Distribution Analysis

We want to test the hypothesis that whether an individual's blood pressure **has changed or not** after exercising regularly for the past month (30-days).

Hypothesis Test:

Step 1: Null and alternative hypothesis as follows:
Ho is our null hypothesis which is "No Change in Blood Pressure"

$$Ho: \mu = \mu o$$

Ha is our alternative hypothesis if Ho is concluded to be untrue.

$$Ha: \mu \neq \mu o$$

```
#Mean (Population)
mu <- mean(BloodPressure$Before)
mu
[1] 138.28
```

Furthermore, since we are testing if the individual's blood pressure has **not** changed, we have the following setup:

$$Ho: \mu = 138.28$$
$$Ha: \mu \neq 138.28$$

```
#Mean (Sample)
mu0 <- mean(BloodPressure$After)
mu0
[1] 130.28
```

The arithmetic mean of "After" is 130.28 which is slightly different from our hypothesized value of 138.28. Is this difference significant, or is it due to chance variation alone?

```
#Standard Deviation of the Sample
sd <- sd(BloodPressure$After)
sd
[1] 7.960946
#Standard Error of the Sample
SE.After <- sd(BloodPressure$After) / sqrt(length(BloodPressure$After))
SE.After
[1] 1.592189
```

Step 2: The significance level = 0.05 (p-value)
Step 3: We are going to use Two-Tail Test, because there is the indication "has changed" in the question.

```
#Calculate z parameters
mu0 <- 130.28 # Specify the mean (sample)
```

```
alpha <- 0.05 # Specify the significance level
sigma <- 7.960946 # Sample standard deviation
n <- nrow(BloodPressure) # Get the sample size
#Calculate z
z<-(mu0-mu)/(sigma/sqrt(n))
z

[1] -5.024528                    # which is on the left-hand side of the normal distribution

#Calculate p-value
2*pnorm(abs(z),lower.tail=FALSE)  # p-values (we multiple by 2 since it's a two-side test)

[1] 5.046709e-07
```

Step 4: Conclusion

Since p-value of [1] 5.046709e-07 is much lower than 0.05 confidence interval, therefore we reject the null hypothesis that μ = 138.28.

We reject the null hypothesis that an individual's blood pressure has not changed after exercising regularly is equal to 138.28 at the 0.05 level. In other words, this shows that exercising regularly has a positive effect on lowering blood pressure.

R-Script

```
#Load Library
library(openintro)
#Load Dataset
BloodPressure
#View first few lines of dataset
head(BloodPressure)
#View key information of dataset
str(BloodPressure)
#Mean (Population)
mu <- mean(BloodPressure$Before)
mu
#Mean (Sample)
mu0 <- mean(BloodPressure$After)
mu0
#Standard Deviation of the Sample
sd <- sd(BloodPressure$After)
sd
#Standard Error of the Sample
SE.After <- sd(BloodPressure$After) / sqrt(length(BloodPressure$After))
SE.After
#Calculate z parameters
mu0 <- 130.28 # Specify the mean
alpha <- 0.05 # Specify the significance level
sigma <- 7.960946 # Sample standard deviation
n <- nrow(BloodPressure) # Get the sample size
#Calculate z
z<-(mu0-mu)/(sigma/sqrt(n))
z
#Calculate p-value
2*pnorm(abs(z),lower.tail=FALSE)
```