

In [4]:

```
#Create Population
create_population <- function(N){
  prop1 <- 0.67 # proportion of 1's
  population <- rbinom(N, size = 1, prob = prop1)

#Checks to see that the population makes sense
  #k <- 0
  #for(j in 1:N){
    #if(population[j]==1){
      #k <- k + 1
    #}
  #}
  #k/N
  return(population)
}
```

In [5]:

```
#Gets a sample
f_sample <- function(population, n) {
  sample_data <- sample(population, size = n, replace = TRUE)
  return(sample_data)
}
```

In [6]:

```
#Traditional Method
traditional <- function(x,n) {
  p_hat <- x/n
  z <- qnorm(p=.975)
  sd <- sqrt(((p_hat)*(1-p_hat))/n)

  #Confidence Interval
  ub <- p_hat + z * sd #Upper bound
  lb <- p_hat - z * sd #lower bound
  ci <- c(lb, ub)
  return (ci)
}
```

In [7]:

```
#Agresti-Coule
agresti <- function(x,n) {
  n_hat = n+4
  p_hat <- (x+2)/n_hat
  z <- qnorm(p=.975)
  sd <- sqrt(((p_hat)*(1-p_hat))/n_hat)

  #Confidence Interval
  ub <- p_hat + z * sd #Upper bound
  lb <- p_hat - z * sd #lower bound
  ci <- c(lb, ub)
  return (ci)
}
```

In [8]:

```
#Sample function
simulation <- function(population, method, n = 200, sim = 10000) {
  true_prop <- mean(population)
  coverage <- 0
  for (i in 1:sim) {
    # Take a sample using our sample function
    sample_data <- f_sample(population, n)
    x <- sum(sample_data)

    # Calculate CI using the specified method
    ci <- method(x, n)

    # Check coverage
    if (true_prop >= ci[1] && true_prop <= ci[2]) {
      coverage <- coverage + 1
    }
  }

  return(coverage/sim)
}
```

In [9]:

```
#Test outputs
# Create population
population <- create_population(N = 5000) #can be changed
```

In [10]:

```
coverage_trad <- simulation(population, traditional)
coverage_agre <- simulation(population, agreсти)

# Display results
cat("Traditional method coverage:", coverage_trad, "\n")
cat("Agresti-Coull method coverage:", coverage_agre, "\n")
```

Out[10]: Traditional method coverage: 0.9388

Agresti-Coull method coverage: 0.9457

In [12]:

```
# Visuals
coverage_rates <- c(coverage_trad, coverage_agre)
names(coverage_rates) <- c("Traditional", "Agresti-Coull")
barplot(coverage_rates,
        col = c("skyblue", "orange"),
        ylim = c(0.9, 1),
        main = "Coverage Probability of CI Methods",
        ylab = "Proportion of CIs Containing True Proportion",
        xlab = "Method")
```

Out[12]:

