Analysis of demand for Just Eat Cycles services and proposal of new pricing

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Identification of active and inactive stations

First of all, it was necessary to define inactive stations. First, I looked at the bare table containing the descriptive statistics of the dataset. Since the whole monitored period was 776 days, I set the limit of the station's activity to more than one record of the given station's use. In other words, I considered the stations (start or end), which occurred in the documents less than 776 times, to be inactive. I filtered out separate stations that were not active as starting points and stations that did not occur at least once a day at the end of the journey. Subsequently, I found the intersection of these two sets and determined the stations used in both directions less than once a day. When choosing the active stations, I again identified the stations that were at least active in at least "one way" and thus appeared in the records on average at least once a day in any direction.

Identification of the most frequented stations

To determine the most frequent stations, I created a smaller dataset containing the numbers of start and end records. Subsequently, I made a column containing the sum of these two data and the total number of paths that included the station. Also, I added a column with information on the average number of bicycles that took turns at a given station on a given day. I sorted these numbers in descending order and selected the ten highest data.

# Identification of stations where bicycles accumulate and stations where they are potentially missing

I identified the accumulation of bicycles by first counting the number of outgoing and incoming bikes for each station. Subsequently, I created a column with the difference between these two data. I then divided the column containing the difference between these two numbers into stations where the difference was greater than 776 (on average more than one bike was lost per day than left) and to stations where the difference was less than -776 and thus left the station on average by at least one bike more than added. The first group represents stations with potential accumulation, and the second, on the contrary, with a potential shortage of bicycles.

Distances between stations

I originally wanted to use Pythagoras' theorem to calculate the distance. However, since I take an exact approach to calculations and do not believe in a flat Earth's conspiracies, I decided to calculate the length of two stations based on a precise formula (Haversine formula). It was impressive from the results that the data contained three significantly remote values (284 -285 km), which did not logically fit in comparison with other matters with a maximum length of 18 km. After checking on the maps, I found that the given geographical coordinates of the destination station correspond to the place in Liverpool. Therefore, it makes sense that the length of the route is significantly longer. Consequently, I would exclude these values from the subsequent analysis, as they do not represent meaningful travel information. Another seemingly illogical result was zero-length roads. However, this seemingly impossible situation only reflected the method of calculation. The GPS coordinates of the start and end stations were used in the calculation, and in some cases, the start and end stations we the same. The coordinates therefore matched, and the distance was zero. As we do not have any additional data available for individual trips, it is impossible to determine the journey's exact length.

Trip durations and histogram of values

Since the input data on the trips' duration were given in seconds, I converted them to minutes first. Subsequently, I filtered values exceeding 120 remote minutes over two hours were special, mainly because of the Just Eat Cycles' pricing policy, which provides an hour's trip in the ticket price and then charges for every additional minute[1]. After cleaning the data, I drew a histogram containing the number of paths falling into each interval. The graphical representation of the data confirmed the tendency of passengers not to pay extra money. For journeys longer than one hour, a decrease in the number of journeys can be seen for this very reason. Another fascinating figure is the significantly higher proportion of journeys lasting less than 25 minutes. Thus, it is likely that people tend to use bike sharing for short trips rather than long distances.


