University of St Andrews

HMO Caps in St Andrews
2023 Candlemas Semester Progress Report

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TABLE OF CONTENTS

Abstract

Since the cap on Housing in Multiple Occupancy (HMO) licences in St Andrews was instituted by Fife Council in 2019, the local housing market has undergone immense stress as the University of St Andrews student population continues to grow annually. The goal of this research project is to understand the full impact of the HMO Licence cap through developing an economic model using raw data from the student body. We aim to meet this goal through answering the research question "How has the cap impacted the economic factors of the rental market in St Andrews?" in this report.

This research paper expands on this work, integrating real-world data to create more accurate results and models. The progress made includes formulation of linear regressions to model the changes in active HMO licences by year, uncovering lost HMOs in Fife, launching a school-wide survey to measure students' willingness to pay for accommodation in St Andrews before relocating to Dundee, and establishing a project website and social media platforms to engage our community.

This semester's team found that 144[1] HMO licenced properties were lost between 2017 and 2022 which is a 11.4% decrease in the total number of active HMO licenced properties in 2017. Furthermore, it was seen that, between 2017 and 2023, the lowest significant survival rate for a HMO licence was for properties with 6 bedrooms while the highest significant survival rate was for properties with 4 bedrooms.

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[1] This number may differ depending on how Fife Council records properties which are reapplying for their HMO licence to be renewed on the HMO register.

Introduction

In April 2019, Fife Council voted to place a cap on the number of Houses of Multiple Occupancy (HMO) licences. These are required for any property which rents to more than two people from different households. Properties can still apply for licences and licence renewals, however through this change in policy it is becoming increasingly difficult to obtain an HMO licence. Hence, there is a decrease in supply of HMO licenced properties for students to rent, thus exacerbating the current housing crisis in St Andrews.

This semester, the goal for this project was to continue to explore the effects of the HMO licence cap on the property landscape in St Andrews. In previous semesters, teams have developed the economic model created in 2021, found and analysed other data sources and prepared the model for real life data collection through a survey.

The purpose of this Progress Report is to reveal and explain the work that has been done in the Candlemas Semester, 2022-2023. Some notable developments made this semester include: the creation of a spreadsheet containing relevant HMO Register data, the generation of graphs which were obtained from the analysis of the respective data sources, the creation of the Lost HMO sub team which works to investigate the properties which have lost their HMO licence, the gathering of new information from Fife Council which clarified the HMO public register terms: 'GRANT', 'CON' and 'DEEM', the accumulation of data and subsequent analysis after resolving how to interpret the HMO public register data, the creation and launch of a survey which aims to gather real life data and the development of social media accounts which aim to increase awareness for the project.

It was found that for every additional bedroom, the average rent decreases by 21.67 pounds. Additionally, international students were seen to be more likely to pay a high rent than Scottish students, and more importantly, students from the University of St Andrews pay rent that is 28% higher than the national average monthly rent, further highlighting the current housing crisis the students are under.

The report is divided by sub team with the general lessons, references and appendixes following the sub team sections. The sub teams for this semester are as follows: HMO Register, Lost HMOs, Survey, and Outreach.

HMO Register

Objectives & Progress

Our initial objective was to recreate the results from last semester in Python; however, due to the new CON and GRANT information outlined in the Lost HMOs section, our aim changed to obtaining accurate results. For the current semester, our method was to conduct a comprehensive longitudinal analysis of the trends in HMO licence applications in St Andrews from 2009 to 2022, utilizing the HMO Register database accessible on the Fife Council website. We recognized that investigating the yearly count of active HMO licences would be essential in detecting any significant patterns that occurred over the 13-year time frame, as would examining the number of occupants per annum.

During the first half of the semester (weeks 1-7), our team focused on extracting the precise number of properties with active HMO licences and the total number of occupants in such licensed properties. We initiated the process by replicating the previously written R code in Python to enhance portability, selecting the repl.it integrated development environment for its real-time collaboration features. Simultaneously, we converted the HMO Register data from PDF to Excel format, meticulously eliminating any duplicate rows from our database. We also communicated with the Fife Council Community & Housing Services committee via email to acquire current HMO licence data in Excel format and a complete list of Fife addresses, which they generously provided. While converting from PDF to Excel, we continued replicating the code in Python to generate graphs illustrating the number of active HMO licences and the total occupants in licensed properties.

In the second half of the semester (weeks 8-11), our team made significant progress with the code replication, aiming to finalize it to a degree that would facilitate attrition and regression analyses. To that end, we successfully completed the attrition and regression sections, with a specific focus on the examination of linear and quadratic regression models and the conducting of a survival analysis to determine the probability of licences remaining active over a 15-quarter period. Our team also addressed the inconsistencies that emerged during the earlier stages of the semester concerning our data. Additionally, we calculated a loss index for both the Q1 2022 and Q1 2023 PDF documents in which we found no lost data. This exercise was critical in ensuring the accuracy and reliability of our analysis.

Methodology of Data Collection

In order to translate the pdf, register into an excel spreadsheet, an additional add-in was employed and downloaded called "Ablebits Toolkit".

Q1.2023 Register

Converting the PDF to Excel
To commence the processing of a full register, a limited version was employed as a preliminary measure to trial various methods of data cleaning and to gain experience with the process ahead. This register,

obtained from the Fife Council's website, was updated in Q1 2023 (hence the name used: Q1.23), and pertained to licences issued between 2017 and 2026, spanning 513 pages. In order to facilitate subsequent analysis, the PDF file needed to be converted to Excel, for which we decided to use a third-party converter, with "Smallpdf" emerging as the optimal option after thorough testing.

However, the converted spreadsheet wasn't usable yet because of the split into various worksheets and inconsistent formatting. More specifically, the converted document was comprised of 245 tables, each exhibiting certain formatting discrepancies that made it impossible to use for analysis. Specifically, worksheets 100, 186, and 235 were notable examples of the different encountered formatting complications, mainly mismerged cells:

F04432/21	Mrs Julia Young	W5R18	46 Chamberlain Street Fife KY16 8JG		Licence Issued St Andrews	28.10.2021	15.11.2022	14.02.2025	4	CON
	Mr George Young	W5R18	46 Chamberlain Street Fife KY16 8JG		Licence Issued St Andrews	28.10.2021	15.11.2022	14.02.2025	4	CON
		W5R18	46 Chamberlain Street Fife KY16 8JG	Bradburne & Co	Licence Issued St Andrews	28.10.2021	15.11.2022	14.02.2025	4	CON
F04431/21	Mr Michael Butler	W5R18	Basement Flat Terrace St Andrews KY16 9HX		Licence Issued 4A Playfair	26.10.2021	25.05.2022	28.03.2023	3	GRANT
	Mrs Mary Butler	W5R18	Basement Flat Terrace St Andrews KY16 9HX		Licence Issued 4A Playfair	26.10.2021	25.05.2022	28.03.2023	3	GRANT
		W5R18	Basement Flat Terrace St Andrews KY16 9HX	Kingask Country C	Licence Issued 4A Playfair	26.10.2021	25.05.2022	28.03.2023	3	GRANT
F04221/21	Rev Robert Anderson	W5R18	4A Hope Street Fife KY16 9HJ		Licence Issued St Andrews	31.08.2021	15.11.2022	30.08.2024	3	GRANT
		W5R18	136 North Street St Andrews Fife KY16 9AF	Rollos Town And G	Licence Issued	22.12.2020	27.04.2022	30.12.2023	5	CON
F03495/20	NHS Fife	W5R11	Flat 4 Accommodation Block 3 University Of Dundee Fife Campus Forth Avenue Kirkcaldy Fife KY2 5YS							
F03309/19		W5R18	Flat 6 Nansen Block David Russell Apartments Buchanan Gardens St Andrews KY16 9LY							
F03191/19	James Murray	W5R18	45C South Street St Andrews Fife KY16 9QR							
		W5R18	45C South Street St Andrews Fife KY16 9QR							
						23.12.2019	14.12.2020	19.12.2022	4	CON
						23.05.2019	29.04.2020	14.09.2022	5	CON
						13.02.2019	19.11.2019	03.03.2022	4	GRANT

To generate a complete register, these tables were manually consolidated, and formatting inconsistencies were remedied. While this method may not have been the most efficient, it certainly proved effective for our objective. Afterwards, all data was collected into one large spreadsheet:

App Ref Number	Applicant Name/s	WARD	HMO Address	Agent Name	License Status	Date of Ap	Date Issued	Expire Date	Tot Occs	Decision
F02769/18	Mr Alan Greig	W5R18	52 Bridge Street St Andrews Fife KY16 8AA		Licence Expired	23.02.2018	11.07.2018	23.02.2021	4	GRANT
	Mrs Jacqueline Greig	W5R18	52 Bridge Street St Andrews Fife KY16 8AA		Licence Expired	23.02.2018	11.07.2018	23.02.2021	4	GRANT
F02776/18	Mrs Grace Robb	W5R18	2 Wallace Street St Andrews KY16 9BU		Licence Expired	27.02.2018	20.08.2018	28.03.2021	4	GRANT
	Mr John Robb	W5R18	2 Wallace Street St Andrews KY16 9BU		Licence Expired	27.02.2018	20.08.2018	28.03.2021	4	GRANT
		W5R18	2 Wallace Street St Andrews KY16 9BU	Mr Scott Robertson	Licence Expired	27.02.2018	20.08.2018	28.03.2021	4	GRANT
F02859/18	Mr Elizabeth Johnstone	W5R12	Flat 1 344 High Street Kirkcaldy KY1 1LD		Licence Expired	23.05.2018	12.12.2018	29.06.2021	4	GRANT
	Mrs James Matthew	W5R12	Flat 1 344 High Street Kirkcaldy KY1 1LD		Licence Expired	23.05.2018	12.12.2018	29.06.2021	4	GRANT
F02910/18	Mr Patrick Burns	W5R18	6 Murrays Bridge Bridge Street St Andrews Fife KY16 8AA		Licence Expired	24.07.2018	17.07.2019	18.07.2022	4	GRANT
		W5R18	6 Murrays Bridge Bridge Street St Andrews Fife KY16 8AA	Eve Brown LTD	Licence Expired	24.07.2018	17.07.2019	18.07.2022	4	GRANT
F02953/18	Mr Gordon Moulds	W5R18	4 John Coupar Court St Andrews Fife KY16 9EB		Licence Expired	17.09.2018	17.07.2019	18.11.2021	4	GRANT
F02880/18	Eric Moran	W5R18	19 Chamberlain Street St Andrews Fife KY16 8JF		Licence Expired	21.06.2018	07.02.2019	30.08.2021	4	GRANT
	Valerie Moran	W5R18	19 Chamberlain Street St Andrews Fife KY16 8JF		Licence Expired	21.06.2018	07.02.2019	30.08.2021	4	GRANT
		W5R18	19 Chamberlain Street St Andrews Fife KY16 8JF		Licence Expired	21.06.2018	07.02.2019	30.08.2021	4	GRANT
F02934/18	Mr Andrew Tennant	W5R18	6 Largo Road St Andrews Fife KY16 8RW		Licence Expired	28.08.2018	01.11.2018	14.08.2021	5	GRANT
	Mrs Samantha Tennant	W5R18	6 Largo Road St Andrews Fife KY16 8RW		Licence Expired	28.08.2018	01.11.2018	14.08.2021	5	GRANT

Cleaning the spreadsheet

The final output was a comprehensive register that encompassed 2990 entries located in the Fife region, formatted as shown above, and can be found here. Nonetheless, further refinement was necessary, as the presence of duplicates rendered the data unsuitable for subsequent analysis. To address this issue, a pattern was identified whereby entries with an agent name would be duplicated without the applicant's name. Subsequently, all entries with an agent name were filtered out, resulting in the deletion of 1013 rows and the retention of 1977 rows. The now-empty agent name column was subsequently eliminated. Although the data could have been preserved, we were solely focusing on collecting the most important information; subsequently, we decided to simplify our table and accept the loss of this information piece. Further duplication was eliminated through the use of Ablebits, from which we employed its "delete duplicates" feature to eliminate two more entries, ultimately leaving the register with 1975 rows. However, this remaining register still contained extraneous addresses that lay outside St Andrews. Consequently, the address column was filtered to only include entries that explicitly mentioned "St Andrews" or "KY16," resulting in a final register containing 1802 lines.

In conclusion, the Q1.2023 Register underwent meticulous processing, involving conversion from PDF to Excel and manual consolidation and data cleaning, to produce a comprehensive and reliable register that is devoid of duplicates and irrelevant entries. The fully cleaned and processed register can be accessed through the provided link.

Q1.2022 Register

Converting the PDF to Excel

Following our successful conversion of the previous register, we ventured to tackle the Quarter 1 2022 Register, which proved to be a more arduous task due to its vast size of 1808 pages and its extensive coverage of applications spanning from 2005 to 2024. Despite implementing the same methodology that proved fruitful in the previous register, we encountered a challenge due to the converter's failure to cope with the enormity of the register. Consequently, the resulting spreadsheet was disjointed, akin to the previous register, but with a higher degree of formatting inconsistencies. Given the register's magnitude, manual correction of these inconsistencies was not feasible, and attempts to rectify them through programming proved futile due to file extension damage or corruption after editing the file using the "Repl.it" platform. After exhausting our efforts to restore the file over an extended period, we opted for a new approach.

RTF file
In light of the failed conversion to an excel format, we embarked on a thorough experimentation with different file types. Utilizing Adobe's capabilities, we endeavoured to convert the register in question into a Word document, an RTF file, and a TXT file. Upon meticulous observation of the divergent outcomes, we elected to opt for the RTF file which, albeit with fewer formatting discrepancies than the other file types, presented a major challenge: if an applicant's name or address spanned multiple lines, the converted file would produce multiple rows, representing a marked deviation from the previous register.
Our first order of business was to address the inconsistencies in merged cells. Consequently, we opted to eliminate entries after 2018 since we could guarantee the accuracy of the Q1.23. Register. We then proceeded to manually scour through the entries, fixing the merger errors one by one, resulting in a final spreadsheet containing over 37,000 rows, with numerous empty cells.
In an attempt to unify the split rows, we turned to Excel functions, specifically

=IF(ISBLANK($A6);"";CONCATENATE(A6;A7;A8;A9))

This if function which sifts through the data, merging cell content with the three cells beneath it, but only when column A (which holds the application number) is not empty. The "$" is used to tie the "if" condition to the same column consistently, even when the formula is applied to more data columns. This formula was subsequently implemented across the entire register, bringing all the data into one row, with a satisfactory success rate of approximately 85%.
However, a few entries proved to be less than three rows apart, leading to the merger of separate entries. These occurrences were promptly dealt with by searching the register for tell-tale formatting errors like "GRANTGRANT" or "NW19NW19", which were obviously merged together falsely. The formula was then adjusted manually, though given the paucity of such errors, the manual intervention proved feasible and mostly time-efficient. Finally, we removed the empty rows using an Ablebtis feature, resulting in a register format like Q1.23 as shown below:

App Ref Number	Applicant Name/s	WARD	HMO Address	License Status	Date of Ap	Date Issued	Expire Date	Tot Occs	Decision
35	University Court of the University ofSt Andrews	NW19	Westburn HouseWest Burn LaneSt AndrewsFifeKY16 9TP	Licence Expired	27.08.01	17.02.03	31.08.05	4	N/A
31	William Griffith-Jones	NW19	Ground Floor Flat12 Howard PlaceSt AndrewsFifeKY16 9HL	Licence Expired	02.08.01	24.03.03	31.07.05	5	N/A
220	University Court of the University ofSt Andrews	NW19	Donaldson House LowBuchanan GardensSt AndrewsFife	Licence Expired	12.12.01	11.02.04	11.12.05	22	N/A
221	University Court of the University ofSt Andrews	NW19	Forbes House LowBuchanan GardensSt AndrewsFife	Licence Expired	12.12.01	11.02.04	11.12.05	22	N/A
222	University Court of the University ofSt Andrews	NW19	Fraser House LowBuchanan GardensSt AndrewsFife	Licence Expired	12.12.01	11.02.04	11.12.05	22	N/A
223	University Court of the University ofSt Andrews	NW19	Haig House LowBuchanan GardensSt AndrewsFife	Licence Expired	12.12.01	11.02.04	11.12.05	22	N/A
224	University Court of the University ofSt Andrews	NW19	Haldane House LowBuchanan GardensSt AndrewsFife	Licence Expired	12.12.01	11.02.04	11.12.05	22	N/A
225	University Court of the University ofSt Andrews	NW19	Herkless House LowBuchanan GardensSt AndrewsFife	Licence Expired	12.12.01	11.02.04	11.12.05	22	N/A
227	University Court of the University ofSt Andrews	NW19	Scott House LowBuchanan GardensSt AndrewsFife	Licence Expired	12.12.01	11.02.04	11.12.05	22	N/A
228	University Court of the University ofSt Andrews	NW19	Shairp House LowBuchanan GardensSt AndrewsFife	Licence Expired	12.12.01	11.02.04	11.12.05	24	N/A
229	University Court of the University ofSt Andrews	NW19	Tulloch House LowBuchanan GardensSt AndrewsFife	Licence Expired	12.12.01	11.02.04	11.12.05	24	N/A
230	University Court of the University ofSt Andrews	NW19	Donaldson House HighBuchanan GardensSt AndrewsFife	Licence Expired	12.12.01	11.02.04	11.12.05	24	N/A
231	University Court of the University ofSt Andrews	NW19	Forbes House HighBuchanan GardensSt AndrewsFife	Licence Expired	12.12.01	11.02.04	11.12.05	24	N/A
232	University Court of the University ofSt Andrews	NW19	Fraser House HighBuchanan GardensSt AndrewsFife	Licence Expired	12.12.01	11.02.04	11.12.05	24	N/A
233	University Court of the University ofSt Andrews	NW19	Haig House HighBuchanan GardensSt AndrewsFife	Licence Expired	12.12.01	11.02.04	11.12.05	24	N/A
234	University Court of the University ofSt Andrews	NW19	Haldane House HighBuchanan GardensSt AndrewsFife	Licence Expired	12.12.01	11.02.04	11.12.05	24	N/A
235	University Court of the University ofSt Andrews	NW19	Herkless House HighBuchanan GardensSt AndrewsFife	Licence Expired	12.12.01	11.02.04	11.12.05	24	N/A
236	University Court of the University ofSt Andrews	NW19	Lindsay House HighBuchanan GardensSt AndrewsFife	Licence Expired	12.12.01	11.02.04	11.12.05	24	N/A
237	University Court of the University ofSt Andrews	NW19	Scott House HighBuchanan GardensSt AndrewsFife	Licence Expired	12.12.01	11.02.04	11.12.05	24	N/A
238	University Court of the University ofSt Andrews	NW19	Shairp House HighBuchanan GardensSt AndrewsFife	Licence Expired	12.12.01	11.02.04	11.12.05	24	N/A
239	University Court of the University ofSt Andrews	NW19	Tulloch House HighBuchanan GardensSt AndrewsFife	Licence Expired	12.12.01	11.02.04	11.12.05	24	N/A
34	University Court of the University ofSt Andrews	NW19	66 South StreetSt AndrewsFifeKY16 9JT	Licence Expired	27.08.01	24.08.04	26.07.05	5	GRANT
226	University Court of the University ofSt Andrews	NW19	Lindsay House LowBuchanan GardensSt AndrewsFife	Licence Expired	12.12.01	11.02.04	11.12.05	22	N/A
158	A D Pinkerton	NW19	1 Alfred Place St Andrews FifeKY16 9XG	Licence Expired	22.09.01	24.03.05	11.10.05	6	N/A
353	Max Wolf	72	11 Greyfriars GardenSt AndrewsFifeKY16 9HG	Licence Expired	16.09.02	18.09.03	18.09.06	5	N/A
461	Richard Lindner	NW19	12 Aikman PlaceSt AndrewsFifeKY16 8XS	Licence Expired	21.11.02	12.10.04	20.11.06	4	N/A
358	Celia Maxwell	NW19	7 Windmill RoadSt AndrewsFifeKY16 9JJ	Licence Expired	23.08.02	06.12.04	22.08.06	4	N/A
249	James Lindsay	NW19	10 Kinnessburn RoadSt AndrewsFifeKY16 8BU	Licence Expired	19.02.02	14.05.04	16.02.06	4	N/A
326	Adam England	NW19	19 Southgait Hall118 South StreetSt AndrewsFifeKY16 9QD	Licence Expired	05.06.02	19.05.04	04.06.06	4	N/A
343	Judith Aitken	NW19	5A Windmill RoadSt AndrewsFifeKY16 9JJ	Licence Expired	06.08.02	19.05.04	05.08.06	4	N/A
259	Catherine Walls	NW19	1 Melbourne PlaceBridge StreetSt AndrewsFifeKY16 9EY	Licence Expired	20.02.02	27.05.04	29.01.06	5	N/A
467	Elizabeth June Baxter	NW19	48 South StreetSt AndrewsFifeKY16 9JT	Licence Expired	19.12.02	27.05.04	18.12.06	4	N/A
240	Catherine Goodier	NW19	1 St Mary StreetSt AndrewsFifeKY16 8AZ	Licence Expired	20.02.02	10.06.04	19.02.06	4	N/A
465	Ivor R Guild	NW19	Step Rock CottageGillespie WyndSt AndrewsFifeKY16 9AU	Licence Expired	09.12.02	14.07.04	08.12.06	3	N/A
276	Ishbel Bass	NW19	13D Howard PlaceSt AndrewsFifeKY16 9HL	Licence Expired	15.03.02	21.02.06	14.03.06	5	N/A
284	Antonia Watson	NW19	11A Hope StreetSt AndrewsFifeKY16 9HJ	Licence Expired	29.03.02	21.02.06	28.03.06	6	N/A
291	Graeme Soutar		5A Gillespie TerraceThe ScoresSt AndrewsFifeKY16 9AT	Licence Expired	24.04.02	21.02.06	24.04.06	4	N/A

Cleaning the spreadsheet

Given that the CONCATENATE function was structured around the application number, a considerable portion of the duplicates had already been eradicated in this step. Nevertheless, any remaining duplicates, as well as non-St Andrews addresses, were swiftly identified and eliminated through the same methodologies as those employed in the previous register. Following this, the register was amalgamated with the Q1.23 spreadsheet, yielding a comprehensive register comprising 7920 entries, thereby facilitating the execution of pertinent calculations, as shown in the subsequent steps. The register can be found here.

Methodology of Python-generated graphs

List of modules and libraries used:
  o pandas - allowed us to read the Excel file into a pandas data frame
  o dataclass - used to create an array of records
  o re - allows use of regular expressions
  o matplotlib.pyplot - plots and generates graphs

The process in generating the graphs involved the following: reading the data into a pandas data frame, transferring the data to an array of records, cleaning the data, gathering the correct information required to create the graphs and finally, plotting and generating the graphs. The code also contains several points where the total number of entries is counted and printed out to standard output; this was done to get the distributions, see how much data was removed or cleaned out and overall help solve our discrepancy issues.

Firstly, the spreadsheet "FullRegister"[2] was read into a data frame called 'df'. Then any rows of data which had a missing application reference number and total occupant number were removed. Initially, anything which had 'N/A' as its decision was also removed, however in Week 6, new information had come to light that meant any address on the register had an 'active' licence i.e. the terms 'GRANT', 'CON' and 'DEEM' all meant that the licence application was approved. Due to this new information, it was decided that all the addresses on the register are active and so no data points were removed based on the decision. See Appendix 3.

After the preliminary cleaning of the data frame, the columns of data that were required were transferred to an array of records. This was done for various reasons, one being that it is easier to handle data in an array of records than a data frame from a coding perspective, another being that the data frame wasn't working smoothly i.e. the column labels were not being read properly by the console and so each column label had to be hard-coded with its respective index in 'df.columns'. The array of records, called Register, has 4 attributes: address, dateIssued, dateExpired and occupants. An extra attribute (decision) was added to help the Lost HMO team verify their data source by creating a list of addresses in 2017 that have the decision 'CON'. See Appendix 4.

Using a conditional loop, the data was transferred from the data frame to Register. Through use of regular expressions, the data was cleaned further by only transferring data which had a St Andrews address and was not a University of St Andrews Halls of Residence. It was assumed that addresses that did not contain 'St Andrews' or did not contain a postcode at all were in St Andrews. Halls of Residence were excluded from our calculations as it was found that the halls of residences were not consistently appearing as active across the time range (2009-2022). As a result, it caused an exaggeration in the decrease of number of active licences and number of occupants when the halls of residence were included. See Appendix 5.

Having populated the array of records with cleaned and correct data, a nested for loop was then used. The first for loop looped through each entry in Register. The second for loop looped through the array 'years' which contained the wanted time range (2009-2022). The first for loop contains a algorithm which checks if the address is unique or not; if it is a duplicate then that iteration of the loop is skipped. For a specific address, the start year of 'activeness' and last year of 'activeness' are recorded. The second for loop checks if the year was in the active range and if so, added the number of occupants or added 1 (depending on the graph we wanted to generate) to a parallel array called 'total' which contained the totals for each year in the array 'years'. After the nested loop was complete, matplotlib.pyplot was utilised to plot and generate the graphs. See Appendix 6 and Appendix 7.

See Appendix 8 for code that produced the data that generated the graphs in a tabular form.

Methodology for Excel-generated graphs

Method 1: Generating Data Tables – Active Licences

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[2] https://universityofstandrews907.sharepoint.com/:x:/r/sites/HMOVIP2022-23/Shared%20Documents/General/HMO%20Register/Full%20Register/Full%20Q1.22%20merged%20with%20Q1.23.xlsx?d=w5c5726b559124a7fbcf4b661d27c12ac&csf=1&web=1&e=SCKNge - this is the link to the spreadsheet used

To ensure a rigorous analysis of the data in the Full Register, we employed various methods, one of which was the use of Excel functions to generate data tables. In order to obtain a more comprehensive view of the data, we conducted the analysis for each quarter. To achieve this, we first added appropriate headers to new columns starting from Q1 2005 to Q4 2025, above which we inserted the relevant start and end dates for each quarter. For instance, for Q1 2005, the start date was 01.01.05, and the end date was 31.03.2005. Next, we applied the function:

=AND($G4<K$2;$H4>K$1)

Here, column G contained the issue date, column H contained the expiry date, and column K included the quarter parameters. The function returns "TRUE" if the licence was issued before the end date and expires after the start date, thus indicating that the licence was active during that quarter. After running this function on all licences and dates, we utilized a simple sum function to count all the cells that returned "TRUE," providing us with the number of active licences for that quarter:

=COUNTIF(K4:K9488;TRUE)

By following this process for each quarter, we were able to obtain data tables that showed the number of active licences for each quarter. This information proved crucial for our analysis, allowing us to draw meaningful conclusions and make informed decisions based on the data at hand.

Generating Data Tables – Active Bedrooms
To run calculations concerning the number of occupants, we first needed to generate a data range that reflected the number of occupants in each licence application. To achieve this, we added a new set of headers to the spreadsheet that excluded the start and end dates, leaving only the application number, the address, and the number of occupants. We then used an IF function to populate the new column with a 1 for each active bedroom and a 0 for each inactive bedroom.

The IF function we used was as follows:

=IF(K4=TRUE,1*I4,0)

This function checked the value in the column filled in the section above (K) to see if it was "TRUE". If it was, the function multiplied the value in the "Number of Occupants" column (I) by 1, assigning a positive value of at least 1. If the value in the column K was anything other than "TRUE", the function returned a 0. This allowed us to create a data range that reflected the number of active bedrooms in each licence application.

With this data range in hand, we then used a COUNTIF function to count the number of times each possible number of occupants occurred. We started by considering applications with 3, 4, 5, 6, 7 and more than 7 occupants. For each of these numbers, we used the COUNTIF function to count the number of rows in the data range that contained that number of occupants.

The COUNTIF function we used was as follows:

=COUNTIF(CR$4:CR$9488,$CQ9494)

Here, CR4:CR9488 was the data range generated using the previous IF function, and CQ9494 held the number of occupants being considered (e.g., 3, 4, etc.). This function counted the number of times the value in CQ9494 appeared in the data range, effectively counting the number of applications with that number of occupants.

We then extrapolated this function for all possible numbers of occupants (up to the maximum number of active bedrooms observed in the data range), allowing us to construct a frequency table that showed how many applications had each possible number of occupants.

Finally, using this frequency table, we were able to determine the average size of properties with more than 10 occupants, which was useful for further analysis.

Crticisms and Assumptions of Method 1
Upon comparing the aforementioned results to the graphs generated by the Python program, it became evident that there were significant discrepancies within the data. Specifically, the data contained within the Excel documents greatly overestimated the number of active licenses. While we were able to rectify the Python data with minor adjustments to the utilized methodology, rectifying the Excel-generated data proved to be a formidable challenge. In our review of the methodology, we hypothesize that the licenses may have been counted multiple times, such as in cases where the license was renewed within the same year. Additionally, there may have been insufficiencies in the cleaning process. However, given the immense size of the data set containing over 9000 rows, it was arduous to thoroughly investigate these hypotheses. Consequently, a secondary methodology was employed to generate more precise and reliable data tables.

Method 2: Generating Data Tables – Active Licenses
Given our belief that a significant contributor to the issue lay in the overwhelming volume of data rows, rendering it challenging to effectively comprehend the data or identify any underlying issues when utilizing Excel, we opted to construct a new table containing fewer rows. To accomplish this, we directed our focus towards the addresses present within the data tables. Upon analyzing the data, we recognized that addresses frequently appeared multiple times as licenses were recurrently renewed. Consequently, we extracted all addresses from the unrefined spreadsheet, which contained over 9000 addresses as previously mentioned, and utilized the "delete duplicates" function. To our amazement, nearly 6000 rows were eliminated, leaving us with a more manageable 3313 rows. This table size was now much more in line with the Q1.23 register, significantly simplifying its management.

