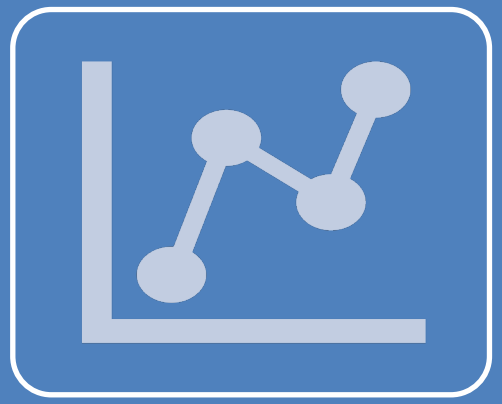
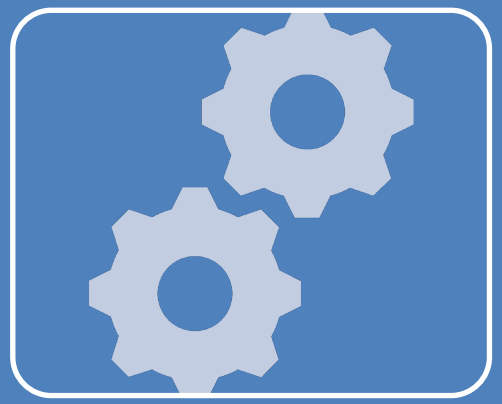
Types of trend

Trend features

Motivation

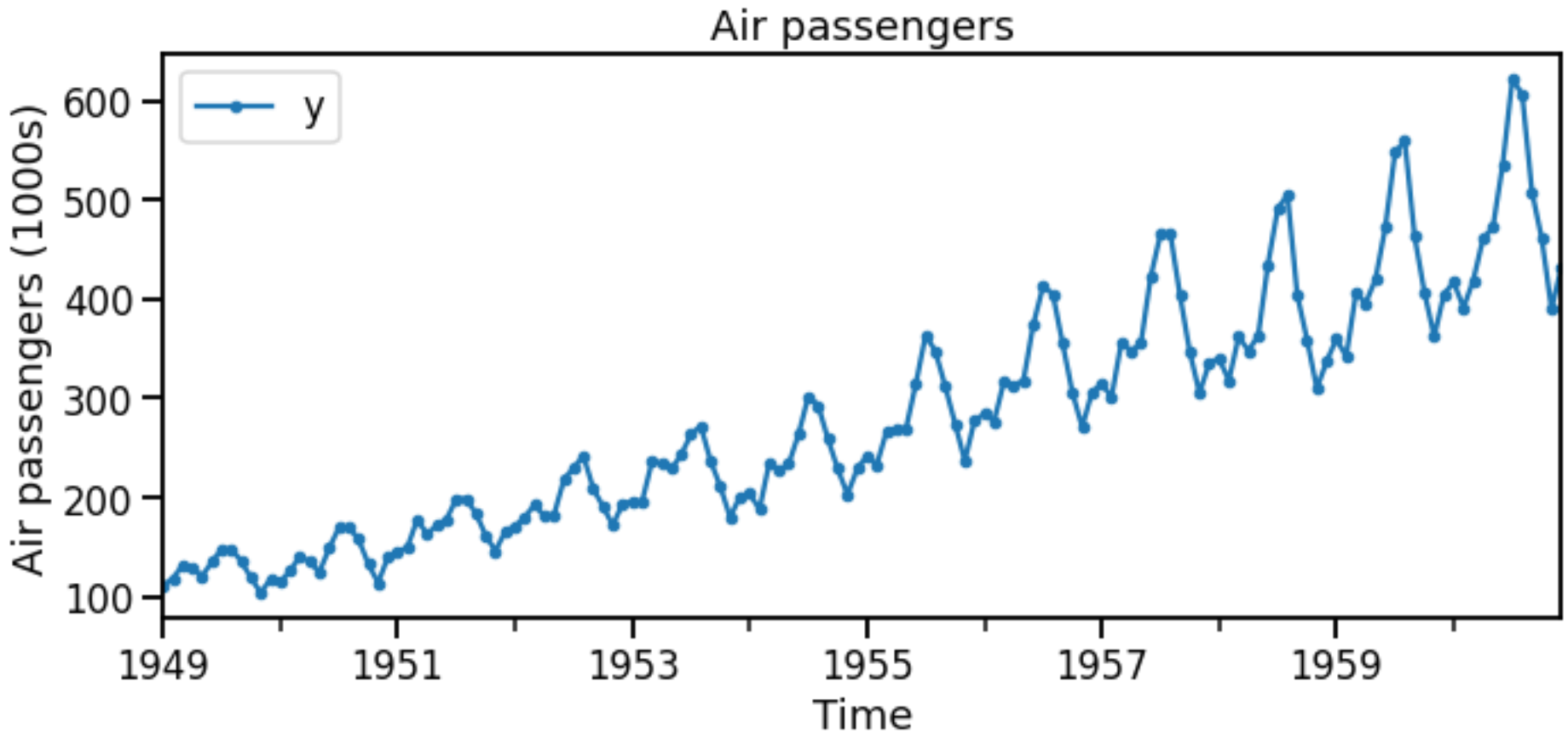


Time series can be modelled by different types of trend.

