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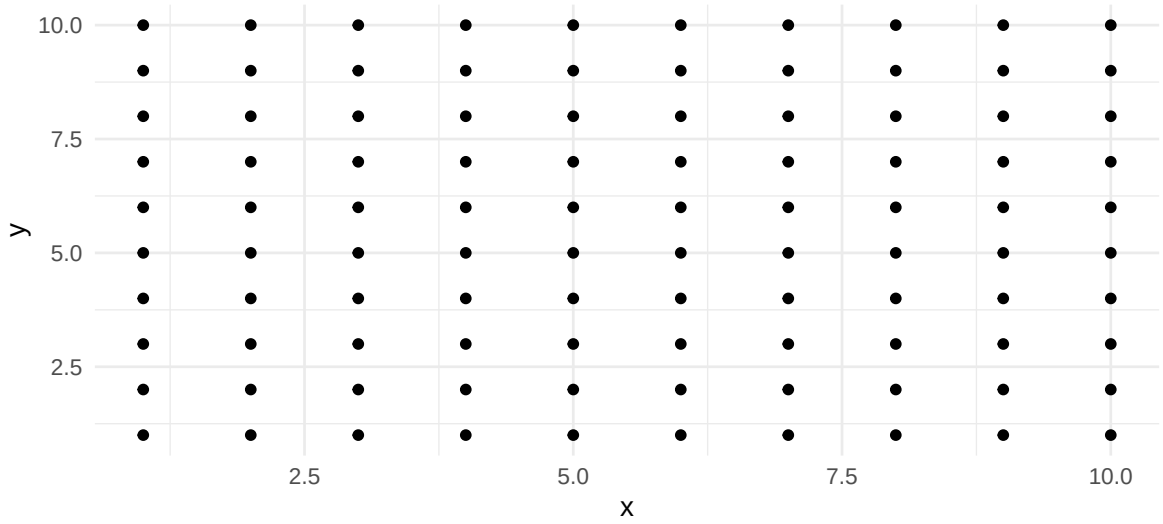
STA 6375

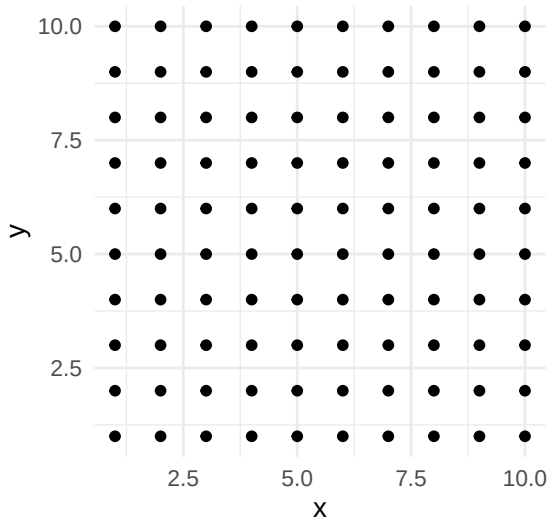
Homework 3

Question 1

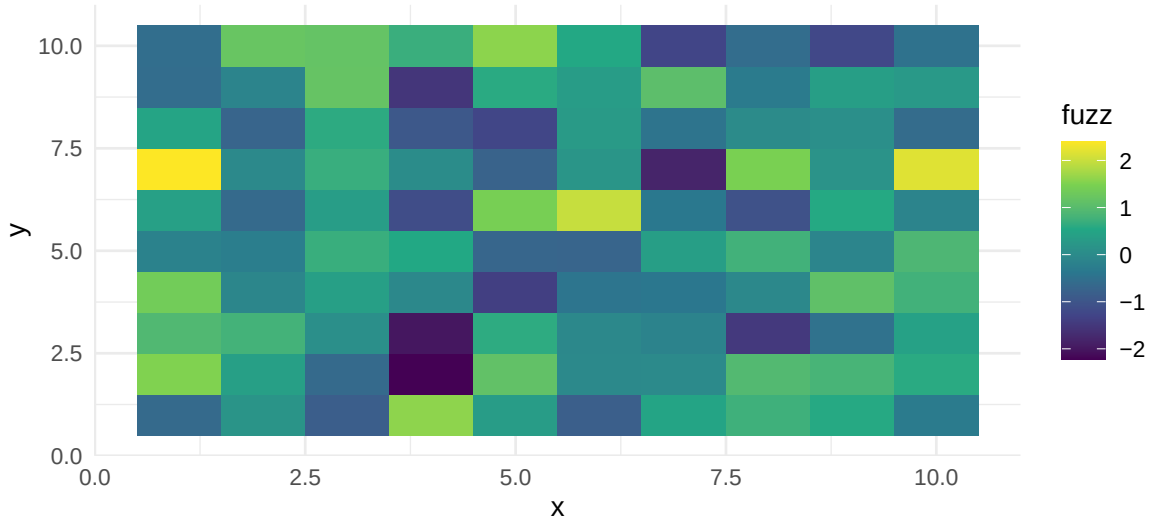
a.
```
library("tidyverse")

df <- expand.grid("x" = 1:10, "y" = 1:10)
ggplot(df, aes(x, y)) +
  geom_point() +
  theme_minimal()
```



