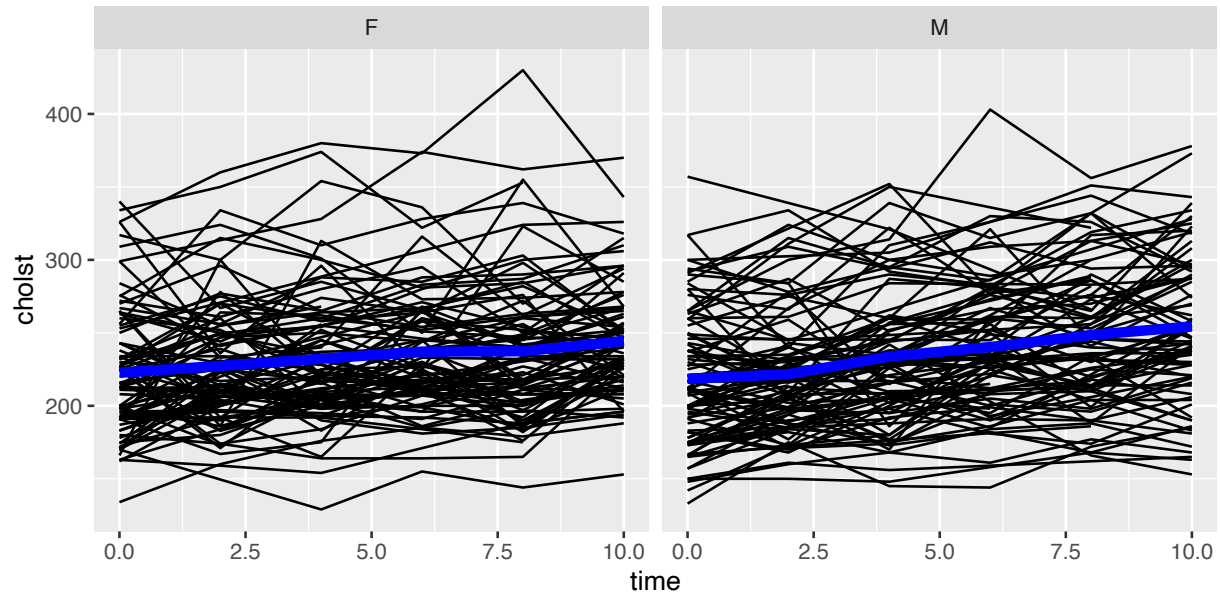
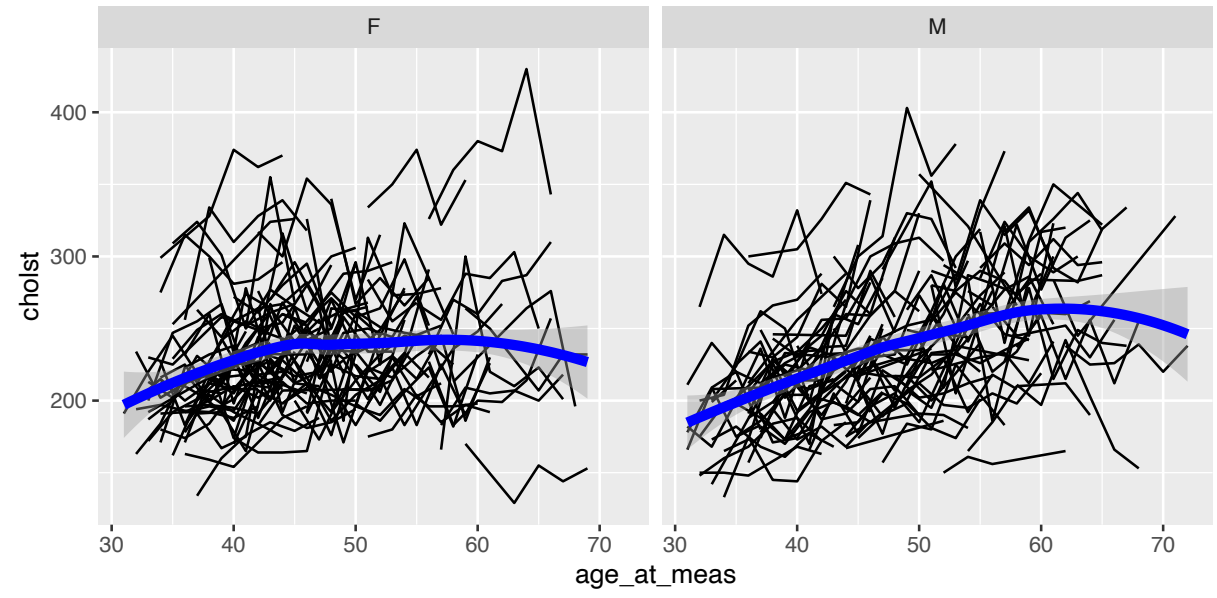
```
data cholst;
input ID cholst sex      age    time;
age_at_meas = time + age;
datalines;
1      175    1      32     0
……Data omitted……
200    252    0      46     10
;
run;
```



```
proc mixed data=cholst;
class ID;
model cholst = Time Sex age/ s;
random intercept Time/type=UN subject=ID g gcorr;
contrast 'Longitudinal vs. Cross sectional' age 1 Time -1;
run;
```



