

# Statistics Experience

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## Library Packages

```
library(ggforce) # Gives ggplot extra geoms
```

Warning: package 'ggforce' was built under R version 4.5.2

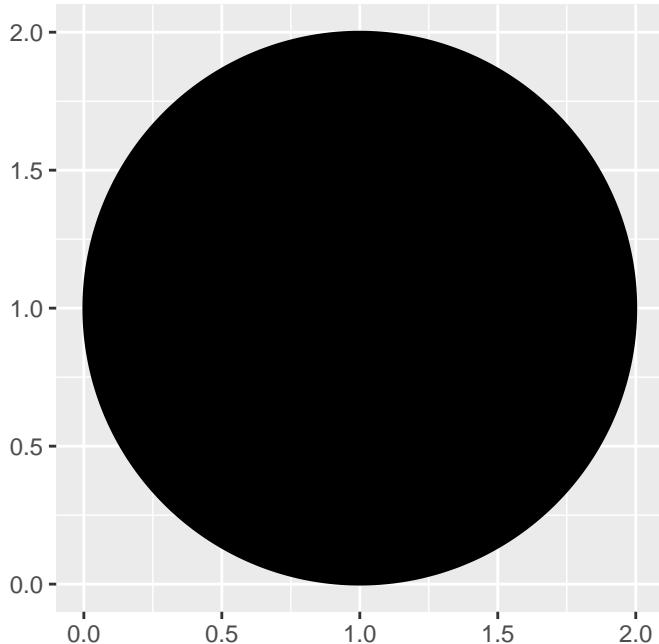
```
library(tidyverse)
library(ggplot2)
```

## Manufacture Data

Need to manufacture data to use in our ggplot object, then we will use ggplot and the geom\_circle call from the ggforce package to visualize the data and ensure true circularity

```
circle <- data.frame(
  x0 = 1,
  y0 = 1,
  r = 1
)

ggplot() +
  geom_circle(
    aes(x0 = x0, y0 = y0, r = r),
    data = circle,
    fill = "black") +
  coord_fixed()
```



### Place many circles in a line

We do the same, but for many circles. We want them to be separate, so we modify the y.

```
circles <- data.frame(
  x0 = rep(1, 9),
  y0 = seq(1, 20, length.out = 9),
  r = 0.5
)

ggplot() +
  geom_circle(
    aes(x0 = x0, y0 = y0, r = r),
    data = circles,
    fill = "black") +
  coord_fixed() +
  theme_void()
```

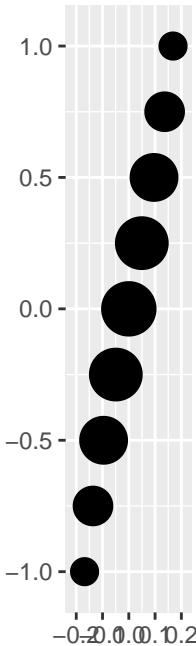


## Get a line of circles

Here we just play around with the data and continually visualize to get things the way we want. Changes in this code are tracked in order (e.g. r1, r2,...)

```
circles2 <- tibble(  
  x1 = rep(1, 9),  
  x2 = seq(-5, 5, length.out = 9),  
  x3 = seq(-1, 1, length.out = 9),  
  x4 = seq(-0.2, 0.2, length.out = 9),  
  y1 = seq(1, 20, length.out = 9),  
  y2 = seq(0, 1, length.out = 9),  
  y3 = seq(-1, 1, length.out = 9),  
  r1 = 1,  
  r2 = (y2^2),  
  r3 = (y3^-2),  
  r4 = (-(y3^2)),  
  r5 = (-(y3^2) + 2),  
  r6 = (-(y3^2) + 2) / 20,  
  x5 = sin(y3) / 5  
)
```

```
ggplot() +
  geom_circle(
    aes(x0 = x5, y0 = y3, r = r6),
    data = circles2,
    fill = "black",
    alpha = 1) +
  coord_fixed()
```

