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Optimal mapping of differing life satisfaction scales

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Access to the data used in this study was provided by Stats NZ under conditions designed to give effect to the security and confidentiality provisions of the Data and Statistics Act 2022. The results presented in this study are the work of the author, not Stats NZ or individual data suppliers.

These results are not official statistics. They have been created for research purposes from the Integrated Data Infrastructure which is carefully managed by Stats NZ. For more information about the IDI please visit https://www.stats.govt.nz/integrated-data/.

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Abstract

We present a distributional matching approach to harmonise life satisfaction scores collected on different scales. We apply the method to two concurrent official New Zealand surveys, one with an 11-point scale and one with a 5-point scale. The optimal mapping from the 11-point to the 5-point scale, which minimises the residuals, is: 0-2 (1), 3-4 (2), 5-6 (3), 7-8 (4), and 9-10 (5). This mapping holds for most subsample populations, with exceptions observed among more marginalised groups.

JEL codes

I31 General welfare, Well-being

Keywords

Life satisfaction scales; mapping; ordinal data

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1 Introduction

Subjective wellbeing is a valuable measure of human flourishing (Diener, 2009; Clark, 2018). However, variations in its definition and measurement present a challenge for policy applications. Within the economics literature, studies of life satisfaction have variously used a 4-point scale (Easterlin, 1974), a 5-point scale (Carver and Grimes, 2019), a 7-point scale (Powdthavee and Van Den Berg, 2011), a 10-point scale (Voerman-Tam et al., 2023) and an 11-point scale (Helliwell et al., 2013); OECD (2013) recommends the 11-point scale. Comparing findings across studies requires reconciling results from different scales. Although, normalisation methods are commonly applied to address scale differences (e.g. Veenhoven, 1993), these methods risk distorting the interpretability of data if formulated only heuristically.

In response to this challenge, we propose a rigorous method for harmonising life satisfaction (and other ordinal scale) scores which respects the ordinality of the data. The approach allocates scores from the more differentiated scale (e.g. an 11-point scale) to a less differentiated scale, aligning (as much as possible) the relative distribution of scores. We apply the method to two concurrent, nationally representative Statistics New Zealand (Stats NZ) surveys, one using a 5-point scale and the other an 11-point scale. Both surveys achieve response rates exceeding 80%. To evaluate the robustness of this method, we further apply it to various population subsamples.

2 Data

We use confidential microdata from the Integrated Data Infrastructure (IDI), hosted by Stats NZ. Our sample includes three waves (2014, 2016, 2018) of the Household Economic Survey (HES) and of the General Social Survey (GSS). These surveys overlap during a 9-month collection period, capturing responses from 21,708 HES participants and 18,537 GSS participants.

Both surveys are representative of the New Zealand adult population, so demographic characteristics are very similar: the average age is 50.3 years (in each survey), with 56% (HES) and 55% (GSS) identifying as female. Most respondents identify as European/Pākehā (73% in HES, 76% in GSS). Further descriptive statistics are included in Table 1. The near-identical composition of survey populations, combined with the concurrent data collection periods, effectively controls for temporal and demographic factors.

Table 1: Descriptive Statistics

Sample	Full Dataset	HES	GSS
Full Sample	40,245	21,708	18,537
2014 Wave	0.26	0.18	0.34
2016 Wave	0.21	0.12	0.30
2018 Wave	0.54	0.69	0.35
Demographic Subsamples			
Gender			
Male	0.45	0.44	0.45
Female	0.55	0.56	0.55
Age			
18-29	0.15	0.15	0.14
30-49	0.35	0.34	0.36
50-65	0.26	0.26	0.26
65+	0.25	0.25	0.24
Ethnicity			
European	0.74	0.73	0.76
Māori	0.15	0.17	0.13
Pacific	0.06	0.06	0.06
Asian	0.10	0.10	0.10
Other Ethnicity	0.03	0.03	0.03
Employment Status			
Employed	0.64	0.64	0.65
Not in Labour force	0.33	0.33	0.32
Unemployed	0.03	0.03	0.03
Employed Part time or Full time			
Employed Full Time	0.79	0.79	0.78
Employed Part Time	0.20	0.20	0.21
Education			
No qualification	0.20	0.21	0.18
Certificate	0.40	0.39	0.42
Diploma	0.15	0.16	0.13
Bachelor's Degree	0.13	0.13	0.13
Post Graduate Degree	0.10	0.10	0.11
Annual Household Income			
<$30,000	0.18	0.17	0.20
$30,001-$70,000	0.30	0.30	0.31
$70,001-$150,000	0.17	0.17	0.18
> $150,000	0.34	0.37	0.32

Life Satisfaction is measured on an 11-point scale in the GSS, where 0 represents "completely dissatisfied" and 10 "completely satisfied". The HES uses a 5-point scale: 1 ("completely

dissatisfied"), 2 ("dissatisfied"), 3 ("neither satisfied nor dissatisfied"), 4 ("satisfied"), 5 ("completely satisfied"). Mean life satisfaction is 4.02 in the HES and 7.7 in the GSS.

