

Dynamic pricing

Tom Archer

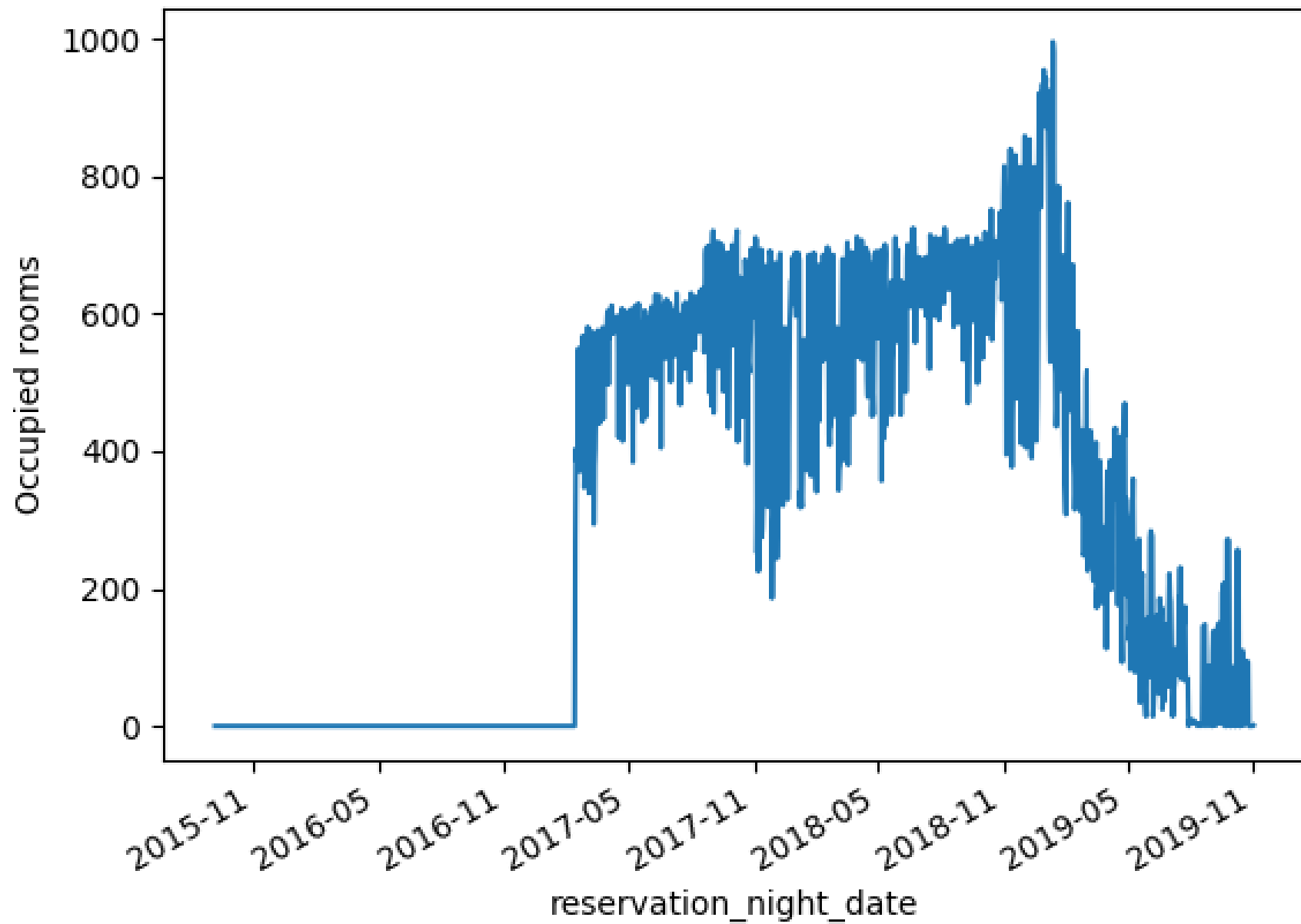
Code and presentation can be found here:

https://github.com/tdarcher/pace_interview.git

Existing dynamic price models

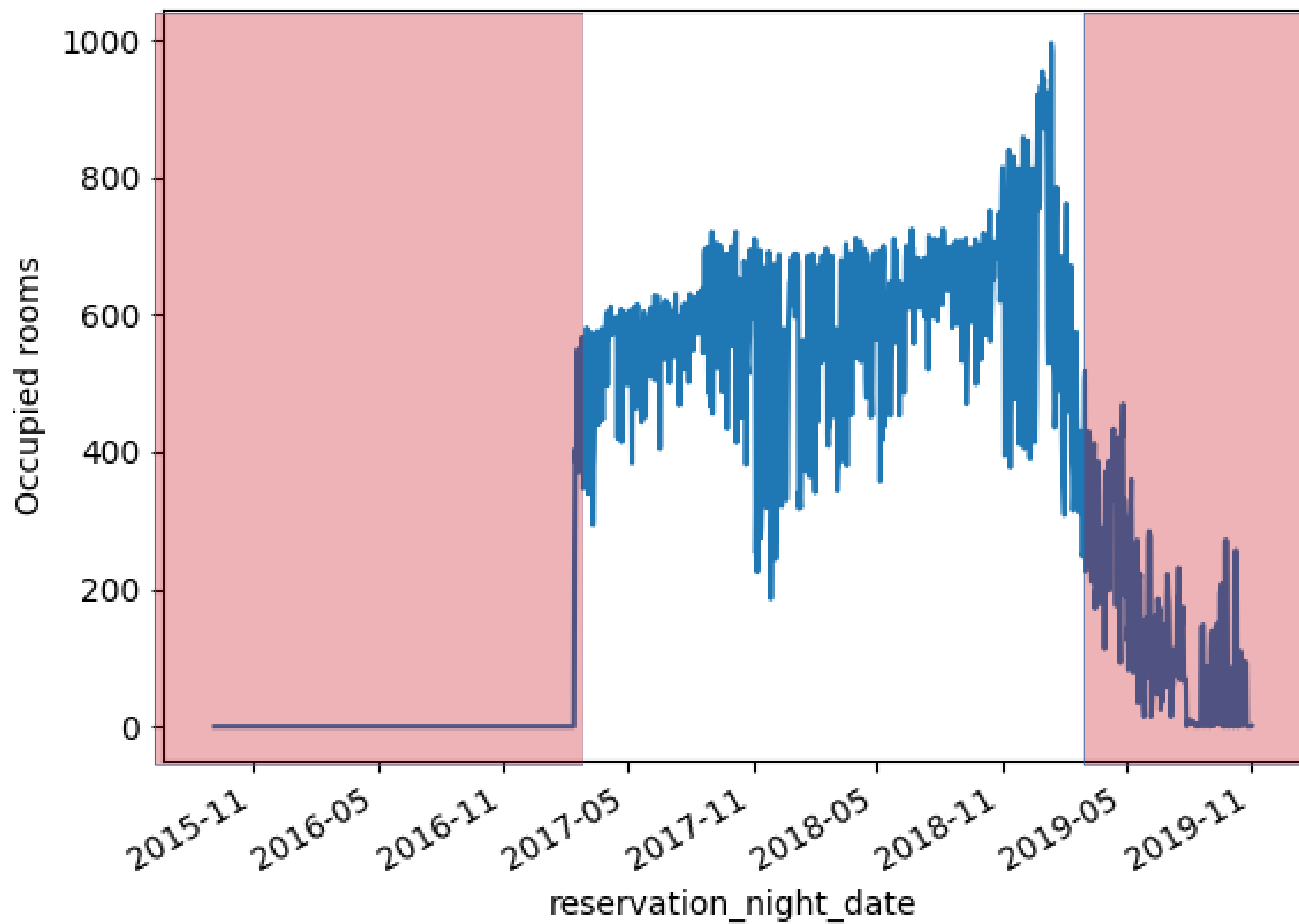
- **Historical:**
Only consider final number of rooms
Same day last year, moving average
- **Advanced booking**
Only consider the number of reservations
Additive, booking curve, time series
- **Combined:**
Weighted average of historical and advanced

