

Confidence Intervals and Hypothesis Tests: Two Samples

9.4 t-Test for Two Population Means: Independent Samples (Equal Variances)

1. The U.S. census bureau released earnings data for year-round full-time workers by age and educational attainment in 2007. The results showed that male workers who were 25 -34 years old with a bachelor's degree earned more than males in the same age group with just a high school diploma. A new study selected a random sample of 20 males (aged 25 – 34) with a bachelor's degree and found they had an average salary of \$66,825 with a standard deviation of \$6,684.5, and a random sample of 22 males with only a high school diploma had a mean of \$35,995 and a standard deviation of \$6,245.1. Use the data provided and a 1% significance level to test the claim that males with a bachelor's degree earn on average more money than males with just a high school diploma (Assume equal variances).
2. Due to historic discrimination of women in the workforce, a researcher in 2007 hypothesized that women in the 25 – 34 age group with a bachelor's degree would have a higher average income than women in the 35 – 44 age range with a bachelor's degree. A sample of 15 women in the 25 – 34 age group with a bachelor's degree had an average salary of \$49,966 with a standard deviation of \$5,104; while a sample of 16 women with a bachelor's degree in the 35 – 44 age group had a mean salary of \$32,358 with a standard deviation of \$4,995. At the 5% significance level, test the claim that women in the 25 – 34 age group with a bachelor's degree earn more than women in the 35 – 44 age group with a bachelor's degree (Assume equal variances).
3. Average hourly earnings for workers have increased by about 50% since the 1990s, but that fact does not take into account inflation. Inflation matters because if your salary goes up by 50% while your cost of living rises by 100% you are losing ground. A study looked at this by randomly selecting wages for workers paid in 1970 and paid in 2008 and compared them after first converting them into constant (1982) dollars. A random sample of average hourly wages for 29 industries in 2008 found (in constant dollars) they had an average hourly wage of \$8.30 with a standard deviation of \$0.60. A random sample of 28 different industries' average hourly wages from 1970 had an average of \$8.46 (in constant dollars) with a standard deviation of \$0.55. At the 1% significance level test the claim that the average hourly wages for workers in 2008 are less than they were for workers in 1970 (Assume equal variances). What can we conclude?

Answers:

1. Based on the sample data, it seems very clear that males in this age group earn a significant amount more when they have a bachelor's degree as compared to having just a high school diploma.

$$\text{Claim: } \mu_{bach} > \mu_{h.s.}$$

$$H_0 : \mu_{bach} - \mu_{h.s.} \leq 0$$

$$H_a : \mu_{bach} - \mu_{h.s.} > 0$$

$$S_p^2 = 41,699,875.47$$

$$\text{Test Stat: } 15.45$$

$$d.f. = 20 + 22 - 2 = 40$$

$$\text{Critical Value(s): } 2.423$$

Initial Conclusion: Reject the null, support the alternative

Final Conclusion: The sample data supports the claim...

2. Based on the sample data, it seems very clear that younger women with a bachelor's degree earn more than older women with a bachelor's degree. This could be due to a more level playing field for younger women who have entered the job market more recently which might have helped them avoid the discrimination faced by many older women. The same pattern does not exist for older men and younger men. Older men earn more than younger men which should be the case since they have a greater amount of experience on the job.

$$\text{Claim: } \mu_{young} > \mu_{old}$$

$$H_0 : \mu_{young} - \mu_{old} \leq 0$$

$$H_a : \mu_{young} - \mu_{old} > 0$$

$$S_p^2 = 25,481,441.34$$

$$\text{Test Stat: } 9.71$$

$$d.f. = 15 + 16 - 2 = 29$$

$$\text{Critical Value(s): } 1.699$$

Initial Conclusion: Reject the null, support the alternative

Final Conclusion: The sample data supports the claim...

3. The sample data does not provide strong enough evidence to conclude that wages have dropped (in constant dollars) since the 1970s. However, the data also shows wages weren't any higher in 2008 as compared to 1970 which means that wages have essentially stagnated since that time.

$$\text{Claim: } \mu_{2008} < \mu_{1970}$$

$$H_0: \mu_{2008} - \mu_{1970} \geq 0$$

$$H_a: \mu_{2008} - \mu_{1970} < 0$$

$$S_p^2 = 0.3317727273$$

$$\text{Test Stat: } -1.05$$

$$d.f. = 29 + 28 - 2 = 55$$

$$\text{Critical Value(s): } -2.396$$

Initial Conclusion: Do not reject the null, do not support the alternative

Final Conclusion: The sample data does not support the claim...