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

$$\mathbf{H_0: \mu_1 - \mu_2 = 0}$$
$$\mathbf{H_a: \mu_1 - \mu_2 \neq 0}$$

Let μ_1 = mean sample distance of the current ball
Let μ_2 = mean sample distance of the new ball

- **Null Hypothesis (H_0)**:
  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 (H_a):**
  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

$$\text{Test statistics} = \frac{\bar{x}_1 - \bar{x}_2 - 0}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$$

$$\text{Degree of Freedom, df} = \frac{\left(\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}\right)^2}{\frac{1}{(n_1-1)}\left(\frac{s_1^2}{n_1}\right)^2 + \frac{1}{(n_2-1)}\left(\frac{s_2^2}{n_2}\right)^2}$$

Where, $\bar{x}_1$: Sample mean of current golf ball
$\bar{x}_2$: Sample mean of new golf ball
s_1: Sample Std Deviation of current golf ball
s_2: Sample Std Deviation of new golf ball
n_1: Sample size of current golf ball
n_2: 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 H_a 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:

$$E = t_{\alpha/2}\frac{s}{\sqrt{n}}$$

$$\text{Interval estimate} = \bar{x} \pm E$$

- For difference between the means of two populations:

$$E = t_{\alpha/2}\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}$$

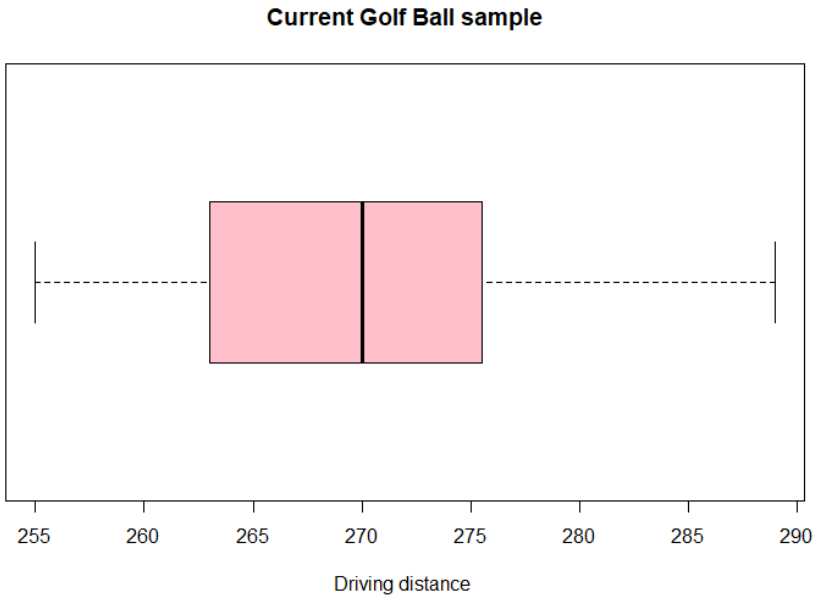
$$\text{Interval estimate} = (\bar{x}_1 - \bar{x}_2) \pm E$$

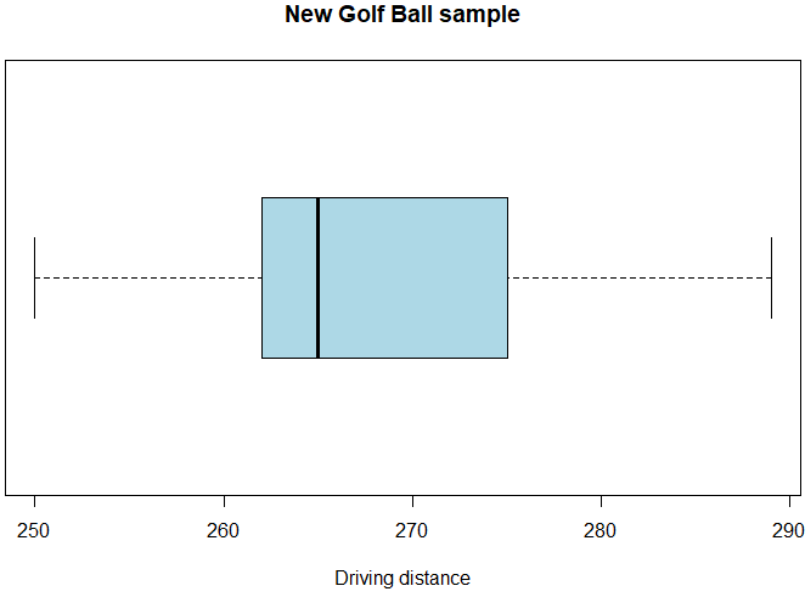
- For 95% confidence level, E is computed using $\alpha=0.05$
- Computed the following values in R using **function t.test**

	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 ($n_1 + n_2$) 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





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