

IDS 702 Team Project - Final Notebook

EDA and Analysis

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Sys.Date()

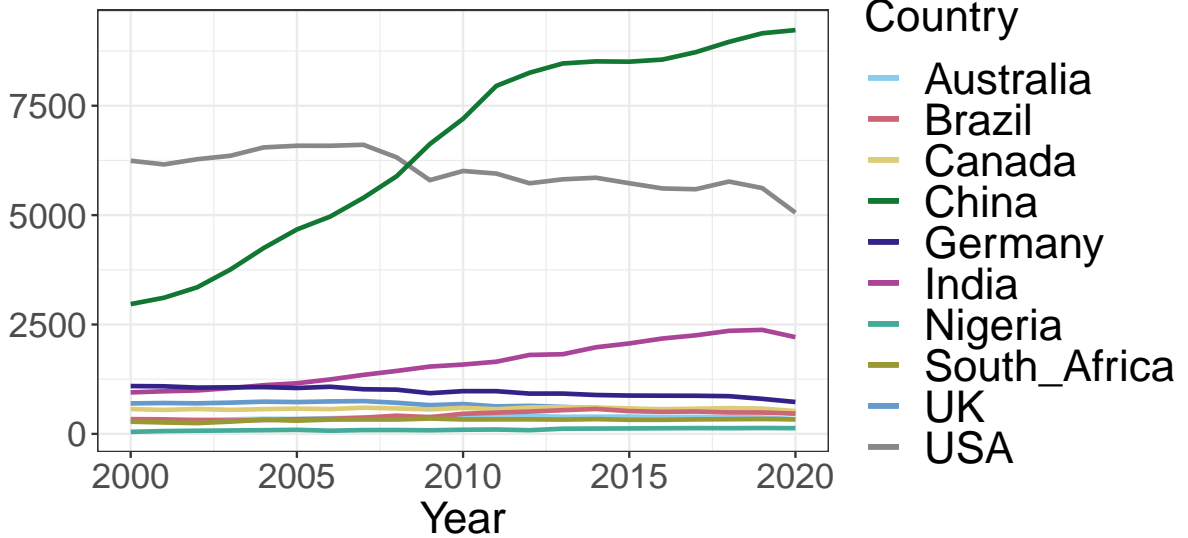
```
## Warning in !is.null(rmarkdown::metadata$output) && rmarkdown::metadata$output
## %in% : 'length(x) = 3 > 1' in coercion to 'logical(1)'
```

Exploratory Data Analysis

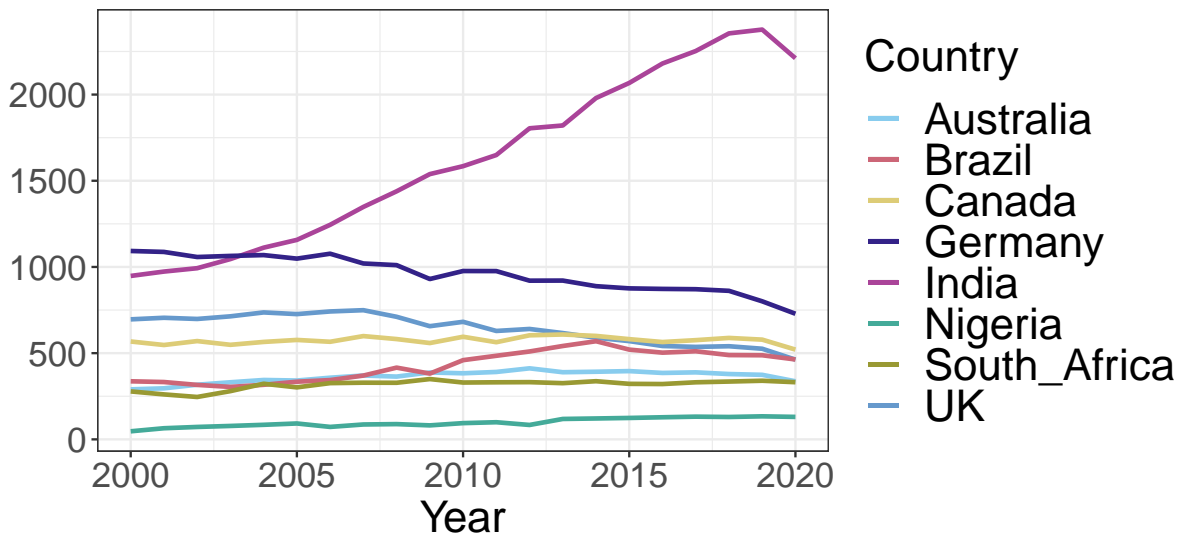
```
## Warning: Using 'size' aesthetic for lines was deprecated in ggplot2 3.4.0.
## i Please use 'linewidth' instead.
```

CO₂ Emissions [tonne per capita]

Graph 1.1 : CO₂ vs Year

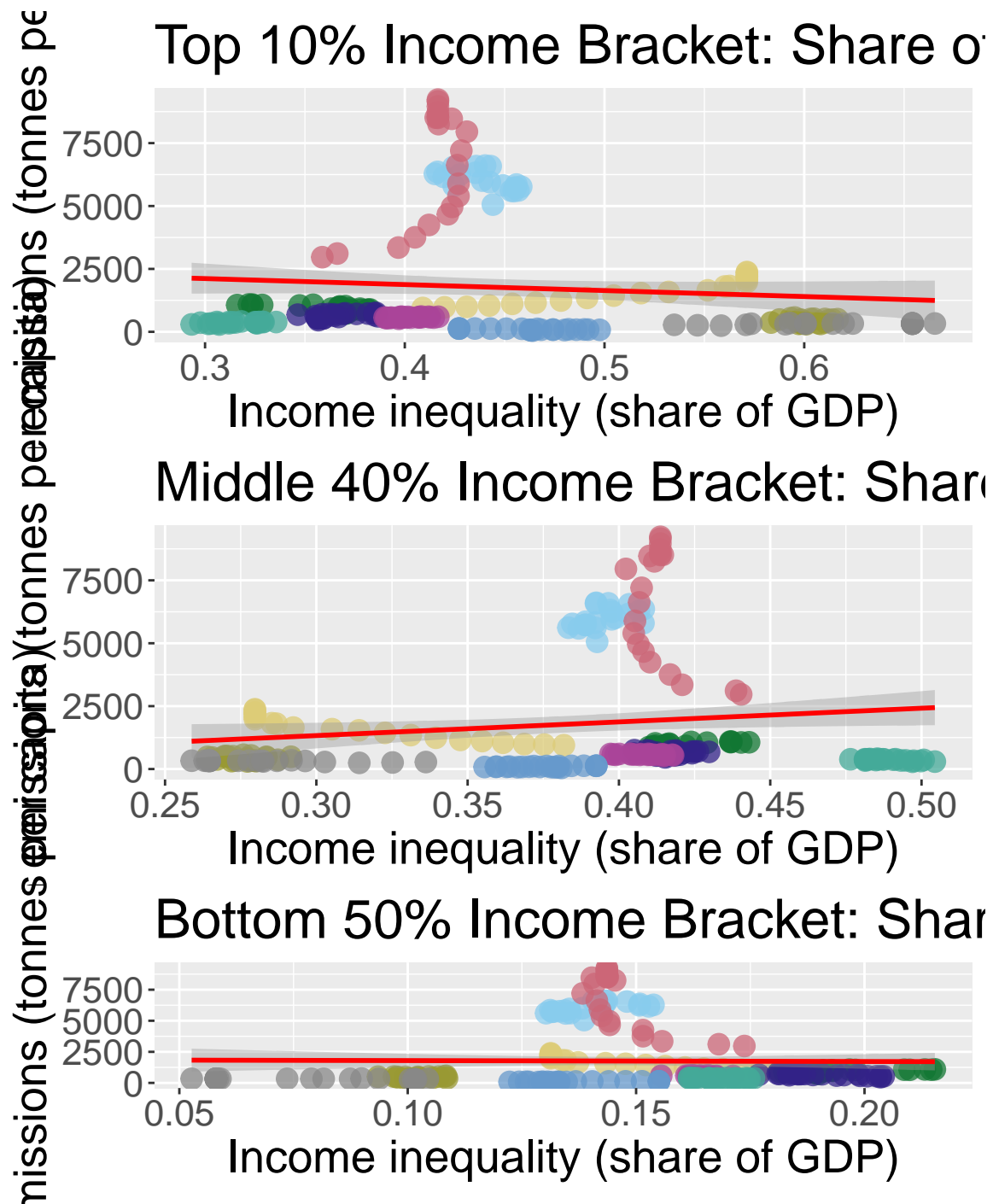


Graph 1.2 : CO₂ vs Year [Excl. China and USA]



Models

Model 1



countries

USA	India	UK	Australia
China	Germany	Canada	Brazil

```
## Linear mixed model fit by REML ['lmerMod']
```

```

## Formula:
## log(stacking_co2) ~ -1 + top10 + middle40 + bottom50 + (1 | country_code)
## Data: dataset_for_model1
##
## REML criterion at convergence: -39.8
##
## Scaled residuals:
##      Min       1Q   Median       3Q      Max
## -3.4401 -0.4820 -0.0375  0.5582  2.2007
##
## Random effects:
## Groups      Name      Variance Std.Dev.
## country_code (Intercept) 1.988    1.4098
## Residual          0.036    0.1897
## Number of obs: 210, groups: country_code, 10
##
## Fixed effects:
##              Estimate Std. Error t value
## top10          8.9154     0.5791  15.395
## middle40       2.8851     1.3318   2.166
## bottom50      10.7420     2.4536   4.378
##
## Correlation of Fixed Effects:
##              top10  mddl40
## middle40 -0.198
## bottom50  0.510 -0.818

```

Table 1: Summary Results for Model 1

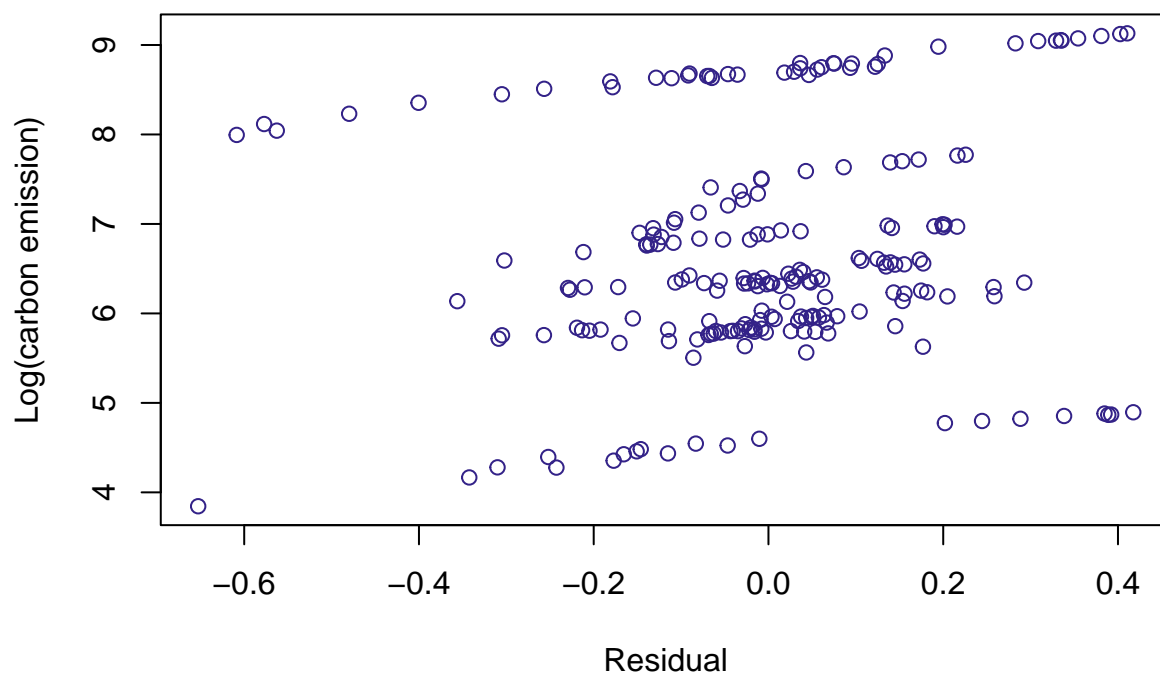
	log(stacking_co2)
top10	8.92***
	p = 0.00
middle40	2.89**
	p = 0.04
bottom50	10.74***
	p = 0.0001
N	210
Log Likelihood	19.88
AIC	-29.75
BIC	-13.02

***p < .01; **p < .05; *p < .1

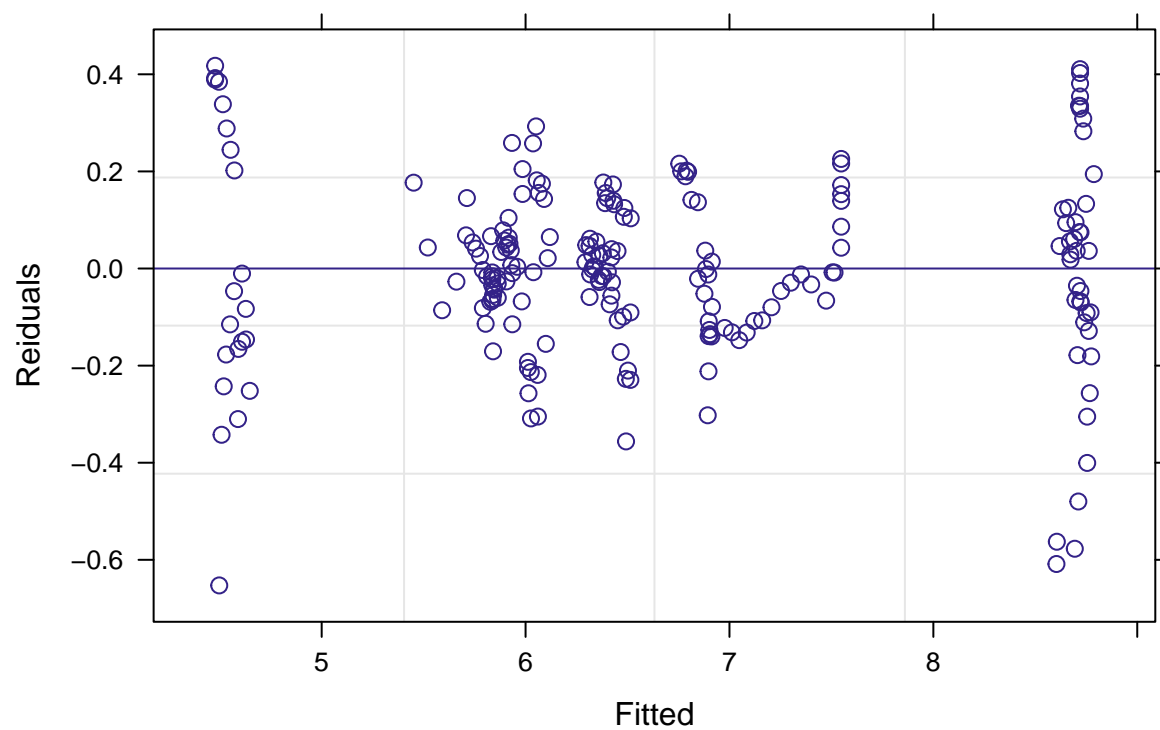
```
## Warning in vif.merMod(mod1): No intercept: vifs may not be sensible.
```

```
## top10 middle40 bottom50
## 1.684168 3.757159 4.882596
```

