Presentation

Quadrant count ratio (QCR):

```
qcr <- function(X, Y) {
    r_Q <- 0
    med_x <- median(X)
    med_y <- median(Y)
    for (i in 1:length(X)) {
        r_Q <- r_Q + sign(X[[i]] - med_x) * sign(Y[[i]] - med_y)
    }
    r_Q <- r_Q/length(X)
}
```

```
mu <- c(X = 0, Y = 0)
rhos <- c(0, 0.5, 0.9)
C <- 2 * (rhos^2 - 1) * log(0.05)
a <- sqrt(C/(1 - rhos))
b <- sqrt(C/(1 + rhos))
sample_size <- c(20, 60, 100)
for (i in 1:length(rhos)) {
    p <- vector("list", length = length(sample_size))
    K <- matrix(c(1, rhos[i], rhos[i], 1), nrow = 2, ncol = 2)
    for (j in 1:length(sample_size)) {
        dta <- mvrnorm(n = sample_size[j], mu = mu, Sigma = K)
        cap <- paste("$\\n$ =", toString(sample_size[j]))
        p[[j]] <- ggplot(data.frame(dta), mapping = aes(x = X, y = Y)) + geom_point(color = "red") +
            geom_ellipse(aes(x0 = 0, y0 = 0, a = a[i], b = b[i], angle = pi/4), color = "darkblue",
                size = 1.05) + labs(caption = TeX(cap)) + theme(plot.caption = element_text(hjust = 0.5
            size = 20))
    }
    name <- paste("resources\\ellipse_rho_", toString(rhos[i]), ".pdf", sep = "")
    ggsave(name, plot_grid(plotlist = p, nrow = 1, ncol = 3), device = "pdf", width = 15)
}
```

```
## Saving 15 x 4.5 in image
## Saving 15 x 4.5 in image
## Saving 15 x 4.5 in image
```

```
rows_name <- c("$E(z)$", "$E(z^2)$", "$D(z)$")
number_of_tests <- 1000
rhos <- c(0, 0.5, 0.9)
# rhos <- c(0)
mu <- c(X = 0, Y = 0)
sample_size <- c(20, 60, 100)
# sample_size <- c(20)
for (size in sample_size) {
    for (rho in rhos) {
        K <- matrix(c(1, rho, rho, 1), nrow = 2, ncol = 2)
        pearson_res_mixt = list()
```

```
        spearman_res_mixt = list()
        qcr_res_mixt = list()
        for (i in 1:number_of_tests) {
            dta <- mvrnorm(n = size, mu = mu, Sigma = K)
            pearson_res_mixt[i] <- cor(dta[1:size], dta[(size + 1):(2 * size)], method = "pearson")
            spearman_res_mixt[i] <- cor(dta[1:size], dta[(size + 1):(2 * size)],
                method = "spearman")
            qcr_res_mixt[i] <- qcr(dta[1:size], dta[(size + 1):(2 * size)])
        }
        pearson_res_mixt <- unlist(pearson_res_mixt)
        spearman_res_mixt <- unlist(spearman_res_mixt)
        qcr_res_mixt <- unlist(qcr_res_mixt)
        Ez <- c(mean(pearson_res_mixt), mean(spearman_res_mixt), mean(qcr_res_mixt))
        Dz <- c(var(pearson_res_mixt), var(spearman_res_mixt), var(qcr_res_mixt))
        Ez2 <- Dz + Ez^2
        Ez <- round(Ez, digits = 3)
        Ez2 <- round(Ez2, digits = 3)
        Dz <- round(Dz, digits = if (rho == 0.9 & size == 100) 4 else 3)
        r <- c(Ez[1], Ez2[1], Dz[1])
        r_s <- c(Ez[2], Ez2[2], Dz[2])
        r_Q <- c(Ez[3], Ez2[3], Dz[3])
        if (rho == 0 & size == 20) {
            Ez <- append(as.list(Ez), rows_name[1], after = 0)
            Ez2 <- append(as.list(Ez2), rows_name[2], after = 0)
            Dz <- append(as.list(Dz), rows_name[3], after = 0)
