MSMS - 106

Ananda Biswas

✎ **Consider 1, 2, 3, . . . , 100 as population observations. Take a sample of size 40 (without replacement) by *sample()* function and compute mean, median, variance, mean absolute deviation about mean, median absolute deviation about median, skewness and kurtosis. Implement the functions on your own and use functions provided by R to verify results.**

➲ *Getting a sample*

```
my_sample <- sample(1:100, size = 40, replace = FALSE)
my_sample

##  [1]  87  74  23  10 100  35  51  75  60  36  22   1  83   6  90  14  67  13  32
## [20]  98  31  44  55  28  26   5  17  40  57  52  54  93  15  42  86  33  12  95
## [39]  29  68
```

➲ *Mean*

To compute mean, we add all the observations and divide the sum by number of observations i.e. $\bar{x} = \frac{1}{n}\sum_{i=1}^{n} x_i$.

```
my_mean_function <- function(x){

  sample_sum <- 0

  for (i in 1:length(x)) {
    sample_sum <- sample_sum + x[i]
  }

  return(sample_sum / length(x))
}
```

```
my_mean_function(my_sample); mean(my_sample)

## [1] 46.475
## [1] 46.475
```

✓ Results matched !!

➜ *Median*

To compute median, we first sort the sample values and return the middle most value.

```
my_median_function <- function(x){

  for (i in 1:(length(x)-1)) {
    for (j in (i+1):length(x)) {

      if(x[i] > x[j]){
        x[c(i, j)] <- x[c(j, i)]
      }
    }
  }

  if(length(x) %% 2 == 0){
    return((x[length(x)/2] + x[length(x)/2 + 1]) / 2)
  }
  else{
    return(x[(length(x) + 1) / 2])
  }
}
```

```
my_median_function(my_sample); median(my_sample)

## [1] 41
## [1] 41
```

✓ Results matched !!

➜ *Variance*

To compute variance, we get the squared deviations, their sum and then we divide the sum by $(n-1)$ i.e. $\dfrac{1}{n-1}\sum_{i=1}^{n}(x_i - \bar{x})^2$.

```
my_sample_central_moments_function <- function(x, r){
  temp <- 0

  for (i in 1:length(x)) {
    temp <- temp + (x[i] - my_mean_function(x))^r
  }

  return(temp / (length(x) - 1))
}
```

```
my_sample_central_moments_function(my_sample, 2); var(my_sample)

## [1] 885.5891
## [1] 885.5891
```

✓ Results matched !!

Mean Absolute Deviation about Mean

We first obtain the deviations $(x_i - \bar{x})$ $\forall i$ and then we calculate their absolute values. Lastly we calculate their mean.

```
deviations_about_mean <- my_sample - my_mean_function(my_sample)

absolute_deviations_about_mean <- c()

for (i in 1:length(deviations_about_mean)) {
  if(deviations_about_mean[i] < 0){
    absolute_deviations_about_mean[i] <- deviations_about_mean[i] * (-1)
  }
  else{
    absolute_deviations_about_mean[i] <- deviations_about_mean[i]
  }
}
```

```
absolute_deviations_about_mean

##  [1] 40.525 27.525 23.475 36.475 53.525 11.475  4.525 28.525 13.525 10.475
## [11] 24.475 45.475 36.525 40.475 43.525 32.475 20.525 33.475 14.475 51.525
## [21] 15.475  2.475  8.525 18.475 20.475 41.475 29.475  6.475 10.525  5.525
## [31]  7.525 46.525 31.475  4.475 39.525 13.475 34.475 48.525 17.475 21.525
```

```
my_mean_function(absolute_deviations_about_mean)

## [1] 25.4225
```

Median Absolute Deviation about Median

We first obtain the deviations $(x_i - \widetilde{x})$ $\forall i$ and then we calculate their absolute values. Lastly we calculate their median.

```
deviations_about_median <- my_sample - my_median_function(my_sample)

absolute_deviations_about_median <- c()

for (i in 1:length(deviations_about_median)) {
  if(deviations_about_median[i] < 0){
    absolute_deviations_about_median[i] <- deviations_about_median[i] * (-1)
  }
  else{
    absolute_deviations_about_median[i] <- deviations_about_median[i]
  }
}
```

```
absolute_deviations_about_median

##  [1] 46 33 18 31 59  6 10 34 19  5 19 40 42 35 49 27 26 28  9 57 10  3 14 13 15
## [26] 36 24  1 16 11 13 52 26  1 45  8 29 54 12 27
```

```
my_median_function(absolute_deviations_about_median)

## [1] 25
```

Skewness

We compute $\frac{m_3}{m_2^{\frac{3}{2}}}$ where m_2 and m_3 are 2nd and 3rd order central moments respectively.

```r
my_skewness_function <- function(x){
  return(my_sample_central_moments_function(x, 3) / my_sample_central_moments_function(x, 2)^(3/2))
}
```

```r
my_skewness_function(my_sample)

## [1] 0.3137019
```

Kurtosis

We compute $\frac{m_4}{m_2^2} - 3$ where m_4 is the 4th order central moment.

```r
my_kurtosis_function <- function(x){
  return(my_sample_central_moments_function(x, 4) / my_sample_central_moments_function(x, 2)^2 - 3)
}
```

```r
my_kurtosis_function(my_sample)

## [1] -1.165996
```