

Example: Atherosclerosis and Physical Activity

Oxidation of components of LDL cholesterol (the bad cholesterol) can result in atherosclerosis, or hardening of the arteries. Elosua *et. al* (2002) examine the impact of a 16 week physical activity program on LDL resistance to oxidation in 17 healthy young adults. After completing the program, the average maximum oxidation rate in the study participants \bar{x} was $8.2 \mu\text{mol}/\text{min}/\text{g}$, and the sample standard deviation of the maximum oxidation rate was $s = 2.5 \mu\text{mol}/\text{min}/\text{g}$. Assume that the oxidation rate is normally distributed.

- What is the distribution of \bar{x} ?

$$\frac{\bar{x} - \mu}{s/\sqrt{n}} \sim t_{16}.$$

- Suppose the average maximum oxidation rate in healthy young adults who did not complete the program was $\mu_0 = 11.3 \mu\text{mol}/\text{min}/\text{g}$ and the standard deviation was $\sigma = 2.3$. Define \bar{x}_0 as the sample mean maximum oxidation rate from a sample of size 17 from this population. Construct a 99% predictive interval for \bar{x}_0 . Is \bar{x} in this interval?

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. di 11.3 - invnormal(0.995)*2.3/sqrt(17)
. di 11.3 + invnormal(0.995)*2.3/sqrt(17)
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- Construct a 99% confidence interval for μ .

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. cii 17 8.2 2.5, level(99)
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- If you constructed the 99% confidence interval for μ assuming that the standard deviation was known and equal to $\sigma = 2.3$, would your confidence interval be wider or narrower? Will this result always be true?

Standard deviation known: $\bar{x} \pm Z_{0.99}\sigma$

Standard deviation unknown: $\bar{x} \pm t_{0.99,16}s$

- Let μ denote the mean maximum oxidation rate in young adults who participate in the program. Test the hypothesis that $\mu = \mu_0$ against the alternative that $\mu \neq \mu_0$ the $\alpha = 0.01$ level. What do you conclude?

$$H_0 : \mu = \mu_0, H_A : \mu \neq \mu_0$$

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. ttesti 17 8.2 2.5 11.3, level(99)
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Using a one-sample t-test, we obtain a test statistic of -5.11, which follows a t-distribution with 16 degrees of freedom under the null hypothesis, corresponding to a p-value of 0.0001. We reject the null at the 99% confidence level and conclude that the data suggest that the 16 week physical activity program lowers the maximum oxidation rate in healthy young individuals.

Elosua R., Molina L., Fito M., Arquer A., Sanchez-Quesada JL, Covas MI, Ordonez-Llanos J., Marrugat J.(2003)Response of oxidative stress biomarkers to a 16-week aerobic physical activity program, and to acute physical activity, in healthy young men and women. *Atherosclerosis* 167(2), 327-334.