

# Learning Module 12: Yield-Based Bond Convexity and Portfolio Properties

## Fixed Income

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### Estimate percentage (full) change using modified duration by itself

As shown in Equation 1, convexity adds to the estimate of the percentage (full) price change provided when using modified duration by itself, which was used in prior lessons.

$$\% \Delta PV^{Full} \approx (-AnnModDur \times \Delta Yield) + \left[ \frac{1}{2} \times AnnConvexity \times (\Delta Yield)^2 \right] \quad (1)$$

- The first expression in parentheses is the effect from modified duration.

- The expression in brackets is the convexity adjustment: the annual convexity statistic,  $AnnConvexity$ , times one-half times the change in the yield-to-maturity squared.
  - This term is always positive for an option-free fixed-rate bond, so, as noted, the bond price is higher for either an increase or decrease in yield

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### Approximate Annualized Convexity (ApproxCon)

$$ApproxCon = \frac{(PV_-) + (PV_+) - [2 \times (PV_0)]}{(\Delta Yield)^2 \times (PV_0)} \tag{2}$$

- This approach is useful for bonds with uncertain cash flows, such as those with contingency features and default risk, which will be explored in later lessons. Note that this equation uses the same inputs as approximating modified duration.

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## Money Convexity (MoneyCon)

$$MoneyCon = AnnConvexity \times PV^{Full} \tag{3}$$

- Recall that money duration indicates the first-order effect on the full price of a bond in currency units given a change in yield-to-maturity. Money convexity (*MoneyCon*) captures the second-order effect in currency terms and is the annual convexity multiplied by the full price, as in Equation 3.

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## Estimate of the change in a bond's full price

$$\Delta PV^{Full} \approx -(MoneyDur \times \Delta Yield) + \left[ \frac{1}{2} \times MoneyCon \times (\Delta Yield)^2 \right] \quad (4)$$

- Similar to estimating the percentage change in a bond's full price, *MoneyDur* and *MoneyCon* are combined to achieve a more accurate, thus less risky, estimate of the change in a bond's full price, as shown in Equation 4.

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