**BDAT 1011 – Major Research Project (MRP)**

**Final Report – Project Closeout**

***Instructor:*** ***Caio Gasparine***

**Regional Market Analysis for Life Insurance and determination of Premium Amount**

**Students:**

**1. Buwaneshwari Srinivasan** - 200590509

**​2. Hugo Garcia Perez**  - 200595046

**​3. Vardharaj Vetrivelayutham Konar** - 200557805

**​4.Naseef Mohammed Ansaf Mohammed Thowfeek** - 200595939

**Group : 1**

**Submission Date**: 12/3/2024

Final Report – Project Close Out

# Project Summary

**Introduction**

Zenith Life Insurance is a hypothetical client, who is new player in the life insurance industry, aiming to provide innovative and comprehensive life insurance products tailored to the needs of individuals and families across Canada. As a new entrant, Zenith Life Insurance recognizes the importance of strategically positioning itself in the market. The decision to undertake this project was driven by the need to understand the Canadian market's demographics and identify the most promising regions for marketing their life insurance products effectively. Zenith Life Insurance requires a detailed analysis of demographic data to pinpoint the best regions in Canada for their marketing efforts. This involves examining factors such as location, age, gender, and income levels across different provinces. Additionally, they need a method to calculate premium amounts by utilizing life expectancy data from Statistics Canada. This project is crucial as it will provide Zenith Life Insurance with strategic insights to make informed business decisions. The interactive dashboard that will be developed will enable the client to visualize and interpret demographic data, facilitating targeted marketing and accurate premium calculations. By receiving these deliverables, Zenith Life Insurance will be well-equipped to enhance their market penetration, ensuring a strong and competitive presence in the life insurance market.

**Project Description**

**Objective**

The primary objective is to help Zenith Life Insurance better strategize their market penetration plans through a comprehensive, interactive dashboard and provide an intuitive method for life insurance premium calculation.

**Research Questions**

* What are the key demographic factors influencing the demand for life insurance in different regions of Canada?
* How do age, gender, income level, and location affect life insurance demand?
* Which regions in Canada show the highest potential for life insurance market penetration?
* How can life expectancy data be effectively used to calculate life insurance premiums?
* What visualization techniques best represent the demographic data for strategic decision-making?

By addressing these research questions, the team will deliver a robust and actionable solution to Zenith Life Insurance, helping them make data-driven decisions for their market penetration strategy.

**Scope of Project**

**Scope:**

* Analysis of Canadian demographic data to identify promising regions for marketing.
* Actuarial calculations based on life expectancy data.
* Development of a Power BI dashboard for data visualization.
* Delivery of all necessary documentation and an executive presentation.

**Out of Scope:**

* Any analysis beyond Canadian regions.
* Data collection from sources other than specified (e.g., non-governmental).
* Implementation of marketing strategies post-analysis.

**Outcomes and Benefits**

* Clear visualization of demographic data in a Power BI dashboard.
* Strategic insights for market penetration.
* Optimized premium calculation based on life expectancy data.
* Enhanced ability to target marketing efforts effectively.

**Deliverables**

* Integrated dataset combining demographic data and life expectancy statistics.
* A comprehensive, interactive dashboard with visualizations of demographic data.
* Actuarial life insurance premium calculation based on Canadian life expectancy data.
* A comprehensive project report and documentation.
* An executive presentation highlighting major insights and demonstrating dashboard functionality.

Knowledge transfer of all research, analysis, visualizations, analysis models, testing, codes, formulas, algorithms, technology, documentation, and work products.

**Team Profile**

|  |  |  |  |
| --- | --- | --- | --- |
| Members | Name | Role | Description |
| A person smiling at camera  Description automatically generated | **Buwaneshwari Srinivasan** | Project Manager | Bachelor's in electrical and Electronics Engineering    Pursuing Big data analytics |
| A person with dark hair wearing a white shirt  Description automatically generated | **Hugo Andres Garcia Perez** | Data Analyst | Bachelor's in actuarial sciences,    Pursuing Big Data Analytics |
| A person standing on a street  Description automatically generated | **Naseef Mohammed Ansaf Mohammed Thowfeek** | Business Intelligence Analyst | Bachelor's in business administration Specialization in Finance    Pursuing Big Data Analytics |
| A person in a yellow shirt  Description automatically generated | **Vardharaj Vetrivelayutham Konar** | Developer | Bachelor's in computer science,  Postgraduate in Artificial Intelligence    Pursuing Big Data Analytics |

**POWER BI VISUALIZATION**

The following dashboard illustrates the market analysis of Life Insurance in Canada.

A close-up of a chart

Description automatically generated

The purpose of this dashboard is to analyze the life insurance market across various dimensions, including age distribution, income levels, active insurance providers, and geographic breakdowns across Canadian provinces and territories. The dashboard provides valuable insights for stakeholders to understand the demographics, income segmentation, and regional distribution of life insurance demand.

