Online Appendix to accompany "*Factors affecting the adequacy and preferability of semiparametric groups-based approximations of continuous growth trajectories*"

Online Appendix Table A. SPGM-approximated random effect variances: Continuous outcomes

Dist	Samp	Best BIC	Intercept variance (1.0) Estimate	MSE	ARB	Linear variance (.15) Estimate	MSE	ARB	Quadratic variance (.12) Estimate	MSE	ARB
2 REs, Correlated											
N	250	4	.955	.015	.045	.070	.007	.534			
	500	6	.972	.007	.028	.109	.002	.271			
	1000	7	.982	.003	.018	.122	.001	.184			
S	250	5	.968	.026	.033	.968	.003	.309			
	500	6	.981	.016	.020	.114	.002	.241			
	1000	7	.990	.006	.010	.125	.001	.167			
B	250	4	.965	.011	.035	.083	.005	.448			
	500	5	.971	.006	.017	.104	.006	.304			
	1000	6	.979	.003	.021	.121	.001	.191			
3 REs, Correlated											
N	250	5	.903	.023	.097	.104	.003	.306	.068	.003	.437
	500	6	.913	.014	.087	.112	.002	.253	.069	.003	.423
	1000	7	.922	.009	.078	.116	.001	.224	.071	.003	.405
S	250	5	.905	.033	.095	.107	.003	.289	.017	.003	.416
	500	6	.917	.022	.083	.111	.002	.262	.074	.002	.380
	1000	7	.936	.011	.064	.117	.001	.223	.078	.002	.353
B	250	4	.888	.022	.112	.089	.004	.408	.058	.004	.513
	500	5	.910	.013	.090	.107	.002	.285	.068	.003	.432
	1000	6	.921	.009	.079	.117	.001	.220	.071	.003	.408

Notes. Dist=Random effect distribution condition: (N=normal, S=skewed, or B=bimodal); RE=random effect; Samp=Sample size; MSE=mean squared error; ARB=absolute relative bias; BIC=Bayesian Information Criteria.

Online Appendix Table B. SPGM-approximated random effect variances: Binary outcomes

Dist	Samp	Best BIC	Intercept variance (1.0) Estimate	MSE	ARB	Linear variance (.15) Estimate	MSE	ARB	Quadratic variance (.12) Estimate	MSE	ARB
2 REs, Correlated											
N	250	2	.627	.153	.373	.046	.011	.692			
	500	3	1.041	.322	.041	.077	.040	.489			
	1000	3	1.024	.189	.024	.046	.013	.696			
S	250	3	1.156	.533	.156	.231	2.427	.538			
	500	3	1.058	.382	.058	.127	.820	.156			
	1000	3	.918	.082	.082	.044	.012	.706			
B	250	2	.731	.099	.269	.046	.011	.691			
	500	2	.715	.089	.285	.047	.011	.688			
	1000	3	1.158	.398	.158	.077	.256	.487			
3 RE, Correlated											
N	250	2	.562	.202	.438	.038	.013	.750	.040	.667	.007
	500	2	.557	.200	.443	.035	.013	.768	.037	.007	.690
	1000	3	.596	.189	.404	.067	.017	.551	.089	.098	.256
S	250	2	.596	.175	.404	.033	.014	.778	.035	.008	.706
	500	3	.882	.385	.118	.242	1.301	.616	.096	.030	.199
	1000	3	.789	.081	.211	.077	.119	.485	.055	.541	.007
B	250	2	.649	.159	.351	.035	.013	.764	.040	.007	.669
	500	2	.627	.144	.373	.034	.010	.773	.038	.007	.685
	1000	2	.622	.146	.378	.034	.014	.775	.038	.007	.684

Notes. Please refer to Online Appendix Table A notes.

Online Appendix Table C. SPGM-approximated fixed effects: Binary outcomes

Dist	Samp	Best BIC	Intercept mean (-1.25) Estimate	MSE	ARB	Linear mean (-.2) Estimate	MSE	ARB	Quadratic mean (-.3) Estimate	MSE	ARB
2 REs, Correlated											
N	250	2	-1.216	.008	.027	-.135	.005	.327	-.088	.046	.705
	500	3	-1.295	.045	.036	-.208	.003	.042	-.170	.022	.433
	1000	3	-1.299	.026	.039	-.193	.026	.036	-.153	.023	.489
S	250	3	-1.345	.009	.020	-.221	.012	.105	-.163	.037	.457
	500	3	-1.340	.040	.072	-.196	.004	.020	-.141	.030	.531
	1000	3	-1.310	.019	.048	-.186	.002	.069	-.143	.027	.522
B	250	2	-1.214	.010	.029	-.156	.003	.218	-.107	.038	.644
	500	2	-1.204	.006	.036	-.157	.002	.215	-.107	.038	.643
	1000	3	-1.321	.048	.057	-.206	.003	.031	-.172	.021	.426
3 REs, Correlated											
N	250	2	-1.179	.012	.057	-.119	.008	.405	-.124	.033	.588
	500	3	-1.181	.007	.055	-.116	.008	.422	-.120	.033	.602
	1000	3	-1.185	.022	.052	-.130	.012	.351	-.132	.052	.561
S	250	3	-1.252	.006	.002	-.083	.014	.583	-.086	.047	.715
	500	3	-1.234	.007	.013	-.165	.012	.174	-.153	.032	.490
	1000	3	-1.239	.002	.009	-.136	.005	.319	-.135	.028	.551
B	250	2	-1.178	.015	.057	-.134	.005	.328	-.143	.026	.524
	500	2	-1.172	.009	.062	-.132	.005	.340	-.139	.026	.536
	1000	3	-1.176	.007	.060	-.131	.005	.343	-.139	.026	.536

Notes. Please refer to Online Appendix Table A notes.

