生統二正課個人作業3 公衛二 梁嫚芳 b07801003

1. Is BP affected by Age?

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| Y: BP  X1: Age  X2: Sex (1: Male; 0: Female)  Model: Y = β0 + β1 X1 + β2 X2 + β3 (X1 X2) +ε, ε~N(0,σ2)  因為已知Age對BP的影響(斜率)會隨不同sex改變，故檢驗Age時須考慮sex的影響  β0: intercept in BP  β1: Age對BP的斜率  β2: Sex對BP的截距差異  β3: Age和Sex交互作用對BP的斜率變化  ε: 誤差  H0: β1 = β3 = 0，意即Age對BP無影響。  進行Partial F Test，Reduced Model為：Y = β0 + β2X2 +ε, ε~N(0, σ2)  F\*= = ~ F2, n-4 under H0  Set significant level α  Rejected H0 if F\* > F2, n-4, 1-α，Age對BP有統計顯著地影響。 |

1. Is BP the same for Mediate and High?

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| |  |  |  |  | | --- | --- | --- | --- | | X4 | X4(1) | X4(2) | X4(3) | | Placebo | 1 | 0 | 0 | | Low | 0 | 1 | 0 | | Mediate | 0 | 0 | 1 | | High | 0 | 0 | 0 |   Y: BP  X1: Age  X2: Sex (1: Male; 0: Female)  X4: Treatment (Placebo, Low, Mediate, High)  Model: Y = β0 + β1 X1 + β2 X2 + β3 (X1 X2) + β4(1) X4(1) + β4(2) X4(2) + β4(3) X4(3) +ε, ε~N(0, σ2)  β0: intercept in BP  β1: 同Treatment 下，Age對BP的斜率  β2: 同Treatment 下，Sex對BP的截距差異  β3: Age和Sex交互作用對BP的斜率變化  β4(1): 同Age, Sex下，Placebo和High對BP的截距差異  β4(2): 同Age, Sex下，Low和High對BP的截距差異  β4(3): 同Age, Sex下，Mediate和High對BP的截距差異  ε: 誤差  H0: β4(3) = 0，意即Mediate和High對BP無差異。  進行T Test  T= = ~ Tn-7 under H0  Set significant level α  Rejected H0 if |T| > Tn-7, 1-α/2，Mediate和High對BP有統計顯著地差異。 |

1. Does the effect of Treatment vary with Age?

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| |  |  |  |  | | --- | --- | --- | --- | | X4 | X4(1) | X4(2) | X4(3) | | Placebo | 1 | 0 | 0 | | Low | 0 | 1 | 0 | | Mediate | 0 | 0 | 1 | | High | 0 | 0 | 0 |   Y: BP  X1: Age  X2: Sex (1: Male; 0: Female)  X4: Treatment (Placebo, Low, Mediate, High)  Model: Y = β0 + β1 X1 + β2 X2 + β3 (X1 X2) + β4(1) X4(1) + β4(2) X4(2) + β4(3) X4(3) + β5(1) (X4(1) X1) + β5(2) (X4(2) X1) + β5(3) (X4(3) X1) +ε, ε~N(0, σ2)  β0: intercept in BP  β1: 同Treatment 下，Age對BP的斜率  β2: 同Treatment 下，Sex對BP的截距差異  β3: Age和Sex交互作用對BP的斜率變化  β4(1): 同Age, Sex下，Placebo和High對BP的截距差異  β4(2): 同Age, Sex下，Low和High對BP的截距差異  β4(3): 同Age, Sex下，Mediate和High對BP的截距差異  β5(1): Placebo和Age交互作用對BP的斜率變化  β5(2): Low和Age交互作用對BP的斜率變化  β5(3): Mediate和Age交互作用對BP的斜率變化  ε: 誤差  H0: β5(1) = β5(2) = β5(3) = 0，意即Treatment和Age交互作用對BP無斜率變化。  進行Partial F Test，Reduced model：Y = β0 + β1 X1 + β2 X2 + β3 (X1 X2) + β4(1) X4(1) + β4(2) X4(2) + β4(3) X4(3) +ε, ε~N(0, σ2)  F\*= = ~ F3, n-10 under H0  Rejected H0 if F\* > F3, n-10, 1-α，Treatment和Age交互作用對BP達統計顯著地斜率變化。 |

1. Based on your model in Problem-3, answer the following questions:

(a) Does the effect of Age vary with Sex?

