2. Paired Permutation Test

- Logistic, Gompertz 모델에 대해 segment 별로 Paired Permutation t-test 시행

- Logistic :

$$f(t) = \sum_{i=1}^{n} \left(\frac{\alpha_i}{1+e^{\beta_i - \gamma_i t}} + q_i\right) I_{Seg_i}(t)$$
$$= \frac{\alpha_1}{1+e^{\beta_1 - \gamma_1 t}} I_{Seg_1}(t) + \left(\frac{\alpha_2}{1+e^{\beta_2 - \gamma_2 t}} + q_2\right) I_{Seg_2}(t)$$

where q_i is number of cumulative cases at breakpoint i $(q_1 = 0)$,

$I_{seg_i}(t) = \begin{cases} 1, t \in seg_i \\ 0, t \notin seg_i \end{cases}$ is indicator function,

seg_i is set of index which is in ith wave.

- Gompertz :

$$f(t) = \sum_{i=1}^{n} (\alpha_i c^{-\beta_i e^{-\gamma_i t}} + q_i) I_{seg_i}(t)$$
$$= (\alpha_1 c^{-\beta_1 e^{-\gamma_1 t}} + q_1) I_{seg_1}(t) + (\alpha_2 c^{-\beta_2 e^{-\gamma_2 t}} + q_{2i}) I_{seg_2}(t)$$

where q_i is number of cumulative cases at breakpoint i $(q_1 = 0)$,

$I_{seg_i}(t) = \begin{cases} 1, t \in seg_i \\ 0, t \notin seg_i \end{cases}$ is indicator function,

seg_i is set of index which is in ith wave.

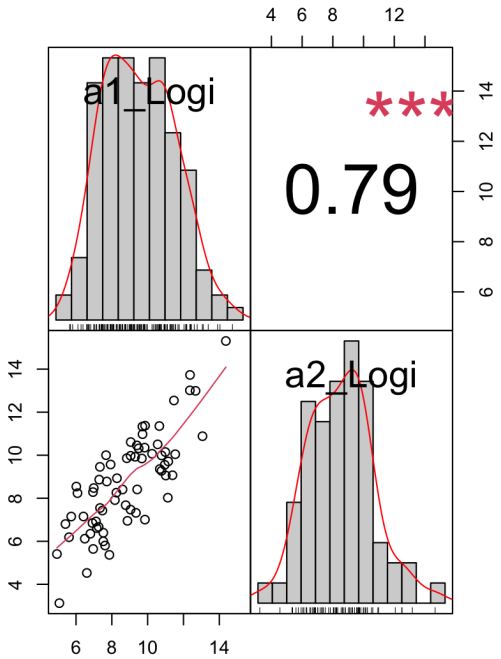
2. Paired Permutation Test

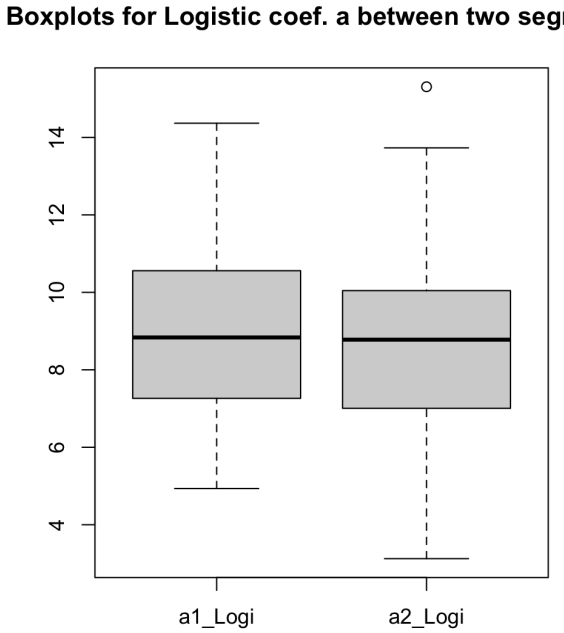
- 하나의 국가에서의 시점(segment)에 따른 평균 차이 검정이므로 등분산 검정은 필요 없음.
- 1000번을 복원추출한 t-test statistic을 검정
  (이때의 permutation test의 t-statistic은 paired t-value)
- **Empirical p-value**((paired t-value) 오른쪽에 있는 개수들의 평균)로 귀무가설 기각 여부 결정
- **귀무가설 (H0)**
  : COVID-19 재확산에 따른 Segment별 Growth Curve Model의 계수는 유의미한 차이가 없다.