The Mixed Procedure

## Model Information

| | |
|---|---|
| **Data Set** | WORK.CHOLST |
| **Dependent Variable** | cholst |
| **Covariance Structure** | Unstructured |
| **Subject Effect** | ID |
| **Estimation Method** | REML |
| **Residual Variance Method** | Profile |
| **Fixed Effects SE Method** | Model-Based |
| **Degrees of Freedom Method** | Containment |

## Class Level Information

| Class | Levels | Values |
|---|---|---|
| **ID** | 200 | 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100 101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 127 128 129 130 131 132 133 134 135 136 137 138 139 140 141 142 143 144 145 146 147 148 149 150 151 152 153 154 155 156 157 158 159 160 161 162 163 164 165 166 167 168 169 170 171 172 173 174 175 176 177 178 179 180 181 182 183 184 185 186 187 188 189 190 191 192 193 194 195 196 197 198 199 200 |

## Dimensions

| | |
|---|---|
| **Covariance Parameters** | 4 |
| **Columns in X** | 4 |
| **Columns in Z per Subject** | 2 |
| **Subjects** | 200 |
| **Max Obs per Subject** | 6 |

**Number of Observations**

| | |
|---|---|
| **Number of Observations Read** | 1044 |
| **Number of Observations Used** | 1044 |
| **Number of Observations Not Used** | 0 |

**Iteration History**

| Iteration | Evaluations | -2 Res Log Like | Criterion |
|---|---|---|---|
| **0** | 1 | 10826.10030074 | |
| **1** | 2 | 9929.92329320 | 0.00000073 |
| **2** | 1 | 9929.92034236 | 0.00000000 |

Convergence criteria met.

**Estimated G Matrix**

| Row | Effect | ID | Col1 | Col2 |
|---|---|---|---|---|
| **1** | Intercept | 1 | 1214.80 | 12.2622 |
| **2** | time | 1 | 12.2622 | 3.8619 |

**Estimated G Correlation Matrix**

| Row | Effect | ID | Col1 | Col2 |
|---|---|---|---|---|
| **1** | Intercept | 1 | 1.0000 | 0.1790 |
| **2** | time | 1 | 0.1790 | 1.0000 |

**Covariance Parameter Estimates**

| Cov Parm | Subject | Estimate |
|---|---|---|
| **UN(1,1)** | **ID** | 1214.80 |
| **UN(2,1)** | **ID** | 12.2622 |
| **UN(2,2)** | **ID** | 3.8619 |
| **Residual** | | 434.17 |

**Fit Statistics**

| | |
|---|---|
| **-2 Res Log Likelihood** | 9929.9 |

**Fit Statistics**

| | |
|---|---|
| **AIC (Smaller is Better)** | 9937.9 |
| **AICC (Smaller is Better)** | 9938.0 |
| **BIC (Smaller is Better)** | 9951.1 |

**Null Model Likelihood Ratio Test**

| DF | Chi-Square | Pr > ChiSq |
|---|---|---|
| 3 | 896.18 | <.0001 |

**Solution for Fixed Effects**

| Effect | Estimate | Standard Error | DF | t Value | Pr > \|t\| |
|---|---|---|---|---|---|
| **Intercept** | 145.60 | 14.7449 | 197 | 9.87 | <.0001 |
| **time** | 2.8165 | 0.2414 | 191 | 11.67 | <.0001 |
| **sex** | -6.3028 | 5.3709 | 652 | -1.17 | 0.2410 |
| **age** | 1.8373 | 0.3413 | 652 | 5.38 | <.0001 |

