Mana Tohu Mātauranga o Aotearoa
New Zealand Qualifications Authority

Level 1 Maths and Statistics RAS 2023

91946 Interpret and apply mathematical and statistical information in context

EXEMPLAR

Merit TOTAL **06**

Section A

Compare and comment:

- Both homes and businesses are on an upwards pattern
- Homes have noticeably increased by more than businesses.
- Homes increased from 9 cents to around 30 cents which means it increased by a total of 21 cents over 32 years. This means that the average home electricity costs (cents per kwh) have increased by about 233.34% over 32 years.
- Businesses started at around 12 cents to around 18 cents meaning it increased by only 6 cents in total over 32 years. This means that the businesses average cost for electricity has increased by 50%.
- Businesses started by paying more for electricity than homes did from 1990-1994. They switched around and businesses gradually increased but the average cost of electricity for homes rapidly increased from around 2002-2014.

Claims be supported?

- Based on the information from the graph from resource 1 this claim seems to be true. This is because the homes have had a drastic increase on the graph whereas the businesses have only slowly increased over the years. This is also shown as the homes have increased by a total of 21 cents and businesses have increased by only 6 cents over the past 32 years.
- You can also see this from the information in the graph from resource 2A. In the first four quarters on the graph the average home expenditure was roughly Q2; $510 Q3; $630 Q4; $480 Q1; $430. This is lower than the final four quarters as they were roughly Q3; $700 Q4: $505 Q1; $450 Q2; $550. This means that in total Quarter 1 increased by $20, quarter 2 increased by $40, quarter 3 increased by $70 and quarter 4 increased by $25.
- In resource 2B you can see that even though the price of electricity has been increasing over the years, the usage of electricity has stayed roughly the same since 2013. This proves that the price is changing and it isn't the usage amount and that the claim made is true.

Conclusions from 2A and 2B

- Looking at the graph from resource 2A you can see that in every third quarter of the year there is a peak. I'm assuming that the 3rd quarter always peaks because it is the winter season, it is darker so more people would be using lights. Also since it is colder in winter more electricity would be used towards heating. You can see in resource 2B the numbers proving this and that in quarter three of every year not only is the average expenditure more, the average usage is also more. An example of this is how in 2019 Q3; $646.67 (which was during winter) which is $134.41 more expensive than quarter 2 (which wasn't winter time).
- The opposite also applies for this as you can see every first quarter of every year on the graph is always the lowest. I'm assuming it is because of summertime. I think it would be because less lights are needed because it is lighter, no heating is needed because it is hot and I also think less electricity in general would be used because people are out of their houses in the summer. You can also see this in resource 2B as every first quarter of every

year since 2013 has a drop and the usage and expenditure is lower than any of the other quarters. An example of this is in 2020 where Q1; $429.27 (summertime) which is $123.06 cheaper than quarter 2 (not summer).

- You can also see that the third quarter of 2021 is clearly the highest peak and you can see on resource 2B that the most money was spent and the most electricity was used. I believe this is because of the covid pandemic, I think more people would have been in their homes using more heating and power. We can compare this to 2013 quarter three where there were no pandemics, the expenditure was $633.41 and the usage was 2365.22kw. This is $62.42 less than 2021 and used 20.73kw less. Quarter three wasn't the only high quarter though, all the quarters in 2021 were quite high compared to other years. For instance, in 2016 the expenditure and usage was Q1;$413.69 & 1398.64kw Q2;$501.08 & 1730.51kw Q4;$467.59 & 1622.89kw. This is less than 2021 by Q1;$18.57 less & 6.16kw less Q2;$40.66 less & 68.28kw less Q4;$36.97 less & 31.16kw less.

How should a household choose their electricity company?

Company	Rhythm energy	Wired 4 power	Equator energy	shout
Anytime rate	$0.1988 x 1800kw = $357.84	$0.2146 x 1800kw = $386.28	$0.2028 x 1800kw = $365.04	$0.1675 x 1800kw = $301.5
Daily charge	$2.99 x 31 = $92.69	$2.3089 x 31 = $71.5759	$1.7502 x 31 = $54.2562	$2.5070 x 31 = $77.717
Off peak plan (day rate)	0.2113 x 800 = $169.04	0.2240 x 800 = $179.2	0.2146 x 800 = $171.68	$0.1675 x 800kw = $134
Off peak plan (night rate)	0.1779 x 1000 = $177.9	0.1685 x 1000 = $168.5	0.1196 x 1000 = $119.6	$0.1675 x 1000kw = $167.5
Total for off-peak plan	$169.04 + $177.9 + $92.69 = $439.63	$179.2 + $168.5 + $71.5759 = $419.2759	$171.68 + $119.6 + $54.2562 = $345.5362	$134 + $167.5 + $77.717 = $379.217
Total for anytime plan	$357.84 + $92.69 = $450.53	$386.28 + $71.5759 = $457.8559	$365.04 + $54.2562 = $419.2962	$301.5 + $77.717 = $379.217

- Judging from resource 2B, I'm going to assume that a typical medium-sized New Zealand household would use roughly 1800 kw/day of electricity and assuming that 1000kw get used at night time and 800kw get used during the day. (Also assuming there are 31 days in the month.)

