

The Geography of the COVID-19 Pandemic in England

Geographically Weighted Regression models

Start Wave 1 | Week commencing 16th March

OLS Regression model

Residuals:

Min	1Q	Median	3Q	Max
-1.5226	-0.4331	-0.1564	0.4350	1.7233

Coefficients:

	Estimate	Std. Error	t value	Pr(> t)	
(Intercept)	1.067114	0.060557	17.622	< 2e-16	***
PopulationDensity	0.164755	0.145701	1.131	0.26017	
WorkfromHome	0.162509	0.154152	1.054	0.29368	
PrivateRent	-0.309336	0.156244	-1.980	0.04977	*
SocialRent	-0.035561	0.109699	-0.324	0.74632	
PublicTransport	0.484998	0.168725	2.874	0.00471	**
TransportOccupation	0.109462	0.090891	1.204	0.23059	
HospitalityOccupation	0.120509	0.091288	1.320	0.18905	
EthnicMinority	0.698199	0.155704	4.484	1.56e-05	***
Students	0.060731	0.093867	0.647	0.51875	
Young	-0.384523	0.133289	-2.885	0.00456	**
OlderPersons	-0.007064	0.158150	-0.045	0.96444	
LongTermIll	-0.222604	0.177354	-1.255	0.21161	
Obesity	0.190103	0.121801	1.561	0.12094	
IMDMostDeprived	0.085424	0.123387	0.692	0.48993	

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

Residual standard error: 0.7392 on 134 degrees of freedom
Multiple R-squared: 0.6779, Adjusted R-squared: 0.6443
F-statistic: 20.15 on 14 and 134 DF, p-value: < 2.2e-16

Start Wave 1 | Week commencing 16th March

GWR model

```
ggwr(formula = m1_startwave1, data = LA_sf_england_var, coords = cbind(long,
  lat), adapt = bw_quasipoissonm1_startwave1, family = quasipoisson(),
  longlat = TRUE)
```

