Does Location influence startup success

Reading the CSV

```
df <- read.csv("C:/Users/chaki/Downloads/cleaned_investments_VC.csv")
```

```
head(df)
```

```
##                 name      market funding_total_usd    status
## 1           #waywire        News           1750000  acquired
## 2  'Rock' Your Paper  Publishing             40000 operating
## 3  (In)Touch Network Electronics           1500000 operating
## 4 -R- Ranch and Mine     Tourism             60000 operating
## 5   004 Technologies    Software                 0 operating
## 6       1,2,3 Listo  E-Commerce             40000 operating
##                region       city funding_rounds founded_at founded_month
## 1         New York City   New York              1 2012-06-01       2012-06
## 2               Tallinn    Tallinn              1 2012-10-26       2012-10
## 3                London     London              1 2011-04-01       2011-04
## 4                Dallas Fort Worth              2 2014-01-01       2014-01
## 5 Springfield, Illinois  Champaign              1 2010-01-01       2010-01
## 6              Santiago Las Condes              1 2012-01-01       2012-01
##   founded_quarter founded_year first_funding_at last_funding_at    seed venture
## 1         2012-Q2         2012       2012-06-30      2012-06-30 1750000       0
## 2         2012-Q4         2012       2012-08-09      2012-08-09   40000       0
## 3         2011-Q2         2011       2011-04-01      2011-04-01 1500000       0
## 4         2014-Q1         2014       2014-08-17      2014-09-26       0       0
## 5         2010-Q1         2010       2014-07-24      2014-07-24       0       0
## 6         2012-Q1         2012       2013-02-18      2013-02-18   40000       0
##   equity_crowdfunding undisclosed convertible_note debt_financing angel grant
## 1                   0           0                0              0     0     0
## 2                   0           0                0              0     0     0
## 3                   0           0                0              0     0     0
## 4               60000           0                0              0     0     0
## 5                   0           0                0              0     0     0
## 6                   0           0                0              0     0     0
##   private_equity post_ipo_equity post_ipo_debt secondary_market
## 1              0               0             0                0
## 2              0               0             0                0
## 3              0               0             0                0
## 4              0               0             0                0
## 5              0               0             0                0
## 6              0               0             0                0
##   product_crowdfunding round_A round_B round_C round_D round_E round_F round_G
## 1                    0       0       0       0       0       0       0       0
## 2                    0       0       0       0       0       0       0       0
```

```
## 3                   0       0       0       0       0       0       0       0
## 4                   0       0       0       0       0       0       0       0
## 5                   0       0       0       0       0       0       0       0
## 6                   0       0       0       0       0       0       0       0
##   round_H        country age success_metric_updated
## 1       0  United States   2             Successful
## 2       0        Estonia   2 Potentially Successful
## 3       0 United Kingdom   3 Potentially Successful
## 4       0  United States   0 Potentially Successful
## 5       0  United States   4 Potentially Successful
## 6       0          Chile   2 Potentially Successful
```

```
nrow(df)
```

```
## [1] 32765
```

Country level analysis

Data Manipulation

```
library(tidyverse)
```

```
## Warning: package 'tidyverse' was built under R version 4.3.3

## Warning: package 'ggplot2' was built under R version 4.3.3

## Warning: package 'tibble' was built under R version 4.3.3

## Warning: package 'tidyr' was built under R version 4.3.3

## Warning: package 'readr' was built under R version 4.3.3

## Warning: package 'purrr' was built under R version 4.3.3

## Warning: package 'dplyr' was built under R version 4.3.3

## Warning: package 'forcats' was built under R version 4.3.3

## Warning: package 'lubridate' was built under R version 4.3.3

## -- Attaching core tidyverse packages ------------------------ tidyverse 2.0.0 --
## v dplyr     1.1.4     v readr     2.1.5
## v forcats   1.0.0     v stringr   1.5.1
## v ggplot2   3.5.0     v tibble    3.2.1
## v lubridate 1.9.3     v tidyr     1.3.1
## v purrr     1.0.2
## -- Conflicts ------------------------------------------ tidyverse_conflicts() --
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()    masks stats::lag()
## i Use the conflicted package (<http://conflicted.r-lib.org/>) to force all conflicts to become errors
```