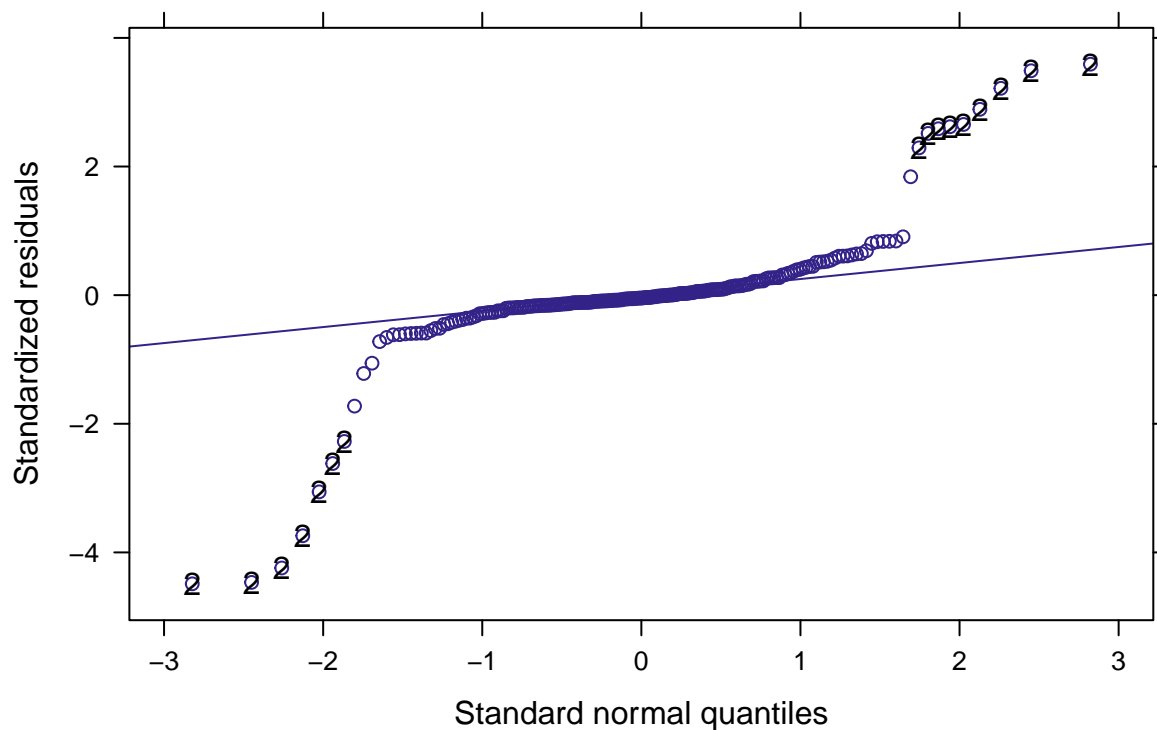
Assumption 1 – Linearity



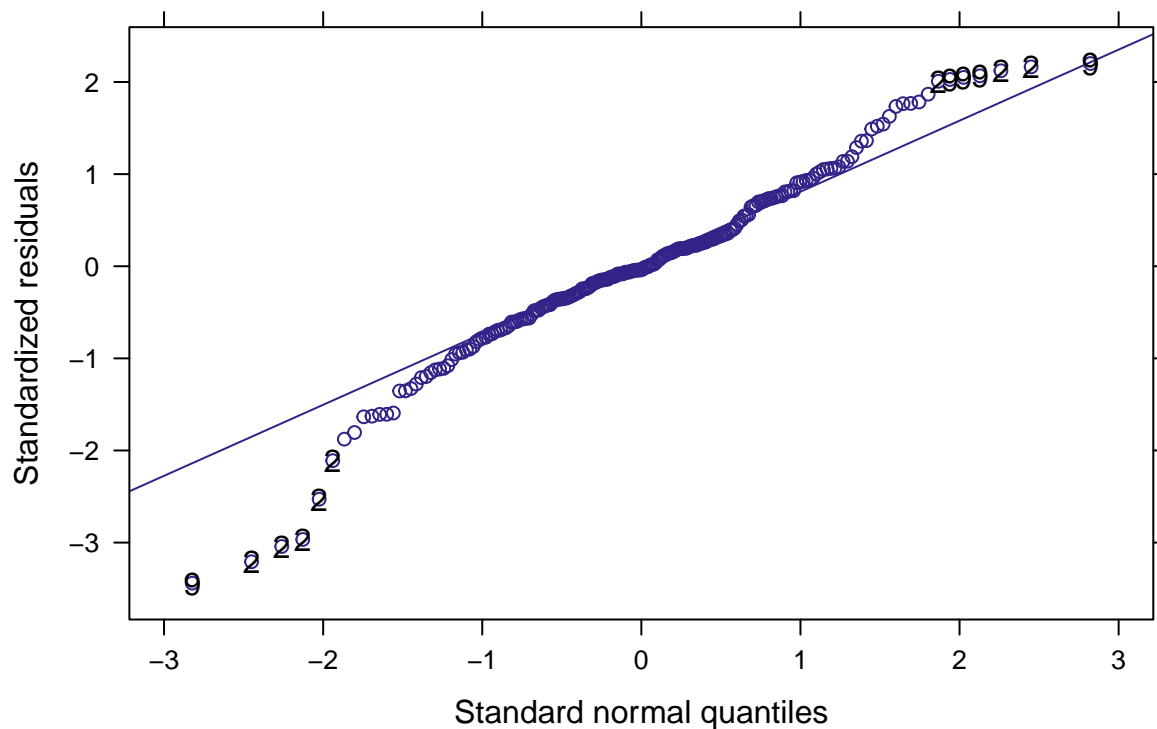
Assumption 2 – Homogeneity of Variance



Assumption 3 – Normality (before log transformation)



Assumption 3 – Normality (after log transformation)



```
## Analysis of Deviance Table (Type II Wald chisquare tests)
##
```

```
## Response: log(stacking_co2)
##           Chisq Df Pr(>Chisq)
## top10      236.9975  1 < 2.2e-16 ***
## middle40    4.6932  1  0.03028 *
## bottom50   19.1679  1 1.197e-05 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

## Warning: 'r.squaredGLMM' now calculates a revised statistic. See the help page.

##           R2m      R2c
## [1,] 0.06287628 0.9833305
```

Model 2:

	Percentile	Year	pop_usa	pop_china	pop_india	pop_germany	pop_uk
## 1	pall	2000	282398000	1267430000	1056575552	82211503	58886000
## 2	pall	2001	285225000	1276270000	1075000064	82349915	59113000
## 3	pall	2002	287955000	1284530000	1093317248	82488490	59366000
## 4	pall	2003	290626000	1292270000	1111523200	82534176	59637000
## 5	pall	2004	293262000	1299880000	1129623424	82516260	59950000
## 6	pall	2005	295993000	1307560000	1147609984	82469422	60413000
## 7	pall	2006	298818000	1314480000	1165486336	82376451	60827000
## 8	pall	2007	301696000	1321290000	1183209472	82266372	61319000
## 9	pall	2008	304543000	1328020000	1200669824	82110097	61824000
## 10	pall	2009	307240000	1334500000	1217726208	81902328	62260000
## 11	pall	2010	309774000	1340910000	1234281216	81776951	62759000
## 12	pall	2011	312010000	1347350000	1250288000	81797673	63285000
## 13	pall	2012	314212000	1354040000	1265780224	81818399	63705000
## 14	pall	2013	316357000	1360720000	1280842112	81839131	64106000
## 15	pall	2014	318631000	1367820000	1295600768	82117400	64539100
## 16	pall	2015	320918000	1374620000	1310152448	82457192	64970292
## 17	pall	2016	323186000	1381656576	1324517248	82866880	65402176
## 18	pall	2017	325220000	1388469248	1338676736	83335328	65825884
## 19	pall	2018	326949000	1394943360	1352642304	83805152	66234508
## 20	pall	2019	328527000	1400938752	1366417792	84201000	66617756
## 21	pall	2020	330152000	1406351872	1380004352	84470080	66968780
##	pop_canada	pop_australia	pop_brazil	pop_nigeria	pop_southafrica		
## 1	30685730	19028802	174790336	122283848	43695928		
## 2	31019020	19274701	177196048	125394048	44552396		
## 3	31353656	19495210	179537520	128596080	45456336		
## 4	31639670	19720737	181809248	131900632	46303560		
## 5	31940676	19932722	184006480	135320416	47071708		
## 6	32245209	20176844	186127104	138865024	47817896		
## 7	32576074	20450966	188167360	142538304	48533604		
## 8	32929733	20827622	190130448	146339984	49215800		
## 9	33319098	21249199	192030368	150269616	49861788		
## 10	33729690	21691653	193886512	154324928	50473912		
## 11	34126181	22031750	195713632	158503200	51056648		
## 12	34482779	22340024	197514528	162805072	51634728		
## 13	34865028	22728254	199287296	167228800	52221984		
## 14	35238912	23117400	201035904	171765824	52875980		
## 15	35606120	23475300	202763744	176404928	53608552		

## 16	35967868	23809652	204471776	181137440	54436288
## 17	36323556	24138170	206163056	185960240	55243480
## 18	36672136	24458424	207833824	190873248	56031828
## 19	37014040	24770346	209469328	195874688	56801168
## 20	37349980	25073828	211049520	200963600	57553784
## 21	37680540	25368990	212559424	206139584	58291328

##	CO2_USA	CO2_China	CO2_India	CO2_Germany	CO2_United_Kingdom	CO2_Canada
## 1	6243.512	2966.438	947.9181	1092.6729	696.0880	567.7579
## 2	6158.156	3111.275	973.3258	1087.2233	705.2561	547.2713
## 3	6278.259	3349.532	992.7863	1057.6714	698.3926	570.1219
## 4	6356.811	3756.494	1045.8105	1064.0225	713.6533	548.4005
## 5	6548.128	4247.222	1112.0221	1068.8797	736.3135	565.2194
## 6	6585.853	4671.877	1157.0825	1048.3137	726.5763	576.6702
## 7	6584.979	4966.312	1244.4029	1076.8192	741.9619	566.1175
## 8	6607.977	5394.594	1348.2947	1020.1647	749.2371	599.0809
## 9	6321.091	5888.035	1438.7902	1010.5018	710.9267	581.7258
## 10	5798.996	6623.902	1538.6289	930.0541	656.4940	558.7508
## 11	6009.014	7202.213	1584.6096	976.3896	681.8591	595.0749
## 12	5950.137	7953.535	1649.3192	976.1004	628.7591	563.5060
## 13	5727.855	8254.039	1804.3167	920.5091	640.3765	603.6116
## 14	5818.528	8466.827	1820.7281	920.9907	616.4803	608.2582
## 15	5854.312	8514.369	1979.7384	888.6082	589.7714	600.0063
## 16	5728.896	8507.310	2067.3493	875.8379	569.8455	581.2418
## 17	5609.857	8555.539	2180.2446	872.7670	541.5390	564.4867
## 18	5591.527	8724.594	2252.4839	870.9329	536.2167	575.3884
## 19	5767.385	8959.962	2354.7946	861.5927	540.1666	588.4063
## 20	5618.349	9156.242	2377.0559	800.6746	525.5872	578.5203
## 21	5056.514	9229.492	2210.6620	728.6139	462.5168	520.6682

##	CO2_Australia	CO2_Brazil	CO2_Nigeria	CO2_South_Africa	Year
## 1	290.0058	336.8040	46.75644	278.0964	2000
## 2	296.0152	332.5702	64.49740	260.8040	2001
## 3	316.9795	315.9631	72.02371	245.8759	2002
## 4	331.1009	304.2479	77.80638	279.7352	2003
## 5	344.4134	316.5276	84.41149	322.6100	2004
## 6	341.2755	334.4246	92.17793	301.6430	2005
## 7	357.6028	343.8018	72.20950	326.1320	2006
## 8	370.4580	370.0410	86.35525	328.7444	2007
## 9	364.0607	416.0265	88.48206	328.2835	2008
## 10	388.0428	381.4825	81.08125	349.8212	2009
## 11	383.2160	459.4822	94.15883	329.5887	2010
## 12	390.9302	484.8448	99.37846	331.0373	2011
## 13	411.9872	509.7443	83.58206	331.9544	2012
## 14	389.4520	541.5421	118.39379	325.9381	2013
## 15	392.2972	569.2059	121.24401	337.3161	2014
## 16	395.8695	520.5365	124.26436	321.9626	2015
## 17	385.2692	502.8934	128.22008	320.8881	2016
## 18	388.6341	511.0102	131.76394	331.0132	2017
## 19	378.9225	488.8707	129.86198	335.3028	2018
## 20	374.4238	487.8927	133.62974	339.9962	2019
## 21	336.9815	463.4981	130.28899	331.4963	2020

```
## Warning in data.frame(Year, Country, CO2, National_wealth, National_income, :
## row names were found from a short variable and have been discarded
```



```
## [1] "Year" "Country"
## [3] "National_Carbon_Emissions" "National_Wealth"
## [5] "National_Income" "National_Population"

## [1] 1761.01

## 'data.frame': 210 obs. of 7 variables:
## $ Year : num 2000 2001 2002 2003 2004 ...
## $ Country : Factor w/ 10 levels "AUSTRALIA","BRAZIL",...: 10 10 10 10 10 10 10 10 10 10 ...
## $ CO2 : num 6244 6158 6278 6357 6548 ...
## $ National_Wealth: num 306733 303177 294610 300248 327275 ...
## $ National_Income: num 64578 64349 64323 65074 67017 ...
## $ Population : num 2.82e+08 2.85e+08 2.88e+08 2.91e+08 2.93e+08 ...
## $ CO2_C : Ord.factor w/ 3 levels "low"<"med"<"high": 3 3 3 3 3 3 3 3 3 3 ...
```

	Year	Country	CO2	National_Wealth	National_Income	Population
## 1	2000	USA	6243.51155	306733.00	64578.100	282398000
## 2	2001	USA	6158.15648	303177.40	64349.000	285225000
## 3	2002	USA	6278.25894	294610.20	64323.100	287955000
## 4	2003	USA	6356.81134	300247.80	65074.400	290626000
## 5	2004	USA	6548.12797	327274.80	67017.000	293262000
## 6	2005	USA	6585.85281	351245.40	68544.100	295993000
## 7	2006	USA	6584.97941	369410.20	70148.400	298818000
## 8	2007	USA	6607.97739	374904.30	69569.500	301696000
## 9	2008	USA	6321.09090	331209.70	67699.500	304543000
## 10	2009	USA	5798.99596	285842.00	64505.500	307240000
## 11	2010	USA	6009.01357	285324.00	66668.300	309774000
## 12	2011	USA	5950.13695	283604.50	68056.300	312010000
## 13	2012	USA	5727.85528	284190.30	69614.100	314212000
## 14	2013	USA	5818.52831	308147.60	70077.300	316357000
## 15	2014	USA	5854.31222	330596.70	71621.300	318631000
## 16	2015	USA	5728.89559	344401.70	73544.600	320918000
## 17	2016	USA	5609.85715	351970.00	73137.100	323186000
## 18	2017	USA	5591.52706	374711.80	74230.400	325220000
## 19	2018	USA	5767.38466	380433.60	75376.100	326949000
## 20	2019	USA	5618.34916	394437.50	76074.700	328527000
## 21	2020	USA	5056.51425	435500.70	72530.500	330152000
## 22	2000	CHINA	2966.43794	37379.01	6259.370	1267430000
## 23	2001	CHINA	3111.27545	38938.06	6544.980	1276270000
## 24	2002	CHINA	3349.53177	42336.16	7181.381	1284530000
## 25	2003	CHINA	3756.49381	45347.28	7721.759	1292270000
## 26	2004	CHINA	4247.22240	49844.96	8489.616	1299880000
## 27	2005	CHINA	4671.87694	55433.03	9138.108	1307560000
## 28	2006	CHINA	4966.31174	61219.75	10119.452	1314480000
## 29	2007	CHINA	5394.59413	71338.67	11243.391	1321290000
## 30	2008	CHINA	5888.03489	72466.92	11696.728	1328020000
## 31	2009	CHINA	6623.90213	78054.68	12309.536	1334500000
## 32	2010	CHINA	7202.21252	88372.76	13274.508	1340910000
## 33	2011	CHINA	7953.53483	92081.52	14064.083	1347350000
## 34	2012	CHINA	8254.03900	99858.58	14949.991	1354040000
## 35	2013	CHINA	8466.82728	111329.84	16231.302	1360720000
## 36	2014	CHINA	8514.36874	121060.89	17531.952	1367820000
## 37	2015	CHINA	8507.30992	130738.92	18482.566	1374620000