All data

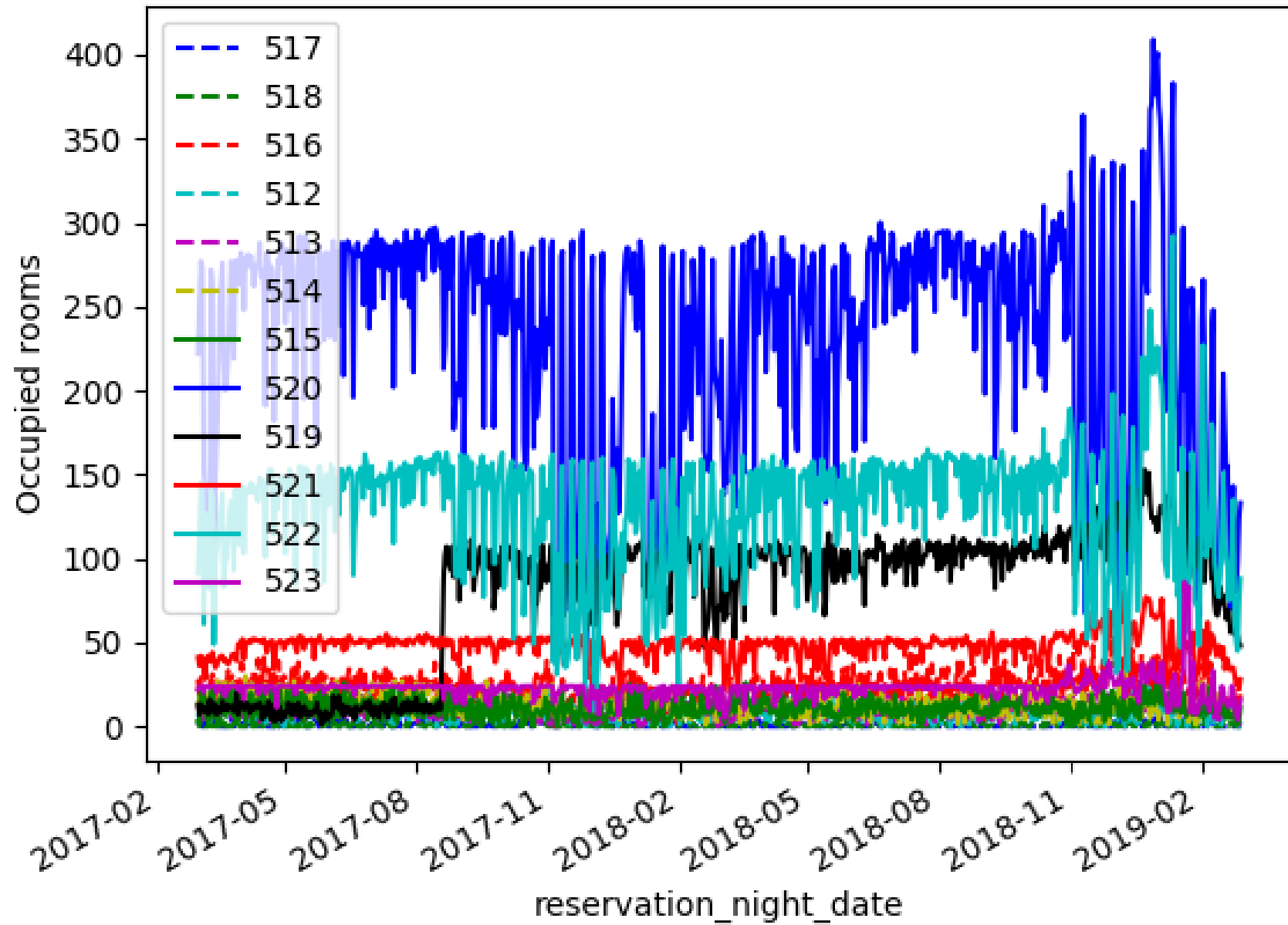


1 Occupancy prediction

All data

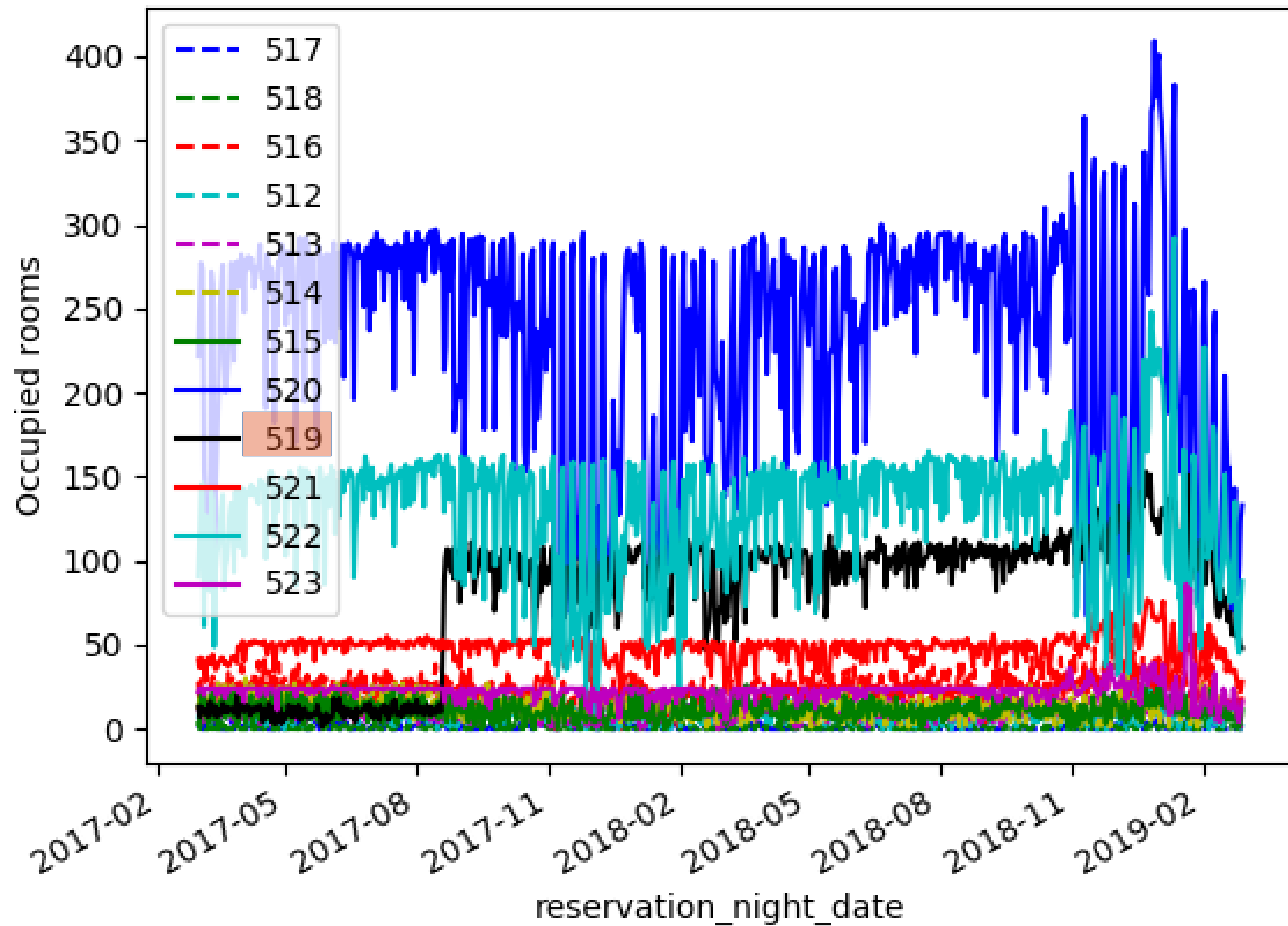


All data

