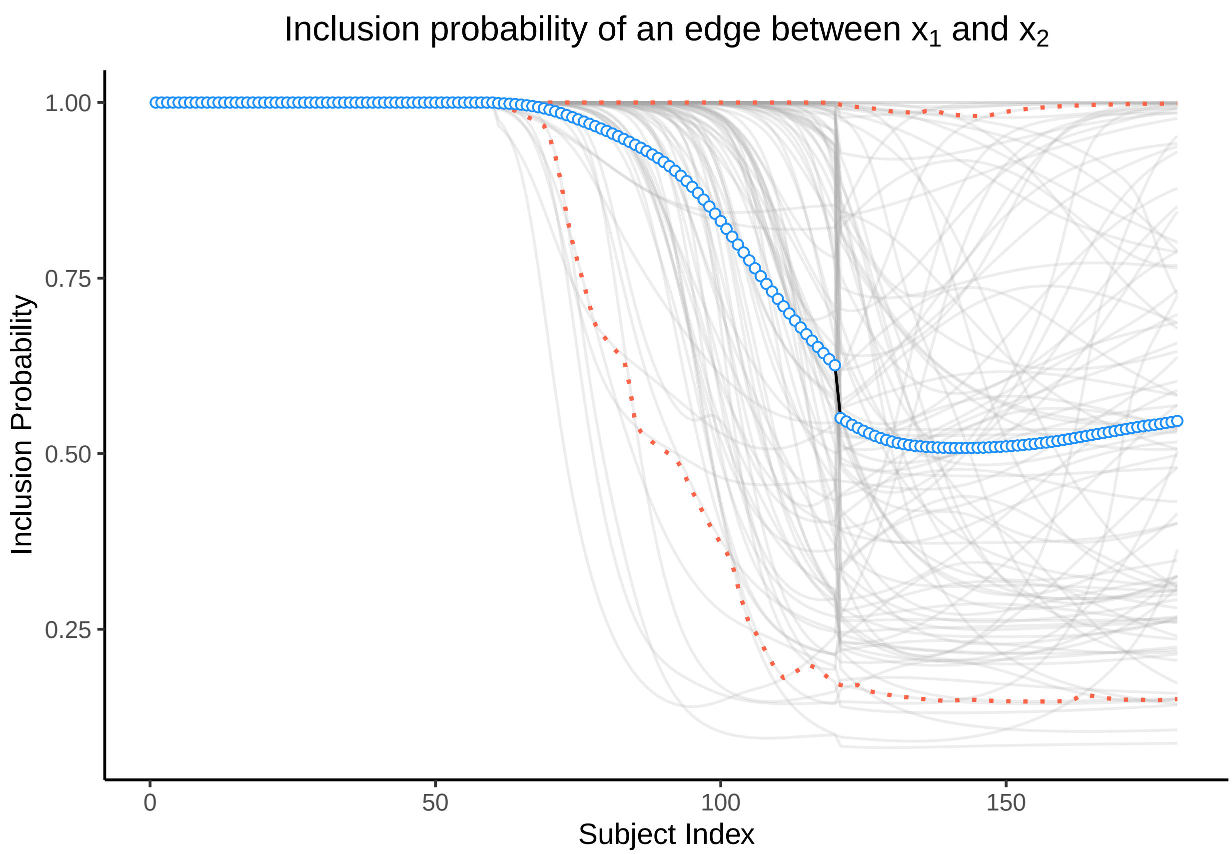
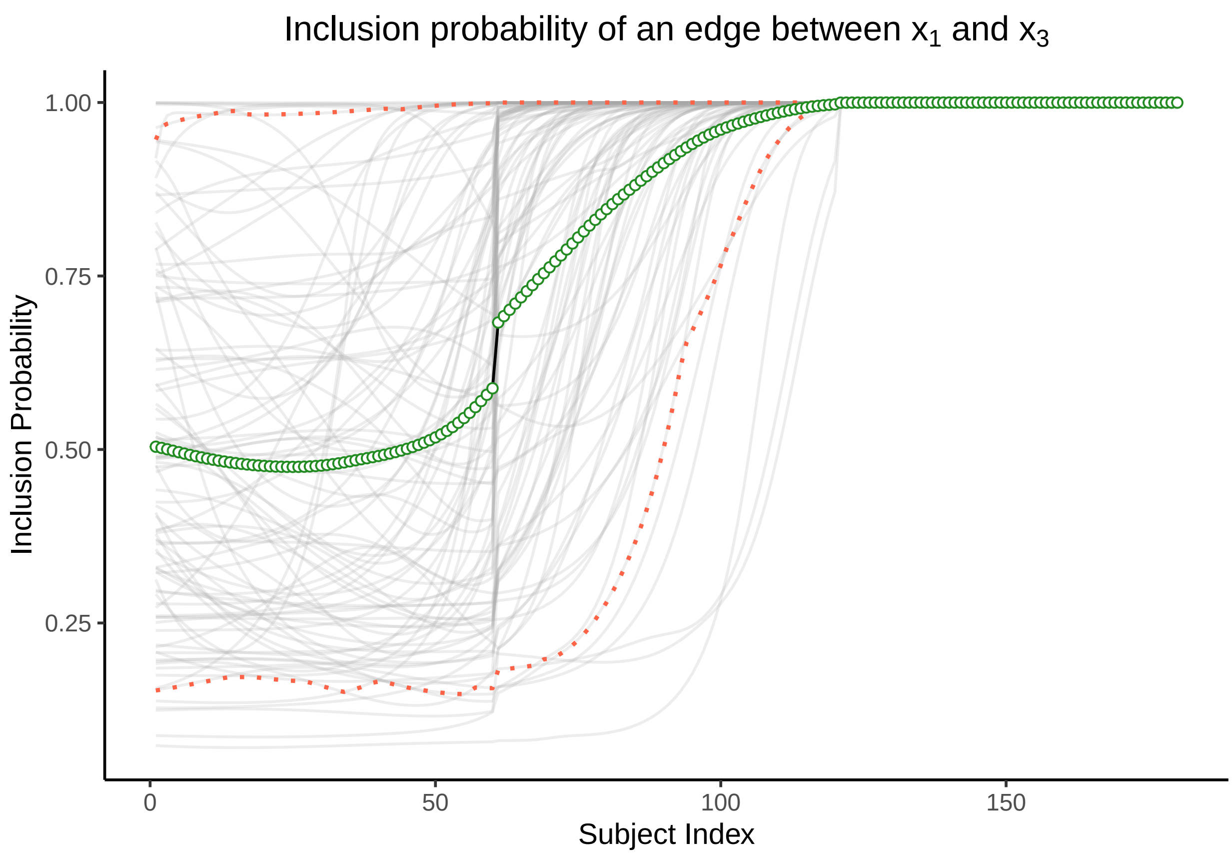
grid-analysis

```r
library(covdepGE)
library(ggplot2)
library(latex2exp)
source("generate_data.R")

# number of trials
trials <- 100

# get data
cont <- generate_continuous()

n <- nrow(cont$data)

# matrices for storing inclusion probabilities
prob_mat12 <- matrix(NA, trials, n)
prob_mat13 <- matrix(NA, trials, n)

# matrix for storing optimal pi values
pi_values <- matrix(NA, trials, 3)
colnames(pi_values) <- paste("response", 1:3)
rownames(pi_values) <- paste("trial", 1:trials)

for (j in 1:trials) {

    # generate the data
    cont <- generate_continuous(seed = j)

    # estimate the graphs
    out <- covdepGE(data_mat = cont$data, Z = cont$covts, tau = 0.56,
        sigmavec = c(0.01, 0.05, 0.1, 0.5, 1, 3, 7, 10), pi_vec = seq(from = 0.05,
            to = 0.95, by = 0.05))

    # get probabilities of inclusion
    incl.probs <- out$inclusion_probs

    # get continuous probabilities of inclusion for x_1 to x_2
    # and x_1 to x_3
    probs12 <- as.numeric(lapply(incl.probs, function(x) x[1, 2]))
    probs13 <- as.numeric(lapply(incl.probs, function(x) x[1, 3]))

    # add them to the probs matrices
    prob_mat12[j, ] <- probs12
    prob_mat13[j, ] <- probs13

    # save the optimal pi_values for each response
    pi_values[j, ] <- as.numeric(lapply(out$ELBO[paste("Response",
```

```
