Cyber Research

```
library(tidyverse)
```

```
## Warning: package 'tidyverse' was built under R version 4.0.5
```

```
## -- Attaching packages --------------------------------------- tidyverse 1.3.1 --
```

```
## v ggplot2 3.3.3     v purrr   0.3.4
## v tibble  3.1.1     v dplyr   1.0.5
## v tidyr   1.1.3     v stringr 1.4.0
## v readr   1.4.0     v forcats 0.5.1
```

```
## Warning: package 'tibble' was built under R version 4.0.5
```

```
## Warning: package 'tidyr' was built under R version 4.0.5
```

```
## Warning: package 'readr' was built under R version 4.0.5
```

```
## Warning: package 'purrr' was built under R version 4.0.5
```

```
## Warning: package 'dplyr' was built under R version 4.0.5
```

```
## Warning: package 'forcats' was built under R version 4.0.5
```

```
## -- Conflicts ------------------------------------------ tidyverse_conflicts() --
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()    masks stats::lag()
```

```
library(dplyr)
library(ggplot2)
library(fastDummies)
```

```
## Warning: package 'fastDummies' was built under R version 4.0.5
```

```
#install.packages("patchwork")
library(patchwork)
```

```
## Warning: package 'patchwork' was built under R version 4.0.5
```

```
df.edu.safety = read.csv("https://raw.githubusercontent.com/tahlla-utd/cybersecresearch/main/CyberResea
                         header = TRUE, sep = ';')
```

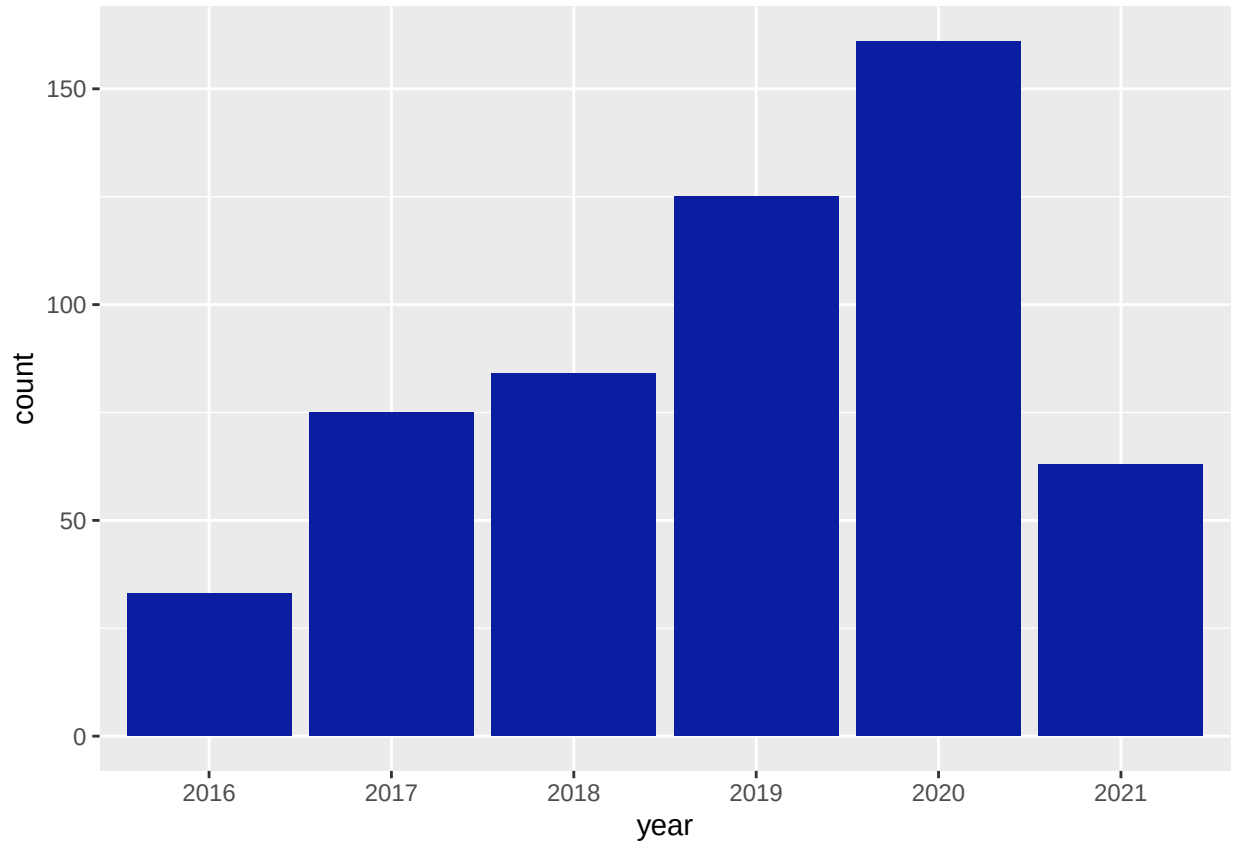
```
#identifying the rows with NAs
rownames(df.edu.safety)[apply(df.edu.safety, 2, anyNA)]
```

```
##   [1] "18"  "19"  "20"  "21"  "22"  "46"  "47"  "48"  "49"  "50"  "74"  "75"
##  [13] "76"  "77"  "78"  "102" "103" "104" "105" "106" "130" "131" "132" "133"
##  [25] "134" "158" "159" "160" "161" "162" "186" "187" "188" "189" "190" "214"
##  [37] "215" "216" "217" "218" "242" "243" "244" "245" "246" "270" "271" "272"
##  [49] "273" "274" "298" "299" "300" "301" "302" "326" "327" "328" "329" "330"
##  [61] "354" "355" "356" "357" "358" "382" "383" "384" "385" "386" "410" "411"
##  [73] "412" "413" "414" "438" "439" "440" "441" "442" "466" "467" "468" "469"
##  [85] "470" "494" "495" "496" "497" "498" "522" "523" "524" "525" "526" "550"
##  [97] "551" "552" "553" "554" "578" "579" "580" "581" "582"
```

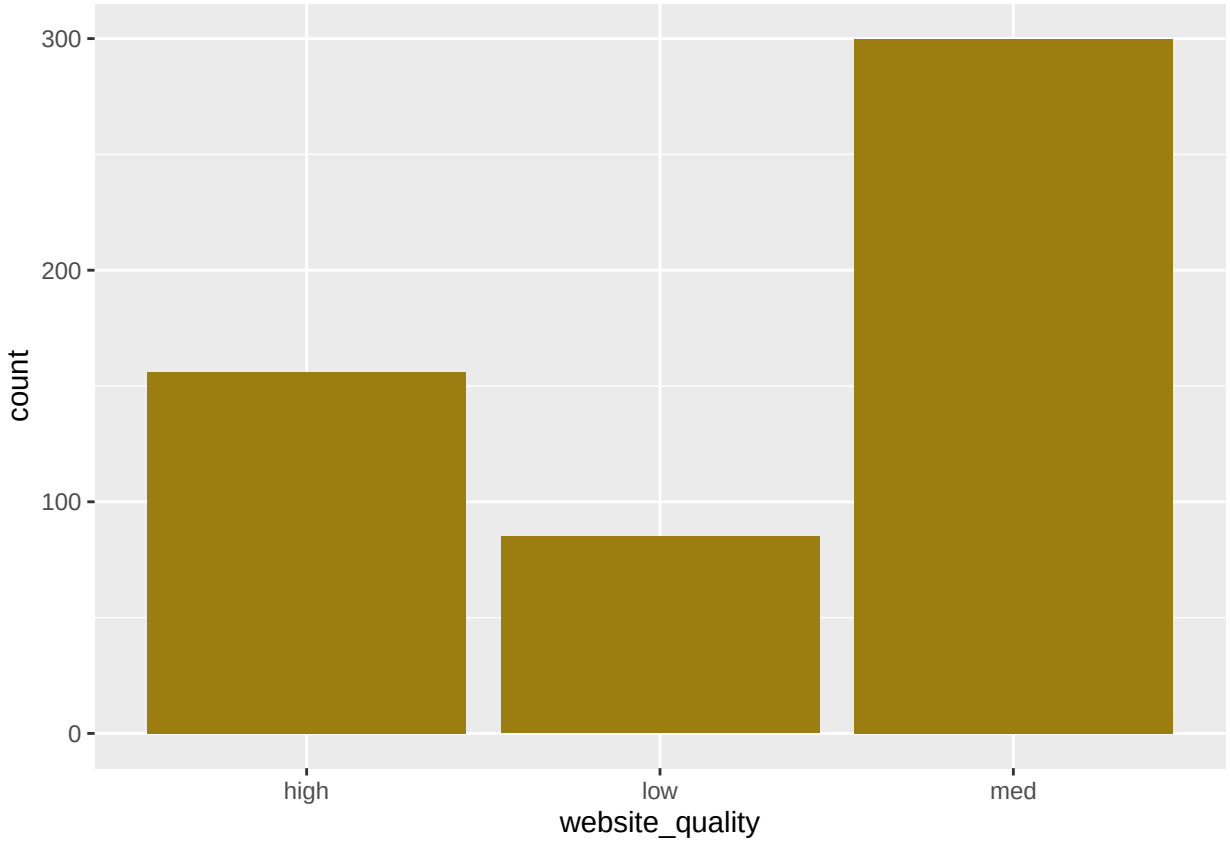
```
#removing all observations with NAs
df.clean <- df.edu.safety %>% na.omit()

df.clean <- df.clean
df.clean$year = as.factor(df.clean$year)
```

Linear Regression of Various variables

```
test.plot <- ggplot(data = df.clean, aes(x = year))+geom_bar(fill = "#0b1da1")

test.plot
```



```
test.plot <- ggplot(data = df.clean, aes(x = website_quality))+geom_bar(fill = "#9c7d10")

test.plot
```