Histogram of the trip durations
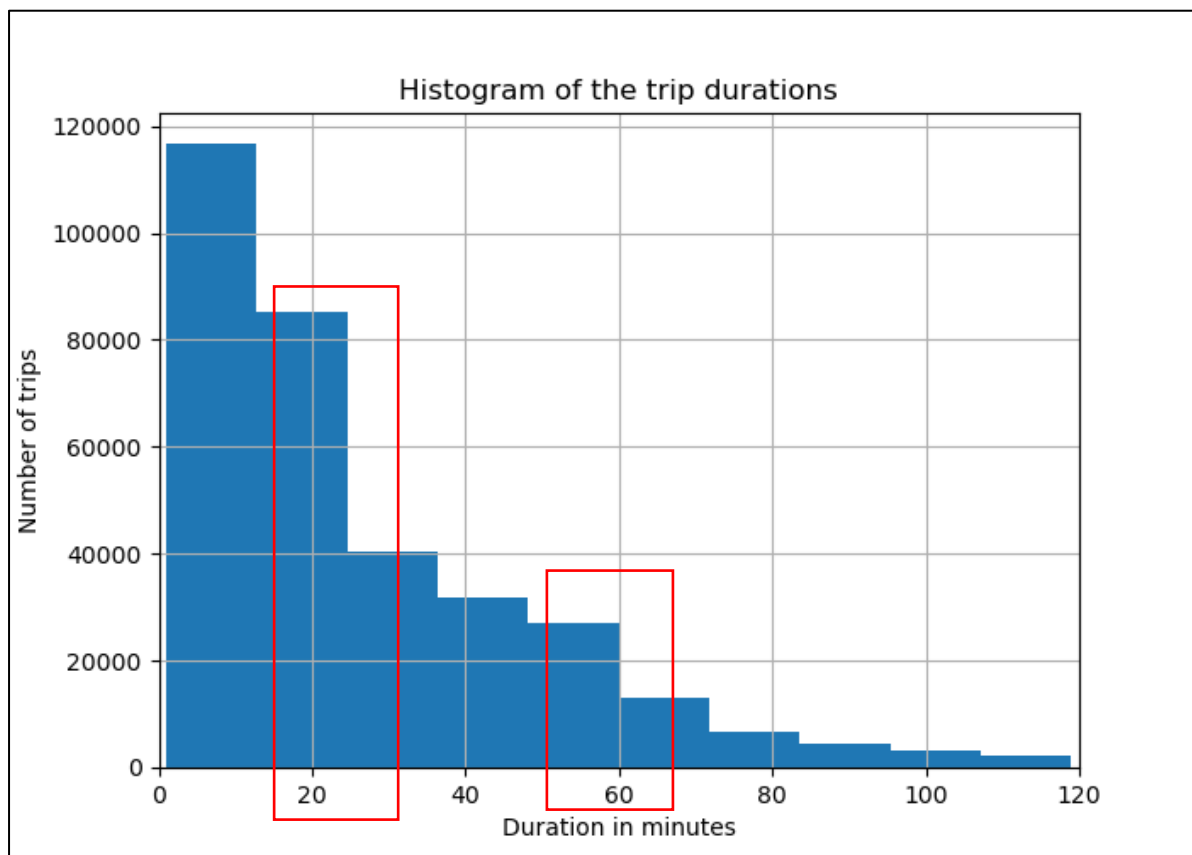
Reasons for changes in demand for Just Eat Cycles

1. Long-term cycling support in Edinburgh

The first fact that has long affected the number of people using bicycles in the city is the quality and number of bike paths. Edinburgh has been considered the most cycle-friendly city in Scotland [1] since 2012 when the city council first declared a minimum guaranteed contribution to cycling in the city of 5% of the total amount of money earmarked for transport. Simultaneously, the city council committed to increasing this contribution by 1% per year [2]. Another proponent of cycling in the city is the Sustrans organization [3], which promotes pedestrian and bicycle transport within Scottish towns. This is confirmed by the fact that in 2015, this organization helped the City of Edinburgh with a donation of £ 5 million to develop the city's cycling infrastructure [4]. The fact that the city is striving to create greener and healthier modes of transport is also evidenced by the fact that in 2019 it came up with a plan for the Edinburgh City Center Transformation (ECCT). This plan was drawn up by experts, based on an opinion poll conducted in advance. This survey involved 3,000 respondents, providing valuable information in developing the program [5]. This project's primary goals are to increase the number of people commuting to work by bicycle, increased safety when moving on foot or by bike. The project aims to reduce the number of cars in the city center to reduce air emissions [6]. One of the concrete improvements is to create a transport network in the city center, which would include new separate and safe cycle routes, including securing a new pedestrian and bicycle bridge connecting the Old and New Towns [6]. Another policy that promotes bicycles in the city is the "Cycle to Work" program. [7] This initiative works for the University of Edinburgh staff. They have the opportunity to purchase a bicycle with accessories up to £ 3,000, which the university will then reimburse them in the form of a wage bonus, respectively Reduced tax levy. Another option is an interest-free bicycle loan of up to £ 500.

All these reasons contribute to a long-term increase in the number of cyclists. In this case, it is not an explanation of the jump changes in the number of cyclists, but rather an explanation of the long-term trend.

