

```

proc sort; by kid visit; run;

proc genmod descending data=growth; class kid;      * GEE - compound symmetry
  model grwthhor =
  lhazag male1fe0 /*g1ng0*/ white privateins highedu incomehigh tannergt1
  agemid agehigh iegfr visit / link=logit dist=bin;
  repeated subject=kid / type=cs corrw;      * type= ind ar1;
  estimate "additional sds" lhazag 1 / exp;
  estimate "male1fe0" male1fe0 1 / exp;
  /*estimate "g1ng0" g1ng0 1 / exp;*/
  estimate "white" white 1 / exp;
  estimate "privateins" privateins 1 / exp;
  estimate "highedu" highedu 1 / exp;
  estimate "incomehigh" incomehigh 1 / exp;
  estimate "tannergt1" tannergt1 1 / exp;
  estimate "agehigh" agehigh 1 / exp;
  estimate "agemid" agemid 1 / exp;
  estimate "iegfr" iegfr 1 / exp;
run;

proc glimmix data=growth method=quad; *(qpoints=31) empirical;      * MLE;
  class kid;
  model grwthhor = lhazag male1fe0 white privateins highedu
                  incomehigh tannergt1 agemid agehigh iegfr visit /
                  solution link=logit dist=bin chisq;
  random intercept / subject=kid g ; *v;
  * random _residual_ / subject=kid type=ar(1);
  estimate "additional sds" lhazag 1 / exp;
  estimate "male1fe0" male1fe0 1 / exp;
  /*estimate "g1ng0" g1ng0 1 / exp;*/
  estimate "white" white 1 / exp;
  estimate "privateins" privateins 1 / exp;
  estimate "highedu" highedu 1 / exp;
  estimate "incomehigh" incomehigh 1 / exp;
  estimate "tannergt1" tannergt1 1 / exp;
  estimate "agehigh" agehigh 1 / exp;
  estimate "agemid" agemid 1 / exp;
  estimate "iegfr" iegfr 1 / exp;
run; *endsas;

```

```
set more off // Stata xtmelogit: random intercept
xtmelogit grwthor lhazag MALE1FE0 white privateins highedu incomehigh ///
    tannergt1 agemid agehigh iegfr visit || KID: , intpoints(7) // default
```

```
set more off
bootstrap, cluster(KID) reps(200) seed(123456): ///
xtmelogit grwthor lhazag MALE1FE0 white privateins highedu incomehigh ///
    tannergt1 agemid agehigh iegfr visit || KID: , intpoints(7) ///
difficult iterate(1000)
```

```
set more off
gllamm grwthor lhazag MALE1FE0 white privateins highedu incomehigh ///
    tannergt1 agemid agehigh iegfr visit , i(KID) link(logit) ///
    family(binomial) nip(7) adapt
```

The GENMOD Procedure - repeated type=ind
 Analysis Of GEE Parameter Estimates
Empirical Standard Error Estimates

Parameter	Estimate	Standard Error	95% Confidence Limits		Z	Pr > Z
Intercept	0.2505	1.4560	-2.6032	3.1041	0.17	0.8634
lhazag	-0.3363	0.2640	-0.8536	0.1811	-1.27	0.2027
MALE1FEO	1.2348	0.5408	0.1749	2.2947	2.28	0.0224
white	-0.2855	0.5613	-1.3857	0.8146	-0.51	0.6110
privateins	-1.3665	0.7041	-2.7466	0.0136	-1.94	0.0523
highedu	-0.0628	0.4845	-1.0124	0.8869	-0.13	0.8969
incomehigh	1.7175	0.7973	0.1549	3.2802	2.15	0.0312
tannergt1	-1.0203	1.3634	-3.6926	1.6519	-0.75	0.4542
agemid	-0.0362	0.6248	-1.2607	1.1883	-0.06	0.9538
agehigh	-0.5693	0.8494	-2.2340	1.0954	-0.67	0.5027
iegfr	-0.0507	0.0230	-0.0958	-0.0057	-2.21	0.0272
VISIT	0.0051	0.0188	-0.0317	0.0419	0.27	0.7858

