Modeling data using linear relationships: CPI and earnings over time

SHORT DESCRIPTION

In this exercise we will investigate how the CPI in Canada changed over a number of years and if there is a relationship between CPI and time that can be modeled by the data. We will then investigate how this model can help us answer questions relating to change in earnings in different industries and if they kept up with inflation. We will develop and use mathematical tools to analyze trends and make projections about expected earnings in different industries and their relationship to changes in CPI.

OVERVIEW

Preparation task: to be completed prior to class; an investigation into the concept and use of CPI in everyday affairs of the Canadian society; expected time required: 20 – 30 minutes

Task 1: Finding and investigating the Canadian historical CPI data and its trends

- to be completed in class;
- estimated time to complete: 10 – 20 minutes

Task 2: Modeling the Canadian CPI data using linear regression

- to be completed in class;
- estimated time to complete: 10 – 20 minutes

Task 3: Investigating trends in earnings by industry

- to be completed in class;
- estimated time to complete: 10 – 20 minutes

Task 4: Investigating trends in earnings by industry in relation to CPI as indicator of inflation

- to be completed in class;
- estimated time to complete: 20 – 30 minutes

REQUIRED TOOLS

Access to internet, laptop, Excel; paper, writing utensils.

DELIVERABLES

Submission of answers to questions posed within the tasks, hand-written or typed, by the end of class period. For easy identification, items with questions that require writing answers are printed in bold font.

PREPARATION TASK:

Create a Word document titled BUSI1915Week6ActivityNotes. Use this document to write down your notes as part of this activity.

Prior to class, visit Statistics Canada Prices and price indexes portal and explore information therein. In particular,

1) Watch *An Overview of Canada's Consumer Price Index (CPI)* video (use Google Chrome if you are experiencing issues) – **and make notes!**

2) Watch *Statistics Canada Training Institute - Producer price indexes* video (use Google Chrome if you are experiencing issues) – **and make notes!**

3) Check out Consumer Price Index Data Visualization Tool and, within it,:

   o *Latest Snapshot of the CPI:* consider the main item categories that go into the *consumer basket* – **which ones have the highest weight and do their weights compare to percentage of your own spending within those categories?**

   o *Price trends: 1914 to today:* consider the graph and identify what the numbers on the horizontal and vertical axes represent; then change Start Date to 2000, then to 1914 – **what do you notice in relation to your historical knowledge of the economy?**

TASK 1: Finding and investigating the data

1) Getting the data – create the data spreadsheet

   o Search for *Statistics Canada CPI, annual average* and open the page *Consumer Price Index, annual average, not seasonally adjusted*

   o Locate the information in the table where it states which year is considered to be the base year.

   o Click on Add/Remove Reference Period, set the From field to the base year, and click on Apply.

   o What data in the table that opens verifies that that is the base year?

   o Click on Download Options and choose CSV: Download as displayed (excluding accompanying symbols)

   o Save the spreadsheet as an Excel Workbook (.xlsx file); name it CPIAnalysis.

2) Visualizing the data – plot the earnings data on a graph

   o Select the CPI data, including the column and row headings; then click on Insert – Charts – Scatter with Smooth Lines and Markers.

   o Right-click on the chart and select Move Chart – New Sheet and name it by typing CPIChart in the box.

   o Go to the newly created worksheet with the graph of the earnings data you selected and type Canadian CPI by Category into Chart Title box.

   o Adjust the vertical scale to remove the empty area below the lowest data points:

     • Right-click on vertical axis scale numbers, choose Format Axis and change Bounds Minimum to a value that is below, but relatively close to the lowest data point value.

     • This should fill in the chart better and spread out the lines for better visualization.

3) Making sense of the data - write down your observations. For example:

   o **What does the vertical axis represent? What does the horizontal axis represent?** Add axis titles: Click on Add Chart Element, select Axis Titles and type in the axis description for each of the axes.

   o **Is the CPI growing for all basket categories? If not, for which one(s) is it not growing?**

   o **Which category's CPI has the rate of lowest growth? The highest rate of growth? The wildest rate of growth?**

TASK 2: Modeling the CPI data using linear regression

1) Creating the chart

    o Go to the worksheet with the data and select the data in the All-items row, including the row headings; then click on Insert – Charts – Scatter.

    o Right-click on the chart and select Move Chart – New Sheet and type in CPIAllItems.

    o Go to the newly created worksheet with the graph of the earnings data you selected and type Canadian CPI into Chart Title box.

    o Adjust the vertical scale to remove the empty area below the lowest data points (follow steps in 11) from Task 1).

2) Understanding the graph

    o **What does the vertical axis represent? What does the horizontal axis represent?** Add axis titles (see steps in 3) for Task 1).

    o **Do the points on the chart appear to follow a trend (increasing or decreasing; straight line or a wiggly line)?**

3) Modeling the data using linear regression

    o Right-click on one of the data points, then select Add trendline. **What was added to the chart?**

    o Under Trendline Options, click on Display Equation on Chart (you can move it around and increase the font for greater visibility) and try different types (exponential, linear, …) – **what do you notice?**

    o **Choose Linear and write down the equation in two variables (x and y) that is provided.** This equation is called a *linear regression model* and it provides the line of best fit for the CPI values in terms of year.

    o **What does the variable x represent and what does the variable y represent? What do the numbers in the equation represent?**

4) Adjusting the input values for the model to reflect the relevant time period

    o Insert a row underneath the current row with column headings for years, name the row *Years since base year* and enter years since base year values into cells corresponding to each of the years.

    o In the CPIAllItems worksheet, right-click on the chart and choose Select Data; click on Edit (under Legend Entries (Series)), then change the row reference number to the row number of the adjusted input values and click OK.

    o How has your chart changed? Has the equation modeling your data changed? What does the variable x represent and what does the variable y represent? What do the numbers in the equation represent? Edit axis titles where necessary (see steps in 3) for Task 1).

5) Making sense of the data – investigate the trends and make predictions

    o **If you substituted the value of 6 for x into the equation and found the corresponding value of y, what would the value of x and y tell you? How does that compare to the CPI value for the corresponding year in the data table from Statistics Canada?**

    o **Can you use the linear regression model to forecast the CPI in year 2023? In 2050? Write down the expected CPI values for those two years, with 2002 as the base year. What do these results mean?**

    o **Why do you think CPI forecasts may be valuable to you, to the businesses and the economists, and to the policy makers in the government? Write down your thoughts.**

TASK 3: Changes in earnings per industry

1) Getting the data – create the data spreadsheet

   o Search for *Statistics Canada weekly earnings by industry, annual* and open the page *Average weekly earnings by industry, annual*

   o Click on Add/Remove Reference Period, set the From field to the base year from Task 1, and click on Apply.

   o **What are the two main industry classifications (groupings) in the data table?**

   o Click on Download Options and choose CSV: Download as displayed (excluding accompanying symbols)

   o Save the spreadsheet as an Excel Workbook (.xlsx file); name it EarningsAnalysis.

