Statements and Declarations

List of Abbreviations:

- **OLR-WA – Online Regression with Weighted Average**
- **OLR-WAA** – **Online Regression with Weighted Average Adaptive.**
- **SGD** – Stochastic Gradient Descent
- **MBGD** – Mini-Batch Gradient Descent
- **LMS** – Least Mean Squares (Widrow-Hoff Algorithm)
- **RLS** – Recursive Least Squares
- **ORR** – Online Ridge Regression
- **OLR** – Online Lasso Regression
- **PA** – Passive-Aggressive Algorithm
- **PA-I, PA-II, PA-III** – Variants of Passive-Aggressive Learning
- **SAM** – Self-Adjusting Memory
- **MSE** – Mean Squared Error
- **RMSE** – Root Mean Squared Error
- **MAE** – Mean Absolute Error
- **R^2** – Coefficient of Determination
- **CCPP** – Combined Cycle Power Plant Dataset
- **KCHSD** – King County House Sales Dataset
- **MCPD** – Medical Cost Personal Dataset
- **1KC** – 1000 Companies Profit Dataset
- **KPI** – Key Performance Indicator
- **KPI-Win** – KPI Window
- **KWS** – KPI Window Size
- **LB** – Lower Bound
- **UB** – Upper Bound
- **α** – Weighting factor for model averaging

- **δ** – Scaling factor for KPI window size
- **λ** – Regularization parameter
- **ϵ** – Insensitivity parameter for Passive-Aggressive Algorithm
- **τ (Threshold)** – Dynamically determined based on standard deviation and a scaling factor
- **σ (Sigma)** – Standard Deviation
- **Z+** – Natural Number ≥ 1
- **DM** – Drift Magnitude
- **MBKPI** – Mini-Batch KPI
- **SM** – Scale Map
- **t** – Time step or iteration index
- **η (Learning Rate)** – Step size for gradient-based optimization methods
- **i.i.d. (Independent and Identically Distributed)** – Assumption that samples are drawn from the same distribution and are mutually independent
- **P (Covariance Matrix)** – Matrix used in Recursive Least Squares (RLS) to estimate parameter uncertainty
- **I** – Identity Matrix
- **CUR-MB** – Current Mini-Batch
- **μKPI** – Mean of the KPI-Window (KPI-Win)
- **EWMA** – Exponentially Weighted Moving Average
- **K (Mini-Batch Size)** – The number of samples used in each mini-batch for model updates
- **U (User-Defined Value)** – A manually specified value used as a threshold or configuration parameter
- **E (Epochs)** – The number of full passes through the training dataset

Availability of Data and Materials

The project, including the implementation and synthetic datasets, is available in the following GitHub repository:

GitHub Repository: (https://github.com/anonymous273800/OLR-WA)

Additionally, publicly available datasets used in this study can be accessed through the following sources. These references are also cited within the manuscript:

1. **Medical Cost Personal Dataset:** (https://www.kaggle.com/datasets/mirichoi0218/insurance)
2. **1000 Companies Profit Dataset:** (https://www.kaggle.com/datasets/rupakroy/1000-companies-profit)
3. **Combined Cycle Power Plant Dataset:** (https://www.kaggle.com/datasets/gova26/airpressure)
4. **King County House Sale Dataset:** (https://www.kaggle.com/datasets/minasameh55/king-country-houses-aa)

Authors' Contributions

Mohammad Abu-Shaira (M.A.) – First Author

M.A. led the conceptualization and development of the research project, ensuring a strong theoretical foundation and alignment with emerging trends in online regression. He conducted an extensive literature review, synthesizing relevant studies to identify research gaps and establish a comparative framework. He was responsible for designing and executing experiments, including data collection, preprocessing, and model implementation. M.A. performed in-depth data analysis, interpreting results, and drawing key insights to validate the study's hypotheses. Additionally, he took the lead in drafting the manuscript, structuring the narrative, and developing coherent arguments. He created figures, tables, and visualizations to effectively present the findings. M.A. also played a crucial role in revising and refining the manuscript, integrating feedback, and collaborating with co-authors to enhance clarity, coherence, and impact.

Weishi Shi (W.S.) – Co-Author

W.S. provided mentorship and strategic guidance, supporting the professional development of the first author throughout the research process. He contributed to shaping the research direction, ensuring methodological soundness and theoretical rigor. W.S. critically reviewed and refined manuscript drafts, enhancing clarity, coherence, and scholarly quality. He offered expert insights on data analysis techniques, helping to interpret results and strengthen the research's empirical foundation. Additionally, he facilitated alignment between the conducted studies and established machine learning theories, proposing innovative ideas to extend the research scope and broaden its impact.

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