

WELLBEING

Science and Policy

EXERCISES

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EXERCISES

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Chapter 1

1. Wellbeing differences within a country

Use the dataset on the respondents over 18 years old adapted from the UK Understanding Society Wave 10 (2018-2019). *The link to the dataset is available at the book page, chapter_1.dta.*

- i) Produce a histogram of life satisfaction in the UK (similar to Figure 1.1). Calculate mean and standard deviation. Is the standard deviation of any interest on its own? What percentage of the population have life satisfaction of 3 or below?
- ii) Calculate correlation coefficients between life satisfaction and each of the variables below. What, if anything, do they suggest?
income per head in household (log)
age
health (no. of problems).
- iii) Produce histograms for individual life satisfaction against the following variables. Calculate mean and standard deviation of life satisfaction for each realisation of the variables.
education (level)
unemployed (0/1)
partnered (0/1)
mental health (1 – ever diagnosed, 0 - otherwise).
- iv) If you know how to, run a multiple regression of life satisfaction on all those variables (including age and age²).

2. Wellbeing differences between countries

Use the dataset on the average country-level wellbeing around the world for 2017-19 adapted from Figure 2.1 of the World Happiness Report 2020

(<https://worldhappiness.report/ed/2020/>). The dataset is available at the book page, *chapter1_ex2.dta*

- i) Plot scatter diagram of average wellbeing against log average income per head
- ii) Calculate correlation coefficient of average wellbeing with income per head. Note outliers – do you see any tendency for particular regions to be high or low in wellbeing at given income levels?

Hint: Plot scatter diagram of average wellbeing against log average income per head for different regions.

Chapter 2

Suppose there are 2 groups of people, rich and poor (equal in number), with average wellbeing now equal to 8 and 7 respectively. The additional wellbeing given by one extra unit of income and one extra unit of healthcare are

	For the rich	For the poor
Extra income	0.6	1.2
Extra healthcare	1.0	1.0

Assume that one unit of healthcare costs one unit of income.

- (1) Would you favour giving an extra unit of healthcare to everyone, if it was paid for by the rich?
- (2) Would you favour mandating extra healthcare, if each group had to pay for their own healthcare?
- (3) Also, revise your understanding of equations (1)-(5).

Chapter3

1. Suppose $W_t = 6 + 0.7X_t - 0.4X_{t-1} - 0.3X_{t-2}$
Is this a case of total adaptation or partial adaptation? What if we change 0.7 to 0.8?
2. Suppose a person rejects the following gamble
50% chance of winning \$15
50% chance of losing \$100
Might she accept the following gamble?
50% chance of winning \$75
50% chance of losing \$50

Chapter 4

In a randomised trial there has to be a control group. One approach is to make a randomly selected group of participants wait before being treated. They become the control group. The Action for Happiness trial reported on page 73 made the following measurements.

Measures of life satisfaction (standard deviation in brackets)

	Treatment group	Wait-list control group
Before the trial	6.4 (1.6)	6.3 (1.8)
2 months after the trial	7.4 (1.6)	6.3 (1.8)

What is your estimate of the effects of the trial, in units of life satisfaction? What is its estimated effect-size (Cohen's d)?

Chapter 5

Suppose a study of twins provides the following data (the twins are now aged 40-50; each pair were reared together; and they still live in the same country).

For each type of twin the correlation between the life-satisfaction of the first- and second-born twin is

- For identical twins 0.42
 - For non-identical twins 0.22
- 1) What is the estimated 'heritability' of life satisfaction?
 - 2) What does this number mean? Suppose that, due to a change in policy, the variance of the environment was reduced – what would happen to measured heritability?

Chapter 6

Take the wellbeing of 15-year olds in Table 6.1 and do a scatter diagram of these against the wellbeing of adults in Table 1.1. *The dataset is available at the book page, chapter6.dta.* In what proportion of countries does child wellbeing exceed adult wellbeing? Any comments?

Chapter 7

1. Bivariate relationships with a continuous right-hand variable

Use the dataset on respondents over 18 years old adapted from the UK Understanding Society Wave 9 (2017-2018) and Wave 10 (2018-2019). *The link to the dataset is available at the book page, chapter_7.dta.* Let W be life satisfaction, and Y household income per head

- i) In pooled data for both years estimate

$$W_{it} = a_0 + a_1 \log Y_{it} + e_{it} \quad (1)$$

What is the value of a_1 ? How does it relate to the correlation of W and $\log Y$?

