

Overview

Understanding the alternative fuel vehicles market in the US

Introduction

Business Context. You are an analyst at the ICCT ([International Council on Clean Transportation](#)), an NGO that provides research to environmental authorities around the world. You are part of a team that is preparing a report on the alternative fuel vehicles (AFV) market in the United States, with a particular focus on the state of Washington.

Business Problem. Your job is to **provide a characterization of the AFV market in the US and in Washington, including data about the energy efficiency of the vehicles over time, geographical distribution, etc.**

Analytical Context. You will be working with the [vehicles.xlsx](#) Excel file that contains four tabs of raw data. The first one is the sales tab, which contains aggregated sales figures for the U.S. The second one is the models tab, which contains data on the EV type. The third one is the range_data tab, which has data about ranges of electric vehicles. These data files come from the US Department of Energy. The last one is ev_data tab, which is a census of all the electric vehicles in circulation in Washington state. This census data comes from the Washington State Department of Licensing.

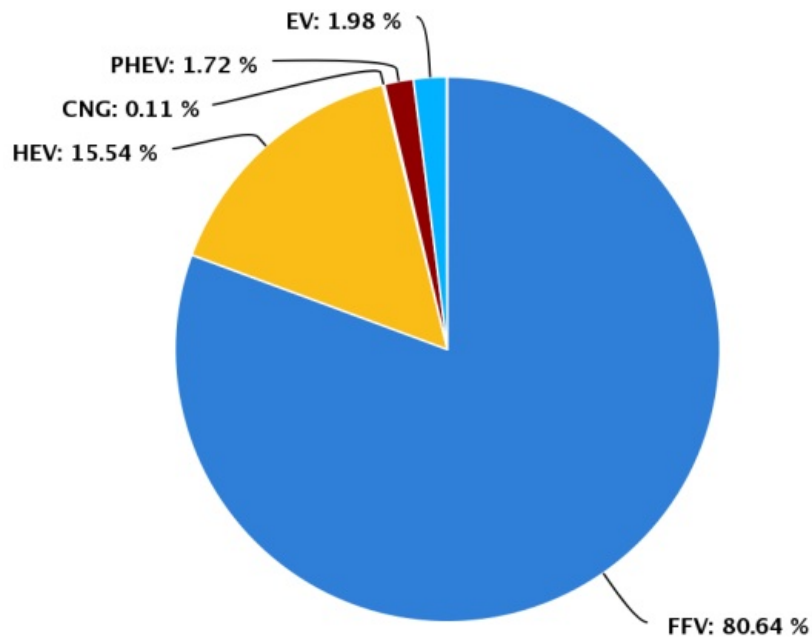
Instructions: For this extended case, you will only submit one Excel file with your answers written in the ANSWER tab. Each question will have its specific designated field that you will be placing your answers into. Continue for further instructions.

Alternative fuel vehicles in the US

[Alternative fuel vehicles \(AFV\)](#) are vehicles that run either partially or totally on an energy source that is not gasoline or diesel, such as ethanol, solar power, electricity, or hydrogen. Some AFVs are highly efficient and, perhaps more importantly, have reduced greenhouse gas emissions relative to traditional vehicles, which makes them an important part of environmental recovery and protection plans around the globe.

This chart shows the distribution of light-duty AFVs in the US as of Dec. 31, 2018:

Light-Duty AFV Registrations



Legend: *FFV*: Flexible fuel vehicle (cars that run on biofuels or mixtures of gas and biofuels - most of the FFVs in the US operate primarily on gasoline, see [here](#) for more information). *HEV*: Hybrid electric vehicle. *CNG*: Compressed natural gas. *EV*: Electric vehicle. *PHEV*: Plug-in hybrid electric vehicle. PHEVs and EVs are often counted as a single category, Plug-in electric vehicles (*PEVs*). **Source:** Alternative Fuels Data Center, US Department of Energy.

Note: Chart totals add to 99.99 due to rounding. This is not uncommon, but a good reason to avoid pie charts.

Exercises 1-5

Exercise 1

Write a paragraph with an interpretation of this chart in your own words.

Instructions: Write your analysis in the Q1 “WRITTEN ANSWER” box in the ANSWER tab.

Use at least two evidence-based examples to support arguments. Your response should be clear and concise without grammatical and spelling errors.

