Rebuttal

Table 1: Node Classification Results with Conformal Baselines (Coverage ↑ / Inefficiency ↓)

Dataset	CF-GNN [1]		DAPS [2]		RR-GNN (Ours)		Cluster-RR-GNN (Ours)	
Model	Cover	Ineff	Cover	Ineff	Cover	Ineff	Cover	Ineff
Cora								
GraphSAGE	$0.9456^{\pm 0.0569}$	$1.6284^{\pm 0.0483}$	$0.9453^{\pm 0.0535}$	$1.8025^{\pm 0.0421}$	$0.9460^{\pm 0.0542}$	$1.6100^{\pm 0.0415}$	$\mathbf{0.9463}^{\pm 0.0509}$	$\mathbf{1.6076}^{\pm 0.0397}$
SGC	$0.9461^{\pm 0.0603}$	$1.6633^{\pm 0.04415}$	$0.9452^{\pm 0.0538}$	$1.7856^{\pm 0.0426}$	$0.9462^{\pm 0.0581}$	$1.6297^{\pm 0.0428}$	$\mathbf{0.9490}^{\pm 0.0643}$	$\mathbf{1.5907}^{\pm 0.0432}$
GCN	$0.9473^{\pm 0.0556}$	$1.6344^{\pm 0.0418}$	$0.9435^{\pm 0.053}$	$1.7120^{\pm 0.0354}$	$0.9432^{\pm 0.0573}$	$1.6251^{\pm 0.0367}$	$\mathbf{0.9476}^{\pm 0.0732}$	$\mathbf{1.6315}^{\pm 0.0303}$
GAT	$0.9464^{\pm 0.0702}$	$1.6278^{\pm 0.0334}$	$0.9480^{\pm 0.065}$	$1.7052^{\pm 0.0384}$	$0.9475^{\pm 0.0624}$	$1.6146^{\pm 0.0351}$	$\mathbf{0.9508}^{\pm 0.0554}$	$\mathbf{1.6114}^{\pm 0.0287}$
DBLP								
GraphSAGE	$0.9501^{\pm 0.0523}$	$1.5723^{\pm 0.0683}$	$0.9500^{\pm 0.0420}$	$1.6436^{\pm 0.0627}$	$0.9499^{\pm 0.0531}$	$1.5351^{\pm 0.0473}$	$\mathbf{0.9503}^{\pm 0.0510}$	$\mathbf{1.5607}^{\pm 0.0487}$
SGC	$\mathbf{0.9451}^{\pm 0.0617}$	$1.5274^{\pm 0.0416}$	$0.9427^{\pm 0.0526}$	$1.6020^{\pm 0.0317}$	$0.9462^{\pm 0.0528}$	$1.4286^{\pm 0.0541}$	$0.9503^{\pm 0.0428}$	$\mathbf{1.3563}^{\pm 0.0626}$
GCN	$\mathbf{0.9473}^{\pm 0.0596}$	$1.5644^{\pm 0.0733}$	$0.9458^{\pm 0.0565}$	$1.6384^{\pm 0.0703}$	$0.9458^{\pm 0.0702}$	$1.5512^{\pm 0.0295}$	$0.9430^{\pm 0.0713}$	$\mathbf{1.5491}^{\pm 0.0278}$
GAT	$0.9467^{\pm 0.0717}$	$1.5729^{\pm 0.0463}$	$0.9455^{\pm 0.0685}$	$1.6493^{\pm 0.0455}$	$0.9485^{\pm 0.0589}$	$1.5725^{\pm 0.0349}$	$\mathbf{0.9505}^{\pm 0.0469}$	$\mathbf{1.5570}^{\pm 0.0356}$
CiteSeer								
GraphSAGE	$0.9528^{\pm 0.0203}$	$1.1680^{\pm 0.0439}$	$0.9501^{\pm 0.0195}$	$1.3425^{\pm 0.0412}$	$0.9538^{\pm 0.0853}$	$1.1621^{\pm 0.0552}$	$\mathbf{0.9540}^{\pm 0.0926}$	$\mathbf{1.1679}^{\pm 0.0605}$
SGC	$0.9525^{\pm 0.0257}$	$1.1827^{\pm 0.0552}$	$0.9513^{\pm 0.0245}$	$1.3578^{\pm 0.0525}$	$0.9579^{\pm 0.0536}$	$1.1782^{\pm 0.0415}$	$\mathbf{0.9598}^{\pm 0.0561}$	$\mathbf{1.1678}^{\pm 0.0372}$
GCN	$0.9496^{\pm 0.0392}$	$1.2310^{\pm 0.0332}$	$\mathbf{0.9520}^{\pm 0.036}$	$1.4026^{\pm 0.0327}$	$0.9512^{\pm 0.0358}$	$1.2189^{\pm 0.0276}$	$0.9518^{\pm 0.0373}$	$\mathbf{1.2153}^{\pm 0.0290}$
GAT	$0.9508^{\pm 0.0309}$	$1.2396^{\pm 0.0416}$	$0.9513^{\pm 0.0291}$	$1.4152^{\pm 0.0393}3$	$0.9535^{\pm 0.0447}$	$1.2085^{\pm 0.0361}$	$\mathbf{0.9562}^{\pm 0.0428}$	$\mathbf{1.1408}^{\pm 0.0361}$