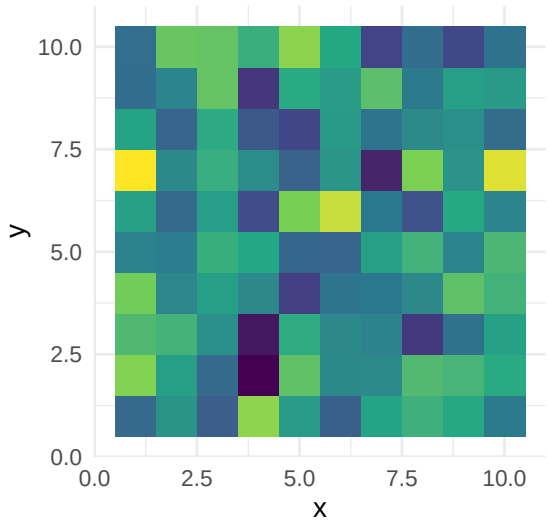
b.
```
ggplot(df, aes(x, y)) +
  geom_point() +
  theme_minimal() +
  coord_equal()
```



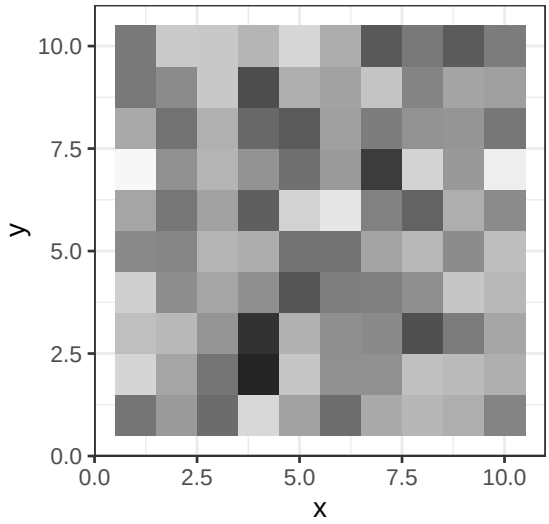
c.
```
set.seed(1)
fuzz <- rnorm(nrow(df))
ggplot(df, aes(x, y, fill = fuzz)) +
  theme_minimal() +
  geom_tile()
```



d.
```
set.seed(1)
fuzz <- rnorm(nrow(df))
ggplot(df, aes(x, y, fill = fuzz)) +
  theme_minimal() +
  geom_tile() +
  theme(legend.position = "none") +
  coord_equal()
```

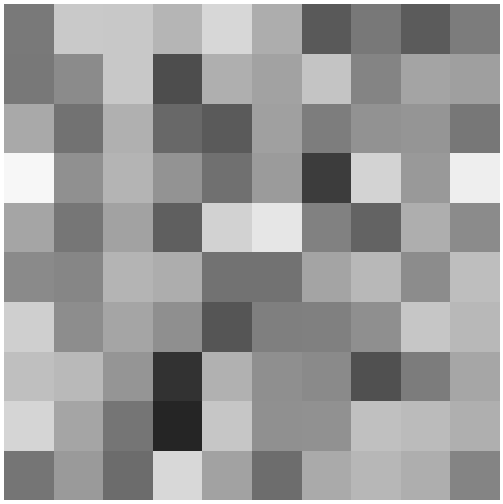


e.
```
set.seed(1)
fuzz <- rnorm(nrow(df))
ggplot(df, aes(x, y, fill = fuzz)) +
  theme_bw() +
  geom_tile() +
  coord_equal() +
  theme(legend.position = "none") +
  scale_fill_distiller(palette = "Greys")
```

