DSCI 510 Submission 3

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I. MOTIVATION

With the growing concern over climate change and its impacts, finding ways to reduce greenhouse gas emissions has become a top priority for governments and individuals around the world. One of the major contributors to these emissions is transportation, particularly from vehicles that are powered by gasoline or diesel fuel. In recent years, electric vehicles (EVs) have emerged as a promising alternative to traditional gasoline-powered vehicles, offering lower emissions and reduced dependency on fossil fuels.

However, the adoption of EVs has been slow, with many consumers still hesitant to make the switch due to concerns over range anxiety, upfront costs, and the availability of charging infrastructure. To accelerate the transition to EVs, it is important to understand the factors that influence consumer behavior and the market demand for these vehicles.

One such factor is the price of gasoline, which has a direct impact on the cost of operating a gasoline-powered vehicle and the attractiveness of EVs as an alternative. As gas prices rise, consumers may be more willing to consider EVs as a viable option, leading to an increase in the number of EVs on the road.

Furthermore, the use of EVs has the potential to significantly reduce CO2 emissions from transportation, which is a critical step towards achieving global climate goals. By analyzing the relationship between gas prices, EV sales, and CO2 emissions, we can gain insights into the potential benefits of promoting EV adoption and developing policies that encourage the use of cleaner, more sustainable modes of transportation.

Therefore, the aim of this project is to investigate the relationship between gas prices, EV sales, and CO2 emissions from transportation, with the goal of understanding how these factors are interrelated and how they can be leveraged to achieve a more sustainable and low-carbon transportation system.

II. BRIEF DESCRIPTION OF DATA SOURCES

My project's data source consists of three components.

Weekly U.S. All Grades All Formulations Retail Gasoline Prices (Dollars per Gallon)