            Ez[[4]] = paste(toString(Ez[[3]]), "\\\\\\hline ", sep = "")
            Ez2[[4]] = paste(toString(Ez2[[3]]), "\\\\\\hline ", sep = "")
            Dz[[4]] = paste(toString(Dz[[3]]), "\\\\\\hline ", sep = "")
            first_line <- c("$\\rho = 0.0$", "$r$\\eqref{eq::pirs}", "$r_s$\\eqref{eq::spir}",
                "$r_Q$\\eqref{eq::rQ}\\\\\\hline ")
            content <- rbind(first_line, Ez, Ez2, Dz)
            write.table(content, file = "resources\\20rho0.tex", sep = "&", col.names = F,
                row.names = F)
        } else {
            content <- data.frame(rows_name, r, r_s, r_Q)
            col_names <- c(paste("$\\rho$ =", toString(rho)), "$r$", "$r_S$", "$r_Q$")
            file_name <- paste("resources\\", toString(size), "rho", toString(rho),
                ".pdf", sep = "")
            knitr::kable(content, format = "latex", col.names = col_names, align = c("l",
                "c", "c", "c"), escape = F) %>% column_spec(1, border_left = T) %>%
                column_spec(4, border_right = T) %>% save_kable(file_name)
        }
    }
}
```

```
rows_name <- c("$E(z)$", "$E(z^2)$", "$D(z)$")
number_of_tests <- 1000
probs <- c(0.9, 0.1)
sample_size <- c(20, 60, 100)
for (size in sample_size) {
    pearson_res_mixt = list()
    spearman_res_mixt = list()
    qcr_res_mixt = list()
    K1 <- matrix(c(1, 0.9, 0.9, 1), nrow = 2, ncol = 2)
```

```
    mu <- c(X = 0, Y = 0)
    K2 <- matrix(c(100, -90, -90, 100), nrow = 2, ncol = 2)
    for (i in 1:number_of_tests) {
        n1 <- rbinom(1, size = size, prob = probs[1])
        n2 <- size - n1
        dta1 <- if (n1 == 0)
            NULL else mvrnorm(n = n1, mu = mu, Sigma = K1)
        dta2 <- if (n2 == 0)
            NULL else mvrnorm(n = n2, mu = mu, Sigma = K2)
        dta <- rbind(dta1, dta2)
        pearson_res_mixt[i] <- cor(dta[1:size], dta[(size + 1):(2 * size)], method = "pearson")
        spearman_res_mixt[i] <- cor(dta[1:size], dta[(size + 1):(2 * size)], method = "spearman")
        qcr_res_mixt[i] <- qcr(dta[1:size], dta[(size + 1):(2 * size)])
    }
    pearson_res_mixt <- unlist(pearson_res_mixt)
    spearman_res_mixt <- unlist(spearman_res_mixt)
    qcr_res_mixt <- unlist(qcr_res_mixt)
    Ez <- c(mean(pearson_res_mixt), mean(spearman_res_mixt), mean(qcr_res_mixt))
    Dz <- c(var(pearson_res_mixt), var(spearman_res_mixt), var(qcr_res_mixt))
    Ez2 <- Dz + Ez^2
    Ez <- round(Ez, digits = 3)
    Ez2 <- round(Ez2, digits = 3)
    Dz <- round(Dz, digits = 3)
    r <- c(Ez[1], Ez2[1], Dz[1])
    r_s <- c(Ez[2], Ez2[2], Dz[2])
    r_Q <- c(Ez[3], Ez2[3], Dz[3])
    content <- data.frame(rows_name, r, r_s, r_Q)
    col_names <- c(paste("$n$ =", toString(size)), "$r$", "$r_S$", "$r_Q$")
    file_name <- paste("resources\\", "mixedDistr", toString(size), ".pdf", sep = "")
    knitr::kable(content, format = "latex", col.names = col_names, align = c("l",
        "c", "c", "c"), escape = F) %>% column_spec(1, border_left = T) %>% column_spec(4,
        border_right = T) %>% save_kable(file_name)
}
```