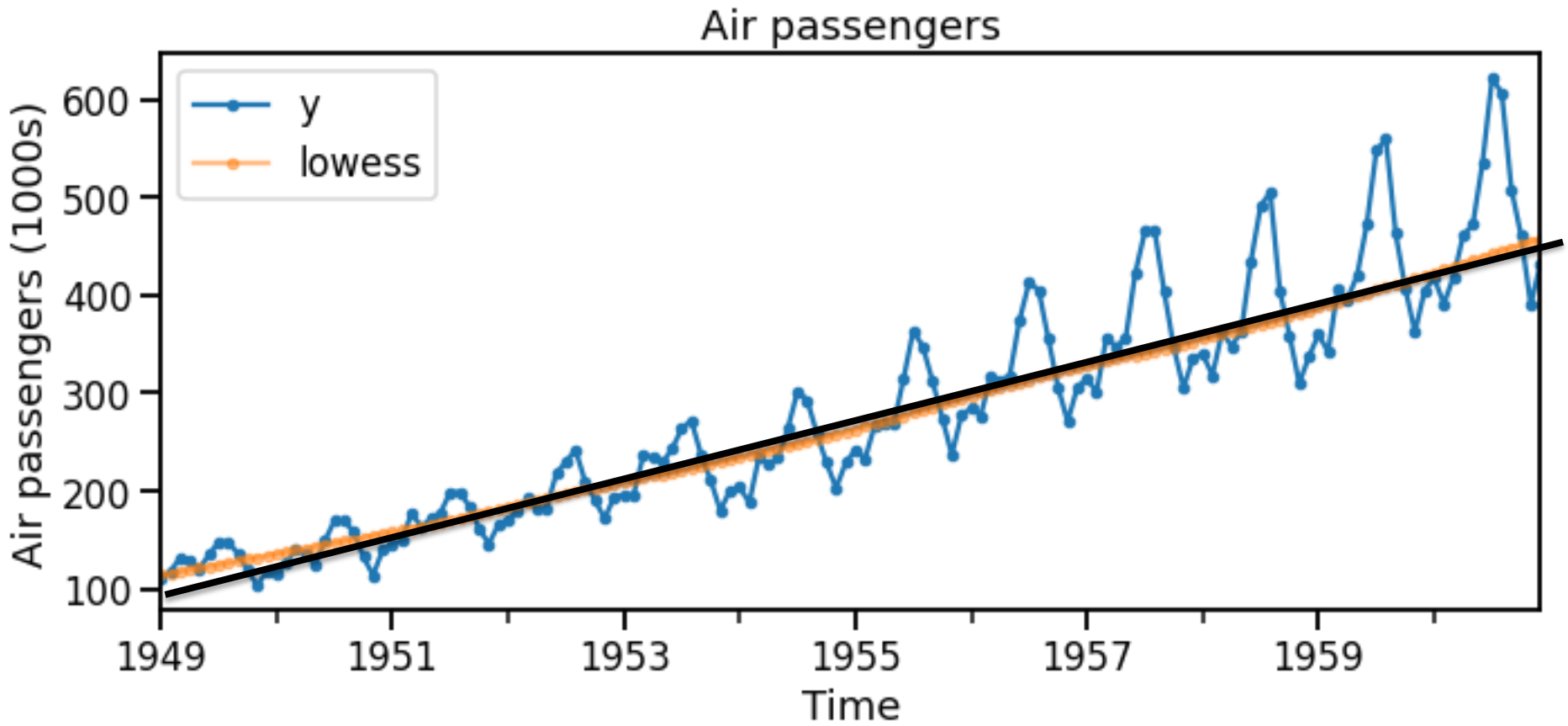


Different types of trend require different features.