Online Appendix Table D. HGLM random effect variances: Binary outcomes

Dist	Samp	Intercept variance (1.0) Estimate	MSE	ARB	Linear variance (.15) Estimate	MSE	ARB	Quadratic variance (.12) Estimate	MSE	ARB
2 RE, Correlated										
N	250	1.026	.043	.026	.163	.007	.090			
	500	1.012	.025	.012	.157	.004	.049			
	1000	1.002	.011	.002	.151	.001	.005			
S	250	1.751	.714	.751	.135	.007	.102			
	500	1.739	.630	.739	.134	.004	.107			
	1000	1.731	.572	.731	.132	.002	.120			
B	250	.969	.035	.031	.173	.009	.156			
	500	.956	.019	.044	.175	.004	.169			
	1000	.943	.012	.057	.167	.002	.115			
3 RE, Correlated										
N	250	1.029	.084	.029	.175	.009	.168	.138	.006	.151
	500	1.004	.038	.004	.155	.004	.034	.127	.003	.060
	1000	.998	.019	.002	.151	.002	.006	.125	.002	.041
S	250	1.743	.791	.743	.195	.012	.301	.167	.013	.390
	500	1.706	.621	.706	.177	.006	.182	.156	.006	.298
	1000	1.687	.533	.687	.167	.003	.112	.146	.003	.219
B	250	.968	.069	.032	.164	.008	.093	.139	.007	.159
	500	.958	.033	.042	.162	.004	.083	.129	.003	.079
	1000	.949	.017	.051	.153	.002	.019	.122	.002	.013

Notes. Please refer to Online Appendix Table A notes. HGLM= Hierarchical Generalized Linear Model.

Online Appendix Table E. HGLM fixed effects: Binary outcomes

		Intercept mean (-1.25)			Linear mean (-.2)			Quadratic mean (-.3)		
Dist	Samp	Estimate	MSE	ARB	Estimate	MSE	ARB	Estimate	MSE	ARB
2 RE's, Correlated										
N	250	-1.263	.013	.010	-.201	.010	.005	-.306	.005	.020
	500	-1.256	.006	.005	-.199	.005	.003	-.302	.002	.005
	1000	-1.247	.003	.003	-.200	.003	.002	-.301	.001	.005
S	250	-1.541	.102	.233	-.213	.017	.063	-.294	.005	.019
	500	-1.539	.092	.231	-.211	.009	.057	-.294	.003	.021
	1000	-1.536	.087	.229	-.216	.004	.081	-.294	.001	.019
B	250	-1.207	.014	.034	-.202	.009	.010	-.308	.005	.028
	500	-1.201	.009	.040	-.200	.005	.002	-.309	.002	.029
	1000	-1.204	.005	.037	-.199	.002	.007	-.302	.001	.006
3 RE's, Correlated										
N	250	-1.257	.016	.005	-.198	.013	.011	-.316	.013	.054
	500	-1.255	.007	.004	-.201	.006	.007	-.302	.008	.008
	1000	-1.253	.003	.003	-.199	.003	.006	-.299	.004	.004
S	250	-1.541	.111	.233	-.147	.023	.266	-.256	.023	.146
	500	-1.535	.094	.228	-.159	.011	.205	-.248	.015	.174
	1000	-1.522	.081	.218	-.157	.006	.216	-.238	.010	.205
B	250	-1.205	.017	.036	-.212	.013	.059	-.326	.015	.088
	500	-1.203	.009	.037	-.207	.006	.035	-.325	.008	.082
	1000	-1.208	.005	.034	-.213	.003	.065	-.318	.004	.061

Notes. Please refer to Online Appendix Table A notes. HGLM=Hierarchical Generalized Linear Model.

Online Appendix Table F. Generalizability checks.
SPGM-approximated vs. HGLM fixed effects and random effect variances: Less-sparse binary outcomes, N=1000

Dist.	Fitted Model	Best BIC	Intercept mean (0) Estimate	MSE	ARB	Linear mean (-.2) Estimate	MSE	ARB	Quadratic mean (-.3) Estimate	MSE	ARB	Intercept variance (1.0) Estimate	MSE	ARB	Linear variance (.15) Estimate	MSE	ARB	Quadratic var. (.12) Estimat	MSE	ARB
1 RE																				
N	SPGM	3	.015	.002	.015	-.199	.003	.006	-.299	.002	.004	.813	.045	.187						
N	HGLM		.001	.002	.001	-.202	.000	.012	-.299	.000	.003	.998	.006	.002						
S	SPGM	3	-.024	.004	.024	-.210	.007	.051	-.291	.002	.028	.804	.135	.196						
S	HGLM		-.099	.011	.079	-.197	.000	.015	-.298	.000	.007	.911	.013	.089						
B	SPGM	3	.008	.002	.008	-.204	.005	.021	-.302	.003	.006	.901	.024	.099						
B	HGLM		-.005	.002	.004	-.204	.000	.018	-.303	.000	.010	1.198	.045	.198						
2 RE, Uncorrelated																				
N	SPGM	4	.014	.002	.014	-.189	.005	.053	-.288	.005	.041	.820	.044	.180	.118	.045	.216			
N	HGLM		.002	.002	.002	-.199	.001	.005	-.300	.001	.001	1.004	.006	.004	.151	.001	.006			
S	SPGM	4	-.024	.007	.024	-.200	.011	.002	-.276	.004	.080	.834	.450	.166	.206	1.093	.373			
S	HGLM		-.101	.010	.081	-.186	.000	.073	-.267	.001	.110	.822	.032	.178	.119	.001	.210			
B	SPGM	4	.014	.005	.014	-.208	.016	.038	-.276	.006	.082	.962	.401	.038	.251	1.980	.673			
B	HGLM		-.003	.002	.002	-.203	.001	.015	-.304	.001	.012	1.192	.046	.192	.154	.001	.029			
3 RE, Uncorrelated																				
N	SPGM	4	-.006	.003	.006	-.177	.004	.114	-.255	.007	.150	.771	.096	.229	.104	.119	.310	.062	.123	.487
N	HGLM		-.001	.002	.001	-.200	.001	.000	-.301	.001	.002	.998	.007	.002	.150	.001	.001	.123	.001	.023
S	SPGM	4	-.047	.005	.047	-.187	.006	.066	-.245	.008	.182	.714	.156	.286	.132	.295	.119	.053	.052	.555
S	HGLM		-.103	.012	.082	-.199	.001	.005	-.283	.001	.057	.869	.023	.131	.147	.001	.022	.134	.002	.115
B	SPGM	4	-.004	.003	.004	-.179	.015	.105	-.249	.021	.171	.875	.111	.125	.184	1.423	.224	.146	1.715	.215
B	HGLM		-.001	.002	.001	-.202	.001	.011	-.303	.001	.010	1.188	.044	.188	.152	.001	.012	.118	.001	.021