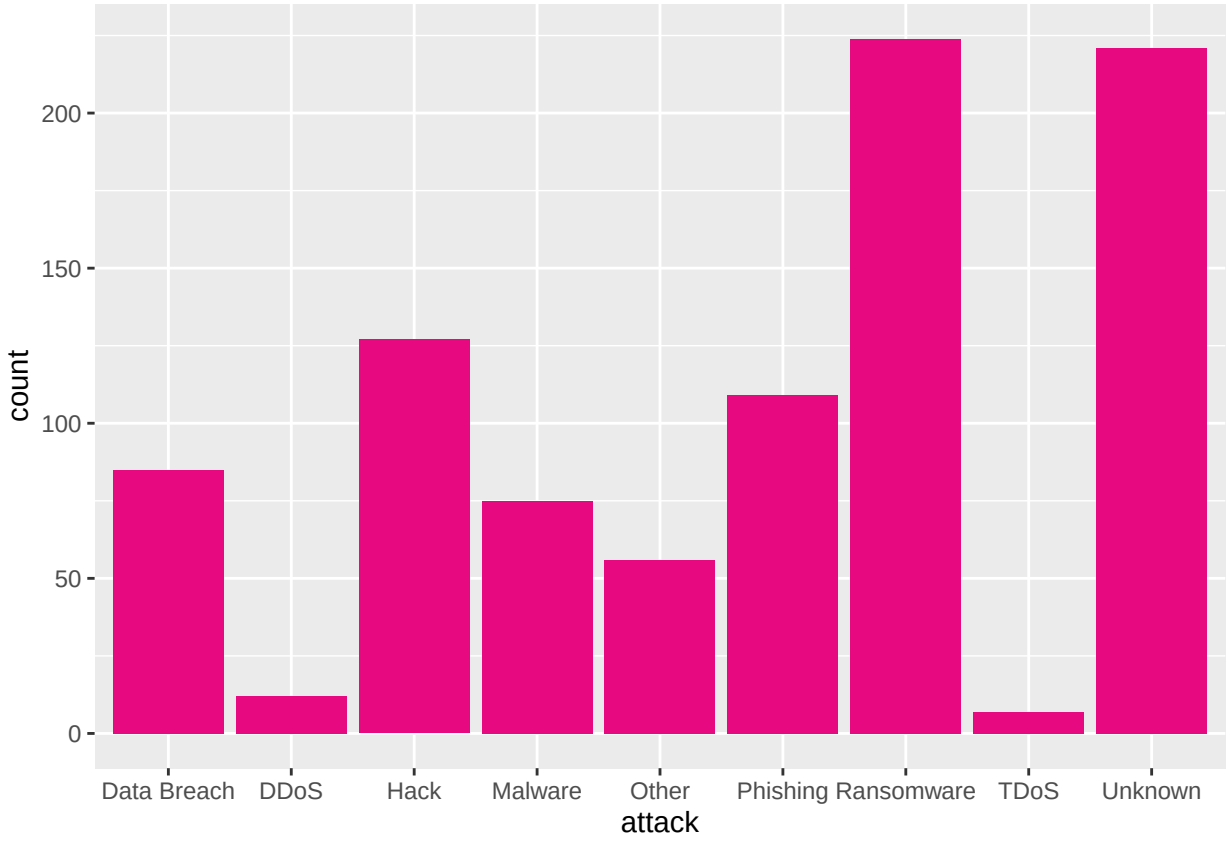



```
#create data frame of attack type counts

df.attack.count <- data.frame(matrix(ncol = 9, nrow = 1))
x <- c("Unknown","Hack","Data Breach","Ransomware","Phishing","TDoS","Malware","DDoS","Other")
colnames(df.attack.count)<- x
```

```
df.attack.count[1, "Unknown"] <- sum(df.clean$Unknown)
df.attack.count[1, "Hack"] <- sum(df.clean$Hack)
df.attack.count[1, "Data Breach"] <- sum(df.clean$Data_Breach)
df.attack.count[1, "Ransomware"] <- sum(df.clean$Ransomware)
df.attack.count[1, "Phishing"] <- sum(df.clean$Phishing)
df.attack.count[1, "TDoS"] <- sum(df.clean$TDoS)
df.attack.count[1, "Malware"] <- sum(df.clean$Malware)
df.attack.count[1, "DDoS"] <- sum(df.clean$DDoS)
df.attack.count[1, "Other"] <- sum(df.clean$Other)


head(df.attack.count)
```

```
##   Unknown Hack Data Breach Ransomware Phishing TDoS Malware DDoS Other
## 1     221  127          85        224      109    7      75   12    56
```

```r
df.long <- df.attack.count %>%
  pivot_longer(Unknown:Other, names_to = "attack", values_to = "count")
ggplot(df.long, aes(x = attack, y = count)) +
geom_col(fill = "#e6097f")
```




```r
graph.attack.by.filter <- function(fill.choice){
  df.unk <- df.clean %>% as_tibble() %>%
  mutate(Unknown = as.factor(if_else(Unknown == 1, "True", "False")))

unk.graph <- ggplot(data = df.unk, aes(Unknown == "True", fill = fill.choice))+geom_bar(position = "dod
################################################################
df.hack <- df.clean %>% as_tibble() %>%
  mutate(Hack = as.factor(if_else(Hack == 1, "True", "False")))

hack.graph <- ggplot(data = df.hack, aes(Hack == "True", fill = fill.choice))+geom_bar(position = "dodg
################################################################
df.data <- df.clean %>% as_tibble() %>%
  mutate(Data_Breach = as.factor(if_else(Data_Breach == 1, "True", "False")))

data.graph <- ggplot(data = df.data, aes(Data_Breach == "True", fill = fill.choice))+geom_bar(position
################################################################
df.ran <- df.clean %>% as_tibble() %>%
  mutate(Ransomware = as.factor(if_else(Ransomware == 1, "True", "False")))

ran.graph <- ggplot(data = df.ran, aes(Ransomware == "True", fill = fill.choice))+geom_bar(position = "
```

```
#####################################################################
df.phish <- df.clean %>% as_tibble() %>%
  mutate(Phishing = as.factor(if_else(Phishing == 1, "True", "False")))

phish.graph <- ggplot(data = df.phish, aes(Phishing == "True", fill = fill.choice))+geom_bar(position =
#####################################################################
df.tdos <- df.clean %>% as_tibble() %>%
  mutate(TDoS = as.factor(if_else(TDoS == 1, "True", "False")))

tdos.graph <- ggplot(data = df.tdos, aes(TDoS == "True", fill = fill.choice))+geom_bar(position = "dodg
#####################################################################
df.mal <- df.clean %>% as_tibble() %>%
  mutate(Malware = as.factor(if_else(Malware == 1, "True", "False")))

mal.graph <- ggplot(data = df.mal, aes(Malware == "True", fill = fill.choice))+geom_bar(position = "dod
#####################################################################
df.ddos <- df.clean %>% as_tibble() %>%
  mutate(DDoS = as.factor(if_else(DDoS == 1, "True", "False")))

ddos.graph <- ggplot(data = df.ddos, aes(DDoS == "True", fill = fill.choice))+geom_bar(position = "dodg
#####################################################################
df.other <- df.clean %>% as_tibble() %>%
  mutate(Other = as.factor(if_else(Other == 1, "True", "False")))

other.graph <- ggplot(data = df.other, aes(Other == "True", fill = fill.choice))+geom_bar(position = "d
#####################################################################
df.serv <- df.clean %>% as_tibble() %>%
  mutate(Server_Shutdown = as.factor(if_else(Server_Shutdown == 1, "True", "False")))

serv.graph <- ggplot(data = df.serv, aes(Server_Shutdown == "True", fill = fill.choice))+geom_bar(posit
#####################################################################


(data.graph + scale_x_discrete(limit = c(TRUE)) | ddos.graph + scale_x_discrete(limit = c(TRUE)) |
  hack.graph + scale_x_discrete(limit = c(TRUE)))/ (mal.graph + scale_x_discrete(limit = c(TRUE))|
  other.graph + scale_x_discrete(limit = c(TRUE)) | phish.graph + scale_x_discrete(limit = c(TRUE)))/
  (ran.graph + scale_x_discrete(limit = c(TRUE)) | tdos.graph + scale_x_discrete(limit = c(TRUE)) | unk
  scale_x_discrete(limit = c(TRUE)))

}
```

```
graph.attack.by.filter(df.clean$year)
```

```
## Warning: Removed 456 rows containing non-finite values (stat_count).

## Warning: Removed 529 rows containing non-finite values (stat_count).

## Warning: Removed 414 rows containing non-finite values (stat_count).

## Warning: Removed 466 rows containing non-finite values (stat_count).

## Warning: Removed 485 rows containing non-finite values (stat_count).
```

```
## Warning: Removed 432 rows containing non-finite values (stat_count).

## Warning: Removed 317 rows containing non-finite values (stat_count).

## Warning: Removed 534 rows containing non-finite values (stat_count).

## Warning: Removed 320 rows containing non-finite values (stat_count).
```


```
graph.attack.by.filter(df.clean$type)
```

```
## Warning: Removed 456 rows containing non-finite values (stat_count).

## Warning: Removed 529 rows containing non-finite values (stat_count).

## Warning: Removed 414 rows containing non-finite values (stat_count).

## Warning: Removed 466 rows containing non-finite values (stat_count).

## Warning: Removed 485 rows containing non-finite values (stat_count).

## Warning: Removed 432 rows containing non-finite values (stat_count).

## Warning: Removed 317 rows containing non-finite values (stat_count).
```

```
## Warning: Removed 534 rows containing non-finite values (stat_count).
```

```
## Warning: Removed 320 rows containing non-finite values (stat_count).
```


```
graph.attack.by.filter((df.clean$website_quality))
```

```
## Warning: Removed 456 rows containing non-finite values (stat_count).
```

```
## Warning: Removed 529 rows containing non-finite values (stat_count).
```

```
## Warning: Removed 414 rows containing non-finite values (stat_count).
```

```
## Warning: Removed 466 rows containing non-finite values (stat_count).
```

```
## Warning: Removed 485 rows containing non-finite values (stat_count).
```

```
## Warning: Removed 432 rows containing non-finite values (stat_count).
```

```
## Warning: Removed 317 rows containing non-finite values (stat_count).
```

```
## Warning: Removed 534 rows containing non-finite values (stat_count).
```

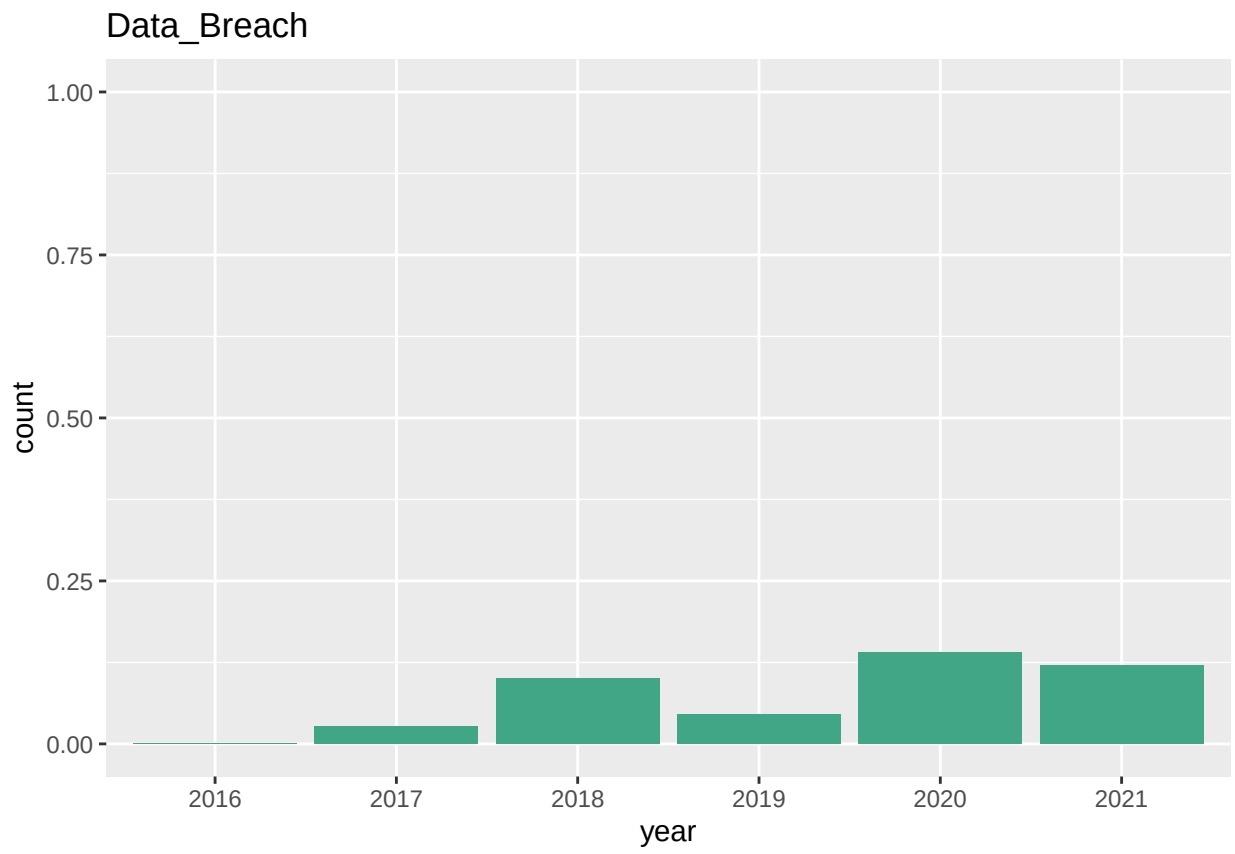
```
## Warning: Removed 320 rows containing non-finite values (stat_count).
```


```
totalattacks <- function(year){
  totalsum = 0;
  totalsum = totalsum + sum((df.clean[which(df.clean$year == year), "Unknown"]));
  totalsum = totalsum + sum((df.clean[which(df.clean$year == year), "Data_Breach"]));
  totalsum = totalsum + sum((df.clean[which(df.clean$year == year), "Malware"]));
  totalsum = totalsum + sum((df.clean[which(df.clean$year == year), "TDoS"]));
  totalsum = totalsum + sum((df.clean[which(df.clean$year == year), "DDoS"]));
  totalsum = totalsum + sum((df.clean[which(df.clean$year == year), "Ransomware"]));
  totalsum = totalsum + sum((df.clean[which(df.clean$year == year), "Phishing"]));
  totalsum = totalsum + sum((df.clean[which(df.clean$year == year), "Other"]));
  totalsum = totalsum + sum((df.clean[which(df.clean$year == year), "Hack"]));

  return(totalsum)
}
```

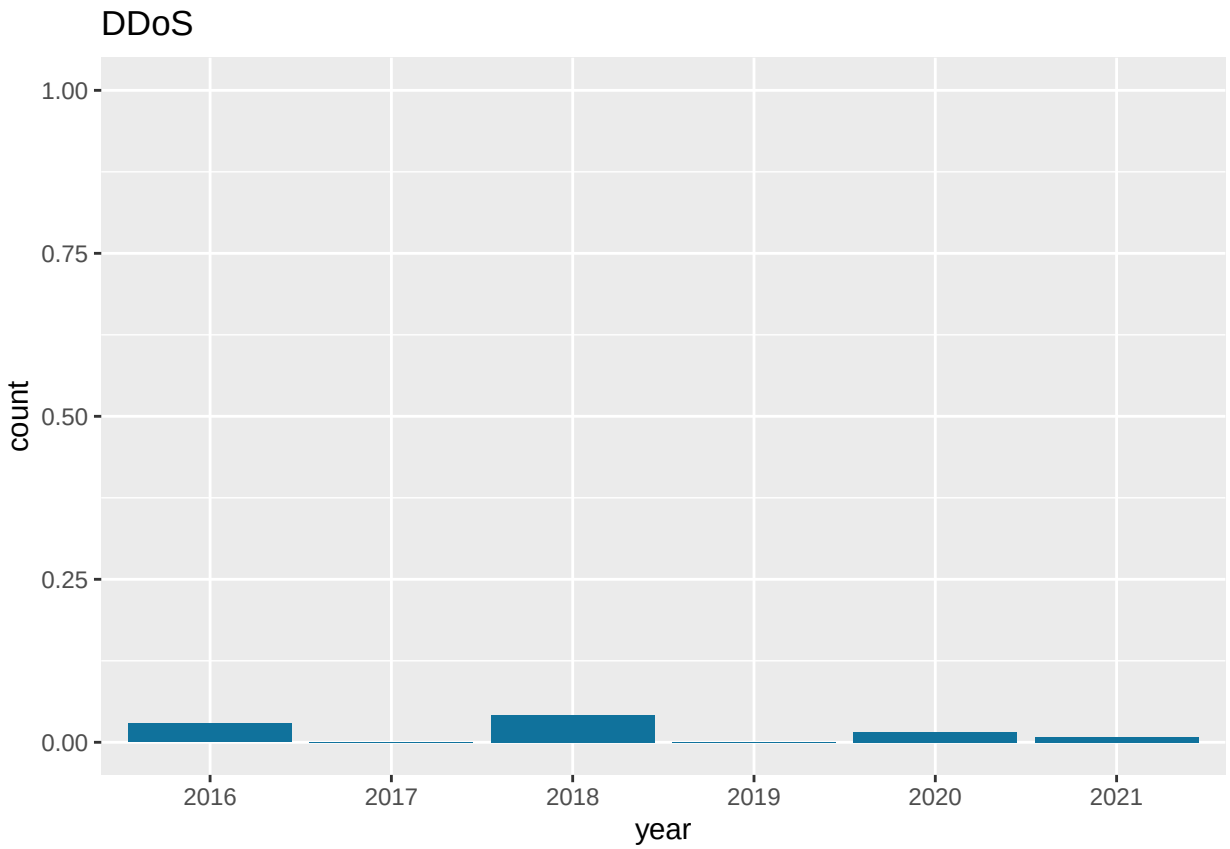
```
year.trend <-function(attack.type, color.choice){

  year.list <- c("2016", "2017", "2018", "2019", "2020", "2021")
  df.tmp <- data.frame(matrix(ncol = 6, nrow = 1))
  colnames(df.tmp) <- year.list


  df.tmp[1, "2016"] <- sum((df.clean[which(df.clean$year == "2016"), attack.type]))/totalattacks("2016")
  df.tmp[1, "2017"] <- sum((df.clean[which(df.clean$year == "2017"), attack.type]))/totalattacks("2017")
  df.tmp[1, "2018"] <- sum((df.clean[which(df.clean$year == "2018"), attack.type]))/totalattacks("2018")
  df.tmp[1, "2019"] <- sum((df.clean[which(df.clean$year == "2019"), attack.type]))/totalattacks("2019")
```

```
  df.tmp[1, "2020"] <- sum((df.clean[which(df.clean$year == "2020"), attack.type]))/totalattacks("2020")
  df.tmp[1, "2021"] <- sum((df.clean[which(df.clean$year == "2021"), attack.type]))/totalattacks("2021")


  df.long <- df.tmp %>%
    pivot_longer(1:6, names_to = "year", values_to = "count")
  ggplot(df.long, aes(x = year, y = count)) +
    geom_col(fill = color.choice) + labs(title =  attack.type) + ylim(0, 1)
}
```