        1:3)], `[[`, 2))
}

# get the mean probabilities for each individual
mean_probs12 <- colMeans(prob_mat12)
mean_probs13 <- colMeans(prob_mat13)

# find the 5% and 95% quantiles
CI12 <- apply(prob_mat12, 2, quantile, c(0.05, 0.95))
CI13 <- apply(prob_mat13, 2, quantile, c(0.05, 0.95))

# visualize them
graphs12 <- ggplot() + theme_classic() + xlab("Subject Index") + ylab("Inclusion Probability") +
    ggtitle(TeX("Inclusion probability of an edge between $x_1$ and x_2")) +
    theme(plot.title = element_text(hjust = 0.5))

graphs13 <- ggplot() + theme_classic() + xlab("Subject Index") + ylab("Inclusion Probability") +
    ggtitle(TeX("Inclusion probability of an edge between $x_1$ and x_3")) +
    theme(plot.title = element_text(hjust = 0.5))

# add each of the instances to the plot
for (j in 1:trials) {
    graphs12 <- graphs12 + geom_line(data = data.frame(subj = 1:length(mean_probs12),
        prob = prob_mat12[j, ]), color = "gray66", alpha = 0.2, aes(subj,
        prob))

    graphs13 <- graphs13 + geom_line(data = data.frame(subj = 1:length(mean_probs13),
        prob = prob_mat13[j, ]), color = "gray66", alpha = 0.2, aes(subj,
        prob))
}

# add error bars to the plot
for (j in 1:2) {
    graphs12 <- graphs12 + geom_line(data = data.frame(subj = 1:length(mean_probs12),
        prob = CI12[j, ]), color = "tomato", linetype = "dotted",
        size = 0.75, aes(subj, prob))
