space.R

HomePC

2024-11-22

```
data <- read.csv("C:/Users/HomePC/Documents/objects launched out of
space.csv")
data2 <- read.csv("C:/Users/HomePC/Documents/objects launched out of
space.csv")
getwd()
```

```
## [1] "C:/Users/HomePC/Documents/space_launches"
```

```
library(dplyr)
```

```
## Warning: package 'dplyr' was built under R version 4.4.2
```

```
##
## Attaching package: 'dplyr'
```

```
## The following objects are masked from 'package:stats':
##
##     filter, lag
```

```
## The following objects are masked from 'package:base':
##
##     intersect, setdiff, setequal, union
```

```
library(ggplot2)
```

```
## Warning: package 'ggplot2' was built under R version 4.4.2
```

```
summary(data)
```

```
##     Entity              Code                Year
##  Length:1108        Length:1108        Min.   :1957
##  Class :character   Class :character   1st Qu.:1992
##  Mode  :character   Mode  :character   Median :2007
##                                        Mean   :2003
##                                        3rd Qu.:2017
##                                        Max.   :2023
##  Annual.number.of.objects.launched.into.outer.space
##  Min.   :   1.00
##  1st Qu.:   1.00
##  Median :   2.00
##  Mean   :  15.64
##  3rd Qu.:   4.00
##  Max.   :2166.00
```

```
str(data)
```

```
## 'data.frame':    1108 obs. of  4 variables:
##  $ Entity                                                : chr  "APSCO"
"Algeria" "Algeria" "Algeria" ...
##  $ Code                                                  : chr  "" "DZA" "DZA"
"DZA" ...
##  $ Year                                                  : int  2023 2002 2010
2016 2017 2017 2022 1985 1992 1996 ...
##  $ Annual.number.of.objects.launched.into.outer.space: int  1 1 1 3 1 1 1
2 1 2 ...
```

```
head(data,30)
```

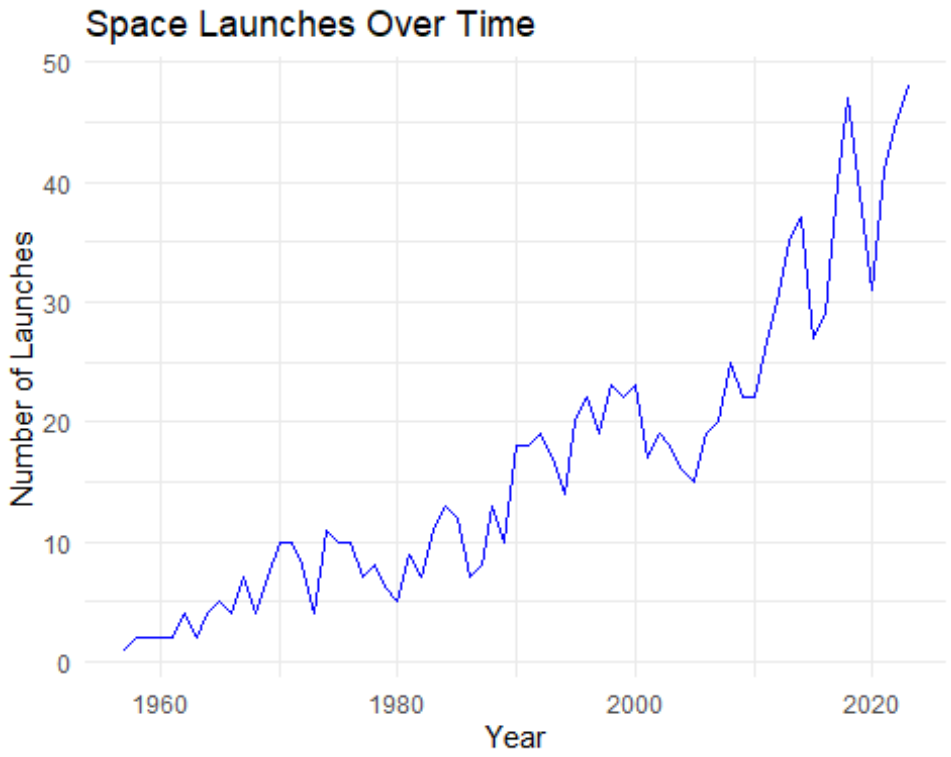
```
##       Entity Code Year Annual.number.of.objects.launched.into.outer.space
## 1      APSCO      2023                                                   1
## 2    Algeria  DZA 2002                                                   1
## 3    Algeria  DZA 2010                                                   1
## 4    Algeria  DZA 2016                                                   3
## 5    Algeria  DZA 2017                                                   1
## 6     Angola  AGO 2017                                                   1
## 7     Angola  AGO 2022                                                   1
## 8    Arabsat      1985                                                   2
## 9    Arabsat      1992                                                   1
## 10   Arabsat      1996                                                   2
## 11   Arabsat      1999                                                   1
## 12   Arabsat      2006                                                   2
## 13   Arabsat      2008                                                   1
## 14   Arabsat      2010                                                   2
## 15   Arabsat      2011                                                   1
## 16   Arabsat      2015                                                   1
## 17   Arabsat      2019                                                   1
## 18   Arabsat      2023                                                   1
## 19 Argentina  ARG 1990                                                   1
## 20 Argentina  ARG 1996                                                   3
## 21 Argentina  ARG 1997                                                   1
## 22 Argentina  ARG 1998                                                   1
## 23 Argentina  ARG 2000                                                   2
## 24 Argentina  ARG 2002                                                   2
## 25 Argentina  ARG 2007                                                   1
## 26 Argentina  ARG 2011                                                   1
## 27 Argentina  ARG 2013                                                   2
## 28 Argentina  ARG 2014                                                   2
## 29 Argentina  ARG 2015                                                   1
## 30 Argentina  ARG 2018                                                   1
```

```
#Total objects launched each year
launches_per_year <- data %>%
  group_by(Year) %>%
  summarise(Total_Launches =
sum(Annual.number.of.objects.launched.into.outer.space, na.rm = TRUE))
print(n=67,launches_per_year)
```

```
## # A tibble: 67 × 2
##     Year Total_Launches
##    <int>          <int>
##  1  1957              2
##  2  1958              8
##  3  1959             14
##  4  1960             20
##  5  1961             38
##  6  1962             77
##  7  1963             71
##  8  1964            109
##  9  1965            165
## 10  1966            145
## 11  1967            159
## 12  1968            141
## 13  1969            141
## 14  1970            130
## 15  1971            156
## 16  1972            138
## 17  1973            140
## 18  1974            130
## 19  1975            161
## 20  1976            158
## 21  1977            137
## 22  1978            165
## 23  1979            126
## 24  1980            130
## 25  1981            160
## 26  1982            147
## 27  1983            156
## 28  1984            163
## 29  1985            165
## 30  1986            134
## 31  1987            135
## 32  1988            147
## 33  1989            141
## 34  1990            172
## 35  1991            135
## 36  1992            130
## 37  1993            108
## 38  1994            123
## 39  1995            105
## 40  1996            102
## 41  1997            152
## 42  1998            157
## 43  1999            134
## 44  2000            124
## 45  2001             86
## 46  2002            100
## 47  2003             88
```

```
## 48  2004             76
## 49  2005             72
## 50  2006            101
## 51  2007            111
## 52  2008            111
## 53  2009            125
## 54  2010            122
## 55  2011            132
## 56  2012            135
## 57  2013            209
## 58  2014            241
## 59  2015            221
## 60  2016            220
## 61  2017            457
## 62  2018            454
## 63  2019            592
## 64  2020           1274
## 65  2021           1813
## 66  2022           2477
## 67  2023           2664
```

```r
# Summarize data by year and count launches
data %>%
  group_by(Year) %>%  # Group by the 'year' column
  summarise(LaunchCount = n()) %>%  # Count the number of launches for each
year
  ggplot(aes(x = Year, y = LaunchCount)) +
  geom_line(color = "blue") +
  labs(title = "Space Launches Over Time", x = "Year", y = "Number of
Launches") +
  theme_minimal()
```




```
# Total objects launched per country
total_launches_per_entity <- data %>%
  group_by(Entity) %>%
  summarise(Total_Launches =
sum(Annual.number.of.objects.launched.into.outer.space, na.rm = TRUE)) %>%
  arrange(desc(Total_Launches))
print(n=110,total_launches_per_entity)
```

```
## # A tibble: 109 × 2
##     Entity                Total_Launches
##     <chr>                          <int>
##   1 United States                   9632
##   2 Russia                          3723
##   3 China                           1051
##   4 United Kingdom                   765
##   5 Japan                            325
##   6 France                           151
##   7 India                            144
##   8 Germany                          120
##   9 European Space Agency            104
##  10 Canada                           102
##  11 Luxembourg                        86
##  12 Italy                             74
##  13 South Korea                       62
##  14 Intelsat                          60
##  15 Spain                             53
##  16 Australia                         47
```

```
##  17 Brazil                          46
##  18 Israel                          45
##  19 Uruguay                         40
##  20 Belgium                         39
##  21 Eutelsat                        33
##  22 Finland                         28
##  23 New Zealand                     26
##  24 European Union                  24
##  25 Singapore                       24
##  26 Indonesia                       23
##  27 Argentina                       22
##  28 Turkey                          22
##  29 United Arab Emirates            22
##  30 Taiwan                          21
##  31 Norway                          20
##  32 Sweden                          20
##  33 Switzerland                     19
##  34 Mexico                          18
##  35 Saudi Arabia                    17
##  36 Netherlands                     16
##  37 Arabsat                         15
##  38 Poland                          15
##  39 Thailand                        15
##  40 Denmark                         14
##  41 Inmarsat                        14
##  42 EUMETSAT                        13
##  43 Egypt                           12
##  44 Lithuania                       12
##  45 Czechia                         11
##  46 Malaysia                        11
##  47 Ukraine                         10
##  48 Iran                             9
##  49 Kazakhstan                       9
##  50 Philippines                      9
##  51 South Africa                     9
##  52 Chile                            7
##  53 Algeria                          6
##  54 Pakistan                         6
##  55 Vietnam                          6
##  56 Greece                           5
##  57 Hungary                          5
##  58 NATO                             5
##  59 Belarus                          4
##  60 Bulgaria                         4
##  61 Nigeria                          4
##  62 Peru                             4
##  63 Rwanda                           4
##  64 Venezuela                        4
##  65 Austria                          3
##  66 Azerbaijan                       3
```