What are the 95% confidence intervals of the estimate of α_1 ?

Is the estimate significantly different from zero at the 95% confidence level?

- ii) Introduce a fixed effect for each individual, thus

$$W_{it} = a_0 + a_1 \log Y_{it} + f_i + e_{it} \quad (2)$$

How does the new estimate of a_1 differ from the previous estimate? Why? Might you also introduce a fixed effect (v_t) for each year? Why?

2. Bivariate relationships with a binary right-hand variable

- i) In pooled data for both years estimate

$$W_{it} = a_0 + a_1 \text{Unemployed}_{it} + e_{it} \quad (3)$$

where Unemployed is a 0/1 variable

What is the value of α_1 ?

What is the 'effect size' (Cohen's d) of being unemployed?

3. Bivariate relationships in standardised form

- i) Re-estimate equation (1) in standardised form. What is the value of β_1 ? How is it related to the estimate of a_1 ? What does β_1^2 tell us?

- ii) Ditto for equation (3). (Remember that the standard error of a 0/1 binary variable is $\sqrt{p(1-p)}$).

In the sample, unemployment rate was 2.3%.

4. The problems of omitted variables and reverse causality

- i) Using the same data estimate the **multiple regression equation**

$$W_{it} = a_0 + a_1 \log Y_{it} + a_2 \text{Education} + e_{it} \quad (5)$$

How does this estimate of a_1 differ from that in equation (1)? Why? (Note that a fixed effect would also control for any omitted variables that do not change over time e.g. for most people, education).

- ii) Using the same data, use an instrumental variable to pick up the effects upon W_{it} of the exogenous variation of $\log Y_{it}$. The instrument you can use is the level of education of person's father and mother.

Estimate (1) using this instrumental variable.

5. Mediating variables

- i) Estimate the following equation on pooled cross-section data for 2018 and 2019

$$W_{it} = a_0 + a_1 \log Y_{it} + a_2 U_{it} + e_{it} \quad (6)$$

How does a_2 compare with the **total** effect of unemployment in equation (3)?

- ii) Estimate the following

$$W_{it} = a_0 + a_1 \log Y_{it} + a_2 U_{it} + a_3 \text{Age} + a_4 \text{Age}^2 + a_5 \text{Partnered} + a_6 \text{Education} \quad (7)$$

How does a_1 compare with the estimate in equation (1)? Does equation (1) offer a reasonable estimate of the total effect of income?

Chapter 8

Use the dataset on the average country-level wellbeing around the world adapted from the World Happiness report. The dataset is based on the Gallup World Poll. *The dataset is available at the book page, chapter8.dta.*

- i) Explore the dataset. Which years does it cover and how many countries are included each year? Is the country where you are from included in the dataset?
- ii) Produce a histogram of average wellbeing scores (Life Ladder question) in 2019. Calculate mean and standard deviation. What percentage of countries have wellbeing of 5 or below? How are your findings different from the findings for the UK that we saw in the exercise of Chapter 1?
- iii) Calculate correlation coefficients between the variables below. What, if anything, do they suggest?
- wellbeing
 - GDP per capita (log)
 - social support
 - healthy life expectancy at birth
 - freedom to make life choices
 - generosity
 - perceptions of corruption

Chapter 9

1. Use the dataset adapted from the randomised controlled trial of the “Exploring What Matters” course. This course is a social-psychological intervention rooted in positive psychology and it is aimed at raising the wellbeing and pro-sociality of the general adult population. The dataset is based on Krekel et al. (2021). (It is adapted so you will not get exactly the same estimates.) *The dataset is available at the book page, chapter9.dta.*
 - i. Estimate average scores of Life Satisfaction, PHQ-9 (Depression), GAD-7 (Anxiety) and Social Trust in the treatment and control groups at three points in time: before treatment ($t = 0$), after the treatment group received the treatment ($t = 1$), after the control group received the treatment ($t = 2$). (Similar to Figure 2 from the paper).
 - ii. Estimate the impact of the course on the same outcomes, each outcome being standardised. Use the data from $t = 0$ and $t = 1$ (Similar to Figure 3 from the paper).