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| H0: β3 = 0，意即Age和Sex的交互作用對BP無影響  進行T test  T= = ~ Tn-10 under H0  Rejected H0 if |T| > Tn-10, 1-α/2，Age和Sex的交互作用對BP達統計顯著地變化。 |

(b) Is BP affected by Treatment and Sex?

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| H0: β2 = β3 = β4(1) = β4(2) = β4(3) = β5(1) = β5(2) = β5(3) = 0，意即Treatment和Sex對BP無影響。  進行Partial F Test，Reduced Model: Y = β0 + β1 X1 +ε, ε~N(0, σ2)  F\*= = ~ F8, n-10 under H0  Rejected H0 if F\* > F8, n-10, 1-α，Treatment和Sex對BP達統計顯著地影響。 |

(c) Is Treatment effective in reducing blood pressure?

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| H0: β4(1) = β5(1) = 0，意即Placebo對BP無影響，代表Treatment有效降低BP。  進行partial F test，Reduced model: Y = β0 + β1 X1 + β2 X2 + β3 (X1 X2) + β4(2) X4(2) + β4(3) X4(3) + β5(2) (X4(2) X1) + β5(3) (X4(3) X1) +ε, ε~N(0, σ2)  F\*= = ~ F2, n-10 under H0  Rejected H0 if F\* > F2, n-10, 1-α，Placebo對BP有影響，代表Treatment達統計顯著地無法有效降低BP。 |

1. Suppose that the effect of Age is the same for “< 15 years old”, the same for “15 – 60 years old”, and the same for “> 60 years old”.
2. Does the effect of Age vary with Sex?

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| |  |  |  | | --- | --- | --- | | X1 | X1(1) | X1(2) | | < 15 years old | 1 | 0 | | 15 – 60 years old | 0 | 1 | | > 60 years old | 0 | 0 |   Y: BP  X1: Age(< 15 years old, 15 – 60 years old, > 60 years old)  X2: Sex (1: Male; 0: Female)  Model: Y = β0 + β1(1) X1(1) + β1(2) X1(2) + β2 X2 + β3(1) (X1(1) X2) + β3(2) (X1(2) X2) +ε, ε~N(0, σ2)  β0: intercept in BP  β1(1): < 15 years old和 > 60 years old對BP的差異  β1(2): 15 – 60 years old和 > 60 years old對BP的差異  β3(1): < 15 years old和Sex交互作用對BP的變化  β3(2): 15 – 60 years old和Sex交互作用對BP的變化  H0: β3(1) = β3(2) = 0，意即Age和Sex交互作用對BP無變化。  進行partial F test，Reduced model: Y = β0 + β1(1) X1(1) + β1(2) X1(2) + β2 X2 +ε, ε~N(0, σ2)  F\*= = ~ F2, n-6 under H0  Rejected H0 if F\* > F2, n-6, 1-α，Age和Sex交互作用對BP達統計顯著地變化。 |

1. Is BP affected by Age?

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| Y: BP   |  |  |  | | --- | --- | --- | | X1 | X1(1) | X1(2) | | < 15 years old | 1 | 0 | | 15 – 60 years old | 0 | 1 | | > 60 years old | 0 | 0 |   X1: Age(< 15 years old, 15 – 60 years old, > 60 years old)  X2: Sex (1: Male; 0: Female)  Model: Y = β0 + β1(1) X1(1) + β1(2) X1(2) + β2 X2 + β3(1) (X1(1) X2) + β3(2) (X1(2) X2) +ε, ε~N(0, σ2)  β0: intercept in BP  β1(1): < 15 years old和 > 60 years old對BP的差異  β1(2): 15 – 60 years old和 > 60 years old對BP的差異  β2: Sex對BP的影響  β3(1): < 15 years old和Sex交互作用對BP的變化  β3(2): 15 – 60 years old和Sex交互作用對BP的變化  H0: β1(1) = β1(2) = β3(1) = β3(2) = 0，意即Age對BP無影響。  進行partial F test，Reduced model: Y = β0 + β2 X2 +ε, ε~N(0, σ2)  F\*= = ~ F4, n-6 under H0  Rejected H0 if F\* > F2, n-6, 1-α，Age對BP達統計顯著地影響。 |