2) Visualizing the data – plot the earnings data on a graph

   o Adjust the input values for the model to reflect the relevant time period by adding a row with years since the base year (follow steps in 4) from Task 2).

   o Select the row with years since base year and the rows of <u>any three</u> goods producing industries and <u>any three</u> service producing industries; then click on Insert – Charts – Scatter with Smooth Lines and Markers.

   o Right-click on the chart and select Move Chart – New Sheet and name it by typing EarningsChart in the box.

   o Go to the newly created worksheet with the graph of the earnings data you selected and type Weekly Earnings into Chart Title box.

   o Adjust the vertical scale to remove the empty area below the lowest data points (follow steps in 11) from Task 1).

3) Making sense of the data - write down your observations. For example:

   o **What does the vertical axis represent? What does the horizontal axis represent?** Add axis titles (see steps in 3) for Task 1).

   o **What trends do you notice? Are the earnings increasing or are they decreasing? Are they doing so at a consistent rate or are they fluctuating?**

   o **Which industry's earnings have the rate of lowest growth? The highest rate of growth? The wildest rate of growth?**

Task 4: Weekly earnings and inflation

1) Creating earnings index data – calculate weekly earnings indexes

   o Open a new worksheet within the document and name it EarningsIndex.

   o Copy into the worksheet the column headings row with years since base year.

   o In the next row, copy the All-Items CPI data from the spreadsheet created in Task 1. Name the row *CPI Index*.

   o Name the rows below for each of the industries selected in Task 3 with a reference to index and the industry category. For example, if you selected the manufacturing industry, name the row *manufacturing earnings index.*

   o For each of the selected industries, enter 100 for the index under the base year column. For all other years, enter the formula that calculates the earnings index for that specific year and industry (use index ratios discussed in class to create the appropriate formulas and enter the formulas into corresponding cells.)

2) Visualizing the data – plot the earnings index data on a graph

   o Select the rows with index information, including the row and column headings; then click on Insert – Charts – Scatter.

   o Right-click on the chart and select Move Chart – New Sheet and name it by typing IndexChart in the box.

   o Go to the newly created worksheet with the graph of the earnings data you selected and type Weekly Earnings Index into Chart Title box.

   o Adjust the vertical scale to remove the empty area below the lowest data points (follow steps in 11) from Task 1).

3) Making sense of the data - write down your observations. For example:

   o **What does the vertical axis represent? What does the horizontal axis represent?** Add axis titles (see steps in 3) for Task 1).

   o **What trends do you notice? Are the earnings indexes increasing or are they decreasing? Are they doing so at a consistent rate or are they fluctuating?**

   o **Would it be reasonable to try to model these index trends using a linear model (a straight line of best fit) and why?**

4) Modeling the data using linear regression

   o For each of the data point sets, right-click on one of the data points, then select Add trendline and, under Trendline Options, choose Linear, click on Display Equation on Chart

   o **Write down the equations in two variables (x and y) that are provided for each of the selected industry earnings index linear models and for the CPI.**

5) Making sense of the models - write down your observations. For example:

   o **What does the variable x represent and what does the variable y represent for each of the equations? What do the numbers in the equations represent?**

   o **How does the earnings index for each of the selected industries compare to CPI over time?**

   o **Can you use the linear regression models to forecast the CPI and the earnings indexes in year 2023? In 2050? Write down the expected index values for those two years, with 2002 as the base year. What does that mean to the change in earnings in real terms?**

- o **Why do you think forecasting earnings index and the CPI and the relationship between them may be valuable to you, to the businesses and the economists, and to the policy makers in the government? Write down your thoughts.**

Modeling data using linear relationships: CPI and earnings over time

PREPARATION TASK
Overview of Canada's Consumer Price Index (CPI)

- CPI -> measure of the average price change for goods and services bought by consumers in Canada
- Widely used indicator of inflation
- Tracks the pure price change year over year
- Things included in the basket of goods measured includes water, utilities, gas, haircuts, etc.
- Basket represents the purchasing patterns of Canadians
- Calculations are collected through Statistics Canada
- Changes in the quantity and quality do matter – these adjustments are made to reflect the CPI
- Adjusting wages /payments – based on changes in the CPI
- Helps monitor the performance of the economy

Statistics Canada Training Institute

- Producer Price → prices at which businesses sell products/services sold to consumers before tax is charged
- Calculates the real value of economic output by adjusting price changes
- Used to calculate GDP – Gross Domestic Product
- Value chain – series of activities that add value to the goods/service
- To build an index, a basket of goods must be identified that businesses will sell by tracking the selling prices of their most represented goods and services over time
- Most of the price quotes used to calculate producer price indexes are collected using surveys from Canadian producers and the internet (non-survey source)
- Once price for basket is obtained, we can measure the change in price from one period to another

Consumer Price Index Data Visualization Tool

Latest Snapshot of the CPI: consider the main item categories that go into the consumer basket – which ones have the highest weight and do their weights compare to percentage of your own spending within those categories?

Highest Weight - Shelter, Transportation, Food
The weights of these do slightly compare to my own spending, as most of my money does go to these top three categories
Price Trends – what I notice is that through the trends presented on these graphs, you can easily see when the economy was suffering during the Great Depression and how the economy managed to build back up.

Student sample (1)

TASK 1: FINDING AND INVESTIGATING THE DATA

What data in the table that opens verifies that that is the base year?
The data that verifies that this is the base year is the fact that the CPI for all items is equal to 100.

What does the vertical axis represent? What does the horizontal axis represent?
The vertical axis represents the consumer price index for each specific category for each year. The horizontal axis represents the year that the CPI is being observed for.

