PowerThruData

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Predicting and Visualizing the Progression of Marginal Villages: A Case Study of Japanese Municipalities

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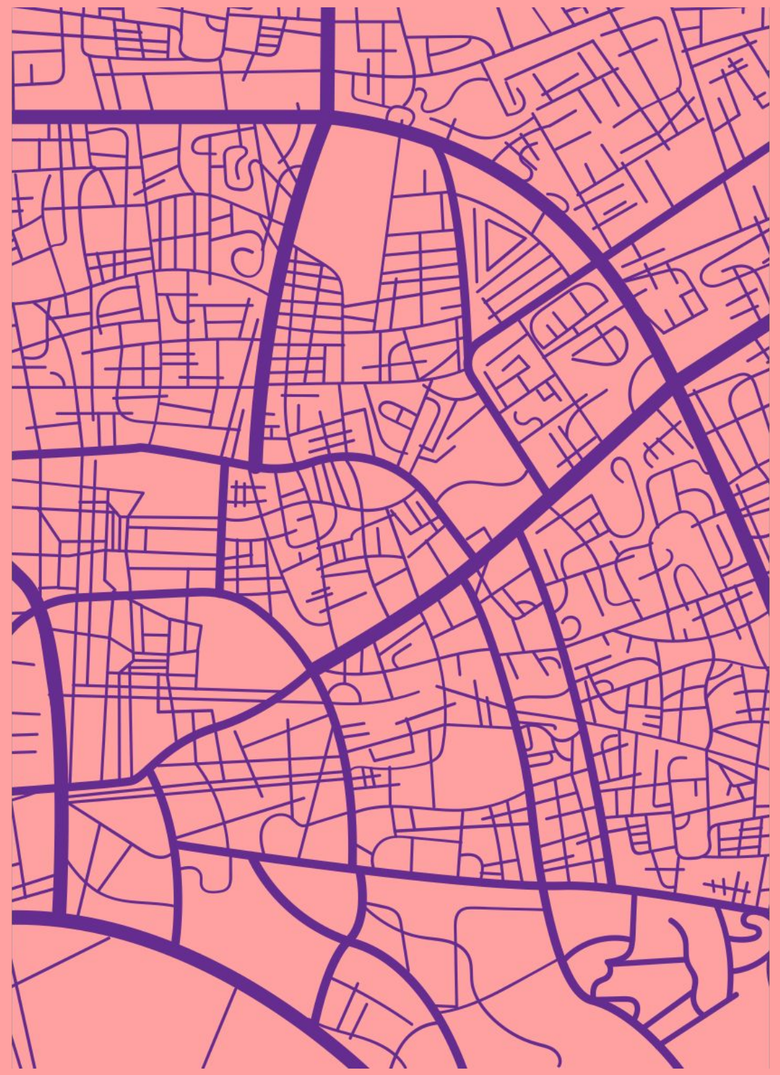
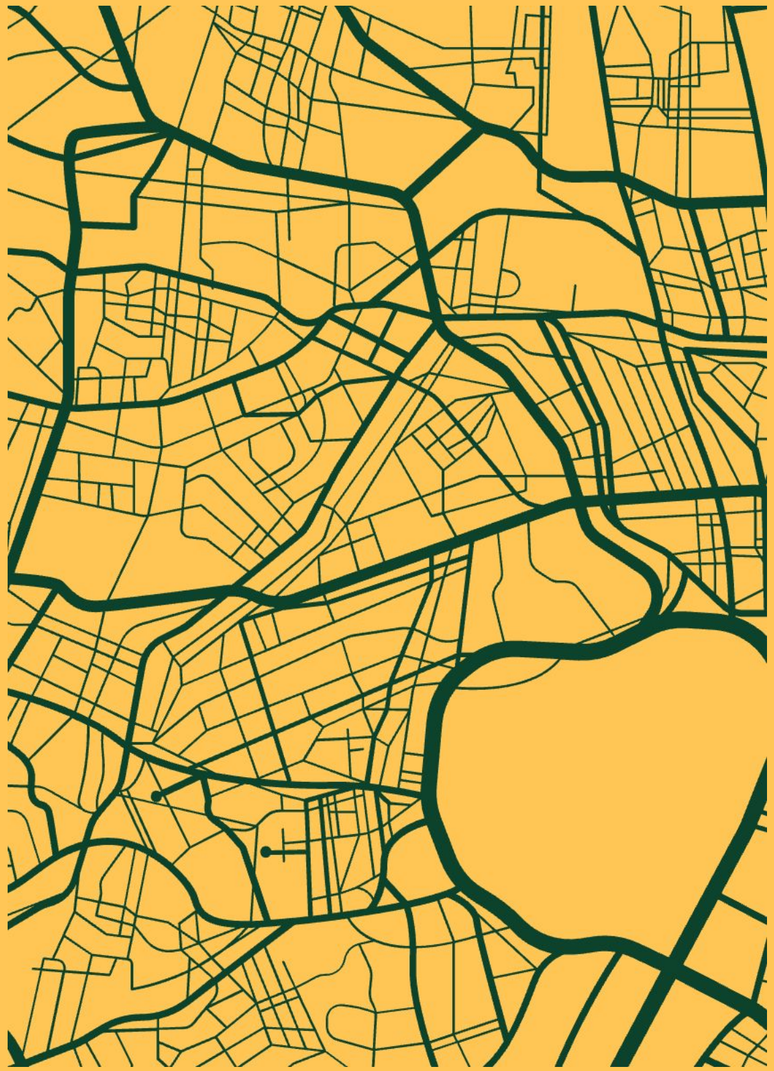


