

## Programming: Practical 2b solutions

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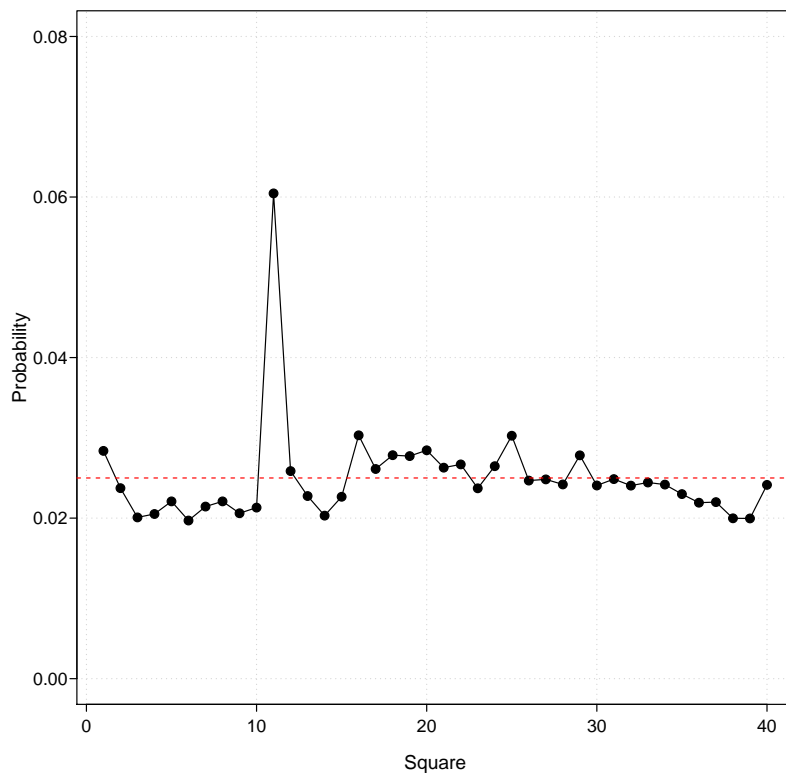


Figure 1: Distribution of resting places in a game of monopoly using  $5 \times 10^4$  rolls.

```
## Dice function
RollTwoDiceWithDoubles = function(current) {

  df = data.frame(d1 = sample(1:6, 3, replace = TRUE),
                  d2 = sample(1:6, 3, replace = TRUE))

  df$Total = apply(df, 1, sum)
  df$IsDouble = df$d1 == df$d2

  if (df$IsDouble[1] & df$IsDouble[2] & df$IsDouble[3]) {
    current = 11 #Go To Jail
  } else if (df$IsDouble[1] & df$IsDouble[2]) {
    current = current + sum(df$Total[1:2])
  } else {
    current = current + df$Total[1]
  }
  return(current)
}
```

```

## Helper function to avoid code replication
CheckState = function(current) {
  if (current > 40) {
    current = current - 40
  } else if (current < 1) {
    current = current + 40
  }
  return(current)
}

```

```

UpdateStateVector = function(current, move, landings) {
  if (move != current) {
    landings[current] = landings[current] + 1
  }
  return(landings)
}

```

```

CommunityChest = function(current) {
  u = runif(1)
  goto = current #Default. Do nothing
  if (u < 1/16) {
    goto = 1 #Go
  } else if (u < 2/16) {
    goto = 11 #Jail
  } else if (u < 3/16) {
    goto = 2 #Old Kent Rd
  } else if (u < 4/16) {
    goto = Chance(current)
  }
  return(goto)
}

```

```

Chance = function(current) {
  u = runif(1)
  goto = current #Default. Do nothing
  if (u < 1/16) {
    goto = 1 #Go
  } else if (u < 2/16) {
    goto = 25 #Tra Square
  } else if (u < 3/16) {
    goto = 12 #Pall Mall
  } else if (u < 4/16) {
    goto = 11 #Jail
  } else if (u < 5/16) {
    goto = 16 #Mary' Stat
  } else if (u < 6/16) {
    goto = 40 #Mayfair
  }
  return(goto)
}

```

```

    } else if (u < 7/16) {
        goto = CheckState(current - 3) #Must check, since goto maybe negative!
    } else if (u < 8/16) {
        if (current > 29 | current < 13) {
            goto = 13
        } else {
            goto = 29
        }
    }
    }
    return(goto)
}

```

```

SimulateMonopoly = function(no_of_turns) {
    landings = numeric(40)
    ## Start GO
    current = 1
    for (i in 1:no_of_turns) {
        current = RollTwoDiceWithDoubles(current)
        current = CheckState(current)
        landings = UpdateStateVector(current, -1, landings)

        if (current == 3 | current == 18 | current ==
            34) {
            # Community Chest
            move = CommunityChest(current)
            landings = UpdateStateVector(move, current,
                landings)
            current = move
        } else if (current == 8 | current == 23 | current ==
            37) {
            # Chance
            move = Chance(current)
            landings = UpdateStateVector(move, current,
                landings)
            current = move
        }

        ## Go To Jail. Chance could also send you here by
        ## going back three places
        if (current == 31) {
            current = 11
            landings = UpdateStateVector(current, -1,
                landings)
        }

    }
    return(landings)
}

```

## Neater Solutions

Some of the functions could be simplified.

```
## Rather than if statements, just work to mod 40
CheckState = function(current) {
  current = current%%40
  if (current == 0)
    current = 40
  return(current)
}
```

```
## Use the sample command to move square
CommunityChest = function(current) {
  u = runif(1)
  goto = current #Default. Do nothing
  if (u < 3/16) {
    goto = sample(c(1, 11, 2), 1)
  } else if (u < 4/16) {
    goto = Chance(current)
  }
  return(goto)
}
```

```
## Use the sample command to move square
Chance = function(current) {
  u = runif(1)
  goto = current #Default. Do nothing
  if (u < 6/16) {
    goto = sample(c(1, 25, 12, 11, 16, 50), 1)
  } else if (u < 7/16) {
    goto = CheckState(current - 3) #Must check, since goto maybe negative!
  } else if (u < 8/16) {
    if (current > 29 | current < 13) {
      goto = 13
    } else {
      goto = 29
    }
  }
  return(goto)
}
```