Furthermore, we also conjectured that part of the problem may have arisen due to inadequate cleaning of the data. Accordingly, we presumed that no cleaning had been performed, therefore starting this process anew, and decided to exclude all applications made by the University of St Andrews. However, since the applicant name was not preserved, we employed a filter to remove addresses associated with the University, as demonstrated below.

David Russell Apartments	468
Fife Park	358
Whitehorn Hall	2
University Hall	3
Andrew Melville Hall	3
McIntosh Hall	4
John Burnet Hall	5
St Regulus Hall	6
Salvator's Hall	2
Powell Hall	3
Agnes Blackadder Hall	4
Gannochy House	3
Kirkcaldy	67
Glenrothes	34
Cupar	50
Dunfermline	74
Anstruther	7
Dysart	8

Utilizing the smaller data set, we were able to more efficiently isolate non-St Andrews addresses. As evidenced by the table, David Russell Apartments and Fife Park, which together accounted for over 700 licenses, would have significantly influenced the data. Consequently, we were left with 2212 addresses, all situated within St Andrews and independent of the University.

Moving forward, we understood the necessity of retrieving the data corresponding to each address. Ascertaining the number of occupants per license was deemed the initial priority. We proceeded on the assumption that if the address remained unchanged, the number of occupants would be consistent as well. To achieve this, we employed the following function:

=XLOOKUP(A3;Sheet5!A:A;Sheet5!B:B;0)

The following function scans the value within cell A3 (which is a filtered address) and examines it against column A in Sheet 5. It then retrieves the corresponding value from Sheet 5's column B for the first match discovered. If no match is found, the function returns 0. Despite its apparent simplicity, this function performed well and returned the occupants without any errors. However, attempting to retrieve the TRUE/FALSE values from the columns in the earlier spreadsheet proved to be more challenging. Therefore, to obtain a better understanding of the problem, we utilized a basic COUNTIF function to evaluate how often addresses appeared. Although most of the previous addresses appeared only once, others appeared as frequently as 24 times. Consequently, reproducing the TRUE/FALSE columns proved

to be a challenging undertaking. Initially, we experimented with combining a COUNTIF function with an IF condition and later attempted to employ SUM functions, both of which failed to produce error-free results. Eventually, we endeavored to use a FILTER function.

=FILTER('[Book2]Full Data Range with COUNTIF'!K:K;'[Book2]Full Data Range with COUNTIF'!$D:$D = 'List of Addresses'!$A3;"ERROR")

This function filters Column K of the entire dataset (which contains the TRUE/FALSE values for Q1 2005) based on which corresponding values in Column D (the address list) match the address in cell A3. If no match is found, the function returns "ERROR" as text. Although this function returned data, it also produced SPILL errors, which occur when a formula produces multiple results that Excel cannot return to the grid. Essentially, the function attempted to condense a list of TRUE/FALSE values into a single cell. To address this issue, we encapsulated the entire function in a UNIQUE function:

= UNIQUE(FILTER('[Book2]Full Data Range with COUNTIF'!K:K;'[Book2]Full Data Range with COUNTIF'!$D:$D = 'List of Addresses'!$A3;"ERROR"))

Despite the fact that some SPILL errors still remained, they were significantly reduced since the errors now only occurred when the addresses returned both TRUE and FALSE for the same quarter. To address this issue, we made an assumption that if an address appeared to be both active and non-active during a quarter, we would assume that it was active. As a result, we enclosed the entire function within an IFERROR function:

=IFERROR(UNIQUE(FILTER('[Book2]Full Data Range with COUNTIF'!K:K;'[Book2]Full Data Range with COUNTIF'!$D:$D = 'List of Addresses'!$A3;"ERROR"));"ERROR")

The aforementioned function has proven to be effective in managing SPILL errors by converting all instances of the error into the text "ERROR". As a result, we were able to employ the search and replace function to replace all "ERROR" text with "TRUE". This process also enabled us to identify and count the approximately 25,000 spill errors present throughout the entire sheet. Given the total number of data cells, which amounted to 185,808, the error rate was computed to be approximately 13.5%. Utilizing this function, we were able to generate a novel set of data tables that more closely aligned with the anticipated values.

Method 2: Generating Data Tables –Number of Occupants
After generating the new data table with accurate TRUE/FALSE values and recovered number of occupants, we applied the same method to generate new values for the number of licenses and ran the same analysis. The accuracy and controllability of this method made it the preferred choice for our analysis.

Findings & Results:

Table 1 **Graph 1:**

Year	Number of Active HMO Licences	Year	Number of Active HMO Licences
2009	535	2016.5	837
2009.25	482	2016.75	804
2009.5	474	2017	814
2009.75	484	2017.25	812
2010	518	2017.5	723
2010.25	563	2017.75	703
2010.5	616	2018	724
2010.75	644	2018.25	689
2011	689	2018.5	743
2011.25	700	2018.75	717
2011.5	671	2019	745
2011.75	717	2019.25	730
2012	753	2019.5	733
2012.25	697	2019.75	727
2012.5	738	2020	732
2012.75	725	2020.25	729
2013	747	2020.5	710
2013.25	759	2020.75	599
2013.5	758	2021	582
2013.75	747	2021.25	517
2014	758	2021.5	522
2014.25	755	2021.75	466
2014.5	695	2022	491
2014.75	636	2022.25	510
2015	648	2022.5	534
2015.25	760	2022.75	523
2015.5	817	2023	507
2015.75	816	2023.25	454
2016	832	2023.5	416
2016.25	834	2023.75	312

Number of Active HMO Licences Per Year (2009-2023)

Table 1 and Graph 1 depicted above present the number of active HMO licenses annually, spanning from 2009 to 2023, as generated using Excel software and the second methodology mentioned previously. The vertical red line exhibited in April 2019 highlights the implementation of the Housing in Multiple Occupancy (HMO) License freeze in St Andrews. As illustrated in the graph above, there was a minor decrease from Q1 2009 to Q3 2009, immediately followed by an upward trend (with small fluctuations) in the number of active licenses from Q3 2009 with 474 to 755 in Q2 2014, indicating a 59.28% increase. It is noteworthy to point out that the rate of increase during this period was decreasing. From Q2 2014, there was a sharp decline to 636 licenses in Q4 2014, which was quickly followed by a steeper increase in Q3 2015 up to 817. The number of active licenses peaked at Q3 2016 with 837, and from that point onward, despite moderate to large fluctuations, there was a general downward trend depicted in the graph, with significantly steep declines from Q3 2020 to Q4 2021 and from Q3 2022 until the end of 2023. Between Q2 2019 (the quarter the HMO license freeze was implemented) and the final quarter of 2023, the number of active licenses decreased from 730 to 312, a 57.26% decrease. This suggests that, following the freeze in St Andrews, properties were no longer being issued or re-issued HMO licenses. As a result, it may be concluded that the implementation of the HMO license freeze had a direct impact on the reduction of active licenses in the region.

Table 2 **Graph 2**

Number of Active Licences Per Year (2009-2022)

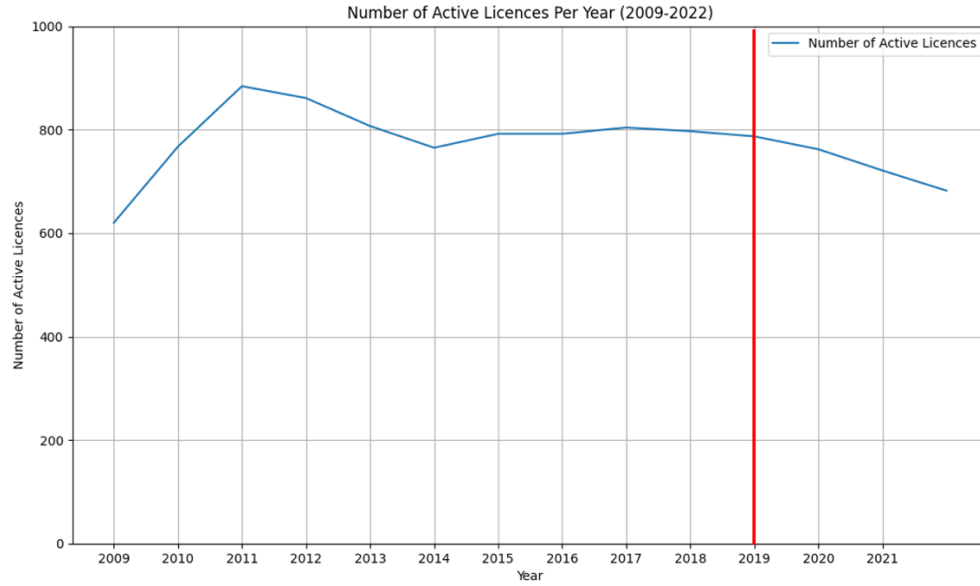| Year	Value
2009	620
2010	767
2011	884
2012	861
2013	807
2014	765
2015	792
2016	792
2017	804
2018	797
2019	787
2020	762
2021	721
2022	682

Table 2 and Graph 2, akin to their respective counterparts Table 1 and Graph 1, present the number of active HMO licences annually spanning from 2009 to 2022. It is noteworthy, however, that Graph 2 was generated in Python. As demonstrated in the graph above, there is a gradual increase in the number of active licences from 620 in 2009 to 884 in 2011, denoting an increase of 42.58%. It is important to acknowledge that while Graph 1 shows the peak number of active licences in 2016, Graph 2 depicts this apex in 2011, which indicates discrepancies in data collection. These minor differences can be attributed to the use of different data collection methods (Python and Excel). The number of active licences experiences a steady decline from 2011 until 2014, whereupon it commences a slight increment until 2017. The figure then undergoes a gradual descent up to 2022, with 682 licences. From 2019 to 2022, the number of active HMO licences falls from 787 to 682, signifying a decrease of 13.34%. This is consistent with the observations made in Graph 1, whereby the implementation of the HMO Licence freeze in St Andrews resulted in a subsequent decrease in active licences during the following years.

Graph 3

Table 3

16
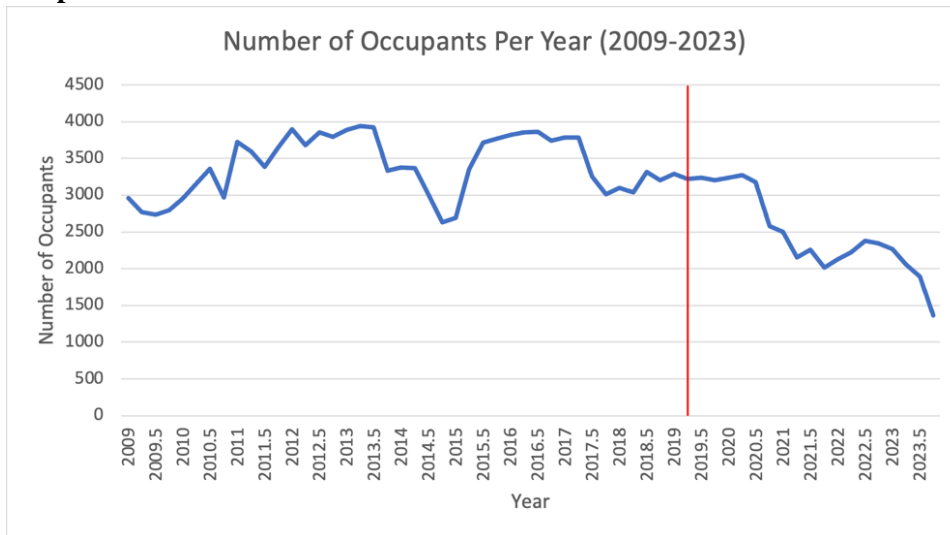
Year	Number of Occupants	Year	Number of Occupants
2009	2958	2016.5	3863
2009.25	2769	2016.75	3743
2009.5	2738	2017	3783
2009.75	2796	2017.25	3788
2010	2951	2017.5	3256
2010.25	3162	2017.75	3010
2010.5	3360	2018	3104
2010.75	2972	2018.25	3039
2011	3728	2018.5	3318
2011.25	3595	2018.75	3201
2011.5	3390	2019	3294
2011.75	3644	2019.25	3223
2012	3900	2019.5	3235
2012.25	3679	2019.75	3207
2012.5	3859	2020	3240
2012.75	3790	2020.25	3271
2013	3892	2020.5	3180
2013.25	3942	2020.75	2577
2013.5	3920	2021	2501
2013.75	3335	2021.25	2157
2014	3378	2021.5	2259
2014.25	3367	2021.75	2015
2014.5	3011	2022	2124
2014.75	2630	2022.25	2221
2015	2692	2022.5	2380
2015.25	3355	2022.75	2344
2015.5	3717	2023	2270
2015.75	3767	2023.25	2056
2016	3817	2023.5	1897
2016.25	3853	2023.75	1366

Table 3 and Graph 3, generated using Microsoft Excel, present the annual number of occupants in properties with active HMO licences, spanning 2009 to 2023. The vertical red line again establishes the point at which the HMO license freeze was implemented in St Andrews. This data is crucial to analyse at it provides an indication of the number of individuals that can reside in a licensed HMO property. Similar to Graph 1, there is an initial dip from Q1 2009 to Q3 2009 with 2738 occupants which is then followed by a gradual increase with moderate fluctuations until Q1 2013, where the number reached 3942, representing a 43.97% increase. Subsequently, the count experienced a sharp decline (with a minor fluctuation) until Q4 2014, with 2630 occupants, which was then countered by a steeper increase to 3767 occupants in Q4 2015. The number of occupants then slightly increased until Q3 2016, with 3863, before gradually decreasing with moderate to large fluctuations until the final quarter of 2023, with 1366 occupants, signifying a 64.64% decrease. Notably, steep declines were observed during this period from Q2 2017 to Q4 2017 and from Q3 2020 to Q1 2021. From Q2 2019 to Q4 2023, the number of occupants in licensed HMO properties declined from 3223 to 1366, reflecting a 57.62% decrease, consistent with the findings from Table 1 and Graph 1. The implementation of the HMO license freeze in St Andrews prevented the issuance or re-issuance of HMO licences, resulting in fewer occupants in properties with active licences in the region.

Table 4   **Graph 4**

Year	Number of Occupants
2009	3325
2010	4341
2011	4856
2012	4746
2013	4289
2014	3754
2015	3987
2016	3993
2017	4058
2018	4025
2019	4015
2020	3913
2021	3748
2022	3572

Number of Occupants Per Year (2009-2022)
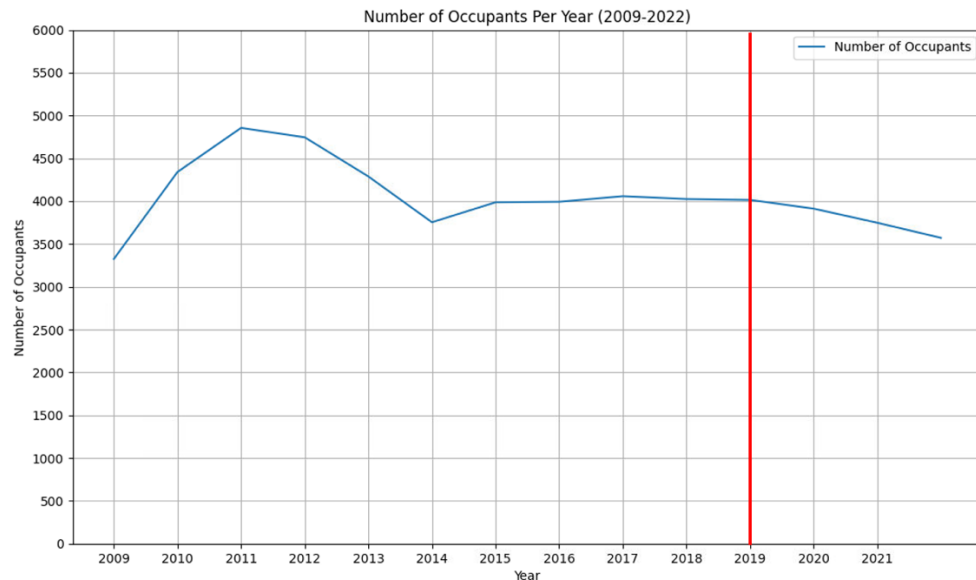
Table 4 and Graph 4 display the total number of occupants residing in properties with active HMO licences each year, spanning from 2009 to 2022. Unlike their Excel-based counterparts Table 3 and Graph 3, Table 4 and Graph 4 were generated through Python. Initially, the data reveals a moderate increase in the total number of occupants, commencing from 3325 in 2009 and culminating in 4856 in 2011, representing an increase of 46.05%. It is worth noting that Graph 4 depicts the peak number of occupants

in 2011. The number of occupants experiences a decline from 2011 to 2014, with a tally of 3754. From 2014 to 2017, the number of occupants begins to increase very marginally, which is then followed by a marginal decrease until 2022. The number of occupants in licensed properties declines from 4015 in 2019 to 3572 in 2022, signifying an 11.03% decrease. It is important to highlight that Table 3 and Table 4 have discrepancies in their data, which can be attributed to the use of different data collection methods (Python and Excel).

In conclusion, the HMO Register team has ascertained that both the Python-generated and Excel-generated tables and graphs demonstrate a decline in the number of active HMO licenses and the total number of occupants in licensed properties per year, after the application of the HMO License freeze in April 2019. This suggests that subsequent to the freeze in St Andrews, there was a decrease in the issuance or re-issuance of HMO licenses for properties, and consequently, a reduction in the number of occupants in properties with active licenses. Therefore, it may be concluded that the implementation of the HMO License freeze had a direct impact on the reduction of active licenses and the number of occupants in licensed properties with the region.

Loss Index

To both measure how much loss of information each type of conversion method was creating and to determine if there was any data lost during the several PDF conversions we had performed this semester, we decided to calculate a loss index. Computing a loss index is a critical step in ensuring that all data is accurately and completely transferred from its original format to a spreadsheet format. By identifying any missing data points, a loss index can prevent errors or inconsistencies that could potentially impact subsequent analysis and decision-making based on the data.

In calculating a loss index, it was important to note that the HMO Register team had merged the data from the Q1 2022 and Q1 2023 PDFs and that these files were converted using different methods – that being RTF file for Q1 2022 and excel for Q1 2023. Accordingly, to account for these factors, it was deemed necessary to calculate a loss index for both the Q1 2022 and Q1 2023 PDF conversions.

To commence the process of calculating a loss index, two random number generators were created: one for the pages and one for the address entries within the PDF documents. Specifically, the $= RANDBETWEEN(1, x)$ function within Microsoft Excel was employed, where 'x' represented the total number of pages and page entries, respectively. Considering that the Q1 2022 PDF file was notably larger than that of Q1 2023, it has a significantly higher likelihood of incurring data loss during the conversion process. Therefore, it was determined that a loss index for Q1 2022 would be calculated first. For this purpose, 60 addresses were randomly generated from the Q1 2022 PDF file using the aforementioned random number generator functions. The resulting addresses were then cross-checked with the data within the corresponding Excel spreadsheet, revealing no instances of lost data. With this method, given that 60 entries were checked, in the case that 5% of data is actually lost, the probability of still retrieving all 60 entries is $(1 - 0.05)^{60} = 0.046069799$.

Table 5

Percentage of Data Lost	Number of Addresses Randomly Sampled		
	20	40	60
5%	0.358486	0.128512	0.046070
10%	0.121577	0.014781	0.001797
20%	0.011529	0.000133	0.000002

Subsequently, this process was repeated for the Q1 2023 PDF file, albeit with only 20 randomly generated addresses, given its considerably smaller size and correspondingly lower likelihood of data loss during the conversion process. For the Q1 2023 file, the cross-checking of the generated addresses with the corresponding data in Excel again revealed no instances of lost data. Similarly, given that 20 entries were checked, in the case that 5% of data is actually lost, the probability of still retrieving all 20 entries is $(1 - 0.05)^{20} = 0.358485922$.

Table 6

Percentage of Data Lost	Number of Addresses Randomly Sampled
	20
5%	0.358486
10%	0.121577
20%	0.011529

Regression and Attrition Results

In order to deepen our analysis of the generated data, we considered attrition of different kinds to explain and possibly predict the behaviour of the St Andrews housing market

Linear Regression is a widely used statistical technique and involves fitting a linear model to a set of data points in order to identify relationships between variables and is particularly useful when attempting to predict future outcomes based on past observations. In our analysis of the data, we employed linear regression as a valuable tool to strengthen our understanding of the trends and patterns present in the data.

Our initial step was to fit the entire data range to a linear model, which we calculated using the formula:

$$A = \frac{(\Sigma y)(\Sigma x^2) - (\Sigma x)(\Sigma xy)}{n(\Sigma x^2) - (\Sigma x)^2}$$

$$B = \frac{n(\Sigma xy) - (\Sigma x)(\Sigma y)}{n(\Sigma x^2) - (\Sigma x)^2}$$

Which would lead to a function in the form of:

Y = ax + b,

where Y represents the dependent variable (in our case, the number of active bedrooms or the number of occupants), x represents the independent variable (the date), and a and b are constants that represent the slope and intercept of the line, respectively. By fitting a linear model to the data, we were able to visualize the relationship between the number of active bedrooms and the date, and to identify any underlying trends or patterns in the data.

Within the linear regression equation presented earlier, the variables 'x' and 'y' maintain their respective definitions, while the variable 'n' denotes the sample size, or the quantity of data points. To facilitate the computational processes, the individual quarter values were transformed into decimal equivalents. For instance, the value corresponding to the first quarter of the year 2005 was transcribed as 2005.0, and the value associated with the third quarter of the year 2006 was transcribed as 2006.5. Subsequently, we applied this model and equation to analyse diverse sets of data.

Linear Regression Results – Excel-generated Data

In order to generate data, we relied exclusively on Table 1 looking at active licences per quarter. Firstly, we fitted the entire data range to this linear model, yielding an equation:
$L1: Y = -7.159x + 15097$

Graphically, compared to the data set, it looks like this:

Graph 5: Active Licences from 2009-2023
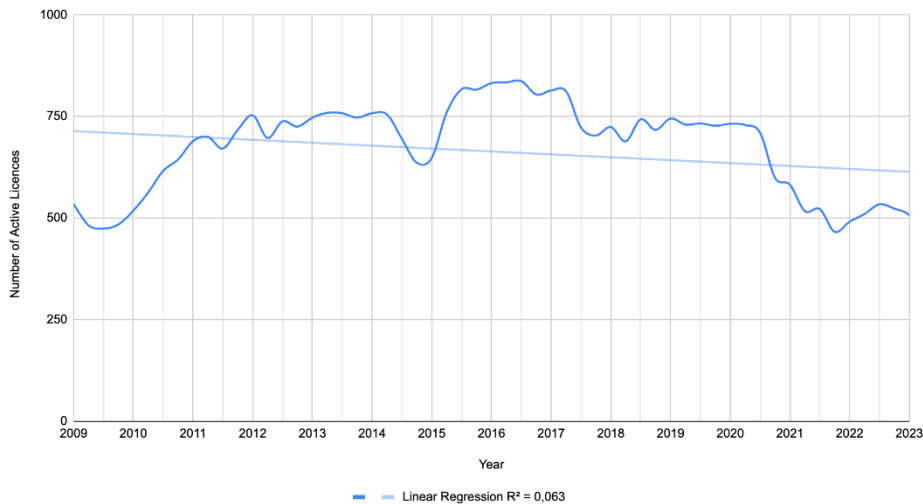
As can be seen, a linear model for the entire period is a poor fit for the data set as a whole, which is proven by the r^2 value of 0.063. So, we decided to split the data set into pre-Licence freeze and after, thereby running two different linear regression models. The regression for all years up to (not including) 2019 was:

$L2: Y = 25.36x - 50356$, with an r^2 of 0.62

The regression after (and including 2019) was:

$L3: Y = -71.70x + 45585$, with an r^2 of 0.88

When looking at L3, we can say with over 95% confidence that the slope will be negative, showing the clear decrease after the licence freeze (the 95% confidence interval stretches from –121.1 to –22.25) Split into these two regression lines, there is now a much higher correlation (as shown above), which can also be seen graphically:

Graph 6: Active Licences Regression Model using two Lines
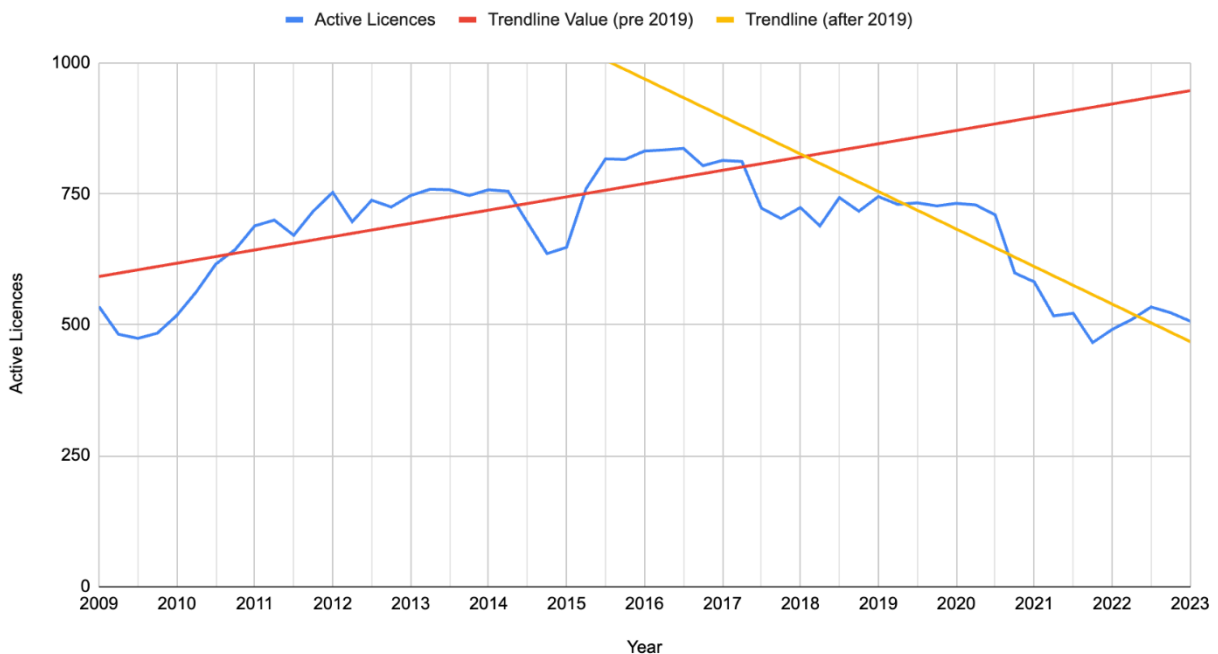
As depicted in Figure 6, the regression line experiences a marked shift that could be attributed to Fife Council's determination in 2019, revealing a steep reduction in the number of active licences. Furthermore, upon comparing the slope values of the two lines, it becomes apparent that the downturn is steeper than the ascent observed before 2019, given that the absolute value of the slope associated with L3 is greater than that of L2. However, when looking at the trendilines goodness of fit, it is clear that there is a closer lienar relationship after 2019 than before. While this could simply be attributed to the larger amount of data points, it is still important to note.

Linear Regression – Excel – Other Data Sets

We can repeat this procedure with occupants and can even split the data into active licences by bedrooms. When running the same calculations, we received these linear regression lines

$L4: Y = 20.88x - 285536$, where $r^2 = 0.29$

$L5: Y = -316.40x + 642310$, where $r^2 = 0.86$

In this case, L4 represents regression pre-2019 and L5 represents regression after (and including) 2019. Similar to before, we can represent these models graphically as well:

Graph 7: Occupants Regression Model using two Lines
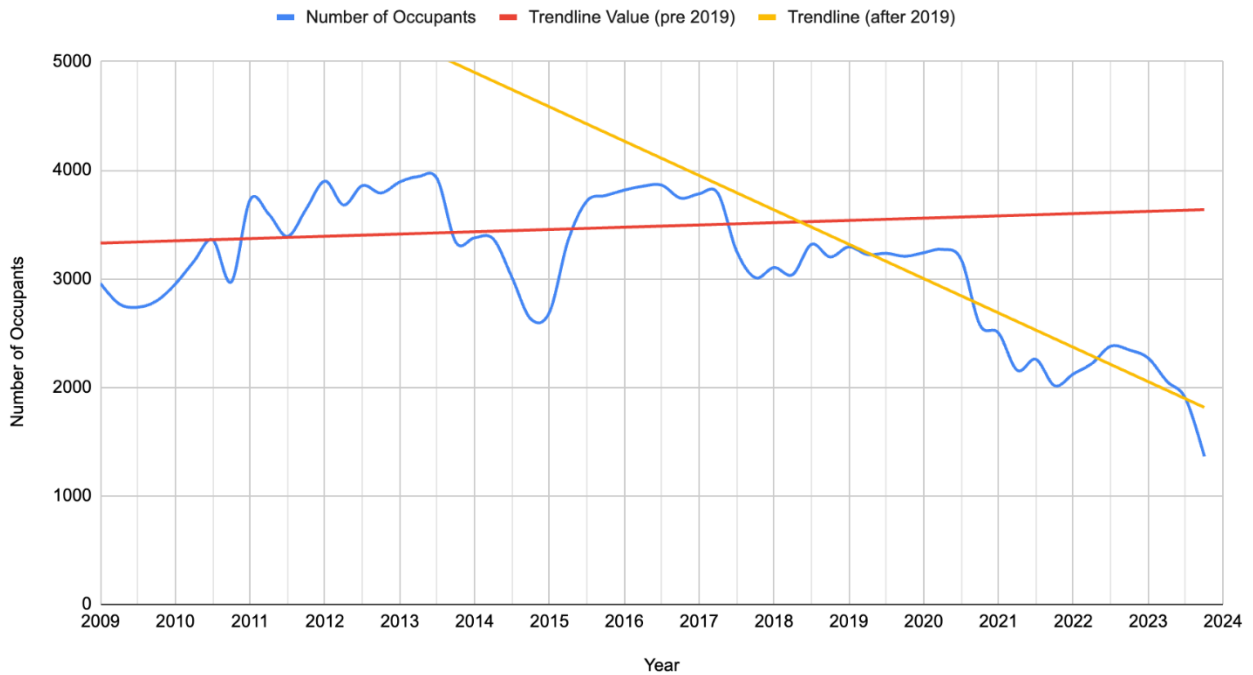
This graphic reaffirms the pattern detected in Figure 6, as evidenced by the fact that the absolute value of the slope associated with L5 is more than ten tiems as substantial as that of L4, thereby exceeding the pattern found between L2 and L3. Furthermore,when comparing where the trendlines intersect in both Figure 6 and 7, the intersection always occurs in the initial half of 2018 and prior to the introduction of Fife Council's policy. However, the trend before 2019 appears almost horizontal, which is reinforced when seeing the significant fluctuations in this period. Nevertheless, this makes the sharp decline after 2019 even more conspicuous. Taken as a whole, these findings establish a consistent trend across both active licences and occupants, showcasing an unequivocal decline subsequent to 2019 that is likely to have commenced in the latter half of 2018.

