ENSF 692 Final Project Report

Spring 2025

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Group #3

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Executive Summary

This report analyzes Calgary's housing and demographic trends using 2,577 records from three City of Calgary open datasets spanning 2016-2017. Our analysis addresses three critical urban planning questions that help city planners understand where Calgary is growing and where housing pressures are emerging.

Research Questions

1. Which city sectors are growing fastest? - To identify where infrastructure investment is needed
2. Which sectors have the highest property values? - To understand Calgary's premium real estate markets
3. How do inner-city and suburban areas grow differently? - To understand Calgary's urban development pattern.

Major Findings

- Southeast sector leads city growth with +3.5% population increase, demonstrating the strongest demographic momentum
- West sector commands Calgary's highest property values at $523,021 average assessment, despite smaller population
- Continued suburban sprawl pattern as suburban areas grow (+2.1%) while inner-city communities experience population decline (-0.5%)

Data Sources

We merged three City of Calgary open datasets [1] – [3]:

1. Civic Census by Community and Dwelling Structure - Provides population counts, dwelling types, and vacancy data across all Calgary communities
2. Assessments by Community - Contains median residential property valuations that reflect market conditions and investment patterns
3. Communities by Ward - Geographic classification system linking communities to wards, sectors, and development characteristics

Time Period: Analysis focused on 2016-2017 as these were the only years with complete assessment data across all three datasets.

Data Quality and Processing

- Scale: 2,577 community-year observations covering 248 distinct Calgary communities
- Completeness: 78.5% usable data (2,024 valid records for analysis)
- Data Integrity: Successfully merged three datasets using community names as primary keys
- Missing Values: 8% of records missing sector classification, primarily industrial areas

Derived Metrics

Metric	Purpose	Interpretation
VACANCY_RATE	Housing market health	<3% indicates tight market, >7% suggests oversupply
GROWTH_MOMENTUM	Demographic trajectory	Year-over-year population change shows community vitality

Research Findings and Analysis

Question 1: Fastest-Growing City Sectors

Methodology: Aggregated population and housing data by Calgary's geographic sectors, calculated year-over-year growth rates, and assessed whether housing supply keeps pace with population growth.

Results:

Sector	Population Growth	Market Assessment
Southeast	+3.5%	Fastest growth sector
North	+2.1%	Strong growth
Northeast	+1.8%	Moderate growth
South	+0.7%	Moderate growth
Centre	+0.8%	Slow growth
East	-1.3%	Population decline
Northwest	-1.1%	Population decline
West	-0.1%	Stable

Key Insight: Southeast Calgary demonstrates the strongest population momentum (+3.5%), while three sectors (East, Northwest, West) experienced population decline.

Planning Implications: City should prioritize Southeast for accelerated permitting processes and infrastructure planning to prevent housing shortages.

Question 2: Premium Property Markets

Methodology: Ranked Calgary sectors by average median residential assessment values to identify premium real estate markets and understand the relationship between population size and property values.

Results:

Sector	Avg Assessment	Total Population	Market Position
WEST	$523,021	247,641	Premium market
SOUTH	$484,939	451,152	High value/high-density
CENTRE	$484,502	388,762	Urban premium

Key Insight: West sector commands Calgary's highest property values ($523,021 average) despite having the smallest population among major sectors, indicating exclusive/low-density premium development.

Planning Implications: The inverse relationship between population density and property values suggests Calgary's premium markets are characterized by lower-density, exclusive development patterns rather than high-density urban cores.

Question 3: Inner-City vs Suburban Development Patterns

Methodology: Classified Calgary communities as Inner-City or Suburban based on historical development patterns, then compared growth trajectories, investment flows, and housing market dynamics.

Results:

Area Type	Population Growth	Median Assessment Growth	Vacancy Rate (2017)	Development Pattern
Suburban	+2.1%	+2.6%	7.8%	Continued expansion
Inner-City	-0.5%	-3.7%	9.0%	Population decline
Difference	+2.6pp	+6.3pp	-1.2pp	Favors suburban sprawl

Key Insight: Both area types experienced property value changes during 2016-2017, with suburban assessments growing (+2.6%) while inner-city assessments declined (-3.7%).

Planning Implications: This trend indicates ongoing urban development challenges. Policy should focus on reversing inner-city population decline through revitalization incentives,

improved transit, and amenity development, while managing suburban infrastructure costs and environmental impacts of continued sprawl.

