Third Assignment

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Contents

1 Research question and project description **2**

2 Processing data **2**

2.1 Data sources and data gathering 2

2.2 Cleaning, processing and merging of datasets 2

3 Descriptive and inferential statistics **3**

3.1 Creating a summary table 3

3.2 Trends in gdp per capita, bottom 90% and top 10% average income 3

3.3 Multiple regression analysis 6

References **7**

1 Research question and project description

In our collaborative research project, we seeks to provide an answer to the following question: **How the rise in inequality and economic growth influences the purchase of cars as an example of luxury good, compared to the usage of public transportation systems in Singapore, from 1995 to 2014**. Therefore, we collected data on economic growth, income inequality, usage of public transports and purchase of cars covering the time span of 29 years, from 1995 until 2014. As suggested by our research question, economic growth, income inequality are the explanatory variables, while purchase of cars and usage of public transports are the dependent variables. The reason why we chose cars as example of luxury goods showing social status, is that in Singapore purchasing of cars is particularly expensive, due to high taxation and a certificate of car entitlement, whose cost can be higher than 70.000 dollars. For more details about the research proposal and case justification see ResearchProposal.

2 Processing data

2.1 Data sources and data gathering

The data that we need for our empirical analysis are to be retrieved from different sources:

- IMF Cross Country Macroeconomic Statistics open data available on Quandl, a website providing high-quality financial and economic data in different formats to facilitate data analysis. From this source we downloaded data showing the trend in Singopore's GDP per capita imported on R in csv format
- Knoema, a knowledge platform connecting data with analytical and presentation tools, in order to allow users to access, present and share data-driven content. From The World Top Incomes Database - providing access to data on the distribution of top incomes in more than twenty five countries across the globe - we downloaded data on the top 10% average income and bottom 90% average income in Singapore. The reason why we did not gather data from the database Clio Infra available on Quandl as we had defined in our ResearchProposal , is that it did not provide sufficient data for the time span we are considering.
- POPULATION OF VEHICLES
- USAGE OF PT

2.2 Cleaning, processing and merging of datasets

After importing data on R and cleaned them, using the "year" as common demonitator for every dataframe, in order to merge them afterwards.

- Singapore's GDP per capita is measured in national currency and at current prices. We selected only the time span of interest and and removed the unnecessary columns, to avoid later merging conflicts.
- As for data on bottom 90% and top 10% average income, data were considered starting from 1995. Since there were no data availble after 2009, we forecasted the value of the average income of the two categories performing a linear regression. Results were available in a new dataframe, which was then bound with the orginal one, in order to have the entire time series. After that, we used these data to create a new dataframe showing the trend in inequality from 1995 until 2014; these data were obtained dividing the values of the top 10% average by the values of the bottom 90% average income for each year, to show how many times the top 10% average income is higher than the bottom 90% throughout the considered period.

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After cleaning the datasets, we proceeded with merging them. However, the various datasets were merged one by one, since more cleaning was sometimes needed in order to avoid merging problems. The final dataframe has 19 observations and 14 variables, observed throughout the years 1995-2014.