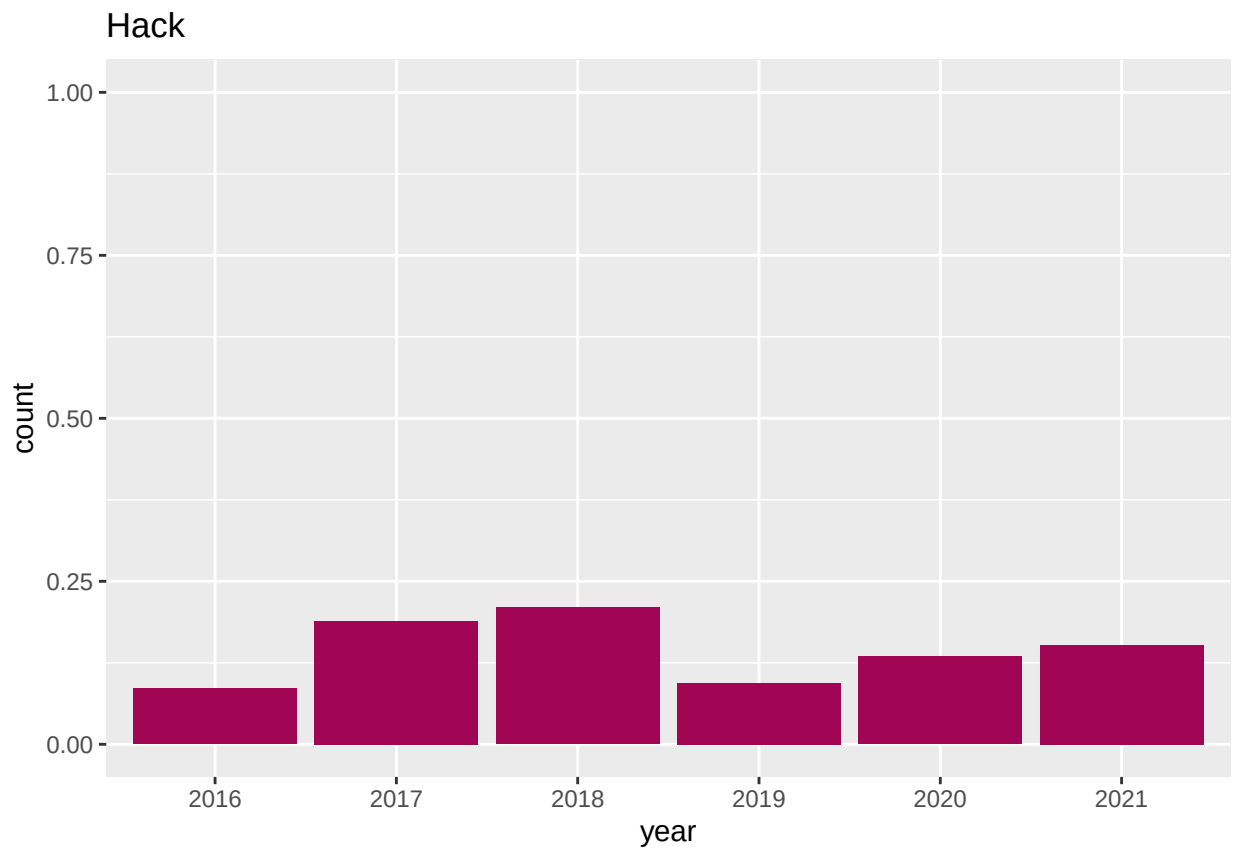
```
year.trend("Data_Breach", "#41a686")
```



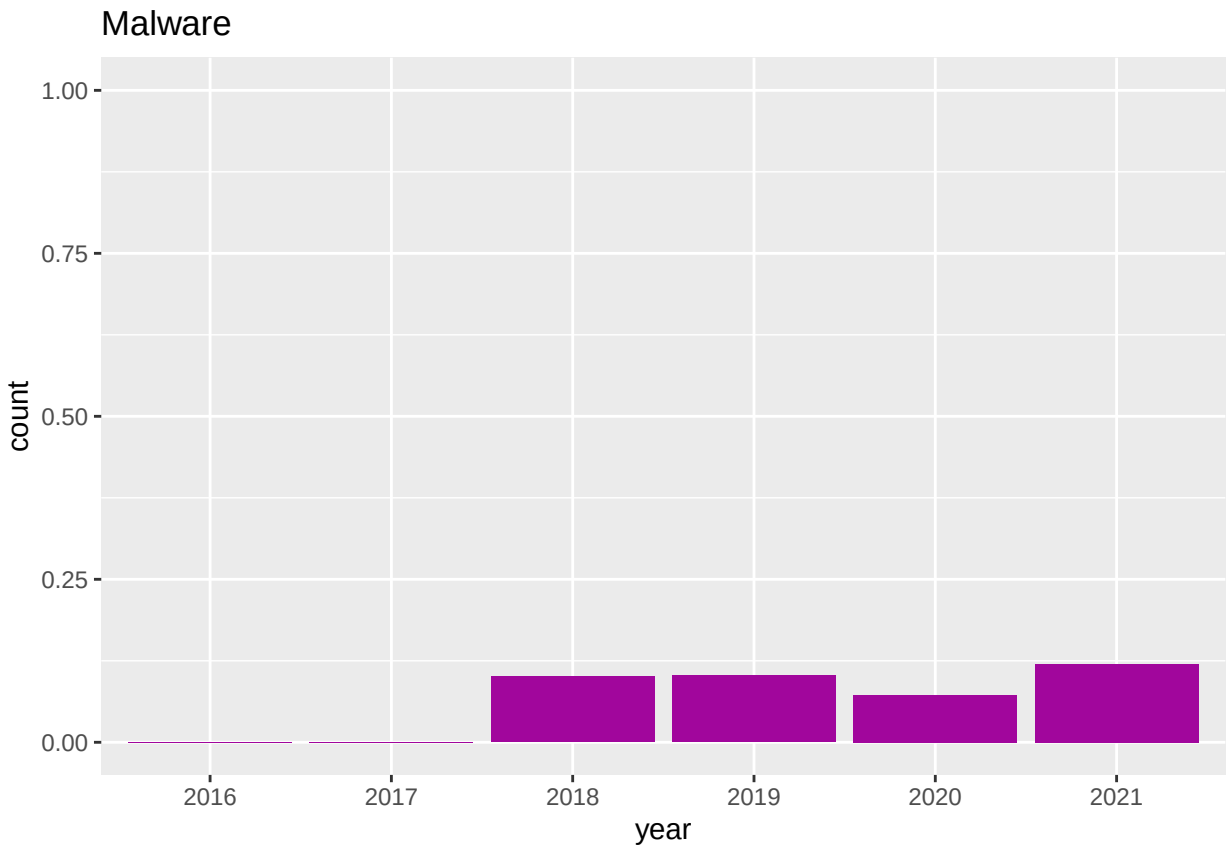

```
year.trend("DDoS", "#10729c")
```



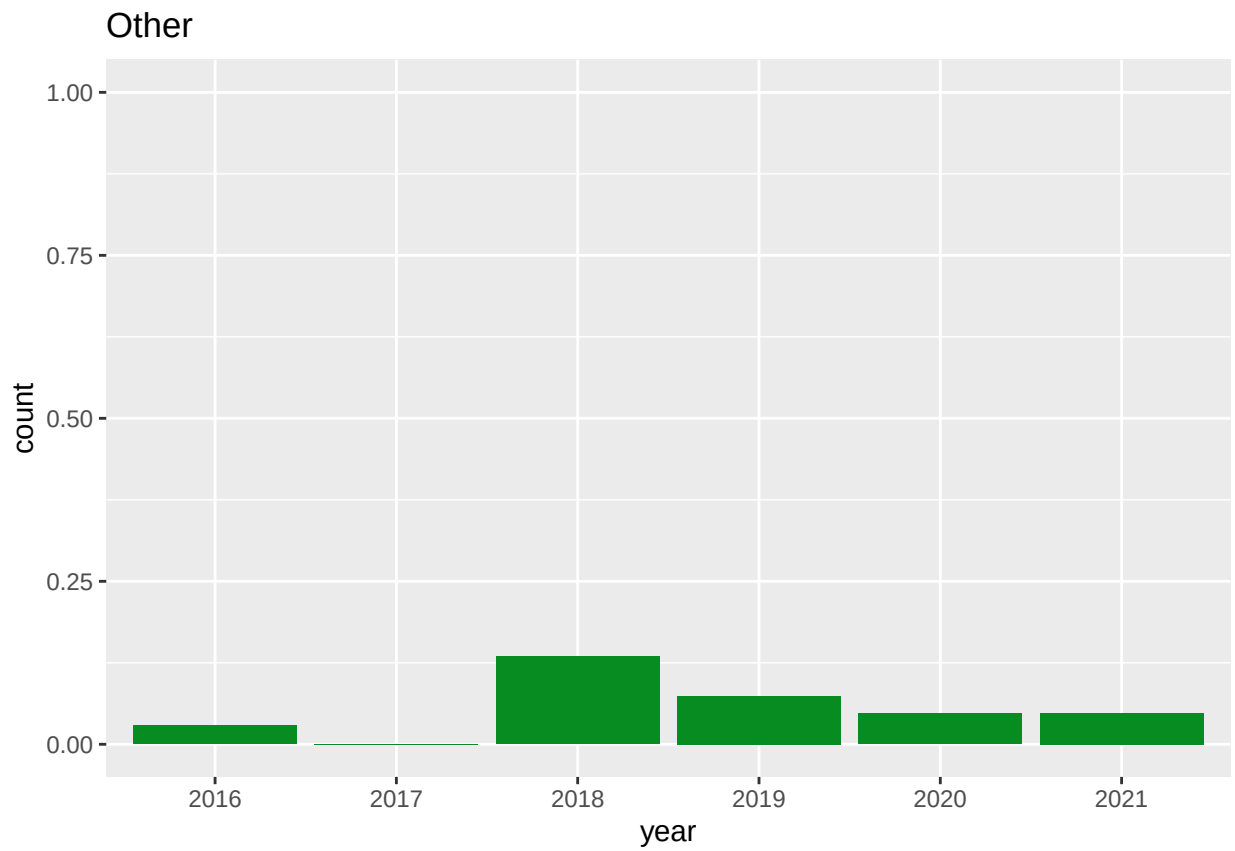

```
year.trend("Hack", "#a10654")
```



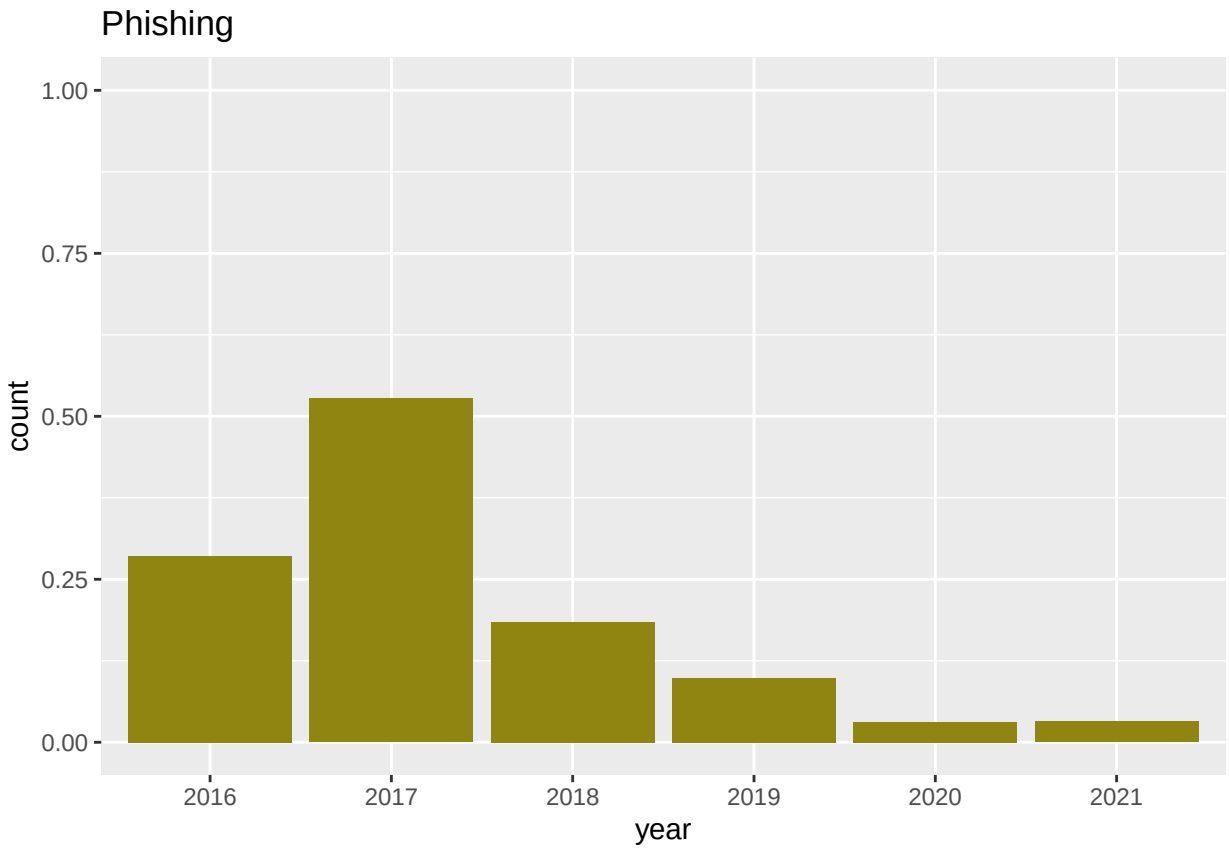

```
year.trend("Malware", "#a1069c")
```