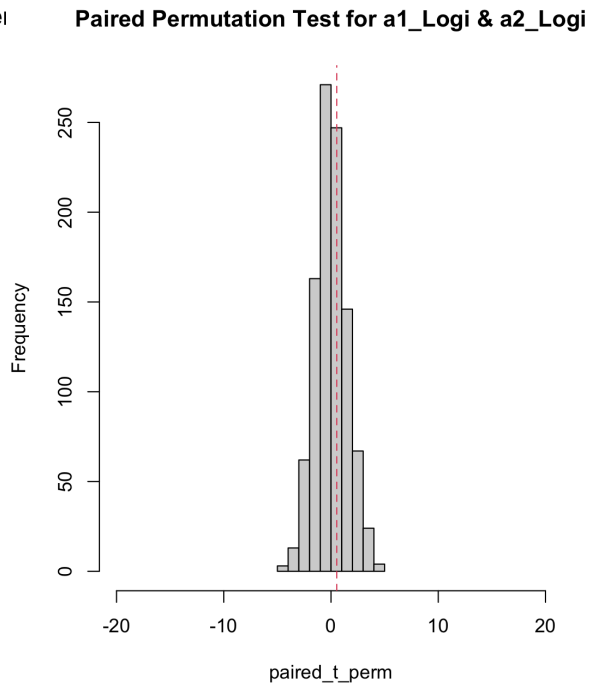
Result Analysis

2-1. Logistic Coefficient “a”

- **Logistic** Model의 **a** coefficient (empirical p-value : 0.692)