3 Empirical Analysis

To align the HES and GSS scales, we employ a distributional matching approach. For each possible score combination (SHES, SGSS), we calculate the difference between their cumulative distribution probabilities:

$$r_{hg} = | F_{HES}(S_{HES}) - F_{GSS}(S_{GSS}) |$$

Here, $F_{HES}(S_{HES})$ and $F_{GSS}(S_{GSS})$ are the cumulative probabilities for scores in the HES and GSS distribution, respectively. The optimal mapping, r^*_{hg}, is the mapping that minimises r_{hg}.

This approach allows us to map the GSS scale onto the HES scale, aligning (to the greatest degree possible) the relative positioning of scores in their respective distributions. The process ensures a robust and interpretable comparison between life satisfaction measures reported on different scales that respects the ordinality of each scale. We apply this method to: (i) the full (unweighted) sample, (ii) individual survey waves, and (iii) key demographic and socioeconomic subsamples. Subsamples are chosen according to age, education, gender, ethnicity, employment status, and household income; each subsample comprises at least 1,000 observations.

4 Results

The optimal full sample mapping, $r^*_{hg}(full\ sample)$, from the (11-point) GSS scale to the (5-point) HES scale is:

- 0-2 → (1)
- 3-4 → (2)
- 5-6 → (3)
- 7-8 → (4)
- 9-10 → (5)

Applying this mapping across the full sample (including all three waves) results in r^*_{hg}=3.2%; i.e. the sum of the difference in cumulative distributions at each point in the scale comprises 3.2% of the sample. Figure 1 presents cumulative distributions for the actual (full sample) HES 5-point scale and for the optimal (full sample) mapping of the 11-point GSS to a 5-point scale, showing the close mapping for the full samples.

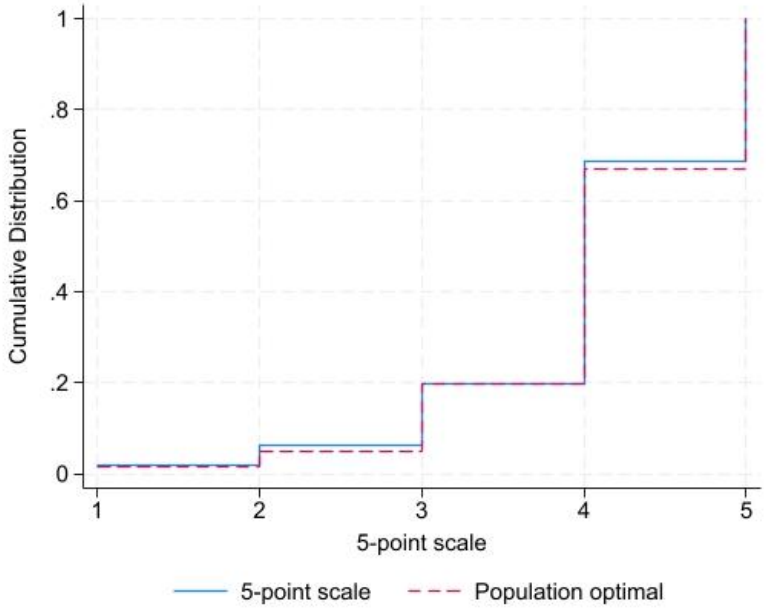

Figure 1: Full sample, optimal mapping of 11-point GSS life satisfaction to 5-point scale

Table 2 summarises results for the full sample and for each subsample. Column 2 shows the sample size for each case. Column 3 reports r_{hg} for each (sub)sample when the optimal full sample mapping is used; values range from 2.1% (for the 2018 wave) to 21.0% (for the Pacific subsample).

