ECS 165 - HW 4

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1. EIA

   i) Electricity(MSN, YYYYMM, Value, Column_Order, Description, Unit)

   ii) Transportation(MSN, YYYYMM, Value, Column_Order, Description, Unit)

   iii) MKWH(MSN, YYYYMM, Value, Column_Order, Description, Unit)

   Observation:
   a) MSN is unique and is an abbreviation of the Description. Repeating Description at every row for the same MSN is redundant. We can remove Description from Electricity, Transportation, and MKWH, and create a table EIA(MSN, Description) with FD: MSN → Description

   We can also add Column_Order in to EIA because it repeats as many times as MSN.

   So, we have EIA(MSN, Column_Order, Description)

   b) Electricity has the same unit across all tuples. The same observation applies to Transportation and MKWH too. To reduce this redundancy, we can also factor Unit into EIA. Let each MSN has its own unit

   Here are the resulting 4 relations:

   EIA(MSN, Column_Order, Description, Unit)
   Electricity(MSN, YYYYMM, Value)
   Transportation(MSN, YYYYMM, Value)
   MKWH(MSN, YYYYMM, Value)

   One of the advantages for factoring out a fourth table EIA, is that in the future, we can even update Unit and Description for each MSN in the EIA table without even touching the other 3 tables (Electricity, Transportations, and MKWH).

NHTS:

We make each file a relation, and for each relation we just use all column names from the CSV file as attributes. “In addition to the information specific to its file, each of the four files includes variables from other files to be used along with its own variables (e.g., the travel day file contains certain data from the household and person files.). This is done for the convenience of the data user to minimize the need to merge data from multiple files. Although this format is less desirable from a data storage standpoint, it significantly simplifies subsequent data manipulation.”

In the future, to update tables we plan to simply insert new tuples from files that aren’t already present by comparing a possible key of the data, such as (houseid, personid, tdtrpnum) in DAYV2PUB. This will have take n time for each insertion so it will be a linear time transaction to enter new data. Alternatively, we can use the COPY command in SQL to copy contents from CSV files, which seems to have a far faster running time that normal inserts from python or c++.

Here are the results for problem 3. Below are screenshots of all of them.

3a)

These are the results of 3a. Note that the numbers are the fraction of people that travel less than x miles a day rather than the percentage of them, which can easily be observed from moving the decimal two places to the right, i.e. the number of people traveling below 5 miles a day would be 12.4982%.

Problem 3a

0.124982 (32862/262934) of persons travel less than 5 miles a day
0.229822 (60428/262934) of persons travel less than 10 miles a day
0.350126 (92060/262934) of persons travel less than 15 miles a day
0.434672 (114290/262934) of persons travel less than 20 miles a day
0.524801 (137988/262934) of persons travel less than 25 miles a day
0.584109 (153582/262934) of persons travel less than 30 miles a day
0.646832 (170074/262934) of persons travel less than 35 miles a day
0.689025 (181168/262934) of persons travel less than 40 miles a day
0.732899 (192704/262934) of persons travel less than 45 miles a day
0.761838 (200313/262934) of persons travel less than 50 miles a day
0.793119 (208538/262934) of persons travel less than 55 miles a day
0.813174 (213811/262934) of persons travel less than 60 miles a day
0.835906 (219788/262934) of persons travel less than 65 miles a day

0.850670 (223670/262934) of persons travel less than 70 miles a day
0.866217 (227758/262934) of persons travel less than 75 miles a day
0.877376 (230692/262934) of persons travel less than 80 miles a day
0.888873 (233715/262934) of persons travel less than 85 miles a day
0.897126 (235885/262934) of persons travel less than 90 miles a day
0.905870 (238184/262934) of persons travel less than 95 miles a day
0.911799 (239743/262934) of persons travel less than 100 miles a day

3b)
These are the results of 3b. So the average fuel economy for trips less than 5 miles would be 26.249510 mpg.