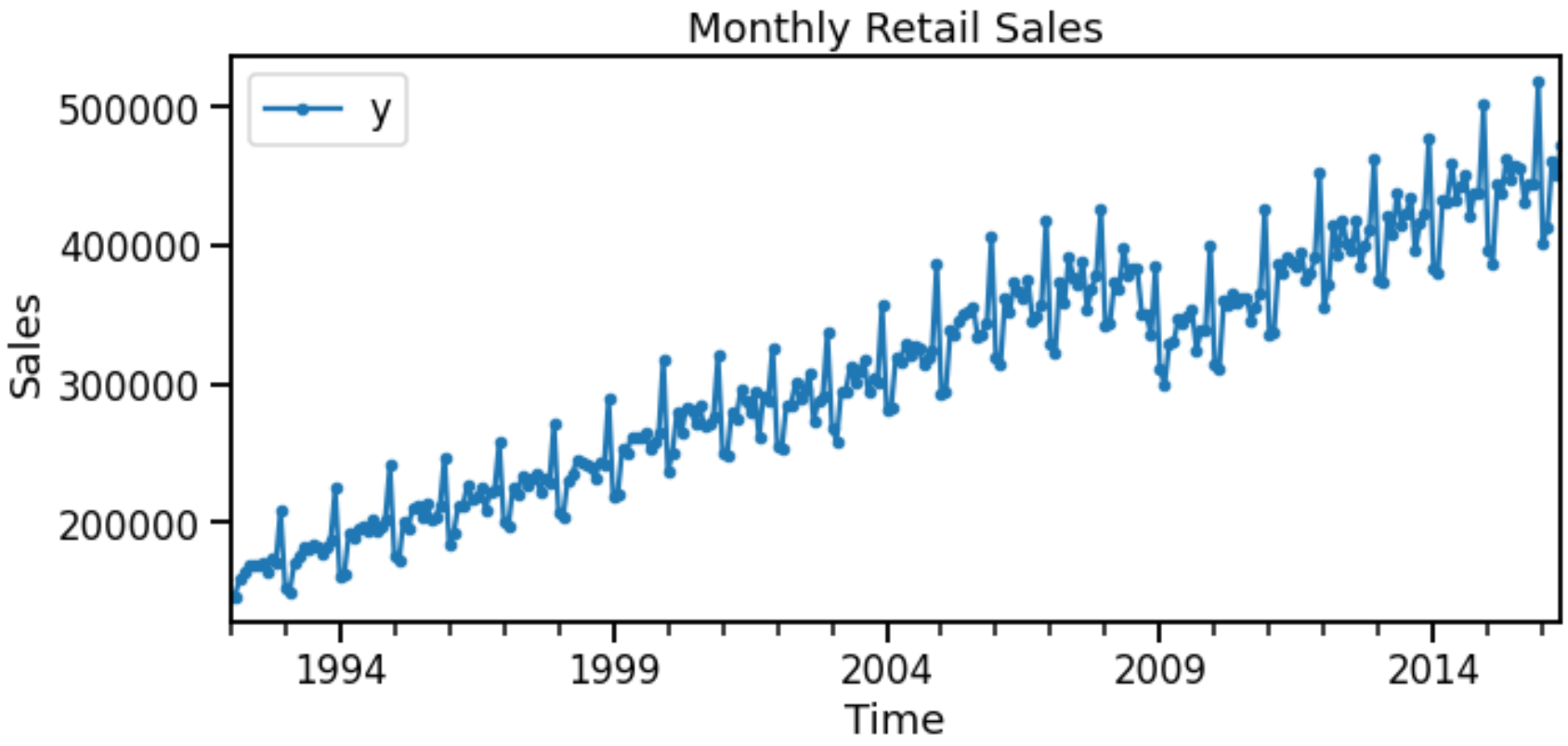
Linear trend



Linear trend

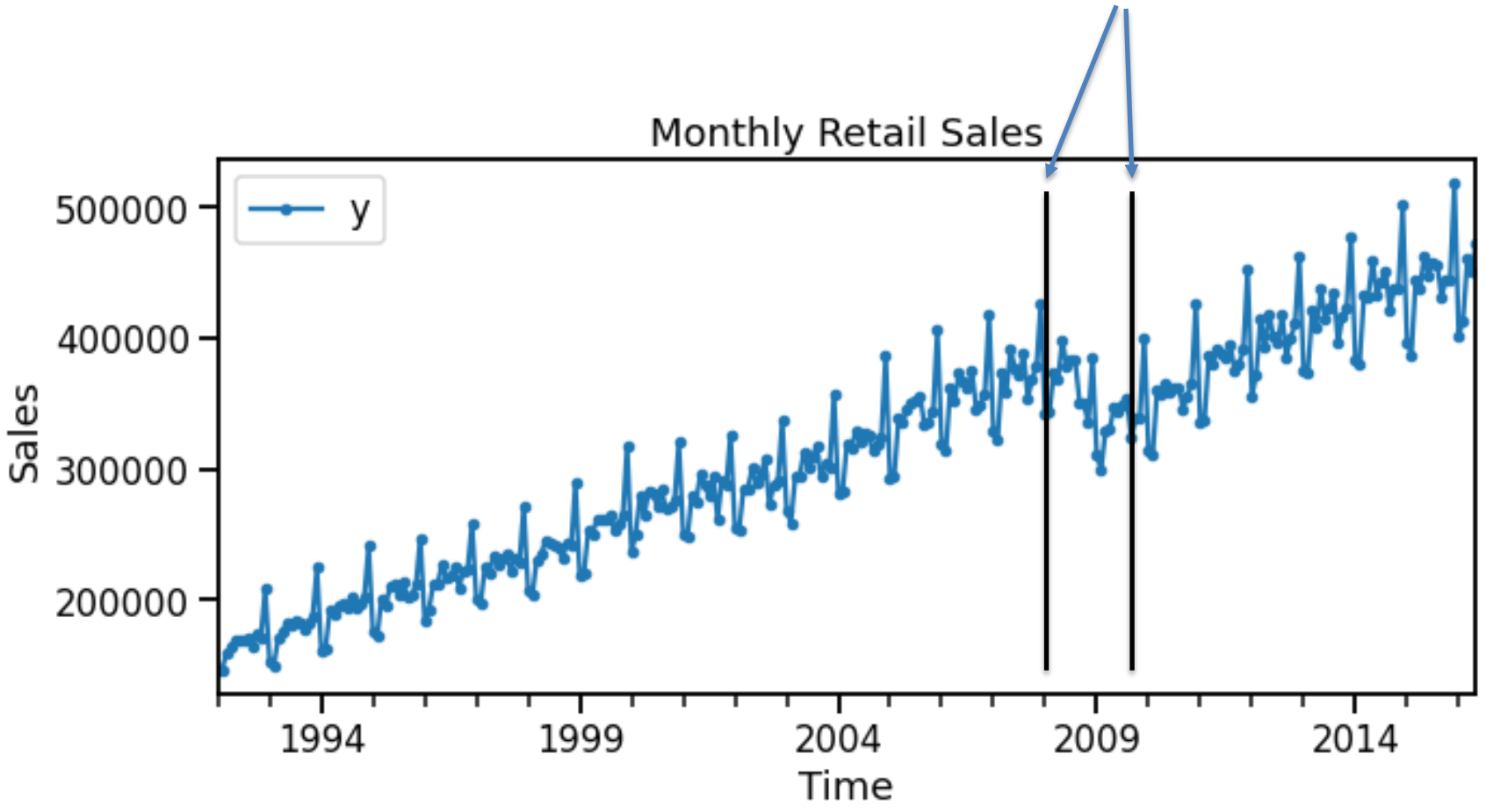


Changepoints



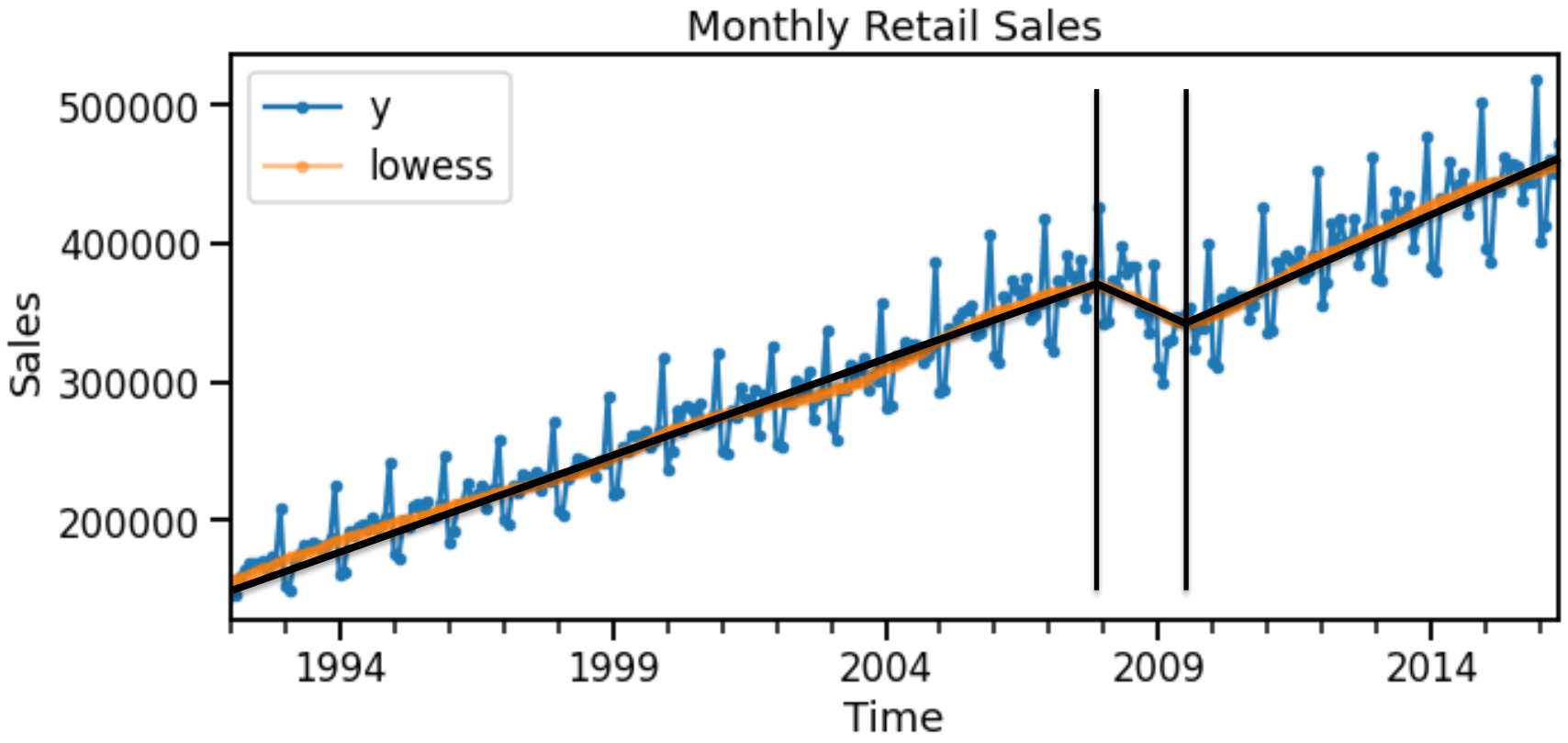
Changepoints

Changepoint: Abrupt change in the property of a time series. (e.g., trend, seasonality, autoregressive properties)



