Testing the U-shaped Evolution of Satisfaction along Life with Sequence Analysis Tools

Gilbert Ritschard

Institute of Demography and Socioeconomics, University of Geneva
http://traminer.unige.ch

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Outline

1. Introduction
2. SHP trajectories of life satisfaction
3. Visualizing with Self-Organizing-Map (SOM)
4. Conclusion
5. References

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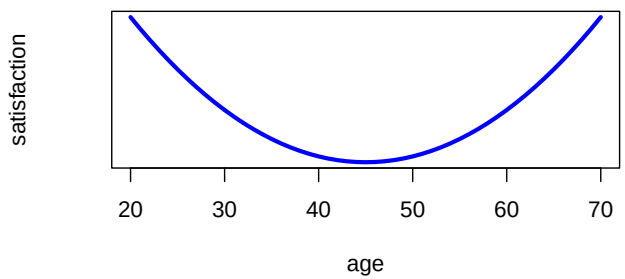
Aim of presentation

- Illustrate usage of recently developed sequence quality indicators taking undesirableness of states into account: degradation, badness, insecurity (Ritschard, 2023)
- Checking assumption of U-shape evolution of satisfaction along the life course (Blanchflower and Oswald, 2008; Frijters and Beatton, 2012)



- Using SHP data about life satisfaction in general

U-shape Assumption of Satisfaction Evolution

(Blanchflower and Oswald, 2008; Frijters and Beatton, 2012)

- U-shape assumption, generally studied by means of multilevel regression, is a controversial issue. For example:
  - Blanchflower and Oswald (2008) and Graham and Ruiz Pozuelo (2017) confirm U-shape.
  - Diener et al. (1999) assert flat (no trend) evolution.
- Bartram (2021) asserts that conclusions of tenants of U-shape assumption result from incorrect choice of control variables:
  - Only confounding variables (causally prior to dependent and core independent variables) should be used.
  - Tenants of U-shape use non-confounding variables such as income and marital status, which are not prior to age.
- Using only confounding variables (sex, country, birth cohort), Bartram founds only a very light post-middle-age increase in satisfaction.

U-shape Assumption of Satisfaction Evolution

SA indicators

- Here, we do not use regression.
- Instead, we look at satisfaction trajectories using SA tools.
- Four sequence indicators of interest
  - Integrative capability (Integr): capability to integrate (reach and stay in) good satisfaction states. (Brzinsky-Fay, 2007)
  - Degradation (Degrad): tendency to have decreasing satisfaction.
  - Badness (Bad): general badness level.
  - Insecurity (Insec): tendency to complex degrading trajectory.

Sequence undesirableness indicators

Integrative capability in $s \subset \mathcal{A}$ (Brzinsky-Fay, 2007)
Sum of positions of states of interest
(time spent in state of interest if ignoring recency)

Degradation:
Difference between proportion of downward and proportion of upward transitions, each weighted by potential to integrate following spell (by length of spell after transition if ignoring recency).

Badness: Overall badness degree.
Sum of tokens, each weighted by capacity to integrate it.

Insecurity: Additive combination of sequence complexity, degradation, and undesirableness degree of initial spell

