]    -3.9554      0.385      -10.267      0.000      -4.711
                                             -3.200
C(country)[COD]    -4.3149      0.346      -12.457      0.000      -4.994
                                             -3.636
C(country)[COG]    -4.7087      0.259      -18.160      0.000      -5.217
                                             -4.200
C(country)[COL]    -3.8535      0.490       -7.861      0.000      -4.814
                                             -2.893
C(country)[CPV]    -6.2875      0.265      -23.687      0.000      -6.808
                                             -5.767
C(country)[CRI]    -5.7775      0.308      -18.748      0.000      -6.382
                                             -5.174
C(country)[CUB]    -4.2574      0.363      -11.739      0.000      -4.968
                                             -3.547
C(country)[CUW]   -28.5936      1.003      -28.518      0.000     -30.559
                                            -26.628
C(country)[CYM]   -30.1000      1.015      -29.656      0.000     -32.089
                                            -28.111
C(country)[CYP]    -5.7491      0.321      -17.898      0.000      -6.379
                                             -5.120
C(country)[CZE]    -4.0794      0.448       -9.101      0.000      -4.958
                                             -3.201
C(country)[DEU]    -3.4658      0.643       -5.392      0.000      -4.726
                                             -2.206
C(country)[DJI]    -5.9062      0.361      -16.372      0.000      -6.613
                                             -5.199
C(country)[DNK]    -3.7730      0.453       -8.327      0.000      -4.661
                                             -2.885
C(country)[DOM]    -4.1578      0.475       -8.754      0.000      -5.089
                                             -3.227
C(country)[DZA]    -3.3766      0.431       -7.833      0.000      -4.221
                                             -2.532
C(country)[ECU]    -2.9335      0.531       -5.527      0.000      -3.974
                                             -1.893
C(country)[EGY]    -3.6125      0.471       -7.672      0.000      -4.535
                                             -2.690
C(country)[ESP]    -2.4918      0.663       -3.761      0.000      -3.790
                                             -1.193
C(country)[EST]    -4.2278      0.343      -12.324      0.000      -4.900
                                             -3.555
C(country)[ETH]    -6.0605      0.256      -23.717      0.000      -6.561
                                             -5.560
C(country)[FIN]    -3.8568      0.422       -9.143      0.000      -4.684
                                             -3.030
C(country)[FRA]    -2.0787      0.623       -3.334      0.001      -3.301
                                             -0.857
C(country)[GAB]    -5.6866      0.354      -16.070      0.000      -6.380
```

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	coef	std err	z	P>|z|	[0.025	0.975]
						-4.993
C(country)[GBR]	-2.2589	0.657	-3.438	0.001	-3.547	-0.971
C(country)[GEO]	-5.2116	0.287	-18.188	0.000	-5.773	-4.650
C(country)[GGY]	-4.1550	0.268	-15.514	0.000	-4.680	-3.630
C(country)[GHA]	-6.1705	0.442	-13.969	0.000	-7.036	-5.305
C(country)[GIN]	-6.0209	0.400	-15.054	0.000	-6.805	-5.237
C(country)[GMB]	-29.0182	1.004	-28.908	0.000	-30.986	-27.051
C(country)[GNB]	-6.2263	0.418	-14.910	0.000	-7.045	-5.408
C(country)[GNQ]	-4.8427	0.314	-15.413	0.000	-5.458	-4.227
C(country)[GRC]	-3.8297	0.374	-10.244	0.000	-4.563	-3.097
C(country)[GTM]	-4.5683	0.357	-12.808	0.000	-5.267	-3.869
C(country)[GUM]	-4.8913	0.235	-20.809	0.000	-5.352	-4.431
C(country)[GUY]	-4.0703	0.178	-22.865	0.000	-4.419	-3.721
