

SPR 16TH ANNUAL MEETING
PRECONFERENCE WORKSHOP III
May 27, 2008
8:30 AM – 4:30 PM

TITLE

Survival Analysis in a Latent Variable Modeling Framework

PRESENTERS

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PURPOSE

This proposed one-day workshop will present the principals of survival analysis conducted in a general latent variable modeling framework. The workshop will provide attendees with a conceptual basis for survival analysis in the discrete-time setting along with practical knowledge about basic model specification in the Mplus V5 software. Methods for including time-invariant and time-varying predictors of event time will be discussed along with extensions to multivariate event histories such as recurring events and competing risks. Issues related to modeling unobserved heterogeneity and underlying individual frailty will be explored. During the second half of the workshop, attendees will have the opportunity to learn how to translate the modeling matters above into a continuous-time setting while remaining in the same latent variable framework. The workshop will conclude with an overview of modeling extensions facilitated by conducting survival analysis in this more general framework.

It would not be realistic to expect that this workshop will singularly enable participants to conduct independent analysis in all the areas to be covered. This course is intended to give participants the knowledge and understanding necessary to identify analysis

strategies that might be most appropriate for their research questions. The course is also intended to provide a foundation for future learning about these models and resources to guide such endeavors.

Learning Objectives

Understanding:

- Appropriate research hypotheses
- Data requirements
- Model assumptions
- Model specification (in Mplus V5)
- Model estimation (in Mplus V5)
- Model inference
- Model interpretation corresponding to the following:
 - Single, non-recurring event discrete-time survival analysis without covariates
 - Single, non-recurring event discrete-time survival analysis with covariates
 - Time-varying and time-invariant covariates
 - Time-varying and time-invariant covariate effects
- Recurring events and multiple spells in discrete-time
- Competing risks in discrete-time
- Discrete-time (continuous) frailty models
- Discrete-time survival mixture models
- Single, non-recurring event continuous-time survival analysis without covariates
- Cox (proportional) hazards model
- Multivariate continuous-time survival analysis including recurring events and competing risks
- Continuous-time frailty and mixture models.

TARGET AUDIENCE

This workshop targets prevention researchers and data analysts wishing to expand their statistical modeling “toolboxes” to include survival/event-history analysis. The workshop may also be of interest to individuals who are already conversant in discrete-time and/or continuous-time survival analysis but who have not seen these models specified and estimated within a general latent variable framework.

Attendees are expected to have a strong foundation in linear and logistic regression analysis. Familiarity with structural equation modeling, latent growth curve modeling, and mixture modeling as well as experience with the Mplus software will be helpful but are not prerequisite.

MATERIALS

All attendees will be provided with hard copies of the workshop slides as well as electronic copies of the slides, input/output example files, and example data files (for publicly available data).

MAXIMUM NUMBER OF ATTENDEES

None.

AUDIO-VISUAL REQUIREMENTS

Microphone, LCD projector, and screen.

PRESENTERS' QUALIFICATIONS*

KATHERINE MASYN

Katherine Masyn received her Ph.D. in Advanced Quantitative Methods in Social Research from UCLA's Graduate School of Education in 2003 under the mentorship of Bengt Muthén, a well-recognized researcher specializing in latent variable modeling and the creator of the Mplus software. She is now an Assistant Professor in the Department of Human and Community Development at UC Davis. Her own research work focuses on discrete-time models of change, particularly event history analysis. She also works on methods utilizing latent categorical variables for the estimation of population heterogeneity, particularly latent class analysis, latent class cluster analysis, and growth mixture modeling. She has been a member of the Prevention Science Methodology Group since 1999 and is one of the founding members and current Chair of the Prevention Science Methodology Group II, established in 2004. She works with several groups of applied researchers in prevention research, public health, psychology, and education, consulting on the applications advanced latent class models. In addition to presenting at conference symposia, Dr. Masyn has appeared as an invited speaker as well as an instructor of multi-day workshops and mini-courses on topics directly related to this proposed course. Listed below is a brief selection of relevant publications and presentations.