Is the CPI growing for all basket categories? If not, for which one(s) is it not growing?
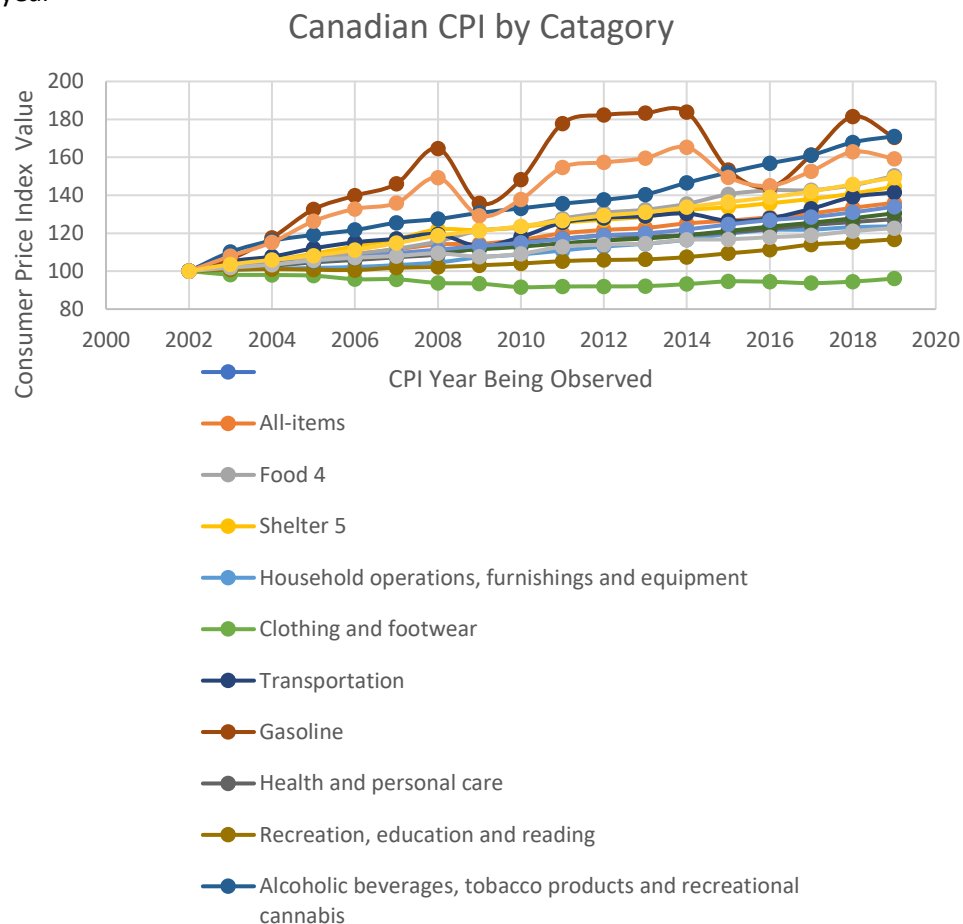For majority of the products, CPI seems to be growing, however, it is observed that for _clothing and footwear there is a decline in the CPI year over year_.

Which category's CPI has the rate of lowest growth? The highest rate of growth? The wildest rate of growth?
Lowest Rate of Growth = _Recreation, education and reading_ seems to stay consistent year over year with a small sense of growth year over year

Highest Rate of Growth = _Alcoholic beverages, tobacco products, and recreational cannabis_ seems to have the highest most consistent rate of growth as it is observed that year over year there has been a gradual increase in price for this category. Even though you could argue that the category _energy_ may have an increase in price, it seem to fluctuate more than the alcohol category.

Wildest Rate of Growth = _Gasoline_ has the most wildest rate of growth as it fluctuates tremendously in price year over year

Canadian CPI by Catagory

Legend:
- All-items
- Food 4
- Shelter 5
- Household operations, furnishings and equipment
- Clothing and footwear
- Transportation
- Gasoline
- Health and personal care
- Recreation, education and reading
- Alcoholic beverages, tobacco products and recreational cannabis

Student sample (1)

TASK 2: MODELING THE CPI DATA USING LINEAR REGRESSION

What does the vertical axis represent? What does the horizontal axis represent? Add axis titles (see steps in 3) for Task 1).

The vertical axis represents the Consumer Price Index for a specific year for ALL products. The horizontal axis represents the year that the CPI is being observed for.

Do the points on the chart appear to follow a trend (increasing or decreasing; straight line or a wiggly line)?

The points on the chart appear to follow an increasing trend, where the CPI consistently continues to increase year over year.

Right-click on one of the data points, then select Add trendline. What was added to the chart?

The trendline was added to the chart to show a consistent trending line for comparison purposes.

Under Trendline Options, click on Display Equation on Chart (you can move it around and increase the font for greater visibility) and try different types (exponential, linear, …) – what do you notice?

When trying different types of settings such as exponential vs linear, the exponential trendline curved ever so slightly, while the linear line was a consistent straight line.

Choose Linear and write down the equation in two variables (x and y) that is provided. This equation is called a linear regression model and it provides the line of best fit for the CPI values in terms of year.

y = 2.0255x - 3954.2

What does the variable x represent and what does the variable y represent? What do the numbers in the equation represent?

Variable x represents the CPI year; Variable y represents the consumer price index value; the value 2.0255 represents the slope, whereas the value 3954.2 is the y-intercept.

How has your chart changed? Has the equation modeling your data changed? What does the variable x represent and what does the variable y represent? What do the numbers in the equation represent?

The x-axis' values representing the years since the base year instead of representing the actual year has changed on the new chart. With this change being made, it did shift the entire graph to the left as the changes reflected the graph to show the CPI for the base year, showing at 0 on the x-axis. The equation ended up changing to y = 2.0255x + 100.81 as the y-intercept now is 100.81. Now, the Variable x represents the number of years since the base year. Everything else is represented the same as before.

If you substituted the value of 6 for x into the equation and found the corresponding value of y, what would the value of x and y tell you? How does that compare to the CPI value for the corresponding year in the data table from Statistics Canada?

If we substituted 6 for x into the equation and found the corresponding value for y, we would know the CPI for the 6th year since the base year.

$$y = 2.0255x + 100.81$$
$$y = 2.0255(6) + 100.8$$
$$y = 112.953$$

Student sample (1)

When we compare the CPI value for the 6th year with the data table from Stats Canada, it is pretty good approximation as to what the CPI was in the 6th year. Therefore, it seems like a reliable way to predict the CPI for future years if needed.

