ALY6070 Communication and Visualization for Data Analytics

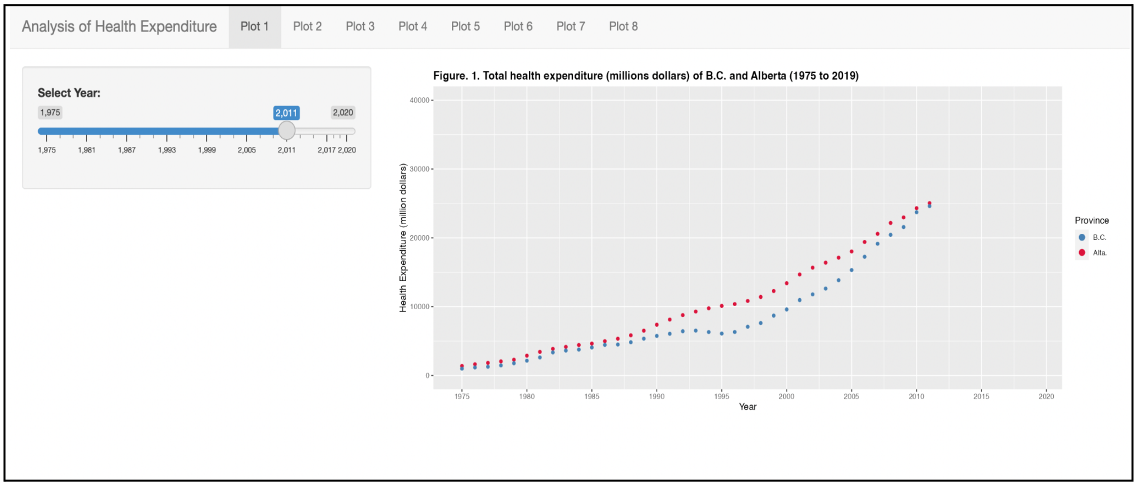
Assignment 5: Signature Assignment Group Dashboard

Lecturer: Mohsen Soltanifar, PhD, AStat Data

Group A

Name/NUID	Questions	Minimum Overall Participation	Confirmation Signature/Date
Papa Ekow Armah (NUID - 002688073)	5 and 6	25%	Papa Ekow Armah/ 6th July 2023
Ram Chunduru (NUID - 002754332)	7 and 8	25%	Ram Chunduru/ 6th July 2023
Sathya Narayanan Balamurugan	1 and 4	25%	Sathya Narayanan Balamurugan/ 6th July 2023
Shreyansh Chandrakant Bhalodiya (NUID - 002664707)	2 and 3	25%	Shreyansh Bhalodiya/ 6th July 2023

Plot 1: Scatter Plot



1. RESEARCH QUESTIONS:

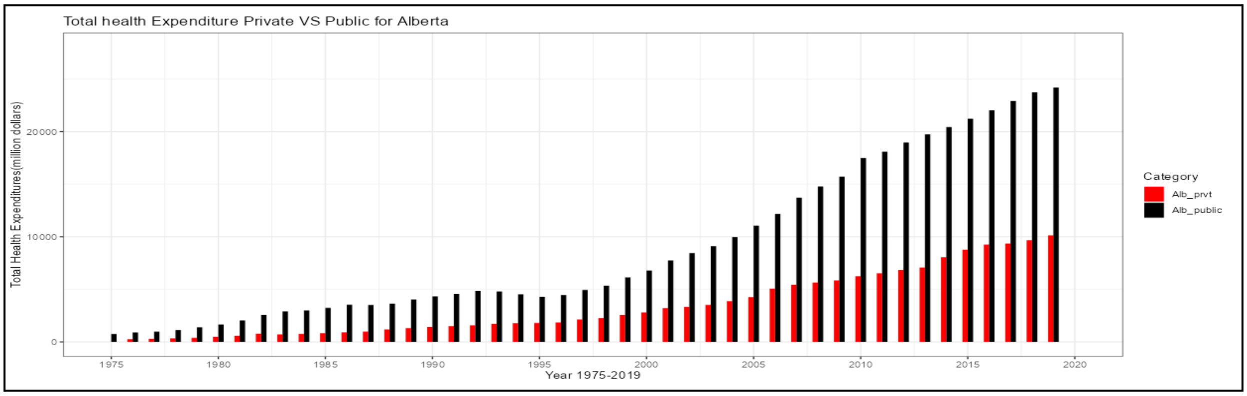
How have Alberta's and British Columbia's health spending evolved over time?

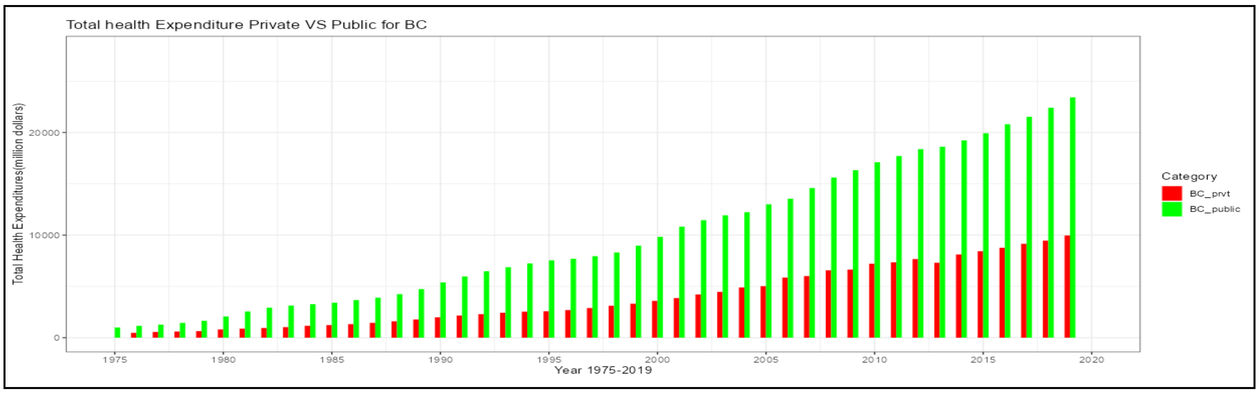
Do the trends in health spending in the two provinces appear to be significantly different from one another?

KEY FINDINGS:

The scatter plot comparing the health spending in Alberta and British Columbia (B.C.) reveals a number of interesting results. First off, over time, both provinces show a positive trend in health expenditure, pointing to a steady rise in healthcare spending. This demonstrates the expanding importance of healthcare services and the monetary commitment necessary to support them. Second, Since healthcare spending is increasing in both B.C. and Alberta, there is a positive correlation between the two provinces' health spending. This suggests that factors common to both regions may be influencing how healthcare resources are allocated. The shift in the trend that took place in 2010 is the most notable finding. In the past, Alberta consistently spent more on healthcare than British Columbia. The trend changed, though, in 2010, when British Columbia's health spending surpassed Alberta's. This change in relative spending patterns denotes a substantial transformation of the healthcare system in the two provinces. These results imply that British Columbia may have introduced measures, programmes, or healthcare reforms that increased health spending and allowed it to surpass Alberta at that time. Alternately, changes in healthcare requirements or demographic trends might have been involved. To fully comprehend the causes and implications of this trend reversal, more investigation is required, including statistical tests, assessments of socio-economic factors, and policy changes. Such information would have significant economic ramifications and could help both provinces decide what policies to consider.

Plot 2 Bar Plot





2. RESEARCH QUESTIONS:

Does the number over shadow Alberta and British Columbia in terms of public and private expenditure each year ?