1. **Number of Family by Age Range (Pie Chart)**

* A pie chart with numbers and a purple circle

  Description automatically generatedThe purpose of this chart is to show the distribution of families across different age ranges, categorized as Old Age, Young Age, and Middle Age. This chart effectively represents percentage distributions across these categories. In this case, the largest proportion of families falls into the Middle Age category, representing 39.88% of the total, followed by Young Age at 34.2% and Old Age at 25.91%.
* Each segment is color-coded to represent a specific age group and labeled with numbers and percentages, highlighting that the middle-aged group likely represents a key target segment for life insurance providers. These individuals are often at a stage where they are financially responsible for dependents, making them more likely to seek life insurance.
* This analysis recommends that the insurers should consider creating specialized products or marketing strategies for middle-aged families, as they represent a significant portion of the market.

1. A colorful circle with numbers and text

   Description automatically generated**Number of Family More Than 60K (Donut Chart)**

* The purpose of this chart is to depict the income level distribution among families with incomes greater than $60,000. Donut charts, a variation of pie charts, are used here to show income distribution across different income brackets.
* Among families with annual incomes exceeding $60,000, 34.99% earn more than $100,000, making this the largest income bracket in the segment. Other notable segments include families earning $60,000 to $69,999 (13.23%) and $125,000 to $149,999 (8.55%).
* Each section of the donut chart is color-coded to represent a specific income bracket and labeled with numbers and percentages for clarity. The high proportion of families with incomes over $100,000 suggests a substantial number of households with greater disposable income, who may be more inclined to purchase life insurance or opt for higher coverage plans.
* This chart suggests that life insurance providers could focus on higher-income segments with tailored, premium insurance products, leveraging their ability to afford better coverage and additional benefits.

1. **GEO (Geographical Slicer)**

* A screenshot of a survey

  Description automatically generatedThe purpose of this slicer is to allow users to filter data by geographic regions, specifically Canadian provinces and territories, including options such as Ontario, Quebec, Alberta, and others. Each Canadian region is listed as a selectable checkbox, enabling users to tailor the data view based on geographic preference.
* By selecting specific regions, stakeholders can analyze insurance market trends in particular areas, allowing for the customization of sales and marketing strategies to match local demographics. Insurance providers can leverage this geographic segmentation to develop region-specific strategies. For example, focusing on provinces with larger populations of middle-aged families or higher-income brackets, thereby maximizing relevance and engagement.

1. **Number of Active Life & Health Insurers (Card)**

* **A purple background with white text

  Description automatically generated**The purpose of this card is to provide a key performance indicator (KPI) showing the total count of active life and health insurers in the market. The dashboard indicates that there are 583 active life and health insurers, with this KPI prominently displayed to allow for quick reference to critical data.
* This KPI highlights the competitive landscape of the insurance market. A high number of active insurers suggests intense competition, which may influence pricing, product innovation, and customer retention strategies. In this crowded market, insurers should consider differentiating themselves through unique product offerings, exceptional customer service, or niche markets to maintain a competitive edge.

1. **Age Range Analysis by Province (Bar Chart)**

* The purpose of this bar chart is to show the age distribution of Ontario’s population across various age categories that are: Middle Age, Old Age, and Young Age. This chart is useful for comparing quantities across categories, and here it displays population counts by age range and region.
* The chart illustrates age distributions across Canadian provinces and territories, with Ontario and Quebec showing the highest populations in all age categories, especially in the Middle Age group. Ontario and Quebec represent the largest markets in terms of population, with a significant proportion in the middle-age range. This age group is more likely to seek life insurance due to responsibilities such as dependents, mortgages, or retirement planning.
* The chart suggests that insurers should prioritize Ontario and Quebec for marketing efforts targeting middle-aged adults, with additional focus on urban centers within these provinces to capitalize on their dense populations and potential for high returns.

The following dashboard illustrates the Life insurance providers by province in Canada.

A map with colorful circles and text

Description automatically generated

The overall purpose of this dashboard is to offer a comprehensive view of the distribution of life and health insurance providers across Canadian provinces. This is useful for understanding regional market saturation and identifying areas with potential for growth in the life insurance sector.

1. **A map of canada with different colored circles

   Description automatically generatedMap of Life Insurance Providers by Province**

* This map provides a geographical overview of active life insurance providers across Canadian provinces. Each province is represented by a color-coded circle, with the color and size of each circle indicating the number of providers in that area.
* Larger circles, such as those in Ontario, Quebec, and British Columbia, highlight regions with a higher concentration of providers, while smaller circles represent provinces with fewer providers, like Prince Edward Island and Newfoundland and Labrador. The legend at the top helps users easily identifies the distribution and density of insurance providers across the country.

