Effects of Age, Income, Hours Worked, and Demographic Variables on Life Satisfaction Level in the Population of United Kingdom

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Assignment description

The first piece of work will be a piece of practical econometrics, written up in the style of an academic article such as those in Applied Economics. As a class, students will help to identify a research topic (or possibly a choice of topics) and gather appropriate data. Students may work in small groups to conduct an appropriate econometric analysis using these data. However, the academic article must be written and submitted individually.

The econometric technique applied should extend upon standard methods covered in Stage 2 econometrics (e.g. **logistic regression** rather than standard OLS). The articles should aim to be around 2,500 - 3,000 words in length. Further details of the style and content will be given in due course.

Abstract

This empirical study uses multinomial logistic regression to analyze effects of age, income, and hours worked, in addition to a range of categorical variables from UK Labor force survey conducted between 2012 and 2015. It finds evidence for negative effect of low income on subjective life satisfaction and supports hypothesis of U-shaped relationship between satisfaction and happiness, while it does not support the hypothesis that midlife crisis would be more prevalent in males. London has been identified as a region with risk of lower life satisfaction. Recommendation is made for promotion of healthy lifestyle and sufficient healthcare funding, especially mental health services. In result of the complexity of predicted variable and classifications of observations into its appropriate categories, call for further research using this method is made.

1 Introduction

Happiness has long been one of the major things individuals have striven to achieve. (Moradi et al. 2013) In economic context, the idea of collective happiness as an indicator of society's advancement has been around since the wake of philosophy.

Until the late 1990s, level of national wellbeing or life satisfaction, had been proxied by the GDP, despite Kuznets's own appeal against this. (Costanza et al. 2014) Since then, measuring satisfaction level of population has been promoted, not only by individual academics across subjects, but also by global organizations, such as the United Nations, as per goals 3 and 17 of the sustainable development goals (Sachs 2015). Nowadays, indicators such as Helliwell et al. (2017), Legatum Institute, (2017), Marks (2016) exist to assess happiness and wellbeing by a universal measure. One of the most endorsed is the World Happiness Report (Helliwell et al. 2017), which uses a great deal of quantitative data while assessing and comparing levels of happiness across societies and identifying contributing factors on the micro level at the same time. On the contrary, the most criticized is the Happy Planet Index (Marks 2016), which is based on further aggregate measures, which Otoiu et al. (2014) classifies as not-wellbeing relevant.

This paper, empirical in nature, takes into account the context of the United Kingdom and employs microeconomic approach to look at what are some of the variables determining whether, and to what extent, does UK workforce feel subjectively well in the long-run. Section 2, will look more closely into the body of microeconomic and psychological research in the area of life satisfaction and form an overview of determinants of self-reported wellbeing. Section 3 will draw on the key elements identified in this literature, while section 4 will detail method of this paper. Section 5 then presents and describes data collected through the UK Labor force survey by Office for National Statistics. Social Survey Division, (2016), while Section 6 presents results, relating outcome of the econometric analysis to the literature. Finally, important remarks and recommendations for both local authorities and macroeconomic indicator developers are summarized in section 7.

2 Literature review

2.1 Demographic Dimension

2.1.1 Age

Econometric analysis of Realo & Dobewall (2011) observe that in some countries relationship between age and subjective life satisfaction is observed, while in other this does not hold. Furthermore, they form a solid comparison of existing research and

unveil the varying nature of their outcomes.

In accordance with their appeal for more studies considering effects of birth cohorts, de Ree & Alessie (2011) conclude "that life satisfaction is certainly not flat or trending linearly over the course of life." The same empirical report however does not confirm or disprove existence of the U-shaped relationship between age and subjective life satisfaction, suggesting inclusion of more covariates to decompose the relationship.

Explaining such relationship from perspective of theoretical psychology as well as medicine is the theory of mid-life crisis, claimed to occur, especially in males. (McCartney 2010, Shek 1996) Of course, this may be specific to individual groups of people. For example, divorced people may be a cause of strong negative effect on the relationship in the middle-aged population. Accumulation of illness over one's lifetime related to unhealthy lifestyle may be further explanation. These effects therefore need to be separated in the model and observed on their own, to see whether the relationship persists.

