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Level 1 Mathematics and Statistics RAS 2023

**91946 Interpret and apply mathematical and
statistical information in context**

EXEMPLAR

Achievement

TOTAL 04

Section A:

- From the graph, I can see that from 1990 to 1993, businesses cost more cents per kWh than homes. Then, from the years 1995 to 2022, electricity has cost more for homes than for businesses. In 1990, businesses used close to 12 cents per kWh, while homes used 9 cents per kWh. In 1994, both businesses and homes used 11 cents per kWh, and the years following, homes cost more than businesses. This could be due to the fact that businesses get offered special rates by energy companies, and so it costs less. Energy companies can offer businesses these deals, as the incredibly high demand for energy by businesses allow for companies to sell them at a lower cost and still make profit. Homes however, do not get these special offers, as they are not as large as a corporate business building, and so do not require as much energy as a business. The overall trend of the graph is that both are increasing. Additionally, there is a massive increase in the electricity rate between the years 2001 to 2015 for both graphs. This is possibly due to the fact that technology has been further developed and is more popular. Appliances such as TV's, smartphones, computers, laptops, could've led to more electricity being used, as it becomes more popular, and more mainstream.
- The claims can be supported due to the fact that the price of power is increasing for "Homes" customers. This is as the average electricity rates from 1990, were 9 cents per kWh, and in 2022, it was around 30 cents per kWh. However, from the years 2013 to 2022, the average home expenditure per household has stayed relatively the same. This could be due to the fact that technology has improved a lot from 1990 to 2013. This is as the appliances could've gotten more advanced, and thus require more energy. However from 2013 to 2022, computers, laptops, TV's, etc, are in most households, and the appliances in homes may not have improved as drastically, and so the energy it requires has not changed much. Additionally, in 1990, there was not as much demand for electricity as there is in 2022, and so the high demand for electricity now, may have made the price for electricity higher as well. So while the claims that the price of power has been increasing for New Zealand "Homes" customers overall, can be supported, in recent years, there is not much evidence that it has increased.
- From the graph, I notice that during the 3rd quarter of the year, the average usage of electricity peaks, and is the highest. This is possibly due to winter affecting the usage of appliances, as heating is required in order to stay warm. Additionally, the 1st quarter, being the months of January, February and March, is always the lowest, possibly due to summer and the warm temperature, where less appliances could be used. People could also be away on holiday, which means electricity is not used as much, as they are not at home. I notice that the seasonal trend is that leading up to the 3rd quarter, the expenditure increases each year, which then drops significantly in the 4th quarter. This is as the 4th quarter is in the months of October, November, and December, which is when the temperature starts to get warmer, and some families begin to go on holidays. An unusual feature I notice is that in the 3rd quarter of 2021, the expenditure is higher than the rest of the years. This could be due to the COVID-19 lockdowns forcing everyone to stay at home, and so more electricity is

used. I notice that the overall trend shows that the average expenditure on electricity does not change that much, and it still costs relatively the same. This could be due to the fact that homes all have similar appliances, such as TV's, computers, fridges, etc, and there hasn't been any new revolutionary innovative piece of technology that has caused a demand for more electricity.

- Looking at all the electricity companies, Equator Energy seems to be the best plan for a typical medium-sized New Zealand household. This is as Equator Energy has a good customer rating, meaning other customers are satisfied with the company, which gives it a reputable look. Equator energy also has an open term, meaning if the family wanted to switch at any time, they could. Furthermore, Equator Energy uses 100% renewable energy, meaning that it is not only safer for the environment, which some customers may want, but can also last longer than every other company, as other companies may use fossil fuels, which are finite. This means that other companies may not be around in the future, as fossil fuels are finite, while Equator Energy utilises 100% renewable energy, which is infinite. The daily charge for Equator Energy is also significantly less than every other company. While the anytime rate and day rate are not cheapest, the night rate is the cheapest. Assuming the typical medium-sized NZ household would have 2 parents and 2 children, it would mean that the parents and children would be away during the day, due to work and school. This would mean that the off-peak plan could benefit them, as they may not be using as much power during the day, than they would during the night. However, the night rate is usually after 9pm, and so it would not be worth it for some families as it is quite late. Even so, the company is still an open term company, and so families would still have the option to choose between the anytime rate and the off-peak plan, depending on what suits them best. While the anytime rate is certainly not the cheapest option, all the other factors would still outweigh this disadvantage, as it is also not the most expensive.

