Our goal is to create a model

- predicting the probability that a borrower will prepay their mortgage
- fitting the model using the prior 10 years worth of data

To over-simplify

- we examine the probability of prepayment
- only for mortgages that are exactly 10 years old

We show the current mortgage rate (blue) and the borrower's actual rate (orange).

The borrower has an incentive to prepay

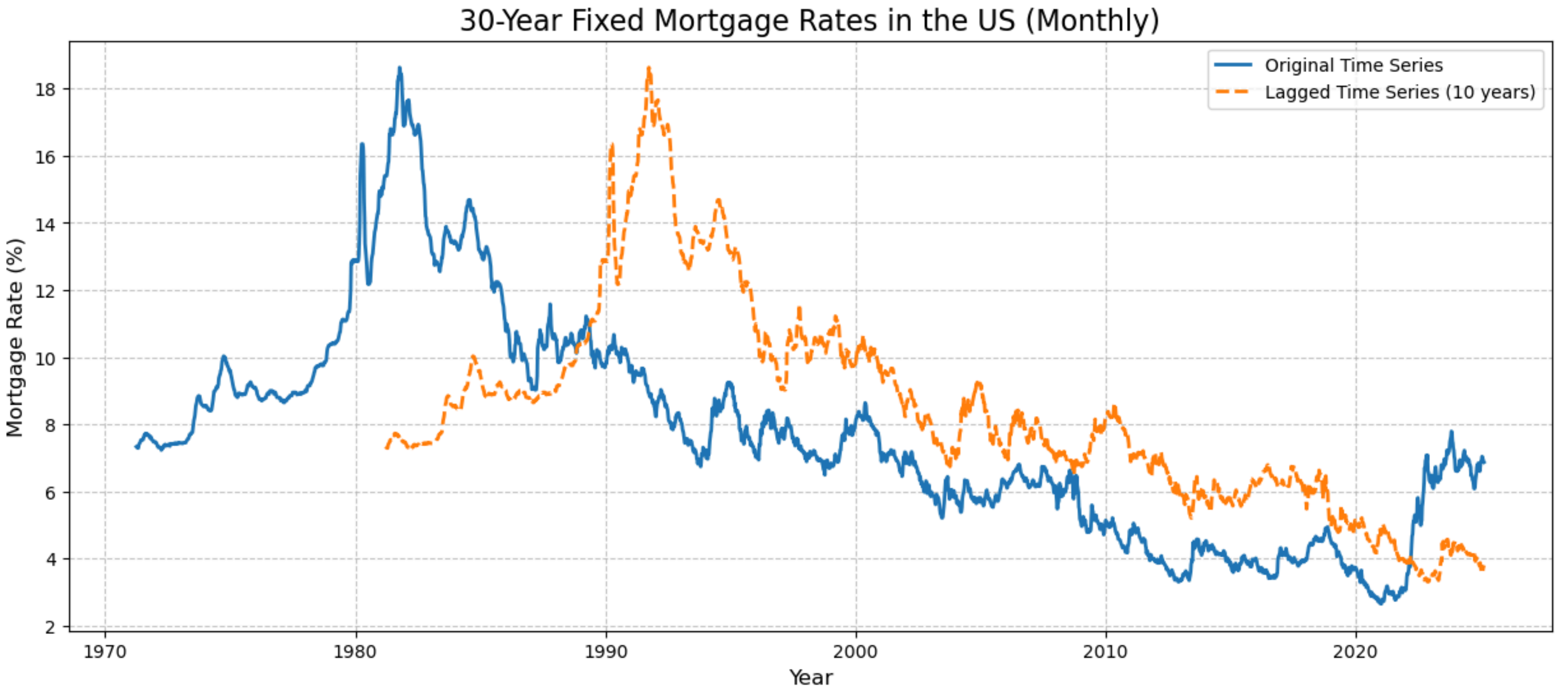
- when the current rate (blue)
- is **lower** than their actual rate (orange)

Here is the data.

In [4]:

```
fig_levels
```

Out[4]:



Imagine that we try to fit a model at each date

- using training data from the prior 10 years

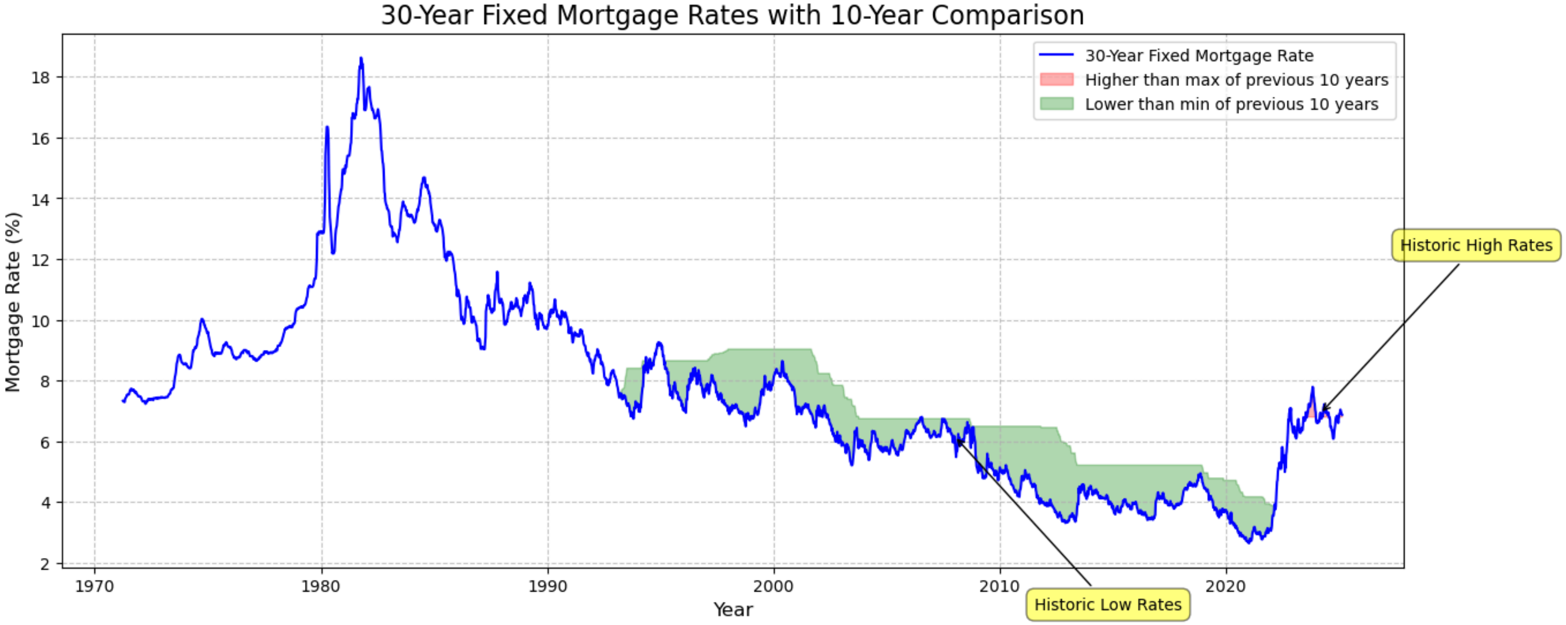
There will be times (highlighted periods in following plot)

