Comparing and classifying personal life courses
From time to event methods to sequence analysis

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Outline

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1 Aim of the presentation

Well-being relies on the dynamics of life courses

$\Rightarrow$ We have to analyse life courses.

Survey of possible approaches, with focus on new data-mining-based ones.

Survival Methods (Event History Analysis, Blossfeld and Rohwer (2002))

- Focus on a specific event (marriage, childbirth, starting new job, ...).
- How does the hazard of experiencing the event evolve with time and other personal characteristics?

Sequence Analysis (Holistic approach, Billari (2005))

- Focus on whole sequences of family, professional, education ... events.
- Clustering sequences (optimal matching),
- Sequencing, Characteristic subsequences and their relationships with personal characteristics.

What is data mining?

Concerned with characterization of interesting patterns

- per se (unsupervised learning)
  - Clustering
  - Frequent itemsets
  - Association rules
- for classification or prediction purposes (supervised learning)
  - Decision trees
  - Bayesian networks
  - SVM and Kernel Methods
  - CBR (case based reasoning), K-NN (k nearest neighbors)

Proceeds mainly heuristically.

Unlike statistical modeling, makes no assumptions about process generating the data.

Typology of methods for individual longitudinal data

questions	nature of data: time stamped event	nature of data: state/event sequences
descriptive	- Survival curves: Parametric (Weibull, Gompertz) and non parametric (Kaplan-Meier, Nelson-Aalen) estimators	- Optimal matching clustering - Frequencies of typical patterns - Discovering typical patterns
causality	- Hazard regression models - Survival trees	- Markov models, Mobility trees - Association rules between subsequences

