```r
rat_data <- data.frame(
  group = rep(c("Control", "Drug_A_Low", "Drug_A_High", "Drug_B_Low", "Drug_B_High"), each = 4),
  score = c(10, 13, 17, 20, 8, 16, 12, 19, 12, 10, 7, 3, 18, 11, 15, 22, 21, 17, 26, 28)
)
model_anova <- aov(rat_data$score ~ rat_data$group)
anovaResults <- anova(model_anova)
print(anovaResults)
```

```
## Analysis of Variance Table
##
## Response: rat_data$score
##                Df Sum Sq Mean Sq F value   Pr(>F)
## rat_data$group  4 466.00 116.500  5.6055 0.005783 **
## Residuals      15 311.75  20.783
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```r
contrast_inverse <- matrix(c(1, 1, 1, 1, 1,
                             1, -1/4, -1/4, -1/4, -1/4,
                             0, 1/2, 1/2, -1/2, -1/2,
                             0, 1, -1, 0, 0,
                             0, 0, 0, 1, -1), nrow = 5, byrow = TRUE)
contrast <- solve(contrast_inverse)


c1 <- c(1, -1/4, -1/4, -1/4, -1/4)
c2 <- c(0, 1/2, 1/2, -1/2, -1/2)
c3 <- c(0, 1, -1, 0, 0)
c4 <- c(0, 0, 0, 1, -1)

s = 20.783
alpha <- 0.05/4
df <- 15
t_value <- qt(alpha, df, lower.tail = FALSE)
t <- t_value

calculate_interval <- function(c, b, t, s) {
  sum_cb <- sum(c * b)
  sqrt_term <- sqrt(s * sum((c*c) / 4))
  lower_bound <- sum_cb - t * sqrt_term
  upper_bound <- sum_cb + t * sqrt_term
  return(c(lower_bound, upper_bound))
}

b <- c(15, 13.75, 8, 16.5, 23)

intervals <- list(
  calculate_interval(c1, b, t, s),
  calculate_interval(c2, b, t, s),
  calculate_interval(c3, b, t, s),
  calculate_interval(c4, b, t, s)
)
intervals
```

```
## [[1]]
## [1] -6.657878  6.032878
##
## [[2]]
## [1] -14.550479  -3.199521
##
## [[3]]
## [1] -2.276339 13.776339
##
## [[4]]
## [1] -14.526339   1.526339
```

```
f_value <- qf(0.9, 4, 15)
f=2*sqrt(f_value)
intervals <- list(
  calculate_interval(c1, b, f, s),
  calculate_interval(c2, b, f, s),
  calculate_interval(c3, b, f, s),
  calculate_interval(c4, b, f, s)
)
intervals
```

```
## [[1]]
## [1] -8.144938  7.519938
##
## [[2]]
## [1] -15.880545  -1.869455
##
## [[3]]
## [1] -4.157337 15.657337
##
## [[4]]
## [1] -16.407337   3.407337
```