C(country)[HND]	-3.8459	0.397	-9.698	0.000	-4.623	-3.069
C(country)[HRV]	-4.0073	0.371	-10.802	0.000	-4.734	-3.280
C(country)[HTI]	-3.8183	0.293	-13.013	0.000	-4.393	-3.243
C(country)[HUN]	-3.0104	0.391	-7.698	0.000	-3.777	-2.244
C(country)[IDN]	-3.3524	0.489	-6.859	0.000	-4.310	-2.395
C(country)[IMN]	-3.5771	0.285	-12.567	0.000	-4.135	-3.019
C(country)[IND]	-3.6662	0.611	-6.000	0.000	-4.864	-2.469
C(country)[IRL]	-3.4203	0.516	-6.632	0.000	-4.431	-2.409
C(country)[IRN]	-3.3048	0.596	-5.543	0.000	-4.473	-2.136
C(country)[IRQ]	-4.2214	0.376	-11.232	0.000	-4.958	-3.485
C(country)[ISL]	-6.1379	0.379	-16.212	0.000	-6.880	-5.396
C(country)[ISR]	-4.7955	0.507	-9.452	0.000	-5.790	

```
                                                              -3.801
C(country)[ITA]     -2.3532     0.644     -3.654     0.000     -3.615
                                                              -1.091
C(country)[JAM]     -5.6232     0.289    -19.459     0.000     -6.190
                                                              -5.057
C(country)[JEY]     -3.6097     0.272    -13.254     0.000     -4.143
                                                              -3.076
C(country)[JOR]     -6.0240     0.259    -23.269     0.000     -6.531
                                                              -5.517
C(country)[JPN]     -3.7889     0.482     -7.856     0.000     -4.734
                                                              -2.844
C(country)[KAZ]     -6.1852     0.438    -14.111     0.000     -7.044
                                                              -5.326
C(country)[KEN]     -4.0117     0.309    -12.991     0.000     -4.617
                                                              -3.406
C(country)[KGZ]     -5.8529     0.331    -17.703     0.000     -6.501
                                                              -5.205
C(country)[KOR]     -4.5321     0.499     -9.091     0.000     -5.509
                                                              -3.555
C(country)[KWT]     -5.2631     0.505    -10.417     0.000     -6.253
                                                              -4.273
C(country)[LBN]     -4.8537     0.300    -16.157     0.000     -5.442
                                                              -4.265
C(country)[LBR]     -3.8698     0.244    -15.883     0.000     -4.347
                                                              -3.392
C(country)[LBY]     -4.8438     0.167    -28.974     0.000     -5.171
                                                              -4.516
C(country)[LIE]    -28.5573     1.001    -28.515     0.000    -30.520
                                                             -26.594
C(country)[LKA]     -6.4656     0.316    -20.450     0.000     -7.085
                                                              -5.846
C(country)[LTU]     -4.6306     0.378    -12.248     0.000     -5.372
                                                              -3.890
C(country)[LUX]     -4.5989     0.435    -10.580     0.000     -5.451
                                                              -3.747
C(country)[LVA]     -4.5509     0.277    -16.450     0.000     -5.093
                                                              -4.009
C(country)[MAR]     -4.4428     0.435    -10.213     0.000     -5.295
                                                              -3.590
C(country)[MCO]     -3.6201     0.137    -26.330     0.000     -3.890
                                                              -3.351
C(country)[MDA]     -4.1265     0.426     -9.697     0.000     -4.960
                                                              -3.292
C(country)[MDV]     -7.3517     0.372    -19.738     0.000     -8.082