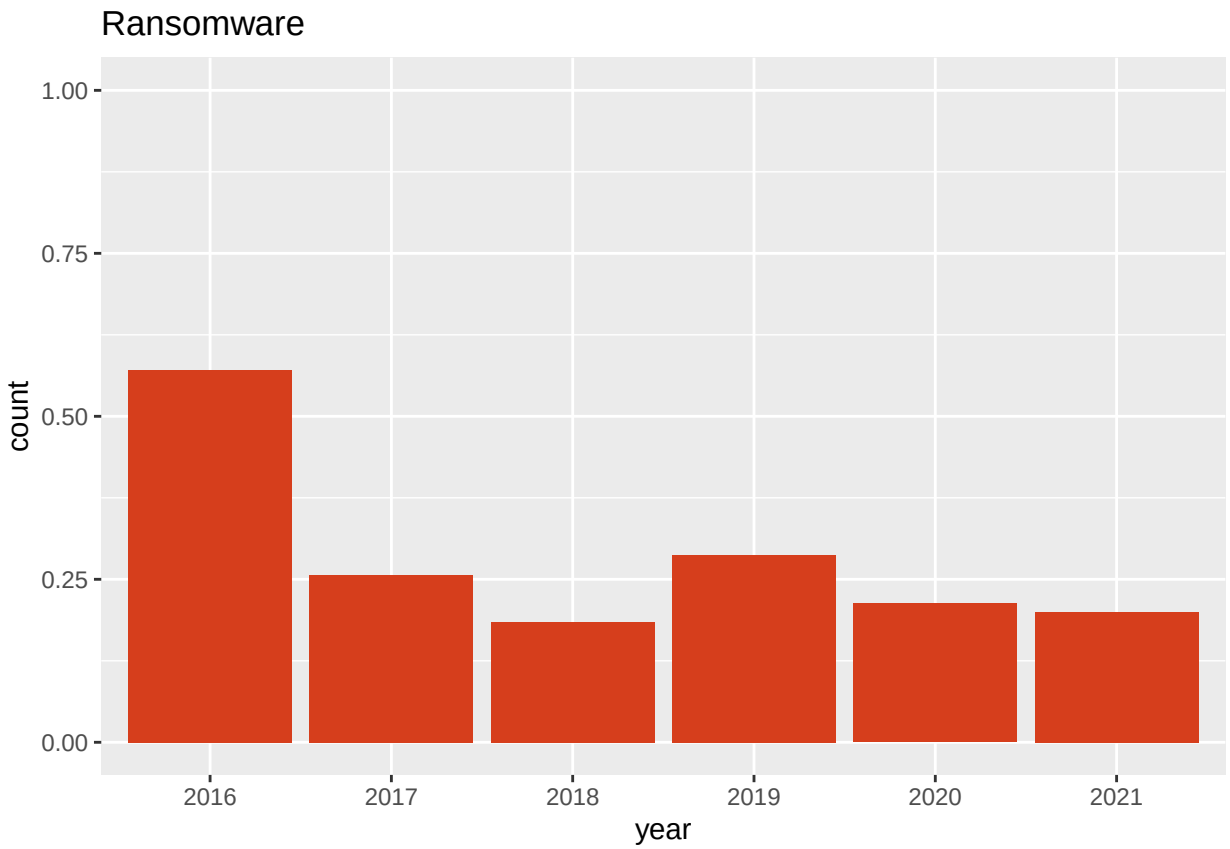

```
year.trend("Other", "#078c22")
```



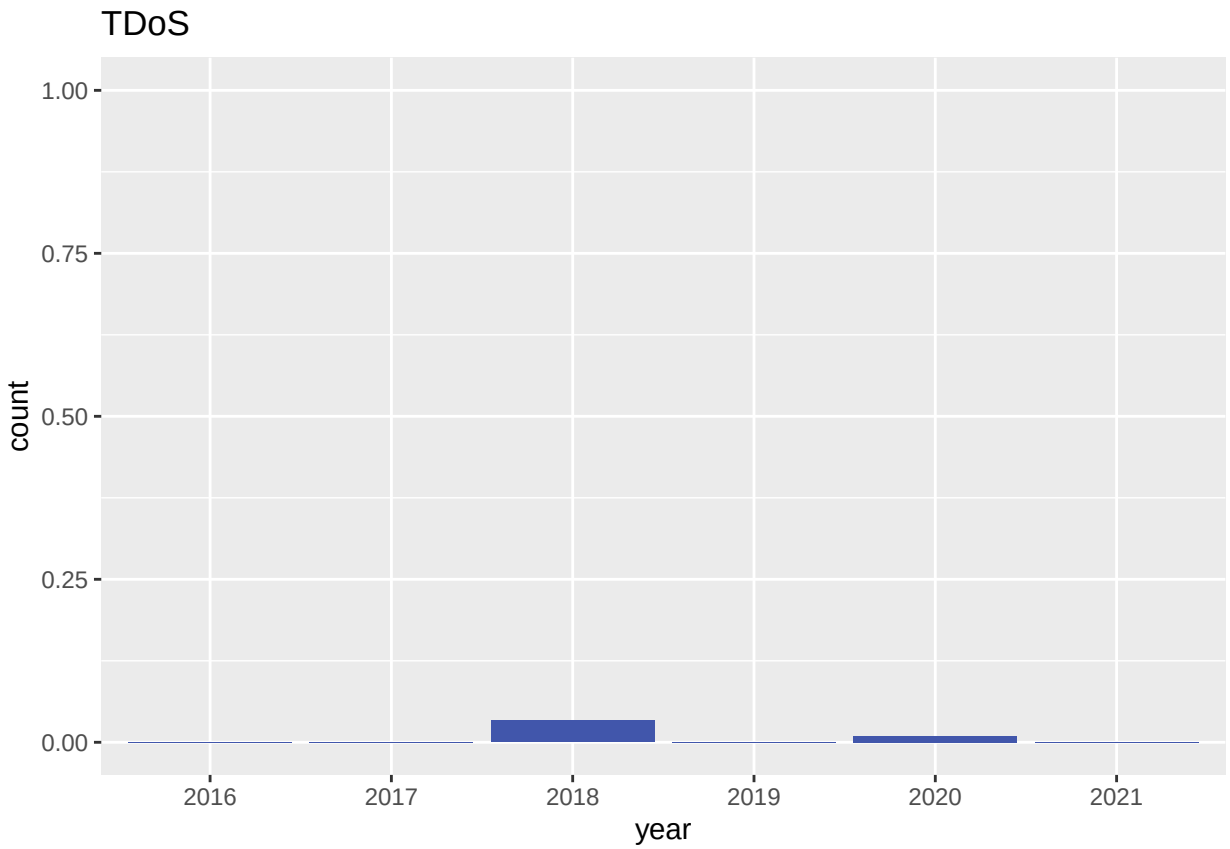

```
year.trend("Phishing", "#918511")
```



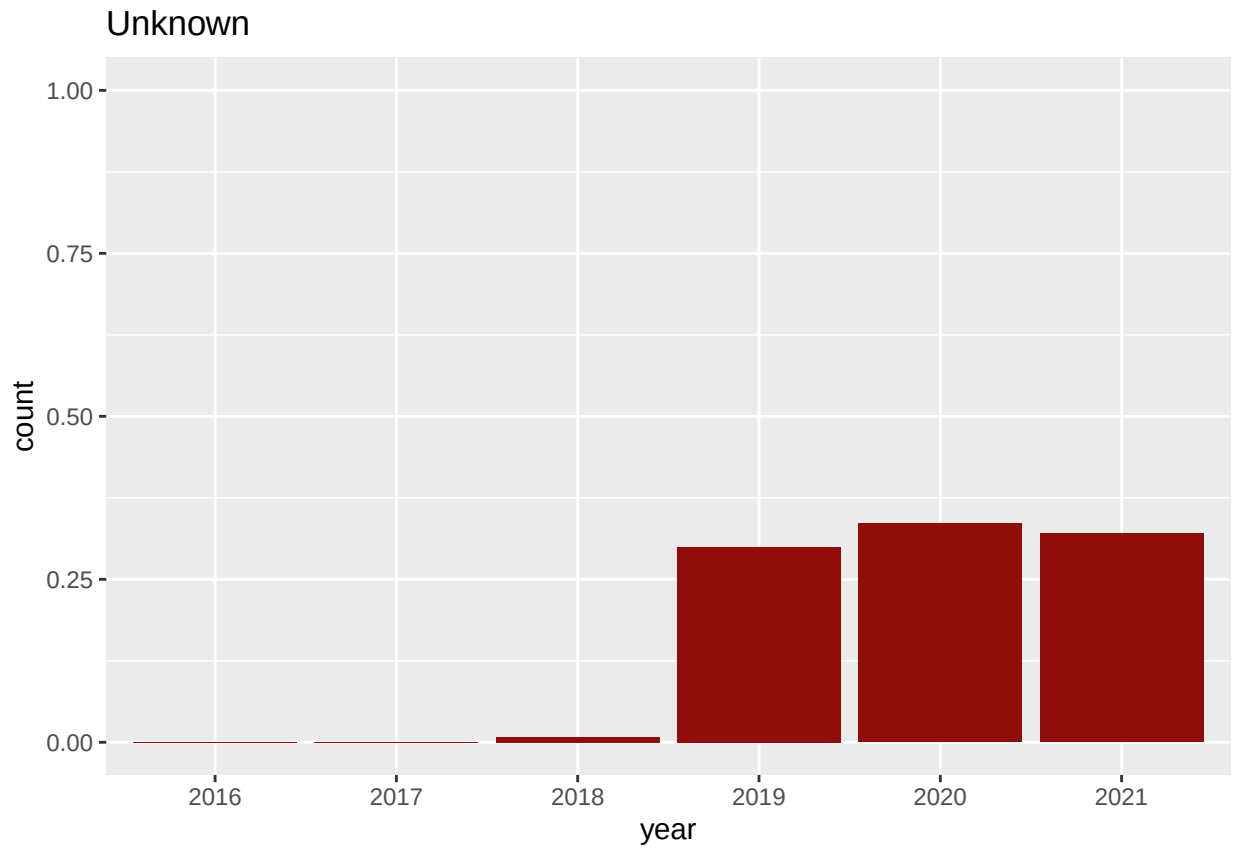

```
year.trend("Ransomware", "#d63e1c")
```




```
year.trend("TDoS", "#4156ab")
```

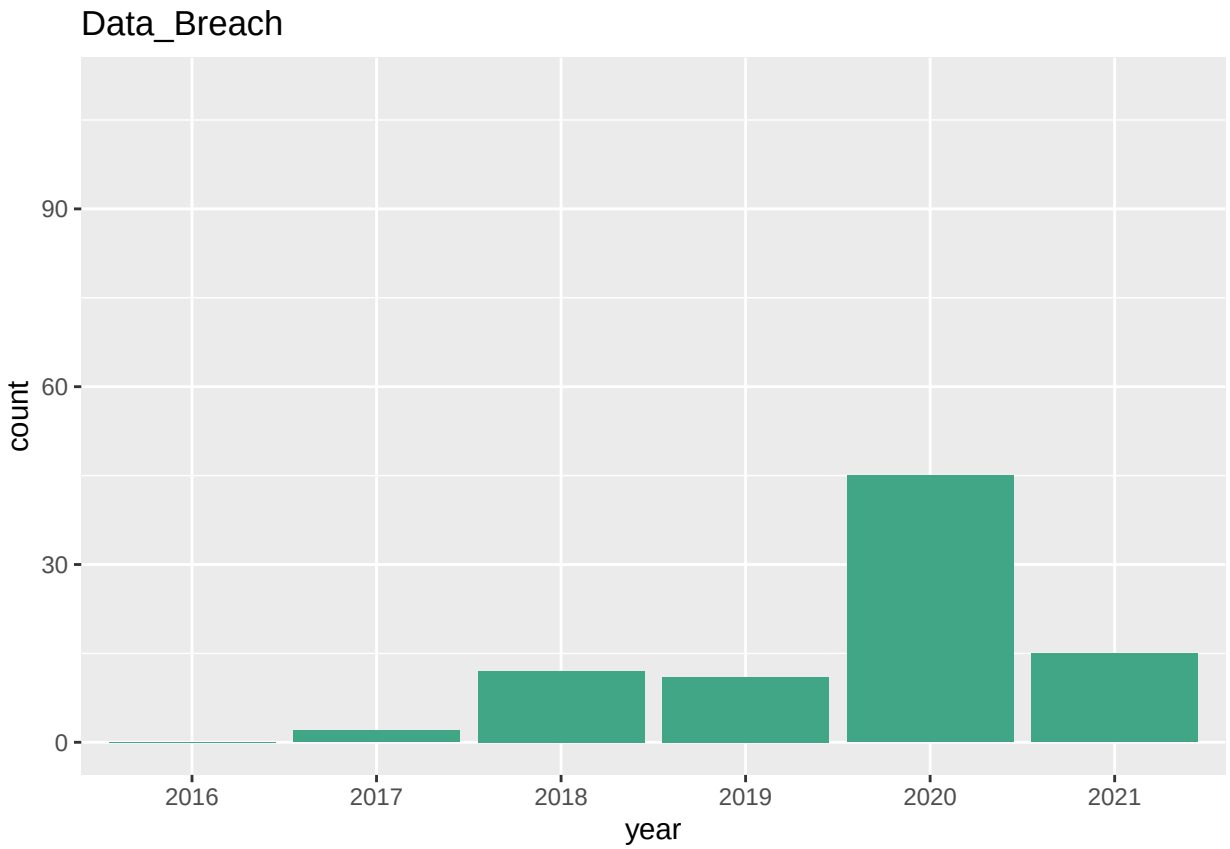



```
year.trend("Unknown", "#910d09")
```

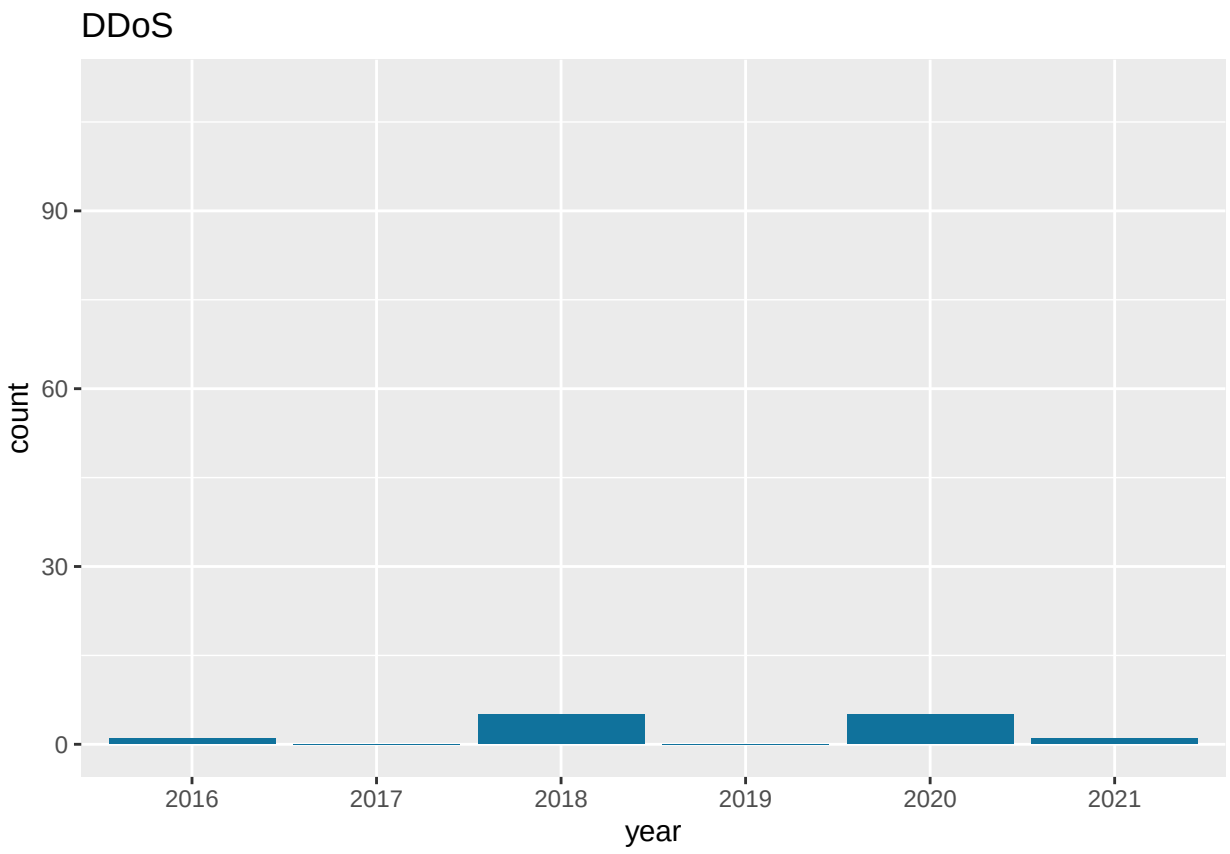



```
year.trend2 <-function(attack.type, color.choice){

  year.list <- c("2016", "2017", "2018", "2019", "2020", "2021")
  df.tmp <- data.frame(matrix(ncol = 6, nrow = 1))
  colnames(df.tmp) <- year.list


  df.tmp[1, "2016"] <- sum((df.clean[which(df.clean$year == "2016"), attack.type]))
  df.tmp[1, "2017"] <- sum((df.clean[which(df.clean$year == "2017"), attack.type]))
  df.tmp[1, "2018"] <- sum((df.clean[which(df.clean$year == "2018"), attack.type]))
  df.tmp[1, "2019"] <- sum((df.clean[which(df.clean$year == "2019"), attack.type]))
  df.tmp[1, "2020"] <- sum((df.clean[which(df.clean$year == "2020"), attack.type]))
  df.tmp[1, "2021"] <- sum((df.clean[which(df.clean$year == "2021"), attack.type]))


  df.long <- df.tmp %>%
    pivot_longer(1:6, names_to = "year", values_to = "count")
  ggplot(df.long, aes(x = year, y = count)) +
    geom_col(fill = color.choice) + labs(title =  attack.type) + ylim(0, 110)
}
```

