

Homework Set 2
Due: September 5, 2019

The Prospectus and Offering Circular Supplement for Freddie Mac, Multiclass Certificate, Series 2848 is attached along with the characteristics of the two Freddie Mac PC pools that constitute the collateral of the REMIC. The REMIC will issue nine classes of bond. You already have a spreadsheet on bspace that includes the amortization schedules for each of the REMIC pools and all the cash flows for the bonds. You will find Matlab Code (prop_haz.m) on bcourses that will be useful for the empirical hazard modeling and two data sets (stmat.txt and tvmat.txt) with the characteristics for a sample of 36 Freddie Mac PCs. For all answers we will need to see your code.

- a. **(Points 15)** Use the data to estimate a non-time varying hazard model of termination speeds. You should assume a log-logistic baseline hazard and you should use the covariates: coupon gap and an indicator variable for summer months. Report your coefficient estimates and standard errors. Provide an economic interpretation for each coefficient.
- b. **(Points 15)** Use your estimated prepayment model, the term structure model you developed in Homework Set 1, and the cash flows for CMO2848 to price the Bonds. (NOTE: The coupon gap is defined as the difference between the coupon and the lagged 10 year rate. An approximation simulation strategy will be provided in the lab notes.)
- c. **(Points 10)** Compute the effective duration and convexity for these bonds and interpret your results.
- d. **(Points 15)** Use the same data to estimate a time-varying hazard model (Note: The estimator may take as long as 15 minutes to converge). Again, you should assume a log-logistic baseline hazard and you should use the covariates, coupon gap and an indicator variable for summer. Provide the coefficient estimates, standard errors, and an economic interpretation for your new estimates. Why do the coefficients differ from those in part (a).
- e. **(Points 15)** Use your estimated prepayment model from part (d), the term structure model you developed in Homework Set 1, and price the bonds.
- f. **(Points 10)** Compute the effective duration and convexity for these bonds and compare your results with part (c).
- g. **(Points 10)** If the market price of bond CA was par what is the implied OAS? How would you interpret your calculated OAS value for this bond?
- h. **(Points 10)** Compute and plot the resulting average hazard rates as a function of time for the non-time varying and time varying valuations. How do you explain the differences? (Hint: recall you are using a reduced-form valuation model - check for out-of-sample situations in your pricing model.)

Two further clarifications:

1. In class, the log-logistic was presented as a continuous time hazard and we talked about how you could go from continuous time to discrete time, especially with a nonparametric baseline hazard. You can do the same with a parametric baseline hazard. In particular, if you just estimate the log-logistic function on discrete time data, then you can think of it as telling you the average hazard for that month or the value of the hazard at the end/beginning of the month.

Key Hint: You don't need to integrate your estimated hazard to simulate mortgage terminations. Just use the predicted values from the estimated hazard as your predicted termination probability.

2. When you decide when the cash flows actually arrive, note that the REMIC document is a little bit vague about exactly what date we should model the first cash flow as arriving. That's kind of the point: these things are complicated and sometimes require interpretation to code. I have my own opinion about how to interpret the Payment Dates section, but you should make a choice and justify it in the comments of your code. Any well-justified decision will be accepted.