GEE Fit Criteria
 QIC 180.129

The GENMOD Procedure - no repeated statement-logistic regression
 Analysis Of Maximum Likelihood Parameter Estimates

Parameter	DF	Estimate	Standard Error	Wald 95% Confidence Limits		Wald Chi-Square	Pr > ChiSq
Intercept	1	0.2505	1.2626	-2.2241	2.7251	0.04	0.8427
lhazag	1	-0.3363	0.2669	-0.8594	0.1868	1.59	0.2077
MALE1FEO	1	1.2348	0.4790	0.2960	2.1736	6.65	0.0099
white	1	-0.2855	0.5871	-1.4362	0.8652	0.24	0.6268
privateins	1	-1.3665	0.5280	-2.4013	-0.3316	6.70	0.0097
highedu	1	-0.0628	0.5315	-1.1046	0.9790	0.01	0.9060
incomehigh	1	1.7175	0.6748	0.3950	3.0401	6.48	0.0109
tannergt1	1	-1.0203	0.7496	-2.4894	0.4488	1.85	0.1734
agemid	1	-0.0362	0.5506	-1.1153	1.0429	0.00	0.9476
agehigh	1	-0.5693	0.6681	-1.8788	0.7402	0.73	0.3942
iegfr	1	-0.0507	0.0185	-0.0869	-0.0146	7.56	0.0060
VISIT	1	0.0051	0.0188	-0.0317	0.0419	0.07	0.7863

The GENMOD Procedure - type=ar1
 Analysis Of GEE Parameter Estimates
 Empirical Standard Error Estimates

Parameter	Estimate	Standard Error	95% Confidence Limits		Z	Pr > Z
			Lower	Upper		
Intercept	0.4870	1.4372	-2.3297	3.3038	0.34	0.7347
lhazag	-0.2982	0.2523	-0.7928	0.1964	-1.18	0.2374
MALE1FE0	1.1907	0.5550	0.1029	2.2786	2.15	0.0319
white	-0.2504	0.5820	-1.3911	0.8903	-0.43	0.6671
privateins	-1.3113	0.7285	-2.7392	0.1166	-1.80	0.0719
highedu	-0.0731	0.4970	-1.0471	0.9009	-0.15	0.8830
incomehigh	1.7355	0.8071	0.1536	3.3174	2.15	0.0315
tannergt1	-0.9214	1.3279	-3.5240	1.6812	-0.69	0.4877
agemid	-0.1209	0.6197	-1.3356	1.0938	-0.20	0.8453
agehigh	-0.6216	0.8161	-2.2211	0.9778	-0.76	0.4462
iegfr	-0.0550	0.0245	-0.1030	-0.0069	-2.24	0.0249
VISIT	0.0063	0.0189	-0.0307	0.0433	0.33	0.7392

Working Correlation Matrix

	Col1	Col2	Col3	Col4	Col5
Row1	1.0000	0.3932	0.1546	0.0608	0.0239
Row2	0.3932	1.0000	0.3932	0.1546	0.0608
Row3	0.1546	0.3932	1.0000	0.3932	0.1546
Row4	0.0608	0.1546	0.3932	1.0000	0.3932
Row5	0.0239	0.0608	0.1546	0.3932	1.0000

GEE Fit Criteria: QIC 181.5858

The GENMOD Procedure - type=cs
 Analysis Of GEE Parameter Estimates
 Empirical Standard Error Estimates