TABLE

date	gdp.per.capita	inequality	cars	rentalcars	taxis	buses	motorbikes	other	bus.u	mrt.u	top
1995	35345.46	3.889421	342245	5144	16517	10723	129587	137913	3009	740	113402.5
1996	37030.85	4.027278	362142	5451	16857	10998	132344	140512	3118	850	121752.3
1997	39178.61	4.002998	373345	6152	16933	11240	132629	142905	3116	911	126460.8
1998	36524.71	4.361630	370804	6536	17886	11429	133375	141051	3121	946	130964.1
1999	36943.71	5.124233	378024	7112	18029	11827	134346	139473	3213	986	139277.7
2000	41018.46	5.529790	386780	8438	18327	12569	131937	134756	3251	1047	156177.5
2001	38659.65	7.034501	398787	8857	18798	12902	131869	137157	3281	1071	159140.3
2002	39423.34	6.939008	398166	8423	19106	12992	132318	135951	3197	1081	156838.4
2003	41069.97	6.347747	399923	7803	19384	12951	135649	135333	2992	1171	159243.3
2004	46320.39	5.735356	412015	7455	20407	13173	137029	137316	2805	1270	161198.4
2005	49715.39	5.367124	432827	7756	22383	13494	139434	139098	2779	1321	170744.3
2006	53355.04	5.938192	465482	9235	23334	14120	142736	144466	2833	1408	185295.8
2007	59113.86	6.122911	505987	11054	24446	14530	144340	150979	2932	1527	208444.0
2008	56201.31	6.974853	540455	12391	24300	15327	146120	156089	3087	1698	202059.2
2009	56111.06	6.377127	566608	12763	24702	16023	147215	158207	3047	1782	192490.8
2010	63497.76	7.091165	584399	13347	26073	16309	148160	157541	3199	2069	210202.0
2011	66816.04	7.275458	592361	13919	27051	17046	146559	159768	3385	2295	216514.0
2012	68204.57	7.458311	605149	14862	28210	17162	144110	160417	3481	2525	222826.0
2013	70047.47	7.639741	607292	16396	27695	17509	144934	160344	3601	2623	229138.0
2014	71317.88	7.819765	600176	18847	28736	17554	145026	161698	3751	2762	235450.0

3 Descriptive and inferential statistics

3.1 Creating a summary table

The table below shows the basic decriptive statistics for our variable included in the complete datasets.

% Table created by stargazer v.5.2 by Marek Hlavac, Harvard University. E-mail: hlavac at fas.harvard.edu
% Date and time: Thu, Apr 14, 2016 - 18:11:24

% Table created by stargazer v.5.2 by Marek Hlavac, Harvard University. E-mail: hlavac at fas.harvard.edu
% Date and time: Thu, Apr 14, 2016 - 18:11:24

3.2 Trends in gdp per capita, bottom 90% and top 10% average income

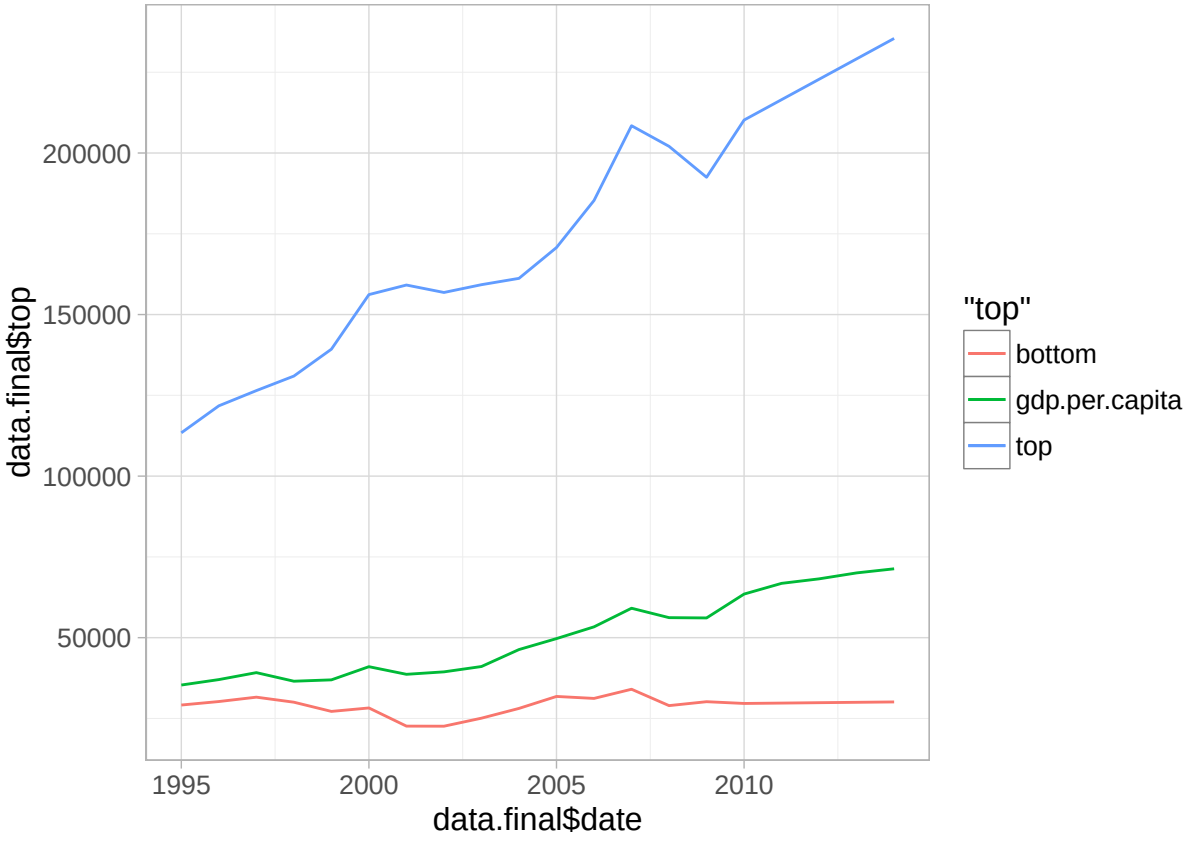
The following graph shows the trend of the three explanatory variables, throughout the period of time taken into consideration in Singapore. As we can see,