Section B:

- The electricity generation method that creates the most environmental impact is coal. This is as from the graph, we can see that coal generates 2.508 billion kg of CO₂. This is nearly 1 billion more kg of CO₂ than gas, which produces 1.573 billion kg of CO₂. While we do not know which year this graph comes from, considering the large gap between coal and gas, it would be safe to assume that coal still produces the most CO₂ out of all the types of electricity generation in future years.
- The claim that New Zealand is on track to reach 100% renewable energy by 2030 could be true. This is as the majority of New Zealand's existing generating capacity already comes from hydro resources, which is a renewable source of energy. We can see in the map/overview that 57% of the operating capacity of power comes from hydro plants, and 9% of the power comes from wind plants. We can see that Wellington is very windy, so it is also a good place for many wind plants to be built. Places like Southland and Otago also get strong and consistent winds from the

Southern Ocean and Tasman Sea, and so more wind plants being built there would be beneficial. Furthermore, the South Island has a lot of lakes, and so they already have a lot of hydro plants operating there. Additionally, 78% of planned power capacity will come from wind plants, as it is eco-friendly, which when paired with the existing majority of renewable energy types, means that New Zealand's plan to reach 100% renewable energy by 2030 is definitely possible.

- A possible solution the New Zealand government could consider in order to reach zero carbon emissions by 2050, is to further expand upon the use of hydro and wind plants. This is as New Zealand already has a lot of hydro and wind plants, as our environment allows for lots of lakes and wind to be utilised, and so investing in more wind plants could be beneficial. This is as wind plants may be favoured over hydro plants, as there are already so many hydro plants in operation, and so wind plants would be more beneficial to use, as there are not as many. Moreover, too many hydro plants may be counter productive, as if there were too many hydro plants, there would not be enough water for all the hydro plants to use effectively, and it would've been a waste of space, time, and money building unnecessary hydro plants. Additionally, the government could also implement the use of solar panels, and use solar power as a type of energy source. This is as solar power is 100% renewable, and makes no carbon emissions so it should definitely be utilised more. Additionally, the best industry to target for limiting carbon emissions is the transport industry. This is as it not only produces the most carbon emissions, but also the fact that electricity and manufacturing has to be transported by vehicles that make carbon emissions. This means that there would be no point in prioritising cutting down on carbon emissions for the electricity and manufacturing industry, as they would still have to get transported by vehicles that make more carbon emissions than them both combined.

Achievement

Subject: Mathematics and Statistics

Standard: 91946

Total score: 04

Grade score	Marker commentary
A4	The candidate has clearly understood the resources and has answered each prompting question. To achieve at Merit there would need to be more supporting evidence in the response to justify the statements made.

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SECTION A: "HOME" ELECTRICITY USAGE

The home's cost originally started at 9 cents per kWh, which is approximately 2 cents per kWh lower than the business cost, which starts at approximately 12 cents per kWh. Over the years, home increases at a faster rate and intersects with business in 1994 at 11 cents per kWh, meaning that the business has dropped by approximately 1 cent per kWh. This may be due to the fact that as the years go by, more people come in from out of New Zealand, which means more houses would be built, resulting in inflation. Houses had a steady increase up until 1998, where it stayed steady until 2001, then had a major increase of approximately 15.5 cents per kWh. This may be due to the increase in population, with houses causing more electricity usage. Businesses, on the other hand, had a very minor decrease of around 2 cents per kWh. This may be due to the fact that there may not have been many businesses. However, after 1999, business increased by nearly 10 cents per kWh, which could be due to more people coming in and starting businesses. Houses also typically use electricity longer, whether it's for the lights or the heater/AC. Most businesses are 9-5 meaning that the electricity they use is only for a certain amount of time. After Homes keep increasing overtime and business decreases, then it increases. Overall, Homes have a faster increase than businesses and are at their peak; homes take over businesses, and by 2022, they will be nearly 14 kWh ahead of businesses.