**Type 3 Tests of Fixed Effects**

| Effect | Num DF | Den DF | F Value | Pr > F |
|---|---|---|---|---|
| **time** | 1 | 191 | 136.17 | <.0001 |
| **sex** | 1 | 652 | 1.38 | 0.2410 |
| **age** | 1 | 652 | 28.98 | <.0001 |

**Contrasts**

| Label | Num DF | Den DF | F Value | Pr > F |
|---|---|---|---|---|
| **Longitudinal vs. Cross sectional** | 1 | 191 | 5.49 | 0.0202 |

Let's peek at the impact of centering.

```
data cholst2;
set cholst;
l_age_c = l_age - log(50);
run;


proc mixed data=cholst2;
class ID;
model cholst = Time Sex l_age_c Time*Sex Time*l_age_c/ s;
random intercept l_age_c Time/type=UN subject=ID g gcorr v=26 vcorr=26;
* ID 26 is 56 years old;
run;
```

**Estimated G Matrix**

| Row | Effect | ID | Col1 | Col2 | Col3 |
|---|---|---|---|---|---|
| **1** | Intercept | 1 | 1435.57 | 2128.29 | 11.9245 |
| **2** | l_age_c | 1 | 2128.29 | 8260.16 | -2.5019 |
| **3** | time | 1 | 11.9245 | -2.5019 | 2.6018 |

**Estimated G Correlation Matrix**

| Row | Effect | ID | Col1 | Col2 | Col3 |
|---|---|---|---|---|---|
| **1** | Intercept | 1 | 1.0000 | 0.6181 | 0.1951 |
| **2** | l_age_c | 1 | 0.6181 | 1.0000 | -0.01707 |
| **3** | time | 1 | 0.1951 | -0.01707 | 1.0000 |

**Estimated V Matrix for ID 26**

| Row | Col1 | Col2 | Col3 | Col4 | Col5 | Col6 |
|---|---|---|---|---|---|---|
| **1** | 2457.94 | 2047.33 | 2070.61 | 2093.89 | 2117.18 | 2140.46 |
| **2** | 2047.33 | 2514.91 | 2114.71 | 2148.40 | 2182.09 | 2215.77 |
| **3** | 2070.61 | 2114.71 | 2592.70 | 2202.90 | 2247.00 | 2291.09 |
| **4** | 2093.89 | 2148.40 | 2202.90 | 2691.30 | 2311.91 | 2366.41 |
| **5** | 2117.18 | 2182.09 | 2247.00 | 2311.91 | 2810.71 | 2441.73 |
| **6** | 2140.46 | 2215.77 | 2291.09 | 2366.41 | 2441.73 | 2950.94 |

**Estimated V Correlation Matrix for ID 26**

| Row | Col1 | Col2 | Col3 | Col4 | Col5 | Col6 |
|---|---|---|---|---|---|---|

**Estimated V Correlation Matrix for ID 26**

| Row | Col1 | Col2 | Col3 | Col4 | Col5 | Col6 |
|---|---|---|---|---|---|---|
| **1** | 1.0000 | 0.8235 | 0.8202 | 0.8141 | 0.8055 | 0.7948 |
| **2** | 0.8235 | 1.0000 | 0.8282 | 0.8258 | 0.8207 | 0.8134 |
| **3** | 0.8202 | 0.8282 | 1.0000 | 0.8339 | 0.8324 | 0.8283 |
| **4** | 0.8141 | 0.8258 | 0.8339 | 1.0000 | 0.8406 | 0.8397 |
| **5** | 0.8055 | 0.8207 | 0.8324 | 0.8406 | 1.0000 | 0.8478 |
| **6** | 0.7948 | 0.8134 | 0.8283 | 0.8397 | 0.8478 | 1.0000 |

**Fit Statistics**

| | |
|---|---|
| **-2 Res Log Likelihood** | 9887.7 |
| **AIC (Smaller is Better)** | 9901.7 |
| **AICC (Smaller is Better)** | 9901.8 |
| **BIC (Smaller is Better)** | 9924.8 |

**Null Model Likelihood Ratio Test**

| DF | Chi-Square | Pr > ChiSq |
|---|---|---|
| 6 | 908.93 | <.0001 |

**Solution for Fixed Effects**

| Effect | Estimate | Standard Error | DF | t Value | Pr > \|t\| |
|---|---|---|---|---|---|
| **Intercept** | 242.39 | 5.0986 | 198 | 47.54 | <.0001 |
| **time** | 1.0897 | 0.4003 | 189 | 2.72 | 0.0071 |
| **sex** | -11.9582 | 5.2892 | 651 | -2.26 | 0.0241 |
| **l_age_c** | 88.5397 | 15.8994 | 0 | 5.57 | . |
| **time*sex** | 1.7804 | 0.4551 | 651 | 3.91 | 0.0001 |
| **time*l_age_c** | -4.7745 | 1.2303 | 651 | -3.88 | 0.0001 |

```
proc mixed data=cholst2;
class ID;
model cholst = Time Sex l_age Time*Sex Time*l_age/ s;
random intercept l_age Time/type=UN subject=ID g gcorr v=26 vcorr=26;
* ID 26 is 56 years old;
run;
```