## 38	2016	CHINA	8555.53899	140193.88	19566.483	1381656576
## 39	2017	CHINA	8724.59387	146572.84	20682.222	1388469248
## 40	2018	CHINA	8959.96155	154389.36	21738.991	1394943360
## 41	2019	CHINA	9156.24206	165082.77	22778.129	1400938752
## 42	2020	CHINA	9229.49200	167898.90	23087.360	1406351872
## 43	2000	INDIA	947.91810	18120.92	4552.485	1056575552
## 44	2001	INDIA	973.32583	18374.40	4597.144	1075000064
## 45	2002	INDIA	992.78627	18883.00	4708.538	1093317248
## 46	2003	INDIA	1045.81046	19715.74	4768.670	1111523200
## 47	2004	INDIA	1112.02207	21355.34	5027.720	1129623424
## 48	2005	INDIA	1157.08253	23034.77	5282.856	1147609984
## 49	2006	INDIA	1244.40292	25036.09	5615.163	1165486336
## 50	2007	INDIA	1348.29468	27117.88	5966.624	1183209472
## 51	2008	INDIA	1438.79016	30012.09	6428.904	1200669824
## 52	2009	INDIA	1538.62890	30811.66	6461.402	1217726208
## 53	2010	INDIA	1584.60956	33206.79	6854.784	1234281216
## 54	2011	INDIA	1649.31925	36511.52	7364.190	1250288000
## 55	2012	INDIA	1804.31667	38686.20	7660.195	1265780224
## 56	2013	INDIA	1820.72811	39810.32	7808.042	1280842112
## 57	2014	INDIA	1979.73836	42422.08	8121.890	1295600768
## 58	2015	INDIA	2067.34933	44968.12	8647.252	1310152448
## 59	2016	INDIA	2180.24464	47670.41	9298.896	1324517248
## 60	2017	INDIA	2252.48385	49571.23	9793.632	1338676736
## 61	2018	INDIA	2354.79461	51046.34	10236.769	1352642304
## 62	2019	INDIA	2377.05587	51906.35	10503.325	1366417792
## 63	2020	INDIA	2210.66196	48818.63	9805.317	1380004352
## 64	2000	GERMANY	1092.67290	213548.38	48311.960	82211503
## 65	2001	GERMANY	1087.22330	212377.11	48683.111	82349915
## 66	2002	GERMANY	1057.67141	208078.83	48259.491	82488490
## 67	2003	GERMANY	1064.02252	205238.45	48167.905	82534176
## 68	2004	GERMANY	1068.87969	206856.16	49489.766	82516260
## 69	2005	GERMANY	1048.31369	210510.94	49847.434	82469422
## 70	2006	GERMANY	1076.81924	215374.77	52205.850	82376451
## 71	2007	GERMANY	1020.16471	221775.67	53369.371	82266372
## 72	2008	GERMANY	1010.50178	226326.15	53449.476	82110097
## 73	2009	GERMANY	930.05410	224584.41	50191.617	81902328
## 74	2010	GERMANY	976.38962	227977.37	51843.243	81776951
## 75	2011	GERMANY	976.10044	229758.50	53089.672	81797673
## 76	2012	GERMANY	920.50914	236534.96	53318.505	81818399
## 77	2013	GERMANY	920.99074	247880.19	53352.816	81839131
## 78	2014	GERMANY	888.60820	260320.06	54239.576	82117400
## 79	2015	GERMANY	875.83791	275193.37	54956.913	82457192
## 80	2016	GERMANY	872.76705	293030.15	56090.128	82866880
## 81	2017	GERMANY	870.93288	313133.10	57266.733	83335328
## 82	2018	GERMANY	861.59273	332035.55	57716.254	83805152
## 83	2019	GERMANY	800.67457	348797.99	57433.751	84201000
## 84	2020	GERMANY	728.61385	341320.48	54640.233	84470080
## 85	2000	UK	696.08799	224227.57	43075.562	58886000
## 86	2001	UK	705.25608	231185.07	44484.701	59113000
## 87	2002	UK	698.39256	236191.25	45294.192	59366000
## 88	2003	UK	713.65332	248911.49	46503.021	59637000
## 89	2004	UK	736.31346	262375.20	47626.349	59950000
## 90	2005	UK	726.57628	275032.70	48223.864	60413000
## 91	2006	UK	741.96187	284992.14	48806.441	60827000

## 92	2007	UK	749.23708	291658.27	49268.377	61319000
## 93	2008	UK	710.92674	270516.91	50648.495	61824000
## 94	2009	UK	656.49401	250220.19	50901.300	62260000
## 95	2010	UK	681.85912	247868.39	46733.207	62759000
## 96	2011	UK	628.75915	245341.33	47234.266	63285000
## 97	2012	UK	640.37652	243128.82	45829.821	63705000
## 98	2013	UK	616.48025	244642.81	46521.516	64106000
## 99	2014	UK	589.77141	254202.62	46997.536	64539100
## 100	2015	UK	569.84551	268953.27	48152.874	64970292
## 101	2016	UK	541.53902	276354.21	48637.999	65402176
## 102	2017	UK	536.21669	283868.81	49583.211	65825884
## 103	2018	UK	540.16664	283466.06	50150.139	66234508
## 104	2019	UK	525.58722	281459.83	49596.157	66617756
## 105	2020	UK	462.51676	255742.08	44407.024	66968780
## 106	2000	CANADA	567.75790	175542.47	50550.550	30685730
## 107	2001	CANADA	547.27128	175526.70	50202.632	31019020
## 108	2002	CANADA	570.12195	169034.71	51102.665	31353656
## 109	2003	CANADA	548.40047	172188.83	51481.946	31639670
## 110	2004	CANADA	565.21937	182508.75	52746.580	31940676
## 111	2005	CANADA	576.67023	197483.74	53778.739	32245209
## 112	2006	CANADA	566.11750	216042.85	55097.925	32576074
## 113	2007	CANADA	599.08089	228888.38	55281.518	32929733
## 114	2008	CANADA	581.72580	217958.44	54533.716	33319098
## 115	2009	CANADA	558.75080	220745.87	51616.659	33729690
## 116	2010	CANADA	595.07495	232661.59	52507.600	34126181
## 117	2011	CANADA	563.50597	235620.52	52836.666	34482779
## 118	2012	CANADA	603.61164	237776.68	53749.962	34865028
## 119	2013	CANADA	608.25821	249331.46	54370.559	35238912
## 120	2014	CANADA	600.00632	265139.17	55199.022	35606120
## 121	2015	CANADA	581.24184	278465.49	54431.284	35967868
## 122	2016	CANADA	564.48669	290485.55	54332.939	36323556
## 123	2017	CANADA	575.38844	303848.33	55753.056	36672136
## 124	2018	CANADA	588.40633	308984.85	56410.938	37014040
## 125	2019	CANADA	578.52025	319379.68	56243.778	37349980
## 126	2020	CANADA	520.66823	339001.81	52203.724	37680540
## 127	2000	AUSTRALIA	290.00579	258389.05	49196.723	19028802
## 128	2001	AUSTRALIA	296.01516	265419.31	49264.472	19274701
## 129	2002	AUSTRALIA	316.97948	278433.02	50641.773	19495210
## 130	2003	AUSTRALIA	331.10087	295593.63	51354.305	19720737
## 131	2004	AUSTRALIA	344.41339	319410.51	52952.241	19932722
## 132	2005	AUSTRALIA	341.27551	339880.30	53336.220	20176844
## 133	2006	AUSTRALIA	357.60276	353010.25	53764.033	20450966
## 134	2007	AUSTRALIA	370.45804	372691.70	54378.305	20827622
## 135	2008	AUSTRALIA	364.06073	379099.43	55362.234	21249199
## 136	2009	AUSTRALIA	388.04278	358257.65	54883.993	21691653
## 137	2010	AUSTRALIA	383.21599	367272.23	54885.925	22031750
## 138	2011	AUSTRALIA	390.93022	362716.78	55097.633	22340024
## 139	2012	AUSTRALIA	411.98715	350881.25	55321.398	22728254
## 140	2013	AUSTRALIA	389.45198	355584.19	56134.656	23117400
## 141	2014	AUSTRALIA	392.29716	372273.48	55739.818	23475300
## 142	2015	AUSTRALIA	395.86949	394787.14	54580.754	23809652
## 143	2016	AUSTRALIA	385.26915	409807.28	55411.531	24138170
## 144	2017	AUSTRALIA	388.63414	423287.58	55754.607	24458424
## 145	2018	AUSTRALIA	378.92248	438983.08	56478.931	24770346

## 146 2019	AUSTRALIA	374.42385	434488.05	56174.226	25073828
## 147 2020	AUSTRALIA	336.98146	435620.06	56154.241	25368990
## 148 2000	BRAZIL	336.80399	50439.44	19398.261	174790336
## 149 2001	BRAZIL	332.57024	51825.35	19130.623	177196048
## 150 2002	BRAZIL	315.96305	50988.20	19197.779	179537520
## 151 2003	BRAZIL	304.24792	50675.09	18858.952	181809248
## 152 2004	BRAZIL	316.52757	54321.95	19573.880	184006480
## 153 2005	BRAZIL	334.42462	56035.48	19711.194	186127104
## 154 2006	BRAZIL	343.80179	57147.53	20035.416	188167360
## 155 2007	BRAZIL	370.04096	61837.34	20879.325	190130448
## 156 2008	BRAZIL	416.02650	65621.70	21553.708	192030368
## 157 2009	BRAZIL	381.48250	69899.30	21024.076	193886512
## 158 2010	BRAZIL	459.48223	76061.49	22101.933	195713632
## 159 2011	BRAZIL	484.84479	81115.90	22667.989	197514528
## 160 2012	BRAZIL	509.74425	84170.63	22825.911	199287296
## 161 2013	BRAZIL	541.54205	86745.99	23410.828	201035904
## 162 2014	BRAZIL	569.20591	87176.34	22971.872	202763744
## 163 2015	BRAZIL	520.53649	82862.85	21701.237	204471776
## 164 2016	BRAZIL	502.89339	76795.06	20611.641	206163056
## 165 2017	BRAZIL	511.01017	74022.48	20662.176	207833824
## 166 2018	BRAZIL	488.87072	71041.45	20576.876	209469328
## 167 2019	BRAZIL	487.89273	71638.46	20551.788	211049520
## 168 2020	BRAZIL	463.49809	68393.73	19421.199	212559424
## 169 2000	NIGERIA	46.75644	25247.13	6474.840	122283848
## 170 2001	NIGERIA	64.49740	27205.46	6728.206	125394048
## 171 2002	NIGERIA	72.02371	32232.88	7639.961	128596080
## 172 2003	NIGERIA	77.80638	33985.51	7957.967	131900632
## 173 2004	NIGERIA	84.41149	36434.64	8334.339	135320416
## 174 2005	NIGERIA	92.17793	39471.59	8751.912	138865024
## 175 2006	NIGERIA	72.20950	42248.35	9087.660	142538304
## 176 2007	NIGERIA	86.35525	43417.67	9111.175	146339984
## 177 2008	NIGERIA	88.48206	45975.06	9492.785	150269616
## 178 2009	NIGERIA	81.08125	48789.65	9939.175	154324928
## 179 2010	NIGERIA	94.15883	51295.11	10449.586	158503200
## 180 2011	NIGERIA	99.37846	52558.42	10652.660	162805072
## 181 2012	NIGERIA	83.58206	53790.52	10844.451	167228800
## 182 2013	NIGERIA	118.39379	56269.71	11328.784	171765824
## 183 2014	NIGERIA	121.24401	59383.44	11939.575	176404928
## 184 2015	NIGERIA	124.26436	59948.06	12032.302	181137440
## 185 2016	NIGERIA	128.22008	58411.23	11703.372	185960240
## 186 2017	NIGERIA	131.76394	57196.79	11422.023	190873248
## 187 2018	NIGERIA	129.86198	56963.32	11323.754	195874688
## 188 2019	NIGERIA	133.62974	57446.58	11376.982	200963600
## 189 2020	NIGERIA	130.28899	55203.29	10889.509	206139584
## 190 2000	SOUTH AFRICA	278.09643	56071.84	18131.601	43695928
## 191 2001	SOUTH AFRICA	260.80398	58176.98	18492.862	44552396
## 192 2002	SOUTH AFRICA	245.87588	59349.12	19144.583	45456336
## 193 2003	SOUTH AFRICA	279.73522	62104.35	19592.415	46303560
## 194 2004	SOUTH AFRICA	322.60998	66732.86	20313.804	47071708
## 195 2005	SOUTH AFRICA	301.64299	72234.20	21168.801	47817896
## 196 2006	SOUTH AFRICA	326.13196	77641.68	21954.055	48533604
## 197 2007	SOUTH AFRICA	328.74438	80382.15	22319.792	49215800
## 198 2008	SOUTH AFRICA	328.28353	79721.35	22336.038	49861788
## 199 2009	SOUTH AFRICA	349.82117	78733.64	22021.053	50473912

##	200	2010	SOUTH AFRICA	329.58867	80548.15	22611.549	51056648
##	201	2011	SOUTH AFRICA	331.03732	81122.95	22939.498	51634728
##	202	2012	SOUTH AFRICA	331.95444	80698.02	22578.177	52221984
##	203	2013	SOUTH AFRICA	325.93809	81312.14	22179.291	52875980
##	204	2014	SOUTH AFRICA	337.31614	81792.65	21796.205	53608552
##	205	2015	SOUTH AFRICA	321.96256	82485.29	21735.353	54436288
##	206	2016	SOUTH AFRICA	320.88808	80752.95	21277.779	55243480
##	207	2017	SOUTH AFRICA	331.01317	80151.81	21114.797	56031828
##	208	2018	SOUTH AFRICA	335.30276	79842.16	21051.319	56801168
##	209	2019	SOUTH AFRICA	339.99618	77519.38	20561.552	57553784
##	210	2020	SOUTH AFRICA	331.49627	73176.29	18960.685	58291328
##			CO2_C				
##	1		high				
##	2		high				
##	3		high				
##	4		high				
##	5		high				
##	6		high				
##	7		high				
##	8		high				
##	9		high				
##	10		high				
##	11		high				
##	12		high				
##	13		high				
##	14		high				
##	15		high				
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##	17		high				
##	18		high				
##	19		high				
##	20		high				
##	21		high				
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##	37		high				
##	38		high				
##	39		high				
##	40		high				
##	41		high				
##	42		high				

## 43	med
## 44	med
## 45	med
## 46	med
## 47	med
## 48	med
## 49	med
## 50	med
## 51	med
## 52	med
## 53	med
## 54	med
## 55	med
## 56	med
## 57	med
## 58	high
## 59	high
## 60	high
## 61	high
## 62	high
## 63	high
## 64	med
## 65	med
## 66	med
## 67	med
## 68	med
## 69	med
## 70	med
## 71	med
## 72	med
## 73	med
## 74	med
## 75	med
## 76	med
## 77	med
## 78	med
## 79	med
## 80	med
## 81	med
## 82	med
## 83	med
## 84	med
## 85	med
## 86	med
## 87	med
## 88	med
## 89	med
## 90	med
## 91	med
## 92	med
## 93	med
## 94	med
## 95	med
## 96	med