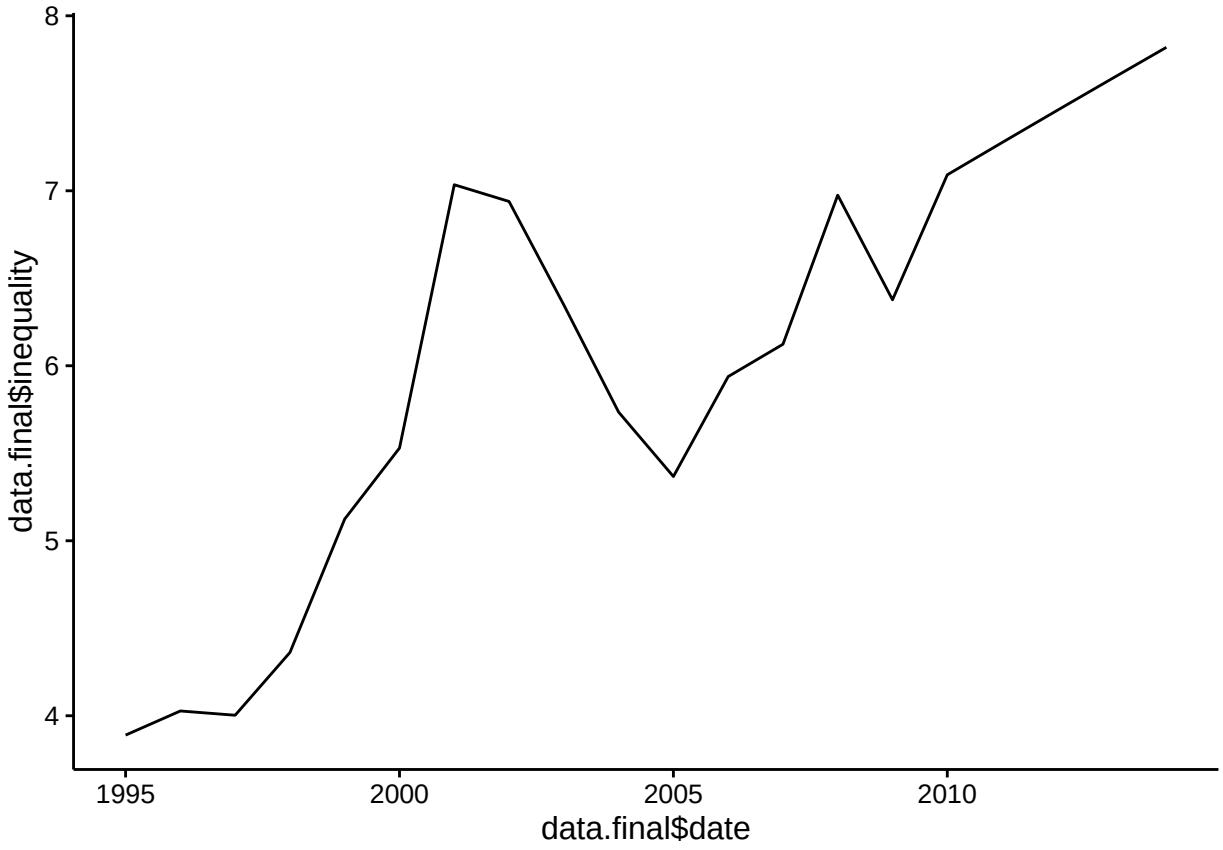
Table 2: General data summary

Statistic	N	Mean	St. Dev.	Min	Max
date	20	2,004.5	5.9	1,995	2,014
gdp.per.capita	20	50,294.8	12,748.0	35,345.5	71,317.9
inequality	20	6.1	1.3	3.9	7.8
cars	20	466,148.3	97,290.5	342,245	607,292
rentalcars	20	10,097.0	3,881.3	5,144	18,847
taxis	20	21,958.7	4,201.0	16,517	28,736
buses	20	13,993.9	2,302.3	10,723	17,554
motorbikes	20	138,985.9	6,435.2	129,587	148,160
other	20	146,548.7	10,180.8	134,756	161,698
bus.u	20	3,159.9	254.5	2,779	3,751
mrt.u	20	1,504.2	635.1	740	2,762
top	20	174,881.0	38,176.0	113,402.5	235,450.0
bottom	20	29,022.2	2,851.4	22,602.4	34,043.3
lrt.u	20	62.8	45.0	0	137