1. Seasonality - The weather has a significant effect on the demand for bicycle transport. The graph shows a steady increase in the number of rides during the spring months, and the summer culminated in August.
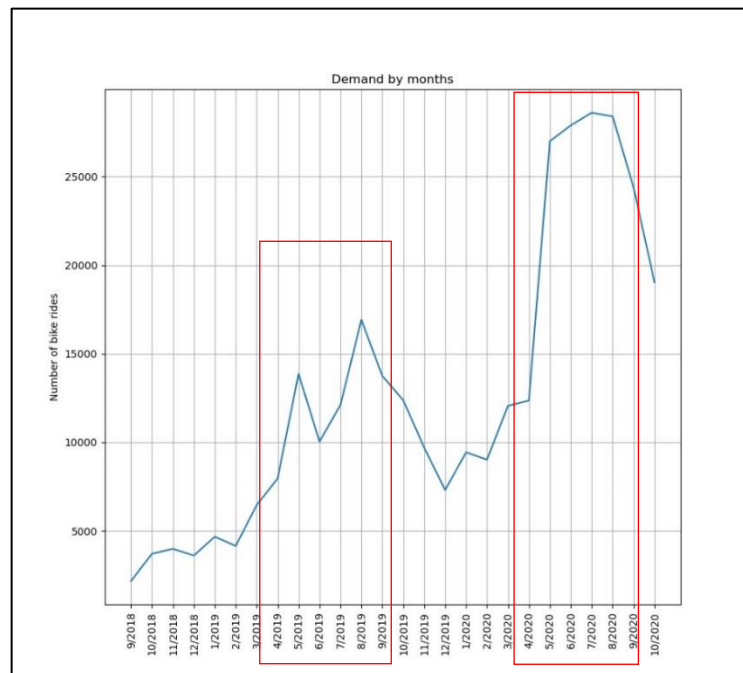
 This is supported by information on the average daily temperature, the average total precipitation per month, and the average duration of sunlight per day.
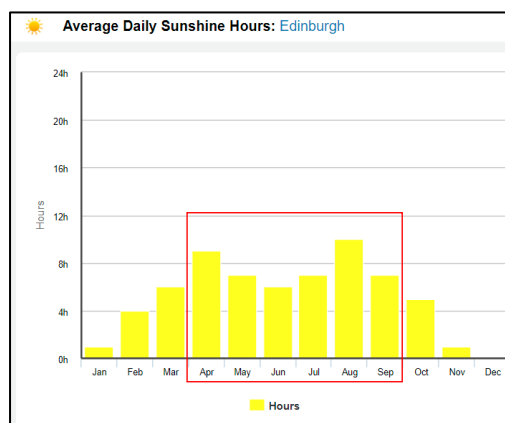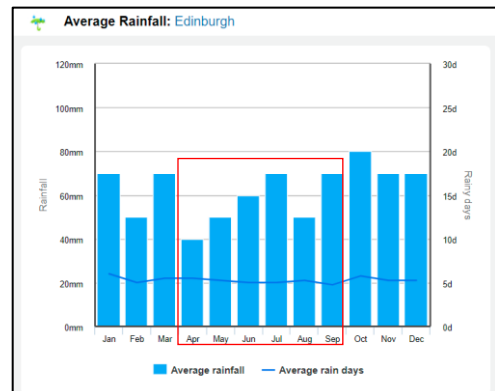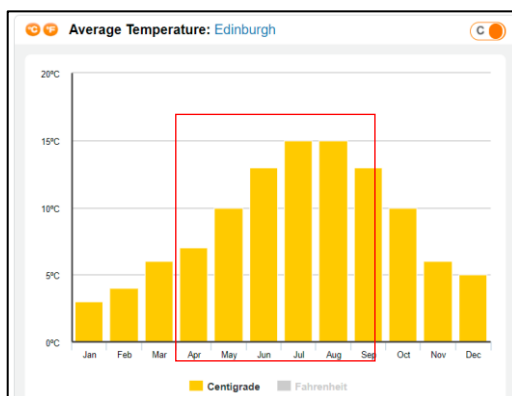
1. COVID Pandemic - 19

The most significant leap in demand for bicycle use was probably caused by the COVID - 19 pandemic, which erupted in Europe in early 2020. Transport Scotland (National Transport Agency) reported a 120% increase in cyclists' number in April 2020 compared to a 70-90% decrease in inroads by another means of transport [8]. To some extent, these numbers were also due to increased monitoring of the number of cyclists, but certainly not exclusively.