2.1.2 Gender

Inspecting self-assessed wellbeing for a gender gap is for example econometric study by Mencarini & Sironi (2010). They claim that "Gender systems are likely to have an important impact on individuals' well-being," focusing on the impact of role of women in households on their respective happiness. The same source adds that recent improvement in "gender equality has enhanced the general well-being of women." Nevertheless, they still observe higher level of wellbeing in males.

Another, more recent study (Dreger et al. 2016) uses European Quality of Life Survey (2011–12) to compare cross-country differences in the wellbeing gap between males and females. Their results support Mencarini & Sironi (2010), proving the proportion of individuals experiencing the highest level of wellbeing is greater in men than women, in the context of the UK. The pitfalls of their work however include narrow focus, only considering highest category against the rest, and lack of account for variables such as income.

2.1.3 Marital status

Two similar studies of (Reneflot & Mamelund 2011) and literature review, Symoens et al. (2014) establish that relationships play crucial role in human lives and hence individual happiness. According to their results from statistical analysis of data from the Norway and the Flanders respectively, married individuals living with their partner report higher degree of wellbeing, while divorced, separated, and widowed people experience drop in life satisfaction and become prone to drinking problems and problematic behavior. They further provide clinical studies, proving that entering new relationships and eventually another marriage leads to recovery in their mental wellbe-

ing and reduces likelihood of developing drinking addiction and potentially harmful behavior.

2.1.4 Region

Regional differences in the UK are always a matter for inspection, especially the disparity between the metropolitan area of London and the rest of the country. Adli (2011) mentions in his essay that living in a large dynamic city "could therefore influence the risk for developing mental disorders." He adds that "urban living can be threatening if you haven't enough space of your own." Furthermore, Migheli (2016) also establishes that "people get dissatisfaction from living in large centers."

2.1.5 Religion

Religion is an aspect that is expected to have a significant effect on the reported level of wellbeing as it alters the way of perceiving life through giving it stronger meaning. Differences among individual religions will then depend on the degree of stimulation it provides to an individual. Especially Buddhism, which is more often described as a way of life, rather than religion may not have as strong effect as Islam, which promotes grace for the gift of life and submission to God. Spackman (2012) Finally, the degree of faith in an individual will play role, as despite being baptized and hence officially religious, some people seldom practice their religion. (**?**)

2.2 Socioeconomic Dimension

Life satisfaction has been proven to be linked to Maslow's hierarchy of needs, which peaks with the need for self-actualization. (Simons et al. 2009) Self actualization and often the security levels of the pyramid are dependent of activities of the individuals which contribute to the society, in exchange for self-approval in the former and for money in the latter case.

Employment and its nature play a significant role in satisfaction of growth needs in individuals. Unemployed people may therefore be expected to exhibit higher probability of falling into the lower categories of self assessed life satisfaction scale. On the other hand, free time is given up in process of economic activity, which suggests that increasing amounts of hours worked may reduce satisfaction experienced. Furthermore, such effect may be eventually compensated by resulting income. Finally, routine jobs may not satisfy esteem needs in some individuals and self actualization in most, which is why they are expected to increase probability of lower life satisfaction levels. (Roberson 1990)

2.2.1 Education

Highly educated individuals may not only have better employment prospects and hence higher degree of optimism, but also possess ability to critically evaluate situations and potentially overthink them. This suggests that in the long run, there may be a relationship between education and life satisfaction level, the direction of which may depend on other constraints. (Migheli 2016)

2.3 Accommodation Dimension

2.3.1 Accommodation Tenure

Paying rent may be associated with increased degree of stress, while owning a house provides an increased degree of security, even when a mortgage to repay is in place. This is mostly related to the general relationship to land.

2.4 Lifestyle Dimension

Two factors available in the concerned dataset are related to the question of lifestyle: self-assessed health status and smoking.

Shahab & West (2012) inspect the question of influence of smoking on individual happiness using a cross-sectional dataset. According to their results, smoking negatively affects individual happiness and may lead to an increase in anxiety. The effect is however reversible, as ex-smokers tend to experience a comparable degree of happiness compared to never smokers.

these effects are proven to be reversible, as they discover that tend to experience lower degree of happiness and Quitting has a positive effect on happiness, therefore it is reversible.