Source: Krekel, C., De Neve, J.-E., Fancourt, D., & Layard, R. (2021). A Local Community Course That Raises Wellbeing and Pro-Sociality: Evidence From a Randomised Controlled Trial. *Journal of Economic Behavior & Organization*.

Chapter 10

1. Use the data on a hypothetical RCT that studies the effect of psychological therapies. *The dataset is available at the book page, chapter10.dta.*

The study includes 40 patients diagnosed with anxiety disorders. The patients were divided into the treatment group (20 patients) and the control group (20 patients). The patients in the treatment group were given 1 therapy session per week for 8 weeks. The patients in the control group were allocated in the waitlist for 8 weeks and received therapy after the end of the study.

In the dataset, the treatment indicator takes the value of 1 for the patients in the treatment group and zero otherwise. We have information on patient's age and the duration of their symptoms in months.

If a patient recovered by the end of the 8-week study, the recovery indicator takes the value of 1. It takes the value of zero otherwise.

- i. Check if the treatment and the control groups are balanced in terms of the patients characteristics (age and symptoms duration).
- ii. What is the recovery rate in the treatment and the control group?
- iii. Use linear regression to estimate the treatment effect of the psychological therapy in a given study with no controls. Is the study effective? How does the effect size correspond to your results above?
- iv. Include individual controls in the regression. What can you conclude?

Chapter 11

1. Consider the following equation

$$W_{ir} = -0.71 \text{Unemployed}_{ir} - 1.38 U_r + \text{etc}$$

where Unemployed_{ir} is a 0/1 dummy for being unemployed and U_r is the proportion of people unemployed in the individual's region. If the unemployment rate in region r rises from 5% to 15%, how does average wellbeing in the region change?

2. Consider a family with two full-time working parents and a teenage child. Now assume that one of the parents becomes unemployed for two years and finds a new job after. Calculate the loss of the total wellbeing of the family over 5 years starting from the job loss of one of the parents. Assume that on a 0 to 10-point scale:
 - i) Being unemployed decreases individual wellbeing by 1 point with no adaptation
 - ii) Parental unemployment decreases child's wellbeing by 0.5 points
 - iii) Partner's unemployment decreases the wellbeing of another partner by 0.3 points

- iv) For each year that a person had been unemployed in the previous five years, they are on average 0.1 points less happy

Chapter 12

1. Consider the following equation adapted from De Neve (2018)

$$JS_i = 6.13 + 0.13 * pay_i - 0.11 * wlb_i + 0.07 * secur_i + 0.27 * intr_i$$

where JS_i is predicted job satisfaction of the employee i on the scale from 0 to 10 in a job with the following characteristics: pay_i is their pay, wlb_i is work-life imbalance, $secur_i$ is job security, $intr_i$ measures how interesting their job is. All independent variables are standardised to have mean of 0 and standard deviation of 1.

- i) Interpret the coefficients of the model.
- ii) Imagine an employee, for whom all independent variables take the value of 0, which is the average in the dataset. What level of job satisfaction does the model predict for this employee?
- iii) Now assume that they consider changing the job to a position which offers 1 standard deviation lower pay and job security. The new position is also 1 standard deviation more interesting. What level of job satisfaction does the model predict now? Would you recommend them changing the job?

Chapter 13

1. The diminishing marginal utility of income

- i) Suppose there are 2 people and, in the initial distribution of daily income (Y), person A has 1 unit of income and person B has 2.718 units of income ($2.718=e$).

In addition $W_i = 7 + 0.3 \log_e Y_i$.

What is the initial value of average wellbeing? And what is the marginal utility of income for A and for B?

- ii) Now, following a revolution, the national income is unchanged, but A and B now have the same income. What is average wellbeing?

2. Social comparisons and adaptation

Consider the following equation

$$W_{it} = a_0 + 0.19 \log Y_{it} - 0.12 \log \bar{Y}_{it} - 0.08 \log Y_{i,t-1}$$

where Y_{it} is the income of individual i at time t and \bar{Y}_{it} is the comparator income of individual i at time t .

How would average wellbeing respond to persistent economic growth?

3. Policy implications of social comparisons

Suppose the hourly wage rate is unity for all workers and weekly wellbeing of the i^{th} worker is

$$W_i = a_1 \log (H_i(1 - t) + t\bar{H}) - a_2 \log \bar{H} - C(H_i)$$

where H is hours worked per week, t is the tax rate, and there are N workers.