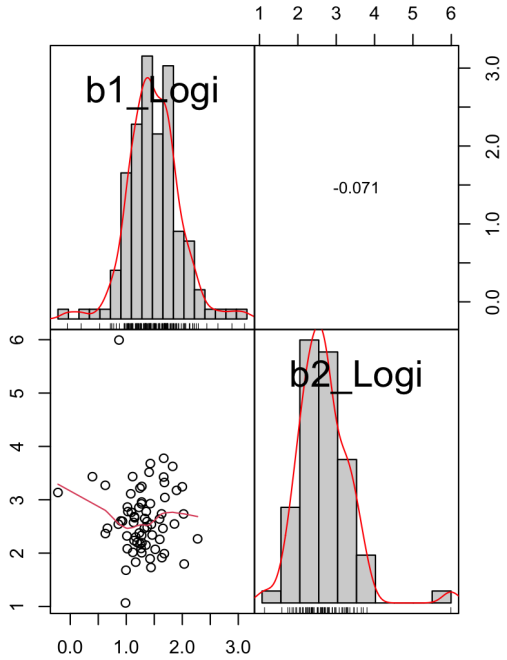


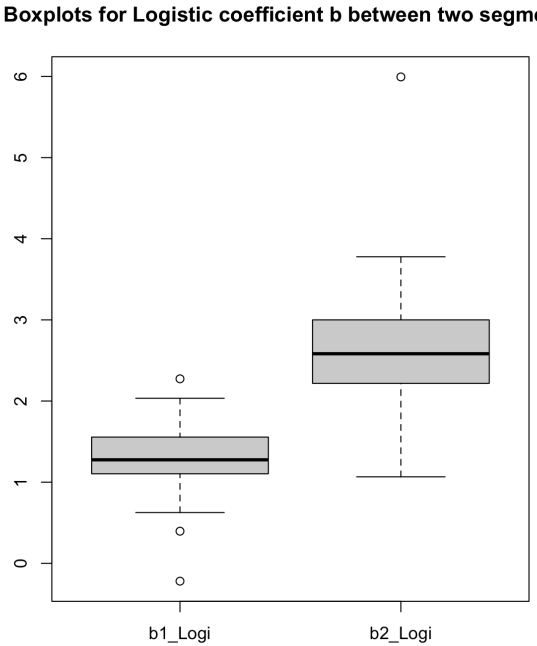


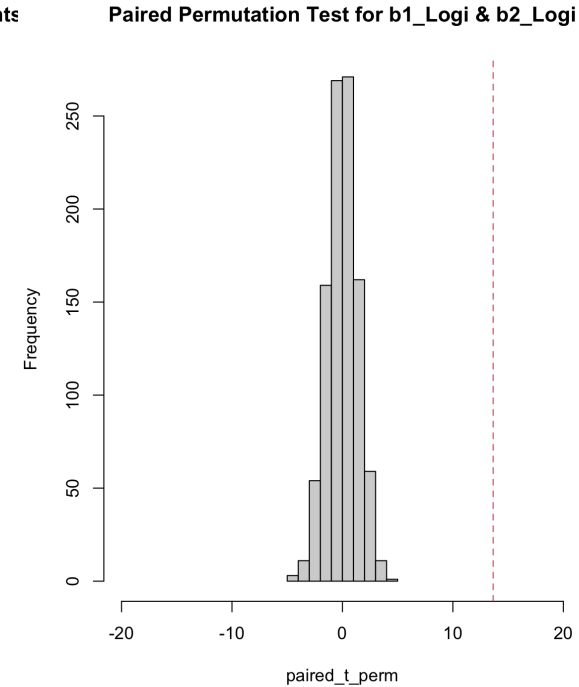
Result Analysis

2-1. Logistic Coefficient “b”

- **Logistic** Model의 **b** coefficient (empirical p-value : 0)



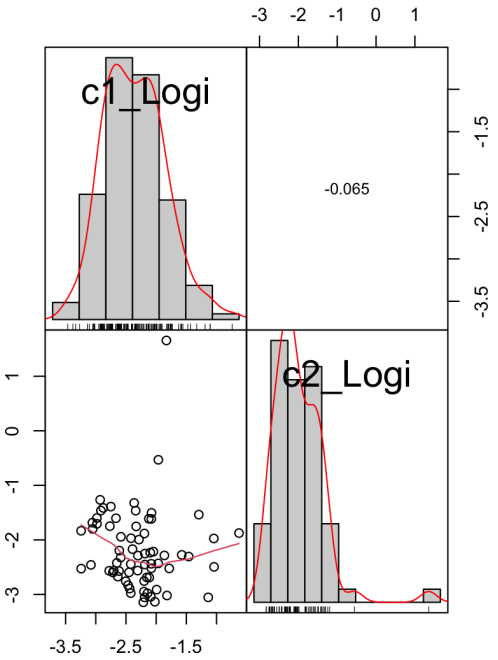


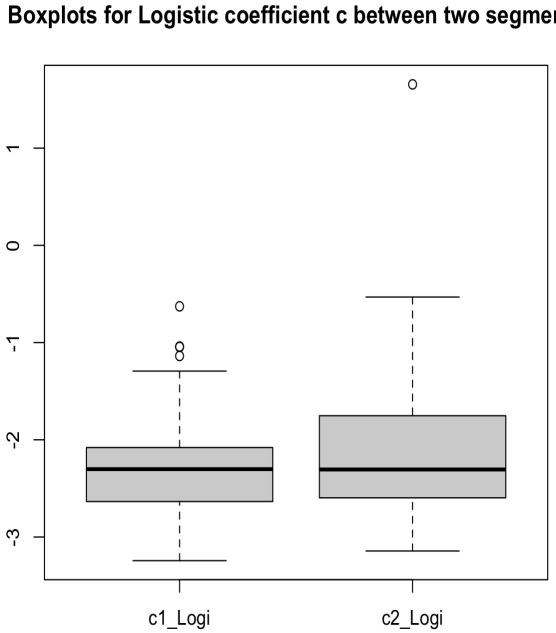


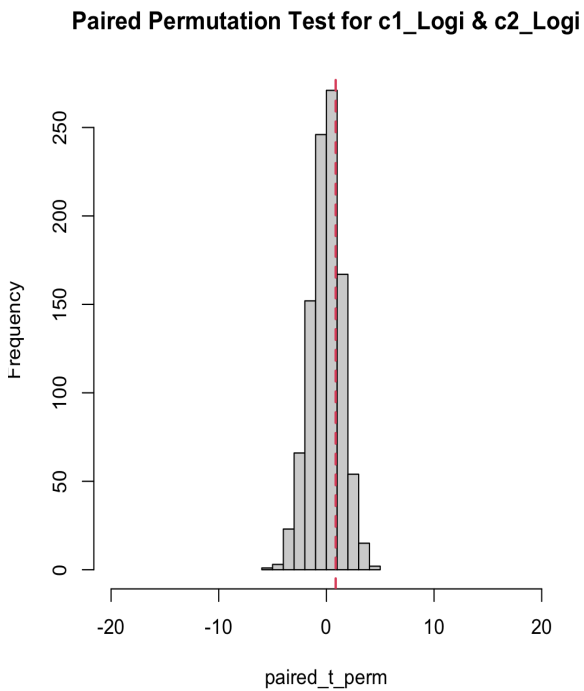
Result Analysis

2-1. Logistic Coefficient “c”