People who feel like dying generally lack satisfaction of the very basic needs, so they are damned. The healthcare system can fix it, tho.

	Property	Variable	±	Values	Theory
Demographics	Age	DG_AGE DG_AGE^2 $M \times DG\_AGE$ $M \times DG\_AGE^2$	↑ ↑ ↑ ↑	16-100	Realo & Dobewall (2011), de Ree & Alessie (2011), McCartney (2010), Shek (1996)
	Gender	$DG\_MALE = M$	↑	1: Male	Mencarini & Sironi (2010), Dreger et al. (2016)
	Marital Status	DG_MAR_PART DG_MAR_EXPART	↑ ↓	1: Partnered 1: Ex-partnered	Symoens et al. (2014), Reneflot & Mamelund (2011)
	Region	DG_LONDON	↑	1: London	Migheli (2016)Adli (2011)
	Ethnicity	DG_NONW	-	1: Non-white	No effect expected
	Religion	DG_RELIG	↑	1: Religious except Buddhist	Perception of life; Buddhism as a way of life, not religion ?Spackman (2012)
Socioeconomics	Weekly Income	$ln(EC\_PPWK)$	↑	scale	Migheli (2016)
	Economic Activity	EC_UNEMP EC_INAC	↓ ↓	1: Unemp 1: Inactive	Simons et al. (2009)
	Time in unemp.	$EC\_UNEMP3M$ $EC\_UNEMP3Y$	↓ ↓	1: >3mo 1: >3yrs	Simons et al. (2009)
	Job type	EC_ROUTJ	↓	1: Routine	Lack of self-actualization Roberson (1990) Simons et al. (2009)
	Hours Worked	EC_WORKHR EC_WORKHR^2	?? ↓	weekly	Free time given up; Satisfaction from work
	Education	DG_LOWEDU	↓	1: below GCSE	Education leads to critical thinking
Ac.	Tenure	AC_RENT	↓	1: Rented	Feeling constrained
Lifestyle	Smoking	HE_SMOKER	↓	1: Current Smoker	Smokers experience lower levels of happiness, quitting leads to recovery Shahab & West (2012)
	Health	HE_Q3 HE_Q4 HE_Q5	↓ ↓ ↓	1: Health quality 3/4/5	Illness decreases comfort

Table 1: Breakdown of theoretical dimensions into analyzed variables and proxies

3 Methodology

This paper takes stance of closed-world ontology, employing inductive emphasis through use of multinomial Logistic Regression Analysis, which classifies as a quantitative research method. The analysis itself was conducted in R version 3.4.2 (R Core Team, 2017) utilizing packages foreign, colorRamps, gplots, knitr, MASS, nnet, and lmtest . Its main assumption is that subjective life satisfaction relates to a number of factors, which are measurable more directly than the variable in question.

Multinomial logistic regression is a commonly used technique for predicting probability of individual categories in non-binary categorical variables. It builds on OLS[1] linear regression, estimating the logartihm of the odds ratio between probability P_x of the variable exhibiting category x and the benchmark category P_0, as shown in equation (1).

$$ln\left(\frac{P_x}{P_0}\right) = \alpha + \beta_1 var_1 + \ldots + \beta_k var_k \tag{1}$$

4 Data

The data source for analysis conducted in this paper comes from Office for National Statistics. Social Survey Division, (2016). The original dataset was collected between years 2012 and 2015 and included 567481 observations of 67 variables. Its primary objective was sampling of the UK Labor force and facilitation of governmental and academic analyses.

For purposes of this paper, 32 relevant variables were chosen and further assessed for suitability based on indices from existing research. The final model uses 12 categorical and 3 scale variables. In terms of number of observations, those that presented with unavailable record of predicted variable, i.e. self assessed level of well-being, were excluded, leaving 303492 for assessment prior to specification of the model.

Because of the number of variables, the exploratory analysis herein has been reduced for purposes of sticking to the word count. Further details are presented in the appendix.

4.1 Predicted variables

At the time of initial analysis, there were two suitable variables for this analysis, overall life satisfaction and the feeling of life being worthwhile. Because they are both closely related and the latter is likely to cause the former as per Simons et al. (2009), the overall life satisfaction was chosen due to its semantic definition being more closely related to the concepts presented in (Helliwell et al. 2017) as well as its broader context.