- Judging from the table above, using equator energy on an off peak plan is the cheapest price. It is clearly the cheapest option at $345.5362 per month compared to the other off-peak plans. It is $94 cheaper than rhythm, $73.7 cheaper than wired 4 power and it's $33.7 cheaper than shout.
- For the anytime plans, shout is clearly the cheapest option at $379.217 whereas the other options are $450.53, $457.9559 and $419.2962.
- The option I picked is 100% renewable energy. Although, some customers might think it's a better deal to get the $100 credit from shout or the $50 credit from wired 4 power.
- Some customers might be big travellers who will be out of the house not using power so they may want to choose one that has a lower daily charge to suit them.

Section B

Which electricity generation method creates the most environmental impact

- As you can see in resource 6, coal has the biggest negative impact on the environment as it lets out the most carbon emissions into the environment. It produces 2.508 billion kgs of CO2 which is 2.508 billion kgs more than renewable sources like solar, hydro and wind power plants produce. Coal burning makes up only 5% of New Zealand's energy sources yet it still emits the most carbon. 16% of New Zealand's energy comes from gas plants yet coal still produces 935 000 000 kgs more even though it produces not nearly as much energy for us. Coal is still being produced in New Zealand purely because it is the cheapest power plant to run yet it is the worst for the environment.
- I believe hydropower is the power source that has the most positive impact on the environment today. Not only does it produce the most power for New Zealand but it also produces 0 kgs of CO2 into the atmosphere. It also doesn't require certain weather like sunny or windy conditions.

Comment on the claim

- I think New Zealand is definitely on track to reach 100% renewable energy by 2030 because in resource 5A-5B you can see all the planned operations and they are all renewable energy sources that don't produce any CO2. All New Zealand would have to do now is stop the production of electricity from coal, gas, cogen and geothermal plants.

What could the government do to reach zero carbon emissions by 2050

- More than 50% of New Zealand's carbon emissions per annum are caused by transport. To try and reduce their carbon emissions by 2050, New Zealand could possibly stop importing and producing cars that run on petrol. They could make only electric cars legal and advocate using electric cars over fuel cars. They should also make public buses electric and advise that more New Zealand citizens use the public bus. To ensure more people use the buses, they could make the cost to ride them cheaper or even free.
- Along with that, as they are already planning to start more renewable energy sources they could also illegalise unrenewable sites like coal, gas geothermal and cogen.
- The government could also advocate for more electricity heated households like heat pumps over having a fireplace.

- The government could also make a law that factories must use renewable electricity sources like solar power. They could also make a law that factories must use recyclable materials in their products when possible.

Merit

Subject: Maths and Statistics RAS

Standard: 91946

Total score: 06

Q	Grade score	Marker commentary
One	M6	To attain Excellence, in Section A – the candidate needed to consider "how" to select an electricity provider – not decide which. The candidate also needed to use supporting evidence from the resources for their response to Section B(iii).

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Section A:

- From resource 1 we can find that the price of electricity for every kilowatt per hour which is in cents has steadily increased from 1990 to 2022. The price for cents per kWh for homes started at 9 cents per kWh and from 1990 to 2022 has risen to 30 cents per kWh. On the contrary, the price of electricity for businesses started at around 12 cents per kWh and from 1990 to 2022 has risen to around 18 cents per kWh. There is a big difference between the electricity rates for households and businesses as seen from above, there is a 12-cent difference between the two rates. The difference between household prices and business prices could be caused by some deals which apply to businesses. Because businesses use much more electricity, service companies may have different rates for these businesses as they use more of their services. The increase in electricity could be due to the increase in prices of other facilities such as manpower, land or maintenance which will cause the consumer prices to increase. From both sets of data, we can see a small dip in prices around 1998 to 1999, the reason for this slight decrease is unknown and could be caused due to worldwide situations or problems. After the year 2000, the prices have been on a steady increase with little slight decreases in prices, this could be due to the evolving technology which causes both households and businesses to use more electricity for items such as computers, printers etc.
- Yes, the claims that the price of power has been increasing for NZ homes is indeed true, we can see this from all resources 1, 2A and 2B. Though the price is increasing, the increase is only a slight increase and is hardly noticeable. From resource 1 we have already identified that the prices are indeed increasing, the cost per kWh for households started at 9 cents per kWh in 1990 and is now at 30 cents per kWh. The starting price for businesses in 1990 was at around 12 cents per kWh and has risen to 18 cents per kWh in 2022. This shows the increase in prices for electricity in both homes and businesses in NZ. In resource 2A we can see that the peaks for each year which are Q3 of each year are slowly increasing, with that said the increase is small and once again barely noticeable except for the increase in 2021. From the data we can see that in Q3 of 2020 the price cost was around $650 while in 2021 the price for Q3 sits around the $700 mark. This is a noticeable and significant increase as compared to the other years which have only increased each year by less than $10. From resource 2B we see the slight increase in prices once again. In Q2 of 2013 the average cost of electricity was $509.19, and the average usage of electricity was 1824.44 kWh. In Q2 of 2017 we can see that the average cost of electricity was $526.14, and the average usage of electricity was 1818.70 kWh.