Year-Month	Week 1		Week 2		Week 3		Week 4		Week 5	
	End Date	Value	End Date	Value	End Date	Value	End Date	Value	End Date	Value
1993-Apr	04/05	1.068	04/12	1.079	04/19	1.079	04/26	1.086		
1993-May	05/03	1.086	05/10	1.097	05/17	1.106	05/24	1.106	05/31	1.107
1993-Jun	06/07	1.104	06/14	1.101	06/21	1.095	06/28	1.089		
1993-Jul	07/05	1.086	07/12	1.081	07/19	1.075	07/26	1.069		
1993-Aug	08/02	1.062	08/09	1.060	08/16	1.059	08/23	1.065	08/30	1.062
1993-Sep	09/06	1.055	09/13	1.051	09/20	1.045	09/27	1.047		
1993-Oct	10/04	1.092	10/11	1.090	10/18	1.093	10/25	1.092		
1993-Nov	11/01	1.084	11/08	1.075	11/15	1.064	11/22	1.058	11/29	1.051
1993-Dec	12/06	1.036	12/13	1.018	12/20	1.003	12/27	0.999		
1994-Jan	01/03	0.992	01/10	0.995	01/17	1.001	01/24	0.999	01/31	1.005
1994-Feb	02/07	1.007	02/14	1.016	02/21	1.009	02/28	1.004		
1994-Mar	03/07	1.007	03/14	1.005	03/21	1.007	03/28	1.012		
1994-Apr	04/04	1.011	04/11	1.028	04/18	1.033	04/25	1.037		
1994-May	05/02	1.040	05/09	1.045	05/16	1.046	05/23	1.050	05/30	1.056
1994-Jun	06/06	1.065	06/13	1.073	06/20	1.079	06/27	1.095		
1994-Jul	07/04	1.097	07/11	1.103	07/18	1.109	07/25	1.114		
1994-Aug	08/01	1.130	08/08	1.157	08/15	1.161	08/22	1.165	08/29	1.161
1994-Sep	09/05	1.156	09/12	1.150	09/19	1.140	09/26	1.129		
1994-Oct	10/03	1.120	10/10	1.114	10/17	1.106	10/24	1.107	10/31	1.121
1994-Nov	11/07	1.123	11/14	1.122	11/21	1.113	11/28	1.117		
1994-Dec	12/05	1.127	12/12	1.131	12/19	1.134	12/26	1.125		
1995-Jan	01/02	1.127	01/09	1.134	01/16	1.126	01/23	1.132	01/30	1.131
1995-Feb	02/06	1.124	02/13	1.121	02/20	1.115	02/27	1.121		
1995-Mar	03/06	1.123	03/13	1.116	03/20	1.114	03/27	1.121		
1995-Apr	04/03	1.133	04/10	1.149	04/17	1.163	04/24	1.184		
1995-May	05/01	1.194	05/08	1.216	05/15	1.226	05/22	1.244	05/29	1.246
1995-Jun	06/05	1.246	06/12	1.243	06/19	1.236	06/26	1.229		
1995-Jul	07/03	1.222	07/10	1.212	07/17	1.200	07/24	1.191	07/31	1.179
1995-Aug	08/07	1.174	08/14	1.172	08/21	1.171	08/28	1.163		
1995-Sep	09/04	1.160	09/11	1.158	09/18	1.157	09/25	1.156		
1995-Oct	10/02	1.151	10/09	1.144	10/16	1.133	10/23	1.125	10/30	1.115
1995-Nov	11/06	1.112	11/13	1.109	11/20	1.106	11/27	1.107		
1995-Dec	12/04	1.108	12/11	1.110	12/18	1.124	12/25	1.128		
1996-Jan	01/01	1.129	01/08	1.139	01/15	1.145	01/22	1.138	01/29	1.133
1996-Feb	02/05	1.130	02/12	1.126	02/19	1.133	02/26	1.153		
1996-Mar	03/04	1.170	03/11	1.171	03/18	1.181	03/25	1.210		
1996-Apr	04/01	1.223	04/08	1.248	04/15	1.287	04/22	1.301	04/29	1.318
1996-May	05/06	1.321	05/13	1.323	05/20	1.330	05/27	1.321		
1996-Jun	06/03	1.315	06/10	1.307	06/17	1.302	06/24	1.289		
1996-Jul	07/01	1.279	07/08	1.276	07/15	1.273	07/22	1.272	07/29	1.263
1996-Aug	08/05	1.253	08/12	1.248	08/19	1.249	08/26	1.253		
1996-Sep	09/02	1.242	09/09	1.247	09/16	1.250	09/23	1.251	09/30	1.245
1996-Oct	10/07	1.239	10/14	1.248	10/21	1.249	10/28	1.260		
1996-Nov	11/04	1.268	11/11	1.272	11/18	1.282	11/25	1.289		
1996-Dec	12/02	1.287	12/09	1.287	12/16	1.283	12/23	1.278	12/30	1.274

FIG. 1. Part of the table shows weekly gas price

HEADER:

```
X-Params: {
    "frequency": "annual",
    "data": [
        "value"
    ],
    "facets": {
        "stateId": [
            "CA"
        ],
        "sectorId": [
            "TC"
        ],
        "fuelId": [
            "NG"
        ]
    },
    "start": null,
    "end": null,
    "sort": [
        {
            "column": "period",
            "direction": "desc"
        }
    ],
    "offset": 0,
    "length": 5000
}
```

FIG. 2. JSON format of CO2 emission data

The first component[1] involves 'Web scraping'. This data displays the Weekly U.S. All Grades All Formulations Retail Gasoline Prices (Dollars per Gallon) from 1993 to the present day. A table, as shown in Figure 1, can be found on this website. And we can 'web scrape' this table.

The second component involves accessing an API [2]. By accessing this free API created by the US government, we can easily obtain CO2 emission data for each year. We can even delve deeper into the data to access CO2 emissions by state, sector, and fuel type. The JSON file structure that we can obtain is illustrated in Figure 2.

The third component involves the number of electric cars for each year. We can simply download an .xlsx file from this website[3] to obtain this data.

III. ANALYSIS PERFORMED

In my thesis, I investigated the relationship between gas price, CO2 emission, and the adoption of electric cars. To accomplish this, I conducted three separate analyses using linear regression models.