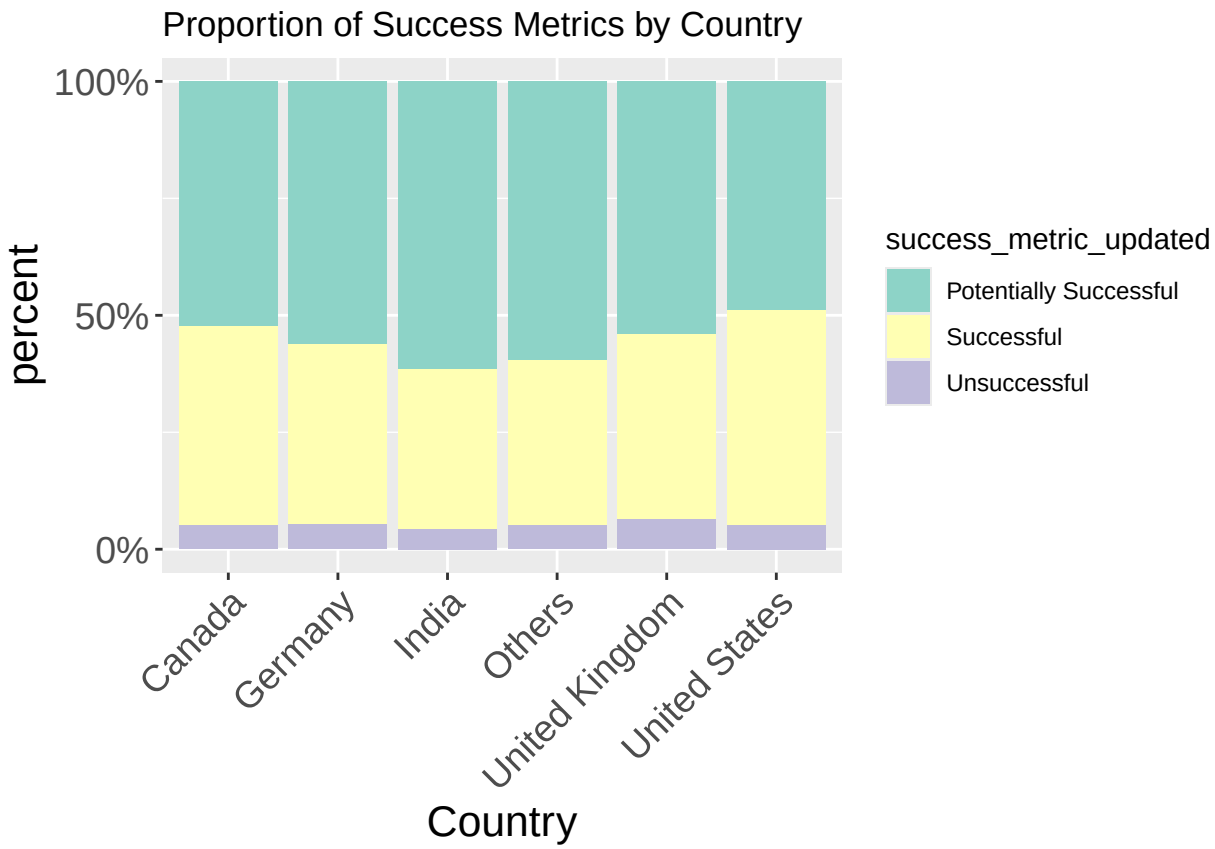
```r
top_5_countries <- df %>%
  count(country, sort = TRUE) %>%
  head(5) %>%
  pull(country)

df$country[!(df$country %in% top_5_countries)] <- "Others"
head(df)
```

```
##                 name      market funding_total_usd    status
## 1           #waywire        News           1750000  acquired
## 2  'Rock' Your Paper  Publishing             40000 operating
## 3  (In)Touch Network Electronics           1500000 operating
## 4 -R- Ranch and Mine     Tourism             60000 operating
## 5   004 Technologies    Software                 0 operating
## 6        1,2,3 Listo  E-Commerce             40000 operating
##                  region       city funding_rounds founded_at founded_month
## 1         New York City   New York              1 2012-06-01       2012-06
## 2               Tallinn    Tallinn              1 2012-10-26       2012-10
## 3                London     London              1 2011-04-01       2011-04
## 4                Dallas Fort Worth              2 2014-01-01       2014-01
## 5 Springfield, Illinois  Champaign              1 2010-01-01       2010-01
## 6              Santiago Las Condes              1 2012-01-01       2012-01
##   founded_quarter founded_year first_funding_at last_funding_at    seed venture
## 1         2012-Q2         2012       2012-06-30      2012-06-30 1750000       0
## 2         2012-Q4         2012       2012-08-09      2012-08-09   40000       0
## 3         2011-Q2         2011       2011-04-01      2011-04-01 1500000       0
## 4         2014-Q1         2014       2014-08-17      2014-09-26       0       0
## 5         2010-Q1         2010       2014-07-24      2014-07-24       0       0
## 6         2012-Q1         2012       2013-02-18      2013-02-18   40000       0
##   equity_crowdfunding undisclosed convertible_note debt_financing angel grant
## 1                   0           0                0              0     0     0
## 2                   0           0                0              0     0     0
## 3                   0           0                0              0     0     0
## 4               60000           0                0              0     0     0
## 5                   0           0                0              0     0     0
## 6                   0           0                0              0     0     0
##   private_equity post_ipo_equity post_ipo_debt secondary_market
## 1              0               0            0                0
## 2              0               0            0                0
## 3              0               0            0                0
## 4              0               0            0                0
## 5              0               0            0                0
## 6              0               0            0                0
##   product_crowdfunding round_A round_B round_C round_D round_E round_F round_G
## 1                    0       0       0       0       0       0       0       0
## 2                    0       0       0       0       0       0       0       0
## 3                    0       0       0       0       0       0       0       0
## 4                    0       0       0       0       0       0       0       0
## 5                    0       0       0       0       0       0       0       0
## 6                    0       0       0       0       0       0       0       0
##   round_H        country age success_metric_updated
## 1       0  United States   2             Successful
## 2       0         Others   2 Potentially Successful
```

```
## 3       0 United Kingdom   3 Potentially Successful
## 4       0  United States   0 Potentially Successful
## 5       0  United States   4 Potentially Successful
## 6       0         Others   2 Potentially Successful
```

