Measuring the Length of the Great Recession via Lapse Rates: A Bayesian Approach to Change-Point Detection
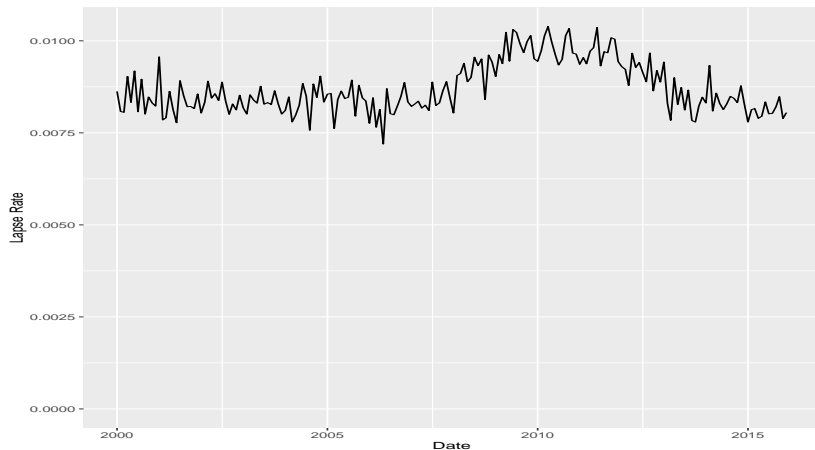
Michael Crawford
michael.crawford@applied.ai

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Structure of Talk

- Introduction and Motivation
- Model Spec and Stan Code
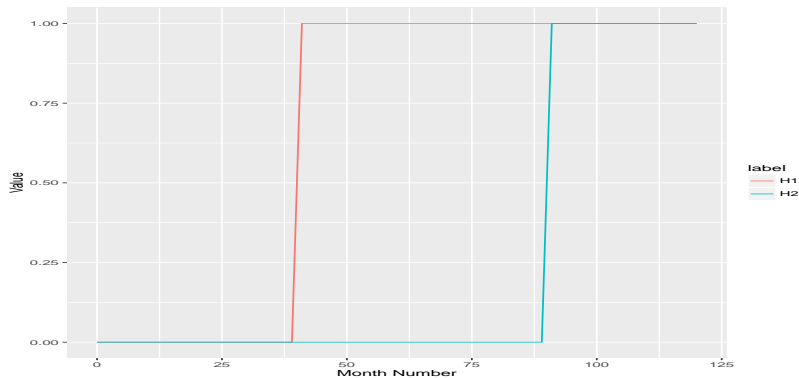- Results and Conclusions

Term Insurance Lapse Rates

Term Insurance Lapse Rates

- Include recession and bias the model
- Wanted to back-out the effect if possible
- Needed estimates for start and end points for lapse model
- Needed it fast
- Wanted to play with Stan!

Stan

$$\text{Lapse Rate} = \mu + H_1\delta\mu_1 + H_2\delta\mu_2$$

Stan

```
data {
  int N;

  int                       beg_idx;
  int<lower=beg_idx, upper=N> end_idx;

  real<lower=0,upper=N> tidx[N];
  real<lower=0>         lapserate[N];
}

parameters {
  real<lower=beg_idx,upper=end_idx>        recess_beg_idx;
  real<lower=recess_beg_idx,upper=end_idx> recess_end_idx;

  real<lower=min(lapserate),upper=max(lapserate)> base_mu;
  real<lower=-valuerange,upper=valuerange> dmu1;
  real<lower=-valuerange,upper=valuerange> dmu2;

  real base_sd_log;
  real do1_log;
  real do2_log;
}
```
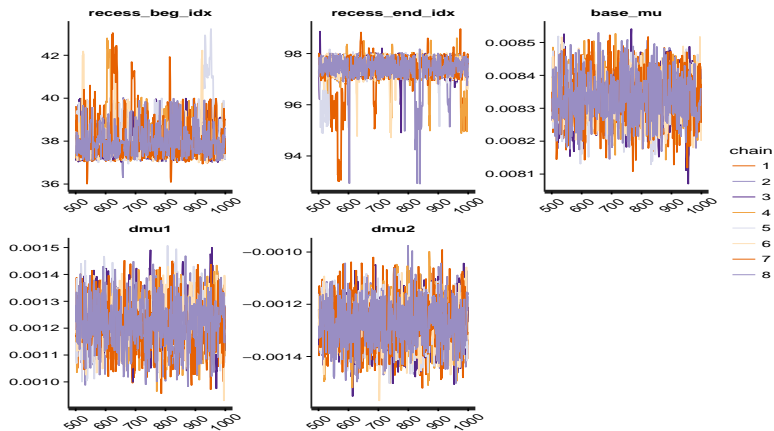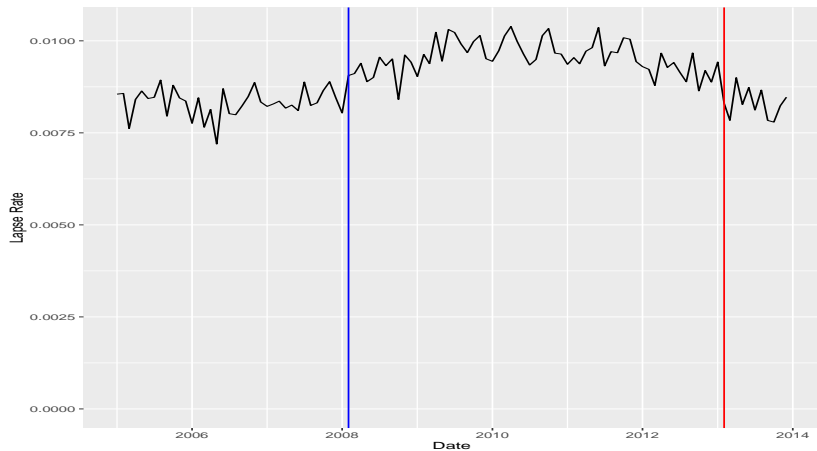
Stan

```
model {
  for(i in 1:N) {
    H1 = inv_logit(A * (tidx[i] - recess_beg_idx));
    H2 = inv_logit(A * (tidx[i] - recess_end_idx));

    mu  = base_mu + H1 * dmu1 + H2 * dmu2;
    sig = exp(base_sd_log + H1 * do1_log  + H2 * do2_log);

    lapserate[i] ~ normal(mu, sig);
  }

  recess_beg_idx ~ normal(beg_idx+12, 12);
  recess_end_idx ~ normal(end_idx-12, 12);

  base_mu ~ lognormal(-6, 2);
  dmu1 ~ normal(0, 0.05);
  dmu2 ~ normal(0, 0.05);

  base_sd_log ~ normal(-8, 3);
  do1_log       ~ normal( 0, 0.1);
  do2_log       ~ normal( 0, 0.1);
}
```

Stan

Stan

Conclusions

- Recession started Jan 2008, ended Jan 2013
- Close enough for government work
- Stan is cool

Michael Crawford
michael.crawford@applied.ai

Slides and code available on GitHub: