

Session 4 - An AI to Help Reduce Heating Bills - Exercises

Consider the `home_heating_ai` notebook.

1. House 4 shows different behaviour from houses 1 to 3. The heating is occasionally off. Presumably because the home owners are not at home. Extend the model to handle house 4 in addition to houses 1 to 3.

HINTS:

- (a) Review how the outliers were addressed in the linear regression example from last week. These used a Bernoulli variable to indicate if each data point was an outlier. Remember the `shape=(N)` argument to ensure that there is one Bernoulli variable per data point.
- (b) Use the same approach here by defining a Bernoulli variable to indicate that the home owner is at home (and will use the heating system). Choose a suitable prior for the probability of success of the Bernoulli variable and declare it as part of the model, along with the Bernoulli variable itself.
- (c) Update the energy calculation to include the Bernoulli variable. You can do this within a switch statement, or use the fact that the Bernoulli variable has a value of 0 or 1 when True or False, to include it explicitly.

For example, if the Bernoulli variable is called `P_home` the energy consumption of the home can be written as `E_app+P_home*24.0*HPLC*(T_s-external_temp)` so that the energy consumed by the heating system is only added when `P_home` is equal to 1.

- (d) The additional variables mean that this model will likely run slower. Reduce the number of samples that are drawn to speed up the sampling process.
2. Confirm that your model correctly fits the data for house 4.
 3. Confirm that this same model also correctly fits the data for house 1. What happens to the mean value of the posterior probability of the success of the Bernoulli variable in each case.
 4. **[More Challenging]** House 5 shows a further complication in the behaviour with the addition of an electric car charger. Update the model to deal with this case as well.

HINTS:

- (a) You will need to add a further Bernoulli variable and prior to indicate whether or not the car is charging.
 - (b) Cars can only be charged when the home owner is at home.
 - (c) You will need to define an appropriate prior for the energy consumed charging the car.
5. Confirm that your model correctly fits the data for house 5.
 6. How much energy is used by the car when it is charged?