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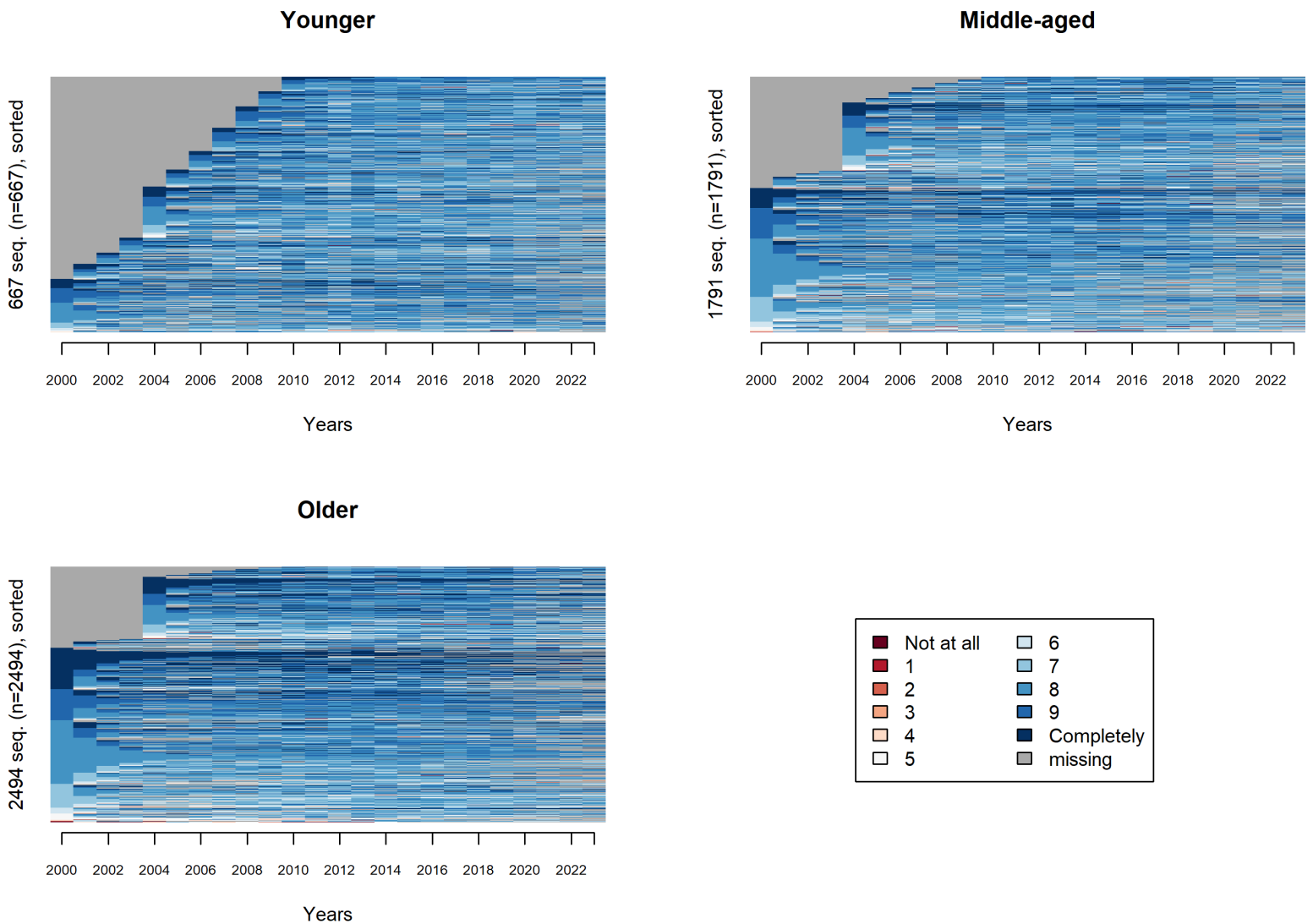
SHP life satisfaction data

