EXPECTED CATCH DATA

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- Filename: ExpCatch.m
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- Purpose: Generate expected catch data that is used in the fishery choice model.

Description: This file generates simulated expected catch data to be used in place of the empirical estimates of expected catch that will be used in the final model.

Model: Let $e_{j,s,t}$ denote a normally-distributed random variable associated with fishery j, species s, and time t. Let $\mu_{j,s,t}$ and σ_s denote the mean and variance, respectively. We model catch as:

$$C_{j,s,t} = exp\{e_{j,s,t}\}$$

so that catch has a lognormal distribution with mean:

$$EC_{j,s,t} = exp\{\mu_{j,s,t} + \sigma_s/2\}$$

For simplicity, I assume that the variance σ_s is constant over time and across fisheries, while the mean $\mu_{j,s,t}$ for each species and fishery is assumed to evolve exogenously and independently according to a continuous-valued Markov process:

$$\mu_{j,s,t+1} = \bar{\mu}_{j,s} + \gamma(\mu_{j,s,t} - \bar{\mu}_{j,s}) + \varepsilon_{j,s,t}$$

where $\bar{\mu}_{j,s}$ is a fishery and species time-invariant mean, γ is a parameter that dictates how fast the time series will revert to its overall mean, and ε is a normally-distributed random variable.

Arguments

- `fish` = Number of fisheries, excluding fishery 1 (port)

- `S` = Number of species
- `T` = Time horizon
- `mubar` = Mean of e in each fishery
- `var` = Variance of e, assumed to be constant across fisheries
- `epspar` = Mean and std of random shock (epsilon)
- `mu0` = Initial values for mu
- `gamma` = Mean reversion parameter
- `N` = Number of vessels
- `shocks` = Number of shocks to catch for calculating mean

Preliminaries

```
    clc, clear
    close all
    directory = 'C:\Users\mnrei\Dropbox\Projects\nprb\fishery_choice-
model';
    cd(directory)
    addpath(genpath(directory))
```

Parameters

```
    m = parameters;             % Model parameters (see function file:
 parameters)
```

Generate random shocks $(\varepsilon_{j,s,t})$

```
    rng(3,'twister');                   % set seed to reproduce
 results
    seed = rng;
    rng(seed);
    % Vector of random shocks
    eps = m.catch.epspar(1) + m.catch.epspar(2)*...
        randn(m.model.fish,m.model.S,m.model.T);
```

Generate means $(\mu_{j,s,t})$

Preallocate mu matrix (for speed)

```
    mu = zeros(m.model.fish,m.model.S,m.model.T+1);
    % Initial value of mu
    mu(:,:,1)=m.catch.mu0;
    % mu follows a Markov process
    for t=1:m.model.T
```

```
        mu(:,:,t+1) = m.catch.mubar + m.catch.gamma*(mu(:,:,t) - ...
            m.catch.mubar) + eps(:,:,t);
    end
    mu(:,:,1)=[];               % Drop "burn-in" initial values
```

Generate expected catch $(EC_{j,s,t})$

```
    EC = exp(mu + m.catch.var/2);
    EC = [zeros(1,m.model.S,m.model.T) ; EC];  % Zero catch at
fishery=1 (port)
```

Generate catchability coefficients, by vessel and species

```
    rng(1), q = rand(m.model.S,m.model.N);
```