This shows the increase throughout the years as the average household was paying more in 2017 than 2013 while using less electricity in 2017 compared to 2013.

- From resources 2A and 2B, a conclusion can be made that the price for electricity in NZ is slowly but steadily increasing while the amount of electricity by an average household stays in the same range. This conclusion is made because as seen from resource 2B, the average cost of electricity for Q2 of 2013 was $509.19, this was achieved while having the average usage of 1824.44 kWh. In 2022, the average cost of electricity was $546.41, while having only using 1736.39 kWh. This shows that even though the average use of electricity was much lower than 2013 in 2022 the cost of electricity in 2022 was still significantly higher than 2013, showing a difference of $37.22. In resource 1 we can also see the increase in prices for both houses and businesses. The rate for houses per kWh has increased by 18 cents from 1990 to 2022 and the rate for businesses has increased by 6 cents per kWh.
- The best option for an electricity company is Shout. Shout provides the lowest anytime rates and the lowest day rates. All day rates, night rates and anytime rates are all priced the same at $0.1675 per kWh, this means that for overall usage Shout is the best as there are no peaks where electricity making it ideal for homes where electricity is constantly used throughout the whole 24 hours of a day. Due to the fluctuation of New Zealand's weather the average household will most likely use electricity throughout the entire day, heaters during winter, fans and air conditioning during summer. Most households tend to have a parent who stays at home or works from home, increasing the electricity usage throughout the day. Shout also promotes $100 credit; this credit approximately helps pay for 5 days of electricity. Though Shout gives the best overall electricity prices depending on each household, Equator Energy may be better. Equator Energy provides higher day rates at $0.2146 per kWh as compared to Shout's $0.1675 but it also provides a lower night rate, at $0.1196 per kWh compared to Shout's $0.1675. The better choice is Shout assuming that there are people in the house during all times and electricity is being consumed but if during the day, both parents are out at work and all kids are at school, there is minimum amounts of energy being used during the day. This means that the better option could be Equator Energy as the common times with the most activity in the house is during night, the better night rates will help save money that way. The decision that Shout is better is also based on the assumption that electricity is being used daily. If a house was not as frequently used and lacks activity; for example, a nurse who mainly sleeps and works in the hospital once again Equator Energy may be the better choice. This is because Equator Energy has a daily charge of $1.7502 while Shout has a daily charge of $2.507.

Section B:

- Electricity generated using coal creates the most environmental impact. Resource 6 shows us that out of over 5 billion kgs of CO2 emitted from electricity generation each year, 2.5 billion kgs come from coal generated facilities. Coal has the highest rates of CO2 emissions while only taking up just 5% of New Zealand's operating capacity as seen in resources 5A and 5B.

- No, from the resources given I do not think New Zealand will be able to reach 100% renewable energy in 2030. With that said it is possible soon. Resource 5B tells us that 21% of current operating power comes from gas and coal powered resources and the total current operating capacity is 9,683 MW. The total planned capacity is 1,564 MW where only 1% comes from coal powered resources. The planned capacity is not nearly enough to cover the gap in the current operating capacity if coal and gas-powered resources were stopped. Coal and gas-powered resources provide 2,033.42 MW of our current capacity. The planned capacity is not nearly enough to fill this gap.
- One way the government could move towards zero carbon emission by 2050 is to increase the amount of power plants which use natural resources to produce power around the country. This means creating more windmills and wind powered facilities in windy areas such as Wellington or increasing the amount of hydro powered facilities in areas with more water such as the South Island or central North Island. An increase in solar powered facilities throughout the whole country could also help. To gain zero carbon emission the government must work in sections starting with electricity. To essentially run the country on 100% zero carbon emission power. The government will have to create enough facilities to fill the gaps which will be created by removing all coal, gas, geothermal and CoGen powered facilities. After gaining zero carbon emissions from electricity, the government must turn towards the manufacturing and agriculture aspects of our country and the transport throughout the country.

Merit

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Total score: 06

Q	Grade score	Marker commentary
One	M6	Good use of supporting evidence from the resources to justify interpretation and to answer the prompts.