[1] Ordinary Least Squares

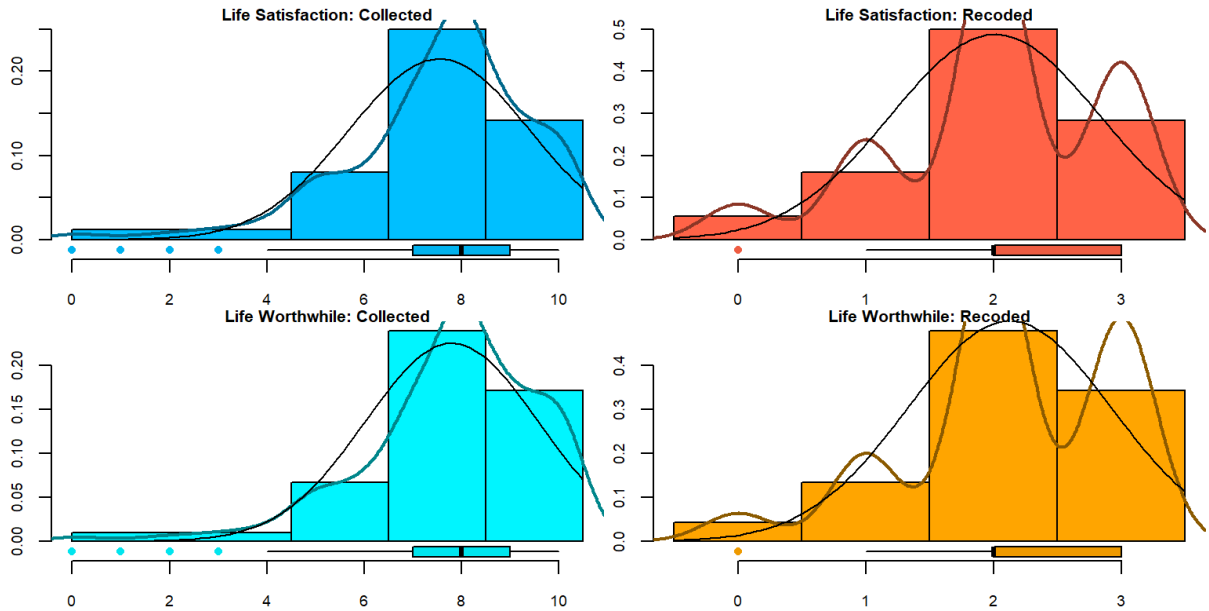

Figure 1: Distribution of explanatory variables

5 Results and discussion

Table below presents all estimated coefficients which represent multiplicative effect of marginal increase in given variable on odds ratio of respective category.

For interpretation, it is firstly necessary to interpret the constant term, i.e. the odds ratio of the benchmark case, which is a 16 year old female with wage of 1 working 0 hours per week, who exhibits value 0 for all of the dummy variables that follow. As first, probability of her falling into the reference category of life satisfaction $P_{7\wedge 8}$, that is 7-8, needs to be calculated as shown in equation (2) where $e \approx 2.718$, α is coefficient of a constant estimated by the model for category c. Probabilities for remaining categories are then calculated using equation (3), which is essentially reverse process of the logit transformation. Sum of all the calculated probabilities then must logically equal 1, which may not be the precise case when rounding takes place in the process. For this reason, figure 2 provides results calculated directly in R.

$$P_{7\wedge 8} = \frac{1}{1+\Sigma e^{\alpha_c}} \approx \frac{1}{1+(0.17+0.45+0.87)} \approx 40.1\% \tag{2}$$

$$P_c = P_{7\wedge 8} \times e^{\alpha_c} \tag{3}$$

	% likelihood
0-4	6.99
5-6	18.09
7-8	39.98
9-10	34.95

Figure 2: Benchmark probabilities per category

When the benchmark probabilities are known, the effects of individual variables may be inspected. Estimates greater than 0 show that marginal increase in given variable has positive effect on probability of given category when and vice versa. The overall equation may be characterized by equation (4), where k is number of variables, x_i a vector of variables and $\beta_{x_{i;c}}$ their respective coefficient for the relevant category c.

$$P_c = P_c \times e^{\alpha_c} \times \Pi_1^k \left(e^{x_k \times \beta_{x_{i;c}}} \right) \tag{4}$$

Therefore, inspecting the dummy variables, decreases likelihood of falling into category $7 \wedge 8$, while increasing likelihood of $(0,4)$, $5 \wedge 6$, and $9 \wedge 10$ in order of magnitude. Unemployment significantly reduces likelihood of falling into the lowest category, while increasing probability of an individual being in the reference category.