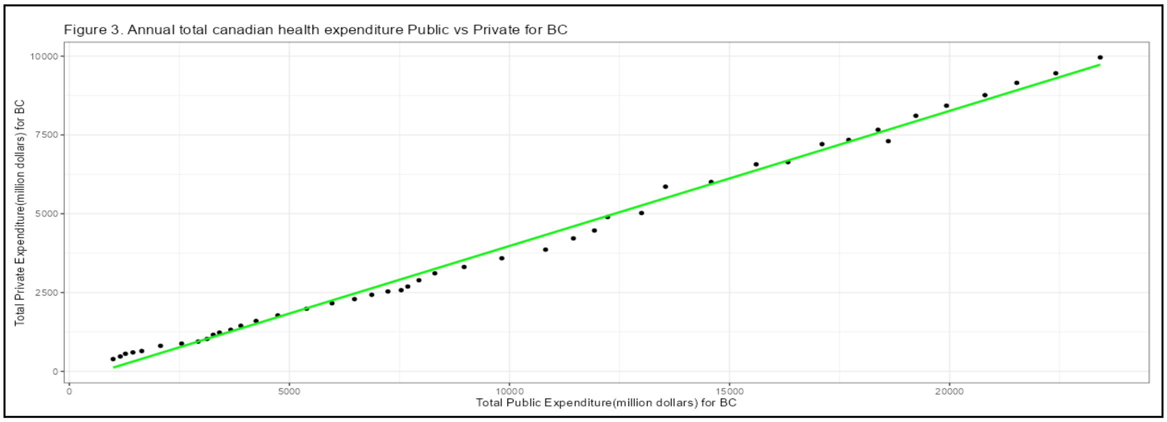
How different are the trends in health spending in the two provinces ?

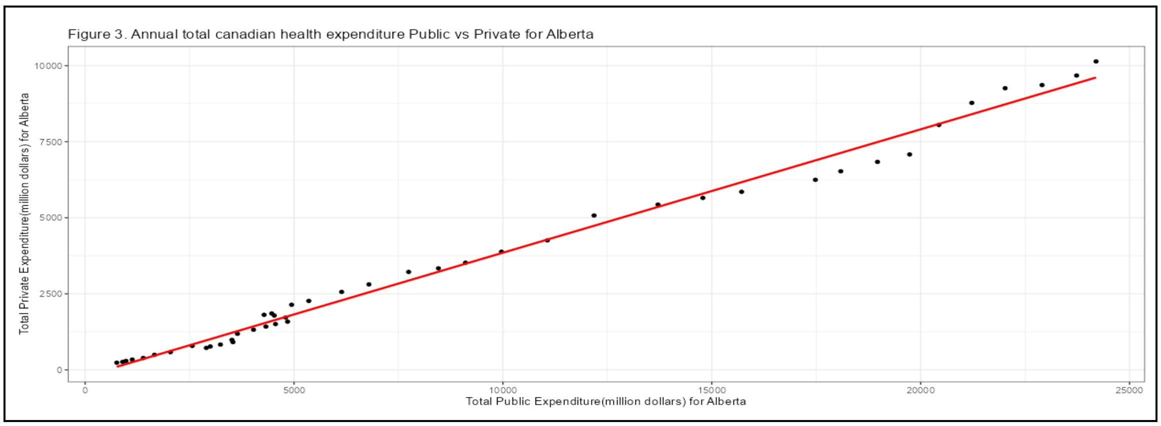
KEY FINDINGS:

Yes, the number overshadows Alberta and British Columbia in terms of public and private expenditure each year. The charts clearly show that the public expenditure is significantly higher than the private expenditure for both provinces. This can be observed by comparing the heights of the bars representing public and private expenditure.

The trends in health spending in the two provinces are somewhat different. In British Columbia, both public and private expenditures have been consistently increasing each year. This indicates a consistent upward trajectory in healthcare spending in the province. On the other hand, in Alberta, there was a noticeable upward trend in expenditure until around 1990. However, there is a slight decrease in expenditure from 1990 to 1995, followed by a subsequent increase. This pattern suggests a temporary shift in expenditure trends within Alberta during that period. Therefore, while both provinces show an overall increase in health spending, Alberta exhibits a more fluctuating pattern compared to the more consistent upward trend seen in British Columbia.

Plot 3 Scatter plot with regression line





3. RESEARCH QUESTIONS:

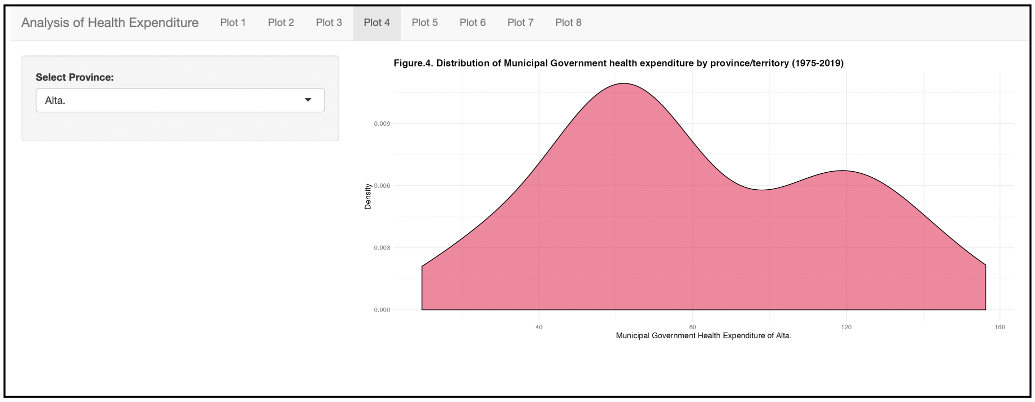
What is the difference between public expenditure and private expenditure for both states?
Can we fit a linear regression model using this data ?

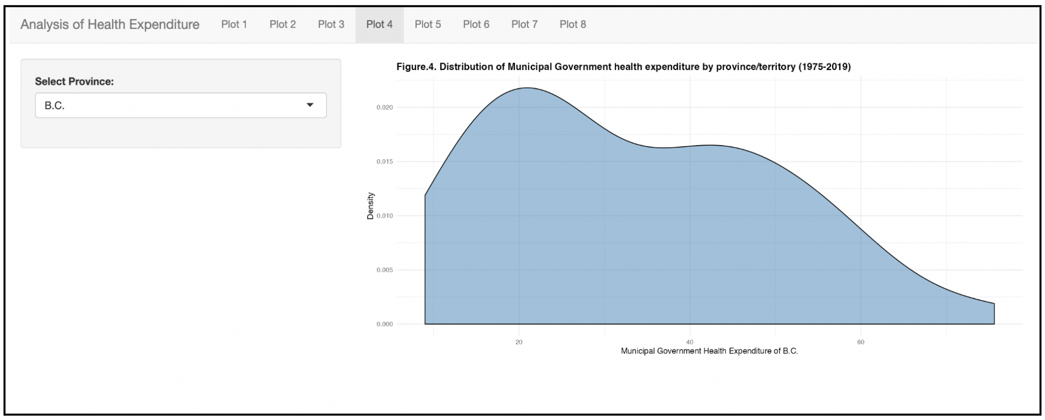
KEY FINDINGS:

The difference between public expenditure and private expenditure for both Alberta and British Columbia is that public expenditure is consistently higher. This is evident from the scatter plot, where the majority of data points for public expenditure are located above those for private expenditure. The general trend indicates that public expenditure tends to be higher than private expenditure in both provinces.

Yes, we can fit a linear regression model using this data. The scatter plot reveals a strong correlation between public and private expenditures, as indicated by the closely clustered data points around the regression line. The regression line represents the best fit line through the data points, indicating the overall trend between public and private expenditures. The closely clustered data points suggest that a linear regression model could be used to develop an accurate model based on the data.