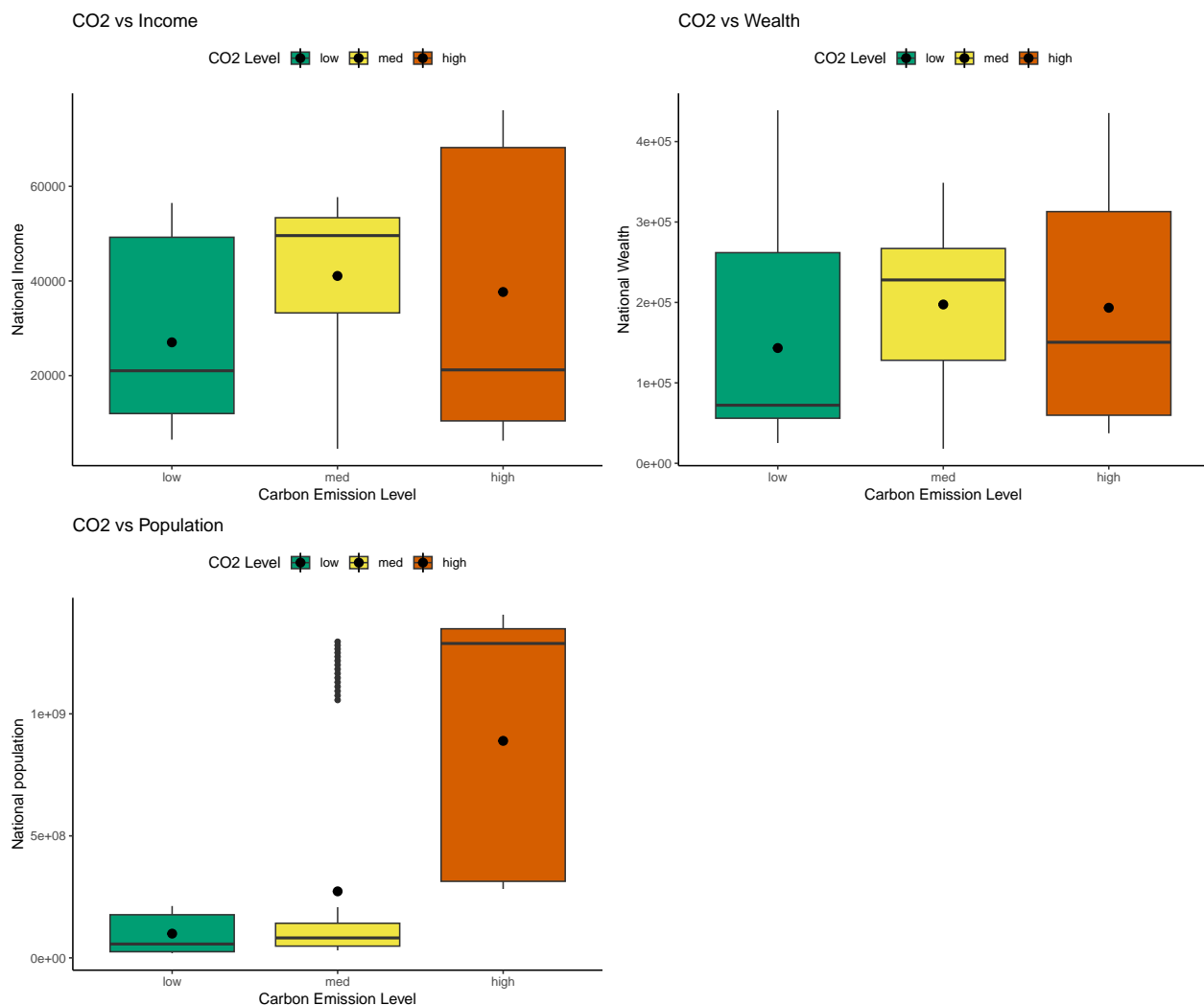
## 97	med
## 98	med
## 99	med
## 100	med
## 101	med
## 102	med
## 103	med
## 104	med
## 105	low
## 106	med
## 107	med
## 108	med
## 109	med
## 110	med
## 111	med
## 112	med
## 113	med
## 114	med
## 115	med
## 116	med
## 117	med
## 118	med
## 119	med
## 120	med
## 121	med
## 122	med
## 123	med
## 124	med
## 125	med
## 126	med
## 127	low
## 128	low
## 129	low
## 130	low
## 131	low
## 132	low
## 133	low
## 134	low
## 135	low
## 136	low
## 137	low
## 138	low
## 139	low
## 140	low
## 141	low
## 142	low
## 143	low
## 144	low
## 145	low
## 146	low
## 147	low
## 148	low
## 149	low
## 150	low

##	151	low
##	152	low
##	153	low
##	154	low
##	155	low
##	156	low
##	157	low
##	158	low
##	159	low
##	160	med
##	161	med
##	162	med
##	163	med
##	164	med
##	165	med
##	166	low
##	167	low
##	168	low
##	169	low
##	170	low
##	171	low
##	172	low
##	173	low
##	174	low
##	175	low
##	176	low
##	177	low
##	178	low
##	179	low
##	180	low
##	181	low
##	182	low
##	183	low
##	184	low
##	185	low
##	186	low
##	187	low
##	188	low
##	189	low
##	190	low
##	191	low
##	192	low
##	193	low
##	194	low
##	195	low
##	196	low
##	197	low
##	198	low
##	199	low
##	200	low
##	201	low
##	202	low
##	203	low
##	204	low


```
## 205 low
## 206 low
## 207 low
## 208 low
## 209 low
## 210 low
```

```
## Warning: The 'fun.y' argument of 'stat_summary()' is deprecated as of ggplot2 3.3.0.
## i Please use the 'fun' argument instead.
```

```
## Warning: Removed 3 rows containing missing values ('geom_segment()').
## Removed 3 rows containing missing values ('geom_segment()').
## Removed 3 rows containing missing values ('geom_segment()').
```



```
##      Year      Country      CO2 National_Wealth National_Income Population
## 1  2000         USA 6243.51155      306733.00      64578.100  282398000
## 2  2001         USA 6158.15648      303177.40      64349.000  285225000
## 3  2002         USA 6278.25894      294610.20      64323.100  287955000
## 4  2003         USA 6356.81134      300247.80      65074.400  290626000
```

## 5	2004	USA	6548.12797	327274.80	67017.000	293262000
## 6	2005	USA	6585.85281	351245.40	68544.100	295993000
## 7	2006	USA	6584.97941	369410.20	70148.400	298818000
## 8	2007	USA	6607.97739	374904.30	69569.500	301696000
## 9	2008	USA	6321.09090	331209.70	67699.500	304543000
## 10	2009	USA	5798.99596	285842.00	64505.500	307240000
## 11	2010	USA	6009.01357	285324.00	66668.300	309774000
## 12	2011	USA	5950.13695	283604.50	68056.300	312010000
## 13	2012	USA	5727.85528	284190.30	69614.100	314212000
## 14	2013	USA	5818.52831	308147.60	70077.300	316357000
## 15	2014	USA	5854.31222	330596.70	71621.300	318631000
## 16	2015	USA	5728.89559	344401.70	73544.600	320918000
## 17	2016	USA	5609.85715	351970.00	73137.100	323186000
## 18	2017	USA	5591.52706	374711.80	74230.400	325220000
## 19	2018	USA	5767.38466	380433.60	75376.100	326949000
## 20	2019	USA	5618.34916	394437.50	76074.700	328527000
## 21	2020	USA	5056.51425	435500.70	72530.500	330152000
## 22	2000	CHINA	2966.43794	37379.01	6259.370	1267430000
## 23	2001	CHINA	3111.27545	38938.06	6544.980	1276270000
## 24	2002	CHINA	3349.53177	42336.16	7181.381	1284530000
## 25	2003	CHINA	3756.49381	45347.28	7721.759	1292270000
## 26	2004	CHINA	4247.22240	49844.96	8489.616	1299880000
## 27	2005	CHINA	4671.87694	55433.03	9138.108	1307560000
## 28	2006	CHINA	4966.31174	61219.75	10119.452	1314480000
## 29	2007	CHINA	5394.59413	71338.67	11243.391	1321290000
## 30	2008	CHINA	5888.03489	72466.92	11696.728	1328020000
## 31	2009	CHINA	6623.90213	78054.68	12309.536	1334500000
## 32	2010	CHINA	7202.21252	88372.76	13274.508	1340910000
## 33	2011	CHINA	7953.53483	92081.52	14064.083	1347350000
## 34	2012	CHINA	8254.03900	99858.58	14949.991	1354040000
## 35	2013	CHINA	8466.82728	111329.84	16231.302	1360720000
## 36	2014	CHINA	8514.36874	121060.89	17531.952	1367820000
## 37	2015	CHINA	8507.30992	130738.92	18482.566	1374620000
## 38	2016	CHINA	8555.53899	140193.88	19566.483	1381656576
## 39	2017	CHINA	8724.59387	146572.84	20682.222	1388469248
## 40	2018	CHINA	8959.96155	154389.36	21738.991	1394943360
## 41	2019	CHINA	9156.24206	165082.77	22778.129	1400938752
## 42	2020	CHINA	9229.49200	167898.90	23087.360	1406351872
## 43	2000	INDIA	947.91810	18120.92	4552.485	1056575552
## 44	2001	INDIA	973.32583	18374.40	4597.144	1075000064
## 45	2002	INDIA	992.78627	18883.00	4708.538	1093317248
## 46	2003	INDIA	1045.81046	19715.74	4768.670	1111523200
## 47	2004	INDIA	1112.02207	21355.34	5027.720	1129623424
## 48	2005	INDIA	1157.08253	23034.77	5282.856	1147609984
## 49	2006	INDIA	1244.40292	25036.09	5615.163	1165486336
## 50	2007	INDIA	1348.29468	27117.88	5966.624	1183209472
## 51	2008	INDIA	1438.79016	30012.09	6428.904	1200669824
## 52	2009	INDIA	1538.62890	30811.66	6461.402	1217726208
## 53	2010	INDIA	1584.60956	33206.79	6854.784	1234281216
## 54	2011	INDIA	1649.31925	36511.52	7364.190	1250288000
## 55	2012	INDIA	1804.31667	38686.20	7660.195	1265780224
## 56	2013	INDIA	1820.72811	39810.32	7808.042	1280842112
## 57	2014	INDIA	1979.73836	42422.08	8121.890	1295600768
## 58	2015	INDIA	2067.34933	44968.12	8647.252	1310152448

## 59	2016	INDIA	2180.24464	47670.41	9298.896	1324517248
## 60	2017	INDIA	2252.48385	49571.23	9793.632	1338676736
## 61	2018	INDIA	2354.79461	51046.34	10236.769	1352642304
## 62	2019	INDIA	2377.05587	51906.35	10503.325	1366417792
## 63	2020	INDIA	2210.66196	48818.63	9805.317	1380004352
## 64	2000	GERMANY	1092.67290	213548.38	48311.960	82211503
## 65	2001	GERMANY	1087.22330	212377.11	48683.111	82349915
## 66	2002	GERMANY	1057.67141	208078.83	48259.491	82488490
## 67	2003	GERMANY	1064.02252	205238.45	48167.905	82534176
## 68	2004	GERMANY	1068.87969	206856.16	49489.766	82516260
## 69	2005	GERMANY	1048.31369	210510.94	49847.434	82469422
## 70	2006	GERMANY	1076.81924	215374.77	52205.850	82376451
## 71	2007	GERMANY	1020.16471	221775.67	53369.371	82266372
## 72	2008	GERMANY	1010.50178	226326.15	53449.476	82110097
## 73	2009	GERMANY	930.05410	224584.41	50191.617	81902328
## 74	2010	GERMANY	976.38962	227977.37	51843.243	81776951
## 75	2011	GERMANY	976.10044	229758.50	53089.672	81797673
## 76	2012	GERMANY	920.50914	236534.96	53318.505	81818399
## 77	2013	GERMANY	920.99074	247880.19	53352.816	81839131
## 78	2014	GERMANY	888.60820	260320.06	54239.576	82117400
## 79	2015	GERMANY	875.83791	275193.37	54956.913	82457192
## 80	2016	GERMANY	872.76705	293030.15	56090.128	82866880
## 81	2017	GERMANY	870.93288	313133.10	57266.733	83335328
## 82	2018	GERMANY	861.59273	332035.55	57716.254	83805152
## 83	2019	GERMANY	800.67457	348797.99	57433.751	84201000
## 84	2020	GERMANY	728.61385	341320.48	54640.233	84470080
## 85	2000	UK	696.08799	224227.57	43075.562	58886000
## 86	2001	UK	705.25608	231185.07	44484.701	59113000
## 87	2002	UK	698.39256	236191.25	45294.192	59366000
## 88	2003	UK	713.65332	248911.49	46503.021	59637000
## 89	2004	UK	736.31346	262375.20	47626.349	59950000
## 90	2005	UK	726.57628	275032.70	48223.864	60413000
## 91	2006	UK	741.96187	284992.14	48806.441	60827000
## 92	2007	UK	749.23708	291658.27	49268.377	61319000
## 93	2008	UK	710.92674	270516.91	50648.495	61824000
## 94	2009	UK	656.49401	250220.19	50901.300	62260000
## 95	2010	UK	681.85912	247868.39	46733.207	62759000
## 96	2011	UK	628.75915	245341.33	47234.266	63285000
## 97	2012	UK	640.37652	243128.82	45829.821	63705000
## 98	2013	UK	616.48025	244642.81	46521.516	64106000
## 99	2014	UK	589.77141	254202.62	46997.536	64539100
## 100	2015	UK	569.84551	268953.27	48152.874	64970292
## 101	2016	UK	541.53902	276354.21	48637.999	65402176
## 102	2017	UK	536.21669	283868.81	49583.211	65825884
## 103	2018	UK	540.16664	283466.06	50150.139	66234508
## 104	2019	UK	525.58722	281459.83	49596.157	66617756
## 105	2020	UK	462.51676	255742.08	44407.024	66968780
## 106	2000	CANADA	567.75790	175542.47	50550.550	30685730
## 107	2001	CANADA	547.27128	175526.70	50202.632	31019020
## 108	2002	CANADA	570.12195	169034.71	51102.665	31353656
## 109	2003	CANADA	548.40047	172188.83	51481.946	31639670
## 110	2004	CANADA	565.21937	182508.75	52746.580	31940676
## 111	2005	CANADA	576.67023	197483.74	53778.739	32245209
## 112	2006	CANADA	566.11750	216042.85	55097.925	32576074

