Fundamental mathematical concepts of ML (Linear & Non-Linear Models)

October 21, 2017

Model equations are given as follows:

Model name	Equation
AR(p)	$\hat{x}[t] = \Sigma_{i=1}^{p}(\alpha_i \times x_{t-i}) + \epsilon_t$
MA(q)	$\hat{x}[t] = \mu + \epsilon_t + \Sigma_{i=1}^{q}(\beta_i \times \epsilon_{t-i})$
ARMA(p, q)	$\hat{x}[t] = \Sigma_{i=1}^{p}(\alpha_i \times x_{t-i}) + \Sigma_{i=1}^{q}(\beta_i \times \epsilon_{t-i}) + \epsilon_t$
ARIMA(p, q, d)	$\hat{x}[t] = x_t - x_{t-1}$ (details omitted)
ARCH(q)	$\epsilon_t = s_t\, z_t$ (details omitted)
GARCH(p, q)	$y_t = x_t' + \epsilon_t$ (details omitted)
Neural Network (sigmoid SLP)	$f(x) = \begin{cases} 1 & \text{if } \sigma(\Sigma_i^m w_i x_i + b) > 0 \\ 0 & \text{otherwise} \end{cases}$
Gradient Descent	solve $\nabla C(x.y)$ to find $\frac{\partial C}{\partial w}(w) = 0$
NARMAX(p)	$x_{t+s} = \beta_0 + \Sigma_{j=1}^{D} B_j g\big(\gamma_{0j} + \Sigma_{i=1}^{m} \gamma_{ij} x_{t-(i-1)d}\big)$

where ϵ *is gaussian white noise (GWN)*
α & β *are model coefficients*
μ *is the expected value of* x
σ *is the sigmoid function*
w *are the weights of the neuron*
$C(x, y)$ *is the cost function*