**Estimated G Matrix**

| Row | Effect | ID | Col1 | Col2 | Col3 |
|---|---|---|---|---|---|
| **1** | Intercept | 1 | 111197 | -30186 | 21.7122 |
| **2** | l_age | 1 | -30186 | 8260.16 | -2.5019 |
| **3** | time | 1 | 21.7122 | -2.5019 | 2.6018 |

**Estimated G Correlation Matrix**

| Row | Effect | ID | Col1 | Col2 | Col3 |
|---|---|---|---|---|---|
| **1** | Intercept | 1 | 1.0000 | -0.9960 | 0.04037 |
| **2** | l_age | 1 | -0.9960 | 1.0000 | -0.01707 |
| **3** | time | 1 | 0.04037 | -0.01707 | 1.0000 |

**Estimated V Matrix for ID 26**

| Row | Col1 | Col2 | Col3 | Col4 | Col5 | Col6 |
|---|---|---|---|---|---|---|
| **1** | 2457.94 | 2047.33 | 2070.61 | 2093.89 | 2117.18 | 2140.46 |
| **2** | 2047.33 | 2514.91 | 2114.71 | 2148.40 | 2182.09 | 2215.77 |
| **3** | 2070.61 | 2114.71 | 2592.70 | 2202.90 | 2247.00 | 2291.09 |
| **4** | 2093.89 | 2148.40 | 2202.90 | 2691.30 | 2311.91 | 2366.41 |
| **5** | 2117.18 | 2182.09 | 2247.00 | 2311.91 | 2810.71 | 2441.73 |
| **6** | 2140.46 | 2215.77 | 2291.09 | 2366.41 | 2441.73 | 2950.94 |

**Estimated V Correlation Matrix for ID 26**

| Row | Col1 | Col2 | Col3 | Col4 | Col5 | Col6 |
|---|---|---|---|---|---|---|
| **1** | 1.0000 | 0.8235 | 0.8202 | 0.8141 | 0.8055 | 0.7948 |
| **2** | 0.8235 | 1.0000 | 0.8282 | 0.8258 | 0.8207 | 0.8134 |
| **3** | 0.8202 | 0.8282 | 1.0000 | 0.8339 | 0.8324 | 0.8283 |
| **4** | 0.8141 | 0.8258 | 0.8339 | 1.0000 | 0.8406 | 0.8397 |
| **5** | 0.8055 | 0.8207 | 0.8324 | 0.8406 | 1.0000 | 0.8478 |

**Estimated V Correlation Matrix for ID 26**

| Row | Col1 | Col2 | Col3 | Col4 | Col5 | Col6 |
|---|---|---|---|---|---|---|
| **6** | 0.7948 | 0.8134 | 0.8283 | 0.8397 | 0.8478 | 1.0000 |

**Fit Statistics**

| | |
|---|---|
| **-2 Res Log Likelihood** | 9887.7 |
| **AIC (Smaller is Better)** | 9901.7 |
| **AICC (Smaller is Better)** | 9901.8 |
| **BIC (Smaller is Better)** | 9924.8 |

**Null Model Likelihood Ratio Test**

| DF | Chi-Square | Pr > ChiSq |
|---|---|---|
| 6 | 908.93 | <.0001 |

**Solution for Fixed Effects**

| Effect | Estimate | Standard Error | DF | t Value | Pr > \|t\| |
|---|---|---|---|---|---|
| **Intercept** | -103.98 | 58.8262 | 197 | -1.77 | 0.0787 |
| **time** | 19.7675 | 4.5805 | 189 | 4.32 | <.0001 |
| **sex** | -11.9582 | 5.2892 | 652 | -2.26 | 0.0241 |
| **l_age** | 88.5397 | 15.8994 | 0 | 5.57 | . |
| **time*sex** | 1.7804 | 0.4551 | 652 | 3.91 | 0.0001 |
| **time*l_age** | -4.7745 | 1.2303 | 652 | -3.88 | 0.0001 |