Can you use the linear regression model to forecast the CPI in year 2023? In 2050? Write down the expected CPI values for those two years, with 2002 as the base year. What do these results mean?
Yes, you can forecast the CPI in future years such as 2023 and 2050. All that you would need to do is determine the number of years by subtracting the future year by the base year to determine the value for the number of years since the base year, then substitute those values for x into the equation:

$$Number\ of\ years\ since\ base\ year\ (x) = 2023 - 2002$$
$$= 21$$

$$Number\ of\ years\ since\ base\ year\ (x) = 2050 - 2002$$
$$= 48$$

Now, substitute those values into the equation to forecast the CPI's for those years.

The CPI for the year 2023 is:
$$y = 2.0255x + 100.81$$
$$y = 2.0255(21) + 100.81$$
$$y = 143.3455$$

The CPI for the year 2050 is:
$$y = 2.0255x + 100.81$$
$$y = 2.0255(48) + 100.81$$
$$y = 198.034$$

With inflation increasing year over year, the CPI could potentially double in 50 years from the base year based off what the equation results are telling us.

Why do you think CPI forecasts may be valuable to you, to the businesses and the economists, and to the policy makers in the government? Write down your thoughts.
It can be valuable to everyone as it helps with predicting spending habits as well as costs of living in Canada. By forecasting based on current data, it can help us make smart and efficient decisions to ensue CPI stays afloat at a good rate. It helps us make smart decisions to ensure that it does not negatively impact our CPI had we kept things the way they currently are in the economy.
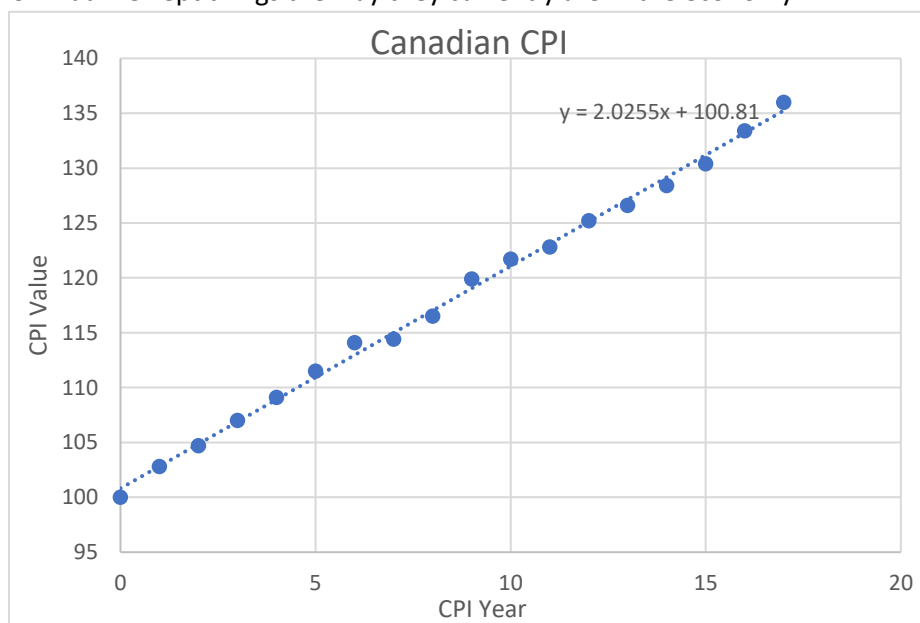
Student sample (1)

TASK 3: CHANGES IN EARNINGS PER INDUSTRY

What are the two main industry classifications (groupings) in the data table?
The two main industry classifications in the data table is the goods producing industry and the service producing industry

What does the vertical axis represent? What does the horizontal axis represent?
The horizontal axis represents the number of years since the base year, and the vertical axis represents the average amount of dollars earned in each industry.

What trends do you notice? Are the earnings increasing or are they decreasing? Are they doing so at a consistent rate or are they fluctuating?
When observing the graph, the earnings seem to steadily increase year over year. Forestry and logging seemed to have a slight dip in earnings roughly 7 years since the base year. Mining and Utilities industries seem to average higher then all other industries in weekly earnings with fluctuations in between certain years.

Which industry's earnings have the rate of lowest growth? The highest rate of growth? The wildest rate of growth?
Lowest = Real Estate and Rental/Leasing
Highest = Mining, quarrying, oil and gas extraction
Wildest = Forestry, logging, and support
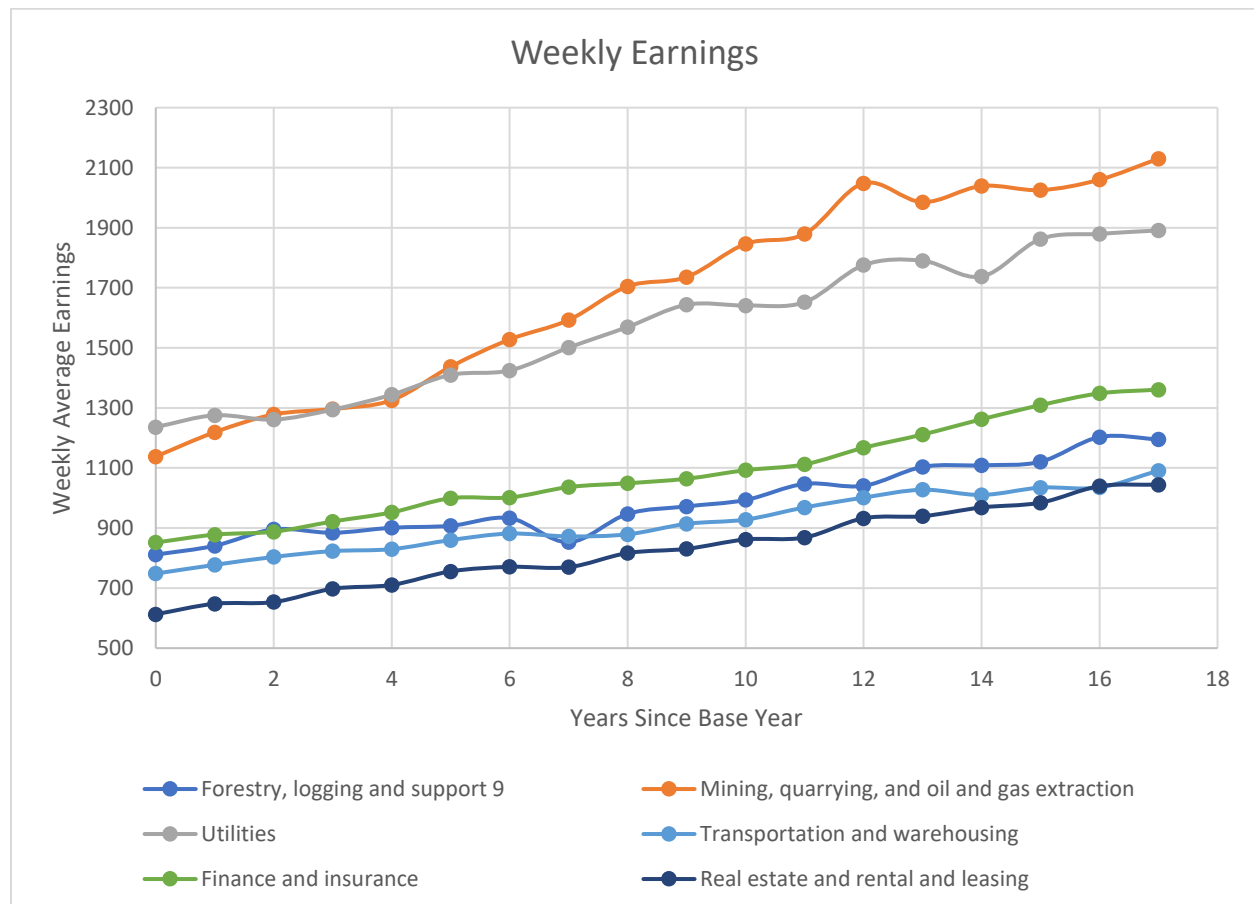
Student sample (1)