                                                              -6.622
C(country)[MEX]     -2.5046     0.570     -4.397     0.000     -3.621
                                                              -1.388
C(country)[MKD]     -3.8598     0.349    -11.074     0.000     -4.543
```

-3.177

C(country)[MLI]	-3.8963	0.321	-12.152	0.000	-4.525	-3.268
C(country)[MLT]	-5.4735	0.235	-23.290	0.000	-5.934	-5.013
C(country)[MMR]	-5.3816	0.220	-24.511	0.000	-5.812	-4.951
C(country)[MNE]	-4.8824	0.300	-16.261	0.000	-5.471	-4.294
C(country)[MNP]	-28.8489	1.003	-28.748	0.000	-30.816	-26.882
C(country)[MRT]	-3.2951	0.186	-17.698	0.000	-3.660	-2.930
C(country)[MSR]	-28.0157	1.000	-28.012	0.000	-29.976	-26.055
C(country)[MUS]	-4.9162	0.331	-14.843	0.000	-5.565	-4.267
C(country)[MWI]	-5.5361	0.156	-35.555	0.000	-5.841	-5.231
C(country)[MYS]	-5.0965	0.431	-11.834	0.000	-5.941	-4.252
C(country)[NER]	-3.8740	0.343	-11.304	0.000	-4.546	-3.202
C(country)[NGA]	-4.1217	0.450	-9.168	0.000	-5.003	-3.241
C(country)[NIC]	-2.9283	0.080	-36.713	0.000	-3.085	-2.772
C(country)[NLD]	-2.6660	0.549	-4.855	0.000	-3.742	-1.590
C(country)[NOR]	-4.3626	0.446	-9.783	0.000	-5.237	-3.489
C(country)[NZL]	-4.4696	0.349	-12.795	0.000	-5.154	-3.785
C(country)[OMN]	-5.9432	0.422	-14.081	0.000	-6.770	-5.116
C(country)[PAK]	-4.1953	0.556	-7.539	0.000	-5.286	-3.105
C(country)[PAN]	-4.3415	0.455	-9.532	0.000	-5.234	-3.449
C(country)[PER]	-3.7678	0.613	-6.151	0.000	-4.968	-2.567
C(country)[PHL]	-3.4880	0.464	-7.513	0.000	-4.398	-2.578
C(country)[POL]	-3.6927	0.494	-7.476	0.000	-4.661	-2.725
C(country)[PRI]	-4.0955	0.399	-10.263	0.000	-4.878	-3.313
C(country)[PRT]	-3.8200	0.531	-7.189	0.000	-4.861	

-2.779

	coef	std err	z	P>|z|	[0.025	0.975]
C(country)[PRY]	-5.6298	0.310	-18.170	0.000	-6.237	-5.022
C(country)[PSE]	-6.1462	0.270	-22.780	0.000	-6.675	-5.617
C(country)[QAT]	-8.3181	0.547	-15.215	0.000	-9.390	-7.247
C(country)[ROU]	-3.4400	0.493	-6.981	0.000	-4.406	-2.474
C(country)[RUS]	-4.7300	0.690	-6.855	0.000	-6.082	-3.378
C(country)[SAU]	-5.5523	0.578	-9.613	0.000	-6.684	-4.420
C(country)[SDN]	-3.7956	0.408	-9.314	0.000	-4.594	-2.997
C(country)[SEN]	-5.1909	0.390	-13.311	0.000	-5.955	-4.427
C(country)[SGP]	-7.8164	0.537	-14.568	0.000	-8.868	-6.765
C(country)[SLE]	-3.7401	0.315	-11.858	0.000	-4.358	-3.122
C(country)[SLV]	-4.8638	0.355	-13.720	0.000	-5.559	-4.169
C(country)[SMR]	-4.0868	0.271	-15.088	0.000	-4.618	-3.556
C(country)[SOM]	-4.2359	0.372	-11.392	0.000	-4.965	-3.507
C(country)[SRB]	-4.6594	0.472	-9.871	0.000	-5.585	-3.734
C(country)[STP]	-4.8585	0.351	-13.829	0.000	-5.547	-4.170
C(country)[SUR]	-28.0878	1.000	-28.086	0.000	-30.048	-26.128
C(country)[SVK]	-4.7054	0.340	-13.824	0.000	-5.373	-4.038
C(country)[SVN]	-3.6208	0.347	-10.423	0.000	-4.302	-2.940
C(country)[SWE]	-2.6989	0.518	-5.213	0.000	-3.714	-1.684
C(country)[SWZ]	-6.4489	0.261	-24.722	0.000	-6.960	-5.938
C(country)[SXM]	-3.8007	0.200	-18.961	0.000	-4.194	-3.408
C(country)[SYR]	-5.4027	0.134	-40.314	0.000	-5.665	-5.140
C(country)[TCA]	-28.4957	1.002	-28.450	0.000	-30.459	-26.533
C(country)[TCD]	-3.5042	0.355	-9.859	0.000	-4.201	

```
                                                                        -2.808
C(country)[TGO]    -4.5313      0.234    -19.362      0.000      -4.990
                                                                        -4.073
C(country)[THA]    -4.9831      0.402    -12.408      0.000      -5.770
                                                                        -4.196
C(country)[TTO]    -4.8482      0.208    -23.330      0.000      -5.256
                                                                        -4.441
C(country)[TUN]    -4.3654      0.336    -12.986      0.000      -5.024