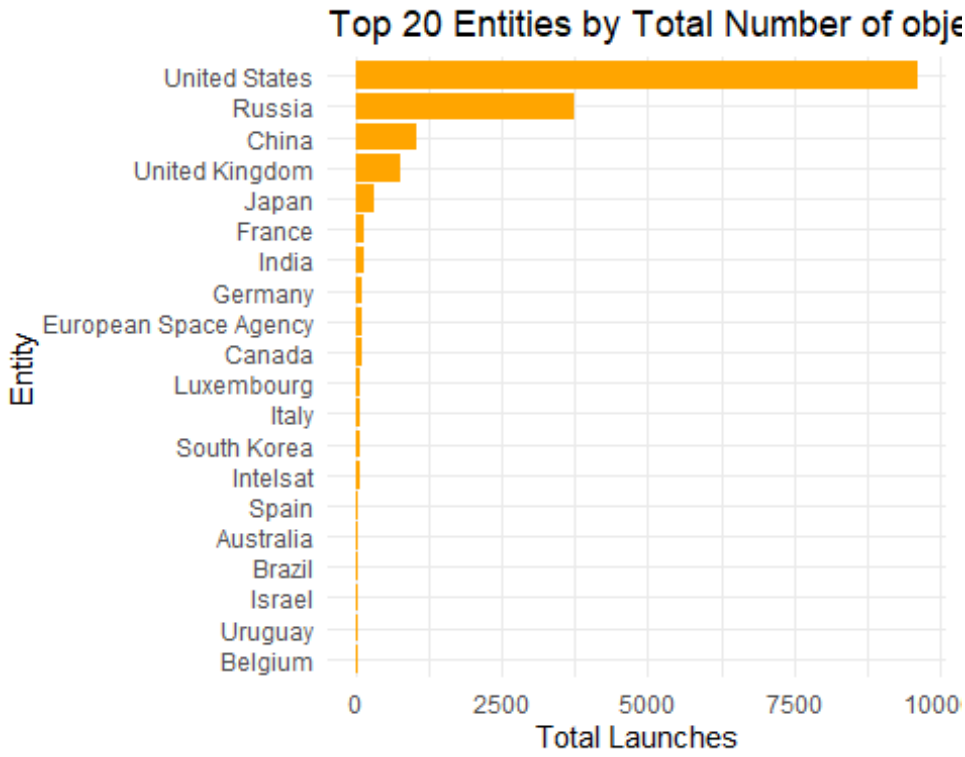
```
##  67 Colombia                              3
##  68 Estonia                               3
##  69 Morocco                               3
##  70 North Korea                           3
##  71 Slovenia                              3
##  72 Angola                                2
##  73 Bangladesh                            2
##  74 Ecuador                               2
##  75 Papua New Guinea                      2
##  76 RASCOM                                2
##  77 Slovakia                              2
##  78 Starsem                               2
##  79 APSCO                                 1
##  80 Armenia                               1
##  81 Bhutan                                1
##  82 Bolivia                               1
##  83 Costa Rica                            1
##  84 Djibouti                              1
##  85 Ethiopia                              1
##  86 Ghana                                 1
##  87 Guatemala                             1
##  88 Intersputnik                          1
##  89 Ireland                               1
##  90 Jordan                                1
##  91 Kenya                                 1
##  92 Kuwait                                1
##  93 Laos                                  1
##  94 Latvia                                1
##  95 Mauritius                             1
##  96 Moldova                               1
##  97 Monaco                                1
##  98 Mongolia                              1
##  99 Nepal                                 1
## 100 Paraguay                              1
## 101 Portugal                              1
## 102 Qatar                                 1
## 103 Romania                               1
## 104 Sea Launch                            1
## 105 Sri Lanka                             1
## 106 Tunisia                               1
## 107 Turkmenistan                          1
## 108 Uganda                                1
## 109 Zimbabwe                              1
```

```r
# top 20 countries by number of objects launched
top_20_entities <- data %>%
  group_by(Entity) %>%
  summarise(Total_Launches =
sum(Annual.number.of.objects.launched.into.outer.space, na.rm = TRUE)) %>%
  arrange(desc(Total_Launches)) %>%
```

```r
  slice(1:20)
print(top_20_entities)
```

```
## # A tibble: 20 × 2
##    Entity                Total_Launches
##    <chr>                          <int>
##  1 United States                   9632
##  2 Russia                          3723
##  3 China                           1051
##  4 United Kingdom                   765
##  5 Japan                            325
##  6 France                           151
##  7 India                            144
##  8 Germany                          120
##  9 European Space Agency            104
## 10 Canada                           102
## 11 Luxembourg                        86
## 12 Italy                             74
## 13 South Korea                       62
## 14 Intelsat                          60
## 15 Spain                             53
## 16 Australia                         47
## 17 Brazil                            46
## 18 Israel                            45
## 19 Uruguay                           40
## 20 Belgium                           39
```

```r
# Plot the top 20 entities
ggplot(top_20_entities, aes(x = reorder(Entity, Total_Launches), y =
Total_Launches)) +
  geom_bar(stat = "identity", fill = "orange") +
  labs(title = "Top 20 Entities by Total Number of objects Launched", x =
"Entity", y = "Total Launches") +
  theme_minimal() +
  coord_flip()
```




```
#number of years each country launched and sort the result
countries_by_years_launched <- data %>%
  count(Entity, sort = TRUE)  # Removed top_n to include all countries

print(countries_by_years_launched)
```

```
##                    Entity  n
## 1                  Russia 67
## 2           United States 66
## 3                   Japan 53
## 4                   China 48
## 5                  France 41
## 6                 Germany 41
## 7                  Canada 39
## 8   European Space Agency 39
## 9                   India 39
## 10         United Kingdom 38
## 11               Intelsat 34
## 12                  Italy 32
## 13             Luxembourg 26
## 14                 Brazil 25
## 15              Australia 22
## 16                 Israel 22
## 17                  Spain 22
## 18               Eutelsat 21
## 19              Indonesia 20
## 20            South Korea 18
```

```
## 21              Argentina 16
## 22                 Turkey 16
## 23                 Mexico 14
## 24                 Sweden 14
## 25               Thailand 14
## 26   United Arab Emirates 14
## 27                 Norway 13
## 28                Arabsat 11
## 29               EUMETSAT 11
## 30                Denmark 10
## 31                Czechia  9
## 32               Inmarsat  9
## 33                  Egypt  8
## 34                   Iran  8
## 35               Malaysia  8
## 36            Netherlands  8
## 37                 Poland  8
## 38              Singapore  8
## 39                 Taiwan  8
## 40                Ukraine  8
## 41                Uruguay  8
## 42                Finland  7
## 43           Saudi Arabia  7
## 44           South Africa  7
## 45            Switzerland  7
## 46                Belgium  6
## 47         European Union  6
## 48              Lithuania  6
## 49                  Chile  5
## 50             Kazakhstan  5
## 51                   NATO  5
## 52            New Zealand  5
## 53               Pakistan  5
## 54            Philippines  5
## 55                Algeria  4
## 56                Belarus  4
## 57               Bulgaria  4
## 58                 Greece  4
## 59                Vietnam  4
## 60             Azerbaijan  3
## 61               Colombia  3
## 62                Estonia  3
## 63                Hungary  3
## 64                Morocco  3
## 65                Nigeria  3
## 66            North Korea  3
## 67                   Peru  3
## 68              Venezuela  3
## 69                 Angola  2
## 70                Austria  2
```