Changepoints

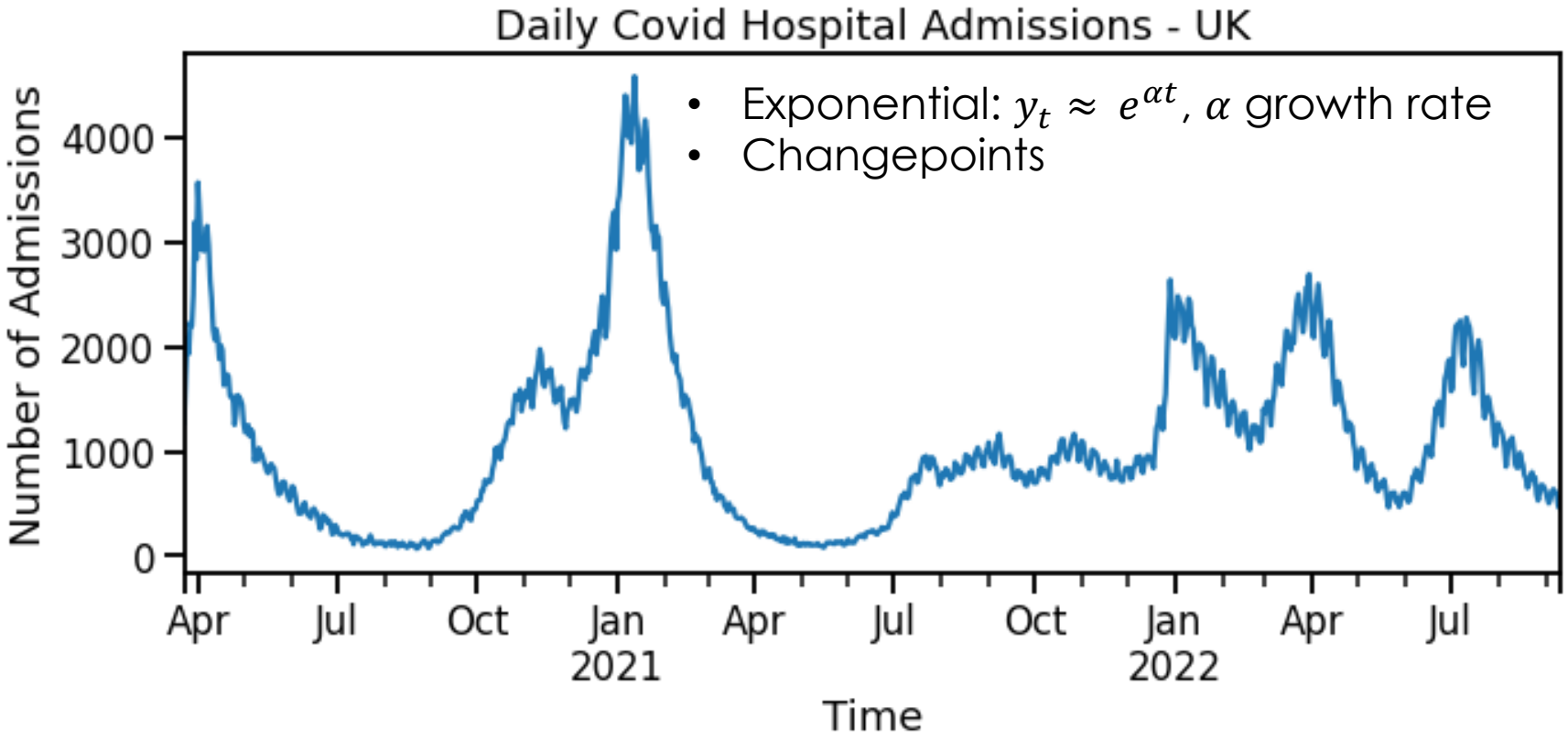
Piecewise linear trend



Non-linear trends

Can try transforming time series to make more linear

