Client case: Rauson Energy Co.
Frank

Nelson-Siegel Model:

We use the Nelson-Siegel model to model the yield curves of USD and EUR zero-coupon bond rates.

The Nelson-Siegel model proposes that the instantaneous forward curve can be modeled with the following:

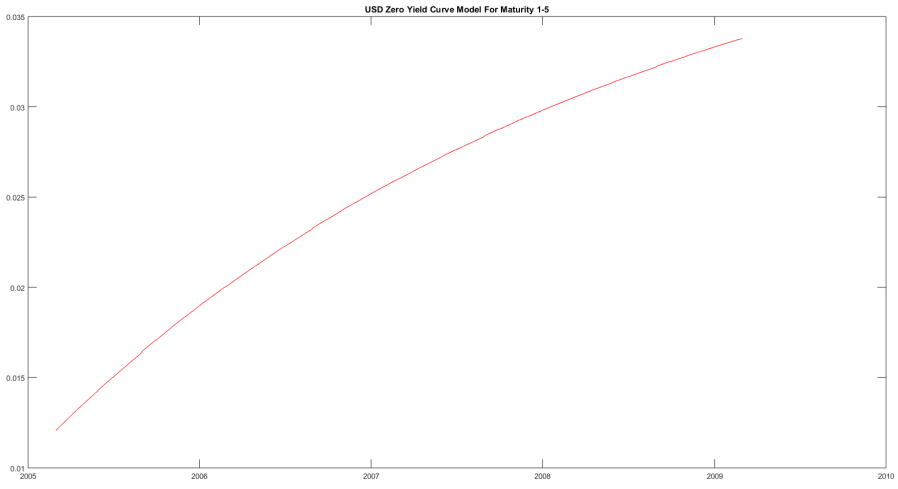
$$f = \beta_0 + \beta_1 e^{\frac{-m}{\tau}} + \beta_2 e^{\frac{-m}{\tau}} \frac{m}{\tau}$$

m - maturity
τ - unit time interval

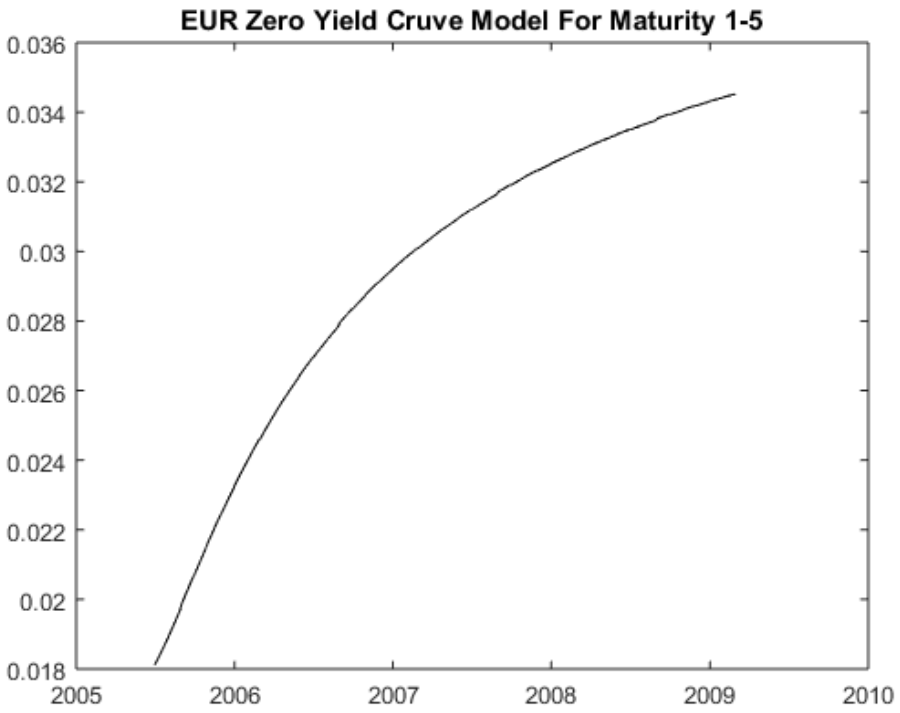
This can be integrated to derive an equation for the zero curve:

$$s = \beta_0 + (\beta_1 + \beta_2) \frac{\tau}{m} (1 - e^{\frac{-m}{\tau}}) - \beta_2 e^{\frac{-m}{\tau}}$$