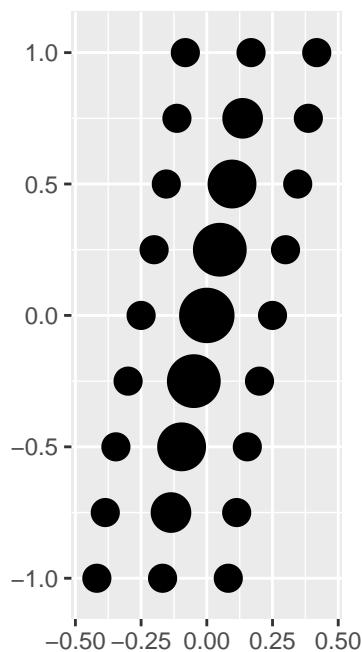


### Get multiple lines of circles

We continue to play around, now adding a second geom\_circle to the ggplot call to get a second line of circles.

```
circles3 <- tibble(
  y3 = seq(-1, 1, length.out = 9),
  r6 = (-(y3^2) + 2) / 20,
  x5 = sin(y3) / 5,
  xx1 = x5 - 0.25,
  xxx1 = x5 + 0.25,
  rr1 = 0.05,
  rrr1 = 0.05
```

```
)  
  
ggplot() +  
  geom_circle(  
    aes(x0 = x5, y0 = y3, r = r6),  
    data = circles3,  
    fill = "black",  
    alpha = 1) +  
  geom_circle(  
    aes(x0 = xx1, y0 = y3, r = rr1),  
    data = circles3,  
    fill = "black",  
    alpha = 1) +  
  geom_circle(  
    aes(x0 = xxx1, y0 = y3, r = rrr1),  
    data = circles3,  
    fill = "black",  
    alpha = 1) +  
  coord_fixed()
```

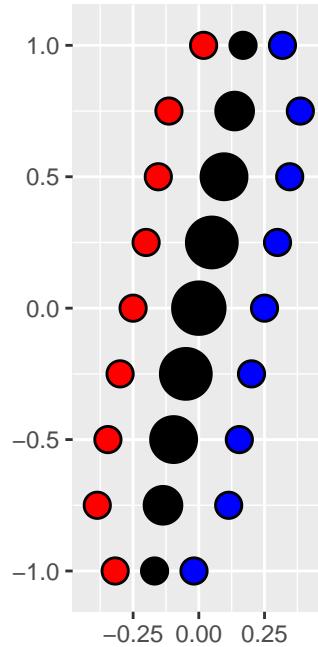


## Taper ends

We want to now taper the ends to a point, so it starts to get pumpkin shaped. We add circle line colors to differentiate between rows as we move things. We also clean the variable names. We mutate the data for x\_center\_m1 (& p1)

```
circles4 <- tibble(
  y3 = seq(-1, 1, length.out = 9),
  r6 = (-(y3^2) + 2) / 20,
  x_center = sin(y3) / 5,
  x_center_m1 = x_center - 0.25,
  x_center_p1 = x_center + 0.25,
  rr1 = 0.05,
  rrr1 = 0.05,
) %>%
  mutate(x_center_m1 =
    if_else(y3 == max(y3) | y3 == min(y3),
            x_center_m1 + 0.1,
            x_center_m1),
    x_center_p1 =
    if_else(y3 == max(y3) | y3 == min(y3),
            x_center_p1 - 0.1,
            x_center_p1))

ggplot() +
  geom_circle(
    aes(x0 = x_center, y0 = y3, r = r6),
    data = circles4,
    fill = "black",
    alpha = 1) +
  geom_circle(
    aes(x0 = x_center_m1, y0 = y3, r = rr1),
    data = circles4,
    fill = "red",
    alpha = 1) +
  geom_circle(
    aes(x0 = x_center_p1, y0 = y3, r = rrr1),
    data = circles4,
    fill = "blue",
    alpha = 1) +
  coord_fixed()
```



### Further play with radius values, add a new line

Add more rows of dots to make the dots overall more pumpkin shaped, try and taper the radius slightly less at the bottom

