ECS 132 HW 1

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Question 3

Suppose we deal a 5-card hand from a regular 52-card deck. Which is larger, P(exactly 2 10's) or P(exactly 4 spades)?

P(exactly 2 10's):

```r
set.seed(123)
# Load necessary packages
library(parallel)

# Define a function to simulate a 5-card hand
simulate_hand <- function() {
  deck <- c(rep("10", 4), rep("Others", 48))  # 4 tens and 48 other cards
  hand <- sample(deck, 5)  # Draw 5 cards
  return(hand)
}

# Define a function to run simulations in parallel
run_simulation <- function(num_simulations, num_tens_needed) {
  count_tens <- 0
  for (i in 1:num_simulations) {
    hand <- simulate_hand()
    if (sum(hand == "10") == num_tens_needed) {
      count_tens <- count_tens + 1
    }
  }
  return(count_tens)
}

# Detect the number of cores
num_cores <- detectCores() - 1  # Use one less than the total number of cores

# Create a cluster
cl <- makeCluster(num_cores)

# Set parameters
num_simulations <- 10000000  # Number of simulations
num_tens_needed <- 2         # Exactly 2 tens

# Divide the simulations among the cores
simulations_per_core <- num_simulations / num_cores
```

```r
# Export necessary variables and functions to the cluster
clusterExport(cl, varlist = c("simulate_hand", "run_simulation", "simulations_per_core","num_tens_needed

# Run the simulations in parallel
results <- parLapply(cl, 1:num_cores, function(x) run_simulation(simulations_per_core, num_tens_needed)

# Stop the cluster
stopCluster(cl)

# Combine the results from all cores
total_count_tens <- sum(unlist(results))

# Calculate the probability
probability_tens <- total_count_tens / num_simulations

# Print the results
cat(paste("Probability of getting exactly 2 tens:", probability_tens))
```

```
## Probability of getting exactly 2 tens: 0.0399061
```

P(exactly 4 spades):

```r
set.seed(123)
num_simulations <- 10000000  # Number of simulations
num_spades_needed <- 4       # Exactly 4 spades

# Function to simulate a 5-card hand
simulate_hand <- function() {
  deck <- c(rep("S", 13), rep("Others", 39))  # 13 spades and 39 other cards
  hand <- sample(deck, 5)  # Draw 5 cards
  return(hand)
}
# initialize the counters for successes
count_spades <- 0

# run the simulations
for (i in 1:num_simulations) {
  hand <- simulate_hand()
  if (sum(hand == "S") == num_spades_needed) {
    count_spades <- count_spades + 1
  }
}

probability_spades <- count_spades / num_simulations

# Print results
cat("Probability of getting exactly 4 spades:", probability_spades, "\n")
```

```
## Probability of getting exactly 4 spades: 0.010753
```