Problem 3b
<5 miles, 26.249510
<10 miles, 26.202820
<15 miles, 26.189873
<20 miles, 26.186827
<25 miles, 26.188208
<30 miles, 26.195363
<35 miles, 26.197273
<40 miles, 26.200710
<45 miles, 26.203278
<50 miles, 26.203910
<55 miles, 26.204266
<60 miles, 26.205272
<65 miles, 26.205499
<70 miles, 26.204829
<75 miles, 26.204893
<80 miles, 26.204414
<85 miles, 26.204485
<90 miles, 26.203987
<95 miles, 26.203414
<100 miles, 26.203608

3c)
These are the results of 3c.

Problem 3c
Household vehicles in month: 200803 attributes 42.72% of total transportation CO2 emission

Household vehicles in month: 200804 attributes 48.70% of total transportation CO2 emission
Household vehicles in month: 200805 attributes 48.34% of total transportation CO2 emission
Household vehicles in month: 200806 attributes 49.08% of total transportation CO2 emission
Household vehicles in month: 200807 attributes 52.12% of total transportation CO2 emission
Household vehicles in month: 200808 attributes 51.20% of total transportation CO2 emission
Household vehicles in month: 200809 attributes 51.19% of total transportation CO2 emission
Household vehicles in month: 200810 attributes 47.12% of total transportation CO2 emission
Household vehicles in month: 200811 attributes 52.43% of total transportation CO2 emission
Household vehicles in month: 200812 attributes 49.55% of total transportation CO2 emission
Household vehicles in month: 200901 attributes 49.31% of total transportation CO2 emission
Household vehicles in month: 200902 attributes 50.82% of total transportation CO2 emission
Household vehicles in month: 200903 attributes 52.53% of total transportation CO2 emission
Household vehicles in month: 200904 attributes 56.25% of total transportation CO2 emission

3d)
These are the results of 3d.

Problem 3d
Plug-in hybrids with 20 mile electric range:
The difference in CO2 emission (million metric tons) is 19.225726 in 200803 | a 27.73% change
The difference in CO2 emission (million metric tons) is 21.874694 in 200804 | a 28.02% change
The difference in CO2 emission (million metric tons) is 21.621269 in 200805 | a 26.89% change
The difference in CO2 emission (million metric tons) is 20.241218 in 200806 | a 25.97% change
The difference in CO2 emission (million metric tons) is 20.833220 in 200807 | a 24.30% change
The difference in CO2 emission (million metric tons) is 20.652784 in 200808 | a 24.70% change
The difference in CO2 emission (million metric tons) is 20.942921 in 200809 | a 27.75% change
The difference in CO2 emission (million metric tons) is 20.751805 in 200810 | a 27.32% change
The difference in CO2 emission (million metric tons) is 20.806379 in 200811 | a 26.24% change
The difference in CO2 emission (million metric tons) is 20.441729 in 200812 | a 26.33% change
The difference in CO2 emission (million metric tons) is 20.817196 in 200901 | a 27.74% change
The difference in CO2 emission (million metric tons) is 19.729559 in 200902 | a 28.21% change
The difference in CO2 emission (million metric tons) is 21.862047 in 200903 | a 26.72% change
The difference in CO2 emission (million metric tons) is 21.751892 in 200904 | a 25.26% change
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Plug-in hybrids with 40 mile electric range:
The difference in CO2 emission (million metric tons) is 24.744373 in 200803 | a 35.68% change
The difference in CO2 emission (million metric tons) is 28.504983 in 200804 | a 36.52% change
The difference in CO2 emission (million metric tons) is 28.585094 in 200805 | a 35.55% change
The difference in CO2 emission (million metric tons) is 26.627606 in 200806 | a 34.16% change

