

INFO20003 Assignment 1 ER Modelling

Date Due: Friday 1st September 2017 10:00am AEST

Submission Attempts: 3 – (Only the last submitted assignment and .mwb file will be assessed)

Weighting: 10% of your total assessment

Case Study: Passenger Vehicle Emissions & Safety

In this assignment, you are assigned to do the job of a data designer working for the company of Tesslar Motor Manufacturing (TMM). This document first outlines new vehicle emission laws for the Republic of Moreland. Then outlines vehicle safety features and warnings that manufacturers need to report for each vehicle they sell. The instructions for your assignment task are detailed at the end of this document.

Vehicle emission laws of the Republic of Moreland

The Republic of Moreland government has recently introduced new vehicle emission standards. All vehicles sold in the republic now require a traffic light rating on the windscreens, so that the republic can encourage consumers to buy lower emitting vehicles. To support this initiative it has introduced three tier surcharge on annual registration for passenger vehicles. The idea is very similar - but not identical to - the European Union's emission standards.

A “green light” label indicates low or no emissions and currently attracts no surcharge. An “amber light” indicates emissions that are moderate and will attract a 10% surcharge on annual vehicle registration. A “red light” indicates high emissions and a 25% surcharge on annual vehicle registration. The categorisation of vehicle emissions as “red”, “amber” or “green” is calculated from information defined in the legislation. This emissions formula is not expected to change in the future.

Next to the traffic light label a summary of important emission standards must be provided:

- The emissions of Total Hydrocarbons (THC) in grams per kilometre of travel (g/km);
- The emissions of Carbon Monoxide (CO) in grams per kilometre of travel (g/km);
- The emissions of Non Methane Hydrocarbons (NMHC) in grams per kilometre of travel (g/km);
- The emissions of Nitrogen Oxides (NOx) in grams per kilometre of travel (g/km);
- The emissions of total Particulate Matter (PM) in grams per kilometre of travel (g/km)

In order to place this information in an appropriate context for consumers to make environmentally friendly choices, the amounts of THC (Total Hydrocarbons), NOx (Nitrogen Oxides) and CO

(Carbon Monoxide) are visually indicated as being “high” or “moderate”. Nothing is displayed if the emissions for THC, NOx and CO are low. The thresholds for what is needed to be considered “high”, “medium” and “low” for each vehicle emission could be changed by the Republic of Moreland government from time to time to meet its commitment to reduce emission targets set at UN climate conferences.

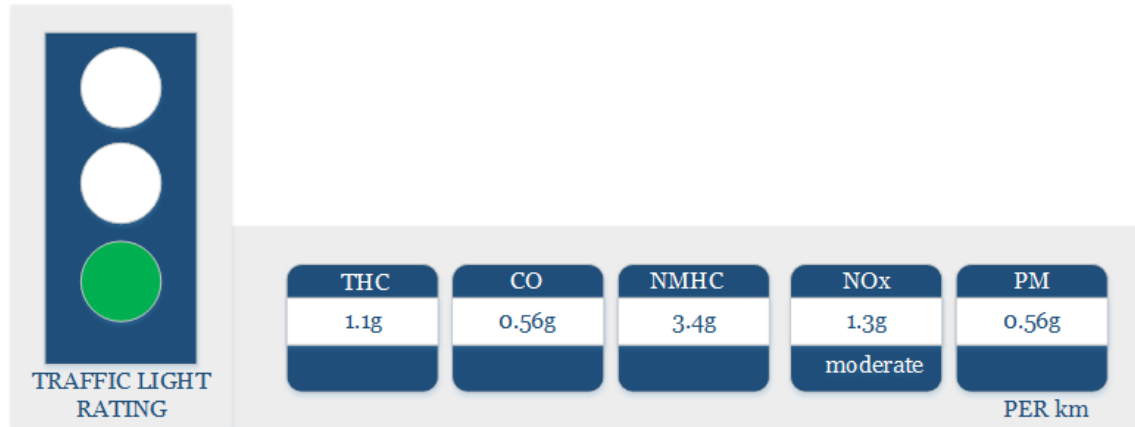


Figure 1: An example of Traffic Light Label as required by the government. This label would typically be included on the front window screen of the vehicle.

The Republic of Moreland also requires vehicle emission facts to be displayed on all forms of advertising including brochures, online advertising, printed advertising, television commercials and social media posts promoting the make and model.

The following information must be displayed in the advertising:

- The make of the passenger vehicle;
- The model of the passenger vehicle;
- The models seating capacity;
- The models fuel tank capacity;
- The fuel economy per 100km;
- The total emissions per 100km and per full tank;
- The total NOx emissions per 100km and per full tank;
- The THC emissions per 100km and per full tank;
- The methane hydrocarbons per 100km and per full tank;
- Particulate Matter per 100km and per full tank;
- The Republic of Moreland recommends that consumers purchase vehicles that meet THC/km at 0.07g/km or lower.

