Using SQL to Answer a Simple Question: How Many Customers Still Use DSL?

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D205: Data Acquisition

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A. Research Question

For this project, I selected the question "How many customers in each pre-determined age group still use DSL for their internet service?" This question is business-relevant because DSL is becoming quickly outdated, and it would be helpful to get a better understanding of how many customers may need to be persuaded into subscribing to newer services. Filtering this question into age groups can help tailor targeted marketing campaigns.

A1. Identifying Data

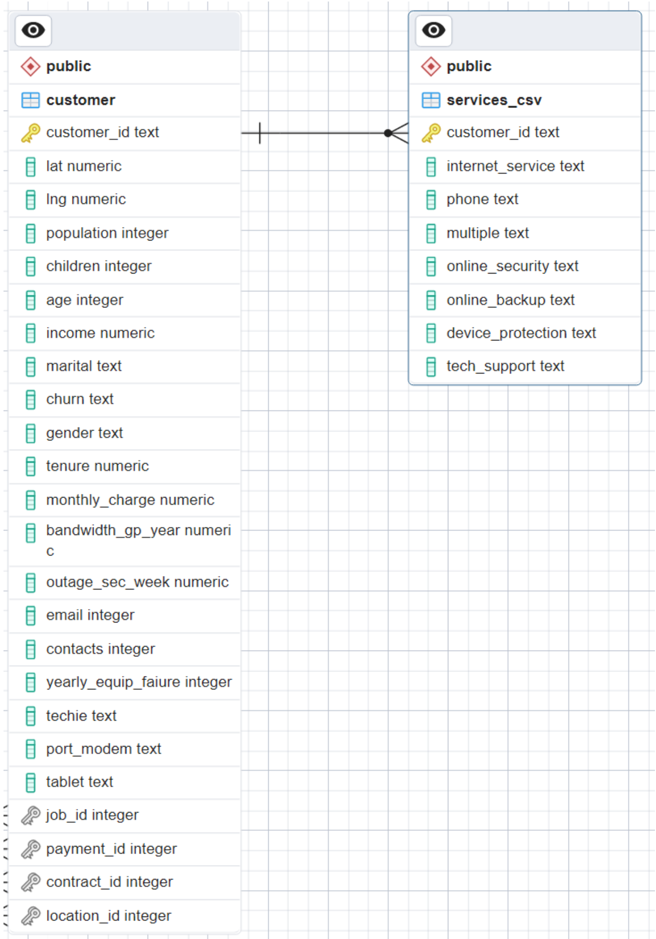
This question requires several columns. From the original dataset in the churn database, I will need to use the customer_id and age columns. The customer_id column is also present in the add-on CSV file titled "services.csv," which I will use to join the CSV data to the customer table in the original dataset. Once the join is complete, I will also need the internet_service column from the add-on CSV file to answer the research question. In addition, this question requires that I pre-define age groups. For these, I will use age groups commonly found in both online and paper surveys, starting from a minimum age I will determine by querying the dataset.