Visualising success status proportion (as percentage) for countries

```
library(ggplot2)

ggplot(df, aes(x = country, fill = success_metric_updated)) +
  geom_bar(stat = "count", position = "fill") +
  scale_fill_brewer(palette = "Set3") +
  scale_y_continuous(name = "percent",
                     breaks = c(0, 0.5, 1),
                     labels = scales::percent(c(0, 0.5, 1))) +
  labs(title = "Proportion of Success Metrics by Country",
       x = "Country",
       y = "Proportion") +
  # Increase font size and rotate x-axis labels
  theme(axis.text = element_text(size = 14),
        axis.title = element_text(size = 16),
        axis.text.x = element_text(angle = 45, hjust = 1))
```



Merging "Potentially Successfully" into "Unsuccessful"

```
df_new <- df
df_new$success_metric_updated[df$success_metric_updated == 'Potentially Successful'] <- 'Unsuccessful'
head(df)
```

```
##                name      market funding_total_usd    status
## 1          #waywire        News           1750000  acquired
## 2  'Rock' Your Paper  Publishing             40000 operating
## 3  (In)Touch Network Electronics           1500000 operating
## 4 -R- Ranch and Mine     Tourism             60000 operating
## 5   004 Technologies    Software                 0 operating
## 6       1,2,3 Listo  E-Commerce             40000 operating
##                 region       city funding_rounds founded_at founded_month
## 1         New York City   New York              1 2012-06-01       2012-06
## 2               Tallinn    Tallinn              1 2012-10-26       2012-10
## 3                London     London              1 2011-04-01       2011-04
## 4                Dallas Fort Worth              2 2014-01-01       2014-01
## 5 Springfield, Illinois  Champaign              1 2010-01-01       2010-01
## 6              Santiago Las Condes              1 2012-01-01       2012-01
##   founded_quarter founded_year first_funding_at last_funding_at    seed venture
## 1         2012-Q2         2012       2012-06-30      2012-06-30 1750000       0
## 2         2012-Q4         2012       2012-08-09      2012-08-09   40000       0
## 3         2011-Q2         2011       2011-04-01      2011-04-01 1500000       0
## 4         2014-Q1         2014       2014-08-17      2014-09-26       0       0
## 5         2010-Q1         2010       2014-07-24      2014-07-24       0       0
## 6         2012-Q1         2012       2013-02-18      2013-02-18   40000       0
##   equity_crowdfunding undisclosed convertible_note debt_financing angel grant
## 1                   0           0                0              0     0     0
## 2                   0           0                0              0     0     0
## 3                   0           0                0              0     0     0
## 4               60000           0                0              0     0     0
## 5                   0           0                0              0     0     0
## 6                   0           0                0              0     0     0
##   private_equity post_ipo_equity post_ipo_debt secondary_market
## 1              0               0             0                0
## 2              0               0             0                0
## 3              0               0             0                0
## 4              0               0             0                0
## 5              0               0             0                0
## 6              0               0             0                0
##   product_crowdfunding round_A round_B round_C round_D round_E round_F round_G
## 1                    0       0       0       0       0       0       0       0
## 2                    0       0       0       0       0       0       0       0
## 3                    0       0       0       0       0       0       0       0
## 4                    0       0       0       0       0       0       0       0
## 5                    0       0       0       0       0       0       0       0
## 6                    0       0       0       0       0       0       0       0
##   round_H        country age success_metric_updated
## 1       0  United States   2             Successful
## 2       0         Others   2 Potentially Successful
## 3       0 United Kingdom   3 Potentially Successful
## 4       0  United States   0 Potentially Successful
```

```
## 5       0  United States   4 Potentially Successful
## 6       0         Others   2 Potentially Successful
```

```
df_new <- df_new[c("country", "success_metric_updated")]
head(df_new)
```

```
##          country success_metric_updated
## 1  United States             Successful
## 2         Others           Unsuccessful
## 3 United Kingdom           Unsuccessful
## 4  United States           Unsuccessful
## 5  United States           Unsuccessful
## 6         Others           Unsuccessful
```

Contigency tables

```
tbl <- table(df_new$country,df_new$success_metric_updated)
tbl
```

```
##
##                 Successful Unsuccessful
##   Canada               441          594
##   Germany              269          428
##   India                220          424
##   Others              2266         4145
##   United Kingdom       712         1084
##   United States      10154        12028
```

```
library(lsr)
```

```
## Warning: package 'lsr' was built under R version 4.3.3
```

```
cramer_v <- cramersV(tbl)

cat("Cramer's V:", cramer_v)
```

```
## Cramer's V: 0.08863159
```

```
tbl_prop <- prop.table(tbl, 1)
tbl_prop
```

```
##
##                 Successful Unsuccessful
##   Canada         0.4260870    0.5739130
##   Germany        0.3859397    0.6140603
##   India          0.3416149    0.6583851
##   Others         0.3534550    0.6465450
##   United Kingdom 0.3964365    0.6035635
##   United States  0.4577585    0.5422415
```