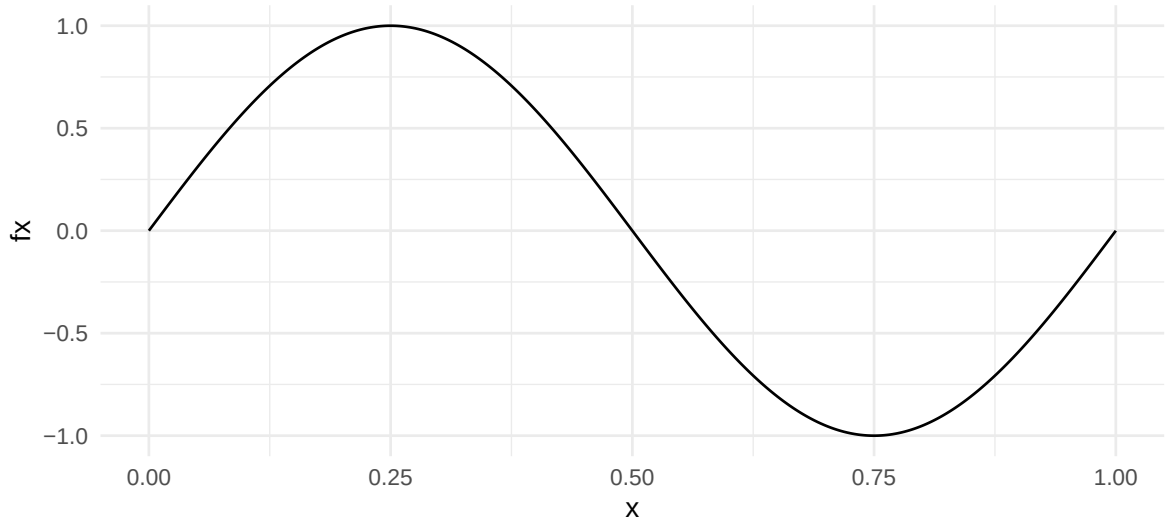


f.
```
set.seed(1)
fuzz <- rnorm(nrow(df))
ggplot(df, aes(x, y, fill = fuzz)) +
  geom_tile() +
  coord_equal() +
  scale_fill_distiller(palette = "Greys") +
  ylab(NULL) +
```

```
  xlab(NULL) +
  theme_void() +
  theme(legend.position = "none")
```

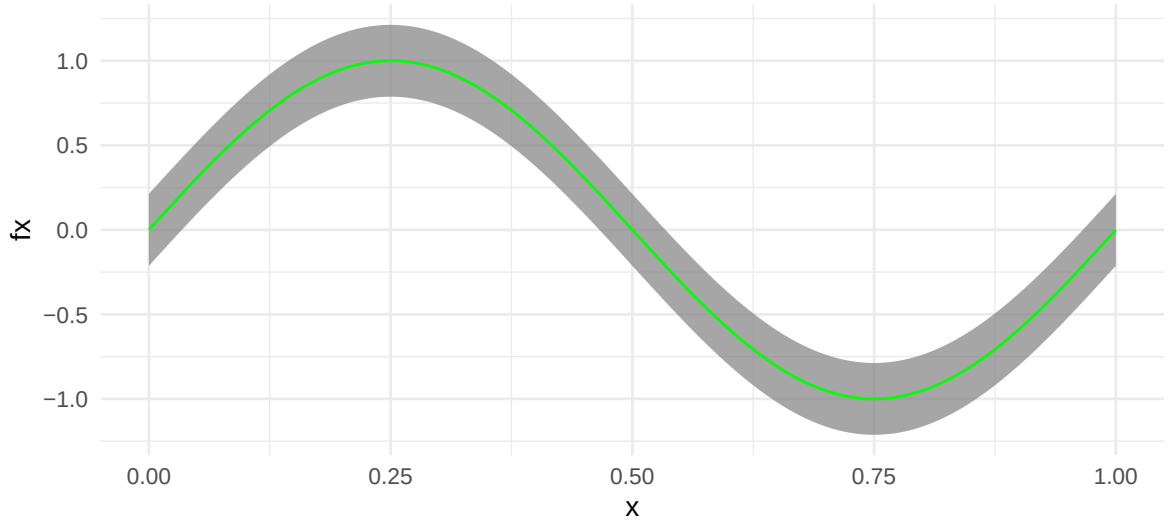


g.
```
x <- seq(0, 1, 1e-4)
fx <- sin(2*pi*x)
sine <- data.frame("x" = x, "y" = fx)
ggplot(sine, aes(x, fx)) +
  theme_minimal() +
  geom_line()
```