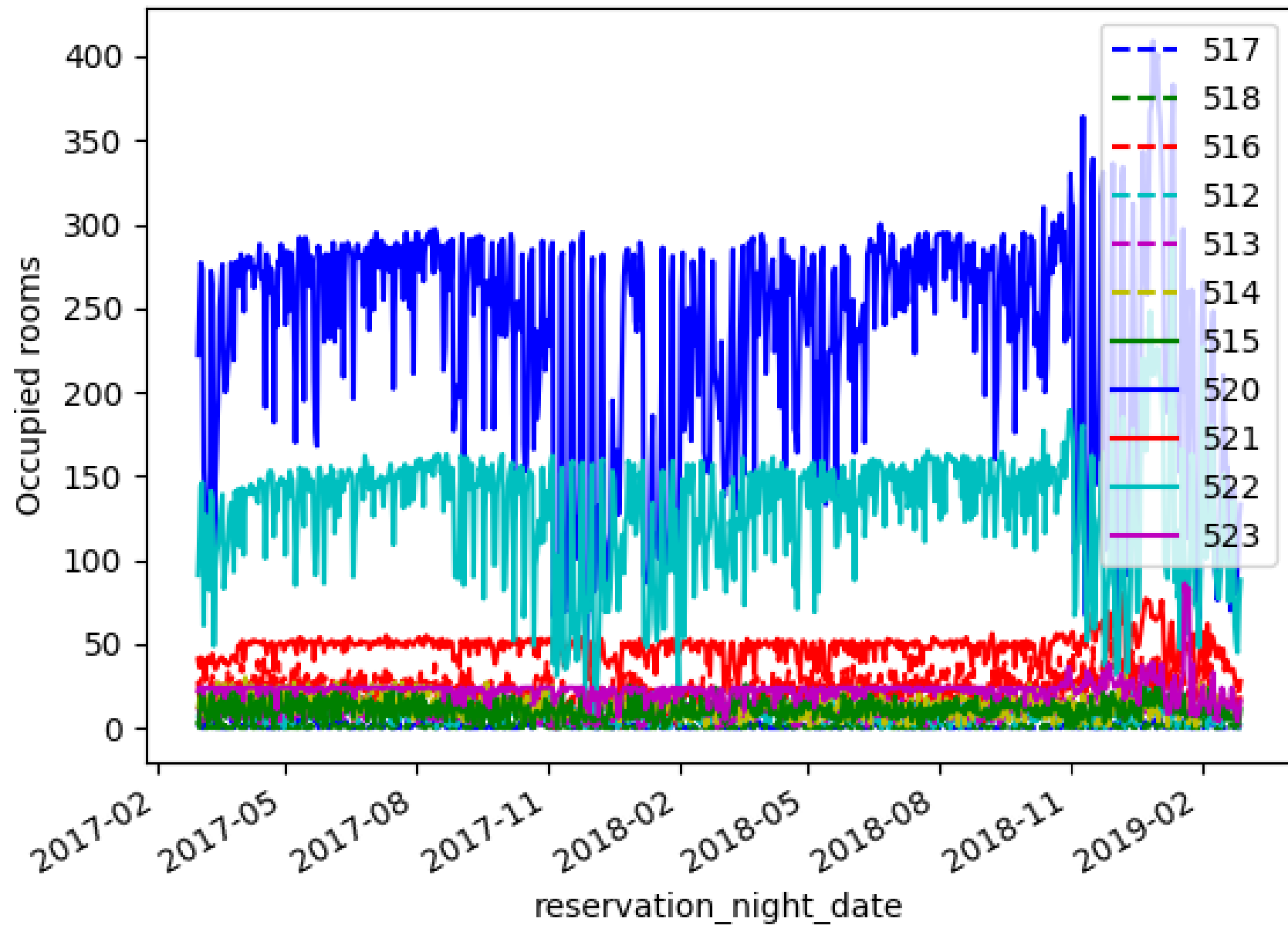


All data

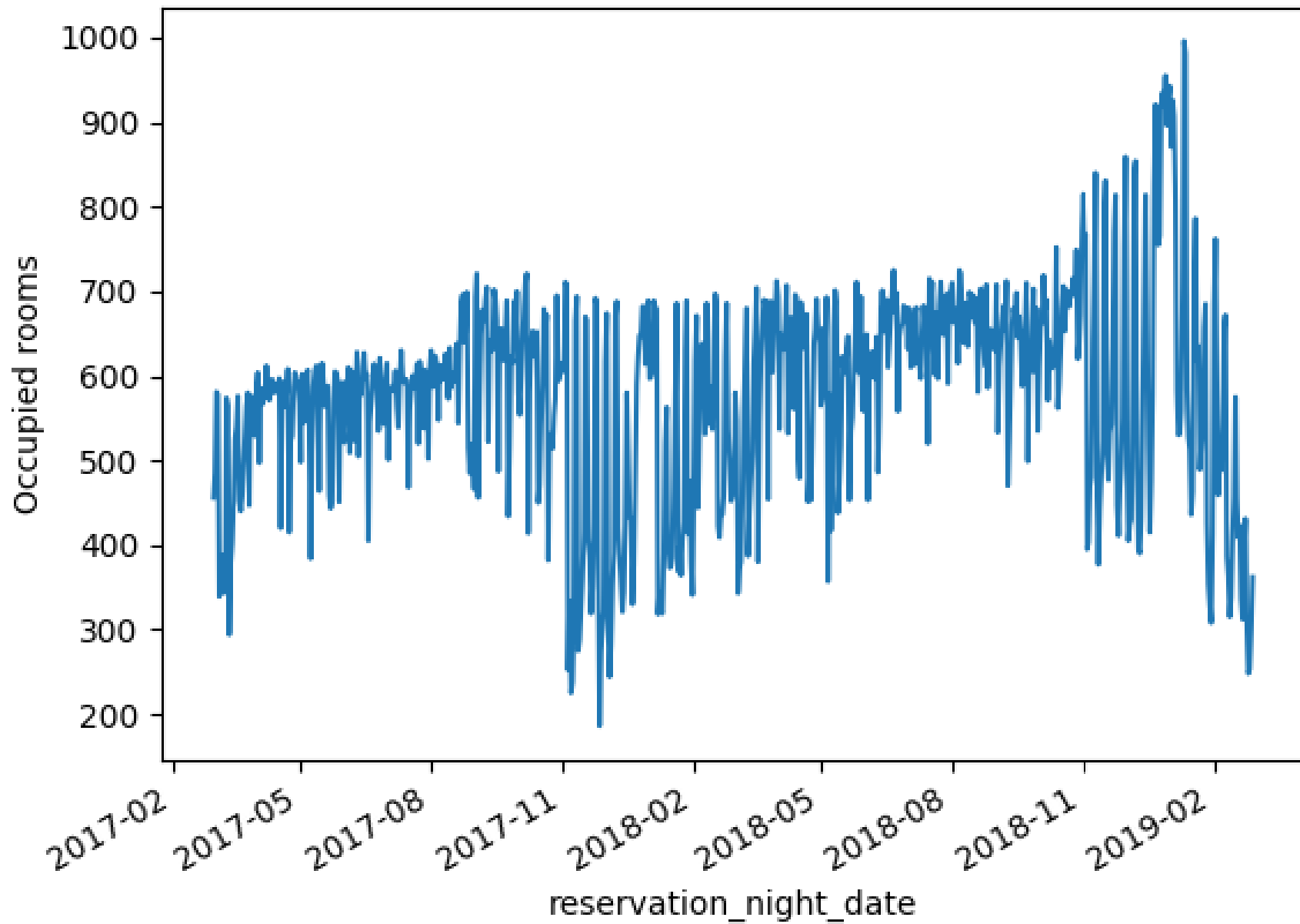
$\frac{733}{835}$ Rooms remaining



Reduced data set