Note: For response-based questions, answers should be clear, and your reasoning should be supported with evidence. For instance, you can compare and contrast various types of EVs based on their respective market proportions and state reasons behind their market presence in 2018.

Exercise 2

Read the excerpt from [this page](#) about flexible fuel vehicles:

Flexible fuel vehicles (FFVs) have an internal combustion engine and are capable of operating on gasoline and any blend of gasoline and ethanol up to 83%. E85 (or flex fuel) is a gasoline-ethanol blend containing 51% to 83% ethanol, depending on geography and season. According to IHS Markit, as of 2017, there were more than 21 million FFVs in the United States. Because FFVs are factory-made and are capable of operating on gasoline and gasoline-ethanol blends, many vehicle owners don't realize their car is an FFV and that they have a choice of fuels to use.

Given the additional information you gained from this excerpt, does the meaning you took from the graph change? Explain your answer.

Instructions: Write your analysis in the Q2 “WRITTEN ANSWER” box in the ANSWER tab.

Exercise 3

Your team would like to know how the sales of fully electric vehicles compare to those of plug-in hybrid electric vehicles over time. The models worksheet has a list of all the models in the dataset with their type (either EV or PHEV), and the sales worksheet shows how many units were sold of each model in each year between 2011 and 2019.

Instruction:

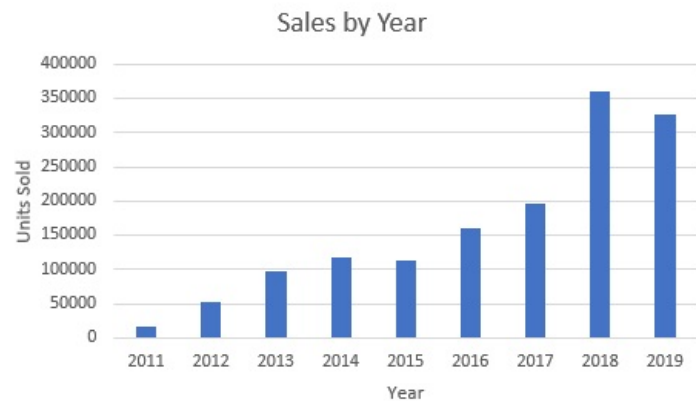
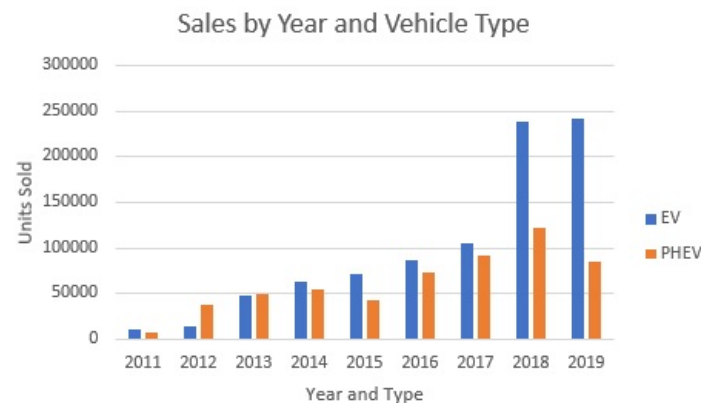
1. Complete “Column D” in the sales tab.
2. Make a pivot table using the information above for the rows and columns and insert it in cell A1 in the Pivot Table 1 tab).

	A	B	C	D
1				
2	Sum of Units sold	Column Labels		
3	Row Labels	EV	PHEV	Grand Total
4	2011			
5	2012			
6	2013			
7	2014			
8	2015			
9	2016			
10	2017			
11	2018			
12	2019			
13	Grand Total			
14				

Getting Started: You will need to use the INDEX() and MATCH() functions.

Exercise 4

The figures you have just calculated can be represented using the plots below. Provide a paragraph in which you explain in your own words what can be inferred from them:



Instructions: Write your analysis in the Q4 “WRITTEN ANSWER” box in the ANSWER tab.

Respond to the question with at least two logical arguments. Mention derivations of two of the key points. Use at least two evidence-based examples to support arguments. Paragraphs should be logical, easy to understand, and generally free of spelling errors.

Exercise 5

Let’s now investigate the range of electric vehicles in the US. The range of an electric vehicle is the theoretical number of miles it can travel without needing to be recharged.

