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Bios 667 HW#3
Due 11/01/17

**Question 1**

model 2

$$\eta_{ij} = \beta_0 + \beta_1 T_j + \beta_2 T_j^2 + \beta_3 H1_i + \beta_4 H2_i + \beta_5 H3_i + \beta_6 Race_i + \beta_7 (H1_i * T_j) + \beta_8 (H2_i * T_j) + \beta_9 (H3_i * T_j)$$

Let race = 0

Table 8.3

| Parameter | Est | SE | p-value |
|---|---|---|---|
| intercept $\beta_0$ | -1.014 | 0.117 | 0.001 |
| $T\beta_1$ | -0.610 | 0.127 | 0.001 |
| $T^2\beta_2$ | 0.130 | 0.029 | 0.001 |
| $H1\beta_3$ | 0.811 | 0.214 | 0.001 |
| $H2\beta_4$ | 0.366 | 0.142 | 0.010 |
| $H3\beta_5$ | 0.271 | 0.141 | 0.055 |
| $Race\beta_6$ | 0.353 | 0.200 | 0.078 |
| $H1*T\beta_7$ | -0.219 | 0.097 | 0.024 |
| $H2*T\beta_8$ | -0.073 | 0.069 | 0.289 |
| $H3*T\beta_9$ | -0.062 | 0.072 | 0.385 |

NOTE

| Group | H1 | H2 | H3 |
|---|---|---|---|
| control | -1 | 0 | 0 |
| No-show | 1/3 | -1 | 0 |
| +x1 | 1/3 | 1/2 | -1 |
| +x2 | 1/3 | 1/2 | 1 |

**PART A** create a 4x4 table of estimated linear predictors

| TRT | TIME 0 | 1 | 2 | 4 |
|---|---|---|---|---|
| control | $\beta_0 - \beta_3$ | $\beta_0 + \beta_1 + \beta_2 - \beta_3 - \beta_7$ | $\beta_0 + 2\beta_1 + 4\beta_2 - \beta_3 - 2\beta_7$ | $\beta_0 + 4\beta_1 + 16\beta_2 - \beta_3 - 4\beta_7$ |
| noshow | $\beta_0 + 1/3\beta_3 - \beta_4$ | $\beta_0 + \beta_1 + \beta_2 + 1/3\beta_3 - \beta_4 + 1/3\beta_7 - \beta_8$ | $\beta_0 + 2\beta_1 + 4\beta_2 + 1/3\beta_3 - \beta_4 + 2/3\beta_7 - 2\beta_8$ | $\beta_0 + 4\beta_1 + 16\beta_2 + 1/3\beta_3 - \beta_4 + 4/3\beta_7 - 4\beta_8$ |
| +x1 | $\beta_0 + 1/3\beta_3 + 1/2\beta_4 - \beta_5$ | $\beta_0 + \beta_1 + \beta_2 + 1/3\beta_3 + 1/2\beta_4 - \beta_5 + 1/3\beta_7 + 1/2\beta_8 - \beta_9$ | $\beta_0 + 2\beta_1 + 4\beta_2 + 1/3\beta_3 + 1/2\beta_4 - \beta_5 + 2/3\beta_7 + \beta_8 - 2\beta_9$ | $\beta_0 + 4\beta_1 + 16\beta_2 + 1/3\beta_3 + 1/2\beta_4 - \beta_5 + 4/3\beta_7 + 2\beta_8 - 4\beta_9$ |
| +x2 | $\beta_0 + 1/3\beta_3 + 1/2\beta_4 + \beta_5$ | $\beta_0 + \beta_1 + \beta_2 + 1/3\beta_3 + 1/2\beta_4 + \beta_5 + 1/3\beta_7 + 1/2\beta_8 + \beta_9$ | $\beta_0 + 2\beta_1 + 4\beta_2 + 1/3\beta_3 + 1/2\beta_4 + \beta_5 + 2/3\beta_7 + \beta_8 + 2\beta_9$ | $\beta_0 + 4\beta_1 + 16\beta_2 + 1/3\beta_3 + 1/2\beta_4 + \beta_5 + 4/3\beta_7 + 2\beta_8 + 4\beta_9$ |