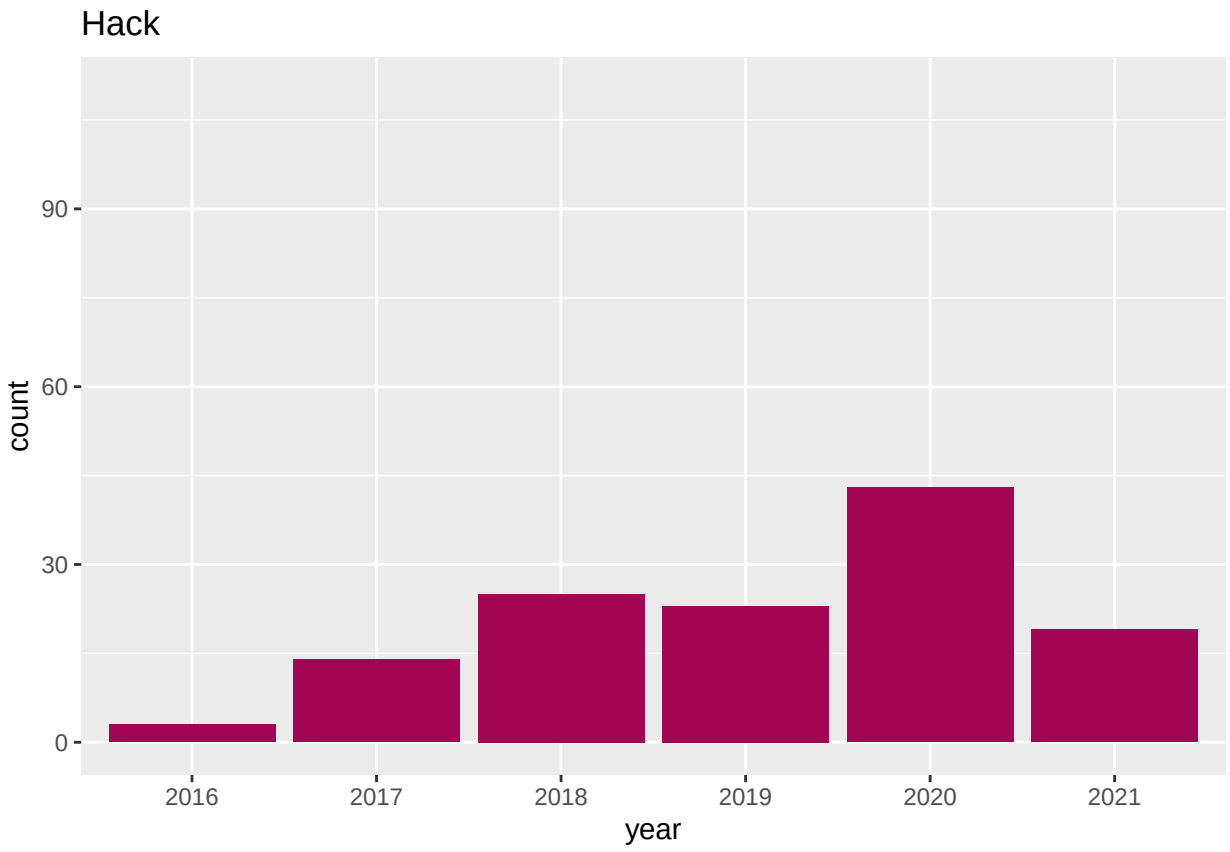
```
year.trend2("Data_Breach", "#41a686")
```



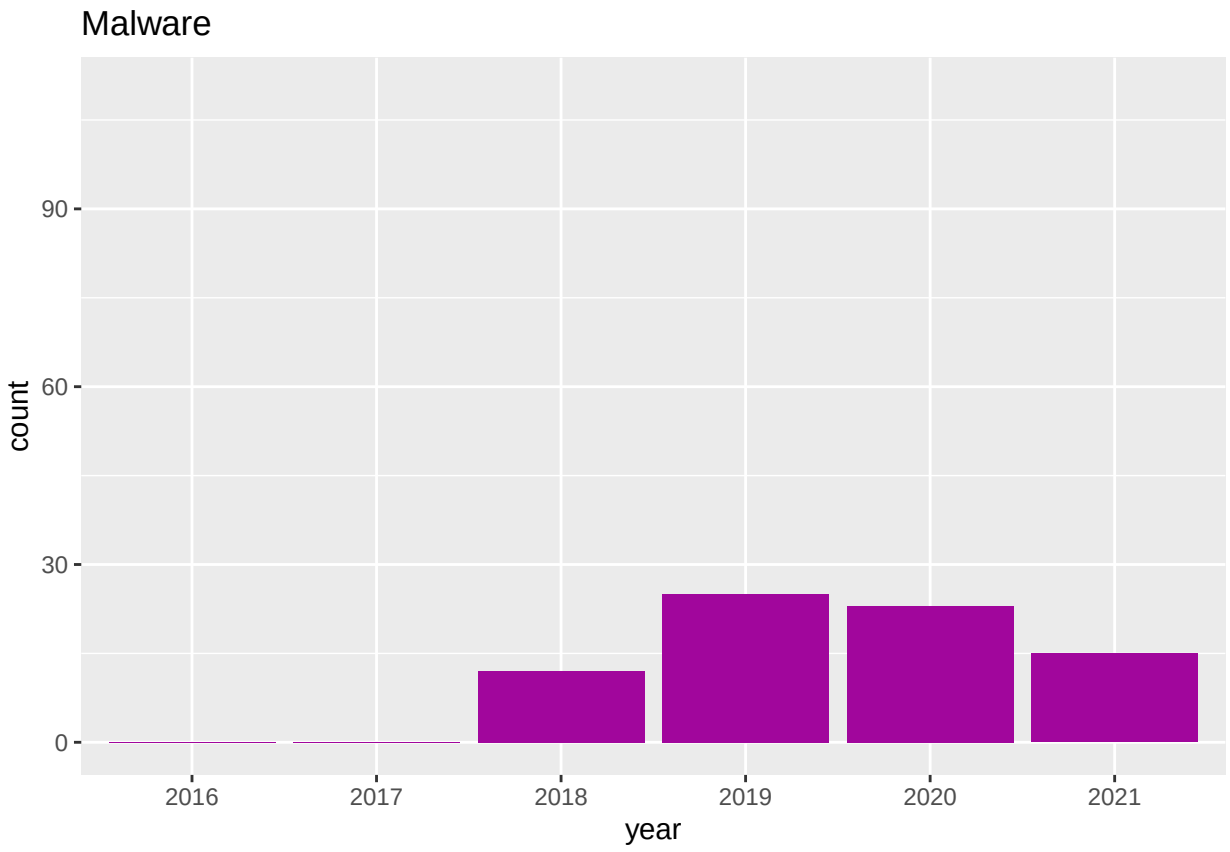

```
year.trend2("DDoS", "#10729c")
```



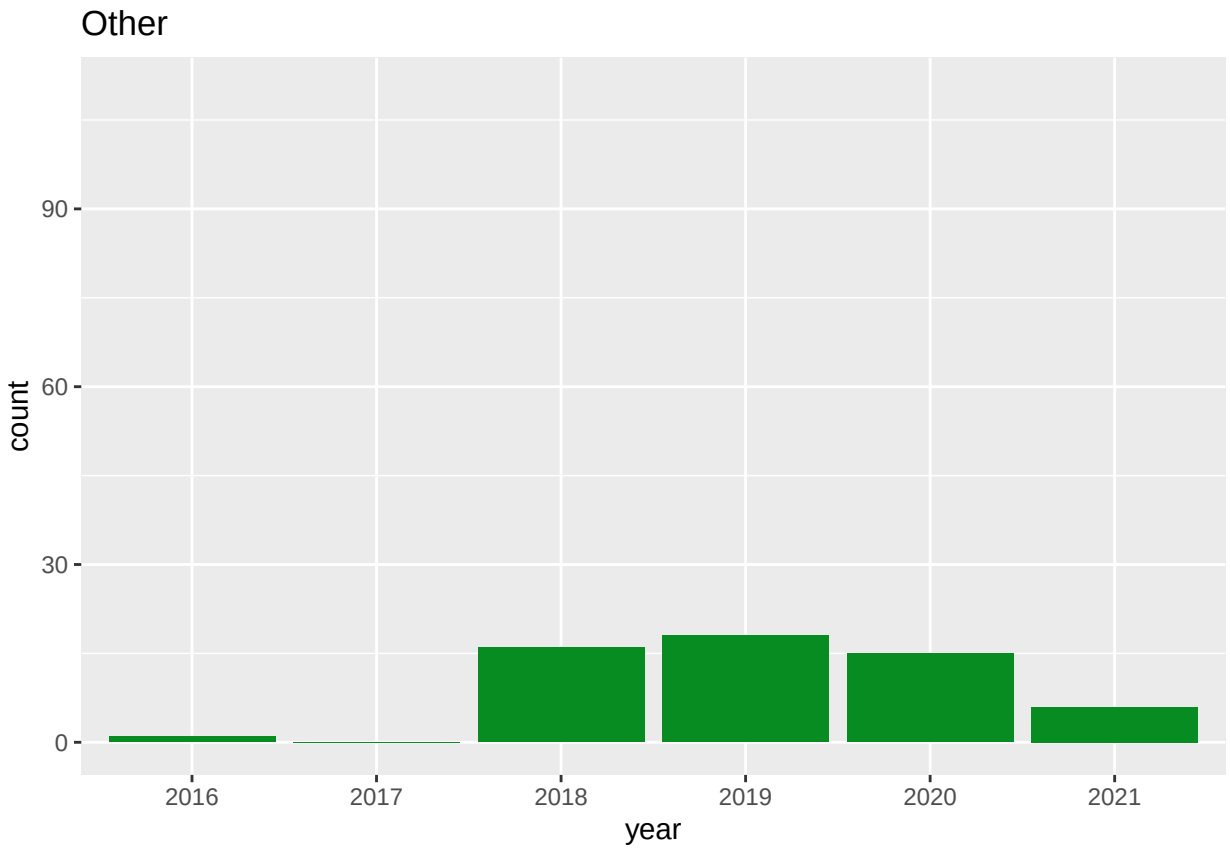

```
year.trend2("Hack", "#a10654")
```



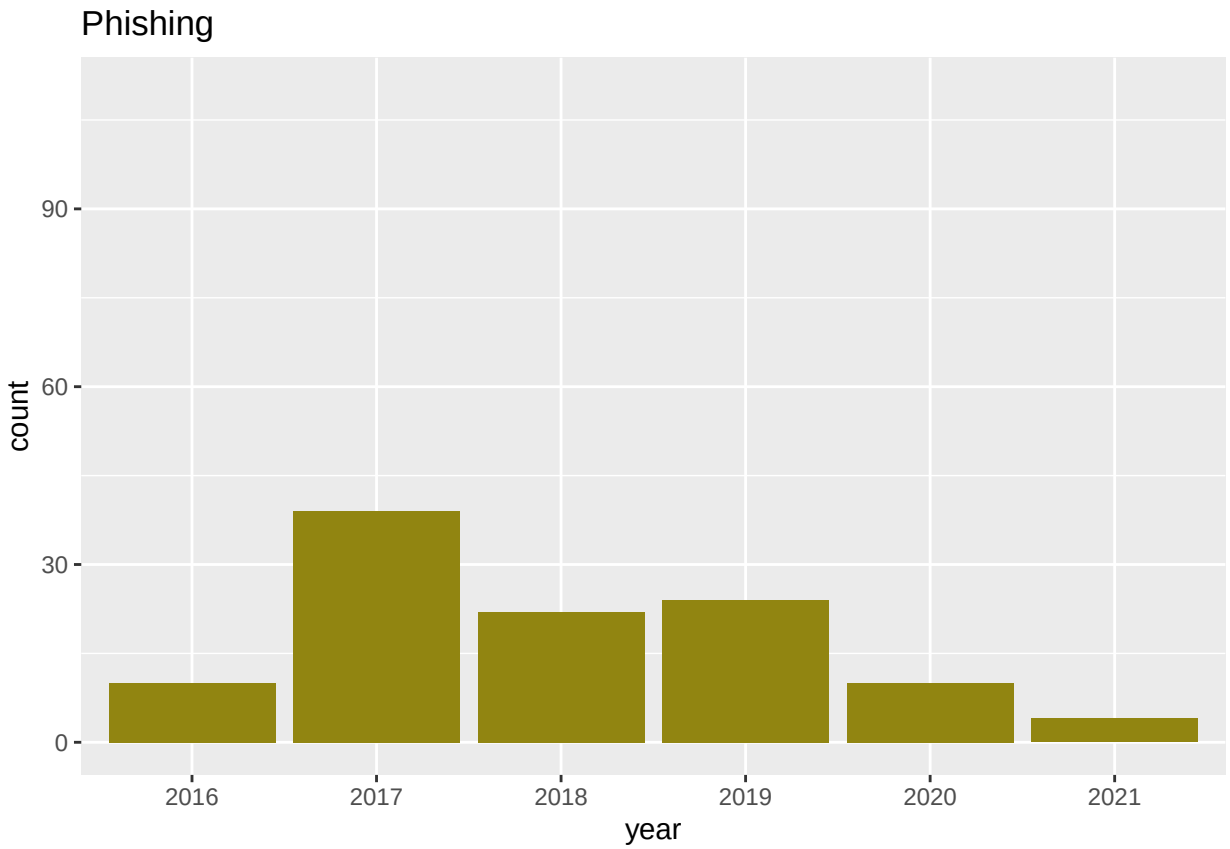

```
year.trend2("Malware", "#a1069c")
```



