Model Summaries

NON-Tranformed Models

Summary of Intercept and Slope Parameters

Intercept

Model Number	Estimate	Std. Error	t-Stat	p-value
M0 (lmod0)	7.8294e+03	2.3480e+02	33.344	<2e-16
M1 (LMwFEint)	10.1124e+03	8.4495e+02	11.968	<2e-16
M2 (LMwFEslope)	9.559e+03	8.956e+02	10.673	<2e-16
M3 (LMMwREint)	7.3994e+03	7.6899e+02	9.622	8.06e-08
M4 (LMMwREslope)	7.4050e+03	7.6776e+02	9.645	8.4e-08
M5 (GEEmod)	7.8294e+03	9.8883e+02	62.692**	2.44e-15**

Note: ** These are Wald test of a single parameter (not t-tests)

Main-Effect Slope

Model Number	Estimate	Std. Error	t-Stat	p-Value
M0 (lmod0)	0.7132	1.5426	0.462	0.644
M1 (LMwFEint)	2.562	1.501	1.707	0.0881
M2 (LMwFEslope)	1.765e+01	8.246	2.140	0.03256
M3 (LMMwREint)	2.495	1.491	1.674	0.0945
M4 (LMMwREslope)	2.168	1.797	1.206	0.282
M5 (GEEmod)	0.7132	2.5028	0.081**	0.776**

Note: ** These are Wald test of a single parameter (not t-tests)

Model Summaries

M0 (lmod0)

```
summary(lmod0)
```

```
##
## Call:
## lm(formula = mala ~ cd19, data = dat)
##
## Residuals:
##    Min     1Q Median     3Q    Max
##  -7762  -4520  -1792   1859  84132
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
```

```
## (Intercept) 7829.3640   234.8033  33.344   <2e-16 ***
## cd19           0.7132     1.5426   0.462    0.644
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 7132 on 1108 degrees of freedom
## Multiple R-squared:  0.0001929,  Adjusted R-squared:  -0.0007095
## F-statistic: 0.2137 on 1 and 1108 DF,  p-value: 0.6439
```

M1 (LMwFEint)

```
summary(LMwFEint)
```

```
##
## Call:
## lm(formula = mala ~ subject.no + cd19, data = dat)
##
## Residuals:
##    Min     1Q Median     3Q    Max
## -13581  -3248   -822   1603  78153
##
## Coefficients:
##               Estimate Std. Error t value Pr(>|t|)
## (Intercept)  10112.394    844.948  11.968  < 2e-16 ***
## subject.no6   1361.882   1091.033   1.248 0.212207
## subject.no7  -3249.839   1414.960  -2.297 0.021820 *
## subject.no9  -4637.584   1430.824  -3.241 0.001226 **
## subject.no10 -3570.094   1635.347  -2.183 0.029242 *
## subject.no11  -468.926   1047.098  -0.448 0.654361
## subject.no13 -4388.158   1047.428  -4.189 3.02e-05 ***
## subject.no14 -4066.530   1059.859  -3.837 0.000132 ***
## subject.no15 -6341.473   1536.371  -4.128 3.94e-05 ***
## subject.no17 -7440.091   1030.433  -7.220 9.69e-13 ***
## subject.no19  3695.543   1018.199   3.629 0.000297 ***
## subject.no20 -2913.783   1122.809  -2.595 0.009583 **
## subject.no22 -3341.977   1088.552  -3.070 0.002193 **
## subject.no24 -3804.534   1110.673  -3.425 0.000637 ***
## subject.no26 -2337.002   1268.822  -1.842 0.065765 .
## cd19             2.562      1.501   1.707 0.088131 .
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 6421 on 1094 degrees of freedom
## Multiple R-squared:  0.1997, Adjusted R-squared:  0.1887
## F-statistic:  18.2 on 15 and 1094 DF,  p-value: < 2.2e-16
```