Parameter	Estimate	Standard Error	95% Confidence Limits		Z	Pr > Z
			Lower	Upper		
Intercept	0.7782	1.4535	-2.0706	3.6269	0.54	0.5924
lhazag	-0.2149	0.2456	-0.6964	0.2665	-0.88	0.3815
MALE1FE0	1.2669	0.5723	0.1453	2.3885	2.21	0.0268
white	-0.2226	0.6163	-1.4304	0.9853	-0.36	0.7180
privateins	-1.3947	0.7372	-2.8397	0.0502	-1.89	0.0585
highedu	-0.2732	0.5220	-1.2963	0.7498	-0.52	0.6007
incomehigh	1.8086	0.8291	0.1835	3.4337	2.18	0.0292
tannergt1	-0.9132	1.3193	-3.4989	1.6725	-0.69	0.4888
agemid	-0.0415	0.6407	-1.2972	1.2143	-0.06	0.9484
agehigh	-0.6258	0.7940	-2.1819	0.9304	-0.79	0.4306
iegfr	-0.0543	0.0246	-0.1024	-0.0061	-2.21	0.0271
VISIT	0.0041	0.0190	-0.0331	0.0414	0.22	0.8278

Working Correlation Matrix

	Col1	Col2	Col3	Col4	Col5
Row1	1.0000	0.3113	0.3113	0.3113	0.3113
Row2	0.3113	1.0000	0.3113	0.3113	0.3113
Row3	0.3113	0.3113	1.0000	0.3113	0.3113
Row4	0.3113	0.3113	0.3113	1.0000	0.3113
Row5	0.3113	0.3113	0.3113	0.3113	1.0000

GEE Fit Criteria: QIC 182.7400

The GLIMMIX Procedure -MLE: 7 integration points (chosen by GLIMMIX)
Covariance Parameter Estimates

Cov Parm	Subject	Estimate	Standard Error
Intercept	KID	5.4542	3.5389

Solutions for Fixed Effects

Effect	Estimate	Standard Error	DF	t Value	Pr > t
Intercept	1.5283	2.7533	41	0.56	0.5819
lhazag	-0.3152	0.5664	108	-0.56	0.5790
MALE1FE0	2.1958	1.1941	108	1.84	0.0687
white	-0.2884	1.3783	108	-0.21	0.8346
privateins	-2.1203	1.2241	108	-1.73	0.0861
highedu	-0.4399	1.2407	108	-0.35	0.7236
incomehigh	2.9496	1.6029	108	1.84	0.0685
tannergt1	-1.4113	1.7105	108	-0.83	0.4111
agemid	-0.1245	1.2849	108	-0.10	0.9230
agehigh	-1.3573	1.6675	108	-0.81	0.4174
iegfr	-0.09774	0.04784	108	-2.04	0.0435
VISIT	0.006182	0.02489	108	0.25	0.8043

Fit Statistics

-2 Log Likelihood	125.95
AIC (smaller is better)	151.95

The GLIMMIX Procedure - MLE: 31 points
Covariance Parameter Estimates

Cov Parm	Subject	Estimate	Standard Error
Intercept	KID	5.4326	3.5917

Solutions for Fixed Effects

Effect	Estimate	Standard Error	DF	t Value	Pr > t
Intercept	1.5256	2.7476	41	0.56	0.5817
lhazag	-0.3172	0.5663	108	-0.56	0.5766
MALE1FE0	2.1891	1.1921	108	1.84	0.0691
white	-0.2871	1.3738	108	-0.21	0.8348
privateins	-2.1226	1.2262	108	-1.73	0.0863
highedu	-0.4405	1.2399	108	-0.36	0.7231
incomehigh	2.9513	1.6078	108	1.84	0.0692
tannergt1	-1.4150	1.7078	108	-0.83	0.4092
agemid	-0.1259	1.2836	108	-0.10	0.9221
agehigh	-1.3532	1.6645	108	-0.81	0.4180
iegfr	-0.09763	0.04782	108	-2.04	0.0436
VISIT	0.006181	0.02489	108	0.25	0.8043

The GLIMMIX Procedure - **MLE**: 31 points, **empirical variance**
Covariance Parameter Estimates