The difference in CO2 emission (million metric tons) is 27.603708 in 200807 | a 32.20% change
The difference in CO2 emission (million metric tons) is 27.342521 in 200808 | a 32.70% change
The difference in CO2 emission (million metric tons) is 26.821143 in 200809 | a 35.53% change
The difference in CO2 emission (million metric tons) is 26.769545 in 200810 | a 35.25% change
The difference in CO2 emission (million metric tons) is 27.312509 in 200811 | a 34.44% change
The difference in CO2 emission (million metric tons) is 26.569012 in 200812 | a 34.22% change
The difference in CO2 emission (million metric tons) is 27.173547 in 200901 | a 36.21% change
The difference in CO2 emission (million metric tons) is 25.812760 in 200902 | a 36.91% change
The difference in CO2 emission (million metric tons) is 28.941286 in 200903 | a 35.37% change
The difference in CO2 emission (million metric tons) is 29.294176 in 200904 | a 34.01% change
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Plug-in hybrids with 60 mile electric range:
The difference in CO2 emission (million metric tons) is 27.934497 in 200803 | a 40.28% change
The difference in CO2 emission (million metric tons) is 29.726631 in 200804 | a 38.08% change
The difference in CO2 emission (million metric tons) is 30.422007 in 200805 | a 37.83% change
The difference in CO2 emission (million metric tons) is 28.521057 in 200806 | a 36.59% change
The difference in CO2 emission (million metric tons) is 29.214901 in 200807 | a 34.08% change
The difference in CO2 emission (million metric tons) is 29.268321 in 200808 | a 35.00% change
The difference in CO2 emission (million metric tons) is 27.791430 in 200809 | a 36.82% change
The difference in CO2 emission (million metric tons) is 28.019381 in 200810 | a 36.89% change
The difference in CO2 emission (million metric tons) is 28.502592 in 200811 | a 35.94% change
The difference in CO2 emission (million metric tons) is 28.229447 in 200812 | a 36.36% change
The difference in CO2 emission (million metric tons) is 28.692460 in 200901 | a 38.23% change
The difference in CO2 emission (million metric tons) is 27.252913 in 200902 | a 38.97% change
The difference in CO2 emission (million metric tons) is 31.081364 in 200903 | a 37.98% change
The difference in CO2 emission (million metric tons) is 31.680389 in 200904 | a 36.78% change

Problem 5a
84 miles threshold :
The difference in CO2 emission (million metric tons) is 9.477445 in 200803 | a 13.67% change
The difference in CO2 emission (million metric tons) is 11.906283 in 200804 | a 15.25% change
The difference in CO2 emission (million metric tons) is 11.931780 in 200805 | a 14.84% change
The difference in CO2 emission (million metric tons) is 11.303127 in 200806 | a 14.50% change
The difference in CO2 emission (million metric tons) is 10.970298 in 200807 | a 12.80% change
The difference in CO2 emission (million metric tons) is 10.677557 in 200808 | a 12.77% change
The difference in CO2 emission (million metric tons) is 10.892961 in 200809 | a 14.43% change
The difference in CO2 emission (million metric tons) is 11.042370 in 200810 | a 14.54% change
The difference in CO2 emission (million metric tons) is 10.820368 in 200811 | a 13.64% change
The difference in CO2 emission (million metric tons) is 10.835777 in 200812 | a 13.96% change
The difference in CO2 emission (million metric tons) is 11.503564 in 200901 | a 15.33% change
The difference in CO2 emission (million metric tons) is 11.507262 in 200902 | a 16.46% change
The difference in CO2 emission (million metric tons) is 13.549055 in 200903 | a 16.56% change
The difference in CO2 emission (million metric tons) is 13.406922 in 200904 | a 15.57% change
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107 miles threshold :
The difference in CO2 emission (million metric tons) is 11.744626 in 200803 | a 16.94% change
The difference in CO2 emission (million metric tons) is 13.740848 in 200804 | a 17.60% change
The difference in CO2 emission (million metric tons) is 14.000217 in 200805 | a 17.41% change
The difference in CO2 emission (million metric tons) is 13.055378 in 200806 | a 16.75% change
The difference in CO2 emission (million metric tons) is 12.673384 in 200807 | a 14.78% change
The difference in CO2 emission (million metric tons) is 12.347574 in 200808 | a 14.77% change
The difference in CO2 emission (million metric tons) is 12.528979 in 200809 | a 16.60% change
The difference in CO2 emission (million metric tons) is 12.728287 in 200810 | a 16.76% change
The difference in CO2 emission (million metric tons) is 12.433909 in 200811 | a 15.68% change
The difference in CO2 emission (million metric tons) is 12.493100 in 200812 | a 16.09% change
The difference in CO2 emission (million metric tons) is 13.354669 in 200901 | a 17.80% change
The difference in CO2 emission (million metric tons) is 13.299467 in 200902 | a 19.02% change
The difference in CO2 emission (million metric tons) is 15.556243 in 200903 | a 19.01% change
The difference in CO2 emission (million metric tons) is 15.527299 in 200904 | a 18.03% change
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208 miles threshold :
The difference in CO2 emission (million metric tons) is 16.867377 in 200803 | a 24.32% change
The difference in CO2 emission (million metric tons) is 17.990897 in 200804 | a 23.05% change
The difference in CO2 emission (million metric tons) is 18.468118 in 200805 | a 22.97% change
The difference in CO2 emission (million metric tons) is 17.207593 in 200806 | a 22.07% change
The difference in CO2 emission (million metric tons) is 16.975971 in 200807 | a 19.80% change