The claim that the price of power has been increasing for New Zealand Homes can be supported. In 2014, the total average cost was \$2094.25; in 2021, the average cost was \$2147.39, meaning that the overall increase had been \$53.14. However, looking closely at the four quarters individually, I can see that over the period of 7 years, it had minor decreases and increases up until 2019, when it had been increasing at an average cost of \$47.50. This means that over the last 3 years, the prices have increased by \$53.14, which overall means that the claim can be supported as inflation has occurred.

The home electricity expenditure usage per household in New Zealand is highest in Q3 and lowest in Q1. In Q3, which is July, August, and September, the prices are the highest, ranging from 600-700. This is due to the fact that it is winter during these months, meaning that electricity will not only be used for light but also for electric appliances such as an electric blanket, dryers and washing machines since the sun won't be to helpful, heaters (which may be more than 1), and devices. Q3 also stays the highest in price from 2013-2022. Another conclusion I can draw is that in Q1, the expenditure on electricity per household is the lowest from 2013-2022. In summer, it will be at its lowest due to the temperature going down, meaning the use of electrical appliances such as washing machines, dryers, heaters, and electrical blankets goes down. As the sun is out, there won't be much need for washing machines and dryers, Instead of using AC or fans in the summer, people want to open there windows to limit the use of electricity. In summer, the electricity usage will also be low as it is not daylight saving time, so it will not get dark early. Q1 is 300-400 lower than Q3, as Q1 ranges from 400-450.

For a medium-sized family in New Zealand, when looking for an electricity company, they should start by understanding their previous consumption of electricity and then compare the prices. By looking at their past usage, they can get an idea of how much money they can expect from companies, as they will know how much electricity they consume. Then comparing the prices, seeing if the prices are fixed, and how much it would cost will help them save money and understand which company is best for them. They could also look at the contract terms; some companies have an open term where you have the flexibility to leave anytime; others don't provide the same flexibility and have a contract term of a certain time that prevents you from changing companies. Looking at the contract term will be important, as you don't want to have limitations to a company that is not the best fit for you. Therefore, I believe comparing prices and understanding the contract terms will help you find an electrical company that suits your needs. Looking at customer ratings can also give you confidence when choosing a company and reassure you that it is a valid company.

SECTION B: ELECTRICITY GENERATION AND THE ENVIRONMENT

The electricity generation method that creates the most environmental impact is coal. Coal provides 2.508 billion kg of CO₂ and is widely used considering it is reliable, affordable, and easy to supply. Electricity, manufacturing, agriculture, and transport are the industries from which coal emissions arise.

It has been claimed that New Zealand is on the right track to reach 100% renewable energy by 2030. This statement can be backed up as New Zealand currently uses 57% hydro, 9% Wind, and 10% geothermal, which are all renewable sources of energy. In the future, they are planning to increase Wind energy by 78%, Geothermal by 11%, and Hydro by 10%. Hydro, geothermal, and Wind are all definitions of Renewable energy. This leaves gas at 16% and coal at 5%, however, as stated, they will soon be replaced as the country aims towards 100% renewable energy. Overall, New Zealand is using 76% renewable energy currently but is planning to add more to make it 100% renewable and is also planning to replace Coal and Gas. These graphs indicate that New Zealand is on the right track, and the statement can be supported.

In order to reach “Zero Carbon Emissions by 2050” in New Zealand, the government can help reach this goal by setting up campaigns that not only run in public areas but are also compulsory for schools. By creating such campaigns and programs, it will spread awareness and draw attention to the issue. Making it compulsory for students to learn about this and understand it will make them alert and even encourage them to get better. Whether it is to change into reusable products or even just walk to school, these steps will contribute and help reach the goal by 2050. These programs could even run on the streets in crowded areas, handing out pamphlets could

influence New Zealand citizens to help make the country better. These programs can even be online, and with the use of popular platforms such as Tik Tok or Instagram, they can help change bad habits and reach a teen/young adult audience. I believe that a good way to reach the Zero Carbon emission goal by 2050 will only be possible if everyone does things to contribute, which could start by alerting everyone to make a change and encouraging them to do some things that may be hurtful differently.

Achievement

Subject: Mathematics and Statistics

Standard: 91946

Total score: 04

Grade score	Marker commentary
A4	Apart from the response to the first question prompt, the candidate has either made unsupported (valid) statements or has not used a combination of sources to support their interpretation.