- when the current mortgage rate
- is either at a historic high (red shading) or low (green shading) relative to the training data

In [5]:

```
fig_historic_low_high
```

Out[5]:



Using the raw features

- current mortgage rate
- borrower's actual rate

will violate the Fundamental Theorem of Machine Learning.

- the distribution of mortgage rates is not the same
    - for the training data (prior 10 years)
    - and the out of sample period

Let us create a synthetic feature

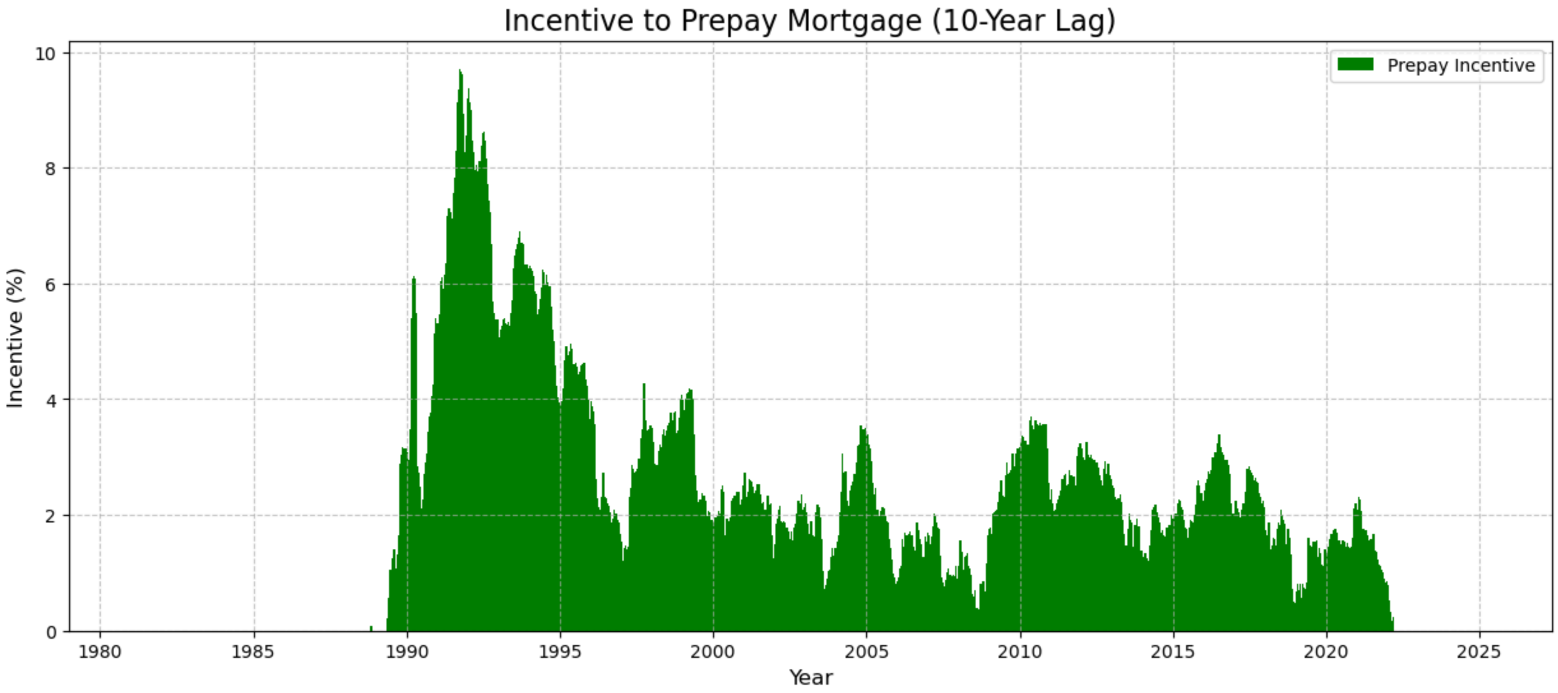
- the Incentive to prepay

This feature is useful both because

- it captures the **reason** (semantics) why a borrower might prepay
- and is **not** dependent on the level of rates

In [6]:
```
fig_incentive
```

Out[6]:



In [7]:

```
print("Done")
```

```
Done
```