    graphs13 <- graphs13 + geom_line(data = data.frame(subj = 1:length(mean_probs13),
        prob = CI13[j, ]), color = "tomato", linetype = "dotted",
        size = 0.75, aes(subj, prob))
}

# add the mean lines and display
graphs12 + geom_line(data = data.frame(subj = 1:length(mean_probs12),
    prob = mean_probs12), aes(subj, prob)) + geom_point(data = data.frame(subj = 1:length(mean_probs12)
    prob = mean_probs12), color = "dodgerblue", fill = "white", shape = 21,
    aes(subj, prob))
```




```
graphs13 + geom_line(data = data.frame(subj = 1:length(mean_probs13),
    prob = mean_probs13), aes(subj, prob)) + geom_point(data = data.frame(subj = 1:length(mean_probs13)
    prob = mean_probs13), color = "forestgreen", fill = "white", shape = 21,
    aes(subj, prob))
```



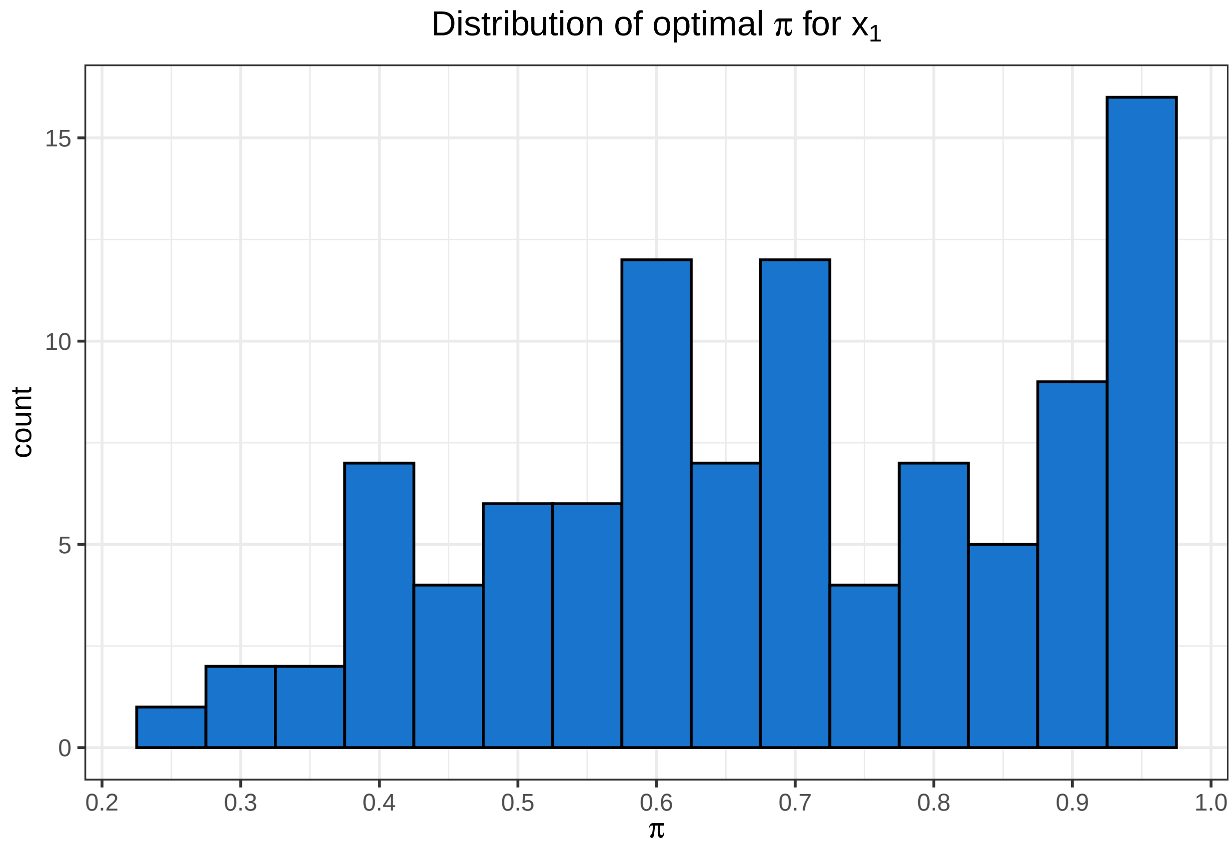

```
# visualize the distribution of the optimal pi values
pi_values
```

```
##            response 1 response 2 response 3
## trial 1          0.45       0.55       0.50
## trial 2          0.95       0.75       0.75
## trial 3          0.60       0.60       0.55
## trial 4          0.95       0.65       0.70
## trial 5          0.50       0.55       0.50
## trial 6          0.70       0.75       0.60
## trial 7          0.65       0.75       0.60
## trial 8          0.95       0.50       0.95
## trial 9          0.70       0.70       0.65
## trial 10         