Swiss household panel survey

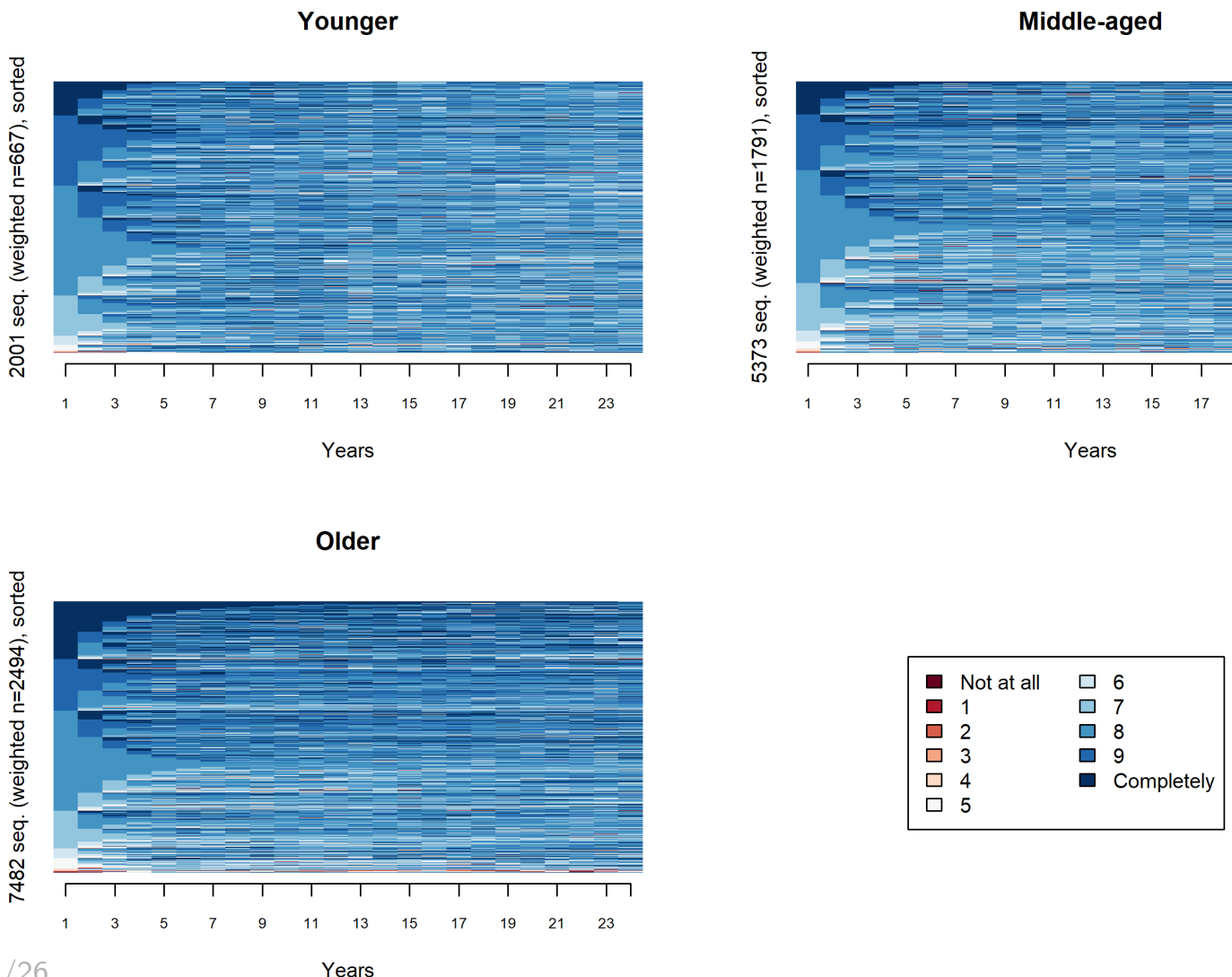
- Life satisfaction in general (P$$C44):
  - scale from 0 to 10 (11 values)
- Available from wave 2 (2000) to wave 25 (2023)
- For most individuals, data cover shorter periods
- 4952 24-years long sequences with at least 14 valid values
  - 667 youngsters (born after 1980)
  - 1791 middle-aged (born between 1961 and 1980)
  - 2494 elder (born in 1960 or earlier)

Index plots by birth cohorts



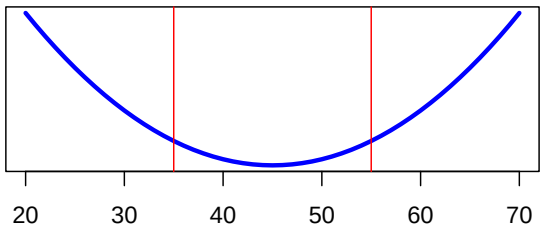
Index plots by birth cohorts after (3×)-imputation

(using seqimpute Emery et al., 2025)



U-shape Hypothesis

U-shape evolution of life satisfaction along the life



- Here we have only portions of life, but three cohorts
- Hypotheses in terms of unfavorableness indicators:
  - H1 best capability to integrate favorable satisfaction states for elder people and worst capability for middle-aged people;
  - H2 degradation of satisfaction for youngsters and improvement for elder people;
  - H3 higher badness for middle-aged persons than for youngsters and elder people;
  - H4 decreasing insecurity values across the three age-groups.

