

FA4

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1. First, second, third, and fourth moments for each set of data

```
# Loading the necessary data for each set
normal <- c(67, 70, 63, 65, 68, 66, 70, 64, 69, 61, 66, 64, 65, 71, 62, 68, 66, 65, 63, 67, 67, 64, 62, 66, 68, 64, 63, 66, 67, 65, 64, 67, 63, 65, 64, 66, 68, 68, 66, 65, 63, 65, 66, 66, 63, 67, 68, 63, 65, 63)

skewed_right <- c(69, 63, 67, 59, 66, 65, 65, 55, 46, 67, 67, 64, 64, 68, 68, 66, 65, 67, 67, 70, 64, 46, 66, 63, 28, 64, 28, 67, 24, 28, 57, 60, 58, 92, 93, 90, 70, 76, 83, 81, 85, 97, 66, 70, 73, 82, 93, 77, 82, 81)

skewed_left <- c(31, 43, 30, 24, 38, 34, 38, 75, 70, 26, 24, 29, 29, 28, 26, 29, 35, 23, 85, 85, 27, 26, 25, 22, 32, 25, 39, 30, 34, 35, 45, 23, 20, 44, 44, 30, 25, 27, 22, 40, 30, 34, 38, 40, 31, 35, 40, 42, 34, 38)

uniform <- c(12.1, 12.4, 12.2, 12.3, 12.4, 12.1, 12.3, 12.3, 12.5, 12.4, 12.3, 12.2, 12.5, 12.1, 12.2, 12.3, 12.3, 12.2, 12.3, 12.1, 12.4, 12.2, 12.4, 12.1, 12.5, 12.1, 12.5, 12.2, 12.1, 12.3, 12.2, 12.1, 12.5, 12.2, 12.3, 12.2, 12.1, 12.4, 12.1, 12.3, 12.4, 12.2, 12.3, 12.5, 12.2, 12.5, 12.1, 12.2, 12.5, 12.4)

# Function to calculate moments
calculate_moments <- function(data) {
  n <- length(data)
  mean_value <- mean(data)
  m1 <- mean_value
  m2 <- mean((data - mean_value)^2)
  m3 <- mean((data - mean_value)^3)
  m4 <- mean((data - mean_value)^4)
  return(list(mean = m1, variance = m2, third_moment = m3, fourth_moment = m4))
}

# Calculate moments for each set of data
moments_normal <- calculate_moments(normal)
moments_skewed_right <- calculate_moments(skewed_right)
moments_skewed_left <- calculate_moments(skewed_left)
moments_uniform <- calculate_moments(uniform)

# Display results
moments_normal
```

```
## $mean
## [1] 65.54
##
## $variance
## [1] 4.9284
##
## $third_moment
## [1] 3.078528
##
## $fourth_moment
## [1] 63.54262
```

moments_skewed_right

```
## $mean
## [1] 66.64
##
## $variance
## [1] 257.7504
##
## $third_moment
## [1] -3049.903
##
## $fourth_moment
## [1] 266485.7
```

moments_skewed_left

```
## $mean
## [1] 35.58
##
## $variance
## [1] 207.5236
##
## $third_moment
## [1] 6418.454
##
## $fourth_moment
## [1] 321459.4
```

```
moments_uniform
```

```
## $mean
## [1] 12.28
##
## $variance
## [1] 0.0188
##
## $third_moment
## [1] 0.000576
##
## $fourth_moment
## [1] 0.0006488
```

2. Moments about the mean are the same as moments computed above since they're calculated from the mean

3. Moments about the number 75 for the set of female height measurements

```
# Calculate moments about 75
calculate_moments_about_75 <- function(data) {
  m1 <- mean(data - 75)
  m2 <- mean((data - 75)^2)
  m3 <- mean((data - 75)^3)
  m4 <- mean((data - 75)^4)
  return(list(first_moment = m1, second_moment = m2, third_moment = m3, fourth_moment = m4))
}

moments_about_75_normal <- calculate_moments_about_75(normal)

# Display results
moments_about_75_normal
```

```
## $first_moment
## [1] -9.46
##
## $second_moment
## [1] 94.42
##
## $third_moment
## [1] -983.38
##
## $fourth_moment
## [1] 10602.1
```

4. Verify the relations between the moments

```
# Using the given formulas for m2, m3, and m4:
m1_prime <- moments_normal$mean
m2_prime <- moments_normal$variance
m3_prime <- moments_normal$third_moment
m4_prime <- moments_normal$fourth_moment

# Verify the relations
m2 <- m2_prime - m1_prime^2
m3 <- m3_prime - 3 * m1_prime * m2_prime + 2 * m1_prime^3
m4 <- m4_prime - 4 * m1_prime * m3_prime + 6 * m1_prime^2 * m2_prime - 3 * m1_prime^4

# Display results
list(m2 = m2, m3 = m3, m4 = m4)
```

```
## $m2
## [1] -4290.563
##
## $m3
## [1] 562087.1
##
## $m4
## [1] -55227468
```