Analysing Linear Regression – Residual Analysis

Residual analysis is a vital tool in examining the performance of a linear regression model and identifying potential sources of heteroscedasticity. This statistical concept refers to the unequal variances in a dataset, which can violate the assumption of homoscedasticity in linear regression. In turn, this can lead to biased and inefficient estimates of the regression coefficients and inaccurate hypothesis testing results. By performing residual analysis on our data set, we can investigate the differences between the actual values and the predicted values generated by the previously calculated regression lines (L2-L5) in Figures 6 and

7. To facilitate this analysis, we will calculate the residuals as a percentage of the actual value, which will allow us to compare the results for both the number of occupants and the active licences on the same graph. Through this process, we can gain valuable insights into the performance of our linear regression model and assess its effectiveness in predicting the likelihood of licence renewal for properties in St Andrews.

Graph 8: Residual Analysis of Linear Regression Models
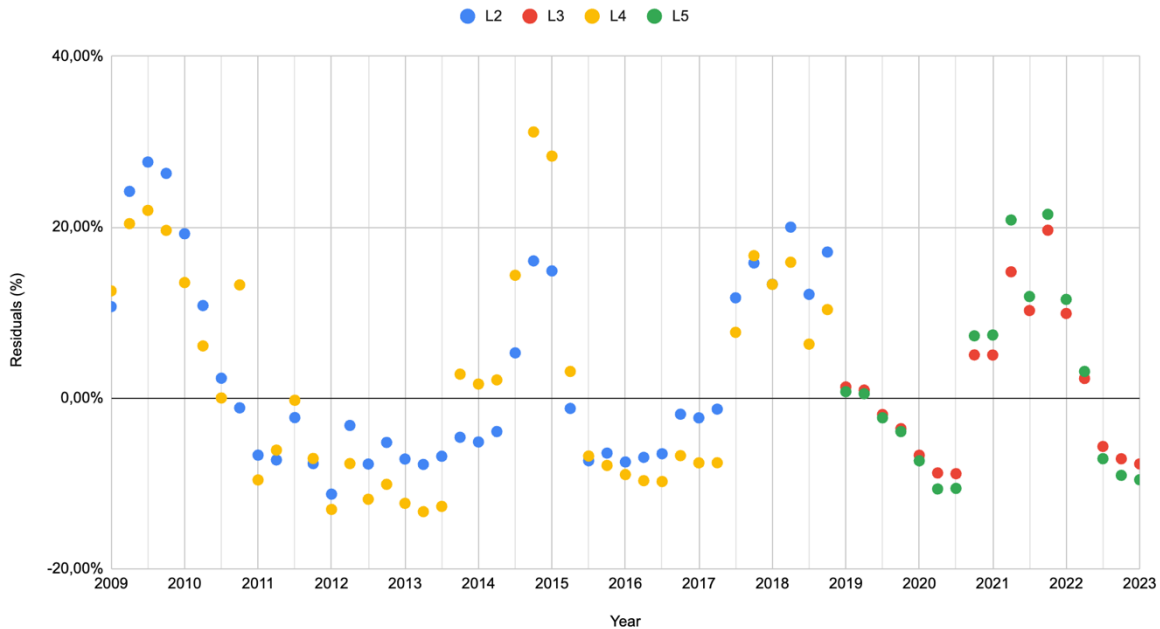
When performing the aforementioned calculations, the resulting graph (Figure 8) displays how the linear regression models differ from the actual values, revealing that both active licences and occupants follow a very similar pattern. However, a more critical observation is that the data does not exhibit homoscedasticity, as it is not equally distributed around the horizontal axis. This observation is reinforced when calculating the average percentage deviation for each line, revealing an incline in L2, L3, L4, and L5, with an average deviation of 2,96%, 2,73%, 2,30%, and 2,65%, respectively.

This residual analysis emphasizes how a linear model, even one split into two lines, is not the optimal fit for this data set, despite the high correlation that would suggest otherwise, indicating the importance of this test. This variance suggests that a different model should at least be considered when attempting to understand the data. This model could be either a polynomial regression model or a weighted regression model, both of which could achieve heteroscedasticity and create a more accurate model.

Polynomial Regression Results
Because of the results from the linear regression, we decided to run a quadratic regression model, hoping to find a better fit. Resultingly, we discovered a curve of best fit:
$L6$: $-6{,}5203787605x^2 + 26287{,}8980132598x - 26495128{,}6874002$, with an r² = 0,844

Graphically, the significantly higher correlation is clearly obesrvable:

Graph 9: Quadratic Regression Model
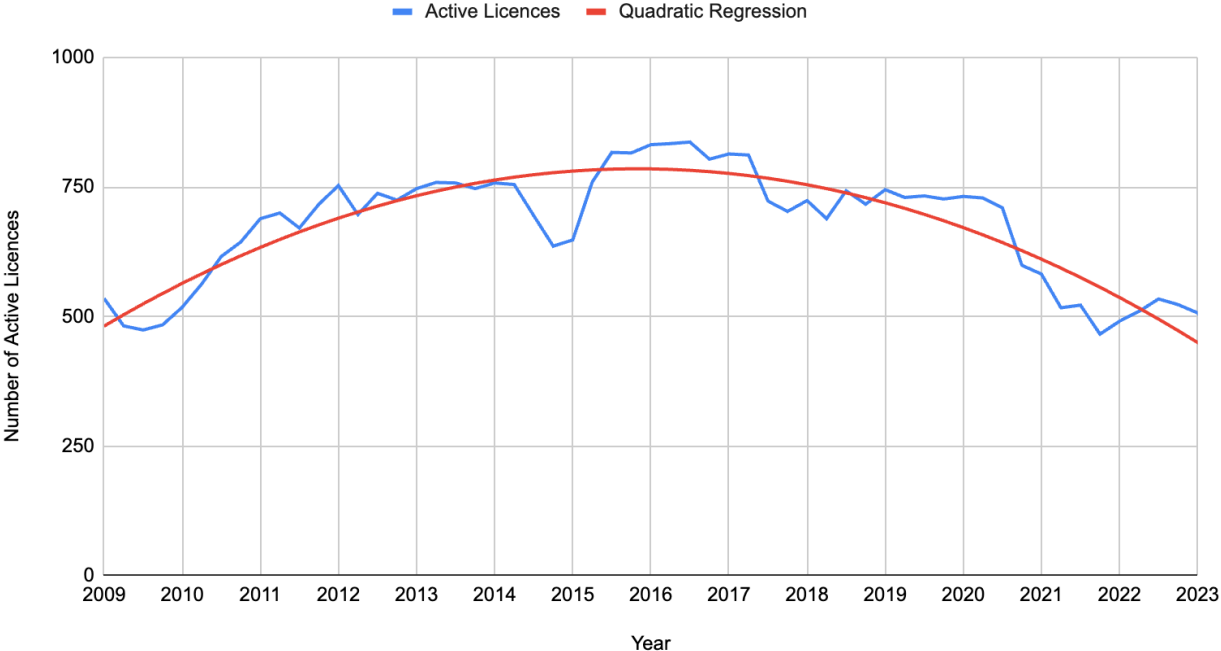
Notably, the model reaches its peak in the last quarter of 2015 (2015.83), which is earlier than the peak of the linear models. Additionally, the quadratic curve appears flatter than the linear models, a conclusion supported by examining the functions' derivatives. At its maximum point (in 2023), the quadratic function has a derivative of -93.55, which is only slightly larger than the slope of L3. Further analysis reveals that the derivative only reaches the slope of L3 in the second quarter of 2021, after which the quadratic model exhibits a less pronounced decline following the license freeze. However, the overall fit appears to be much closer, as confirmed by the residuals.

Graph 10: Residuals of the Quadratic Model
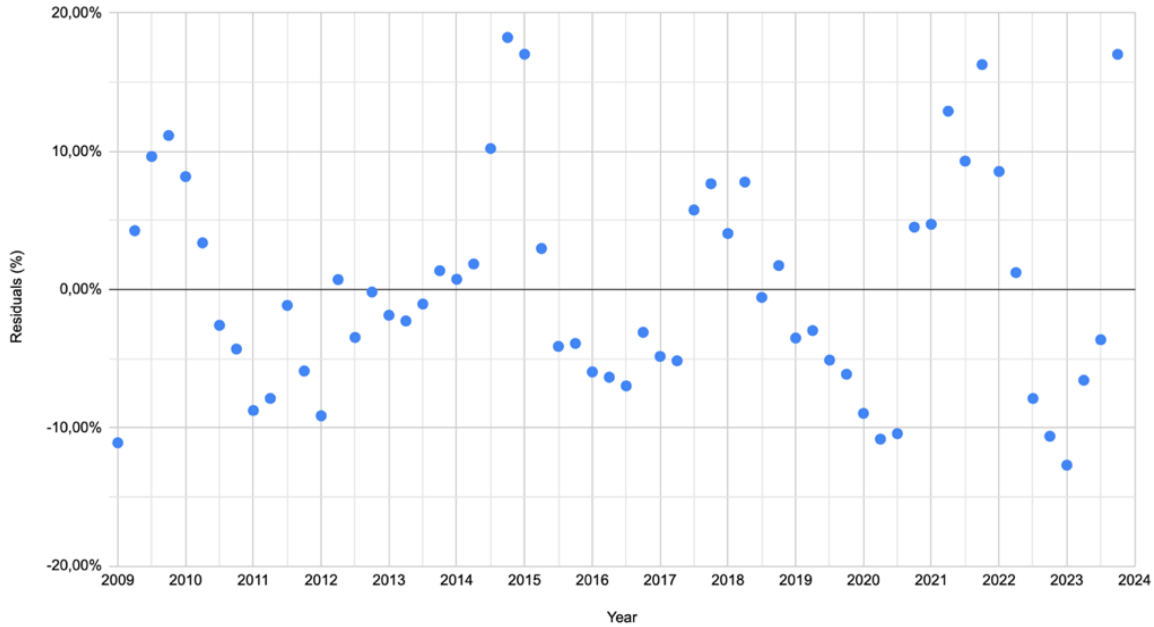
While the overall residuals shape is similar to Figure 8, the scatter plot appears much more random and more centered around the x axis. This is reinforced when calculating the average (just 0.02%), showing a much smaller (absolute) value than L2-5. Therefore, one could assume the quadratic model to exhibit homoscedasticity.

Attrition Results

Survival Analysis
In the context of active HMO licences in St Andrews, a survival analysis is necessary to examine the duration for which HMO licences remain active or "survive" in the area before they are terminated or expired. In this analysis, the activity of licences was examined at each quarter and then 15 quarters prior to determine if the licences had in fact remained active. St Andrews is a university town with a large student population, and HMOs are a largely popular type of accommodation for students. Therefore, analysing the survival of HMO licences can help to understand the demand for HMO housing and how it changes over time.

In commencing the survival analysis process, an Excel spreadsheet was created using the cleaned HMO licence data, including addresses, the number of occupants and active/inactive status of licences quarterly. The first column contained the full addresses in St Andrews. The second column contained the number of occupants for each address. The subsequent set of columns contained data on whether the HMO licence was active or inactive during each quarter, starting from Q1 2015 (labelled Q1) and ending with Q4 2023 (labelled Q36). For the sake of efficiency and interpretability, the active licence data was converted into binary values, with a value of '1' representing active and '0' representing inactive licenses.

Following this binary value conversion, the total number of active licences in Q15 was calculated using the SUM function in Excel. This process was then repeated for the number of active licences in Q1, 15

quarters prior. These two steps were then repeated for the other quarter pairs: Q16 and Q2, Q17 and Q3, and so on up until Q36 and Q22, using the Autofill option in Excel.

The next step was to calculate the number of licences that are active in both Q15 and Q1. To achieve this, the binary values in Q15 and Q1 were multiplied. If both cells hold a 1, as in "active", then the multiplication would equal 1. In any other case, as in the license is active in Q15, but not in Q1 or vice versa, the multiplication would equal 0. This process was repeated for every address and quarter pair using the Autofill option, and the total number of active licenses in both quarters was calculated using the $= SUM()$ function.

To ascertain the survival analysis, or the probability of HMO licences still being active after 15 quarters, the total number of licences that are active in both Q15 and Q1 was divided by the total number of licences that were active in Q1 to understand how many of these licences remained active ("survived") in Q15. This process is then repeated for all quarter pairs.

Table 7

Quarter	Number of Active Licences	Number of Active Licences 15 Quarters Prior	Number of Licences that Remained Active	Probability of Licence Still Being Active
Q15	741	646	447	0.69195
Q16	715	758	503	0.66359
Q17	743	815	550	0.67485
Q18	728	814	547	0.67199
Q19	731	830	567	0.68313
Q20	725	832	552	0.66346
Q21	730	835	554	0.66347
Q22	727	802	537	0.66958
Q23	708	812	530	0.65271
Q24	597	810	454	0.56049
Q25	580	721	433	0.60055
Q26	515	701	376	0.53638
Q27	520	722	382	0.52909
Q28	464	687	361	0.52547
Q29	489	741	362	0.48853
Q30	508	715	371	0.51888
Q31	532	743	395	0.53163
Q32	521	728	379	0.52060
Q33	505	731	387	0.52941
Q34	452	725	354	0.48828
Q35	414	730	331	0.45342
Q36	310	727	244	0.33563

Graph 11 depicted below illustrates a general diminishing trend in the probability of HMO licences remaining active on a quarterly basis, as in over time the probability of HMO licences still being active declines. As can be seen above, the probability demonstrates a minor decrease from Q15 to Q23, declining from 0.692 to 0.664. Subsequently, the probability experiences a steeper descent from Q23 to Q29, dropping to 0.489, before then experiencing a slight increase to 0.521 in Q33. However, after Q33 to Q36, the probability experiences a sharp decline once again, decreasing to 0.336. Overall, from Q3 2018 (Q15) to Q4 2023 (Q36), the probability of licences still being active over a 15-quarter period decreases.

Graph 11: Survival Analysis, Q3 2018 – Q4 2023

Table 8 and
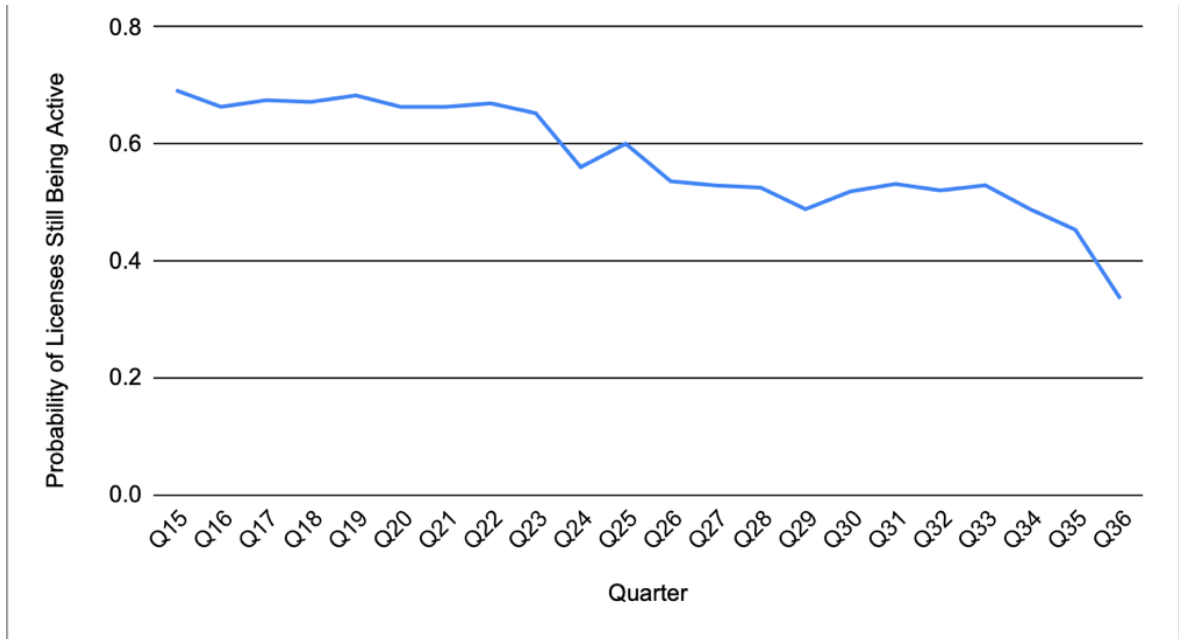
Graph 12 - Impact of an Additional Occupant on Licence Survival

Quarter	Slope of the Regression Line
Q15	-0.0006999
Q16	-0.0006911
Q17	-0.0006203
Q18	-0.0005179
Q19	-0.0005168
Q20	-0.0005296
Q21	-0.0005196
Q22	-0.0004094
Q23	-0.0003943
Q24	-0.0005104
Q25	-0.0005008
Q26	-0.0006155
Q27	-0.0006528
Q28	-0.0004983
Q29	-0.0004193
Q30	-0.0004126
Q31	-0.0003377
Q32	-0.0003308
Q33	-0.0003178
Q34	-0.0002545
Q35	-0.0002101
Q36	-0.0002309
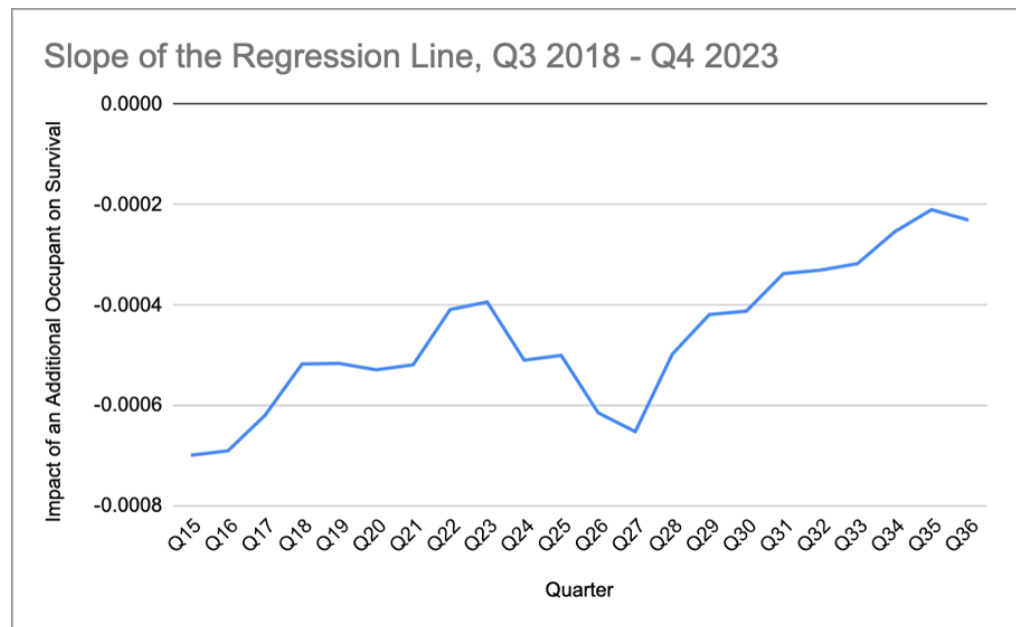
When conducting an analysis that involves the slope of a linear regression line, it is important to take into account the relationship that the regression is conveying. In this particular instance, the relationship between the total number of occupants and whether the HMO licence has remained active over 15 quarters is of interest. The slope measures the change in the dependent variable (i.e., whether the HMO

licence has remained active) for every unit increase in the independent variable (i.e., the number of occupants). Given that the slope of the regression line is constantly negative, it can be concluded that there is a negative correlation between the two variables. Specifically, as the number of occupants increases, the probability of HMO licences remaining active decreases.

To calculate the slope of the linear regression line, one may utilize the SLOPE function in Excel. The SLOPE function takes two arguments: the array of y values (i.e., whether the HMO licence has remained active) and the array of x values (i.e., the number of occupants). For example, . The function then returns the slope of the linear regression line that best fits the given set of data. Here, the $ symbol is used to lock in the specific range of cells holding the data for the number of occupants, so that it doesn't change when the formula is copied or moved to another location.

As illustrated by the graph above, from Q15 to Q23, the slope of the regression line gradually rises with considerable fluctuations, from -0.0006999 to -0.0003943, suggesting that having an additional occupant residing in a HMO property will decrease the property's licence's probability of survival at a slower pace during this period. Following this general trend up to Q23, the slope decreases sharply to -0.0006528 at Q27. This signifies that having an additional occupant will cause the property's survival probability to drop at a faster rate than before. From Q27 onwards, the slope of the regression line rises sharply until Q35, reaching -0.0002101, suggesting that having an additional occupant leads to a slower decline in the probability of a HMO licence remaining active. Nonetheless, it is noteworthy that the slope begins to decline slightly again from Q35 to Q36, implying that having an additional occupant will result in a faster decline in the probability of survival. In Q36, having one more occupant leads to the probability of licence survival going down by -0.02309%.

Comparing 2017 and 2023
After identifying 2017 as an appropriate starting point due to its exemption from the licence freeze, but clsoe proximity to modern circumstances, we proceeded to use the previously created binary sheet to calculate the number of inactive licenses in 2023 that were active in 2017, resulting in 488 licenses. Additionally, we found that 103 new licenses were active in 2023, leading to a net loss of 385 licenses over this period.
To further analyze the impact of an additional occupant on survival during this specific timeframe, we calculated the distribution of bedrooms in both 2017 and 2023. By doing so, we were able to determine the percentage decrease in each bedroom category. This additional analysis allowed us to gain a deeper understanding of the effects of the net loss of licenses on the number of occupants in different bedroom categories.

Table 9: Comparing HMOS (Housing in Multiple Occupancy) in 2017 and 2023

Number of Occupants	Active in 2017	Fraction of total licenses	Active in 2023	Fraction of total licenses	% decrease
3	242	28,40%	145	29,00%	40,08%
4	327	38,38%	210	42,00%	35,78%
5	169	19,84%	103	20,60%	39,05%

6	104	12,21%	17	3,40%	83,65%
>7	38	1,17%	25	5,00%	34,21%
Total Licences	880	100,00%	495	100,00%	43,18%

Upon examining the distribution of bedrooms in 2017 and 2023, it becomes evident that the decrease in licenses is not evenly distributed across all categories. The most significant decrease is observed in 6-bedroom properties, which were likely split up to circumvent HMO licensing. However, this category represents only a small percentage of the overall licenses.

The largest category, 4-bedroom properties, exhibits a smaller decrease in absolute numbers, although it is still the most significant decrease nominally. Interestingly, the second-largest percentage decrease is observed in 3-bedroom properties. This may be due to their flexibility in being converted into two-bedroom properties, thereby avoiding HMO licensing requirements. A closer look at the distributions of 2017 and 2023 reveals that the latter is much more unevenly distributed. More than 2/5 of all properties are 4-bedroom properties, indicating a higher concentration in this category. The number of 3-bedroom properties remains relatively constant between the two years, while the proportion of 5-bedroom properties also remains consistent.

In contrast, the distribution of 6-bedroom properties differs significantly between the two years. Furthermore, the number of properties with more than 7 occupants increases distribution-wise in 2023. These findings suggest that the license freeze has had a significant impact on the distribution of properties with different bedroom configurations.

Conclusion:
In conclusion, our analysis of the HMO register provided valuable insights into the effects of Fife Council's policy. Despite facing challenges with data collection and conversion, we remained steadfast in our commitment to ensuring the accuracy and reliability of our results, utilizing new methodologies and the loss index as a means of verification. One of our key findings was a significant decrease in the number of licenses issued after 2019. This decline was further compounded by our observation that the number of occupants had decreased by nearly 58%, albeit not equally across all property sizes.

Our analysis also revealed interesting trends in the category of properties licensed. We observed that four-bedroom properties continued to be the largest category when comparing 2017 and 2023, but with an increasing concentration in the latter year. Conversely, six-bedroom properties saw the greatest decrease, followed by three-bedroom properties, possibly due to their ease of conversion into two-bedroom properties that do not require a license. Moreover, our linear model exhibited heteroscedasticity, prompting us to switch to a quadratic model with an average deviation of 0.02%, indicating its superiority. Finally, our survival analysis demonstrated a significant drop in survival chances after 2019, and an additional occupant was found to decrease the survival chance further.

Overall, our findings suggest that the policy freeze has had a considerable impact on the HMO register. Despite the challenges faced, our analysis underscores the importance of continued efforts to monitor and evaluate the impact of policies on the housing market to ensure effective and equitable outcomes.

Lost HMOs

Lost HMO sub-team motivation

Lost HMOs is a new sub-team introduced this semester with the aim of investigating the properties who have lost their HMO licence. Our primary goal was to find a complete record of the number of HMO licences that have been lost, including: their addresses, postcodes, licence expiration dates and analysis. For our analysis, we are using our list of properties who have lost their licences to ascertain the new use of each property. Our research thus far has indicated properties being sold and maintained by private homeowners or families or converted into holiday lets, to name the largest trends. While we have no definitive evidence of the motives of the property owner, planning permissions on the Fife Council Planning Portal and other property advertisements indicate the property's current use.

Investigating the repurposing of these "lost" HMO properties is crucial in our understanding of how the property owners themselves are dealing with the HMO cap in St Andrews. For some it may mean lost opportunity, as the demand for houses with HMO licences remains high for student lets. Some property owners who own properties with a low number of beds may continue to rent their non-HMO licenced properties to students who are willing to pay for the whole house and leave bedrooms empty for the sake of staying in town. Other property owners are simply changing their target market to families or tourists.

Methodology

To find the out what has happened to a "lost" HMO once it has been identified, the following methodology was utilised:

- Google the address

The aim is to find historical property listings on websites such as Rightmove or Zoopla etc. These can be either sale or rental listings. Within such listings there could be an indication of differing use. This could include statements such as "been operated as a successful holiday let", indicating a change of use to a holiday let. Other notable indications of differing use include properties being advertised as an Airbnb holiday let, or a good fit for a family which would indicate the landlord wishes to rent to families instead of students (the main target demographic for HMO properties in St Andrews). This is attractive for a property owner since family lettings do not require a HMO licence.

- Search property on Fife Council Planning portal website

The aim is to find a change of use or other planning applications which could indicate property use after losing its licence. Examples of applications of interest are subdividing a large property into multiple smaller ones (2 persons) which would render the need for an HMO licence redundant. Additionally, the

planning portal would indicate if the property still exists: a planning application for demolition would have to be made and displayed on the portal. Finally, there could be a change of use application from residential to something else, for example the Scottish Government has introduced legislation (Scottish Government, 2023) which requires all Holiday Let operators to submit an application to operate their Holiday Lets by October 2023. This means in future months this will help establish which lost HMOs have been converted into holiday lets.