Chi square

```
chisq.test(tbl)
```

```
##
##  Pearson's Chi-squared test
##
## data:  tbl
## X-squared = 257.39, df = 5, p-value < 2.2e-16
```

Testing if proportion of success for US is different from other countries

```
# Create a new data frame with the "Others" category
df_new_merge <- df[c("country", "success_metric_updated")]
df_new_merge$country[!(df_new_merge$country %in% c("United States", "Others"))] <- "Others"

# Create a new table with the updated data frame
tbl_merge <- table(df_new_merge$country, df_new_merge$success_metric_updated)

tbl_merge
```

```
##
##                 Potentially Successful Successful Unsuccessful
##   Others                          6122       3908          553
##   United States                  10879      10154         1149
```

```
cramer_v <- cramersV(tbl_merge)
cat("Cramer's V:", cramer_v)
```

```
## Cramer's V: 0.08518362
```

```
# Subset data for US and Others
usa_data <- df_new_merge[df_new_merge$country == "United States", ]
other_data <- df_new_merge[df_new_merge$country != "United States", ]

# Calculate success proportions for each group
p_usa <- sum(usa_data$success_metric_updated == "Successful") / nrow(usa_data)
p_other <- sum(other_data$success_metric_updated == "Successful") / nrow(other_data)

# Calculate pooled proportion (assuming equal variances)
pooled_p <- (sum(usa_data$success_metric_updated == "Successful") + sum(other_data$success_metric_updat

# Calculate standard error for the difference in proportions
se_diff <- sqrt(pooled_p * (1 - pooled_p) * (1/nrow(usa_data) + 1/nrow(other_data)))

# Calculate the z-statistic
z_stat <- (p_usa - p_other) / se_diff
```

```r
# Interpretation
# A p-value less than the chosen significance level 0.05 indicates
# a statistically significant difference between the success proportions
# in US and Others category.
```

```r
# Confidence level (e.g., 95%)
confidence_level <- 0.95

# Critical value (one-tailed) from standard normal distribution table for confidence level
z_crit <- qnorm(1 - (1 - confidence_level) / 2, mean = 0, sd = 1)

# Confidence interval for the difference in proportions
lower_bound <- (p_usa - p_other) - z_crit * se_diff
upper_bound <- (p_usa - p_other) + z_crit * se_diff

# Interpretation
# Report the z-statistic, p-value, and confidence interval.
# The confidence interval captures the range of plausible values for the true
# difference in success proportions between US and Others with a confidence level
# of (e.g.,) 95%.

cat("z-statistic:", z_stat, "\n")
```

```
## z-statistic: 15.13249
```

```r
cat("p-value (two-tailed):", 2 * pnorm(-abs(z_stat), mean = 0, sd = 1, lower.tail = TRUE), "\n")
```

```
## p-value (two-tailed): 9.887838e-52
```

```r
cat("Confidence Interval (", confidence_level * 100, "%):", lower_bound, " - ", upper_bound, "\n")
```

```
## Confidence Interval ( 95 %): 0.0770262  -  0.09994794
```

City level analysis

```r
df_us <- df %>%
  filter(country == "United States")

length(unique(df_us$city))
```

