$\hat\beta_5 \doteq \hat\beta_{\text{Advert}}$

$a = (0, 0, 0, 0, 1, 0, 0, 1, 0)$

$\hat\beta_8 \doteq \hat\beta_{\text{region south : Advert}}$

5^{th} pos $\quad 8^{th}$ pos

$a^T\hat\beta = (0, \ldots 0\ 1, 0 \ldots 1)\,\hat\beta = \hat\beta_5 + \hat\beta_8$

$\overset{A}{\underbrace{a^T\hat\beta}}$

$$var[\overset{A}{a^T}\hat\beta] = \overset{A}{a^T}\, Var[\hat\beta]\, \overset{A^T}{a}$$

$$= \underbrace{[0 \ldots 0\ 1, 0\ 0, 1\ 0 \ldots]}_{a^T} \boxed{Var[\hat\beta]} \begin{bmatrix} 0 \\ \vdots \\ 0 \\ 1 \\ 0 \\ 0 \\ 1 \\ 0 \\ \vdots \end{bmatrix}$$

(5,5) entry $\qquad$ (8,8) entry

$$= \boxed{var[\hat\beta_5]} + var[\hat\beta_8]$$

$$+ \underset{(5,8)\text{ entry}}{cov[\hat\beta_5, \hat\beta_8]} + \underset{(8,5)\text{ entry}}{cov[\hat\beta_8, \hat\beta_5]}$$

$$\underset{1\times n}{x^T}\ \underset{n\times n}{A}\ \underset{n\times 1}{y} = \sum_{i=1}^{n}\sum_{j=1}^{n} a_{ij}\, x_i\, y_j$$