Life Satisf. trajectories: Mean unfavorableness values

	Integr	Degrad	Bad	Insec
Younger	0.29	-0.004	0.205	0.51
Middle-aged	0.28	-0.010	0.212	0.49
Older	0.36	-0.013	0.193	0.48
Young vs Middle				
t	1.11	2.222	1.762	3.41
p-value	0.13	0.013	0.039	0.00
Middle vs Old				
t	9.39	2.520	6.685	2.52
p-value	0.00	0.006	0.000	0.01

- Integr and Degrad show reversed-L shape (compatible with U-shape)
- Bad and Insec as expected in case of U-shape
- Small differences principally significant for post-middle-age (confirm findings by Bartram (2021))

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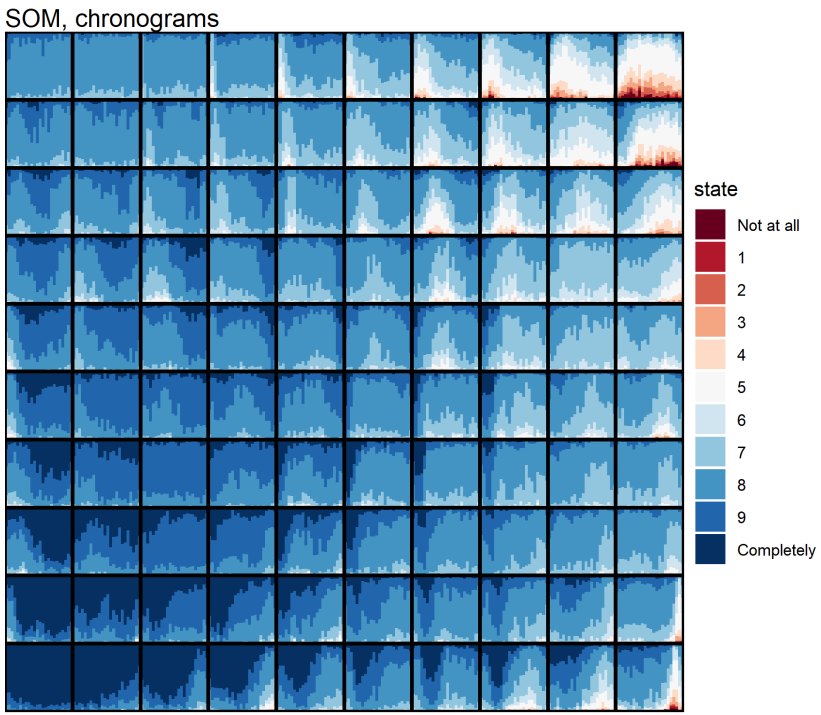
Self-Organizing-Map (SOM) of satisfaction sequences

OM with substitution costs set as level difference



Self-Organizing-Map (SOM)

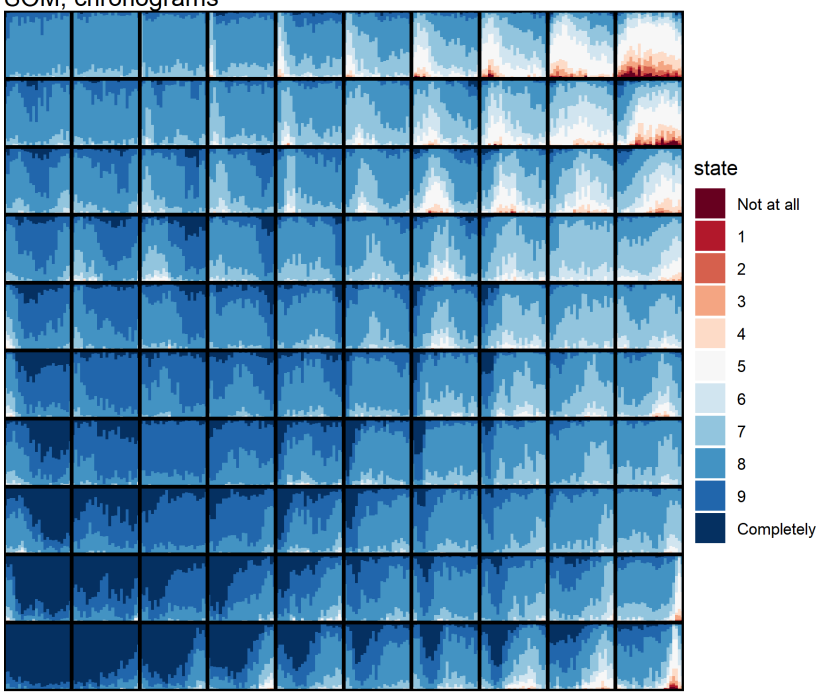
- SOM (Kohonen, 1995) clustering method that groups data into grid cells (neurons) by respecting data topological structure.
- Works like k-means but, instead of grouping around means, groups around prototypes.
- Prototypes: linear combination of all data with weights decreasing with neighboring distance.
- Weights (and prototypes) iteratively adjusted.
- At end: close cells resemble each others and distant cells have greater differences.