## 113	2007	CANADA	599.08089	228888.38	55281.518	32929733
## 114	2008	CANADA	581.72580	217958.44	54533.716	33319098
## 115	2009	CANADA	558.75080	220745.87	51616.659	33729690
## 116	2010	CANADA	595.07495	232661.59	52507.600	34126181
## 117	2011	CANADA	563.50597	235620.52	52836.666	34482779
## 118	2012	CANADA	603.61164	237776.68	53749.962	34865028
## 119	2013	CANADA	608.25821	249331.46	54370.559	35238912
## 120	2014	CANADA	600.00632	265139.17	55199.022	35606120
## 121	2015	CANADA	581.24184	278465.49	54431.284	35967868
## 122	2016	CANADA	564.48669	290485.55	54332.939	36323556
## 123	2017	CANADA	575.38844	303848.33	55753.056	36672136
## 124	2018	CANADA	588.40633	308984.85	56410.938	37014040
## 125	2019	CANADA	578.52025	319379.68	56243.778	37349980
## 126	2020	CANADA	520.66823	339001.81	52203.724	37680540
## 127	2000	AUSTRALIA	290.00579	258389.05	49196.723	19028802
## 128	2001	AUSTRALIA	296.01516	265419.31	49264.472	19274701
## 129	2002	AUSTRALIA	316.97948	278433.02	50641.773	19495210
## 130	2003	AUSTRALIA	331.10087	295593.63	51354.305	19720737
## 131	2004	AUSTRALIA	344.41339	319410.51	52952.241	19932722
## 132	2005	AUSTRALIA	341.27551	339880.30	53336.220	20176844
## 133	2006	AUSTRALIA	357.60276	353010.25	53764.033	20450966
## 134	2007	AUSTRALIA	370.45804	372691.70	54378.305	20827622
## 135	2008	AUSTRALIA	364.06073	379099.43	55362.234	21249199
## 136	2009	AUSTRALIA	388.04278	358257.65	54883.993	21691653
## 137	2010	AUSTRALIA	383.21599	367272.23	54885.925	22031750
## 138	2011	AUSTRALIA	390.93022	362716.78	55097.633	22340024
## 139	2012	AUSTRALIA	411.98715	350881.25	55321.398	22728254
## 140	2013	AUSTRALIA	389.45198	355584.19	56134.656	23117400
## 141	2014	AUSTRALIA	392.29716	372273.48	55739.818	23475300
## 142	2015	AUSTRALIA	395.86949	394787.14	54580.754	23809652
## 143	2016	AUSTRALIA	385.26915	409807.28	55411.531	24138170
## 144	2017	AUSTRALIA	388.63414	423287.58	55754.607	24458424
## 145	2018	AUSTRALIA	378.92248	438983.08	56478.931	24770346
## 146	2019	AUSTRALIA	374.42385	434488.05	56174.226	25073828
## 147	2020	AUSTRALIA	336.98146	435620.06	56154.241	25368990
## 148	2000	BRAZIL	336.80399	50439.44	19398.261	174790336
## 149	2001	BRAZIL	332.57024	51825.35	19130.623	177196048
## 150	2002	BRAZIL	315.96305	50988.20	19197.779	179537520
## 151	2003	BRAZIL	304.24792	50675.09	18858.952	181809248
## 152	2004	BRAZIL	316.52757	54321.95	19573.880	184006480
## 153	2005	BRAZIL	334.42462	56035.48	19711.194	186127104
## 154	2006	BRAZIL	343.80179	57147.53	20035.416	188167360
## 155	2007	BRAZIL	370.04096	61837.34	20879.325	190130448
## 156	2008	BRAZIL	416.02650	65621.70	21553.708	192030368
## 157	2009	BRAZIL	381.48250	69899.30	21024.076	193886512
## 158	2010	BRAZIL	459.48223	76061.49	22101.933	195713632
## 159	2011	BRAZIL	484.84479	81115.90	22667.989	197514528
## 160	2012	BRAZIL	509.74425	84170.63	22825.911	199287296
## 161	2013	BRAZIL	541.54205	86745.99	23410.828	201035904
## 162	2014	BRAZIL	569.20591	87176.34	22971.872	202763744
## 163	2015	BRAZIL	520.53649	82862.85	21701.237	204471776
## 164	2016	BRAZIL	502.89339	76795.06	20611.641	206163056
## 165	2017	BRAZIL	511.01017	74022.48	20662.176	207833824
## 166	2018	BRAZIL	488.87072	71041.45	20576.876	209469328

##	167	2019	BRAZIL	487.89273	71638.46	20551.788	211049520
##	168	2020	BRAZIL	463.49809	68393.73	19421.199	212559424
##	169	2000	NIGERIA	46.75644	25247.13	6474.840	122283848
##	170	2001	NIGERIA	64.49740	27205.46	6728.206	125394048
##	171	2002	NIGERIA	72.02371	32232.88	7639.961	128596080
##	172	2003	NIGERIA	77.80638	33985.51	7957.967	131900632
##	173	2004	NIGERIA	84.41149	36434.64	8334.339	135320416
##	174	2005	NIGERIA	92.17793	39471.59	8751.912	138865024
##	175	2006	NIGERIA	72.20950	42248.35	9087.660	142538304
##	176	2007	NIGERIA	86.35525	43417.67	9111.175	146339984
##	177	2008	NIGERIA	88.48206	45975.06	9492.785	150269616
##	178	2009	NIGERIA	81.08125	48789.65	9939.175	154324928
##	179	2010	NIGERIA	94.15883	51295.11	10449.586	158503200
##	180	2011	NIGERIA	99.37846	52558.42	10652.660	162805072
##	181	2012	NIGERIA	83.58206	53790.52	10844.451	167228800
##	182	2013	NIGERIA	118.39379	56269.71	11328.784	171765824
##	183	2014	NIGERIA	121.24401	59383.44	11939.575	176404928
##	184	2015	NIGERIA	124.26436	59948.06	12032.302	181137440
##	185	2016	NIGERIA	128.22008	58411.23	11703.372	185960240
##	186	2017	NIGERIA	131.76394	57196.79	11422.023	190873248
##	187	2018	NIGERIA	129.86198	56963.32	11323.754	195874688
##	188	2019	NIGERIA	133.62974	57446.58	11376.982	200963600
##	189	2020	NIGERIA	130.28899	55203.29	10889.509	206139584
##	190	2000	SOUTH AFRICA	278.09643	56071.84	18131.601	43695928
##	191	2001	SOUTH AFRICA	260.80398	58176.98	18492.862	44552396
##	192	2002	SOUTH AFRICA	245.87588	59349.12	19144.583	45456336
##	193	2003	SOUTH AFRICA	279.73522	62104.35	19592.415	46303560
##	194	2004	SOUTH AFRICA	322.60998	66732.86	20313.804	47071708
##	195	2005	SOUTH AFRICA	301.64299	72234.20	21168.801	47817896
##	196	2006	SOUTH AFRICA	326.13196	77641.68	21954.055	48533604
##	197	2007	SOUTH AFRICA	328.74438	80382.15	22319.792	49215800
##	198	2008	SOUTH AFRICA	328.28353	79721.35	22336.038	49861788
##	199	2009	SOUTH AFRICA	349.82117	78733.64	22021.053	50473912
##	200	2010	SOUTH AFRICA	329.58867	80548.15	22611.549	51056648
##	201	2011	SOUTH AFRICA	331.03732	81122.95	22939.498	51634728
##	202	2012	SOUTH AFRICA	331.95444	80698.02	22578.177	52221984
##	203	2013	SOUTH AFRICA	325.93809	81312.14	22179.291	52875980
##	204	2014	SOUTH AFRICA	337.31614	81792.65	21796.205	53608552
##	205	2015	SOUTH AFRICA	321.96256	82485.29	21735.353	54436288
##	206	2016	SOUTH AFRICA	320.88808	80752.95	21277.779	55243480
##	207	2017	SOUTH AFRICA	331.01317	80151.81	21114.797	56031828
##	208	2018	SOUTH AFRICA	335.30276	79842.16	21051.319	56801168
##	209	2019	SOUTH AFRICA	339.99618	77519.38	20561.552	57553784
##	210	2020	SOUTH AFRICA	331.49627	73176.29	18960.685	58291328
##			CO2_C	pop_log	income_log	wealth_log	
##	1	high	19.45883	11.075631	12.633733		
##	2	high	19.46879	11.072077	12.622073		
##	3	high	19.47831	11.071674	12.593408		
##	4	high	19.48755	11.083287	12.612363		
##	5	high	19.49658	11.112702	12.698555		
##	6	high	19.50585	11.135233	12.769240		
##	7	high	19.51535	11.158368	12.819663		
##	8	high	19.52493	11.150082	12.834426		
##	9	high	19.53432	11.122834	12.710507		

## 10	high	19.54314	11.074506	12.563194
## 11	high	19.55135	11.107485	12.561381
## 12	high	19.55855	11.128091	12.555336
## 13	high	19.56558	11.150722	12.557399
## 14	high	19.57238	11.157354	12.638334
## 15	high	19.57954	11.179148	12.708654
## 16	high	19.58670	11.205647	12.749564
## 17	high	19.59374	11.200091	12.771301
## 18	high	19.60001	11.214929	12.833912
## 19	high	19.60531	11.230246	12.849067
## 20	high	19.61013	11.239471	12.885216
## 21	high	19.61506	11.191762	12.984252
## 22	high	20.96026	8.741835	10.528865
## 23	high	20.96721	8.786454	10.569728
## 24	high	20.97366	8.879247	10.653397
## 25	high	20.97967	8.951797	10.722105
## 26	high	20.98554	9.046599	10.816673
## 27	high	20.99143	9.120209	10.922931
## 28	high	20.99671	9.222215	11.022225
## 29	high	21.00187	9.327536	11.175194
## 30	high	21.00695	9.367064	11.190886
## 31	high	21.01182	9.418130	11.265165
## 32	high	21.01661	9.493601	11.389319
## 33	high	21.02141	9.551380	11.430430
## 34	high	21.02636	9.612466	11.511510
## 35	high	21.03128	9.694697	11.620253
## 36	high	21.03648	9.771780	11.704049
## 37	high	21.04144	9.824583	11.780958
## 38	high	21.04655	9.881573	11.850782
## 39	high	21.05147	9.937030	11.895278
## 40	high	21.05612	9.986863	11.947233
## 41	high	21.06041	10.033556	12.014202
## 42	high	21.06426	10.047041	12.031117
## 43	med	20.77830	8.423429	9.804822
## 44	med	20.79559	8.433190	9.818714
## 45	med	20.81248	8.457133	9.846018
## 46	med	20.82900	8.469823	9.889173
## 47	med	20.84515	8.522722	9.969057
## 48	med	20.86095	8.572222	10.044760
## 49	med	20.87640	8.633226	10.128074
## 50	med	20.89150	8.693937	10.207949
## 51	med	20.90615	8.768559	10.309355
## 52	med	20.92025	8.773602	10.335648
## 53	med	20.93375	8.832702	10.410510
## 54	med	20.94664	8.904384	10.505383
## 55	med	20.95895	8.943793	10.563238
## 56	med	20.97078	8.962910	10.591881
## 57	med	20.98224	9.002318	10.655424
## 58	high	20.99341	9.064997	10.713709
## 59	high	21.00431	9.137651	10.772066
## 60	high	21.01495	9.189488	10.811166
## 61	high	21.02533	9.233741	10.840489
## 62	high	21.03546	9.259447	10.857196
## 63	high	21.04535	9.190680	10.795867

## 64	med	18.22481	10.785434	12.271619
## 65	med	18.22649	10.793087	12.266119
## 66	med	18.22817	10.784348	12.245672
## 67	med	18.22872	10.782448	12.231928
## 68	med	18.22851	10.809521	12.239779
## 69	med	18.22794	10.816722	12.257293
## 70	med	18.22681	10.862950	12.280135
## 71	med	18.22547	10.884992	12.309422
## 72	med	18.22357	10.886492	12.329732
## 73	med	18.22104	10.823603	12.322007
## 74	med	18.21951	10.855980	12.337002
## 75	med	18.21976	10.879738	12.344784
## 76	med	18.22001	10.884039	12.373851
## 77	med	18.22027	10.884682	12.420701
## 78	med	18.22366	10.901166	12.469667
## 79	med	18.22779	10.914305	12.525229
## 80	med	18.23275	10.934715	12.588031
## 81	med	18.23838	10.955475	12.654384
## 82	med	18.24401	10.963294	12.712997
## 83	med	18.24872	10.958387	12.762248
## 84	med	18.25191	10.908526	12.740577
## 85	med	17.89111	10.670711	12.320417
## 86	med	17.89496	10.702901	12.350974
## 87	med	17.89923	10.720934	12.372397
## 88	med	17.90379	10.747273	12.424853
## 89	med	17.90902	10.771141	12.477531
## 90	med	17.91671	10.783609	12.524645
## 91	med	17.92354	10.795618	12.560217
## 92	med	17.93160	10.805038	12.583338
## 93	med	17.93980	10.832665	12.508090
## 94	med	17.94683	10.837644	12.430097
## 95	med	17.95481	10.752210	12.420653
## 96	med	17.96316	10.762875	12.410406
## 97	med	17.96977	10.732690	12.401347
## 98	med	17.97605	10.747670	12.407555
## 99	med	17.98278	10.757850	12.445887
## 100	med	17.98944	10.782136	12.502293
## 101	med	17.99607	10.792160	12.529439
## 102	med	18.00252	10.811408	12.556267
## 103	med	18.00871	10.822777	12.554848
## 104	med	18.01448	10.811669	12.547745
## 105	low	18.01974	10.701153	12.451925
## 106	med	17.23931	10.830729	12.075636
## 107	med	17.25011	10.823823	12.075546
## 108	med	17.26084	10.841592	12.037859
## 109	med	17.26992	10.848986	12.056347
## 110	med	17.27939	10.873254	12.114553
## 111	med	17.28888	10.892633	12.193412
## 112	med	17.29909	10.916867	12.283232
## 113	med	17.30989	10.920194	12.340990
## 114	med	17.32164	10.906574	12.292060
## 115	med	17.33389	10.851600	12.304767
## 116	med	17.34558	10.868713	12.357340
## 117	med	17.35597	10.874961	12.369978