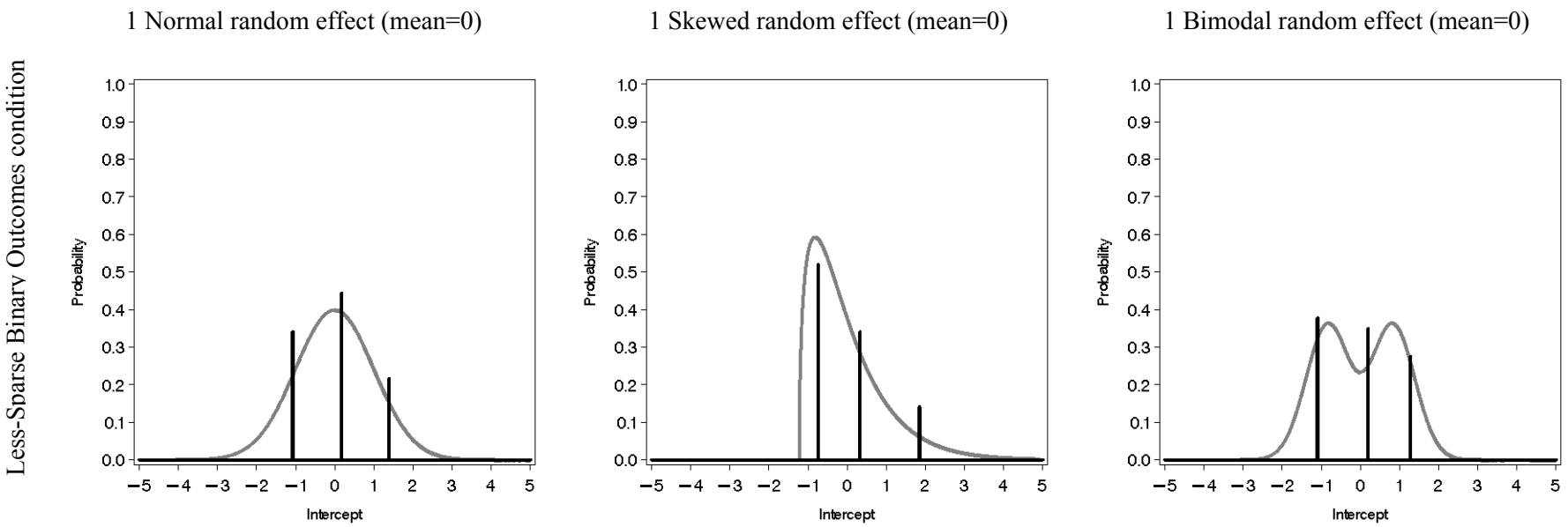
Notes. Dist=Random effect distribution condition: (N=normal, S=skewed, or B=bimodal); RE=random effect; MSE=mean squared error; ARB=absolute relative bias; BIC=Bayesian Information Criteria; HGLM=hierarchical generalized linear model; SPGM=semiparametric groups-based trajectory model.

Online Appendix Table G. Generalizability checks.
HLM and HGLM fixed effects and random effect variances: All nonnormal random effects (3 uncorrelated random effect condition)

		Intercept mean (-1.25)			Linear mean (-.2)			Quadratic mean (-.3)			Intercept variance (1.0)			Linear variance (.15)			Quadratic var. (.12)		
Dist.	Samp	Estimate	MSE	ARB	Estimate	MSE	ARB	Estimate	MSE	ARB	Estimate	MSE	ARB	Estimate	MSE	ARB	Estimate	MSE	ARB
Continuous Repeated Measures																			
SSS	250	-1.254	.005	.003	-.199	.001	.006	-.302	.001	.007	.988	.026	.012	.150	.001	.001	.117	.001	.029
	500	-1.248	.002	.002	-.198	.001	.008	-.299	.001	.003	.997	.014	.003	.150	.001	.001	.120	.000	.003
	1000	-1.250	.001	.000	-.200	.000	.001	-.300	.000	.001	.994	.006	.006	.149	.000	.008	.121	.000	.005
BBB	250	-1.249	.006	.000	-.197	.001	.013	-.301	.001	.004	.993	.008	.007	.150	.001	.003	.119	.001	.010
	500	-1.246	.006	.004	-.200	.001	.001	-.301	.001	.005	.993	.006	.007	.149	.000	.009	.120	.000	.001
	1000	-1.248	.001	.002	-.200	.000	.000	-.300	.000	.001	.999	.002	.001	.149	.000	.003	.120	.000	.002
Binary Repeated Measures																			
SSS	250	-1.514	.090	.211	-.192	.004	.040	-.324	.015	.080	1.645	.585	.645	.149	.008	.006	.192	.022	.601
	500	-1.505	.074	.204	-.196	.002	.018	-.317	.006	.058	1.641	.489	.641	.148	.004	.011	.190	.013	.581
	1000	-1.506	.070	.204	-.198	.001	.008	-.314	.003	.048	1.633	.438	.633	.144	.002	.043	.184	.008	.530
BBB	250	-1.208	.014	.033	-.198	.004	.009	-.317	.010	.058	.978	.044	.022	.161	.007	.075	.123	.008	.025
	500	-1.213	.008	.030	-.197	.002	.014	-.308	.006	.027	.979	.019	.021	.159	.003	.059	.125	.004	.043
	1000	-1.207	.005	.034	-.200	.001	.001	-.302	.003	.006	.962	.011	.038	.157	.002	.048	.117	.002	.022

Notes. Dist=Random effect distribution condition: (SSS=skewed, skewed, skewed, or BBB=bimodal, bimodal, bimodal); RE=random effect; error; ARB=absolute relative bias; MSE=mean squared error; HGLM=hierarchical generalized linear model; HLM=hierarchical linear model.

Online Appendix Figure A. Generalizability checks.
SPGM approximation: PDF of a single dimension random effect distribution for binary repeated measures: N=1000, intercept mean=0.



Notes. Grey line= theoretical (true) random effect distribution. Black bars= SPGM discrete approximation. The number of bars corresponds with the best-BIC number of classes. The height of each bar is the across-samples average class probability for that class, and the location of each bar is the across-samples average growth coefficient for that class.

Online Appendix Table H. Externalizing Behavior Empirical Illustration: SPGM indirect approximation and HLM/HGLM results for implied random effect covariances.

	Continuous repeated measures		Binary repeated measures	
	HLM	SPGM-approximation	HGLM	SPGM-approximation
Covariance:				
Intercept, Linear	.1923	.2545	.3647	-.0201
Intercept, Quad	-.2025*	-.1434	-.2199	-.0411
Intercept, Cubic	-.0280	-.0462	---	---
Linear, Quad	-.0327	-.0423	-.0440	.0003
Linear, Cubic	-.0243	-.0215	---	---
Quad, Cubic	-.0001	.0035	---	---

Notes. * $p < .05$. SPGM approximation used Equations (8) and (9). Significance level reported only for HLM/HGLM, where parameters were directly estimated. SPGM-approximated and HLM/HGLM estimated random effect means and variances are provided in the manuscript.