kernel function: gwr.Gauss

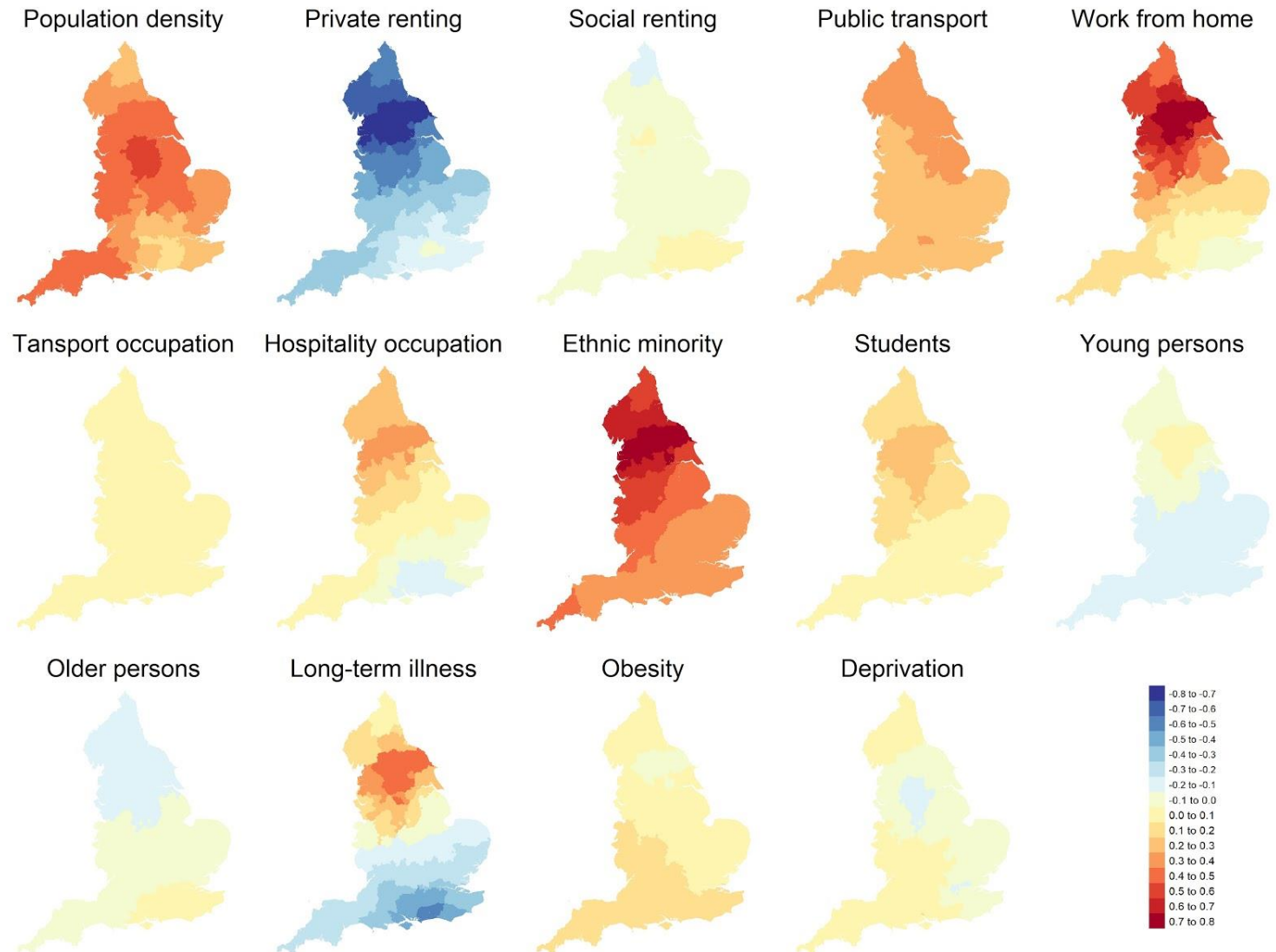
Adaptive quantile: 0.3422289 (about 50 of 149 data points)

Summary of GWR coefficient estimates at data points:

	Min.	1st Qu.	Median	3rd Qu.	Max.	Global
X.Intercept.	-0.4553546	-0.3658580	-0.3313808	-0.2734920	-0.1989652	-0.2913
PopulationDensity	0.1445454	0.2387114	0.3717880	0.4450819	0.5564467	0.3681
WorkfromHome	-0.0430688	0.0086279	0.1753503	0.5380569	0.7893542	0.2275
PrivateRent	-0.7857201	-0.5976025	-0.3327023	-0.1530785	-0.0945616	-0.3590
SocialRent	-0.1016060	-0.0440528	-0.0156853	0.0181967	0.0485801	-0.0718
PublicTransport	0.2390197	0.2549746	0.2783480	0.2933150	0.3881178	0.3026
TransportOccupation	0.0590953	0.0669551	0.0750908	0.0804776	0.0921521	0.0632
HospitalityOccupation	-0.1381051	-0.0916695	0.0322186	0.2312202	0.3250147	0.0757
EthnicMinority	0.3126719	0.3330818	0.4094295	0.6088391	0.7428574	0.4251
Students	-0.0030499	0.0248808	0.0826378	0.1829337	0.2367531	0.1093
Young	-0.1888576	-0.1670188	-0.1541462	-0.0709912	0.0357874	-0.1514
OlderPersons	-0.1851252	-0.1229160	-0.0509833	0.0073882	0.0493659	-0.0609
LongTermIll	-0.5083653	-0.3745574	-0.1622995	0.1707962	0.4581771	-0.1820
obesity	-0.0276740	0.0658663	0.0927715	0.1105725	0.1705924	0.1456
IMDMostDeprived	-0.1558753	-0.0925922	-0.0418126	0.0064469	0.1004198	0.0162

