Uncertainty Quantification via Spatial-Temporal Tweedie Model for Zero-inflated and Long-tail Travel Demand Prediction

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INTRODUCTION

- We integrate the Tweedie distribution to model demand, replacing the traditional two-part zero-inflated model, thereby effectively capturing the zero-inflation and long-tail non-zero characteristics of O-D travel data.
- The proposed combination is adept at quantifying the spatial-temporal uncertainty inherent in sparse travel demand data.
- We validate the superiority of the STTD through experiments on two real-world travel demand datasets, tested across various spatial-temporal resolutions and performance metrics.

METHOD

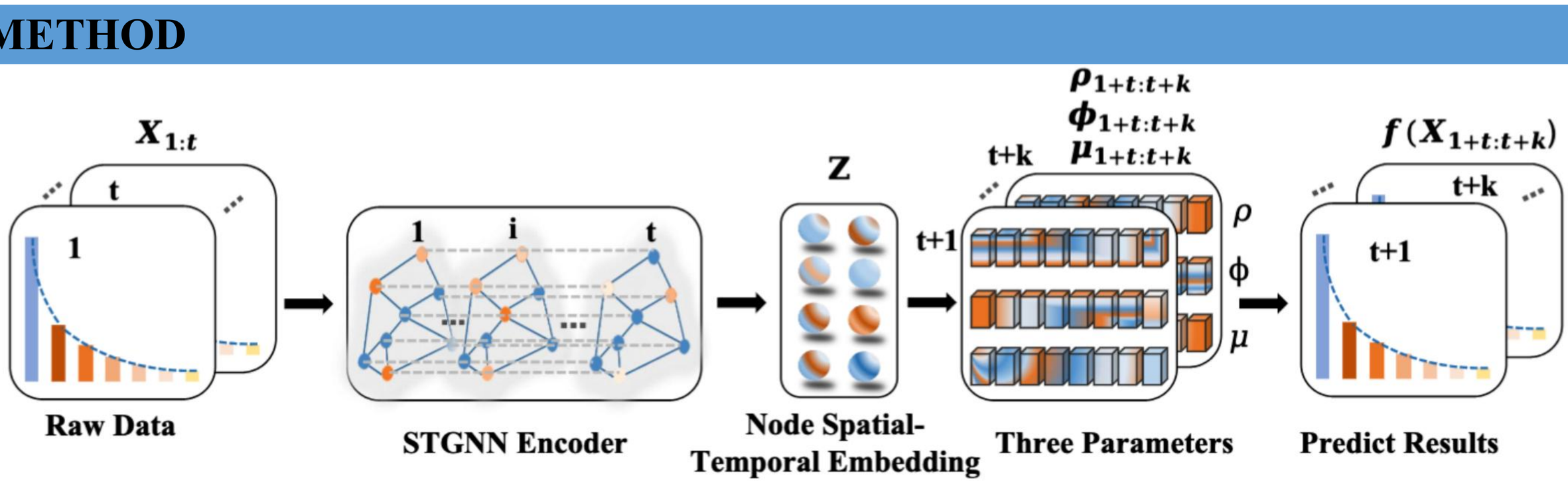

Figure 1: Framework of STTD model.

1. We learn the three Tweedie parameters via STGNN Encoder;

2. We minimize the distribution loss and optimize the model parameters to better model uncertainty.

EXPERIMENT

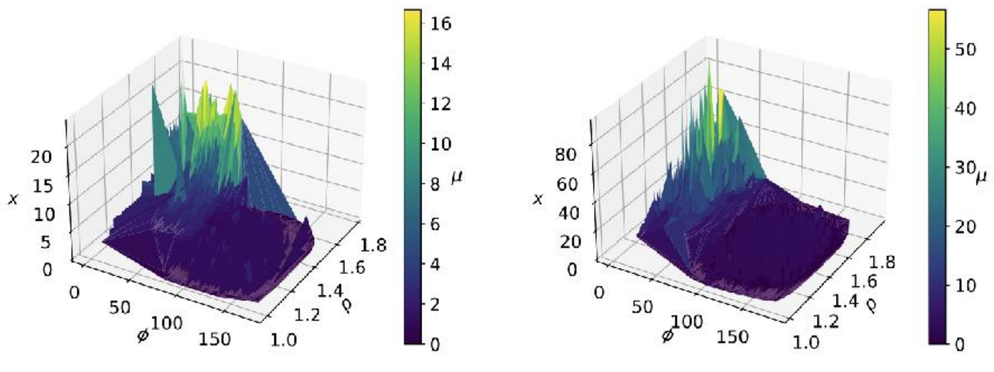

Figure 2: Surface plots for learned STTD parameters (μ, ϕ, ρ) on CDPSAMP10 (left) and SLDSAMP10 (right) test sets.

CONCLUSION

We validated the performance of our model through extensive experiments across five representative scenarios, with a keen focus on point estimation and uncertainty measurement. Our results underscore the model's robustness and effectiveness, setting a new benchmark in the field.