Literature Review of Semiparametric Groups-Based Modeling (SPGM) Applications in Psychology

Literature Review Procedures. First, we identified all published articles from PsycInfo or PsychLit databases through 2010 that (a) mentioned: semiparametric group-based; group-based trajectory; semiparametric trajectory; latent class growth model; or latent class growth or (b) cited Nagin's (1999) *Psychological Methods* article introducing SPGM to a psychology audience. The several hundred resulting publications were inspected to see if they indeed used SPGM (vis a vis growth mixture modeling, for example) and if their journal was relevant to psychology and mental health (which we defined to include drug abuse/addiction and psychiatry). Articles on psychological topics in outlets specifically affiliated with other fields (e.g. sociology, criminology) were excluded but articles in more general outlets on psychology topics were included. Of these, 100 articles were selected with simple random sampling for inclusion--with the exception that a limit was placed (3 articles) on the number of articles that could be first-authored by the same person. (In certain cases there were many SPGM applications first-authored by the same person, often on the same dataset, and we wanted to reduce such dependency in the review.) The final list of 100 articles was surveyed regarding several conditions relevant to the present article's motivation and simulation conditions, including: sample size; distribution of the dependent variable; whether BIC was the only criteria used to select the number of classes. Averages or frequencies of the data in each column of this chart were reported in the manuscript.

Notes. First, in some instances, selection criteria used to select the number of classes (*K*) were unclear, and such instances are denoted NR (not reported). Second, in some instances the assumed form for the conditional response distribution of repeated meausres was unclear, so the most probable form was recorded given available information. Third, in some studies SPGM was used even though the authors labeled their analysis as growth mixture modeling; such studies were included in this review. Fourth, if a given article included multiple SPGMs with apparently different conditional response distributions, a fraction of a percentage point was assigned to each response type represented, but totals reported in the manuscript were rounded to the nearest percentage. Fifth, in our review we did not distinguish between normal and censored normal conditional response distributions. The use of one vs. the other seemed to depend mainly on software choice. Researchers with continuous repeated measures using SAS Proc Traj employed censored normal (because normal was not available) whereas those using Mplus tended to employ normal.

Abbreviations. *K*= number of classes; BIC=Bayesian Information Criteria; SPGM=Semiparametric Groups-Based Trajectory Model.

	Reference	BIC to select *K*?	Conditional response distribution	*N*
1	Anderson, K., Ramob, D., Cumminsc, K. and Brown, S. (2010). Alcohol and drug involvement after adolescent treatment and functioning during emerging adulthood. *Drug and Alcohol Dependence,* 107, 171-181.	no	count	171
2	Barker, E.D., Seguin, J.R., White, H.R., Bates, M.E., Lacourse, E., Carbonneau, R., & Tremblay, R.E. (2007). Developmental trajectories of male physical violence and theft relations to neurocognitive performance. *Archives of General Psychiatry, 64* , 592-599.	yes	count	698
3	Bauer, D.J. & McNaughton Reyes, H.L. (2010). Modeling variability in individual development: Differences of degree or kind? *Child Development Perspectives, 4,* 114–122.	no	normal	893
4	Beyers, W., Seiffge-Krenke, I. (2007). Are friends and romantic partners the “best medicine”? How the quality of other close relations mediates the impact of changing family relationships on adjustment. *International Journal of Behavioral Development* , *31* , 559–568.	no	normal	228

5	Biggs, B.K., Vernberg, E., Little, T.D., Dill, E.J., Fonagy, P. & Twemlow, S.W. (2010). Peer victimization trajectories and their association with children's affect in late elementary school. *International Journal of Behavioral Development* , 34, 136-146.	NR	normal	1528
6	Bobo, J.K., Klepinger, D.H., Dong, F.B. (2007). Identifying social drinkers likely to consume alcohol during pregnancy: Findings from a prospective cohort study. *Psychological Reports* , 101, 857-870.	yes	binary	754
7	Boivin, M., Petitclerc, A., Feng, B. & Barker, E. (2010). The developmental trajectories of peer victimization in middle to late childhood and the changing nature of their behaviroal correlates. *Merrill-Palmer Quarterly* , 56, 231-260	no	normal	727
8	Bongers, I., Koot, H., van der Ende, J., Verhulst, F.C. (2004) Developmental trajectories of externalizing behaviors in childhood and adolescence. *Child Development* , 75, 1523-1537.	yes	count	2076
9	Brame, B., Nagin, D.S. & Tremblay, R.E. (2001). Developmental trajectories of physical aggression from school entry to late adolescence. *Journal of Child Psychology and Psychiatry* , 42, 503-512.	yes	count	926
10	Brendgen, M., Vitaro, F., Bukowski, W.M., Doyle, A.B., & Markiewicz, D. (2001). Developmental profiles of peer social preference over the course of elementary school: Associations with trajectories of externalizing and internalizing behavior. *Developmental Psychology, 37,* 308-320.	yes	normal	299
11	Le Brocque, R.M., Hendrikz, J. & Kenardy, J.A. (2010). The course of posttraumatic stress in children: Examination of recovery trajectories following traumatic injury. *Journal of Pediatric Psychology, 35,* 637–645.	yes	normal	190
12	Broidy, L.M., Nagin, D.S., Tremblay, R.E., Bates, J.E., Brame, B., Dodge, K.A., Fergusson, D., Horwood, J.L., Loeber, R., Laird, R., Lynam, D.R., Moffitt, T.E., Pettit, G.S., & Vitaro, F. (2003). Developmental trajectories of childhood disruptive behaviors and adolescent delinquency: A six-site cross-national study. *Developmental Psychology* , 39, 222-245.	yes	count	range: 585-2000
13	Buchy, L., Bodnar, M., Malla, A., Joober, R. & Lepage, M. (2010) A 12-month outcome study of insight and symptom change in first-episode psychosis, *Early Intervention in Psychiatry* , 4, 79-88.	yes	normal	165
14	Campbell, S.B., Matestic, P., von Stauffenberg, C., Mohan, R. & Kirchner, T. (2007). Trajectories of maternal depressive symptoms, maternal sensitivity, and children's functioning at school entry. *Developmental Psychology,* 43, 1202-1215.	yes	normal	1261
15	Campbell, S.B., Spieker, S., Vandergrift, N., Belsky, J., Burchinal, M. & The NICHD Early Child Care Research Network. (2000). Predictors and sequelae of trajectories of physical aggression in school-age boys and girls. *Development and Psychopathology* , 22, 133-150.	yes	count	1,081
16	Carrasco, M., Barker, E.D., Tremblay, R.E. & Vitaro, F. (2006). Eysenck's personality dimensions as predictors of male adolescent trajectories of physical aggression, theft and vandalism. *Personality and Individual Differences, 41,* 1309-1320.	yes	normal	868
17	Chassin, L., Pitts, S.C., Prost, J. (2002). Binge Drinking Trajectories From Adolescence to Emerging Adulthood in a High-Risk Sample: Predictors and Substance Abuse Outcomes. *Journal of Consulting and Clinical Psychology, 70* , 67-78.	yes	count	446
18	Chi, F. & Weisner, C. (2008). Nine-year psychiatric trajectories and substance use outcomes an application of the group-based modeling approach. Evaluation Review, 32, 39-58.	yes	normal	934
19	Constantino, M. & Smith-Hansen, L. (2008) Patient interpersonal factors and the therapeutic alliance in two treatments for bulimia nervosa. *Psychotherapy Research, 18,* 683-698.	yes	normal	207

