HW3 Complex Data

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1. Page 7

Structure	-2 REML Log-Likelihood	Parameters
Compound Symmetry	1905.823	2
Unstructured	1900.877	10
Difference	4.946	8

LRT yields $G^2 = 4.946$ with 8 df (p = 0.7632715), so we *fail to* reject the null hypothesis at $\alpha = 0.05$ and conclude that the assumption of compound symmetry covariance structure is *reasonable* for the data.

2. Page 8

Structure	-2 REML Log-Likelihood	Parameters
Autoregressive	1931.247	2
Unstructured	1900.877	10
Difference	30.37	8

LRT yields $G^2 = 30.37$ with 8 df (p = 0.0001817803), so we *reject* the null hypothesis at $\alpha = 0.05$ and conclude that the assumption of autoregressive covariance structure is *unreasonable* when compared to unstructured.

Since CS and AR-1 have the same number of parameters *2*, no LRT is necessary. We can directly compare their likelihoods, or -2*log(likelihood):

- -2*log(likelihood) for CS = 1905.823
- -2*log(likelihood) for AR-1 = 1931.247

Since -2*log(likelihood) for CS is *smaller* than for AR-1, CS has a *higher* likelihood and we conclude that CS is a *more* adequate model for the covariance structure when compared to AR-1.
The most adequate covariance structure is *compound symmetry*

Are all these tests correct?
- The first two tests are correct, since the compound symmetry structure and the autoregressive structure are nested in the unstructured covariance model. For the second test it should be pointed out that, because the compound symmetry structure and the autoregressive structure are not nested, the LRT cannot be used, and we should instead use AIC. The results are the same however, since AIC for structures with the same number of parameters simply compares the likelihoods.

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Structure	-2 REML Log-Likelihood	Parameters	AIC
Compound Symmetry	1905.823	2	1909.823
Autoregressive	1931.247	2	1935.247
Unstructured	1900.877	10	1920.877

Thus, we will use a *compound symmetry* covariance structure for the remainder of the lab.
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Q1)

```
L2 <- c(-7.5, 3, 3, 1.5)
```

Estimated mean AUC in encouragement program:

```
wgt.mean[,1] %*% L2
```

```
##           [,1]
## [1,] -319.5706
```

Estimated mean AUC in no encouragement program:

```
wgt.mean[,2] %*% L2
```

```
##           [,1]
## [1,] -117.7038
```

Q2) With multivariate Wald test.

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Structure	-2 Log-Likelihood	Parameters
Quadratic model	1935.7	8
Saturated model	1935.331	10
Difference	0.369	2

```
anova(wtloss.cs.cat.ml, wtloss.cs.quad)
```

```
##                  Model df      AIC      BIC    logLik   Test   L.Ratio p-value
## wtloss.cs.cat.ml     1 10 1955.331 1990.138 -967.6657
## wtloss.cs.quad       2  8 1951.700 1979.545 -967.8500 1 vs 2 0.3686901  0.8316
```

LRT yields $G^2 = 0.3686901$ (p = 0.8316), so we fail to reject the null hypothesis at $\alpha = 0.05$ and conclude that the model with Month as a quadratic effect seems to *fit* the data adequately.

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Structure	-2 Log-Likelihood	Parameters
Linear model	1936.295	6
Quadratic model	1935.7	8
Difference	0.5954	2

```r
anova(wtloss.cs.quad, wtloss.cs.lin)
```

```
##                Model df      AIC      BIC    logLik   Test   L.Ratio p-value
## wtloss.cs.quad     1  8 1951.700 1979.545 -967.8500
## wtloss.cs.lin      2  6 1948.295 1969.179 -968.1477 1 vs 2 0.5954061  0.7425
```

LRT yields $G^2 = 0.5954061$ (p = 0.7425), so we *fail to reject* the null hypothesis at $\alpha = 0{:}05$ and conclude that the model with Month as a linear effect fits the data *better* than the model with Month as a quadratic effect.

7. Page 1

Since the p-value for month*program is 0, we *reject* the null hypothesis and conclude that there is a *positive* interaction between month and program. Thus, our final model is the *linear* model *with* (with/without) interaction.
What can you conclude about the two weight programs in terms of their effectiveness?
We can conclude that the first program (with encouragement) is more effective.