Start Wave 1 | Week commencing 16th March

GWR model



Peak Wave 1 | Week commencing 6th April

OLS Regression model

Residuals:

Min	1Q	Median	3Q	Max
-5.3602	-1.5277	-0.1428	1.3541	6.8922

Coefficients:

	Estimate	Std. Error	t value	Pr(> t)	
(Intercept)	7.37584	0.20227	36.465	< 2e-16	***
PopulationDensity	0.16505	0.48667	0.339	0.735036	
workfromHome	-0.77078	0.51490	-1.497	0.136759	
PrivateRent	-2.04649	0.52189	-3.921	0.000140	***
SocialRent	-0.38080	0.36642	-1.039	0.300566	
PublicTransport	1.92050	0.56358	3.408	0.000866	***
TransportOccupation	0.21203	0.30360	0.698	0.486133	
HospitalityOccupation	0.19410	0.30492	0.637	0.525496	
EthnicMinority	0.48790	0.52009	0.938	0.349873	
Students	-0.02408	0.31354	-0.077	0.938884	
Young	-0.33891	0.44522	-0.761	0.447861	
OlderPersons	-0.25020	0.52826	-0.474	0.636526	
LongTermIll	0.51401	0.59240	0.868	0.387129	
Obesity	-0.85842	0.40684	-2.110	0.036721	*
IMDMostDeprived	0.78681	0.41214	1.909	0.058389	.

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

Residual standard error: 2.469 on 134 degrees of freedom

Multiple R-squared: 0.4102, Adjusted R-squared: 0.3485

F-statistic: 6.656 on 14 and 134 DF, p-value: 4.029e-10

Peak Wave 1 | Week commencing 6th April

GWR model

```
ggwr(formula = m1_peakwave1, data = LA_sf_england_var, coords = cbind(long,
  lat), adapt = bw_quasipoissonm1peakwave1, family = quasipoisson(),
  longlat = TRUE)
```

