1. Linhan borrows 100,000 at an annual effective interest rate of 5%. Linhan will repay the loan with level annual payments of 9000 plus a balloon payment.

Determine the amount of the balloon payment.
2. Kyle is the beneficiary of a trust fund. He receives a payment at the end of each quarter for 23 years. The first payment is 200. The second payment is 400. The third payment is 600. The payments continue to increase so that each payment is 200 greater than the previous payment.

Kyle takes each payment and invests in a fund earning 8% compounded quarterly.

How much does Kyle have in the fund at the end of 23 years?
3. A 16 year continuous annuity makes payments at an annual rate of $t^3$ at time $t$.

Using a discount function of $1 - 0.04t$, calculate the present value of this annuity.
4. A callable bond matures in 10 years for 1000. The bond pays semi-annual coupons of 42.

The bond may be called at the end of year 6 or year 8. The call value at the end of year 6 is 1085. The call value at the end of year 8 is 1043.

Andrew purchases this bond at issue to yield 6% convertible semi-annually. The price is $P_1$.

Two years after issue, Andrew sells the bond for a price of $P_2$ to yield 5% convertible semi-annually.

Calculate $P_2 - P_1$. 
5. A loan is being repaid with 20 annual payments. The payments at the end of years 1, 3, 5, \ldots, 19 are 1000. The payments at the end of years 2, 4, 6, \ldots, 20 are 5000.

The annual effective interest rate on the loan is 7.25%.

Calculate the principal in the payment at the end of the 18\textsuperscript{th} year.
6. Kristen has $X$ to invest. She will either buy Bond A which is described below or she will loan the money to Sarah in the form of a sinking fund loan.

Bond A is a 20 year bond with a par value of 25,000. The bond matures for 30,000 and has a coupon rate of 10% convertible semi-annually. The price of Bond A is $X$ when it is bought to yield a rate of 9% convertible semi-annually.

Under the sinking fund loan, Sarah will borrow $X$ to be repaid over 10 years. Sarah will repay the loan by paying interest at the end of each year to Kristen at annual effective interest rate of 7%. Additionally, Sarah will make a deposit into a sinking fund at the end of each year so that at the end of 10 years there will be $X$ in the sinking fund. The sinking fund will earn 5%.

Let $I$ be the interest payment each year under the sinking fund loan and $D$ be the annual sinking fund deposit.

Calculate $D - I$. 

7. A 15 year bond has a maturity value of 88,000 and annual coupons. The annual coupons are not level. The first coupon is 2000. The second coupon is 2000(1.03). The third coupon is 2000(1.03)^2. The coupons continue to increase in this pattern until the 15th coupon is paid.

Ben buys this bond to yield an annual rate of 7%.

Calculate the price that Ben pays for the bond.
8. Aric invests 6000 in Fund A at the end of each year for 8 years. This fund pays interest at an annual effective rate of $i\cdot$

Each year the interest is withdrawn from Fund A and invested in Fund B which earns 8% interest.

At the end of 8 years, Aric has 58,342.17.

Determine $i\cdot$
9. A loan is being repaid with level monthly payments of 1000 for \( n \) months. The interest in the 34\(^{\text{th}}\) payment is 515.48. The interest in the 46\(^{\text{th}}\) payment is 471.92.

Calculate the amount of the loan.
10. Taylor is receiving a continuous annuity for the next 20 years. The annuity pays at an annual rate of $1000t$ at time $t$.

Using a force of interest of 9%, calculate the present value of Taylor’s annuity.
11. Rui is receiving an annuity immediate which makes monthly payments over the next 18 years. The payments during the first year are each equal to 1000. The payments during the second year are each equal to 2000. The payments continue to increase in the same pattern until payments of 18,000 each are made during the 18th year.

Using an annual effective interest rate of 6%, calculate the present value of Rui’s annuity.
12. Thomas buys a 30 year bond with a maturity value of 62,500. The bond has level semi-annual coupons. The bond is bought to yield 12% convertible semi-annually at a discount of 22,706.81.

Calculate the amortization of discount in the 11\textsuperscript{th} coupon.