All four variables from the lifestyle dimension, suggesting bad health status in case of *HE_QX* and bad habit in case of *HE_SMOKER* increase likelihood of falling into the lowest life satisfaction categories. Londoners also seem to be more likely to fall into lower categories, compared to individuals living in the rest of the UK. Both of these effects are consistent with the findings of ongoing literature.

The effect of marriage and divorce is consistent with the theory, and so is

	0-4	5-6	9-10
Constant	−1.745***	−0.793***	−0.135***
	(0.002)	(0.003)	(0.004)
I(DG_AGE - 16)	0.068***	0.030***	−0.024***
	(0.002)	(0.001)	(0.001)
I((DG_AGE - 16)^2)	−0.001***	−0.0004***	0.0004***
	(0.00003)	(0.00002)	(0.00002)
I(DG_MALE ∗(DG_AGE - 16))	−0.010***	0.002	−0.002*
	(0.002)	(0.001)	(0.001)
I(DG_MALE ∗(DG_AGE - 16)^2)	0.0001	−0.00005*	0.00003
	(0.00004)	(0.00002)	(0.00002)
log(EC_PPWK_ECAC1)	−0.556***	−0.332***	−0.064***
	(0.002)	(0.010)	(0.008)
EC_WORKHR_ECAC1	0.029***	0.028***	−0.014***
	(0.002)	(0.003)	(0.002)
I(EC_WORKHR_ECAC1^2)	−0.0002***	−0.0002***	0.0002***
	(0.00004)	(0.00004)	(0.00003)
DG_LOWEDU	0.038***	0.102***	0.209***
	(0.003)	(0.007)	(0.010)
EC_UNEMP	−1.165***	−0.721***	−0.800***
	(0.003)	(0.007)	(0.003)
EC_INAC	−2.010***	−1.154***	−0.237***
	(0.003)	(0.008)	(0.006)
EC_UNEMP3M	0.192***	0.251***	0.095***
	(0.002)	(0.005)	(0.002)
EC_UNEMP3Y	0.305***	0.295***	0.291***
	(0.0004)	(0.001)	(0.0004)
EC_ROUTJ	0.125***	0.170***	0.037***
	(0.005)	(0.008)	(0.009)
AC_RENT	0.231***	0.230***	−0.016
	(0.008)	(0.007)	(0.009)
HE_Q3	1.065***	0.719***	−0.528***
	(0.005)	(0.010)	(0.012)
HE_Q4	2.363***	1.317***	−0.689***
	(0.004)	(0.005)	(0.001)
HE_Q5	3.300***	1.519***	−0.437***
	(0.001)	(0.001)	(0.0003)
DG_MALE	0.326***	−0.076***	−0.114***
	(0.001)	(0.001)	(0.001)
DG_MAR_PART	−0.584***	−0.366***	0.408***
	(0.005)	(0.007)	(0.007)
DG_MAR_EXPART	0.200***	0.108***	0.001
	(0.004)	(0.007)	(0.005)
DG_RELIGIOUS	−0.151***	−0.033**	0.130***
	(0.004)	(0.011)	(0.010)
DG_LONDON	0.071***	0.062***	−0.162***
	(0.001)	(0.002)	(0.002)
DG_NONW	0.357***	0.404***	0.057***
	(0.001)	(0.003)	(0.002)
HE_SMOKER	0.529***	0.263***	−0.006
	(0.006)	(0.008)	(0.010)

Table 2: Logit model: Subjective life satisfaction level

In order to visualize outcome of the model, especially how probabilities of individual categories evolve over the ranges scale variables, figure 3figure 4 show absolute and aggregate probabilities of individual wellbeing categories plotted against age in the benchmark case, and age in the benchmark case altered to $DG\_MALE = 1$ respectively. The hypothesis of midlife crisis or potential cross-cohort differences in life satisfaction seems to hold but the true cause of this relationship remains unclear. Men seem to be only marginally more negatively affected by the quadratic component of the age than women, with low statistical significance.