Kernel function: gwr.Gauss

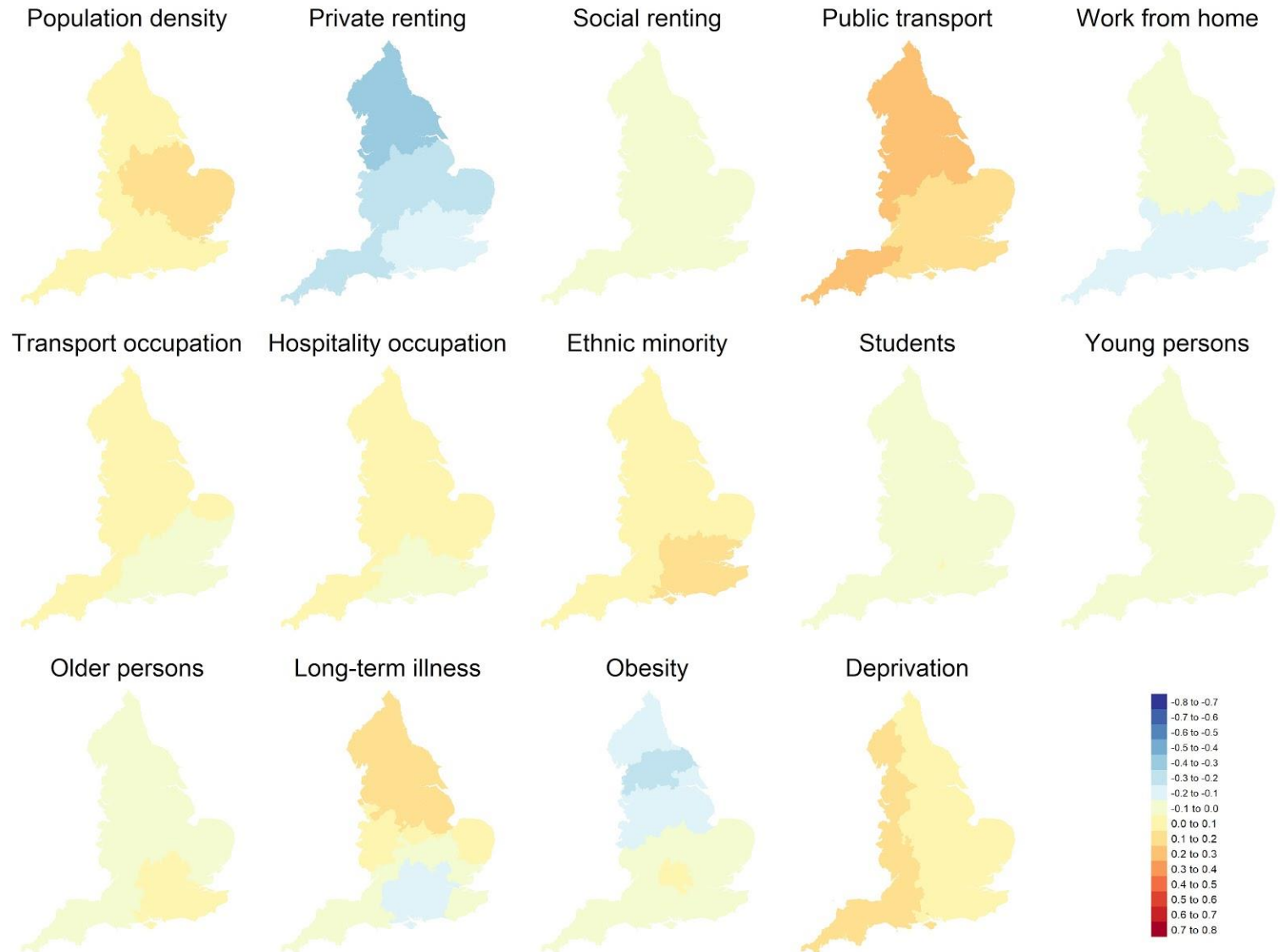
Adaptive quantile: 0.4496688 (about 67 of 149 data points)

Summary of GWR coefficient estimates at data points:

	Min.	1st Qu.	Median	3rd Qu.	Max.	Global
X.Intercept.	1.84874161	1.88153179	1.93283137	1.97669389	1.98489538	1.9619
PopulationDensity	0.02485118	0.06741351	0.08854139	0.10209997	0.15184868	0.0295
WorkfromHome	-0.16957135	-0.14834552	-0.09717955	-0.07198699	-0.03926271	-0.1314
PrivateRent	-0.34255973	-0.31490248	-0.23579038	-0.17207572	-0.14354708	-0.2760
SocialRent	-0.08787971	-0.07323146	-0.06844845	-0.05162484	-0.02524042	-0.0637
PublicTransport	0.11379732	0.12484353	0.18770454	0.25751434	0.27605093	0.2379
TransportOccupation	-0.03282413	-0.02675597	0.01440196	0.04317114	0.05066845	0.0247
HospitalityOccupation	-0.02574424	-0.00711748	0.02798775	0.06631014	0.08328653	0.0243
EthnicMinority	0.02625777	0.03914202	0.07465378	0.11025506	0.11934920	0.0655
Students	-0.02299910	-0.01844149	-0.01101804	-0.00569334	0.00013939	-0.0080
Young	-0.07012681	-0.04847926	-0.04394317	-0.03645616	-0.01108156	-0.0593
OlderPersons	-0.05246041	-0.03471515	-0.02360833	0.01607026	0.03418361	-0.0536
LongTermIll	-0.17557587	-0.12458567	-0.00582550	0.12573716	0.16785372	0.0631
Obesity	-0.21169775	-0.17200714	-0.07066748	-0.01085199	0.00428643	-0.1268
IMDMostDeprived	0.03559211	0.06371371	0.08836982	0.10292115	0.13263590	0.1060