                                                                        -3.707
C(country)[TUR]    -4.0237      0.649     -6.200      0.000      -5.296
                                                                        -2.752
C(country)[TWN]    -5.5181      0.259    -21.311      0.000      -6.026
                                                                        -5.011
C(country)[TZA]    -4.2875      0.314    -13.649      0.000      -4.903
                                                                        -3.672
C(country)[UKR]    -4.1525      0.505     -8.222      0.000      -5.142
                                                                        -3.163
C(country)[URY]    -4.7485      0.270    -17.571      0.000      -5.278
                                                                        -4.219
C(country)[USA]    -2.8350      0.773     -3.669      0.000      -4.350
                                                                        -1.320
C(country)[UZB]    -6.4453      0.388    -16.606      0.000      -7.206
                                                                        -5.685
C(country)[VEN]    -5.6648      0.258    -21.954      0.000      -6.170
                                                                        -5.159
C(country)[VGB]   -28.5253      1.001    -28.497      0.000     -30.487
                                                                       -26.563
C(country)[VIR]    -3.3290      0.121    -27.501      0.000      -3.566
                                                                        -3.092
C(country)[XKX]    -4.6203      0.317    -14.568      0.000      -5.242
                                                                        -3.999
C(country)[YEM]    -2.5522      0.284     -8.972      0.000      -3.110
                                                                        -1.995
C(country)[ZAF]    -4.3015      0.492     -8.746      0.000      -5.266
                                                                        -3.338
C(country)[ZMB]    -5.6548      0.323    -17.516      0.000      -6.288
                                                                        -5.022
C(country)[ZWE]    -4.2769      0.116    -36.770      0.000      -4.505
                                                                        -4.049
logcumpos0          0.4508      0.084      5.352      0.000       0.286
                                                                         0.616
logcumpos1          0.3266      0.100      3.252      0.001       0.130
                                                                         0.524
logcumpos2          0.1448      0.069      2.097      0.036       0.009
                                                                         0.280
logcumpos3         -0.0742      0.045     -1.637      0.102      -0.163
                                                                         0.015
==============================================================================
```

| Skew: | 16.4479 | Kurtosis: | 695.8259 |
| Centered skew: | 16.4479 | Centered kurtosis: | 695.8259 |
===

Including either relative time or calendar time in the model could capture risk-modifying effects of interest. For example, if there is a role for calendar time, this could reflect a changing case/fatality ratio as the epidemic progresses.

[12]:
```
fml = "deaths ~ 0 + C(country) + bs(rdays, 5) + "
fml += "logcumpos0 + logcumpos1 + logcumpos2 + logcumpos3"
m2 = sm.GEE.from_formula(fml, groups="country", data=df, family=sm.families.
 →Poisson())
r2 = m2.fit(scale="X2")
print(r2.summary())
print(m2.compare_score_test(r1))
```

```
                            GEE Regression Results