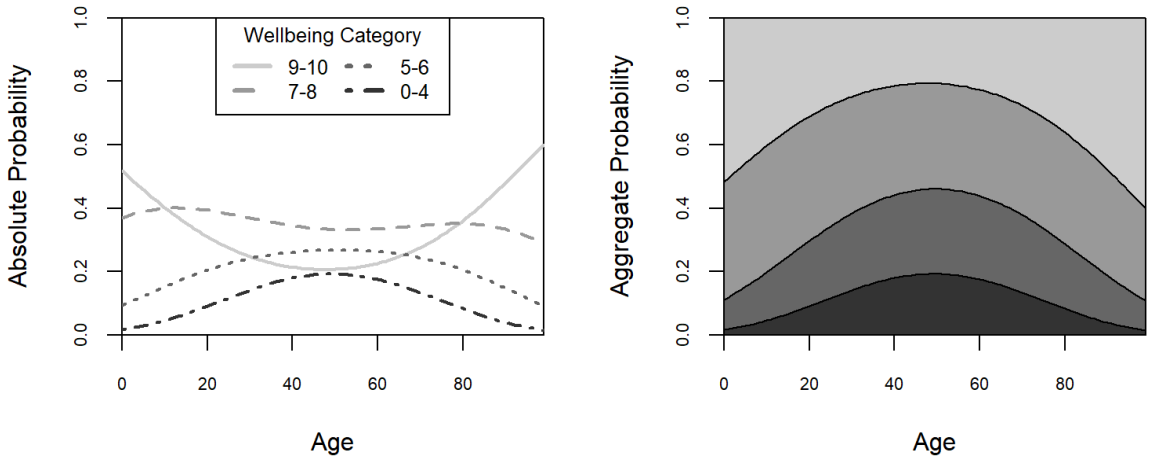

Figure 3: Effect of age on probability of wellbeing categories in females

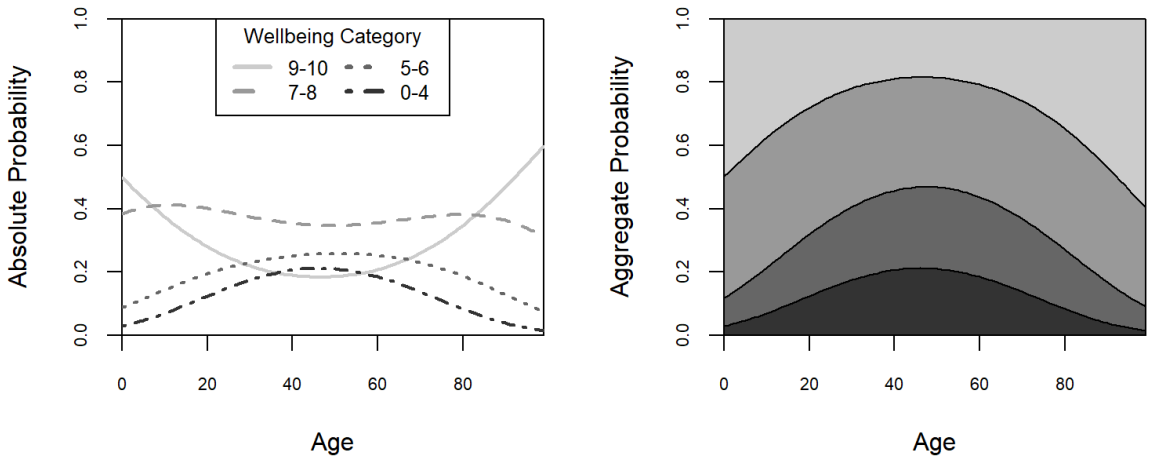

Figure 4: Effect of age on probability of wellbeing categories in males

Graphs in figure 5 express the same concept in relation to hours worked per week in the benchmark case. They show that although likelihood of falling into the lowest wellbeing category rises in the unnaturally high working hours, probability of being in $9 \wedge 10$ grows above 45 hours of work per week. This may suggest that entrepreneurial individuals with highly positive attitude to work exist.