Peak Wave 1 | Week commencing 6th April

GWR model



Start Wave 2 | Week commencing 5th October

OLS Regression model

Residuals:

Min	1Q	Median	3Q	Max
-43.628	-7.647	-1.728	7.149	101.708

Coefficients:

	Estimate	Std. Error	t value	Pr(> t)	
(Intercept)	26.0537	1.3760	18.935	< 2e-16	***
PopulationDensity	-3.1671	3.3106	-0.957	0.340469	
workfromHome	2.0012	3.5027	0.571	0.568724	
PrivateRent	-12.4533	3.5502	-3.508	0.000616	***
SocialRent	-2.7115	2.4926	-1.088	0.278631	
PublicTransport	8.4013	3.8338	2.191	0.030152	*
TransportOccupation	1.6526	2.0652	0.800	0.425001	
HospitalityOccupation	-0.3759	2.0743	-0.181	0.856451	
EthnicMinority	1.6060	3.5379	0.454	0.650612	
Students	12.1192	2.1329	5.682	7.94e-08	***
Young	-0.2851	3.0286	-0.094	0.925132	
OlderPersons	-4.1345	3.5935	-1.151	0.251964	
LongTermIll	8.1540	4.0299	2.023	0.045022	*
Obesity	-5.1992	2.7676	-1.879	0.062471	.
IMDMostDeprived	15.1229	2.8036	5.394	3.02e-07	***

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

Residual standard error: 16.8 on 134 degrees of freedom

Multiple R-squared: 0.592, Adjusted R-squared: 0.5494

F-statistic: 13.89 on 14 and 134 DF, p-value: < 2.2e-16

Start Wave 2 | Week commencing 5th October

GWR model

```
ggwr(formula = m1_startwave2, data = LA_sf_england_var, coords = cbind(long,
  lat), adapt = bw_quasipoissonm1startwave2, family = quasipoisson(),
  longlat = TRUE)
```