The difference in CO2 emission (million metric tons) is 16.547671 in 200808 | a 19.79% change
The difference in CO2 emission (million metric tons) is 15.892003 in 200809 | a 21.05% change
The difference in CO2 emission (million metric tons) is 16.374429 in 200810 | a 21.56% change
The difference in CO2 emission (million metric tons) is 16.169853 in 200811 | a 20.39% change
The difference in CO2 emission (million metric tons) is 16.321697 in 200812 | a 21.02% change
The difference in CO2 emission (million metric tons) is 17.393534 in 200901 | a 23.18% change
The difference in CO2 emission (million metric tons) is 17.147756 in 200902 | a 24.52% change
The difference in CO2 emission (million metric tons) is 20.369260 in 200903 | a 24.89% change
The difference in CO2 emission (million metric tons) is 20.812216 in 200904 | a 24.16% change
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270 miles threshold :
The difference in CO2 emission (million metric tons) is 17.486249 in 200803 | a 25.22% change
The difference in CO2 emission (million metric tons) is 19.160739 in 200804 | a 24.55% change
The difference in CO2 emission (million metric tons) is 19.867706 in 200805 | a 24.71% change
The difference in CO2 emission (million metric tons) is 18.427811 in 200806 | a 23.64% change
The difference in CO2 emission (million metric tons) is 18.220953 in 200807 | a 21.25% change
The difference in CO2 emission (million metric tons) is 17.766830 in 200808 | a 21.25% change
The difference in CO2 emission (million metric tons) is 16.982046 in 200809 | a 22.50% change
The difference in CO2 emission (million metric tons) is 17.554967 in 200810 | a 23.11% change
The difference in CO2 emission (million metric tons) is 17.361171 in 200811 | a 21.89% change
The difference in CO2 emission (million metric tons) is 17.377159 in 200812 | a 22.38% change
The difference in CO2 emission (million metric tons) is 18.658814 in 200901 | a 24.86% change
The difference in CO2 emission (million metric tons) is 18.293621 in 200902 | a 26.16% change
The difference in CO2 emission (million metric tons) is 21.899067 in 200903 | a 26.76% change
The difference in CO2 emission (million metric tons) is 22.552208 in 200904 | a 26.18% change
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5b)
Problem 5b
84 miles threshold :
The difference in CO2 emission (million metric tons) is 24.012093 in 200803 | a 34.63% change
The difference in CO2 emission (million metric tons) is 29.702597 in 200804 | a 38.05% change
The difference in CO2 emission (million metric tons) is 28.897925 in 200805 | a 35.94% change
The difference in CO2 emission (million metric tons) is 26.937467 in 200806 | a 34.56% change
The difference in CO2 emission (million metric tons) is 27.089383 in 200807 | a 31.60% change
The difference in CO2 emission (million metric tons) is 26.872387 in 200808 | a 32.14% change
The difference in CO2 emission (million metric tons) is 27.426136 in 200809 | a 36.34% change
The difference in CO2 emission (million metric tons) is 26.357996 in 200810 | a 34.71% change
The difference in CO2 emission (million metric tons) is 27.249721 in 200811 | a 34.36% change
The difference in CO2 emission (million metric tons) is 26.779896 in 200812 | a 34.49% change
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107 miles threshold :
The difference in CO2 emission (million metric tons) is 29.884105 in 200803 | a 43.10% change
The difference in CO2 emission (million metric tons) is 34.415970 in 200804 | a 44.09% change
The difference in CO2 emission (million metric tons) is 34.073641 in 200805 | a 42.37% change
The difference in CO2 emission (million metric tons) is 31.315212 in 200806 | a 40.17% change
The difference in CO2 emission (million metric tons) is 31.489120 in 200807 | a 36.73% change
The difference in CO2 emission (million metric tons) is 31.251248 in 200808 | a 37.37% change
The difference in CO2 emission (million metric tons) is 31.707440 in 200809 | a 42.01% change
The difference in CO2 emission (million metric tons) is 30.543497 in 200810 | a 40.22% change
The difference in CO2 emission (million metric tons) is 31.466512 in 200811 | a 39.68% change
The difference in CO2 emission (million metric tons) is 31.040649 in 200812 | a 39.98% change
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208 miles threshold :
The difference in CO2 emission (million metric tons) is 43.152054 in 200803 | a 62.23% change
The difference in CO2 emission (million metric tons) is 45.335210 in 200804 | a 58.08% change
The difference in CO2 emission (million metric tons) is 45.253384 in 200805 | a 56.28% change
The difference in CO2 emission (million metric tons) is 41.688921 in 200806 | a 53.48% change
The difference in CO2 emission (million metric tons) is 42.604383 in 200807 | a 49.70% change
The difference in CO2 emission (million metric tons) is 42.264088 in 200808 | a 50.54% change
The difference in CO2 emission (million metric tons) is 40.508153 in 200809 | a 53.67% change
The difference in CO2 emission (million metric tons) is 39.595503 in 200810 | a 52.14% change
The difference in CO2 emission (million metric tons) is 41.229939 in 200811 | a 51.99% change
The difference in CO2 emission (million metric tons) is 40.883457 in 200812 | a 52.66% change
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270 miles threshold :

