Grade sheet for Problem Two Part 5:
Two Sample Paired T Test For Mean of the Differences in Weights on Day 1 and Day 15 for High Exposure Test Group.

Part 5: As a result of high exposure, is there a change between the Day1 and Day 15 body weights? Justify

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Topic:
Previous studies have shown a link between pesticide exposure and thyroid disease, which can lead to increased weight gain, a symptom of thyroid disease.

Population:
Rats who are exposed to a high amount of the pesticide of interest.

Research Question:
Whether or not there is a difference in weights on day 1 and day 15 of rats who were exposed to a high level amount of this pesticide.

Methods

Description of Outcome: The weights of day 1 and day 15
Description of Predictor: High exposure of this pesticide

Description of Data Summary:

Weights on Day 1-High Exposure	Weights on Day 15-High Exposure
Mean: 97.16	Mean: 127.79
Sample Size: 61	Sample Size: 61
Standard Deviation: 10.78	Standard Deviation:10.72
95% CI on Mean: 94.40113 ,99.92182	95% CI on Mean: 125.0412, 130.5319

Description of Data Summary for Each Variable:
110 rats were a part of a research study to test the effects of a certain pesticide on weight gain. The rats were randomly selected, and divide among two groups: rats that either receive low exposure of this pesticide or high exposure of this pesticide. The trial lasted for 15 days and the weights of the rats were recorded on day 1 and day 15.

Verification of normality:
Per the central limit theorem, if the sample size is above 30 the sample mean will follow a normal distribution.

Statement of Null Hypothesis:
The differences in body weight after a high exposure of the pesticide is centered at 0 (H_0: $\mu_d=0$)

Statement of Alternative Hypothesis:
The differences in body weight after a high exposure of the pesticide is less than 0 (H_A: $\mu_{d<}0$)

Statistical Method for Test:
Paired T test

Decision Rule:
Reject H_O in favor of H_A if p-value is less than alpha (p-value<α) otherwise fail to reject the null H_O

Method of Computation:
R statistical software version 2.11.1

Significance Level:
α=0.05

Results

Data summary of the difference is in table 5.0

Table 5.0 Data Summary: For Day 1 and Day 15 Body Weights of High Exposure of the Pesticide

Groups	*n*	mean	SD	95% CI
High Exposure: Day 1 Weights	61	97.16	10.78	94.4011, 99.9218
High Exposure: Day 15 Weights	61	127.79	10.72	125.0412, 130.5319
Difference(D1-D15)		-30.63	7.12	-32.4500, -28.8001

Normality is assumed per the CLT based on adequate sample size for each group

Assumptions:
Sample is large enough
Sample is representative of the population from which it is drawn
Subjects were randomized into each group, therefore we assume measurements of each subject is independent of one another

Test Results of Paired T-Test:
t = -33.567, df = 60, p-value < 0.001

P-value Results
Since p-value < 0.05, we reject the H_O in favor of the Alternative H_A

Description of Results:
The paired t-test p-value is less than the stated alpha level (0.05), indicating that the data provided enough evidence to reject the null hypothesis and conclude that on average, high exposure of this pesticide causes increased weight gain. We find that the mean difference for μ_d is -30.64 and the 95% CI for μ_d, (the mean difference of day 1 and day 15 of high pesticide exposure) is roughly -32.4500 -28.8001. Therefore, we can say with 95% confidence that after being exposed to high levels of this pesticide for 15 days the true mean increase of body weight is between 32.4500, 28.8001

Discussion

Since the mean reduction from day 1 and day 15 was significantly different from zero, we conclude that the evidence suggests that high exposure to this pesticide causes increased weight gain.

Implication of Results

Based on the evidence, we conclude that high levels of exposure to this pesticide causes an increase in weight gain, a symptom of thyroid disease. Therefore, we encourage that all future users of this pesticide be made aware of this through proper labeling on the bottle.

R-code

```
#As a result of high exposure, is there a change between the Day1
#and Day 15 body weights? Justify.
#null Ho: ud = uo alt. Ha ud /=uo
#paired sunjects, before and after
#assumptions: sample size is above 30, there for CLT holds, subjects are represensative, measurements are
indpendent of eachother
#$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$4sumary$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
weight_diff_hi<-(MDay15_hi-MDay1_hi) #-30.62508

Q5_hi_day1<-T4_Problem2[T4_Problem2$Exposure=='high' & T4_Problem2$BWDay1,1]
Q5_hi_day15<-T4_Problem2[T4_Problem2$Exposure=='high' & T4_Problem2$BWDay15,2]

mean_diff_high_day1_vs_day15.data<-(Q5_hi_day1-Q5_hi_day15)

t.test(mean_diff_high_day1_vs_day15.data)

diff_day_1_high<-sqrt((-30.63--15.315)^2/60)


CI(Q5_hi_day1,ci=0.95)
#upper     mean    lower
#99.92182 97.16148 94.40113
#>
CI(Q5_hi_day15, ci=0.95)
#> CI(Q5_hi_day15, ci=0.95)
#upper     mean    lower
#130.5319 127.7866 125.0412

#stadand deviation
#Exposure    BWDay1
#     high 10.777890

#Exposure  BWDay15
#     high 10.71949


#$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$paired t test$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
t.test(Day1_hi,Day15_hi, mu=0,alternative="two.sided", paired=TRUE)
Paired t-test

#data:  Day1_hi and Day15_hi
#t = -33.567, df = 60, p-value < 2.2e-16
#alternative hypothesis: true difference in means is not equal to 0
#95 percent confidence interval:
#  -32.45006 -28.80011
#sample estimates:
#  mean of the differences
#-30.62508
```