Kernel function: gwr.Gauss

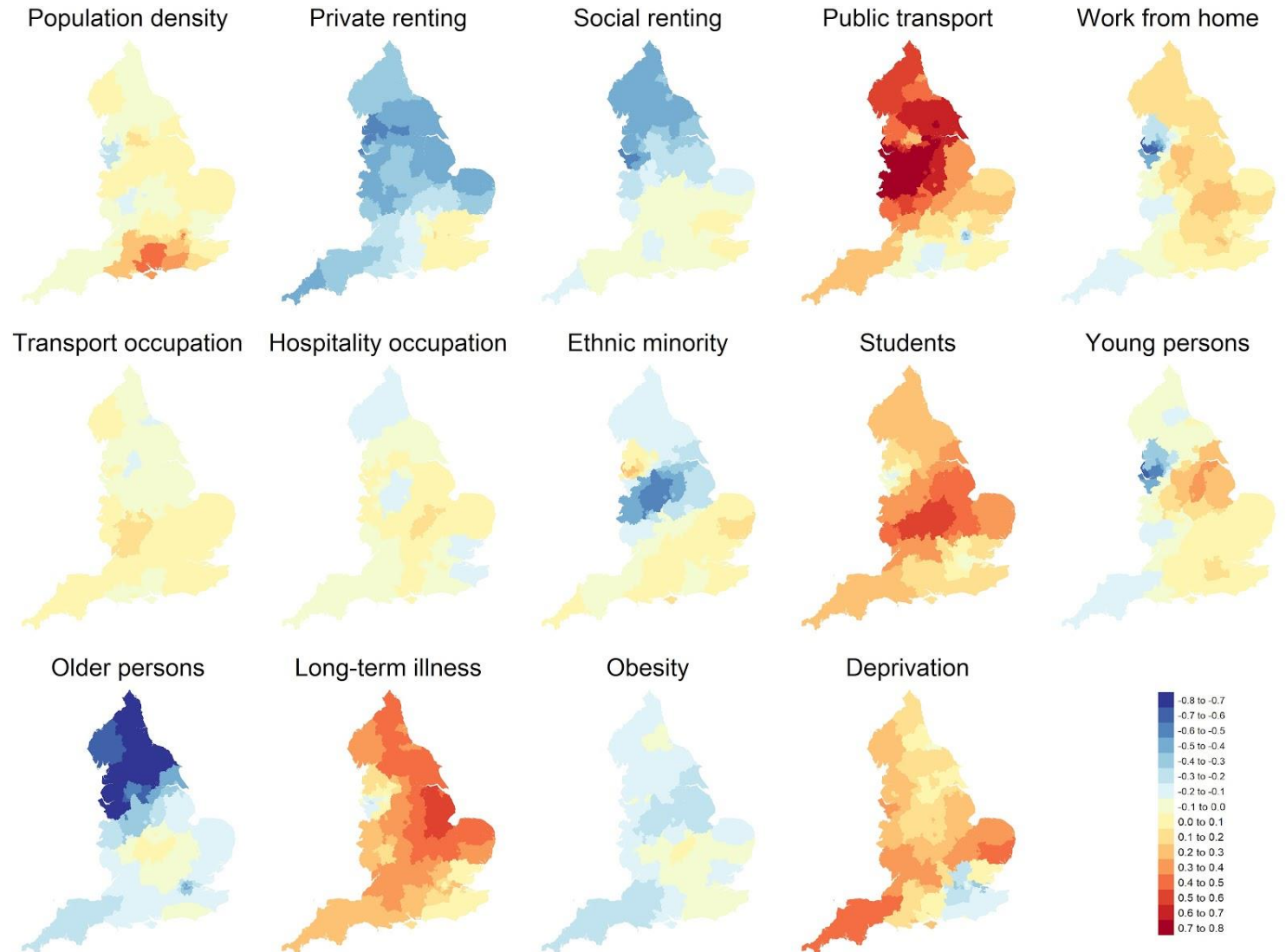
Adaptive quantile: 0.07631903 (about 11 of 149 data points)

Summary of GWR coefficient estimates at data points:

	Min.	1st Qu.	Median	3rd Qu.	Max.	Global
X.Intercept.	1.9351576	2.4146963	2.9785317	3.7381496	4.1014787	3.0463
PopulationDensity	-0.2936828	-0.0466846	0.0327238	0.1514974	0.4460957	-0.0311
WorkfromHome	-0.6999715	-0.0296562	0.0971730	0.1632889	0.2644027	-0.1531
PrivateRent	-0.5554232	-0.4128576	-0.3256680	0.0389379	0.1035477	-0.4447
SocialRent	-0.5107108	-0.3436065	-0.0879792	-0.0596459	0.0245780	-0.1838
PublicTransport	-0.4246757	0.0091984	0.2892724	0.5547161	1.1030733	0.1360
TransportOccupation	-0.1638995	-0.0240211	0.0298945	0.0617674	0.1231736	-0.0415
HospitalityOccupation	-0.1742001	-0.0430253	-0.0078906	0.0279415	0.1439349	-0.0163
EthnicMinority	-0.5725062	-0.1436877	-0.0056662	0.0383116	0.2403929	0.0633
Students	-0.1746698	-0.0031492	0.1513792	0.3083297	0.5703459	0.2931
Young	-0.6129039	-0.0710534	0.0327699	0.0897345	0.3082924	-0.1209
OlderPersons	-0.9411204	-0.6190940	-0.2874801	-0.1176569	0.0414635	-0.2703
LongTermIll	-0.2400824	0.1010367	0.2453327	0.3581472	0.5525462	0.3100
Obesity	-0.2806098	-0.1547747	-0.1046838	-0.0817312	0.0179990	-0.2471
IMDMostDeprived	-0.3476421	-0.1430121	0.1686816	0.2513274	0.4518363	0.3590