The difference in CO2 emission (million metric tons) is 44.754936 in 200803 | a 64.54% change
The difference in CO2 emission (million metric tons) is 48.340771 in 200804 | a 61.93% change
The difference in CO2 emission (million metric tons) is 48.755484 in 200805 | a 60.63% change
The difference in CO2 emission (million metric tons) is 44.737459 in 200806 | a 57.39% change
The difference in CO2 emission (million metric tons) is 45.820660 in 200807 | a 53.45% change
The difference in CO2 emission (million metric tons) is 45.460778 in 200808 | a 54.36% change
The difference in CO2 emission (million metric tons) is 43.360692 in 200809 | a 57.45% change
The difference in CO2 emission (million metric tons) is 42.526338 in 200810 | a 56.00% change
The difference in CO2 emission (million metric tons) is 44.343299 in 200811 | a 55.91% change
The difference in CO2 emission (million metric tons) is 43.596909 in 200812 | a 56.15% change
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Screenshots:

3a)

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Problem 3a
0.124982 (32862/262934) of persons travel less than 5 miles a day
0.229822 (60428/262934) of persons travel less than 10 miles a day
0.350126 (92060/262934) of persons travel less than 15 miles a day
0.434672 (114290/262934) of persons travel less than 20 miles a day
0.524801 (137988/262934) of persons travel less than 25 miles a day
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0.888873 (233715/262934) of persons travel less than 85 miles a day
0.897126 (235885/262934) of persons travel less than 90 miles a day
0.905870 (238184/262934) of persons travel less than 95 miles a day
0.911799 (239743/262934) of persons travel less than 100 miles a day
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3b)