Question 1 cont.

| TRT | TIME T 0 | 1 | 2 | 4 |
|---|---|---|---|---|
| control | -1.825 | -2.086 | -2.087 | -1.309 |
| no show | -1.110 | -1.590 | -1.810 | -1.470 |
| tx1 | -0.832 | -1.359 | -1.630 | -1.382 |
| tx2 | -0.290 | -0.941 | -1.333 | -1.336 |

Numbers are off -3

No vertical lines -2

By doing $e^{(a)}/1+e^{(a)}$ ⇒ estimated cell probabilities

| TRT | 0 | 1 | 2 | 4 |
|---|---|---|---|---|
| control | 0.139 | 0.110 | 0.110 | 0.213 |
| noshow | 0.248 | 0.169 | 0.141 | 0.187 |
| tx1 | 0.303 | 0.204 | 0.164 | 0.201 |
| tx2 | 0.428 | 0.281 | 0.209 | 0.208 |

numbers are off

④ plot see attached

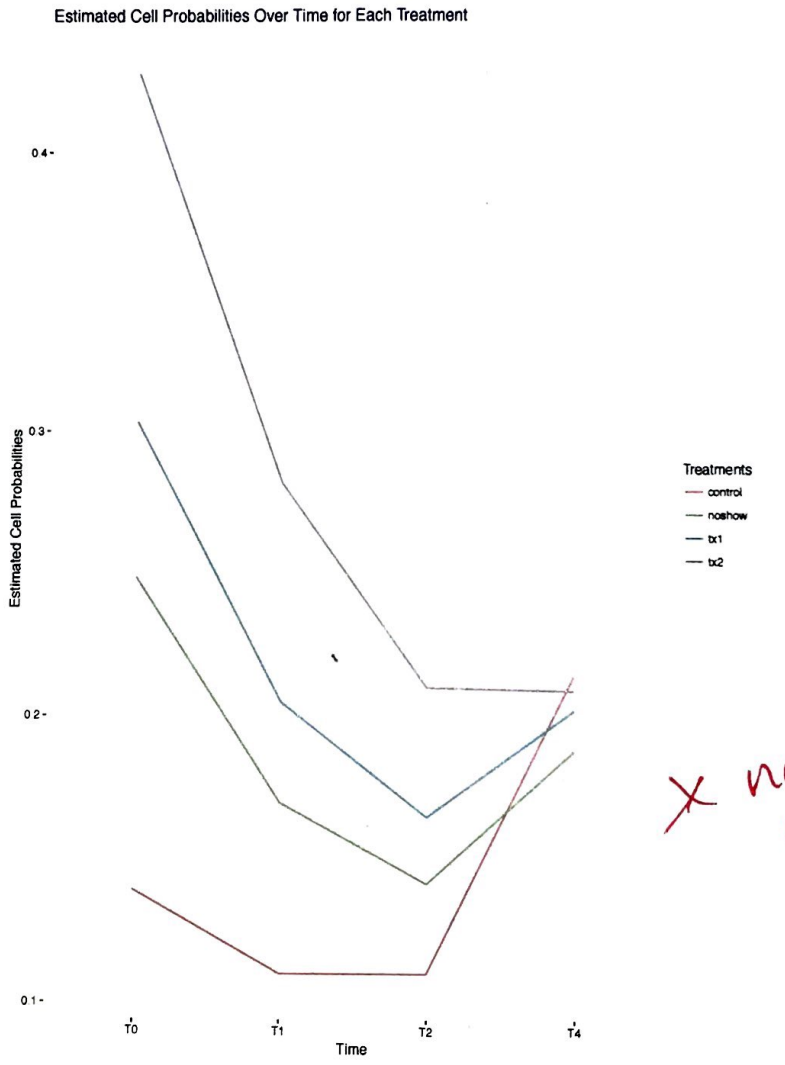
Question: Describe what aspects of the graph reflect the estimate of $\beta_3$ and $\beta_7$.

Answer: $\beta_3$ is the $H_1$ contrast $[-1, 1/3, 1/3, 1/3]$. Note none of the treatments contain 0. so $\beta_3$ effects all treatments. ✓ since $\beta_2$ is not impacted by time it only effects the Y axis. $\beta_3$ is "scaled" based on the contrast which takes into account trt type. to test whether randomization to group vs. control influenced subsequent cessation.

