

Support for Eliminating Tariffs on Electric Vehicles from China

Leonardo L Sanchez

2026-01-23

Given Data

A random sample of Canadians from four major cities was surveyed.

City	Sample Size (n)	% Yes	Yes	No
Vancouver	400	62%	248	152
Calgary	250	58%	145	105
Toronto	300	52%	156	144
Montreal	250	48%	120	130

```
setwd("P:/langara/term 3/dana 4820")

# City data
city <- c("Vancouver", "Calgary", "Toronto", "Montreal")
n     <- c(400, 250, 300, 250)
pyes <- c(0.62, 0.58, 0.52, 0.48)

yes <- round(n * pyes)    # counts are exact here
no   <- n - yes
df   <- data.frame(City = city, n = n, YesPercent = pyes, Yes = yes, No = no)
df

##          City    n YesPercent Yes  No
## 1 Vancouver 400      0.62 248 152
## 2   Calgary 250      0.58 145 105
## 3   Toronto 300      0.52 156 144
## 4 Montreal 250      0.48 120 130
```

Part A – Test for Differences Among Cities

Hypotheses

Let p_V, p_C, p_T, p_M denote the true population proportions answering “Yes” in Vancouver, Calgary, Toronto, and Montreal.

Null hypothesis:

$$H_0 : p_V = p_C = p_T = p_M$$

Alternative hypothesis:

$$H_a : \text{At least one of the proportions differs}$$

Estimated proportion assuming H_0 is true

If the null hypothesis is true, all cities share a common population proportion. This proportion is estimated using the pooled sample proportion:

$$\hat{p} = \frac{248 + 145 + 156 + 120}{400 + 250 + 300 + 250} = \frac{669}{1200} = 0.5575$$

Therefore, assuming H_0 is true, the estimated proportion of Canadians in Vancouver who agree is **0.5575 (55.75%)**.

Chi-square test statistic and p-value

```
# Counts from the problem
yes <- c(248, 145, 156, 120)
no  <- c(152, 105, 144, 130)

# Create contingency table
tab <- rbind(Yes = yes, No = no)
colnames(tab) <- c("Vancouver", "Calgary", "Toronto", "Montreal")

tab
##      Vancouver Calgary Toronto Montreal
## Yes        248      145     156      120
## No         152      105     144      130

# Chi-square test of homogeneity
test <- chisq.test(tab, correct = FALSE)
test

##
## Pearson's Chi-squared test
##
## data: tab
## X-squared = 14.644, df = 3, p-value = 0.002148
```

Conclusion from the Chi-square Test (Part A)

From the R output:

- Test statistic: $\chi^2 = 14.644$
- Degrees of freedom: $df = 3$
- p-value: 0.002148

Decision ($\alpha = 0.05$)

Since

$$\text{p-value} = 0.002148 < 0.05,$$

we **reject the null hypothesis H_0** .

Conclusion

At the 5% significance level, there is sufficient statistical evidence to conclude that the proportion of Canadians who agree that Canada should eliminate tariffs on electric vehicles from China **differs among the four cities**.

Part B – Continuing from Part A, complete the following using appropriate confidence intervals. Assume an overall error rate of 5%. The proportion of Canadians who agree that Canada should eliminate tariffs on electric vehicles in Vancouver is (choose one: lower than / higher than / different from) Calgary by between _____ % and _____ %.

```
# Part B: CI for (p_Vancouver - p_Calgary)
# Overall error rate = 5% using Marascuilo (chi-square critical value)

# Number of cities
k <- nrow(df)

# Overall alpha
alpha <- 0.05

# Chi-square critical value
chisq_c <- qchisq(1 - alpha, df = k - 1)

# Extract proportions and sample sizes from df
p_V <- df$YesPercent[df$City == "Vancouver"]
p_C <- df$YesPercent[df$City == "Calgary"]

n_V <- df$n[df$City == "Vancouver"]
n_C <- df$n[df$City == "Calgary"]

# Difference in proportions
diff_VC <- p_V - p_C

# Margin of error (Marascuilo)
me_VC <- sqrt(chisq_c) * sqrt(
  p_V * (1 - p_V) / n_V +
  p_C * (1 - p_C) / n_C
)

# Confidence interval
lower_VC <- diff_VC - me_VC
upper_VC <- diff_VC + me_VC

# Print results as percentages
paste(
  "Vancouver vs Calgary CI:",
  round(100 * lower_VC, 2), "% to",
  round(100 * upper_VC, 2), "%"
)
## [1] "Vancouver vs Calgary CI: -7.05 % to 15.05 %"
```