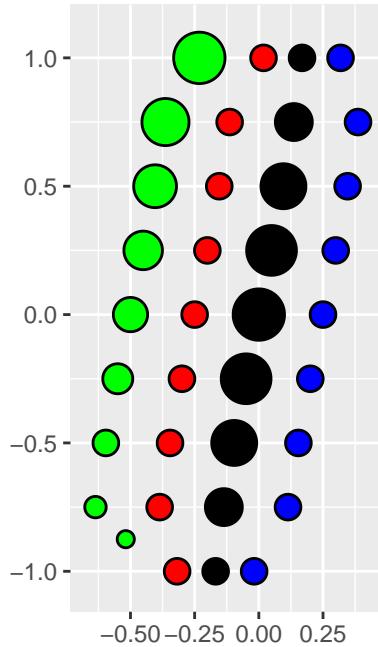
```
circles5 <- tibble(
  y3 = seq(-1, 1, length.out = 9),
  r6 = (-y3^2 + 2) / 20,
  x_center = sin(y3) / 5,
  x_center_m1 = x_center - 0.25,
  x_center_p1 = x_center + 0.25,
  rr1 = 0.05,
  rrr1 = 0.05,
) %>%
  mutate(x_center_m1 =
    if_else(y3 == max(y3) | y3 == min(y3),
           x_center_m1 + 0.1,
           x_center_m1),
  x_center_p1 =
    if_else(y3 == max(y3) | y3 == min(y3),
           x_center_p1 - 0.1,
           x_center_p1),
```

```

x_center_m2 =
  if_else(y3 == min(y3), x_center_m1 - 0.25 + 0.05, x_center_m1 - 0.25),
r_center_m2 = (y3 + 2) / 30,
y_center_m2 = if_else(y3 == min(y3), y3 + 0.125, y3))

ggplot() +
  geom_circle(
    aes(x0 = x_center, y0 = y3, r = r6),
    data = circles5,
    fill = "black",
    alpha = 1) +
  geom_circle(
    aes(x0 = x_center_m1, y0 = y3, r = rr1),
    data = circles5,
    fill = "red",
    alpha = 1) +
  geom_circle(
    aes(x0 = x_center_p1, y0 = y3, r = rrr1),
    data = circles5,
    fill = "blue",
    alpha = 1) +
  geom_circle(
    aes(x0 = x_center_m2, y0 = y_center_m2, r = r_center_m2),
    data = circles5,
    fill = "green",
    alpha = 1) +
  coord_fixed()

```



### Add in that same line on the other side

Mirror the previous line (green) to the other side.

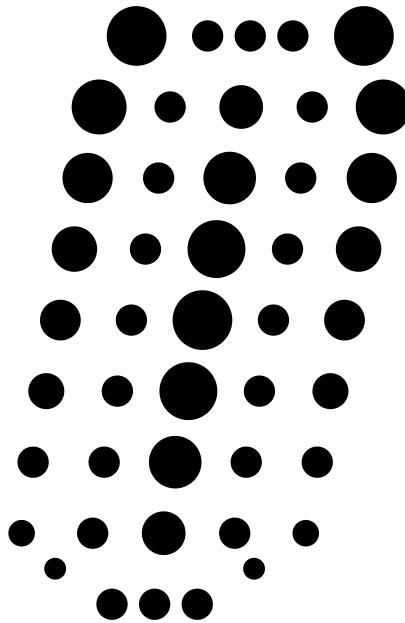
```
circles6 <- tibble(
  y3 = seq(-1, 1, length.out = 9),
  r6 = (-(y3^2) + 2) / 20,
  x_center = sin(y3) / 5,
  x_center_m1 = x_center - 0.25,
  x_center_p1 = x_center + 0.25,
  rr1 = 0.05,
  rrr1 = 0.05,
) %>%
  mutate(x_center_m1 =
    if_else(y3 == max(y3) | y3 == min(y3),
           x_center_m1 + 0.1,
           x_center_m1),
  x_center_p1 =
    if_else(y3 == max(y3) | y3 == min(y3),
           x_center_p1 - 0.1,
           x_center_p1),
  x_center_m2 =
```

```

    if_else(y3 == min(y3), x_center_m1 - 0.25 + 0.05, x_center_m1 - 0.25),
r_center_mp2 = (y3 + 2) / 30,
y_center_mp2 = if_else(y3 == min(y3), y3 + 0.125, y3),
x_center_p2 = if_else(y3 == min(y3), x_center_p1 + 0.25 - 0.05, x_center_p1 + 0.25)

ggplot() +
  geom_circle(
    aes(x0 = x_center, y0 = y3, r = r6),
    data = circles6,
    fill = "black",
    alpha = 1) +
  geom_circle(
    aes(x0 = x_center_m1, y0 = y3, r = rr1),
    data = circles6,
    fill = "black",
    alpha = 1) +
  geom_circle(
    aes(x0 = x_center_p1, y0 = y3, r = rrr1),
    data = circles6,
    fill = "black",
    alpha = 1) +
  geom_circle(
    aes(x0 = x_center_m2, y0 = y_center_mp2, r = r_center_mp2),
    data = circles6,
    fill = "black",
    alpha = 1) +
  geom_circle(
    aes(x0 = x_center_p2, y0 = y_center_mp2, r = r_center_mp2),
    data = circles6,
    fill = "black",
    alpha = 1) +
  coord_fixed() +
  theme_void()