- If there is a chance of it being a holiday let

  o Click on icons in approximate location on Airdna (Listings sometimes have approximate locations), Airbnb Map search, VRBO map search or TripAdvisor
  o Confirm listing matched address by finding property on google earth street view

If the property is found to be on any of these sites and available to let, or booked for more than 210 days per year it is considered a furnished holiday let (HM Revenue & Customs, 2022). The reason that searching the above websites must be done via map search is because addresses are withheld until a booking is made on these websites to protect the privacy and security of the properties. Airdna map search for St Andrews is found below:
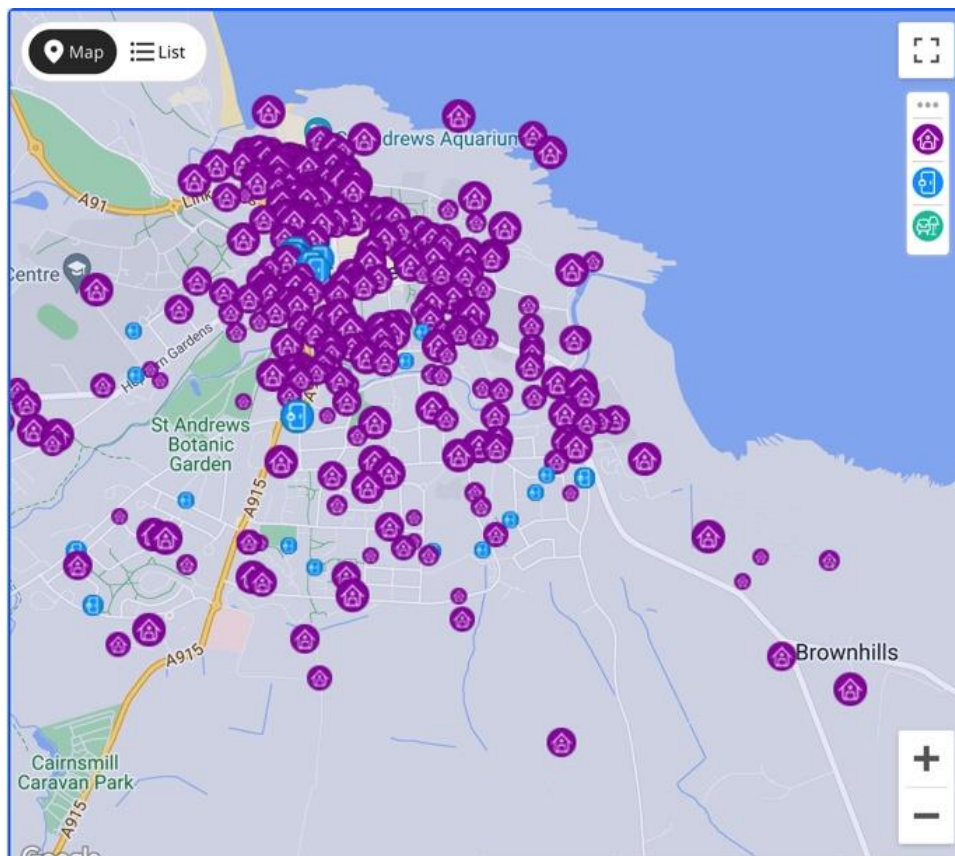
- To confirm the property has been sold:

- o Recommend using Zoopla house prices tool – this will also show previous listings such as rental advertisements, alternatives include Rightmove
  - o https://www.zoopla.co.uk/house-prices/fife/st-andrews/
  - o https://www.rightmove.co.uk/house-prices.html

- To check whether the property is no longer operated as a buy to let we checked the Scottish Landlord Register

If the address is no longer on the register, the property is no longer rented out, therefore it is now either owner-occupied or empty. However it cannot always be true that if the property is on the landlord register that it is rented out, since it may be either vacant or the landlord has not yet taken their name of the register for that property.

Analysis of lost HMOs spreadsheet

After obtaining clarification from Fife Council, the sub-team checked the current HMO licence status of all the addresses with an active licence from 2017 using the Q1 2023 pdf provided on Fife Council's website. We considered a HMO to be "lost" if the latest entry in the pdf had an expiry date before 2022. The reason behind this was to not inaccurately consider a HMO "lost" if it was in fact in process of getting its HMO licence renewed. This is because during the renewal process the address is permitted to continue operating as a HMO.

From manually checking the pdf we concluded there were 144 "lost" HMOs in St Andrews which equates to 686 rooms being lost between 2017 and 2022. Out of the lost HMOs, 53 were located in the St Andrews Consevation Area whilst 91 were located outside it. Once the 56 Lost HMO addresses which were part of the former hall of residence Albany Park are excluded from the count of "lost" HMOs in St Andrews, the number of "lost" HMOs outside the conservation area is 35. Therefore there is little evidence to suggest attrition of HMOs operated by organisations other than the University of St Andrews is significantly higher inside or outside the Conservation Area.

Research: Property case studies

210 Lamond Drive, St Andrews, KY16 8RR

Licence Expired: 09/06/2020

210 Lamond Drive's HMO licence expired on 09/60/2020. The registered HMO applicant associated with the property decided not to reapply for a renewed licence. This could be because the HMO application fees are too expensive, or they re-applied and were unsuccessful. The ownership of the property did not remain the same; the property had been sold twice around the time its licence expired: in 2020 and in 2021. The 2020 property listing was advertised as a 3 person HMO for students, whereas the 2021 property listing was advertised as a family investment.

The property is now advertised as a "superb family home" with a "family bathroom and excellent decorations". This differs from its previous advertisement of a "HMO licenced property for 3 persons" with "good functionality and great location". Its target market has shifted from a functional and value-for-money student let to an upmarket family let since its licence was lost. Alternatively, the property could still be let to 2 students, leaving one bedroom empty. The address was checked in the landlord register and there was still a registered landlord assigned to the property indicating the property is still part of the rental housing supply.

A member of the sub-team consensually visited the property to confirm whether the above research came to the correct outcome. The resident informed them that the property did not have an HMO licence and was being rented to 2 students with the 3rd bedroom being empty. The resident also said that the landlord decided to not renew the HMO licence as it was too costly, so they deemed it unworthwhile.

58 Argyle Street, St Andrews, KY16 9BU

Licence Expired: 04/01/2016

57 Argyle Street's licence expired on 04/01/2016, and the registered HMO applicant associated with this property decided not to reapply for a new licence or was unsuccessful. Since its licence expired the ownership of the property remained the same; hence the property has not been sold since its licence expired in 2016. We confirmed the property was not sold due to a registered refurbishment of the property on Fife Council planning portal in 2019 which was requested by the same person who is the registered HMO applicant associated with the property in 2013.

The property was renovated and is now listed on a holiday villa rental website called villacompare. It is aimed towards families and tourists, notably golf players. This was determined by the heavy promotion of proximity to the golf courses and a new additional name for the property: 'Kinbrae Golf House'. The property has become a lot more upmarket, and its target market has completely changed.

To ensure the property was the documented property on the spreadsheet it was necessary to compare photos of the front exterior of the house to a google earth satellite view of the address. This clarification was important as the property had both changed name and appearance. For this particular property this was confirmed by noticing a post next to the property's driveway with a sign titled 'CHAGFORD 60'.

38 Market Street, St Andrews, KY16 9NT

Licence Expired: 04/14/2017

Whilst following the methodology outlined above each step was timed.

The Google search of the address resulting in finding that the property had been sold in 2009. This took 1 minute.

https://espc.com/property/38-market-street-st-andrews-fife-ky16-9nt/34712172

Then the property was searched on the planning portal where applications for development works were found which had little relevance since they were from 2003. This took 1 minute.

https://planning.fife.gov.uk/online/propertyDetails.do?activeTab=relatedCases&keyVal=I2WEVOHFLI776

The property was found on the landlord register which said the property was being managed by Rollos LLP. – a major letting agent in St Andrews. This took 1 minute 30 seconds and gave us an indication that the property may still be on the rental market however this cannot be said for certain.

https://www.landlordregistrationscotland.gov.uk/search/registration/property-results

Registration details for this property

Registered by	Thomas Jebsen
Joint owner(s)	None
Agent's details	Rollos Law LLP
Local authority	Fife
Contact address	67, Crossgate, Cupar, KY155AS

Since there was very limited information a search for the property was done on holiday let platforms where the property was not found. This took 7 minutes. Overall, we concluded there was insufficient information to confirm the current status of the property so it was categorised as "unknown". The total time taken was 9 minutes 30 seconds.

16 St Mary Street, St Andrews, KY16 8AZ

After completing a google search of the address, a confirmed sale took place in the middle of 2022. There were several "For Sale" listings on property platforms which advertised the property as having a HMO licence, which contradicts our interpretation of the Q1 2023. This step took 3 minutes.

https://www.bradburne.co.uk/wp-content/uploads/2022/03/16-St-Mary-Street-St-Andrews-1.pdf

https://www.zoopla.co.uk/property/uprn/320070380/

As a result of there being evidence of property being let in the listings. The address was checked in the landlord register. This produced an unusual output photographed below. This took 1 minute.

https://www.landlordregistrationscotland.gov.uk/search/registration/property-results

Scottish Government
Riaghaltas na h-Alba
gov.scot

BETA This is a new service – your feedback will help us to improve it.

◄ Back

Contact details cannot be provided

Please contact the relevant local authority for more information.

New search

However, on Fife Council planning portal there was a document attached which was an application from the landlord to change the use of the property from a dwellinghouse to an HMO-licenced property for 6 persons. The application was made on 28th August and a letter was written a month later to confirm the application was successful:

Fife
COUNCIL

Jack Fisher Partnership
Angus McGhie
7 Alexandra Place
St Andrews
United Kingdom
KY16 9XE

Economy, Planning and Employability Services

Bryan Reid
03451 55 11 22
development.central@fife.gov.uk

Your Ref:
Our Ref: 19/02505/FULL

Date 28th October 2019

Dear Sir/Madam

Application No: 19/02505/FULL
Proposal: Change of use from dwellinghouse (Class 9) to HMO (6 persons)
Address: 16 St Mary Street St Andrews Fife KY16 8AZ

Please find enclosed a copy of Fife Council's decision notice in relation to the above application made on behalf of **Mr Tony Grace.** You are advised carefully to read any conditions which form part of the decision notice and to contact me if anything in the decision notice requires further explanation.

The decision notice is an important document and should be kept safe for future reference.

Yours faithfully,

Bryan Reid, Graduate Planner

Enc

As a consequence of the contradictory results, Fife council was contacted to seek clarification. They had confirmed that whilst the property had been granted an HMO licence in 2019 (and so should appear on the spreadsheet), the property was undergoing a re-appliation for a licence which was yet to be determined. For this reason, it would not show on the HMO public register. This was problematic as it means all properties which are applying or re-applying for a licence will not show on the register,

meaning we are missing a number of properties. We contacted Fife Council once again, asking them to provide us with a list of such 'undecided' properties but have not had a reply. [See appendixes (2) for email contents].

Communications with fife council

When we started compiling research on lost HMO properties, we suspected inaccuracies with the Fife Council Public HMO Register involving 'missing' properties and the use of the term 'CON'. In the early stages of research, we had interpreted the term 'CON' to mean a HMO application had been rejected. The sub-team could not do any further research without explicit clarification from Fife Council on the apparent problems in the spreadsheet. This was fundamental to our project, as it ensured our research was of accurate quality.

We compiled a word document of all of the suspected problems with the HMO register to provide Fife Council with a detailed and thorough description of each 'inaccurate' property record. We also asked for clarification on the terms in the 'Decision' column in the spreadsheet which described the status of the application of the HMO licence for each property. The terms were: GRANT, CON, and a more recent addition DEEM. Our aim was to receive an up-to-date spreadsheet of all of the properties with an active HMO licence in St Andrews and fully understand the contents of the spreadsheet. [See appendixes (1) for email contents].

The contents of the word document describing all of the suspected problems with the HMO register is as follows:

1. Property address

2. Description of the 'problem' with the aforementioned property.

3. Screenshot of aforementioned property on the Fife Council HMO Public Register (if on spreadsheet).

4. Link to property advertisement (if it's a listed university-managed property).

Inaccuracies with the HMO Public Register (Q1 2023)

19 Faser avenue

This property does not appear anywhere on the Q1 2023 HMO register but is listed on the university of St Andrews accommodation website (linked below) as a HMO.

https://www.st-andrews.ac.uk/accommodation/pg/current/managed/properties/3bedroom/

72 Market Street

This property does not appear anywhere on the Q1 2023 HMO register but is listed on the university of St Andrews accommodation website (linked below) as a HMO.

https://www.st-andrews.ac.uk/accommodation/pg/current/managed/properties/5bedroom/

Rectory Lodge, 39 North Street

This property does not appear anywhere on the Q1 2023 HMO register but is listed on the university of St Andrews accommodation website (linked below) as a HMO.

https://www.st-andrews.ac.uk/accommodation/pg/current/managed/properties/3bedroom/

72 Lawmill Gardens

This property does not appear anywhere on the Q1 2023 HMO register but is listed on the university of St Andrews accommodation website (linked below) as a HMO.

https://www.st-andrews.ac.uk/accommodation/pg/current/managed/properties/3bedroom/

87 bridge street

Applied for HMO 06/07/2020 but was rejected ("CON") on page 331 of the Q1 2023 spreadsheet, still advertised as university managed accommodation that was let to students from 1 September 2021 – 30 June 2022 (see link).

App Ref Number	Applicant Name/s	WARD	HMO Address	Agent Name	License Status	Date of Ap	Date Issued	Expire Date	Tot Occs	Decision
F03658/20	Gillian Ratcliffe	W5R18	87 Bridge Street St Andrews KY16 8AA		Licence Issued	06/07/2020	23/08/2021	31/07/2023	4	CON
	Paul Ratcliffe	W5R18	87 Bridge Street St Andrews KY16 8AA		Licence Issued	06/07/2020	23/08/2021	31/07/2023	4	CON
		W5R18	87 Bridge Street St Andrews KY16 8AA	University Of St Anc	Licence Issued	06/07/2020	23/08/2021	31/07/2023	4	CON

4 bedroom properties | Student accommodation | University of St Andrews (st-andrews.ac.uk)

Castle Wynd house 28 north castle street

Applied for HMO 20/04/2021 but was rejected ("CON") on page 419 of the Q1 2023 spreadsheet, still advertised as university managed accommodation that was let to students from 11 June 2021 – 9 June 2022 (see link).

| F04084/21 | All Saints Episcopal Church | W5R18 | Castle Wynd House 28 North Castle Street St Andrews KY16 9BG | | Licence Issued | 20/04/2021 | 19/10/2022 | 21/05/2024 | 4 | CON |
| | | W5R18 | Castle Wynd House 28 North Castle Street St Andrews KY16 9BG | University Of St Anc | Licence Issued | 20/04/2021 | 19/10/2022 | 21/05/2024 | 4 | CON |

4 bedroom properties | Student accommodation | University of St Andrews (st-andrews.ac.uk)

Upon receiving correspondence from Fife Council, we realised that it was not the spreadsheet contents that was incorrect. It was, in fact, our understanding of the spreadsheet data. This meant that it was not only our sub-team, but all sub-teams from all previous semesters that were interpreting the spreadsheet data wrongly. The reason as to why it took so long for our team to distinguish this was because we thought previous teams had already clarified with Fife Council on the meaning of the HMO Public Register contents before using it for research. It also explained the uncharacteristically high number of lost HMOs from last semester's research, and shed light on why the graph trends were so extreme. This issue had been a withstanding challenge for a multiple weeks, however gaining this information from Fife Council was a crucial pivot in working on our sub-team's main goal: to research what happened to the properties who had lost their HMO licences.

Supply Demand Analysis
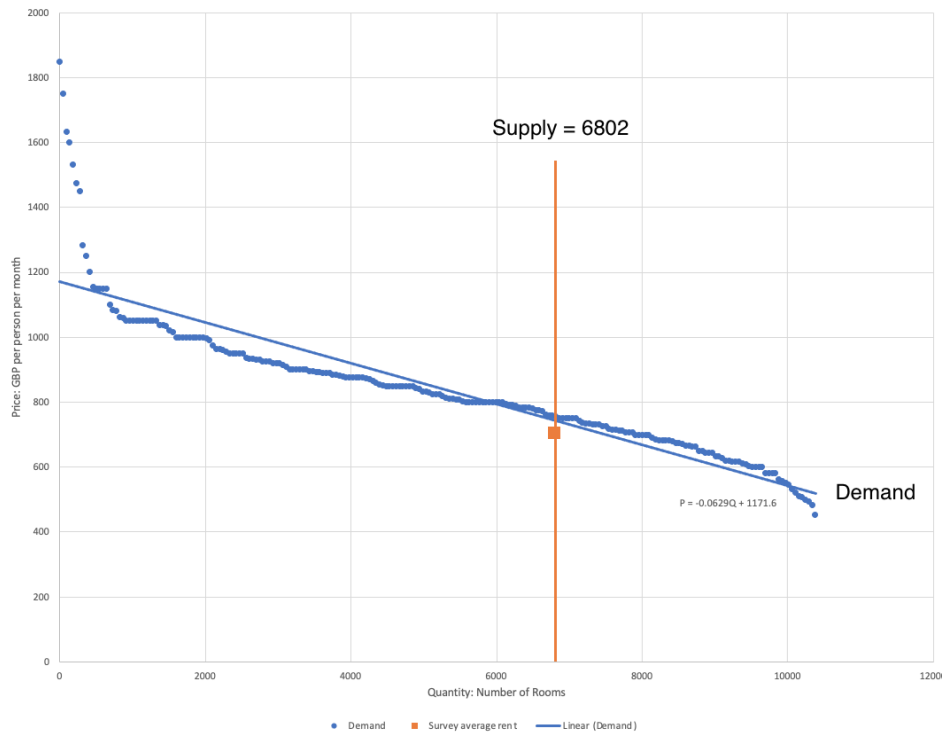
As a result of obtaining relevant data from the survey and analysis of the lost HMO spreadsheet it was possible to create a supply – demand analysis for the HMO rental market in St Andrews.

The following assumptions were utilised to obtain the supply and demand curves.

1. Only University of St Andrews students demand rooms in HMOs in St Andrews
2. The only location a student can live in instead of St Andrews is Dundee

3. The survey data used is not biased and completely representative of the University of St Andrews student population
4. The only type of housing a University St Andrews Student can rent in St Andrews is a room in a HMO

To find the demand curve we utilised data obtained in the survey. Each blue circle represents a respondent's willingness to pay to remain in St Andrews. This was obtained by calculating their monthly rent plus the amount their rent would have to rise for them to move to Dundee. If the response for the increase was a range with a maximum and a minimum, the midpoint was assumed to be the amount their rent would have to increase. Where the response was their rent would have to increase by "more than £200" it was assumed that their rent would increase by £250 for them to move to Dundee. Overall, there were 228 respondents provided the above information. To make the demand curve reflective of the number of students at the University of St Andrews each respondent represented 45.72 students. This was obtained by dividing the total number of students at the university in the 21-22 academic year which was 10424 (University of St Andrews, 2023) by the number of useful survey respondents. The quantity allocated to each blue circle was the number of people willing to pay its assigned price based on the survey multiplied by 45.72. A straight line of best fit was added with the equation: $P = -0.0629Q + 1171.6$ which is our estimated demand curve equation for St Andrews HMO Market.

The supply curve was assumed to be perfectly inelastic with its quantity equalling the number of rooms in HMOs calculated by the Lost HMOs sub-team, 6802. This equalled the difference between the number of rooms in active HMOs in 2022. Consequently, the intercept price of the supply and demand curve is £743.75 . This is greater than the average rent from the data used in the graph from the survey represented by the orange square equalling £702.97. This is unsurprising since not every student is paying the maximum they are willing to pay to live in St Andrews instead of Dundee. Additionally, the supply curve utilised is an underestimate of the true supply of rooms for students in St Andrews. This is because it does not count properties without a HMO licence which includes all properties that have 2 bedrooms or less which take up a large proportion of the St Andrews rental stock for students.

Process (timeline of events so far)

Due to several unforeseeable circumstances outlined above, the sub-team is unfortunately not as far along in completing research as expected. Our goal was to form a spreadsheet of lost HMOs in week 2, but due to previously mentioned misunderstandings with the HMO public register, we only recently completed it. We ideally wanted additional case studies, to give context behind the data and to provide future participants in the sub-team a helpful resource to familiarise themselves with how we implemented methodology. Although the team dedicated significant time emailing with Fife Council and attempting to obtain answers about the spreadsheet, successful research outcomes were only achieved from independent learning week onwards. Through our frequent corrrespondence with Fife Council, we have not only

stablished a form of communication with them, but have also had questions about the spreadsheet answered that could benefit the Lost HMO sub-team in future semesters. By week 8 the team had checked all 1,260 active HMOs in 2017 according to the previous semester's list to find which were lost by 2022 and developed a couple case studies as outlined above. Now, since week 8, the sub-team has calculated and discovered that there are 144 "lost" HMOs. In week 9 two additional case studies were completed and each step in the methodology was timed. In week 10 and 11 the spreadsheet was sorted through in preparation for future coding that we didn't have enough time for, but would be the next step for future Lost HMO's subteams. One thing that was done to help the excel spreadsheet for when it eventually gets converted into code, was organizing and ensuring all of the postal codes were present and in the same cateogry. Additionally a supply demand graph and analysis was completed.

Plans for continuing research

Since the sub-team counted a different number of lost HMOs compared to HMO register sub-team, our objective is to assess which count is more accurate or if the true number is in between; and find the source of the discrepancy between them. Whilst the figures are a much closer match to what they were at the beginning of the semester, there is still a slight difference in the two values. Finally, the sub-team's long-term plan is to establish whether the HMO cap has met Fife Council's objective of protecting and increasing housing stock of family homes in St Andrews by investigating the current status of each lost HMO and whether their new use match this objective. This process would hopefully be automatic rather than manual as it requires processing a large amount of data.

Survey

Overview

Last semester, the survey team set out to design a survey aimed at understanding the impact of the HMO cap on the St Andrews housing market and the willingness to pay (WTP) of University of St Andrews students. We created the survey in Qualtrics and provided reasoning for each of our questions, thought through the logistics of keeping respondent data secure and private, and submitted our ethics application for review by the School of Economics ethics committee before leaving for break.

This semester, we have continued moving forward with preparing and distributing the survey. In weeks 1 and 2 we reviewed the survey and planned out our semester timeline and deliverables. In week 3,

we prepared to launch a small pilot of the survey, this involved choosing participants and learning the Qualtrics distribution methods. We also received feedback from the ethics committee and made the requested changes before resubmitting for final approval. In week 4, we launched the pilot and in week 5 began interviewing pilot participants about their experiences and suggestions for improvements. In week 6, we incorporated their recommended changes, fixed a few Qualtrics settings to improve data protection and anonymity, and worked on our marketing plan for the survey. Over reading week, we emailed every school president along with the president of the student's association and asked them to include our survey in their weekly emails.

Ethics Review

The first round of ethics committee feedback requested the following changes which we responded to by changing the survey question or adding more explanation to the application.

Issue	How we Resolved This
HMO not defined	We included the definition and a brief explanation in both the ethics application and the Participant Information Sheet (PIS)
Handling of Data	Added on PIS that participant data is to be password protected. Ethics asked how we will store the survey data and so we added that all data will be kept up in Qualtrics which is password protected and only accessible by survey team members. All data that is shared with the rest of the team will be anonymized. After current survey team members leave the VIP, future storage of the data will be managed by project supervisors who can determine when the data should be deleted after it has been analysed and the project concludes.
Affiliation with CASH	Ethics committee raised concerns about our collaboration with the Campaign for Affordable Student Housing (CASH). We clarified that this partnership is purely for publicizing the survey through their social media channels. They will have no access to data and thus will not impact participant confidentiality.
Discussion of Face-to-Face Interviews	Last semester when completing the ethics application, we were considering also conducting in person interviews; however, we have since scrapped that idea and made note of this in our resubmission of the ethics application. The only face-to-face contact we would have with participants is simply asking them to fill out the survey.
Application question no. 22 asking if students will have the option to omit questions.	We provided further explanation as to why we answered no to this question. We feel it is important that all responses are complete to create the most comprehensive and accurate data set possible, thus we have required responses to every survey question. Participants are not forced to complete the survey and can choose to stop taking the survey at any point.
Application question no. 25 questioning our response yes to if we will provide	We provided further explanation that all participants will be entered to win one of 4 £100 pound Amazon gift cards. This financial incentive is not based on the content of their answers, but simply upon completion of the survey.

financial incentives.	After realizing that distributing the survey through the anonymous link and QR codes does not collect participant email addresses, we added a final question to the survey asking participants to share their email address if they would like to be included in the gift card raffle. This is the only question on the survey that is not required, allowing students to remain even more anonymous, although at the cost of not being included in the raffle.

The second round of ethics committee feedback was that it was unclear why we were asking about gender identity and ethnicity. This was the topic of much discussion last semester, however we felt that these questions are important to creating a profile of the average renter in St Andrews and allows us to assess whether certain factors such as willingness to pay more for a safer location are dependent on gender and/or ethnicity.

Pilot

Before launching the survey to the whole student body, we released it to a small group of 14 students. We chose people we knew so that we could contact them and interview them on a casual basis about their experience taking the survey. We aimed to select people representative of the student body, varying participants by year, nationality, degree type, and gender. However, given our small sample size, it was impossible to make it perfectly representative of the student body, as is true with most survey pilots. We emailed participants through Qualtrics, informing them of the purpose of the survey and asking them to complete it as well as including the same incentive of 4 £100 Amazon gift cards that general survey participants will be offered, but not informing them that they had been chosen as pilot participants.

We waited a few days after emailing the link to the participants to see who would fill it out of their own accord. We had 2 participants complete it without knowing who had sent it to them. We then reached out letting them know we had sent it and interviewed them about their experience, asking for recommendations on how we could improve it before general release. After this, we reached out to those who had yet to respond and asked them to please do so, then interviewed them as well.

Most feedback of the survey was overall positive, but we did receive some important feedback. Many found that the automatic Qualtrics email address was suspicious, as it did not follow the typical St Andrews email address format, we planned to rectify this by distributing the survey using a link sent by school presidents and other weekly emails to students as well as QR codes posted on flyers around town instead of emailing students through Qualtrics directly.

One aim of the pilot was to measure which participation incentive was most enticing. We decided to stay with Amazon gift cards regardless, as they are well liked by students, easy to procure, and do not involve handling cash on our part. However, incentives vary in their effectiveness based on individual levels of risk tolerance and wealth. We asked pilot participants if they preferred a chance at winning 4 (£100) gift cards, 8 (£50) gift cards, or 2 (£200) gift cards. Most participants chose the first option, except for one who chose the second and two who chose the third. We selected the most popular choice as the raffle prize.

Survey Pilot Results Analysis:

Survey Pilot Results Overview.docx

Question:	Responses (9 Total)
How do you describe yourself?	5 male, 4 female
What best describes your ethnic origin?	7 White, 1 Asian, 1 Mixed two or more ethnic groups
What is your year of study?	Total invited to take the survey: 4 1st years, 6 2nd years, 2 Third years, 2 4th years Respondents: 3 First years, 3 second years, 2 third years, 1 fourth year (9/14)
Do you live in halls?	All three third years said 'yes,' the other 6 respondents in years 2-4 said 'no'
Do you live in a university managed property?	0/9 live in a university managed property
What is your address?	This information is kept secure for the privacy of the respondents
Do you rent your property from a letting agency, private landlord, or do you own your accommodation?	4 letting agency, 2 private landlords, 3 in halls
How many occupied bedrooms are in your flat?	0 1 bedroom, 0 3 bedroom 2 bedrooms, 2 four bedrooms, one five bedroom and one six bedrooms
What is your individual monthly rent?	670, 550, 1000, 475, 752, 790 for flats 7000, 9850, 10000 for halls (9 month renting period) **Average**: 802 pounds per month
What is your fee status?	22% Scottish (2), 11% rest of UK (1), 67% international (6)
What is your nationality?	1 English, 2 Scottish, 2 American, 1 Russian, 1 Polish, 1 Brazilian, and 1 Chinese
How much would your rent have to increase before moving to Dundee?	11% 25-50 pounds, 11% 50-75pounds, 22% 75-100 pounds, 11% 100-200 pounds, 44% far more than 200 pounds
Have you lived in your accommodation for more than one year?	1 yes, 8 no
By how much has your rent increased since moving into your accommodation?	For the 1 'yes' in the previous question, their rent did not increase
What is your primary means of transit to town each day?	81.82% walk, 9.09% bike, 9.09% have a bike or car, but can walk easily
How long would it take you to walk to Tesco on Market St?	64% 5-10 mins, 18% 10-15 mins, 18% 15-20 mins
Rank the following categories based on order of importance to you: Safety, Price, Convenience	(see table below)

	Safety	Price	Convenience
Important	1	9	10

	Indifferent	7	1	1
	Unimportant	3	1	0

What would you pay to rent a room in a three-bedroom flat above Pret on Market St? (Pounds per month)	**Mean**: 777.78 **Mode**: 800 **Range**: 1000-550= 450
What would you pay to rent a room in a three-bedroom flat on Lamond Drive? (Pounds per month)	**Mean**: 583.33 **Mode**: none **Range**: 900-400= 500
What would you pay to rent a room in a three-bedroom flat in Dundee? (Pounds per month)	**Mean**: 2/9 said they would not live in Dundee, but the mean for the other pilot respondents is: 435.71 **Mode**: none **Range**: 600-0= 600

Other points of pilot feedback were to change a few specific questions:

Question #	Original Question	Issue with the Question	How We fixed This
10	What is your monthly rent?	Participants were confused whether this meant that they were supposed to give their rent for the entire house or just for their share of the rent.	As we are interested in the willingness to pay of each individual and less so in the total rent, we changed this question to say, 'What is your individual monthly rent?' This also allows for multiple flat mates to take the survey, allowing us to capture if there are differences in the amount each occupant pays.
12	What is your current nationality?	One participant pointed out that nationality doesn't often change	Changed question to 'What is your nationality?

13	Are you solely responsible for paying your rent?	Some participants were confused by this question and what we meant by solely. Some considered having loans as being solely responsible and some considered having their parents pay their rent as still being solely responsible as it was paid by their family and not an external grant or scholarship.	It was a free response question initially so people could elaborate if they wanted to, but we changed it to a drop-down menu listing the following options: - Pay rent with my own income - A family member or guardian pays my rent - I have an accommodation grant to pay my rent - My student loans go toward paying my rent - Other We also removed the troublesome 'solely' and changed it to simply ask 'Who is responsible for paying your rent?'

