MAS1802: Computing Project

Due on Tuesday 14th May at 4:00pm

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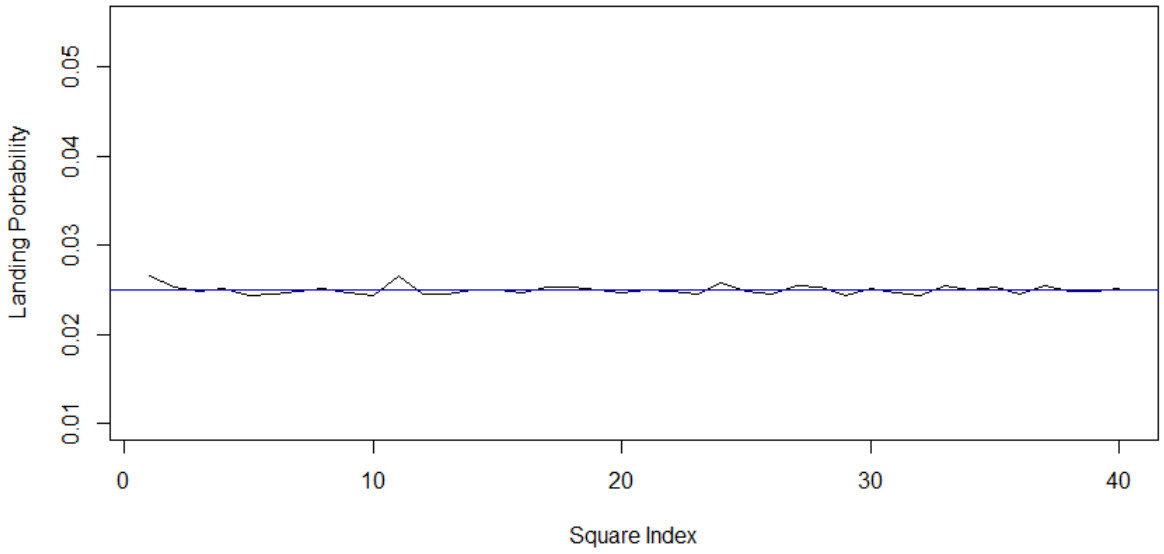
Section 1: Monopoly

Initial Simulation

Below is a plot of `SimulateMonopoly1`, showing a baseline probability of 2.5% to land on any given square.



Adding further complexity

Main Function: SimulateMonopoly

The `while` loop on line 6 freezes the roll counter if the player rolls a double as to simulate 'free rolls', and to prevent the case of the simulation ending on a double where it is possible two further doubles could result in being sent to jail.

```
1  SimulateMonopoly = function(no_of_rolls) {
2    landings = numeric(40)
3    current = 1
4    doubles = 0
5    for (i in 1:no_of_rolls) {
6      while (TRUE) { # Stops 'i' from incrementing on doubles
7        roll = RollTwoDice()
8        if (doubles == 3) {
9          current = 11 # Send to jail on rolling three doubles
10         doubles = 0 # Reset doubles counter
11       } else {
12         current = current + sum(roll)
13         if (roll[1] == roll[2]) {
14           doubles = doubles + 1 # Increment doubles counter on rolling a
                 double
15         }
16         if (current > 40) {
17           current = current - 40
18         }
19         landings[current] = landings[current] + 1
20        # Community Chests Squares
21         if (current == 3 || current == 18 || current == 34) {
```

```
            cc_move = CommunityChest(current)
            if (cc_move != current) {
              current = cc_move
              landings[current] = landings[current] + 1
            }
          }
          # Go to Jail
          if (current == 31) {
            jail = 11
            current = jail
            landings[current] = landings[current] + 1
          }
          # Chance Squares
          if (current == 8 || current == 23 || current == 37) {
            chance_move = Chance(current)
            if (chance_move != current) {
              current = chance_move
              landings[current] = landings[current] + 1
            }
          }
        }
        if (roll[1] != roll[2]) {
          break # Increment 'i' if a non-double is rolled
        }
      }
    }
    return(landings)
}
```

Helper Function: Community Chest

```
CommunityChest = function(current) {
  goto = current
  u = runif(1) # Create random number between 0 and 1
  if (u < 1 / 16) {
    goto = 1 # Advance to Go
  } else if (u < 2 / 16) {
    goto = 11 # Go to Jail
  } else if (u < 3 / 16) {
    goto = 2 # Go to Old Kent Road
  } else if (u < 4 / 16) {
    goto = Chance(current) # Take a chance card
  }
  return(goto)
}
```