The proportion of Canadians who agree that Canada should eliminate tariffs on electric vehicles in Vancouver is *different from* Calgary by between -7.05% and 15.05%.

```

# Part B: CI for (p_Vancouver - p_Toronto)
# Overall error rate = 5% using Marascuilo (chi-square critical value)

# Number of cities
k <- nrow(df)

# Overall alpha
alpha <- 0.05

# Chi-square critical value
chisq_c <- qchisq(1 - alpha, df = k - 1)

# Extract proportions and sample sizes from df
p_V <- df$YesPercent[df$City == "Vancouver"]
p_T <- df$YesPercent[df$City == "Toronto"]

n_V <- df$n[df$City == "Vancouver"]
n_T <- df$n[df$City == "Toronto"]

# Difference in proportions
diff_VT <- p_V - p_T

# Margin of error (Marascuilo)
me_VT <- sqrt(chisq_c) * sqrt(
  p_V * (1 - p_V) / n_V +
  p_T * (1 - p_T) / n_T
)

# Confidence interval
lower_VT <- diff_VT - me_VT
upper_VT <- diff_VT + me_VT

# Print results as percentages
paste(
  "Vancouver vs Toronto CI:",
  round(100 * lower_VT, 2), "% to",
  round(100 * upper_VT, 2), "%"
)

```

[1] "Vancouver vs Toronto CI: -0.54 % to 20.54 %"

The proportion of Canadians who agree that Canada should eliminate tariffs on electric vehicles in Vancouver is *different from* Toronto by between -0.54% and 20.54% .

Part C – West vs East (One-sided two-proportion z-test)

We want to test whether support is **higher in the West** (Vancouver + Calgary) than in the **East** (Toronto + Montreal).

Step 1: Define the parameters

Let

- p_W = true proportion of Canadians who agree in the **western cities** (Vancouver + Calgary)
 - p_E = true proportion of Canadians who agree in the **eastern cities** (Toronto + Montreal)
-

Step 2: State the hypotheses (symbolically)

$$H_0 : p_W = p_E$$

$$H_a : p_W > p_E$$

```
# West vs East: your chi-square approach (2x2 table)

# Group sizes
n_group <- c(West = 650, East = 550)

# Sample proportions
p_group <- c(West = 393/650, East = 276/550)

# Yes / No counts
row_yes <- n_group * p_group
row_no <- n_group - row_yes

# 2x2 contingency table
two_way_table_CE <- rbind(Yes = row_yes, No = row_no)
two_way_table_CE

##      West   East
## Yes    393   276
## No     257   274

# Chi-square test (with Yates correction, default)
chisq.test(two_way_table_CE)

##
## Pearson's Chi-squared test with Yates' continuity correction
##
## data: two_way_table_CE
## X-squared = 12.348, df = 1, p-value = 0.0004414
```

Part D – Estimating the Overall Proportion of Canadians

We want to estimate the proportion of all Canadians (across the four cities) who agree that Canada should eliminate tariffs on electric vehicles from China.

95% Confidence Interval

From the sample data: - Total number of respondents: $n = 1200$ - Number who responded “Yes”: $x = 669$

```
# Part D: 95% confidence interval for the overall proportion

# Total "Yes" responses and total sample size
```

```

x_total <- 248 + 145 + 156 + 120    # 669
n_total <- 400 + 250 + 300 + 250    # 1200

# Sample proportion
p_hat <- x_total / n_total

# 95% confidence level
alpha <- 0.05
z_crit <- qnorm(1 - alpha/2)          # 1.96

# Margin of error
ME <- z_crit * sqrt(p_hat * (1 - p_hat) / n_total)

# Confidence interval
lower <- p_hat - ME
upper <- p_hat + ME

c(p_hat = p_hat, lower_CI = lower, upper_CI = upper)

##      p_hat lower_CI upper_CI
## 0.557500 0.529398 0.585602

```

conclusion

the entire 95% confidence interval for the population proportion (0.5294,0.5856) lies above 0.50, we can conclude at the 95% confidence level that more than 50% of Canadians support eliminating tariffs on electric vehicles from China