$$y_t \to \log(y_t) \approx \alpha t$$



Non-linear trends

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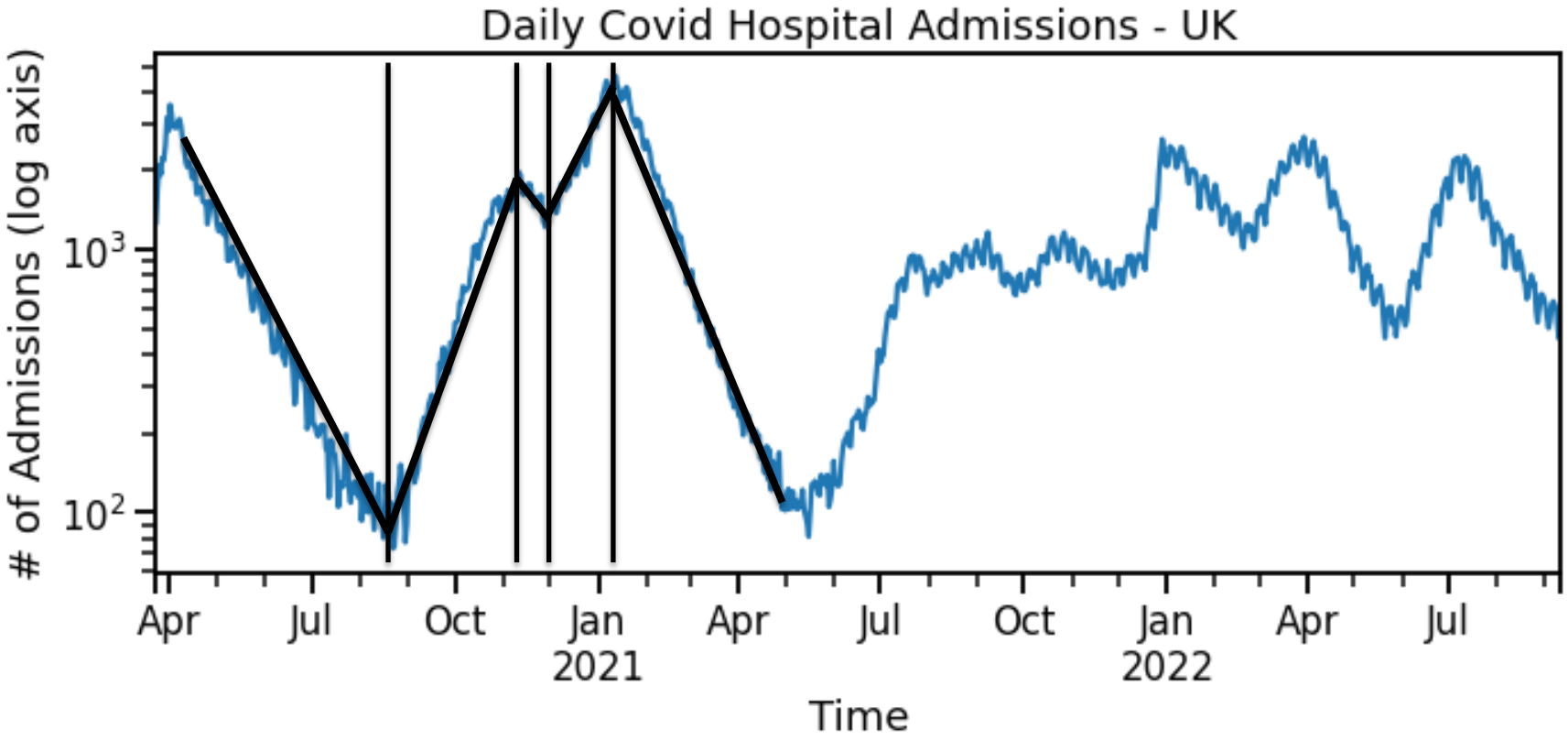
