Random dots

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Introduction

We are not good at judging randomness. This document will compare two figures containing a selection of dots scattered on a grid. One of the grids will have a truly random scattering of dots. The other has a pattern of dots, but nevertheless, will look more random to the average observer.

Preliminaries

```
library(ggplot2)
set.seed(1234)
```

Functions

The `total_dots` argument is the total number of dots to plot in an `m` by `n` grid. The `random_dots` function will create exactly this many dots randomly distributed over the region, whereas `not_so_random_dots` will create `total_dots/(m * n)` dots in each of the `m * n` squares. (This number is rounded if `total_dots/(m * n)` is not a whole number.)[1]

```
random_dots <- function(total_dots, m, n){
    x <- runif(total_dots)
    y <- runif(total_dots)
    xy <- data.frame(x, y)
    return(xy)
}

not_so_random_dots <- function(total_dots, m, n){
    # Fill each square randomly
    each_square <- function(x_shift,  y_shift) {
        x <- x_shift + (1/m) * runif(round(total_dots/(m * n)))
        y <- y_shift + (1/n) * runif(round(total_dots/(m * n)))
        return(data.frame(x, y))
        }
    # Initialize empty data frame
    xy <- data.frame()
    # Glue all the squares together
    for(i in seq(0, (1 - 1/m), by = 1/m)){
        for(j in seq(0, (1 - 1/n), by = 1/n)){
            new_points <- each_square(x_shift = i, y_shift = j)
            xy <- rbind(xy, new_points)
        }
    }
    return(xy)
}
```

[1] Rounded in R's weird "go to the even digit" way, though!

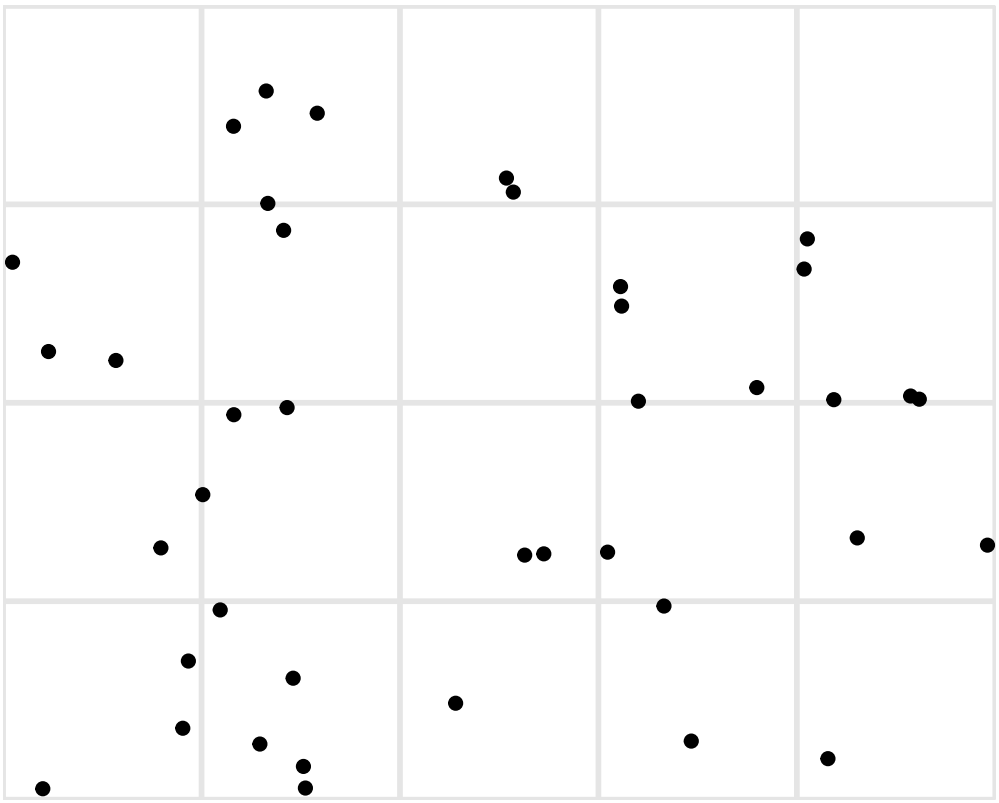
```
plot_dots <- function(xy, m, n) {
    ggplot(xy, aes(x = x, y = y)) +
        geom_point(size = rel(2)) +
        theme_minimal() +
        theme(panel.grid.major = element_line(size = rel(2))) +
        coord_fixed(ratio = n/m) +
        scale_x_continuous(name = NULL, labels = NULL,
                           breaks = seq(0, 1, by = 1/m),
                           minor_breaks = NULL,
                           limits = c(0, 1), expand = c(0, 0)) +
        scale_y_continuous(name = NULL, label = NULL,
                           breaks = seq(0, 1, by = 1/n),
                           minor_breaks = NULL,
                           limits = c(0, 1), expand = c(0, 0))
}
```

Set parameters

```
total_dots <- 40
m <- 5
n <- 4
```

Plot of random dots

```
xy <- random_dots(total_dots, m,  n)
plot_dots(xy, m, n)
```



Plot of not-so-random dots

```
xy <- not_so_random_dots(total_dots, m,  n)
plot_dots(xy, m, n)
```