0.60       0.80       0.50
## trial 11         0.60       0.60       0.60
## trial 12         0.50       0.70       0.60
## trial 13         0.95       0.90       0.70
## trial 14         0.90       0.60       0.65
## trial 15         0.60       0.55       0.60
## trial 16         0.90       0.95       0.95
## trial 17         0.65       0.65       0.55
## trial 18         0.65       0.75       0.65
## trial 19         0.65       0.45       0.65
## trial 20         0.50       0.70       0.80
## trial 21         0.95       0.65       0.75
## trial 22         0.70       0.60       0.55
```

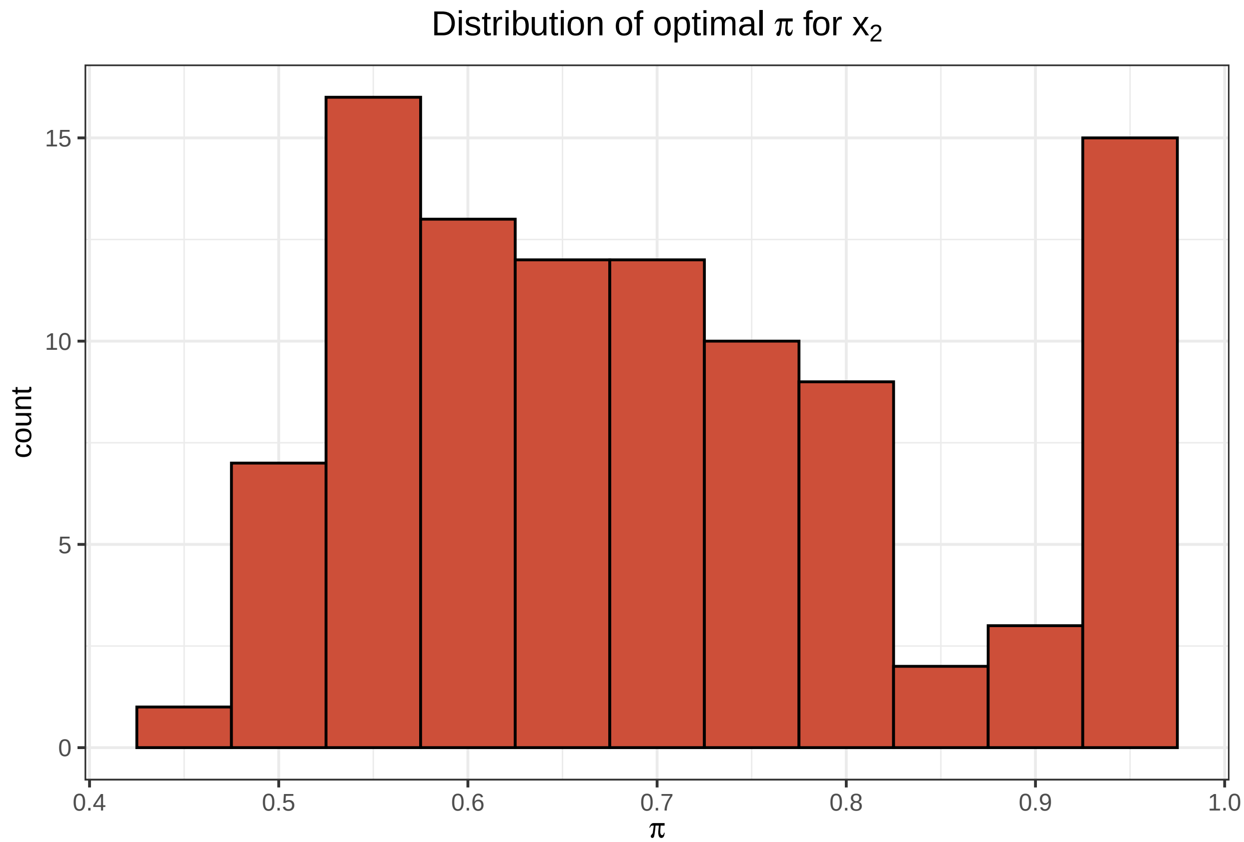
```
## trial 23          0.95        0.50        0.50
## trial 24          0.65        0.65        0.60
## trial 25          0.50        0.95        0.95
## trial 26          0.60        0.60        0.50
## trial 27          0.80        0.70        0.95
## trial 28          0.80        0.75        0.50
## trial 29          0.50        0.95        0.70
## trial 30          0.60        0.65        0.75
## trial 31          0.60        0.75        0.60
## trial 32          0.90        0.70        0.70
## trial 33          0.35        0.80        0.55
## trial 34          0.90        0.75        0.90
## trial 35          0.95        0.95        0.65
## trial 36          0.40        0.55        0.55
## trial 37          0.65        0.90        0.85
## trial 