2 Three examples

- Mobility trees
- Survival trees
- Characteristic sequences

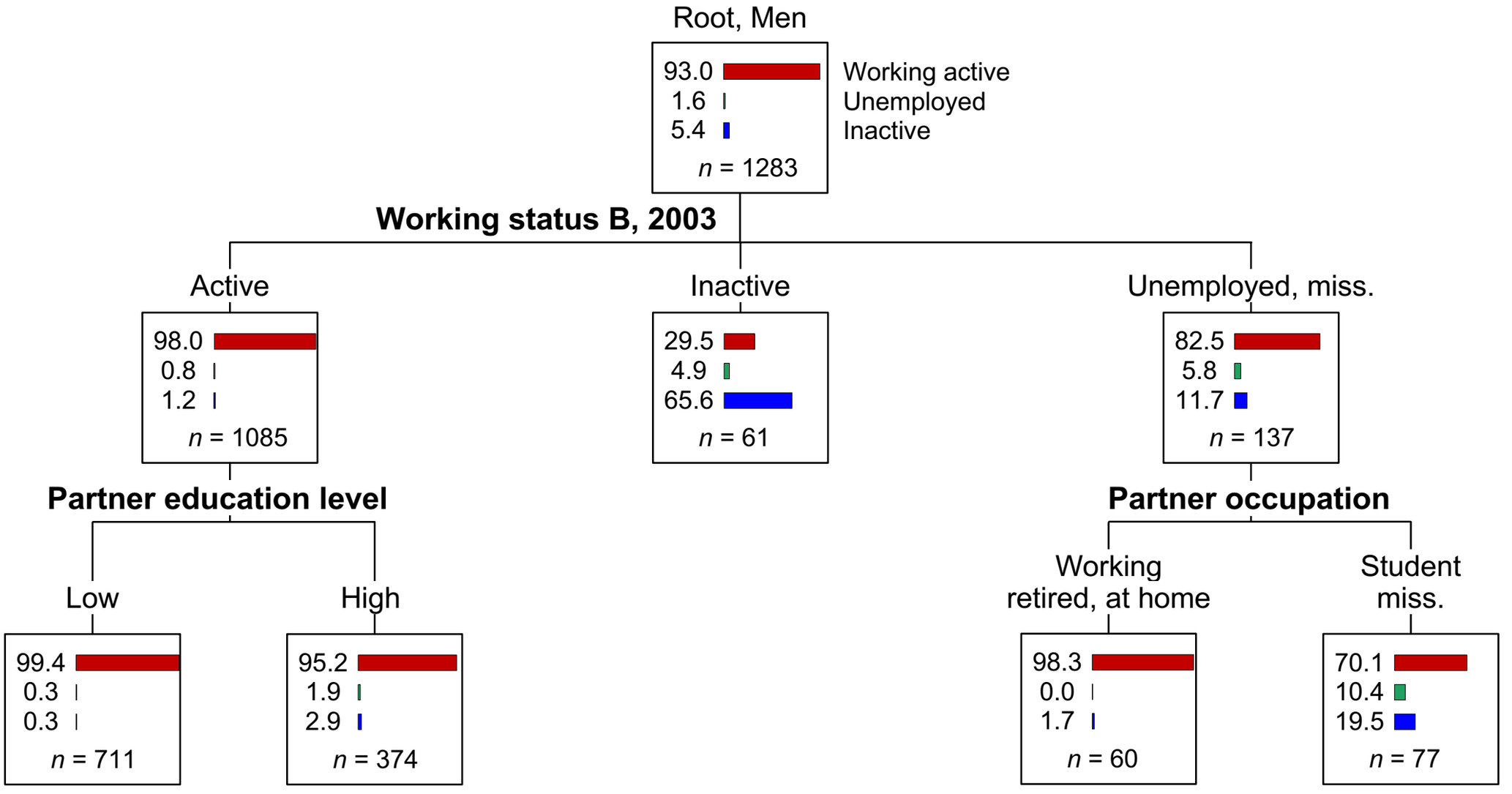
2.1 Mobility trees

- (SHP Data, Waves 1 to 6 (1999-2004), aged between 20 and 64 in 2004.)
- How does working status (occupied active, unemployed, inactive) in 2004 depend on
  - working status in previous year (1999 to 2003)