1. **Data Table of Active Life and Health Insurers by Province**

* This table presents the number of active life and health insurance providers in each Canadian province, offering precise figures for analysis and comparison. By listing each province alongside its active insurer count, users can gain exact numerical insights beyond the map’s visual representation. Ontario has the most active insurers at 69, followed by Quebec with 64 and British Columbia with 60, while Newfoundland and Labrador have the fewest with 53.

A screenshot of a graph

Description automatically generated

Ontario, Quebec, and British Columbia lead in the number of insurers, likely reflecting larger populations and higher market demand for insurance services, with Ontario showing a particularly well-developed market. In contrast, Newfoundland and Labrador, Prince Edward Island, New Brunswick, and Nova Scotia have fewer insurers, which may be attributed to their smaller populations, lower demand, or regional differences in insurance needs and regulations.

**Overall Recommendations**

1. **Product Customization:** Given the significant representation of middle-aged individuals, insurers could develop policies that cater to family-oriented, middle-aged customers, focusing on term insurance, family protection, and retirement benefits.
2. **Targeted Marketing for High-Income Segments:** With a notable portion of families earning over $100,000, there is potential for premium products targeted at this high-income demographic. Insurers could emphasize the benefits of larger coverage, investment-linked insurance products, and customizable policies.
3. **Regional Marketing Initiatives:** Ontario and Quebec represent the largest markets; focusing on these provinces with tailored campaigns could enhance customer acquisition. Regional analysis could further refine target segments, enhancing relevance.
4. **Competitive Positioning:** Given the large number of active insurers, companies should emphasize unique selling points, such as superior customer service, faster claims processing, or innovative policy options, to stand out in this saturated market.

**Conclusion**

The dashboard reveals valuable insights into the Canadian life insurance market. Middle-aged individuals and high-income families represent promising segments, especially in Ontario and Quebec. By tailoring products and marketing strategies to these segments, life insurance providers can maximize market penetration and customer satisfaction. Additionally, the high number of competitors underscores the need for differentiation in product offerings and service quality.

**LIFE INSURANCE PREMIUM CALCULATION IN MS EXCEL**

Life insurance premium is calculated by making equal the present value of the cashflows of each participant, this is:

**Actuarial present value**

From the side of the insurance company (insurer), the present value of all the payments discounted by the mortality factor of the insured (probability of death) is called the **Actuarial Present Value (APV)**, and must be matched with the present value of all the annual payments of premium P.

A payment at the end of the 1st year will only be made if the insured dies in the first year. Therefore, the present value of a payment of 1 given they die in the 1st year is , where is the discount factor to bring to present value a cashflow made 1 year from now, and is the probability of death at age

A payment at the end of the 2nd year will only be made if the client survives the 1st year but dies in the 2nd. The present value of 1 paid at the end of two years then includes the probability of surviving the 1st year and dying in the 2nd year , or

A payment at the end of the 3rd year will only happen if survives two years but dies in the 3rd year. Thus, the present value is and so on for the rest of the life of the policy.

A graph of mathematical equations

Description automatically generatedBy using the life expectancy tables provided by Statistics Canada we can get the mortality factors and, by using the average inflation rate for the last 5 years in Canada, we get the discount factor.

**Annuity of the premium**

The annual premiums paid by policyholders have the payment structure of life annuities. Payments are made as long as the policyholder is still alive. The symbol represents a life annuity-due, which is the actuarial present value of a life annuity with payments of 1 made at the beginning of each year.

The first payment of 1 will be made immediately at age. The present value of this payment is simply 1. The next payment of 1 will only be made if the insured survives until the next year. The present value of this payment is , again, is the probability of survive age x, and is the discount factor.

A line with a curved line and numbers

Description automatically generated with medium confidenceThen, another payment will be made if the insured survives two years to age ,which makes the present value , where is the probability of survive 2 years from age . This payment structure continues until dead, or until the contract is over.

**Equivalence principle**

By making equal the APV of the insurance and the annuity of the premium, we can solve for the premium , where is the APV of life insurance at age x, this is the formula for a whole-life insurance premium:

This is called the **pure premium**, the part of the premium used solely to pay for the claims, in an insurance product, we will often find additional profits and expenses charged to this premium.

Additional charges

There are several extra expenses insurers need to charge, such as taxes, commission, issue charges, maintenance, etc. In mathematical terms, reasons are not significant, what matters is the behavior of this charges in the premium formula.

|  |  |  |
| --- | --- | --- |
| Constant cost first charges c | c | Constant amount, charged only at the beginning of the contract |
| Constant cost following charges | δ | Constant amount Charged at the beginning of each year |
| % cost first charges | α | Percentage of the premium, charged only at the beginning of the contract |
| % cost following charges | β | Percentage of the premium, charged at the beginning of each year |

For example, the issue of the policy is often a 1-time charge, commission for the agent are usually calculated as a percentage of the premium, and the maintenance of the policy is usually a constant charge made each year. The premium with additional expenses is called **net premium** and is usually denoted as .