TASK 4: WEEKLY EARNINGS AND INFLATION

What does the vertical axis represent? What does the horizontal axis represent? Add axis

The vertical axis represents the Weekly Earnings Index, whereas the horizontal axis represents the number of years since the base year.

What trends do you notice? Are the earnings indexes increasing or are they decreasing? Are they doing so at a consistent rate or are they fluctuating?

The trends that are observed in the graph are that the Mining Earnings Index seems to be drastically increasing year over year, whereas the others seem to increase consistently. Forestry earnings index shows a dip in Year 7 as being the lowest earnings index point on the graph. All other industries seem to be increasing at a consistent rate.

Would it be reasonable to try to model these index trends using a linear model (a straight line of best fit) and why?

If the data was modelled using a linear model, it would be beneficial to compare trends as it would have more information to compare to. The linear model itself helps with being able to interpret the data more clearly.

Write down the equations in two variables (x and y) that are provided for each of the selected industry earnings index linear models and for the CPI.

Mining → y = 5.4522x + 101.43
Utilities → y = 3.4308x + 97.526
Real Estate → y = 4.1382x + 99.95
Finance → y = 3.5353x + 97.177
Forest → y = 2.6877x + 98.743
Transportation → y = 2.505x + 101.1

What does the variable x represent and what does the variable y represent for each of the equations? What do the numbers in the equations represent?

The variable x represents the number of years since base year, and the variable y represents the weekly earnings index. The first number in each equation represents the slope, and the second number in each equation represents the y-intercept.

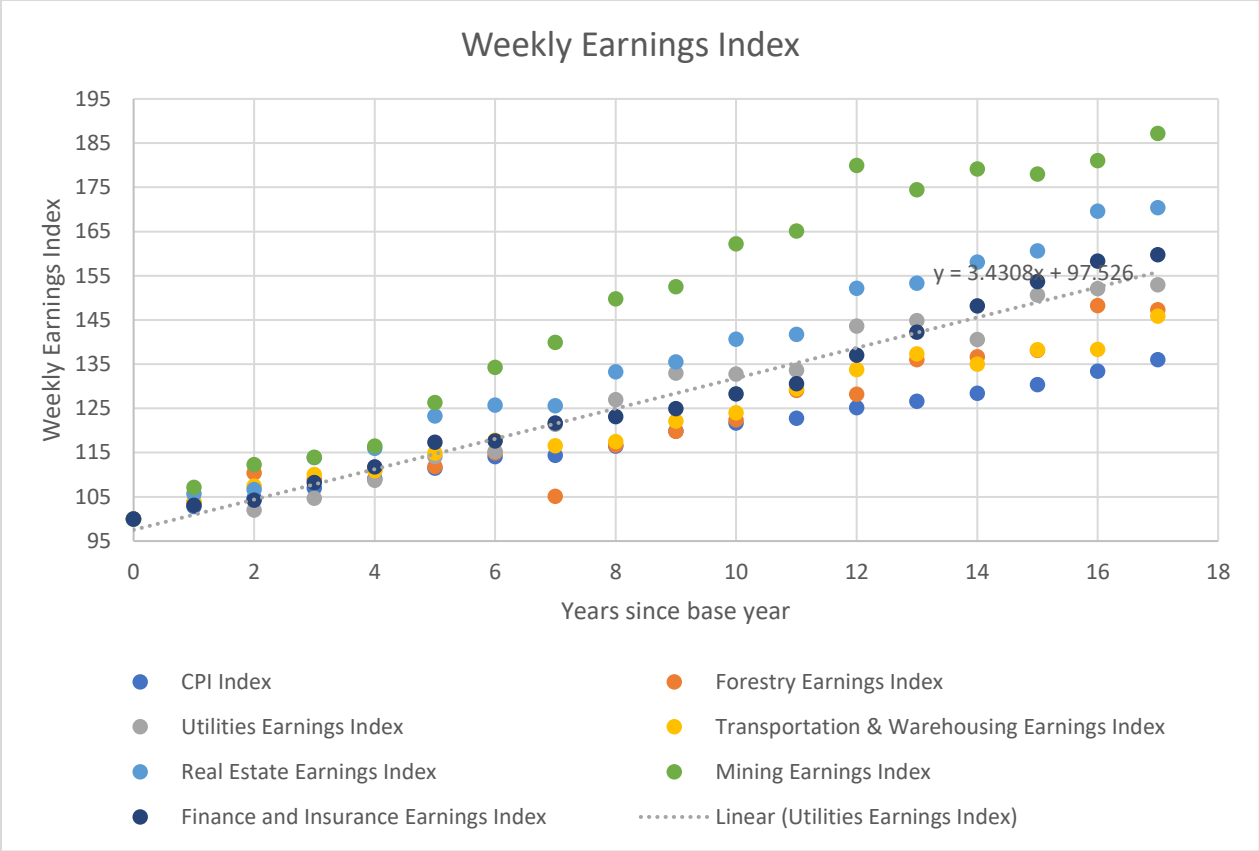***How does the earnings index for each of the selected industries compare to CPI over time?***

The earnings index for each of the selected industries compare to CPI over time as they are both consistently increasing year over year at the same rate.