B. Logical Data Model

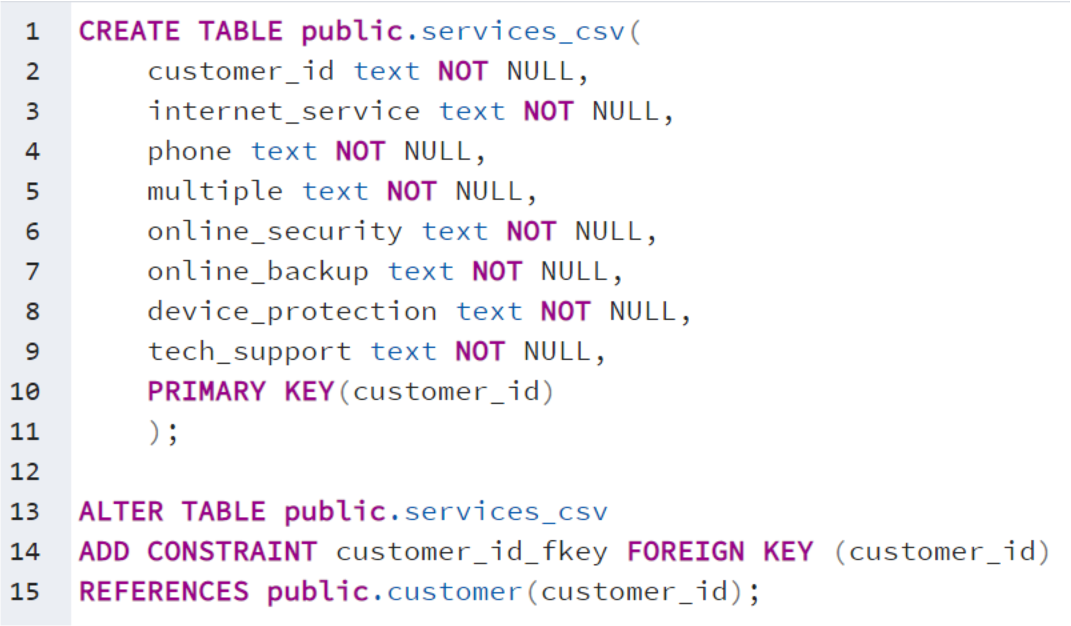
I will be using the services.csv file for this research question. I will import the entire file into a table which I will name "services_csv." The header names in the CSV file will be used for the column names in the new table. For each column, I will use the text datatype. The customer_id column will eventually serve as a foreign key, as noted below. Since the customer_id column of the customer table is also stored as text, choosing text for this column will allow this constraint. Since the negative answers in this file are always recorded as "No" or "None" instead of null, I will also add NOT NULL constraints to every column.

In the new table, the customer_id column will serve as both the primary key for the table and also as a foreign key referencing the customer_id column in the customer table in the original dataset. The customer_id column makes a good primary key for the new table since two customers cannot share a customer ID, and any updates to the services a customer receives should be reflected by altering an existing record for that customer, not via the creation of an entirely new record. By making the customer_id column a foreign key, we also maintain relational integrity between the customer table and the new table: a customer should not and cannot be added to the services_csv table without already being present in the customer table.

Below is the ERD generated by pgAdmin using the "Generate ERD" functionality. This diagram illustrates the relationships described above for the new table, as well as the original customer table that will be involved in my SQL query used to answer the research question. Please note that while the diagram below shows a one-to-many relationship between the customer table and the services_csv table, it is in fact one-to-one. PgAdmin does not currently support showing a one-to-one relationship in ERD diagrams, only one-to-many and many-to-many (PgAdmin Development Team, 2023).



B1. Code for the Physical Data Model

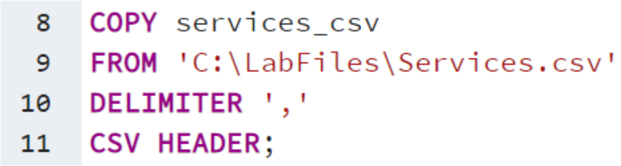


```sql
CREATE TABLE public.services_csv(
    customer_id text NOT NULL,
    internet_service text NOT NULL,
    phone text NOT NULL,
    multiple text NOT NULL,
    online_security text NOT NULL,
    online_backup text NOT NULL,
    device_protection text NOT NULL,
    tech_support text NOT NULL,
    PRIMARY KEY(customer_id)
    );

ALTER TABLE public.services_csv
ADD CONSTRAINT customer_id_fkey FOREIGN KEY (customer_id)
REFERENCES public.customer(customer_id);
```

The above code generates the new table services_csv and assigns the constraints described in section B.

B2. Loading CSV Data

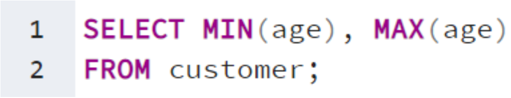


```
COPY services_csv
FROM 'C:\LabFiles\Services.csv'
DELIMITER ','
CSV HEADER;
```

The code above loads the services.csv data into the newly created services_csv table.

C. SQL Query

Before writing the query that will answer the research question, I first need to know the minimum and maximum ages of all customers in the customer table. While I could skip this step and simply create age groups ranging from 0 to an unbounded maximum, I felt it would be better to limit the number of age groups so as not to have an unwieldy CASE statement in my query. In addition, completing this step will ensure there are no unneeded rows in the results once the query is run. The short query below was used to find this information. In section C1, I have pasted the results of this query and all queries to follow in section C.