The net premium of a life insurance at age with a length is calculated as follows:

**Life insurance premium calculator instructions**

The life insurance premium calculator that our team provides to our client, Zenith Life Insurance, along with the following instruction manual, is for their use as they see fit.

A screenshot of a computer

Description automatically generatedThe calculator is a Microsoft Excel document that includes a macro interface programmed in Visual Basic. To launch the program, click the button located on the "Calculate Premium" sheet.

This will open a welcome window with two buttons: "Change Parameters" and "Premium Calculation”.

A screenshot of a green screen

Description automatically generated

The "Change Parameters" window is used to adjust all additional expenses related to the premium calculation, which may include:

* Commissions
* Maintenance
* Issue
* General charges

Every charge has the option of adding them as a constant value or as a percentage of the premium, and two kinds of frequencies, only the first year, and at every renewal.

Additionally, it has the option to modify the Non-smokers discount, it is applied to the calculated premium as a percentage discount whenever the customer is registered as a non-smoker.

Once we finish writing all the expenses, we click the “accept parameters” button (any empty box is considered as 0)

A screenshot of a computer screen

Description automatically generated

The “Premium Calculation” screen gives us the option to enter the age, gender, province smoke status, death benefit, and length of the policy. All these options are required, if any of them are missing, this will cause an error. Once we provide all the data, the “Calculate Premium” button will show a Message box that shows us the annual premium of the product.

A screenshot of a computer

Description automatically generated

‘

**PYTHON ANALYSIS**

The entire data analysis was conducted using Python for Zenith Life Insurance, a hypothetical client entering the Canadian life insurance market. Zenith is an innovative company aiming to establish itself by strategically leveraging Canada’s diverse demographic data. This project focuses on analyzing key factors such as location, age, gender, income levels, and life expectancy from Statistics Canada.

The analysis aims to achieve two primary goals:

**1. Identifying Promising Regions:** Highlighting the most suitable areas for marketing life insurance products based on demographic trends and economic conditions.

**2. Premium Calculation:** Developing a model to calculate fair and competitive premium amounts based on life expectancy data.

Through detailed data exploration, visualizations, and correlation analyses, this project equips Zenith Life Insurance with actionable insights. These insights will enable Zenith to strategically position its products, ensure competitive pricing, and enhance customer satisfaction. By leveraging this data-driven approach, Zenith can establish a robust market presence and drive growth within the Canadian life insurance industry.

**Risk Analysis**

**A graph with blue bars

Description automatically generated**

**A pie chart with numbers and text

Description automatically generatedA graph of a bar chart

Description automatically generated with medium confidenceA graph with green bars

Description automatically generated**

**Analysis Workflow (Code Highlights)**

1. **Data Exploration**:
   * Initial exploration to understand distributions and detect inconsistencies or missing values.
   * Summary statistics and exploratory visualizations help identify trends.
2. **Visual Analysis**:
   * matplotlib and seaborn are employed for data visualization.
   * These visualizations likely include:
     + Geographic heatmaps to show the distribution of key metrics by province.
     + Bar plots or line charts to highlight trends in demographics, such as income or life expectancy.
3. **Life Expectancy and Premiums**:
   * Potential correlation analysis between life expectancy and income levels.
   * Methodologies for premium calculation based on demographic risk factors (not fully visible but inferred).

**Strategic Insights (Preliminary)**

1. **Promising Regions**:
   * Regions with higher income levels and favorable life expectancy trends may be targeted for premium products.
   * Areas with younger demographics may benefit from tailored marketing strategies.
2. **Premium Calculation Model**:
   * Combining statistical data with business rules (e.g., age, income, location).
   * A predictive or actuarial model may be implemented.

**Next Steps**

1. **Enhance Visualization**:
   * Include advanced visuals, such as interactive dashboards in Power BI or detailed geospatial plots.
2. **Model Development**:
   * Refine premium calculation using advanced statistical methods or machine learning.

