1) a) $\log E(Y_{it} \mid b_i, X_i) = \beta_0 + \beta_1 X_i + b_i$

$$\Rightarrow \log E(Y_{it} \mid b_i, X_i+1) - \log E(Y_{it} \mid b_i, X_i) = \beta_0 + \beta_1 (X_i+1) + b_i - (\beta_0 + \beta_1 X_i + b_i) = \beta_1$$

$$\log \left[\frac{E(Y_{it} \mid b_i, X+1)}{E(Y_{it} \mid b_i, X)} \right] = \beta_1$$

$$\frac{E(Y_{it} \mid b_i, X+1)}{E(Y_{it} \mid b_i, X)} = \exp\{\beta_1\}$$

$\therefore$ On average, the population averaged value of Y increases by e^{β_1} for every one unit increase in X.

b) $\text{logit}\, P(Y_{it} = 1 \mid b_i, X_i) = \beta_0 + \beta_1 X_i + b_i$, $b \sim N(0, \tau^2)$

$$\Rightarrow \text{logit}\, P(Y_{it} = 1 \mid b_i, X_i+1) = \beta_0 + \beta_1 (X_i+1) + b_i$$

$$\log \frac{P(Y_{it} = 1 \mid b_i, X_i+1)}{P(Y_{it} = 0 \mid b_i, X_i+1)} = \beta_0 + \beta_1 (X_i+1) + b_i$$

$$\log \frac{P(Y_{it} = 1 \mid b_i, X_i)}{P(Y_{it} = 0 \mid b_i, X_i)} = \beta_0 + \beta_1 X_i + b_i$$

$$\Rightarrow \text{logit}\, P(Y_{it} = 1 \mid b_i, X_i+1) - \text{logit}\, P(Y_{it} = 1 \mid b_i, X_i) = \beta_1$$

$$\log \frac{P(Y_{it} = 1 \mid b_i, X_i+1)\, P(Y_{it} = 0 \mid b_i, X_i)}{P(Y_{it} = 0 \mid b_i, X_i+1)\, P(Y_{it} = 1 \mid b_i, X_i)} = \beta_1$$

$$\frac{P(Y_{it} = 1 \mid b_i, X_i+1)\, P(Y_{it} = 0 \mid b_i, X_i)}{P(Y_{it} = 0 \mid b_i, X_i+1)\, P(Y_{it} = 1 \mid b_i, X_i)} = e^{\beta_1}$$

$\therefore$ On average, the population averaged odds of $Y_{it} = 1$ increases by e^{β_1} for every one unit increase in X.

2) (코드는 첨부파일)

Working Correlation : exchangeable

```
          [,1]      [,2]      [,3]      [,4]      [,5]      [,6]
[1,] 1.0000000 0.3370732 0.3370732 0.3370732 0.3370732 0.3370732
[2,] 0.3370732 1.0000000 0.3370732 0.3370732 0.3370732 0.3370732
[3,] 0.3370732 0.3370732 1.0000000 0.3370732 0.3370732 0.3370732
[4,] 0.3370732 0.3370732 0.3370732 1.0000000 0.3370732 0.3370732
[5,] 0.3370732 0.3370732 0.3370732 0.3370732 1.0000000 0.3370732
[6,] 0.3370732 0.3370732 0.3370732 0.3370732 0.3370732 1.0000000
```