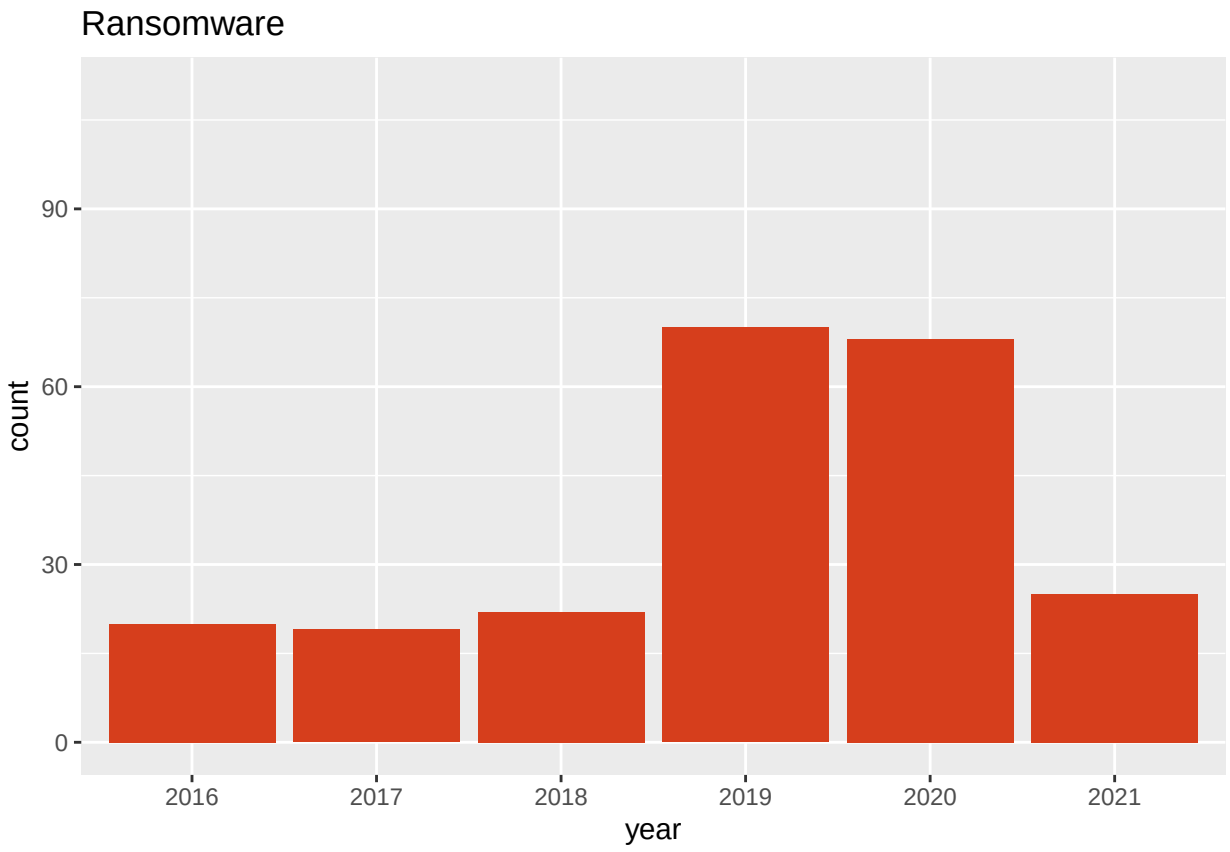

```
year.trend2("Other", "#078c22")
```



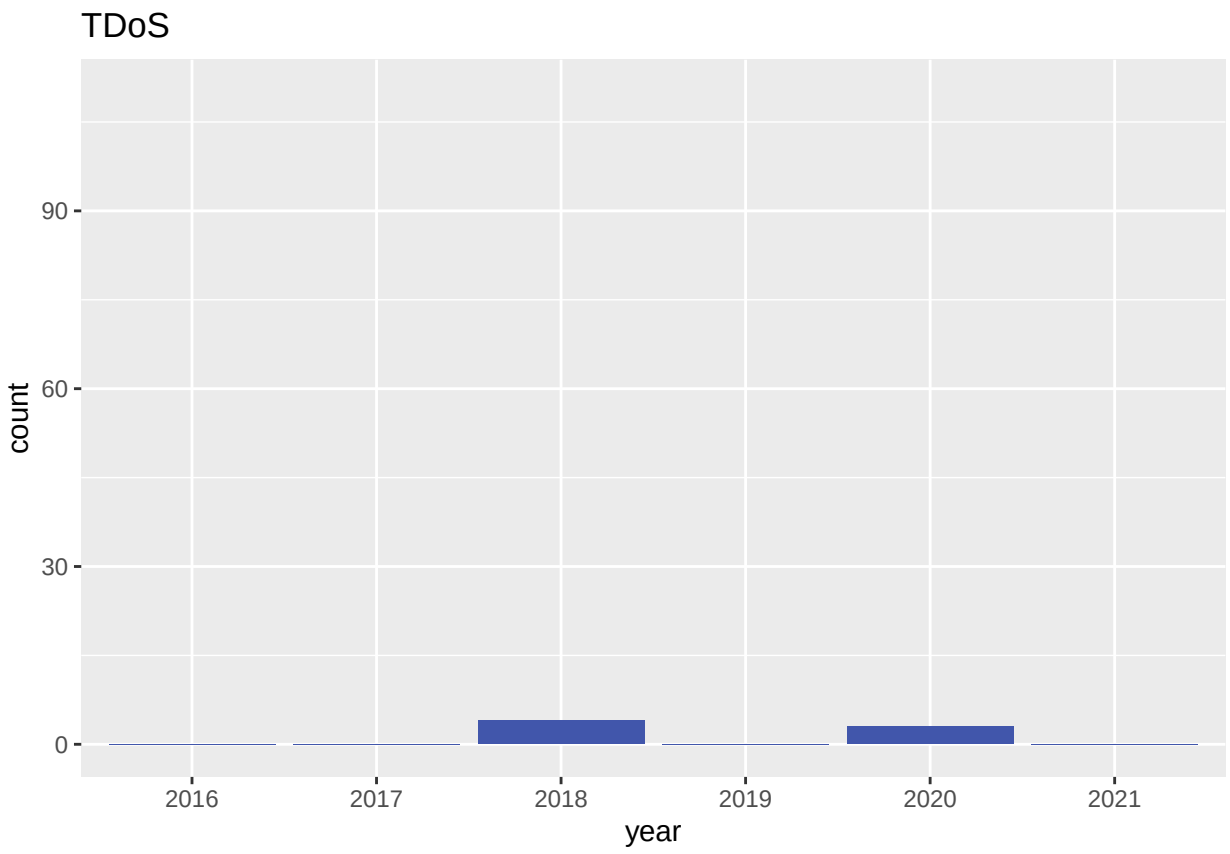

```
year.trend2("Phishing", "#918511")
```



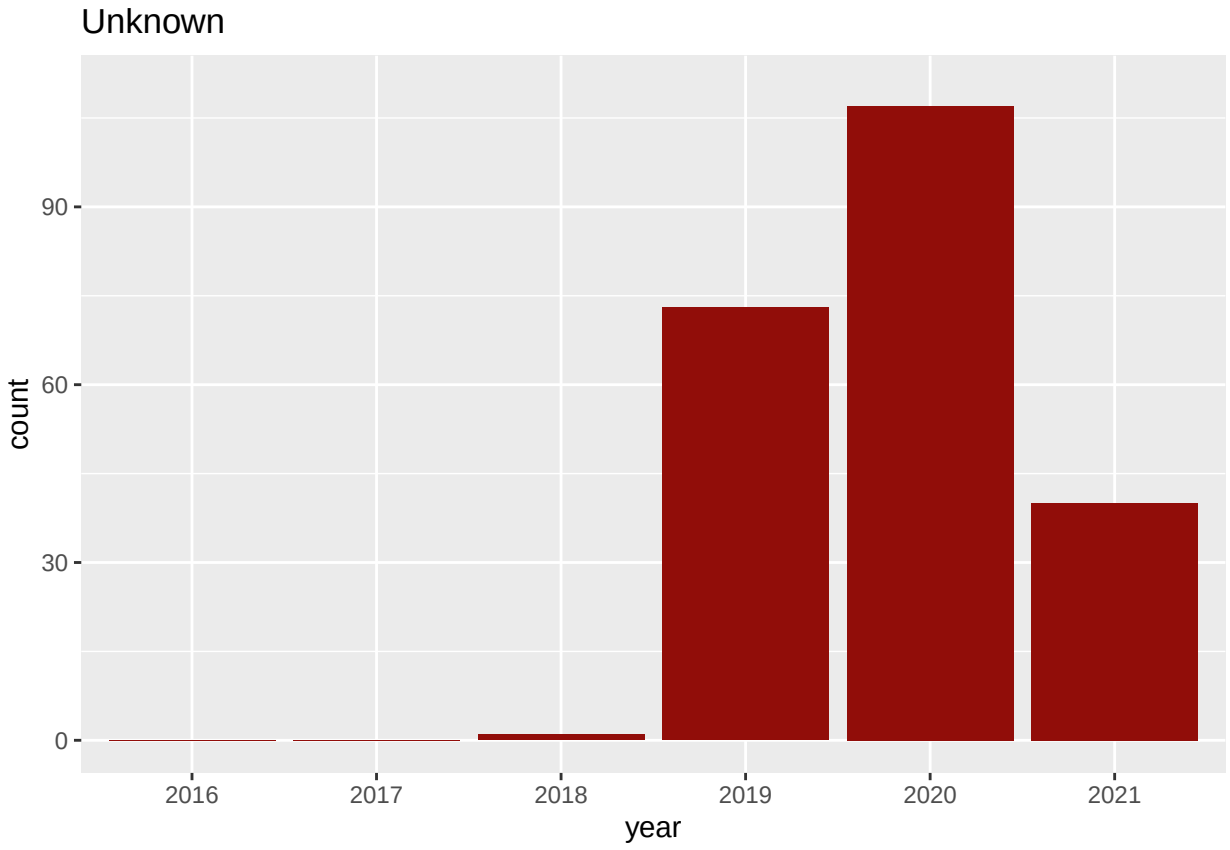

```
year.trend2("Ransomware", "#d63e1c")
```




```
year.trend2("TDoS", "#4156ab")
```




```
year.trend2("Unknown", "#910d09")
```




```
#subset for education and one for safety

df.education <- subset(df.clean, type == "Education")
df.safety <- subset(df.clean, type == "Safety")
```

```
#a work around to not have to change a bunch of small code;

df.temporary <- df.clean
df.clean <- df.education

graph.attack.by.filter <- function(fill.choice){
  df.unk <- df.clean %>% as_tibble() %>%
  mutate(Unknown = as.factor(if_else(Unknown == 1, "True", "False")))

unk.graph <- ggplot(data = df.unk, aes(Unknown == "True", fill = fill.choice))+geom_bar(position = "dod
################################################################
df.hack <- df.clean %>% as_tibble() %>%
  mutate(Hack = as.factor(if_else(Hack == 1, "True", "False")))

hack.graph <- ggplot(data = df.hack, aes(Hack == "True", fill = fill.choice))+geom_bar(position = "dodg
################################################################
df.data <- df.clean %>% as_tibble() %>%
  mutate(Data_Breach = as.factor(if_else(Data_Breach == 1, "True", "False")))

data.graph <- ggplot(data = df.data, aes(Data_Breach == "True", fill = fill.choice))+geom_bar(position =
################################################################
```

```r
df.ran <- df.clean %>% as_tibble() %>%
  mutate(Ransomware = as.factor(if_else(Ransomware == 1, "True", "False")))

ran.graph <- ggplot(data = df.ran, aes(Ransomware == "True", fill = fill.choice))+geom_bar(position = "
#####################################################################
df.phish <- df.clean %>% as_tibble() %>%
  mutate(Phishing = as.factor(if_else(Phishing == 1, "True", "False")))

phish.graph <- ggplot(data = df.phish, aes(Phishing == "True", fill = fill.choice))+geom_bar(position =
#####################################################################
df.tdos <- df.clean %>% as_tibble() %>%
  mutate(TDoS = as.factor(if_else(TDoS == 1, "True", "False")))

tdos.graph <- ggplot(data = df.tdos, aes(TDoS == "True", fill = fill.choice))+geom_bar(position = "dodg
#####################################################################
df.mal <- df.clean %>% as_tibble() %>%
  mutate(Malware = as.factor(if_else(Malware == 1, "True", "False")))

mal.graph <- ggplot(data = df.mal, aes(Malware == "True", fill = fill.choice))+geom_bar(position = "dod
#####################################################################
df.ddos <- df.clean %>% as_tibble() %>%
  mutate(DDoS = as.factor(if_else(DDoS == 1, "True", "False")))

ddos.graph <- ggplot(data = df.ddos, aes(DDoS == "True", fill = fill.choice))+geom_bar(position = "dodg
#####################################################################
df.other <- df.clean %>% as_tibble() %>%
  mutate(Other = as.factor(if_else(Other == 1, "True", "False")))

other.graph <- ggplot(data = df.other, aes(Other == "True", fill = fill.choice))+geom_bar(position = "d
#####################################################################
df.serv <- df.clean %>% as_tibble() %>%
  mutate(Server_Shutdown = as.factor(if_else(Server_Shutdown == 1, "True", "False")))

serv.graph <- ggplot(data = df.serv, aes(Server_Shutdown == "True", fill = fill.choice))+geom_bar(posit
#####################################################################


(data.graph + scale_x_discrete(limit = c(TRUE)) | ddos.graph + scale_x_discrete(limit = c(TRUE)) |
  hack.graph + scale_x_discrete(limit = c(TRUE)))/ (mal.graph + scale_x_discrete(limit = c(TRUE))|
  other.graph + scale_x_discrete(limit = c(TRUE)) | phish.graph + scale_x_discrete(limit = c(TRUE)))/
  (ran.graph + scale_x_discrete(limit = c(TRUE)) | tdos.graph + scale_x_discrete(limit = c(TRUE)) | unk
  scale_x_discrete(limit = c(TRUE)))

}

graph.attack.by.filter(df.clean$year)
```

```
## Warning: Removed 291 rows containing non-finite values (stat_count).
```

```
## Warning: Removed 337 rows containing non-finite values (stat_count).
```