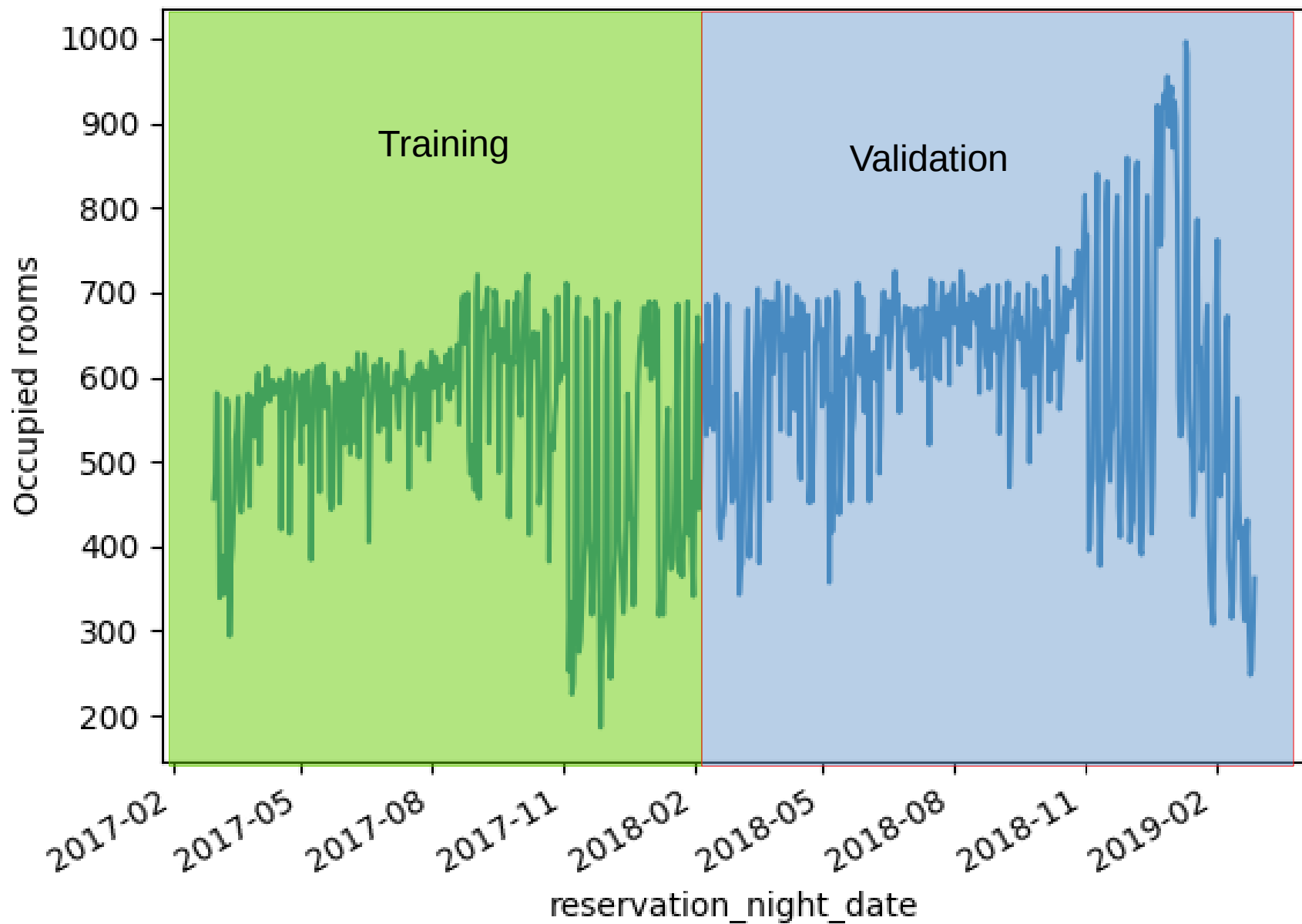
Reduced data set



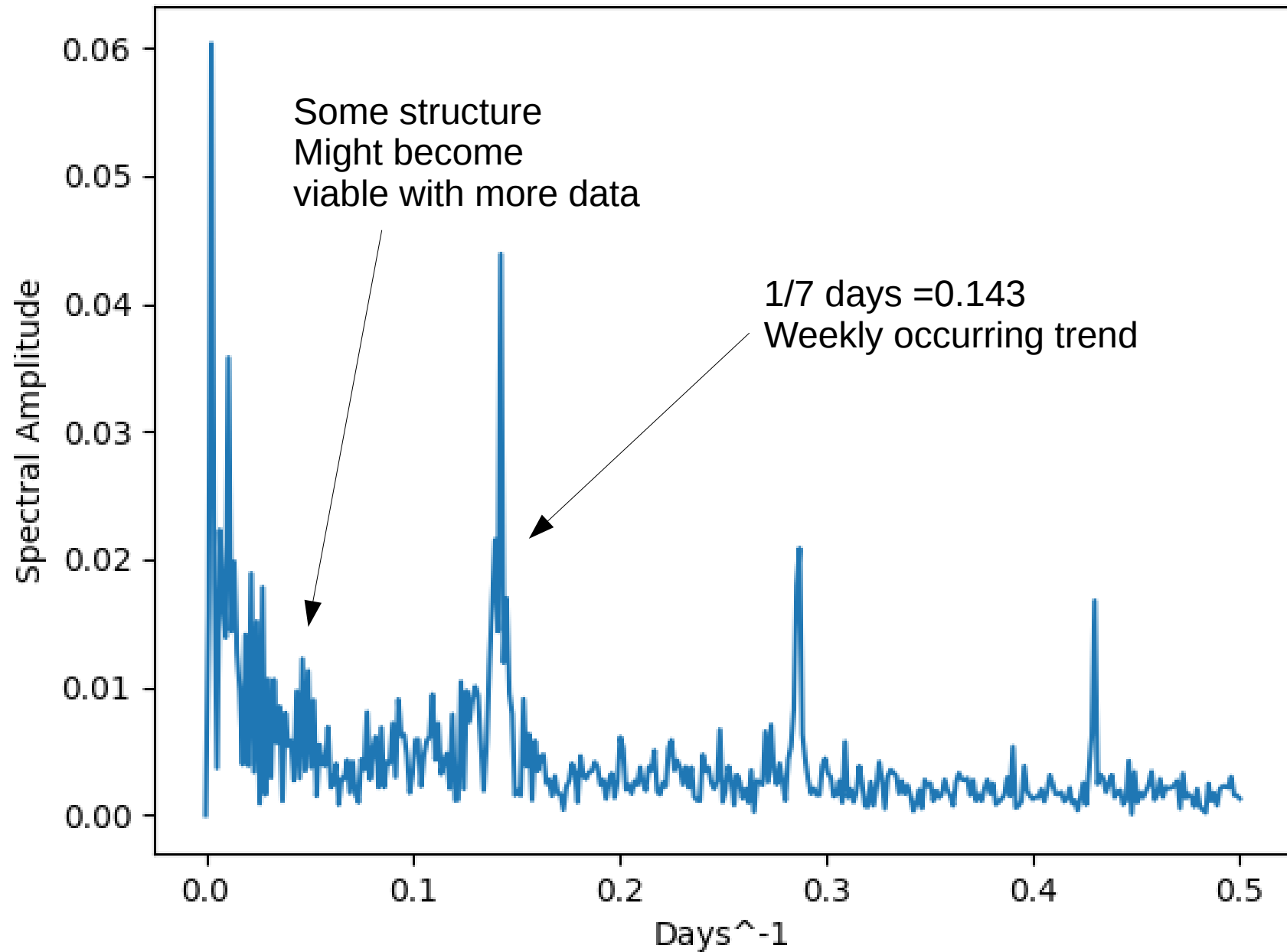
Analysis of Historical trends

Predicting demand