Cov Parm	Subject	Estimate	Standard Error
Intercept	KID	5.4326	4.1012

Solutions for Fixed Effects

Effect	Estimate	Standard Error	DF	t Value	Pr > t
Intercept	1.5256	2.5983	41	0.59	0.5603
lhazag	-0.3172	0.4458	108	-0.71	0.4783
MALE1FE0	2.1891	1.0961	108	2.00	0.0483
white	-0.2871	1.0333	108	-0.28	0.7816
privateins	-2.1226	1.1667	108	-1.82	0.0716
highedu	-0.4405	0.9315	108	-0.47	0.6372
incomehigh	2.9513	1.4277	108	2.07	0.0411
tannergt1	-1.4150	1.9798	108	-0.71	0.4763
agemid	-0.1259	1.0676	108	-0.12	0.9064
agehigh	-1.3532	1.4836	108	-0.91	0.3637
iegfr	-0.09763	0.04687	108	-2.08	0.0396
VISIT	0.006181	0.03079	108	0.20	0.8413

The GLIMMIX Procedure - **RSPL** (default-NOT MLE) empirical - (Not recommended)
Covariance Parameter Estimates

Cov Parm	Subject	Estimate	Standard Error
Intercept	KID	3.6568	1.5775

Solutions for Fixed Effects

Effect	Estimate	Standard Error	DF	t Value	Pr > t
Intercept	1.0428	1.8537	41	0.56	0.5768
lhazag	-0.2403	0.3197	108	-0.75	0.4540
MALE1FE0	1.5551	0.6468	108	2.40	0.0179
white	-0.2156	0.7302	108	-0.30	0.7684
privateins	-1.5751	0.8107	108	-1.94	0.0546
highedu	-0.2710	0.6039	108	-0.45	0.6545
incomehigh	2.1028	0.9204	108	2.28	0.0243
tannergt1	-1.0109	1.4147	108	-0.71	0.4764
agemid	-0.1333	0.7559	108	-0.18	0.8604
agehigh	-0.9481	1.0594	108	-0.89	0.3728
iegfr	-0.06877	0.02938	108	-2.34	0.0211
VISIT	0.004607	0.02499	108	0.18	0.8541

Fit Statistics

-2 Res Log Pseudo -Likelihood	844.16
Generalized Chi-Square	77.11
Gener. Chi-Square / DF	0.52

The GLIMMIX Procedure - **RSPL** Random intercept, Random ar1 (R side)
 (No likelihood with R side effects - GEE flavor)
 Estimated V Matrix for KID 101013

Row	Col1	Col2	Col3	Col4	Col5
1	162.13	-5.9365	10.7229	9.1097	9.2724
2	-5.9365	153.44	-4.6443	10.6630	9.1199
3	10.7229	-4.6443	137.23	-3.6777	10.5271
4	9.1097	10.6630	-3.6777	134.09	-2.9904
5	9.2724	9.1199	10.5271	-2.9904	124.00

Covariance Parameter Estimates

Cov Parm	Subject	Estimate	Standard Error
Intercept	KID	9.2578	3.1015
AR(1)	KID	-0.1023	0.1345
Residual		0.3903	0.05257

Fit Statistics

-2 Res Log Pseudo-Likelihood	941.83
Generalized Chi-Square	58.16
Gener. Chi-Square / DF	0.39

```
. xtmelogit grwthhor lhazag MALE1FE0 white privateins highedu incomehigh tannergt1 ///
> agemid agehigh iegfr visit || KID: , intpoints(7)
```

```
Mixed-effects logistic regression      Number of obs      =      161
Group variable: KID                   Number of groups   =       51
                                      Obs per group: min =       1
                                      avg =           3.2
                                      max =           5
Integration points = 7                 Wald chi2(11)      =      11.21
Log likelihood = -62.973352            Prob > chi2        =      0.4261
```

grwthhor	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]
lhazag	-.3028234	.5651927	-0.54	0.592	-1.410581 .8049339
MALE1FE0	2.16784	1.182735	1.83	0.067	-.1502788 4.485959
white	-.3052391	1.371575	-0.22	0.824	-2.993477 2.382999
privateins	-2.118569	1.218486	-1.74	0.082	-4.506758 .2696206
highedu	-.4422988	1.235175	-0.36	0.720	-2.863198 1.9786
incomehigh	2.960992	1.599533	1.85	0.064	-.1740359 6.09602
tannergt1	-1.42472	1.702905	-0.84	0.403	-4.762353 1.912913
agemid	-.1408883	1.278518	-0.11	0.912	-2.646738 2.364961
agehigh	-1.366583	1.659642	-0.82	0.410	-4.619422 1.886256
iegfr	-.0983706	.0478521	-2.06	0.040	-.192159 -.0045823
visit	.0057866	.0248555	0.23	0.816	-.0429293 .0545024
_cons	1.642837	2.75756	0.60	0.551	-3.761881 7.047555