- **Logistic** Model의 **c** coefficient (empirical p-value : 0 .541)



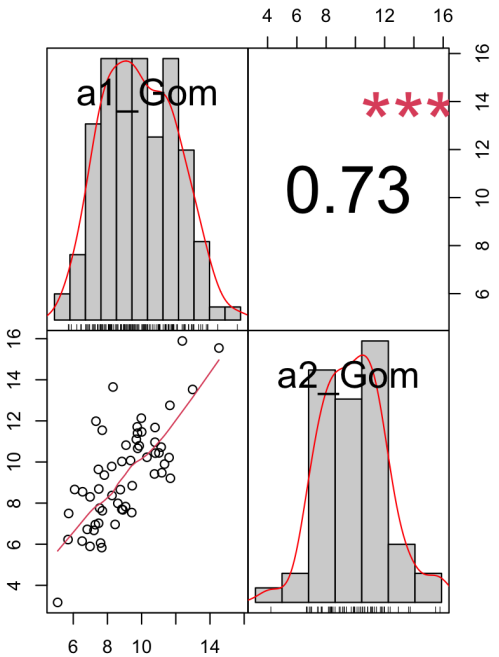


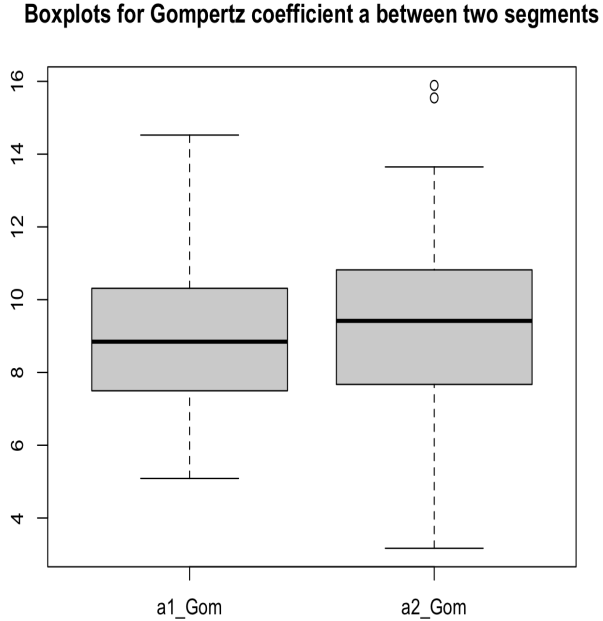


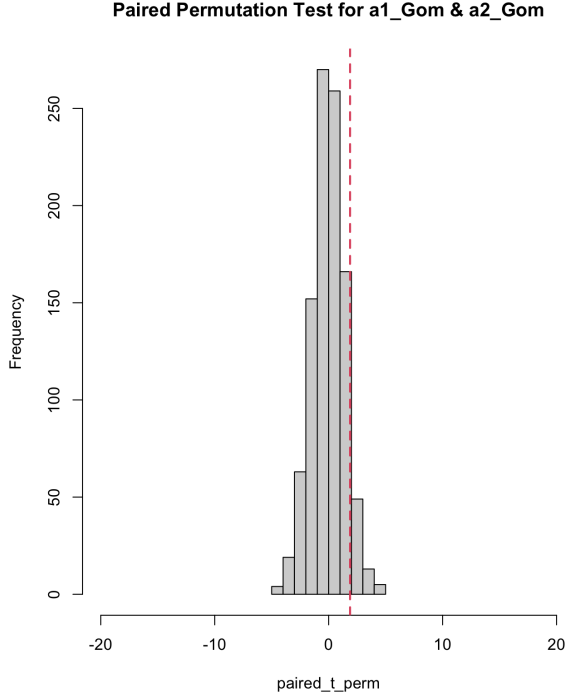
Result Analysis

2-2. Gompertz Coefficient “a”

