

Comparisons between the inferences of the population mean μ and the population slope β

		Population mean μ	Population slope β
Sampling distribution	Point estimate	$\bar{x}$ (sample mean)	b (sample slope)
	Mean and standard deviation of the point estimate	$\mu_{\bar{x}} = \mu$ $\sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}}$	Given fixed x , $\mu_b = \beta$ $\sigma_b = \frac{\sigma}{\sqrt{\sum_{i=1}^n (x_i - \bar{x})^2}}$ (NOT required to memorize σ_b)
	Standard error of the point estimate	$\frac{s}{\sqrt{n}}$	$se(b) = \sqrt{\frac{\frac{1}{n-2} \sum_{i=1}^n (y_i - \hat{y}_i)^2}{\sum_{i=1}^n (x_i - \bar{x})^2}}$ (NOT required to memorize)
	Sampling distribution of the point estimate	$\frac{\bar{x} - \mu}{\sigma/\sqrt{n}} \sim N(0, 1),$ but $\frac{\bar{x} - \mu}{s/\sqrt{n}} \sim T_{n-1}$	$\frac{b - \beta}{se(b)} \sim T_{n-2}$
100(1 - α)% Confidence interval	Assumptions	- Random sample from the population - Population is approximately normal, or sample size is large	- Random sample from the population - Linearity: The mean of y given x is $\mu_x = \alpha + \beta x$ - Normality of errors: The conditional distribution of y given x is $N(\alpha + \beta x, \sigma)$ - Constant variance: The conditional standard deviation of y given x, σ, does NOT depend on x
	100(1 - α)% CI	$\bar{x} \pm t_{\frac{\alpha}{2}, n-1} \frac{s}{\sqrt{n}}$	$b \pm t_{\frac{\alpha}{2}, n-2} se(b)$
	Interpretation	We are 100(1 - α)% confident that the true mean of ... is between $\bar{x} - t_{\frac{\alpha}{2}, n-1} \frac{s}{\sqrt{n}}$ and $\bar{x} + t_{\frac{\alpha}{2}, n-1} \frac{s}{\sqrt{n}}$	We are 100(1 - α)% confident that the mean of y increases between $b - t_{\frac{\alpha}{2}, n-2} se(b)$ and $b + t_{\frac{\alpha}{2}, n-2} se(b)$ units for each unit of increase in x .
Level α , two-sided hypothesis test	Assumptions	(same as the assumptions for confidence interval)	(same as the assumptions for confidence interval)
	Hypotheses	$H_0: \mu = \mu_0$ $H_a: \mu \neq \mu_0$	$H_0: \beta = 0$ $H_a: \beta \neq 0$
	Test statistic	$t = \frac{\bar{x} - \mu_0}{s/\sqrt{n}}$	$t = \frac{b - 0}{se(b)}$
	p -value	$2P(T_{n-1} > t)$, where T_{n-1} is the t -distribution with $(n - 1)$ degrees of freedom	$2P(T_{n-2} > t)$, where T_{n-2} is the t -distribution with $(n - 2)$ degrees of freedom
	Conclusion and Interpretation	- If p-value $< \alpha$: Reject H_0. We have strong evidence to conclude that the true mean of ... is different from μ_0 at the significance level α. - If p-value $\geq \alpha$: Failed to reject H_0. We do NOT have enough evidence to conclude that the true mean of ... is different from μ_0 at the significance level α.	- If p-value $< \alpha$: Reject H_0. We have strong evidence to conclude that the x and y are significantly associated the significance level α. - If p-value $\geq \alpha$: Failed to reject H_0. We do not have enough evidence to conclude that the x and y are significantly associated at the significance level α.