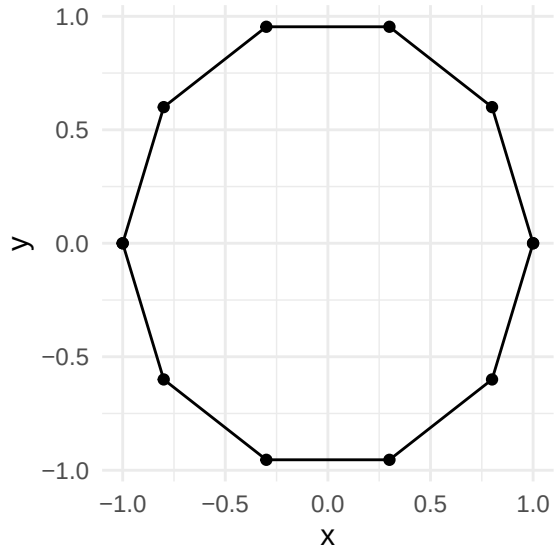


h.
```
x <- seq(0, 1, 1e-4)
fx <- sin(2*pi*x)
sine <- data.frame("x" = x, "y" = fx)
ggplot(sine, aes(x, fx)) +
```

```
  theme_minimal() +
  geom_ribbon(aes(ymin = fx - 0.2125, ymax = fx + 0.2125), fill = "grey50", alpha = 0.7) +
  geom_line(color = "green")
```



i.
```
x1 <- c(-1, -0.8, -0.3, 0.3, 0.8, 1)
decagon_top <- sqrt(1 - (x1)^2)
x2 <- c(1, 0.8, 0.3, -0.3, -0.8, -1)
decagon_bot <- -1*sqrt(1 - (x2)^2)
decagon <- data.frame(x = c(x1, x2), y = c(decagon_bot, decagon_top))
ggplot(decagon, aes(x, y)) +
  geom_point() +
  geom_path() +
  theme_minimal()
```



j.
```r
set.seed(1)
df <- data.frame(x = rnorm(1e3, mean = 3, sd = 2))
ggplot(df, aes(x)) +
  geom_density() +
  stat_function(fun = dnorm, args = list(mean = 3, sd = 2), color = "red") +
  geom_vline(xintercept = 8, color = "red", linetype = "twodash", size = 1) +
  theme_minimal()
```

Question 2

a.
```r
A <- matrix(c(
  -1, 3, 1,
  -7, 9, 1,
  -2, 3, 4),
  nrow = 3, byrow = TRUE)
I <- matrix(c(
  1, 0, 0,
  0, 1, 0,
  0, 0, 1),
  nrow = 3, byrow = TRUE)

r <- eigen(A)
V <- r$vector
lam <- r$values
Lambda <- lam*I

V %*% Lambda %*% solve(V)
```

```
##      [,1] [,2] [,3]
## [1,]   -1    3    1
## [2,]   -7    9    1
## [3,]   -2    3    4
```

b.
```
A <- matrix(c(
  10, 2, -6,
  2, 7, 0,
  -6, 0, 2),
  nrow = 3, byrow = TRUE)
I <- matrix(c(
  1, 0, 0,
  0, 1, 0,
  0, 0, 1),
  nrow = 3, byrow = TRUE)

r <- eigen(A)
V <- r$vector
lam <- r$values
Lambda <- lam*I

# V is orthogonal
zapsmall(crossprod(V))
```

```
##      [,1] [,2] [,3]
## [1,]    1    0    0
## [2,]    0    1    0
## [3,]    0    0    1
```

```
zapsmall(V %*% Lambda %*% t(V))
```

```
##      [,1] [,2] [,3]
## [1,]   10    2   -6
## [2,]    2    7    0
## [3,]   -6    0    2
```

c.
```
A <- matrix(c(
  1, 5, 6,
  2, 6, 8,
  3, 7, 10,
  4, 8, 12),
  nrow = 4, byrow = TRUE)

s <- svd(A)
U <- s$u
D <- diag(s$d)
V <- s$v

U
```

```
##            [,1]       [,2]       [,3]
## [1,] -0.3340803 -0.7670661  0.5425798
## [2,] -0.4359333 -0.3316054 -0.6676264
## [3,] -0.5377863  0.1038552 -0.2924864
## [4,] -0.6396393  0.5393158  0.4175331
```

```r
zapsmall(D)
```

```
##           [,1]     [,2] [,3]
## [1,] 23.37183 0.000000    0
## [2,]  0.00000 1.325693    0
## [3,]  0.00000 0.000000    0
```

```r
V
```

```
##             [,1]       [,2]       [,3]
## [1,] -0.2301002  0.7834032  0.5773503
## [2,] -0.5633970 -0.5909742  0.5773503
## [3,] -0.7934972  0.1924290 -0.5773503
```

```r
U %*% D %*% t(V)
```

```
##      [,1] [,2] [,3]
## [1,]    1    5    6
## [2,]    2    6    8
## [3,]    3    7   10
## [4,]    4    8   12
```

d.

e.

f.