```



### Change the background color to yellow

Now that we have a solid base of dots, make the background the color of the pumpkins in the reference photo.

```
circles6 <- tibble(
  y3 = seq(-1, 1, length.out = 9),
  r6 = (-(y3^2) + 2) / 20,
  x_center = sin(y3) / 5,
  x_center_m1 = x_center - 0.25,
  x_center_p1 = x_center + 0.25,
  rr1 = 0.05,
  rrr1 = 0.05,
) %>%
  mutate(x_center_m1 =
    if_else(y3 == max(y3) | y3 == min(y3),
           x_center_m1 + 0.1,
           x_center_m1),
  x_center_p1 =
    if_else(y3 == max(y3) | y3 == min(y3),
           x_center_p1 - 0.1,
           x_center_p1),
```

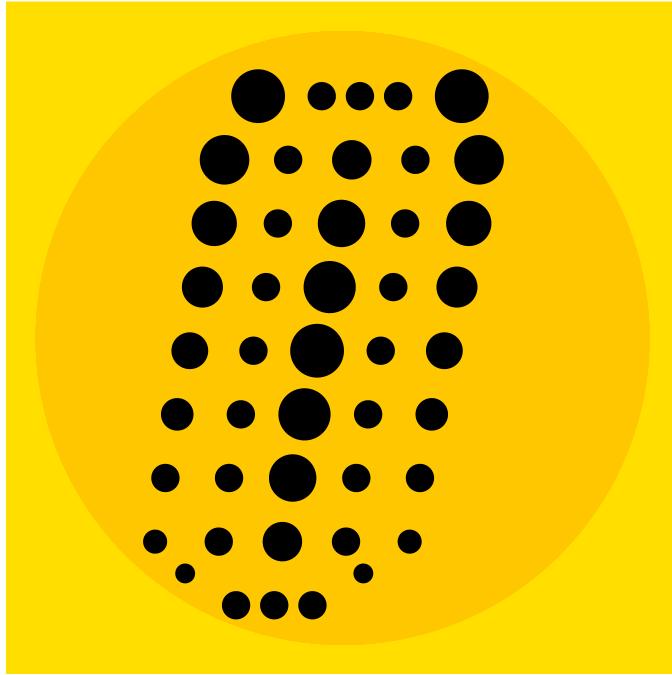
```

x_center_m2 =
  if_else(y3 == min(y3), x_center_m1 - 0.25 + 0.05, x_center_m1 - 0.25),
r_center_mp2 = (y3 + 2) / 30,
y_center_mp2 = if_else(y3 == min(y3), y3 + 0.125, y3),
x_center_p2 = if_else(y3 == min(y3), x_center_p1 + 0.25 - 0.05, x_center_p1 + 0.25)

ggplot() +
  geom_circle(
    aes(x0 = 0.1, y0 = 0.05, r = 1.2),
    data = circles6,
    fill = "#FFC700",
    color = "#FFC700") +
  geom_circle(
    aes(x0 = x_center, y0 = y3, r = r6),
    data = circles6,
    fill = "black") +
  geom_circle(
    aes(x0 = x_center_m1, y0 = y3, r = rr1),
    data = circles6,
    fill = "black") +
  geom_circle(
    aes(x0 = x_center_p1, y0 = y3, r = rrr1),
    data = circles6,
    fill = "black") +
  geom_circle(
    aes(x0 = x_center_m2, y0 = y_center_mp2, r = r_center_mp2),
    data = circles6,
    fill = "black",
    alpha = 1) +
  geom_circle(
    aes(x0 = x_center_p2, y0 = y_center_mp2, r = r_center_mp2),
    data = circles6,
    fill = "black",
    alpha = 1) +
  coord_fixed() +
  theme_void() +
  theme(panel.background = element_rect(fill = "#FFDDE00", color = "#FFDDE00"))