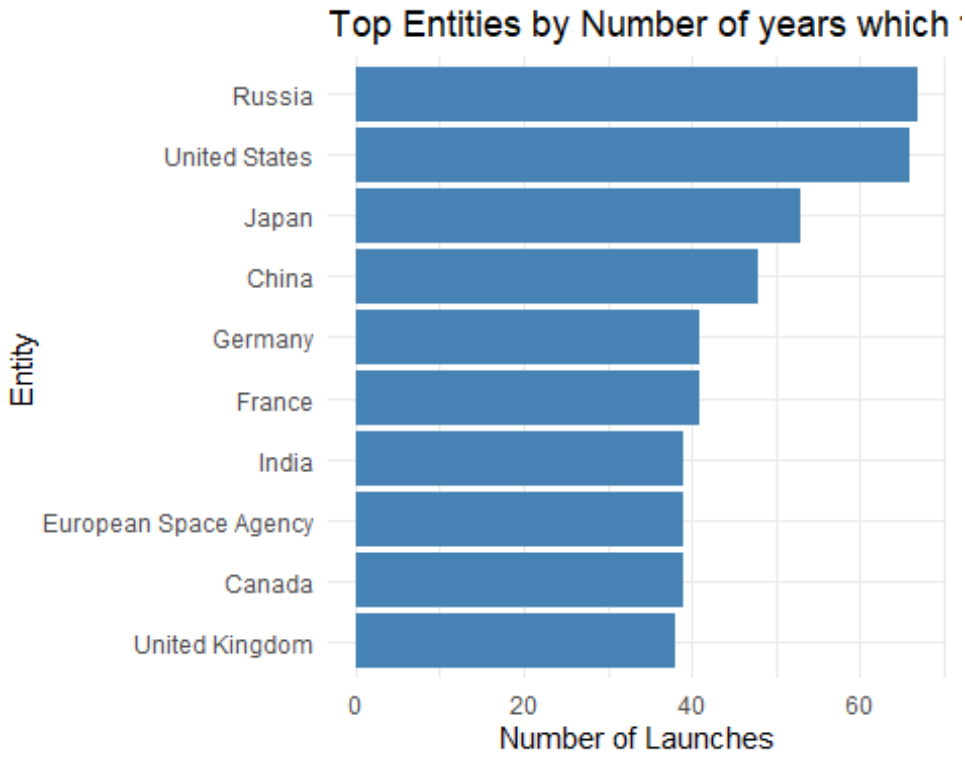
```
## 71             Bangladesh  2
## 72       Papua New Guinea  2
## 73                 RASCOM  2
## 74                 Rwanda  2
## 75               Slovakia  2
## 76               Slovenia  2
## 77                  APSCO  1
## 78                Armenia  1
## 79                 Bhutan  1
## 80                Bolivia  1
## 81             Costa Rica  1
## 82               Djibouti  1
## 83                Ecuador  1
## 84               Ethiopia  1
## 85                  Ghana  1
## 86              Guatemala  1
## 87           Intersputnik  1
## 88                Ireland  1
## 89                 Jordan  1
## 90                  Kenya  1
## 91                 Kuwait  1
## 92                   Laos  1
## 93                 Latvia  1
## 94              Mauritius  1
## 95                Moldova  1
## 96                 Monaco  1
## 97               Mongolia  1
## 98                  Nepal  1
## 99               Paraguay  1
## 100              Portugal  1
## 101                 Qatar  1
## 102              Romania  1
## 103            Sea Launch  1
## 104             Sri Lanka  1
## 105               Starsem  1
## 106               Tunisia  1
## 107          Turkmenistan  1
## 108                Uganda  1
## 109              Zimbabwe  1
```

```
# Top ten countries by number of years which they launched
topten_countries_by_years_launched <- data %>%
  count(Entity, sort = TRUE) %>%
  top_n(10, n)
print(topten_countries_by_years_launched)
```

```
##                   Entity  n
## 1                 Russia 67
## 2          United States 66
## 3                  Japan 53
```

```
## 4                  China 48
## 5                 France 41
## 6                Germany 41
## 7                 Canada 39
## 8  European Space Agency 39
## 9                  India 39
## 10        United Kingdom 38
```

```r
ggplot(topten_countries_by_years_launched, aes(x = reorder(Entity, n), y =
n)) +
  geom_bar(stat = "identity", fill = "steelblue") +
  coord_flip() +
  labs(title = "Top Entities by Number of years which they Launched objects",
x = "Entity", y = "Number of Launches") +
  theme_minimal()
```