================================================================================
===
Dep. Variable:                      deaths   No. Observations:
8586
Model:                                 GEE   No. clusters:
173
Method:                        Generalized   Min. cluster size:
12
                       Estimating Equations   Max. cluster size:
123
Family:                            Poisson   Mean cluster size:
49.6
Dependence structure:         Independence   Num. iterations:
2
Date:                      Mon, 01 Jun 2020   Scale:
32.362
Covariance type:                    robust   Time:
13:29:28
================================================================================
===
                    coef     std err          z      P>|z|       [0.025
0.975]
--------------------------------------------------------------------------------
---
C(country)[ABW]   -4.3474       0.112    -38.814      0.000       -4.567
-4.128
C(country)[AFG]   -4.3828       0.379    -11.577      0.000       -5.125
-3.641
C(country)[AGO]   -5.6477       0.173    -32.714      0.000       -5.986
-5.309
C(country)[ALB]   -4.8199       0.252    -19.157      0.000       -5.313
```

	coef	std err	z	P>|z|	[0.025	0.975]
C(country)[AND]	-4.1263	0.271	-15.201	0.000	-4.658	-3.594
C(country)[ARE]	-5.3159	0.442	-12.029	0.000	-6.182	-4.450
C(country)[ARG]	-3.7956	0.369	-10.300	0.000	-4.518	-3.073
C(country)[ARM]	-5.1724	0.345	-14.995	0.000	-5.848	-4.496
C(country)[ATG]	-4.4169	0.125	-35.286	0.000	-4.662	-4.172
C(country)[AUS]	-5.1977	0.359	-14.492	0.000	-5.901	-4.495
C(country)[AUT]	-4.0598	0.445	-9.125	0.000	-4.932	-3.188
C(country)[AZE]	-5.4350	0.324	-16.768	0.000	-6.070	-4.800
C(country)[BDI]	-29.8546	1.014	-29.439	0.000	-31.842	-27.867
C(country)[BEL]	-2.4533	0.490	-5.002	0.000	-3.415	-1.492
C(country)[BEN]	-6.7881	0.239	-28.348	0.000	-7.257	-6.319
C(country)[BFA]	-4.1275	0.247	-16.731	0.000	-4.611	-3.644
C(country)[BGD]	-4.5713	0.453	-10.087	0.000	-5.460	-3.683
C(country)[BGR]	-4.0408	0.300	-13.488	0.000	-4.628	-3.454
C(country)[BHR]	-7.4507	0.368	-20.246	0.000	-8.172	-6.729
C(country)[BHS]	-5.0550	0.154	-32.757	0.000	-5.357	-4.753
C(country)[BIH]	-4.0382	0.302	-13.381	0.000	-4.630	-3.447
C(country)[BLR]	-5.8660	0.473	-12.407	0.000	-6.793	-4.939
C(country)[BLZ]	-28.9500	1.007	-28.735	0.000	-30.925	-26.975
C(country)[BMU]	-4.7620	0.166	-28.756	0.000	-5.087	-4.437
C(country)[BOL]	-3.9070	0.351	-11.124	0.000	-4.595	-3.219
C(country)[BRA]	-2.6575	0.593	-4.479	0.000	-3.820	-1.495
C(country)[BRB]	-4.6904	0.123	-38.236	0.000	-4.931	-4.450
C(country)[BRN]	-29.2221	1.007	-29.029	0.000	-31.195	

```
                                        -27.249
C(country)[BWA]    -29.4434      1.011    -29.109    0.000    -31.426
                                        -27.461
C(country)[CAN]     -3.0506      0.505     -6.042    0.000     -4.040
                                        -2.061
C(country)[CHE]     -3.6923      0.457     -8.075    0.000     -4.589
                                        -2.796
C(country)[CHL]     -4.8331      0.485     -9.963    0.000     -5.784
                                        -3.882
C(country)[CHN]     -3.3699      0.502     -6.714    0.000     -4.354
                                        -2.386
C(country)[CIV]     -5.5137      0.303    -18.194    0.000     -6.108
                                        -4.920
C(country)[CMR]     -4.0924      0.324    -12.634    0.000     -4.727
                                        -3.457
C(country)[COD]     -4.4204      0.296    -14.954    0.000     -5.000
                                        -3.841
C(country)[COG]     -4.9514      0.225    -21.997    0.000     -5.393
                                        -4.510
C(country)[COL]     -3.9150      0.418     -9.372    0.000     -4.734
