

“Household expenditures on gas, electricity, and water have been drastically increased in the year of 2020 because of the change of working styles and the residential consumption and commercial consumption are negatively correlated?”

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**Raw data available from:**

Government of Canada, Statistics Canada. Supply and disposition of natural gas, monthly (data in thousands). Government of Canada, Statistics Canada; 2021. <https://doi.org/10.25318/2510005501-eng>

Government of Canada, Statistics Canada. Gross domestic product, expenditure-based, Canada, quarterly. Government of Canada, Statistics Canada; 2020 . <https://doi.org/10.25318/3610010401-eng>

# Variables

## **Two choices of one-variable statistics**

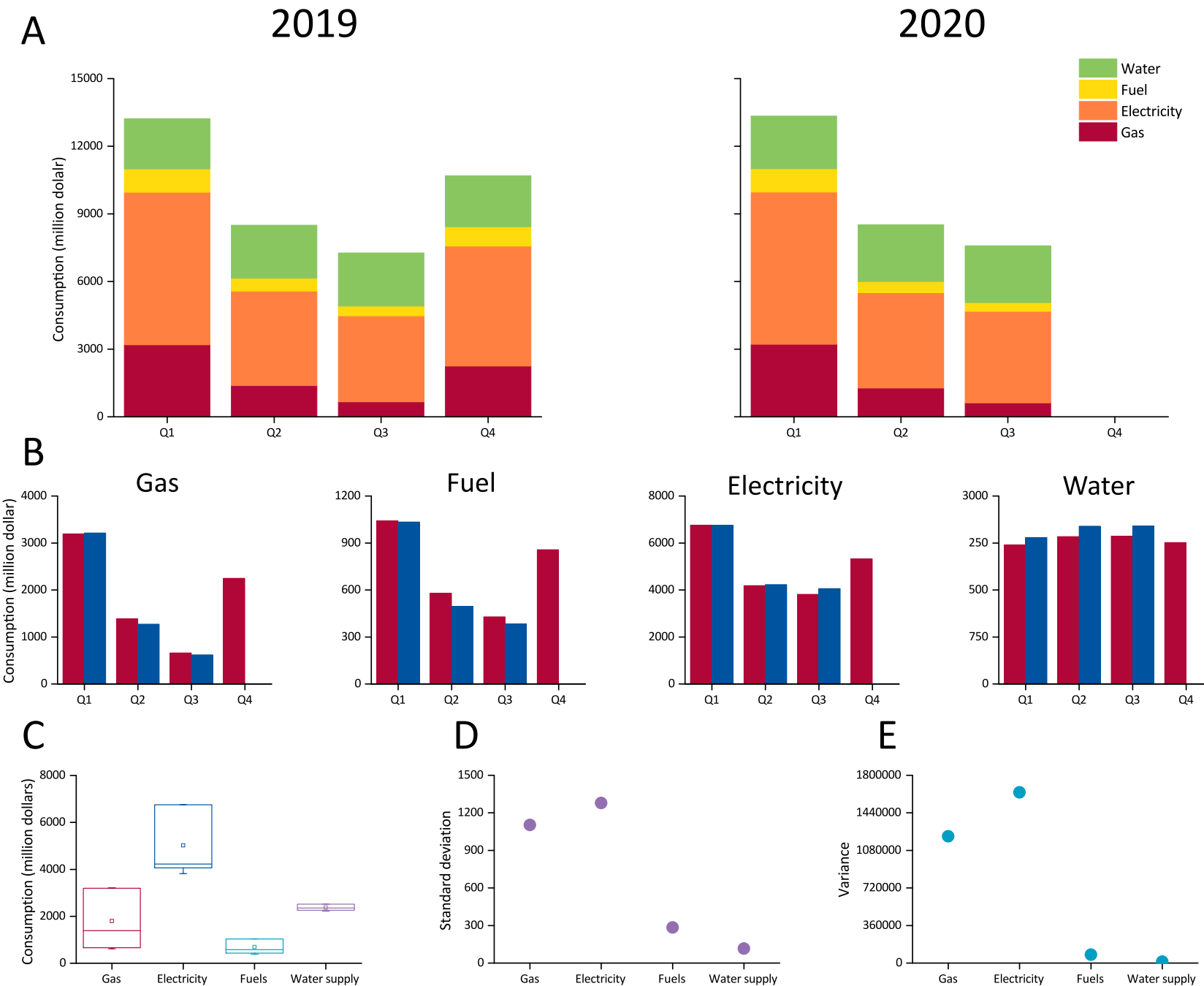
Variable 1 &2: Consumption of water, gas, electricity, and fuel  
(I picked 4)