Why do you think forecasting earnings index and the CPI and the relationship between them may be valuable to you, to the businesses and the economists, and to the policy makers in the government? Write down your thoughts

The below information is important to understand as it allows us to compare year over year the weekly earnings in comparison to the CPI index. This can help determine if weekly earnings are staying afloat year over year with CPI.

Student sample (1)

Weekly Earnings Index

y = 3.4308x + 97.526

Years since base year

Weekly Earnings Index

CPI Index
Utilities Earnings Index
Real Estate Earnings Index
Finance and Insurance Earnings Index

Forestry Earnings Index
Transportation & Warehousing Earnings Index
Mining Earnings Index
Linear (Utilities Earnings Index)

Modeling data using linear relationships: CPI and earnings over time

Last name, first name:

Student number:

PREPARATION TASK

Notes and observations:

- Consumer Price Index is known as the measure of the price change for goods and services
- CPI is the most widely used indicator of inflation
- The basket items have a weight for each item. For example, Milk, Gasoline etc
- Some households may spend more on gas, while others spend more on milk. In this case gas would carry a larger weight in their basket
- Basket updates with new commonly purchased goods. For example, includes smartphones now
- CPI is used to adjust wages and payments in order to maintain purchasing power
- Overall, inflation is an important measure for the economy. The government, policymakers, businesses and even individuals impacted by inflation and it influences their decision.
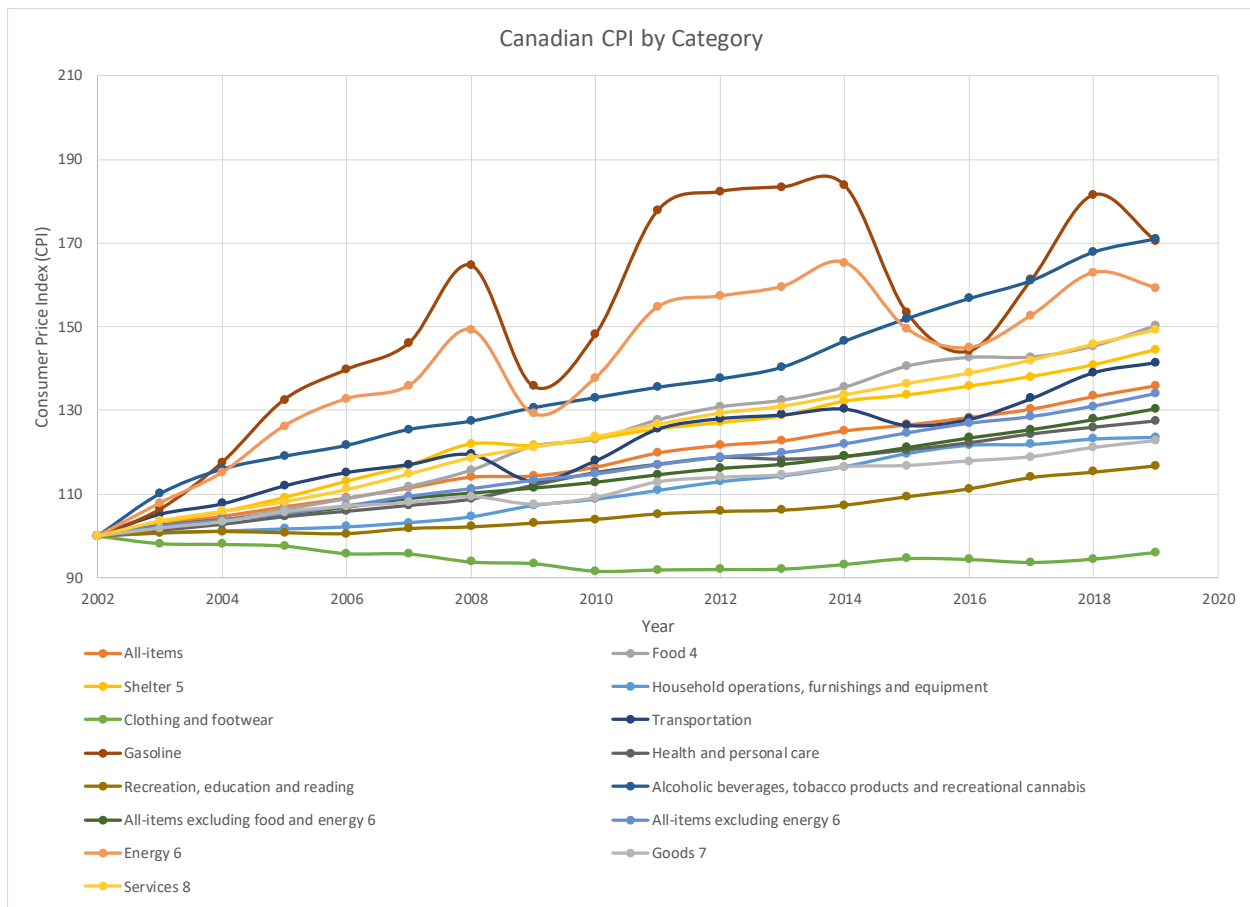
Student sample (2)

TASK 1: FINDING AND INVESTIGATING THE DATA

Notes and observations:
- Vertical axis (y-axis) is the consumer price index. The horizontal axis (x-axis)
- The CPI is not growing for all categories – it declined for clothing and footwear from the base year.
- Lowest growth rate– recreation/education/readings (or clothing/footwear if you include the one that declined, not grew)
- Highest growth rate – alcohol, gasoline
- Wildest rate of growth/most volatile – gasoline, energy

Chart:

Canadian CPI by Category

Student sample (2)

TASK 2: MODELING THE CPI DATA USING LINEAR REGRESSION

Notes and observations:

- Chart follows an increasing trend
- Chart follows the linear trend best – the trend line is close to a straight line
- y = 2.0255x - 3954.2
  - The 2.0255x represents the rate of change (the slope) and -3954.2 is the y-intercept
- The chart has changed now and instead of years it is based on years since the base year. The equation which is now y = 2.0255x + 100.81 makes more sense. The base year is approximately 100 (the y-intercept) and the slope is still 2.0255x that represents the approximately year over year change.
- If I input 6 into the equation y = 2.0255x + 100.81 = 2.0255 (6) + 100.81 = 112.963 (versus the 114.1 in 2008). The x variable, 6, represents year since base year i.e. 2008. The value is fairly close to the 114.1 in the actual data.
- For 2023
  - Years since base year = 2023 – 2002 = 21 years
  - Y = 2.0255x + 100.81
  - = 2.0255(21) + 100.81 = 143.3455
- For 2050
  - Years since base year = 2050 – 2002 = 48 years
  - Y = 2.0255x + 100.81
  - Y = 2.0255 (48) + 100.81
  - = 198.034
- CPI analysis is valuable to myself to understand how purchasing power will change, so will my wealth and my buying behaviours, etc. For businesses it helps understand how costs change and how their prices should adjust also. Its important for governments since the CPI is an indicator of the economy and they want to maintain steady inflation of something close to 2%. If it goes above or below, then they may need to influence the economy through monetary or fiscal stimulus.
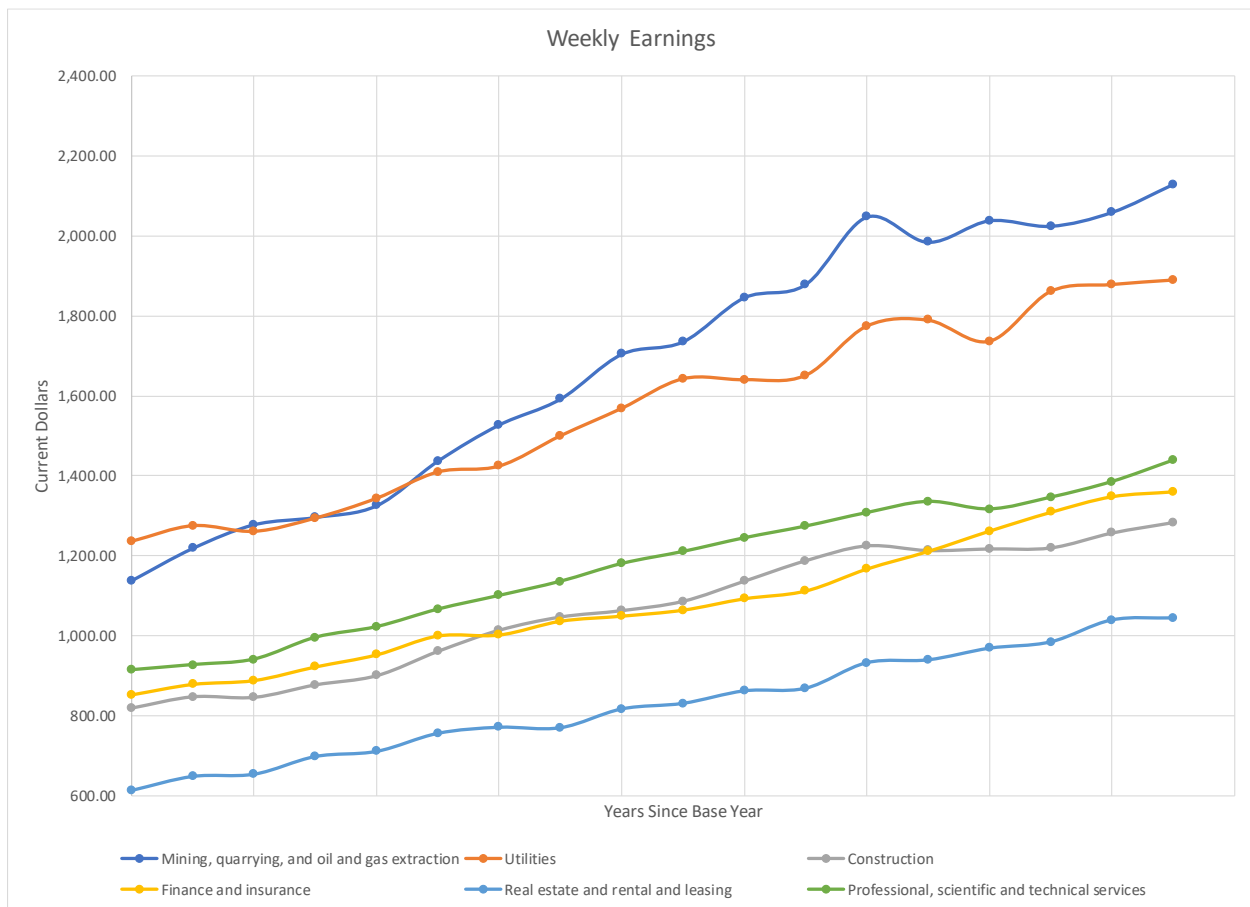
Student sample (2)

Chart:

Canadian CPI

$y = 2.0255x + 100.81$
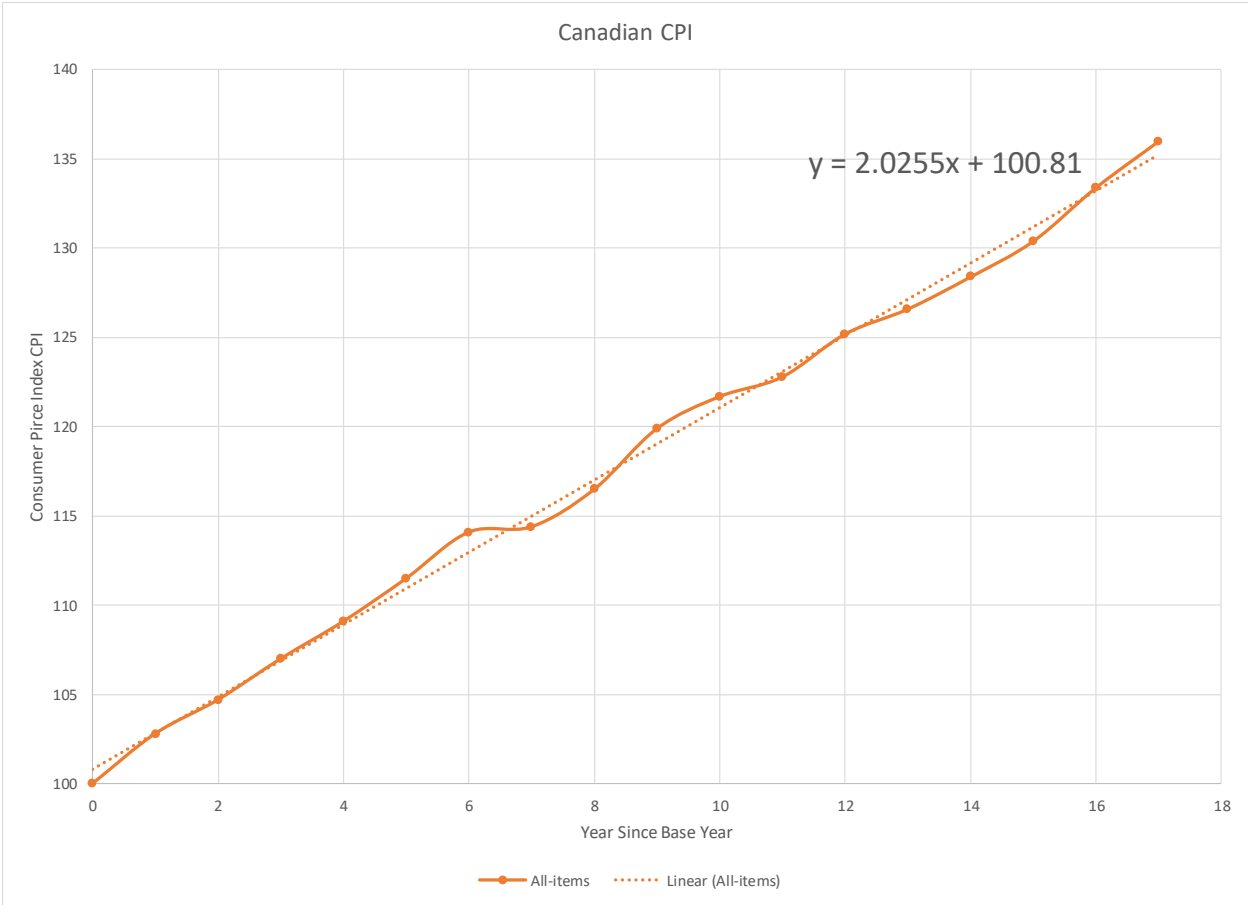
Student sample (2)

