Answer on Question #44850 - Math - Statistics and probability

A men's softball league is experimenting with a yellow baseball that is easier to see during night games. One way to judge the effectiveness is to count the number of errors. In a preliminary experiment, the yellow baseball was used in 10 games and the traditional white baseball was used in another 10 games. The number of errors in each game was recorded and is listed here. Can we infer that there are fewer errors on average when the yellow ball is used?

Yellow: 5 2 6 7 2 5 3 8 4 9
White: 7 6 8 5 9 11 8 3 6 10

Answer

Let's define μ_d as mean number of errors when the yellow ball is used minus mean number of errors when the white ball is used.
The null hypothesis contains "equal" sign ("=" or "≥" or "≤"), the alternative hypothesis is the complement to the null hypothesis.
The null hypothesis: means are equal, the mean number of errors is equal in the case of yellow and in the case of white ball.
H_0: $\mu_d \geq 0$
The alternative hypothesis: the number of errors when using yellow ball is less (claim).
H_a: $\mu_d < 0$
As alternative hypothesis contain "<" sign, we will use left-tailed test.

We will use t-distribution as number of observations is less than 30 and 95% confidence level, i. e. $\alpha = 0.05$.

We assume that variances are not equal as we do not know them, so df = 9. Critical value at 9 degrees of freedom: $t_c = -1.833$.

Standardized test statistics is:
$$t = \frac{(\bar{x}_1 - \bar{x}_2) - \mu_d}{\sqrt{\dfrac{s_1^2}{n_1} + \dfrac{s_2^2}{n_2}}} = \frac{5.1 - 7.3 - 0}{\sqrt{\dfrac{2.424^2}{10} + \dfrac{2.406^2}{10}}} = -2.037$$

As the test statistic lies in the rejection region, we have enough evidence to reject the null hypothesis that means are equal.

At 95% confidence level, we can reject the null hypothesis, so we can conclude that the mean number of errors in the case of yellow ball is less.

R code:
```
d1 <- c(5, 2, 6, 7, 2, 5, 3, 8, 4, 9)
d2 <- c(7, 6, 8, 5, 9, 11, 8, 3, 6, 10)
t.test(d1,d2,level=0.95,alternative="less",var.equal=F)
```