Plot 4: Density Plot





4. RESEARCH QUESTIONS:

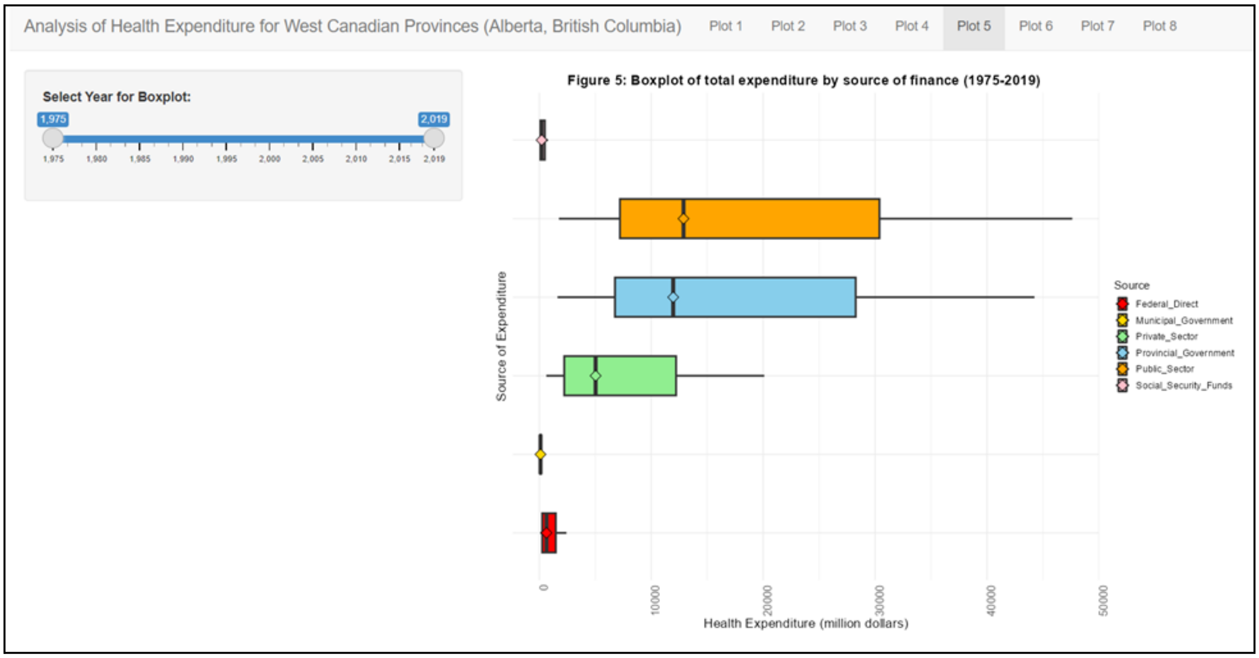
What is the distribution of particular health indicators in Alberta and British Columbia?

Are there any notable differences between the two provinces' patterns of distribution?

KEY FINDINGS:

Our health expenditure dashboard's density plot offers useful information about the distribution of municipal government health spending in British Columbia (B.C.) and Alberta. The distribution appears to be positively skewed or right-skewed in the density plot of BC. This implies that a tail extending towards the higher values is observed at the lower end of the range, where a higher concentration of health indicator values is observed. The density plot for Alberta, on the other hand, shows a bimodal distribution, which denotes the presence of two distinct peaks or modes in the distribution of the values of the health indicator. The patterns of distribution and variations of health indicators in the two provinces are usefully revealed by these findings. While the bimodal distribution in Alberta suggests the presence of distinct subgroups or patterns within the health indicator values, the positively skewed distribution in British Columbia suggests that a significant portion of the health indicator values may be concentrated at lower levels. This information aids in the understanding of the dynamics of distribution and potential differences in healthcare outcomes between B.C. and Alberta by stakeholders and policymakers.

Plot 5: Boxplot



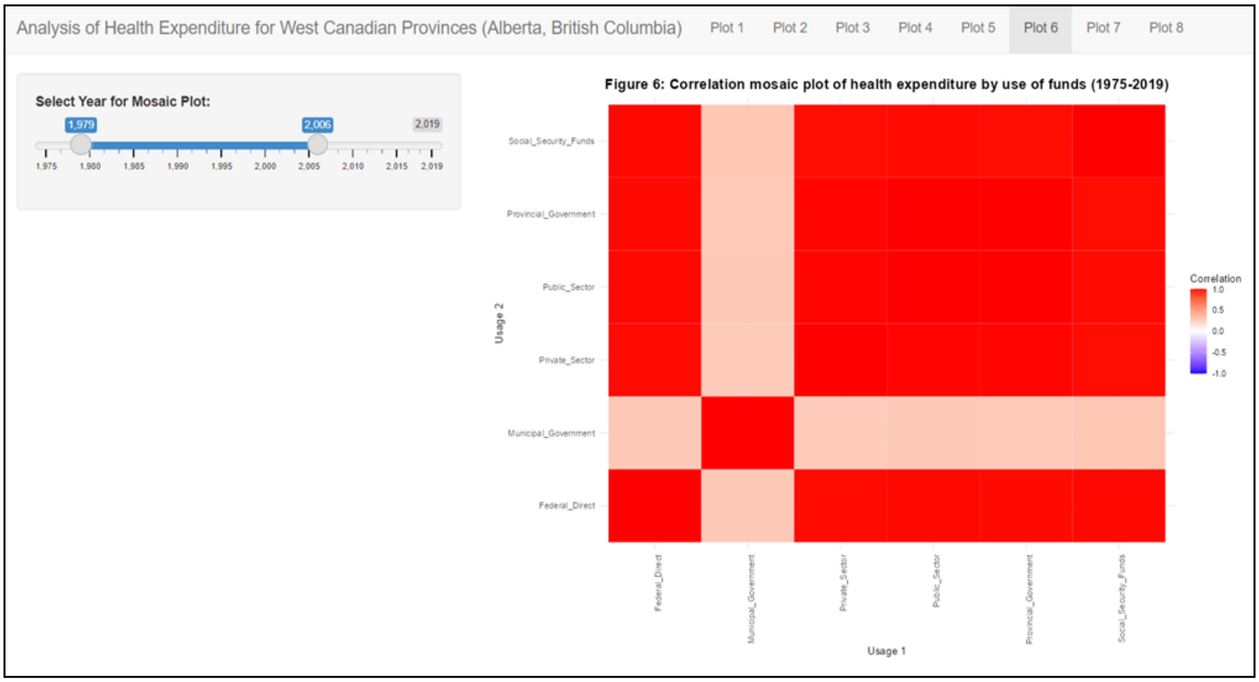
5. RESEARCH QUESTIONS:

How does the total health expenditure from different sources of finance compare between Alberta and British Columbia from 1975 to 2019?

KEY FINDINGS:

The boxplot shows distinct health financing trends between 1975 and 2019. Alberta's median health expenditure was $7082.1M around the mid-1990s, significantly lower than British Columbia's median of $10832M around the same period. Despite this, Alberta's expenditure range increased more significantly, from $992.3M in the late 1970s to $34337M by 2019, surpassing British Columbia's range of $1383M to $33383M. This plot reveals Alberta's larger expenditure growth despite British Columbia consistently maintaining higher median expenditures. These trends are crucial for future healthcare financial planning. The lack of outliers in the data for both provinces suggests that there were no extreme spikes or drops in total health expenditures during these years, indicating relative consistency in the expenditure patterns.

Plot 6: Correlation mosaic plot



6. RESEARCH QUESTIONS:

What are the significant changes in correlations between various health expenditure funding sources from 1975 to 2019?