## 118	med	17.36699	10.892098	12.379087
## 119	med	17.37766	10.903578	12.426538
## 120	med	17.38803	10.918701	12.488010
## 121	med	17.39814	10.904694	12.537049
## 122	med	17.40798	10.902886	12.579309
## 123	med	17.41753	10.928687	12.624284
## 124	med	17.42681	10.940418	12.641048
## 125	med	17.43584	10.937451	12.674136
## 126	med	17.44465	10.862909	12.733761
## 127	low	16.76146	10.803582	12.462222
## 128	low	16.77430	10.804958	12.489066
## 129	low	16.78568	10.832532	12.536933
## 130	low	16.79718	10.846504	12.596741
## 131	low	16.80787	10.877146	12.674232
## 132	low	16.82005	10.884371	12.736349
## 133	low	16.83354	10.892360	12.774252
## 134	low	16.85179	10.903721	12.828507
## 135	low	16.87183	10.921653	12.845554
## 136	low	16.89244	10.912977	12.789008
## 137	low	16.90800	10.913012	12.813859
## 138	low	16.92189	10.916862	12.801378
## 139	low	16.93912	10.920915	12.768203
## 140	low	16.95610	10.935509	12.781517
## 141	low	16.97146	10.928450	12.827384
## 142	low	16.98560	10.907437	12.886102
## 143	low	16.99930	10.922543	12.923442
## 144	low	17.01249	10.928715	12.955807
## 145	low	17.02516	10.941623	12.992216
## 146	low	17.03734	10.936213	12.981924
## 147	low	17.04904	10.935857	12.984526
## 148	low	18.97910	9.872939	10.828529
## 149	low	18.99277	9.859046	10.855635
## 150	low	19.00589	9.862550	10.839350
## 151	low	19.01847	9.844743	10.833190
## 152	low	19.03048	9.881951	10.902684
## 153	low	19.04194	9.888942	10.933740
## 154	low	19.05284	9.905257	10.953391
## 155	low	19.06322	9.946515	11.032263
## 156	low	19.07316	9.978303	11.091662
## 157	low	19.08278	9.953424	11.154811
## 158	low	19.09216	10.003420	11.239297
## 159	low	19.10132	10.028709	11.303634
## 160	med	19.11026	10.035652	11.340601
## 161	med	19.11899	10.060954	11.370739
## 162	med	19.12755	10.042026	11.375688
## 163	med	19.13594	9.985125	11.324942
## 164	med	19.14418	9.933611	11.248896
## 165	med	19.15225	9.936060	11.212124
## 166	low	19.16009	9.931923	11.171019
## 167	low	19.16760	9.930703	11.179387
## 168	low	19.17473	9.874120	11.133036
## 169	low	18.62186	8.775679	10.136468
## 170	low	18.64697	8.814064	10.211173
## 171	low	18.67219	8.941148	10.380742


```

## 172 low 18.69756 8.981929 10.433690
## 173 low 18.72316 9.028140 10.503275
## 174 low 18.74901 9.077027 10.583336
## 175 low 18.77512 9.114673 10.651321
## 176 low 18.80144 9.117257 10.678622
## 177 low 18.82794 9.158287 10.735854
## 178 low 18.85457 9.204239 10.795273
## 179 low 18.88129 9.254318 10.845351
## 180 low 18.90806 9.273565 10.869681
## 181 low 18.93487 9.291409 10.892853
## 182 low 18.96164 9.335102 10.937912
## 183 low 18.98829 9.387614 10.991771
## 184 low 19.01477 9.395350 11.001234
## 185 low 19.04104 9.367632 10.975263
## 186 low 19.06712 9.343299 10.954253
## 187 low 19.09299 9.334658 10.950163
## 188 low 19.11863 9.339347 10.958611
## 189 low 19.14406 9.295555 10.918778
## 190 low 17.59277 9.805412 10.934389
## 191 low 17.61218 9.825140 10.971245
## 192 low 17.63226 9.859775 10.991193
## 193 low 17.65073 9.882898 11.036571
## 194 low 17.66718 9.919056 11.108453
## 195 low 17.68291 9.960284 11.187669
## 196 low 17.69777 9.996707 11.259860
## 197 low 17.71173 10.013229 11.294547
## 198 low 17.72477 10.013957 11.286293
## 199 low 17.73697 9.999754 11.273826
## 200 low 17.74845 10.026216 11.296610
## 201 low 17.75971 10.040615 11.303721
## 202 low 17.77101 10.024739 11.298469
## 203 low 17.78346 10.006914 11.306051
## 204 low 17.79722 9.989491 11.311943
## 205 low 17.81254 9.986695 11.320375
## 206 low 17.82726 9.965419 11.299150
## 207 low 17.84143 9.957729 11.291678
## 208 low 17.85507 9.954719 11.287807
## 209 low 17.86823 9.931178 11.258283
## 210 low 17.88096 9.850123 11.200627

## Cumulative Link Mixed Model fitted with the Laplace approximation
##
## formula: CO2_C ~ income_log + wealth_log + pop_log + (1 | Country)
## data: m2_data1
##
## link threshold nobs logLik AIC niter max.grad cond.H
## logit flexible 210 -25.21 62.41 589(5148) 2.68e+01 5.6e+00
##
## Random effects:
## Groups Name Variance Std.Dev.
## Country (Intercept) 138.8 11.78
## Number of groups: Country 10
##
## Coefficients:

```

```

##           Estimate Std. Error z value Pr(>|z|)
## income_log  6.816633   0.002120   3216  <2e-16 ***
## wealth_log 12.149477   0.002279   5331  <2e-16 ***
## pop_log    21.251618   0.002590   8206  <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Threshold coefficients:
##           Estimate Std. Error z value
## low|med  6.014e+02  1.405e-03  428010
## med|high 6.274e+02  1.368e-03  458720

## Warning in vif.default(mixcl): No intercept: vifs may not be sensible.

## income_log wealth_log    pop_log
##   1.000004   1.338899   1.397561

## Call:
## polr(formula = CO2_C ~ income_log + wealth_log + pop_log, data = m2_data1,
##       Hess = TRUE)
##
## Coefficients:
##           Value Std. Error t value
## income_log 3.601     1.1547   3.119
## wealth_log 3.354     0.9327   3.596
## pop_log    5.329     0.6779   7.860
##
## Intercepts:
##           Value Std. Error t value
## low|med 173.6421  22.7853   7.6208
## med|high 180.1029  23.4115   7.6929
##
## Residual Deviance: 142.6022
## AIC: 152.6022

## Warning: glm.fit: algorithm did not converge

## Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred

## -----
## Test for X2 df probability
## -----
## Omnibus      0    3    1
## income_log    0    1  0.99
## wealth_log    0    1  0.99
## pop_log       0    1  0.99
## -----
##
## H0: Parallel Regression Assumption holds

```

Predict 10 countries

##	Percentile	Year	pop_france	pop_japan	pop_russia	pop_mexico	pop_belgium
## 1	pall	2000	60545335	126926000	146890100	100895800	10282033
## 2	pall	2001	60970281	127316000	146303600	102122300	10319019
## 3	pall	2002	61406145	127486000	145167000	103417900	10364885
## 4	pall	2003	61838483	127694000	144963600	104719900	10419032
## 5	pall	2004	62257573	127787000	144134000	105951600	10480117
## 6	pall	2005	62634127	127768000	143801000	107151000	10546886
## 7	pall	2006	62995134	127901000	143236000	108408800	10619475
## 8	pall	2007	63387496	128033000	142863000	109787400	10697572
## 9	pall	2008	63723197	128084000	142748000	111299000	10778758
## 10	pall	2009	64048540	128032000	142737000	112852600	10859940
## 11	pall	2010	64325269	128057000	142857000	114255600	10938739
## 12	pall	2011	64679700	127799000	142865000	115682900	11013853
## 13	pall	2012	65031692	127515000	143056000	117053800	11085358
## 14	pall	2013	65370448	127298000	143347000	118395100	11154009
## 15	pall	2014	65680936	126949000	143667000	119917504	11221231
## 16	pall	2015	65953204	126767240	146267000	121415168	11287940
## 17	pall	2016	66182816	126547480	146545000	122884936	11354420
## 18	pall	2017	66375188	126289432	146800000	124323632	11419748
## 19	pall	2018	66542168	125991752	147005728	125731944	11482178
## 20	pall	2019	66700848	125653120	147145168	127111648	11539328
## 21	pall	2020	66863724	125272928	147207920	128463944	11589623
##	pop_norway	pop_indonesia	pop_argentina	pop_ghana	pop_qatar		
## 1	4499367	211513824	36870788	19278856	592468		
## 2	4523145	214427424	37275652	19756928	615012		
## 3	4546019	217357792	37681748	20246380	640868		
## 4	4570106	220309472	38087868	20750300	681788		
## 5	4598214	223285680	38491972	21272324	753334		
## 6	4632364	226289472	38892932	21814642	865416		
## 7	4672994	229318256	39289880	22379056	1022711		
## 8	4719402	232374240	39684296	22963946	1218434		
## 9	4771019	235469760	40080160	23563824	1436665		
## 10	4826848	238620560	40482788	24170940	1654950		
## 11	4885878	241834208	40895752	24779620	1856327		
## 12	4948330	245115984	41320500	25387712	2035871		
## 13	5013709	248451728	41755196	25996450	2196073		
## 14	5079455	251805312	42196032	26607644	2336574		
## 15	5142265	255128080	42637512	27224472	2459198		
## 16	5199836	258383264	43075416	27849204	2565710		
## 17	5250949	261556384	43508460	28481944	2654374		
## 18	5296326	264650960	43937140	29121464	2724728		
## 19	5337962	267670544	44361152	29767102	2781682		
## 20	5378857	270625568	44780676	30417856	2832067		
## 21	5421241	273523616	45195776	31072940	2881053		

Warning: clmm2 may not have converged:

optimizer 'ucminf' terminated with max|gradient|: 2.06623470854188

Warning in sqrt(diag(vc)): NaNs produced

Cumulative Link Mixed Model fitted with the Laplace approximation

```
##
## Call:
## clmm2(location = CO2_C ~ income_log + wealth_log + pop_log, random = Country,
##       data = m2_data1, Hess = TRUE)
##
## Random effects:
##           Var   Std.Dev
## Country 186.2037 13.64565
##
## Location coefficients:
##           Estimate   Std. Error z value   Pr(>|z|)
## income_log      1.1593         NaN      NaN NA
## wealth_log     12.4032      0.0003 46835.2735 < 2.22e-16
## pop_log         7.6020         NaN      NaN NA
##
## No scale coefficients
##
## Threshold coefficients:
##           Estimate   Std. Error z value
## low|med      297.4135      0.0143 20813.6807
## med|high     317.0889      3.6050   87.9577
##
## log-likelihood: -29.39725
## AIC: 70.7945
## Condition number of Hessian: 0.004892671
```

	Year	Country	National_Wealth	National_Population
## 1	2000	ARGENTINA	25009.165	36870788
## 2	2001	ARGENTINA	23304.697	37275652
## 3	2002	ARGENTINA	16395.632	37681748
## 4	2003	ARGENTINA	17363.950	38087868
## 5	2004	ARGENTINA	24640.685	38491972
## 6	2005	ARGENTINA	32433.125	38892932
## 7	2006	ARGENTINA	39118.996	39289880
## 8	2007	ARGENTINA	43846.601	39684296
## 9	2008	ARGENTINA	48385.877	40080160
## 10	2009	ARGENTINA	45665.647	40482788
## 11	2010	ARGENTINA	52695.690	40895752
## 12	2011	ARGENTINA	58475.425	41320500
## 13	2012	ARGENTINA	58685.830	41755196
## 14	2013	ARGENTINA	61785.169	42196032
## 15	2014	ARGENTINA	59993.582	42637512
## 16	2015	ARGENTINA	61287.905	43075416
## 17	2016	ARGENTINA	59659.328	43508460
## 18	2017	ARGENTINA	61072.895	43937140
## 19	2018	ARGENTINA	58539.699	44361152
## 20	2019	ARGENTINA	58328.982	44780676
## 21	2020	ARGENTINA	53818.917	45195776
## 22	2000	GHANA	4396.827	19278856
## 23	2001	GHANA	4733.218	19756928
## 24	2002	GHANA	5679.922	20246380
## 25	2003	GHANA	6478.586	20750300
## 26	2004	GHANA	7732.468	21272324
## 27	2005	GHANA	9284.538	21814642

##	28	2006	GHANA	11770.964	22379056
##	29	2007	GHANA	12311.710	22963946
##	30	2008	GHANA	13002.561	23563824
##	31	2009	GHANA	12664.019	24170940
##	32	2010	GHANA	13125.776	24779620
##	33	2011	GHANA	14555.620	25387712
##	34	2012	GHANA	15226.895	25996450
##	35	2013	GHANA	16847.886	26607644
##	36	2014	GHANA	16404.284	27224472
##	37	2015	GHANA	16013.642	27849204
##	38	2016	GHANA	16153.895	28481944
##	39	2017	GHANA	16893.446	29121464
##	40	2018	GHANA	17463.018	29767102
##	41	2019	GHANA	18503.166	30417856
##	42	2020	GHANA	18511.254	31072940
##	43	2000	MEXICO	77013.688	100895800
##	44	2001	MEXICO	77995.966	102122300
##	45	2002	MEXICO	76352.867	103417900
##	46	2003	MEXICO	75646.204	104719900
##	47	2004	MEXICO	76302.698	105951600
##	48	2005	MEXICO	81719.522	107151000
##	49	2006	MEXICO	84058.881	108408800
##	50	2007	MEXICO	88508.555	109787400
##	51	2008	MEXICO	97624.710	111299000
##	52	2009	MEXICO	99658.047	112852600
##	53	2010	MEXICO	97340.664	114255600
##	54	2011	MEXICO	109807.651	115682900
##	55	2012	MEXICO	120673.878	117053800
##	56	2013	MEXICO	121180.500	118395100
##	57	2014	MEXICO	115706.155	119917504
##	58	2015	MEXICO	108330.408	121415168
##	59	2016	MEXICO	102018.487	122884936
##	60	2017	MEXICO	105416.723	124323632
##	61	2018	MEXICO	111157.673	125731944
##	62	2019	MEXICO	113561.255	127111648
##	63	2020	MEXICO	102268.717	128463944
##	64	2000	NORWAY	182384.809	4499367
##	65	2001	NORWAY	196650.317	4523145
##	66	2002	NORWAY	203547.836	4546019
##	67	2003	NORWAY	208252.180	4570106
##	68	2004	NORWAY	229433.725	4598214
##	69	2005	NORWAY	257655.792	4632364
##	70	2006	NORWAY	287866.703	4672994
##	71	2007	NORWAY	316999.721	4719402
##	72	2008	NORWAY	320204.465	4771019
##	73	2009	NORWAY	328195.063	4826848
##	74	2010	NORWAY	345050.728	4885878
##	75	2011	NORWAY	359589.452	4948330
##	76	2012	NORWAY	370209.320	5013709
##	77	2013	NORWAY	398582.383	5079455
##	78	2014	NORWAY	444855.940	5142265
##	79	2015	NORWAY	505209.971	5199836
##	80	2016	NORWAY	544478.591	5250949
##	81	2017	NORWAY	556381.560	5296326

##	82	2018	NORWAY	542335.460	5337962			
##	83	2019	NORWAY	563551.644	5378857			
##	84	2020	NORWAY	617716.147	5421241			
##	85	2000	QATAR	958946.648	592468			
##	86	2001	QATAR	876650.798	615012			
##	87	2002	QATAR	815822.413	640868			
##	88	2003	QATAR	739841.944	681788			
##	89	2004	QATAR	677994.377	753334			
##	90	2005	QATAR	573871.556	865416			
##	91	2006	QATAR	512493.379	1022711			
##	92	2007	QATAR	447076.455	1218434			
##	93	2008	QATAR	375453.357	1436665			
##	94	2009	QATAR	320089.121	1654950			
##	95	2010	QATAR	304633.695	1856327			
##	96	2011	QATAR	306658.405	2035871			
##	97	2012	QATAR	293557.619	2196073			
##	98	2013	QATAR	294902.572	2336574			
##	99	2014	QATAR	298029.626	2459198			
##	100	2015	QATAR	321888.360	2565710			
##	101	2016	QATAR	315785.200	2654374			
##	102	2017	QATAR	298505.799	2724728			
##	103	2018	QATAR	289765.551	2781682			
##	104	2019	QATAR	282507.048	2832067			
##	105	2020	QATAR	270749.044	2881053			
##	National_Carbon_Emissions			National_Income	pop_log	income_log	wealth_log	
##	1			139.890359	20415.292	17.42293	9.924039	10.126998
##	2			128.937970	19127.621	17.43385	9.858889	10.056410
##	3			82.197850	16057.990	17.44469	9.683962	9.704770
##	4			107.752136	17460.984	17.45541	9.767724	9.762151
##	5			126.295772	20604.722	17.46596	9.933276	10.112154
##	6			134.255969	22537.768	17.47632	10.022948	10.386936
##	7			149.306864	23703.238	17.48648	10.073367	10.574363
##	8			155.085326	25058.123	17.49647	10.128953	10.688452
##	9			170.176539	26373.236	17.50639	10.180105	10.786963
##	10			160.036500	24196.463	17.51639	10.093962	10.729102
##	11			174.548450	27119.370	17.52654	10.208004	10.872289
##	12			182.576754	29484.515	17.53687	10.291620	10.976362
##	13			188.108012	29195.382	17.54733	10.281766	10.979954
##	14			193.475344	30372.487	17.55784	10.321292	11.031419
##	15			192.412685	29102.452	17.56824	10.278578	11.001993
##	16			201.589825	29564.202	17.57846	10.294320	11.023338
##	17			194.803188	28390.326	17.58847	10.253804	10.996406
##	18			194.792852	28855.749	17.59827	10.270065	11.019823
##	19			187.564297	27410.801	17.60787	10.218692	10.977460
##	20			181.390524	26315.633	17.61729	10.177918	10.973854
##	21			172.320997	23137.458	17.62651	10.049208	10.893380
##	22			8.925980	5942.443	16.77452	8.689876	8.388638
##	23			9.537462	6017.560	16.79901	8.702437	8.462361
##	24			9.747900	6068.455	16.82349	8.710859	8.644693
##	25			10.822221	6191.413	16.84807	8.730919	8.776258
##	26			11.899650	6388.498	16.87292	8.762254	8.953183
##	27			12.273784	6574.698	16.89809	8.790984	9.136106
##	28			13.913890	6783.269	16.92364	8.822214	9.373391
##	29			15.045304	6798.542	16.94944	8.824464	9.418306