                                        -3.096
C(country)[CPV]     -6.4307      0.248    -25.882    0.000     -6.918
                                        -5.944
C(country)[CRI]     -5.9683      0.250    -23.872    0.000     -6.458
                                        -5.478
C(country)[CUB]     -4.4139      0.290    -15.235    0.000     -4.982
                                        -3.846
C(country)[CUW]    -28.9281      1.012    -28.596    0.000    -30.911
                                        -26.945
C(country)[CYM]    -30.3426      1.017    -29.836    0.000    -32.336
                                        -28.349
C(country)[CYP]     -5.9710      0.267    -22.333    0.000     -6.495
                                        -5.447
C(country)[CZE]     -4.2663      0.402    -10.606    0.000     -5.055
                                        -3.478
C(country)[DEU]     -3.5230      0.573     -6.151    0.000     -4.645
                                        -2.401
C(country)[DJI]     -6.1004      0.312    -19.522    0.000     -6.713
                                        -5.488
C(country)[DNK]     -3.9241      0.389    -10.079    0.000     -4.687
                                        -3.161
C(country)[DOM]     -4.2507      0.401    -10.609    0.000     -5.036
                                        -3.465
C(country)[DZA]     -3.4397      0.362     -9.497    0.000     -4.150
                                        -2.730
C(country)[ECU]     -2.9789      0.453     -6.572    0.000     -3.867
                                        -2.091
C(country)[EGY]     -3.5882      0.401     -8.939    0.000     -4.375
```

	coef	std err	z	P>|z|	[0.025	0.975]
						-2.801
C(country)[ESP]	-2.5198	0.584	-4.318	0.000	-3.663	-1.376
C(country)[EST]	-4.4882	0.305	-14.693	0.000	-5.087	-3.890
C(country)[ETH]	-6.2898	0.221	-28.433	0.000	-6.723	-5.856
C(country)[FIN]	-4.0406	0.363	-11.142	0.000	-4.751	-3.330
C(country)[FRA]	-1.9663	0.540	-3.642	0.000	-3.025	-0.908
C(country)[GAB]	-5.7311	0.318	-18.033	0.000	-6.354	-5.108
C(country)[GBR]	-2.2147	0.577	-3.837	0.000	-3.346	-1.083
C(country)[GEO]	-5.4853	0.245	-22.396	0.000	-5.965	-5.005
C(country)[GGY]	-4.4017	0.229	-19.189	0.000	-4.851	-3.952
C(country)[GHA]	-6.2294	0.368	-16.925	0.000	-6.951	-5.508
C(country)[GIN]	-6.2426	0.360	-17.334	0.000	-6.948	-5.537
C(country)[GMB]	-29.3006	1.021	-28.705	0.000	-31.301	-27.300
C(country)[GNB]	-6.3140	0.365	-17.295	0.000	-7.030	-5.598
C(country)[GNQ]	-5.0892	0.297	-17.153	0.000	-5.671	-4.508
C(country)[GRC]	-4.0179	0.313	-12.848	0.000	-4.631	-3.405
C(country)[GTM]	-4.6102	0.321	-14.371	0.000	-5.239	-3.981
C(country)[GUM]	-5.0996	0.187	-27.224	0.000	-5.467	-4.733
C(country)[GUY]	-4.2551	0.219	-19.412	0.000	-4.685	-3.825
C(country)[HND]	-3.9371	0.326	-12.075	0.000	-4.576	-3.298
C(country)[HRV]	-4.2321	0.322	-13.143	0.000	-4.863	-3.601
C(country)[HTI]	-4.0014	0.276	-14.506	0.000	-4.542	-3.461
C(country)[HUN]	-3.1526	0.321	-9.822	0.000	-3.782	-2.523
C(country)[IDN]	-3.3818	0.415	-8.149	0.000	-4.195	-2.568
C(country)[IMN]	-3.7883	0.236	-16.052	0.000	-4.251	

	coef	std err	z	P>|z|	[0.025	0.975]
						-3.326
C(country)[IND]	-3.5876	0.532	-6.741	0.000	-4.631	-2.545
C(country)[IRL]	-3.4965	0.435	-8.044	0.000	-4.348	-2.645
C(country)[IRN]	-3.2512	0.517	-6.292	0.000	-4.264	-2.238
C(country)[IRQ]	-4.2805	0.316	-13.525	0.000	-4.901	-3.660
C(country)[ISL]	-6.3642	0.343	-18.554	0.000	-7.036	-5.692
C(country)[ISR]	-4.9505	0.448	-11.040	0.000	-5.829	-4.072
C(country)[ITA]	-2.3253	0.563	-4.133	0.000	-3.428	-1.223
C(country)[JAM]	-5.8207	0.230	-25.306	0.000	-6.272	-5.370
C(country)[JEY]	-3.8279	0.211	-18.134	0.000	-4.242	-3.414
C(country)[JOR]	-6.2656	0.217	-28.853	0.000	-6.691	-5.840
C(country)[JPN]	-3.6813	0.409	-8.991	0.000	-4.484	-2.879