Own package based on SOMbrero (Vialaneix et al., 2025)

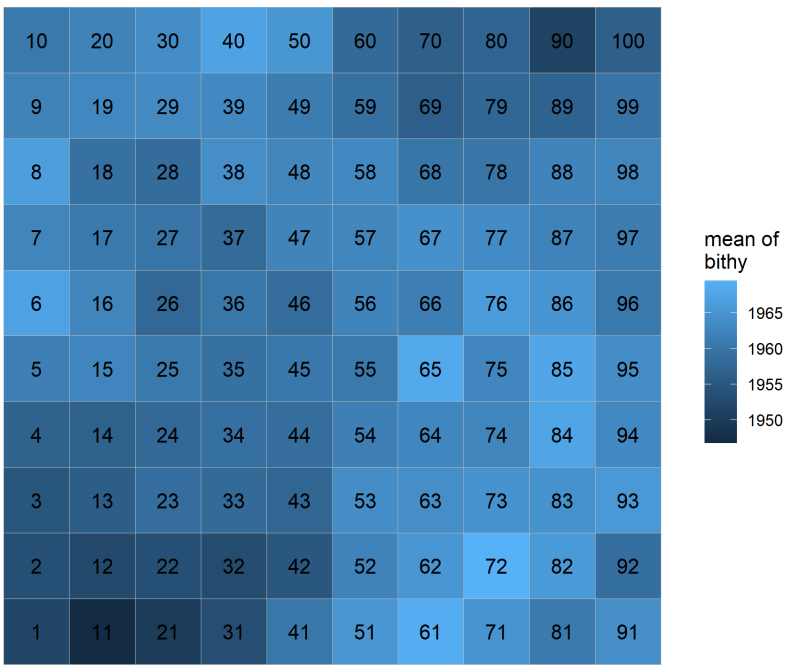
SOM of life satisfaction trajectories

Chronograms and mean birth year

SOM, chronograms

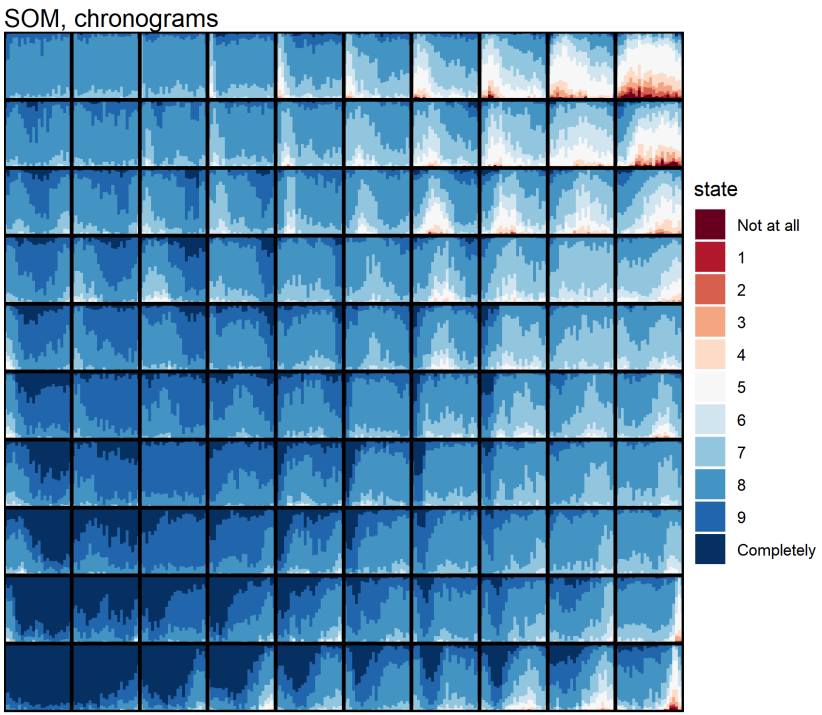


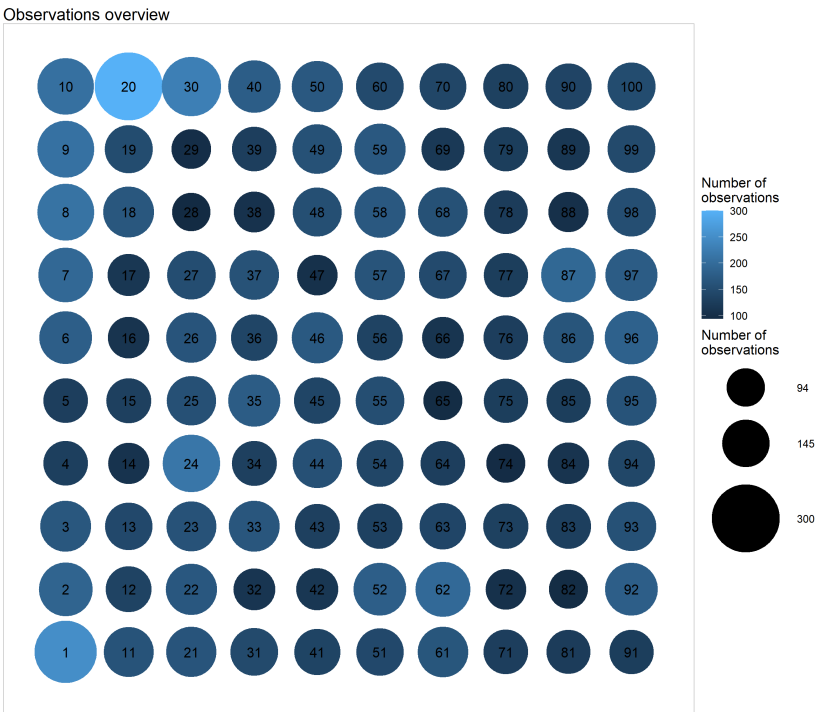
Additional variable overview



SOM of life satisfaction trajectories

Chronograms and cell size





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Conclusion

- Our (covariate-free) results weakly support the U-shape assumption:
  - small but statistically significant cohort differences.
- L-shaped form for Integr and Degrad confirm Bertram's findings.
- SOM shows that results should be nuanced: Many elders have good and improving satisfaction but most worst satisfaction trajectories also belong to older cohort.

Thank you!

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References I

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Sequence undesirableness indicators I

Integrative capability in $s \subset \mathcal{A}$ (Brzinsky-Fay, 2007)

$$I_{\text{integr}}(x, s) = \frac{\sum_{i=1}^{\ell} \text{is}(x_i \in s)\ i^{\omega}}{\sum_{i=1}^{\ell} i^{\omega}}$$

Degradation: difference between proportion of upward and proportion of downward transitions, each weighted by potential to integrate following spell.

$$I_{\text{degrad}}(x) = q^{-}(x) - q^{+}(x)$$

Badness: Overall badness degree. $\pi(s)$ undesirableness of token s normalized s.t. $\min \pi(s) = 0$ and $\max \pi(s) = 1$.

$$I_{\text{bad}}(x) = \sum_{s \in \mathcal{A}} \pi(s) I_{\text{integr}}(x, s)$$

Sequence undesirableness indicators II

Insecurity: Combines complexity and degradation

easily interpretable additive form

$$I_{\text{insec}}(x) \quad = \quad \pi(x_1) I_{\text{integr}}(x, sp(x_1)) + I_{\text{degrad}}(x) + c(x)$$

where $c(x)$ is the complexity of the sequence

(geometric mean between normalized entropy and proportion of transitions)

Gabadinho et al. (2010)