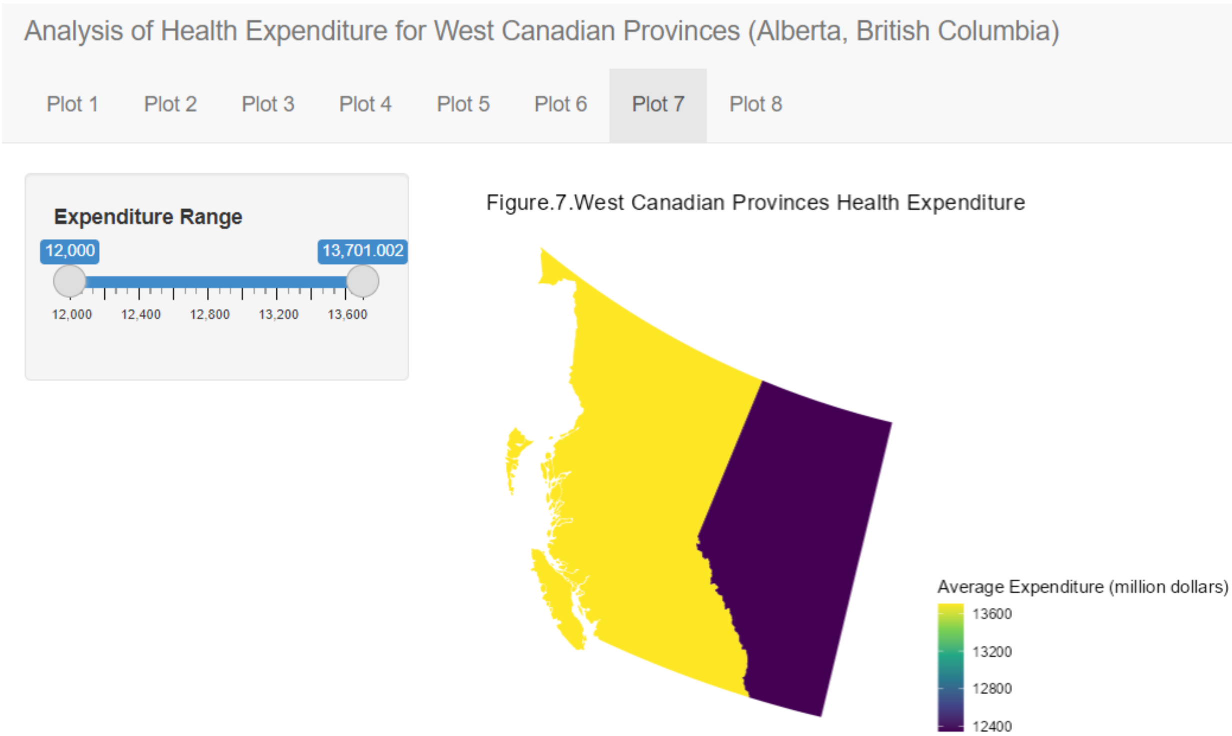
KEY FINDINGS:

The analysis reveals a strong positive correlation (0.9888) between Total Health Expenditure in Alberta and British Columbia, indicating similar health expenditure trends in these provinces over the 45-year period. This implies uniformity in healthcare financing strategies, potentially due to similar health demands, demographic factors, or policy decisions. However, to fully comprehend the nature and causes of these similarities, it is crucial to investigate the unique healthcare needs, policies, and economic conditions of both provinces.

Over the 1975-2019 period, a pattern emerged revealing strong positive correlations between different sources of health funding. Notably, the correlation between Federal Direct Funding and Provincial Government Funding increased significantly, reaching a peak of 0.9944. Simultaneously, Municipal Government Funding and Social Security Funds weakened in their correlation, down to 0.8842. This implies shifting strategies in health expenditure allocation over the years. Decisionmakers should monitor these correlations to optimize resource allocation and devise informed policies. However, we need to explore causation beyond these correlations for a comprehensive understanding of health expenditure dynamics.

PLOT 7

AVERAGE TOTAL HEALTH EXPENDITURE FOR WEST CANADIAN PROVINCES (1975-2019)



7. RESEARCH QUESTIONS:

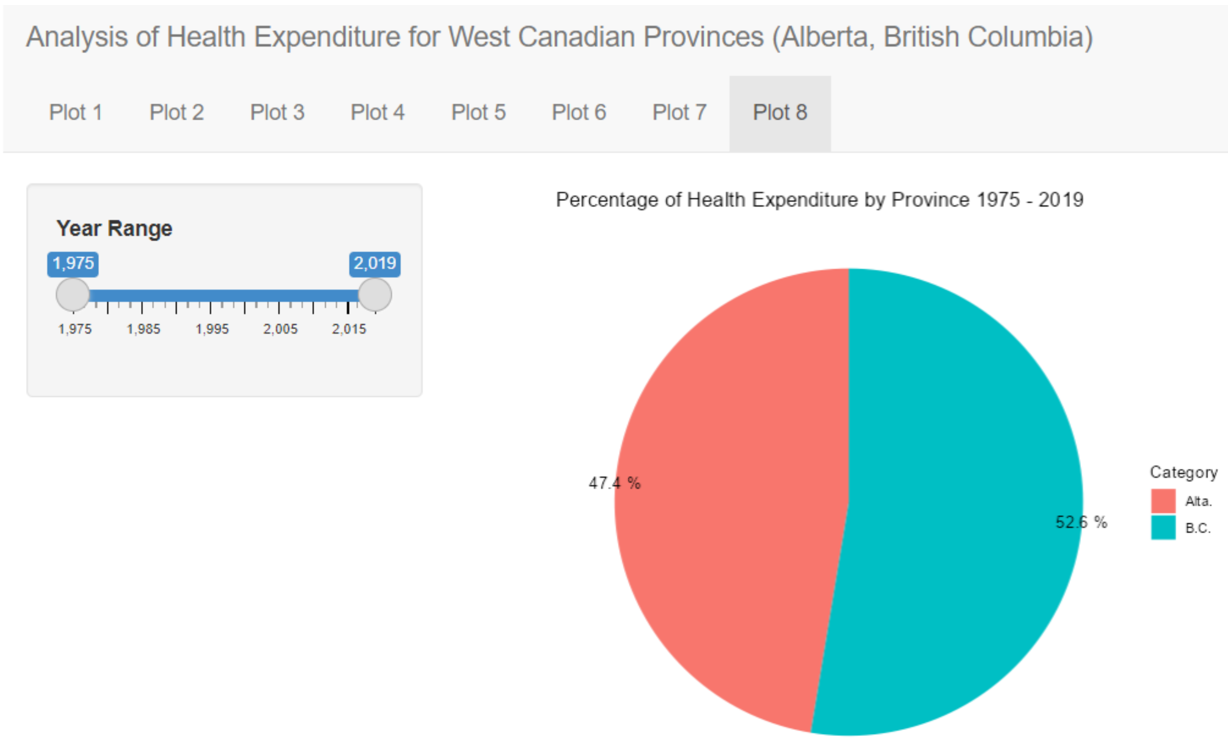
How is health expenditure spent across West Canadian provinces?

KEY FINDINGS:

The map displays the average total health expenditure by province/territory in West Canadian Provinces. In this case we can find that Alberta coloured in purple with significant value as 12,346.125 million dollars and British Columbia coloured in yellow with expenditure as 13,701.002 million dollars respectively. This indeed showcases the **regional disparities in health expenditure, with some provinces/territories having higher average expenditures** like British Columbia compared to others like Alberta. It also highlights the **importance of considering regional variations in healthcare needs and resource allocation** as we can see that the share of expenditure between the two provinces is not equal. Moreover, the visualization can also **aid policymakers and healthcare administrators in identifying regions with higher healthcare demands** and potential areas for targeted interventions.