1. Is BP affected by Treatment and Sex?

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| Y: BP   |  |  |  | | --- | --- | --- | | X1 | X1(1) | X1(2) | | < 15 years old | 1 | 0 | | 15 – 60 years old | 0 | 1 | | > 60 years old | 0 | 0 |   X1: Age(< 15 years old, 15 – 60 years old, > 60 years old)  X2: Sex (1: Male; 0: Female)  X4: Treatment (Placebo, Low, Mediate, High)   |  |  |  |  | | --- | --- | --- | --- | | X4 | X4(1) | X4(2) | X4(3) | | Placebo | 1 | 0 | 0 | | Low | 0 | 1 | 0 | | Mediate | 0 | 0 | 1 | | High | 0 | 0 | 0 |   Model: Y = β0 + β1(1) X1(1) + β1(2) X1(2) + β2 X2 + β3(1) (X1(1) X2) + β3(2) (X1(2) X2) + β4(1) X4(1) + β4(2) X4(2) + β4(3) X4(3) + β6(1) (X4(1) X2) + β6(2) (X4(2) X2) + β6(3) (X4(3) X2)+ε, ε~N(0, σ2)  β0: intercept in BP  β1(1): 同Treatment，< 15 years old和> 60 years old對BP的差異  β1(2): 同Treatment，15–60 years old和> 60 years old對BP的差異  β2: 同Treatment，Sex對BP的影響  β3(1): < 15 years old和Sex交互作用對BP的變化  β3(2): 15 – 60 years old和Sex交互作用對BP的變化  β4(1): 同Age, Sex下，Placebo和High對BP的差異  β4(2): 同Age, Sex下，Low和High對BP的差異  β4(3): 同Age, Sex下，Mediate和High對BP的差異  β6(1): Placebo和Sex交互作用對BP的變化  β6(2): Low和Sex交互作用對BP的變化  β6(3): Mediate和Sex交互作用對BP的變化  H0: β2 = β3(1) = β3(2) = β4(1) = β4(2) = β4(3) = β6(1) = β6(2) = β6(3) = 0，意即Age和Sex交互作用對BP無變化。  進行partial F test，Reduced model: Y = β0 + β1(1) X1(1) + β1(2) X1(2) + β2 X2 +ε, ε~N(0, σ2)  F\*= = ~ F9, n-12 under H0  Rejected H0 if F\* > F9, n-12, 1-α，Age和Sex交互作用對BP達統計顯著地變化。 |

1. Is BP the same among Low, Mediate, and High?

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| Y: BP   |  |  |  | | --- | --- | --- | | X1 | X1(1) | X1(2) | | < 15 years old | 1 | 0 | | 15 – 60 years old | 0 | 1 | | > 60 years old | 0 | 0 |   X1: Age(< 15 years old, 15 – 60 years old, > 60 years old)  X4: Treatment (Placebo, Low, Mediate, High)  Model: Y = β0 + β4(1) X4(1) + β4(2) X4(2) + β4(3) X4(3) + ε, ε~N(0, σ2)   |  |  |  |  | | --- | --- | --- | --- | | X4 | X4(1) | X4(2) | X4(3) | | Placebo | 1 | 0 | 0 | | Low | 0 | 1 | 0 | | Mediate | 0 | 0 | 1 | | High | 0 | 0 | 0 |   β0: intercept in BP  β4(1): Placebo和High對BP的差異  β4(2): Low和High對BP的差異  β4(3): Mediate和High對BP的差異  H0: β4(2) = β4(3) = 0，意即各種Treatment對BP無影響。  進行partial F test，Reduced model: Y = β0 + β1(1) X1(1) + β1(2) X1(2) + β2 X2 + ε , ε~N(0, σ2)  F\*= = ~ F2, n-4 under H0  Rejected H0 if F\* > F2, n-4, 1-α，Low, Mediate, and High對BP達統計顯著地變化。 |