Program Execution Screenshots

Figure 1: Clean Dataset Module Output

Figure 2: Calgary Housing Analysis Program Invalid Community Name Error Handling

```
base .venv ~/UofC/ensf692/project/ensf692-project git:(main)±11
python3 calgary-housing-analysis.py

Calgary Housing and Demographics Analysis System
ENSF 692 Spring 2025 - Final Project

Loading Calgary Housing and Demographics Data ...

Area Type Classification Summary:
AREA_TYPE
Suburban     192
Inner-City   120
Name: count, dtype: int64

Sample classifications:
   COMM_STRUCTURE   AREA_TYPE    COMMUNITY_NAME
0    BUILDING OUT    Suburban          CRANSTON
1          1950s   Inner-City         PARKHILL
2    INNER CITY   Inner-City  CRESCENT HEIGHTS
3          2010s    Suburban        ROYAL OAK
4    BUILDING OUT    Suburban       ALPINE PARK
5    1980s/1990s    Suburban      FALCONRIDGE
6          1950s  Inner-City     RUTLAND PARK
7     EMPLOYMENT    Suburban     NORTH AIRWAYS
8    1980s/1990s    Suburban         SUNDANCE
9     EMPLOYMENT    Suburban          SUNRIDGE
Dataset loaded successfully! 2577 records available.

Missing Values Summary:
  COMM_CODE_y: 205 (8.0%)
  CLASS: 205 (8.0%)
  CLASS_CODE: 205 (8.0%)
  SECTOR: 205 (8.0%)
  SRG: 296 (11.5%)
  COMM_STRUCTURE: 205 (8.0%)
  WARD_NUM: 205 (8.0%)
  AREA_TYPE: 205 (8.0%)
  COMM_CODE: 382 (14.8%)
  Number of taxable accounts: 382 (14.8%)
  ASSESSMENT_PER_PERSON: 407 (15.8%)
  VACANCY_RATE: 193 (7.5%)


Dataset Overview:
              WARD  DWELLING_TYPE_CODE  DWELLINGS_TOTAL        RES_CNT  DWELLINGS_VACANT  RENOVATION_DWELLING_CNT  INACTIVE_CNT  OTHER_PURPOSE_CNT  CLASS_CODE    WARD_NUM  MEDIAN_ASSESSMENT
count  2577.000000         2577.000000     2577.000000    2577.000000       2577.000000              2577.000000   2577.000000        2577.000000  2372.000000  2577.000000       2.577000e+03
mean      7.815289            5.190532      391.002716     962.944509         17.227784                 1.353512      1.444703           1.204501     1.039629     7.736903       4.003446e+05
std       3.566476            3.537918      830.782910    2217.042105         56.783038                 3.602371      6.908687           6.315564     0.201507     3.464529       2.391789e+05
min       1.000000            1.000000        0.000000       0.000000          0.000000                 0.000000      0.000000           0.000000     1.000000     1.000000       0.000000e+00
25%       5.000000            2.000000        2.000000      12.000000          0.000000                 0.000000      0.000000           0.000000     1.000000     5.000000       3.150000e+05
50%       8.000000            5.000000       81.000000     164.000000          4.000000                 0.000000      0.000000           0.000000     1.000000     8.000000       4.120000e+05
75%      11.000000            7.000000      400.000000     828.000000         19.000000                 1.000000      0.000000           1.000000     1.000000    10.000000       5.030000e+05
max      14.000000           13.000000    16725.000000   20617.000000       1719.000000               101.000000    205.000000         151.000000     3.000000    14.000000       1.620000e+06


User Input Section

Available communities (showing first 10):
  - ABBEYDALE
  - ACADIA
  - ALBERT PARK/RADISSON HEIGHTS
  - ALTADORE
  - ALYTH/BONNYBROOK
  - APPLEWOOD PARK
  - ARBOUR LAKE
  - ASPEN WOODS
  - AUBURN BAY
  - BANFF TRAIL
  ... and 238 more

Enter community name (or 'list' to see all): Fake Community

Error: 'FAKE COMMUNITY' not found.
Tip: Try typing just the first few letters, or use 'list' to see all options
Available communities (showing first 10):
  - ABBEYDALE
  - ACADIA
  - ALBERT PARK/RADISSON HEIGHTS
  - ALTADORE
  - ALYTH/BONNYBROOK
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  - ARBOUR LAKE
  - ASPEN WOODS
  - AUBURN BAY
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  ... and 238 more

Enter community name (or 'list' to see all):
```