The optimal mapping for some subsamples differs from the full sample optimal mapping. Entries in column 4 indicate when $r^*_{hg}(full\ sample)$ is not the best fit for the specific subsample, with the best mapping included for that specific subsample. In these cases, column 5 presents r_{hg} calculated using the optimal subsample mapping. Blank cells in columns 4 and 5 indicate that the full sample optimal mapping is optimal for that subsample.

For most subsamples, the optimal score mapping mirrors that of the full sample or, when it differs, results in only marginally higher residuals compared to the full sample mapping. However, for several more marginalised groups (older individuals, Pacific, Asian or other ethnicity, not in the labour force, less educated, or low income), the full sample optimal mapping no longer holds. For most of these cases, only the top step in the 11-point GSS scale maps to the top step of the 5-point HES scale, with other minor adjustments according to the specific subsample. Consistent with this pattern, Joshanloo (2014) reports that people from Asian and other non-Western cultures are more likely to prioritise contentment over satisfaction. This philosophical approach to life reduces the likelihood that even a highly satisfied respondent will select the highest point on a life satisfaction scale, irrespective of whether the scale be a 5-point

or an 11-point scale. Instead, such a respondent may rate themselves as a 9 on a 0-10 scale and a 4 on a 1-5 scale; a Western respondent, by contrast, may rate themselves as a 9 and as a 5, respectively.

Table 2: Residuals and Optimal Mappings of GSS 11-point scale to 5-point scale

Sample	Sample size	r_{hg} using full sample optimal mapping	Full sample optimal mapping & subsample optimal mapping (if different)	r_{hg} using subsample optimal mapping
Full Sample	**40,245**	**3.2%**	**0-2 (1), 3-4 (2), 5-6 (3), 7-8 (4), 9-10 (5)**	
Survey wave				
2014	10,335	7.9%		
2016	8,349	5.2%	0-3 (1), 4 (2), 5-6 (3), 7-8 (4), 9-10 (5)	5.1%
2018	21,561	2.1%		
Sex				
Female	22,281	3.8%		
Male	17,961	3.3%		
Age				
18-29	5,946	9.3%	0-3 (1), 4 (2), 5-6 (3), 7-8 (4), 9-10 (5)	8.8%
30-49	14,001	4.8%		
50-65	10,386	4.4%		
65+	9,912	12.8%	0-2 (1), 3-4 (2), 5-6 (3), 7-9 (4), 10 (5)	10.1%
Ethnicity				
European	29,850	3.0%		
Māori	6,129	7.8%		
Pacific	2,334	21.0%	0-3 (1), 4 (2), 5-6 (3), 7-9 (4), 10 (5)	8.1%
Asian	4,008	12.2%	0-1 (1), 2-4 (2), 5-6 (3), 7-9 (4), 10 (5)	4.0%
Other Ethnicity	1,170	5.1%	0-2 (1), 3-4 (2), 5 (3), 6-8 (4), 9-10 (5)	4.1%
Employment Status				
Employed FT	20,379	3.4%		
Employed PT	5,271	2.6%		
Not in Labour force	13,077	11.3%	0-2 (1), 3-4 (2), 5-6 (3), 7-9 (4), 10 (5)	9.0%
Unemployed	1,236	15.3%		
Education				
No qualification	8,052	15.1%	0-2 (1), 3-4 (2), 5-6 (3), 7-9 (4), 10 (5)	3.6%
Certificate	16,083	5.0%		
Diploma	5,931	3.9%		
Bachelor's Degree	5,259	5.8%		
Post Graduate Degree	4,209	9.0%		

Annual Household Income				
<$30,000	7,335	14.6%	0-2 (1), 3-4 (2), 5-6 (3), 7-9 (4), 10 (5)	5.4%
$30,001-$70,000	12,105	9.2%		
$70,001-$150,000	6,948	6.8%		
> $150,000	13,851	7.5%		

5 Conclusion

Using two official representative surveys of the adult population, conducted concurrently and including a question on life satisfaction - but with different scales -we identify an optimal mapping from an 11-point to a 5-point life satisfaction scale. The lowest three scores on the 11-point scale map to the lowest score on the 5-point scale, with each subsequent pair of points from the 11-point scale mapping to the 5-point scale. For the full sample, the mapping is highly accurate, with only 3.2% of observations deviating from expected alignment. However, the mapping is less precise for more marginalised populations, particularly those from Asian and Pacific cultures. This may reflect cultural differences in response patterns, including a possible reluctance among some non-Western or more marginalised groups to respond that they are at the highest step on any given scale.

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