Here is my idea of best fitting and error estimating when dealing with different distributions (correlation functions) that have to be matched:

Let $\zeta_i(r)$ be different correlation functions (or any other things to fit) with Gaussian errors only in y-direction, i.e. no error in r. These errors are described by functions describing the σ parameter at given r, which gives additional functions: $\sigma_i(r)$.

Now we shall define a likehood function which compares 2 curves on $[r_1, r_2] \subset \mathcal{R}$. We can do it "properly" (I hope) like that:

I hope we can treat every single point r as a measurement with some Gaussian error. So if we have at given r two measurements ζ_1 and ζ_2 with corresponding errors σ_1 and σ_2, we can construct the error distribution from those two as follows:

$$F_{12}(r) = \frac{1}{\sqrt{2\pi}(\sigma_1(r) + \sigma_2(r))} \exp\left(-\frac{(\zeta_1(r) - \zeta_2(r))^2}{2(\sigma_1(r) + \sigma_2(r))^2}\right) \tag{1}$$

which is somehow proper.

Next step is to take "measurements" for any r into account. Following the max. likehood procedure we shall define the *likehood function* as:

$$L_{12} := \prod_{r=r_1}^{r_2} F_{12}(r) \tag{2}$$

which is simply understandable if you think about probabilities of let us say n events — the total probability of getting the given result consisting of states of all the events is a product of probabilities of every single states in events.

The task is to **maximise this function** — that is why the method is called *maximum likehood method*

The likehood function depends in this case on choice of the curves and their errors — in our case this means cosmological parameters.

In dealing with 3 curves we shall define:

$$L_{123} := L_{12} \times L_{23} \times L_{13} \tag{3}$$

which again should be self-explaining.

There is a nice connection with the *minimum squares* method: let us calculate the logarithm of function (2) — with "-" sign:

$$l_{12} := -\log L_{12} = -\sum_{r=r_1}^{r_2} \log F_{12}(r) = -\sum_{r=r_1}^{r_2} \left\{ -\log\sqrt{2\pi} - \log\sqrt{\sigma_1(r) + \sigma_2(r)} - \frac{(\zeta_1(r) - \zeta_2(r))^2}{2(\sigma_1(r) + \sigma_2(r))^2} \right\} \tag{4}$$

which takes the nicer form if we sort the things:

$$\begin{aligned} l_{12} = &\sum_{r=r_1}^{r_2} \frac{(\zeta_1(r) - \zeta_2(r))^2}{2(\sigma_1(r) + \sigma_2(r))^2} + \\ &+ \sum_{r=r_1}^{r_2} \log\sqrt{\sigma_1(r) + \sigma_2(r)} + \\ &+ C \end{aligned} \tag{5}$$

C can be neglected. If sigmas do not change, we get minimum squares method itself!

For three curves we get

$$l_{123} = l_{12} + l_{23} + l_{13} \tag{6}$$

It is always much easier to minimise the l than maximise L. At this point minimising routines can be applied to find the minimum of $l(\{\text{cosmological parameters}\})$.

The advantage is that likehood function is proportional to density distribution in the parameter space. In that case we can rescale it

$$L \to L \Big/ \int_{\mathcal{R}^n} \mathrm{d}^n x\, L \tag{7}$$

to have total integral equal one — and have the probability distribution in parameter space! And there is only one step to find contours with given probability inside, eg. 67%.

If any question — these methods are implemented in my soft, so are tested and work. I hope to be able to clear any doubts.