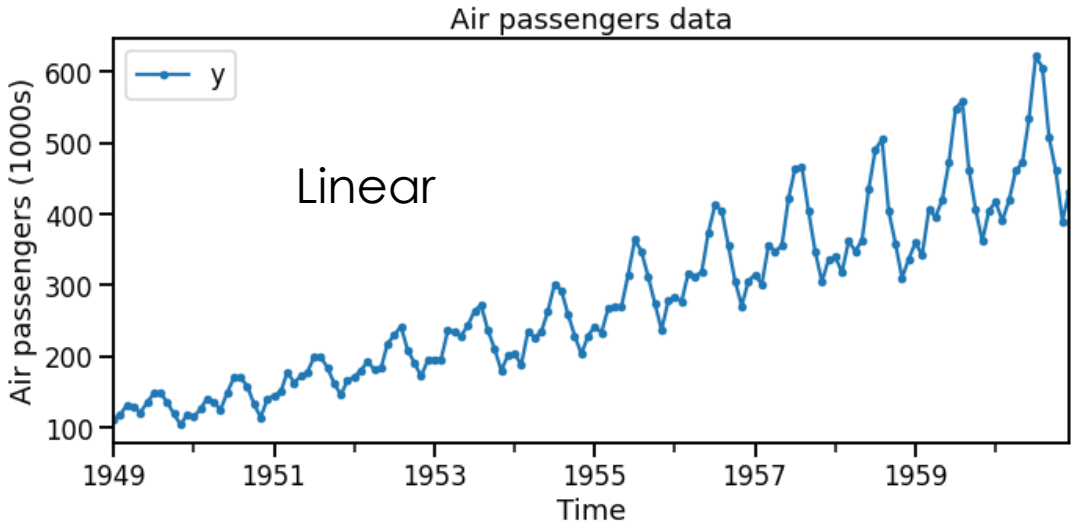
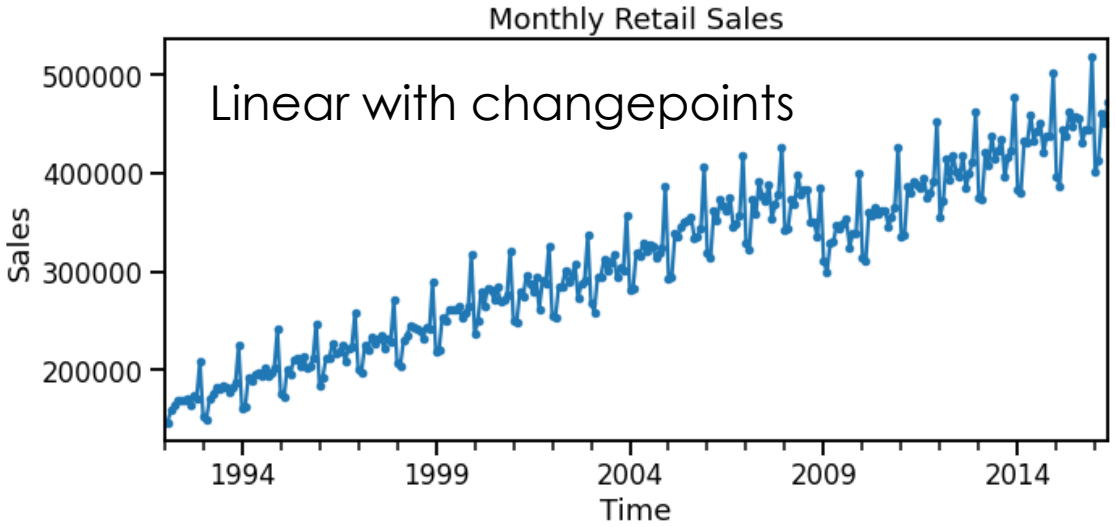
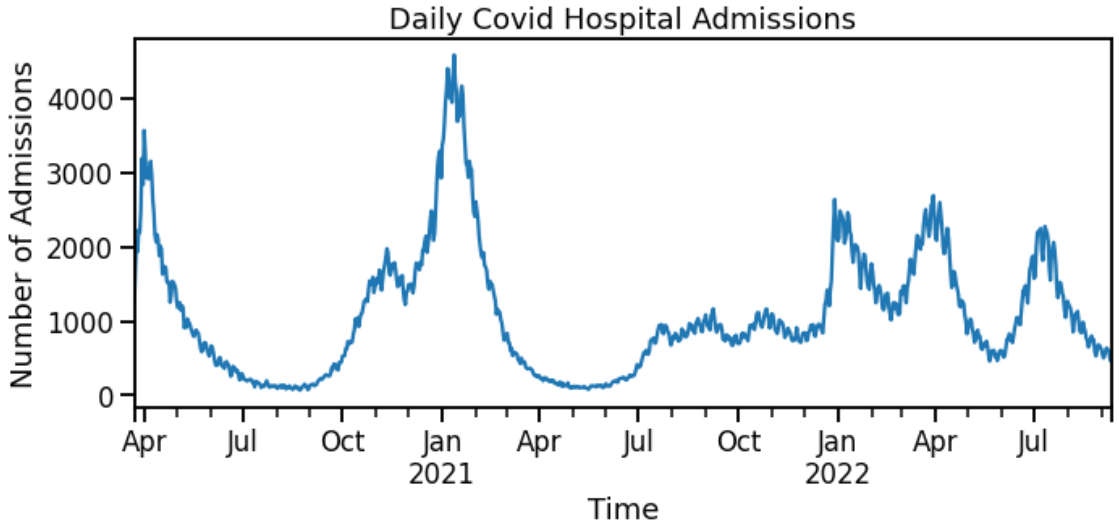