Introduction

Introducing the background and aims of our chosen topic



Implementation

Implementing our data-driven solution

Evaluation

Evaluating the strengths, limitations, and implications of our work for future research

Introduction

Background & Problem

Background

Japan's Ageing Population

- 1/10 aged 80 or over (Ng, 2023)
- World's highest % of people aged 65+ (Ng, 2023)
- By 2040, 34.8% will be aged 65+ (National Institute of Population and Social Security Research, 2023)
- Other nations, such as Italy (2nd)and Finland (3rd), are also facing an ageing populations (Washington, DC: Population Reference Bureau, 2019)

→ local problem that requires widely applicable solutions

Causes

1. Low birth rates
2. Increasing cost of living
3. Long working hours
4. Long life expectancy (e.g., centenarians)

Problem & Solution

Localised problem: marginal villages (Sato, 2012)

- Lack of village management affects quality of life
- Arises from having 50%+ of local population being 65+ years old

Consequences (Niimura, 2009)

- Poor quality of life
- Environmental issues (e.g., land and waste management)
- Lack of security
- Decreased economic growth = limited employment

→ Connects to **Jobs and Social Protection**

Few good data visualisaton or predictive tools on the progression of marginal villages (i.e., munincipalities)

Solution

- Visualisation → PowerBI
- Prediction → Python linear regression model

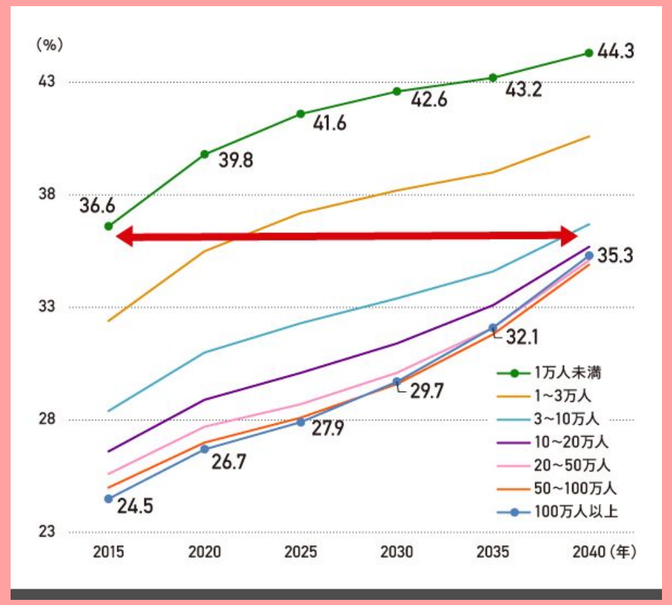


Figure 1 (Tanaka, 2019)
Percentage of 65+ population over time

Predictive model provides insight into contribution of variables to ageing population
→ allows for recommendations on high-priority factors