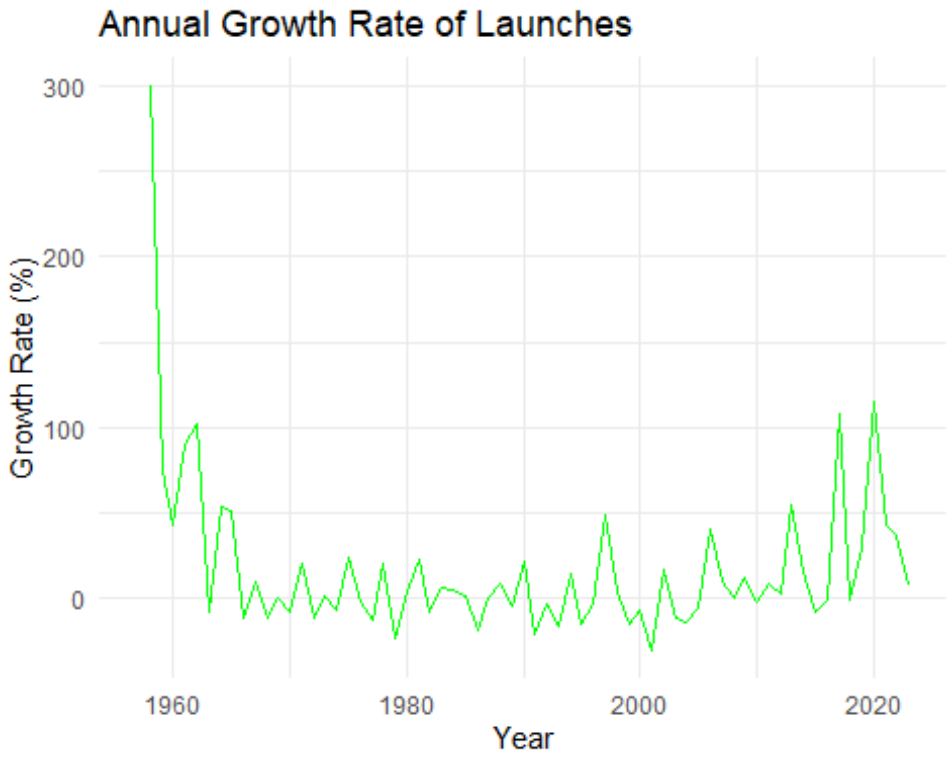

```r
# Calculate growth rates
launches_per_year <- data %>%
  group_by(Year) %>%
  summarise(Total_Launches =
sum(Annual.number.of.objects.launched.into.outer.space, na.rm = TRUE))

# Calculate annual growth rate
launches_per_year <- launches_per_year %>%
  mutate(Growth_Rate = (Total_Launches / lag(Total_Launches) - 1) * 100)

# Average growth rate
```

```r
avg_growth_rate <- mean(launches_per_year$Growth_Rate, na.rm = TRUE)
cat("Average Annual Growth Rate: ", avg_growth_rate, "%\n")
```

```
## Average Annual Growth Rate:  17.32665 %
```

```r
# Plot growth rates
ggplot(launches_per_year, aes(x = Year, y = Growth_Rate)) +
  geom_line(color = "green") +
  labs(title = "Annual Growth Rate of Launches", x = "Year", y = "Growth Rate
(%)") +
  theme_minimal()
```

```
## Warning: Removed 1 row containing missing values or values outside the
scale range
## (`geom_line()`).
```




```r
library(readr)
```

```
## Warning: package 'readr' was built under R version 4.4.2
```

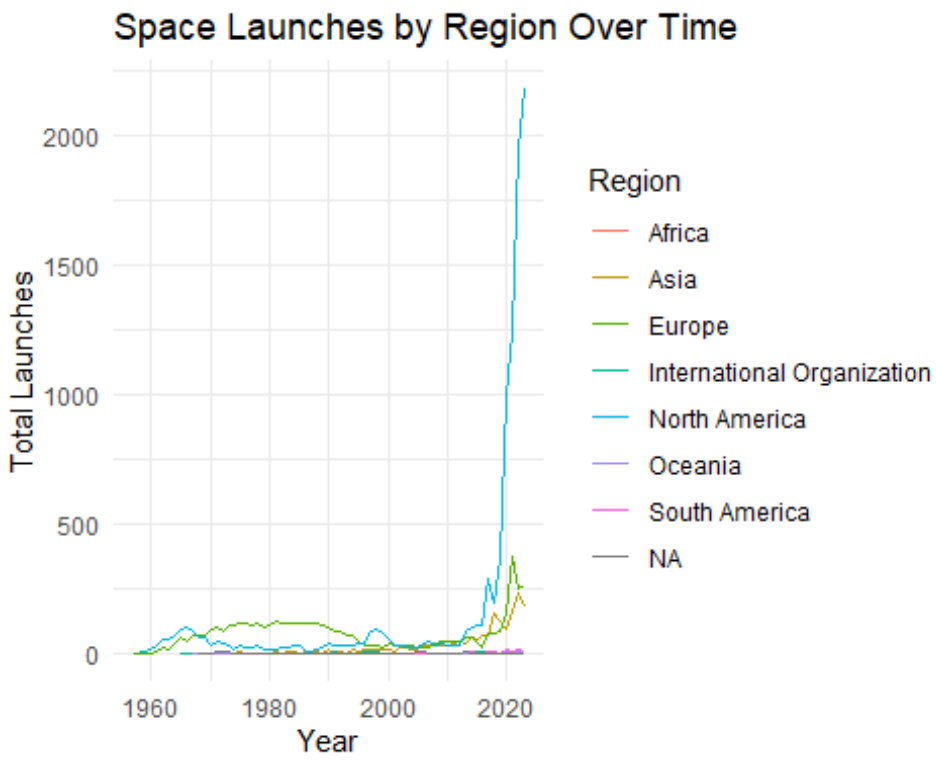
```r
# Read region mapping
region_mapping <- read_csv("country_to_region.csv")
```

```
## Rows: 108 Columns: 2
```