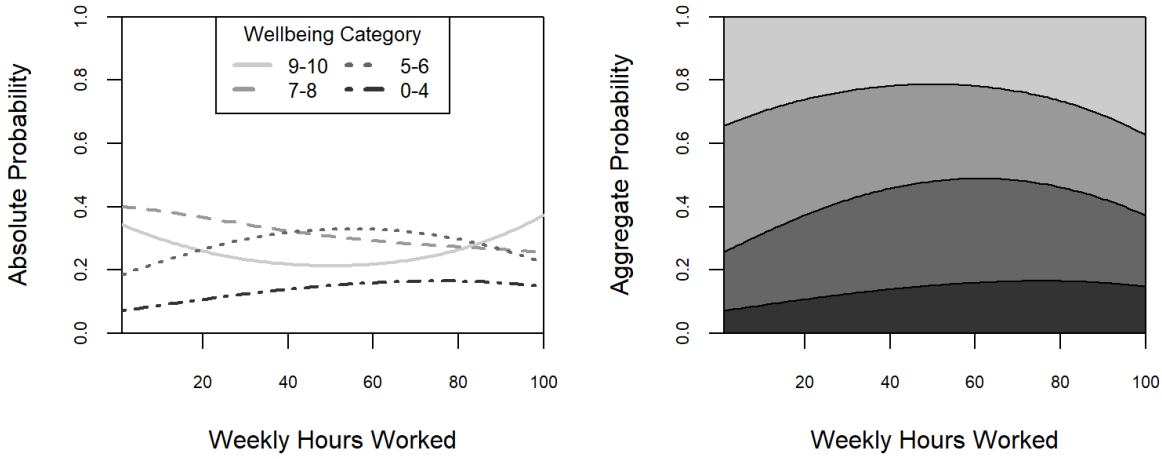

Figure 5: Effect of weekly hours worked on probability of wellbeing categories

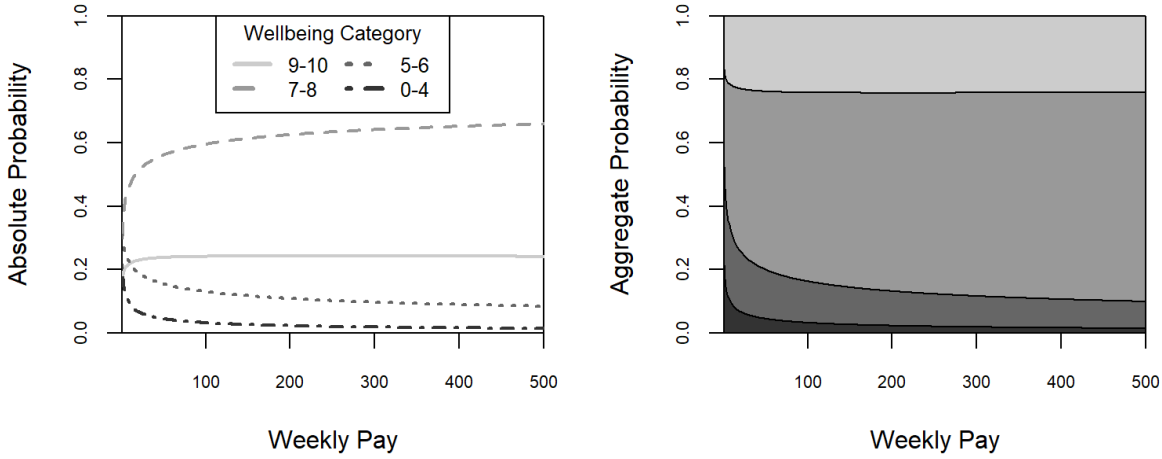

Figure 6: Effect of income on probability of wellbeing categories

Finally, figure 6 shows the effect of income modeled on a more appropriate example, which differs from the benchmark by being 22 years old, male, working 20 hours a week, and being a rent payer. This illustration demonstrates that the effect of income is most relevant in population earning below GBP 100 weekly, converging towards constant probabilities for each category as it increases. Observation that may be of interest is the slight negative slope of probability of falling into life satisfaction category of $9 \wedge 10$ at incomes exceeding GBP 400 per week.