$\beta_7$ is the is the $H_1$ * time interaction effect. This impacts the X axis and Y axis. $\beta_2$ does not impact the estimated cell probabilities at baseline (the Y intercept).

Note. col 1 ⇒ $4/3\beta_3$, col 2 ⇒ $4/3(\beta_3+\beta_7)$, col 3 ⇒ $4/3(\beta_3+2\beta_7)$, col 4 ⇒ $4/3(\beta_3+4\beta_7)$ ✓

→




X numbers are off

# Question 2

## Placebo

$E(y) = \text{time1}\,\alpha_1 + \text{time4}\,\alpha_2 + \text{time6}\,\alpha_3 + \text{time1} * \text{baseline}\,\beta_1 + \text{time4} * \text{baseline}\,\beta_2 + \text{time6} * \text{baseline}\,\beta_3$

$$\hat{V}_P = \begin{bmatrix} 0.0077 & 0.0043 & 0.0034 \\ 0.0043 & 0.0081 & 0.0063 \\ 0.0034 & 0.0063 & 0.0113 \end{bmatrix}$$ ✓

$$\hat{\beta}_P = \begin{bmatrix} 0.9013 \\ 0.9611 \\ 0.8485 \end{bmatrix}$$ ✓

## Active

$$\hat{V}_A = \begin{bmatrix} 0.0408 & 0.0287 & 0.0181 \\ 0.0287 & 0.0434 & 0.0159 \\ 0.0181 & 0.0159 & 0.0533 \end{bmatrix}$$ ✓

$$\hat{\beta}_A = \begin{bmatrix} 0.6135 \\ 0.6005 \\ 0.9118 \end{bmatrix}$$ ✓

$$\Rightarrow (\hat{\beta}_A - \hat{\beta}_P) = \hat{\delta} = \begin{bmatrix} -0.2878 \\ -0.3606 \\ 0.0633 \end{bmatrix}$$ ✓

$$\Rightarrow \hat{V}_A + \hat{V}_P = \hat{V} = \begin{bmatrix} 0.0485 & 0.0330 & 0.0215 \\ 0.0330 & 0.0515 & 0.0222 \\ 0.0215 & 0.0222 & 0.0646 \end{bmatrix}$$ ✓ →

$$\delta^T \hat{V}^{-1} \hat{\delta} \sim \chi^2_3$$

$= 3.673$ ⇒ p-value $= 0.299$ ✓

Assume $\alpha = 0.05$

$\chi^2_3 = 7.815$ ok

since 3.673 is not greater than 7.815 so we cannot reject $H_0$.

state the null -2 ↑ and conclude that...?

**PART B** perform 3 seperate tests using numbers given on the midterm. Give 3 p-values

$\frac{\mu_A - \mu_{\hat{P}}}{\sqrt{SE_{\hat{P}}^2 + SE_A^2}} \sim N(0,1)$

| | A | P |
|---|---|---|
| $j=2$ | 0.413 (0.202) | 0.901 (0.0898) |
| $j=3$ | 0.600 (0.208) | 0.961 (0.0898) |
| $j=4$ | 0.912 (0.231) | 0.848 (0.106) |

for $j=2$

$$\frac{0.613 - 0.901}{\sqrt{(0.202)^2 + (0.0898)^2}} = -1.308 \Rightarrow \text{p-value} = 0.19$$

⇒ we fail to reject and conclude there is not a significant treatment effect at $j=2$

for $j=3$

$$\frac{0.600 - 0.961}{\sqrt{(0.208)^2 + (0.0898)^2}} = -1.59 \Rightarrow \text{p-value} = 0.11$$

⇒ we fail to reject and conclude there is not a significant treatment effect at $j=3$

for $j=4$

$$\frac{0.912 - 0.848}{\sqrt{(0.231)^2 + (0.106)^2}} = 0.252 \Rightarrow \text{pvalue} = 0.801$$

⇒ we fail to reject and conclude there is not a significant treatment effect at $j=4$

@ significance levels?