Methods

Data Wrangling

Portal Site of Official Statistics of Japan

→ Open-access governmental statistics

- Selected variables for all municipalities from 2000 to 2020 in 5-year intervals
  - Original dataset: 1,916 municipalities
  - Excluded 262 municipalities with missing or miscoded data across any year
  - Final dataset: **N=1,654 municipalities**

Variables

Based on Ministry of Finance (2011) and Niinuma (2009)

Demographic IVs

- % of employed persons
- Birth rate per 1,000
- Mortality rate per 1,000

$$\frac{\text{No. of births/deaths*1,000}}{\text{Total municipal population}}$$

Area IVs

- % of inhabitable area over total municipal area (ha)
- Number of educational infrastructure (i.e., kindergarten, elementary, and upper/lower secondary infrastructure)

DV

- % of total municipal population over 65 years old

$$\frac{\text{Total over 65}}{\text{Total municipal population}}$$

Data Analysis

Tableau Visualisation

- % of population over 65 per municipality
- Summary per prefecture
- Correlations between predictor and outcome variables
- Filters (e.g., by year, region, % of population over 65)

Linear Regression Model

- Run within municipalities

% of population over 65 ~ year + % of employed persons + birth rate + mortality rate + % of inhabitable land + no. of educational infrastructure

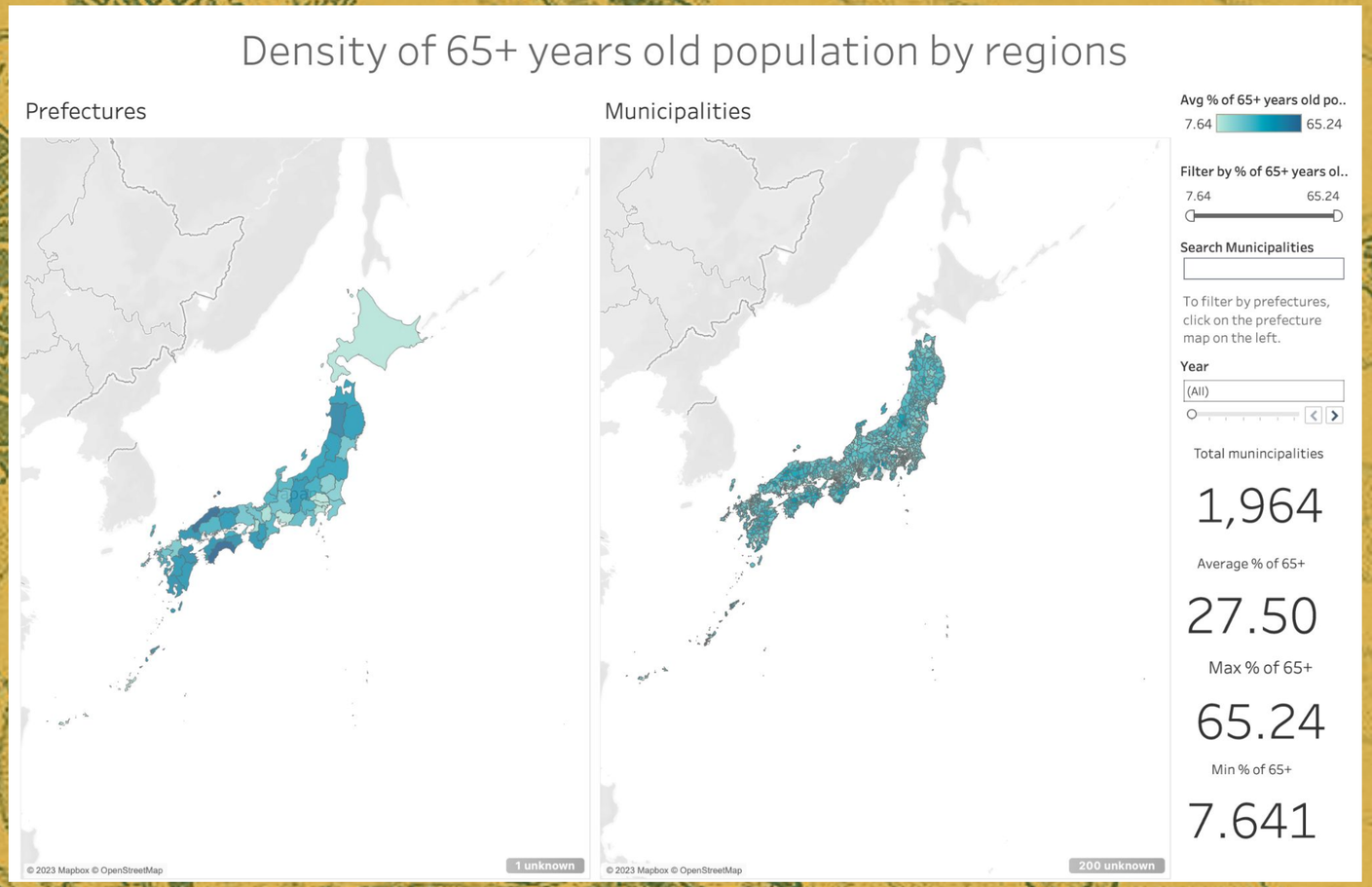
Implementation

Descriptive Statistics

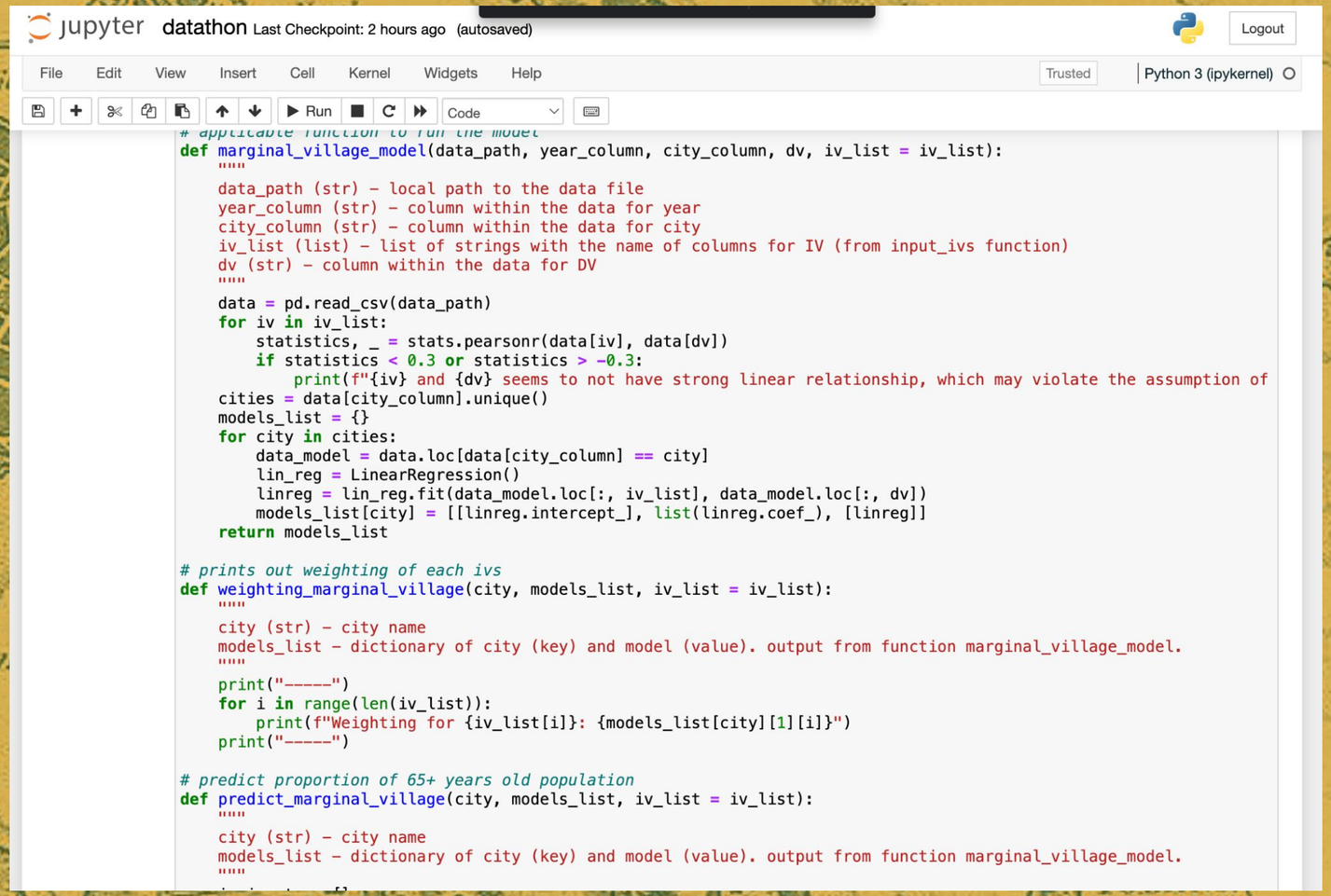
	2000	2005	2010	2015	2020
Municipalities	1654.00	1654.00	1654.00	1654.00	1654.00
M Total Population	83276.04	84099.16	84620.18	84330.74	84023.97
M % of Population > 65	21.46	24.35	27.08	30.89	33.74
M % of Employed Persons	49.96	48.90	47.29	48.06	47.96
M Birth Rate	8.66	7.62	7.49	7.07	5.85
M Mortality Rate	9.22	10.49	11.86	13.08	14.04
M % of Inhabitable Land	52.57	52.57	52.39	52.59	52.70
No of Educational Infrastructure	34.42	33.47	32.25	30.15	28.14