PLOT 8

PIE CHART OF TOTAL HEALTH EXPENDITURE FOR WEST CANADIAN PROVINCES (1975-2019)



8. RESEARCH QUESTIONS:

What proportions of health expenditure is shared by the West Canadian provinces over the past 45 years?

KEY FINDINGS:

The pie chart provides a visual representation of the distribution of Canadian health expenditure by province/territory within West Canadian provinces. Each slice of the pie represents the proportion of expenditure attributed to a specific province/territory where **British Columbia contributes 52.6% followed by Alberta with 47.4% for years 1975-2019**. However, **between 2010 -2019, Alberta contribution has been dominant with 50.7% and B.C with 49.3%** respectively. It also highlights that in the **recent 10 years, Alberta has had a larger share** of total health expenditure, **suggesting potential areas for focused resource allocation** and healthcare planning. However, **over the last 40 years, B.C still dominates with larger share of 52.6**

CONCLUSION:

Key findings from the analysis include the consistent increase in total health expenditure over the years, reflecting the growing significance of healthcare in West Canada. The division between public and private sectors in health expenditure has remained relatively stable, with the public sector accounting for a larger share. However, there have been variations and outliers, indicating potential areas of divergence between the sectors.

Moreover, this analysis emphasizes the importance of understanding health expenditure patterns in West Canada for effective policy formulation, resource allocation, and healthcare planning. The insights gained can support decision-makers, policymakers, and healthcare administrators in optimizing the efficiency, accessibility, and quality of healthcare services across the provinces.

Further exploration and in-depth analysis of the data are required to uncover underlying factors and inform targeted interventions aimed at improving healthcare outcomes and cost containment in West Canadian Provinces.

REFERENCES:

- Canadian Institute for Health Information. (2020). National Health Expenditure Trends, 1975 to 2020. Ottawa, ON: CIHI.
- Frost, J. (2023). Bar Charts: Using, Examples, and Interpreting. Statistics by Jim. https://statisticsbyjim.com/graphs/bar-charts/
- *ggplot2 themes and background colors : The 3 elements - Easy Guides - Wiki - STHDA. (n.d.).* *http://www.sthda.com/english/wiki/ggplot2-themes-and-background-colors-the-3-elements/*
- Kiernan, D. (n.d.). Chapter 7: Correlation and Simple Linear Regression | Natural Resources Biometrics. https://courses.lumenlearning.com/suny-natural-resources-biometrics/chapter/chapter-7-correlation-and-simple-linear-regression/
- *mapcan function - RDocumentation*. (n.d.). https://www.rdocumentation.org/packages/mapcan/versions/0.0.1/topics/mapcan/
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- Statistics Solutions. (2021, August 11). Questions the Linear Regression Answers - Statistics Solutions. https://www.statisticssolutions.com/free-resources/directory-of-statistical-analyses/questions-the-linear-regression-answers/#:~:text=There%20are%203%20major%20areas,%2C%20(3)%20trend%20forecasting/

APPENDIX

R Code:

```
##ALY6070 - GROUP ASSIGNMENT - GROUP A - R SHINY DASHBOARD
##########################################################################
######
# install.packages('shiny')
# install.packages('ggplot2')
# install.packages('dplyr')
# install.packages('ggthemes')
# install.packages('viridis')
# install.packages('mapcan')
# install.packages('reshape')
# install.packages('plotly')
# install.packages('tidyverse')
# install.packages('ggmosaic')
# install.packages('RColorBrewer')

#PART [1] : LOAD LIBRARY
library(shiny)
library(ggplot2)
library(plotly)
library(dplyr)
library(tidyverse)
library(ggmosaic)
library(RColorBrewer)
library(ggthemes)
library(viridis)
library(mapcan)
library(reshape)

##########################################################################
######
#PART [2] : DATASET
# Load matrices frames of data.
# Each matrix must show your data variables, numbers, provinces, etc.
mydata1<-matrix(data = c("Year", "B.C", "Alta.",
                         1975, 1383.35878714174, 992.343323713156,
                         1976, 1628.32034817086, 1158.89891309998,
                         1977, 1831.82003271085, 1272.11732262727,
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1979, 2288.57310704556, 1780.9591740735,
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1981, 3430.3725048125, 2623.70427221621,
1982, 3870.24886092447, 3351.65035261713,
1983, 4155.72084859497, 3622.08961832032,
1984, 4428.91633711193, 3764.22917885827,
1985, 4637.90865069251, 4070.41301869285,
1986, 4984.08596641948, 4448.47801711877,
1987, 5341.28663991549, 4499.89163039372,
1988, 5839.14894972573, 4830.58512686067,
1989, 6509.73671029317, 5349.76562366944,
1990, 7376.31723635814, 5749.41380476617,
1991, 8127.35199859456, 6062.54095612859,
1992, 8769.72890509511, 6430.65312378625,
1993, 9297.44510196595, 6520.433399575,
1994, 9771.32410154034, 6313.44303512831,
1995, 10113.2356534136, 6092.48026310455,
1996, 10378.1194617981, 6320.62953659314,
1997, 10831.9845279822, 7082.14888000143,
1998, 11414.3381435849, 7619.82432139012,
1999, 12279.7003602781, 8701.73463919487,
2000, 13412.6030392207, 9601.75163018843,
2001, 14680.0627816059, 10962.4220540117,
2002, 15670.1522119533, 11793.7884263925,
2003, 16396.3014240724, 12628.006229712,
2004, 17124.0722698081, 13848.3970530796,
2005, 18022.3516348998, 15321.1984635138,
2006, 19403.268232363, 17255.0091538278,
2007, 20590.0015666545, 19145.3397637144,
2008, 22170.951318772, 20439.0682380995,
2009, 22965.235123637, 21566.4061814085,
2010, 24310.2882364733, 23727.5397283606,
2011, 25047.3973706268, 24614.0507885794,
2012, 26037.2418803282, 25802.2819620776,
2013, 25909.1576610064, 26816.1074490244,
2014, 27341.1165243974, 28487.045628523,
2015, 28356.4187708856, 29999.969916187,
2016, 29565.3907130796, 31279.2850586753,
2017, 30677.2851115974, 32266.6151656363,
```

```
                         2018, 31869.4747036428, 33407.4543463819,
                         2019, 33382.8833433967, 34337.0184929), nrow =
46, ncol = 3, byrow = TRUE)
colnames(mydata1) <- mydata1[1, ]
mydata1 <- mydata1[-1, ]
mydata1 <- as.data.frame(mydata1)
# Convert Year and Expenditure to numeric
mydata1$Year <- as.numeric(as.character(mydata1$Year))
mydata1$B.C <- as.numeric(as.character(mydata1$B.C))
mydata1$Alta. <- as.numeric(as.character(mydata1$Alta.))

mydata2 <- data.frame(Year =
c(1975,1976,1977,1978,1979,1980,1981,1982,1983,1984,1985,1986,1987,

1988,1989,1990,1991,1992,1993,1994,1995,1996,1997,1998,1999,2000,

2001,2002,2003,2004,2005,2006,2007,2008,2009,2010,2011,2012,2013,
                                2014,2015,2016,2017,2018,2019),
                      Alb_prvt =
c(234.5710792,260.4369903,293.2544876,337.6971011,

389.0818591,493.0536925,581.5095746,786.9134548,

720.4870992,767.4577698,831.2846424,910.5911206,

985.5208436,1184.941543,1318.75034,1422.520773,

1505.059399,1584.236188,1719.905168,1785.661427,

1809.002815,1854.160534,2140.103765,2265.857873,

2561.556757,2808.829985,3218.447161,3337.375278,

3522.464474,3882.299182,4256.848496,5073.643735,

5432.928342,5651.854359,5852.829318,6247.532953,

6527.689039,6836.879717,7080.974533,8051.696085,

8776.156537,9257.752015,9361.565764,9675.779142,
```

```
                                        10138.95239),
                        BC_prvt =
c(388.8425371,471.1523482,556.8345327,599.9028918,643.351357,

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5021.96326,5858.297685,6006.729709,6566.254959,6637.550681,

7208.422951,7341.18151,7663.671959,7302.611346,8108.24367,

8427.704559,8762.162923,9151.741018,9456.813045,9960.246574),
                        Alb_public =
c(757.7722445,898.4619228,978.862835,1127.658109,1391.877315,1660.05523,

2042.194698,2564.736898,2901.602519,2996.771409,3239.128376,3537.886897,

3514.370787,3645.643583,4031.015284,4326.893032,4557.481557,4846.416936,

4800.528232,4527.781608,4283.477448,4466.469003,4942.045115,5353.966448,

6140.177882,6792.921645,7743.974893,8456.413149,9105.541756,9966.097871,

11064.34997,12181.36542,13712.41142,14787.21388,15713.57686,17480.00678,

18086.36175,18965.40224,19735.13292,20435.34954,21223.81338,22021.53304,
                                          22905.0494,23731.6752,24198.0661),
                        BC_public =
c(994.520,1157.17,1274.99,1444.51,1645.22,2072.05,2551.29,2927.13,3128.78,
3269.71,3410.77,

3666.85,3896.36,4242.03,4736.76,5390.37,5967.81,6478.54,6870.43,7238.12,75
38.93,7688.73,
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7942.63,8304.50,8969.44,9825.850,10819.74,11452.12,11929.80,12230.35,13000
.39,13544.97,14583.27,

15604.70,16327.68,17101.87,17706.22,18373.57,18606.55,19232.87,19928.71,20
803.23,21525.54,22412.66,
                                        23422.64))

mydata3 <- mydata2

mydata4 <- matrix(data = c("Alta.", "B.C.",
                             9.5, 9.0,
                             21.9,  11.4,
                             33.7,  12.3,
                             38.5,  11.6,
                             55.8,  13.4,
                             66.6,  40.9,
                             76.5,  56.6,
                             42.4,  61.9,
                             26.3,  37.8,
                             23.5,  24.1,
                             66.4,  25.6,
                             70.2,  24.7,
                             53.3,  24.5,
                             55.8,  21.8,
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                             62.7,  27.9,
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                             66.2,  47.7,
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                             123.4, 53.5,
                             50.8, 55.4,
                             50.2,  36.4,
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                             91.1,  23.1,
                             102.5, 21.0,
```