  - other factors (attained education level, partner working status, partner education level, ...)

  and what are main interaction effects?

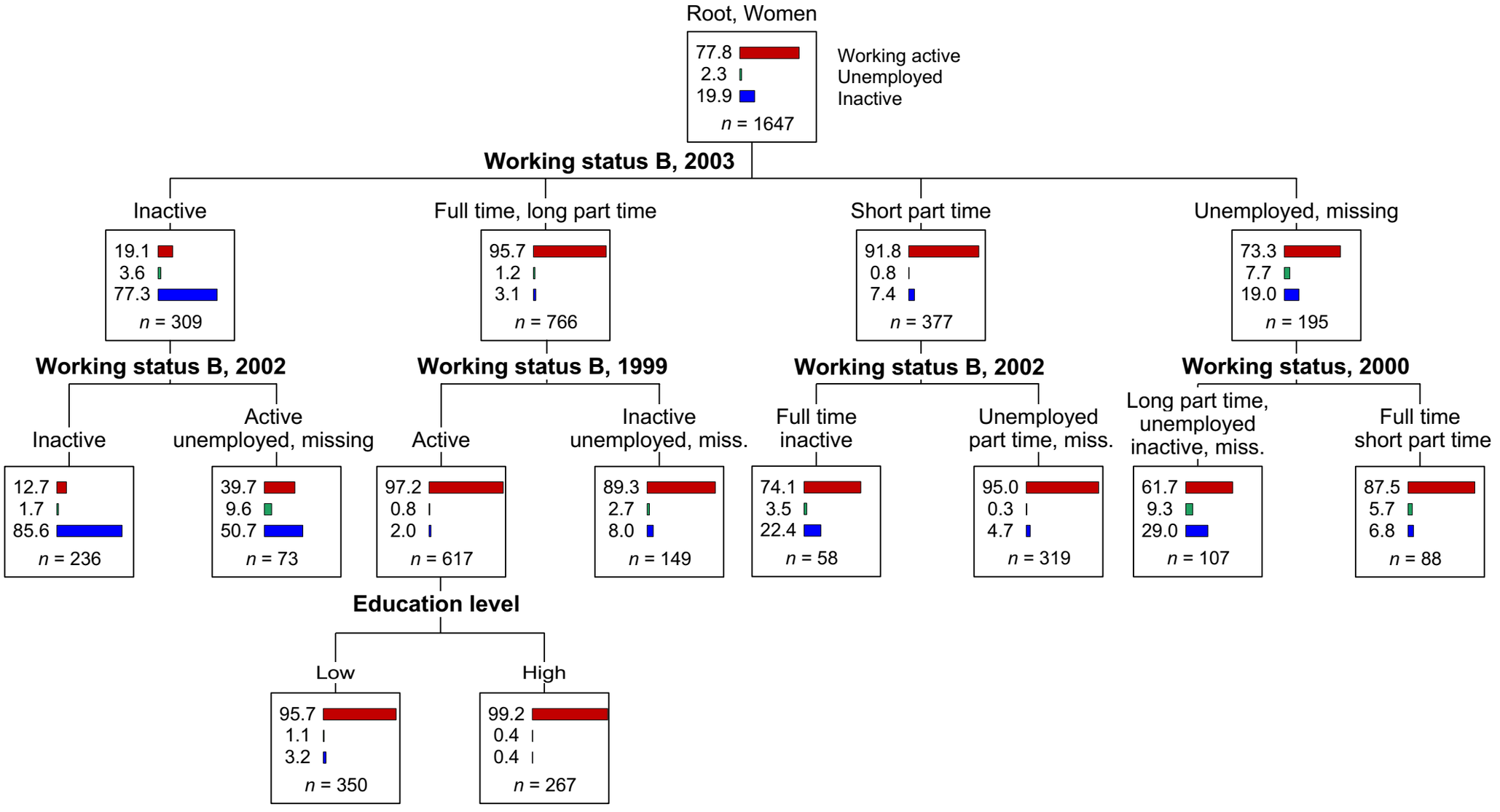
- Mobility trees are alternative to Markovian transition models.
- Growing separate classification trees for women and men highlights gender differences.