- i) What equation determines how long the i^{th} worker works?
- ii) In equilibrium H_i will equal \bar{H} . So what equation determines the social optimum level of hours (where $H_i = \bar{H}$)
- iii) What is the optimal rate of tax?

4. Use the dataset on the average country-level wellbeing around the world adapted from the World Happiness report. The dataset is based on the Gallup World Poll. The dataset is available at the book page, *chapter8.dta*.

- i) Create a scatter plot of life ladder and GDP per capita for all countries in 2015. Present countries by regions. Do you notice any countries or regions that stand out or do not align with the general trend?
- ii) Create longitudinal graphs of changes in GDP per capita and wellbeing for the following countries: Canada, China, Denmark, Egypt, Georgia, Mexico, India, Spain, Sweden, Turkey, United Kingdom, and United States.

Chapter 14

1. Assume a world with only two countries A and B:

	Population, Million people	Average wellbeing (0 to 10 scale)
Country A	250	5
Country B	80	7.5

- i) What is the global average wellbeing in this world?
- ii) Now assume that 10 million people from Country A immigrated to Country B. We know that the wellbeing of immigrants is likely to converge to the wellbeing of the local population. Assume that the wellbeing of the residents of country A and country B is not affected. What is the level of global average happiness now? Is migration beneficial for this world overall from the wellbeing perspective?

Chapter 15

Suppose we have to choose between two types of electricity generation. The (hypothetical) costs of supplying electricity are

	Capital cost Per kilowatt	Current cost Per kilowatt hour (including cost of carbon)
Nuclear	\$10,000	\$0.02
Gas	\$1,000	\$0.08

Suppose both sources would supply electricity for 5,000 hours per year, and both can work indefinitely:

- i) Which method is preferable at a discount rate of 5% per year?
- ii) Which is preferable at a discount rate of 1% per year?

Hint: The present value of the perpetual flow of costs is equal to C/δ , where C is an annual cost and δ is the discount rate per year.

Chapter 16

Use the dataset from the World Happiness report on the average country-level wellbeing around the world. The dataset is based on the Gallup World Poll. *The dataset is available at the book page, chapter8.dta.*

- i) Run a multiple regression of wellbeing on the variables below. What are your findings?
GDP per capita (log)
social support
healthy life expectancy at birth
freedom to make life choices

- generosity
- perceptions of corruption
- ii) Choose one country and plot a time series of wellbeing (left axis) and the time series of the variables below (right axis):
- GDP per capita (log)
- healthy life expectancy at birth
- social support, freedom to make life choices, generosity, perceptions of corruption.
- iii) Run the same regression as in point iv) including country and year fixed effects. How does this change the results are why? Why one might want to include fixed effects.
- iv) Do you expect the results to be the same in different regions of the world? Run the fixed effects regression again, but this time separately for all five world regions. Are the results different or similar?

Chapter 17

1. Revise your understanding of Figure 17.4 adapted from Ward (2020). What does it represent?
2. Ward (2020) estimates a multivariate regression model which includes the four indicators simultaneously. The model uses cabinet vote share as the dependent variable. The estimates of the indicators' coefficients and their standard errors are presented below

	Cabinet vote share
National happiness	6.13**
	(2.82)
GDP growth rate	2.85**
	(1.25)
Unemployment rate	0.04
	(1.24)

Inflation rate	1.96
	(1.48)

Note: The sample is a panel of 15 European countries, 1973–2014. The outcome is the percentage vote share of the incumbent government, lying between 0 and 100. Independent variables are standardised by subtracting the mean and dividing by the standard deviation. The resulting variables have mean = 0 and SD = 1. * $p < .1$, ** $p < .05$, *** $p < .01$.

Interpret the coefficient on National happiness. Why one might want to use multivariate regression to complement the results presented in Figure 17.4.

Chapter 18

Calculate the cost-effectiveness of Healthy Minds (see Chapter 9) i.e. the ratio of total WELLBY gains per £ of cost. Use the following simplified data.

- Change in average life-satisfaction (0-10) at end of 4-year course = 0.37
- Change in average life-satisfaction halfway through = 0.3
- Cost of training a teacher to teach course = £6,300
- Cost of materials per student = £30

Each teacher teaches 90 students. (You will need to make some assumption about the time profile of wellbeing gains).

Note that British National Health Service approves all treatments that provide more than 1/10,000 WELLBYs per £.