## 30	14.971844	7259.095	16.97522	8.890010	9.472902
## 31	12.847915	7207.899	17.00066	8.882933	9.446520
## 32	14.706538	7551.044	17.02553	8.929441	9.482333
## 33	18.268825	8298.727	17.04978	9.023857	9.585732
## 34	22.338492	8675.645	17.07347	9.068275	9.630819
## 35	21.006665	9226.243	17.09671	9.129807	9.731980
## 36	20.970054	9116.880	17.11963	9.117883	9.705298
## 37	20.552461	9129.529	17.14231	9.119269	9.681196
## 38	20.330997	9175.132	17.16478	9.124252	9.689916
## 39	18.392335	9410.808	17.18699	9.149614	9.734681
## 40	19.045270	9581.391	17.20891	9.167578	9.767841
## 41	19.676498	9936.583	17.23054	9.203978	9.825697
## 42	19.184585	9691.915	17.25185	9.179047	9.826134
## 43	435.460043	28703.972	18.42960	10.264791	11.251738
## 44	446.110349	28166.552	18.44168	10.245890	11.264412
## 45	449.358874	26651.908	18.45429	10.190616	11.243121
## 46	471.388135	25510.715	18.46680	10.146854	11.233823
## 47	464.595391	25862.664	18.47849	10.160556	11.242464
## 48	505.614600	26004.391	18.48975	10.166021	11.311048
## 49	520.198822	26781.734	18.50142	10.195475	11.339273
## 50	501.991241	27011.622	18.51406	10.204023	11.390854
## 51	518.394251	26742.675	18.52773	10.194016	11.488886
## 52	494.360844	24849.250	18.54159	10.120583	11.509500
## 53	498.759307	25849.951	18.55395	10.160064	11.485972
## 54	513.814262	26295.822	18.56636	10.177165	11.606485
## 55	542.712226	26696.864	18.57814	10.192301	11.700847
## 56	542.454042	26349.631	18.58954	10.179210	11.705036
## 57	532.830634	26776.806	18.60231	10.195291	11.658809
## 58	512.753358	26829.993	18.61473	10.197276	11.592941
## 59	498.047264	26781.765	18.62676	10.195477	11.532909
## 60	480.764663	26725.129	18.63840	10.193360	11.565677
## 61	473.373928	26560.222	18.64966	10.187170	11.618705
## 62	460.168841	25909.878	18.66058	10.162380	11.640098
## 63	437.160399	23306.488	18.67116	10.056487	11.535359
## 64	38.134063	53794.956	15.31945	10.892935	12.113874
## 65	38.370006	54580.663	15.32472	10.907435	12.189182
## 66	39.822721	53813.878	15.32976	10.893287	12.223656
## 67	45.041955	54600.146	15.33505	10.907792	12.246505
## 68	44.044175	59542.347	15.34118	10.994443	12.343369
## 69	45.372235	66243.587	15.34858	11.101094	12.459380
## 70	48.366768	70234.412	15.35731	11.159594	12.570253
## 71	53.199529	72623.136	15.36719	11.193039	12.666656
## 72	50.694074	77272.993	15.37807	11.255100	12.676715
## 73	48.895794	69454.096	15.38970	11.148421	12.701363
## 74	51.096242	72505.262	15.40186	11.191414	12.751447
## 75	51.263500	75948.700	15.41456	11.237813	12.792718
## 76	50.079263	76750.795	15.42769	11.248319	12.821824
## 77	48.545604	76237.289	15.44071	11.241606	12.895669
## 78	48.263366	78102.820	15.45300	11.265781	13.005506
## 79	48.824628	78669.936	15.46414	11.273016	13.132729
## 80	49.158957	78225.168	15.47392	11.267347	13.207584
## 81	48.807778	79514.023	15.48252	11.283689	13.229210
## 82	48.353885	79792.343	15.49035	11.287183	13.203640
## 83	46.834488	75563.603	15.49799	11.232730	13.242014

## 84	42.151039	74578.996	15.50584	11.219614	13.333784
## 85	16.342799	121208.722	13.29205	11.705269	13.773591
## 86	20.056483	116504.915	13.32940	11.665689	13.683864
## 87	23.789883	118937.605	13.37058	11.686354	13.611952
## 88	23.013705	118799.908	13.43247	11.685196	13.514192
## 89	22.461357	118366.649	13.53226	11.681542	13.426894
## 90	28.482738	112736.858	13.67097	11.632812	13.260161
## 91	30.906118	109535.417	13.83797	11.604003	13.147043
## 92	34.476060	104722.899	14.01308	11.559073	13.010485
## 93	39.698722	100301.314	14.17784	11.515934	12.835890
## 94	45.482174	90873.757	14.31928	11.417227	12.676355
## 95	42.188322	93746.625	14.43411	11.448351	12.626865
## 96	36.116814	101581.375	14.52643	11.528615	12.633490
## 97	45.537716	100815.699	14.60218	11.521049	12.589829
## 98	42.083997	101775.236	14.66420	11.530522	12.594400
## 99	54.223115	102319.195	14.71535	11.535853	12.604948
## 100	65.638710	105736.610	14.75775	11.568706	12.681960
## 101	73.067576	107142.928	14.79172	11.581919	12.662818
## 102	71.190937	103232.110	14.81788	11.544735	12.606545
## 103	70.508521	100486.899	14.83857	11.517783	12.576827
## 104	70.573080	98654.106	14.85652	11.499375	12.551459
## 105	68.808753	93773.983	14.87367	11.448643	12.508948
##	C02_C				
## 1	low				
## 2	low				
## 3	low				
## 4	low				
## 5	low				
## 6	low				
## 7	low				
## 8	low				
## 9	low				
## 10	low				
## 11	low				
## 12	low				
## 13	low				
## 14	low				
## 15	low				
## 16	low				
## 17	low				
## 18	low				
## 19	low				
## 20	low				
## 21	low				
## 22	low				
## 23	low				
## 24	low				
## 25	low				
## 26	low				
## 27	low				
## 28	low				
## 29	low				
## 30	low				
## 31	low				

##	32	low
##	33	low
##	34	low
##	35	low
##	36	low
##	37	low
##	38	low
##	39	low
##	40	low
##	41	low
##	42	low
##	43	low
##	44	low
##	45	low
##	46	low
##	47	low
##	48	med
##	49	med
##	50	med
##	51	med
##	52	low
##	53	low
##	54	med
##	55	med
##	56	med
##	57	med
##	58	med
##	59	low
##	60	low
##	61	low
##	62	low
##	63	low
##	64	low
##	65	low
##	66	low
##	67	low
##	68	low
##	69	low
##	70	low
##	71	low
##	72	low
##	73	low
##	74	low
##	75	low
##	76	low
##	77	low
##	78	low
##	79	low
##	80	low
##	81	low
##	82	low
##	83	low
##	84	low
##	85	low

```

## 86    low
## 87    low
## 88    low
## 89    low
## 90    low
## 91    low
## 92    low
## 93    low
## 94    low
## 95    low
## 96    low
## 97    low
## 98    low
## 99    low
## 100   low
## 101   low
## 102   low
## 103   low
## 104   low
## 105   low

```

##	Year	Country	National_Wealth	National_Population
## 1	2000	ARGENTINA	25009.165	36870788
## 2	2001	ARGENTINA	23304.697	37275652
## 3	2002	ARGENTINA	16395.632	37681748
## 4	2003	ARGENTINA	17363.950	38087868
## 5	2004	ARGENTINA	24640.685	38491972
## 6	2005	ARGENTINA	32433.125	38892932
## 7	2006	ARGENTINA	39118.996	39289880
## 8	2007	ARGENTINA	43846.601	39684296
## 9	2008	ARGENTINA	48385.877	40080160
## 10	2009	ARGENTINA	45665.647	40482788
## 11	2010	ARGENTINA	52695.690	40895752
## 12	2011	ARGENTINA	58475.425	41320500
## 13	2012	ARGENTINA	58685.830	41755196
## 14	2013	ARGENTINA	61785.169	42196032
## 15	2014	ARGENTINA	59993.582	42637512
## 16	2015	ARGENTINA	61287.905	43075416
## 17	2016	ARGENTINA	59659.328	43508460
## 18	2017	ARGENTINA	61072.895	43937140
## 19	2018	ARGENTINA	58539.699	44361152
## 20	2019	ARGENTINA	58328.982	44780676
## 21	2020	ARGENTINA	53818.917	45195776
## 22	2000	GHANA	4396.827	19278856
## 23	2001	GHANA	4733.218	19756928
## 24	2002	GHANA	5679.922	20246380
## 25	2003	GHANA	6478.586	20750300
## 26	2004	GHANA	7732.468	21272324
## 27	2005	GHANA	9284.538	21814642
## 28	2006	GHANA	11770.964	22379056
## 29	2007	GHANA	12311.710	22963946
## 30	2008	GHANA	13002.561	23563824
## 31	2009	GHANA	12664.019	24170940
## 32	2010	GHANA	13125.776	24779620

## 33	2011	GHANA	14555.620	25387712
## 34	2012	GHANA	15226.895	25996450
## 35	2013	GHANA	16847.886	26607644
## 36	2014	GHANA	16404.284	27224472
## 37	2015	GHANA	16013.642	27849204
## 38	2016	GHANA	16153.895	28481944
## 39	2017	GHANA	16893.446	29121464
## 40	2018	GHANA	17463.018	29767102
## 41	2019	GHANA	18503.166	30417856
## 42	2020	GHANA	18511.254	31072940
## 43	2000	MEXICO	77013.688	100895800
## 44	2001	MEXICO	77995.966	102122300
## 45	2002	MEXICO	76352.867	103417900
## 46	2003	MEXICO	75646.204	104719900
## 47	2004	MEXICO	76302.698	105951600
## 48	2005	MEXICO	81719.522	107151000
## 49	2006	MEXICO	84058.881	108408800
## 50	2007	MEXICO	88508.555	109787400
## 51	2008	MEXICO	97624.710	111299000
## 52	2009	MEXICO	99658.047	112852600
## 53	2010	MEXICO	97340.664	114255600
## 54	2011	MEXICO	109807.651	115682900
## 55	2012	MEXICO	120673.878	117053800
## 56	2013	MEXICO	121180.500	118395100
## 57	2014	MEXICO	115706.155	119917504
## 58	2015	MEXICO	108330.408	121415168
## 59	2016	MEXICO	102018.487	122884936
## 60	2017	MEXICO	105416.723	124323632
## 61	2018	MEXICO	111157.673	125731944
## 62	2019	MEXICO	113561.255	127111648
## 63	2020	MEXICO	102268.717	128463944
## 64	2000	NORWAY	182384.809	4499367
## 65	2001	NORWAY	196650.317	4523145
## 66	2002	NORWAY	203547.836	4546019
## 67	2003	NORWAY	208252.180	4570106
## 68	2004	NORWAY	229433.725	4598214
## 69	2005	NORWAY	257655.792	4632364
## 70	2006	NORWAY	287866.703	4672994
## 71	2007	NORWAY	316999.721	4719402
## 72	2008	NORWAY	320204.465	4771019
## 73	2009	NORWAY	328195.063	4826848
## 74	2010	NORWAY	345050.728	4885878
## 75	2011	NORWAY	359589.452	4948330
## 76	2012	NORWAY	370209.320	5013709
## 77	2013	NORWAY	398582.383	5079455
## 78	2014	NORWAY	444855.940	5142265
## 79	2015	NORWAY	505209.971	5199836
## 80	2016	NORWAY	544478.591	5250949
## 81	2017	NORWAY	556381.560	5296326
## 82	2018	NORWAY	542335.460	5337962
## 83	2019	NORWAY	563551.644	5378857
## 84	2020	NORWAY	617716.147	5421241
## 85	2000	QATAR	958946.648	592468
## 86	2001	QATAR	876650.798	615012

## 87	2002	QATAR	815822.413		640868	
## 88	2003	QATAR	739841.944		681788	
## 89	2004	QATAR	677994.377		753334	
## 90	2005	QATAR	573871.556		865416	
## 91	2006	QATAR	512493.379		1022711	
## 92	2007	QATAR	447076.455		1218434	
## 93	2008	QATAR	375453.357		1436665	
## 94	2009	QATAR	320089.121		1654950	
## 95	2010	QATAR	304633.695		1856327	
## 96	2011	QATAR	306658.405		2035871	
## 97	2012	QATAR	293557.619		2196073	
## 98	2013	QATAR	294902.572		2336574	
## 99	2014	QATAR	298029.626		2459198	
## 100	2015	QATAR	321888.360		2565710	
## 101	2016	QATAR	315785.200		2654374	
## 102	2017	QATAR	298505.799		2724728	
## 103	2018	QATAR	289765.551		2781682	
## 104	2019	QATAR	282507.048		2832067	
## 105	2020	QATAR	270749.044		2881053	
##	National_Carbon_Emissions		National_Income	pop_log	income_log	wealth_log
## 1			139.890359	20415.292	17.42293	9.924039
## 2			128.937970	19127.621	17.43385	9.858889
## 3			82.197850	16057.990	17.44469	9.683962
## 4			107.752136	17460.984	17.45541	9.767724
## 5			126.295772	20604.722	17.46596	9.933276
## 6			134.255969	22537.768	17.47632	10.022948
## 7			149.306864	23703.238	17.48648	10.073367
## 8			155.085326	25058.123	17.49647	10.128953
## 9			170.176539	26373.236	17.50639	10.180105
## 10			160.036500	24196.463	17.51639	10.093962
## 11			174.548450	27119.370	17.52654	10.208004
## 12			182.576754	29484.515	17.53687	10.291620
## 13			188.108012	29195.382	17.54733	10.281766
## 14			193.475344	30372.487	17.55784	10.321292
## 15			192.412685	29102.452	17.56824	10.278578
## 16			201.589825	29564.202	17.57846	10.294320
## 17			194.803188	28390.326	17.58847	10.253804
## 18			194.792852	28855.749	17.59827	10.270065
## 19			187.564297	27410.801	17.60787	10.218692
## 20			181.390524	26315.633	17.61729	10.177918
## 21			172.320997	23137.458	17.62651	10.049208
## 22			8.925980	5942.443	16.77452	8.689876
## 23			9.537462	6017.560	16.79901	8.702437
## 24			9.747900	6068.455	16.82349	8.710859
## 25			10.822221	6191.413	16.84807	8.730919
## 26			11.899650	6388.498	16.87292	8.762254
## 27			12.273784	6574.698	16.89809	8.790984
## 28			13.913890	6783.269	16.92364	8.822214
## 29			15.045304	6798.542	16.94944	8.824464
## 30			14.971844	7259.095	16.97522	8.890010
## 31			12.847915	7207.899	17.00066	8.882933
## 32			14.706538	7551.044	17.02553	8.929441
## 33			18.268825	8298.727	17.04978	9.023857
## 34			22.338492	8675.645	17.07347	9.068275