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Problem 3b
<5 miles, 26.249510
<10 miles, 26.202820
<15 miles, 26.189873
<20 miles, 26.186827
<25 miles, 26.188208
<30 miles, 26.195363
<35 miles, 26.197273
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<50 miles, 26.203910
<55 miles, 26.204266
<60 miles, 26.205272
<65 miles, 26.205499
<70 miles, 26.204829
<75 miles, 26.204893
<80 miles, 26.204414
<85 miles, 26.204485
<90 miles, 26.203987
<95 miles, 26.203414
<100 miles, 26.203608
```

3c)

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Problem 3c
Household vehicles in month: 200803 attributes 42.72% of total transportation CO2 emission
Household vehicles in month: 200804 attributes 48.70% of total transportation CO2 emission
Household vehicles in month: 200805 attributes 48.34% of total transportation CO2 emission
Household vehicles in month: 200806 attributes 49.08% of total transportation CO2 emission
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Household vehicles in month: 200902 attributes 50.82% of total transportation CO2 emission
Household vehicles in month: 200903 attributes 52.53% of total transportation CO2 emission
Household vehicles in month: 200904 attributes 56.25% of total transportation CO2 emission
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3d) screenshot below |

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v

3d)

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Problem 3d
Plug-in hybrids with 20 mile electric range:
The difference in CO2 emission (million metric tons) is 19.225726 in 200803  | a 27.73% change
The difference in CO2 emission (million metric tons) is 21.874694 in 200804  | a 28.02% change
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The difference in CO2 emission (million metric tons) is 20.833220 in 200807  | a 24.30% change
The difference in CO2 emission (million metric tons) is 20.652784 in 200808  | a 24.70% change
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The difference in CO2 emission (million metric tons) is 20.751805 in 200810  | a 27.32% change
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The difference in CO2 emission (million metric tons) is 20.817196 in 200901  | a 27.74% change
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Plug-in hybrids with 40 mile electric range:
The difference in CO2 emission (million metric tons) is 24.744373 in 200803  | a 35.68% change
The difference in CO2 emission (million metric tons) is 28.504983 in 200804  | a 36.52% change
The difference in CO2 emission (million metric tons) is 28.585094 in 200805  | a 35.55% change
The difference in CO2 emission (million metric tons) is 26.627606 in 200806  | a 34.16% change
The difference in CO2 emission (million metric tons) is 27.603708 in 200807  | a 32.20% change
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The difference in CO2 emission (million metric tons) is 26.821143 in 200809  | a 35.53% change
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----------------------------
Plug-in hybrids with 60 mile electric range:
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The difference in CO2 emission (million metric tons) is 29.268321 in 200808  | a 35.00% change
The difference in CO2 emission (million metric tons) is 27.791430 in 200809  | a 36.82% change
The difference in CO2 emission (million metric tons) is 28.019381 in 200810  | a 36.89% change
The difference in CO2 emission (million metric tons) is 28.502592 in 200811  | a 35.94% change
The difference in CO2 emission (million metric tons) is 28.229447 in 200812  | a 36.36% change
The difference in CO2 emission (million metric tons) is 28.692460 in 200901  | a 38.23% change
The difference in CO2 emission (million metric tons) is 27.252913 in 200902  | a 38.97% change
The difference in CO2 emission (million metric tons) is 31.081364 in 200903  | a 37.98% change
The difference in CO2 emission (million metric tons) is 31.680389 in 200904  | a 36.78% change
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5a)

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Problem 5a
84 miles threshold :
The difference in CO2 emission (million metric tons) is 9.477445 in 200803  | a 13.67% change
The difference in CO2 emission (million metric tons) is 11.906283 in 200804  | a 15.25% change
The difference in CO2 emission (million metric tons) is 11.931780 in 200805  | a 14.84% change
The difference in CO2 emission (million metric tons) is 11.303127 in 200806  | a 14.50% change
The difference in CO2 emission (million metric tons) is 10.970298 in 200807  | a 12.80% change
