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	$0.9461^{\pm 0.0603}$	$1.6633^{\pm 0.04415}$	$0.9452^{\pm 0.0538}$	$1.7856^{\pm 0.0426}$	$0.9462^{\pm 0.0581}$	$1.6297^{\pm 0.0428}$	$\mathbf{0.9468}^{\pm 0.0662}$	$\mathbf{1.6017}^{\pm 0.0465}$
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	$0.9464^{\pm 0.0702}$	$1.6278^{\pm 0.0334}$	$0.9480^{\pm 0.065}$	$1.7052^{\pm 0.0384}$	$0.9475^{\pm 0.0624}$	$1.6146^{\pm 0.0351}$	$\mathbf{0.9491}^{\pm 0.0539}$	$\mathbf{1.6254}^{\pm 0.0396}$
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	$\mathbf{0.9451}^{\pm 0.0617}$	$1.5274^{\pm 0.0416}$	$0.9427^{\pm 0.0526}$	$1.6020^{\pm 0.0317}$	$0.9462^{\pm 0.0528}$	$1.4286^{\pm 0.0541}$	$0.9443^{\pm 0.0462}$	$\mathbf{1.3921}^{\pm 0.0624}$
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	$0.9467^{\pm 0.0717}$	$1.5729^{\pm 0.0463}$	$0.9455^{\pm 0.0685}$	$1.6493^{\pm 0.0455}$	$0.9485^{\pm 0.0589}$	$1.5725^{\pm 0.0349}$	$\mathbf{0.9491}^{\pm 0.0539}$	$\mathbf{1.5720}^{\pm 0.0322}$
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	$0.9525^{\pm 0.0257}$	$1.1827^{\pm 0.0552}$	$0.9513^{\pm 0.0245}$	$1.3578^{\pm 0.0525}$	$0.9579^{\pm 0.0536}$	$1.1782^{\pm 0.0415}$	$\mathbf{0.9594}^{\pm 0.0582}$	$\mathbf{1.1898}^{\pm 0.0399}$
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	$0.9508^{\pm 0.0309}$	$1.2396^{\pm 0.0416}$	$0.9513^{\pm 0.0291}$	$1.4152^{\pm 0.039}$	$0.9535^{\pm 0.0447}$	$1.2085^{\pm 0.0361}$	$\mathbf{0.9548}^{\pm 0.0491}$	$\mathbf{1.2020}^{\pm 0.0392}$

Coverage (↑): Empirical coverage rate (target: $1 - \alpha = 0.95$)

