linear models: $y_i = \beta_0 + \beta_1 x_i + \varepsilon_i$

b_1 is an <u>unbiased</u> <u>estimator</u> of β_1

Pf: Treat x_i as fixed.

$$b_1 = r\frac{s_y}{s_x} = \frac{1}{(n-1)s_x^2}\sum (x_i-\bar{x})(y_i-\bar{y})$$

$$= \frac{1}{(n-1)s_x^2}\sum y_i(x_i-\bar{x})$$

since $\sum x_i - \bar{x} = 0$

$$E(\hat{b}_1) = \frac{1}{(n-1)s_x^2}\sum E(y_i)(x_i-\bar{x})$$

$$= \frac{1}{(n-1)s_x^2}\sum (\beta_0+\beta_1 x_i)(x_i-\bar{x})$$

$$= \frac{\beta_1}{(n-1)s_x^2}\sum (x_i-\bar{x})(x_i-\bar{x})$$

$$= \beta_1$$