An example of the advertisement brochure is shown in Figure 2 (see below).

Either an “Emissions Certified From” or an “Emissions Certified Until” date must be included. It is also possible for advertising to have both an “Emissions Certified From” and an “Emissions Certified Until” published.

EMISSION INFORMATION: MAZDA3		
Make: Mazda, Model: 3		
Seating capacity: 5		Fuel Tank capacity: 51 litres
	Quantity Per full tank	Quantity Per 100km
Fuel Economy		7.2litre
Total Emissions	20g	2.4g
Total NOx emissions	15.0g	1.56g
THC emissions	4.0g	0.098g
Methane hydrocarbons	7.6g	0.007g
Particulate Matter	9.2g	0.001g
This vehicle will incur a 10% registration surcharge due to moderate emissions		
https://www.mazda.com.au/		Made in Japan

Figure 2 An example of the advertisement brochure (All these values are hypothetical and included to demonstrate one way in which the information can be displayed)

Next to the Emissions Information Panel must be a text description warning customers of registration surcharge for moderate and higher emitting vehicles. (For example, “This vehicle will incur a 10% registration surcharge”. There are a few details which must be in all advertising too:

- The majority country of origin where the passenger vehicle was manufactured (e.g. "Made in Australia", "Made in Spain"). This may change over time as vehicle manufacturers have a global supply chain;
- Website address related to the vehicle model and manufacturer;
- Maximum capacity of passengers;
- A QR code to be scanned for obtaining the publically available documentation of emissions testing documentation as required by the Republic of Moreland.

Vehicle Safety Standards for the Republic of Moreland

The Republic of Moreland has long led the world on passenger safety in an attempt to reduce preventable deaths by vehicle accidents. In 1974 it was the second nation behind Sweden to require

all passenger vehicles sold in the republic to be fitted with compulsory seat belts. This initiative witnessed a dramatic drop in the number of deaths due to passenger vehicle accidents.

The new emissions standards traffic light scheme and reporting has evolved from the original Safety Certification Shapes and warnings introduced to inform citizens of a vehicles safety. The Vehicle Safety Standards scheme uses a red hexagon to mimic a stop sign, an amber triangle to mimic the shape of a give way sign and a green circle to represent a green traffic light. The red hexagon identifies compliance with the minimum safety standard. The orange triangle represents compliance with the voluntary safety standards which provide higher levels of safety than the minimum standard. The **green circle** represents safety standards which exceed the voluntary standard and provide the highest level of vehicle safety.

With the ever increasing focus of reducing the republic's road toll each vehicle sold must notify customers of the passenger vehicle safety measures in four key areas:

- **Adult Occupants**
- **Child Occupants**
- **Pedestrian Safety**
- **Safety Assist (Overall vehicle safety category)**

For each category there is a mandated minimum standard which all vehicles must pass and a higher voluntary standard. If a vehicle exceeds the voluntary standard in the majority of criteria a green circle is awarded. If a vehicle meets the majority of criteria an Amber triangle is awarded. Lastly, for passing the mandated standard but failing to meet the voluntary safety standard for the majority of criteria a red hexagon is awarded. A passenger vehicle must pass the majority of standards at the prescribed level to use that shape and colour.

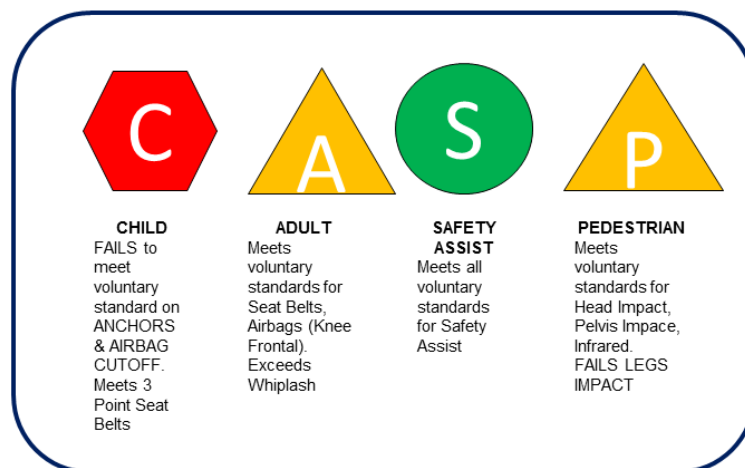


Figure 3: Sample "Safety Certification Shapes" - In the above example Child has a red hexagon because it fails to meet the voluntary standards for most tasks. The Adult rating is an amber triangle because the majority

of measures only meet the voluntary standard despite this vehicle exceeding the whiplash category. In the Pedestrian category the majority of voluntary standards are met and the only failure is listed in CAPITALS. The criteria for each category is listed below:

- Child Occupant
 - Manufacturer-fitted Child Restraint Anchors
 - Three-point seat belts for row 3 seats
 - Airbag Cutoff Switch
- Adult Occupant
 - Frontal Crash Protection
 - Frontal Airbag
 - Knee Airbag
 - Seat Belt Pretensioner
 - Seat Belt Load Limiter
 - Whiplash Rear Impact
 - Lateral Crash Protection
 - Side Head Airbag ("Curtain Airbag")
 - Side Chest Airbag ("Curtain Airbag")
 - Side Pelvis Airbag
- Pedestrian Safety
 - Head Impact
 - Pelvis Impact
 - Legs Impact
 - Infrared Collision Alert

Safety Assist

- Seatbelt Warning Light (Timed/Persistent)
- Grade 2 First Aid Kit
- Headlight and Taillight Lamp failure alert
- Wombat roll test results (whether the vehicle will survive a collision with a Wombat and stay upright)
- Electronic Stability Assist (formerly known as Anti Brake Skidding)
- Speed Assist (aka "Cruise Control")
- Hill Assist (prevents vehicle rolling backwards in neutral on hills)

Safety Certification Shapes like the example shown in Figure 3 will be displayed along with the Vehicle Emission Information (shown in Figure 2).

To provide passenger vehicle manufacturers a degree of certainty, vehicle safety standards are reviewed every five years and manufacturers have two years to submit their vehicles for assessment at the Republic's vehicle assessment recovery centre.

Tessler Motor Manufacturing (TMM)

TMM are a multinational vehicle manufacturing company. However, most of their operations are in the Republic of Moreland. The company is eager to comply with the new Republic of Moreland emission laws and obtain green lights for exceeding the voluntary safety laws.

Thus TMM need to design a database to store all the relevant information that is needed to generate product information that complies with the emissions and safety labelling laws of the Republic of Moreland. The CEO Nicola Tessler in conjunction with the CIO has mandated that MySQL be used as the company standard for all relational databases.

The TMM CEO has said that they face particular difficulties complying with the emission laws because of the changes in manufacturing from year to year. For example, the recent recall of TATA airbags has resulted in a heavier airbag replacement changing the fuel emissions results and resulting in all vehicles having to be reassessed for the safety certification shapes. Furthermore, stretched supply chains and materials shortages are causing increases in costs. The Republic of Moreland has mandated when vehicle manufacturing changes affect emission standards all historical data in the database must be stored for internal and government auditing. An example of the kind of audit would be an ad-hoc queries such as: *What NOx values would have appeared on a label for Tessler's model P two years ago or 11 days ago? When did Tessler's model P first obtain its green circle for child safety? Has any vehicle achieved 100% in a safety category?* Thus TMM has useful records of compliance with the old safety and new emission laws. The CEO would *prefer* the solution to be flexible to accommodate plausible changes to the safety and emission laws as global emissions standards are reviewed and as vehicle safety standards are revised.

Instructions

Your task for this assignment is to act as a database designer in the case study that has been provided.

You need to model the system described in the case study by creating a Conceptual Model of your solution using either Chen's notation or Crow's foot notation and a Physical Data Model using MySQL Workbench (using Crow's foot notation).

Both your conceptual and physical diagrams must conform to the notation used in this subject (e.g. showing multiple value attributes, or compound attributes, Weak or Strong entity types and showing the correct cardinality of the relationship).

If your model includes resolved sub types you must explain this in the written part of the submission. You may wish to add labels to your ER diagram to aid your explanation (e.g. *"as seen next to point 1.1 in the ER diagram..."*). You need to show the name of each relationship.

Write down any assumptions you made when designing your model (Making an assumption for no other reason than to simplify the exercise will not be accepted). Your assumptions should be no more than 500 words. Make sure you explain the reasons for your design decisions or you will receive lower marks.

For example, you may decide to denormalise part of your solution for the purposes of query speeds. However, such answer is indistinguishable from the answer of a student who simply did not know how to create a better model! The only way we'll know you've made a *deliberate decision* rather than a *mistake* is if you tell us! Submitting your conceptual design will help us understand your intentions.

Assignment Submission

Your assignment must be submitted via LMS before the due date. Your assignment must be submitted in two parts:

1. A pdf document containing the signed academic honesty page, a clear legible image of your conceptual model (using any Chen or Crow's foot notation) and a clear legible image of your physical model using MySQL Workbench. State all your assumptions in this document.
2. The MySQL Workbench MWB file of your final submitted physical model in case we want to confirm a part of your design.

Name your files 'STUDENT_ID'.pdf and 'STUDENT_ID'.mwb, where STUDENT_ID represents your student id.