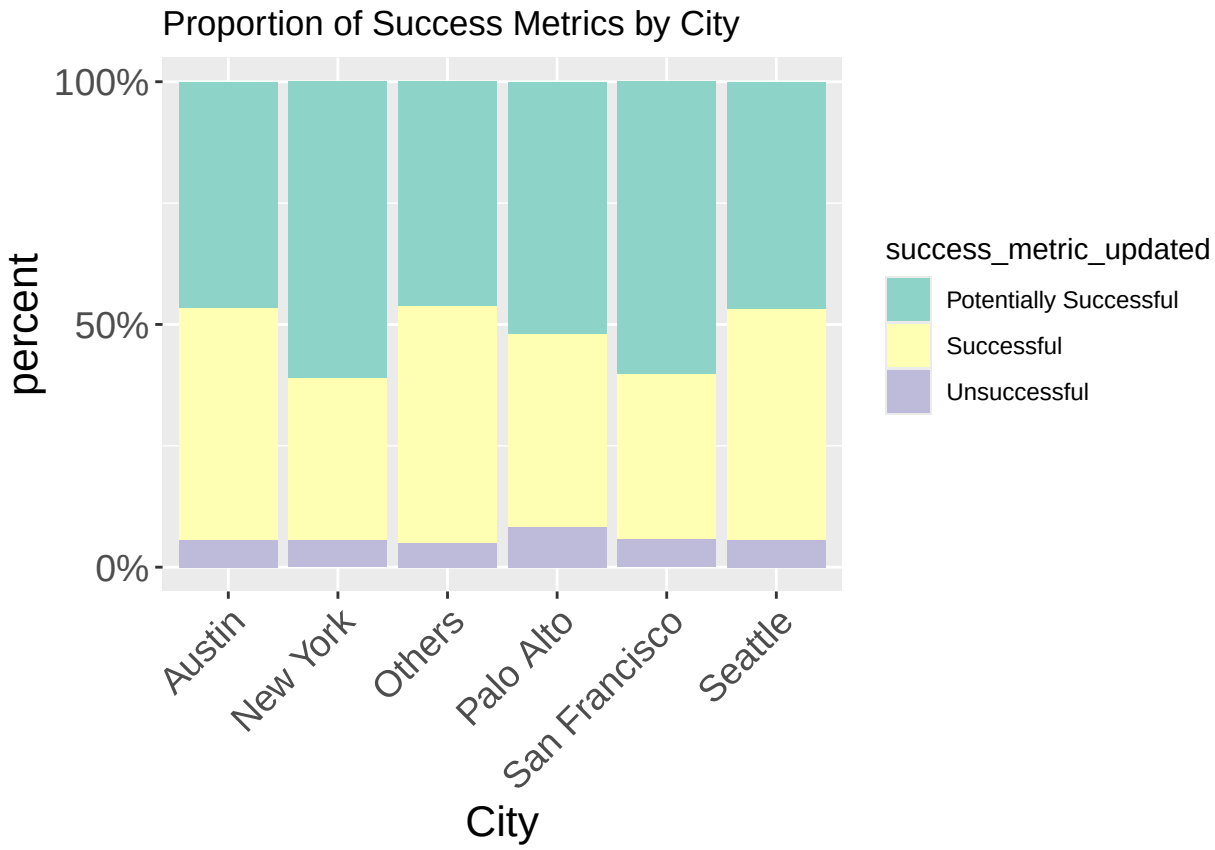
```
## [1] 1975
```

```r
top_5_cities <- df_us %>%
  count(city, sort = TRUE) %>%
  head(5) %>%
  pull(city)

df_us$city[!(df_us$city %in% top_5_cities)] <- "Others"
head(df_us)
```

```
##                 name              market funding_total_usd    status
## 1           #waywire                News           1750000  acquired
## 2 -R- Ranch and Mine             Tourism             60000 operating
## 3   004 Technologies            Software                 0 operating
## 4      1-800-DENTIST Health and Wellness                 0 operating
## 5      1-800-DOCTORS Health and Wellness           1750000 operating
## 6   1.618 Technology         Real Estate                 0 operating
##                  region     city funding_rounds founded_at founded_month
## 1         New York City New York              1 2012-06-01       2012-06
## 2                Dallas   Others              2 2014-01-01       2014-01
## 3 Springfield, Illinois   Others              1 2010-01-01       2010-01
## 4           Los Angeles   Others              1 1986-01-01       1986-01
## 5                Newark   Others              1 1984-01-01       1984-01
## 6               Orlando   Others              1 2013-12-07       2013-12
##   founded_quarter founded_year first_funding_at last_funding_at    seed venture
## 1         2012-Q2         2012       2012-06-30      2012-06-30 1750000       0
## 2         2014-Q1         2014       2014-08-17      2014-09-26       0       0
## 3         2010-Q1         2010       2014-07-24      2014-07-24       0       0
## 4         1986-Q1         1986       2010-08-19      2010-08-19       0       0
## 5         1984-Q1         1984       2011-03-02      2011-03-02       0       0
## 6         2013-Q4         2013       2014-01-22      2014-01-22       0       0
##   equity_crowdfunding undisclosed convertible_note debt_financing angel grant
## 1                   0           0                0              0     0     0
## 2               60000           0                0              0     0     0
## 3                   0           0                0              0     0     0
## 4                   0           0                0              0     0     0
## 5                   0           0          1750000              0     0     0
## 6                   0           0                0              0     0     0
##   private_equity post_ipo_equity post_ipo_debt secondary_market
## 1              0               0             0                0
## 2              0               0             0                0
## 3              0               0             0                0
## 4              0               0             0                0
## 5              0               0             0                0
## 6              0               0             0                0
##   product_crowdfunding round_A round_B round_C round_D round_E round_F round_G
## 1                    0       0       0       0       0       0       0       0
## 2                    0       0       0       0       0       0       0       0
## 3                    0       0       0       0       0       0       0       0
## 4                    0       0       0       0       0       0       0       0
## 5                    0       0       0       0       0       0       0       0
## 6                    0       0       0       0       0       0       0       0
##   round_H       country age success_metric_updated
## 1       0 United States   2             Successful
## 2       0 United States   0 Potentially Successful
## 3       0 United States   4 Potentially Successful
## 4       0 United States  28             Successful
## 5       0 United States  30             Successful
## 6       0 United States   1 Potentially Successful
```

```r
library(ggplot2)

ggplot(df_us, aes(x = city, fill = success_metric_updated)) +
  geom_bar(stat = "count", position = "fill") +
```

```
  scale_fill_brewer(palette = "Set3") +
  scale_y_continuous(name = "percent",
                     breaks = c(0, 0.5, 1),
                     labels = scales::percent(c(0, 0.5, 1))) +
  labs(title = "Proportion of Success Metrics by City",
       x = "City",
       y = "Proportion") +
  # Increase font size and rotate x-axis labels
  theme(axis.text = element_text(size = 14),  # Change 14 to your desired size
        axis.title = element_text(size = 16),  # Change 16 to your desired size
        axis.text.x = element_text(angle = 45, hjust = 1))  # Rotate x-axis labels
```




```
df_us_new <- df_us
df_us_new$success_metric_updated[df_us$success_metric_updated == 'Potentially Successful'] <- 'Unsucces
```

```
df_us_new <- df_us_new[c("city", "success_metric_updated")]
head(df_us_new)
```

```
##       city success_metric_updated
## 1 New York             Successful
## 2   Others           Unsuccessful
## 3   Others           Unsuccessful
## 4   Others             Successful
## 5   Others             Successful
## 6   Others           Unsuccessful
```

```r
tbl2 <- table(df_us_new$city,df_us_new$success_metric_updated)
tbl2
```

```
##
##                 Successful Unsuccessful
##   Austin               220          242
##   New York             655         1296
##   Others              8118         8500
##   Palo Alto            192          292
##   San Francisco        756         1463
##   Seattle              213          235
```

```r
cramer_v <- cramersV(tbl2)

cat("Cramer's V:", cramer_v)
```

```
## Cramer's V: 0.1184705
```

```r
tbl_prop2 <- prop.table(tbl2, 1)
tbl_prop2
```

```
##
##                 Successful Unsuccessful
##   Austin         0.4761905    0.5238095
##   New York       0.3357253    0.6642747
##   Others         0.4885064    0.5114936
##   Palo Alto      0.3966942    0.6033058
##   San Francisco  0.3406940    0.6593060
##   Seattle        0.4754464    0.5245536
```

```r
chisq.test(tbl2)
```

```
##
##  Pearson's Chi-squared test
##
## data:  tbl2
## X-squared = 311.33, df = 5, p-value < 2.2e-16
```

```r
# Create a new data frame with the "Others" category
df_us_new_merge <- df[c("city", "success_metric_updated")]
df_us_new_merge$city[!(df_us_new_merge$city %in% c("Seattle", "Others"))] <- "Others"

# Create a new table with the updated data frame
tbl_us_merge <- table(df_us_new_merge$city, df_us_new_merge$success_metric_updated)

tbl_us_merge
```

```
##
##           Potentially Successful Successful Unsuccessful
##   Others                   16791      13849         1677
##   Seattle                    210        213           25
```

```r
# Subset data for US and Others
seattle_data <- df_us_new_merge[df_us_new_merge$city == "Seattle", ]
other_data <- df_us_new_merge[df_us_new_merge$city != "Seattle", ]

# Calculate success proportions for each group
p_sea <- sum(seattle_data$success_metric_updated == "Successful") / nrow(seattle_data)
p_other <- sum(other_data$success_metric_updated == "Successful") / nrow(other_data)

# Calculate pooled proportion (assuming equal variances)
pooled_p <- (sum(seattle_data$success_metric_updated == "Successful") + sum(other_data$success_metric_u

# Calculate standard error for the difference in proportions
se_diff <- sqrt(pooled_p * (1 - pooled_p) * (1/nrow(seattle_data) + 1/nrow(other_data)))

# Calculate the z-statistic
z_stat <- (p_sea - p_other) / se_diff

# Interpretation
# A p-value less than the chosen significance level 0.05 indicates
# a statistically significant difference between the success proportions
# in US and Others category.
```

```r
# Confidence level (e.g., 95%)
confidence_level <- 0.95

# Critical value (one-tailed) from standard normal distribution table for confidence level
z_crit <- qnorm(1 - (1 - confidence_level) / 2, mean = 0, sd = 1)

# Confidence interval for the difference in proportions
lower_bound <- (p_sea - p_other) - z_crit * se_diff
upper_bound <- (p_sea - p_other) + z_crit * se_diff

# Interpretation
# Report the z-statistic, p-value, and confidence interval.
# The confidence interval captures the range of plausible values for the true
# difference in success proportions between US and Others with a confidence level
# of (e.g.,) 95%.

cat("z-statistic:", z_stat, "\n")
```

```
## z-statistic: 1.992275
```

```r
cat("p-value (two-tailed):", 2 * pnorm(-abs(z_stat), mean = 0, sd = 1, lower.tail = TRUE), "\n")
```

```
## p-value (two-tailed): 0.04634092
```

```r
cat("Confidence Interval (", confidence_level * 100, "%):", lower_bound, " - ", upper_bound, "\n")
```

```
## Confidence Interval ( 95 %): 0.0007607936  -  0.09305993
```