M2 (LMwFEslope)

```
summary(LMwFEslope)
```

```
##
```

```
## Call:
## lm(formula = mala ~ subject.no + subject.no:cd19 + cd19, data = dat)
##
## Residuals:
##    Min     1Q Median     3Q    Max
## -14011  -3287   -844   1696  77723
##
## Coefficients:
##                     Estimate Std. Error t value Pr(>|t|)
## (Intercept)        9.559e+03  8.956e+02  10.673  < 2e-16 ***
## subject.no6        1.358e+03  1.209e+03   1.123  0.26165
## subject.no7       -1.490e+03  1.671e+03  -0.892  0.37265
## subject.no9       -3.871e+03  1.529e+03  -2.532  0.01149 *
## subject.no10      -2.498e+03  1.960e+03  -1.274  0.20280
## subject.no11       3.193e+02  1.144e+03   0.279  0.78029
## subject.no13      -3.477e+03  1.157e+03  -3.005  0.00272 **
## subject.no14      -3.950e+03  1.221e+03  -3.235  0.00125 **
## subject.no15      -5.672e+03  1.761e+03  -3.221  0.00132 **
## subject.no17      -6.627e+03  1.125e+03  -5.893 5.06e-09 ***
## subject.no19       4.679e+03  1.107e+03   4.227 2.57e-05 ***
## subject.no20      -2.541e+03  1.284e+03  -1.979  0.04809 *
## subject.no22      -2.491e+03  1.180e+03  -2.111  0.03504 *
## subject.no24      -3.173e+03  1.291e+03  -2.458  0.01414 *
## subject.no26      -2.528e+03  1.408e+03  -1.795  0.07286 .
## cd19               1.765e+01  8.246e+00   2.140  0.03256 *
## subject.no6:cd19   9.599e-02  1.423e+01   0.007  0.99462
## subject.no7:cd19  -5.828e+02  3.941e+02  -1.479  0.13948
## subject.no9:cd19  -1.748e+01  9.680e+00  -1.805  0.07129 .
## subject.no10:cd19 -2.889e+01  2.884e+01  -1.002  0.31668
## subject.no11:cd19 -2.338e+01  1.485e+01  -1.575  0.11565
## subject.no13:cd19 -2.146e+01  1.078e+01  -1.990  0.04682 *
## subject.no14:cd19 -4.750e+00  1.494e+01  -0.318  0.75053
## subject.no15:cd19 -1.945e+01  3.141e+01  -0.619  0.53600
## subject.no17:cd19 -1.739e+01  8.825e+00  -1.971  0.04897 *
## subject.no19:cd19 -2.233e+01  9.795e+00  -2.280  0.02282 *
## subject.no20:cd19 -1.060e+01  1.589e+01  -0.667  0.50494
## subject.no22:cd19 -2.195e+01  1.139e+01  -1.926  0.05437 .
## subject.no24:cd19 -1.650e+01  1.347e+01  -1.226  0.22058
## subject.no26:cd19 -1.231e+01  8.578e+00  -1.436  0.15142
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 6420 on 1080 degrees of freedom
## Multiple R-squared:  0.2101, Adjusted R-squared:  0.1889
## F-statistic: 9.908 on 29 and 1080 DF,  p-value: < 2.2e-16
```

M3 (LMMwREint)

```
summary(LMMwREint)
```

```
## Loading required package: lmerTest
```

```
## Loading required package: lme4

## Loading required package: Matrix

##
## Attaching package: 'lmerTest'

## The following object is masked from 'package:lme4':
##
##     lmer

## The following object is masked from 'package:stats':
##
##     step

## Linear mixed model fit by REML. t-tests use Satterthwaite's method [
## lmerModLmerTest]
## Formula: mala ~ cd19 + (1 | subject.no)
##    Data: dat
##
## REML criterion at convergence: 22632.7
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -2.0770 -0.5069 -0.1414  0.2513 12.2113
##
## Random effects:
##  Groups     Name        Variance Std.Dev.
##  subject.no (Intercept)  7994717 2827
##  Residual               41219324 6420
## Number of obs: 1110, groups:  subject.no, 15
##
## Fixed effects:
##             Estimate Std. Error       df t value Pr(>|t|)
## (Intercept) 7399.427    768.993   15.045   9.622 8.06e-08 ***
## cd19           2.495      1.491 1107.879   1.674   0.0945 .
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##      (Intr)
## cd19 -0.121
```

M4 (LMMwREslope)

```
summary(LMMwREslope)
```

```
## Linear mixed model fit by REML. t-tests use Satterthwaite's method [
## lmerModLmerTest]
## Formula: mala ~ 1 + cd19 + (1 | subject.no) + (0 + cd19 | subject.no)
##    Data: dat
##
## REML criterion at convergence: 22632.4
##
```

```
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -2.0890 -0.5074 -0.1405  0.2503 12.2105
##
## Random effects:
##  Groups       Name        Variance  Std.Dev.
##  subject.no   (Intercept) 7.960e+06 2821.30
##  subject.no.1 cd19        5.018e+00    2.24
##  Residual                 4.115e+07 6415.17
## Number of obs: 1110, groups:  subject.no, 15
##
## Fixed effects:
##             Estimate Std. Error       df t value Pr(>|t|)
## (Intercept) 7404.974    767.757   14.921   9.645  8.4e-08 ***
## cd19           2.168      1.797    4.948   1.206    0.282
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##      (Intr)
## cd19 -0.114
## convergence code: 0
## Model failed to converge with max|grad| = 0.244883 (tol = 0.002, component 1)
## Model is nearly unidentifiable: very large eigenvalue
##  - Rescale variables?
```

