25. SAS Code for Repeated Measures

Compound Symmetry Structure

$$\begin{bmatrix} \sigma_e^2 + \sigma_s^2 & \sigma_s^2 & \sigma_s^2 & \sigma_s^2 & \sigma_s^2 & \sigma_s^2 & \sigma_s^2 \\ \sigma_s^2 & \sigma_e^2 + \sigma_s^2 & \sigma_s^2 & \sigma_s^2 & \sigma_s^2 & \sigma_s^2 & \sigma_s^2 \\ \sigma_s^2 & \sigma_s^2 & \sigma_e^2 + \sigma_s^2 & \sigma_s^2 & \sigma_s^2 & \sigma_s^2 & \sigma_s^2 \\ \sigma_s^2 & \sigma_s^2 & \sigma_s^2 & \sigma_e^2 + \sigma_s^2 & \sigma_s^2 & \sigma_s^2 & \sigma_s^2 \\ \sigma_s^2 & \sigma_s^2 & \sigma_s^2 & \sigma_s^2 & \sigma_e^2 + \sigma_s^2 & \sigma_s^2 & \sigma_s^2 \\ \sigma_s^2 & \sigma_s^2 & \sigma_s^2 & \sigma_s^2 & \sigma_s^2 & \sigma_e^2 + \sigma_s^2 & \sigma_s^2 \\ \sigma_s^2 & \sigma_s^2 & \sigma_s^2 & \sigma_s^2 & \sigma_s^2 & \sigma_s^2 & \sigma_e^2 + \sigma_s^2 \end{bmatrix}$$

```
proc mixed;
  class program subj time;
  model strength = program time program * time;
  random subj(program);
run;
```

Alternative Code for Compound Symmetry

```
proc mixed;
  class program subj time;
  model strength = program time program * time;
  repeated time / subject = subj type = cs;
run;
```

AR(1) Structure

$$\sigma^2 \begin{bmatrix} 1 & \phi & \phi^2 & \phi^3 & \phi^4 & \phi^5 & \phi^6 \\ \phi & 1 & \phi & \phi^2 & \phi^3 & \phi^4 & \phi^5 \\ \phi^2 & \phi & 1 & \phi & \phi^2 & \phi^3 & \phi^4 \\ \phi^3 & \phi^2 & \phi & 1 & \phi & \phi^2 & \phi^3 \\ \phi^4 & \phi^3 & \phi^2 & \phi & 1 & \phi & \phi^2 \\ \phi^5 & \phi^4 & \phi^3 & \phi^2 & \phi & 1 & \phi \\ \phi^6 & \phi^5 & \phi^4 & \phi^3 & \phi^2 & \phi & 1 \end{bmatrix}$$

```
proc mixed;
  class program subj time;
  model strength = program time program * time;
  repeated time / subject = subj type = ar(1);
run;
```

General Positive Definite Structure (Unstructured)

$$\begin{bmatrix} \sigma_{11} & \sigma_{12} & \sigma_{13} & \sigma_{14} & \sigma_{15} & \sigma_{16} & \sigma_{17} \\ \sigma_{12} & \sigma_{22} & \sigma_{23} & \sigma_{24} & \sigma_{25} & \sigma_{26} & \sigma_{27} \\ \sigma_{13} & \sigma_{23} & \sigma_{33} & \sigma_{34} & \sigma_{35} & \sigma_{36} & \sigma_{37} \\ \sigma_{14} & \sigma_{24} & \sigma_{34} & \sigma_{44} & \sigma_{45} & \sigma_{46} & \sigma_{47} \\ \sigma_{15} & \sigma_{25} & \sigma_{35} & \sigma_{45} & \sigma_{55} & \sigma_{56} & \sigma_{57} \\ \sigma_{16} & \sigma_{26} & \sigma_{36} & \sigma_{46} & \sigma_{56} & \sigma_{66} & \sigma_{67} \\ \sigma_{17} & \sigma_{27} & \sigma_{37} & \sigma_{47} & \sigma_{57} & \sigma_{67} & \sigma_{77} \end{bmatrix}$$

```
proc mixed;
  class program subj time;
  model strength = program time program * time;
  repeated time / subject = subj type = un;
run;
```

AIC and BIC for Repeated Measures in SAS

- $AIC = -2\ell(\hat{\boldsymbol{\theta}}) + 2k$

- $BIC = -2\ell(\hat{\boldsymbol{\theta}}) + k\ln(n)$

- $k =$ number of variance parameters

- $n =$ total number of independent subjects