Different types of trend need different features

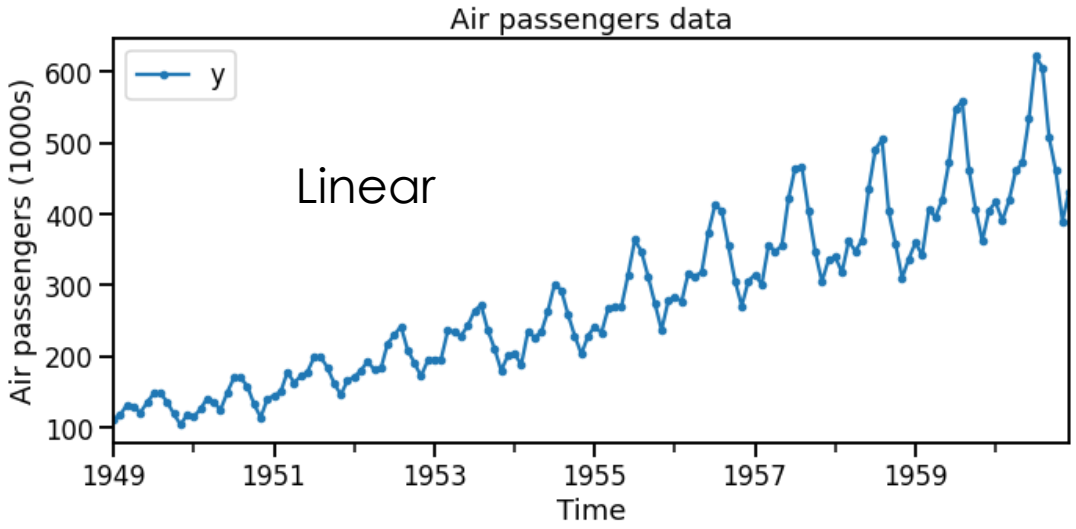


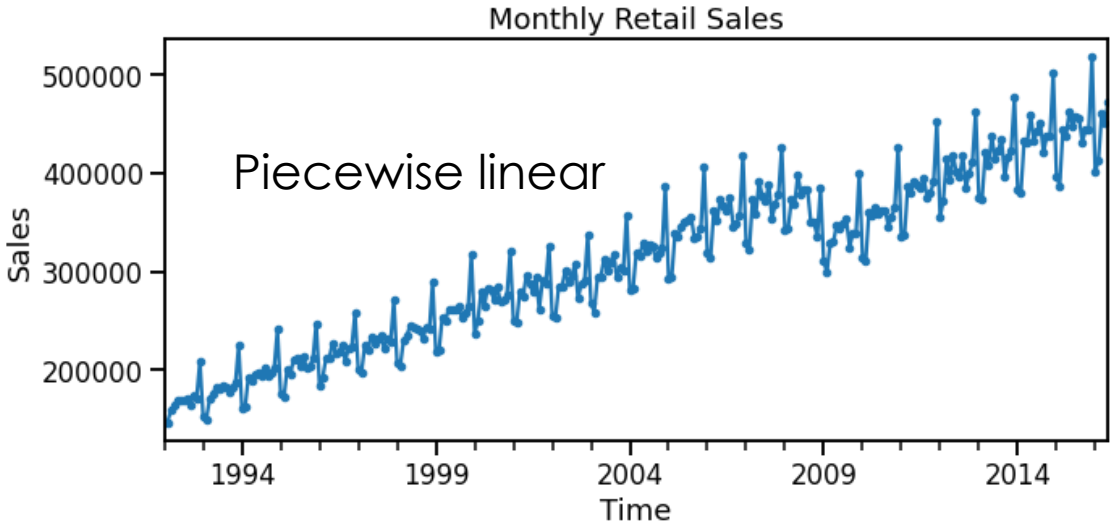


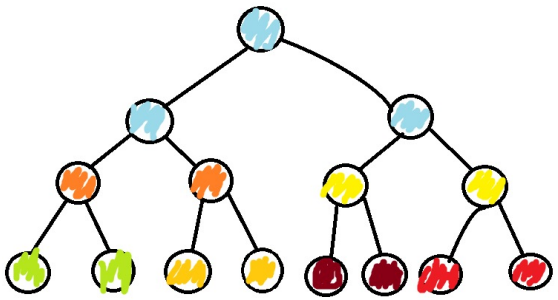


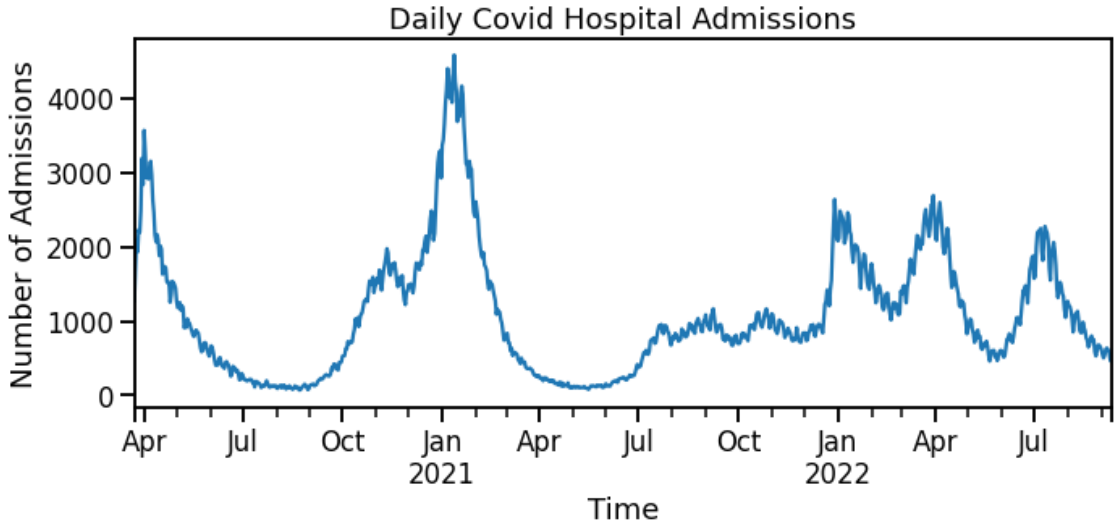
Non-linear (exponential) with change points

Modelling trend depends on the model









$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots$$

The trend section is structured as follows:

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots$$

Linear models

Type of feature	Type of trend
Feature which track time.	• Linear trend. • Non-linear trends.
Features for piecewise linear regression.	• Changepoints. • Non-linear trends.
Transformations to make the target linear.	• Non-linear trends.

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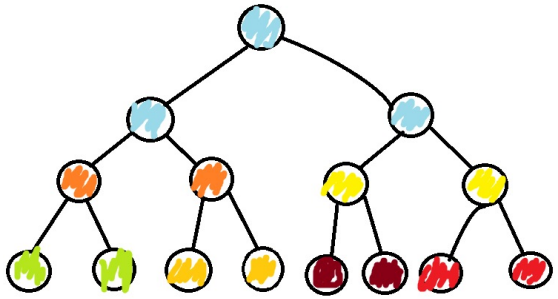
Linear models



Tree-based models

Type of feature	Type of trend
Feature which track time.	• Linear trend. • Non-linear trends.
Features for piecewise linear regression.	• Changepoints. • Non-linear trends.
Transformations to make the target linear.	• Non-linear trends.

- De-trend $\tilde{y}_t = y_t - T_t$, use tree to forecast $\tilde{y}_t$, and forecast trend separately T_t.
- More advance tree algorithms.
- Feature which tracks time needed alongside the above points.

References

Changepoints:
Aminikhanghahi S, Cook DJ. A Survey of Methods for Time Series Change Point Detection. Knowl Inf Syst. 2017 May;51(2):339-367. doi: 10.1007/s10115-016-0987-z. Epub 2016 Sep 8. PMID: 28603327; PMCID: PMC5464762.

Piecewise linear trends:
https://otexts.com/fpp3/nonlinear-regression.html