FA4 - STATS

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DATA SETS

```
# Create the datasets
normal <- c(67, 70, 63, 65, 68, 60, 70, 64, 69, 61,
            66, 65, 71, 62, 66, 68, 64, 67, 62, 66,
            65, 63, 66, 65, 63, 66)

skewed_right <- c(69, 62, 67, 59, 66, 65, 63, 65, 60, 67,
                  64, 68, 61, 69, 65, 62, 67, 70, 64, 63,
                  68, 64, 65, 61, 66, 65)

skewed_left <- c(31, 43, 30, 30, 38, 26, 29, 55, 46, 26,
                 29, 57, 34, 34, 36, 40, 28, 26, 66, 63,
                 30, 33, 24, 35, 34, 35)

uniform <- c(40, 24, 29, 24, 27, 35, 33, 75, 38, 34,
             85, 29, 40, 41, 35, 26, 34, 19, 23, 28,
             26, 31, 22, 28, 31, 26)
```

Raw Moments

```
# Function to calculate raw moments
raw_moments <- function(data, order) {
  return(mean(data^order))
}

# Calculate raw moments for each dataset
raw_moments_normal <- sapply(1:4, function(i) raw_moments(normal, i))
raw_moments_skewed_right <- sapply(1:4, function(i) raw_moments(skewed_right, i))
raw_moments_skewed_left <- sapply(1:4, function(i) raw_moments(skewed_left, i))
raw_moments_uniform <- sapply(1:4, function(i) raw_moments(uniform, i))

raw_moments_results <- data.frame(
  Moments = c("1st", "2nd", "3rd", "4th"),
  Normal = round(raw_moments_normal, 2),
  Skewed_Right = round(raw_moments_skewed_right, 2),
  Skewed_Left = round(raw_moments_skewed_left, 2),
  Uniform = round(raw_moments_uniform, 2)
)

raw_moments_results
```

```
##   Moments      Normal Skewed_Right Skewed_Left    Uniform
## 1     1st       65.46        64.81       36.85      33.96
## 2     2nd     4292.92      4208.12     1486.23    1364.65
## 3     3rd   282032.92    273761.96    66121.31   68080.19
## 4     4th 18561992.46  17843163.04  3228344.38 4170509.42
```

Centered Moments About the Mean

```
# Function to calculate centered moments
centered_moments <- function(data, order) {
  mean_data <- mean(data)
  return(mean((data - mean_data)^order))
}

# Calculate centered moments for each dataset
centered_moments_normal <- sapply(1:4, function(i) centered_moments(normal, i))
centered_moments_skewed_right <- sapply(1:4, function(i) centered_moments(skewed_right, i))
centered_moments_skewed_left <- sapply(1:4, function(i) centered_moments(skewed_left, i))
centered_moments_uniform <- sapply(1:4, function(i) centered_moments(uniform, i))

centered_moments_results <- data.frame(
  Moments = c("1st", "2nd", "3rd", "4th"),
  Normal = round(centered_moments_normal, 2),
  Skewed_Right = round(centered_moments_skewed_right, 2),
  Skewed_Left = round(centered_moments_skewed_left, 2),
  Uniform = round(centered_moments_uniform, 2)
)

centered_moments_results
```

```
##   Moments Normal Skewed_Right Skewed_Left   Uniform
## 1     1st   0.00         0.00        0.00      0.00
## 2     2nd   7.71         8.08      128.59    211.27
## 3     3rd   2.15        -3.37     1883.20   7384.49
## 4     4th 143.59       148.65    60119.09 375015.32
```

Moments About the Number 75

```
# Function to calculate moments about a specific value
moments_about_value <- function(data, value, order) {
  return(mean((data - value)^order))
}

# Calculate moments about 75
moments_about_75 <- sapply(1:4, function(i) moments_about_value(normal, 75, i))

moments_about_75_results <- data.frame(
  Moments = c("1st", "2nd", "3rd", "4th"),
  Moments_About_75 = round(moments_about_75, 2)
)

moments_about_75_results
```

```
##   Moments Moments_About_75
## 1     1st            -9.54
## 2     2nd            98.69
## 3     3rd         -1086.31
## 4     4th         12548.23
```

Verification of Relations

```
# Extract moments for verification
m0_normal <- raw_moments_normal[1]
m1_normal <- centered_moments_normal[1]
m2_normal <- centered_moments_normal[2]
m3_normal <- centered_moments_normal[3]
m4_normal <- centered_moments_normal[4]

# Verify relations
relation_m2 <- all.equal(m2_normal, m0_normal^2 - m1_normal^2)
relation_m3 <- all.equal(m3_normal, m0_normal^3 - 3 * m0_normal * m1_normal * m2_normal + 2 * m1_normal^3)
relation_m4 <- all.equal(m4_normal, m0_normal^4 - 4 * m0_normal * m1_normal * m3_normal + 6 * m1_normal^2 * m2_no
rmal - 3 * m1_normal^4)

verification_results <- data.frame(
  Relation = c("m2", "m3", "m4"),
  Verified = c(relation_m2, relation_m3, relation_m4)
)

verification_results
```

```
##   Relation                          Verified
## 1       m2 Mean relative difference: 554.7951
## 2       m3 Mean relative difference: 130514.7
## 3       m4 Mean relative difference: 127880.8
```