- **Gompertz** Model의 **a** coefficient (empirical p-value : 0 .177)



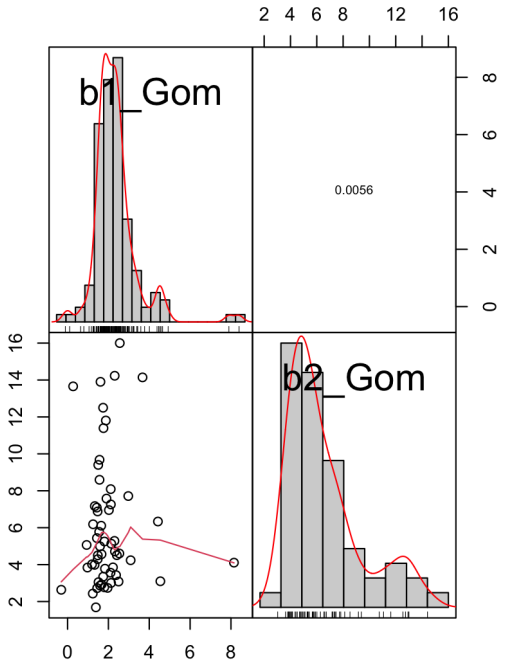


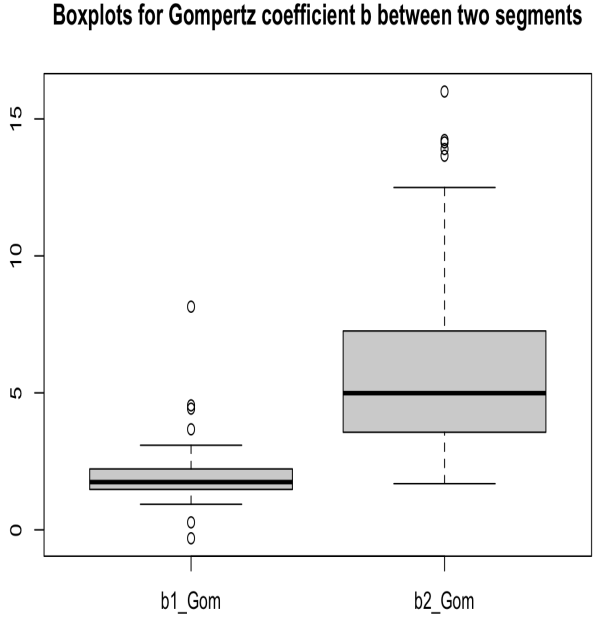


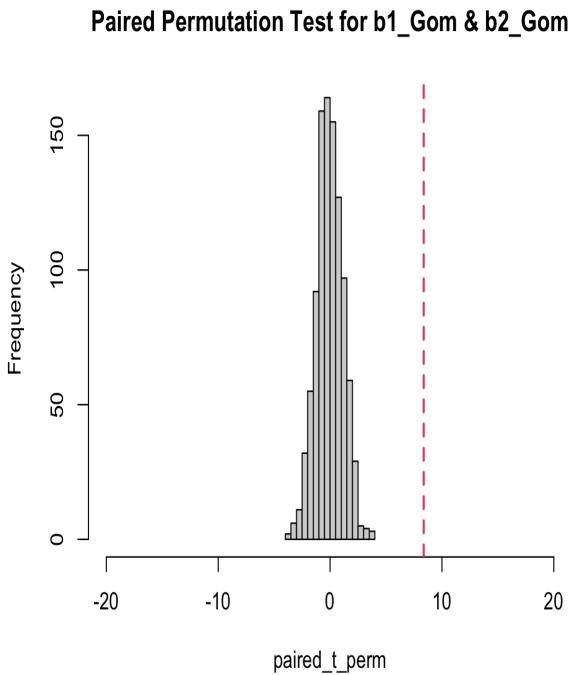
Result Analysis

2-2. Gompertz Coefficient “b”

- **Gompertz** Model의 **b** coefficient (empirical p-value : 0)







Result Analysis

2-2. Gompertz Coefficient “c”

- **Gompertz** Model의 **c** coefficient (empirical p-value : 0 .087)