# Learning Module 14: Credit Risk

**Fixed Income**

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### Expected Loss

$$\text{EL} = \text{POD} \times \text{LGD} \tag{1}$$

Where:

- $\text{LGD} = \text{EE} \times (1 - \text{RR})$
- POD: Probability of Default
- LGD: Loss given Default

- EE: Expected Exposure
- RR: Recovery Rate

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### Credit Spread

$$\text{Credit Spread} \approx \text{POD} \times \text{LGD} \tag{2}$$

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### Price Impact from Spread Changes

$$\%\Delta PV^{Full} = -AnnModDur \times \Delta Spread \tag{3}$$

Where:

- $AnnModDur$ is the annualized modified duration
- $PV^{Full}$ is the bond's full price

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### Price Impact from Larger Spread Changes

$$\%\Delta PV^{Full} = -(AnnModDur \times \Delta Spread) + \tfrac{1}{2} AnnConvexity \times (\Delta Spread)^2 \tag{4}$$

Where:

- $AnnModDur$ is the annualized modified duration
- $PV^{Full}$ is the bond's full price
- $AnnConvexity$ is annualized convexity

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### Price Impact from Larger Spread Changes

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### Annualized ModDur

$$Annualized\ ModDur \approx \frac{(PV_{-}) - (PV_{+})}{2 \times (\Delta Yield) \times (PV_0)} \tag{5}$$

- Here we apply the methodology from an earlier lesson to approximate modified duration and convexity. We estimated the modified duration by increasing and decreasing the yield-to-maturity by the same amount ($\Delta Yield$) to calculate corresponding bond prices $PV_{+}$ and $PV_{-}$ for a given initial price ($PV_0$), as shown in Equation 5:

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### Approximate Annualized Convexity (ApproxCon)

$$ApproxCon = \frac{(PV_{-}) + (PV_{+}) - [2 \times (PV_0)]}{(\Delta Yield)^2 \times (PV_0)} \tag{6}$$

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```
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ApproxCon = \frac{(PV_{-}) + (PV_{+}) - [2 \times
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