Evidence of the already mentioned active interest of the city in the safety and quality of bicycle traffic is also a quick response to maintaining a safe distance during a pandemic. In April, the town reacted immediately and expanded the individual cycle routes so that cyclists and pedestrians kept the necessary two-meter distance [9]. Subsequently, in May 2020, the city council even ordered, in the interests of safety, the creation of temporary cycle paths separated from the pedestrian zone on routes around hospitals [10].

Thanks to these measures, the increased interest in cycling remained significant even after the summer measures were relaxed. This is evidenced by a Cycling Scotland (National Cycling Organization) report of August 2020, which reports a 44% year-on-year increase in passenger numbers in July 2020 [11]. Although the overall year-on-year increase has decreased, it remains relevant.

Cycling journeys in Scotland

% change

Comparing 2020 journeys with 2019
Source: Cycling Scotland
BBC
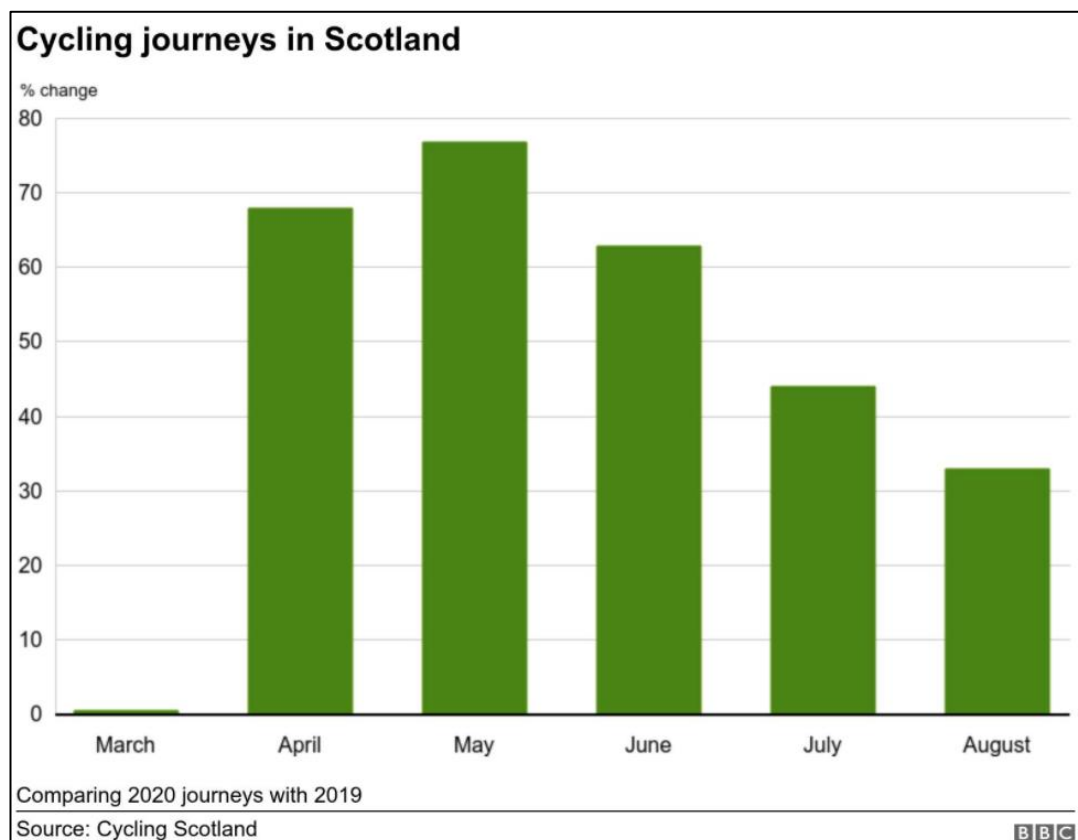
Government Secretary for Transport Michael Matheson would like to maintain this trend and has therefore decided to set aside £ 500 million to support "active" travel over the next five years [12].

