

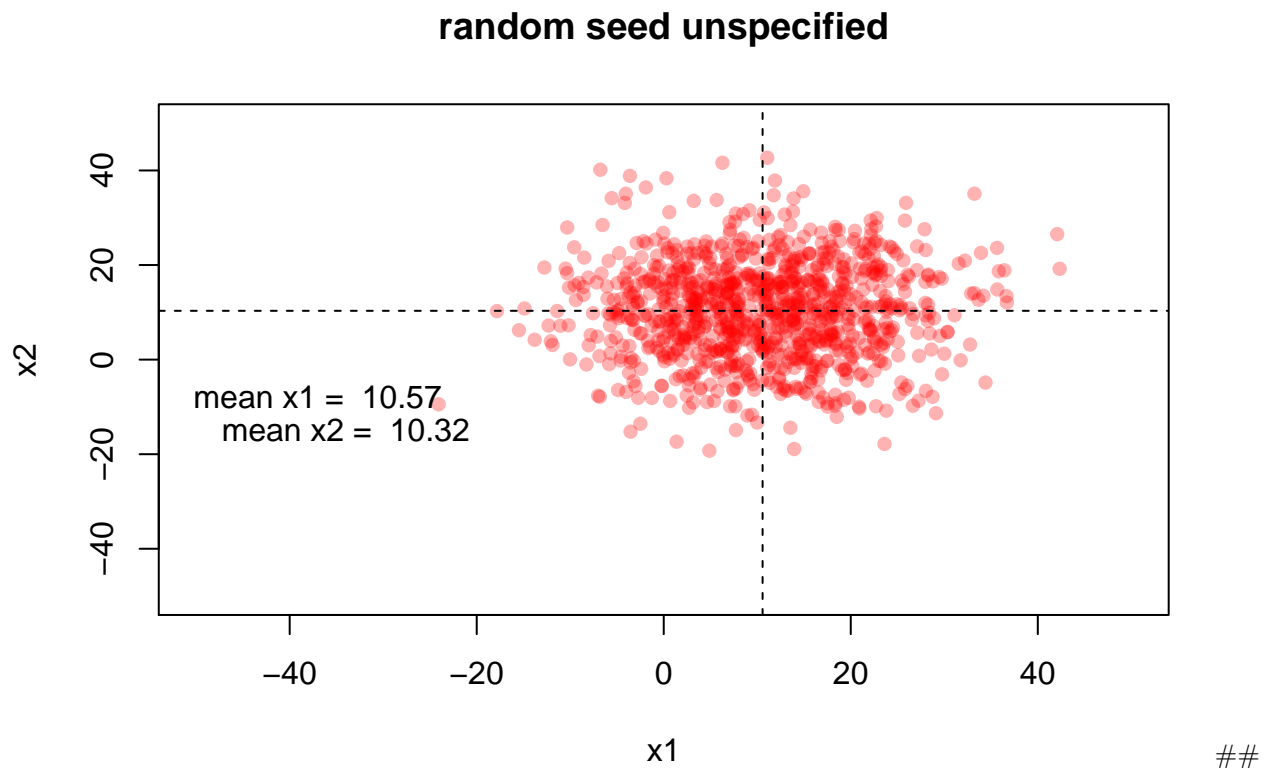
Ec/ACM/CS 112. Problem set 1.

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Step 1: Programming stochastic simulations

1.A

```
x1 = rnorm(1000, 10, 10)
x2 = rnorm(1000, 10, 10)
plot(x1, x2, main = "random seed unspecified", pch = 16, xlim = c(-50,50), ylim = c(-50,50), col = rgb(1, 0, 0, 0.5))
abline(v = mean(x1), lty=2)
abline(h = mean(x2), lty=2)
text(-37, -8, paste("mean x1 = ", round(mean(x1), 2)))
text(-34, -15, paste("mean x2 = ", round(mean(x2), 2)))
```