Mobility tree, Men



Working status B (full time, long part time, short part time, unemployed, inactive)

Mobility tree, Women



Working status B (full time, long part time, short part time, unemployed, inactive)

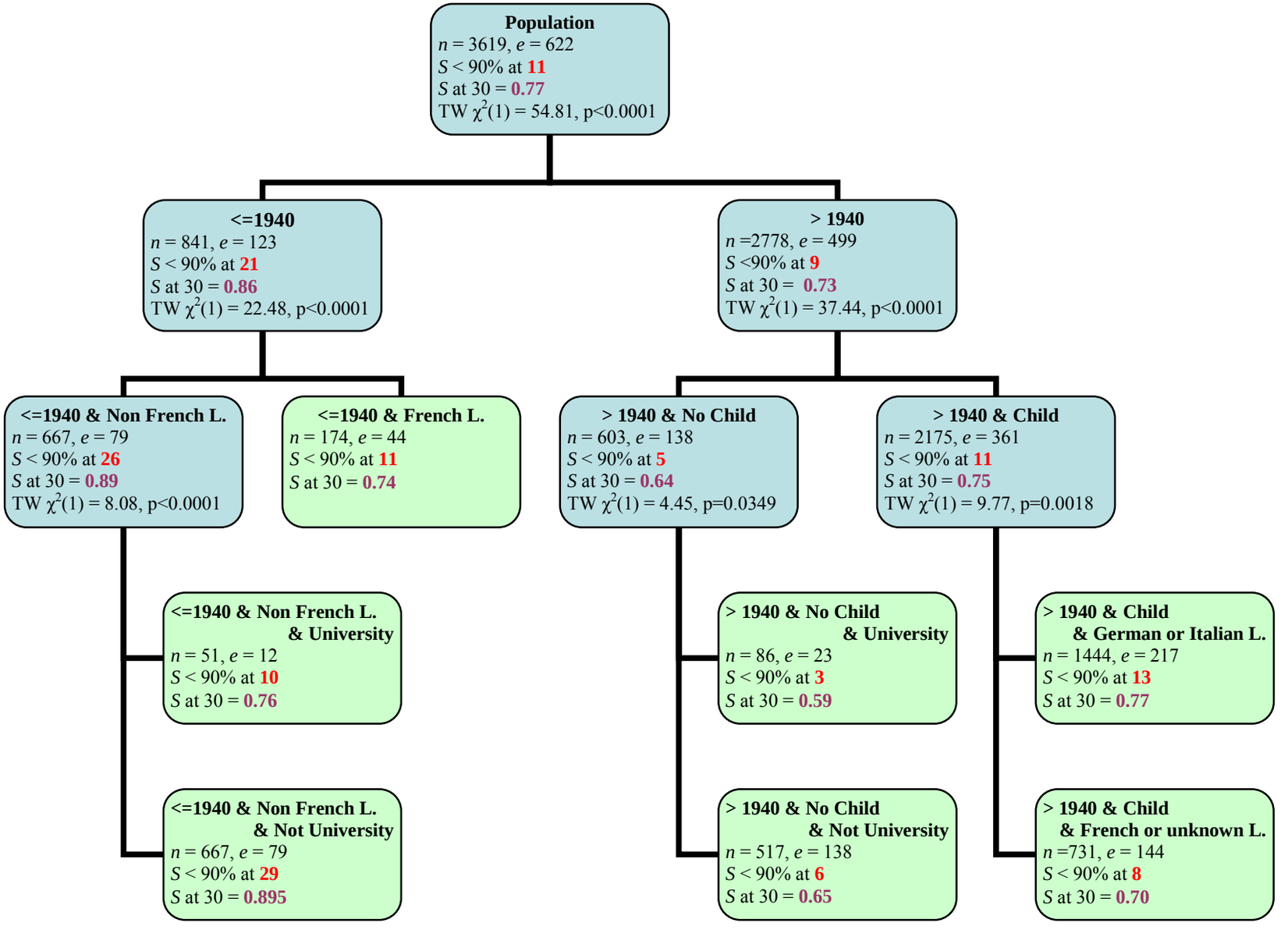
