glmer in R and glimmix in SAS

1. Compliance in Pet-Covid project

1.1 Laplace Approximation (default method in R)

R code and result

```
m <- glmer(Compliance ~ MostAttach + time +(1|workerId), data = alldata, family = "binomial")
```

```
Random effects:
 Groups   Name        Variance Std.Dev.
 workerId (Intercept) 94.29    9.71
Number of obs: 1164, groups:  workerId, 498

Fixed effects:
             Estimate Std. Error z value Pr(>|z|)
(Intercept)   -6.8722     0.8305  -8.275  < 2e-16 ***
MostAttachCat -1.2829     0.5851  -2.193  0.02833 *
time2          0.8226     0.3279   2.509  0.01211 *
time3          0.9795     0.3370   2.906  0.00366 **
```

SAS code and result

```
proc glimmix data=set1 method=laplace;
class workerId MostAttach time(ref='1') Compliance(ref='0');
model Compliance = MostAttach time /s dist=binary link=logit;
random intercept/subject=workerId;
run;
```

Covariance Parameter Estimates

Cov Parm	Subject	Estimate	Standard Error
Intercept	workerId	94.5486	27.0308

Solutions for Fixed Effects

Effect	MostAttach	time	Estimate	Standard Error	DF	t Value	Pr > |t|
Intercept			-6.8793	0.8343	497	-8.25	<.0001
MostAttach	"Cat"		-1.2814	0.5853	663	-2.19	0.0289
MostAttach	"Dog"		0	.	.	.	.
time		2	0.8237	0.3283	663	2.51	0.0123
time		3	0.9805	0.3374	663	2.91	0.0038
time		1	0	.	.	.	.

1.2 Adaptive Quadrature Method (Common method used in SAS)

```
m <- glmer(Compliance ~ MostAttach + time +(1|workerId), data = alldata, family = "binomial",nAGQ = 7)
```

```
Random effects:
 Groups   Name        Variance Std.Dev.
 workerId (Intercept) 10.36    3.219
Number of obs: 1164, groups:  workerId, 498

Fixed effects:
             Estimate Std. Error z value Pr(>|z|)
(Intercept)  -1.7163     0.2933  -5.852 4.86e-09 ***
MostAttachCat -1.7361     0.4178  -4.156 3.25e-05 ***
time2         0.3912     0.2539   1.541   0.1234
time3         0.5077     0.2640   1.923   0.0545 .
```

```
proc glimmix data=set1 method=quad(qpoints=7);
class workerId MostAttach time(ref='1') Compliance(ref='0');
model Compliance = MostAttach time /s dist=binary link=logit;
random intercept/subject=workerId;
run;
```

Covariance Parameter Estimates

Cov Parm	Subject	Estimate	Standard Error
Intercept	workerId	10.3621	1.9484

Solutions for Fixed Effects

Effect	MostAttach	time	Estimate	Standard Error	DF	t Value	Pr > |t|
Intercept			-1.7163	0.2933	497	-5.85	<.0001
MostAttach	"Cat"		-1.7361	0.4178	663	-4.16	<.0001
MostAttach	"Dog"		0	.	.	.	.
time		2	0.3912	0.2539	663	1.54	0.1239
time		3	0.5077	0.2640	663	1.92	0.0549
time		1	0	.	.	.	.

2. Simulation data with only subject effect

Here is my simulation process

```
rm(list = ls())
library(locfit)
library(lme4)
library(dplyr)
set.seed(1)
### data size
total_cattle <- 800
# fix and random effect
var_subject <- 3.29
PLC <- -0.3759
TIL <- -1.547269
# design 1
sim_1 <- data.frame(subject=c(1:total_cattle))
# animals are randomly allocated to receive trts
sim_1$trt <-sample(rep(1:2,each=total_cattle/2),replace = F)
################### part 2: simulate the outcome ########################
sim_1$subject_effect=rnorm(total_cattle,0,sqrt(var_subject))
sim_1 <- sim_1 %>%
  mutate(trt_effect = ifelse(trt==1,PLC,TIL)) %>%  # added fixed effect column
  mutate(added_effect = trt_effect+subject_effect) %>% # added all effect
  mutate(risk = expit(added_effect))  # get the inverse of the logistic link function
sim_1$y <- rbinom(n=total_cattle, size = 1, prob = sim_1$risk)
```

2.1 Laplace Approximation

```r
sim_1$trt <- as.factor(sim_1$trt)
sim_1$subject <- as.factor(sim_1$subject)
sim_1$y <- as.factor(sim_1$y)
m <- glmer(y ~ trt+(1|subject:trt), data=sim_1, family = "binomial")
```

```
Random effects:
 Groups       Name        Variance  Std.Dev.
 subject:trt (Intercept) 1.915e-09 4.377e-05
Number of obs: 800, groups:  subject:trt, 800

Fixed effects:
            Estimate Std. Error z value Pr(>|z|)
(Intercept)  -0.3125     0.1012  -3.087  0.00202 **
trt2         -0.6073     0.1500  -4.047 5.18e-05 ***
```

```
proc glimmix data=set1 method=laplace;
class subject trt(ref='1') y(ref='0');
model y = trt /s dist=binary link=logit;
random intercept /subject = subject(trt);
run;
```

Covariance Parameter Estimates

Cov Parm	Subject	Estimate	Standard Error
Intercept	subject(trt)	3.501E-6	0.2511

Solutions for Fixed Effects

Effect	trt	Estimate	Standard Error	DF	t Value	Pr > |t|
Intercept		-0.3125	0.1031	798	-3.03	0.0025
trt	2	-0.6073	0.1540	798	-3.94	<.0001
trt	1	0	.	.	.	.

2.2 Adaptive Quadrature Method

```
m <- glmer(y ~ trt+(1|subject:trt), data=sim_1, family = "binomial",nAGQ = 7)
```

```
Random effects:
 Groups       Name        Variance  Std.Dev.
 subject:trt (Intercept) 3.331e-07 0.0005772
Number of obs: 800, groups:  subject:trt, 800

Fixed effects:
            Estimate Std. Error z value Pr(>|z|)
(Intercept)  -0.3125     0.1013  -3.085  0.00203 **
trt2         -0.6073     0.1502  -4.043 5.27e-05 ***
```

```
proc glimmix data=set1 method=quad(qpoints=7);
class subject trt(ref='1') y(ref='0');
model y = trt /s dist=binary link=logit;
random intercept /subject = subject(trt);
run;
```

Covariance Parameter Estimates

Cov Parm	Subject	Estimate	Standard Error
Intercept	subject(trt)	0.3323	30.1047

Solutions for Fixed Effects

Effect	trt	Estimate	Standard Error	DF	t Value	Pr > |t|
Intercept		-0.3366	2.0454	798	-0.16	0.8693
trt	2	-0.6506	3.7242	798	-0.17	0.8614
trt	1	0	.	.	.	.