38          0.80        0.90        0.85
## trial 39          0.85        0.95        0.95
## trial 40          0.70        0.95        0.55
## trial 41          0.60        0.95        0.50
## trial 42          0.80        0.95        0.95
## trial 43          0.55        0.95        0.65
## trial 44          0.75        0.75        0.65
## trial 45          0.85        0.65        0.70
## trial 46          0.70        0.65        0.60
## trial 47          0.40        0.50        0.55
## trial 48          0.55        0.55        0.55
## trial 49          0.40        0.55        0.55
## trial 50          0.40        0.60        0.65
## trial 51          0.75        0.60        0.55
## trial 52          0.95        0.95        0.95
## trial 53          0.40        0.95        0.50
## trial 54          0.80        0.70        0.65
## trial 55          0.95        0.80        0.75
## trial 56          0.60        0.70        0.55
## trial 57          0.70        0.60        0.75
## trial 58          0.90        0.65        0.60
## trial 59          0.80        0.80        0.70
## trial 60          0.30        0.55        0.65
## trial 61          0.95        0.55        0.55
## trial 62          0.85        0.95        0.95
## trial 63          0.30        0.55        0.95
## trial 64          0.70        0.60        0.55
## trial 65          0.85        0.80        0.60
## trial 66          0.85        0.70        0.55
## trial 67          0.95        0.85        0.55
## trial 68          0.60        0.55        0.65
## trial 69          0.80        0.65        0.60
## trial 70          0.70        0.60        0.65
## trial 71          0.25        0.70        0.50
## trial 72          0.70        0.95        0.95
## trial 73          0.35        0.95        0.95
## trial 74          0.70        0.55        0.95
## trial 75          0.45        0.80        0.80
## trial 76          0.40        0.55        0.50
```

```
## trial 77        0.50       0.85       0.95
## trial 78        0.65       0.65       0.95
## trial 79        0.55       0.75       0.65
## trial 80        0.75       0.55       0.55
## trial 81        0.95       0.65       0.70
## trial 82        0.40       0.80       0.90
## trial 83        0.60       0.70       0.70
## trial 84        0.90       0.95       0.65
## trial 85        0.55       0.60       0.45
## trial 86        0.45       0.55       0.95
## trial 87        0.70       0.60       0.60
## trial 88        0.90       0.80       0.80
## trial 89        0.60       0.75       0.75
## trial 90        0.55       0.80       0.80
## trial 91        0.45       0.50       0.65
## trial 92        0.75       0.50       0.65
## trial 93        0.90       0.60       0.70
## trial 94        0.70       0.50       0.60
## trial 95        0.90       