

Nonlinear Estimation with Fminunc

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Nonlinear Estimation Inputs LHS and RHS

Estimate this equation: $\omega_t = (\nu_0 + a_0) + a_1 t - \log(1 - \exp(a_0 + a_1 t)) + \nu_t$. We have data from multiple t , and want to estimate the a_0 , and a_1 coefficients mainly, but also ν_0 is good as well. This is an estimation problem with 3 unknowns. t ranges from

```
% LHS outcome variable
ar_w = [-1.7349, -1.5559, -1.4334, -1.3080, -1.1791, -1.0462, -0.9085, -0.7652, -0.6150, -0.4564, -0.2874];
% RHS t variable
ar_t = [0, 3, 5, 7, 9, 11, 13, 15, 16, 19, 21, 23, 25];
% actual parameters, estimation checks if gets actual parameters back
ar_a = [-1.8974, 0.0500];
```

Prediction and MSE Equations

Objective function for prediction and mean-squared-error.

```
obj_ar_predictions = @(a) (v_0 + a(1) + a(2).*ar_t - log(1 - exp(a(1) + a(2).*ar_t)));
obj_fl_mse = @(a) mean((obj_ar_predictions(a) - ar_w).^2);
```

Evaluate given ar_a vectors.

```
ar_predict_at_actual = obj_ar_predictions(ar_a);
fl_mse_at_actual = obj_fl_mse(ar_a);
mt_compare = [ar_w', ar_predict_at_actual'];
tb_compare = array2table(mt_compare);
tb_compare.Properties.VariableNames = {'lhs-outcomes', 'evaluate-rhs-at-actual-parameters'};
disp(tb_compare);
```

| lhs-outcomes | evaluate-rhs-at-actual-parameters |
|--------------|-----------------------------------|
| -1.7349 | -1.7349 |
| -1.5559 | -1.556 |
| -1.4334 | -1.4335 |
| -1.308 | -1.3081 |
| -1.1791 | -1.1793 |
| -1.0462 | -1.0464 |
| -0.9085 | -0.90877 |
| -0.7652 | -0.76546 |
| -0.615 | -0.69133 |
| -0.4564 | -0.45679 |
| -0.2874 | -0.28786 |
| -0.1052 | -0.10571 |
| 0.0943 | 0.093688 |

Unconstrained Nonlinear Estimation

Estimation to minimize mean-squared-error.

```

% Estimation options
options = optimset('display','off');
% Starting values
ar_a_init = [-10, -10];
% Optimize
[ar_a_opti, fl_fval] = fminunc(obj_est, ar_a_init, options);

```

Compare results.

```

mt_compare = [ar_a_opti', ar_a'];
tb_compare = array2table(mt_compare);
tb_compare.Properties.VariableNames = {'estimated-best-fit', 'actual-parameters'};
disp(tb_compare);

```

| estimated-best-fit | actual-parameters |
|--------------------|-------------------|
| -1.8939 | -1.8974 |
| 0.050037 | 0.05 |