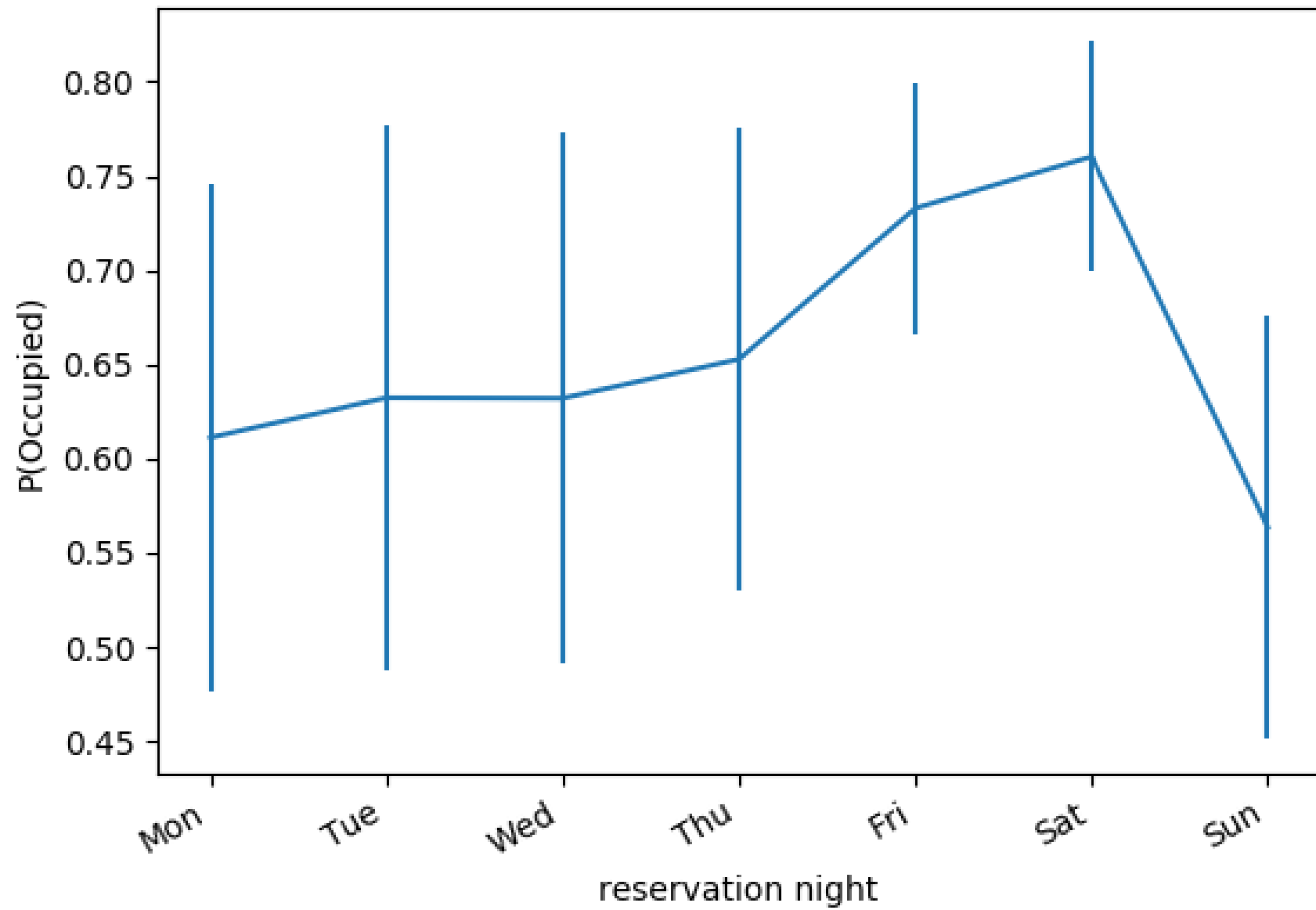
Reduced data set

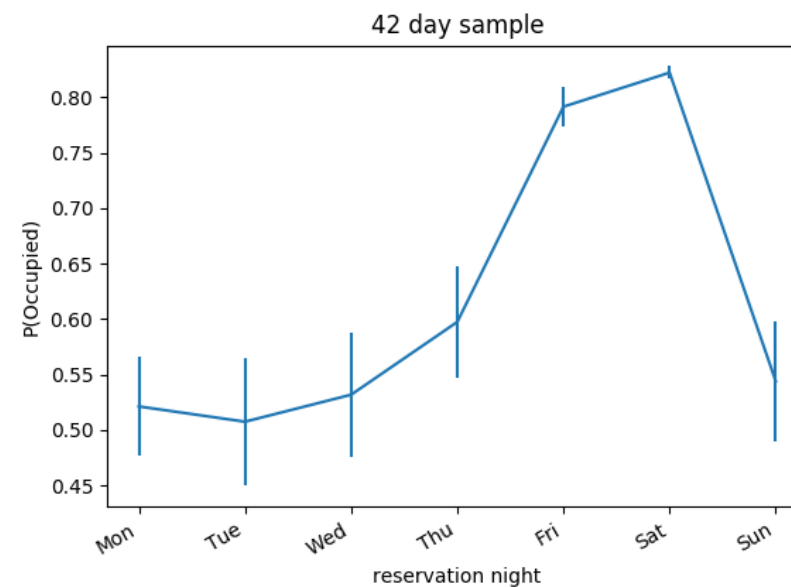
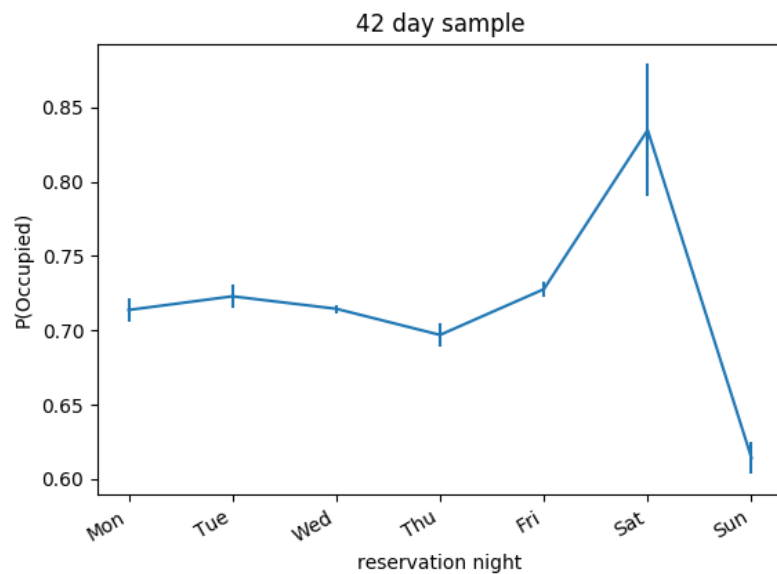


