1. Collect sensitivities from "Sensitivities and weights" sheet. Sensitivities are in "GIRR Sensitivities" sheet for each tenor.
   a) Column A, Asset has to be Bond, not CCBS because CCBS does not have optionality and hence not eligible for Curvature risk charge calculation
   b) Column B, Currency = Currency bucket. Currently there are 2 buckets in this sheet USD and EUR.
   c) Column C, Tenor = Tenor of GIRR (Irrelevant here)
   d) Column D, Delta Sensitivity: sensitivity at that tenor.

2. **Aggregated Currency bucket delta sensitivity based on currency:**
   a) Sum all Bond Sensitivities irrespective of tenor into a single number based on column B(Currency). This is Total sensitivity for Currency A.
   b) Sum all Bond Sensitivities irrespective of tenor into a single number based on column B(Currency). This is Total sensitivity for Currency B.
   This means that tenor is not relevant. Think like this, The Tenor column does not exist.

3. Read girr_curvature_parallel_shifts_input file for each position. No aggregation or summation in this step.
   Important columns, and some actions on them below
   a) Security
   b) Currency-Currency of position
   c) Notional_Exposure-Divide it by 100 to get number of bonds i.e. position size
   d) Base_Price-Multiply by position size to get V_base
   e) Price_Up-Multiply by position size to get V_RW_up
   f) Price_Down-Multiply by position size to get V_RW_down

4. Aggregation: Aggregate(Sum) V_base, V_RW_up, V_RW_down based on Currency.

5. Calculate Curvature_Up and Curvature_Down for each currency(column = Currency)
   For Currency A
   a) Curvature_Up for a bond: Curvature_Up = -(V_RW_up - V_base - 0.017*(Sum of sensitivity for currency A from step 2))
   b) Curvature_Down for a bond: Curvature_Down = -(V_RW_down - V_base + 0.017*(Sum of sensitivity for currency A from step 2))

   Same has to be done for currency B and currency C if any. So we will get currency wise Curvature_Up and Curvature_Down

6. Bucket charge for that currency K_b= max(Cuvature_Up, Curvature_Down). So now we have currency level curvature charge for all currencies.

7. Calculate ψ (psi) for each currency pair. $\psi(K_b, K_c)$ takes the value 0 if both buckets b and c have negative sign and the value 1 otherwise. So for each currency pair we will calculate $\psi(K_b, K_c)$.

8. **Get inter-bucket correlation(γ_{bc})-**Read sheet "Misc Weights" row . γ_{bc}Read column Correlation%.

a) Remember this is in %. So you would need to multiply by 0.01 to convert to decimals.

b) γ_{bc} needs to be squared. So here inter bucket aggregation for curvature risk charge is different from delta risk charge

9. **Medium inter-bucket correlation:** γ_{bc}

10. **High inter-bucket correlation γ_{bc}^{High}**: Multiply $\gamma_{bc}$by 1.25. Correlation should be capped at 100% so if you get any value over 1 then this will be capped to 1.

11. **Low inter-bucket Correlations**:
   Use below formula
   $$\gamma_{bc}^{low} = \max\left(2 \times \gamma_{bc} - 100\%; 75\% \times \gamma_{bc}\right)$$

12. Total Curvature Risk : We will calculate 3 γ_{bc} values in all 3 curvature risk charge calculations.

   a) Low correlation curvature risk in which we will use γ_{bc}^{low}. Everything else stays same.

   b) Medium correlation curvature risk in which we will use γ_{bc}. Everything else stays same.

   c) High correlation curvature risk in which we will use γ_{bc}^{High}. Everything else stays same.
   Formula as below,

$$= \sqrt{max(0, \sum_b K_b^2 + \sum_{c \neq b} \sum_b \gamma_{bc} \, \psi(K_b, K_c) \times K_b \times K_c)}$$

13. We will transport all these position level and aggregations into excel.