Table 3: General data summary

labels1




8
7
6
5
4
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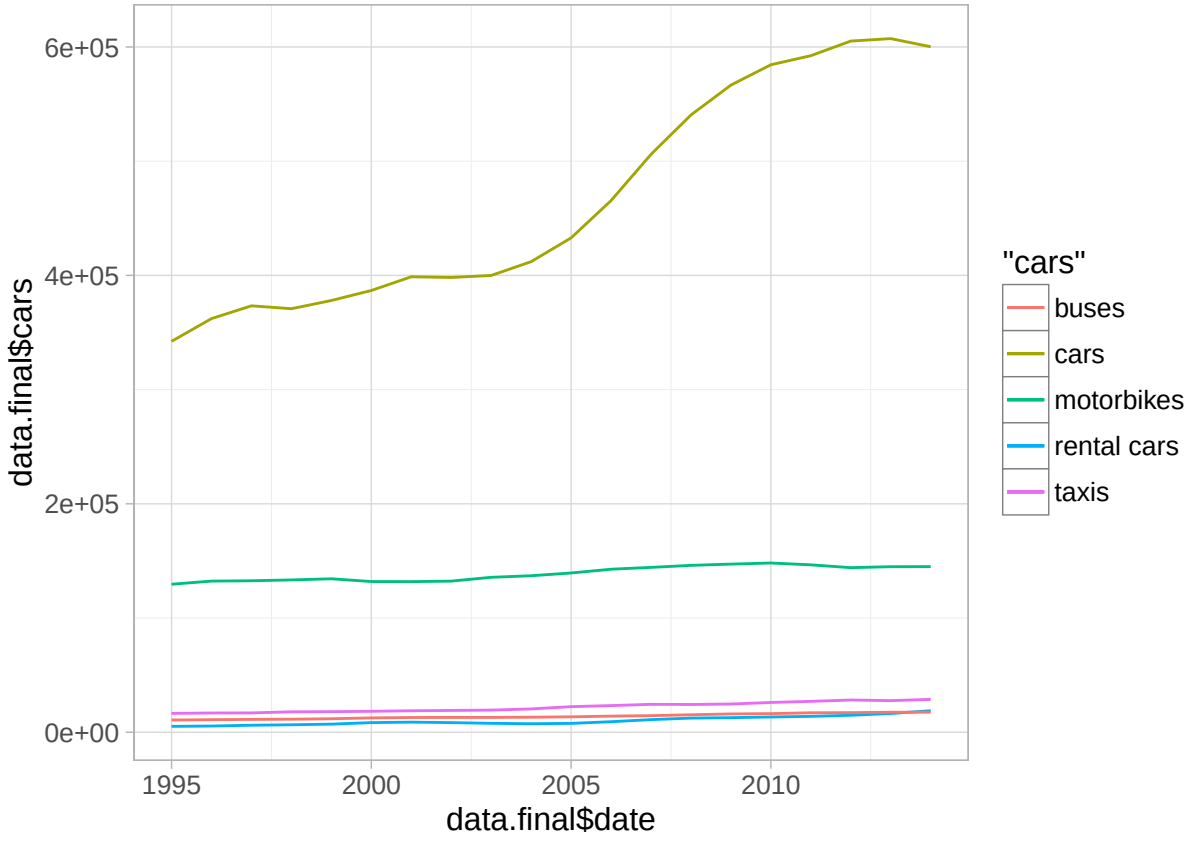
1995
2000
2005
2010