Influence of weather

I have already pointed out the influence of the weather in the last part of the project. In this section, I would like to supplement it with a graphical relationship of sensory temperature and a statistically confirmed correlation of these two variables. To capture the weather's effect, I used the variable feels, which expresses the sensory temperature, including temperature and humidity. The graph shows the similarity in the development of both variables indicating the dependence above the weather's demand. This fact is also confirmed by a correlation coefficient of 0.63. There is, therefore, a clear correlation between these two quantities. In the context of year-round variable weather, which is not very favorable in terms of outdoor activities, the coefficient's size makes sense. In other words, Scottish cyclists are accustomed to local conditions and therefore do not react in direct proportion to changes in temperature.
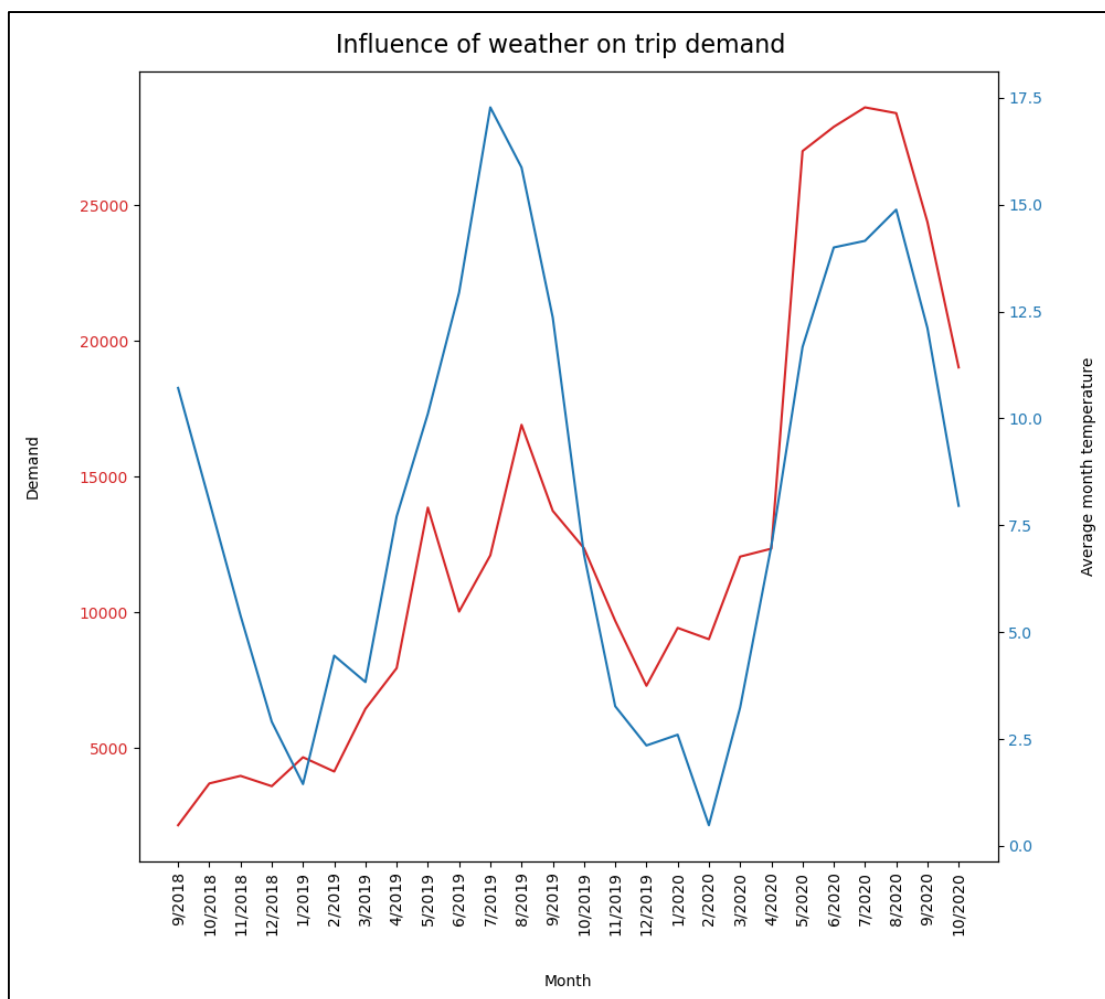
Weekends and weekdays