2.2 Survival trees

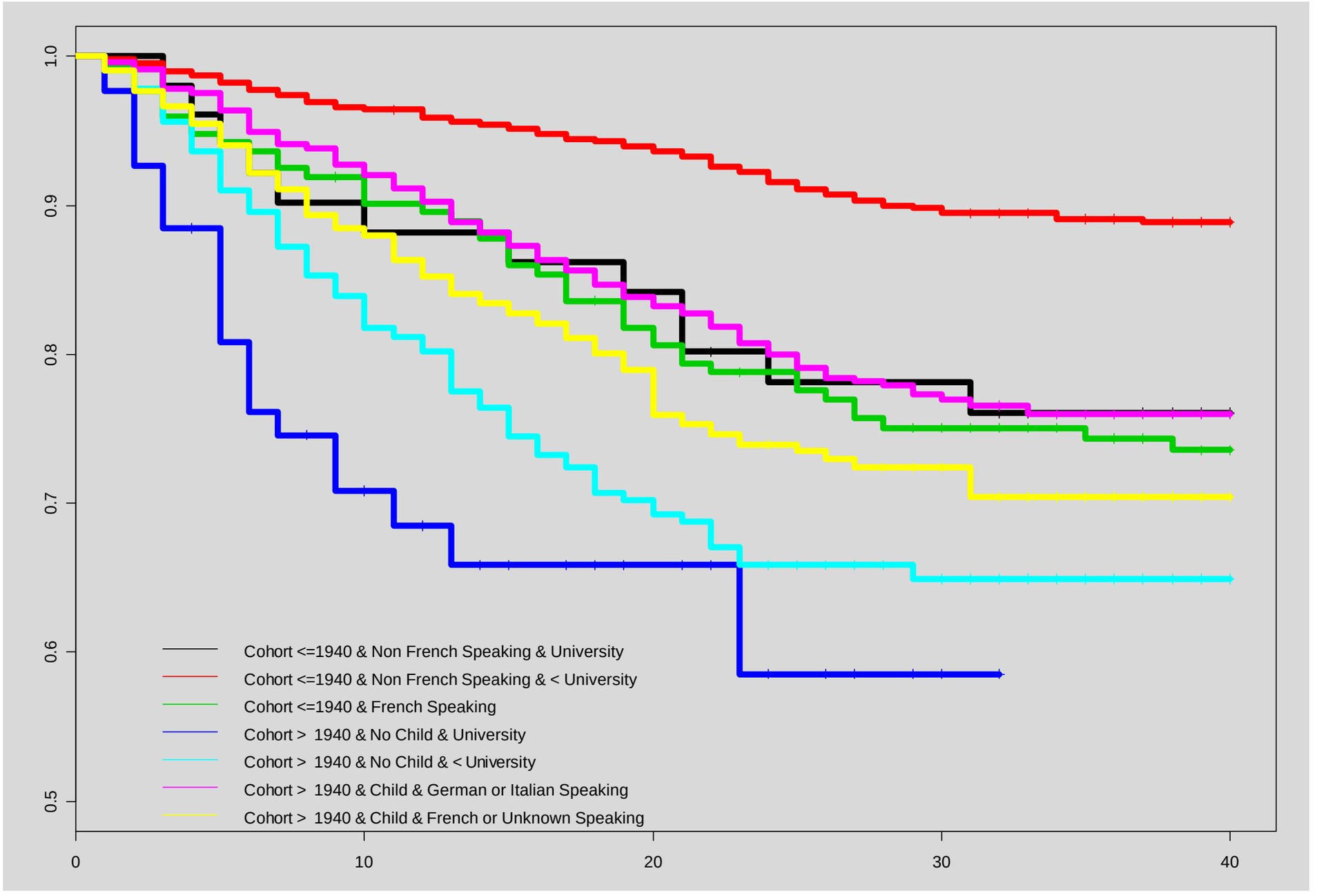
- (SHP 2002 biographical data, 2002 Wave data for some potential explanatory factors)
- Which are the most discriminating factors for marriage duration until divorce/separation?