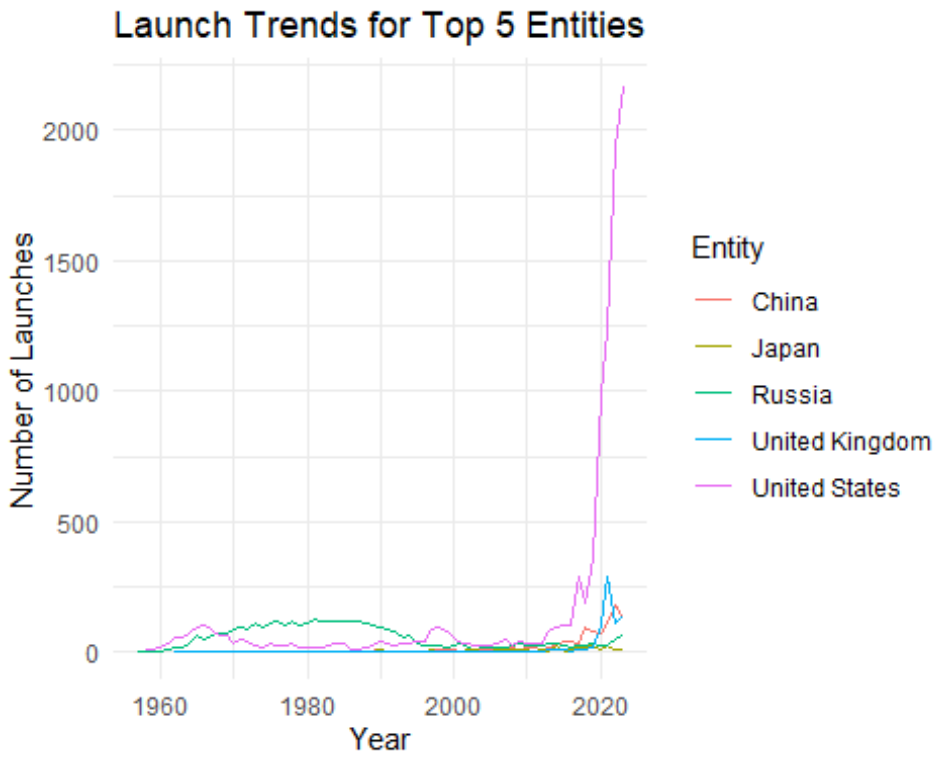
```
## ── Column specification
──────────────────────────────────────────────────────
```

```
## Delimiter: ","
```

```
## chr (2): Entity, Region
##
## ℹ Use `spec()` to retrieve the full column specification for this data.
## ℹ Specify the column types or set `show_col_types = FALSE` to quiet this
message.

# Merge with launch data
data_with_region <- data %>%
  left_join(region_mapping, by = "Entity")

# Group by region and year
launches_by_region <- data_with_region %>%
  group_by(Region, Year) %>%
  summarise(Total_Launches =
sum(Annual.number.of.objects.launched.into.outer.space, na.rm = TRUE))

## `summarise()` has grouped output by 'Region'. You can override using the
## `.groups` argument.

# Plot launches by region
ggplot(launches_by_region, aes(x = Year, y = Total_Launches, color = Region))
+
  geom_line() +
  labs(title = "Space Launches by Region Over Time", x = "Year", y = "Total
Launches") +
  theme_minimal()
```



```r
# Get top 5 entities
top_5_entities <- data %>%
  group_by(Entity) %>%
  summarise(Total_Launches =
sum(Annual.number.of.objects.launched.into.outer.space, na.rm = TRUE)) %>%
  arrange(desc(Total_Launches)) %>%
  slice(1:5)

# Filter data for top 5 entities
top_5_data <- data %>%
  filter(Entity %in% top_5_entities$Entity)

# Plot trends
ggplot(top_5_data, aes(x = Year, y =
Annual.number.of.objects.launched.into.outer.space, color = Entity)) +
  geom_line() +
  labs(title = "Launch Trends for Top 5 Entities", x = "Year", y = "Number of
Launches") +
  theme_minimal()
```



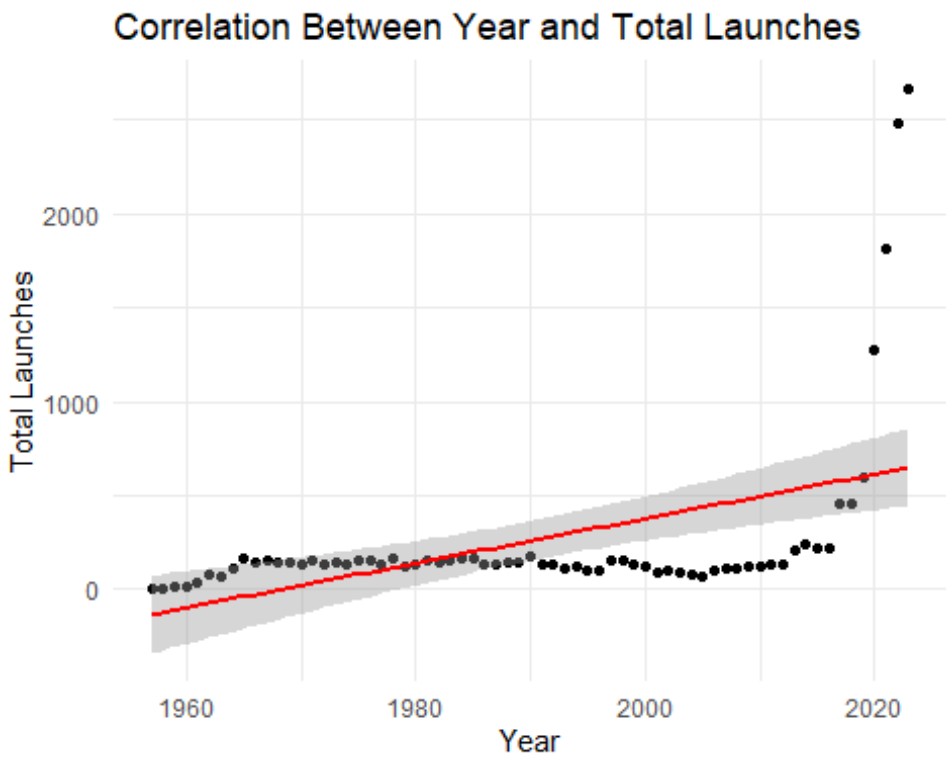

```r
# Calculate total launches per year
launches_per_year <- data %>%
  group_by(Year) %>%
  summarise(Total_Launches =
sum(Annual.number.of.objects.launched.into.outer.space, na.rm = TRUE))
```

```r
# Correlation analysis
correlation <- cor(launches_per_year$Year, launches_per_year$Total_Launches)
cat("Correlation between Year and Total Launches: ", correlation, "\n")
```

```
## Correlation between Year and Total Launches:  0.4763814
```