Before the official survey launch, Sumedh pointed out that we were not asking about participant's degree and said that this would be an important characteristic to know about respondents. We added this question in as a free response, given the sheer number of degree types and joint degree combinations. This has also served as an additional way of knowing which distribution channels have been most effective, as large numbers of one degree type completing the survey within a few hours is indicative of their school president having shared the survey in their weekly email.

Marketing Plan & Survey Distribution

To prepare for launch, over reading week we emailed every school president, the president of the student's union, and the university memos team and asked them to please include the survey link in their weekly emails. We had mixed success with this approach as only a few presidents confirmed; however, the president of the student's association confirmed he would, and we all received it in his weekly email so we know for sure that the survey link has landed in the inbox of every student at the university. We reminded all the presidents and memos again in Week 7 to include in their Week 8 email and will do so again for Week 9. Additionally, we personally reached out to the school president of econ and she sent an email separate from her weekly email to share the survey.

We also posted on various class Facebook pages as well as the popular Facebook page students use for finding housing in town, Get A Room, giving a brief introduction of the VIP and the survey and asking them to please fill it out. We had positive responses to each post with several people liking them and with some people tagging friends. The outreach team posted about the survey on the Instagram so that people can share it on their stories. Additionally, they reached out to CASH to ask them to also share our post.

The outreach team also helped us to promote the survey by designing a flyer with the QR code. We wanted it to grab people's attention, but not have a campaign like feel in the way that CASH's marketing does, so as not to bias participants.

As expected, we have seen a sharp peak in response rates on the Mondays when these weekly emails are sent out, followed by declining response rates throughout the rest of the week. We had 42 responses on Monday of Week 7, launch day, followed by 44 the following day Similarly, we had 116 responses on Monday of Week 8, followed by 28 the following day. We know that most people who are interested in filling out the survey will do it the first time they are exposed to it, so expect response rates to peak on Mondays with the school emails and on days when we post. Our marketing plan centered on exposing people to the survey through as many avenues as possible, to have the largest reach and to remind people several times. Our final day of survey promotion, Friday of Week 10, had the second highest overall levels of response, receiving 122 new responses. After closing the survey, we also received the partially completed responses from those who did not submit. In total, we received 635 responses with representatives from each degree and year of study.
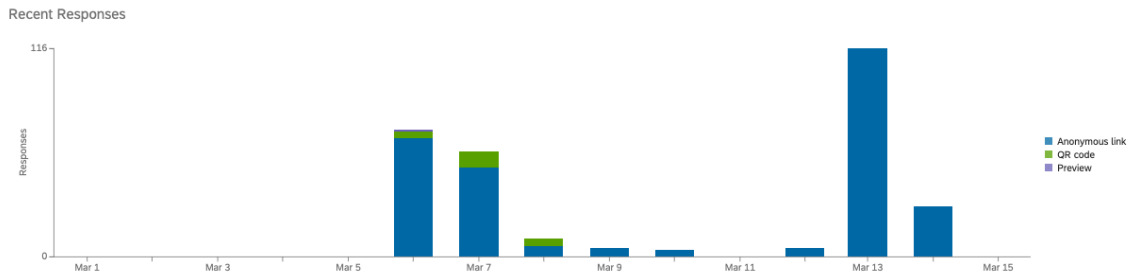
Distribution Channel	Audience Size	Surveys started	Responses	Completion Rate
Preview	N/A	N/A	1	N/A
Invite Over Email	21	8	8	100%
QR code	N/A	N/A	17	N/A
Anonymous link	N/A	N/A	281	N/A
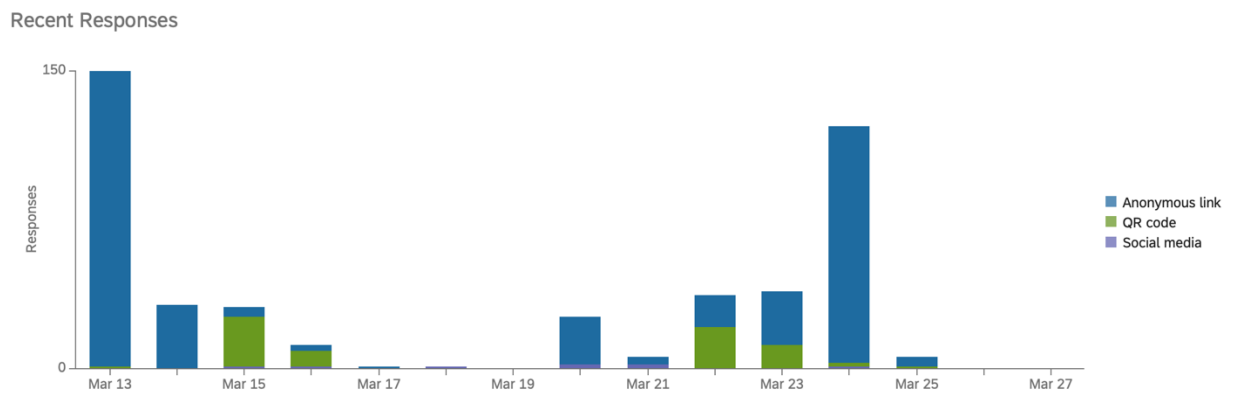
- These figures show the response rates for each day with obvious peaks at the beginning and end of the survey as well as on each Monday when weekly emails were sent out.

Survey Launch

We officially launched the survey on Monday, March 6th, the start of Week 7! We noticed some initial issues with the launch and tried to fix these as soon as we noticed them so that they would affect as few responses as possible.

Issues noticed after survey launch:

Issue	Change	Result
Using the anonymous link helps to further protect participant data, but also does not allow us to collect participant emails which we need to enter them into the raffle. Not knowing who is taking the survey also introduced the large risk of not being able to verify that those taking it are in fact students.	We added a question to the very end of the survey asking them to please provide their university email address if they would like the chance of winning one of the gift cards.	Most participants have given their email address; however a few have not wished to, which is completely fine. We realized this issue a few hours after launch and added the question immediately after noticing, but there were a few responses that will not be able to be entered into the raffle.
Requiring question feature turned off.	While all questions were required in the pilot, something must have changed when we went to republish it for launch as it was not requiring answers for several of the questions and participants were leaving many that they could blank.	We turned on the force response feature for every question after noticing a few responses with some blank answer. We now are confident that most responses give us complete data sets on all questions, except for free response questions wherein some cases people have avoided answering by writing n/a or 'do not wish to answer'
When asked "What is your address? Please include your postal code," Many just included their postal code and not their street address.	This is the question we know through the pilot that people were the most hesitant to disclose, so the wording of this question was carefully considered. We wanted to ask, 'what is your full address?' but thought this may make people wary as this wording of the question feels more invasive	More people have given their street address since the change, which is good since we can easily find their postal code from that. As the question is free response, some have avoided answering the question by just simply saying 'don't wish to answer' or 'n/a'.

	We noticed this on the first day of the survey but gave it another day to see if we were getting incomplete answers from more respondents. The next day we decided to change it to simply ask: "what is your address?"	

Survey Close

The survey closed at 6pm on Friday of Week 9. The next week, after extracting the Qualtrics data into excel and thereby giving each response a row number, we used a random number selection wheel (pictured below) to choose the four winners of the Amazon gift cards. We also selected an alternate winner in case the original winners do not respond to the emails within a week as we want to ensure that the e-giftcards will be used.

Official Survey Results:

635 Total Responses, 540 Fully Completed Responses

Having only two weeks between the close of the survey and the date of this report, we had limited time to clean our data set, learn to use STATA, and begin analyzing and interpreting our results. Thus, our main goal was to identify a few key findings and clean the data set for future teams to analyze more fully.

Question 1: What best describes you?

192 male, 403 female, 23 non-binary, 16 prefer not to say

2.52%
3.63%

30.28%

63.56%

| ■ Male | ■ Female | ■ Non-binary / third gender | ■ Prefer to self-describe | ■ Prefer not to say |
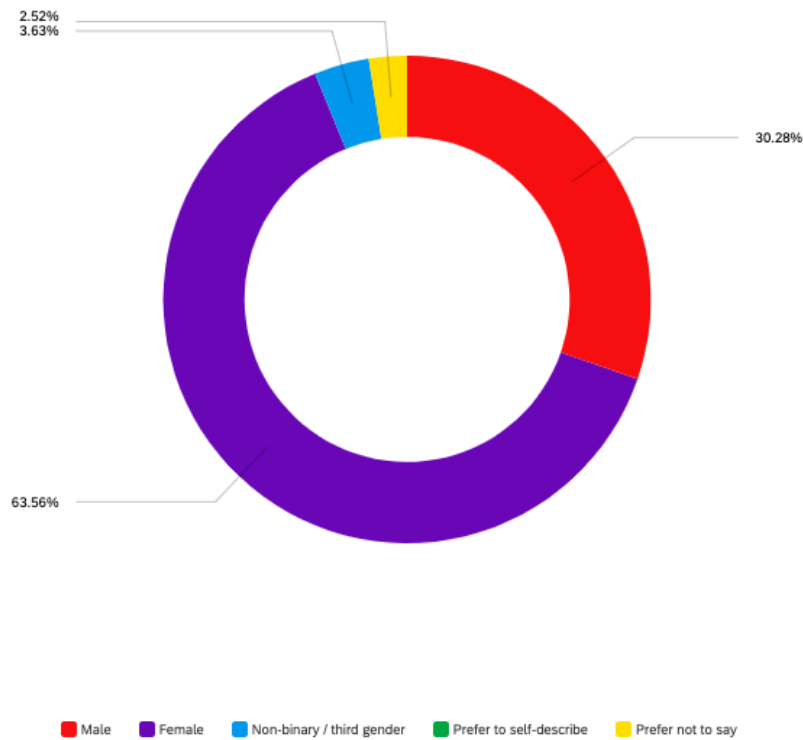
. tab gender

How do you describe yourself? - Selected Choice	Freq.	Percent	Cum.
Female	271	63.32	63.32
Male	130	30.37	93.69
Non-binary / ird gender	18	4.21	97.90
Prefer not to say	9	2.10	100.00
Total	428	100.00	

- The above graph shows the gender percentages for all survey participants, the STATA results below show results for all the fully completed responses

Question 2: Which ethnic origin best describes you?

489 White, 9 Black/African/Caribbean, 78 Asian, 31 mixed two or more ethnic groups, 17 Other (Arab or any others), Prefer not to say 18

White 76.17%
Asian (Indian, Pakistani, Bangladeshi, Chinese, any other Asian background) 12.15%
Mixed two or more ethnic groups 4.83%
Other (Arab or any others) 2.80%
Prefer not to say 2.65%
Black/African/Caribbean 1.40%

White ■ Black/African/Caribbean ■ Asian (Indian, Pakistani, Bangladeshi, Chinese, any other Asian background) ■ Mixed two or more ethnic groups ■
Other (Arab or any others) ■ Prefer not to say ■

The results of the fully completed response are as follows:

Ethnicity Distribution

Asian (Indian, Pakiani, Banglade ■ Black/African/Caribbean ■
Black/African/Caribbean,Oer (Ara ■ Mixed two or more enic groups ■
Mixed two or more enic groups,Oe ■ Oer (Arab or any oers) ■
Prefer not to say ■ White ■
White,Asian (Indian, Pakiani, Ba ■ White,Mixed two or more enic gro ■
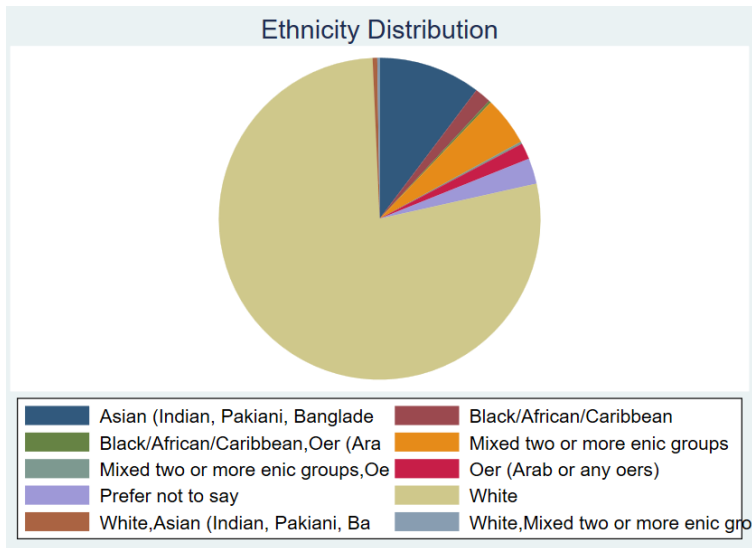
```
. tab ethnicity
```

UK Enic Origin	Freq.	Percent	Cum.
Asian (Indian, Pakiani, Bangladeshi, ..	44	10.28	10.28
Black/African/Caribbean	7	1.64	11.92
Black/African/Caribbean,Oer (Arab or ..	1	0.23	12.15
Mixed two or more enic groups	21	4.91	17.06
Mixed two or more enic groups,Oer (Ar..	1	0.23	17.29
Oer (Arab or any oers)	7	1.64	18.93
Prefer not to say	11	2.57	21.50
White	333	77.80	99.30
White,Asian (Indian, Pakiani, Banglad..	2	0.47	99.77
White,Mixed two or more enic groups	1	0.23	100.00
Total	428	100.00	

Question 3: What is your year of study?

1st years: 175, 2nd years: 160, 3rd years: 148, 4th years: 70, Postgraduate: 36
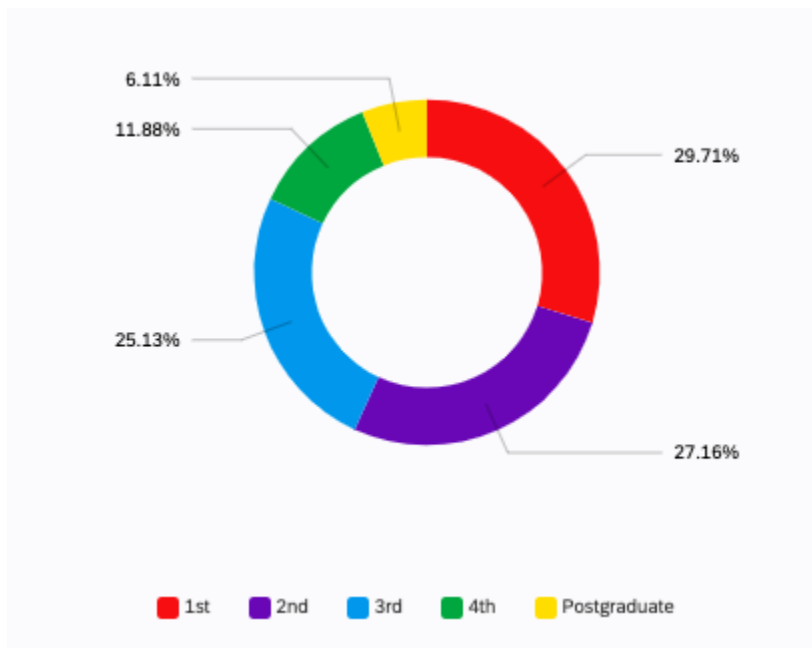
Question 4: What is your degree?

Question 5: Do you live in halls?

329 'no', 260 'yes'
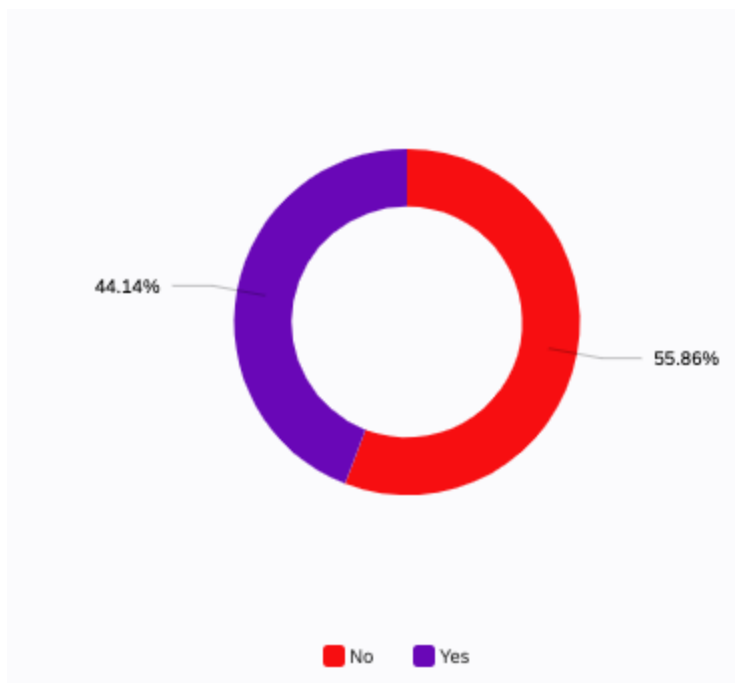
Question 6: Do you live in a university managed property?

28 'Yes', 358 'No'
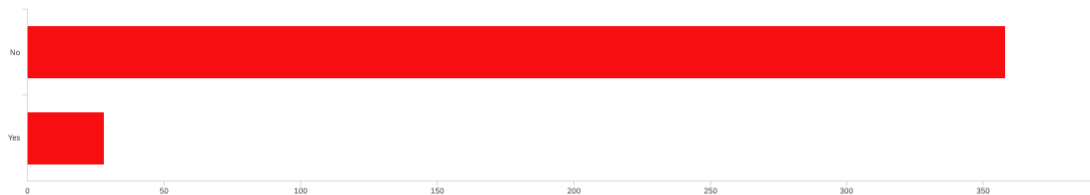
#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	Do you live in a University Managed Property?	1.00	2.00	1.07	0.26	0.07	386

Question 7: What is your address?

245 responses
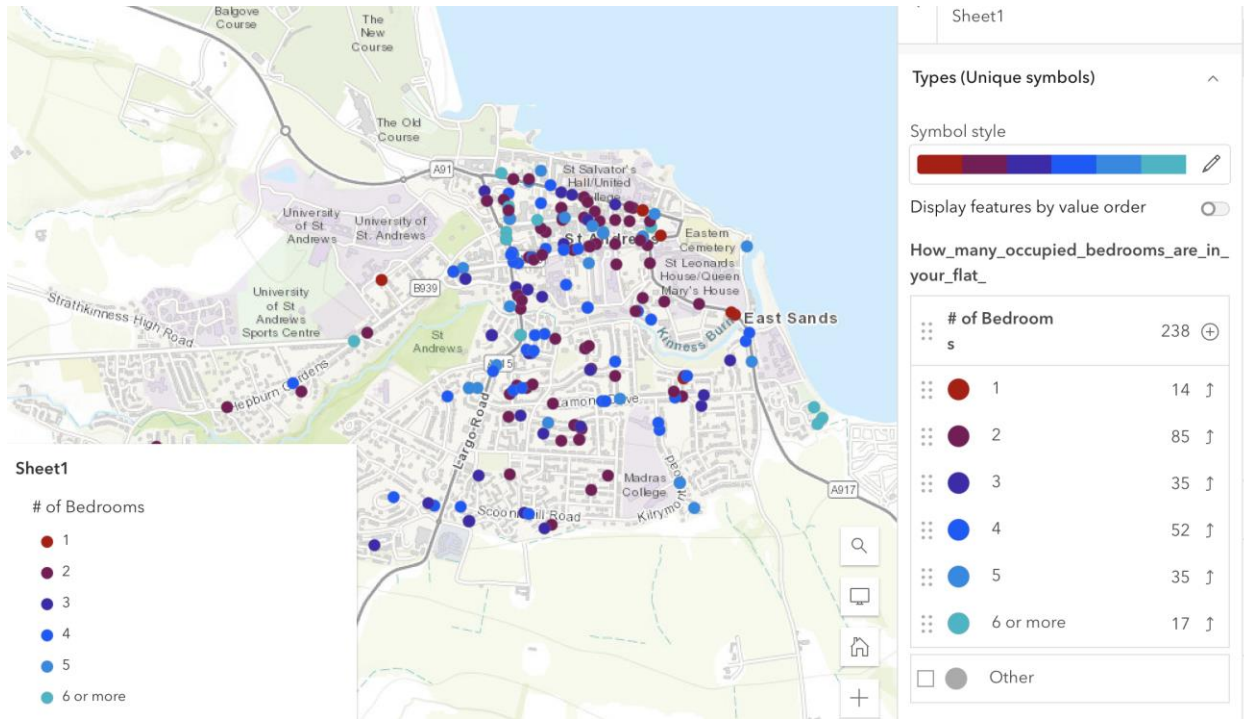
- This image displays the map of the addresses of survey respondents (dot size increased to add noise to maintain privacy as well as not displaying map alongside participant data)

Question 8 Is your property rented through a letting agency, private landlord, or do you own your accommodation?

156 Letting Agency, 118 Private Landlord, 13 Own, 257 none of the above I live in halls or university managed property

28.68%

47.24%

21.69%

2.39%

■ Letting Agency   ■ Private Landlord   ■ I own the property I live in

■ None of the above. I live in Halls or in a University Managed Property.
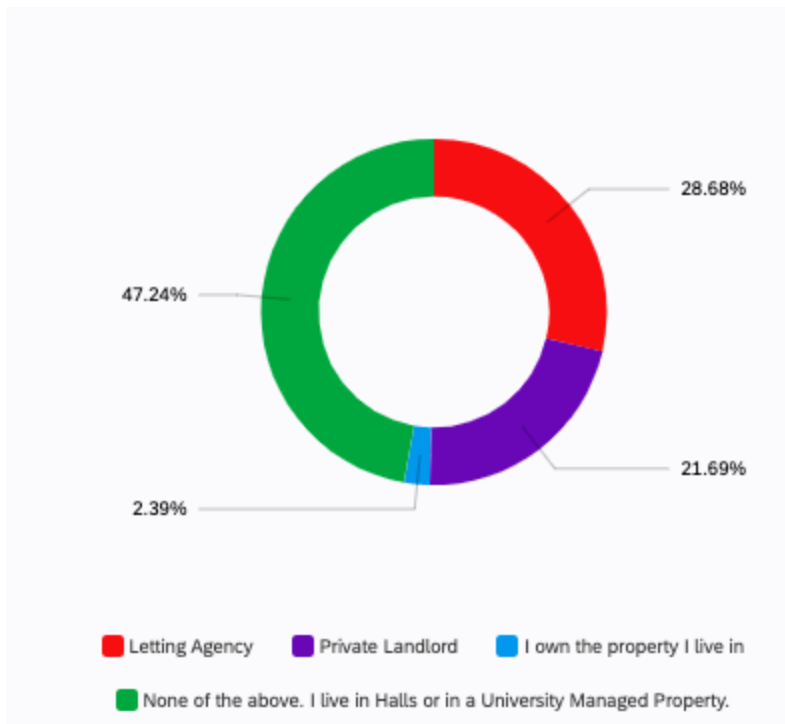
Question 9 How many occupied bedrooms are in your flat?

Of students living in flats with completed responses:
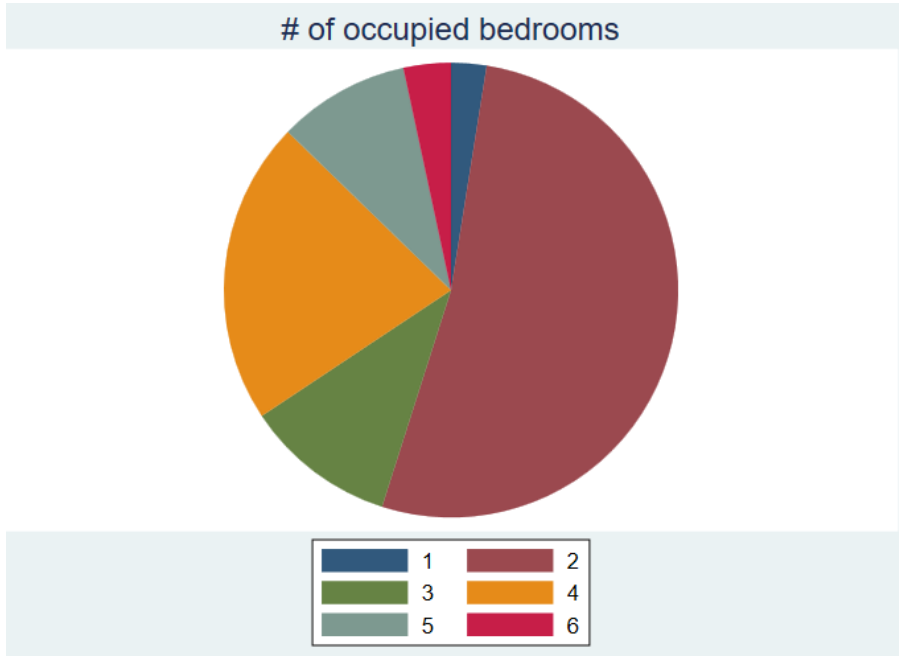
# of occupied bedrooms

	1		2
	3		4
	5		6

```
. tab Howmanyoccupiedbedroomsarei
```

How many occupied bedrooms are in your flat?	Freq.	Percent	Cum.
1	14	5.96	5.96
2	81	34.47	40.43
3	37	15.74	56.17
4	51	21.70	77.87
5	35	14.89	92.77
6 or more	17	7.23	100.00
Total	235	100.00	

Question 10: What is your individual monthly rent? If you live in a university hall, what is your accommodation fee?

For St Andrews student flats only:

Mean: 707.57 pounds per month

Minimum: 370 pounds per month

Outlier (Maximum): 4,000 pounds per month, next highest rent was 1,550 pounds

To account for outliers in our data, we removed the responses above the 99th percentile to account for individuals who may have accidentally given rent for their whole flat instead of just their individual share of the rent.

```
. sum rent, detail
```

```
         What is your individual monthly rent? If you live
                   in a University Hall, what is
        ─────────────────────────────────────────────────────────
             Percentiles      Smallest
        1%          360            330
        5%          450            350
       10%          500            360        Obs                 237
       25%          563            370        Sum of wgt.         237

       50%          662                       Mean           705.1013
                                  Largest     Std. dev.      290.5647
       75%          775           1500
       90%          900           1550        Variance       84427.82
       95%         1026           1600        Skewness       6.679392
       99%         1550           4000        Kurtosis       72.01066
```

```
.
. local p1 = r(p1)


.
. local p99 = r(p99)



. drop if rent > `p99'
(3 observations deleted)

. summarize rent
```

Variable	Obs	Mean	Std. dev.	Min	Max
rent	235	687.2723	187.1179	330	1550

This reduced the average mean rent to 687.27 pounds per rent

Question 11: What is your fee status?

155 Scottish, 135 rest of the UK, 204 International, 8 other
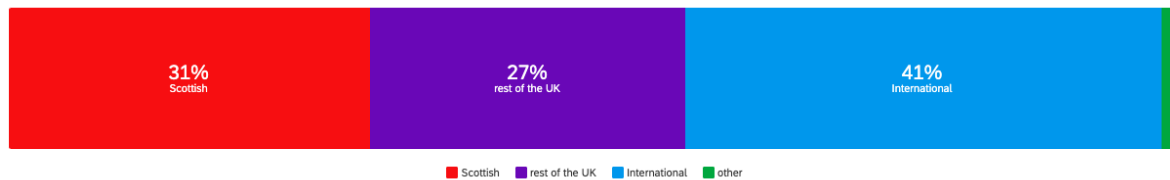
#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	What is your fee status?	1.00	4.00	2.13	0.87	0.76	502

Question 12: What is your nationality?

42 countries represented

Question 13: Who is responsible for paying your rent?

43 I pay rent with my own income, 278 a family member or guardian pays my rent, 7 I have an accommodation grant to pay my rent, 114 my student loans go toward paying my rent, 23 'other'
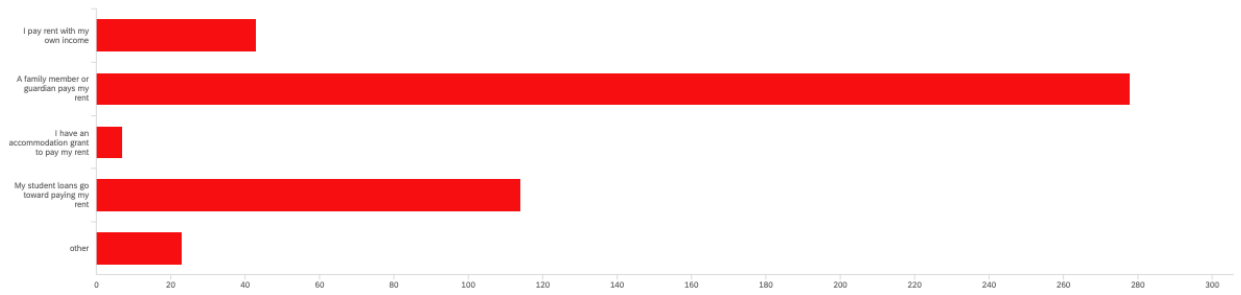
#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	Who is responsible for paying your rent?	6.00	10.00	7.56	1.10	1.22	465

Of respondents who live in private flats, the results for paying their monthly rent are as follows:

```
. tab responsible
```

Who is responsible for paying your rent?	Freq.	Percent	Cum.
A family member or guardian pays my r..	142	59.66	59.66
I have an accommodation grant to pay ..	3	1.26	60.92
I pay rent with my own income	26	10.92	71.85
My student loans go toward paying my ..	55	23.11	94.96
other	12	5.04	100.00
Total	238	100.00	

Question 14: By how much would your individual monthly rent have to increase by for you to move to Dundee

25-50 pounds: 54

50-75 pounds: 40

75-100 pounds: 69

100-200 pounds: 143

Much more than 200 pounds: 174

#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	By how much would your individual monthly rent have to increase by for you to move to Dundee?	1.00	5.00	3.71	1.33	1.77	480

| 11% 25-50 pounds | 14% 75-100 pounds | 30% 100-200 pounds | 36% Much more than 200 pounds |

■ 25-50 pounds ■ 50-75 pounds ■ 75-100 pounds ■ 100-200 pounds ■ Much more than 200 pounds
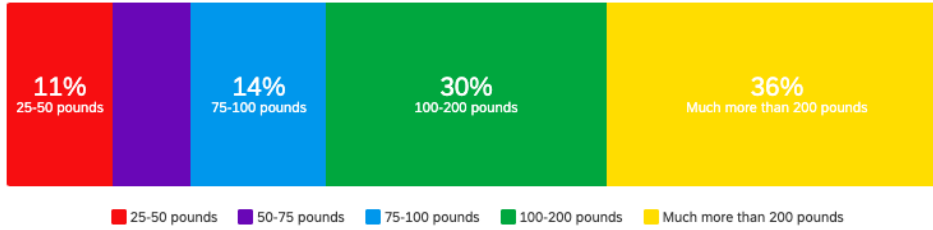
Question 15: Have you lived in your accommodation for more than 1 year?