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                            76.5,  27.6,
                            107.3, 31.5,
                            112.4, 32.1,
                            114.5, 34.9,
                            117.0, 39.3,
                            126.8, 43.0,
                            140.2, 47.1,
                            147.9, 51.0,
                            156.3, 56.0,
                            120.7, 75.6,
                            120.7, 64.3,
                            124.3, 44.2,
                            131.4, 42.8,
                            135.9, 43.0), nrow = 46, ncol = 2, byrow =
TRUE)
colnames(mydata4) <- mydata4[1, ]
mydata4 <- mydata4[-1, ]
mydata4 <- as.data.frame(mydata4)
mydata4$Alta. <- as.numeric(as.character(mydata4$Alta.))
mydata4$B.C. <- as.numeric(as.character(mydata4$B.C.))


mydata5 <- data.frame(
  Year <- seq(1975, 2019,1),
  TotalHealthExpAlta = c(992.3433237, 1158.898913, 1272.117323,
1465.35521, 1780.959174, 2153.108922, 2623.704272, 3351.650353,
3622.089618, 3764.229179, 4070.413019, 4448.478017, 4499.89163,
4830.585127, 5349.765624, 5749.413805, 6062.540956, 6430.653124,
6520.4334, 6313.443035, 6092.480263, 6320.629537, 7082.14888, 7619.824321,
8701.734639, 9601.75163, 10962.42205, 11793.78843, 12628.00623,
13848.39705, 15321.19846, 17255.00915, 19145.33976, 20439.06824,
21566.40618, 23727.53973, 24614.05079, 25802.28196, 26816.10745,
28487.04563, 29999.96992, 31279.28506, 32266.61517, 33407.45435,
34337.01849),
  TotalHealthExp_BC = c(1383.358787, 1628.320348, 1831.820033,
2044.413892, 2288.573107, 2879.995068, 3430.372505, 3870.248861,
4155.720849, 4428.916337, 4637.908651, 4984.085966, 5341.28664,
5839.14895, 6509.73671, 7376.317236, 8127.351999, 8769.728905,
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11414.33814, 12279.70036, 13412.60304, 14680.06278, 15670.15221,
16396.30142, 17124.07227, 18022.35163, 19403.26823, 20590.00157,
22170.95132, 22965.23512, 24310.28824, 25047.39737, 26037.24188,
25909.15766, 27341.11652, 28356.41877, 29565.39071, 30677.28511,
31869.4747, 33382.88334),
  PrivExp_Alta = c(234.5710792, 260.4369903, 293.2544876, 337.6971011,
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124.2978641, 131.4005992, 135.9055788),
  MunipGovt_BC = c(9.024, 11.431, 12.323, 11.627, 13.365, 40.865, 56.64,
61.872, 37.782, 24.05253249, 25.61427417, 24.67240254, 24.5362393,
21.75885737, 17.73475436, 27.87661014, 45.77902683, 47.658, 52.863,
53.459, 55.395, 36.39365, 17.59, 13.737, 13.944, 17.46, 17.635, 23.107,
20.968, 19.706, 24.953, 27.55, 31.493, 32.067, 34.92224189, 39.27709158,
43.01248336, 47.0624954, 51.00073929, 55.96207983, 75.63624852,
64.26895105, 44.15757862, 42.84596737, 42.95828773),
  SocialSec_Alta = c(9.736, 13.018, 14.387, 15.448, 18.275, 23.511,
28.869, 18.577, 12.731, 29.319, 35.384, 37.316975, 36.023266, 38.350494,
42.325142, 53.925933, 74.589367, 82.01200257, 78.71779898, 69.762437,
74.727196, 76.796773, 82.577408, 95.321269, 105.019658, 127.854846,
146.053415, 161.977182, 187.448508, 210.525846, 222.627308, 244.112008,
248.90852, 270.119461, 279.880165, 287.927969, 315.775821, 325.713801,
344.314854, 355.790043, 363.643408, 358.593032, 371.995742, 426.974338,
447.638072),
  SocialSec_BC = c(17.643, 20.324, 22.539, 25.423, 29.069, 39.232, 46.907,
55.546, 58.835, 56.499, 55.241, 57.862, 62.52920177, 70.55791819,
70.3365547, 85.77031267, 88.73998073, 96.802273, 104.142709, 119.719841,
129.0238987, 120.687113, 123.5202997, 136.8383062, 164.8812505,
180.3484111, 154.2212142, 149.2010897, 149.3109703, 166.6413906,
176.8423897, 170.5265274, 182.1291436, 236.1682653, 213.1940257,
```

```
250.8831204, 255.6790919, 284.7150298, 299.4531776, 286.6742519,
290.3370262, 288.8098488, 304.9192136, 308.7368706, 327.9548262)
)

##Plot 7
province <- c("British Columbia", "Alberta")
abbreviated <- c("British Columbia", "Alberta")
expenditure <- c(13701.002, 12346.125)
mydata7 <- data.frame(province, abbreviated, expenditure)

