# AP Statistics
# 2000 Student Samples



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4. Baby walkers are seats hanging from frames that allow babies to sit upright with their legs dangling and feet touching the floor. Walkers have wheels on their legs that allow the infant to propel the walker around the house long before he or she can walk or even crawl. Typically, babies use walkers between the ages of 4 months and 11 months.

Because most walkers have tray tables in front that block babies' views of their feet, child psychologists have begun to question whether walkers affect infants' cognitive development. One study compared mental skills of a random sample of those who used walkers with a random sample of those who never used walkers. Mental skill scores averaged 113 for 54 babies who used walkers (standard deviation of 12) and 123 for 55 babies who did not use walkers (standard deviation of 15).

(a) Is there evidence that the mean mental skill score of babies who use walkers is different from the mean mental skill score of babies who do not use walkers? Explain your answer.

The 2-test can be used because the sample size is greater than 30, according to the Central Limit Theorem. A significance of 1% will be used.

$\mu_1$: mean score of babies with walkers

$\mu_2$: mean score of babies w/o walkers

$H_0: \mu_1 - \mu_2 = 0$

$H_1: \mu_1 - \mu_2 \neq 0$

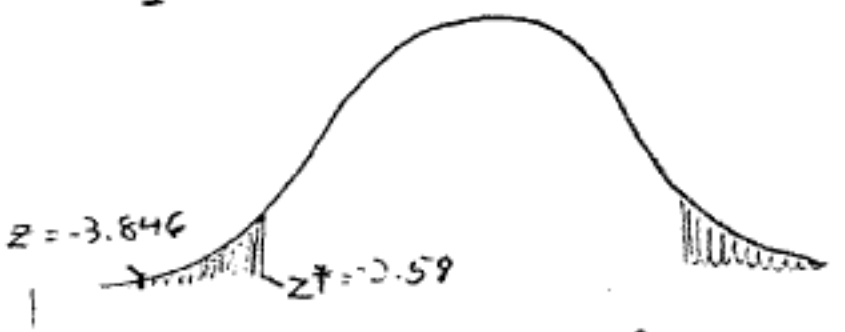
$\alpha = .01$

$\sigma = \sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}$

$\sigma = 2.5995$

$Z = \frac{113 - 123}{2.5995} = -3.846$

$Z^* = -2.58$




Therefore, with 1% significance, the mean mental skill score of babies with walkers is different than that of those w/o walkers.

(b) Suppose that a study using this design found a statistically significant result. Would it be reasonable to conclude that using a walker causes a change in mean mental skill score? Explain your answer.

Perhaps. There is strong evidence against the claim that the scores are relatively the same, however, there may be several confounding or common response variables influencing the outcome. Families with more money to spend on walkers may tend to have smarter children because of the financial situation, for example. It's not to say that a walker would cause a change, but a relationship is viable.

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**Because most walkers have tray tables in front that block babies' views of their feet, child psychologists have begun to question whether walkers affect infants' cognitive development. One study compared mental skills of a random sample of those who used walkers with a random sample of those who never used walkers. Mental skill scores averaged 113 for 54 babies who used walkers (standard deviation of 12) and 123 for 55 babies who did not use walkers (standard deviation of 15).**

**(a) Is there evidence that the mean mental skill score of babies who use walkers is different from the mean mental skill score of babies who do not use walkers? Explain your answer.**

① walker ② no walker

$n_1 = 54 \quad n_2 = 55$

$\bar{x}_1 = 113 \quad \bar{x}_2 = 123$

$\sigma_1 = 12 \quad \sigma_2 = 15$

④ $\alpha = .05$ or 5%

⑤ $z = \frac{(\bar{x}_1 - \bar{x}_2) - 0}{\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}}$

$z = \frac{113 - 123}{\sqrt{\frac{12^2}{54} + \frac{15^2}{55}}} = -3.8468$

$(z \neq -3.8468) = p = 1.1969 \times 10^{-4} \approx 0$

① $H_0: \mu_1 - \mu_2 = 0 \quad H_a: \mu_1 - \mu_2 \neq 0$ ② Z-test for difference of means

③ 1) We are told that the sample is random.

2) We will assume there are more than 540 babies who do use walkers and more than 550 who don't use walkers, or more than 1090 babies total, therefore, $n < 10\%$ of the population

3) We will invoke the power of the Central Limit Theorem, that as n gets larger, the sample becomes closer to normal, since the sample size is sufficiently large; therefore the normal approximation assumption will be met.

⑥ If in fact there is no difference in the mean scores of babies who use walkers and those who don't, then in repeated samples of 54 and 55 (109 total) we can expect a difference of $|-10|$ or more in approximately none (.011967%) of the samples.

At the 5% level, this data is significant because p is less than $\alpha$, therefore we will reject the null.

* There is evidence that the mean mental skill scores of babies who do & do not use walkers is different.

**(b) Suppose that a study using this design found a statistically significant result. Would it be reasonable to conclude that using a walker causes a change in mean mental skill score? Explain your answer.**

It would not be reasonable to conclude that using a walker causes a change in mean mental skill score using the above data because all it proves is that the mean mental skill score is different for babies who do and do not use walkers. An experiment would have to be conducted to conclude cause & effect.

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(a) **Is there evidence that the mean mental skill score of babies who use walkers is different from the mean mental skill score of babies who do not use walkers? Explain your answer.**

note:
$\mu_1$ = mean mental skill of babies who use walkers

$\mu_2$ = mean mental skill of babies who don't use walkers

Assumptions for T test
1) both SRS ✓
2) independent samples ✓
3) approx. normal distributions for both samples ✓
4) both samples → $\mu$ and $\sigma$ unknown ✓

$H_0: \mu_1 = \mu_2$

$H_a: \mu_1 \neq \mu_2$

note:
I will use a 2 Sample T-Test on the TI-83 to determine any significance

TI-83 results
$t = -3.8468$
$p = 2.0778 \times 10^{-4}$
$df = 102.8280$

Conclusion
The incredibly small p-value indicates that the data is very significant, extremely significant at the standard $\alpha = .05$ level. I would reject $H_0$ in favor of $H_a$, that there is definitely evidence that the mean mental skill of babies who use walkers is different from babies who don't use them.

(b) **Suppose that a study using this design found a statistically significant result. Would it be reasonable to conclude that using a walker causes a change in mean mental skill score? Explain your answer.**

It would be reasonable to conclude that there is a difference in mental skills, but not reasonable to say it caused a change. For cause-and-effect relationships, an experiment should be implemented to determine if walkers actually do <u>cause</u> a change in mental skills. The above was only an observational study, <u>not</u> an experiment.

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