Generate random catch errors

```
    e = err(mu,m);
```

Save data

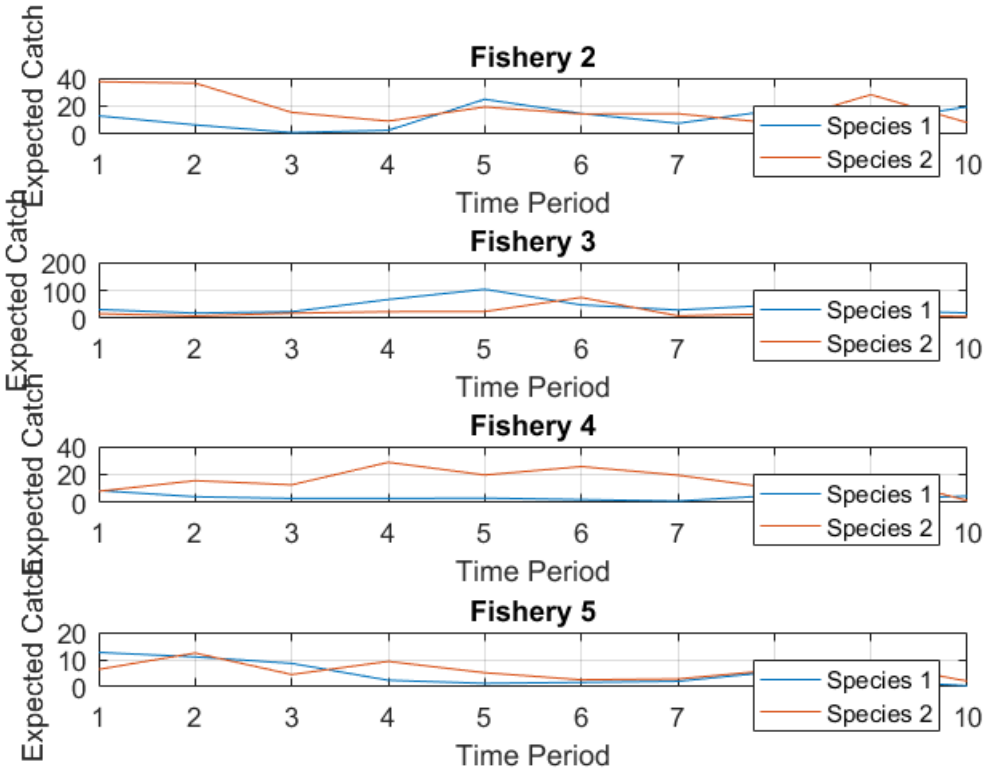
```
    save('data\ExpCatch.mat','EC','q','e');
```