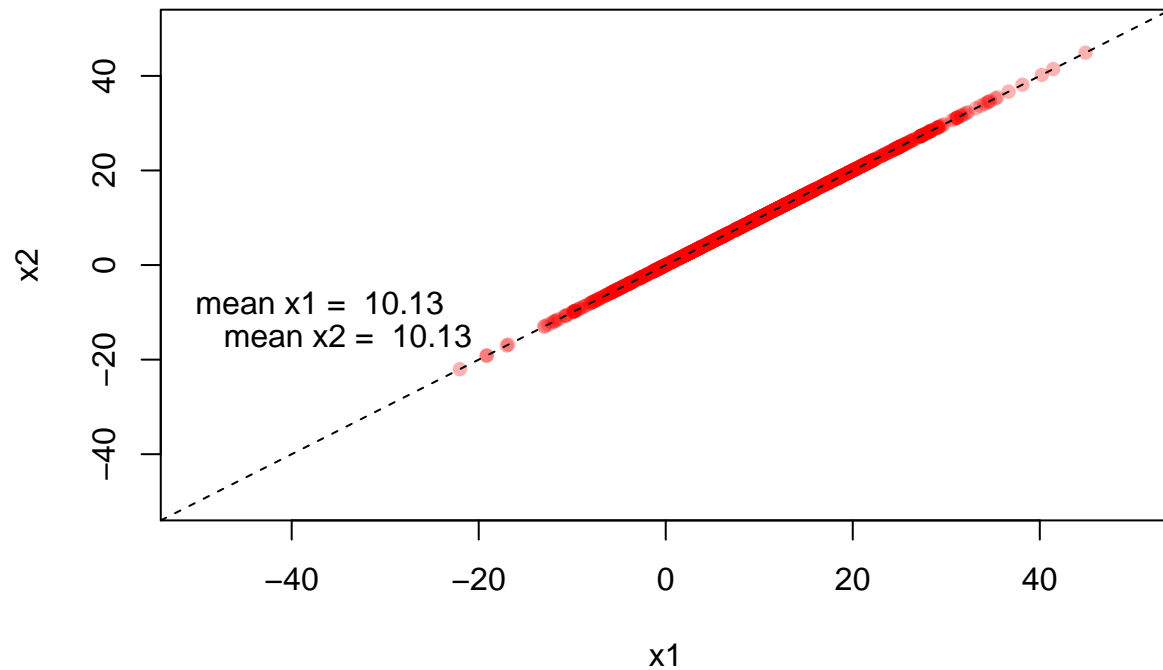


1.B

```
set.seed(2021)
x1 = rnorm(1000, 10, 10)
set.seed(2021)
x2 = rnorm(1000, 10, 10)
plot(x1, x2, main = "random seed specified", pch = 16, xlim = c(-50,50), ylim = c(-50,50), col = rgb(1, 0, 0, 0.5))
abline(a = 0, b = 1, lty=2)
```

```
text(-37, -8, paste("mean x1 = ", round(mean(x1), 2)))
text(-34, -15, paste("mean x2 = ", round(mean(x2), 2)))
```

random seed specified



2: Simulating the hot-hand in basketball

Step

2.A

```
simulate_player = function(p) {
  return(unlist(rbinom(25, 1, p)))
}

count_sequence = function(l) {
  streaks = list()

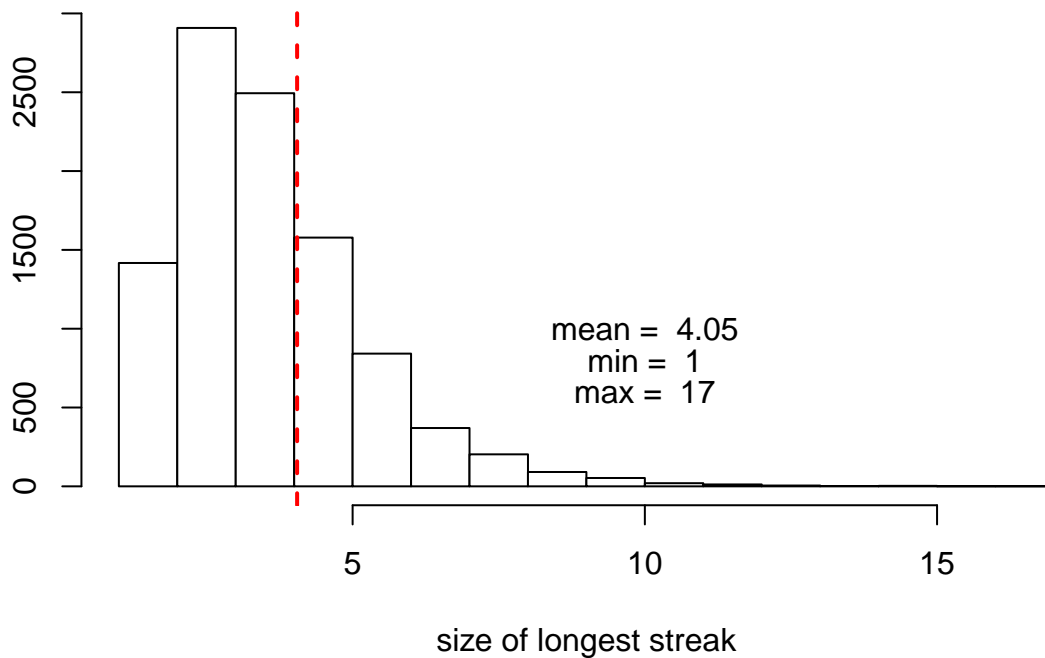
  for (i in 1:length(l)) {
    streak = 0
    for (j in i:length(l)) {
      if (l[j] == 0) {
        break
      }
      streak = streak + 1
    }
    streaks[[i]] = streak
  }

  return(max(unlist(streaks)))
}
```

2.B

```
x = c()
set.seed(2021)
for (i in 1:10000) {
  x[i] = count_sequence(simulate_player(.5))
}
hist(x, col = "white", main = "Distribution of longest streaks", xlab = "size of longest streak", ylab = "frequency",
# axis(2, at = c(500, 1500, 2500), labels = c(500, 1500, 2500))
abline(v = mean(x), lty = 2, lwd = 2, col = "red")
text(10, 1000, paste("mean = ", round(mean(x), 2)))
text(10, 800, paste("min = ", min(x)))
text(10, 600, paste("max = ", max(x)))
```

Distribution of longest streaks



2.C

```
pHit = replicate(16,.1)
for (i in 2:17) {
  pHit[i] = pHit[i - 1] + .05
}

means = c()
maxes = c()
mins = c()
s = c()
for (i in 1:length(pHit)) {
  set.seed(2021)
  for (j in 1:10000) {
```

```

    s[j] = count_sequence(simulate_player(pHit[i]))
  }
  means[i] = mean(s)
  maxes[i] = max(s)
  mins[i] = min(s)
}
plot(pHit, means, ylim = c(0,25), xlim = c(0.0, 1.0), col = "blue", type = "o", pch = 16, xlab = "prob score", ylab = "streak height")
points(pHit, maxes, col = "green", type = "l", pch = 16, lty = 2)
points(pHit, mins, col = "red", type = "l", pch = 16, lty = 2)
legend("topleft", legend = c("mean", "max", "min"), lty = c(1, 2, 2), col = c("blue", "green", "red"), bty = "n")

```

