Grade sheet for Problem Two Part 6:
Two Sample T Test For Difference of Mean Weights on Day 1 and Day 15 for Low and High Exposure Groups

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Part 6: At significance level alpha = 0.05, does the level of exposure have an effect on the amount of change in body weight from Day 1 to Day 15? Justify.

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 low and high amount of the pesticide of interest.

Research Question:
Whether or not the level of exposure have an effect on the amount of change in body weight from Day 1 to Day 15.

Methods

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

Description of Data Summary:

Difference in Weights of Low Exposure Day 1 and Day 15	Difference in Weights of Low Exposure Day 1 and Day 15
Mean: 28.57	Mean: 30.62
Sample Size: 49	Sample Size: 61
Standard Deviation: 7.08	Standard Deviation: 7.13
95% CI on Mean: 26.5315,30.6020	95% CI on Mean: 28.8001,32.4500

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 difference in the mean body weight of the low exposure group and the difference of the mean body weight of the high exposure group are equal (H_0: $\mu_L-\mu_H=0$)

Statement of Alternative Hypothesis:
The difference in the mean body weight of the low exposure group and the difference of the mean body weight of the high exposure group is not equal to zero (H_A: $\mu_L-\mu_H \neq 0$)

Statistical Method for Test:

Equal Variance or Unequal Variance Independent Two sample T-test

Statistical Method for testing for testing equality of variances:
F-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 6.0
Table 6.0 Data Summary: For Day 1 and Day 15 of Difference of Body Weights of Low and High Exposure of the Pesticide

Groups	*n*	mean	SD	95% CI
Low Exposure group Day 1-Day 15	49	28.57	7.08	-26.5315, -30.6020
High Exposure group Day 1-Day 15	61	30.62	7.13	-28.8001, -32.4500
		Mean	SE	95%CI
Difference(D1-D15)		-2.05	1.36	-0.6445 4.7612

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
Equal Variance

F-Test Results
F-test p-value = 0.9755

Test Results of T-Test:
t = 1.5095, df = 108, p-value = 0.1341

P-value Results
Since p-value > 0.05, we fail to reject the H_O

Description of Results:

Since the F value is higher than alpha level we assume equal variances. For the equal variance independent two sample t-test yields a p-value higher than the stated alpha level, therefore we reject fail to reject the null hypothesis.

Discussion

Based on the observed data, it is interesting that the evidence suggests that the difference in mean body weight for the low exposure group on day 1 and day 15 and mean body weight of high exposure group on day 1 and day 15 is approximately less than zero. Therefore, the test suggest there is no significant difference in means weights between the day 1 and day 15 of low exposure group and day 1 and day 15 of high exposure group..

Implication of Results

Based on the evidence, we conclude that neither high nor low levels of this pesticide cause a difference in weight, a symptom of thyroid disease. We conclude that subjects who use this pesticide should not be concerned about exposure levels.

R code

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# At significance level alpha = 0.05, does the level of exposure
#have an effect on the amount of change in body weight from Day 1 to Day 15? Justify



##################summary


high_exp_day1<-T4_Problem2[T4_Problem2$Exposure=='high' & T4_Problem2$BWDay1,1]
high__exp_day15<-T4_Problem2[T4_Problem2$Exposure=='high' & T4_Problem2$BWDay15,2]

lo_exp_day1<-T4_Problem2[T4_Problem2$Exposure=='low' & T4_Problem2$BWDay1,1]
lo__exp_day15<-T4_Problem2[T4_Problem2$Exposure=='low' & T4_Problem2$BWDay15,2]

diff_in_high_exp.data<-high_exp_day1-high__exp_day15
diff_in_low_exp.data<-lo_exp_day1-lo__exp_day15

mean(diff_in_low_exp.data)
mean(diff_in_high_exp.data)

prob6_mean_diff<-(mean(diff_in_low_exp.data)-mean(diff_in_high_exp.data))


sp_for_group_prob_6<-((48)*7.08*7.08+(60)*7.13*7.13)/(49+61-2)


standard_error_pooled_prob_6<-sqrt(sp_for_group_prob_6*(1/49+1/61))

prob_6_hi<-diff_in_high_exp.data
prob_6_lo<-diff_in_low_exp.data
diff.data<-(prob_6_lo-prob_6_hi)
sd(diff.data)

CI(prob_6_hi, ci=0.95)
#upper    mean    lower
#32.45006 30.62508 28.80011

CI(prob_6_lo, ci=0.95)
#upper    mean    lower
#30.60198 28.56673 26.53149

sd(prob_6_hi)
sd(prob_6_lo)

var.test(prob_6_lo, prob_6_hi, ratio = 1,
        alternative = c("two.sided"),
        conf.level = 0.95)

t.test(diff_in_high_exp.data,diff_in_low_exp.data, mu=0, alternative="two.sided", var.equal = TRUE)
```

#Two Sample t-test

#data: diff_in_high_exp.data and diff_in_low_exp.data
#t = 1.5095, df = 108, p-value = 0.1341
#alternative hypothesis: true difference in means is not equal to 0
#95 percent confidence interval:
-0.6444804 4.7611749
#sample estimates:
mean of x mean of y
#30.62508 28.56673