Problem 1

(a)

$i = 1$ Placebo $\quad i = 2$ Active Treatment

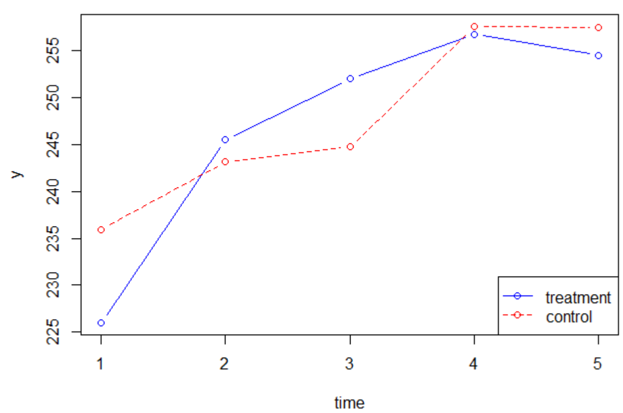
$$\mu_1 = \begin{bmatrix} 235.93 & 243.17 & 244.76 & 257.60 & 257.48 \end{bmatrix}^T$$

$$\mu_2 = \begin{bmatrix} 226.02 & 245.53 & 252.02 & 256.80 & 254.55 \end{bmatrix}^T$$

$$\Sigma_1 = \begin{bmatrix} 3080.44 & 2342.72 & 2158.73 & 2404.83 & 2086.78 \\ 2342.72 & 2755.49 & 2261.28 & 2392.10 & 2123.54 \\ 2158.73 & 2261.28 & 2267.72 & 2184.92 & 1828.96 \\ 2404.83 & 2392.10 & 2184.92 & 2666.96 & 2012.98 \\ 2086.78 & 2123.54 & 1828.96 & 2012.98 & 2439.19 \end{bmatrix}$$

$$\Sigma_2 = \begin{bmatrix} 1962.46 & 1302.20 & 1150.85 & 952.35 & 1009.28 \\ 1302.20 & 1715.22 & 1109.22 & 1023.43 & 1199.37 \\ 1150.85 & 1109.22 & 1553.90 & 696.86 & 1265.57 \\ 952.35 & 1023.43 & 696.86 & 1147.61 & 866.61 \\ 1009.28 & 1199.37 & 1265.57 & 866.61 & 2545.69 \end{bmatrix}$$

Means over time



(b)

Imposing the estamability restrictions and fitting the general two-way anova model

For $j = (2, 3, 4, 5)$ we have:

$$E[Y_{ij}] = \mu + \alpha_2 I(group2) + \beta_i Itimej + \gamma_{2j} I(group = 2) I(time = j)$$

Month	0	6	12	20	24
P	μ	$\mu+\beta_2$	$\mu+\beta_3$	$\mu+\beta_4$	$\mu+\beta_5$
A	$\mu+\alpha_2$	$\mu+\alpha_2+\beta_2+\gamma_{22}$	$\mu+\alpha_2+\beta_3+\gamma_{23}$	$\mu+\alpha_2+\beta_4+\gamma_{24}$	$\mu+\alpha_2+\beta_5+\gamma_{25}$

Treatment effect $=\boldsymbol{\delta}=(\gamma_{22},\gamma_{23},\gamma_{24},\gamma_{25})^T$

$\boldsymbol{\delta}$ represents the treament effect on the changes in mean cholesterol level over time

$\hat{\delta}$	$\hat{se}$
$\gamma_{22}=12.272$	6.194
$\gamma_{23}=16.418$	6.752
$\gamma_{24}=4.977$	7.011
$\gamma_{24}=6.903$	9.887

(c) Wald Chi-square test
$H_0:\delta=0$
$H_1:\delta\neq 0$
Wald $\chi^2=7.86$ df=4
p-value= .0968 > .05 Thus fail to reject H_0
Not enough evidence to suggest δ is not equal to 0. The mean response profiles are statistically the same for the two groups.