#Plot8
# Part 8
mydata8 <- data.frame(
  Year = c(1975:2019),
  Alta. = c(992.343323713156, 1158.89891309998, 1272.11732262727,
1465.3552104598, 1780.9591740735,
            2153.10892233636, 2623.70427221621, 3351.65035261713,
3622.08961832032, 3764.22917885827,
            4070.41301869285, 4448.47801711877, 4499.89163039372,
4830.58512686067, 5349.76562366944,
            5749.41380476617, 6062.54095612859, 6430.65312378625,
6520.433399575, 6313.44303512831,
            6092.48026310455, 6320.62953659314, 7082.14888000143,
7619.82432139012, 8701.73463919487,
            9601.75163018843, 10962.4220540117, 11793.7884263925,
12628.0062297119, 13848.3970530796,
            15321.1984635138, 17255.0091538278, 19145.3397637144,
20439.0682380995, 21566.4061814085,
            23727.5397283606, 24614.0507885794, 25802.2819620776,
26816.1074490244, 28487.045628523,
            29999.969916187, 31279.2850586753, 32266.6151656363,
33407.4543463819, 34337.0184929),
  B.C. = c(1383.35878714174, 1628.32034817086, 1831.82003271085,
2044.41389183194, 2288.57310704556,
           2879.99506756979, 3430.3725048125, 3870.24886092447,
4155.72084859497, 4428.91633711193,
           4637.90865069251, 4984.08596641948, 5341.28663991549,
5839.14894972573, 6509.73671029317,
           7376.31723635814, 8127.35199859456, 8769.72890509511,
9297.44510196595, 9771.32410154034,
```

```
           10113.2356534136, 10378.1194617981, 10831.9845279822,
11414.3381435849, 12279.7003602781,
           13412.6030392207, 14680.0627816059, 15670.1522119533,
16396.3014240724, 17124.0722698081,
           18022.3516348998, 19403.268232363, 20590.0015666545,
22170.951318772, 22965.235123637,
           24310.2882364733, 25047.3973706268, 26037.2418803282,
25909.1576610064, 27341.1165243974,
           28356.4187708856, 29565.3907130796, 30677.2851115974,
31869.4747036428, 33382.8833433967))

############################################################################
######
#PART [3] : UI PART

# Define UI  Panel of components.
ui <- fluidPage(
  navbarPage(
    "Analysis of Health Expenditure for West Canadian Provinces (Alberta,
British Columbia)",
    tabPanel("Plot 1",
      sidebarLayout(
        sidebarPanel(
          sliderInput(
            inputId = "scatterYear",
            label = "Select Year:",
            min = 1975,
            max = 2020,
            value = 1975,
            step = 2

          )
        ),
        mainPanel(
          plotOutput("Plot1")
        )
      )
    ),
    tabPanel("Plot 2",
             sidebarLayout(
```

```
               sidebarPanel(
                 selectInput("state1", "SELECT PROVINCE",choices =
c("Alberta","BC"), selected = "BC")),
               mainPanel(
                 plotOutput("Plot2")
               )
             )
    ),

    tabPanel("Plot 3",
             sidebarLayout(
               sidebarPanel(
                 selectInput("state2", "SELECT PROVINCE",choices =
c("Alberta","BC"),selected="BC")),
               mainPanel(
                 plotOutput("Plot3")
               )
             )
    ),
    tabPanel("Plot 4",
    sidebarLayout(
      sidebarPanel(
        selectInput("variable", "Select Province:", choices = c("Alta.",
"B.C."), selected = "Alta.")
      ),
      mainPanel(plotOutput("Plot4"))
      )
    ),
    tabPanel("Plot 5",
    sidebarLayout(
      sidebarPanel(
        sliderInput("year1", "Select Year for Boxplot:", min =
min(mydata5$Year), max = 2019, value = c(min(mydata5$Year),
max(mydata5$Year)), step=1)
      ),
      mainPanel(plotOutput("Plot5", height = "800px", width = "100%"))
      )
    ),
    tabPanel("Plot 6",
    sidebarLayout(
```

```
      sidebarPanel(
        sliderInput("year2", "Select Year for Mosaic Plot:", min =
min(mydata6$Year), max = max(mydata6$Year), c(min(mydata6$Year),
max(mydata6$Year)), step=1)
      ),
      mainPanel(plotOutput("Plot6", height = "800px", width = "100%")))
    ),
    tabPanel(
      "Plot 7",
      sidebarLayout(
        sidebarPanel(
          sliderInput("part7_expenditure_range", "Expenditure Range", min
= 12000, max = max(mydata7$expenditure), value = c(12000,
max(mydata7$expenditure)), step=100)
        ),
        mainPanel(
          plotOutput("Plot7")
        )
      )
    ),
    tabPanel(
      "Plot 8",
      sidebarLayout(
        sidebarPanel(
          sliderInput("part8_freq_range", "Year Range", min =
min(mydata8$Year), max = max(mydata8$Year), value = c(min(mydata8$Year),
max(mydata8$Year)), step=1)
        ),
        mainPanel(
          plotOutput("Plot8")
        )      )
    )

  )
  )


##########################################################################
######
# PART [4] : SERVER PART
```

```
# Define server  with component output
server <- function(input, output) {


  output$Plot1 <- renderPlot({
    year <- input$scatterYear

    filtered_data <- mydata1[mydata1$Year <= year, ]

    ggplot() +
      geom_blank(data = mydata1, aes(x = Year)) +
      geom_point(data = filtered_data, aes(x = Year, y = B.C, color =
"B.C.")) +
      geom_point(data = filtered_data, aes(x = Year, y = Alta., color =
"Alta.")) +
      labs(
        x = "Year",
        y = "Health Expenditure (million dollars)",
        title = "Figure. 1. Total health expenditure (millions dollars) of
B.C. and Alberta (1975 to 2019)"
      ) +
      scale_x_continuous(
        breaks = seq(1975, 2020, by = 5),
        labels = function(x) as.character(x)
      ) +
      scale_y_continuous(
        limits = c(0, 40000),
        breaks = seq(0, 40000, by = 10000),
        labels = function(x) format(x, scientific = FALSE)
      ) +
      scale_color_manual(
        values = c("#4682B4", "#DC143C"),
        labels = c("B.C.", "Alta."),
        name = "Province"
      ) +
      theme(legend.position = "right", plot.title = element_text(face =
"bold")) +
      guides(color = guide_legend(override.aes = list(size = 3)))
  })
```

```
output$Plot2 <- renderPlot({
  var <- input$state1
  if (var == "Alberta") {
    y1 = 'Alb_prvt'
    y2 = 'Alb_public'
    title = 'Total health Expenditure Private VS Public for Alberta'
    colr = c("red","black")
  } else {
    y1 = 'BC_prvt'
    y2 = 'BC_public'
    title = 'Total health Expenditure Private VS Public for BC'
    colr = c("red","green")
  }

  mydata2 <- mydata2 %>%
    select(Year, y1, y2) %>%
    pivot_longer(-Year, names_to = "Category", values_to = "the_values")

  ggplot(mydata2, aes(x = Year, y = the_values, fill = Category)) +
    geom_col(position = "dodge", width = 0.5) +
    labs(
      x = "Year 1975-2019",
      y = "Total Health Expenditures(million dollars)",
      title = title,
      fill = "Category"
    ) +
    scale_x_continuous(
      breaks = seq(1975, 2020, by = 5),
      limits = c(1975, 2020)
    ) +
    scale_y_continuous(limits = c(0, 28000)) +
    scale_fill_manual(values = colr)+
    theme_bw()
})


output$Plot3 <- renderPlot({
  var <- input$state2
```

```
    if (var == "Alberta") {
      color = "red"
        x_main = 'Alb_public'
        y_main = 'Alb_prvt'
        x_lab = 'Total Public Expenditure(million dollars) for Alberta'
        y_lab = 'Total Private Expenditure(million dollars) for Alberta'
        title = 'Figure 3. Annual total canadian health expenditure Public
vs Private for Alberta'
    } else {
      color = "green"
        x_main = 'BC_public'
        y_main = 'BC_prvt'
        x_lab = 'Total Public Expenditure(million dollars) for BC'
        y_lab = 'Total Private Expenditure(million dollars) for BC'
        title = 'Figure 3. Annual total canadian health expenditure Public
vs Private for BC'
    }

    ggplot(mydata3, aes_string(x = x_main, y = y_main)) +
      geom_point() +
      geom_smooth(method = "lm", se = FALSE, color = color) +
      labs(x = x_lab , y = y_lab, title = title) +
      theme_bw()
  })