Note. Descriptive statistics were averaged across municipalities. M = mean.

Tableau Visualisation



Predictive Model



Evaluation

Summary of Implementation

Power BI dashboard: allows for visualisation of marginal village progression per municipalities/prefectures

Linear regression model: predicts progression of marginal villages per municipality and estimates contribution of significant factors

Strengths

- **Novel:** marginal villages are an important local issue but not well-addressed with data
  - Clear visualisation
- **Local:** municipality-specific predictive models
- **Applicable:** predictive function can be adapted to other regions with an ageing population

Limitations

- **Data:** limited high-quality data of Japanese municipalities
- **Variables:** choice of predictors and exclusion criteria must be more systematic and evidence-based
- **Model evaluation**
  - Doesn't account for acceleration of effect
  - Missing assumption checks and appropriate variable transformation
  - Missing variance explained for models

Future Directions

Improve data wrangling and analysis

- Use evidence-base on ageing population and marginal villages to select variables of interests

Improve model accuracy and evaluation

- Incorporate evaluation into Python function
  - Assumption checks
  - Variance explained
- Polynomial regression model to account for acceleration
- Machine learning
  - Training and testing sets

Improve flexibility of visualisation and predictive model

- Visualise predictions for ageing population
- Allow for different types and numbers of predictors/outcomes
- Evaluate applicability to other regions facing ageing population


Thank you!

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References

D'AMBROGIO, Enrico. *Japan's Ageing Society*. EPRS: European Parliamentary Research Service, 2020.

Ministry of Finance. *過疎地域等における集落の状況に関する現況把握調査*. 総務省, 2011.

---. *過疎地域における集落の状況に関す現況把握 調査最終報告*.

National Institute of Population and Social Security Research. "日本の将来推計人口（令和5年推計）| 国立社会保障・人口問題研究所." *Www.ipss.go.jp*, 26 Apr. 2023, www.ipss.go.jp/pp-zenkoku/j/zenkoku2023/pp_zenkoku2023.asp.

Ng, Kelly. "Japan Population: One in 10 People Now Aged 80 or Older." *BBC News*, 19 Sept. 2023, www.bbc.co.uk/news/world-asia-66850943.

Niinuma, Shiori. "「限界集落」における集落機能の維持と住民生活の持続可能性に関する考察—東京都西多摩郡檜原村 M 集落の事例から—." *E-Journal GEO*, vol. 4, 2009, pp. 21–36.

Official Statistics of Japan. " Municipality Data | System of Social and Demographic Statistics(SSDS) | Search by Areas." *Portal Site of Official Statistics of Japan*, 2023, www.e-stat.go.jp/en/regional-statistics/ssdsview/municipality. Accessed 5 Nov. 2023.

Sato, Makoto. *「限界集落」論と北海道の農村社会*. 北海学園大学開発研究所, 2012.

Suzuki, Yusuke. *IMPACT of JAPAN'S AGING POPULATION in 2030 – FOCUSING on the EFFECT on the SOCIAL SECURITY SYSTEM and LOCAL ECONOMIES –* . Mitsui & Co., July 2023.

Tanaka, Yusuke. "【限界集落】ふるさとの消滅は何を意味するのか." *NewsPicks*, 21 June 2019, newspicks.com/news/3950529/body/. Accessed 6 Nov. 2023.

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