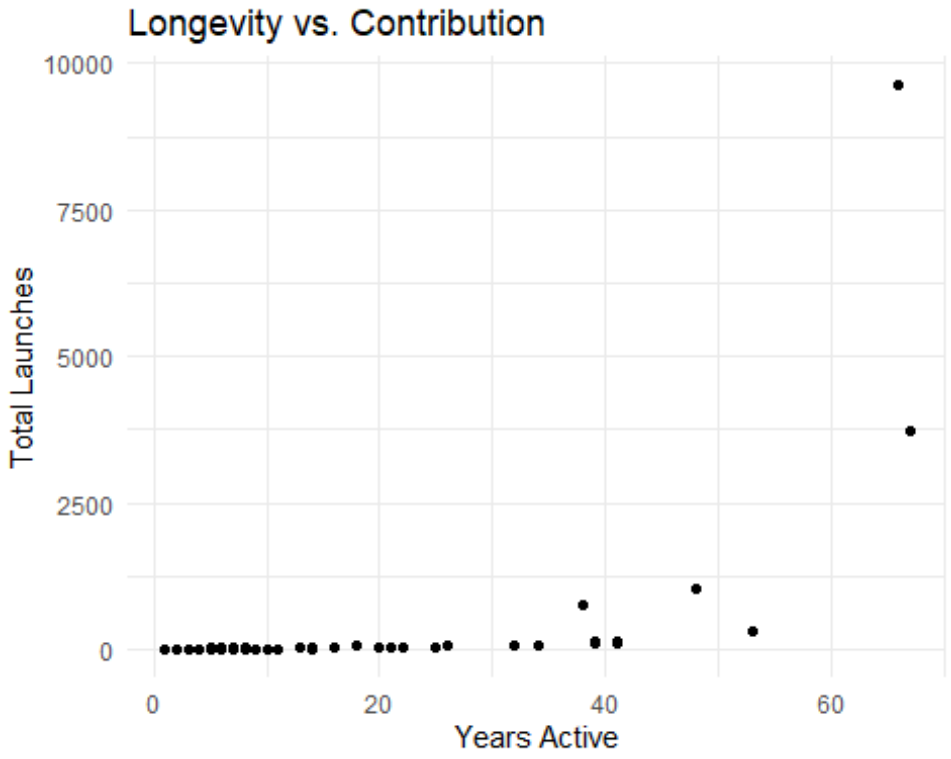
```r
# Plot with regression line
ggplot(launches_per_year, aes(x = Year, y = Total_Launches)) +
  geom_point() +
  geom_smooth(method = "lm", color = "red") +
  labs(title = "Correlation Between Year and Total Launches", x = "Year", y =
"Total Launches") +
  theme_minimal()
```

```
## `geom_smooth()` using formula = 'y ~ x'
```

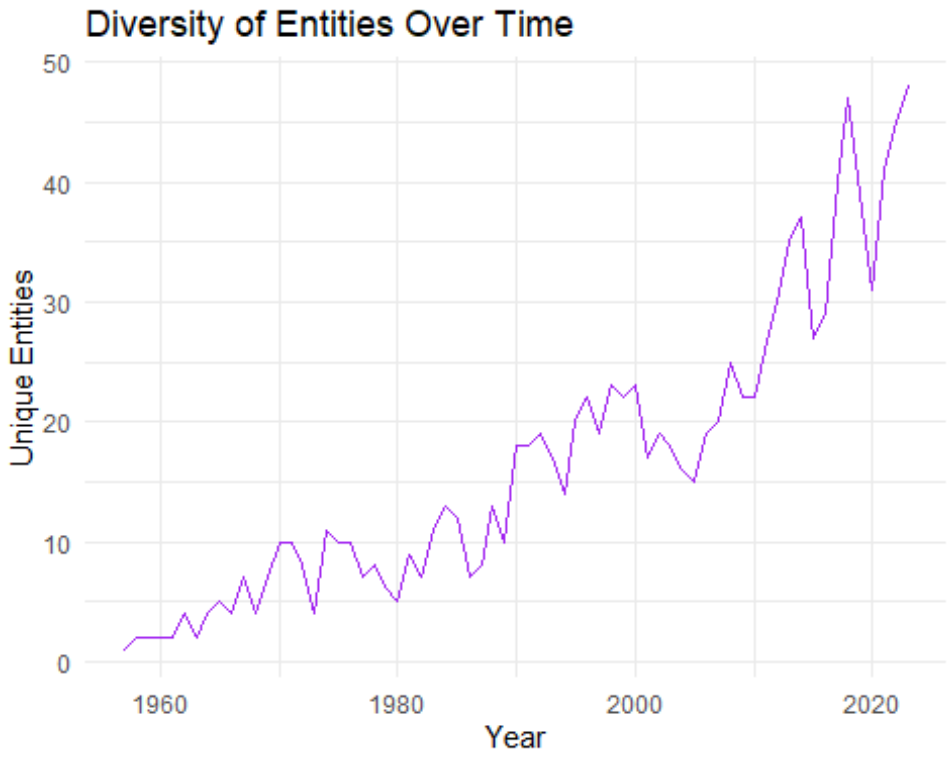



```r
# Calculate longevity and contribution
entity_analysis <- data %>%
  group_by(Entity) %>%
  summarise(
    Years_Active = n_distinct(Year),
    Total_Launches = sum(Annual.number.of.objects.launched.into.outer.space,
na.rm = TRUE)
  )

# Scatter plot
ggplot(entity_analysis, aes(x = Years_Active, y = Total_Launches)) +
```

