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.

```
v_0 = 0.5;
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	-1.2349
-1.5559	-1.056
-1.4334	-0.93353
-1.308	-0.80813
-1.1791	-0.67928
-1.0462	-0.54641
-0.9085	-0.40877
-0.7652	-0.26546
-0.615	-0.19133
-0.4564	0.043211
-0.2874	0.21214
-0.1052	0.39429
0.0943	0.59369

Unconstrained Nonlinear Estimation

Estimation to minimize mean-squared-error.

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

```
Local minimum found.

Optimization completed because the size of the gradient is less than
the value of the optimality tolerance.

<stopping criteria details>
```

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
-2.3541	-1.8974
0.057095	0.05