FFT of total occupancy

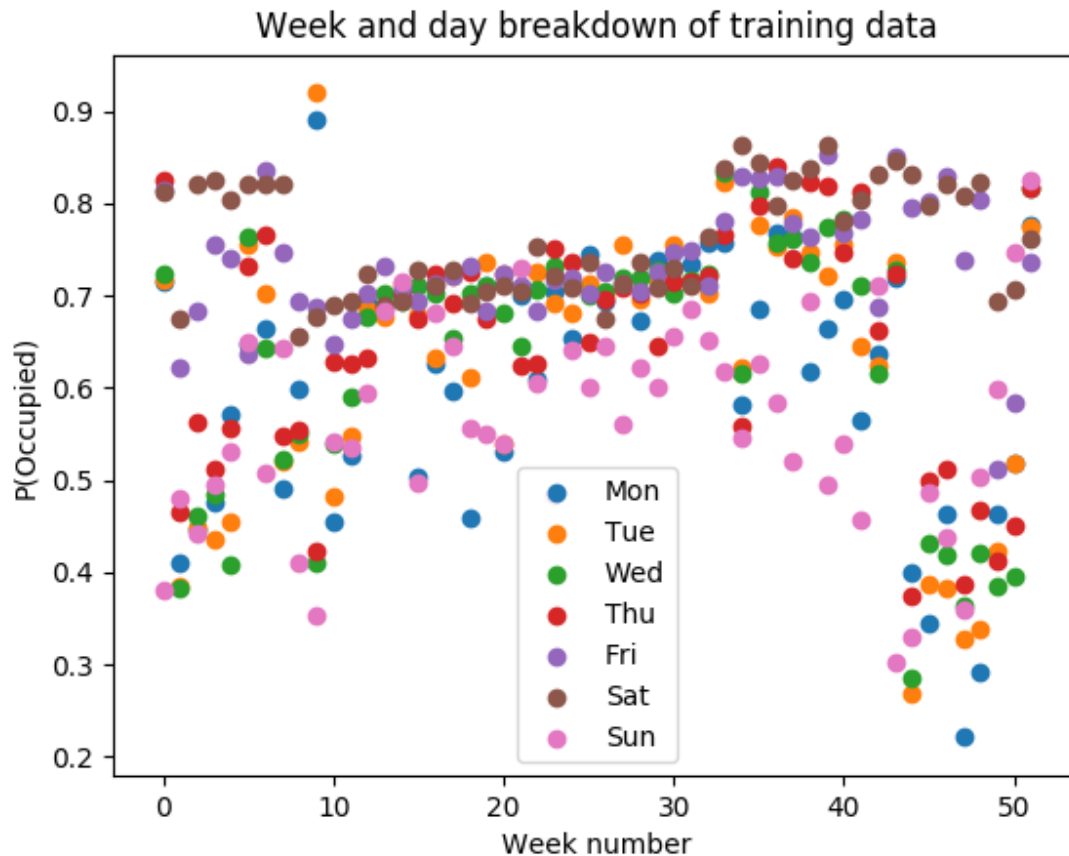


1 Year training set





Initial model



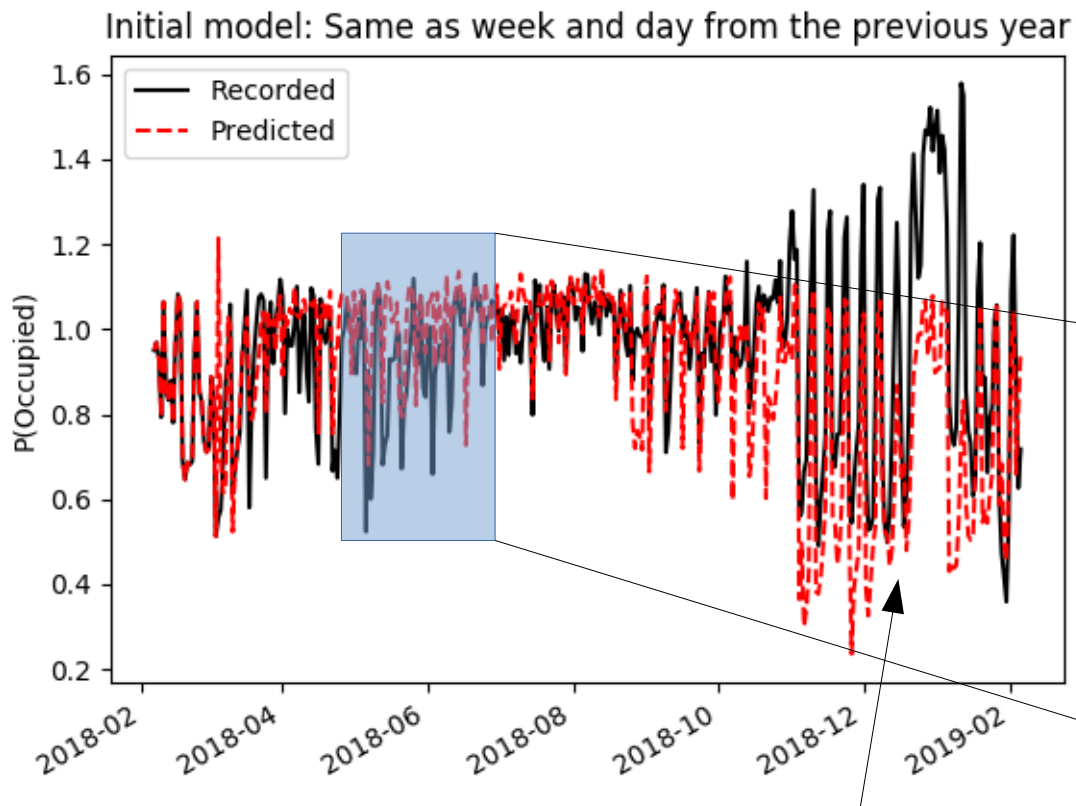
- Data broken down into week number and day
- Demand estimated to be the same as previous year

Predict occupancy from historical data

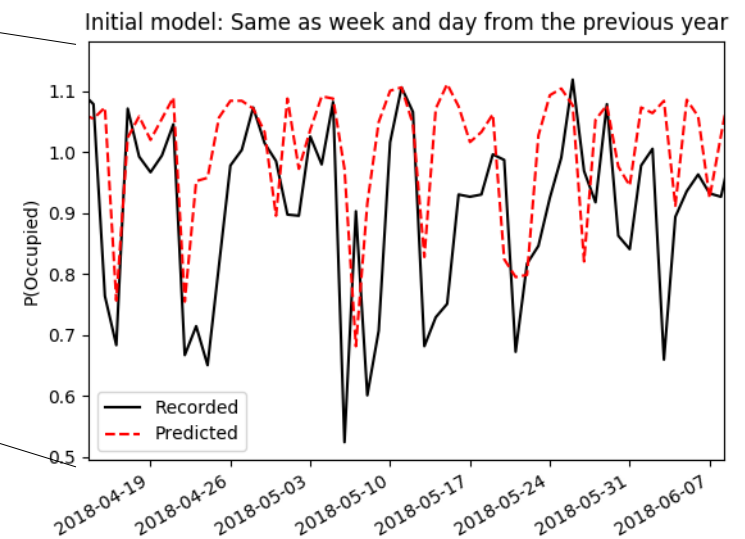
- Historical occupancy taken from day and week of previous year.

Works well for the fitted data:

- Need to refit for each hotel
- No variation with improved performance of the hotel

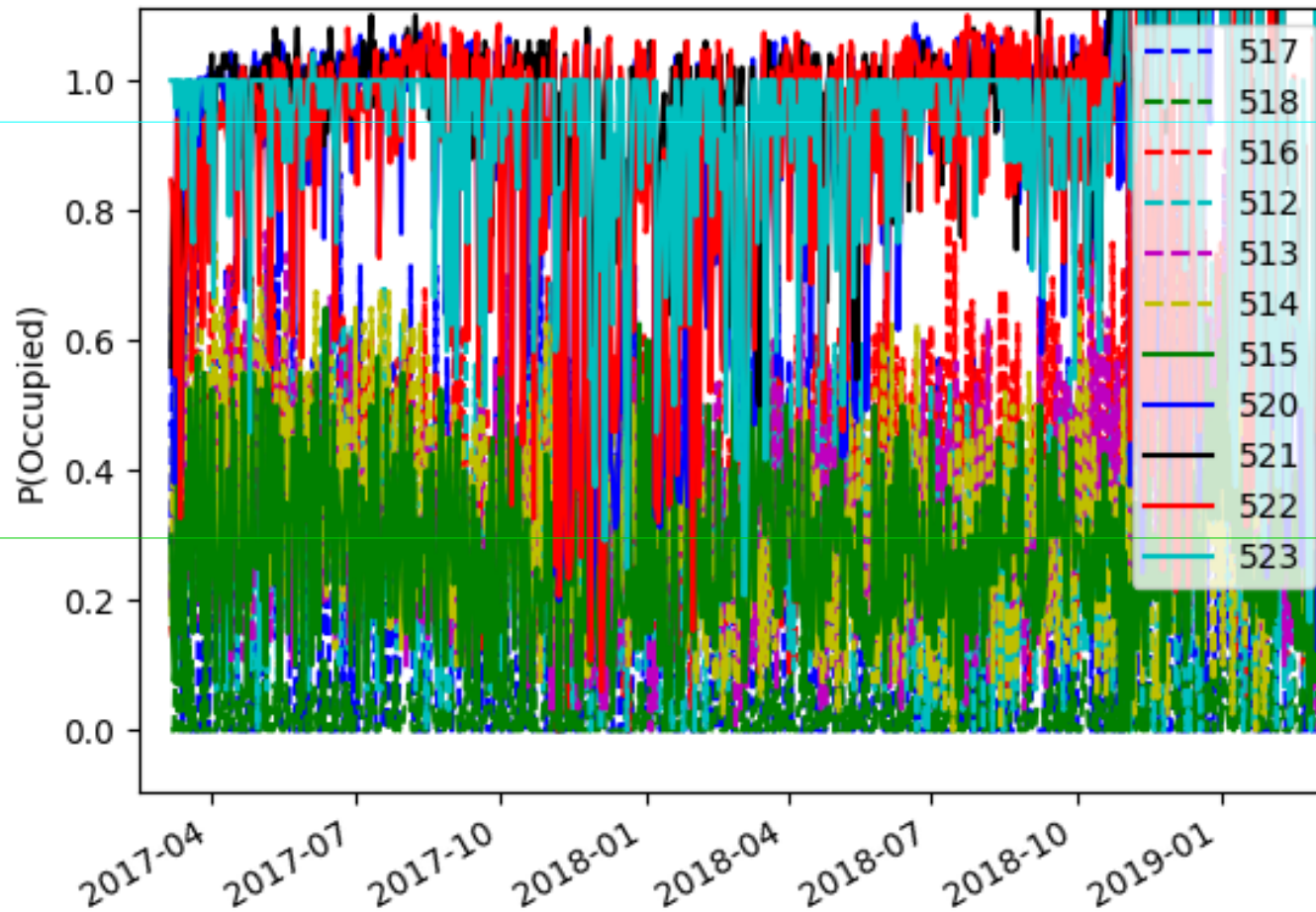


$$Residual = \sum_{Day=1, N} \frac{|P_{Day} - P_{Day}^{fitted}|}{N} = 0.13$$



Over occupancy/more rooms on line?