data.final$date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1995
2000
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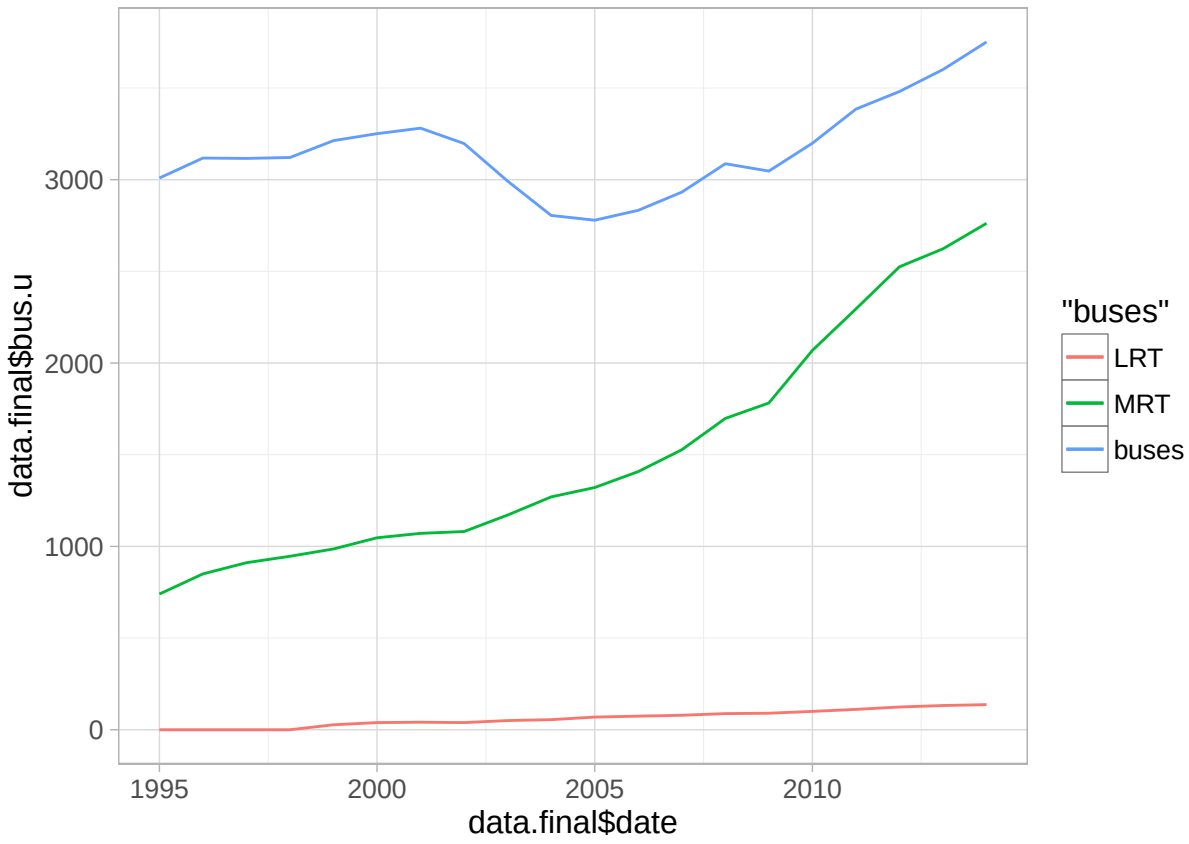
buses
cars
motorbikes
rental cars
taxis