Additional analysis: Logistic Regression

Country level analysis

```
df_new$success_metric_updated <- as.numeric(df_new$success_metric_updated == "Successful")
```

```
df_new <- within(df_new,relevel(factor(country),ref = "Others"))
head(df_new)
```

```
##          country success_metric_updated
## 1  United States                       1
## 2         Others                       0
## 3 United Kingdom                       0
## 4  United States                       0
## 5  United States                       0
## 6         Others                       0
```

```
model <- glm(success_metric_updated ~ country , data = df_new, family = "binomial")
summary(model)
```

```
##
## Call:
## glm(formula = success_metric_updated ~ country, family = "binomial",
##     data = df_new)
##
## Coefficients:
##                         Estimate Std. Error z value Pr(>|z|)
## (Intercept)            -0.29783    0.06286  -4.738 2.16e-06 ***
## countryGermany         -0.16658    0.10002  -1.665 0.095841 .
## countryIndia           -0.35827    0.10419  -3.439 0.000584 ***
## countryOthers          -0.30605    0.06807  -4.496 6.92e-06 ***
## countryUnited Kingdom -0.12250    0.07923  -1.546 0.122091
## countryUnited States   0.12846    0.06429   1.998 0.045681 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 44762  on 32764  degrees of freedom
## Residual deviance: 44502  on 32759  degrees of freedom
## AIC: 44514
##
## Number of Fisher Scoring iterations: 4
```

```
library("effects")
```