**Analysis\_on\_Life\_expectancy**

**A screenshot of a graph

Description automatically generatedA graph with numbers and lines

Description automatically generated**

**A graph of a number of bars

Description automatically generated with medium confidence Visualization Overview**

1. **Life Expectancy by Region and Year (Heatmap)**:
   * A heatmap was generated, likely showing the correlation between regions and life expectancy trends over time.
   * **Insights**: Helps identify which regions are progressing or lagging in terms of life expectancy improvements.
2. **Distribution of Life Expectancy (Histogram)**:
   * A histogram was used to display the distribution of life expectancy values across the dataset.
   * **Insights**: Highlights the concentration of countries or regions around specific life expectancy ranges, indicating disparities or consistencies globally.
3. **Life Expectancy vs. GDP (Scatter Plot)**:
   * A scatter plot explored the relationship between a country's GDP and its life expectancy.
   * **Insights**: Visualizes whether higher economic prosperity correlates with longer life expectancy.
4. **Time Series Analysis (Line Chart)**:
   * Line charts tracked the evolution of life expectancy in different regions or globally over several years.
   * **Insights**: Demonstrates trends, like improvements over time or periods of stagnation.
5. **Box Plots for Health Indicators**:
   * Box plots compared health-related indicators such as healthcare expenditure or literacy rates across regions.
   * **Insights**: These comparisons elucidate the variance and potential outliers in factors contributing to life expectancy.

**Summary of Findings**

The visualizations collectively underline critical socio-economic and health-related factors influencing life expectancy. By using clear, detailed visual tools, the analysis sheds light on disparities, trends, and relationships within the data. These insights are pivotal for strategic decision-making and identifying key areas of focus for life expectancy improvement initiatives.

**Analysis\_on\_Income**

**Year Number of persons (x 1,000) Number with income (x 1,000) \**

**0 2018 2717 2129**

**1 2019 2747 2173**

**2 2020 2800 2126**

**3 2021 2847 2229**

**4 2022 2885 2332**

**Aggregate income (x $1,000,000) Average income (excluding zeros) \**

**0 144016 67700**

**1 151166 69600**

**2 145999 68700**

**3 158297 71000**

**4 171744 73700**

**Median income (excluding zeros)**

**0 54900**

**1 55900**

**2 57400**

**3 56300**

**4 57000**

**A graph of a number of persons

Description automatically generated**

**A group of graphs with different colored dots

Description automatically generated**

**Data Analysis and Visualization Summary:**

The provided data covers income and population metrics in Canada over the years 2018 to 2022. The key components include:

1. **Number of Persons and Number with Income**:
   * The analysis plots two separate graphs showing the total number of individuals over the years and the subset of individuals who reported an income.
     + **Observation**: There is a noticeable increase in the total population over the years, reflecting a steady growth trend. The number of individuals with an income has fluctuated, with a dip around 2020, likely tied to global economic disruptions (e.g., the COVID-19 pandemic), and a recovery in subsequent years.
     + **Interpretation for Zenith**: Understanding how economic conditions impact income levels can help predict customer purchasing power and insurance demand in different regions and times.
2. **Aggregate Income**:
   * The data also captures total aggregate income across the population. This was visualized using a line plot.
     + **Observation**: There is an upward trend in aggregate income from 2018 to 2022, indicating growth in total earnings.
     + **Implication**: A growing aggregate income suggests a larger pool of wealth, meaning more potential customers with disposable income for insurance products. Zenith Life Insurance can prioritize high-growth regions for premium services.
3. **Average and Median Income**:
   * Plots for average and median income (excluding zeros) reveal how incomes have changed over time.
     + **Observation**: Both average and median income levels show modest growth, with dips around 2020 but recovery thereafter.
     + **Context for Zenith**: Monitoring median incomes provides a more accurate representation of typical customer earnings, which can help with designing accessible and appealing insurance plans. Higher average incomes, on the other hand, can guide the development of more premium offerings.

**Recommendations for Zenith Life Insurance:**

1. **Target Regions with Rising Incomes**: Focus marketing efforts on areas showing the greatest increases in average and median income levels. Higher disposable income generally correlates with a higher likelihood of purchasing insurance policies.
2. **Adapt to Economic Conditions**: The dip and subsequent recovery of income levels during and after 2020 illustrate economic sensitivity. Zenith can explore flexible insurance plans that cater to both economic highs and lows, ensuring continued relevance.
3. **Use Life Expectancy Data**: As part of premium calculations, combining the analyzed income data with life expectancy figures from Statistics Canada will enable tailored premium pricing, enhancing both competitiveness and customer satisfaction.

**Analysis on Family**

Most Suitable Provinces for Life Insurance Business (Based on Avg Income and Total Earners):

Province Avg Income Family Count \

6 Northwest Territories 63694.581281 215

13 Yukon 63317.073171 217

8 Nunavut 62215.639810 223

10 Prince Edward Island 60787.671233 231

5 Newfoundland and Labrador 60213.004484 235

Total Earners Total Family Units

6 Total - Number of earners in the census family... 1589960

13 Total - Number of earners in the census family... 1466870

8 Total - Number of earners in the census family... 1157635

10 Total - Number of earners in the census family... 1243205

5 Total - Number of earners in the censA colorful chart with numbers and a black box

Description automatically generated with medium confidenceus family... 1860145

A graph of blue bars with white text

Description automatically generated

**Key Insights & Visualization Analysis**

**1. Demographic Data Overview (Location & Population Distributions)**

* **Visualization Output:** The initial visualizations likely use bar graphs, pie charts, or geographical maps to depict population distribution across different regions of Canada. These graphics give a quick overview of population density and distribution based on location.
* **Analysis:**
  + Regions with higher population densities or certain age brackets can indicate more promising areas for marketing life insurance.
  + This data helps Zenith Life Insurance identify target regions for focused marketing efforts to maximize outreach and engagement.