Can we introduce transferability?



Average occupancy
of 523 close to 100%

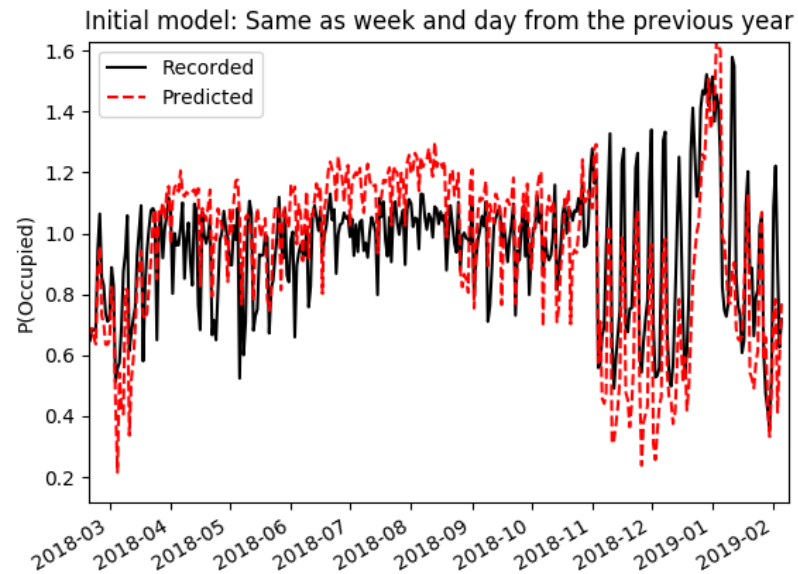
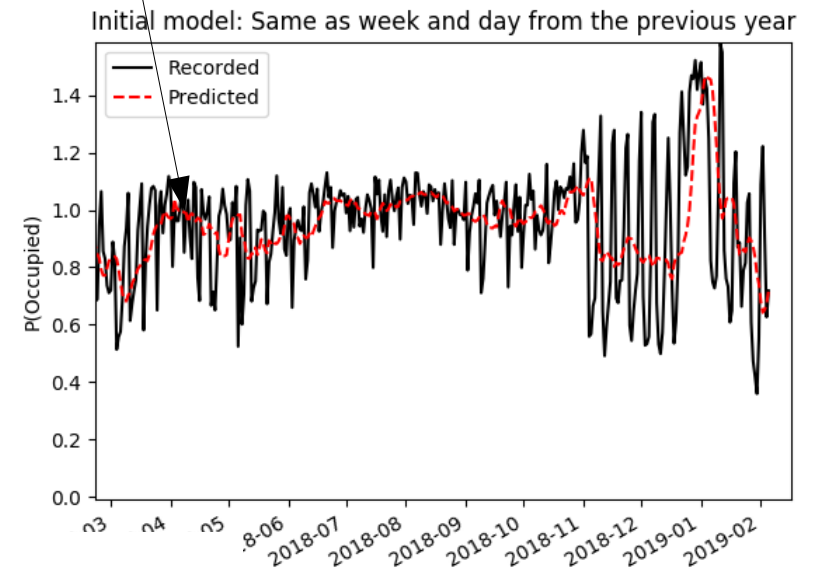
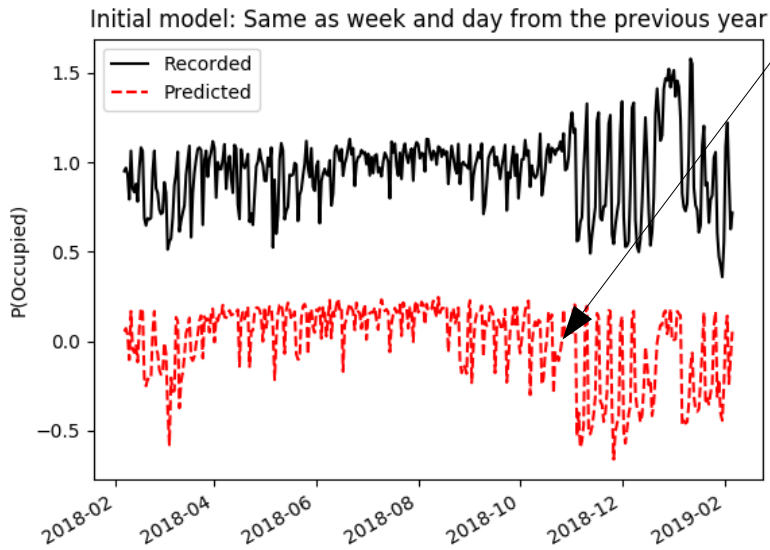
Average occupancy
of 515 only 30%

Similar demand curve for each room id, but a systematic shift present

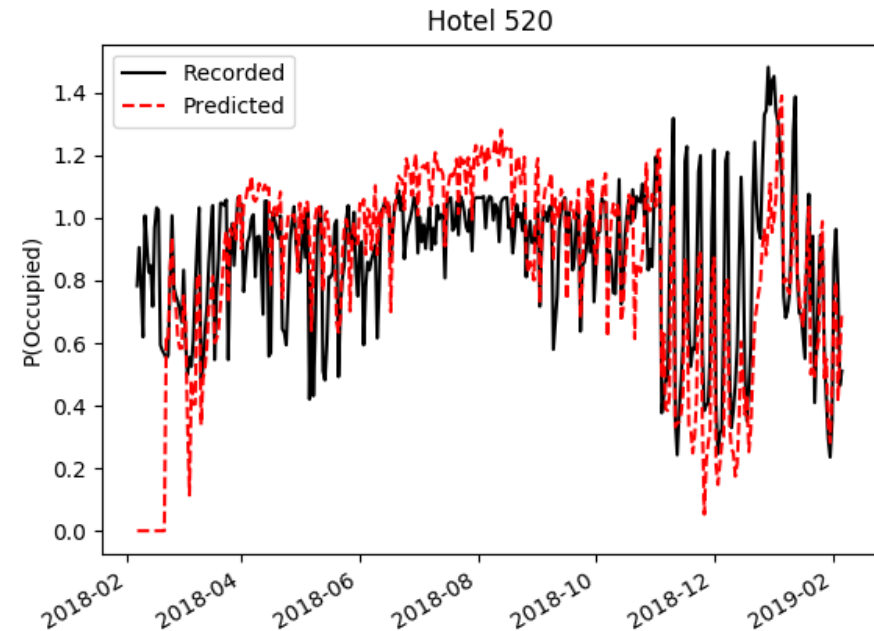
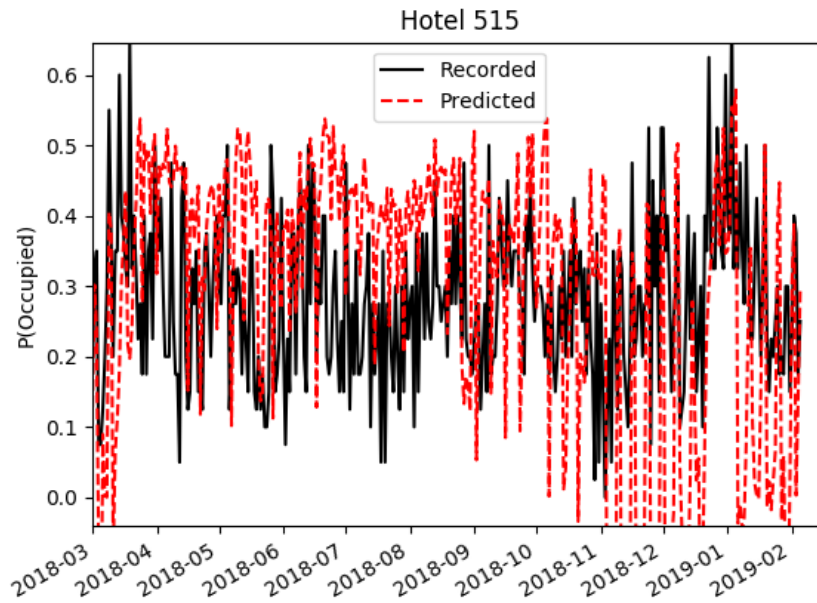
Normalized demand