Helper Function: Chance Cards

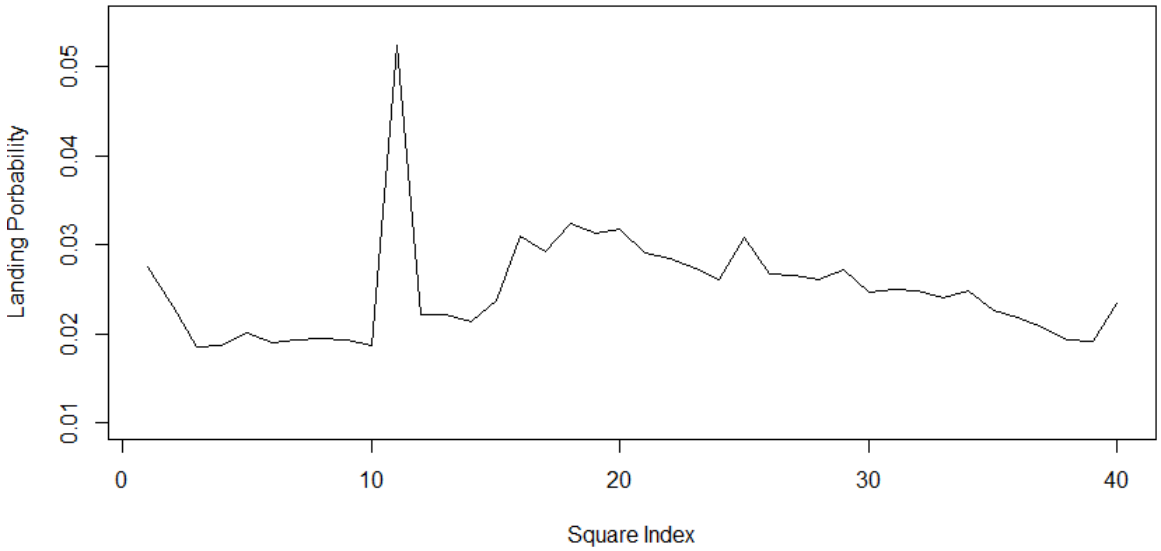
```
Chance = function(current) {
  goto = current
  u = runif(1) # Create random number between 0 and 1
  if (u < 1 / 16) {
    goto = 1 # Advance to Go
  } else if (u < 2 / 16) {
    goto = 25 # Advance to Trafalgar Square
  } else if (u < 3 / 16) {
    goto = 12 # Advance to Pall Mall
  } else if (u < 4 / 16) {
    goto = 11 # Go to Jail
  } else if (u < 5 / 16) {
    goto = 16 # Take a trip to Marylebone Station
  } else if (u < 6 / 16) {
    goto = 40 # Advance to Mayfair
  } else if (u < 7 / 16) {
    if (current >= 1 & current <= 13) {
      goto = 13 # Advance to nearest utility
    }
    if (current >= 14 & current <= 29) {
      goto = 29 # Advance to nearest utility
    }
    if (current >= 30 & current <= 40) {
      goto = 13 # Advance to nearest utility
    }
  } else if (u < 8 / 16) {
    goto = current - 3 # Go back three spaces
  }
  return(goto)
}
```

Helper Function: Rolling Dice

```
RollTwoDice = function() {
  d1 = sample(1:6, 1)
  d2 = sample(1:6, 1)
  roll = c(d1, d2)
  return(roll)
}
```

Final plot

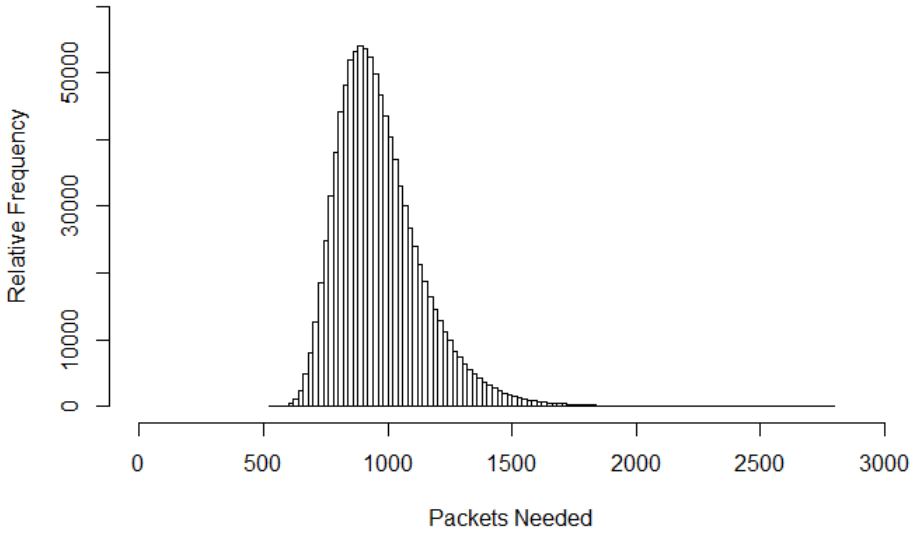
The final plot was carried out with `number_of_rolls=100,000,000`. The final results suggest landing on the Jail square had the highest likelihood, of 6.42%, whereas the lowest likelihood was to land on the Community Chest at square 3, with a probability of 2.27%. The average probability of landing on any given square was still 2.5%, meaning on average it is over twice as likely to land on jail than any other given square.



Section 2: Sticker Album

Main Function

Across 1,000,000 simulations, the average amount of packets needed for a full set was 969.417. This would suggest an average cost of £775.53. In these simulations, in the most unlucky case it took 2789 packets to complete a set, totalling £2231.20, and in the luckiest case it took only 538 packets, costing £430.40. The standard deviation for packets needed was 174.15, implying a £139.32 standard deviation for cost.




```
sim_number = 1000000
packets_bought = vector(length = sim_number)

sticker_sim = function(sim_number) {
  for (i in 1:sim_number) {
    stickers = 1:682 # Sticker sequence, a vector containing an entry for each
        sticker.
    for (j in 1:10000) { # Open up to 10,000 packs of stickers (arbitrary
       upper limit).
      packet = sample(1:682, 5, replace = TRUE) # Create a packet from a
          random pool 682 of stickers, with replacement.


      for (k in 1:5) { # Pick 5 stickers from the random pool, find the picked
          stickers' entry in 'stickers' vector and set to zero.
        stickers[packet[k]] = 0
      }

      # If all entries in 'stickers' vector are zero then all stickers have
          been collected, stop looping.
      if (sum(stickers) == 0) {
        packets_bought[i] = j
        break
      }
    }
```

```
21    }
22    return(packets_bought)
23  }
24
25  output_vector = sticker_sim(sim_number)
26  sum(output_vector) / sim_number # Outputs average number of packets needed for
        a full set
```