  Used same variables as for discrete time logistic model in Ritschard and Sauvain-Dugerdil (2007)

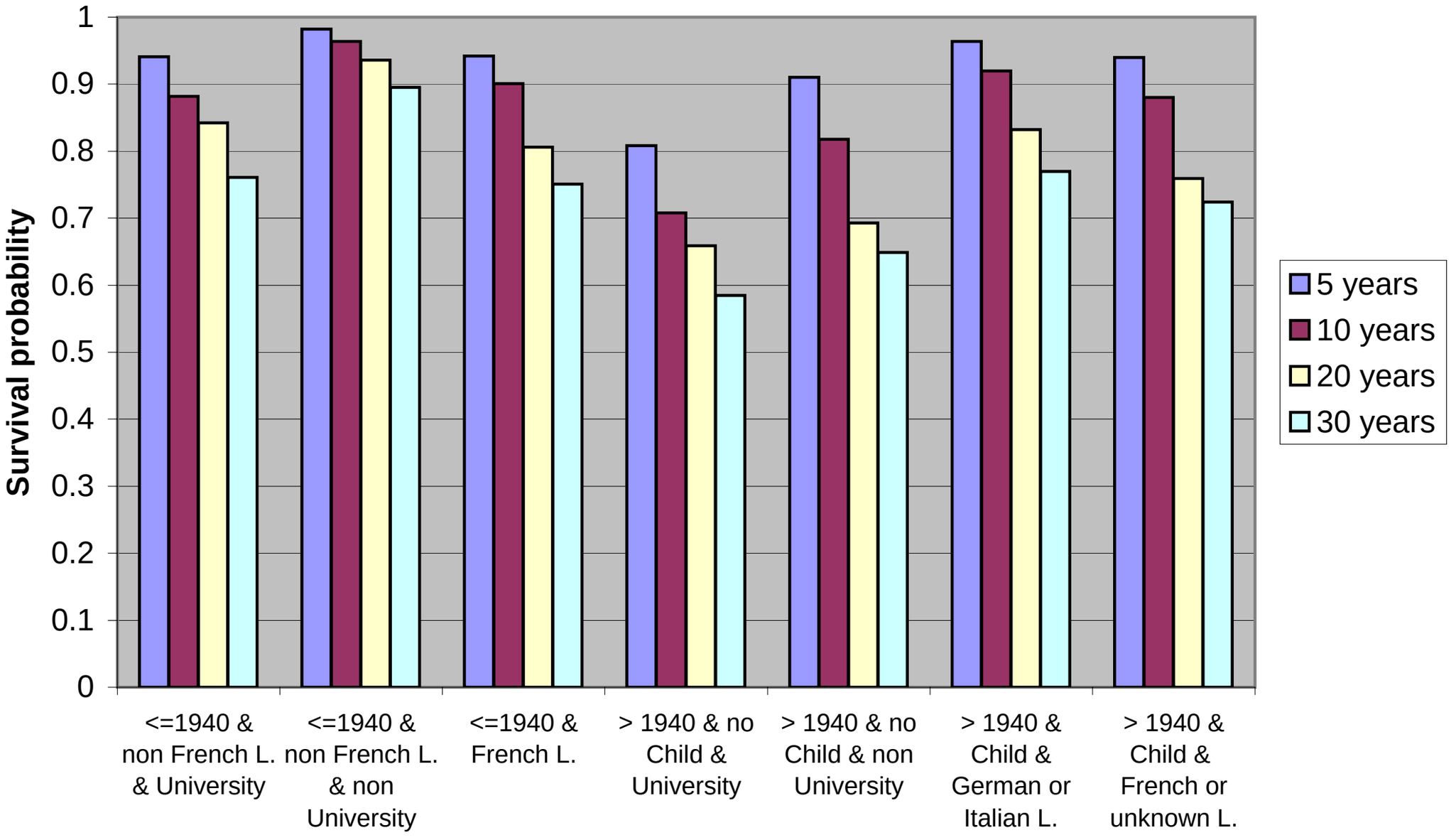
- Tried two methods
  - Maximize differences in KM survival curves using Tarone-Ware (T-W) p-value (Segal, 1988).
  - Cox regression tree: maximize differences in proportionality factors among groups (Leblanc and Crowley, 1992; Therneau and Atkinson, 1997)