  # Generate density plot based on selected variable
  output$Plot4 <- renderPlot({
    selected_variable <- input$variable

    if (selected_variable == "Alta.") {
      color <- "#DC143C"
        x_label <- "Municipal Government Health Expenditure of Alta."
    } else {
      color <- "#4682B4"
        x_label <- "Municipal Government Health Expenditure of B.C."
    }

    ggplot(mydata4, aes_string(x = selected_variable)) +
      geom_density(fill = color, alpha = 0.5,outline.type="full") +
```

```
      labs(x = x_label , y = "Density") +
      ggtitle("Figure.4. Distribution of Municipal Government health
expenditure by province/territory (1975-2019)") +
      theme_minimal()+
      theme(plot.title = element_text(face = "bold"))
  })

  output$Plot5 <- renderPlot({
    start_year <- input$year1[1]
    end_year <- input$year1[2]
    data <- subset(mydata5, Year >= start_year & Year <= end_year)

    data$Federal_Direct <- data$FedDirHealth_Alta + data$FedDirHealth_BC
    data$Municipal_Government <- data$MunipGovt_Alta + data$MunipGovt_BC
    data$Private_Sector <- data$PrivExp_Alta + data$PrivExp_BC
    data$Public_Sector <- data$PubExp_Alta + data$PubExp_BC
    data$Provincial_Government <- data$ProvGov_Alta + data$ProvGov_BC
    data$Social_Security_Funds <- data$SocialSec_Alta + data$SocialSec_BC

    sectors_cols <- c("Federal_Direct", "Municipal_Government",
"Private_Sector", "Public_Sector", "Provincial_Government",
"Social_Security_Funds")

    mydata_long <- data %>%
      pivot_longer(cols = sectors_cols, names_to = "Source", values_to =
"HealthExpenditure")

    ggplot(mydata_long, aes(y = Source, x = HealthExpenditure, fill =
Source)) +
      geom_boxplot(width = 0.5, lwd = 1) +  # Adjusted box width and line
width
      stat_summary(fun = median, geom = "point", shape = 23, size = 4) + #
Added median point
      scale_fill_manual(values = c("red", "gold", "lightgreen", "skyblue",
"orange", "pink")) +
      theme_minimal() +
      theme(axis.text.x = element_text(angle = 90, hjust = 1, size = 12),
            axis.text.y = element_blank(),
            axis.title.x = element_text(size = 14),
            axis.title.y = element_text(size = 14),
```

```
            legend.text = element_text(size = 10),
            legend.title = element_text(size = 12),
            plot.title = element_text(size = 15, face = "bold", hjust =
0.5)) +
      labs(title = "Figure 5: Boxplot of total expenditure by source of
finance (1975-2019) ", x = "Health Expenditure (million dollars)", y =
"Source of Expenditure")
  },
  height = 600,  # Adjusted the height of the output plot
  width = 800)


  output$Plot6 <- renderPlot({
  start_year <- input$year2[1]
  end_year <- input$year2[2]
  data <- subset(mydata5, Year >= start_year & Year <= end_year)

    data$Federal_Direct <- data$FedDirHealth_Alta + data$FedDirHealth_BC
    data$Municipal_Government <- data$MunipGovt_Alta + data$MunipGovt_BC
    data$Private_Sector <- data$PrivExp_Alta + data$PrivExp_BC
    data$Public_Sector <- data$PubExp_Alta + data$PubExp_BC
    data$Provincial_Government <- data$ProvGov_Alta + data$ProvGov_BC
    data$Social_Security_Funds <- data$SocialSec_Alta + data$SocialSec_BC

    correlation_matrix <- cor(data[, c("Federal_Direct",
"Municipal_Government", "Private_Sector", "Public_Sector",
"Provincial_Government", "Social_Security_Funds")], use="complete.obs")
    correlation_df <- reshape2::melt(correlation_matrix)
    names(correlation_df) <- c("Source1", "Source2", "Correlation")

    correlation_df <-
correlation_df[is.finite(correlation_df$Correlation), ]

    ggplot(correlation_df, aes(x = Source1, y = Source2, fill =
Correlation)) +
      geom_tile() +
      scale_fill_gradient2(low = "blue", high = "red", mid = "white",
midpoint = 0, limit = c(-1,1)) +
      theme_minimal() +
```

```
      theme(axis.text.x = element_text(angle = 90, hjust = 1),  plot.title
= element_text(size = 15, face = "bold", hjust = 0.5)) +
      labs(title = "Figure 6: Correlation mosaic plot of health
expenditure by use of funds (1975-2019)",
           x = "Usage 1", y = "Usage 2", fill = "Correlation")
  }, height = 600, width = 800)


  output$Plot7 <- renderPlot({
    filtered_data <- subset(mydata7, expenditure >=
input$part7_expenditure_range[1] & expenditure <=
input$part7_expenditure_range[2])
    pr_geographic <- mapcan(boundaries = province, type = standard)
    pr_geographic <- inner_join(pr_geographic,filtered_data, by =
c("pr_english" = "province"))
    ggplot(pr_geographic, aes(x = long, y = lat, group = group, fill =
expenditure)) +
      geom_polygon() +
      coord_fixed() +
      theme_mapcan() +
      scale_fill_viridis_c(name = "Average Expenditure (million dollars)")
+
      ggtitle("Figure.7.West Canadian Provinces Health Expenditure") +
      theme(legend.position = "right")
  })

  # Render the ggplot for Part 8 with reactive inputs
  output$Plot8 <- renderPlot({
    # Select the desired year range
    start_year <- input$part8_freq_range[1]
    end_year <- input$part8_freq_range[2]

    # Filter the data based on the selected year range
    filtered_data <- subset(mydata8, Year >= start_year & Year <=
end_year)

    # Calculate the sum of Alta. and B.C. within the selected year range
    total_expenditure <- sum(filtered_data$Alta.) +
sum(filtered_data$B.C.)
```

```
    # Create a new dataframe for the pie chart
    pie_data <- data.frame(
      Category = c("Alta.", "B.C."),
      Expenditure = c(sum(filtered_data$Alta.), sum(filtered_data$B.C.))
    )

    # Create the pie chart
    ggplot(pie_data, aes(x = "", y = Expenditure, fill = Category)) +
      geom_col(width = 1) +
      geom_text(aes(label = paste(round(Expenditure / total_expenditure *
100, 1), "%"), x = 1.5),
                position = position_stack(vjust = 0.5)) +
      theme_void() +
      labs(fill = "Category",
           title = paste("Percentage of Health Expenditure by Province",
start_year, "-", end_year)) +
      coord_polar("y")
  })

}


############################################################################
######
# PART [5] : RUNNING
# Run the application
shinyApp(ui = ui, server = server)
```