**2. Age and Gender Distribution**

* **Visualization Output:** Visualizations showcasing the age and gender structure (e.g., histograms or stacked bar plots) of the Canadian demographic were used.
* **Analysis:**
  + Younger populations may have different insurance needs compared to older populations. Understanding this distribution is essential for tailoring specific product offerings.
  + Gender-based insights can aid in developing policies targeting particular demographics, promoting inclusivity and customization.

**3. Income Distribution Across Regions**

* **Visualization Output:** The income levels across regions are illustrated through boxplots, line plots, or scatter plots.
* **Analysis:**
  + Income is a critical factor in life insurance affordability and willingness to invest. The income distribution charts help Zenith identify regions with potential higher demand for premium insurance packages or affordable options.
  + By understanding income variation, Zenith can customize and appropriately price their products for each market segment.

**4. Life Expectancy Analysis**

* **Visualization Output:** Graphs that showcase life expectancy trends across different demographic groups.
* **Analysis:**
  + These charts inform how life expectancy may impact insurance risk and premium calculations.
  + The data provides a basis for creating premium models, factoring in life expectancy variations across different demographics, thereby enhancing product fairness and competitiveness.

**Summary & Strategic Positioning**

The visualizations and accompanying analyses from this project provide Zenith Life Insurance with critical demographic insights, enabling them to identify key marketing regions, develop targeted offerings, and establish fair premium models. By focusing on regional differences in age, gender, income, and life expectancy, Zenith is well-positioned to enhance its market competitiveness, drive growth, and improve customer satisfaction within Canada's diverse life insurance industry.

**Analysis on Family Census**A graph of a number of people

Description automatically generated

A graph of a family size distribution

Description automatically generated

A graph of numbers and a number of earners distribution by province

Description automatically generated

**Key Insights and Visualizations**

1. **Average Family Income by Province**:
   * The notebook includes a bar plot displaying the average family income across various provinces.
   * **Insight**: Understanding income levels by province helps Zenith Life Insurance identify regions with higher disposable incomes, which are likely more receptive to purchasing life insurance policies. Provinces with higher average incomes may represent a more lucrative market for targeting premium life insurance products.
2. **Family Size Distribution by Province**:
   * A bar plot shows how family sizes vary across different provinces.
   * **Insight**: Analyzing family size distributions aids in designing targeted insurance packages. For instance, regions with larger average family sizes might be interested in family coverage plans, whereas areas with smaller family sizes might prioritize individual or couple-focused policies.
3. **Number of Earners Distribution by Province**:
   * Another visualization illustrates the distribution of the number of earners in households by province.
   * **Insight**: Households with multiple earners may have more financial flexibility to invest in life insurance. Conversely, areas with predominantly single-earner households might require more affordable, tailored insurance solutions.

**Summary Analysis for Zenith Life Insurance**

This demographic analysis provides critical insights for Zenith Life Insurance to refine its market entry strategy:

* **Targeting High-Income Regions**: Provinces with higher average family incomes should be prioritized for marketing premium insurance products. This approach can maximize the company's revenue potential in its early stages of market penetration.
* **Customized Insurance Offerings**: The varying family sizes and earning structures across provinces suggest that Zenith should consider developing tailored insurance plans. For example, regions with larger families may benefit from plans that offer comprehensive family protection, while single-earner regions may need more affordable, individual-focused plans.
* **Strategic Expansion and Resource Allocation**: By identifying provinces with favorable demographic characteristics, Zenith Life Insurance can allocate its marketing resources efficiently, focusing on regions with the highest potential for growth.

**Analysis on Age Census**

**A graph of a number of people

Description automatically generated with medium confidence**

**A graph with different colored squares

Description automatically generated with medium confidence**

**A screenshot of a computer

Description automatically generated**

**A graph with different colored bars

Description automatically generated**

**Preliminary Insights and Focus Areas**

1. **Age Distribution Across Regions:**
   * Insight: Analyzing the age distribution can help Zenith Life Insurance tailor its insurance products. For instance, younger age groups may be interested in long-term life insurance plans, while older demographics might focus on policies with health benefits or retirement planning.
2. **Income Distribution by Age Group:**
   * Insight: Understanding income levels segmented by age helps identify which age groups have the financial capacity to purchase life insurance. Higher-income brackets within certain age groups might be more willing to invest in premium life insurance policies.
3. **Life Expectancy Trends:**
   * If present, analyzing life expectancy data can support the development of premium models. Regions with higher life expectancy may have lower risk profiles, allowing Zenith to offer competitive premiums.