Coverage (↑): Empirical coverage rate (target: $1 - \alpha = 0.95$)
Inefficiency (↓): $\mathbb{E}[|\hat{C}(x)|]$

Table 2: Conditional Coverage Evaluation of RR-GNN (Subgroups with Small Variations)

Condition Type	**Subgroup**	$\alpha = 0.1$	$\alpha = 0.2$	$\alpha = 0.3$
3*Cluster-Conditional	Cluster 1	0.9023	0.8041	0.7124
	Cluster 2	0.9015	0.8034	0.7085
	Cluster 3	0.8967	0.7945	0.6845
4*Class-Conditional	Class A	0.9018	0.8075	0.7064
	Class B	0.8986	0.7914	0.6947
	Class C	0.9047	0.8035	0.7016
	Class D	0.8935	0.7942	0.6964

Table 3: Overall Coverage at Different α Values on Edge Weight Prediction Task on Cora(Close to $1 - \alpha$, within $\pm 5\%$)

α **Value**	**Ineff**
0.05	1.6315
0.10	1.5576
0.15	1.5528
0.20	1.2468
0.25	1.1178
0.30	1.0373

Response:

Table 4: Coverage Across Different Set Sizes (Close to $1 - \alpha$, within $\pm 5\%$)

Set Size	Node Count	Coverage ($\alpha = 0.1$)
Small (2DatasetTwitter)	81,306	0.8957
Medium (5: Dataset: CiteSeer)	3,327	0.9036
Large (¿10: Dataset: OGBN-Arxiv)	169,343	0.9014

Table 5: Performance(AUC) Comparison of Graph Transformer Models with RR Enhancement on dataset Mol-HIV

Model	Method	Cora	CiteSeer	PubMed	OGB-Arxiv
2*Graphormer	Original	0.763 ± 0.012	0.691 ± 0.015	0.792 ± 0.008	0.718 ± 0.005
	+ RR	$\mathbf{0.781} \pm 0.011$	$\mathbf{0.705} \pm 0.013$	$\mathbf{0.803} \pm 0.007$	$\mathbf{0.729} \pm 0.004$
2*Graphormer with Spatial Encoding	Original	0.772 ± 0.010	0.702 ± 0.014	0.801 ± 0.007	0.725 ± 0.005
	+ RR	$\mathbf{0.789} \pm 0.009$	$\mathbf{0.715} \pm 0.012$	$\mathbf{0.812} \pm 0.006$	$\mathbf{0.736} \pm 0.004$
2*Graphormer with Graph Structure	Original	0.781 ± 0.011	0.712 ± 0.013	0.808 ± 0.007	0.732 ± 0.004
	+ RR	$\mathbf{0.796} \pm 0.010$	$\mathbf{0.724} \pm 0.011$	$\mathbf{0.819} \pm 0.006$	$\mathbf{0.742} \pm 0.003$

Table 6: Performance of Graph Transformer Networks (GT) with RR Enhancement

Node Classification	F1 Score	ACM	DBLP	IMDB
2*Base GT	Original	0.912 ± 0.014	0.938 ± 0.034	0.609 ± 0.023
	+ RR	$\mathbf{0.923} \pm 0.012$	$\mathbf{0.942} \pm 0.025$	$\mathbf{0.724} \pm 0.036$

Table 7: Node Classification Results with Conformal Baselines (Coverage ↑ / Inefficiency ↓)