T-W Survival Tree: Marriage until Divorce/Separation




1.0
0.9
0.8
0.7
0.6
0.5
0
10
20
30
40
Cohort <=1940 & Non French Speaking & University
Cohort <=1940 & Non French Speaking & < University
Cohort <=1940 & French Speaking
Cohort > 1940 & No Child & University
Cohort > 1940 & No Child & < University
Cohort > 1940 & Child & German or Italian Speaking
Cohort > 1940 & Child & French or Unknown Speaking

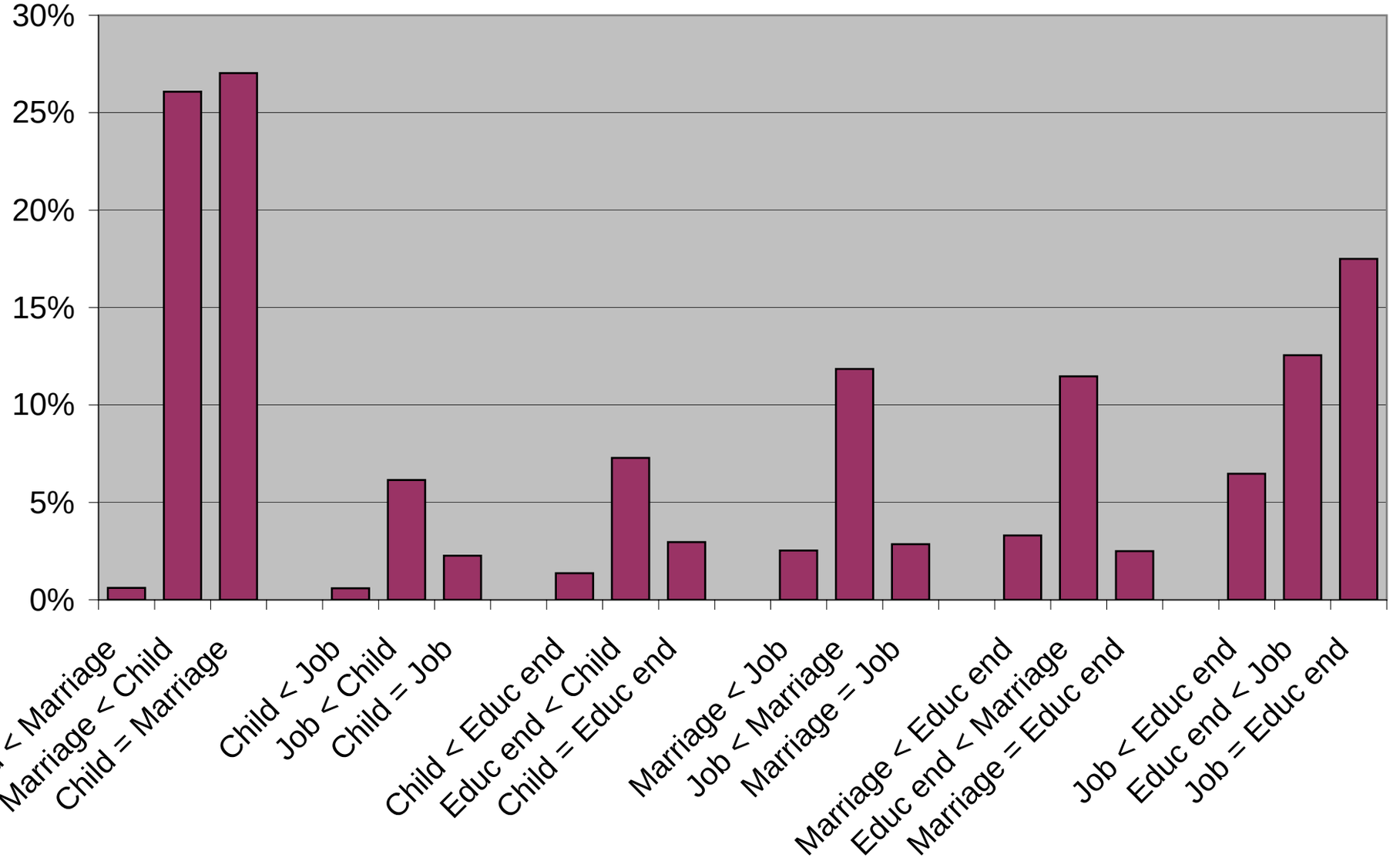
Marriage survival probabilities until Divorce/Separation, by leaves



