d) $$t\,stat = \frac{\hat{\beta}}{SE(\hat{\beta})}$$

$$= \frac{\dfrac{\sum_{i=1}^{n} x_i y_i}{\sum_{i=1}^{n} x_i^2}}{\sqrt{\dfrac{\sum_{i=1}^{n}(y_i - x_i\hat{\beta})^2}{(n-1)\sum_{i=1}^{n} x_i^2}}}$$

$$= \frac{\sum^{n} x_i y_i}{\sum_{i=1}^{n} x_i^2} \frac{\sqrt{(n-1)\sum_{i=1}^{n} x_i^2}}{\sqrt{\sum_{i=1}^{n}(y_i - x_i\hat{\beta})^2}}$$

$$= \frac{\sum^{n} x_i y_i \sqrt{(n-1)}}{\sqrt{\sum_{i=1}^{n} x_i^2}\sqrt{\sum_{i=1}^{n}(y_i - x_i\hat{\beta})^2}}$$

- by result 1 and distribution

$$\boxed{= \frac{\sum^{n} x_i y_i \sqrt{(n-1)}}{\sqrt{\sum x_i^2 \sum y_i^2 - \sum x_i^2 y_i^2}}}$$

Result 1

$$\boxed{\begin{aligned}&\sum^{n}(y_i - x_i\hat{\beta})^2 \\ &= \sum y_i^2 - 2y_i x_i\left(\frac{\sum x_i y_i}{\sum x_i^2}\right) + x_i^2\left(\frac{\sum x_i^2 y_i^2}{\sum x_i^4}\right) \\ &= \sum y_i^2 - 2\frac{\sum x_i^2 y_i^2}{\sum x_i^2} + \frac{\sum x_i^2 y_i^2}{\sum x_i^2} \\ &= \sum y_i^2 - \frac{\sum x_i^2 y_i^2}{\sum x_i^2}\end{aligned}}$$