C(country)[KAZ]	-6.3375	0.369	-17.160	0.000	-7.061	-5.614
C(country)[KEN]	-4.1824	0.260	-16.096	0.000	-4.692	-3.673
C(country)[KGZ]	-6.0643	0.275	-22.029	0.000	-6.604	-5.525
C(country)[KOR]	-4.6010	0.411	-11.201	0.000	-5.406	-3.796
C(country)[KWT]	-5.3724	0.431	-12.473	0.000	-6.217	-4.528
C(country)[LBN]	-5.0336	0.250	-20.175	0.000	-5.523	-4.545
C(country)[LBR]	-4.1216	0.198	-20.791	0.000	-4.510	-3.733
C(country)[LBY]	-5.1408	0.155	-33.124	0.000	-5.445	-4.837
C(country)[LIE]	-28.9888	1.007	-28.788	0.000	-30.962	-27.015
C(country)[LKA]	-6.6742	0.257	-26.012	0.000	-7.177	-6.171
C(country)[LTU]	-4.8161	0.318	-15.161	0.000	-5.439	-4.193
C(country)[LUX]	-4.7259	0.349	-13.525	0.000	-5.411	-4.041
C(country)[LVA]	-4.8524	0.243	-20.008	0.000	-5.328	

-4.377

	coef	std err	z	P>|z|	[0.025	0.975]
C(country)[MAR]	-4.5017	0.362	-12.447	0.000	-5.211	-3.793
C(country)[MCO]	-3.9633	0.131	-30.162	0.000	-4.221	-3.706
C(country)[MDA]	-4.2387	0.355	-11.941	0.000	-4.934	-3.543
C(country)[MDV]	-7.5073	0.385	-19.480	0.000	-8.263	-6.752
C(country)[MEX]	-2.5189	0.493	-5.114	0.000	-3.484	-1.554
C(country)[MKD]	-4.0695	0.290	-14.033	0.000	-4.638	-3.501
C(country)[MLI]	-4.0910	0.259	-15.773	0.000	-4.599	-3.583
C(country)[MLT]	-5.7647	0.200	-28.839	0.000	-6.156	-5.373
C(country)[MMR]	-5.6547	0.191	-29.632	0.000	-6.029	-5.281
C(country)[MNE]	-5.0672	0.238	-21.262	0.000	-5.534	-4.600
C(country)[MNP]	-29.1647	1.014	-28.771	0.000	-31.151	-27.178
C(country)[MRT]	-3.5387	0.324	-10.919	0.000	-4.174	-2.903
C(country)[MSR]	-28.4281	1.009	-28.174	0.000	-30.406	-26.450
C(country)[MUS]	-5.0545	0.251	-20.175	0.000	-5.546	-4.563
C(country)[MWI]	-5.8301	0.173	-33.771	0.000	-6.168	-5.492
C(country)[MYS]	-5.2746	0.374	-14.098	0.000	-6.008	-4.541
C(country)[NER]	-4.0270	0.265	-15.222	0.000	-4.546	-3.509
C(country)[NGA]	-4.1751	0.374	-11.166	0.000	-4.908	-3.442
C(country)[NIC]	-3.2371	0.191	-16.921	0.000	-3.612	-2.862
C(country)[NLD]	-2.7288	0.470	-5.808	0.000	-3.650	-1.808
C(country)[NOR]	-4.5337	0.389	-11.669	0.000	-5.295	-3.772
C(country)[NZL]	-4.6770	0.315	-14.863	0.000	-5.294	-4.060
C(country)[OMN]	-6.1089	0.361	-16.933	0.000	-6.816	-5.402
C(country)[PAK]	-4.2144	0.481	-8.769	0.000	-5.156	

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-3.272
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	coef	std err	z	P>|z|	[0.025	0.975]
C(country)[PAN]	-4.3909	0.377	-11.656	0.000	-5.129	-3.653
C(country)[PER]	-3.7499	0.532	-7.052	0.000	-4.792	-2.708
C(country)[PHL]	-3.4249	0.430	-7.961	0.000	-4.268	-2.582
C(country)[POL]	-3.7525	0.417	-9.007	0.000	-4.569	-2.936
C(country)[PRI]	-4.2041	0.312	-13.465	0.000	-4.816	-3.592
C(country)[PRT]	-3.9298	0.462	-8.502	0.000	-4.836	-3.024
C(country)[PRY]	-5.7475	0.261	-21.987	0.000	-6.260	-5.235
C(country)[PSE]	-6.4016	0.222	-28.780	0.000	-6.838	-5.966
C(country)[QAT]	-8.4001	0.471	-17.843	0.000	-9.323	-7.477
C(country)[ROU]	-3.5780	0.427	-8.378	0.000	-4.415	-2.741
C(country)[RUS]	-4.7340	0.611	-7.750	0.000	-5.931	-3.537
C(country)[SAU]	-5.5982	0.500	-11.193	0.000	-6.579	-4.618
C(country)[SDN]	-3.7117	0.365	-10.172	0.000	-4.427	-2.997
C(country)[SEN]	-5.3418	0.318	-16.786	0.000	-5.966	-4.718
C(country)[SGP]	-7.8760	0.453	-17.400	0.000	-8.763	-6.989
C(country)[SLE]	-3.9680	0.293	-13.545	0.000	-4.542	-3.394
C(country)[SLV]	-5.0137	0.292	-17.145	0.000	-5.587	-4.441
C(country)[SMR]	-4.2326	0.236	-17.936	0.000	-4.695	-3.770
C(country)[SOM]	-4.4151	0.301	-14.667	0.000	-5.005	-3.825
C(country)[SRB]	-4.7899	0.393	-12.180	0.000	-5.561	-4.019
C(country)[STP]	-4.9368	0.316	-15.636	0.000	-5.556	-4.318
C(country)[SUR]	-28.4847	1.019	-27.955	0.000	-30.482	-26.488
C(country)[SVK]	-4.9695	0.320	-15.522	0.000	-5.597	-4.342
C(country)[SVN]	-3.8213	0.287	-13.319	0.000	-4.384	

