# Background Information

In recent years, there has been a large transformation in the car market that is helping to deliver improved vehicle fuel efficiency. Enhancements to conventional gasonline engines, as well as the growing adoption of technologies such as turbocharges, hybrid batteries, and electric vehicles have helped to drmatically reduce the amount of oil required to operate new vehicles.

In the U.S., the Corporate Average Fuel Economy (CAFE) standards specifies minimum miles per gallon (MPG) rates that each manufacturer must meet. CAFE requirements are divided into two categories: passenger cars and light trucks/SUVs. Under federal regulations enacted in 2022, passenger cars and light trucks will be required to average 49 MPG as of the 2026 model year [1].

## Problem Statement

In this assignment, students will create a database to store and analyze fuel economy for vehicles in the compact, midsize, large sedan, SUV, and minivan categories from several major automobile manufacturers.

# Instructions

**IMPORTANT:** This assignment requires the Windows version of Microsoft 365. macOS users can access a ready-to-use installation through Windows Virtual Desktop by following the instructions at https://cs101.wvu.edu/wvd.

**IMPORTANT:** Complete the steps below in the order they are given. Completing the steps out of order may complicate the assignment or result in an incorrect result.

1.  Create a new Microsoft Access database named **hw4_*lastname_firstname*_vfep.accdb**.

2.  We would like to begin by making a table store the vehicle makes.

    a.  Create a table named *Makes* to store the make names, their make abbreviations, and if they are a domestic make. Designate the make abbreviation as primary key.

b.  Enter records for all makes below.

> **HINT:** The *Makes* table will contain 8 records.

| Make Abbreviation | Make Name | Domestic Make |
|---|---|---|
| CHEV | Chevrolet | Y |
| DODG | Dodge | Y |
| FORD | Ford | Y |
| HOND | Honda | N |
| TOYT | Toyota | N |
| CHRY | Chrysler | Y |
| TSLA | Tesla | Y |
| MAZD | Mazda | N |

3.  We need to store information on the categories in our dataset.

a.  Create a new table named *Categories* to store the category name and category abbreviation. Designate the category abbreviation as primary key.

b.  Enter records for all categories below.

> **HINT:** The *Categories* table will contain 5 records.

| Category Abbreviation | Category Name |
|---|---|
| COM | Compact |
| MID | Midsize |
| LRG | Large |
| MVN | Minivan |
| SUV | Sport Utility Vehicle |

4.  To finish adding our dataset, we must store the vehicle model information.

a.  Create a table named *Models* to store information on each car model (listed below under Step 4b). Some requirements for this table appear below.

> **IMPORTANT:** Completely define the *Models* table before entering records.

i.  For the primary key, use an AutoNumber-type field to store an ID number.

ii.  Provide a field to store the make. Using a lookup field referencing the *Makes* table, allow the user to select the make abbreviation and name (e.g., "DODG | Dodge") from a dropdown list.

Do not hide the key column. Store the value of the make abbreviation field. Enable data integrity, restricting deletes, on the relationship created by the Lookup Wizard.

iii. Provide a field to store the model name of the vehicle (e.g., "Charger" if the vehicle is a Dodge Charger).

iv. Provide a field to store the vehicle category. Using a lookup field referencing the *Categories* table, allow the user to select the vehicle category abbreviation and name (e.g., "SUV | Sport Utility Vehicle") from a dropdown list.

Do not hide the key column. Store the value of the vehicle category abbreviation field. Enable data integrity, restricting deletes, on the relationship created by the Lookup Wizard.

v. Provide a currency field with no decimal places to store the MSRP (manufacturer's suggested retail price) of the model.

vi. Provide a field to store the engine type. Using a lookup field, allow the user to select the transmission from a dropdown list. Permit the user to choose only from these values:

◇ Gasoline

◇ Hybrid

◇ Electric

vii. Provide a fixed-type number field with one decimal place to specify the engine size. For gasoline and hybrid vehicles, this value will represent displacement in liters; for electric vehicles, it is in hundreds of kilowatts. Use the *Double* field size.

viii. Include a yes/no field to specify if the vehicle's engine is turbocharged.

ix. Provide a standard-type number field with no decimal places to store the horsepower rating.

x. Provide an appropriately-formatted field to store the combined MPG estimate.

b. Enter the vehicle data below into your *Models* table as appropriate. The information is from 2023 and 2024 model year vehicles [2].