114 'Yes', 369 'No'
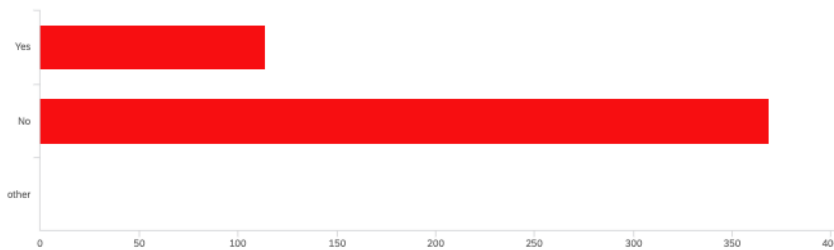
#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	Have you lived in your present accommodation for more than 1 year?	1.00	2.00	1.76	0.42	0.18	483

Question 16: By how much has your rent increased since moving into your accommodation?

N	40				
Mean	27.12725	Mean Standard Error	4.99291		
Mean LCL 95%	17.02813	Mean UCL 95%	37.22637		
Trimmed Mean (5%)	24.58583	Geometric Mean	6.66588	Harmonic Mean	0.87606
Median	17.50000	Median Error	0.98943	Mode	0.00000
Standard Deviation	31.57794	Variance	997.16657	Coefficient of Variation	1.16407
Range	100.00000	Minimum	0.00000	Maximum	100.00000
IQR	50.00000	Percentile 25% (Q1)	0.00000	Percentile 75% (Q3)	50.00000
Mean Deviation	26.54820	Median Absolute Deviation	17.50000	Coefficient of Dispersion	1.49273

Question 17: What is your primary means of transit to town each day?

Total Responses: Walk 388, Bike 34, Car 6, Public Transport 33, Has a bike or car but can easily walk into town 13

Data from the completed responses:
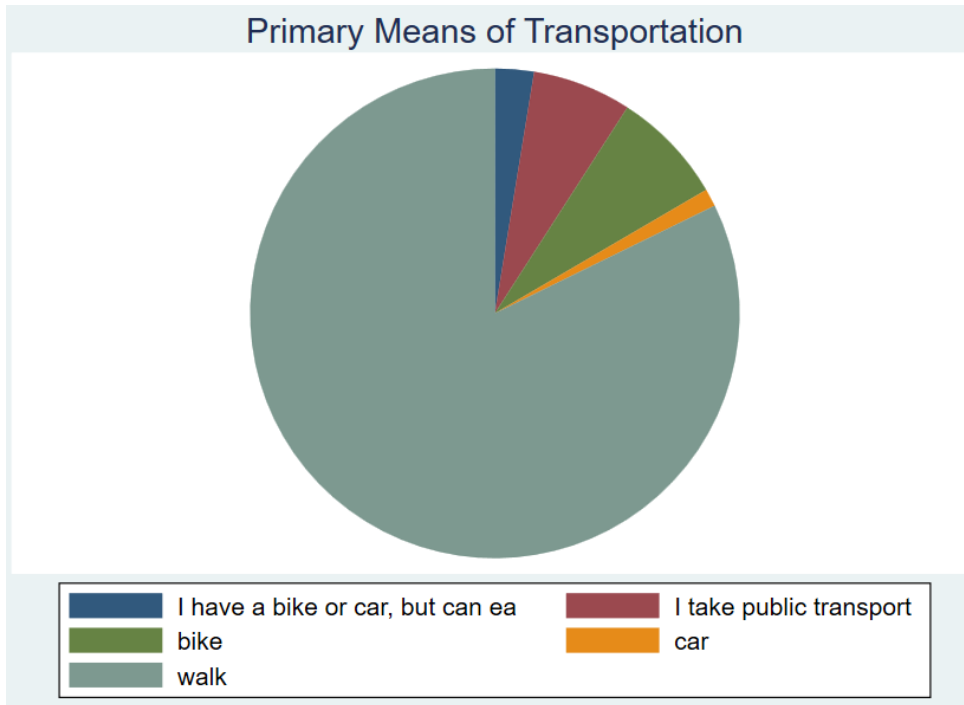
What is your primary means of transit to town each day?	Freq.	Percent	Cum.
I have a bike or car, but can easily ..	11	2.57	2.57
I take public transport	28	6.54	9.11
bike	32	7.48	16.59
car	5	1.17	17.76
walk	352	82.24	100.00
Total	428	100.00	

Question 18: How long would it take you to walk to Tesco on Market Street?

5-10 mins: 200

10-15 mins: 114

15-20 mins: 82

More than 20 mins: 78

| 42%
5-10 mins | 24%
10-15 mins | 17%
15-20 mins | 16%
More than 20 minutes |

■ 5-10 mins ■ 10-15 mins ■ 15-20 mins ■ More than 20 minutes
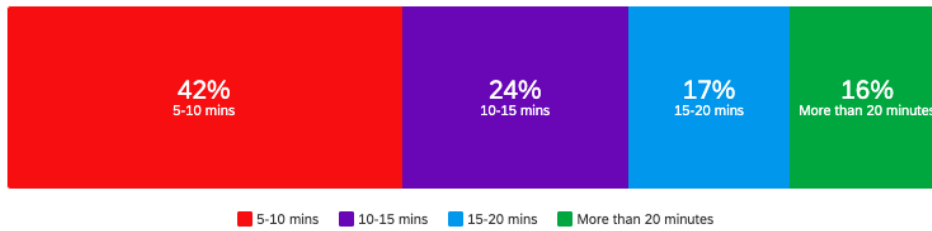
#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	How long would it take you to walk to Tesco on Market St?	1.00	4.00	2.08	1.12	1.25	474

Question 19: Rank the following in order of importance to you: Safety, Price, Convenience
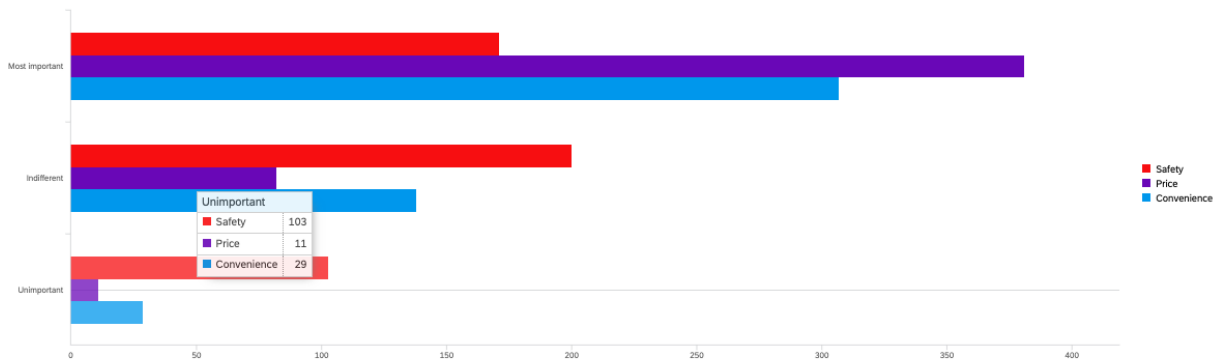
#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	Safety	1.00	3.00	1.86	0.75	0.56	474
2	Price	1.00	3.00	1.22	0.47	0.22	474
3	Convenience	1.00	3.00	1.41	0.60	0.36	474

	Most Important	Indifferent	Unimportant
Safety	171	200	103
Price	381	82	11
Convenience	307	138	29

Question 20: Imagine a 3-bedroom furnished flat above Pret on Market Street became available to let for the next academic year and you do not have your accommodation planned. How much would you individually pay per month to rent a room here, utilities not included? If you would not consider living here, please state why:

N	423				
Mean	748.88889	Mean Standard Error	7.47801		
Mean LCL 95%	734.19010	Mean UCL 95%	763.58768		
Trimmed Mean (5%)	745.09456	Geometric Mean	724.72209	Harmonic Mean	722.16252
Median	750.00000	Median Error	0.45570	Mode	700.00000
Standard Deviation	153.80003	Variance	23,654.44971	Coefficient of Variation	0.20537
Range	1,500.00000	Minimum	0.00000	Maximum	1,500.00000
IQR	150.00000	Percentile 25% (Q1)	650.00000	Percentile 75% (Q3)	800.00000
Mean Deviation	108.62359	Median Absolute Deviation	150.00000	Coefficient of Dispersion	0.14474

Question 21: Imagine a 3-bedroom furnished flat on Lamond Drive became available to let for the next academic year and you do not have your accommodation planned. How much would you individually pay per month to rent a room here, utilities not included? If you would not consider living here, please state why:

N	422				
Mean	608.70853	Mean Standard Error	6.63144		
Mean LCL 95%	595.67367	Mean UCL 95%	621.74339		
Trimmed Mean (5%)	603.90995	Geometric Mean	587.10497	Harmonic Mean	580.90909
Median	600.00000	Median Error	0.40459	Mode	600.00000
Standard Deviation	136.22734	Variance	18,557.88872	Coefficient of Variation	0.22380
Range	1,500.00000	Minimum	0.00000	Maximum	1,500.00000
IQR	150.00000	Percentile 25% (Q1)	500.00000	Percentile 75% (Q3)	650.00000
Mean Deviation	92.26051	Median Absolute Deviation	225.00000	Coefficient of Dispersion	0.15081

Question 22: Imagine a 3-bedroom furnished flat in Dundee became available to let for the next academic year and you do not have your accommodation planned. How much would you individually pay per month to rent a room here, utilities not included? If you would not consider living here, please state why:

N	324				
Mean	448.20988	Mean Standard Error	12.71383		
Mean LCL 95%	423.19750	Mean UCL 95%	473.22225		
Trimmed Mean (5%)	436.71125	Geometric Mean	416.02670	Harmonic Mean	366.94378
Median	450.00000	Median Error	0.88525	Mode	400.00000
Standard Deviation	228.84900	Variance	52,371.86294	Coefficient of Variation	0.51058
Range	4,000.00000	Minimum	0.00000	Maximum	4,000.00000
IQR	100.00000	Percentile 25% (Q1)	400.00000	Percentile 75% (Q3)	500.00000
Mean Deviation	94.09198	Median Absolute Deviation	25.00000	Coefficient of Dispersion	0.20885

Evaluation of Survey Data Strength

	University Published	UK	Survey
Gender Breakdown	41.6% men
58.4% women	43.3% men
56.7% women	192 male (30.28%) 403 female (63.5%)
23 non-binary (3.63%)
16 prefer not to say (2.52%)

Ethnicity	UK and non-UK domiciled students combined: BAME (Black, Asian, Minority, Ethnic): 20.2% White: 77% Unknown: 2.7%	White (76.4%) BAME (23.6%)	489 White (76.17%) BAME (21.03%) - 9 Black/African/ Caribbean (1.40%) - 78 Asian (12.15%) - 31 mixed two or more ethnic groups (4.83%) - 17 Other (Arab or any others) (2.65%) - 18 Prefer not to say (2.80%)
Student Numbers	10,425 students in 2021-2022 8260 undergraduates 2164 postgraduates		635 total responses (6.1% of St Andrews student body) 428 total completed responses: (4.1% of St Andrews student body)
Countries Represented	137		42 (30.66%)
UK Citizen vs International	55% UK nationals 45% International students	72% of students in the UK are UK nationals, while 28% are International. (HESA)	155 Scottish (31%), 135 rest of the UK (27%) 204 International (41%) 8 other (2%)
Average Rent for students in flats per month		Approx 550 pounds per month	Approx 707.57 pounds per month (28% higher than national average)

T-Tests for Statistical Significance

One Sample Tests

How does the St Andrews average monthly rent compare to the UK projected national average?

Mean	95% LCL	95% UCL	Std Err	N	Hypothesized value	Difference	Test Statistic	d.f.	p (1-tailed)	H1: Mu > Mu0?
707.56838	671.17413	743.96262	18.47238	234	550.00000	157.56838	8.52994	233	1.00000	Rejected

The average rent collected from the survey of students only in flats is approximately 707.57 pounds per month. This is 28% higher than the UK national average. We reject the null hypothesis that the national UK average rent is the same as the St Andrews average monthly rent at the 0.05 significance level. We have enough evidence to conclude that there is a statistically significant difference between the UK average national monthly rent and the St Andrews average monthly rent for flats.

Two Sample Tests
Variable: What is your individual monthly rent (only students in flats)
Group: What best describes you? (male, female, non-binary, prefer not to say)

Compare Means

Descriptive Statistics

VAR	N	Mean	Std Dev	Variance	Minimum	Maximum
Female (1)	157	667.10191	170.07534	28,925.62096	330.00000	1,600.00000
Male (2)	75	758.88000	433.12282	187,595.37730	350.00000	4,000.00000

Means Report

VAR	Mean	95% LCL	95% UCL
Female (1)	667.10191	640.29037	693.91346
Male (2)	758.88000	659.22749	858.53251
Mean Difference (1-2)	-91.77809	13.56446	169.99172

t-test assuming equal variances (homoscedastic)

Hypothesized Mean Difference	0.00000		
Mean Difference	-91.77809		
Pooled Variance	79,975.89039		
Test Statistic	2.31204		
Degrees of Freedom	230		

H1: Mu1 - Mu2 ≠ 0 / Not equal (two-tailed)

t Critical Value (5%)	1.97033	p-value	0.02166	H1 (5%)	Accepted

H1: Mu1 - Mu2 < 0 / Less than (lower-tailed)

t Critical Value (5%)	-1.65151	p-value	0.98917	H1 (5%)	Rejected

H1: Mu1 - Mu2 > 0 / Greater than (upper-tailed)

t Critical Value (5%)	1.65151	p-value	0.01083	H1 (5%)	Accepted

There is a 91.78 pound per month difference in monthly average rents between male and female respondents. The hull hypothesis states that the difference is predicted to be 0. When the alternative hypothesis is that the difference in Mu1 and Mu2 is less than 0, we reject the null hypothesis because we have statistically significant evidence that the true mean is less than 0 at the 0.05 significance level.

Variable: What is your individual monthly rent (only students in flats)
Group: Which best describes your ethnic origin?

Compare Means

Descriptive Statistics

VAR	N	Mean	Std Dev	Variance	Minimum	Maximum
White (1)	194	697.35052	292.09269	85,318.13816	350.00000	4,000.00000
Asian (Indian, Pakistani, Bangladeshi, Chinese, any other Asian background) (2)	20	659.75000	119.31245	14,235.46053	330.00000	800.00000

Means Report

VAR	Mean	95% LCL	95% UCL
White (1)	697.35052	655.98868	738.71235
Asian (Indian, Pakistani, Bangladeshi, Chinese, any other Asian background) (2)	659.75000	603.91005	715.58995
Mean Difference (1-2)	37.60052	-92.47475	167.67578

t-test assuming equal variances (homoscedastic)

Hypothesized Mean Difference	0.00000				
Mean Difference	37.60052				
Pooled Variance	78,947.52083				
Test Statistic	0.56981				
Degrees of Freedom	212				
H1: Mu1 - Mu2 ≠ 0 / Not equal (two-tailed)					
t Critical Value (5%)	1.97122	p-value	0.56941	H1 (5%)	Rejected
H1: Mu1 - Mu2 < 0 / Less than (lower-tailed)					
t Critical Value (5%)	-1.65207	p-value	0.71530	H1 (5%)	Rejected
H1: Mu1 - Mu2 > 0 / Greater than (upper-tailed)					
t Critical Value (5%)	1.65207	p-value	0.28470	H1 (5%)	Rejected

The hypothesised mean difference in monthly rents between students of different ethnicities is 0. In this sample, white students are shown to pay on average 37.60 more pounds per month than Asian students. At the 0.05 level of significance, we reject the null hypothesis and conclude that there is a statistically significant difference between the true mean monthly rents of White and Asian students.

Variable: What is your individual monthly rent (only students in flats)
Group: What is your fee status?

Compare Means

Descriptive Statistics

VAR	N	Mean	Std Dev	Variance	Minimum	Maximum
International (1)	101	777.18812	389.55548	151,753.47426	330.00000	4,000.00000
Scottish (2)	83	647.50602	194.53850	37,845.22862	350.00000	1,600.00000

Means Report

VAR	Mean	95% LCL	95% UCL
International (1)	777.18812	700.28498	854.09126
Scottish (2)	647.50602	605.02736	689.98469
Mean Difference (1-2)	129.68209	37.04366	222.32053

t-test assuming equal variances (homoscedastic)

Hypothesized Mean Difference	0.00000
Mean Difference	129.68209
Pooled Variance	100,432.17677

Test Statistic	2.76207
Degrees of Freedom	182

H1: Mu1 - Mu2 ≠ 0 / Not equal (two-tailed)

t Critical Value (5%)	1.97308	p-value	0.00633	H1 (5%)	Accepted

H1: Mu1 - Mu2 < 0 / Less than (lower-tailed)

t Critical Value (5%)	-1.65327	p-value	0.99683	H1 (5%)	Rejected

H1: Mu1 - Mu2 > 0 / Greater than (upper-tailed)

t Critical Value (5%)	1.65327	p-value	0.00317	H1 (5%)	Accepted

The null hypothesis states that the expected mean difference between the average monthly rent between International and Scottish students is 0. When the alternative hypothesis states that the mean difference is less than 0, we reject the null hypothesis at the 0.05 significance level and conclude there is a significant difference between the mean monthly rents of International and Scottish students.

Regressions with the Rent Variable:

We decided to split the rent variable into three categories to see if there were significant correlations to which student types paid which level of rent. We started by splitting the rent variable into three categories: high, medium, and low.

```
. tab rent_cat feestatus
```

	What is your fee status?				
rent_cat	Interna..	Scottish	other	rest of..	Total
high	44	16	0	17	77
low	25	37	3	18	83
medium	26	28	2	19	75
Total	95	81	5	54	235

We then compared this with student fee statuses:

```
. tab responsible rent_cat, row
```

```
Key

  frequency
row percentage
```

Who is responsible for paying your rent?	rent_cat high	low	medium	Total
A family member or ..	60	38	44	142
	42.25	26.76	30.99	100.00
I have an accommoda..	1	0	1	2
	50.00	0.00	50.00	100.00
I pay rent with my ..	6	14	6	26
	23.08	53.85	23.08	100.00
My student loans go..	6	27	21	54
	11.11	50.00	38.89	100.00
other	4	4	3	11
	36.36	36.36	27.27	100.00
Total	77	83	75	235
	32.77	35.32	31.91	100.00

We found that international students are more likely to pay a high rent, with 46.32% paying a high rent. Conversely, we found that only 19.75% Scottish students pay a high rent, while 45.68% of Scottish students pay a low rent.

We also performed the same analysis to compare the rent categories with who pays the individuals rent. The results were unsurprising with only 42.25 % of students whose family pays their rent paying a high rent as compared to only 11.11% of students paying their rent using student loans paying a high rent. We also used the fact that we had rents as a continuous variable to identify the mean rents paid depending on responsibility of paying for rent.

```
. tab responsible, sum(rent)
```

Who is responsible for paying your rent?	Summary of Individual Monthly Rent Mean	Std. dev.	Freq.
A family member or guardian pay..	724.54225	187.36817	142
I have an accommodation grant t..	815	190.91883	2
I pay rent with my own income	638.13462	246.63834	26
My student loans go toward payi..	598.56481	113.34494	54
other	734.54545	162.09094	11
Total	687.27234	187.11787	235

We were also curious to see the correlation between the number of bedrooms in a property and the rent. To do this, we ran a regression between the two variables with the following results:

```
. regress rent bedroom, robust

Linear regression                               Number of obs   =        235
                                                F(1, 233)       =       4.83
                                                Prob > F        =     0.0289
                                                R-squared       =     0.0266
                                                Root MSE        =     185.01

                         Robust
      rent │ Coefficient  std. err.      t    P>|t|     [95% conf. interval]
───────────┼────────────────────────────────────────────────────────────────
   bedrooms │  -21.67621    9.85848    -2.20   0.029    -41.09936   -2.253052
      _cons │    758.112   40.75999    18.60   0.000     677.8068    838.4173
```

The coefficient for bedrooms is -21.67 which means that for each additional bedroom, the rent decreases by an average 21.67 pounds. These results also suggest that while the number of bedrooms is a significant predictor of rent, it does not explain much of the variation in rent such as the quality of the flat or the location.

One important thing to note however, is that to run this regression, we had to encode the bedroom variable, which required giving a numeric value to the '6 or more' category. We decided to just use the number 6 as properties larger than six bedrooms are quite rare in the town and of this option, most in this category would thus likely be 6 bedrooms. This could have had some impact on our results as we had 17 responses in this category:

```
. tab Howmanyoccupiedbedroomsarei

  How many │
  occupied │
  bedrooms │
 are in your │
    flat? │      Freq.     Percent        Cum.
───────────┼───────────────────────────────────
         1 │        14        5.96        5.96
         2 │        81       34.47       40.43
         3 │        37       15.74       56.17
         4 │        51       21.70       77.87
         5 │        35       14.89       92.77
         6 │        17        7.23      100.00
───────────┼───────────────────────────────────
     Total │       235      100.00
```

Hindsight

Despite several rounds of development for the survey design and after making changes after the pilot and initial launch results, there are still a few things that we would have changed for next time.

Question	Issue	How we could have fixed this
Question 19: Rank the following in order of importance to you: safety, price, convenience.	As we did not limit what people could respond for each of these factors, several people put very important for all the options. This did not allow us to identify which of the factors were most important to people. We also only included three rankings of most important, indifferent, and unimportant. We could have probably identified more nuance in people's answer by giving more choices. For example, some may have cared about safety but as it was not most important to them their only option was to mark indifferent, not reflecting how they truly may have felt.	We could have used a Likert scale for this question, and changed the settings to allow people to only select one option for which factor was most important to them.
Question 18: How long would it take you to walk to Tesco?	We did not include an option for 0-5 minutes to walk to Tesco, overlooking several people living in the three main streets of the conservation area.	Include the option for 0-5 minutes.
Question 20: Imagine a 3-bedroom furnished flat above Pret on Market Street became available to let for the next academic year and you do not have your accommodation planned. How much would you individually pay per month to rent a room here, utilities not included?	The survey developers decided that a flat bove Pret on Market St would be considered a prime location to live in St Andrews. This is purely based on the convenient location in the center of town. However, we did not consult others opinions about location preferences in St Andrews and were surprised to receive numerous responses from students who would be unwilling to live there due to factors such as noise and lack of parking.	Prior to launching the survey, we should have done an Instagram poll or randomised interviews to determine what most students to be the best location to live in St Andrews.
Questions 20-22	These questions were intended to gauge students willingness to pay for varying locations in St Andrews and Dundee. It is possible that some students noted what they think the property would be listed for rather than what they could individually afford to pay in rent. It is unlikely that we will	Change language to include that 'how much would you pay' must be a value that the respondent can feasibly afford.

			determine which respondents actually noted what they could afford versus the property's hypothesised value.			

Regarding survey methodology, free response questions are most difficult to categorise and require significantly more time to analyse than a simple multiple choice question. Though it is helpful to have specific numerical data to calculate average rent in flats, for instance, we recommend limiting free response questions as much as possible. This allows for greater efficiency and helps to create figures representing data collected more easily. However, it some of the free response questions proved quite insightful, paticularly Question 22, where numerous students noted that under no circumstance would they live in Dundee over St Andrews. Additionally, instead of using one single link/bar code for survey distribution in the first two weeks, it is helpful to utilise seperate barcodes with slight question variation to determine which groups are most responsive, who to follow up with for further publicity, and which platform is most effective in collecting responses. This change was made at the start of Week 9, and we determined that using the anonymous survey link via school president's pushpages gathered the most complete survey responses. Lastly, we never utilised the physical poster design created with the help of the Outreach sub-team. Leaving posters throughout town and organising a survey promotion event would liklely boost the response rate through guaging a broader audience.

Future Steps

H	I	J	K	L	M	N
Do you live i	What is your	What is your	Postal Code		In Town?	Is your prop
No	7AP KY16 9XD	7Alexandra Place KY16 9XD	KY16 9XD	KY16 9	in town	Private Landlord
No	6 Pipeland Road (KY16 8AH)	6 Pipeland Road KY16 8AH	KY16 8AH	KY16 8	out of town	Letting Agency
No	47 Boase Avenue KY16 8BX	47 Boase Avenue KY16 8BX	KY16 8BX	KY16 8	out of town	Letting Agency
No	44 Auldburn Park, KY16 8JD	44 Auldburn Park KY16 8JD	KY16 8JD	KY16 8	out of town	Letting Agency
No	3 Queens Terrace KY16 9QF	3 Queens Terrace KY16 9QF	KY16 9QF	KY16 9	in town	Private Landlord
No	13A Hope Street, St Andrews, KY16 9HJ	13A Hope Street KY16 9HJ	KY16 9HJ	KY16 9	in town	Letting Agency

We have cleaned our data set to include the postal codes for all addresses that did not include them. There were some entries we were unable to match to postal codes. We then sorted all of these so that all postal codes beginning with KY16 9_ _ were listed as 'in town' and all beginning with KY16 8 _ _ as 'out of town'. This follows the general demarcation of the town conservation area and is precise enough for general analysis purposes. The next steps for this will be to run regressions using this binary

categorization into in town and out of town to answer questions such as: how much more are rents in town as compared to out of town? Do students living in town have a greater elasticity of demand?

There is much more work future teams can do to analyze our data set. We are pleased with the data we collected through our survey and think that more meaningful results can be explicated from a more robust analysis.

Conclusion

Through comparing our survey findings with university published statistics and UK national averages, we are able to estimate how well our data correlates with the true population. This is then tested using one and two sample t-test which determines any statistically significant differences amongst different groups of students represented in the sample. We are then able to use STATA and ArcGIS to create figures representing our statistical analyses and map flats throughout St Andrews to display where rent is most expensive, which demographics live where, along with numerous other variables gathered through the survey.

Regarding gender breakdown, we received more responses from female students than what is reflective of the university average. The difference is only 7%, but is worth denoting when considering factors that contribute to response bias. The representation of ethncities in St Andrews matches the university averages extremely well, which enhances the robustness of our statistical analysis of differences in rent paid each month between White and BAME students. Additionally, the ratio of UK to International students who responded to the survey correlates well with university student averages, with 55% of the student body being from the UK and 45% considered International. This was evaluated based on those who responded to the question 'what is your fee status?".

Interestingly, the average price of a student flat in St Andrews estimated at 707.53 pounds per month is substantially higher than the UK average. Through categorising respondents based on 'high' and 'low' rent, we concluded that International students pay on average higher rents that UK students. This is a contributing factor to the building division of affordability between the town of St Andrews and the more undesirable alternative, Dundee.

Through running t-tests at the 5% significance level, we determined there is a statistically significant difference between average monthly rents between male and female students, Scottish and International students, along with White and BAME students. These tests should be repeated at the 10% and 1% levels to determine if these hypotheses hold with adjusted regions accounting for error. There is a possibility of Type I error occuring, meaning that we incorrectly rejected a true null hypothesis. Factors that could cause this are misrepresentations of the student body such as a larger proportion of femals in the sample than in the true population. Any errors in our data set could also result in a Type I error.

Planning, launching, and analysisng the survey data has been a valuable learning experience, and we hope to share our findings with the University and the student body with the help of the Outreach team. We have an organised database of survey findings that sort students in halls from students in flats, along with

flats deemed 'in town' and 'out of town'. Our next aim is to develop and Supply and Demand analysis of how the implementation of the HMO licensce cap has influenced availability of flats for students, along with subsequent price increases.

Outreach

Overview

A new addition to the VIP is the outreach team, run by Stephanie and Manya. One of the main goals of the team is to ensure that the public is aware of what the project is, what is being worked on and its objectives for the semester. This requires effective communication and engagement strategies, which include building a website, the use of social media platforms, and promoting the newly launched survey.

At the heart of our outreach goals, we have our website – which will be a topic of discussion in the following sections. To us, our website serves as a central hub for information about the project, providing a space for the public to access the latest news, research findings, and other important information. As the outreach team, therefore, we are responsible for ensuring that it is user-friendly and easy to navigate to keep the user engagement high.

From personal experience we know that many students obtain their news and receive information through Instagram which is why another task of ours is running the Instagram account in a way that would interest people in our VIP. The outreach team, therefore, focuses on running social media accounts to keep the public updated on the project's progress and any new developments.