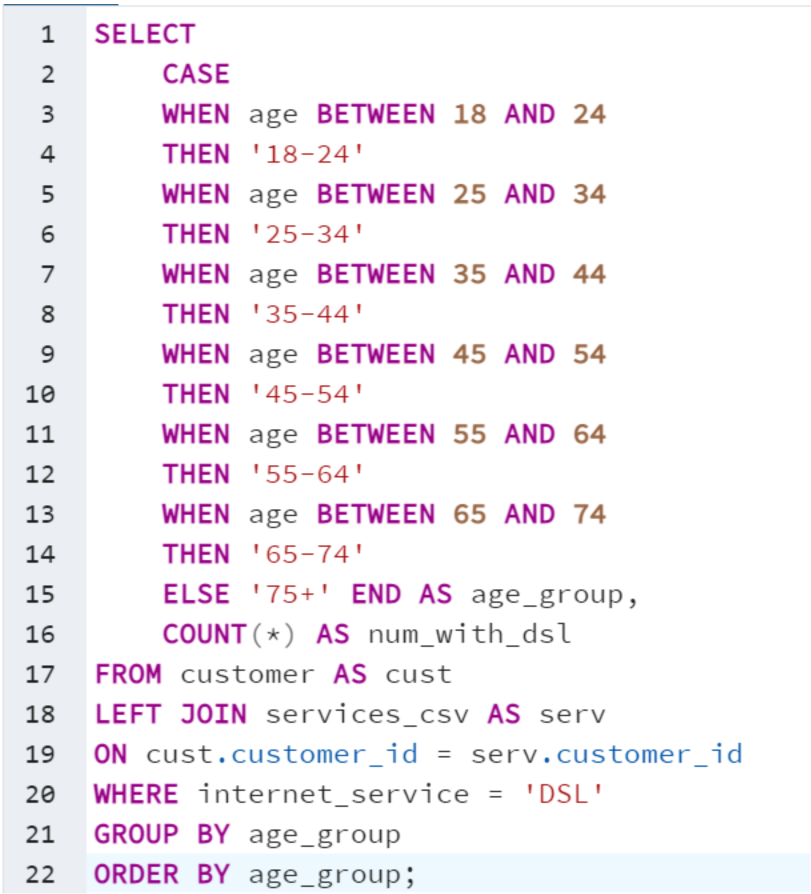


```
SELECT MIN(age), MAX(age)
FROM customer;
```

This query returns a minimum age of 18 and a maximum age of 89. Thus, I decided to start the age groups at 18, rather than zero. The age groups can be configured in any way that proves useful for analysis, but I chose to use roughly 10-year increments with the exception of the first age group and the last. Since the first age group begins with 18, this group will be 18-24 or a 6-year bracket since I cannot continue the pattern and use 15-24. This bracket is followed by

10-year brackets: 25-34, 35-44, and so on. For the last age bracket, I chose to use an ELSE clause and create a group for ages 75 or older, but this, again, was simply a choice I made. The pattern could be continued if it made sense for the data.

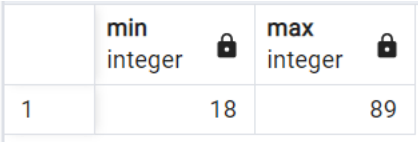
The query below creates these age brackets using a CASE statement aliased as age_group and informs the research question by calculating a COUNT of all rows that, after a left join between the left table customer and the right table services_csv on customer_id, have DSL as their internet service as listed in the column internet_service. The query groups by age_group so that it returns a count of customers in each age group. To make this easier to read, I also ordered the results by age_group so the groups would list in numerical order.



```sql
SELECT
    CASE
    WHEN age BETWEEN 18 AND 24
    THEN '18-24'
    WHEN age BETWEEN 25 AND 34
    THEN '25-34'
    WHEN age BETWEEN 35 AND 44
    THEN '35-44'
    WHEN age BETWEEN 45 AND 54
    THEN '45-54'
    WHEN age BETWEEN 55 AND 64
    THEN '55-64'
    WHEN age BETWEEN 65 AND 74
    THEN '65-74'
    ELSE '75+' END AS age_group,
    COUNT(*) AS num_with_dsl
FROM customer AS cust
LEFT JOIN services_csv AS serv
ON cust.customer_id = serv.customer_id
WHERE internet_service = 'DSL'
GROUP BY age_group
ORDER BY age_group;
```