The difference in CO2 emission (million metric tons) is 10.677557 in 200808  | a 12.77% change
The difference in CO2 emission (million metric tons) is 10.892961 in 200809  | a 14.43% change
The difference in CO2 emission (million metric tons) is 11.042370 in 200810  | a 14.54% change
The difference in CO2 emission (million metric tons) is 10.820368 in 200811  | a 13.64% change
The difference in CO2 emission (million metric tons) is 10.835777 in 200812  | a 13.96% change
The difference in CO2 emission (million metric tons) is 11.503564 in 200901  | a 15.33% change
The difference in CO2 emission (million metric tons) is 11.507262 in 200902  | a 16.46% change
The difference in CO2 emission (million metric tons) is 13.549055 in 200903  | a 16.56% change
The difference in CO2 emission (million metric tons) is 13.406922 in 200904  | a 15.57% change
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107 miles threshold :
The difference in CO2 emission (million metric tons) is 11.744626 in 200803  | a 16.94% change
The difference in CO2 emission (million metric tons) is 13.740848 in 200804  | a 17.60% change
The difference in CO2 emission (million metric tons) is 14.000217 in 200805  | a 17.41% change
The difference in CO2 emission (million metric tons) is 13.055378 in 200806  | a 16.75% change
The difference in CO2 emission (million metric tons) is 12.673384 in 200807  | a 14.78% change
The difference in CO2 emission (million metric tons) is 12.347574 in 200808  | a 14.77% change
The difference in CO2 emission (million metric tons) is 12.528979 in 200809  | a 16.60% change
The difference in CO2 emission (million metric tons) is 12.728287 in 200810  | a 16.76% change
The difference in CO2 emission (million metric tons) is 12.433909 in 200811  | a 15.68% change
The difference in CO2 emission (million metric tons) is 12.493100 in 200812  | a 16.09% change
The difference in CO2 emission (million metric tons) is 13.354669 in 200901  | a 17.80% change
The difference in CO2 emission (million metric tons) is 13.299467 in 200902  | a 19.02% change
The difference in CO2 emission (million metric tons) is 15.556243 in 200903  | a 19.01% change
The difference in CO2 emission (million metric tons) is 15.527299 in 200904  | a 18.03% change
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208 miles threshold :
The difference in CO2 emission (million metric tons) is 16.867377 in 200803  | a 24.32% change
The difference in CO2 emission (million metric tons) is 17.990897 in 200804  | a 23.05% change
The difference in CO2 emission (million metric tons) is 18.468118 in 200805  | a 22.97% change
The difference in CO2 emission (million metric tons) is 17.207593 in 200806  | a 22.07% change
The difference in CO2 emission (million metric tons) is 16.975971 in 200807  | a 19.80% change
The difference in CO2 emission (million metric tons) is 16.547671 in 200808  | a 19.79% change
The difference in CO2 emission (million metric tons) is 15.892003 in 200809  | a 21.05% change
The difference in CO2 emission (million metric tons) is 16.374429 in 200810  | a 21.56% change
The difference in CO2 emission (million metric tons) is 16.169853 in 200811  | a 20.39% change
The difference in CO2 emission (million metric tons) is 16.321697 in 200812  | a 21.02% change
The difference in CO2 emission (million metric tons) is 17.393534 in 200901  | a 23.18% change
The difference in CO2 emission (million metric tons) is 17.147756 in 200902  | a 24.52% change
The difference in CO2 emission (million metric tons) is 20.369260 in 200903  | a 24.89% change
The difference in CO2 emission (million metric tons) is 20.812216 in 200904  | a 24.16% change
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270 miles threshold :
The difference in CO2 emission (million metric tons) is 17.486249 in 200803  | a 25.22% change
The difference in CO2 emission (million metric tons) is 19.160739 in 200804  | a 24.55% change
The difference in CO2 emission (million metric tons) is 19.867706 in 200805  | a 24.71% change
The difference in CO2 emission (million metric tons) is 18.427811 in 200806  | a 23.64% change
The difference in CO2 emission (million metric tons) is 18.220953 in 200807  | a 21.25% change
The difference in CO2 emission (million metric tons) is 17.766830 in 200808  | a 21.25% change
The difference in CO2 emission (million metric tons) is 16.982046 in 200809  | a 22.50% change
The difference in CO2 emission (million metric tons) is 17.554967 in 200810  | a 23.11% change
The difference in CO2 emission (million metric tons) is 17.361171 in 200811  | a 21.89% change
The difference in CO2 emission (million metric tons) is 17.377159 in 200812  | a 22.38% change