Another important aim of the outreach team is to communicate with external interest groups to help spread awareness about the project. This involves contacting local community organizations such as CASH (campaign for affordable student housing) or other stakeholders interested in the topic. We aim to develop relationships with these groups. The way the work is divided is that Manya focuses on running and adding to website alongside being in charge of the Instagram account while Stephanie focuses on creating all graphics and communication with the public. Both roles aim to ensure that the project findings are presented in a way that is easy to understand and that appeals to a broad audience.

Reading previous progress reports

We recognized the importance of creating our social media profiles and website as quickly as possible, but at this stage we did not have any content from the other teams that we could share with the public. To bridge the gap until the first results from the semester were available from the teams, we decided to focus on creating content by reading and analysing previous progress reports. We read through all the reports from the previous semester to identify the most interesting and relevant findings that would resonate with our target audience. We then formatted the extracts, that we collected in a file, into simple and easy-to-understand graphics.

Research

Before we began our main tasks, we research on ways other VIPs (Vertically Integrated Projects) in St Andrews were approaching Outreach. We found that most VIPs had at least a website and an accompanying social media, therefore, we also decided to create a website along with an Instagram. We also researched on ways the public wants to receive this information, but no conclusive data was found on this. However, we noticed that the public primarily voices their opinions on this topic on forums. Though, we cannot

include a forum on our website due to concerns of inappropriate behaviour on the forum affecting the university's image, we may, in the future with enough followers and reach, have regular QnA sessions on our Instagram.

Our strategy to Outreach remains to be transparent and neutral. This was especially important during the conference when several people asked us questions relating to the abolishment of HMO Caps.

Communication with external members

Communication is a crucial aspect of any organization's outreach and success, and the HMO cap VIP group is no exception. Our outreach attracted people through various outlets, which worked well for us, as we were able to reach a diverse range of people. We used multiple outreach channels to attract people's attention, including Instagram, emailing independent organizations', and contacting people through our supervisors.

The first external contact we had was with a *Saint* Journalist who reached out to us in early February. The journalist was interested in knowing whether we think the HMO cap in St Andrews should be abolished and if we could provide him with any interesting findings, we have come across so far. In response, we explained that we could not provide an official answer to whether we think the cap should be abolished as we were launching a survey for students that aimed to understand the full effect of the HMO licence cap in St Andrews and did not want to reveal any potential bias that could influence the responses of the questions in the survey. Nonetheless, we gave him some interesting information that was found by previous teams. However, following this email we never heard back from the journalist. This journalist specifically contacted us through our supervisors.

The second external person who contacted us was also a journalist, this was around the same time as the *Saint* journalist reached out to us. She too was interested in learning more about us and what the VIP does. This journalist contacted us via our Instagram DMs which is an indicator to us that our Instagram is garnering attention from the public. Although we have not conducted an interview with her yet, we are still in touch with her and plan on doing it soon.

In February, the outreach team reached out to independent organizations who concern themselves with housing issues in St Andrews. One of these was CASH (Campaign for affordable student housing) to see if they would be interested in helping us promote our survey. After emailing them and receiving a form of interest, we asked them if they could promote the survey while keeping it clear that we are not affiliated with them. After this email, we got a mention on their official Instagram account and had a dissertation student reach out to us who was referred from the CASH president.

Because of CASH, our most recent communication activity was with a journalism student from Sterling who was interested in learning more about the HMO cap issues in St Andrews as part of her dissertation. She came to our conference on March 15th, 2023, and asked some questions about our current activities and personal experience with the housing situation.

In conclusion, the VIP used multiple outreach channels to attract people's attention, and it worked well for us. We had external contacts with journalists, and although we provided them with some information, we did not hear back from some of them. Nonetheless, our most recent communication activities with a journalism student from Sterling were successful, and we were able to provide her with information about our current activities and personal experience with the housing situation. Communication is a continuous

process, and we will keep using multiple outreach channels to reach a diverse range of people and continue our work towards spreading awareness about our VIP.

Graphics

Graphics are a great way to bring across information to an audience who has no background knowledge on a specific topic, and you want to inform. Creating informative, accessible graphics is imperative to garner sufficient interest from the public. Depending on the audience and the outreach channel graphic designs vary. The following graphics aim to show why some design decisions were made and what we learnt over the past weeks. Each decision is based on a set of six characteristics which we wanted to include for optimal engagement. These characteristics are; our target audience, the core message, the tone we use for the relevant audience, the adequate graphical elements that are the most persuasive for a graphic, the continuity of language across graphics and lastly how dense the content of a graphic should be.

Outreach Graphic 1
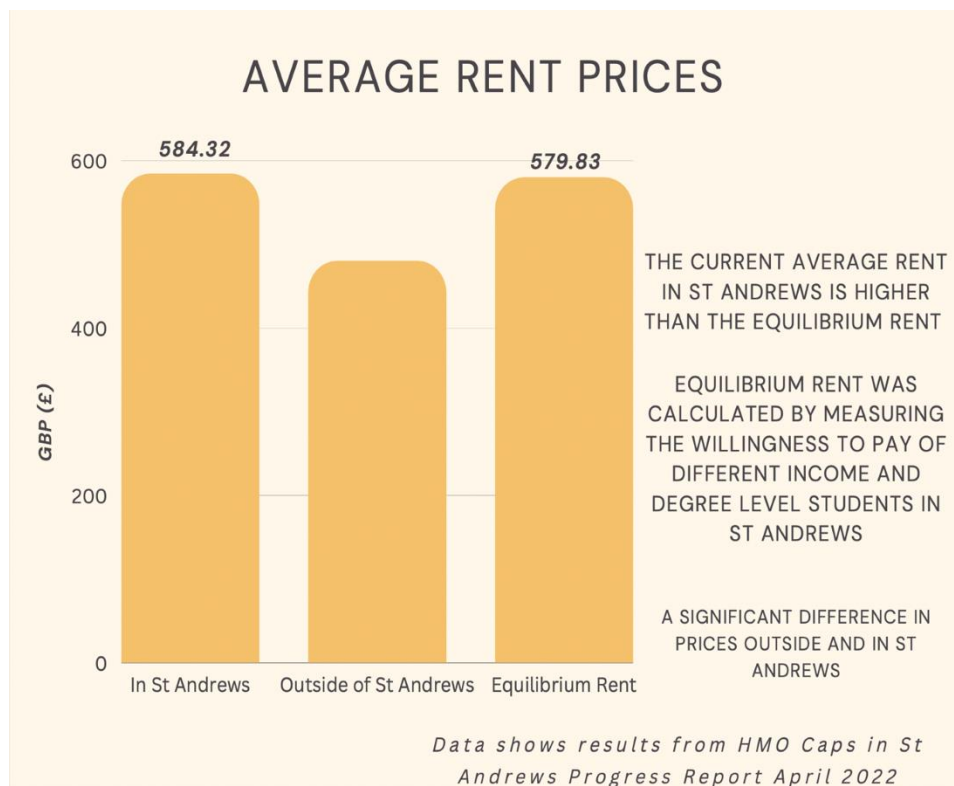
The first graphic is a chart that shows the average rent price outside (but around) of St Andrews and in St Andrews and comparing those two values to the market equilibrium price. The target audience for *Outreach Graphic 1* are students who are not necessarily familiar with the numbers presented. The core message is to bring attention to the average rent price. While the graphical elements are simple, the readability is tough. Firstly, it does not have a reading key but instead a conclusion from data presented. Further, it is missing the market equilibrium price and lastly it assumes that readers know what the term equilibrium rent price

means. As mentioned, the target audience are students who are not familiar with this topic which can make *Outreach Graphic 1* hard to read, understand and take away from.

Outreach Graphic 2

How financial background influences what students are willing to pay for rent

Rent prices

£1.250
£1.000
£750
£500
£250
£0

High income undergraduate   Equilibrium rent   Low income undergraduate

Reading key

Undergraduate students from high-income families are willing to pay on average £1036.78 for rent
Undergraduate students from low-income families are willing to pay on average £542.33 for rent

Equilibrium rent
The point where consumers are willing to pay the same for rent as landlords are willing to rent at is £579.83 – this is the equilibrium rent

Method and source
A model created in python, a programming language, found financial background influences what students are willing to pay for rent.

The results from the model stem from the *HMO Caps in St Andrews Progress Report April 2022*

Following the detailed feedback from our supervisors we re-evaluated our approach to making graphics and implemented the changes according to the changes. *Outreach Graphic 2* shares the same target audience as *Outreach Graphic 1*. The core message 'how financial background influences what students are willing to pay for rent' is presented with simple graphical elements that do not require prior knowledge of the topic to be understood. For the color theme, which is a part of the graphical elements, the outreach team decided on green and beige – two neutral and appealing colors. With the color theme in mind, it was imperative that we stay consistent with our colors to show continuity. Further, *Outreach Graphic 2* was intended for our social media accounts hence the simplicity of language and the casual tone. Regarding the density of the graphic, it includes more content than *Outreach Graphic 1* as there is not a reading key to help readers understand the graphs better and we assumed that our audience is willing to read longer sentences when seeing it on our social media.

Outreach Graphic 3 & 4

Outreach Graphic 3 & 4 are promotional flyers for the survey. While the previous two graphics were intended for the social media accounts, *Outreach Graphic 3 & 4* was to be distributed across town, making it available for everyone to read. the target audience remained the same, nonetheless, we changed our language for these graphics specifically. The core message of the graphics was to animate students to participate in the survey. The graphic on the left is a first version of the flyer and does not consider that our message needs to be neutral in order to refrain from displaying any bias. The heading "*St Andrews Housing Crisis"* appears too inflammatory which is why we changed the title to simply "*Student housing survey."* While the graphic on the right side contains more text and information I would, in hindsight, make it less dense.

Outreach Graphic 5

Outreach Graphic 5 was our poster for the conference, it highlights the work of each team in a concise and simple narrative. The target audience was not limited to students but extended to the public - anyone interested in attending the conference. The core message was, as alluded to, to show all the work the team had done up until the conference and to participate in the survey. We assumed that the public would not have the time to read a cluttered poster, therefore, we decided on keeping the density of the content minimal while still showing the most important achievements of each team. Regarding graphical elements, the colors were kept simple to maintain a clear and consistent appearance. In hindsight, we acknowledged that we could have added more words and information to our poster, especially after seeing the other VIP posters of which all made use of more words. However, we believed that the audience would want to read key points and then ask team members for further details. Overall, our conference poster provides a quick and effective overview of the work done by each team.

VIP email

In order to make any social media and communicate effectively with the public easier, we had to set up an email address for this project. This was done for us by the supervisors who contacted IT services to create an email and grant Team Outreach access to operate it. The email: hmocaps.vip@st-andrews.ac.uk, has proven to be a very significant tool since we have been approached by 2 external researchers; wanting to a learn more about this VIP and potentially mention our project in their work. The email also allows people to easily approach us with questions whenever they are visiting our website or Instagram. It has been used by Outreach to communicate more professionally because using our personal email to contact people may seem unprofessional and negatively impact the image of this project.

Website

Establishing a robust online infrastructure to aid the marketing of this project is one of the main goals of Outreach. Therefore, having a website was crucial. The university's default web development software is WordPress.

As with the decision-making process for the graphics, the webpages design followed the similar characteristics that were considered during their creation. The target audience of the website are general public; regardless of their familiarity with this topic which also effects the tone and langauge used in webpages since they are kept professional yet simple; invetibaly different from tone and languages used in graphics . Thirdly, the core message of individual webpages. We also considered the density of the content which should ensure that it is not overwhelming for readers and the ratio of information to images is appropriate.

- Getting full WordPress access

Getting access to WordPress was a difficult and confusing procedure. The following incident had really delayed our timeline of tasks we had planned for this semester. First, we were emailed links which required signing in with our university login details and granted us access to the WordPress' 'Dashboard'. So far, the lack of elements available on the website's ribbon raised no concerns. Soon after receiving the access, we decided to familiarise ourselves with posting and editing the webpages, however, it became evident that we were missing some commands since we could only make 'posts' which would get published under 'Blog Posts' in VIP St Andrews' main landing page. After watching some YouTube tutorials, we realised the issue concerned the 'User Rights' of WordPress, i.e., we were only given partial access which only allowed us to make blog posts. We emailed the VIP coordinator in order to fix this problem who changed our user permissions and rights, providing us more access to edit and upload webpages on the VIP website. The exact communication will be mentioned in the Appendix 8.

Below is the Dashboard we had before the extra access rights. The ribbon (top) only allowed to add a 'New' blog post. Some elements on the Menu (left) were also missing compared to a normal WordPress Dashboard.
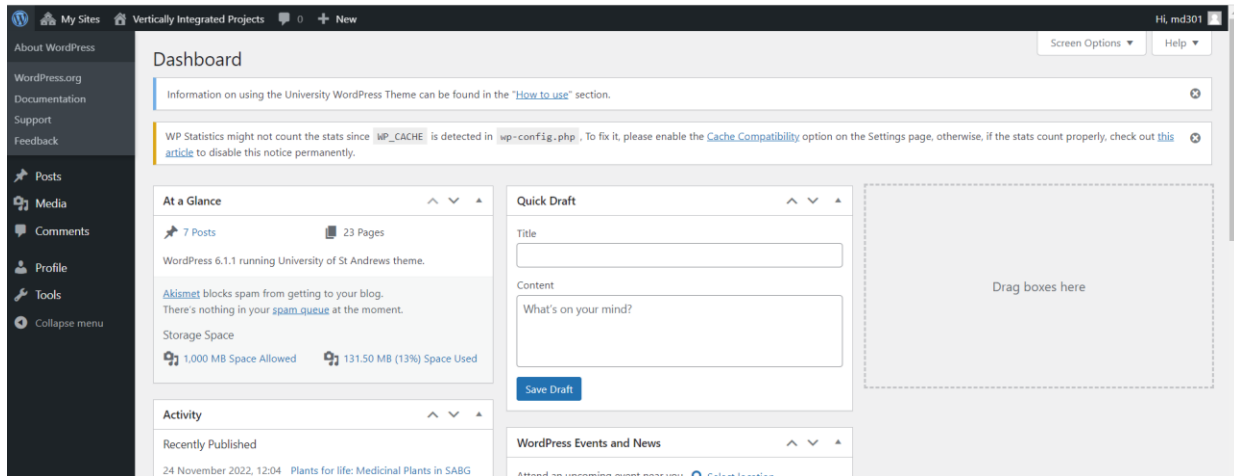
Below is what our research showed a 'normal' WordPress Dashboard looked like (Miller, 2023):
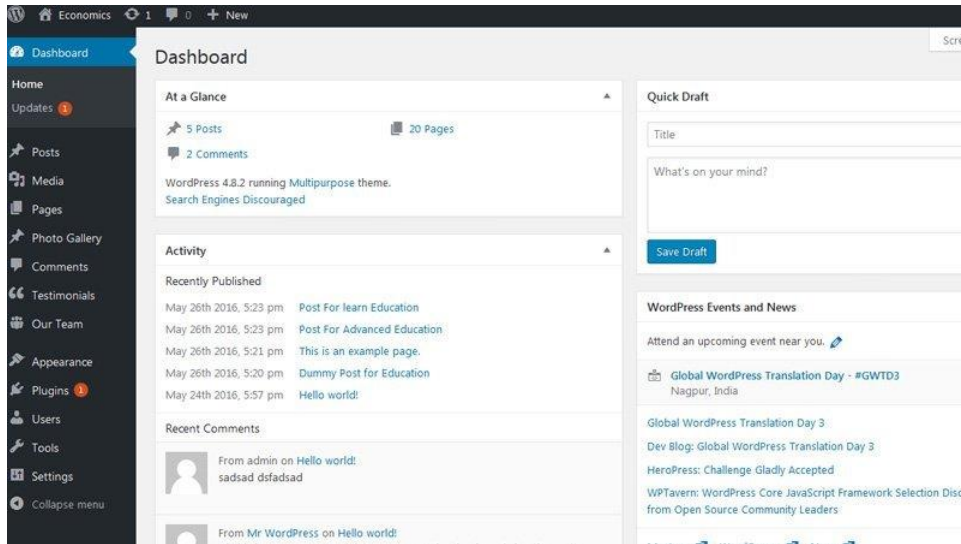
Notice the increased number of elements and commands on the Menu (Left). There was an option for 'Pages' which was our main access necessity. After, we heard back from the VIP Supervisor, we were granted permission to add and edit pages. Our Dashboard now looks like this:
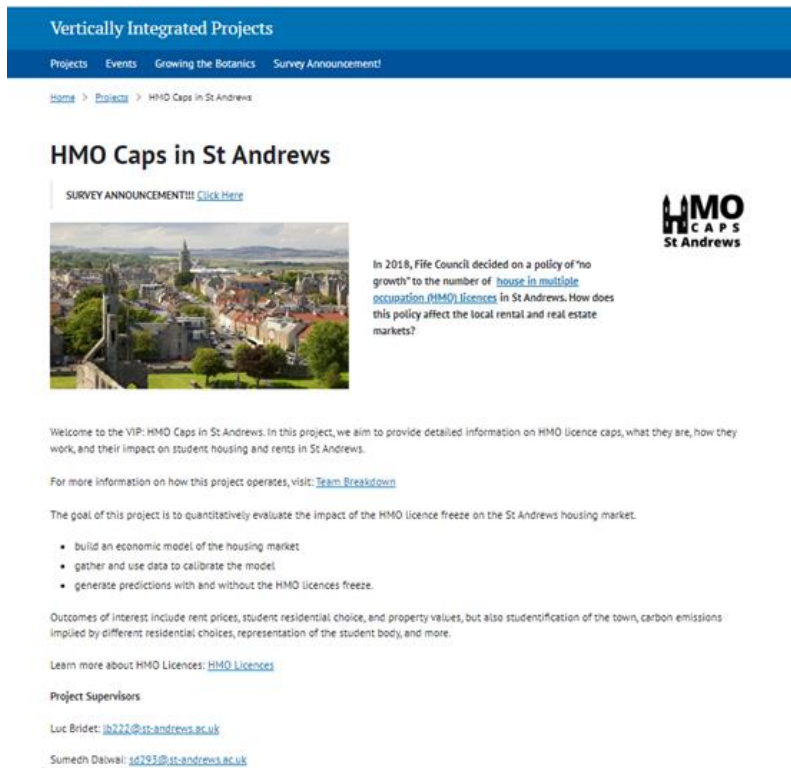
Furthermore, when we visit our webpages now, we have the option to edit them, which was unavailable to us prior to the permissions. Even though the Menu is not identical to what we researched, it is expected from a university account since there are more restrictions in order to protect the university website and prevent any inappropriate behaviour.

- Redesigning landing page

After receiving better user access. Our first task was to redesign the HMO Caps in St Andrews' official website. The landing page did not have a lot of components; just the basic logo, description of the project, an option to view previous student posters and out-dated supervisor information. We decided to change most of it. We added a picture of St Andrews to catch the reader's attention and making it more aesthetic to the eye, inducing a sense of interest in the reader. Having a picture of St Andrews could also allow people - unaware of this town or the project – better retain and visualise the information they will be reading on the webpages. We made the logo smaller and relocated it towards the right of the page in order to make it an accompanying element of the webpage instead of its focal point. Below is the landing page before our edits:

The page is rather boring to look at and there is nothing that will motivate the reader to go through all the content mentioned on it. Below is our updated page:

Even though there is not a drastic change since our approach was to keep anything that did not need to be removed, the landing page now looks a lot more professional and engaging. The modernity of its nature suggests that the website is regularly updated, and the project is ongoing. This is more likely to increase engagement. We also updated the supervisor information and removed the 'Student Poster' button. All the subsequent pages and announcement are linked on this landing page for ease, after the project description to allow new readers to understand the research topic and fundamental concept of this project before proceeding to explore all other webpages.

- Webpage 1: What are HMOs

The first webpage we made is named 'HMO Licences' which provides all information on what they are, how they work, their requirements, their types etc. We thought it was important to have a page detailing the topic this project is based on. This could help people less familiar with the topic to develop a foundational knowledge which can aid their browse around our website. The link to this webpage is kept near the bottom, following all the other links and information on the landing page because this page is not one we want to draw most attention to. Again, it accompanies our website by providing some background on the topic, it is not the main takeaway we aim for the public to have. The large amount of infomation is offset by question graphics as to not overwhelm and bore the reader while they learn about HMO Licences.

- Webpage 2: Survey Announcement

Our second webpage was made prior to the release of the student survey. Its link is on the top of our landing page to ensure it is read instantly by people visiting the website and convinces them to go read the announcement; possibly filling the survey if they were eligible for it. It is also displayed on the ribbon of the VIP website which allows it to be even visible to visitors of the website who may not be actively looking for our project's webpages and increased chances of an eligible candidate being persuaded to take the survey.

Vertically Integrated Projects

Projects   Events   Growing the Botanics   **Survey Announcement!**

Home > Projects > HMO Caps in St Andrews > Survey Announcement!

Survey Announcement!

HMO Caps in St Andrews VIP project survey on the impact of HMO licences on **student housing** has now been released. If you are a **student** at the University of St Andrews, we would like to invite you to participate in the survey.

Please scan the QR Code or click on the link above to get directed to the survey form. We really appreciate your time!

Link:
https://standrews.eu.qualtrics.com/jfe/form/SV_54jpJSE725zKUGa?Q_CHL=qr

We are conducting this survey to gather information about the impact of HMO Licences Caps that have been introduced in our region.

The purpose of the survey is to understand

We ensured that the survey link and QR Code was the centre of attention for this webpage and therefore, kept it near the top to allow students to quickly respond to it without losing their interest. The rest of the page includes some information about the survey and its aim; which is kept as brief as possible and the reader is reminded to fill the survey throughout. After receiving some feedback, we highlighted that the survey was for student exclusively (this was previously ambiguous) and ensured that only relevant information was used. There is an image of houses in St Andrews to aid the information and keep the reader focused, but the image used is deliberately of houses that students privately rent which are affected by the HMO cap, and not university halls. We hope this subconsiously tells the readers that this survey is targeted more towards privately let properties if they decide not to read any other information. We also decided to add our email near the end of this page to allow people to contact us with any questions they might have. This reflects a genuine want to help and assist the public which may encourage them to actually reach out to us and give us a perspective on what the public thinks and knows about this issue (another important task of Outreach).

- Webpage 3: Team Breakdown

Our 3rd webpage includes an explanation for each team in this VIP. This includes information on all teams whether they are active this semester or not. We thought a page as such could allow people to better grasp the operation of this project and the methods used by each team to achieve the results. We also believe that

having descriptions of each team can allow people to understand the findings and data of the project clearly. We included the graphic - containing all the teams which makes up this VIP - shown below at the top of this webpage in order to summarise the article for people to briefly look over and read further if interested.

This is a very content heavy and dense page. Brief descriptions of all VIP teams to exist to date accumulates to create large paragraphs which could discourage many people from reading it. We highlighted each team for better navigation for people looking for a specific team. Again, following our approach to breakdown information and retain reader interest, we included another St Andrews landscape image to distract from the amount of information and help the reader realise that everything was distributed adequately. This webpage succeeds Webpage 4 in terms of importance, therefore, absolute reader engagement is neither required nor needed, it helps the understanding of our project and how we reseach this topic.

This webpage can also be used by future members of this VIP to help with their decisions while choosing teams based on what they do, how they do it and the importance and contribution of different teams to the progression of this research. This page is linked near the top, following the brief introduction of this project and results and findings on the website in order to encourage people to read it and understand our project better before or after going through the results; since they mention the involvment of different teams in the generation process.

- "What is VIP" Section

We added an extra section on our main landing page informing the public about what an Vertically Integrated Project actually is. Recurring feedback from the website users was they were unaware of what a VIP was since they were often navigated to our landing page through links on our Instagram. Therefore, even though the official VIP website landing page contains information on VIPs, it would be unfamiliar to people visiting our webpage for the first time and to aid this we decided to add this section. It sits at the end of the project description and webpage links as to attract the right amount of attention while still spotlighting our other webpages. There are two short paragraphs explaining what a VIP is, the 'vertical' aspect of
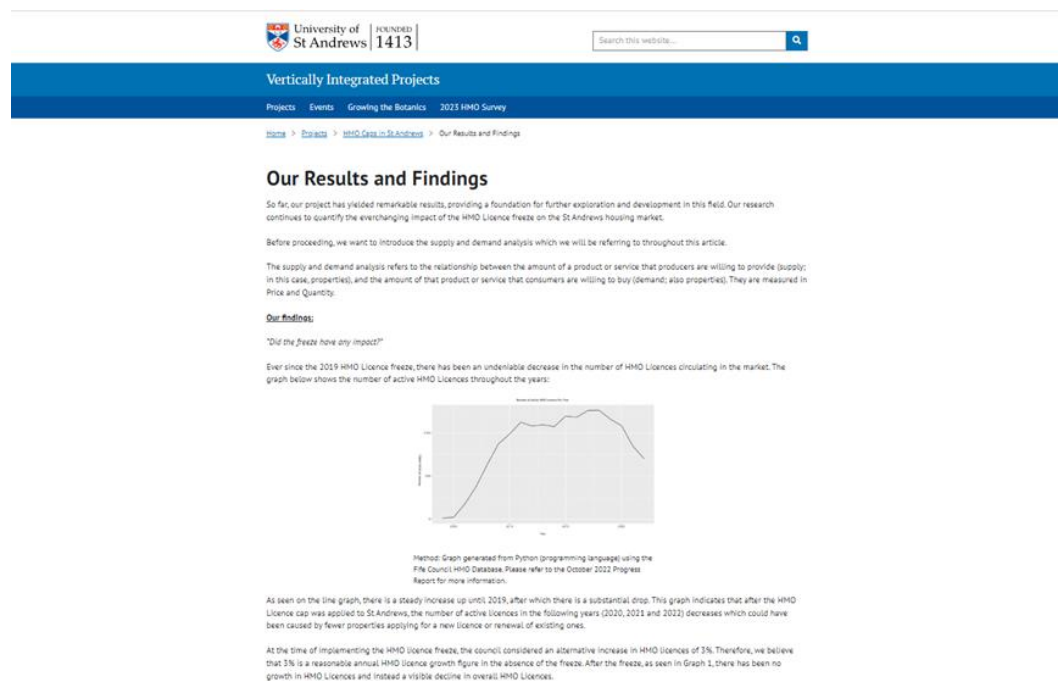
projects and general outline of what happens in such projects. Again, it is kept short to not deviate the reader's attention from our main focal points; the webpages.

- Webpage 4: Results and Findings

This was a very important webpage. More than conveying what our project was, this webpage conveys our progress and results, solidifying the need for all other webpages. This page was decided very early on, however, it was the last one to be released publicly since it provides a conclusion to the journey of an oblivious reader. The order of all webpages mimicked the questions one might ask while reading a topic they were previously unaware of.

Our approach to this page was different than other webpages because we focused more on effectively communicating the information instead of making it 'aesthetic'.

Below is what the webpage looks like:

Unlike, our previous webpages, throughout this page, no graphics of the St Andrews landscape was included. All images are pertinent to the results or represent the results themselves. The line graphs were centralised for better visibility of figures and to establish them as the main focal point. A brief explanation of the graphs and figures are given in the following paragraphs to help the reader interpret them. This is done for both line graphs on the webpage.

Introducing results with questions such as "Did the freeze have any impact?" followed by "How does this freeze impact the rent prices in St Andrews?", instead of section headings like "The impact of the freeze" and "The impact of freeze on rent prices" induces interest and engagement within the readers. Doing so

encourages people to read the whole article. These questions also align with our project's key goals stated on our landing page, which creates standardisation. Furthermore, given the uncharacterizable nature of the results, where it was harder to group or even separate the results, the questions provide structure by addressing the two most obvious questions our readers may have.

The layout of bar graphs follows a similar reasoning to line graphs, although, they are not given as much central space as the latter:

- Postgraduates show a similar pattern but their difference in willingness to pay is smaller
- The Equilibrium rent is £579.83; this is the price the students are willing to pay and landlords are willing to rent a property at.

How financial background influences what students are willing to pay for rent

Reading Key:

High-income undergraduate = £1036.78

Low-income undergraduate = £543.33

Equilibrium rent = £ 579.83

Methods: A model created in Python (programming language) which analysed the financial background and a student's willingness to pay.

The graph above helps visualise the significant difference in preferences.

NOTE: These figures were extracted from April 2022 Progress Report (linked below) which contains raw data. They are likely to change following the new 2023 survey analysis.

Our research revealed that the probability that a high-income undergraduate will remain in St Andrews is 80%. This proportion drops to 60% for lower-income undergraduates. High-income postgraduates have a probability of 70%, while for lower-income postgraduates this proportion is 50%. Undergraduate students seem to be more price inelastic when compared to postgraduates.

Price elasticity: a measure of how responsive the quantity demanded or supplied of a good or service is to a change in its price. Here, an increase in property price will not affect an undergraduate's willingness to stay in St Andrews as much as it will affect a postgraduate's. Nonetheless, it will have an impact on an undergraduate, just not significant enough to trigger a location change.

In an ideal world, each student's differing willingness to pay would be paired with a landlord's willingness to rent at a certain price, or at least we could expect an equilibrium in the housing market. The average rent in St Andrews

AVERAGE RENT PRICES

Reading Key:

On average, the rent price in St Andrews is £584.32

The average rent outside of St Andrews (in locations mentioned above) is £480

Equilibrium rent remains at £579.83

The current average rent in St Andrews is higher than the equilibrium rent*.