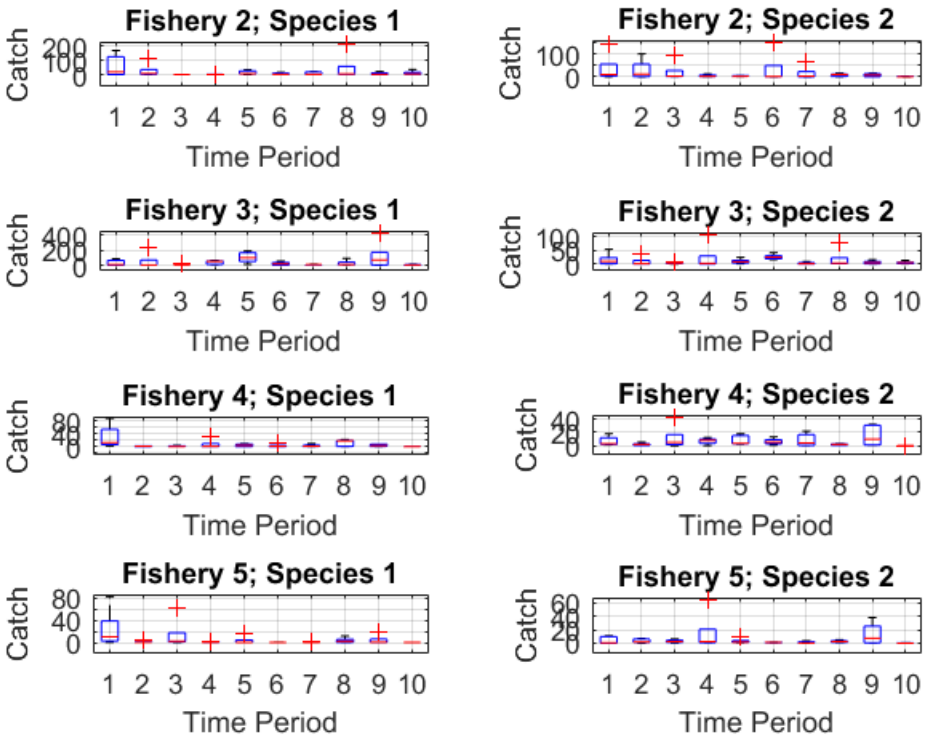
Plots

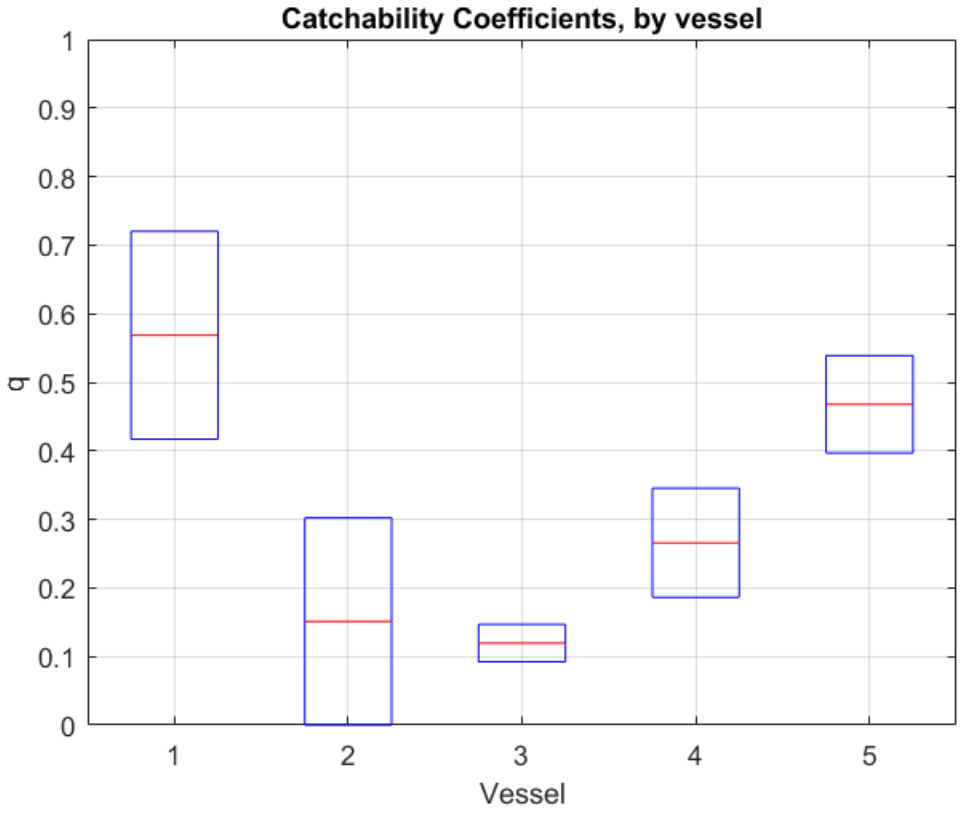
Expected Catch

```
    figure(1)
        for i=1:m.model.fish
            subplot(m.model.fish,1,i)
            plot(1:m.model.T,squeeze(EC(i+1,:,:)));
            title(['Fishery ',num2str(i+1)]);
            ylabel('Expected Catch'); xlabel('Time Period');
            legend('Species 1','Species 2');
            xticks(1:m.model.T); xlim([1 m.model.T]); grid on
        end

    % Random Catch
    figure(2)
        k=1;
        for i=1:m.model.fish
            for j=1:m.model.S
                subplot(m.model.fish,m.model.S,k)
                x=exp(squeeze(e(i+1,j,:,:))');
                boxplot(x);
                title(['Fishery ',num2str(i+1), '; Species ',
num2str(j)]);
```

```
            ylabel('Catch'); xlabel('Time Period'); grid on
            k = k+1;
        end
    end

% Catchability coefficients
figure(3)
    boxplot(q);
    title('Catchability Coefficients, by vessel');
    ylabel('q'); xlabel('Vessel');
    yticks(0:0.1:1); ylim([0 1]); grid on
```




Fishery 2; Species 1
Fishery 2; Species 2
Fishery 3; Species 1
Fishery 3; Species 2
Fishery 4; Species 1
Fishery 4; Species 2
Fishery 5; Species 1
Fishery 5; Species 2
Catch
Time Period
1 2 3 4 5 6 7 8 9 10


Catchability Coefficients, by vessel
q
Vessel
0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1
1 2 3 4 5

Functions

```
function [e] = err(mu,m)
% err returns a vector of shocks to catch (e) for each fishery, time,
 and
% species. Purpose is for approximating the expectation of the value
% function, using Monte Carlo quadrature.

% n = sample size from distribution (i.e. number of values to compute
% expectation)
% mu = mean for each species in each fishery

% Parameters %
    mean = repmat(mu,[1 1 1 m.model.N]);  % Mean of random variable e
    std = m.catch.var^0.5;        % Stdv of random variable e

% Generate random catch %
    rng(4,'twister');           % set seed to reproduce results
    seed = rng;
    rng(seed);
    e =
 zeros(m.model.fish,m.model.S,m.model.T,m.model.N,m.model.shocks);
    for j=1:m.model.shocks
        e(:,:,:,:,j)= normrnd(mean,std);
    end
    % Shock=-Inf (Catch==0) at fishery=1 (port)
    e = [-Inf*ones(1,m.model.S,m.model.T,m.model.N,m.model.shocks) ;
 e];
end
```

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