Problem Set: Numeric Dynamic Programming

The goal of this problem set is to perform numeric dynamic programming on the patent renewal problem in Pakes (1986; "Patents as Options").

- Use the parameter estimates for France, as reported in Table II
- Use the average renewal fee schedule for France, as reported in Figure 3. (Since its hard to read it off Figure 3, you can also use a monotonically increasing sequence which =0 for ages 2–4, and then increases up to 200 at age 20.)
- Discretize the state space of returns from (say) 0 to 2000, with gaps of 20. You should experiment a little here.
- Start from the final age=20, and approximate the value function for each age in the manner described in the lecture notes. For each age, graph the estimated value function, and report the "cutoff" values of r (below which a patent is allowed to expire).

For the second part of the exercise, we consider an infinite-horizon version of Pakes' model.

- Assume that the renewal cost each period is constant, and equal to 50.
- Assume that the return r is independent across time, with the following stochastic specification:

$$r_t = \begin{cases} 0 & \text{with prob } \exp(-\theta) \\ z & \text{with prob } 1 - \exp(-\theta) \end{cases}$$

  where the density of z is $\frac{1}{\sigma}\exp\left[-(\gamma + z)/\sigma\right]$.
- Compute the value function $V(r)$ by iterating on Bellman's equation. The stopping criterion is when $\sup_r |V^{\tau}(r) - V^{\tau-1}(r)| < 0.0001$, where τ indexes iterations.