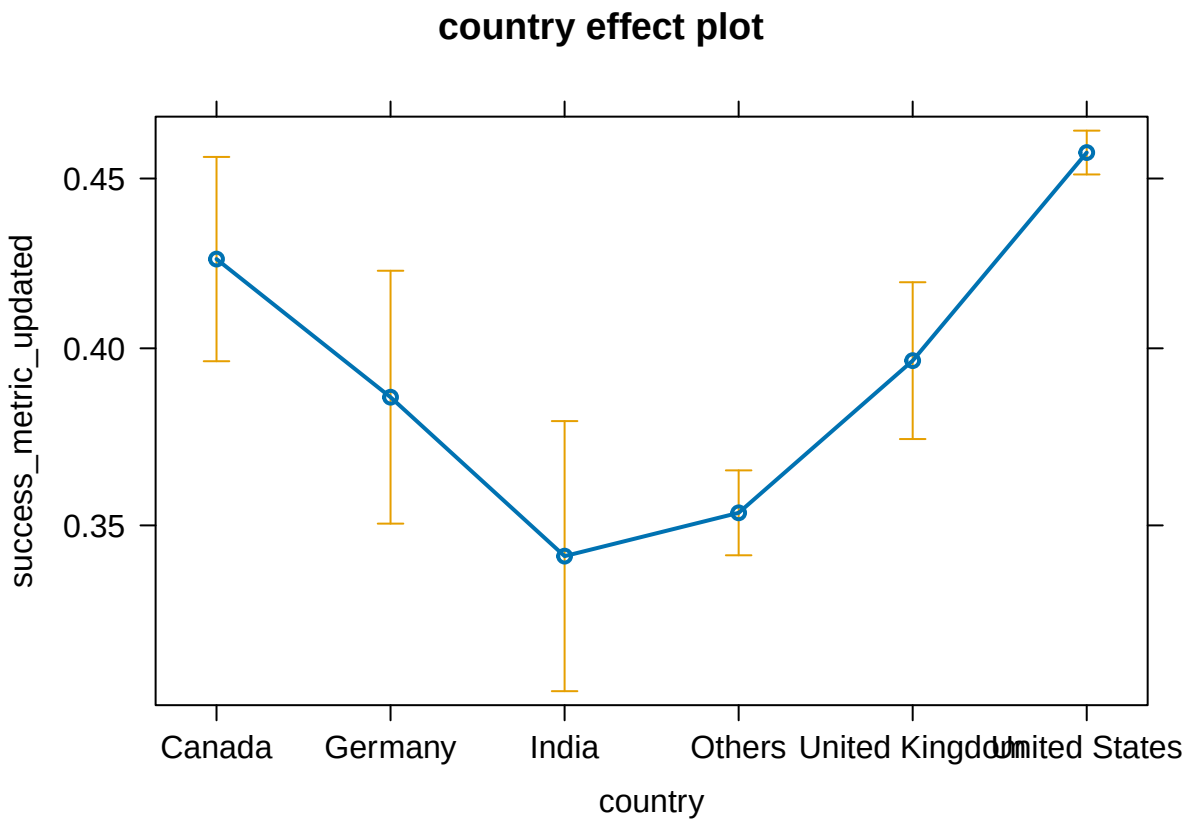
```
## Warning: package 'effects' was built under R version 4.3.3
```

```
## Loading required package: carData
```

```
## Warning: package 'carData' was built under R version 4.3.3
```

```
## lattice theme set by effectsTheme()
## See ?effectsTheme for details.
```

```
plot(Effect('country', model), confint=T)
```




```
# Get the estimated coefficients
coefs <- coef(model, simplify=TRUE)

# Calculate odds ratios for each country compared to the reference category
odds_ratios <- as.data.frame(exp(coefs))
odds_ratios
```

```
##                          exp(coefs)
## (Intercept)               0.7424242
## countryGermany            0.8465573
## countryIndia              0.6988833
## countryOthers             0.7363482
## countryUnited Kingdom     0.8847052
## countryUnited States      1.1370815
```

City level analysis

```
df_us_new <- within(df_us_new,relevel(factor(city),ref = "Others"))
```

```
library(nnet)
df_us_new$city <- as.factor(df_us_new$city)
df_relevel_us <- df_us_new %>%
  mutate(city = relevel(city, ref = "Seattle"))
model2 <- multinom(success_metric_updated ~ city, data = df_relevel_us)
```

```
## # weights:  7 (6 variable)
## initial  value 15375.390759
## iter  10 value 15137.631892
## iter  10 value 15137.631885
## iter  10 value 15137.631885
## final  value 15137.631885
## converged
```

```
summary(model2)
```

```
## Call:
## multinom(formula = success_metric_updated ~ city, data = df_relevel_us)
##
## Coefficients:
##                        Values  Std. Err.
## (Intercept)        0.098291453 0.09460525
## cityAustin        -0.002981561 0.13276988
## cityNew York       0.584116158 0.10605885
## cityOthers        -0.052309359 0.09586962
## cityPalo Alto      0.320967783 0.13260146
## citySan Francisco  0.561910200 0.10467297
##
## Residual Deviance: 30275.26
## AIC: 30287.26
```

```
df_us_new$success_metric_updated <- as.numeric(df_us_new$success_metric_updated == "Successful")
```

```
model2 <- glm(success_metric_updated ~ city, data = df_us_new, family = "binomial")
summary(model2)
```