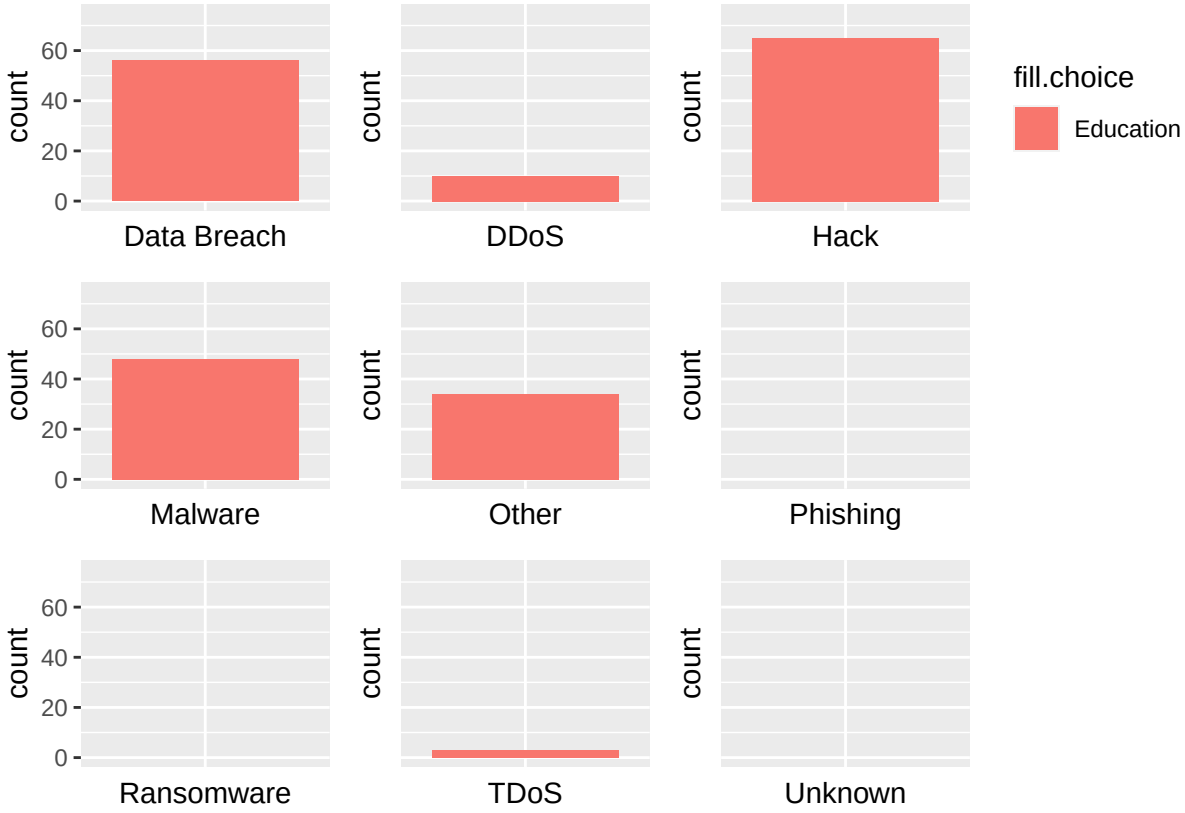
```
## Warning: Removed 282 rows containing non-finite values (stat_count).
```

```
## Warning: Removed 299 rows containing non-finite values (stat_count).

## Warning: Removed 313 rows containing non-finite values (stat_count).

## Warning: Removed 248 rows containing non-finite values (stat_count).

## Warning: Removed 223 rows containing non-finite values (stat_count).

## Warning: Removed 344 rows containing non-finite values (stat_count).

## Warning: Removed 194 rows containing non-finite values (stat_count).

## Warning: Removed 1 rows containing missing values (geom_bar).
```


```
graph.attack.by.filter(df.clean$type)
```

```
## Warning: Removed 291 rows containing non-finite values (stat_count).

## Warning: Removed 337 rows containing non-finite values (stat_count).

## Warning: Removed 282 rows containing non-finite values (stat_count).

## Warning: Removed 299 rows containing non-finite values (stat_count).
```

```
## Warning: Removed 313 rows containing non-finite values (stat_count).

## Warning: Removed 248 rows containing non-finite values (stat_count).

## Warning: Removed 1 rows containing missing values (geom_bar).

## Warning: Removed 223 rows containing non-finite values (stat_count).

## Warning: Removed 1 rows containing missing values (geom_bar).

## Warning: Removed 344 rows containing non-finite values (stat_count).

## Warning: Removed 194 rows containing non-finite values (stat_count).

## Warning: Removed 1 rows containing missing values (geom_bar).
```




```
graph.attack.by.filter((df.clean$website_quality))
```

```
## Warning: Removed 291 rows containing non-finite values (stat_count).

## Warning: Removed 337 rows containing non-finite values (stat_count).

## Warning: Removed 282 rows containing non-finite values (stat_count).
```

```
## Warning: Removed 299 rows containing non-finite values (stat_count).

## Warning: Removed 313 rows containing non-finite values (stat_count).

## Warning: Removed 248 rows containing non-finite values (stat_count).

## Warning: Removed 223 rows containing non-finite values (stat_count).

## Warning: Removed 344 rows containing non-finite values (stat_count).

## Warning: Removed 194 rows containing non-finite values (stat_count).

## Warning: Removed 1 rows containing missing values (geom_bar).
```

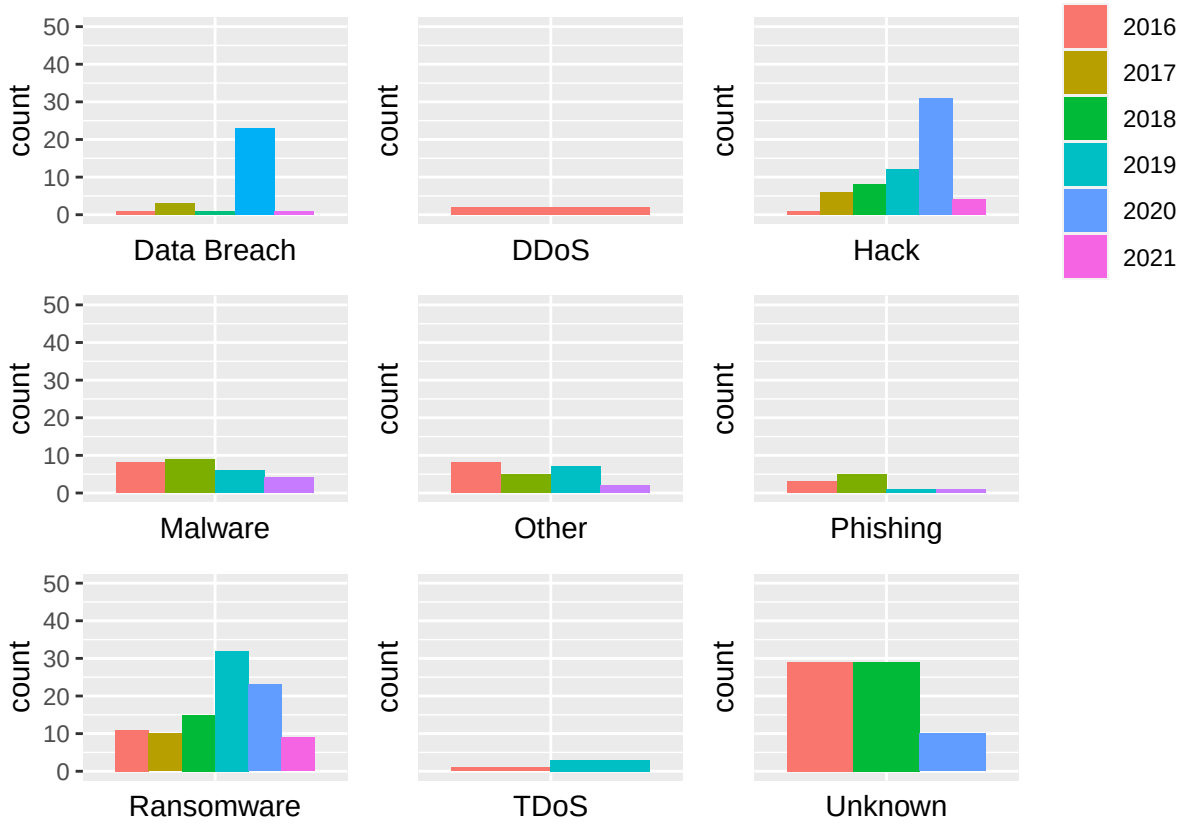

```
df.clean <- df.temporary
```

```
#a work around to not have to change a bunch of small code;

df.temporary <- df.clean
df.clean <- df.safety

graph.attack.by.filter <- function(fill.choice){
  df.unk <- df.clean %>% as_tibble() %>%
```

```
  mutate(Unknown = as.factor(if_else(Unknown == 1, "True", "False")))

unk.graph <- ggplot(data = df.unk, aes(Unknown == "True", fill = fill.choice))+geom_bar(position = "dod
#################################################################
df.hack <- df.clean %>% as_tibble() %>%
  mutate(Hack = as.factor(if_else(Hack == 1, "True", "False")))

hack.graph <- ggplot(data = df.hack, aes(Hack == "True", fill = fill.choice))+geom_bar(position = "dodg
#################################################################
df.data <- df.clean %>% as_tibble() %>%
  mutate(Data_Breach = as.factor(if_else(Data_Breach == 1, "True", "False")))

data.graph <- ggplot(data = df.data, aes(Data_Breach == "True", fill = fill.choice))+geom_bar(position =
#################################################################
df.ran <- df.clean %>% as_tibble() %>%
  mutate(Ransomware = as.factor(if_else(Ransomware == 1, "True", "False")))

ran.graph <- ggplot(data = df.ran, aes(Ransomware == "True", fill = fill.choice))+geom_bar(position = "
#################################################################
df.phish <- df.clean %>% as_tibble() %>%
  mutate(Phishing = as.factor(if_else(Phishing == 1, "True", "False")))

phish.graph <- ggplot(data = df.phish, aes(Phishing == "True", fill = fill.choice))+geom_bar(position =
#################################################################
df.tdos <- df.clean %>% as_tibble() %>%
  mutate(TDoS = as.factor(if_else(TDoS == 1, "True", "False")))

tdos.graph <- ggplot(data = df.tdos, aes(TDoS == "True", fill = fill.choice))+geom_bar(position = "dodg
#################################################################
df.mal <- df.clean %>% as_tibble() %>%
  mutate(Malware = as.factor(if_else(Malware == 1, "True", "False")))

mal.graph <- ggplot(data = df.mal, aes(Malware == "True", fill = fill.choice))+geom_bar(position = "dod
#################################################################
df.ddos <- df.clean %>% as_tibble() %>%
  mutate(DDoS = as.factor(if_else(DDoS == 1, "True", "False")))

ddos.graph <- ggplot(data = df.ddos, aes(DDoS == "True", fill = fill.choice))+geom_bar(position = "dodg
#################################################################
df.other <- df.clean %>% as_tibble() %>%
  mutate(Other = as.factor(if_else(Other == 1, "True", "False")))

other.graph <- ggplot(data = df.other, aes(Other == "True", fill = fill.choice))+geom_bar(position = "d
#################################################################
df.serv <- df.clean %>% as_tibble() %>%
  mutate(Server_Shutdown = as.factor(if_else(Server_Shutdown == 1, "True", "False")))

serv.graph <- ggplot(data = df.serv, aes(Server_Shutdown == "True", fill = fill.choice))+geom_bar(posit
#################################################################


(data.graph + scale_x_discrete(limit = c(TRUE)) | ddos.graph + scale_x_discrete(limit = c(TRUE)) |
  hack.graph + scale_x_discrete(limit = c(TRUE)))/ (mal.graph + scale_x_discrete(limit = c(TRUE))|
```

