$\boxed{10.2}$

(a) $\beta_1 \Rightarrow$ zero or positive $\Rightarrow$ hours can't be negative.

$\beta_2 \Rightarrow$ positive. It will be more attractive if wage is higer.

$\beta_3 \Rightarrow$ positive. high-level education will lead to more willing and ability in job.

$\beta_4 \Rightarrow$ not sure. getting older may lead to more experience. But maybe their productivity will be lower due to age.

$\beta_5 \Rightarrow$ negative. It may cause them focus on children rather than work.

$\beta_6 \Rightarrow$ negative. If other family member has the financial capability may cause women don't have the pressure to working.

(b) 因為 Wage 可能有內生性：hours、wage 之間存在 simultaneity bias or omitted variable bias. 例如工作能力同時影響工資、工作時數，讓 OLS 估計有偏.

(c) Relevance: EXPER 與 WAGE 高度相關，EXPER 越多，Wage 越高

Exogeneity: 假設 EXPER、$EXPER^2$ 直接影響 HOURS 的唯一途徑是 WAGE，並未直接影響 HOURS.

(d) Yes. Because the instruments $\geq$ endogenous variable.
(EXPER、$EXPER^2$) (WAGE)

(e) Step 1: Regress that

$$WAGE = \gamma_1 + \gamma_2 EDUC + \gamma_3 AGE + \gamma_4 KIDSL6 + \gamma_5 NWIFEINC + \gamma_6 EXPER + \gamma_7 EXPER^2 + e$$

Step 2: use the $\widehat{WAGE}$ to regress HOURS and OLS estimate.

$$HOURS = \beta_1 + \beta_2 \widehat{WAGE} + \beta_3 EDUC + \beta_4 AGE + \beta_5 KIDSL6 + \beta_6 NWIFEINC + e$$

$\boxed{10.3}$

(a) $x = \gamma_1 + \theta_1 z + v$

$\rightarrow E(x) = \gamma_1 + \theta E(z)$

$\theta_1[z - E(z)] + v$

$[x - E(x)][z - E(z)] = \theta_1[z - E(z)]^2 + [z - E(z)] \cdot v$

$E([x - E(x)][z - E(z)]) = \theta_1 E[z - E(z)]^2 + E([z - E(z)] \cdot v)$

$E([z - E(z)][x - E(x)]) = \theta_1 E([z - E(z)]^2) \Rightarrow \theta_1 = \dfrac{Cov(z, x)}{Var(z)}$

(b) $y = \pi_0 + \pi_1 z + u$

$\rightarrow E(y) = \pi_0 + \pi_1 E(z)$

$\pi_1[z - E(z)] + u$

$[z - E(z)][y - E(y)] = \pi_1[z - E(z)]^2 + [z - E(z)] \cdot u$

$E([z - E(z)][y - E(y)]) = \pi_1 E[z - E(z)]^2 + E([z - E(z)] \cdot u) \Rightarrow \pi_1 = \dfrac{Cov(z, y)}{Var(z)}$

(c) $y = \beta_1 + \beta_2(\gamma_1 + \theta_1 z + v) + e = \underbrace{(\beta_1 + \beta_2\gamma_1)}_{\pi_0} + \underbrace{(\beta_2\theta_1)}_{\pi_1} z + \underbrace{(\beta_2 v + e)}_{u}$

(d) $\pi_1 = \beta_2\theta_1 \Rightarrow \beta_2 = \dfrac{\pi_1}{\theta_1}$

(e) $\hat{\theta}_1 = \dfrac{\widehat{cov}(z, x)}{\widehat{var}(z)} = \dfrac{\sum(z_i - \bar{z})(x_i - \bar{x})}{\sum(z_i - \bar{z})^2}$

$\hat{\pi}_1 = \dfrac{\widehat{cov}(z, y)}{\widehat{var}(z)} = \dfrac{\sum(z_i - \bar{z})(y_i - \bar{y})}{\sum(z_i - \bar{z})^2}$

$\hat{\beta}_2 = \dfrac{\hat{\pi}_1}{\hat{\theta}_1} = \dfrac{\widehat{cov}(z, y)}{\widehat{cov}(z, x)} \xrightarrow{P} \dfrac{cov(z, y)}{cov(z, x)} = \beta_2$