w/ gaussian errors ML model is the one that minimizes

$$\chi^2 = \sum \left[\frac{(d_i - A_i(m))}{\sigma_i}\right]^2 \Leftarrow$$

for linear models $\langle d \rangle = Am$

$$(A^T N^{-1} A) m = A^T N^{-1} d$$

$$\langle (m - m_t)(m - m_t)^T \rangle = (A^T N^{-1} A)^{-1} \Leftarrow$$

$$\langle (Am - d_t)(Am - d_t) \rangle = A (A^T N^{-1} A)^{-1} A^T \Leftarrow$$

$$\chi^2 \quad (d - Am)^T N^{-1} (d - Am)$$

$\chi^2 = (d-Am)^T N^{-1} (d-Am)$ $\quad r \equiv d-Am$ (residual) $\quad \langle \hat{N}_{ij} \rangle = \langle \hat{n}_i \hat{n}_j \rangle$

$\chi^2 = r^T N^{-1} r$

$V^T V = I$

$V^{-1} = V^T$

$\Rightarrow r^T V^T V N^{-1} V^T V r$

$\Rightarrow (Vr)^T \underbrace{(VNV^T)^{-1}}_{\to V N^{-1} V^T} (Vr)$

$\Rightarrow \hat{d} = Vd = VAm + Vn$

$\Rightarrow VA = \hat{A}$

$Vn = \hat{n}$

i can calculate $\hat{N}$ directly

if I can calculate $\langle \hat{n}_i \hat{n}_j \rangle$

$\hat{r} \Rightarrow Vr$

$\hat{N} = VNV^T$

$\Rightarrow \chi^2 = \hat{r}^T \hat{N}^{-1} \hat{r}$

$\chi^2 = (d-Am)^T N^{-1} (d-Am)$

Just like we made if $N_{ij} = \langle n_i n_j \rangle$