0.70       0.95
## trial 96        0.95       0.50       0.50
## trial 97        0.55       0.65       0.60
## trial 98        0.95       0.70       0.60
## trial 99        0.95       0.55       0.85
## trial 100       0.95       0.55       0.65
```

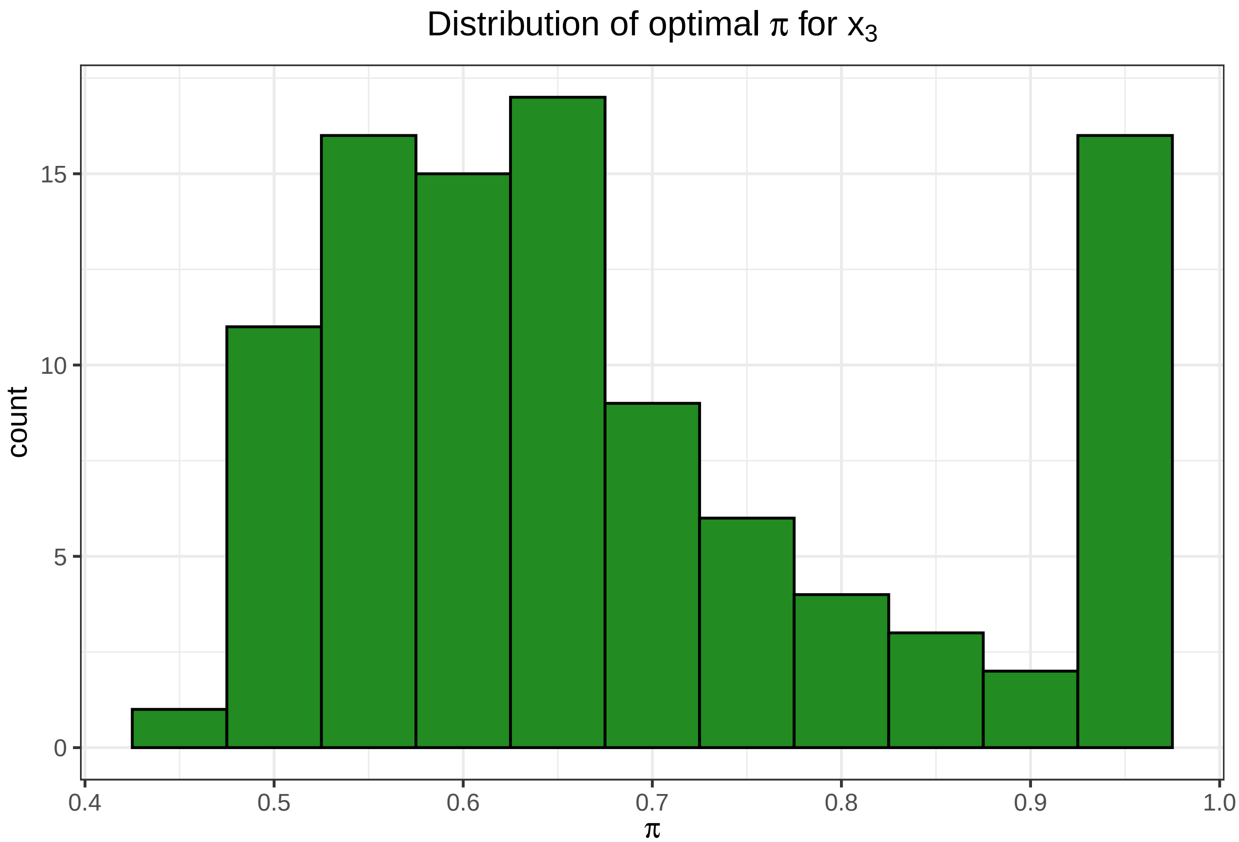
```
ggplot(data.frame(pi = pi_values[, "response 1"]), aes(pi)) + geom_histogram(binwidth = 0.05,
    fill = "dodgerblue3", color = "black") + theme_bw() + scale_x_continuous(breaks = seq(0,
    1, 0.1)) + ggtitle(TeX("Distribution of optimal $\\pi$ for $x_1$")) +
    theme(plot.title = element_text(hjust = 0.5)) + xlab(TeX("$\\pi$"))
```




```
ggplot(data.frame(pi = pi_values[, "response 2"]), aes(pi)) + geom_histogram(binwidth = 0.05,
    fill = "tomato3", color = "black") + theme_bw() + scale_x_continuous(breaks = seq(0,
    1, 0.1)) + ggtitle(TeX("Distribution of optimal $\\pi$ for $x_2$")) +
    theme(plot.title = element_text(hjust = 0.5)) + xlab(TeX("$\\pi$"))
```




```
ggplot(data.frame(pi = pi_values[, "response 3"]), aes(pi)) + geom_histogram(binwidth = 0.05,
    fill = "forestgreen", color = "black") + theme_bw() + scale_x_continuous(breaks = seq(0,
    1, 0.1)) + ggtitle(TeX("Distribution of optimal $\\pi$ for $x_3$")) +
    theme(plot.title = element_text(hjust = 0.5)) + xlab(TeX("$\\pi$"))
```



Distribution of optimal π for x3
count
15
10
5
0
0.4
0.5
0.6
0.7
0.8
0.9
1.0
π