The difference in CO2 emission (million metric tons) is 18.658814 in 200901  | a 24.86% change
The difference in CO2 emission (million metric tons) is 18.293621 in 200902  | a 26.16% change
The difference in CO2 emission (million metric tons) is 21.899067 in 200903  | a 26.76% change
The difference in CO2 emission (million metric tons) is 22.552208 in 200904  | a 26.18% change
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5b)

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Problem 5b
84 miles threshold :
The difference in CO2 emission (million metric tons) is 24.012093 in 200803  | a 34.63% change
The difference in CO2 emission (million metric tons) is 29.702597 in 200804  | a 38.05% change
The difference in CO2 emission (million metric tons) is 28.897925 in 200805  | a 35.94% change
The difference in CO2 emission (million metric tons) is 26.937467 in 200806  | a 34.56% change
The difference in CO2 emission (million metric tons) is 27.089383 in 200807  | a 31.60% change
The difference in CO2 emission (million metric tons) is 26.872387 in 200808  | a 32.14% change
The difference in CO2 emission (million metric tons) is 27.426136 in 200809  | a 36.34% change
The difference in CO2 emission (million metric tons) is 26.357996 in 200810  | a 34.71% change
The difference in CO2 emission (million metric tons) is 27.249721 in 200811  | a 34.36% change
The difference in CO2 emission (million metric tons) is 26.779896 in 200812  | a 34.49% change
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107 miles threshold :
The difference in CO2 emission (million metric tons) is 29.884105 in 200803  | a 43.10% change
The difference in CO2 emission (million metric tons) is 34.415970 in 200804  | a 44.09% change
The difference in CO2 emission (million metric tons) is 34.073641 in 200805  | a 42.37% change
The difference in CO2 emission (million metric tons) is 31.315212 in 200806  | a 40.17% change
The difference in CO2 emission (million metric tons) is 31.489120 in 200807  | a 36.73% change
The difference in CO2 emission (million metric tons) is 31.251248 in 200808  | a 37.37% change
The difference in CO2 emission (million metric tons) is 31.707440 in 200809  | a 42.01% change
The difference in CO2 emission (million metric tons) is 30.543497 in 200810  | a 40.22% change
The difference in CO2 emission (million metric tons) is 31.466512 in 200811  | a 39.68% change
The difference in CO2 emission (million metric tons) is 31.040649 in 200812  | a 39.98% change
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208 miles threshold :
The difference in CO2 emission (million metric tons) is 43.152054 in 200803  | a 62.23% change
The difference in CO2 emission (million metric tons) is 45.335210 in 200804  | a 58.08% change
The difference in CO2 emission (million metric tons) is 45.253384 in 200805  | a 56.28% change
The difference in CO2 emission (million metric tons) is 41.688921 in 200806  | a 53.48% change
The difference in CO2 emission (million metric tons) is 42.604383 in 200807  | a 49.70% change
The difference in CO2 emission (million metric tons) is 42.264088 in 200808  | a 50.54% change
The difference in CO2 emission (million metric tons) is 40.508153 in 200809  | a 53.67% change
The difference in CO2 emission (million metric tons) is 39.595503 in 200810  | a 52.14% change
The difference in CO2 emission (million metric tons) is 41.229939 in 200811  | a 51.99% change
The difference in CO2 emission (million metric tons) is 40.883457 in 200812  | a 52.66% change
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270 miles threshold :
The difference in CO2 emission (million metric tons) is 44.754936 in 200803  | a 64.54% change
The difference in CO2 emission (million metric tons) is 48.340771 in 200804  | a 61.93% change
The difference in CO2 emission (million metric tons) is 48.755484 in 200805  | a 60.63% change
The difference in CO2 emission (million metric tons) is 44.737459 in 200806  | a 57.39% change
The difference in CO2 emission (million metric tons) is 45.820660 in 200807  | a 53.45% change
The difference in CO2 emission (million metric tons) is 45.460778 in 200808  | a 54.36% change
The difference in CO2 emission (million metric tons) is 43.360692 in 200809  | a 57.45% change
The difference in CO2 emission (million metric tons) is 42.526338 in 200810  | a 56.00% change
The difference in CO2 emission (million metric tons) is 44.343299 in 200811  | a 55.91% change
The difference in CO2 emission (million metric tons) is 43.596909 in 200812  | a 56.15% change
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