The data can be found in the range_data tab. It contains range data for a number of EV models in the form of text strings. For example, 2013 Toyota - Scion Iq 038 means that the range of a Toyota Scion Iq model 2013 is 38 miles. Your job is to use Excel functions to create a table out of this data with the four columns YEAR, MAKE, MODEL, and RANGE, to end up with something like this:

	A	B	C	D	E	F
1	ORIGINAL DATA		YEAR	MAKE	MODEL	RANGE
2	2011 BMW	Active E 094	2011	BMW	Active E	94
3	2011 Nissan	Leaf 073	2011	Nissan	Leaf	73
4	2011 smart	fortwo 063	2011	smart	fortwo	63
5	2012 Azure Dynamics	Transit Connect E 056	2012	Azure Dyn	Transit Co	56
6	2012 Ford	Focus 076	2012	Ford	Focus	76
7	2012 Mitsubishi	PAJERO	2012	Mitsubishi	Pajero	63

Instructions:

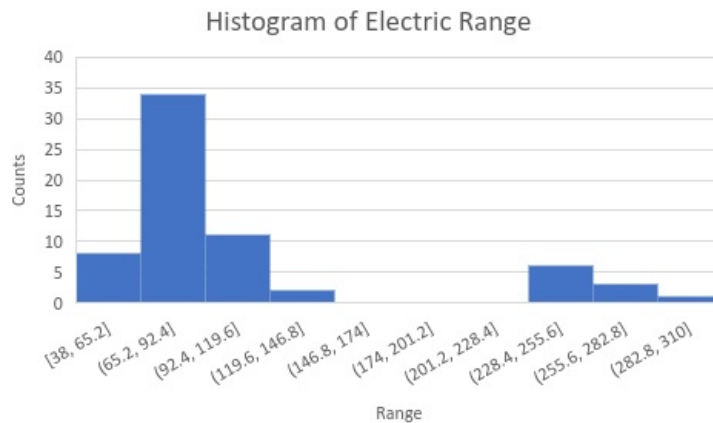
1. Split Column A using Text-to-Column Feature
2. Complete Column C
3. Complete Column D
4. Complete Column E
5. Complete Column F

Getting Started: Use the `FIND()`, `LEN()`, `RIGHT()`, `LEFT()`, `TRIM()`, and `VALUE()` functions to wrangle the data. It is also useful to start with Text to Columns, available under the Data tab, and split by -. Notice that all years have four characters, and all ranges have three. You must recreate all four columns for credit, but as long as you can extract the year and mileage, you will be able to complete exercises 6 and 7.

Exercises 6-9

Exercise 6

This is a histogram made with the data from Exercise 5:



6.1

Recreate this histogram on the range_data sheet.

Instructions: Be sure to consider each feature of the histogram:

1. Number of Bins (10)
2. Axis Labels
3. Title

Once the chart is complete, copy the chart and paste it in the Q6.1 “CHART ANSWER” box in the ANSWER tab.

6.2

There is a gap in the interval from ~147 to ~228 miles. What does that mean? What could be causing it?

Instructions: Write your analysis in the Q6.2 “WRITTEN ANSWER” box in the ANSWER tab.

Respond to the question with at least two logical arguments. Mention the derivations of two of the key points. Use at least two evidence-based examples to support arguments. Paragraphs should be clear, easy to understand, and generally free of spelling errors.

Exercise 7

7.1

Create a pivot table showing the average range for each year.

Instructions: Insert your pivot table in cell A1 in the Pivot Table 2 tab.

7.2

Use your pivot table to answer this question: How has the average range changed over time? (Do newer cars have longer ranges?)

Instructions: Write your analysis in the Q7.2 “WRITTEN ANSWER” box in the ANSWER tab.

Respond to the question with one or two logical arguments. The response should be clear, easy to understand, and generally free of spelling errors.

Electric vehicle population in Washington state

Let’s now move on to studying the population of electric vehicles in Washington State using pivot tables. The relevant tabs are `ev_data` and `sales`.

Note: There are vehicles with states other than Washington in the “State” field. There is no error in the dataset. It contains all EVs that were *registered* in Washington in the given period. The “State” field is the state where the owner *resides*. There are vehicles that were registered in Washington but whose owners live somewhere else. See the data dictionary [here](#).