20	Costello, D.M. Dierker, L.C., Jones, B.J., & Rose, J.S. (2008). Trajectories of smoking from adolescence to early adulthood and their psychosocial risk factors. *Health Psychology, 27* , 811-818.	yes	count	5,789
21	Cote, S.M., Boivin, M., Liu, X., Nagin, D.S., Zoccolillo, M., & Tremblay, R.E. (2009). Depression and anxiety symptoms: onset, developmental course and risk factors during early childhood. *Journal of Child Psychology and Psychiatry, 50* , 1201-1208.	yes	normal	1759
22	Cote, S., Tremblay, R.E., Nagin, D., Zoccolillo, M. & Vitaro, F.(2002). The development of impulsivity, fearfulness, and helpfulness during childhood: patterns of consistency and change in the trajectories of boys and girls. *Journal of Child Psychology and Psychiatry, 43* , 609–618.	yes	normal	1865
23	Dekker, M.C., Ferdinand, R.F., van Lang, N., Bongers, I., van der Ende, J., Verhulst, F.C. (2007). Developmental trajectories of depressive symptoms from early childhood to late adolescence: gender differences and adult outcome. *Journal of Child Psychology and Psychiatry, 48,* 657–666.	yes	normal	2076
24	Delucchi, K.L., Matzger, H. & Weisner, C. (2004). Dependent and problem drinking over 5 years: A latent class analysis. *Drug and Alcohol Dependence, 74* , 235-244.	yes	normal	1094
25	Duchesne, S., Ratelle, C.F., Larose, S., Guay, F. (2007). Adjustment trajectories in college science programs: Perceptions of qualities of parents' and college teachers' relationships. *Journal of Counseling Psychology, 54* , 62-71 .	yes	normal	498
26	Falck, R.S., Wang, J. & Carlson, R.G. (2007).Crack cocaine trajectories among users in a midwestern American city. *Addiction, 102* , 1421–1431.	yes	binary	401
27	Feldman, B.J., Masyn, K.E. & Conger, R.D. (2009). New approaches to studying problem behaviors: A comparison of methods for modeling longitudinal, categorical adolescent drinking data. *Developmental Psychology, 45* , 652–676.	no	binary; ordinal discussed	451
28	Feng, X., Shaw, D.S., and Silk, J.S. (2008). Developmental trajectories of anxiety symptoms among boys across early and middle childhood. *Journal of Abnormal Psychology,117* , 32–47.	yes	normal	290
29	Flory, K., Lynam, D., Milich, R., Leukefeld, C., Clayton, R. (2004). Early adolescent through young adult alcohol and marijuana use trajectories: Early predictors, young adult outcomes, and predictive utility. *Development and Psychopathology, 16* , 193–213.	yes	normal	481
30	Gaudreau, P., Amiot, C.E., & Vallerand, R.J. (2009). Trajectories of affective states in adolescent hockey players: Turning point and motivational antecedents. *Developmental Psychology, 45* , 307-319.	yes	normal	265
31	Gross, H.E., Shaw, D.S., Burwell, R.A., & Nagin, D.S.(2009). Transactional processes in child disruptive behavior and maternal depression: A longitudinal study from early childhood to adolescence. *Development and Psychopathology, 21* , 139–156.	yes	normal	289
32	Halliday-Boykins, C.A., Henggeler, S.W., Rowland, M.D., & DeLucia, C. (2004). Heterogeneity in youth symptom trajectories following psychiatric crisis: Predictors and placement outcomes. *Journal of Consulting and Clinical Psychology, 72* , 993–1003.	yes	normal	156
33	Harachi, T.W., Fleming, C.B., White, H.R., Ensminger, M.E., Abbott, R.D., Catalano, R.F., Haggerty, K.P. (2006). Aggressive behavior among girls and boys during middle childhood: Predictors and sequelae of trajectory group membership. *Aggressive Behavior* , 32, 279-293.	yes	normal	523; 461
34	Haviland, A., Nagin, D.S., Rosenbaum, P.R., & Tremblay, R.E. (2008).Combining group-based trajectory modeling and propensity score matching for causal inferences in nonexperimental longitudinal data. *Developmental Psychology, 44* , 422-436.	yes	count	1037