PAPERS

- Masyn, K. E. (In press). Modeling measurement error in event occurrence for single, non-recurring events in discrete-time survival analysis. Forthcoming in Hancock, G.R. and Samuelsen, K.M. (Eds.). *Advances in latent variable mixture models*. Charlotte, NC: Information Age Publishing, Inc.
- Quartz, K.H., Thomas, A., Anderson, L., Masyn, K., Lyons, K.B., and Olsen, B. (In press). Careers in motion: A longitudinal retention study of role changing among early career urban educators. *Teachers College Record*.

- Witkiewitz, K., and Masyn, K. (In press). Drinking trajectories following an initial lapse. *Psychology of Addictive Behaviors*.
- Asparouhov, T., Masyn, K. and Muthén, B. (2006). Continuous time survival in latent variable models. In *ASA Biometrics Section: Proceedings of the Joint Statistical Meeting, August 6-10* (pp. 180-187). Seattle, WA
- Masyn, K. (2006). A review of *Applied Longitudinal Data Analysis: Modeling Change and Event Occurrence* by J.D. Singer and J.B. Willett. *Journal of Educational and Behavioral Statistics*, 31(3), 353-356.
- Muthén, B., and Masyn, K. (2005). Discrete-time survival mixture analysis. *Journal of Educational and Behavioral Statistics*, 30(1), 27-58.

INVITED SEMINARS

- Masyn, K. (October 2007). *Modeling sequential and concurrent survival and growth processes in a latent variable framework*. Presented as part of the Department of Mental Health Seminar Series, Bloomberg School of Public Health, Johns Hopkins University, Baltimore, MD.
- Masyn, K. (May 2006). *Modeling uncertainty in event occurrence for discrete-time survival analysis*. Presented as part of the Center for Integrated Latent Variable Research (CILVR) Inaugural Conference, University of Maryland, College Park, MD.
- Masyn, K. (November 2004). *Advancements in discrete-time survival analysis*. Presented as part of the Department of Mental Health Seminar Series, Bloomberg School of Public Health, Johns Hopkins University, Baltimore, MD.
- Masyn, K. (September 2004). *Multivariate extensions in discrete-time survival analysis using latent variables*. Presented as part of the 2004-2005 Program on Latent Variables in the Social Sciences Kickoff Workshop, Statistical and Applied Mathematical Sciences Institute, Research Triangle Park, NC.
- Masyn, K. (August 2004). *Discrete-time survival analysis using latent variables*. Presented at the Penn State Summer Methodology Workshop, Penn State Population Research Institute, State College, PA.
- Masyn, K. (January 2004) *Discrete-time survival mixture analysis for single and recurrent events using latent variables*. Presented as part of the Department of Biostatistics Seminar Series, University of California, Los Angeles, CA.

WORKSHOPS

- Masyn, K. and Petras, H. (July 2007). *Longitudinal Analysis with Latent Variables*. 4-day short course presented as part of the Summer Institute in Mental Health, Department of Mental Health, Bloomberg School of Public Health, Johns Hopkins University, Baltimore, MD.
- Masyn, K. Petras, H., and Jo, B. (July 2006). *Longitudinal Analysis with Latent Variables*. 4-day short course presented as part of the Summer Institute in Mental Health, Department of Mental Health, Bloomberg School of Public Health, Johns Hopkins University, Baltimore, MD.
- Masyn, K. (March 2006). *Advances in Multilevel Modeling of Longitudinal Data*. ½-day workshop presented at the meeting of the Society for Research on Adolescence, San Francisco, CA.

- Little, T., Masyn, K, and Belmore, A. (April 2005). *Multilevel Modeling for Context Effects*. ½-day pre-conference workshop presented at the meeting of the Society for Research on Child Development, Atlanta, GA.
- Masyn, K. and Kreuter, F. (July 2004). *General Growth Modeling: Longitudinal Analyses with Latent Variables*. 2-day short course presented at the Max Planck Institute for Human Development, Berlin, Germany.
- Masyn, K. and Kreuter, F. (July 2004). *Latent Class Regression: Cross-sectional and Longitudinal Analyses with Categorical Latent Variables*. 2-day short course presented at the Max Planck Institute for Human Development, Berlin, Germany.
- Masyn, K. (April 2002). *A Journey to HLM and Beyond*. 1-day workshop presented at the Research Institute on Addictions, SUNY Buffalo.

REFEREED CONFERENCES (SINCE 2004)

- Masyn, K. (August 2007). *Discrete-time survival analysis in a latent Markov chain modeling framework*. Presented at the meeting of the American Psychological Association, San Francisco, CA.
- Masyn, K. (June 2007). *Event history mediation of risk factor influences on growth processes*. Presented at the meeting of the Society for Prevention Research, Washington, DC.
- Asparouhov, T., Muthén, B. and Masyn, K.- Presenting author (August 2006). *Continuous-time survival analysis in a general latent variable framework*. Presented at the Joint Statistical Meetings, Seattle, WA.
- Masyn, K. (May 2006). *Modeling multiple mechanisms in longitudinal processes*. Presented at the meeting of the Society for Prevention Research, San Antonio, TX.
- Masyn, K. (April 2006). *Modeling migration and attrition: Using discrete-time Markov chain models to analyze the career patterns of urban educators*. Presented at the meeting of the American Educational Research Association, San Francisco, CA.
- Masyn, K. (April 2006). *Modeling reciprocity in discrete-state developmental processes using latent Markov chains*. Presented at the meeting of the Society for Research on Adolescence, San Francisco, CA.
- Masyn, K. (July 2005). *Joint modeling of individual heterogeneity in time-to-onset and consequent developmental processes using latent variables*. Presented at the meeting of the International Society for the Study of Individual Differences, Adelaide, AUS.
- Masyn, K (May 2005). *Modeling measurement error in event occurrence for discrete-time survival analysis*. Presented at the meeting of the Society for Prevention Research, Washington, DC.
- Masyn, K (May 2005). *Advanced applications of discrete-time survival analysis*. Organized paper symposium for the meeting of the Society for Prevention Research, Washington, DC.
- Masyn, K. (April 2005). *Joint modeling of growth trajectories and time-to-event processes in a latent variable framework*. Presented at the meeting of the Society for Research on Child Development, Atlanta, GA.
- Masyn, K. (April 2004). *Analysis techniques for modeling occupational patterns originating in K-12 urban*

classroom teaching. Presented at the meeting of the American Educational Research Association, San Diego, CA.

HANNO PETRAS

Dr. Petras received his Ph.D. in sociology, psychology and statistics from Christian-Albrechts University in Kiel, Germany and has extensive experience in the application of cross-sectional and longitudinal latent variable models using the Mplus software. Dr. Petras is an Assistant Professor in the Department of Criminology/Criminal Justice at the University of Maryland, College Park and an adjunct Assistant Professor in the Department of Mental Health in the School of Public Health at Johns Hopkins University. He has published his research using latent variable models in several peer reviewed journals, among them *Development and Psychopathology*, *Developmental Psychology* as well as in the *Journal of Behavioral and Health Services Research*. Since 2003, Dr. Petras has offered the course “Longitudinal Analysis with Latent Variables” at Johns Hopkins University and continues to teach this course at the University of Maryland. He has been a member of The Prevention Science Methodology Group since 2000 and is one of the founding members of the Prevention Science Methodology Group II, established in 2004.

PAPERS

- Raspe, H., Weber, U. Voigt, S. Kosinski, A. & Petras, H. (1997). *Qualitaetssicherung in der medizinischen Rehabilitation: Wahrnehmung und Bewertung von Reha-Strukturen und -prozessen (Rehabilitationszufriedenheit)*, in: *Die Rehabilitation*, 36 (3), pp. 31-42, Stuttgart/New York. [*Quality management in medical rehabilitation: Perception and evaluation of the structures and processes in rehabilitation (satisfaction with rehabilitation services)*]
- Petras, H. & Raspe, H. (2000). *Subjektive Gesundheit und Rehabilitationsbeduerftigkeit von LVA-Versicherten, die aktuell eine medizinische Rehabilitation beantragen, Das Gesundheitswesen*, 62, pp. 257-263, Stuttgart/New York. [*Subjective health and need for medical rehabilitation by patients insured by the Federal German Statuary Health Insurance Scheme who apply for such rehabilitation*]
- Clark, M.D., Petras, H., Kellam, S., Ialongo, N., & Poduska, J.M. (2003). Who's most at risk for school removal and later juvenile delinquency? Effects of early risk factors, gender, school/community poverty, and their Impact on more distal outcomes. *Women and Criminal Justice*. 14, pp. 89-116.
- Schaeffer, C., Petras, H., Ialongo, N., Kellam, S., & Poduska, J. (2003). Modeling growth in aggressive behavior across elementary school: Early identification of boys with later criminal involvement, conduct disorder, and antisocial personality disorder. *Developmental Psychology*, 6, pp. 1020-1035.
- Petras, H., Chilcoat, H., Leaf, P., Ialongo, N. & Kellam, S. (2004). The utility of teacher ratings of aggression during the elementary school years in identifying later violence in adolescent males. *Journal of the American Academy of Child and Adolescent Psychiatry*, 1, 88-96.
- Furr, CDM, Ialongo, NA, Anthony, JC, Petras, H., & Kellam, SG. (2004). Developmentally inspired drug prevention: New preliminary estimates from a randomized prevention trial. *Drug and Alcohol Dependence*, 73, pp. 149-158.
- Walrath, C.M., Petras, H., Mandell, D.S., Stephens, R., Holden, W., Santiago, R.L.,

- Leaf, P.J. (2004). Gender differences in patterns of risk factors among youth receiving mental health services. *Journal of Behavioral and Health Services Research, 31*, pp. 297-311.
- Petras, H., Schaeffer, C., Ialongo, N., Hubbard, S., Muthen, B., Lambert, S., Poduska, J., & Kellam, S. (2004). When the course of aggressive behavior in childhood does not predict antisocial outcomes in adolescence and young adulthood: An examination of potential explanatory variables. *Development and Psychopathology, 16*, pp. 919-941.
- Petras, H., Ialongo, N., Lambert, S.F., Barrueco, S., Schaeffer, C.M., Chilcoat, H., & Kellam, S. (2005). The Utility of Elementary School TOCA-R Scores in Identifying Later Criminal Court Violence amongst Adolescent Females. *Journal of the American Academy of Child and Adolescent Psychiatry, 8*, pp. 790-797.
- Schaeffer, C.M., Petras, H., Ialongo, N., Masyn, K.E., Hubbard, S., Poduska, J., & Kellam, S. (2006). A comparison of girls' and boys' aggressive-disruptive behavior trajectories across elementary school: Prediction to young adult antisocial outcomes. *Journal of Consulting and Clinical Psychology, 3*, pp. 500-510
- Kellam, S., Brown, C.H., Poduska, J., Ialongo, N., Petras, H., Wang, W., Toynbo, P., Wilcox, H.C., Ford, C., & Windham, A. (in press). Effects of a Universal Classroom Behavior Management Program in First and Second Grades on Young Adult Behavioral, Psychiatric, and Social Outcomes. *Submitted to Drug and Alcohol Dependence*.
- Gaskin, D.J., Arbelaez, J.J., Brown, J., Petras, H., Wagner, F., & Cooper, L.A. (in press). Examining racial and ethnic disparities in site of unusual source of care. *Submitted to Journal of the National Medical Association*.
- Petras, H., Kellam, S., Brown, H., Ialongo, N., Muthen, B. & Poduska, J. (in press). Developmental antecedents and malleability of antisocial personality disorder: Long-term effects of a first-grade universal classroom preventive intervention. *Submitted to Drug and Alcohol Dependence*
- Reinke, W.M., Herman, K.C., Petras, H., & Ialongo, N. (in press). Empirically-Derived Subtypes of Child Academic and Behavior Problems: Co-Occurrence and Distal Outcomes. *Submitted to Journal of Consulting and Clinical Psychology*.

INVITED PRESENTATIONS

Guest Lecture, Growth Curve Model – Current Controversies in: B. Eaton, Statistics for Psychosocial Research II, Structural Models, Department of Biostatistics and Department of Mental Hygiene, Johns Hopkins University, Baltimore, USA, 12.11.2006

Guest Lecture, Growth Curve Models, in: L. Garret & R. Miech, Statistics for Psychosocial Research II, Structural Models, Department of Biostatistics and Department of Mental Hygiene, Johns Hopkins University, Baltimore, USA, 12.11.2002

Guest Lecture on Growth Curve Models, Training Program in Drug Epidemiology, Department of Mental Hygiene, Johns Hopkins University, Baltimore, USA, 10.17.2002, 10.24.2002, 10.31.2002.

Guest Lecture, Growth Curve Models, in: L. Garret & R. Miech, Statistics for

Psychosocial Research II, Structural Models, Department of Biostatistics and Department of Mental Hygiene, Johns Hopkins University, Baltimore, USA, 12.2.2001.

WORKSHOPS

Lecturer (together with Katherine Masyn) at the Department of Mental Health Summer Institute workshop “Longitudinal Analysis with Latent Variables with Mplus” at Johns Hopkins University, Baltimore, 6/2007

Lecturer (together with Katherine Masyn) at the Department of Mental Health Summer Institute workshop “Longitudinal Analysis with Latent Variables with Mplus” at Johns Hopkins University, Baltimore, 6/2006

Lecturer at the 5-day Summer Institute workshop “Advance Statistical Analysis with Latent Variables with Mplus” at Morgan State University, Baltimore, 6/2004

Assistant Lecturer with Bengt Muthén at the 2-day workshop “Longitudinal Modeling with Mplus”, Johns Hopkins University, Baltimore, USA, 6.2001.

REFERRED CONFERENCES (SINCE 2004)

Petras, H., Furr-Holden, D., Ialongo, N.S., & Kellam, S.G. (2004). The course of aggression and juvenile violence - A gender comparison of antecedents and consequences. In: Feaster, D., Petras, H., Henderson, C., Greenbaum, P., & Van Horn, L. , Advanced applications of General Growth Mixture modeling. Presented at 12th annual meeting of the Society for Prevention Research.

Petras, H., & Ialongo, N. (2004). The development of aggression and peer rejection in predominately African American Urban Youth. In: Crijnen, A., & Dishion, T., The development of aggression and peer rejection leading to adolescent maladjustment in the USA, Canada, and the Netherlands: Impact of a Preventive Intervention and Cross cultural implications for prevention programs. Presented at 12th annual meeting of the Society for Prevention Research.

Rhodes, W., Petras, H., Clubb, P., Masyn, K., Wagner, F., & Browne, D.C. (2004). Studying age of onset for marijuana use among African American youth. Presented at 12th annual meeting of the Society for Prevention Research.

Masyn, K., Kreuter, F., & Petras, H. (2004). New methods and applications in the analysis of longitudinal data with non-normal outcomes. Presented at 12th annual meeting of the Society for Prevention Research.

Schaeffer, C., Petras, H., Ialongo, N.S., Matvya, J., Poduska, J. & Kellam, S. (2005). Predicting nonaggressive negative life outcomes from aggressive behavior trajectories: Differential Multifinality among girls and boys. Presented at the 13th annual meeting of the Society for Prevention Research.

Petras, H. , Buckley, J., Masyn, K., & Kellam, S. (2005). Modeling time to school removal in public school students. Presented at the 13th annual meeting of the Society for Prevention Research.

Petras, H. (2006). Logitudinal relationship between conduct disorder and later criminality – A gender comparison. Presented at the American Society for Criminology meeting in Los Angeles.

Petras, H. (2006). Symposium on the application of person-centered latent variable

- methods to criminological research. Presented at the American Society for Criminology meeting in Los Angeles.
- Petras, H. (2006) Application of the Two-Part Growth Mixture Model to Continuous Outcomes. Presented at the Society for Prevention Research in San Antonio, TX.
- Van Horn, L., Petras, H., Nylund, K., Greenbaum, P. (2006). Identifying and validating latent classes in general mixture models. Presented at the Society for Prevention Research in San Antonio, TX.
- Petras, H. , Buckley, J. & Ialongo, N. (2007). Specificity and sensitivity in identifying multi problem males during the elementary school years. Presented at the Society for Prevention Research in Washington, DC.
- Petras, H., Buckley, J., Masyn, K., & Kellam, S. (2007). Modeling Time to School Removal in Public School Students. Presented at the Society for Prevention Research in Washington, DC.
- Petras, H. & Liu, W. (2007). Crime Specialization – An Application of Latent Class Transition Analysis. Presented at the American Psychological Society meeting in San Francisco.
- Petras, H. & Kellam, S. (2007). Developmental Course and prevention of Antisocial Personality Disorder and Violence in Young Adulthood. To be presented at the American Society for Criminology meeting in Atlanta
- Liu, W. & Petras, H. (2007). Age and Specialization. An Event History Analysis. To be presented at the American Society for Criminology meeting in Atlanta.
- Nieuwbeerta, P. & Petras, H. (2007). The true value of Lambda...Appears to be nonzero and constant with age. To be presented at the American Society for Criminology meeting in Atlanta.
- Petras, H. (2008). Early Identification of Developmental Trajectories (working title). To be presented at Jerry Lee Crime Prevention Symposium at the University of Maryland, College Park.

MASYN & PETRAS

In addition to their individual accomplishments in areas related to this workshop, Drs. Masyn and Petras also have a successful history together in research and teaching. For the past two summers, they have co-taught a 4-day course in Longitudinal Analysis with Latent Variables as part of the Johns Hopkins Bloomberg School of Public Health Summer Institute. The class has had a full enrollment both years and received high ratings from attendees with regards to content and presentation as well as the team-teaching style of Drs. Masyn and Petras. They will return to the Institute this summer to teach a new 4-day course with emphasis on longitudinal categorical data. Dr. Petras has a paper under review that utilizes multilevel discrete-time survival analysis on which Dr. Masyn is a co-author, and they currently have another active research collaboration related to an application of multivariate discrete-time survival analysis.

*Please also see attached CV's.

OUTLINE

The workshop will be conducted mainly in lecture format. Each of the two presenters will play equal and alternating roles throughout the duration of the workshop. At points throughout the class, presenters will demonstrate how these models are specified and run in the Mplus software using a laptop projector. Each participant will have a copy of the lecture slides with references and it is expected that participants will be able to ask questions throughout the presentation. Unfortunately, however, it is not possible to provide participants with hands-on analysis experience in this setting. Arranging artificial activities during this workshop would be at the expense of the breadth of topics that is proposed. What follows is an approximate topic-specific timetable for the class.

INTRODUCTION (8:30AM-9:30AM)

- 1) Opening remarks
- 2) Statistical modeling in a latent variable framework
- 3) Introduction to the Mplus V5 software

PART I: DISCRETE-TIME SURVIVAL (9:30AM-12:30PM)

- 1) Introduction to discrete-time survival analysis
 - a. Unconditional hazard and survival probabilities
 - b. Censoring and truncation
 - c. Model specification in a latent variable framework
 - d. Conditional hazard probabilities model
 - i. Proportional hazard odds model
 - ii. Non-proportional hazard odds model
 - iii. Time-varying and time-invariant covariates
- 2) Recurring events and multiple spells in discrete time
- 3) Competing risks in discrete time
- 4) Unobserved heterogeneity and frailty models
 - a. Continuous frailty
 - b. Finite mixtures

PART II: CONTINUOUS-TIME SURVIVAL (1:30PM-4:00PM)

- 1) Introduction to continuous-time survival analysis
 - a. Unconditional hazard and survival functions
 - b. Model specification in a latent variable framework
 - c. Cox (proportional) hazards model
- 2) Recurring events and multiple spells in continuous time
- 3) Competing risks in continuous time
- 4) Unobserved heterogeneity and frailty models
 - a. Continuous frailty
 - b. Finite mixture

PART III: OVERVIEW OF EXTENSIONS (4:00PM-5:00PM)

- 1) Multilevel survival models
- 2) Continuous and categorical latent variable predictors
- 3) Survival models as Markov chain models
- 4) Joint models
 - a. Multiple-process survival models
 - b. Survival and growth models
- 5) Future directions