Figure 3: Calgary Housing Analysis Program Invalid Year Error Handling

Figure 4,5,6: Calgary Housing Analysis Program Successful User Input and Community Profile, Analysis Output, Program Completion and File Export

```
base .venv ~/UofC/ensf692/project/ensf692-project git:(main)±11 (12.1s)
python3 calgary-housing-analysis.py
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Calgary Housing and Demographics Analysis System
ENSF 692 Spring 2025 - Final Project
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User Input Section
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Available communities (showing first 10):
  - ABBEYDALE
  - ACADIA
  - ALBERT PARK/RADISSON HEIGHTS
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  - ALYTH/BONNYBROOK
  - APPLEWOOD PARK
  - ARBOUR LAKE
  - ASPEN WOODS
  - AUBURN BAY
  - BANFF TRAIL
  ... and 238 more

Enter community name (or 'list' to see all): ACADIA
Enter year (2016 or 2017): 2017
```

```
Community Profile: ACADIA (2017)
================================================

Basic Information:
  Ward: 11
  Sector: SOUTH
  Area Type: Inner-City

Population & Housing:
  Total Population: 10,656
  Total Dwellings: 5,033
  Vacant Dwellings: 224
  Vacancy Rate: 4.5%

Assessment Values:
  Median Assessment: $385,000
  Assessment per Person: $70

Dwelling Types:
  A structure originally built to be movable whether it is now movable or on a permanent foundation. Include summer travel trailers only if used as a permanent residence.: 92
  A structure originally designed and built to contain a single dwelling unit.: 2,282
  A structure originally designed and built to contain at least three dwelling units on three or more levels. The dwelling units share outside entrances.: 2,025
  A structure originally designed and built to contain one or more dwelling units which is designated as a nursing home, auxiliary hospital, care centre, lodge, etec. There are many seniors'
d stove to be considered as a separate dwelling unit. Otherwise, all suites included at one address and are part of this definition for lodges, care centres, or assisted living.: 1
  A structure originally designed and built to contain three or more attached, or semi-attached dwelling units, each of which has a separate outside entrance.: 384
  A structure originally designed and built to contain two dwelling units, either side-by-side, front-to-back or one above the other.: 132
  A structure that provides lodging.: 3
  Any residential structure that contains a dwelling unit which does not fit the other structure codes, e.g. shack, garage.: 2
  The additional dwelling units in a structure that contains more units than the building was originally designed and built to contain.: 112

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COMPREHENSIVE DATA ANALYSIS
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1. AGGREGATION: Average Assessment by Area Type (2017 only):
            Average Assessment  Community Count
AREA_TYPE
Inner-City           459469.0              648
Suburban             420278.0              371
Note: Excluded 214 records with missing data

2. MASKING: High-Value Communities (Median Assessment > $600,000):
  Total high-value records: 274
  Unique communities: 35

  Top 5 Highest Assessments:
    UPPER MOUNT ROYAL (2016): $1,620,000 - CENTRE
    UPPER MOUNT ROYAL (2016): $1,620,000 - CENTRE
    UPPER MOUNT ROYAL (2016): $1,620,000 - CENTRE
    UPPER MOUNT ROYAL (2016): $1,620,000 - CENTRE
    UPPER MOUNT ROYAL (2016): $1,620,000 - CENTRE

3. GROUPBY: Population and Assessment Summary by Sector:
          Total Population  Avg Assessment  Avg Vacancy Rate
SECTOR
SOUTH             451152.0        484939.0               5.0
CENTRE            388762.0        484502.0               9.1
NORTHEAST         355220.0        330680.0               8.5
NORTHWEST         350289.0        478830.0               6.4
NORTH             306927.0        412251.0               5.4
SOUTHEAST         259419.0        395150.0               5.1
WEST              247641.0        523021.0               4.4
EAST              115726.0        265728.0               7.0

4. PIVOT TABLE: Growth by Sector and Year:
          MEDIAN_ASSESSMENT          RES_CNT            VACANCY_RATE