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## **One pair of two-variable statistics**

Variable 3&4: Commercial and residential consumption of natural gas

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**Figure 1: Consumption of gas, fuel, electricity, and water.**

(A) The consumption of water, fuel, electricity, and gas by quartile in 2019 and 2020. (B) Comparison of the consumption of gas, fuel, electricity, and water between 2019 and 2020 by quartile. (C) Box chart of gas, electricity, fuels, and water by. The line between the box represents mean; the square represents median; the upper and the lower lines respectively represent Q3 and Q1; the short upper and lower line represent max and min, respectively. (D) Standard deviation of consumption of gas, fuel, electricity, and water in 2019 and 2020. (E) Variance of consumption of gas, fuel, electricity, and water in 2019 and 2020.

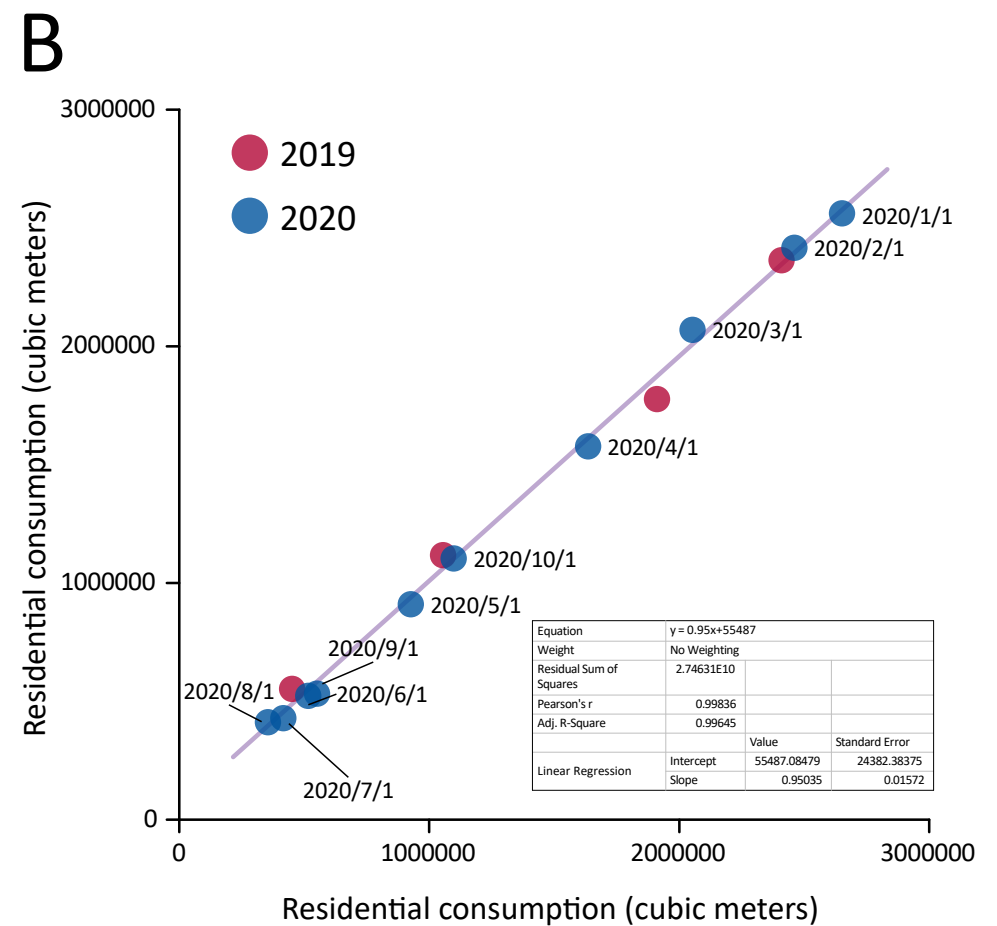
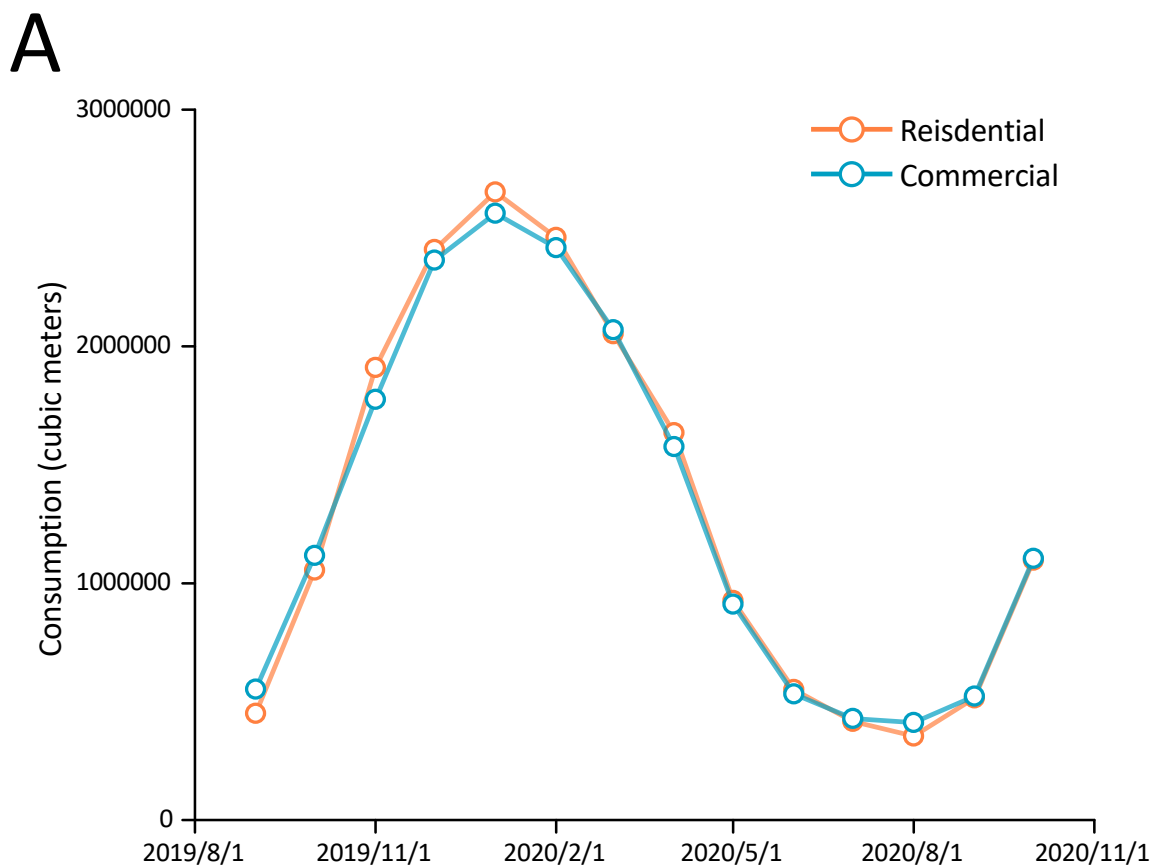
**Government of Canada, Statistics Canada. Gross domestic product, expenditure-based, Canada, quarterly. Government of Canada, Statistics Canada; 2020.**

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# Data set for variable 1&2

<https://docs.google.com/spreadsheets/d/1h0GzWDVsPXpuZUsmoUvX7nrYil0L0nQkspOVKVJLRvg/edit?usp=sharing>