M5 (GEEmod)

```
summary(GEEmod)
```

```
##
## Call:
## geeglm(formula = mala ~ cd19, family = "gaussian", data = dat,
##     id = IDgee, corstr = "independence")
##
## Deviance Residuals:
##    Min      1Q  Median      3Q     Max
##  -7762   -4520   -1792    1859   84132
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept) 7829.3640   234.8033  33.344   <2e-16 ***
## cd19           0.7132     1.5426   0.462    0.644
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for gaussian family taken to be 50859648)
##
##     Null deviance: NULL  on 1108  degrees of freedom
## Residual deviance: NULL  on 1108  degrees of freedom
## AIC: NULL
##
```

```
## Number of Fisher Scoring iterations:
```

Nested Model Comparisons

```
# M0 < M1
anova(lmod0, LMwFEint )
```

Res.Df	RSS	Df	Sum of Sq	F	Pr(>F)
1108	56352489563	NA	NA	NA	NA
1094	45108378581	14	11244110981	19.47858	0

```
# M1 < M2
anova(LMwFEint, LMwFEslope)
```

Res.Df	RSS	Df	Sum of Sq	F	Pr(>F)
1094	45108378581	NA	NA	NA	NA
1080	44519149650	14	589228932	1.021017	0.4291261

```
# M3 < M4
anova(LMMwREint, LMMwREslope)
```

```
## refitting model(s) with ML (instead of REML)
```

	Df	AIC	BIC	logLik	deviance	Chisq	Chi Df	Pr(>Chisq)
LMMwREint	4	22658.37	22678.42	-11325.18	22650.37	NA	NA	NA
LMMwREslope	5	22660.32	22685.38	-11325.16	22650.32	0.0486878	1	0.8253626

AIC Measurement Statistics

```
AIC(lmod0,LMwFEint, LMwFEslope, LMMwREint, LMMwREslope)
```

	df	AIC
lmod0	3	22850.53
LMwFEint	17	22631.49
LMwFEslope	31	22644.89
LMMwREint	4	22640.66
LMMwREslope	5	22642.37

Tranformed Models

Summary of Intercept and Slope Parameters

Intercept

Model Number	Estimate	Std. Error	t-Stat	p-Value
M0 (loglmod0)	8.46182	0.04568	185.258	< 2e-16
M1 (logLMwFEint)	7.54861	0.12261	61.564	< 2e-16
M2 (logLMwFEslope)	6.97932	0.13896	50.226	< 2e-16
M3 (logLMMwREint)	8.41374	0.11825	71.151	< 2e-16
M4 (logLMMwREslope)	8.39722	0.13957	60.166	<2e-16
M5 (logGEEmod)	8.4618	0.1842	2109.82**	<2e-16**

Note: ** These are Wald test of a single parameter (not t-tests)

Main-Effect Slope

Model Number	Estimate	Std. Error	t-Stat	p-value
M0 (loglmod0)	0.04918	0.01455	3.381	0.000747
M1 (logLMwFEint)	0.04833	0.01381	3.500	0.000484
M2 (logLMwFEslope)	0.51428	0.06017	8.546	< 2e-16
M3 (logLMMwREint)	0.04920	0.01374	3.579	0.00036
M4 (logLMMwREslope)	0.05938	0.03538	1.678	0.119
M5 (logGEEmod)	0.0492	0.0397	1.53**	0.22**

Note: ** These are Wald test of a single parameter (not t-tests)

Model Summaries

M0 (loglmod0)

```
summary(loglmod0)
```

```
##
## Call:
## lm(formula = logmala ~ logcd19, data = dat)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -4.2423 -0.4473  0.1046  0.6152  2.9673
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)  8.46182    0.04568 185.258  < 2e-16 ***
## logcd19      0.04918    0.01455   3.381 0.000747 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.027 on 1108 degrees of freedom
## Multiple R-squared:  0.01021,    Adjusted R-squared:  0.009319
## F-statistic: 11.43 on 1 and 1108 DF,  p-value: 0.000747
```

