```
### Problem 3 ###
q1_xbar = 140.03
q1_r = 13.63
q1_s = 5.1
m = 30
n = 5
q1_xdbar = q1_xdbar / m
q1_rbar = q1_r / m
q1_sbar = q1_s / m

## X and R Charts Limits ##
# X Chart Limits #
q1_xr_x_CL = q1_xdbar
q1_xr_x_UCL = q1_xr_x_CL + 0.577 * q1_sbar
q1_xr_x_LCL = q1_xr_x_CL - 0.577 * q1_sbar

# R Chart Limits #
q1_xr_r_CL = q1_rbar
q1_xr_r_UCL = 2.11 * q1_rbar
q1_xr_r_LCL = 0 * q1_rbar

## X and S Charts Limits ##
# X Chart Limits #
q1_xs_x_CL = q1_xdbar
q1_xs_x_UCL = q1_xs_x_CL + (3 * q1_sbar) / (0.94 * sqrt(n))
q1_xs_x_LCL = q1_xs_x_CL - (3 * q1_sbar) / (0.94 * sqrt(n))

# S Chart Limits #
q1_xs_s_CL = q1_sbar
q1_xs_s_UCL = q1_sbar + (3 * q1_sbar * sqrt(1-0.94^2))/0.94
q1_xs_s_LCL = q1_sbar - (3 * q1_sbar * sqrt(1-0.94^2))/0.94
q1_xs_s_LCL = 0 #the previous row will give you a negative


### Problem 2 ###
library(qcc)
data <- matrix(data = c(4.960, 4.946, 4.950, 4.956, 4.958,
                4.958, 4.927, 4.935, 4.940, 4.920,
                4.971, 4.929, 4.965, 4.952, 4.938,
                4.940, 4.982, 4.970, 4.953, 4.960,
                4.964, 4.951, 4.953, 4.962, 4.956,
                4.969, 4.951, 4.955, 4.966, 4.954,
                4.960, 4.944, 4.957, 4.948, 4.951,
                4.969, 4.949, 4.963, 4.952, 4.962,
                4.984, 4.928, 4.960, 4.943, 4.955,
                4.970, 4.934, 4.961, 4.940, 4.965,
                4.975, 4.959, 4.962, 4.971, 4.968,
                4.945, 4.977, 4.950, 4.969, 4.954,
                4.976, 4.964, 4.970, 4.968, 4.972,
                4.970, 4.954, 4.964, 4.959, 4.968,
                4.982, 4.962, 4.968, 4.975, 4.963,
                4.961, 4.943, 4.950, 4.949, 4.957,
                4.980, 4.970, 4.975, 4.978, 4.977,
                4.975, 4.968, 4.971, 4.969, 4.972,
                4.977, 4.966, 4.969, 4.973, 4.970,
                4.975, 4.967, 4.969, 4.972, 4.972), nrow = 20, ncol = 5)
```

```
XbarChart = qcc(data, type = "xbar", nsigmas = 5)
RChart = qcc(data, type = "R", nsigmas = 5)
SChart = qcc(data, type = "S", nsigmas = 5)
```