Supply and disposition	Residential consumption	Commercial consumption	Estimates	Gas	Electricity	Other fuels	Water supply
2019/9/1	450,832	552,474	Q1 2019	3,195	6,760	1,042	2,221
2019/10/1	1,055,341	1,117,391	Q2 2019	1,386	4,185	579	2,351
2019/11/1	1,910,612	1,776,750	Q3 2019	662	3,817	429	2,361
2019/12/1	2,408,889	2,363,664	Q4 2019	2,250	5,323	857	2,258
2020/1/1	2,651,548	2,562,649	Q1 2020	3,215	6,754	1,034	2,338
2020/2/1	2,460,004	2,416,359	Q2 2020	1,273	4,230	495	2,518
2020/3/1	2,053,383	2,070,085	Q3 2020	618	4,062	384	2,520
2020/4/1	1,635,211	1,577,249	<b>Variable</b>				
2020/5/1	926,900	910,937	<b>Mean</b>	<b>1,799.857</b>	<b>5,018.714</b>	<b>688.571</b>	<b>2,366.714</b>
2020/6/1	550,927	532,037	<b>Median</b>	<b>1,386</b>	<b>4,230</b>	<b>579</b>	<b>2,351</b>
2020/7/1	416,827	428,191	<b>S.D. (<math>\sigma</math>)</b>	<b>1,102.425</b>	<b>1,278.831</b>	<b>283.495</b>	<b>115.859</b>
2020/8/1	354,802	411,957	<b>Variance</b>	<b>1,215,340</b>	<b>1,635,409</b>	<b>80,369.62</b>	<b>13,423.238</b>
2020/9/1	515,523	523,627	<b>Q1</b>	<b>967.5</b>	<b>4,123.5</b>	<b>462</b>	<b>2,298</b>
2020/10/1	1,097,562	1,103,953	<b>Q3</b>	<b>2,722.5</b>	<b>6,038.5</b>	<b>945.5</b>	<b>2,439.5</b>
			<b>Min</b>	<b>618</b>	<b>3,817</b>	<b>384</b>	<b>2,221</b>
			<b>Max</b>	<b>3,215</b>	<b>6,760</b>	<b>1,042</b>	<b>2,520</b>



**Figure 2: Comparison of residential consumption and commercial consumption (gas).**

(A) Commercial and residential consumption from 2019/09 to 2020/10. The blue and orange lines respectively represent residential consumption and commercial consumption of natural gas. (B) Scatter plot of Commercial and residential consumption from 2019/09 to 2020/10. The red circles represent consumption in months in 2019, and blue circles represent consumption by month in 2020. The transparent purple curve is the fitted line generated from linear regression. The details (function, parameters) of the curve is listed in the chart below.

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# Evaluate the strength

The data we collected demonstrated an extremely strong positive correlation ( $R = 0.9984$ ). I believe this is a very strong piece of evidence because of that the  $R$  value is very close to 1 (perfect positive linear correlation) and higher than 0.7 (strong positive linear correlation).

# Results & Conclusion

I found that both commercial consumption and residential consumption of gas, water, electricity, and fuel demonstrated an annual periodic pattern of increase and decrease. Although there is slight change in the consumption (which could be considered as error/fluctuation), I did not find a drastic increment from the last year.

The commercial consumption of natural gas demonstrated a extremely strong correlation with residential consumption of natural gas ( $R = 0.9984$ ). Unexpectedly, the correlation is stronger in 2020 ( $R = 0.9994$ ) than in 2019 ( $R = 0.9971$ ) .

# Limitations and future research

Our data did not consider the price change of water, fuel, gas, and electricity in Canada. Therefore, the price of these consumptions may vary and therefore the number of resources consumed could be inaccurate.

Secondly, we did not consider the overall trend of the yearly change of both types of consumptions (ie, the annual residential consumption may be increasing at a certain rate).

Multiple relevant studies can be conducted based on my study. I believe that a sensitivity analysis on the prize of the different relevant resources is required before a more thorough, accurate conclusion is drawn.



# References

- Government of Canada, Statistics Canada. Supply and disposition of natural gas, monthly (data in thousands). Government of Canada, Statistics Canada; 2021. <https://doi.org/10.25318/2510005501-eng>
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# Thank you!

Data/Figure available from: <https://github.com/blairyeung/Data-ISP-Raw-Data-and-figures>