As the last part of the demand analysis, I focused on the difference between the weekends and the weekdays. First, I calculated the total demand during the working days and the entire weekend demand. Subsequently, I took the different days into account and thus calculated the average market during the working and weekend day. Graphic processing shows that, on average, there was more interest in cycling during the weekend. This information corresponds to intuition, as we assume that most locals have more free time on weekends and at the same time there are more tourists in the city at that time.
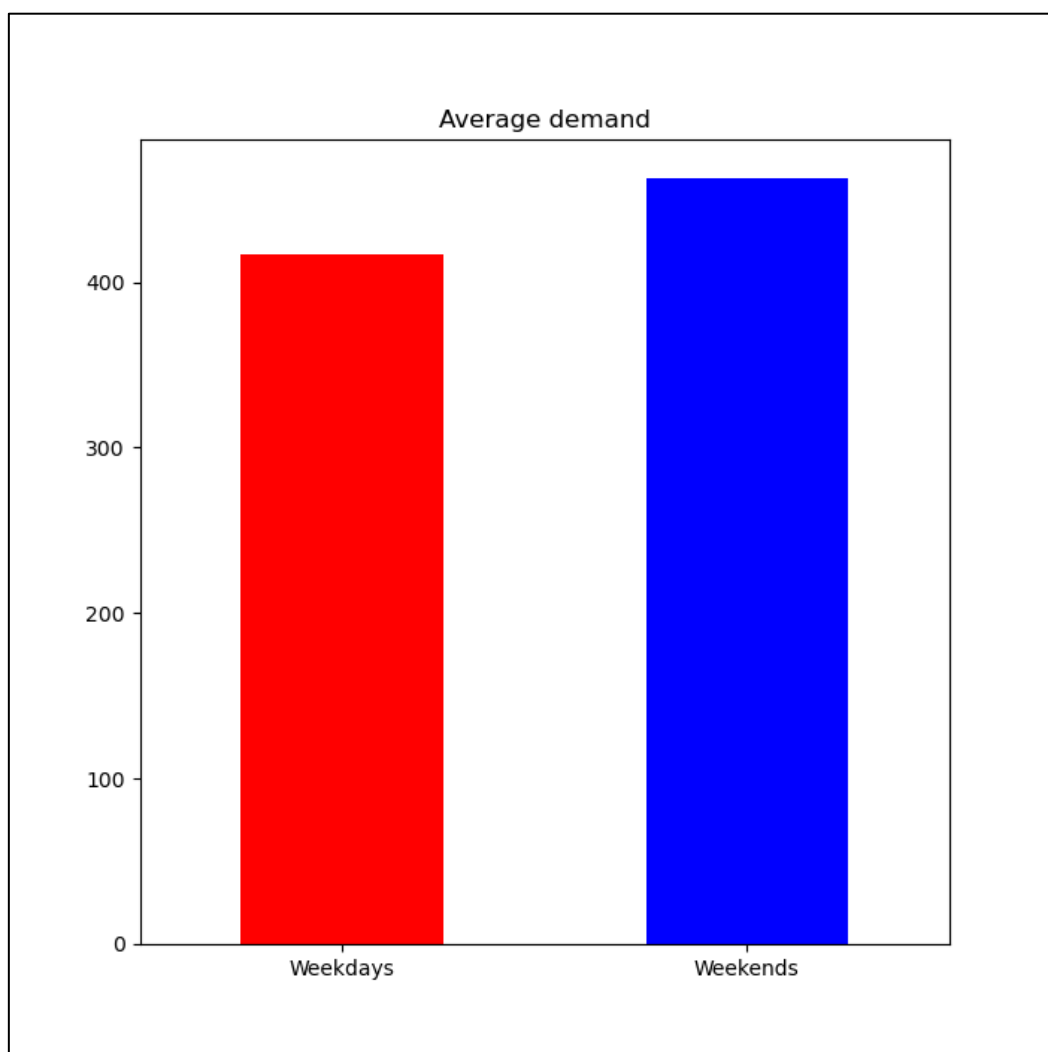
Pricing proposal

Based on the analysis of the mentioned factors, I created a list of potentially beneficial pricing changes, respectively, overall company policy. I divided the proposed changes into categories according to the target group.