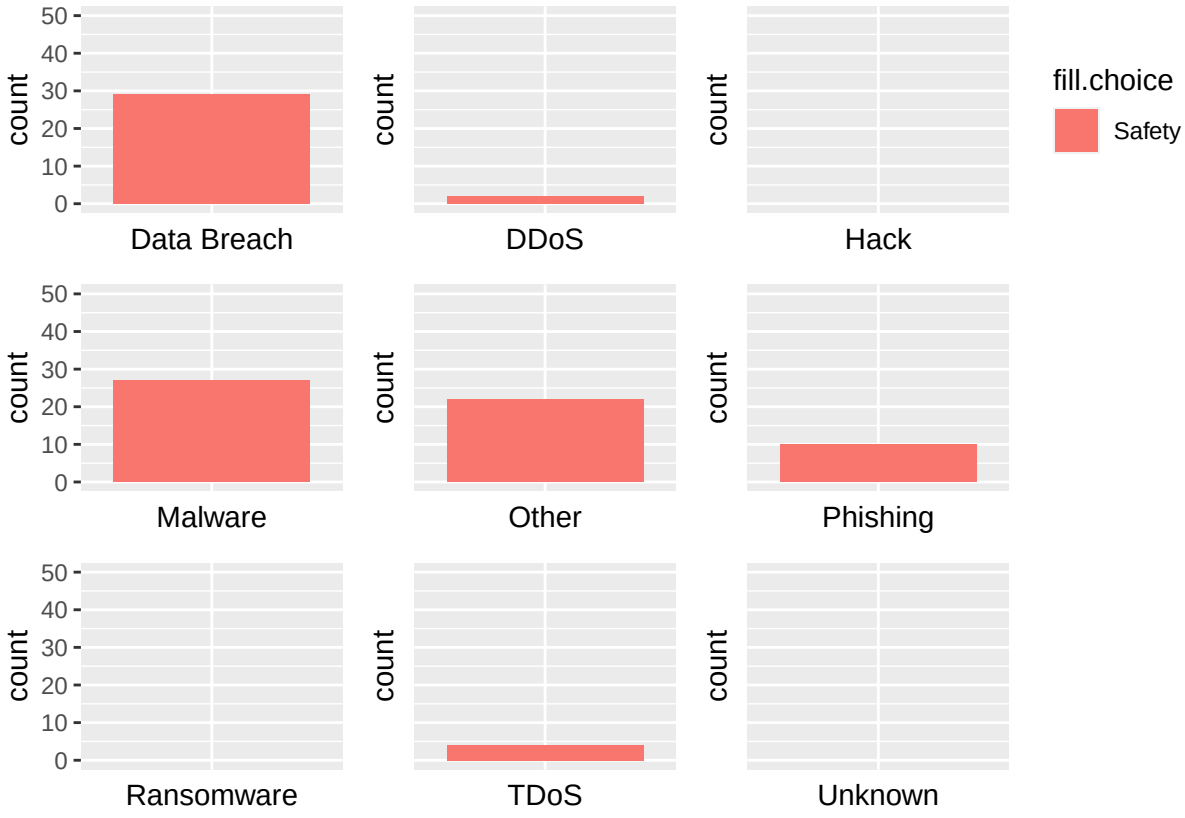
```
  other.graph + scale_x_discrete(limit = c(TRUE)) | phish.graph + scale_x_discrete(limit = c(TRUE)))/
  (ran.graph + scale_x_discrete(limit = c(TRUE)) | tdos.graph + scale_x_discrete(limit = c(TRUE)) | unk
  scale_x_discrete(limit = c(TRUE)))

}

graph.attack.by.filter(df.clean$year)
```

```
## Warning: Removed 165 rows containing non-finite values (stat_count).

## Warning: Removed 192 rows containing non-finite values (stat_count).

## Warning: Removed 132 rows containing non-finite values (stat_count).

## Warning: Removed 167 rows containing non-finite values (stat_count).

## Warning: Removed 172 rows containing non-finite values (stat_count).

## Warning: Removed 184 rows containing non-finite values (stat_count).

## Warning: Removed 94 rows containing non-finite values (stat_count).

## Warning: Removed 190 rows containing non-finite values (stat_count).

## Warning: Removed 126 rows containing non-finite values (stat_count).
```



```
graph.attack.by.filter(df.clean$type)
```

```
## Warning: Removed 165 rows containing non-finite values (stat_count).

## Warning: Removed 192 rows containing non-finite values (stat_count).

## Warning: Removed 132 rows containing non-finite values (stat_count).

## Warning: Removed 1 rows containing missing values (geom_bar).

## Warning: Removed 167 rows containing non-finite values (stat_count).

## Warning: Removed 172 rows containing non-finite values (stat_count).

## Warning: Removed 184 rows containing non-finite values (stat_count).

## Warning: Removed 94 rows containing non-finite values (stat_count).

## Warning: Removed 1 rows containing missing values (geom_bar).

## Warning: Removed 190 rows containing non-finite values (stat_count).

## Warning: Removed 126 rows containing non-finite values (stat_count).

## Warning: Removed 1 rows containing missing values (geom_bar).
```



```
graph.attack.by.filter((df.clean$website_quality))
```

```
## Warning: Removed 165 rows containing non-finite values (stat_count).

## Warning: Removed 192 rows containing non-finite values (stat_count).

## Warning: Removed 132 rows containing non-finite values (stat_count).

## Warning: Removed 167 rows containing non-finite values (stat_count).

## Warning: Removed 172 rows containing non-finite values (stat_count).

## Warning: Removed 184 rows containing non-finite values (stat_count).

## Warning: Removed 94 rows containing non-finite values (stat_count).

## Warning: Removed 1 rows containing missing values (geom_bar).

## Warning: Removed 190 rows containing non-finite values (stat_count).

## Warning: Removed 126 rows containing non-finite values (stat_count).
```

```
df.clean <- df.temporary
```

```
get.percent <- function(attack.type, sector){

sum.type <- sum(df.clean$type == sector)

sum.attack <- sum(df.clean[which(df.clean$type == sector), attack.type])
percent.attack = sum.attack/sum.type;

#sprintf("%f of % s attacks are % s", percent.attack, sector, attack.type )
return(percent.attack)
}
```

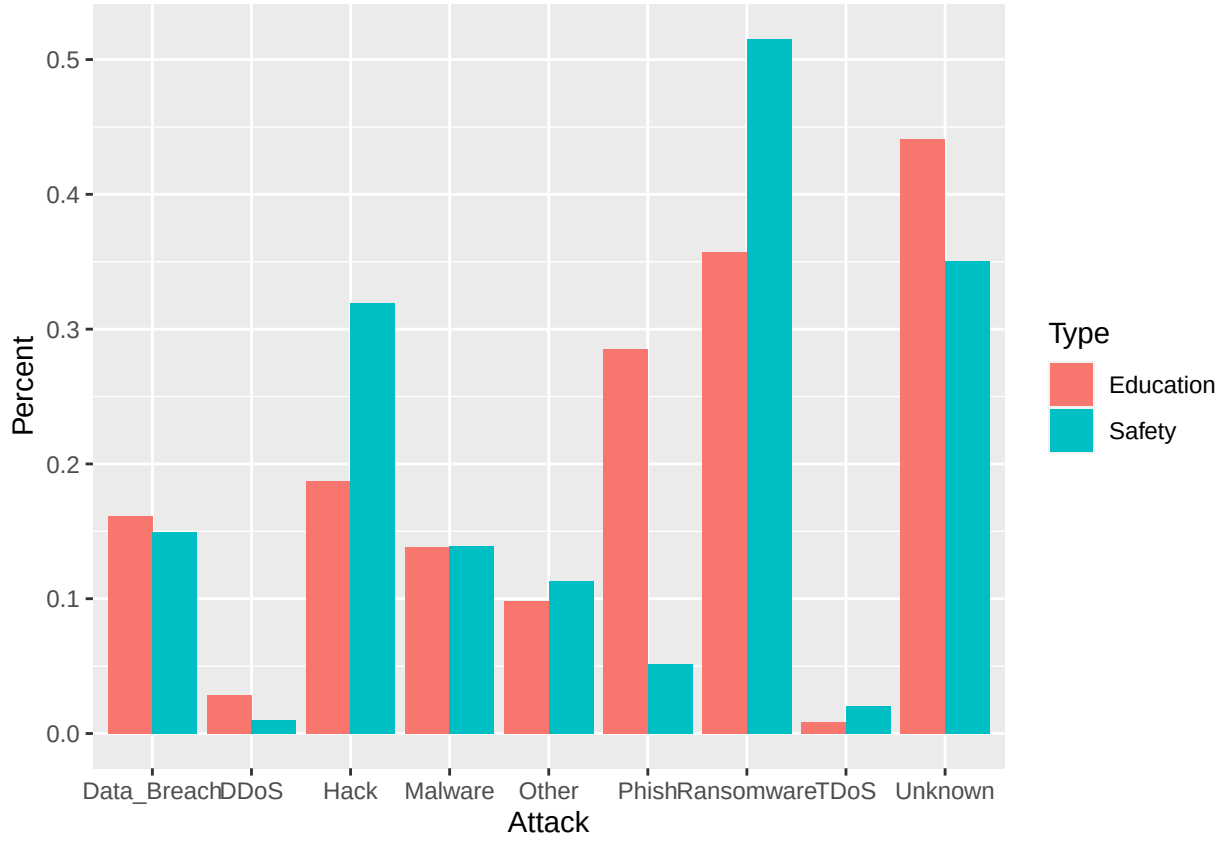
```
df.attack.count <- data.frame(matrix(ncol = 3, nrow = 18))
x <- c("Attack", "Type", "Percent")
colnames(df.attack.count)<- x

df.attack.count[1, "Attack"] = "Data_Breach"
df.attack.count[2, "Attack"] = "DDoS"
df.attack.count[3, "Attack"] = "Hack"
df.attack.count[4, "Attack"] = "Malware"
df.attack.count[5, "Attack"] = "Other"
df.attack.count[6, "Attack"] = "Phish"
df.attack.count[7, "Attack"] = "Ransomware"
df.attack.count[8, "Attack"] = "TDoS"
df.attack.count[9, "Attack"] = "Unknown"
df.attack.count[10, "Attack"] = "Data_Breach"
df.attack.count[11, "Attack"] = "DDoS"
df.attack.count[12, "Attack"] = "Hack"
df.attack.count[13, "Attack"] = "Malware"
df.attack.count[14, "Attack"] = "Other"
df.attack.count[15, "Attack"] = "Phish"
df.attack.count[16, "Attack"] = "Ransomware"
df.attack.count[17, "Attack"] = "TDoS"
df.attack.count[18, "Attack"] = "Unknown"
df.attack.count[1:9, "Type"] = "Education"
df.attack.count[10:18, "Type"] = "Safety"

df.attack.count[1, "Percent"] = get.percent("Data_Breach", "Education")
df.attack.count[2, "Percent"] = get.percent("DDoS", "Education")
df.attack.count[3, "Percent"] = get.percent("Hack", "Education")
df.attack.count[4, "Percent"] = get.percent("Malware", "Education")
df.attack.count[5, "Percent"] = get.percent("Other", "Education")
df.attack.count[6, "Percent"] = get.percent("Phishing", "Education")
df.attack.count[7, "Percent"] = get.percent("Ransomware", "Education")
df.attack.count[8, "Percent"] = get.percent("TDoS", "Education")
df.attack.count[9, "Percent"] = get.percent("Unknown", "Education")


df.attack.count[10, "Percent"] = get.percent("Data_Breach", "Safety")
df.attack.count[11, "Percent"] = get.percent("DDoS", "Safety")
df.attack.count[12, "Percent"] = get.percent("Hack", "Safety")
df.attack.count[13, "Percent"] = get.percent("Malware", "Safety")
```

```
df.attack.count[14, "Percent"] = get.percent("Other", "Safety")
df.attack.count[15, "Percent"] = get.percent("Phishing", "Safety")
df.attack.count[16, "Percent"] = get.percent("Ransomware", "Safety")
df.attack.count[17, "Percent"] = get.percent("TDoS", "Safety")
df.attack.count[18, "Percent"] = get.percent("Unknown", "Safety")
```

```
head(df.attack.count)
```

```
##        Attack      Type    Percent
## 1 Data_Breach Education 0.16138329
## 2        DDoS Education 0.02881844
## 3        Hack Education 0.18731988
## 4     Malware Education 0.13832853
## 5       Other Education 0.09798271
## 6       Phish Education 0.28530259
```

```
ggplot(df.attack.count, aes(x = Attack, y = Percent, fill = Type)) + geom_bar(stat = "identity", positi
```




```
get.percent <- function(quality, sector){

sum.type <- sum(df.clean$type == sector)

sum.attack <- sum(df.clean[which(df.clean$type == sector), quality])
percent.attack = sum.attack/sum.type;
```

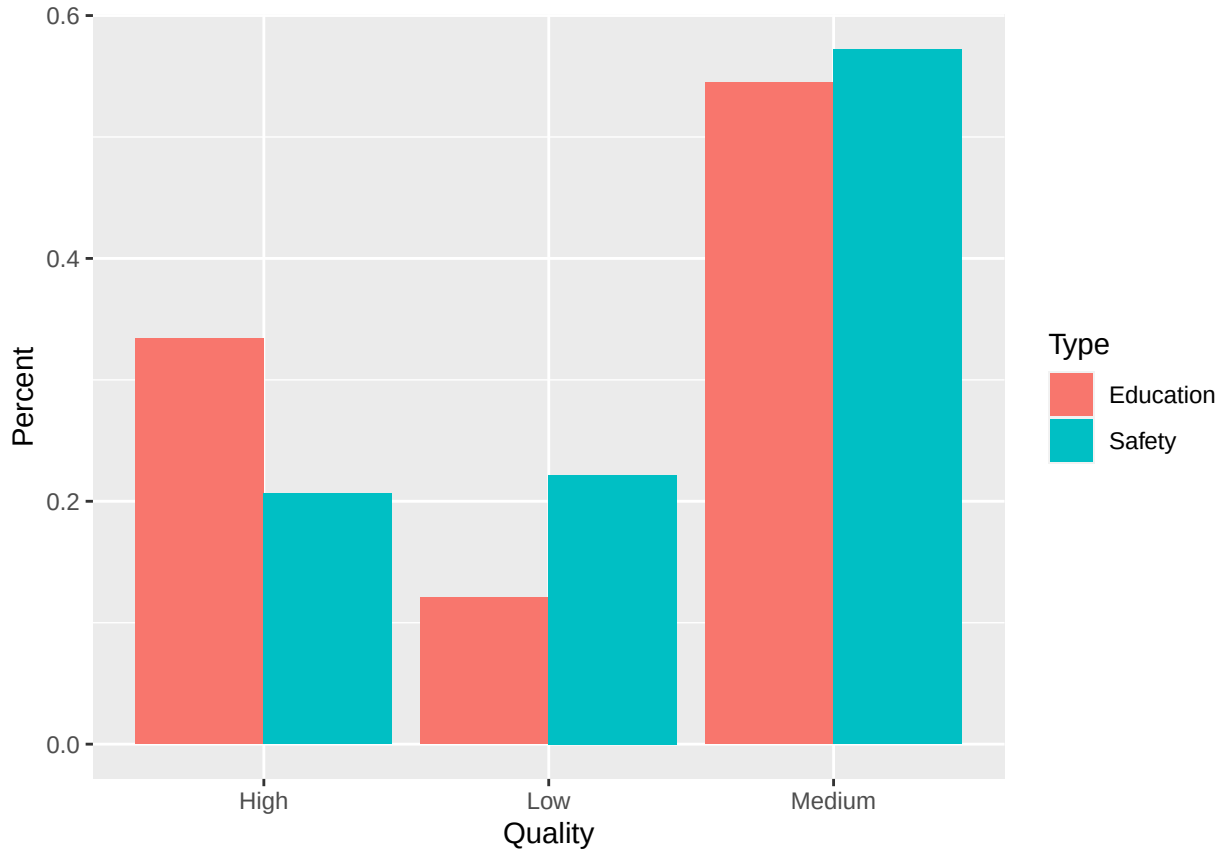
```
#sprintf("%f of % s attacks are % s", percent.attack, sector, attack.type )
return(percent.attack)
}
```

```
df.quality.count <- data.frame(matrix(ncol = 3, nrow = 6))
x <- c("Type", "Quality", "Percent")
colnames(df.quality.count)<- x

df.quality.count[1, "Quality"] = "Low"
df.quality.count[2, "Quality"] = "Medium"
df.quality.count[3, "Quality"] = "High"
df.quality.count[4, "Quality"] = "Low"
df.quality.count[5, "Quality"] = "Medium"
df.quality.count[6, "Quality"] = "High"
df.quality.count[1:3, "Type"] = "Education"
df.quality.count[4:6, "Type"] = "Safety"

df.quality.count[1, "Percent"] = get.percent("low", "Education")
df.quality.count[2, "Percent"] = get.percent("med", "Education")
df.quality.count[3, "Percent"] = get.percent("high", "Education")



df.quality.count[4, "Percent"] = get.percent("low", "Safety")
df.quality.count[5, "Percent"] = get.percent("med", "Safety")
df.quality.count[6, "Percent"] = get.percent("high", "Safety")
```

```
head(df.quality.count)
```

```
##        Type Quality   Percent
## 1 Education     Low 0.1210375
## 2 Education  Medium 0.5446686
## 3 Education    High 0.3342939
## 4    Safety     Low 0.2216495
## 5    Safety  Medium 0.5721649
## 6    Safety    High 0.2061856
```

```
ggplot(df.quality.count, aes(x = Quality, y = Percent, fill = Type)) + geom_bar(stat = "identity", posi
```


0.6
0.4
0.2
0.0
Percent
High
Low
Medium
Quality
Type
Education
Safety

‘‘