TASK 3: CHANGES IN EARNINGS PER INDUSTRY

Notes and observations

1. The two main groupings are "Industrial aggregate excluding unclassified businesses" and "service producing industries"
2. The x-axis is years since the base year and the y-axis is earnings in current dollars
3. For the 6 industries I plotted (3 service and 3 industrial goods) – all of them show earnings growth. The highest rate of earnings growth was shown by the mining industry in the 6 that I did and real estate and rental and leasing had the slowest.
4. If I plot out all the industries, mining also had the highest growth rate whereas manufacturing has the slowest growth rate since the base year.
5. Mining also appears to have the wildest rate of growth (the most volatile)

Chart:

Student sample (2)

TASK 4: WEEKLY EARNINGS AND INFLATION

Notes and observations:

1. The horizontal (x-axis) are the years since the base year. The vertical axis (y-axis) is the earnings index I have constructed which compares earnings growth since the base year, and it also plots the cpi index as well. The chart at whole essentially shows how the industry's earnings outpace or are less than inflation.
2. The scatter plot does seem to follow linear trends which implies that there is consistent earnings growth. There is a linear looking trend upwards which implies all industries have seen positive earnings growth.
3. It does make sense to model these using a linear equation/linear trend line since the scatter plot shows fairly consistent growth rates in a linear trend upwards.
4. Equations for Indexes
   a. Mining: $y = 5.4522x + 101.43$
   b. Utilities: $y = 3.4308x + 97.526$
   c. Construction: $y = 3.5886x + 99.75$
   d. Rental: $y = 3.2319x + 100.71$
   e. Professional: $y = 3.0451x + 99.499$
   f. Finance & insurance: $y = 3.5353x + 97.177$
   g. CPI Index: $y = 2.0255x + 100.81$
5. The y is the estimated weekly earnings index (vs the base year) as predicted by the linear regression trend line and x is the number of years since the base year.
6. Earnings in all industries outpace CPI. Mining did so the by the most whereas professional services was the slowest out of the group but still outpaced inflation.
7. Yes, the linear regression models can be used to predict the earnings index and the CPI index in 2023 and 2050. In 2023, the years since base year = 21 (2023-2002) and in 2050, the years since base year = 48 (2050-2002)
8. Linear regression estimates:

   CPI
   - 2023: 143.3455
   - 2050 198.034

   Mining
   - 2023: 215.9262
   - 2050 363.1356

   Utilities
   - 2023 173.4768
   - 2050 262.2044

   Construction
   - 2023 175.1106
   - 2050 272.0028

   Rental
   - 2023 168.5799
   - 2050 255.8412

Student sample (2)

Professional

- 2023 163.4461
- 2050 245.6638

Finance & Insurance

- 2023 171.4183
- 2050 266.8714

With these values obtained, we can compare the estimates earnings index versus the estimated CPI index to get the estimated change in earnings in real terms – in other words, adjusting for price effects. For example, the earnings index growth in real terms for mining in 2050 is 165.1016

Forecasting the earnings index is valuable to me as a post-secondary student because it will show me which industries are expected to have the highest real earnings growth which may influence my decision in terms of which career path I will take. The CPI index is important as well as it can show me what inflation is expected to look like going forward and how my purchasing power of any cash I have today will change. For businesses, it's also very helpful to see how if their industries are expected to have above-average wage growth which they should factor into their longer-term profitability estimates. The CPI index is also very helpful for them to understand inflation and price their products and estimate their costs appropriately. Economists spend their days looking into various parts of the economy and employment and inflation are very important aspects so being able to construct an earnings index or a CPI index is very important for them and their economic analysis. To policymakers, it's important to have a CPI index to understand where inflation is headed to see if it needs to be controlled or brought up. Similarly, the earnings index is also important for the government to understand where earnings growth may be lagging or may be too quick and this can sometimes reveal information about labour demand and supply in specific industries.

Student sample (2)

Weekly Earnings Index

y = 5.4522x + 101.43

y = 3.5353x + 97.177

y = 3.2319x + 100.71

y = 3.0451x + 99.499

y = 3.4308x + 97.526

y = 3.5886x + 99.75

y = 2.0255x + 100.81

X-axis: Years Since Base Year

Y-axis: Earnings Index

Legend:
- Mining earnings index
- Utilities earnings index
- Construction earnings index
- Finance and insurance earnings index
- Real estate and rental and leasing earnings index
- Professional, scientific and technical services earnings index
- CPI Index
- Linear (Mining earnings index)
- Linear (Utilities earnings index)
- Linear (Construction earnings index)
- Linear (Finance and insurance earnings index)
- Linear (Real estate and rental and leasing earnings index)
- Linear (Professional, scientific and technical services earnings index)
- Linear (CPI Index)