35	Higgins, G.E., Jennings, W.G., & Mahoney, M. (2010). Developmental trajectories of maternal and paternal attachment and delinquency in adolescence. *Deviant Behavior*, *31*, 655–677.	yes	normal	383
36	Hill, K.G., White, H.R., Chung, I., Hawkins, J.D. & Catalano, R.F. (2000). Early adult outcomes of adolescent binge drinking: Person- and variable-centered analyses of binge drinking trajectories. *Alcoholism: Clinical and Experimental Research, 24*, 892-901.	yes	count	808
37	Huijbregts, S., Seguin, J.R., Zoccolillo, M., Boivin, M. & Tremblay, R.E. (2008). Maternal prenatal smoking, parental antisocial behavior, and early childhood physical aggression. *Development and Psychopathology, 20* , 437–453.	yes	count	1,745
38	Hynes, K. & Clarkberg, M. (2005). Women's employment patterns during early parenthood: A group-based trajectory analysis. *Journal of Marriage and Famil* y, 67, 222–239.	yes	binary	2,093
39	Jackson, K.M. & Sher, K.J. (2008). Comparison of longitudinal phenotypes based on alternate heavy drinking cut Scores: A systematic comparison of trajectory approaches III. *Psychology of Addictive Behaviors, 22* , 198–209.	no	binary	3,720
40	Johnsson, K.O., Leifman, A., Berglund, M. (2008). College students' drinking patterns: Trajectories of AUDIT scores during the first four years. *European Addiction Research, 14* , 11–18.	yes	normal	359
41	Jones, D.J., Runyan, D.K., Lewis, T., Litrownik, Black, M.M., Wiley, T., English, D.E. Proctor, L.J., Jones, B.L., Nagin, D.S. (2010). Trajectories of childhood sexual abuse and early adolescent HIV/AIDS risk behaviors: The role of other maltreatment, witnessed violence, and child gender. *Journal of Clinical Child & Adolescent Psychology, 39* , 667–680.	yes	binary; count	844
42	Kaskutas, L.A., Ammon, L., Delucchi, K., Room, R., Bond, J., and Weisner, C. (2005). Alcoholics anonymous careers: Patterns of AA involvement five years after treatment entry. *Alcoholism: Clinical and Experimental Research, 29* , 1983-1990.	yes	count	349
43	Klimstra, T.A., Hale, W.W., Raaijmakers, Q., Branje, S., & Meeus, W. (2010). A developmental typology of adolescent personality. *European Journal of Personality, 24* , 309–323.	no	normal	923
44	Kokko, K., Tremblay, R.E., Lacourse, E., Nagin, D.S. & Vitaro, F. (2006) Trajectories of prosocial behavior and physical aggression in middle childhood: Links to adolescent school dropout and physical violence. *Journal of Research on Adolescence, 16* , 403-428.	yes	normal	1,037
45	Lacourse, E., Cote, S., Nagin, D., Vitaro, F., Brendgen, M. & Tremblay, R. (2002). A longitudinal–experimental approach to testing theories of antisocial behavior development. *Development and Psychopathology* , *14*, 909–924.	yes	count	909
46	Lacourse, E., Nagin, D., Tremblay, R.E., Vitaro, F. & Claes, M. (2003). Developmental trajectories of boys' delinquent group membership and facilitation of violent behaviors during adolescence. *Development and Psychopathology* , 15, 183–197.	yes	binary	969
47	Lahey, B.B., Van Hulle, C.A., Waldman, I.D., Rogers, J.L., D'Onofrio, B.M., Pedlow, S., Rathouz, P. & Keenan, K. (2006). Testing descriptive hypotheses regarding sex differences in the development of conduct problems and delinquency. *Journal of Abnormal Child Psychology, 34*, 737–755.	yes	count	4,572
48	Laird, R.D., Criss, M.M. Pettit, G.S., Dodge, K.A., & Bates, J.E. (2008). Parents' monitoring knowledge attenuates the link between antisocial friends and adolescent delinquent behavior. *Journal of Abnormal Child Psychology, 36* , 299–310.	yes	normal	504

49	Lansford, J.E., Criss, M.M., Dodge, K.A., Shaw, D.S., Pettit, G.S. & Bates, J.E. (2009). Trajectories of physical discipline: Early childhood antecedents and developmental outcomes. *Child Development, 80* , 1385–1402.	yes	normal	499; 258
50	Leblanc, N., Boivin, M., Dionne, G., Brendgen, M., Vitaro, F., Tremblay, R.E., & Perusse, D. (2008). The development of hyperactive–impulsive behaviors during the preschool years: The predictive validity of parental assessments. *Journal of Abnormal Child Psychology, 36,* 977–987.	yes	normal	1,112
51	Lee, B.R. & Thompson, R. (2009). Examining externalizing behavior trajectories of youth in group homes: Is there evidence for peer contagion? *Journal of Abnormal Child Psychology, 37,* 31–44.	no	count	744
52	Letcher, P., Smart, D., Sanson, A., & Toumbourou, J.W. (2009). Psychosocial precursors and correlates of differing internalizing trajectories from 3 to 15 Years. *Social Development, 18* , 618-646.	yes	normal	874; 810
53	Losoya, S.H., Knight, G.P., Chassin, L., Little, M., Vargas-Chanes, O., Mauricio, A., & Piquero, A. (2008) Trajectories of acculturation and enculturation in relation to heavy episodic drinking and marijuana use in a sample of Mexican American serious juvenile offenders. *Journal of Drug Issues, 1* , 171-198.	no	normal	332
54	Louvet, B., Gaudreau, P., Menaut, A., Genty, J., & Deneuve, P. (2007). Longitudinal patterns of stability and change in coping across three competitions: A latent class growth analysis. *Journal of Sport & Exercise Psychology, 29* , 100-117.	yes	normal	107
55	Luyckx, K., Schwartz, S.J., Goossens, L., Soenens, B. & Beyers, W. (2008). Developmental typologies of identity formation and adjustment in female emerging adults: A latent class growth analysis approach. *Journal of Research on Adolescence, 18* , 595–619.	no	normal	428
56	Lynne-Landsman, S.D., Graber, J.A., Andrews, J.A., (2010). Do trajectories of household risk in childhood moderate pubertal timing effects on substance initiation in middle school? *Developmental Psychology,46,* 853–868.	yes	normal	1070
57	Maggi, S., Hertzman, C., Vaillancourt, T. (2007) Changes in smoking behaviors from late childhood to adolescence: Insights from the Canadian national longitudinal survey of children and youth. *Health Psychology, 26,* 232-240.	yes	binary; count	260; 280; 2886
58	Marmorstein, N.R., White, H., Chung, T., Hipwell, A. Stouthamer-Loeber, M. and Loeber, R. (2010). Associations between first use of substances and change in internalizing symptoms among girls: Differences by symptom trajectory and substance use type. *Journal of Clinical Child & Adolescent Psychology, 39* , 545–558.	no	normal	2299
59	Mazza, J.J., Fleming, C.B., Abbott, R.D., Haggerty, K.P. & Catalano. (2010) Identifying trajectories of adolescents' depressive phenomena: An examination of early risk factors. *Journal of Youth and Adolescence, 39* , 579-593.	yes	normal	440; 511
60	McDevitt-Murphy, M.E., Parra, G.R., Shea, M.R., & Yen, S., Grilo, C.M., Sanislow, C.A., McGlashan, T.H., Gunderson, J.G., Skodol, A.E., Markowitz, J.C. (2009). Trajectories of PTSD and substance use disorders in a longitudinal study of personality disorders. *Psychological Trauma: Theory, Research, Practice, and Policy, 1* , 269–281.	no	binary	668
61	Moilanen, K.L., Crockett, L.J., Raffaelli, M., & Jones, B.L. (2010). Trajectories of sexual risk from middle adolescence to early adulthood. *Journal of Research on Adolescence, 20* , 114–139.	no	normal	1121