**HINT:** The *Models* table will contain 18 records.

| Make | Model Name | Category | MSRP | Eng. Type | Eng. Size | Turbo | HP | MPG |
|------|-----------|----------|------|-----------|-----------|-------|----|----|
| Honda | Civic Sedan | Compact | $25,045 | Gas | 2.0 | N | 158 | 35 |
| Mazda | Mazda 3 | Compact | $25,335 | Gas | 2.5 | N | 191 | 31 |
| Toyota | Corolla | Compact | $22,995 | Gas | 2.0 | N | 169 | 35 |
| Toyota | Prius | Compact | $28,745 | Hybrid | 2.0 | N | 194 | 57 |
| Chevy | Bolt EV | Midsize | $27,495 | Electric | 1.5 | N | 200 | 120 |
| Tesla | Model 3 RWD | Midsize | $38,990 | Electric | 1.4 | N | 192 | 132 |
| Toyota | Camry | Midsize | $27,515 | Gas | 2.5 | N | 203 | 32 |
| Toyota | Camry Hybrid | Midsize | $29,940 | Hybrid | 2.5 | N | 208 | 52 |
| Chrysler | 300 | Large | $37,110 | Gas | 3.6 | N | 292 | 23 |
| Honda | Accord | Large | $28,990 | Gas | 1.5 | Y | 192 | 32 |
| Honda | Accord Hybrid | Large | $33,920 | Gas | 2.0 | N | 204 | 44 |
| Chrysler | Pacifica | Minivan | $40,020 | Gas | 3.6 | N | 287 | 22 |
| Honda | Odyssey | Minivan | $39,215 | Gas | 3.5 | N | 280 | 22 |
| Toyota | Sienna | Minivan | $38,580 | Hybrid | 2.5 | N | 245 | 36 |
| Chevy | Equinox | SUV | $27,995 | Gas | 1.5 | Y | 175 | 28 |
| Ford | Escape | SUV | $29,495 | Gas | 1.5 | Y | 180 | 30 |
| Honda | CR-V | SUV | $30,825 | Gas | 1.5 | Y | 190 | 30 |
| Toyota | RAV4 | SUV | $29,825 | Gas | 2.5 | N | 203 | 30 |

5. Create separate queries to provide the information requested below. Name each query after the step in which it appears (e.g., name the query in Step 5a as *Query5A*).

**HINT:** Run your queries to test them. Make sure that they display all and only the records that you would expect to appear.

a. Create a query to display information on each vehicle. List the make name, model name, MSRP, MPG estimate, horsepower, and whether the vehicle is turbocharged.

Sort by MSRP in ascending order.

**HINT:** This query will show 18 records and 6 fields.

b.  We wish to explore fuel economy data. Create a query listing the make name, model name, MSRP, engine size, MPG estimate, horsepower, and engine type. Also, include a field to calculate the MPG-to-engine size ratio.

You can calculate the MPG-to-engine size ratio using the formula:
$$\frac{[Models.MPG]}{[Models.EngineSize]}$$

Format the calculated field as a standard-type number with 2 decimal places. Sort by horsepower in ascending order.

**HINT:** This query will show 18 records and 8 fields.

c.  Create a query to view information on domestic vehicles. List the make name, model name, category name, MSRP, MPG estimate, and the engine type.

Only display models from domestic makes. Do not show the domestic make field in the results.

**HINT:** This query will show 6 records and 6 fields.

d.  We wish to compare statistics by vehicle category. Create a query listing, for each category name, the count of its models, average of horsepower, and average of MPG estimates.

Format the count and averages as standard-type numbers with no decimal places.

**HINT:** This query will show 5 records and 4 fields.

e.  Create a query to compare makes. List, for each make name, the average of its MSRPs, average of horsepower, and average of MPG estimates.