The first analysis I conducted focused on the relationship between gas price and the number of electric cars. I constructed a linear regression model to explore this relationship, as shown in Figure 3. The results revealed a strong positive correlation between gas prices and the number of electric cars, as evidenced by the positive slope of the linear regression line. This suggests that as gas prices increase, more people may be willing to adopt electric cars.

The second analysis aimed to investigate the relationship between CO2 emission and the adop-

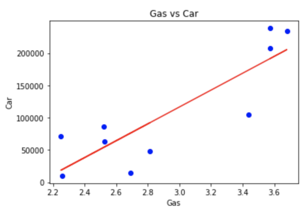

FIG. 3. Gas price vs number of cars

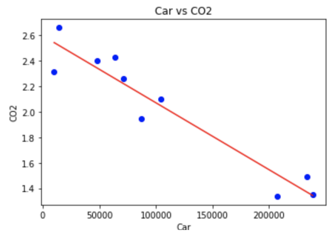

FIG. 4. number of cars vs co2 emission

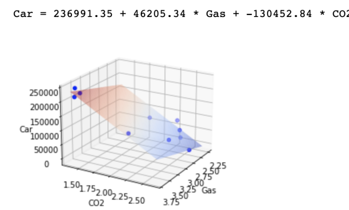

FIG. 5. regression model

tion of electric cars. I built a linear regression model to explore this relationship, as shown in Figure 4. The findings revealed a strong negative correlation between CO2 emission and the number of electric cars, as indicated by the negative slope of the linear regression line. This suggests that electric cars can significantly contribute to reducing CO2 emissions and benefit the environment.

Finally, I developed a multiple linear regression model to examine the relationship between gas price, CO2 emission, and the adoption of electric cars. The model, presented in Figure 5, had the mathematical format of Car = 236991.35 + 46205.34 * Gas + -130452.84 * CO2. The intercept of the model represented the expected number of cars when both gas price and CO2 emissions were zero. The results showed that the coefficient of the Gas price variable was positive, indicating that an increase in gas price led to an increase in the adoption of electric cars, while the coefficient of the CO2 emission variable was negative, indicating that an increase in CO2 emission led to a decrease in the adoption of electric cars. These findings not only provide valuable insights into the factors that influence the adoption of electric cars but can also guide policymakers in developing effective strategies to promote sustainable transportation.

IV. ANALYSIS PERFORMED

Based on the results of my analyses, it can be concluded that there is a significant relationship between gas price, CO2 emission, and the adoption of electric cars.

The first analysis showed a strong positive correlation between gas price and the number of electric cars, indicating that as gas prices increase, more people may be willing to adopt electric cars. The second analysis revealed a strong negative correlation between CO2 emission and the number of electric cars, suggesting that electric cars can significantly contribute to reducing CO2 emissions and benefit the environment.

Finally, the multiple linear regression model demonstrated that both gas price and CO2 emission are important predictors of the adoption of electric cars. Specifically, an increase in gas price led to an increase in the adoption of electric cars, while an increase in CO2 emission led to a decrease in the adoption of electric cars.

These findings highlight the potential for electric cars to play a critical role in promoting sustainable transportation and reducing greenhouse gas emissions. Policymakers and industry leaders can use these results to develop effective strategies to promote the adoption of electric cars, such as implementing incentives for consumers to purchase electric cars or investing in infrastructure to support electric vehicle charging.

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[1] Weekly u.s. all grades all formulations retail gasoline prices (dollars per gallon), https://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=pet&s=emm_epm0_pte_nus_dpg&f=w.

[2] Co2 emission, https://www.eia.gov/opendata/browser/co2-emissions/co2-emissions-aggregates?frequency=annual&data=value;&facets=stateId;sectorId;fuelId;&stateId=CA;&sectorId=TC;&fuelId=NG;&sortColumn=period;&sortDirection=desc;.

[3] Number of ev each year, https://www.bts.gov/content/gasoline-hybrid-and-electric-vehicle-sales.