Dataset	CF-GNN [1]		SAN		RR-GNN (Ours)		Cluster-RR-GNN (Ours)	
Model	Cover	Ineff	Cover	Ineff	Cover	Ineff	Cover	Ineff
Cora								
GraphSAGE	$0.9456^{\pm0.0569}$	$1.6284^{\pm0.0483}$	$0.9476^{\pm0.0532}$	$1.6825^{\pm0.0541}$	$0.9460^{\pm0.0542}$	$1.6100^{\pm0.0415}$	$\mathbf{0.9463}^{\pm0.0509}$	$\mathbf{1.6076}^{\pm0.0397}$
SGC	$0.9461^{\pm0.0603}$	$1.6633^{\pm0.04415}$	$0.9482^{\pm0.05348}$	$1.6956^{\pm0.0236}$	$0.9462^{\pm0.0581}$	$1.6297^{\pm0.0428}$	$\mathbf{0.9468}^{\pm0.0662}$	$\mathbf{1.6017}^{\pm0.0465}$
GCN	$0.9473^{\pm0.0556}$	$1.6344^{\pm0.0418}$	$0.9426^{\pm0.0453}$	$1.6520^{\pm0.0344}$	$0.9432^{\pm0.0573}$	$1.6251^{\pm0.0367}$	$\mathbf{0.9476}^{\pm0.0732}$	$\mathbf{1.6315}^{\pm0.0303}$
GAT	$0.9464^{\pm0.0702}$	$1.6278^{\pm0.0334}$	$0.9473^{\pm0.065}$	$1.6752^{\pm0.0364}$	$0.9475^{\pm0.0624}$	$1.6146^{\pm0.0351}$	$\mathbf{0.9491}^{\pm0.0539}$	$\mathbf{1.6254}^{\pm0.0396}$
DBLP								
GraphSAGE	$0.9501^{\pm0.0523}$	$1.5723^{\pm0.0683}$	$0.9501^{\pm0.0420}$	$\mathbf{1.5524}^{\pm0.0637}$	$0.9499^{\pm0.0531}$	$1.5351^{\pm0.0473}$	$\mathbf{0.9503}^{\pm0.0510}$	$1.5607^{\pm0.0487}$
SGC	$\mathbf{0.9451}^{\pm0.0617}$	$1.5274^{\pm0.0416}$	$0.9235^{\pm0.0526}$	$1.4520^{\pm0.0345}$	$0.9462^{\pm0.0528}$	$1.4286^{\pm0.0541}$	$0.503^{\pm0.0428}$	$\mathbf{1.3563}^{\pm0.062}$
GCN	$\mathbf{0.9473}^{\pm0.0596}$	$1.5644^{\pm0.0733}$	$0.9445^{\pm0.0565}$	$1.5984^{\pm0.0743}$	$0.9458^{\pm0.0702}$	$1.5512^{\pm0.0295}$	$0.9430^{\pm0.0713}$	$\mathbf{1.5491}^{\pm0.0278}$
GAT	$0.9467^{\pm0.0717}$	$1.5729^{\pm0.0463}$	$0.9456^{\pm0.0624}$	$1.5943^{\pm0.0425}$	$0.9485^{\pm0.0589}$	$1.5725^{\pm0.0349}$	$\mathbf{0.9505}^{\pm0.0469}$	$\mathbf{1.5570}^{\pm0.0356}$
CiteSeer								
GraphSAGE	$0.9528^{\pm0.0203}$	$1.1680^{\pm0.0439}$	$0.9502^{\pm0.0164}$	$1.2523^{\pm0.0416}$	$0.9538^{\pm0.0853}$	$1.1621^{\pm0.0552}$	$\mathbf{0.9540}^{\pm0.0926}$	$\mathbf{1.1679}^{\pm0.0605}$
SGC	$0.9525^{\pm0.0257}$	$1.1827^{\pm0.0552}$	$0.9505^{\pm0.0645}$	$1.2678^{\pm0.0532}$	$0.9579^{\pm0.0536}$	$1.1782^{\pm0.0415}$	$\mathbf{0.9598}^{\pm0.0561}$	$\mathbf{1.1678}^{\pm0.0372}$
GCN	$0.9496^{\pm0.0392}$	$1.2310^{\pm0.0332}$	$0.9502^{\pm0.0536}$	$1.3024^{\pm0.0324}$	$0.9512^{\pm0.0358}$	$1.2189^{\pm0.0276}$	$0.9518^{\pm0.0373}$	$\mathbf{1.2153}^{\pm0.0290}$
GAT	$0.9508^{\pm0.0309}$	$1.2396^{\pm0.0416}$	$0.9515^{\pm0.0251}$	$1.3112^{\pm0.0123}$	$0.9535^{\pm0.0447}$	$1.2085^{\pm0.0361}$	$\mathbf{0.9562}^{\pm0.0428}$	$\mathbf{1.1408}^{\pm0.0361}$