```r
set.seed(131131)
library(gtools)

calculate_W2 <- function(m, n, co) {
    N <- m + n
    W <- sum(co)
    W2 <- (W - 0.5 * n * (N + 1)) / sqrt(m * n * (N + 1) / 12)
    return(W2)
}

calculate_prob <- function(m, n, alpha) {
    N <- m + n
    combi <- combinations(N, n)
    # Dla każdego wiersza wyłowaj calculate_W2
    W2s <- apply(combi, 1, function(comb) calculate_W2(m, n, comb))
    z_alpha <- qnorm(1 - alpha)
    prob <- mean(W2s >= z_alpha)
    return(prob)
}

mn <- list(c(5, 5), c(8, 5), c(10, 5))
alphas <- c(0.1, 0.05, 0.01, 0.005)
ext <- matrix(nrow = length(mn), ncol = length(alphas))

for (i in 1:length(mn)) {
    m <- mn[[i]][1]
    n <- mn[[i]][2]
    for (j in 1:length(alphas)) {
        ext[i, j] <- calculate_prob(m, n, alphas[j])
    }
}
```

```
##        alpha = 0.1 alpha = 0.05 alpha = 0.01 alpha = 0.005
## (5,5)    0.1111111   0.04761905  0.007936508   0.003968254
## (8,5)    0.1111111   0.04662005  0.009324009   0.003108003
## (10,5)   0.1032301   0.04961705  0.009657010   0.002331002
```

Dla (5,5) aproksymacja może nie być zbyt dokładna, szczególnie dla małych alpha. Dla (8,5) i (10,5) aproksymacja powinna być lepsza, ale wciąż mogą występować pewne rozbieżności.

```r
calculate_alpha0 <- function(m, n, w) {
    N <- m + n
    combi <- combinations(N, n)
    W_values <- rowSums(combi)
    prob <- mean(W_values >= w)
    return(prob)
}

calculate_alpha1 <- function(m, n, w) {
    N <- m + n
    W2 <- (w - 0.5 * n * (N + 1)) / sqrt(m * n * (N + 1) / 12)
    prob <- 1 - pnorm(W2)
    return(prob)
}
```

```r
calculate_alpha2 <- function(m, n, w) {
    N <- m + n
    W2 <- (w - 0.5 - 0.5 * n * (N + 1)) / sqrt(m * n * (N + 1) / 12)
    prob <- 1 - pnorm(W2)
    return(prob)
}


m <- 6
n <- 3
w_values <- c(9, 12, 15, 18, 21)

ext1 <- matrix(nrow = 3, ncol = length(w_values))

for (i in 1:length(w_values)) {
    ext1[1, i] <- calculate_alpha0(m, n, w_values[i])
    ext1[2, i] <- calculate_alpha1(m, n, w_values[i])
    ext1[3, i] <- calculate_alpha2(m, n, w_values[i])
}

n <- 6
w_values <- c(27, 33, 39, 45, 51)

ext2 <- matrix(nrow = 3, ncol = length(w_values))
for (i in 1:length(w_values)) {
    ext2[1, i] <- calculate_alpha0(m, n, w_values[i])
    ext2[2, i] <- calculate_alpha1(m, n, w_values[i])
    ext2[3, i] <- calculate_alpha2(m, n, w_values[i])
}
```

```
## [1] "m = 6, n = 3"
```

```
##           w = 27    w = 33    w = 39    w = 45     w = 51
## alpha0 0.9523810 0.8095238 0.5476190 0.2738095 0.08333333
## alpha1 0.9393324 0.7807110 0.5000000 0.2192890 0.06066763
## alpha2 0.9533550 0.8169217 0.5513605 0.2593025 0.07779017
```

```
## [1] "m = 6, n = 6"
```

```
##           w = 27    w = 33    w = 39    w = 45     w = 51
## alpha0 0.9794372 0.8452381 0.5313853 0.1969697 0.03246753
## alpha1 0.9726680 0.8316658 0.5000000 0.1683342 0.02733197
## alpha2 0.9773362 0.8510235 0.5319069 0.1892388 0.03277608
```