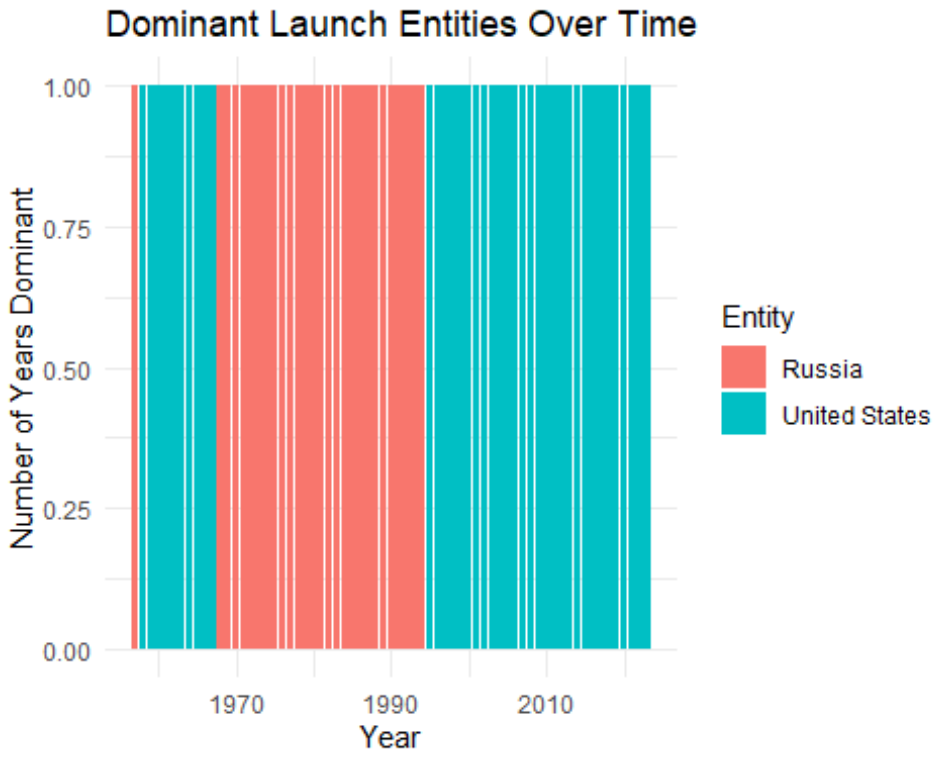
```
  geom_point() +
  labs(title = "Longevity vs. Contribution", x = "Years Active", y = "Total
Launches") +
  theme_minimal()
```



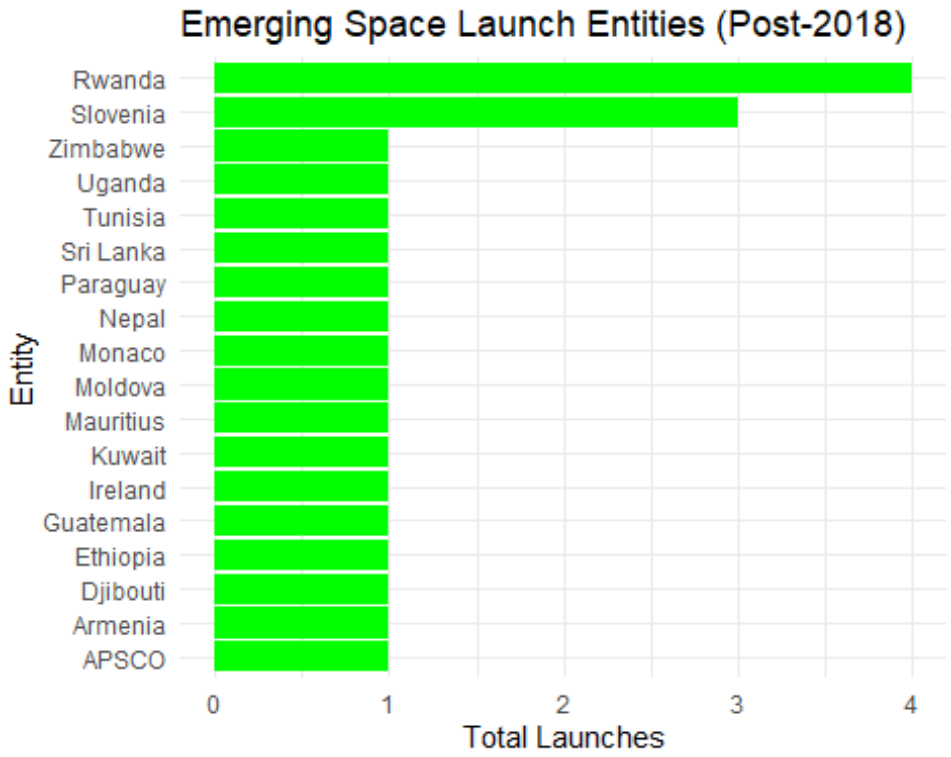

```
# Count unique entities per year
diversity_by_year <- data %>%
  group_by(Year) %>%
  summarise(Unique_Entities = n_distinct(Entity))

# Plot diversity trend
ggplot(diversity_by_year, aes(x = Year, y = Unique_Entities)) +
  geom_line(color = "purple") +
  labs(title = "Diversity of Entities Over Time", x = "Year", y = "Unique
Entities") +
  theme_minimal()
```