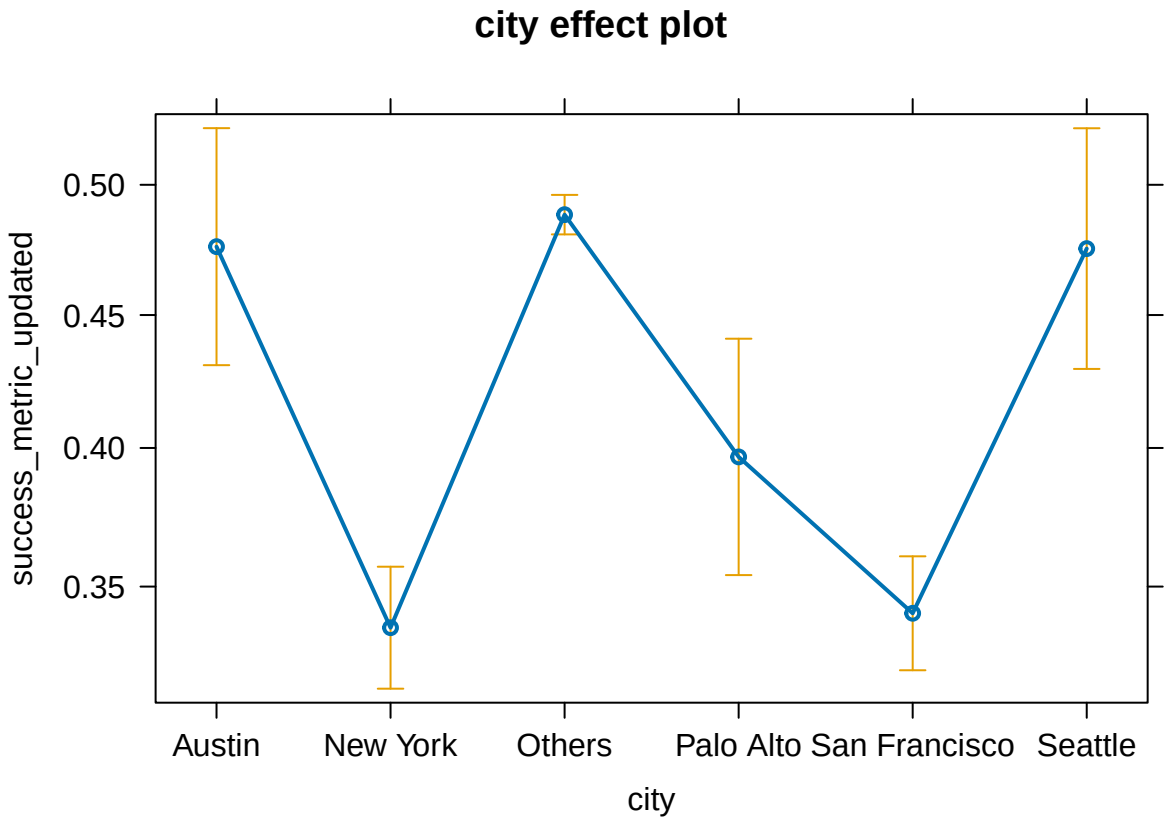
```
##
## Call:
## glm(formula = success_metric_updated ~ city, family = "binomial",
##     data = df_us_new)
##
## Coefficients:
##                    Estimate Std. Error z value Pr(>|z|)
## (Intercept)       -0.095310   0.093154  -1.023   0.3062
## cityNew York      -0.587092   0.104766  -5.604 2.10e-08 ***
## cityOthers         0.049328   0.094438   0.522   0.6014
```

```
## cityPalo Alto     -0.323948   0.131570  -2.462   0.0138 *
## citySan Francisco -0.564893   0.103363  -5.465 4.63e-08 ***
## citySeattle       -0.002983   0.132770  -0.022   0.9821
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 30592  on 22181  degrees of freedom
## Residual deviance: 30275  on 22176  degrees of freedom
## AIC: 30287
##
## Number of Fisher Scoring iterations: 4
```

```
# Get the estimated coefficients
coefs <- coef(model2, simplify=TRUE)

# Calculate odds ratios for each country compared to the reference category
odds_ratios <- as.data.frame(exp(coefs))
odds_ratios
```

```
##                   exp(coefs)
## (Intercept)        0.9090909
## cityNew York       0.5559414
## cityOthers         1.0505647
## cityPalo Alto      0.7232877
## citySan Francisco  0.5684211
## citySeattle        0.9970213
```

```
library("effects")
plot(Effect('city', model2), confint=T)
```


city effect plot
success_metric_updated
0.50
0.45
0.40
0.35
Austin
New York
Others
Palo Alto
San Francisco
Seattle
city