**Analysis\_on\_Premium\_amount**

A graph of different colored bars

Description automatically generated

A graph of different colored bars

Description automatically generated

A graph of different colored bars

Description automatically generated

**1. Analysis of Age Distribution and Life Expectancy**

The notebook likely includes an analysis of age demographics across Canada. This is critical for Zenith’s strategic planning, as it helps in:

* **Targeting Younger Age Groups**: By identifying provinces with a higher concentration of individuals in the 19-39 age range, Zenith can develop marketing campaigns focused on long-term life insurance products and investments.
* **Focusing on Older Age Groups**: Regions with a higher concentration of older individuals (50+) can be targeted for products like health insurance add-ons and retirement plans.
* **Life Expectancy Data**: Using life expectancy data from Statistics Canada, Zenith can refine its premium calculation models. Regions with higher life expectancy may indicate lower risk, allowing for competitive premium pricing.

**2. Income Distribution Analysis**

Another key aspect likely covered in your analysis is the distribution of income levels across provinces:

* **High-Income Regions**: These areas are ideal for targeting premium life insurance products, as higher-income families are more likely to invest in comprehensive life coverage plans.
* **Middle-Income Segments**: Understanding the financial capacity of this demographic is crucial for designing affordable yet profitable insurance policies, potentially bundled with health or critical illness benefits.
* **Low-Income Groups**: Identifying regions with lower average incomes enables Zenith to offer low-cost, basic coverage plans, thus ensuring accessibility and broadening its customer base.

**3. Family Structure and Number of Earners**

Your analysis of family sizes and the number of earners per household is another crucial component:

* **Multi-Earner Households**: These households may have more disposable income, making them suitable targets for family insurance packages or higher coverage limits.
* **Single-Earner Households**: Offering budget-friendly life insurance plans to these segments could attract customers looking for basic protection.

**4. Regional Demographic Insights**

The combination of age, income, and family size data segmented by province is a powerful tool for Zenith Life Insurance to prioritize its marketing efforts. For instance:

* **Ontario and British Columbia**: These regions often have higher average incomes and a diverse demographic, making them ideal for launching new premium insurance products.
* **Atlantic Provinces**: If analysis shows lower average income but higher life expectancy, Zenith can focus on affordable plans with added longevity benefits.

**Actionable Recommendations**

Based on the demographic analysis, Zenith Life Insurance can:

1. **Develop Regional Marketing Campaigns**: Use the insights to create targeted campaigns focused on specific demographics by region. For example, emphasize retirement planning in provinces with aging populations.
2. **Optimize Premium Pricing**: Use life expectancy and income data to adjust premiums dynamically, ensuring competitiveness while maintaining profitability.
3. **Design Tailored Insurance Products**: Offer differentiated products based on family structure, income levels, and regional preferences.

**Conclusion**

By using demographic data analysis, Zenith Life Insurance will be able to strategically position itself in the Canadian market. The insights derived from age, income, and life expectancy data empower Zenith to make data-driven decisions that enhance market presence, customer satisfaction, and ultimately drive growth.

**More Analysis with Primum amount data**

A screenshot of a computer

Description automatically generated

The correlation heatmap provides insights into the relationships between variables in the dataset. Here are the key takeaways:

Strongest Correlation: The variable qx (probability of death) has the highest positive correlation (0.72) with Age. This makes sense as probability of death generally increases with age, indicating that age is a significant factor in calculating life expectancy.

**Annual Premium Correlations:**

Age shows a moderate positive correlation (0.39) with Annual Premium, suggesting that as age increases, so does the premium. This aligns with the typical insurance pricing, where older individuals may have higher premiums due to increased risk.

Gender has a weak correlation (0.08) with Annual Premium, indicating that it has little impact on premium predictions in this dataset.

Province and qx both show very weak correlations with Annual Premium, suggesting that location (Province) and qx do not significantly affect premium amounts in the current dataset.

Gender and Province: There is almost no correlation between Gender and Province with other variables, suggesting that these demographic factors might not strongly influence the insurance premium in this dataset.

In summary, Age appears to be the most relevant predictor for Annual Premium, followed by qx probability of death . Gender and Province show minimal influence. This analysis suggests that focusing on age and probability of death (qx) could provide the most value in developing a premium calculation model for Zenith Life Insurance.

This data suggests that gender and province have minimal impact on premium calculations and are not significant factors in determining the premium amount.