62	Morgan-Lopez, A.A., Cluff, L.A., Fals-Stewart, W. (2009). Capturing the impact of membership turnover in small groups via latent class growth analysis: Modeling the rise of the New York Knicks of the 1960s and 1970s. *Group Dynamics, 13* , 120-132.	yes	normal	118
63	Mulvey, E.P., Steinberg, L., Piquero, A.R., Besana, M., Fagan, J., Schubert, C. & Cauffman, E. (2010). Trajectories of desistance and continuity in antisocial behavior following court adjudication among serious adolescent offenders. *Development and Psychopathology, 22* , 453–475.	yes	count	1119
64	Murphy, D.A., Brecht, M.L., Herbeck, D.M., Huang, D. (2009). Trajectories of HIV risk behavior from age 15 to 25 in the National Longitudinal Survey of Youth sample. *Journal of Youth Adolescence, 38* , 1226–1239.	yes	normal	4169; 4039
65	Mustillo, S., Worthman, S., Erkanli, A., Keeler, G. Angold, A., Costello, E.J. (2003). Obesity and Psychiatric Disorder: Developmental Trajectories. *Pediatrics, 111* , 851-859.	yes	binary	991
66	Nagin, D.S. & Odgers, C.L. (2010). Group-based trajectory modeling in clinical research. *Annual Review of Clinical Psychology, 6* , 109–138.	no	count	1037
67	Nagin, D. & Tremblay, R.E (1999). Trajectories of boys' physical aggression, opposition, and hyperactivity on the path to physically violent and nonviolent juvenile delinquency. *Child Development, 70* , 1181-1196.	yes	normal	1037
68	Nagin, D.S. & Tremblay, R.E. (2005). What has been learned from group-based trajectory modeling? Examples from physical aggression and other problem behaviors. *The Annals of the American Academy of Political and Social Science, 602* , 82-117.	no	binary; count; normal	various
69	Nash, J.K. & Kim, J.S. (2007). Patterns of change over time in beliefs legitimizing aggression in adolescents and young adults: Risk trajectories and their relationship with serious aggression. *Social Work Research, 31* , 231-240.	yes	normal	1227
70	Nash, J.K., Thompson, S., & Kim, J.S. (2006). Residential trajectories of participants in North Carolina's Willie-M. Program. *Journal of Social Service Research, 33,* 53-68.	yes	normal	611
71	Oberlander, S.E., Agostini, W., Houston, A., Black, W. (2010). A seven-year investigation of marital expectations and marriage among urban, low-Income, African American adolescent mothers. *Journal of Family Psychology, 24* , 31–40.	yes	normal	181
72	Obradovic, J., Burt, K.B., & Masten, A.S. (2006). Pathways of adaptation from adolescence to young adulthood antecedents and correlates. *Annals of the New York Academy of Sciences, 1094* , 340–344.	yes	normal	205
73	Odgers, C.L., Moffitt, T.E., Broadbent, J.M., Dickson, N., Hancox, R.J., Harrington, H., Poulton, R., Sears, M.R., Thomson, W. & Caspi, A. (2008). Female and male antisocial trajectories: From childhood origins to adult outcomes. *Development and Psychopathology, 20,* 673–716.	no	normal	494; 526
74	Otten, R., Wanner, B., Vitaro, F., & Engels, R. (2008). Own and friends' smoking attitudes and social preference as early predictors of adolescent smoking. *Journal of Clinical Child & Adolescent Psychology* , 37, 808–819.	yes	count	203
75	Paciello, M., Fida, R., Tramontano, C., Lupinetti, C. & Caprara, G. (2008). Stability and change of moral disengagement and its impact on aggression and violence in late adolescence. *Child Development, 79* , 1288 – 1309.	yes	normal	366
76	Pepler, D., Jiang, D., Craig, W., Connolly, J. (2008). Developmental trajectories of bullying and associated factors. *Child Development,79* , 325 – 338.	yes	normal	871

77	Petitclerc, A., Boivin, M. Dionne, G. Zoccolillo, M. & Tremblay, R. (2009). Disregard for rules: the early development and predictors of a specific dimension of disruptive behavior disorders. *Journal of Child Psychology and Psychiatry, 50* , 1477–1484.	yes	normal	1942
78	Piquero, A.R., Blumstein, A., Brame, R., Haapanen, R., Mulvey, E.P., & Nagin, D.S. (2001). Assessing the impact of exposure time and incapacitation on longitudinal trajectories of criminal offending. *Journal of Adolescent Research, 16,* 154-174.	yes	count	277
79	Ramos-Marcusea, F., Oberlanderb, S.E., Papasb, M.A., McNaryc, S.W., Hurleyb, S. and Blackb, M.M. (2010). Stability of maternal depressive symptoms among urban, low-income, African American adolescent mothers. *Journal of Affective Disorders, 122* , 68-75.	yes	normal	181
80	Ratelle, C.F., Guay, F., Larose, S. & Seneca, C. (2004). Family correlates of trajectories of academic motivation during a school transition: A semiparametric group-based approach. *Journal of Educational Psychology, 96* , 743–754.	yes	normal	729
81	Reinecke, J. (2006). Longitudinal analysis of adolescents' deviant and delinquent behavior: applications of latent class growth curves and growth mixture models, *Methodology* 2, 100-112.	no	count	813
82	Romens, S.E., Abramson, L.Y., & Alloy, L.B. (2009). High and low cognitive risk for depression: Stability from late adolescence to early adulthood. *Cognitive Therapy and Research, 33* , 480–498.	yes	normal	345
83	Sablonniere, R., Taylor, D., Perozzo, C. & sadykova, N. (2009). Reconceptualizing relative deprivation in the context of dramatic social change: the challenge confronting the people of Kyrgyzstan. *European Journal of Social Psychology, 39* , 325–345.	NR	normal	565
84	Sallinen, M., Ronka, A., Kinnunen, U. & Kokko, K. (2007). Trajectories of depressive mood in adolescents: Does parental work or parent–adolescent relationship matter? A follow-up study through junior high school in Finland. *International Journal of Behavioral Development* , 31, 181–190.	yes	normal	116
85	Segawa, E., Ngwe, J.E., Li, Y., Flay, B. & Aban Aya Coinvestigators. (2005). Evaluation of the effects of the Aban Aya Youth Project in reducing violence among African American adolescent males using latent class growth mixture modeling techniques, *Evaluation Review,* 29, 128-148.	yes	normal	552
86	Shaw, D.S., Lacourse, E. & Nagin, D.S. (2005). Developmental trajectories of conduct problems and hyperactivity from ages 2 to 10, *Journal of Child Psychology and Psychiatry, 46,* 931–942.	yes	normal	284
87	Shaw, D.S., Gilliom, M. Ingoldsby, E. & Nagin, D.S. (2003). Trajectories leading to school-age conduct problems. *Developmental Psychology, 39* , 189–200.	yes	normal	284
88	Sher, K.J., Gotham, H.J. & Watson, A.L. (2004). Trajectories of dynamic predictors of disorder: Their meanings and implications. *Development and Psychopathology, 16* , 825–856.	no	binary	336
89	Suarez-Orozco, C., Gaytan, F., Bang, H., Pakes, J., O'Connor, E., Rhodes, J. (2010). Academic trajectories of newcomer youth. *Developmental Psychology, 46* , 602-618.	yes	normal	407
90	Torppa, M., Poikkeus, A., Laakso, M., Eklund, K., Lyytinen, H. (2006). Predicting delayed letter knowledge development and its relation to grade 1 reading achievement among children with and without familial risk for dyslexia. *Developmental Psychology, 42* , 1128-1142.	yes	count	186
91	Tucker, J.S., Ellickson, P., Orlando, M., Martino, S. & Klein, D. (2005). Substance use trajectories from early adolescence to emerging adulthood: A comparison of smoking, binge drinking, and marijuana use. *Journal of Drug Use, 2* , 307-332.	yes	count	6,527