	coef	std err	t	P>|t|	[0.025	0.975]
						-3.259
C(country)[SWE]	-2.7594	0.446	-6.189	0.000	-3.633	-1.885
C(country)[SWZ]	-6.6922	0.220	-30.454	0.000	-7.123	-6.261
C(country)[SXM]	-4.0716	0.164	-24.850	0.000	-4.393	-3.750
C(country)[SYR]	-5.7107	0.156	-36.624	0.000	-6.016	-5.405
C(country)[TCA]	-28.8639	1.010	-28.589	0.000	-30.843	-26.885
C(country)[TCD]	-3.6503	0.334	-10.922	0.000	-4.305	-2.995
C(country)[TGO]	-4.7115	0.229	-20.616	0.000	-5.159	-4.264
C(country)[THA]	-5.0895	0.310	-16.427	0.000	-5.697	-4.482
C(country)[TTO]	-5.1048	0.172	-29.700	0.000	-5.442	-4.768
C(country)[TUN]	-4.5717	0.271	-16.854	0.000	-5.103	-4.040
C(country)[TUR]	-4.0379	0.558	-7.237	0.000	-5.131	-2.944
C(country)[TWN]	-5.6526	0.235	-24.085	0.000	-6.113	-5.193
C(country)[TZA]	-4.4663	0.237	-18.807	0.000	-4.932	-4.001
C(country)[UKR]	-4.2057	0.424	-9.929	0.000	-5.036	-3.375
C(country)[URY]	-5.0180	0.223	-22.484	0.000	-5.455	-4.581
C(country)[USA]	-2.6937	0.693	-3.885	0.000	-4.053	-1.335
C(country)[UZB]	-6.6301	0.326	-20.359	0.000	-7.268	-5.992
C(country)[VEN]	-5.8782	0.232	-25.351	0.000	-6.333	-5.424
C(country)[VGB]	-28.9022	1.009	-28.633	0.000	-30.881	-26.924
C(country)[VIR]	-3.6752	0.132	-27.744	0.000	-3.935	-3.416
C(country)[XKX]	-4.8228	0.253	-19.050	0.000	-5.319	-4.327
C(country)[YEM]	-2.6646	0.274	-9.710	0.000	-3.202	-2.127
C(country)[ZAF]	-4.3892	0.421	-10.437	0.000	-5.213	-3.565
C(country)[ZMB]	-5.7899	0.299	-19.335	0.000	-6.377	

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                                                                            -5.203
C(country)[ZWE]     -4.5722        0.183      -24.972        0.000        -4.931
                                                                            -4.213
bs(rdays, 5)[0]      0.6237        0.203        3.066        0.002         0.225
                                                                             1.022
bs(rdays, 5)[1]      0.3886        0.299        1.298        0.194        -0.198
                                                                             0.975
bs(rdays, 5)[2]      0.3619        0.414        0.875        0.382        -0.449
                                                                             1.173
bs(rdays, 5)[3]     -1.0331        0.551       -1.876        0.061        -2.113
                                                                             0.046
bs(rdays, 5)[4]      2.5080        0.804        3.120        0.002         0.932
                                                                             4.084
logcumpos0           0.4148        0.099        4.195        0.000         0.221
                                                                             0.609
logcumpos1           0.2811        0.102        2.753        0.006         0.081
                                                                             0.481
logcumpos2           0.1379        0.061        2.257        0.024         0.018
                                                                             0.258
logcumpos3          -0.0098        0.039       -0.255        0.799        -0.085
                                                                             0.066
==============================================================================
Skew:                              15.3071   Kurtosis:                    626.6341
Centered skew:                     15.3071   Centered kurtosis:           626.6341
==============================================================================
{'statistic': 8.038538341636286, 'df': 5, 'p-value': 0.15412445444462763}
```

There variance is around 30 times the mean.

```python
[13]: print(r1.scale)
      print(r2.scale)
```

```
33.04612879864114
32.361938777767186
```