5.1 Predictive ability

To assess how well the model classifies observations based on exogenous variables into specific bins of wellbeing level, a random sample test shall be conducted. Relevant variables are taken from the source table, incomplete cases removed, and 50,000 rows selected at random. Then, a bin of WB_SATIS5 is assigned based on highest probability estimated by model to each observation. Finally, the differences between actual and

predicted values are contrasted in figure 7. Out of the 50,000 observation sample, the number of observations on the diagonal has been classified correctly.

The most predicted life satisfaction bin was satisfaction level between 7 and 8, which corresponds to the original mode and mean of the variable. Nevertheless, it seems that way too many observations fall in this bin.

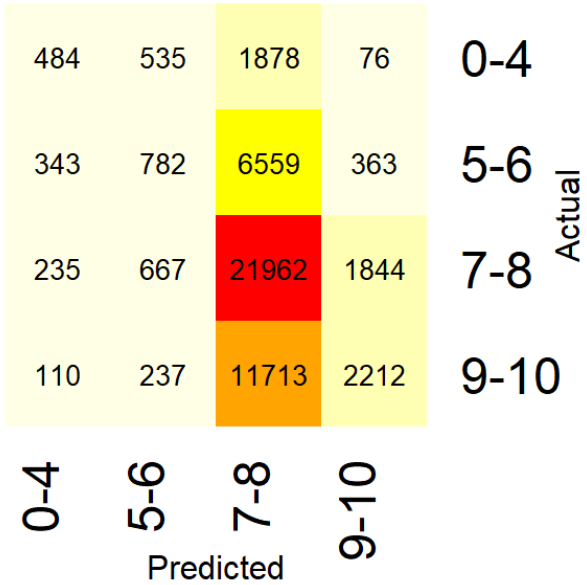

Figure 7: Heatmap of predicted and actual values of WB_SATIS5

To express the model strength in a single number, an indicator of misclassification error may be calculated by dividing sum of numbers of the misclassified observations, i.e. those that are not on the diagonal by the size of the random sample. In this case, the misclassification error is equal to 49.1%. This suggests that in spite of inclusion of numerous variables across four key themes, there are still further factors at play in determining

6 Recommendations and Conclusion

Firstly, promotion of healthy lifestyle is a key aspect the UK governing bodies should not overlook in their fiscal planning. Special precautions should then be taken to analyze mental health of London population through clinical studies in the field of psychology and help develop ways to improve resilience of individuals living in the growing metropolis.

Home-ownership schemes are also a good way to increase wellbeing of British population, as those who need to pay rent tend to have increased probability of falling into less satisfied categories. Although there is a government-funded scheme in place, the current housing market situation is not helping, which is why building new housing

units should be broadly encouraged, mainly in urban areas. Replacement of the slowly decaying build-up of Victorian houses.

One of the weaknesses of the dataset analyzed herein was its focus on labor force and hence mostly work-related questions. Instead, design of survey with more focus on wellbeing-relevant variables including psychological, social, and deficiency needs dimension should be considered. Such surveys exist in some parts of the world but are generally proprietary, while analysis done on their data brings more to the corporate audience than public.

Further, far more obvious gap in the data source is unavailability on information on the deficiency needs as opposed to growth needs. It is argued, that for effect of growth needs on subjective life satisfaction, these need to be secured first, which is an assumption, which makes this analysis relevant for the context it is applied on. However, for microeconometric assessment of wellbeing in developing countries, these will be crucial.

In conclusion, this report has proven variation in life satisfaction levels to be explained by factors across multiple dimensions. Firstly, it proves age to have effect with the highest likelihood of low life satisfaction levels in the midlife age group, while it does not provide support to the claim that this occurrence is of higher magnitude nor more frequent in males. Financial situation does influence individual life satisfaction, however the effect diminishes rapidly with increasing income. Health and smoking status are in addition to marital status categorical variables with the highest influence on life satisfaction. Religion and ethnicity are also proven to play some role, while the effect of employment and hours worked is rather ambiguous. Even though the model provided shows results of high significance, its ability to classify individuals into life satisfaction level groups fails in almost 50% of cases, which is why further research on the topic utilizing logistic regression method is greatly encouraged.

3112 words

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Software used

- RStudio; output available at http://rpubs.com/mattved/326488
- LyX