Your results must include all makes, even if they have no models.

Format the average of MSRPs as currency with no decimal places. Format the average of MPG estimates and average of horsepower as standard-type numbers with no decimal places.

**HINT:** This query will show 8 records and 4 fields.

6.  Using the Form Wizard, create a form with subform. The main form should display the full make name. The subform must display a datasheet with all *Models* table fields.

Name the main form *VehicleData* and the subform *VehicleDataSubform*.

7.  Using the Report Wizard, create a report to show the results of the *Query5A* query. Display all fields from the query.

    View by make and sort by model name in ascending order. Use a stepped layout and landscape page orientation. Name the report *VehicleSummary*.

    Ensure the full widths of all columns are visible on the report.

8.  We need to create a new table to store analysis questions responses.

    a.  Create a table named *AnalysisQuestions* with the fields below. Use appropriate field types and designate a good primary key.

| Table: *AnalysisQuestions* | |
|---|---|
| **Field Name** | **Description** |
| **QuestionNumber** | Question being answered. |
| **Response** | Response to the analysis question prompt. |

9.  In the *AnalysisQuestions* table, answer three of the five analysis questions below. Respond to one question per record.

    a.  What sort of relationship exists between car prices (MSRPs) and fuel economy (MPG) estimates for gasoline (non-hybrid and non-electric) vehicles? Provide an explanation for the relationship.

    b.  Electric vehicles can be much cheaper to operate than gasoline-powered cars. With more electric vehicles becoming available, why might someone choose a gasoline-powered car over a comparable electric vehicle?

    c.  Most road funding currently comes from taxes on gasoline and diesel fuel. How does the growth of electric and plug-in hybrid vehicles affect this funding? What sort of alternative funding mechanisms might be used to compensate for the changes?

    d.  If many people were to switch to hybrid or electric vehicles, what effect might this have on fuel prices? What impact could there be on the cost benefits of the hybrids or electric vehicles themselves?

    e.  The Honda Accord is available in both gasoline and hybrid versions. The hybrid's MSRP is $4,930 higher than the gasoline version's MSRP. Assuming gasoline costs $3.335/gallon and the car is driven 15,000 miles per year, how long would it take to recoup the increased purchase price of the hybrid? Do you think choosing the hybrid option is a good financial choice? Explain your answer.

10. Run the Compact and Repair Database utility on your database. Ignore any errors you receive when running the utility.

# Homework #4
## Vehicle Fuel Economy Problem

## Grading Rubric

This assignment is worth 60 points. It will be graded by your instructor using this rubric, with partial credit awarded as appropriate:

| | | | |
|---|---|---|---|
| Steps 2a-b | 5 points total | Step 6 | 4 points |
| Steps 3a-b | 5 points total | Step 7 | 4 points |
| Step 4a | 6 points | Step 8a | 3 points |
| Step 4b | 4 points | Steps 9a-e (pick 3 of 5) | 3 points each |
| Steps 5a-e | 4 points each | | |

The analysis questions in Steps 9a-e will be evaluated using this rubric:

| Standard | Meets Requirements (1.5 points) | Does Not Meet Requirements (0 points) |
|---|---|---|
| Answer is reasonable. | Answer addresses the question prompt and is factually correct or a reasonable interpretation of available data. | Answer does not address the question prompt, is factually incorrect, or is an unreasonable interpretation of available data. |
| Answer is supported. | Logical rationale is provided to support the given answer. | Logical rationale is not provided to support the given answer. |

## Acknowledgments

The image in the introduction appears courtesy of Brian M. Powell [3].

## References

[1] "USDOT Announces New Vehicle Fuel Economy Standards for Model Year 2024-2026," *National Highway Traffic Safety Administration*, Apr. 01, 2022. Available: *https://www.nhtsa.gov/press-releases/usdot-announces-new-vehicle-fuel-economy-standards-model-year-2024-2026*.
[2] "Car and Driver," Oct. 27, 2023. Available: *https://www.caranddriver.com/new-cars/*.
[3] B. M. Powell, *GM Vehicles at the Renaissance Center in Detroit, MI*. 2019.