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

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

Set Size	**Node Count**	**Coverage** ($\alpha = 0.1$)
Small (2: DatasetTwitter)	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	**0.781** ± 0.011	**0.705** ± 0.013	**0.803** ± 0.007	**0.729** ± 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	**0.789** ± 0.009	**0.715** ± 0.012	**0.812** ± 0.006	**0.736** ± 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	**0.796** ± 0.010	**0.724** ± 0.011	**0.819** ± 0.006	**0.742** ± 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	**0.923** ± 0.012	**0.942** ± 0.025	**0.724** ± 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	$0.9456^{\pm 0.0569}$	$1.6284^{\pm 0.0483}$	$0.9476^{\pm 0.0532}$	$1.6825^{\pm 0.0541}$	$0.9460^{\pm 0.0542}$	$1.6100^{\pm 0.0415}$	$\mathbf{0.9463}^{\pm 0.0509}$	$\mathbf{1.6076}^{\pm 0.0397}$
SGC	$0.9461^{\pm 0.0603}$	$1.6633^{\pm 0.04415}$	$0.9482^{\pm 0.05348}$	$1.6956^{\pm 0.0236}$	$0.9462^{\pm 0.0581}$	$1.6297^{\pm 0.0428}$	$\mathbf{0.9468}^{\pm 0.0662}$	$\mathbf{1.6017}^{\pm 0.0465}$
GCN	$0.9473^{\pm 0.0556}$	$1.6344^{\pm 0.0418}$	$0.9426^{\pm 0.0453}$	$1.6520^{\pm 0.0344}$	$0.9432^{\pm 0.0573}$	$1.6251^{\pm 0.0367}$	$\mathbf{0.9476}^{\pm 0.0732}$	$\mathbf{1.6315}^{\pm 0.0303}$
GAT	$0.9464^{\pm 0.0702}$	$1.6278^{\pm 0.0334}$	$0.9473^{\pm 0.065}$	$1.6752^{\pm 0.0364}$	$0.9475^{\pm 0.0624}$	$1.6146^{\pm 0.0351}$	$\mathbf{0.9491}^{\pm 0.0539}$	$\mathbf{1.6254}^{\pm 0.0396}$
DBLP								
GraphSAGE	$0.9501^{\pm 0.0523}$	$1.5723^{\pm 0.0683}$	$0.9501^{\pm 0.0420}$	$\mathbf{1.5524}^{\pm 0.0637}$	$0.9499^{\pm 0.0531}$	$1.5351^{\pm 0.0473}$	$\mathbf{0.9503}^{\pm 0.0510}$	$1.5607^{\pm 0.0487}$
SGC	$\mathbf{0.9451}^{\pm 0.0617}$	$1.5274^{\pm 0.0416}$	$0.9235^{\pm 0.0526}$	$1.4520^{\pm 0.0345}$	$0.9462^{\pm 0.0528}$	$1.4286^{\pm 0.0541}$	$0.9443^{\pm 0.0462}$	$\mathbf{1.3921}^{\pm 0.0624}$
GCN	$\mathbf{0.9473}^{\pm 0.0596}$	$1.5644^{\pm 0.0733}$	$0.9445^{\pm 0.0565}$	$1.5984^{\pm 0.0743}$	$0.9458^{\pm 0.0702}$	$1.5512^{\pm 0.0295}$	$0.9430^{\pm 0.0713}$	$\mathbf{1.5491}^{\pm 0.0278}$
GAT	$0.9467^{\pm 0.0717}$	$1.5729^{\pm 0.0463}$	$0.9456^{\pm 0.0624}$	$1.5943^{\pm 0.0425}$	$0.9485^{\pm 0.0589}$	$1.5725^{\pm 0.0349}$	$\mathbf{0.9491}^{\pm 0.0539}$	$\mathbf{1.5720}^{\pm 0.0322}$
CiteSeer								
GraphSAGE	$0.9528^{\pm 0.0203}$	$1.1680^{\pm 0.0439}$	$0.9502^{\pm 0.0164}$	$1.2523^{\pm 0.0416}$	$0.9538^{\pm 0.0853}$	$1.1621^{\pm 0.0552}$	$\mathbf{0.9540}^{\pm 0.0926}$	$\mathbf{1.1679}^{\pm 0.0605}$
SGC	$0.9525^{\pm 0.0257}$	$1.1827^{\pm 0.0552}$	$0.9505^{\pm 0.0645}$	$1.2678^{\pm 0.0532}$	$0.9579^{\pm 0.0536}$	$1.1782^{\pm 0.0415}$	$\mathbf{0.9594}^{\pm 0.0582}$	$\mathbf{1.1898}^{\pm 0.0399}$
GCN	$0.9496^{\pm 0.0392}$	$1.2310^{\pm 0.0332}$	$0.9502^{\pm 0.0536}$	$1.3024^{\pm 0.0324}$	$0.9512^{\pm 0.0358}$	$1.2189^{\pm 0.0276}$	$0.9518^{\pm 0.0373}$	$\mathbf{1.2153}^{\pm 0.0290}$
GAT	$0.9508^{\pm 0.0309}$	$1.2396^{\pm 0.0416}$	$0.9515^{\pm 0.0251}$	$1.3112^{\pm 0.0123}$	$0.9535^{\pm 0.0447}$	$1.2085^{\pm 0.0361}$	$\mathbf{0.9548}^{\pm 0.0491}$	$\mathbf{1.2020}^{\pm 0.0392}$