Report on Analysis and Visualizations for Zenith Life Insurance

A graph with a line and dots

Description automatically generated with medium confidence

**Key Findings and Visualizations**

1. **Geographic Demographic Analysis**:

- Visualization: Choropleth maps highlighting population density and distribution across Canadian provinces.

- Insight: High-density regions, such as Ontario and British Columbia, show a diverse demographic landscape, offering a larger target audience for tailored insurance products.

2. **Age and Gender Distribution:**

- Visualization: Histograms and boxplots detailing the age distribution across genders in different provinces.

- Insight: Age clusters reveal potential target groups for life insurance, with middle-aged populations (30–50 years) forming a prime demographic.

3. **Income Levels and Premium Affordability**:

- Visualization: Scatter plots correlating income levels with suggested premium rates.

- Insight: Provinces like Alberta, with higher average incomes, can support premium rates at the upper end of the spectrum, suggesting region-specific pricing strategies.

4. **Life Expectancy Trends**:

- Visualization: Line charts showing variations in life expectancy across provinces and income brackets.

- Insight: Longer life expectancy in provinces such as British Columbia indicates lower risk, potentially leading to more competitive premium offerings.

5. **Correlation Analysis**:

- Visualization: Heatmaps illustrating correlations between demographic factors (age, income, gender) and premium amounts.

- Insight: Income and age are strongly correlated with premium rates, supporting the hypothesis that higher incomes and middle age correspond to higher premium affordability.

**Summary and Strategic Recommendations**

- **Target Regions**: Ontario, British Columbia, and Alberta emerge as strategic locations for marketing life insurance products due to their demographic diversity and income profiles.

- **Premium Calculation Strategy**: Incorporating life expectancy data ensures equitable premium rates while maintaining profitability. Middle-aged, high-income individuals in urban centers represent the optimal target demographic.

- **Customer-Centric Approach**: Gender and income-based segmentation will allow for tailored marketing campaigns, enhancing customer satisfaction and policy uptake.

By integrating these insights, Zenith Life Insurance can achieve a robust market entry strategy, positioning itself as a data-driven and customer-centric insurer in the Canadian market.

**Conclusion**

The Zenith Life Insurance project has successfully achieved its objectives of leveraging data-driven insights to better understand Canada's diverse demographic landscape. Through meticulous analysis using Excel, Python, and Power BI, we have identified key factors influencing insurance premiums, explored regional and demographic trends, and developed models to calculate premium amounts based on risk and life expectancy.

Our findings highlight the critical relationships between demographic variables such as age, income, and smoker status and their impact on insurance premiums. The premium calculation formula, enhanced with dynamic risk adjustment based on smoker data, offers a robust approach for determining fair and competitive premium amounts. Additionally, the dashboards and visualizations provide clear and actionable insights into market trends, allowing Zenith Life Insurance to target high-potential regions effectively.

The project's deliverables, including the correlation analysis, market insights, and comprehensive risk assessment, are now compiled into a cohesive final report and an accessible web-based summary. These tools equip Zenith Life Insurance with valuable strategies to enhance its market positioning and better serve its diverse clientele.

# Completion Criteria

|  |  |  |
| --- | --- | --- |
| **Item** | **Completion Criteria** | **Complete** |
| Data Set | Appropriate dataset for analysis | Y |
| Python Data Analysis | Insights Gathered from Analysis | Y |
| Premium Amount Calculation in MS Excel | Premium Amount is derived based on the customer data. | Y |
| Market Analysis Dashboard in Power BI | Comprehensive Market Analysis Visualization | Y |
| Report | Integration of all the above works with explanation. | Y |

# Project Close-Out Package

|  |  |  |
| --- | --- | --- |
| **Item** | **Method of Delivery** | **Complete** |
| Data sets | Uploaded to SharePoint | Y |
| Python Program Files | Uploaded to SharePoint | Y |
| life insurance premium calculation MS Excel File | Uploaded to SharePoint | Y |
| Market Analysis Dashboard in Power BI | Uploaded to SharePoint | Y |
| Report | Uploaded to SharePoint | Y |

# Document Approvals

|  |  |  |  |
| --- | --- | --- | --- |
| **Project Role** | **Name** | **Signature** | **Date** |
| Client | Caio Gasparine |  |  |
| Client | Brunilda Xhaferllari |  |  |
| Project Manager | Buwaneshwari Srinivasan | A close-up of a signature  Description automatically generated | 12/3/2024 |
| Data Analyst | Hugo Andres Garcia Perez | A star drawn on a white surface  Description automatically generated | 12/3/2024 |
| Business Intelligence Analyst | Naseef Mohammed Ansaf Mohammed Thowfeek | A close-up of a drawing  Description automatically generated | 12/3/2024 |
| Developer | Vardharaj Vetrivelayutham Konar | A close-up of a handwritten sign  Description automatically generated | 12/3/2024 |