**Question 1:**

* Par incorporation has introduced new cut resistant and long-lasting golf ball. They would like to compare the features of the new ball with the current one before entering the market
* Par research depicted some concerns regarding the driving distance of the new ball compared to the current one
* To gain confidence about the driving distance of the new ball they conducted an experiment with sample of 40 old and new golf balls using mechanical hitting machine
* Par hopes to have comparable driving distances between these two samples. The difference between the mean distances of the samples would infer the difference between the two balls
* So, to help Par prove that the driving distances are comparable of the current and the new golf ball below hypothesis is formulated

**H0: µ1 - µ2 = 0**

**Ha: µ1 - µ2 ≠ 0**

Let µ1 = mean sample distance of the current ball

Let µ2 = mean sample distance of the new ball

* **Null Hypothesis (H0)**:

To show the mean distances are comparable the difference between them should be equal to zero, hence it is considered as null hypothesis

* **Alternative Hypothesis (Ha):**

The alternative hypothesis the mean distances are not equal to zero which means they are not comparable

**Question 2:**

* To compute the p-value, test statistic value and degree of freedom needs to be determined

Test statistics =

Degree of Freedom, df =

Where, x̅1: Sample mean of current golf ball

x̅2: Sample mean of new golf ball

s1: Sample Std Deviation of current golf ball

s2: Sample Std Deviation of new golf ball

n1: Sample size of current golf ball

n2: Sample size of new golf ball

* From the given sample data following values are computed using R **function t.test**

|  |  |  |
| --- | --- | --- |
|  | Current Golf Ball | New Golf Ball |
| Mean | 270.275 | 267.5 |
| Standard deviation | 8.7529 | 9.896 |
| Test statistics | 1.382 | |
| Degree of freedom | 76.852 (≈ 77) | |
| P-value | 0.188 | |

* According to the above data, p-value is 0.188 which is greater than 0.10
* **As the p-value is greater than 0.10 we have insufficient evidence to conclude that Ha is true**
* Above statement concludes, it cannot be proved that the driving distances of the current and new golf balls are not comparable
* **Recommendation to Par:**

It would be safe to recommend that the driving distance of the new golf ball are comparable to those of the current golf ball

**Question 3:**

* Interval estimate is computed using the sample mean and margin of error (E)
* Since population standard deviation is unknown t-distribution method is used
* For each model:

E = tα/2

Interval estimate = x̅ ± E

* For difference between the means of two populations:

E = tα/2

Interval estimate = (x̅1 - x̅2) ± E

* For 95% confidence level, E is computed using α=0.05
* Computed the following values in R using **function t.test**

|  |  |
| --- | --- |
|  | Interval Estimate |
| Current sample | 267.47 to 273.07 |
| New sample | 264.33 to 270.66 |
| Difference of current and new sample | -1.38 to 6.93 |

**Question 4:**

* There is no need for larger sample size and more testing with the golf balls for the following reasons:
  + In most applications, total sample size (n1 **+** n2) of 20 or more provides very good results. The experiment conducted by Par Inc has sample size 40 + 40 = 80
  + Larger sample size is recommended if the sample data contains any outliners
  + From the box plot below for the current and new golf ball samples, there are no outliers

Chart, box and whisker chart

Description automatically generated

Chart, box and whisker chart

Description automatically generated

* It can be concluded that the results provided by the sample size of 40 are satisfactory