Fixed Income
Quiz 12 December 2, 2019

1. **(25 points)** Explain in detail how we modify the Vasicek model with no risk aversion to accommodate a risk premium. Include the 2 equations of the model–the equation for the continuous-time process of the state variable, and the equation that shows the valuation of a zero-coupon bond (that we had to evaluate with Monte Carlo)– and show and provide a detailed explanation of how we modify these equations to handle a risk premium.

2. **(10 points)** Here is the VBA code of a function that returns the price of a T-year zero-coupon bond according to the Vasicek model in the absence of risk aversion.

```
Function VasZero1F(k, theta, sigma, f, Term)
B = 1 / k * (1 - Exp(-k * Term))
Var = sigma * sigma
A = (B - Term) * (theta - Var / (2 * k ^ 2)) - Var / (4 * k) * B ^ 2
pow = A - B * f
VasZero1F = Exp(pow)
End Function
```

How can we modify this code to account for a risk premium? Provide an explanation for your proposed modification, including a description of any additional parameters.

3. **(15 points)** What is the difference between duration –which is how we measured risk with the simple (base) model (with horizontal yield curves)– and factor duration –which is how we measure risk with the Vasicek model? Explain and be mathematically precise.

4. Consider the following as the "base case" parameters:

- $\theta = .04$
- $k = 0.6$
- $\sigma = 0.03$
- $\lambda = .01$
- state variable $= 0.04$.

(a) **(10 points)** Sketch the yield curve–showing the numerical values of its vertical intercept and approximate high point–for this base case.

(b) **(10 points)** What happens to your yield curve if everything else is the same, but λ is 0? Explain and provide a sketch–showing numerical values.

(c) **(10 points)** What happens to your yield curve if everything else is the same as the base case, but the state variable is .075? Explain and provide a sketch–showing numerical values.

(d) **(10 points)** What happens to your yield curve if everything else is the same as the base case, but the state variable is .025? Explain and provide a sketch–showing numerical values.

(e) **(10 points)** What happens to your yield curve if everything else is the same as the base case, but the state variable is .025 and $k = 2.0$? Explain and provide a sketch–showing numerical values.