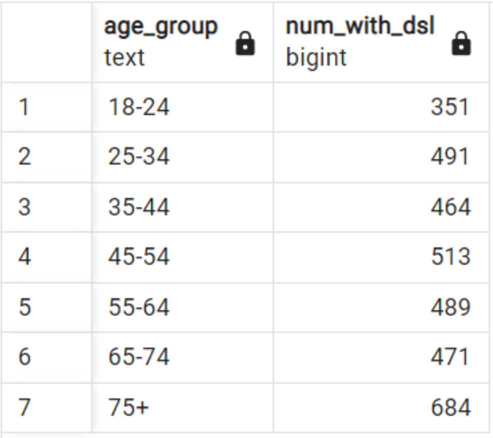
C1. CSV File

Below are the results of the query requesting the minimum and maximum age of all customers in the customer table.



	min integer	max integer
1	18	89

The next image shows the table that is displayed after running my main query, which will answer the research question.



	age_group text	num_with_dsl bigint
1	18-24	351
2	25-34	491
3	35-44	464
4	45-54	513
5	55-64	489
6	65-74	471
7	75+	684

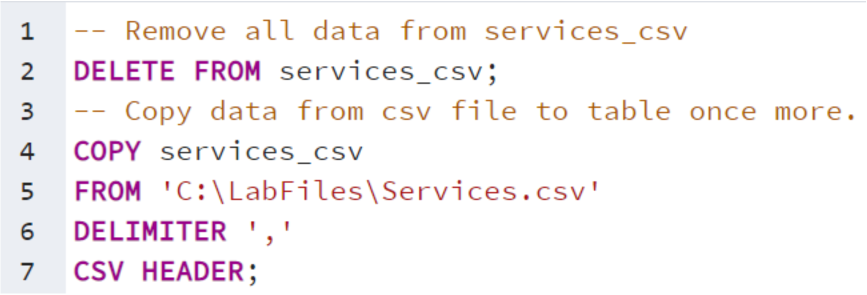
A CSV file with the main query results shown above is also submitted alongside this essay.

D. Add-On File

The information contained in the add-on file, services.csv, appears to be highly transactional. A customer could call in at any time to cancel, change, or add new services. Thus, this file could be updated daily, even if marketing campaigns are only run monthly or quarterly. It is valuable that this information is kept up to date so as to avoid frustrating customers who may have already changed their service from DSL to a more modern offering but continue to receive outdated marketing emails.

However, if there is an issue with updating that frequently, then the add-on file must, at minimum, be updated as often as there are marketing campaigns. For example, if marketing campaigns are quarterly, then the add-on file should be updated quarterly, but prior to the campaign run date.

E. SQL Script



```sql
1  -- Remove all data from services_csv
2  DELETE FROM services_csv;
3  -- Copy data from csv file to table once more.
4  COPY services_csv
5  FROM 'C:\LabFiles\Services.csv'
6  DELIMITER ','
7  CSV HEADER;
```

In order to refresh the data in the services_csv table, I must first clear the table of records. The first line of code under the comment does just this. If this step is skipped, the code starting on line 4 will try to add new records to the bottom of the table still containing the old rows. This will result in an error since many of the rows the code will attempt to insert are only updates to previously existing rows. Attempting to add a new row with the same customer_id as an existing row will violate the primary key constraint on customer_id.

After the table is cleared, the same SQL commands used in section B2 are used to load the refreshed services.csv file, so long as the file name and location have not changed. Should the file name or location change, the new path can be pasted in single quotes on line 5 of the above code.

F. Panopto Video

The Panopto video can be found in the appropriate D205 folder on Panopto.com, but here is a link to it as well: https://wgu.hosted.panopto.com/Panopto/Pages/Viewer.aspx?id=35b51bce-cd53-4283-9a66-b03200197c7e.

G. Web Sources

PgAdmin Development Team. (2023, June 29). *ERD Tool*. ERD Tool - pgAdmin 4 7.4 documentation. https://www.pgadmin.org/docs/pgadmin4/development/erd_tool.html

H. Sources

None were used.