```

Warning in geom\_circle(aes(x0 = 0.1, y0 = 0.05, r = 1.2), data = circles6, : All aesthetics must be length 1 or 1樽。  
 i Please consider using `annotate()` or provide this layer with data containing  
 a single row.



## Going beyond the video

The video ended as the hosts hit the 1 hour mark. To continue editing this graph beyond the point they finished at, I will add in a stem for the pumpkin, and change the exterior circle to an ellipse to better match our dots.

```
circles6
```

```
# A tibble: 9 x 11
  y3      r6 x_center x_center_m1 x_center_p1    rr1    rrr1 x_center_m2
  <dbl>  <dbl>   <dbl>     <dbl>     <dbl> <dbl> <dbl>   <dbl>
1 -1     0.05   -0.168    -0.318    -0.0183  0.05  0.05   -0.518
2 -0.75 0.0719  -0.136    -0.386     0.114  0.05  0.05   -0.636
3 -0.5   0.0875  -0.0959   -0.346     0.154  0.05  0.05   -0.596
4 -0.25  0.0969  -0.0495   -0.299     0.201  0.05  0.05   -0.549
5  0     0.1     0         -0.25      0.25   0.05  0.05   -0.5
6  0.25 0.0969  0.0495   -0.201     0.299  0.05  0.05   -0.451
7  0.5   0.0875  0.0959   -0.154     0.346  0.05  0.05   -0.404
8  0.75 0.0719  0.136    -0.114     0.386  0.05  0.05   -0.364
9  1     0.05   0.168     0.0183    0.318  0.05  0.05   -0.232
# i 3 more variables: r_center_mp2 <dbl>, y_center_mp2 <dbl>, x_center_p2 <dbl>
```

```

trap1 <- tibble(
  x <- c(1, 3, 1.5, 2.5),
  y <- c(0, 0, 2, 2)
)

ggplot() +
  geom_polygon(
    aes(x = c(-0.15, -0.05, 0.25, 0.35), y = c(1, 2, 2, 1)),
    data = trap1,
    fill = "brown") +
  geom_ellipse(
    aes(x0 = 0, y0 = 0.1, a = 0.8, b = 1.4, angle = pi / 1.05),
    data = circles6,
    fill = "#FFC700",
    color = "#FFC700") +
  geom_circle(
    aes(x0 = x_center, y0 = y3, r = r6),
    data = circles6,
    fill = "black") +
  geom_circle(
    aes(x0 = x_center_m1, y0 = y3, r = rr1),
    data = circles6,
    fill = "black") +
  geom_circle(
    aes(x0 = x_center_p1, y0 = y3, r = rrr1),
    data = circles6,
    fill = "black") +
  geom_circle(
    aes(x0 = x_center_m2, y0 = y_center_mp2, r = r_center_mp2),
    data = circles6,
    fill = "black",
    alpha = 1) +
  geom_circle(
    aes(x0 = x_center_p2, y0 = y_center_mp2, r = r_center_mp2),
    data = circles6,
    fill = "black",
    alpha = 1) +
  coord_fixed() +
  theme_void() +
  theme(panel.background = element_rect(fill = "#FFDDE00", color = "#FFDDE00"))

```

Warning in geom\_ellipse(aes(x0 = 0, y0 = 0.1, a = 0.8, b = 1.4, angle = pi/1.05), : All aesthetics must be explicitly mapped

i Please consider using `annotate()` or provide this layer with data containing a single row.