Random-effects Parameters	Estimate	Std. Err.	[95% Conf. Interval]
KID: Identity			
sd(_cons)	2.320076	.7480343	1.233273 4.364605

```
LR test vs. logistic regression: chibar2(01) = 14.90 Prob>=chibar2 = 0.0001
```

The GLIMMIX Procedure - MLE: 7 points

Effect	Estimate	Standard Error	DF	t Value	Pr > t
Intercept	1.5283	2.7533	41	0.56	0.5819
lhazag	-0.3152	0.5664	108	-0.56	0.5790
MALE1FE0	2.1958	1.1941	108	1.84	0.0687
white	-0.2884	1.3783	108	-0.21	0.8346
privateins	-2.1203	1.2241	108	-1.73	0.0861
highedu	-0.4399	1.2407	108	-0.35	0.7236
incomehigh	2.9496	1.6029	108	1.84	0.0685
tannergt1	-1.4113	1.7105	108	-0.83	0.4111
agemid	-0.1245	1.2849	108	-0.10	0.9230
agehigh	-1.3573	1.6675	108	-0.81	0.4174
iegfr	-0.09774	0.04784	108	-2.04	0.0435
VISIT	0.006182	0.02489	108	0.25	0.8043

Cov Parm	Subject	Estimate	Standard Error
Intercept	KID	5.4326	3.5917

Fit Statistics

```
-2 Log Likelihood 125.95
```



```
. gllamm grwthhor lhazag MALE1FEO white privateins highedu incomehigh tannergt1 ///
>      agemid agehigh iegfr visit , i(KID) link(logit) family(binomial) nip(7) adapt
```

Running adaptive quadrature

```
Iteration 0:  log likelihood = -68.597962
Iteration 1:  log likelihood = -67.157558
Iteration 2:  log likelihood = -63.727766
Iteration 3:  log likelihood = -63.015054
Iteration 4:  log likelihood = -62.967555
Iteration 5:  log likelihood = -62.967569
```

Adaptive quadrature has converged, running Newton-Raphson

```
Iteration 0:  log likelihood = -62.967569
Iteration 1:  log likelihood = -62.967569 (backed up)
Iteration 2:  log likelihood = -62.967562
Iteration 3:  log likelihood = -62.967562
```

```
number of level 1 units = 161
number of level 2 units = 51
```

Condition Number = 324.93049

gllamm model

log likelihood = -62.967562

grwthhor	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]	
lhazag	-.2993026	.5609315	-0.53	0.594	-1.398708	.800103
MALE1FEO	2.161773	1.180376	1.83	0.067	-.1517217	4.475268
white	-.3012487	1.364004	-0.22	0.825	-2.974648	2.37215
privateins	-2.133808	1.241471	-1.72	0.086	-4.567046	.2994305
highedu	-.4571072	1.244212	-0.37	0.713	-2.895718	1.981503
incomehigh	2.977027	1.612492	1.85	0.065	-.1833997	6.137453
tannergt1	-1.457006	1.678205	-0.87	0.385	-4.746227	1.832214
agemid	-.1433654	1.272568	-0.11	0.910	-2.637552	2.350821
agehigh	-1.344188	1.609531	-0.84	0.404	-4.498811	1.810436
iegfr	-.0987381	.0481971	-2.05	0.040	-.1932027	-.0042735
visit	.0058072	.0248665	0.23	0.815	-.0429303	.0545447
_cons	1.676762	2.737177	0.61	0.540	-3.688008	7.041531

Variances and covariances of random effects

***level 2 (KID)

var(1): 5.5181355 (3.7023799)