Start Wave 2 | Week commencing 5th October

GWR model



Peak Wave 2 | Week commencing 9th November

OLS Regression model

```
Residuals:
    Min       1Q   Median       3Q      Max
-30.762  -8.118   0.425   7.619  36.594

Coefficients:
              Estimate Std. Error t value Pr(>|t|)
(Intercept)    42.2550     1.0388  40.677 < 2e-16 ***
PopulationDensity  0.3015     2.4994   0.121 0.904160
WorkfromHome   -12.8798     2.6443  -4.871 3.09e-06 ***
PrivateRent     -2.2367     2.6802  -0.835 0.405462
SocialRent      -0.9188     1.8818  -0.488 0.626180
PublicTransport -11.2829     2.8943  -3.898 0.000152 ***
TransportOccupation -4.2630     1.5591  -2.734 0.007099 **
HospitalityOccupation -2.9989     1.5660  -1.915 0.057618 .
EthnicMinority   8.4825     2.6710   3.176 0.001854 **
Students        -1.4833     1.6102  -0.921 0.358616
Young           -6.2007     2.2864  -2.712 0.007566 **
OlderPersons     -2.7221     2.7129  -1.003 0.317487
LongTermIll      -3.5248     3.0423  -1.159 0.248682
Obesity          -0.1153     2.0894  -0.055 0.956069
IMDMostDeprived  5.7230     2.1166   2.704 0.007742 **
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 12.68 on 134 degrees of freedom
Multiple R-squared:  0.6005,    Adjusted R-squared:  0.5588
F-statistic: 14.39 on 14 and 134 DF,  p-value: < 2.2e-16
```

Peak Wave 2 | Week commencing 9th November

GWR model

```
ggwr(formula = m1_peakwave2, data = LA_sf_england_var, coords = cbind(long,
  lat), adapt = bw_quasipoissonm1_peakwave2, family = quasipoisson(),
  longlat = TRUE)
```

Kernel function: gwr.Gauss

Adaptive quantile: 0.2147612 (about 31 of 149 data points)

Summary of GWR coefficient estimates at data points:

	Min.	1st Qu.	Median	3rd Qu.	Max.	Global
X.Intercept.	3.2432022	3.4097285	3.6746030	3.7534561	3.9331277	3.6790
PopulationDensity	-0.1118380	-0.0257473	0.0452996	0.1096291	0.1658305	-0.0179
WorkfromHome	-0.5335438	-0.4515410	-0.3426537	-0.2282473	-0.1367059	-0.3961
PrivateRent	-0.0886786	-0.0549544	0.0169528	0.0998510	0.1506631	-0.0574
SocialRent	-0.0748235	-0.0426793	-0.0269266	0.0251448	0.1104193	-0.0478
PublicTransport	-0.5318380	-0.4112386	-0.2895988	-0.1668386	-0.0840610	-0.2840
TransportOccupation	-0.2032151	-0.1784085	-0.0841551	0.0113287	0.0372991	-0.1083
HospitalityOccupation	-0.1439650	-0.0768355	-0.0203078	0.0019263	0.0695850	-0.0566
EthnicMinority	-0.0282326	0.0252358	0.1722290	0.2066325	0.2591353	0.1923
Students	-0.2540366	-0.1178549	-0.0315102	0.0268842	0.0849711	-0.0361
Young	-0.2651455	-0.1721186	-0.1310504	-0.0477317	-0.0180005	-0.1739
OlderPersons	-0.2014411	-0.1046869	-0.0595555	-0.0333439	0.0023705	-0.1010
LongTermIll	-0.2907039	-0.1903858	-0.0284700	0.1139371	0.1984445	-0.0921
Obesity	-0.0794549	-0.0372266	-0.0021802	0.0235676	0.0489456	-0.0051
IMDMostDeprived	-0.4266758	-0.1439346	0.0084456	0.0372922	0.1106556	0.0888

Peak Wave 2 | Week commencing 9th November

GWR model