3.3 Multiple regression analysis

```
##
## \begin{table}[!htbp] \centering
##   \caption{Multiple regeression models}
##   \label{}
## \begin{tabular}{@{\extracolsep{5pt}}lcccc}
## \\[-1.8ex]\hline
## \hline \\[-1.8ex]
##  & \multicolumn{4}{c}{\textit{Dependent variable:}} \\
## \cline{2-5}
## \\[-1.8ex] & cars & bus.u & mrt.u & buses \\
## \\[-1.8ex] & (1) & (2) & (3) & (4)\\
## \hline \\[-1.8ex]
##  gdp.per.capita & 5.62$^{*}$ & 0.004 & 0.04$^{***}$ & 0.05 \\
##   & (2.68) & (0.01) & (0.004) & (0.04) \\
##   & & & & \\
##  inequality & 16,917.56 & 82.29 & 82.35$^{*}$ & 436.15$^{**}$ \\
##   & (12,232.97) & (62.70) & (40.97) & (171.16) \\
##   & & & & \\
##  bus.u & $-$39.70 &  &  & $-$0.72 \\
##   & (49.70) &  &  & (0.70) \\
##   & & & & \\
##  mrt.u & 71.41 &  &  & 1.68 \\
##   & (71.02) &  &  & (0.99) \\
##   & & & & \\
```

```
##  lrt.u & $-$745.93 &  &  & 5.87 \\
##   & (869.85) &  &  & (12.17) \\
##   & & & & \\
##  Constant & 145,753.90 & 2,477.90$^{***}$ & $-$1,110.31$^{***}$ & 8,336.84$^{***}$ \\
##   & (162,408.10) & (249.55) & (163.05) & (2,272.35) \\
##   & & & & \\
## \hline \\[-1.8ex]
## Observations & 20 & 20 & 20 & 20 \\
## R$^{2}$ & 0.96 & 0.32 & 0.95 & 0.99 \\
## Adjusted R$^{2}$ & 0.95 & 0.24 & 0.95 & 0.98 \\
## Residual Std. Error & 22,249.39 (df = 14) & 222.36 (df = 17) & 145.28 (df = 17) & 311.31 (df = 14) \\
## F Statistic & 69.86$^{***}$ (df = 5; 14) & 3.94$^{**}$ (df = 2; 17) & 173.04$^{***}$ (df = 2; 17) & 1
## \hline
## \hline \\[-1.8ex]
## \textit{Note:}  & \multicolumn{4}{r}{$^{*}$p$<$0.1; $^{**}$p$<$0.05; $^{***}$p$<$0.01} \\
## \end{tabular}
## \end{table}
```

References