92	Tucker, J.S., Orlando, M., Ellickson, P.L. (2003). Patterns and correlates of binge drinking trajectories from early adolescence to young adulthood. *Health Psychology, 22* , 79–87.	yes	normal	5,694
93	Underwood, M.K., Beron, K.J., and Rosen, L. (2009). Continuity and change in social and physical aggression from middle childhood through early adolescence. *Aggressive Behavior, 35* , 357–375.	yes	normal	281
94	Vaillancourt, T., Miller, J.L., Fagbemi, J., Cote, S. & Tremblay, R. (2007). Trajectories and predictors of indirect aggression: Results from a nationally representative longitudinal study of canadian children aged 2–10. *Aggressive Behavior, 33,* 314–326.	yes	normal	1,401
95	Van Der Vorst, H., Vermulst, A., Meeus, W., Dekovic, M., & Engels, R. (2009). Identification and prediction of drinking trajectories in early and mid-adolescence. *Journal of Clinical Child & Adolescent Psychology, 38* , 329–341.	no	count	428
96	Vermote, R., Fonagy, P., Vertommen, H., Fonagy, P., Vertommen, H., Verhaest, Y., Stroobants, R., Vandeneede, B., Corveleyn, J., Lowyck, B., Luyten, P., & Peuskens, J. (2009). Outcome and outcome trajectories of personality disordered patients during and after a psychoanalytic hospitalization-based treatment. *Journal of Personality Disorders, 23,* 294–307.	no	normal	70
97	Vitaro, F., Brendgen, M., Wanner, B. (2005). Patterns of affiliation with delinquent friends during late childhood and early adolescence: Correlates and consequences. *Social Development, 14* , 82-108.	yes	count	376
98	Wiesner, M. & Kim, H. (2006). Co-Occurring delinquency and depressive symptoms of adolescent boys and girls: A dual trajectory modeling approach. *Developmental Psychology, 42* , 1220–1235.	yes	normal; count	985
99	Xie, H., McHugo, G., He, X., & Drake, R. (2010). Using the group-based dual trajectory model to analyze two related longitudinal outcomes. *Journal of Drug Issues, 1* , 45-62.	yes	normal	223
100	Zhou, Q., Hofer, C. Eisenberg, N., Reiser, M., Spinrad, T., and Fabes, R. (2007). The developmental trajectories of attention focusing, attentional and behavioral persistence, and externalizing problems during school-age years. *Developmental Psychology , 43* , 369–385.	yes	normal	356

Calculating SPGM-approximated means and variances of underlying random effects:
K=6 class empirical example SAS code

```
%MACRO PALL(K=6);
proc iml;
alpha_1={5.1853639 -1.4321252   0.25801088   0.11413666};
alpha_2={1.6987561 -.096339802  .037193793   -.013339989};
alpha_3={14.430648  1.0015364   -0.17040364  -0.13718840};
alpha_4={4.1738782 -0.64797717  .0078335891  .010642704};
alpha_5={7.0980349 -1.6577085   0.13105988   .027797890};
alpha_6={9.2412841  0.17286687  -0.16417953  -.039763760};
/*input K vectors of SPGM's class-specific fixed effects*/

prob_c1=0.06582;
prob_c2=0.34718;
prob_c3=0.03522;
prob_c4=0.38566;
prob_c5=0.06263;
prob_c6=0.10348; /*input K class probabilities*/

alpha=alpha_1//alpha_2//alpha_3//alpha_4//alpha_5//alpha_6;
prob=prob_c1||prob_c2||prob_c3||prob_c4||prob_c5||prob_c6;

lambda={
1 -3.5  12.25 -42.875,
1  -2.5  6.25 -15.625,
1  -1     1     -1 ,
1  .5    .25   .125,
1  1.5   2.25  3.375,
1  3.5  12.25  42.875};

/*Equation (8) in manuscript*/
mu_growth=prob*alpha;
print mu_growth;

/*Equation (9) in manuscript*/
VARi=J(4,4,0); /* <--put your implied dimension of u (# underlying random
                    effects) in place of 4*/
%do i= 1 %to &k.;
  %do j=(&i.+1) %to &k.;
    q1=(alpha_&i.`);
    q2=(alpha_&j.`);
      q3=(q1-q2);
      q4=(q1-q2)`;
      vari = vari` +(prob_c&i.*prob_c&j.*(q3*q4));
  %end;
%end;
var_growth_only=(vecdiag(vari))`;
covar_growth=vari;
print var_growth_only;
print covar_growth;
QUIT;
%mend;
%pall(K=6); /*put # of SPGM classes here*/
```