1) **University staff**

   As I mentioned, the local university supports its staff in using bicycles as their primary means of transport. As the current number of employees is 15396 (3% of the city's total population) [13], this group of people represents a potentially large number of clients. At the current price of a 90-day ticket, it would be worthwhile to buy a new bicycle instead of renting it when used for more than 33 years. At the same time, the company could start cooperating with the university and offer them a longer-term cost-effective ticket, which would make this service even more attractive.

2) **Students**

   Another group that the company could focus on our students. There are 30,519 full-time students in the city, and another 10,793 are studying externally in the town. There are 41,312 students in Edinburgh (8% of the total population) [14]. I think that the potential for gaining students as regular customers is sufficient. I believe that a certain price advantage could attract students to travel by bike. I think that such a discount could be interesting for an annual ticket. The one-time fare could be left without a discount, as at the same time, many tourists come to the city every year to buy short-term tickets.

3) **Elderly people**

   The city's aging report speaks of an increase in the population aged 65+ by 77,000 by 2041 [6]. Such a significant increase in the elderly population will want to be captured by the city in time. Given the need for healthy exercise, especially in times of pandemic, it could be helpful to promote cycling among the elderly. Again, I think that a possible discount on a long-term ticket could make this mode of transport accessible to pensioners. Just Eat Cycles also offers electric bicycles, which allows even the less physically fit to travel. This fact further increases the potential to attract older people.

4) **Tourists**

   The last but no less critical category are tourists. Tourism has been on the rise in Edinburgh in recent years. Between 2013 and 2017, the number of tourists increased by 28%, with up to 4.9 million people visiting the city in 2017 [6]. The company could use this undeniable potential in several ways. One of them is the creation of a service for a tour of historical monuments in the city. Tourists would pay for a bike and a guide, who would take them to the historic center. The second option is to cooperate with hotels that could offer their guests a coupon for a 20% discount on a ticket from Just Eat Cycles.

Sources:
Pictures:
1) Weather: https://www.holiday-weather.com/edinburgh/averages/
2) BBC News: https://www.bbc.com/news/uk-scotland-54253224

Text:
[1] https://www.cyclingweekly.com/news/latest-news/new-9m-cycle-route-proposed-for-edinburgh-196584

[2] Edinburgh city budget 2012/2013: http://www.spokes.org.uk/wp-content/uploads/2012/02/1202-Administration_Budget_Motion_2_.pdf

[3] Sustrans: https://www.sustrans.org.uk/about-us/

[4] Sustrans gift to the city: https://www.cyclingweekly.com/news/latest-news/edinburgh-cycling-infrastructure-gets-5m-boost-168601

[5] https://www.connectingedinburgh.com/citycentre

[6] ECCT plan: https://democracy.edinburgh.gov.uk/documents/s6001/Item%207.1%20-%20ECCT%20Final%20Strategy%20with%20all%20appendices.pdf

[7] Cycle to Work: https://www.ed.ac.uk/transport/cycling/getting-a-bike/cycle-to-work

[8] Transport Scotland: https://www.cyclinguk.org/news/cycling-scotland-has-more-doubled

[9] Expansion of cycle paths : https://www.scotsman.com/news/transport/pop-cycle-lanes-and-widened-pavements-edinburgh-and-glasgow-2545363

[10] Temporary cycle paths: https://www.edinburghnews.scotsman.com/health/coronavirus/edinburgh-introduce-segregated-cycle-lanes-routes-hospitals-2864267

[11] Cycling Scotland: https://www.cycling.scot/news-article/sustained-increase-in-cycling-despite-further-easing-of-lockdown-in-scotland

[12] BBC News: https://www.bbc.com/news/uk-scotland-54253224

[13] University of Edinburgh: https://www.ed.ac.uk/human-resources/about/facts-figures

[14] Students in Edinburgh: https://www.ed.ac.uk/about/annual-review/student-numbers