*Equilibrium rent was calculated by measuring the willingness to pay of different income and degree level students in St Andrews

The line graphs have clearer figures, axis labels and with the need for an accompanying reading key, it was best for these graphs to not be in the centre. The reading key on the right makes it easier for the reader to reference back and forth; helping them understand the graph wherever needed. We further explain the implications of the information in the graph and how it connects to the housing market in the following paragraphs. Again, distractions are minimised as much as possible but having the graphs provoke a similar effect as images – which maintains reader attention without a simple landscape becoming the centre of interest instead of the results. All figures derived have been cited and sourced from this project's previous progress reports – specifically April and October 2022. Both have been linked at the end of this page as shown:

Link to progress reports:

Please note that the progress reports in our project are not academically peer-assessed documents. They are compiled by students who have researched this topic and include methods used by each team to generate results, the results, any shortcomings of their teams, observations made, future plans and references. The results are not guaranteed to be fully correct, they are as accurate as we could get them to be with our small sample size and data points.

We understand and expect some of our results to change as time progresses and new technologies/methodologies are used to test the previous results. Hence, some progress reports may also be contradictory to each other.

April-2022-Progress-Report [Download]

October-2022-Progress-Report [Download]
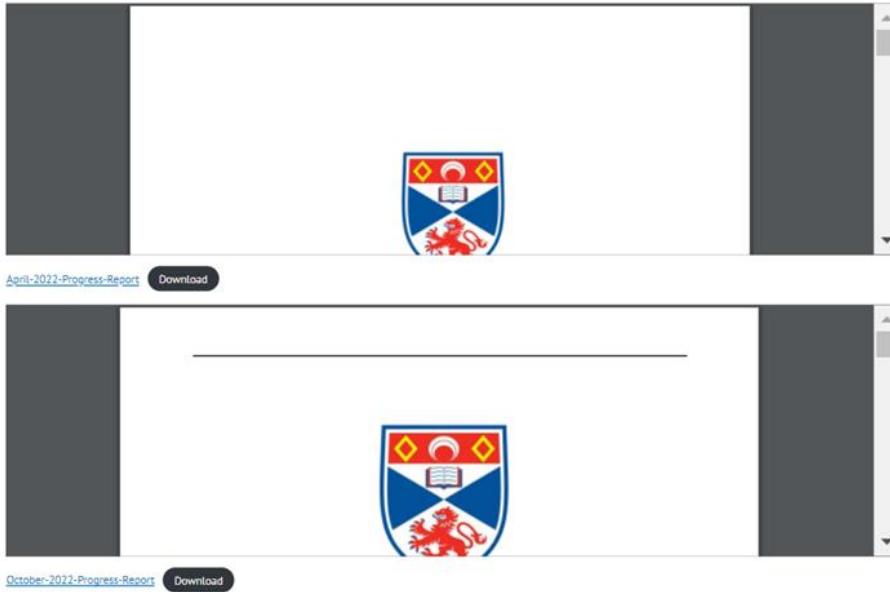
This is a useful document for readers who wish to explore the methodologies and technologies used to generate the results mentioned in the article; readers can see the raw data and report behind the brief summary of results stated on the website if that interests them more. The progress reports also have results that have been omitted from this webpage due to a lack of immediate correlation with the results already being discussed. For example, the reports discuss the environmental impact of HMO caps; which is an important aspect of the impact to consider, but is irrelevant when stating the change in rent prices. This can be researched further by the future teams. This webpage is linked first; following the project description, giving it priority over other webpages since presenting the results of our project was one of the main aim of the website.

Overall, the website is catered to professionals and contains formal language since it is the main point of contact for information and findings along with being on the university's official VIP site. Therefore, we must maintain a level of civility and competence.

Instagram

Using Instagram as our main social media site has proven to be very effective. Our decision to create an Instagram account stemmed from wanting to target two very different audience. Therefore, it was decided that HMO Caps VIP's Instagram will take on a more casual approach to promoting the project and its findings. All login details of all social media are mentioned in the 'Social Media Info' document on Teams.

- Followers

Our strategy to make ourselves known on Instagram was pretty basic. We began by following a lot of accounts, especially university committees, societies, and association accounts. The Instagram algorithm then goes on to recommend our account to followers of the accounts we followed, thinking that since they (individual people) follow the university accounts, they may also be interested in following us. This has been proven successful since, even though we had a slow start, by week 2 of the existence of our account we had almost 30 followers with 1 post announcing the survey. This may not seem like a huge number, but it is great progress considering how new our account was. As we were preparing for the survey launch, our continued posts and effort resulted in an increase of followers by 50% in just one week. We reached 168 accounts by the end of the semester. However, only 26 accounts interacted with us e.g., liked our posts/stories. This could be addressed in the future by setting plans to promote our account further to the wider student body of St Andrews.

Our engagement rate remained 86%. This was calculated by dividing the number of people who viewed our story by the number of followers we had. This was great news because it solidified the fact that our followers were not random bots but actually active individuals who would be interested in our project. The remaining 14% may have viewed our story after we calculated this or were not online during the 24hrs the story was available -100% engagement is seldom. However, the engagement rate fell drastically after the survey. This could mean that public is not consistently interested in our account and measures should be taken to establish regular engagement.

The reach of our Instagram can be evaluated by the Courier Fife journalist approaching us to learn more about our project, what we do, how we do it and our results in hopes to write an article on us. We have since been in contact with the journalist and hope to see some results from it.

- Marketing

One of our main reasons to have an Instagram is to market this VIP and its findings. Therefore, we place great emphasis on keeping people updated on what the project has been working on through posts and stories. Since the focus of our project over the semester has been the launch of the student survey, we mainly worked on posts related to that to ensure that people were aware of this survey. Detailed decisions behind each graphic have already been mentioned. Having these posts has really benefitted us since we were also acknowledged by CASH recently on their Instagram story which expanded our reach and made more people – especially CASH's followers who are already interested in student housing and HMO Caps – aware of our existence.

Interview

The idea of conducting an interview with different people affected by the HMO cap originated from the outreach team wanting to gather more intel on the public's opinion. To us it seemed like and an excellent way to assess the impact of the policy and understand the advantages or drawbacks. As a team we settled on three parties to conduct the interview with, which included the Scottish politician and councillor for the

Fife Council, Jane Ann Liston, a tenant living in a three-bedroom apartment which is only rented out to two people as the landlord does not have an HMO licence, and finally a homeowner in St Andrews. Each of these stakeholders received the same set of four questions. The questions consisted of; firstly, asking *if they had been affected by the HMO cap? If so, in what way?* Then if they *thought the HMO cap is needed?* The third question which was, *what things the government had considered while planning and establishing the cap*, was more tailored to the opinion of the councillor but still relevant for the other stakeholders. From there on the final question asked if the *HMO cap had served its intended purpose.*

The process of conducting the interview consisted of meeting up with all the people and asking them the questions while recording their responses, except for the Fife Council member who provided us with her responses through written statements.

We had to decide the best way to convey the information while using what was available to us. We initially planned to create a podcast but since the Councillor had sent in written statements, it was harder to incorporate it into solely a podcast form. Moreover, while we could have recorded the statements ourselves, we realised that a podcast may make listeners loose interest quicker and is complicated to navigate through if they wish to skip to a specific answer or question. Therefore, we decided to publish a presentation video interview instead which was made using Canva. Doing so required transcribing the two audio clips into text and then using these texts in the presentation, adding animations to the questions and answers to imitate an informative video often used by professional entities. We decided to exclude the use of audio clips in this video for two reasons; firstly, we would have to record for the councillor, and secondly, editing and coordinating everything would be extremely time consuming. Considering we only had a few days to create this video, we tried our best to maintain high quality content, but we would have liked to include more stakeholders in this interview to provide a reliable valid argument from all perspectives of students, homeowners etc, since different students and homeowners may have different opinion on this topic.

LinkedIn

One of our last tasks was to expand our social media infrastructure by incorporating LinkedIn in it. LinkedIn is a great platform to reach professionals and scholars who are interested, have worked, or work in related industries. Even though no official post has been made yet, LinkedIn has the potential to introduce our project to a whole new segment of the market and help us cater to them while learning more niche information through their interactions with us. Here is what the profile looks like so far:
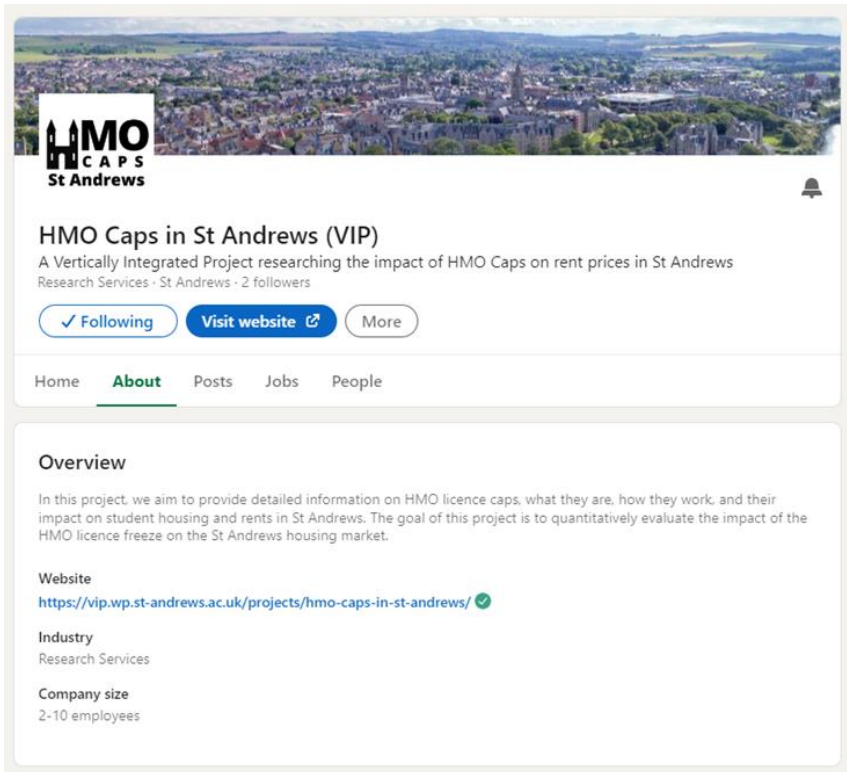
Even without any posts or attempts at promoting, the page has appeared in 15 search appearances, 50 % increase from the week it was created. This suggests that users are searching words similar to "HMO Caps in St Andrews" and there exists an untapped market for us to exploit. LinkedIn could be proven very effective in widening the outreach of this project and should be given as much attention as Instagram and website in the future.

Future Aims

Team Outreach has accomplished most of its plans for this semester. We wanted to organise a panel event but unfortunately some delays out with our control meant the event had to postponed to next semester. The panel was set to discuss student housing and rent in St Andrews as well as HMO Caps and their involvement in changes around the housing market. We contacted the Economics Society and CASH; both of which can provide us with panel speakers. However, the communication between these societies was slow which led to the cancellation of this event this semester following timing concerns. We also decided to include someone from Fife Council to advocate for HMO Caps in order to keep this event neutral – like our project itself. For next semester, if Team Outreach decides to go ahead with this idea, they should set dates, confirm venue and panel members by ideally week 3/4 and leave ample time for marketing to ensure a successful run of the event.

General Lessons

Team Communication & Workflow

Having a dedicated meeting space for unsupervised team meetings this semester has greatly helped team collaboration. Everyone being able to be in the same place and work in sub-teams while also checking in as a larger team has worked very well.

Being able to submit our own slides to present each week has been nice as it has allowed us to gather our thoughts and organize what we think is important to share with the team. It is also helpful to see the graphics and charts that other team members are producing and to have them explain the significance of what they have on their slides.

Being very divided into sub teams is great for making sure we are able to work on various angles of the project, however it does mean that when one group hits a roadblock, it is harder for others to jump in and help them and harder for the team having the issue to migrate to other teams while waiting for issue is resolved.

We have also learned that our team needs to be more proactive in reaching out to the supervisors for help when they first encounter issues instead of letting the problem fester.

Conference Insights

The VIP Conference on the Wednesday, 15th March, 2023, was quite a good learning experience. Not only was it interesting to see what other teams were working on, but also to learn what worked well and what didn't within their own teams. As we discovered last semester, having the whole team present is inefficient, hard for the audience to follow, and a sure way to run over time. Makenna and Ross presented, with Makenna giving an overview of the VIP, past work, the goals of our project, introducing the survey, and sharing some preliminary results and Ross presenting on lost HMOs and giving an example of a lost HMO property.

The presentations were all very good, but we noticed a downfall of many of the presentations was that they tried to fit too many words on to their slides. We thought that our presentation struck a good balance with only using words on our slides that would act as signposts for what we would talk about during the presentation. I think that physically engaging the audience by having them raise their hands if they had heard about HMO licences before helped to capture their attention. It was positive to see many students pulling out their phones and scanning the QR code at the end of our presentation.

We had some interesting conversations with students from other VIPs during the networking session. We had a masters student we have been in previous contact with attend the conference to hear about our team's work and she asked us several questions. One student from the Visualizing Peace VIP is doing her anthropology project on the St Andrews housing market and its impact on the student experience and was very curious about our results. We gave her our contact details and said we would be happy to share what we could with her.

Having a few people remain at our poster at all times was helpful as we could have at least one answering questions and speaking about the VIP and another asking people passing by to scan the poster QR code

and take our survey. In hindsight, it would have been good to have the gift card incentive listed on the poster and the ppt slides. Further, regarding the content on the poster it could have been better to add more information instead of keeping it so minimal (see Outreach Graphic 5) seeing as the public did not have issues withstanding by a poster and taking their time reading the content of other VIPs.

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Appendixes

Appendix 1: Lost HMOs Communications with Fife Council – Apparent problems with HMO register

Lucy Grunnell

To: ○ HMO.licensing@fife.gov.uk <HMO.Licensing@fife.gov.uk>   Mon 13/02/2023

Cc: ○ Luc Bridet; ○ Sumedh Dalwai; ○ Lane Ostroff; ○ Ross Greig

To whom it may concern,

I am Lucy, a student at the University of St Andrews taking part in a research project investigating the St Andrews HMO Cap.

I have searched the Q1 2023 HMO register PDF and found apparent inaccuracies for the following properties:

The reason my team and I believe these are incorrect is because they are either advertised as "University Managed Accommodation" on the university's website, are halls of residence, or I or my colleagues personally know the property and its residents and have seen the relevant HMO license documentation.

I would appreciate it if you could investigate these properties and provide us with a list of all the currently active HMO addresses in St Andrews.

Please let me know if you need any further clarification.

Kind regards,
Lucy Grunnell

Appendix 1.5: Lost HMOs Communications with Fife Council – Response from Fife Council on appendix 1

HMO Licensing <HMO.Licensing@fife.gov.uk>

To: ○ Lucy Grunnell   Tue 21/02/2023 1

Good afternoon Lucy,

I refer to your email below and have explained the terms detailed on the Public Register.

Grant – The licence was granted with standard conditions.
Con – The licence was granted with additional conditions.
Deem – The licence was granted unconditionally.

The Public Register is the most up to date list that we have of HMO licences that have been granted. Due to it's size and the fluidity of the information contained in the document, this is generated on a quarterly basis.

I can confirm that Rectory Lodge and Flat 2 135 South Street currently have an ongoing application to renew their licence and as such are licenced under the terms of the previous licence.
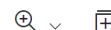
I trust this is of assistance to you.

Kind regards

Claire

Appendix 2: Lost HMOs Communications with Fife Council – HMO property not displayed on register

HMO Register Query

🔍 1 attachment ⌄

LG   To: HMO Licensing <HMO.Licensing@fife.gov.uk>

Dear Claire,

Thank you for assisting us previously with our questions on the Fife Council HMO Public Register. We are currently researching the following property: 16 Saint Mary Street, St Andrews, KY16 8AZ
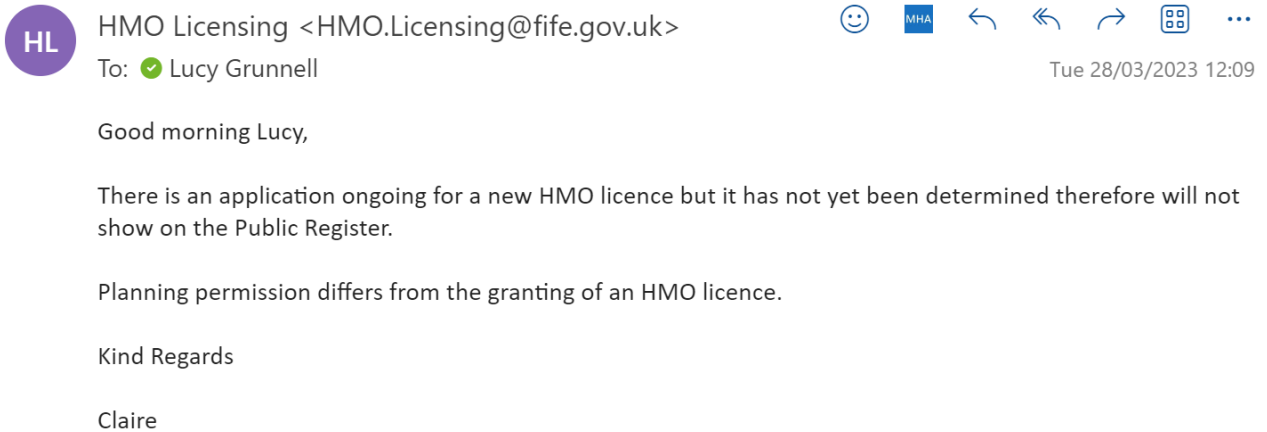and have encountered some further issues.

This property was granted an HMO licence for 6 persons on 28th August 2019 (and was confirmed on 28th October 2019 - please see fife council confirmation letter below taken from Fife Council Planning Portal) but does not appear on the Public Register. As the licence was granted in 2019 it would've expired in 2022, but properties which have recently expired have been listed on the spreadsheet.

Could you please elaborate as to why we can't find this property?

Kind regards,
Lucy Grunnell and the St Andrews Lost HMO Research Team

Appendix 2.5: Lost HMOs Communications with Fife Council – Reponse from Fife Council on appendix 2

HL HMO Licensing <HMO.Licensing@fife.gov.uk>
To: ✓ Lucy Grunnell

Tue 28/03/2023 12:09

Good morning Lucy,

There is an application ongoing for a new HMO licence but it has not yet been determined therefore will not show on the Public Register.

Planning permission differs from the granting of an HMO licence.

Kind Regards

Claire

Appendix 3: Reading the spreadsheet that contains HMO Register data into a pandas data frame

```python
#Imports the FullRegister into a dataframe
df = pd.read_excel("FullRegister.xlsx")

count = len(df)
print("Total addresses to begin with: "+ str(count))

#Removes any address which has an incomplete set of
data in these columns (we are assuming N/A means
licence is active)
updatedDf = df.dropna(subset=[
  df.columns[0], df.columns[8]
])
```

Appendix 4: Transferring and filtering content of data frame to array of records

```python
#Creating a dataframe with just the address, date of
issuance, date of expiry and number of occupants
(the decision column is included to help the Lost
HMO team)
updatedDf.drop(columns=[
  updatedDf.columns[0], updatedDf.columns[1],
updatedDf.columns[2],
  updatedDf.columns[4], updatedDf.columns[5]
],
                inplace=True)

#Convert dataframe to array of records for easier
access of data
@dataclass
class Register:
  address: str = ""
  dateIssued: str = ""
  dateExpired: str = ""
  occupants: int = 0
  decision: str = ""

HMORegister = [Register() for x in
range(len(updatedDf))]
```

Appendix 5: Populating and cleaning data in array of records

```python
#Populating the array of records with the dataframe
data - makes it easier to handle the dataframe data
for x in range(len(HMORegister)):

  #Only populates the array of records if the
address is in St Andrews and not a Halls of
Residence. Since we are assuming addresses without a
postcode are located in St Andrews, therefore we
cannot select just 'St Andrews' addresses; instead
we ignore those which we definitely know are not in
St Andrews.
  tempAddress = str(updatedDf.iloc[x]
[updatedDf.columns[0]])

  regex1 = re.search("Kirkcaldy", tempAddress)
  regex2 = re.search("Glenrothes", tempAddress)
  regex3 = re.search("Cupar", tempAddress)
  regex4 = re.search("Dunfermline", tempAddress)

  regex5 = re.search("David Russell", tempAddress)
  regex6 = re.search("Mcintosh", tempAddress)
  regex7 = re.search("John Burnett", tempAddress)
  regex8 = re.search("Regulus", tempAddress)
  regex9 = re.search("^Uni$", tempAddress)
  regex10 = re.search("Whitehorn", tempAddress)
  regex11 = re.search("Salvator's", tempAddress)
  regex12 = re.search("Melville", tempAddress)
  regex13 = re.search("Powell", tempAddress)
  regex14 = re.search("Agnes Blackadder",
tempAddress)
```

```python
regex15 = re.search("Buckhaven", tempAddress)
regex16 = re.search("Fife Park", tempAddress)
regex17 = re.search("Gannochy", tempAddress)
regex18 = re.search("Albany Park", tempAddress)

regex19 = re.search("Anstruther", tempAddress)
regex20 = re.search("Rosyth", tempAddress)
regex21 = re.search("Leuchars", tempAddress)
regex22 = re.search("Falkland", tempAddress)
regex23 = re.search("Inverkeithing", tempAddress)
regex24 = re.search("Auchtermuchty", tempAddress)
regex25 = re.search("Crail", tempAddress)
regex26 = re.search("Tayport", tempAddress)
regex27 = re.search("Methil", tempAddress)
regex28 = re.search("Kincardine", tempAddress)
regex29 = re.search("North Queensferry",
tempAddress)
regex30 = re.search("Cardenden", tempAddress)
regex31 = re.search("Earlsferry", tempAddress)
regex32 = re.search("Saint Monans", tempAddress)
regex33 = re.search("Culross", tempAddress)
regex34 = re.search("Cowdenbeath", tempAddress)
regex35 = re.search("Guardbridge", tempAddress)
regex36 = re.search("Ceres", tempAddress)
regex37 = re.search("Limekilns", tempAddress)
regex38 = re.search("Aberdour", tempAddress)
regex39 = re.search("Crossford", tempAddress)
regex40 = re.search("Collessie", tempAddress)
regex41 = re.search("Kennoway", tempAddress)
regex42 = re.search("Ballingry", tempAddress)
regex43 = re.search("Oakley", tempAddress)
regex44 = re.search("Ladybank", tempAddress)
regex45 = re.search("Freuchie", tempAddress)
regex46 = re.search("Wormit", tempAddress)
regex47 = re.search("Markinch", tempAddress)
regex48 = re.search("Newburgh", tempAddress)
regex49 = re.search("Cellardyke", tempAddress)
regex50 = re.search("Leven", tempAddress)
regex51 = re.search("Newport", tempAddress)
regex52 = re.search("Dysart", tempAddress)

regex53 = re.sub("\n", " ", tempAddress)
```

```
#Populating the array of records
  if regex1 == None and regex2 == None and regex3 ==
None and regex4 == None and regex5 == None and
regex6 == None and regex7 == None and regex8 == None
and regex9 == None and regex10 == None and regex11
== None and regex12 == None and regex13 == None and
regex14 == None and regex15 == None and regex16 ==
None and regex17 == None and regex18 == None and
regex19 == None and regex20 == None and regex21 ==
None and regex22 == None and regex23 == None and
regex24 == None and regex25 == None and regex26 ==
None and regex27 == None and regex28 == None and
regex29 == None and regex30 == None and regex31 ==
None and regex32 == None and regex33 == None and
regex34 == None and regex35 == None and regex36 ==
None and regex37 == None and regex38 == None and
regex39 == None and regex40 == None and regex41 ==
None and regex42 == None and regex43 == None and
regex44 == None and regex45 == None and regex46 ==
None and regex47 == None and regex48 == None and
regex49 == None and regex50 == None and regex51 ==
None and regex52 == None:
      HMORegister[x].address = str(regex53)
      HMORegister[x].dateIssued = str(updatedDf.iloc[x]
[updatedDf.columns[1]])
      HMORegister[x].dateExpired =
str(updatedDf.iloc[x][updatedDf.columns[2]])
      HMORegister[x].occupants = int(updatedDf.iloc[x]
[updatedDf.columns[3]])
      HMORegister[x].decision = str(updatedDf.iloc[x]
[updatedDf.columns[4]])
      totalInRegister += 1
  else:
     lostAddresses.append(str(regex53))
```

Appendix 6: Getting the required information from the array of records to generate the graphs

```
#Getting information for graphs
years = [
  2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021,
  2022
]
total = [0] * 14

#Looping through the array to find and count number of occupants or number of active licences per year
for p in range(len(HMORegister)):

  if HMORegister[p].address not in listOfUniqueAddresses:
    listOfUniqueAddresses.append(HMORegister[p].address)
  else:
    continue

  min = 3000
  max = 0
  for z in range(len(HMORegister)):
    if HMORegister[z].address == HMORegister[p].address:

      startActiveDate = ''.join(filter(str.isdigit, str(HMORegister[z].dateIssued)))
      endActiveDate = ''.join(filter(str.isdigit, str(HMORegister[z].dateExpired)))

      if len(startActiveDate) == 6 and startActiveDate != "":
        startActiveYear = int("20" + startActiveDate[4:])
      elif startActiveDate != "":
        startActiveYear = int(startActiveDate[4:])
      if len(endActiveDate) == 6 and endActiveDate != "":
        endActiveYear = int("20" + endActiveDate[4:])
      elif endActiveDate != "":
        endActiveYear = int(endActiveDate[4:])

        #If duplicates are still appearing in array of
records (due to irregular patterns), the first year
activeness and last year of activeness is recorded
        if (startActiveYear <= min):
          min = startActiveYear
        if (endActiveYear >= max):
          max = endActiveYear

  for q in range(len(years)):
    if years[q] >= min and years[q] <= max:
      #total[q] += HMORegister[p].occupants
      total[q] += 1
```

Appendix 7: Code which generates the graphs using Matplotlib

```
#Comment out the code for the graph you do not want
#Graph of occupants per year

data = {'Year': years, 'Number of Occupants': total}
graphDf = pd.DataFrame(data)
graphDf.plot(x="Year",
             y="Number of Occupants",
             kind="line",
             xticks=range(2009, 2022),
             yticks=(0, 500, 1000, 1500, 2000, 2500, 3000, 3500, 4000, 4500,
                     5000, 5500, 6000),
             grid=True)

plt.ylabel("Number of Occupants")
plt.title("Number of Occupants Per Year (2009-2022)")
"""

#Graph of active licences per year
data = {'Year': years, 'Number of Active Licences': total}
graphDf = pd.DataFrame(data)
graphDf.plot(x="Year",
             y="Number of Active Licences",
             kind="line",
             xticks=range(2009, 2022),
             yticks=(0,200,400,600,800,1000),
             grid=True)

plt.ylabel("Number of Active Licences")
plt.title("Number of Active Licences Per Year (2009-2022)")
"""
plt.show()
```

Appendix 8: Code which generates the tables

```
#Producing tables
for t in range(len(years)):
  print(str(years[t]) + ":" + str(total[t]))
```
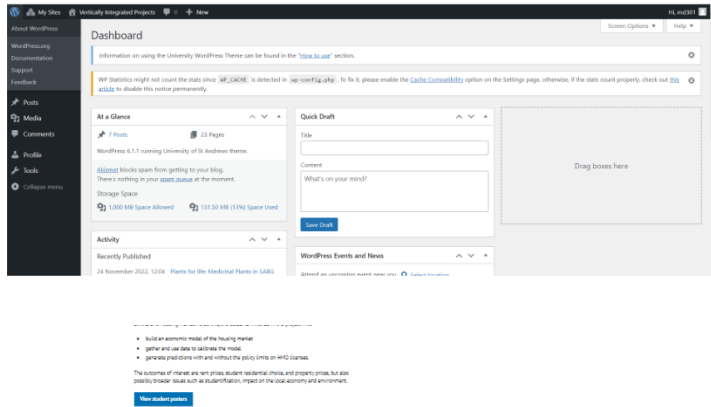
Appendix 9: Communication with VIP Coordinator; Shruti

Good Morning Shruti,

I am writing on behalf of the VIP: HMO Caps in St Andrews regarding a few issues Team Outreach has faced with the WordPress access given to us.

So far, we can only make Blog posts on the VIP website and we are unable to add or edit any existing pages. Below is a picture of our WordPress Dashboard:

I understand some elements will be restricted by the University but we are unable to do anything except post a text with some media. We would like to create an entirely new webpage or be able to edit the existing one.

Is there anything that can be done? Maybe there are some admin settings that require permission or change in order for us to edit and use this WordPress account effectively.

Thank you so much,
Manya Dutt
Team Outreach, HMO Caps in St Andrews

Shruti's response and fixing the issue:

Re: Problems regarding VIP Wordpress

Shruti Narayanswamy <sn52@st-andrews.ac.uk>
Thu 09/02/2023 10:58

To: HMO caps in St A-VIP <hmocaps.vip@st-andrews.ac.uk>

Cc: Sumedh Dalwai <sd293@st-andrews.ac.uk>;Stephanie Lusser <satl1@st-andrews.ac.uk>

Hello Manya,

Thank you for reaching out about this. I have changed your's and Stephanie's roles on the Wordpress site. Can you try logging in now and let me know if you now have the required level of access?

Best wishes,
Shruti

Please note that my working hours are 8:00 to 17:45 from Mon-Thurs

[cid:image001.gif@01D3315A.76F93EA0]

Dr. Shruti Narayanswamy
Entrepreneurial Education Developer
Rising Star in Enterprise Education 2022: Winner of the National Enterprise Educator Awards
Runner-up for Best Journal Article: BAFTSS Publications Awards 2022
Module Convener and Lecturer: Enterprise and Creativity (ID2007)
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