(d)

Month	0	6	12	20	24
P	μ	$\mu+\beta_2$	$\mu+\beta_3$	$\mu+\beta_4$	$\mu+\beta_5$
A	μ	$\mu+\beta_2+\gamma_{22}$	$\mu+\beta_3+\gamma_{23}$	$\mu+\beta_4+\gamma_{24}$	$\mu+\beta_5+\gamma_{25}$

Treatment effect $=\boldsymbol{\delta}=(\gamma_{22},\gamma_{23},\gamma_{24},\gamma_{25})^T$

$\boldsymbol{\delta}$ represents the treament effect on the changes in mean cholesterol level over time

$\hat{\delta}$	$\hat{se}$
$\gamma_{22}=9.478$	5.596
$\gamma_{23}=12.886$	5.85
$\gamma_{24}=1.614$	6.208
$\gamma_{24}=3.003$	9.064

(e)

$$\text{t}=time \quad x=I(group2)$$
$$\text{group 1: } E(Y_{ij})=\beta_1+\beta_2*t_{ij}+\beta_3*t_{ij}^2$$
$$\text{group 2: } E(Y_{kj})=\alpha_1+\alpha_2*t_{kj}+\alpha_3*t_{kj}^2$$
$$\text{Restrictions: } E(Y_i1)=E(Y_{k1}),\quad \beta_1=\alpha_1$$

Month	0	6	12	20	24
P	μ	$\mu+6t+36t^2$	$\mu+12t+144t^2$	$\mu+20t+400t^2$	$\mu+24t+576t^2$
A	μ	$\mu+6t+36t^2$ $+6xt+36xt^2$	$\mu+12t+144t^2+$ $+12xt+144xt^2$	$\mu+20t+400t^2+$ $20xt+400xt^2$	$\mu+24t+576t^2+$ $24xt+576xt^2$

Treatment effect $=\boldsymbol{\delta}=(xt,xt^2)^T$

$\boldsymbol{\delta}$ represents the treament effect on the changes in mean cholesterol level over time

$\hat{\delta}$	$\hat{se}$
$xt=1.937$	.823
$xt^2=-.086$	.037

Wald Chi-square test
$H_0:\delta=0$
$H_1:\delta\neq 0$
Wald $\chi^2=5.89$ df=2
p-value= .0527 > .05 Thus fail to reject H_0
Not enough evidence to suggest δ is not equal to 0. The mean response profiles are statistically the same for the two groups.

(f)

Treatment Effect on the changes in mean cholesterol level over time $=\lambda=(\alpha_2,\gamma_{23},\gamma_{24},\gamma_{25})$

$\hat{\lambda}$	$\hat{se}$
$\alpha_2=12.272$	6.194
$\gamma_{23}=4.028$	5.979
$\gamma_{24}=-8.07$	6.097
$\gamma_{25}=-5.226$	8.901

(g) Wald Chi-square test
$H_0:\lambda=0$
$H_1:\lambda\neq 0$
Wald $\chi^2=7.99$ df=4
p-value= .0919 > .05 Thus fail to reject H_0
Not enough evidence to suggest λ is not equal to 0. The mean response profiles are statistically the same for the two groups.

(h)

Treatment Effect on the changes in mean cholesterol level over time $=\lambda^*=(\alpha_2,\gamma_{23},\gamma_{24},\gamma_{25})$

$$\left[\begin{array}{c|c} \hat{\lambda}^* & \hat{se} \\ \hline \alpha_2 = 9.023 & 5.653 \\ \gamma_{23} = 4.144 & 5.937 \\ \gamma_{24} = -7.394 & 6.03 \\ \gamma_{25} = -5.218 & 8.842 \end{array}\right]$$

(i) Wald Chi-square test
$H_0 : \lambda^* = 0$
$H_1 : \lambda^* \neq 0$
Wald $\chi^2 = 6.54$ df=4
p-value= $.1623 > .05$ Thus fail to reject H_0
Not enough evidence to suggest λ^* is not equal to 0. The mean response profiles are statistically the same for the two groups.

(j) Full LRT test
$H_0 : \lambda^* = 0$
$H_1 : \lambda^* \neq 0$
$-2Log(L)_{Full} = 3218.6$ df=8
$-2Log(L)_{Reduced} = 3225.1$ df=4
$\chi^2 = 3225.1 - 3218.6 = 6.5$ df=4
p-value= $.165 > .05$ Thus fail to reject H_0
Not enough evidence to suggest λ^* is not equal to 0. The mean response profiles are statistically the same for the two groups.

(k) You need the following assumptions to guarantee $\lambda = \lambda^*$:
1) No interaction
2) At baseline the two groups have the same mean