## 35	21.006665	9226.243	17.09671	9.129807	9.731980
## 36	20.970054	9116.880	17.11963	9.117883	9.705298
## 37	20.552461	9129.529	17.14231	9.119269	9.681196
## 38	20.330997	9175.132	17.16478	9.124252	9.689916
## 39	18.392335	9410.808	17.18699	9.149614	9.734681
## 40	19.045270	9581.391	17.20891	9.167578	9.767841
## 41	19.676498	9936.583	17.23054	9.203978	9.825697
## 42	19.184585	9691.915	17.25185	9.179047	9.826134
## 43	435.460043	28703.972	18.42960	10.264791	11.251738
## 44	446.110349	28166.552	18.44168	10.245890	11.264412
## 45	449.358874	26651.908	18.45429	10.190616	11.243121
## 46	471.388135	25510.715	18.46680	10.146854	11.233823
## 47	464.595391	25862.664	18.47849	10.160556	11.242464
## 48	505.614600	26004.391	18.48975	10.166021	11.311048
## 49	520.198822	26781.734	18.50142	10.195475	11.339273
## 50	501.991241	27011.622	18.51406	10.204023	11.390854
## 51	518.394251	26742.675	18.52773	10.194016	11.488886
## 52	494.360844	24849.250	18.54159	10.120583	11.509500
## 53	498.759307	25849.951	18.55395	10.160064	11.485972
## 54	513.814262	26295.822	18.56636	10.177165	11.606485
## 55	542.712226	26696.864	18.57814	10.192301	11.700847
## 56	542.454042	26349.631	18.58954	10.179210	11.705036
## 57	532.830634	26776.806	18.60231	10.195291	11.658809
## 58	512.753358	26829.993	18.61473	10.197276	11.592941
## 59	498.047264	26781.765	18.62676	10.195477	11.532909
## 60	480.764663	26725.129	18.63840	10.193360	11.565677
## 61	473.373928	26560.222	18.64966	10.187170	11.618705
## 62	460.168841	25909.878	18.66058	10.162380	11.640098
## 63	437.160399	23306.488	18.67116	10.056487	11.535359
## 64	38.134063	53794.956	15.31945	10.892935	12.113874
## 65	38.370006	54580.663	15.32472	10.907435	12.189182
## 66	39.822721	53813.878	15.32976	10.893287	12.223656
## 67	45.041955	54600.146	15.33505	10.907792	12.246505
## 68	44.044175	59542.347	15.34118	10.994443	12.343369
## 69	45.372235	66243.587	15.34858	11.101094	12.459380
## 70	48.366768	70234.412	15.35731	11.159594	12.570253
## 71	53.199529	72623.136	15.36719	11.193039	12.666656
## 72	50.694074	77272.993	15.37807	11.255100	12.676715
## 73	48.895794	69454.096	15.38970	11.148421	12.701363
## 74	51.096242	72505.262	15.40186	11.191414	12.751447
## 75	51.263500	75948.700	15.41456	11.237813	12.792718
## 76	50.079263	76750.795	15.42769	11.248319	12.821824
## 77	48.545604	76237.289	15.44071	11.241606	12.895669
## 78	48.263366	78102.820	15.45300	11.265781	13.005506
## 79	48.824628	78669.936	15.46414	11.273016	13.132729
## 80	49.158957	78225.168	15.47392	11.267347	13.207584
## 81	48.807778	79514.023	15.48252	11.283689	13.229210
## 82	48.353885	79792.343	15.49035	11.287183	13.203640
## 83	46.834488	75563.603	15.49799	11.232730	13.242014
## 84	42.151039	74578.996	15.50584	11.219614	13.333784
## 85	16.342799	121208.722	13.29205	11.705269	13.773591
## 86	20.056483	116504.915	13.32940	11.665689	13.683864
## 87	23.789883	118937.605	13.37058	11.686354	13.611952
## 88	23.013705	118799.908	13.43247	11.685196	13.514192

## 89	22.461357	118366.649	13.53226	11.681542	13.426894
## 90	28.482738	112736.858	13.67097	11.632812	13.260161
## 91	30.906118	109535.417	13.83797	11.604003	13.147043
## 92	34.476060	104722.899	14.01308	11.559073	13.010485
## 93	39.698722	100301.314	14.17784	11.515934	12.835890
## 94	45.482174	90873.757	14.31928	11.417227	12.676355
## 95	42.188322	93746.625	14.43411	11.448351	12.626865
## 96	36.116814	101581.375	14.52643	11.528615	12.633490
## 97	45.537716	100815.699	14.60218	11.521049	12.589829
## 98	42.083997	101775.236	14.66420	11.530522	12.594400
## 99	54.223115	102319.195	14.71535	11.535853	12.604948
## 100	65.638710	105736.610	14.75775	11.568706	12.681960
## 101	73.067576	107142.928	14.79172	11.581919	12.662818
## 102	71.190937	103232.110	14.81788	11.544735	12.606545
## 103	70.508521	100486.899	14.83857	11.517783	12.576827
## 104	70.573080	98654.106	14.85652	11.499375	12.551459
## 105	68.808753	93773.983	14.87367	11.448643	12.508948
##	C02_C	probs	predicted_class		
## 1	low	1.000000000	low		
## 2	low	1.000000000	low		
## 3	low	1.000000000	low		
## 4	low	1.000000000	low		
## 5	low	1.000000000	low		
## 6	low	1.000000000	low		
## 7	low	1.000000000	low		
## 8	low	0.999999998	low		
## 9	low	0.999999993	low		
## 10	low	0.999999997	low		
## 11	low	0.999999975	low		
## 12	low	0.999999890	low		
## 13	low	0.999999877	low		
## 14	low	0.999999736	low		
## 15	low	0.999999811	low		
## 16	low	0.999999730	low		
## 17	low	0.999999801	low		
## 18	low	0.999999707	low		
## 19	low	0.999999825	low		
## 20	low	0.999999828	low		
## 21	low	0.999999941	low		
## 22	low	1.000000000	low		
## 23	low	1.000000000	low		
## 24	low	1.000000000	low		
## 25	low	1.000000000	low		
## 26	low	1.000000000	low		
## 27	low	1.000000000	low		
## 28	low	1.000000000	low		
## 29	low	1.000000000	low		
## 30	low	1.000000000	low		
## 31	low	1.000000000	low		
## 32	low	1.000000000	low		
## 33	low	1.000000000	low		
## 34	low	1.000000000	low		
## 35	low	1.000000000	low		
## 36	low	1.000000000	low		

## 37	low 1.000000000	low
## 38	low 1.000000000	low
## 39	low 1.000000000	low
## 40	low 1.000000000	low
## 41	low 1.000000000	low
## 42	low 1.000000000	low
## 43	low 0.997141124	low
## 44	low 0.996414706	low
## 45	low 0.997155858	low
## 46	low 0.997350145	low
## 47	low 0.996726590	low
## 48	med 0.008358635	med
## 49	med 0.013345665	med
## 50	med 0.027722998	med
## 51	med 0.095425336	med
## 52	low 0.877952881	low
## 53	low 0.893339206	low
## 54	med 0.373704290	med
## 55	med 0.681599425	low
## 56	med 0.707760676	low
## 57	med 0.605142013	low
## 58	med 0.427176048	med
## 59	low 0.720830226	low
## 60	low 0.612096620	low
## 61	low 0.430443259	med
## 62	low 0.354433391	med
## 63	low 0.677388287	low
## 64	low 0.999999986	low
## 65	low 0.999999962	low
## 66	low 0.999999940	low
## 67	low 0.999999916	low
## 68	low 0.999999677	low
## 69	low 0.999998372	low
## 70	low 0.999992636	low
## 71	low 0.999972719	low
## 72	low 0.999963925	low
## 73	low 0.999952721	low
## 74	low 0.999898561	low
## 75	low 0.999803315	low
## 76	low 0.999684409	low
## 77	low 0.999136427	low
## 78	low 0.996203202	low
## 79	low 0.980136116	low
## 80	low 0.947973036	low
## 81	low 0.927572141	low
## 82	low 0.942867135	low
## 83	low 0.911548362	low
## 84	low 0.759507781	low
## 85	low 0.999993612	low
## 86	low 0.999997337	low
## 87	low 0.999998471	low
## 88	low 0.999999273	low
## 89	low 0.999999476	low
## 90	low 0.999999820	low

```

## 91    low 0.999999848          low
## 92    low 0.999999900          low
## 93    low 0.999999962          low
## 94    low 0.999999986          low
## 95    low 0.999999981          low
## 96    low 0.999999955          low
## 97    low 0.999999954          low
## 98    low 0.999999921          low
## 99    low 0.999999867          low
## 100   low 0.999999504          low
## 101   low 0.999999486          low
## 102   low 0.999999701          low
## 103   low 0.999999765          low
## 104   low 0.999999808          low
## 105   low 0.999999878          low

## Confusion Matrix and Statistics
##
##
##      low med high
## low    94   2   0
## med     3   6   0
## high    0   0   0
##
## Overall Statistics
##
##              Accuracy : 0.9524
##              95% CI : (0.8924, 0.9844)
##      No Information Rate : 0.9238
##      P-Value [Acc > NIR] : 0.1804
##
##              Kappa : 0.6801
##
##      McNemar's Test P-Value : NA
##
## Statistics by Class:
##
##              Class: low Class: med Class: high
## Sensitivity          0.9691    0.75000    NA
## Specificity          0.7500    0.96907     1
## Pos Pred Value       0.9792    0.66667    NA
## Neg Pred Value       0.6667    0.97917    NA
## Prevalence           0.9238    0.07619     0
## Detection Rate       0.8952    0.05714     0
## Detection Prevalence 0.9143    0.08571     0
## Balanced Accuracy     0.8595    0.85954    NA

```

Appendix

```

# 4. GDP by Carbon Footprint (one graph per country (max 10))
# Countries: United States, China, India, Germany, United Kingdom, Canada, Australia,
# Brazil, Nigeria, South Africa

```



```

# colorblind-friendly palette: c("#88CCEE", "#CC6677", "#DDCC77", "#117733", "#332288", "#AA4499", "#444444")
graph4.1 <- ggplot(ten_countries)+
  geom_point(aes(x = GDP_USA, y = CO2_USA, color = "USA")) +
  scale_color_manual(values=c("#888888")) +
  ggtitle("USA CO2 vs GDP") + labs(x = "GDP", y = "CO2") + theme_bw()+ theme(legend.position="none")

graph4.2 <- ggplot(ten_countries)+
  geom_point(aes(x = GDP_China, y = CO2_China, color = "China")) +
  scale_color_manual(values=c("#117733")) +
  ggtitle("China CO2 vs GDP") + labs(x = "GDP", y = "CO2") + theme_bw() + theme(legend.position="none")

graph4.3 <- ggplot(ten_countries)+
  geom_point(aes(x = GDP_India, y = CO2_India, color = "India")) +
  scale_color_manual(values=c("#AA4499")) +
  ggtitle("India CO2 vs GDP") + labs(x = "GDP", y = "CO2") + theme_bw() + theme(legend.position="none")

graph4.4 <- ggplot(ten_countries)+
  geom_point(aes(x = GDP_Germany, y = CO2_Germany, color = "Germany")) +
  scale_color_manual(values=c("#332288")) +
  ggtitle("Germany CO2 vs GDP") + labs(x = "GDP", y = "CO2") + theme_bw()+ theme(legend.position="none")

graph4.5 <- ggplot(ten_countries)+
  geom_point(aes(x = GDP_United_Kingdom, y = CO2_United_Kingdom, color = "UK")) +
  scale_color_manual(values=c("#6699CC")) +
  ggtitle("United Kingdom CO2 vs GDP") + labs(x = "GDP", y = "CO2") + theme_bw()+ theme(legend.position="none")

graph4.6 <- ggplot(ten_countries)+
  geom_point(aes(x = GDP_Canada, y = CO2_Canada, color = "Canada")) +
  scale_color_manual(values=c("#DDCC77")) +
  ggtitle("Canada CO2 vs GDP") + labs(x = "GDP", y = "CO2") + theme_bw() + theme(legend.position="none")

graph4.7 <- ggplot(ten_countries)+
  geom_point(aes(x = GDP_Australia, y = CO2_Australia, color = "Australia")) +
  scale_color_manual(values=c("#88CCEE")) +
  ggtitle("Australia CO2 vs GDP") + labs(x = "GDP", y = "CO2") + theme_bw() + theme(legend.position="none")

graph4.8 <- ggplot(ten_countries)+
  geom_point(aes(x = GDP_Brazil, y = CO2_Brazil, color = "Brazil")) +
  scale_color_manual(values=c("#CC6677")) +
  ggtitle("Brazil CO2 vs GDP") + labs(x = "GDP", y = "CO2") + theme_bw() + theme(legend.position="none")

graph4.9 <- ggplot(ten_countries)+
  geom_point(aes(x = GDP_Nigeria, y = CO2_Nigeria, color = "Nigeria")) +
  scale_color_manual(values=c("#44AA99")) +
  ggtitle("Nigeria CO2 vs GDP") + labs(x = "GDP", y = "CO2") + theme_bw() + theme(legend.position="none")

graph4.10 <- ggplot(ten_countries)+
  geom_point(aes(x = GDP_South_Africa, y = CO2_South_Africa, color = "South_Africa")) +
  scale_color_manual(values=c("#999933")) +
  ggtitle("South Africa CO2 vs GDP") + labs(x = "GDP", y = "CO2") + theme_bw() + theme(legend.position="none")

plot_grid(graph4.1, graph4.2, graph4.3, graph4.4, graph4.5, graph4.6, graph4.7, graph4.8, graph4.9, graph4.10)

```

```

#correlation matrix
only_co2_ten_countries <- ten_countries[, c(4,7,10,13,16,19,22,25,28,31)]
only_wealth_ten_countries <- wealth_ten_countries[, c(3,5,7,9,11,13,15,17,19,21)]
co2_wealth_ten_countries <- cbind(only_co2_ten_countries, only_wealth_ten_countries)
colnames(co2_wealth_ten_countries) <- c(
  "co2_usa", "co2_china", "co2_india", "co2_germany", "co2_uk", "co2_canada", "co2_australia", "co2_brazil", "co2_russia",
  "wealth_usa", "wealth_china", "wealth_india", "wealth_germany", "wealth_uk", "wealth_canada", "wealth_australia", "wealth_brazil", "wealth_russia")

#corrplot(cor(co2_wealth_ten_countries), method = "circle", type = "upper")
#cor(co2_wealth_ten_countries)
! [Correlation Matrix] (image.png){width=75%}

```

```

try1 <- lm(stacking_co2 ~ top10 + middle40 + bottom50, data=dataset_for_model1)
summary(try1)

```

```

plot(try1)

```

```

library(car)
try <- lm(log(stacking_co2) ~ top10 + bottom50 + country_code, data=dataset_for_model1)
summary(try)

```

```

vif(try)

```

```

plot(try)

```

```

try2 <- lm(stacking_co2 ~ top10 + middle40 + bottom50 + country_code, data=dataset_for_model1)
summary(try2)

```

```

plot(try2)

```

```

try3 <- lmer(stacking_co2 ~ top10 + middle40 + bottom50 + (1|country_code), data=dataset_for_model1)
summary(try3)

```

```

plot(try3)

```

```

try4 <- lmer(log(stacking_co2) ~ top10 + middle40 + bottom50 + (1|country_code), data=dataset_for_model1)
summary(try4)

```

```

plot(try4)

```

```

mixclmod_predict <- data.frame(probs=predict(mixcl2, predict_model_df, type = "class"))
mixclmod_predict <- mixclmod_predict %>% mutate(
  predicted_class = case_when(probs<0.5 ~ "med",
    probs >= 0.5 ~ "low"))
mixclmod_predict$predicted_class <- ordered(mixclmod_predict$predicted_class, levels = c("low", "med", "high"))

```

```

post_pred <- cbind(predict_model_df, mixclmod_predict)
post_pred

```

```
truth_table <- table(post_pred$C02_C, post_pred$predicted_class)
confusionMatrix(truth_table)
```