YEAR            2016       2017      2016       2017       2016      2017
SECTOR
CENTRE      477664.89  458302.27  193627.0   195135.0   0.107667   0.09772
EAST        235433.33  268046.88   58247.0    57479.0   0.063683  0.070673
NORTH       410118.28  377281.55  151874.0   155053.0   0.071887  0.060852
NORTHEAST   283669.42  301739.84  176068.0   179152.0   0.087795  0.117928
NORTHWEST   486379.31  467683.76  176079.0   174210.0   0.070313   0.07569
SOUTH       483284.26  465329.95  224797.0   226355.0   0.054618  0.069909
SOUTHEAST   372102.94  373410.96  127488.0   131931.0   0.042647  0.080709
WEST        506586.47  540791.04  123859.0   123782.0   0.048813  0.081244
```

```
RESEARCH QUESTIONS: ANALYSIS FINDINGS


RESEARCH QUESTION 1: Which sectors show the most population growth?

Sector Population Growth Analysis (2016 → 2017):
  CENTRE      : 193,627.0 → 195,135.0 (+1,508.0) =  +0.8%
  EAST        : 58,247.0 → 57,479.0 (+-768.0) =   -1.3%
  NORTH       : 151,874.0 → 155,053.0 (+3,179.0) =  +2.1%
  NORTHEAST   : 176,068.0 → 179,152.0 (+3,084.0) =  +1.8%
  NORTHWEST   : 176,079.0 → 174,210.0 (+-1,869.0) =  -1.1%
  SOUTH       : 224,797.0 → 226,355.0 (+1,558.0) =  +0.7%
  SOUTHEAST   : 127,488.0 → 131,931.0 (+4,443.0) =  +3.5%
  WEST        : 123,859.0 → 123,782.0 (+-77.0) =   -0.1%

  KEY FINDING 1A: SOUTHEAST has highest growth rate at +3.5%
  KEY FINDING 1B: SOUTHEAST has largest population increase of 4,443.0 people

RESEARCH QUESTION 2: Which sectors have the highest property values?

Top 3 Sectors by Average Property Assessment:
  WEST        : $ 523,021 average (Population: 247,641.0)
  SOUTH       : $ 484,939 average (Population: 451,152.0)
  CENTRE      : $ 484,502 average (Population: 388,762.0)

  KEY FINDING 2: WEST sector has highest average assessments

Population vs Property Value Analysis:
  Largest Population: SOUTH (451,152.0 people)
  Highest Values: WEST ($523,021 average)
  KEY FINDING 2B: Population size and property values are inversely related

RESEARCH QUESTION 3: How do Inner-City and Suburban areas compare?

Area Type Comparison (2016 vs 2017):

  Inner-City:
    Population Growth:  -0.5% (570,099.0 → 567,317.0)
    Assessment Growth:  -3.7% ($474,558 → $457,011)
    2017 Vacancy Rate:   9.0%

  Suburban:
    Population Growth:  +2.1% (661,940.0 → 675,780.0)
    Assessment Growth:  +2.6% ($378,927 → $388,692)
    2017 Vacancy Rate:   7.8%

  KEY FINDING 3A: Suburban areas growing faster
    - Suburban: +2.1% vs Inner-City: -0.5%
  KEY FINDING 3B: Suburban areas now have larger population (675,780.0 vs 567,317.0)
  KEY FINDING 3C: Inner-City areas have higher vacancy (1.1% difference)


SUMMARY: KEY INSIGHTS

1. FASTEST GROWING SECTOR: SOUTHEAST (+3.5% population growth)
2. HIGHEST PROPERTY VALUES: WEST sector ($523,021 average)
3. DEVELOPMENT PATTERN: Calgary shows suburban sprawl trend
4. DATA QUALITY: Analysis based on 2024 valid records from 2577 total


Creating Visualizations ...


Creating research visualizations ...
  Creating Chart 1: Sector Population Growth ...
  Creating Chart 2: Property Values Analysis ...
  Creating Chart 3: Area Type Comparison ...
  Creating Chart 4: Dataset Summary ...
  Visualization saved as: calgary_housing_research_analysis.png


Exporting Results ...


Complete dataset exported to 'calgary_housing_complete_analysis.xlsx'
  - Main dataset: 2577 records
  - 5 sheets included: Complete Dataset, Summary Statistics, Sector Analysis, High Value Communities, Missing Values


Analysis Complete!


Files generated:
  1. calgary_housing_research_analysis.png - Research visualization plots
  2. calgary_housing_complete_analysis.xlsx - Complete dataset and analysis

Thank you for using the Calgary Housing Analysis System!
```

References

[1] Civic Census by Community and Dwelling Structure, City of Calgary, June 2021. [Online]. Available: https://data.calgary.ca/Demographics/Civic-Census-by-Community-and-Dwelling-Structure/set9-futw

[2] Assessments by Community, City of Calgary, June 2021. [Online]. Available: https://data.calgary.ca/Government/Assessments-by-Community/p84b-7zbi

[3] Communities by Ward, City of Calgary, June 2021. [Online]. Available: https://data.calgary.ca/Government/Communities-by-Ward/jd78-wxjp