Estimate Drawdown Caused by Groundwater Pumping

Using Transfer noise functions

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Introduction

Assumption in ARIMA

The conditions under which the data for the time series process is collected remains the same.

Transfer Function Noise Model

If however, these conditions change over time, ARIMA models can be improved by introducing certain inputs reflecting these changes in the process conditions

Example

The estimation of the effect of interventions in the groundwater system (such as groundwater pumping and changes in surface water levels),

Transfer Function Noise Models

The basic model structure of a TFN model to simulate a Time series may be written as:

$$h(t) = \sum_{m=1}^{M} h_m(t) + d + r(t)$$

Where ***h(t)*** is an observed time series,
$h_m(t)$ is the contribution of stress ***m*** to **h**, ***d*** is the base elevation of the model, ***r(t)*** are the residuals

The contribution of stress ***m*** to the head is computed through convolution
where S_m is a time series of stress *m*, and θ_m is the impulse response function for stress *m*

$$h_m(t) = \int_{-\infty}^{t} S_m(\tau)\theta_m(t-\tau)d\tau$$

$$\theta(t) = A\frac{t^{n-1}}{a^n\,\Gamma(n)}e^{-t/a} \qquad t \geq 0$$

A commonly used impulse response function is the scaled Gamma distribution.
where *A* is the scaling factor, *a* and *n* are shape parameters, and Γ is the Gamma function

Approach followed

1. Exploring Dataset

   import the Pastas package

2. Create a Model object and supply the observed head series.

3. Create StressModel objects by supplying the observed stress and specifying a response function, and add each Stress Model object to the Model object.

4. Estimate the parameters of the Model and compute fit statistics.

4. Fitting model
   Checking residual plot
   Validating forecast

Thanks

References:

science direct- Article
science direct
NCBI