M1 (logLMwFEint)

```
summary(logLMwFEint)
```

```
##
## Call:
## lm(formula = logmala ~ subject.no + logcd19, data = dat)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -3.7095 -0.3703  0.0720  0.4735  2.9955
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)   7.54861    0.12261  61.564  < 2e-16 ***
## subject.no6   1.36644    0.15788   8.655  < 2e-16 ***
## subject.no7   0.83410    0.20377   4.093 4.56e-05 ***
## subject.no9   0.65633    0.20615   3.184 0.001495 **
## subject.no10  1.04840    0.23588   4.445 9.70e-06 ***
## subject.no11  1.39888    0.15099   9.265  < 2e-16 ***
## subject.no13  0.73715    0.15185   4.855 1.38e-06 ***
## subject.no14  0.90673    0.15383   5.894 5.00e-09 ***
## subject.no15  0.43635    0.22134   1.971 0.048928 *
## subject.no17  0.16535    0.14914   1.109 0.267806
## subject.no19  1.59025    0.14732  10.795  < 2e-16 ***
## subject.no20  1.06929    0.16277   6.569 7.80e-11 ***
## subject.no22  0.85005    0.15692   5.417 7.44e-08 ***
## subject.no24  0.89129    0.16133   5.525 4.12e-08 ***
## subject.no26  0.98955    0.18073   5.475 5.41e-08 ***
## logcd19       0.04833    0.01381   3.500 0.000484 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.9249 on 1094 degrees of freedom
## Multiple R-squared:  0.2067, Adjusted R-squared:  0.1959
## F-statistic: 19.01 on 15 and 1094 DF,  p-value: < 2.2e-16
```

M2 (logLMwFEslope)

```
summary(logLMwFEslope)
```

```
##
## Call:
## lm(formula = logmala ~ subject.no + subject.no:logcd19 + logcd19,
##     data = dat)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -3.8962 -0.3558  0.0731  0.4440  3.5648
##
## Coefficients:
##                      Estimate Std. Error t value Pr(>|t|)
```

```
## (Intercept)           6.97932    0.13896  50.226  < 2e-16 ***
## subject.no6           1.66094    0.21247   7.817 1.28e-14 ***
## subject.no7           1.69723    0.25921   6.548 9.01e-11 ***
## subject.no9           1.18173    0.26027   4.540 6.25e-06 ***
## subject.no10          1.83239    0.31554   5.807 8.35e-09 ***
## subject.no11          2.07273    0.18186  11.397  < 2e-16 ***
## subject.no13          1.44739    0.19447   7.443 2.01e-13 ***
## subject.no14          1.49582    0.20687   7.231 9.07e-13 ***
## subject.no15          0.99660    0.26711   3.731 0.000201 ***
## subject.no17          0.83424    0.18790   4.440 9.92e-06 ***
## subject.no19          2.34622    0.18108  12.957  < 2e-16 ***
## subject.no20          1.62114    0.22778   7.117 2.00e-12 ***
## subject.no22          1.46241    0.18610   7.858 9.38e-15 ***
## subject.no24          1.49079    0.22219   6.709 3.15e-11 ***
## subject.no26          1.30015    0.31352   4.147 3.63e-05 ***
## logcd19               0.51428    0.06017   8.546  < 2e-16 ***
## subject.no6:logcd19  -0.34727    0.08180  -4.246 2.37e-05 ***
## subject.no7:logcd19  -0.84347    0.20262  -4.163 3.39e-05 ***
## subject.no9:logcd19  -0.44516    0.09300  -4.787 1.93e-06 ***
## subject.no10:logcd19 -0.56719    0.11370  -4.988 7.09e-07 ***
## subject.no11:logcd19 -0.52591    0.07530  -6.985 4.98e-12 ***
## subject.no13:logcd19 -0.52225    0.07329  -7.125 1.89e-12 ***
## subject.no14:logcd19 -0.47358    0.07690  -6.159 1.03e-09 ***
## subject.no15:logcd19 -0.46019    0.10785  -4.267 2.16e-05 ***
## subject.no17:logcd19 -0.50141    0.06936  -7.229 9.17e-13 ***
## subject.no19:logcd19 -0.54758    0.07060  -7.756 2.02e-14 ***
## subject.no20:logcd19 -0.45912    0.08345  -5.502 4.69e-08 ***
## subject.no22:logcd19 -0.49155    0.07590  -6.476 1.43e-10 ***
## subject.no24:logcd19 -0.47691    0.07897  -6.039 2.13e-09 ***
## subject.no26:logcd19 -0.40536    0.08437  -4.805 1.77e-06 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.898 on 1080 degrees of freedom
## Multiple R-squared:  0.2618, Adjusted R-squared:  0.2419
## F-statistic: 13.21 on 29 and 1080 DF,  p-value: < 2.2e-16
```