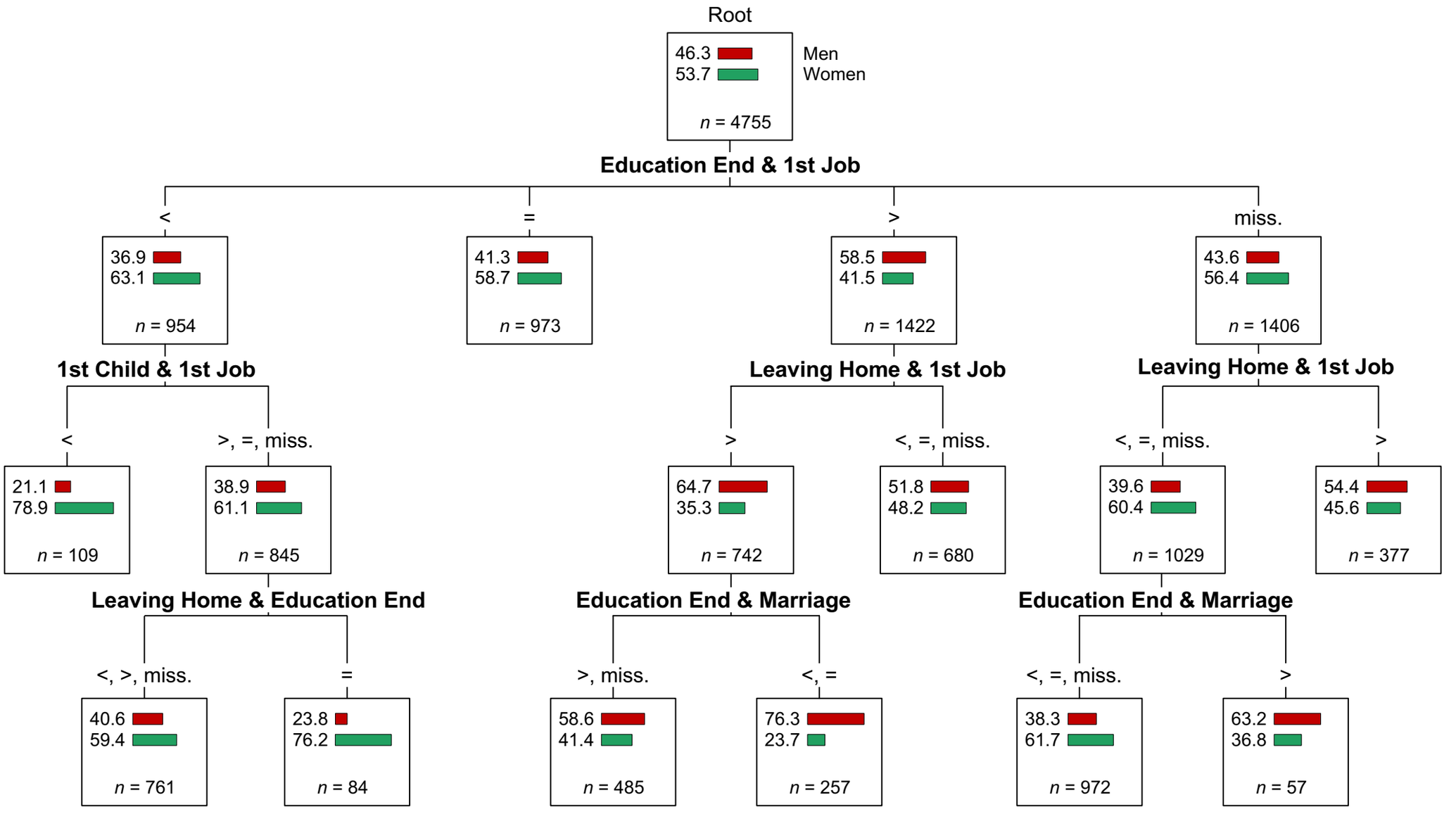
2.3 Characteristic sequences

- (SHP 2002 biographical data)
- Selection of pairs of events, e.g. marriage and first job.
- For each pair, order of sequence: $<$, $=$, $>$, missing
- Which are the most typical sequences?
- Most discriminating sequences between
  - sex
  - birth cohort (1940 and before, after 1940)

Frequencies of characteristic 2-event sequences



Discriminating sex with 2-event sequences



3 Foreseen Developments

- Extend tree approaches for
  - Time varying covariates
  - Multilevel contexts
- Mining typical sequence patterns and association rules
- Suitable validation criteria
- Friendly graphical interface for making methods easily accessible
- Analysis of Swiss life courses
  - Differential impact of various profiles of social insertion
  - Broken lives
  - ...

THANK YOU

References

Billari, F. C. (2005). Life course analysis: Two (complementary) cultures? Some reflections with examples from the analysis of transition to adulthood. In P. Ghisletta, J.-M. Le Goff, R. Levy, D. Spini, and E. Widmer (Eds.), *Towards an Interdisciplinary Perspective on the Life Course*, Advancements in Life Course Research, Vol. 10, pp. 267–288. Amsterdam: Elsevier.

Blossfeld, H.-P. and G. Rohwer (2002). *Techniques of Event History Modeling, New Approaches to Causal Analysis* (2nd ed.). Mahwah NJ: Lawrence Erlbaum.

Leblanc, M. and J. Crowley (1992). Relative risk trees for censored survival data. *Biometrics 48*, 411–425.

Ritschard, G. et C. Sauvain-Dugerdil (2007). L'enfant ciment du couple ou le couple comme ciment de la relation du père à l'enfant ? Quelques enseignements de l'enquête rétrospective du Panel Suisse de Ménages. In C. Burton-Jeangros, E. Widmer, et C. Lalive d'Epinay (Eds.), *Interactions familiales et constructions de l'intimité.*, coll. Questions sociologiques. Paris : L'Harmattan. (à paraître).

Segal, M. R. (1988). Regression trees for censored data. *Biometrics 44*, 35–47.

Therneau, T. M. and E. J. Atkinson (1997). An introduction to recursive partitioning using the rpart routines. Technical Report Series 61, Mayo Clinic, Section of Statistics, Rochester, Minnesota.