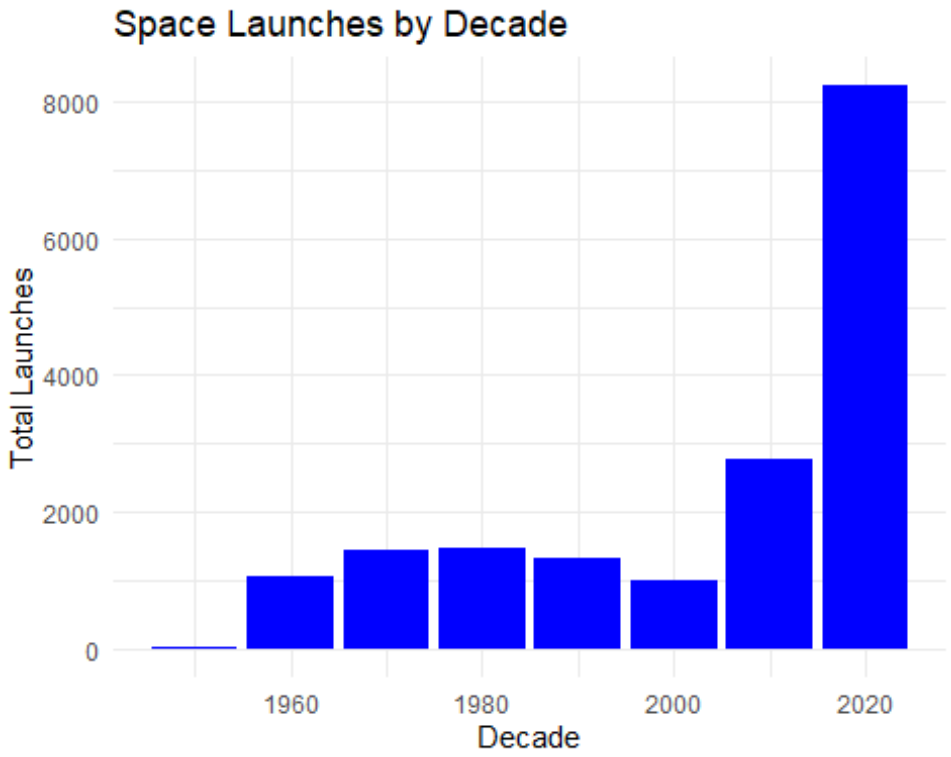

```r
# Find the top entity by year
top_entities_by_year <- data %>%
  group_by(Year) %>%
  slice_max(Annual.number.of.objects.launched.into.outer.space, n = 1)

# Plot dominance over time
ggplot(top_entities_by_year, aes(x = Year, fill = Entity)) +
  geom_bar(stat = "count") +
  labs(title = "Dominant Launch Entities Over Time", x = "Year", y = "Number
of Years Dominant") +
  theme_minimal()
```




```r
# Filter for entities starting launches after 2018
recent_launchers <- data %>%
  group_by(Entity) %>%
  filter(min(Year) > 2018) %>%
  summarise(Total_Launches =
sum(Annual.number.of.objects.launched.into.outer.space, na.rm = TRUE))

# Plot recent launchers
ggplot(recent_launchers, aes(x = reorder(Entity, Total_Launches), y =
Total_Launches)) +
  geom_bar(stat = "identity", fill = "green") +
  labs(title = "Emerging Space Launch Entities (Post-2018)", x = "Entity", y
= "Total Launches") +
  coord_flip() +
  theme_minimal()
```




```r
# Create a new column for decades
data <- data %>%
  mutate(Decade = floor(Year / 10) * 10)

# Summarize total launches by decade
launches_by_decade <- data %>%
  group_by(Decade) %>%
  summarise(Total_Launches =
sum(Annual.number.of.objects.launched.into.outer.space, na.rm = TRUE))

# Plot the trends by decade
ggplot(launches_by_decade, aes(x = Decade, y = Total_Launches)) +
  geom_bar(stat = "identity", fill = "blue") +
  labs(title = "Space Launches by Decade", x = "Decade", y = "Total
Launches") +
  theme_minimal()
```




```
model <- lm(Total_Launches ~ Year, data = launches_per_year)
summary(model)
```

```
##
## Call:
## lm(formula = Total_Launches ~ Year, data = launches_per_year)
##
## Residuals:
##    Min     1Q Median     3Q    Max
## -384.5 -242.3  -34.4  119.8 2014.0
##
## Coefficients:
##               Estimate Std. Error t value Pr(>|t|)
## (Intercept) -23335.814   5401.652  -4.320 5.45e-05 ***
## Year            11.857      2.714   4.368 4.60e-05 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 429.7 on 65 degrees of freedom
## Multiple R-squared:  0.2269, Adjusted R-squared:  0.215
## F-statistic: 19.08 on 1 and 65 DF,  p-value: 4.602e-05
```

```
predict(model, data.frame(Year = c(2024, 2025)))
```

```
##        1        2
## 661.8087 673.6652
```

```r
library(dplyr)
library(ggplot2)

# Summarize data
launches_per_year <- data %>%
  group_by(Year) %>%
  summarise(Total_Launches =
sum(Annual.number.of.objects.launched.into.outer.space, na.rm = TRUE))

# Build linear regression model
model <- lm(Total_Launches ~ Year, data = launches_per_year)

# Model summary
summary(model)
```

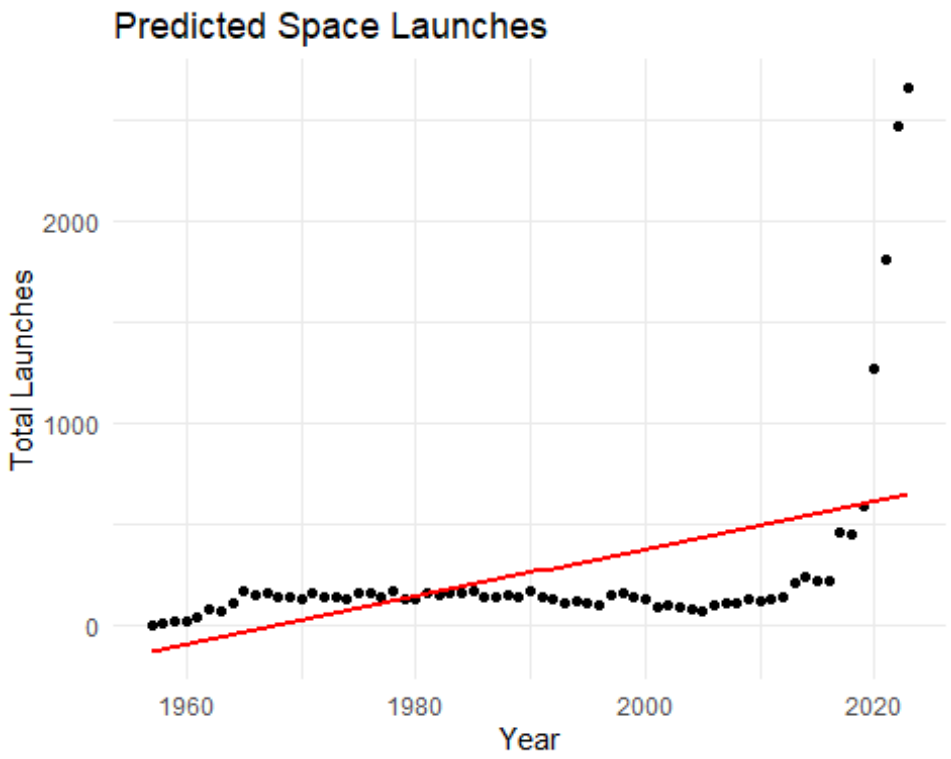
```
##
## Call:
## lm(formula = Total_Launches ~ Year, data = launches_per_year)
##
## Residuals:
##    Min     1Q Median     3Q    Max
## -384.5 -242.3  -34.4  119.8 2014.0
##
## Coefficients:
##               Estimate Std. Error t value Pr(>|t|)
## (Intercept) -23335.814   5401.652  -4.320 5.45e-05 ***
## Year            11.857      2.714   4.368 4.60e-05 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 429.7 on 65 degrees of freedom
## Multiple R-squared:  0.2269, Adjusted R-squared:  0.215
## F-statistic: 19.08 on 1 and 65 DF,  p-value: 4.602e-05
```

```r
# Predict launches for future years
future_years <- data.frame(Year = c(2024, 2025, 2026))
predicted_launches <- predict(model, newdata = future_years)
print(predicted_launches)
```

```
##        1        2        3
## 661.8087 673.6652 685.5217
```

```r
# Plot historical data and predictions
ggplot(launches_per_year, aes(x = Year, y = Total_Launches)) +
  geom_point() +
  geom_smooth(method = "lm", se = FALSE, color = "red") +
  labs(title = "Predicted Space Launches", x = "Year", y = "Total Launches")
+
  theme_minimal()
```

```
## `geom_smooth()` using formula = 'y ~ x'
```


Predicted Space Launches
Total Launches
2000
1000
0
1960
1980
2000
2020
Year