M3 (logLMMwREint)

```
summary(logLMMwREint)
```

```
## Linear mixed model fit by REML. t-tests use Satterthwaite's method [
## lmerModLmerTest]
## Formula: logmala ~ logcd19 + (1 | subject.no)
##    Data: dat
##
## REML criterion at convergence: 3024
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -3.9835 -0.3932  0.0789  0.5139  3.1694
##
```

```
## Random effects:
##  Groups     Name        Variance Std.Dev.
##  subject.no (Intercept) 0.1801   0.4244
##  Residual               0.8553   0.9248
## Number of obs: 1110, groups:  subject.no, 15
##
## Fixed effects:
##              Estimate Std. Error        df t value Pr(>|t|)
## (Intercept) 8.414e+00  1.182e-01 1.663e+01  71.151  < 2e-16 ***
## logcd19     4.920e-02  1.374e-02 1.107e+03   3.579  0.00036 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##         (Intr)
## logcd19 -0.260
```

M4 (logLMMwREslope)

```
summary(logLMMwREslope)
```

```
## Linear mixed model fit by REML. t-tests use Satterthwaite's method [
## lmerModLmerTest]
## Formula:
## logmala ~ 1 + logcd19 + (1 | subject.no) + (0 + logcd19 | subject.no)
##    Data: dat
##
## REML criterion at convergence: 2991.4
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -4.2660 -0.3885  0.0751  0.5067  3.7477
##
## Random effects:
##  Groups       Name        Variance Std.Dev.
##  subject.no   (Intercept) 0.26053  0.5104
##  subject.no.1 logcd19     0.01473  0.1214
##  Residual                 0.80823  0.8990
## Number of obs: 1110, groups:  subject.no, 15
##
## Fixed effects:
##             Estimate Std. Error       df t value Pr(>|t|)
## (Intercept)  8.39722    0.13957 15.02322  60.166   <2e-16 ***
## logcd19      0.05938    0.03538 12.04256   1.678    0.119
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##         (Intr)
## logcd19 -0.103
```

M5 (logGEEmod)

```
summary(logGEEmod)
```

```
##
## Call:
## geeglm(formula = logmala ~ logcd19, family = "gaussian", data = dat,
##     id = IDgee, corstr = "independence")
##
## Deviance Residuals:
##     Min       1Q   Median       3Q      Max
## -4.2423  -0.4473   0.1046   0.6152   2.9673
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)  8.46182    0.04568 185.258  < 2e-16 ***
## logcd19      0.04918    0.01455   3.381 0.000747 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for gaussian family taken to be 1.053934)
##
##     Null deviance: NULL  on 1108  degrees of freedom
## Residual deviance: NULL  on 1108  degrees of freedom
## AIC: NULL
##
## Number of Fisher Scoring iterations:
```

Nested Model Comparisons

```
# M0 < M1
anova(loglmod0, logLMwFEint )
```

Res.Df	RSS	Df	Sum of Sq	F	Pr(>F)
1108	1167.7592	NA	NA	NA	NA
1094	935.8887	14	231.8705	19.36023	0

```
# M1 < M2
anova(logLMwFEint, logLMwFEslope)
```

Res.Df	RSS	Df	Sum of Sq	F	Pr(>F)
1094	935.8887	NA	NA	NA	NA
1080	870.9723	14	64.9164	5.749708	0

```
# M3 < M4
anova(logLMMwREint, logLMMwREslope)
```

```
## refitting model(s) with ML (instead of REML)
```

	Df	AIC	BIC	logLik	deviance	Chisq	Chi Df	Pr(>Chisq)
logLMMwREint	4	3022.752	3042.800	-1507.376	3014.752	NA	NA	NA
logLMMwREslope	5	2994.391	3019.451	-1492.195	2984.391	30.3608	1	0

AIC Measurement Statistics

```
AIC(loglmod0, logLMwFEint, logLMwFEslope,
    logLMMwREint, logLMMwREslope)
```

	df	AIC
loglmod0	3	3212.350
logLMwFEint	17	2994.657
logLMwFEslope	31	2942.863
logLMMwREint	4	3032.024
logLMMwREslope	5	3001.430