The modeled USD yield curve:



The modeled EUR yield curve:



FX (USD/EUR) Simulation Process:

Domestic point of view: USD
Foreign point of view: EUR

Underlying dynamic from domestic prospective:

$$F_t = F_t(r_{\mathrm{USD}t} - r_{\mathrm{EUR}t})\,\mathrm{dt} + F_t\,\sigma_t\,\mathrm{dW}_t$$

Local Volatility Model For FX Simulation:

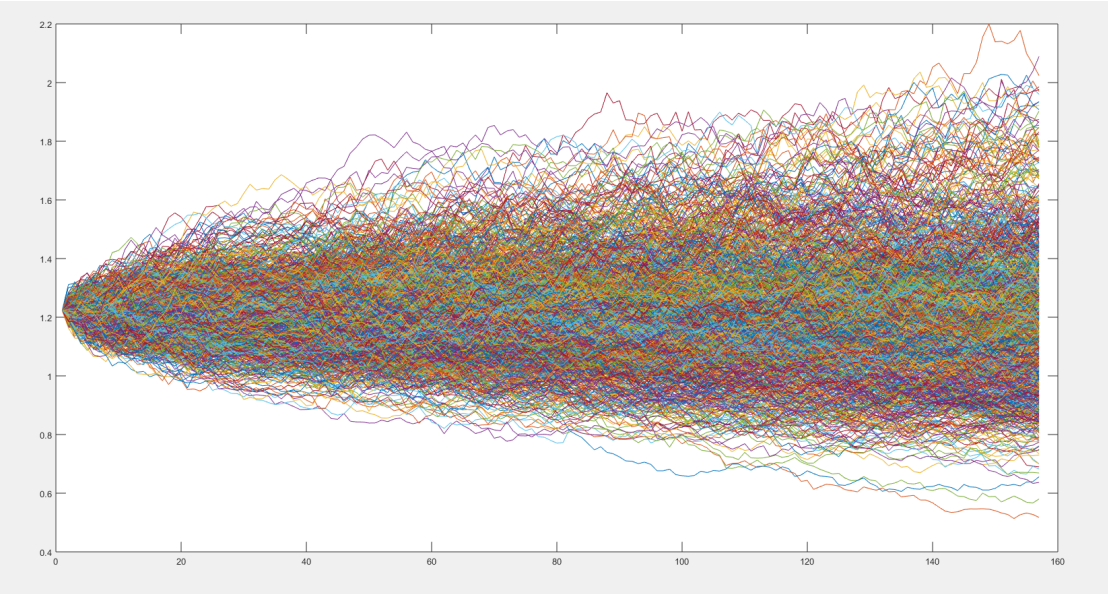
0 – 0.25	0.25 – 0.5	0.5 – 0.75	0.75 – 1	1 – 2	2 – 3
σ_1	σ_2	σ_3	σ_4	σ_5	σ_6

The model implied volatilities are calibrated to

Maturity (yrs)	0.25	0.5	0.75	1
ISD	0.1135	0.112	na	0.111

$$\text{minimize} \sum_{i}^{1,2,4} (\sigma_{i\,\text{model implied volatility}} - \sigma_{i\,\text{market implied volatility}})^2$$

Key assumption: we assume the volatility beyond year 1 is the same at the volatility at year 1 due to the stable nature of FX volatility.



Simulation timesteps: weekly (deltaT= 1/52)