Week 2: Trend modelling

Nonlinear trends

- exponential $Tr_t = \alpha\beta^t$
- modified exponential $T_r = \gamma + \alpha\beta^t$
- logarithmic trend $Tr_t = \alpha + \beta \log(t)$
- logistic

$$Tr_t = \frac{\gamma}{1 + \alpha\beta^t}$$

- Gompertz

$$Tr_t = e^{\gamma + \alpha\beta^t}$$

Nonlinear $\rightsquigarrow$ nonlinear least squares $\rightsquigarrow$ **need for starting values** $\rightsquigarrow$ formulas in the book

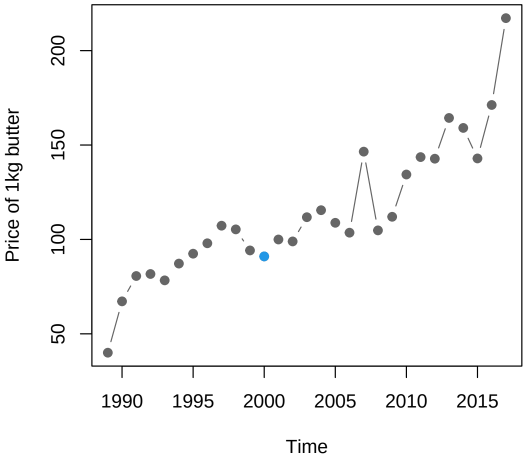
R: function `nls()`

Task: Try to plot the curves for various values of the parameters

Parametric modelling: summary

1. Plot the series
2. Choose several candidate models $\rightsquigarrow$ fit them
3. Choose the best fitting model: graphical visualization, goodness-of-fit criteria
4. Explore the residuals.
   - If they can be considered as iid $\rightsquigarrow$ you are done
   - If they exhibit a dependence $\rightsquigarrow$ model for innovations

Adaptive approaches: moving averages (linear filters)



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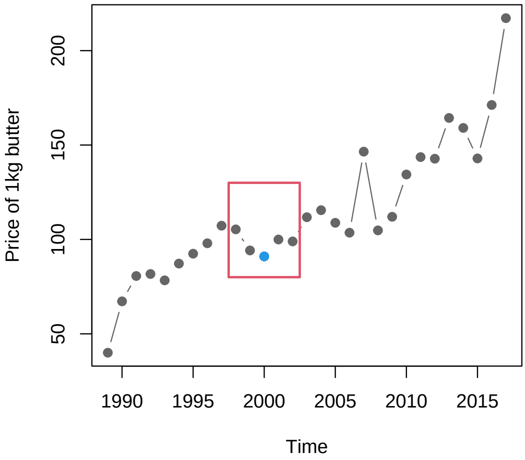

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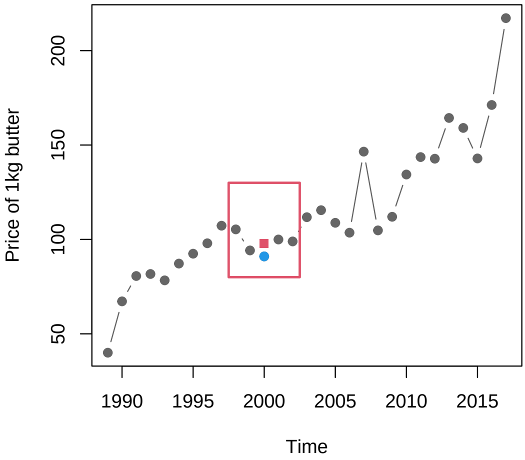

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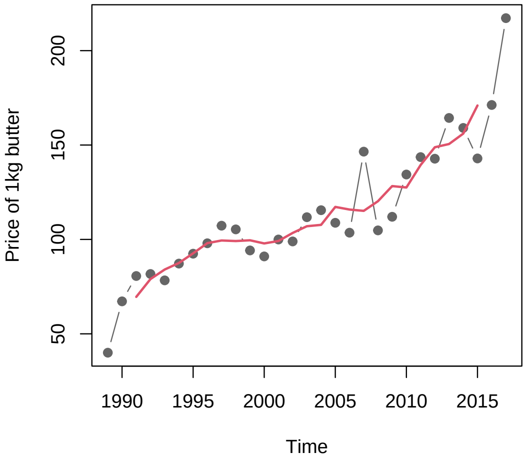

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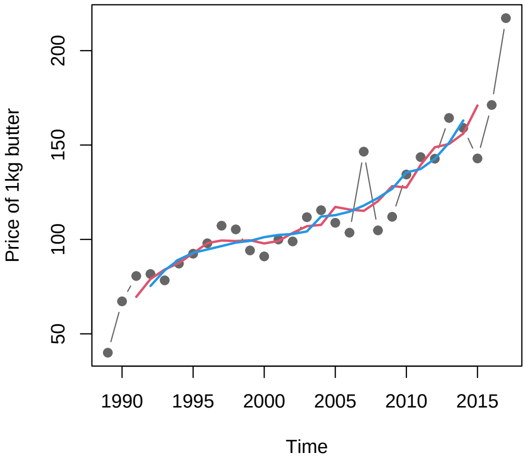

Adaptive approaches: moving averages (linear filters)

$$\widehat{Tr}_t = \sum_{i=-m}^{m} w_i y_{t-i},$$

where $w_i \geq 0$, $\sum_{i=-m}^{m} w_i = 1$ are weights

How to choose the weights and m?

R functions `filter`, `decompose`

Adaptive approaches: moving averages (linear filters)

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How to choose the weights and m?

- seasonal data
  - monthly $\rightsquigarrow$ $m = 6$, $w_i = \frac{1}{12}(1/2, 1, \ldots, 1, 1/2)$

R functions `filter`, `decompose`

Adaptive approaches: moving averages (linear filters)

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How to choose the weights and m?

- seasonal data
  - monthly $\rightsquigarrow$ $m = 6$, $w_i = \frac{1}{12}(1/2, 1, \ldots, 1, 1/2)$
- non-seasonal data
  - the choice of m rather subjective
  - very often $w_i = \frac{1}{2m+1}$
  - book reading:
    - ↪ more fancy methods for w_i under local polynomial trends
    - ↪ ”edges”

R functions `filter`, `decompose`