**Callum:**

**Question: The specific research question is: how does ocean proximity affect house value?**

### Data Cleaning

We see that there is only 5 homes in the island data. These are homes which are classified as being on an island.

**Fig 1: Average Median House Value vs Ocean Proximity**

According to the law of small numbers, small random changes have a large apparent effect on the analysis of the data. This is shown by the large error bar of the values of the island data, marked by the black line in the graph. Such a small dataset of five homes, means that if even one home was an outlier, then this whole dataset would be largely affected by that one outlier.

For now on, we will remove the island data, as this data is unreliable with such a small data set.

**Fig 2: Average Median House Value vs Ocean Proximity without island data**

Now, we need to scan for further outliers with the rest of the data using a box plot. It will mark outliers with a dot (since they lie further than 1.5 multiplied by the interquartile range).

**Fig 3: Median House Value vs Ocean Proximity**

It is important to say however, that all the data is shown to be in 'reasonable' values (no median house prices above $10,000,000 for example). Furthermore, excluding homes in the inland, there are not too many outliers present. We can forgive the inland data for having outliers. This is since there were over 6500 homes, which means there will be plenty of individual homes which could be outliers in this large sample. Furthermore, the regions in California considered 'inland' are vast and very different, so the house prices will be very varied. For example, you cannot compare the house prices to the relatively built-up urban Sacramento (the capital of California), to a small country town in the Mohave Desert except they are both classified as 'inland'.

**Analysis of Data**

Looking at the boxplot prior...

We see that the homes located near the bay have a higher median housing value in 1990 compared to the homes in any of the other areas (about $9552 more then homes near the ocean, despite both being near the ocean). Now this definitely makes sense, as any homes which are near the bay are in the San Francisco Bay area.

**Fig 4: Graph describing where homes ‘near the bay’ are**

Chart, scatter chart

Description automatically generated

We indeed see that the homes near the 'bay' are all in a similar location. That location is the San Francisco Bay area. From 2014 to 2020, San Francisco was ranked the most expensive city to live in the United States. Some websites argue San Francisco is even the most expensive city in the world. Even in 1990, a suburb called Atherton in San Francisco was the most expensive zip code in the United States in 1998 (which was very close to the year this survey was conducted). Therefore, it is completely unsurprising that we would see homes in San Francisco be so expensive compared to other areas not in San Francisco.

However, we see that the difference of the median value of homes in San Francisco compared to other homes near the ocean is quite small ($9552), we need to consider that if we adjust for inflation ($1 in 1990 is now $2.21 today), we see that the difference in the median house value is $18,750. This does still show that even in 1990, San Francisco had substantially more expensive housing on average than the rest on the state. Factoring how the US also had an interest rate of 8.31% compared to 0.75% today, this shows even more clearly how San Francisco’s average housing is more expensive than in other areas.

### General Trend Apart from the San Francisco Data

**Fig4: Median House Value vs Ocean Proximity**

Even in homes not in San Francisco, we see a general trend. As homes get further away from the ocean, we see the average price of those homes being cheaper. We see for certain however that the homes located 'inland' have a drastically lower housing price on average then the homes on the ocean. This can be compared to how homes near the ocean only have a difference in price of $8250 to the homes near the ocean.

### Why are housing prices closer to the ocean more expensive?

### Possible Demand Factors

### The basic law of supply and demand tells us that housing prices change by the demand for housing, and the amount (supply) of homes built. More demand means housing is valued more, and there is an incentive to raise the price.

#### Population

You would expect that with a higher population, there would be a higher demand for homes (with more people needed to live in housing), and as such driving up housing prices. However, is this really the case?

We can see that a higher population does not correlate to higher housing prices. This is since that the number of people in the data which were 'near the ocean' (3,562,615) was the least amount compared to the population which were inland (9,045,105) or were farer away from the ocean (13,717,591). This is even though those homes near the ocean had higher housing prices.

#### Median Income

An increase in median income theoretically increases demand for housing as well. As income increases, consumers will have more money to perhaps upsize their drelling (with their increase in income allowing them to be supported with a mortgage to buy more expensive housing).

**Fig 5: Average Median Income vs Ocean Proximity**

This seems to be much more of a clear indicator of how the median housing value will be affected in each area then the population. We see that median income decreases as the homes are away from the ocean. This is in line with how housing prices decrease as you move further inland.

#### The Climate

Typically, because of the ocean breeze, places near the ocean have a cooler and nicer climate in California, then places further inland. For example, in summer San Francisco (which is near the ocean) has an average temperature of a pleasant 20C. This can be compared to the temperature in the Mojave Desert (the most inland portion of California) in summer, that area is a boiling 36C on average. Furthermore, the Mojave Desert only receives between 7 and 25 cm of rainfall on average every year. This can be compared to San Francisco, which has an average rainfall of 63.5cm every year. Clearly, areas further inland will have drought issues, and the lack of rain and clouds will not allow for any protection from the scorching sun, and not provide cooling breeze.

Therefore, San Francisco and areas near the ocean in general, have a nicer climate then areas further inland. Therefore, there will be higher demand for living in areas near the ocean, which will thus drive up housing prices.

Possible Supply Factors

#### Less homes have been built then has been demanded in California's coastal areas

There have been less homes being built in California's coastal areas then even in the inland areas of California. This is shown by this graph...

**Fig 6: Annual Growth in Housing Units in California vs Rest of US**

The reason for this is several things.

#### Land Prices are Expensive

The cost to buy land to build housing in California's coastal areas is one of the most expensive in the United States. Therefore, there is not much housing built because of the huge cost to buy the land to build it on. Land prices in the inland regions of California however, are at or below the US average. Therefore they build more housing then even is necessary

Limited Vacant Developable Land

The topography of California’s cities (particularly San Francisco) has unfavourable terrain for building housing compared to inland areas. Two thirds of all the San Francisco Bay area and other urban centers is undevelopable. This is compared to 25% for the average urban center in the United States, and therefore the regional inland areas of California.

Reference List:

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