Hotel performance

$$P = P_{Occupied, Historical} - \overline{P_{Occupied, Historical}} + \sum_{Night-8}^{Night-1} P_{Occupied}$$



Applying model to different hotels



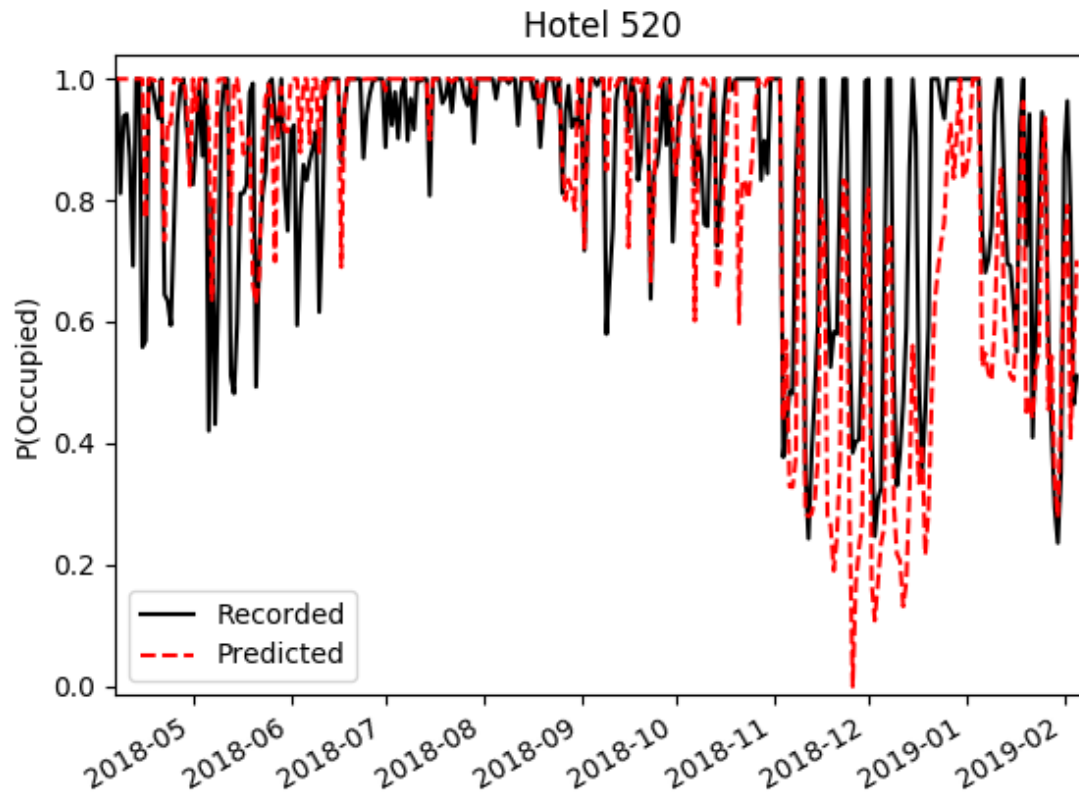
$$Residual = \sum_{Day=1, N} \frac{|P_{Day} - P_{Day}^{fitted}|}{N} = 0.13$$

Residual=0.17

Residual=0.14

2.Revenue

Revenue

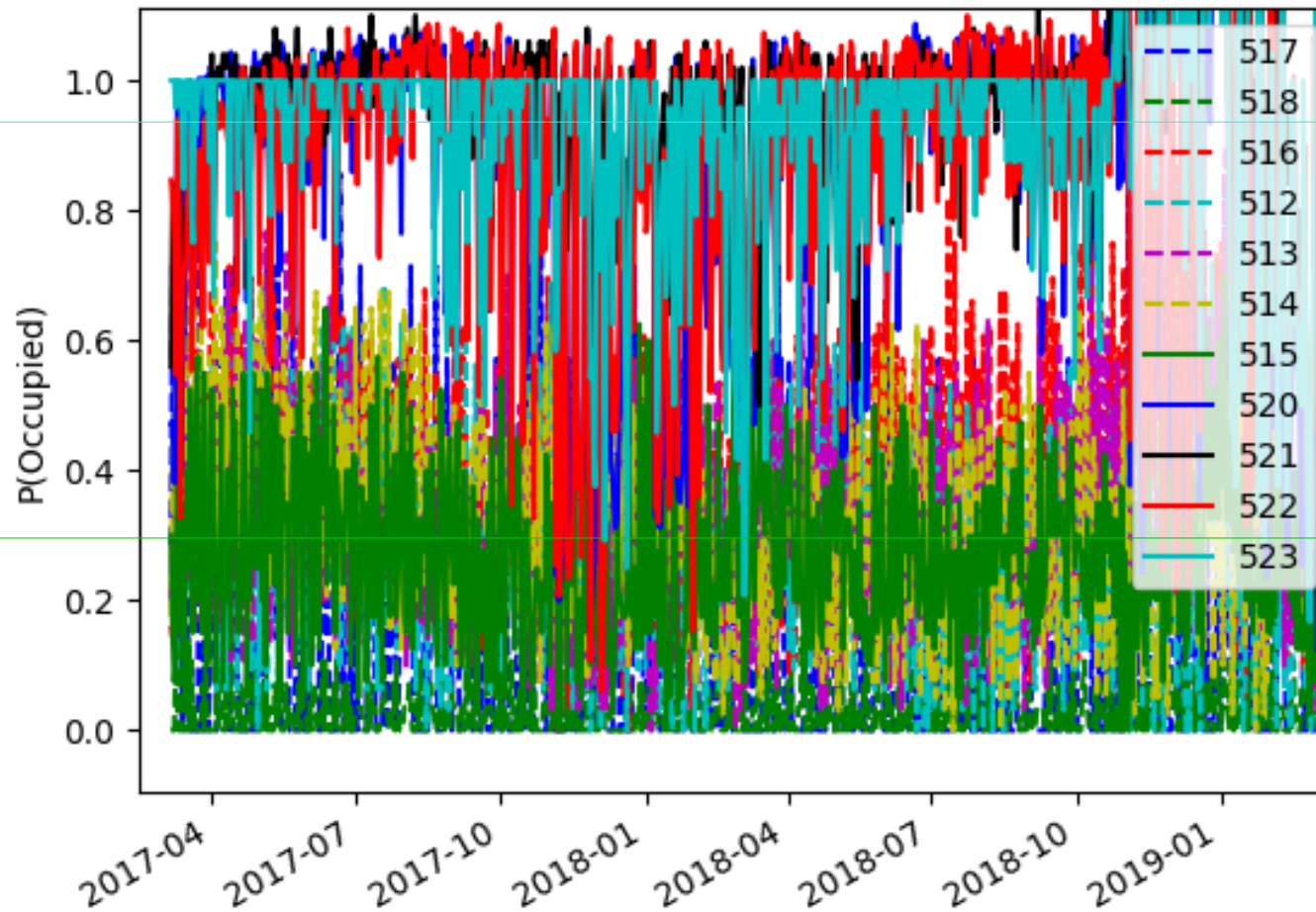


$P > 1$ is not a real, the prediction must be truncated

$$Revnu e = Rooms \times Cost \text{ per room} \times P_{Occupancy}$$

However the occupancy probability is a function of price which will create feedback if the price is changed

3. Price recommendation



Average occupancy
of 523 close to 100%

Average occupancy
of 515 only 30%

Hotels which are fully occupied most of the year could benefit from a price increase, e.g. 523,520,522

Hotels which have extra capacity could try a price decrease

Considerations

$$P_{Occupancy} (Room Price, Room abundance, location)$$

Feedback between changing the price and the occupancy is unknown

Small changes the the price could be made to probe how the occupancy responds.

Rooms could be divided up into price bands to
– promote constant occupation keeping the workload consistent

Conclusion

- A simple model based on historical demand and more recent average performance has been implemented. Data is reproduce within 17%
- The model can be used to estimate the nightly revenue.
- Pricing recommendations need to be implemented slowly to allow deviations to the model to be assessed.

Thank you

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