Exercise 8

Complete the following two questions by creating a pivot table for each question. Both pivot tables should be placed in their own separate sheets titled Pivot Table 3 and Pivot Table 4. Use the output to answer each question in a complete sentence.

8.1

What are the 5 most popular makes of electric vehicles registered in Washington (considering the entire dataset)?

Instructions:

1. Make a pivot table in cell A1 in the Pivot Table 3 sheet.
2. Provide a quick summary of the top 5 makes in Washington in the Q8.1 “WRITTEN AND PIVOT TABLE ANSWER” box in the ANSWER tab.

8.2

What are the most common model years in Washington? (The answer to this question would be the 5 years that had the most models.) Please answer the following question. Does this result and that of the previous

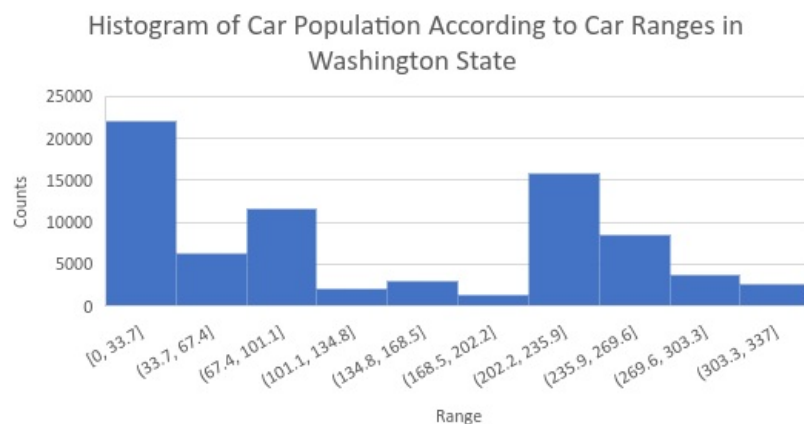
exercise suggest that cars in Washington tend to have long ranges?

Instructions:

1. Make a pivot table in cell A1 in the Pivot Table 4 sheet.
2. Provide a quick summary of the top 5 most common model years in Washington in the Q8.2 “WRITTEN AND PIVOT TABLE ANSWER” box in the ANSWER tab.

Exercise 9

This is a histogram of vehicles in Washington state according to their ranges.



9.1

Recreate this histogram and place it to the right of the data on the ev_data sheet.

Instructions: Be sure to consider each feature of the histogram:

1. Number of Bins (10)
2. Axis Labels
3. Title

Once the chart is complete, copy the chart and paste it in the the Q9.1 “CHART ANSWER” box in the ANSWER tab.

9.2

Is this histogram consistent with the hypothesis that cars there tend to have long ranges?

Note: While the histogram you analyzed in Exercise 6 showed the distribution of ranges from a list of *models*, this histogram shows you the distribution from a list of *individual vehicles*, and therefore the two histograms are not comparable. The dataset from Exercise 6 had 65 models, while the Washington state dataset has 76,767 vehicles.

Instructions: Write your analysis in the Q9.2 “WRITTEN ANSWER” box in the ANSWER tab.

Submission Instructions

Be sure to turn in a single Excel file. Your Excel files should only have the following tabs: ev_data, range_data, models, sales, Pivot Table 1, Pivot Table 2, Pivot Table 3, Pivot Table 4, ANSWER, TA Feedback and TA ONLY.

Attribution

“Light-Duty AFV Registrations”, Aug 2020, Alternative Fuels Data Center, U.S. Department of Energy, [Public Domain](https://afdc.energy.gov/data/10861), <https://afdc.energy.gov/data/10861>

“Electric Vehicle Population Data”, Aug 2021, Washington State Department of Licensing (DOL), [DOL Conditions of Use](https://catalog.data.gov/dataset/electric-vehicle-population-data), <https://catalog.data.gov/dataset/electric-vehicle-population-data>

“U.S. Plug-in Electric Vehicle Sales by Model”, Jan 2020, Alternative Fuels Data Center, U.S. Department of Energy, [Public Domain](https://afdc.energy.gov/data/10567), <https://afdc.energy.gov/data/10567>

“Average Range and Efficiency of U.S. Electric Vehicles”, Jan 2020, Alternative Fuels Data Center, U.S. Department of Energy, [Public Domain](https://afdc.energy.gov/data/10963), <https://afdc.energy.gov/data/10963>