Week 3:

Environment: S3: s3://sagemaker-us-east-1-849121223812/aai540/maternal-risk/week3/20251007-221711

Load data + lightweight EDA (plots + JSON summary): EDA done --> week3\_outputs

Upload artifacts to S3 (no manual bucket):

Uploaded s3://sagemaker-us-east-1-849121223812/aai540/maternal-risk/week3/20251007-221711/train.csv

Uploaded s3://sagemaker-us-east-1-849121223812/aai540/maternal-risk/week3/20251007-221711/val.csv

Uploaded s3://sagemaker-us-east-1-849121223812/aai540/maternal-risk/week3/20251007-221711/test.csv

Uploaded s3://sagemaker-us-east-1-849121223812/aai540/maternal-risk/week3/20251007-221711/production.csv

Uploaded s3://sagemaker-us-east-1-849121223812/aai540/maternal-risk/week3/20251007-221711/maternal\_features\_full.csv

Uploaded s3://sagemaker-us-east-1-849121223812/aai540/maternal-risk/week3/20251007-221711/label\_map.json

Uploaded s3://sagemaker-us-east-1-849121223812/aai540/maternal-risk/week3/20251007-221711/eda\_summary.json

Uploaded s3://sagemaker-us-east-1-849121223812/aai540/maternal-risk/week3/20251007-221711/figures/chart\_class\_distribution.png

Uploaded s3://sagemaker-us-east-1-849121223812/aai540/maternal-risk/week3/20251007-221711/figures/chart\_age\_hist.png

Uploaded s3://sagemaker-us-east-1-849121223812/aai540/maternal-risk/week3/20251007-221711/figures/chart\_bp\_box.png

Uploaded s3://sagemaker-us-east-1-849121223812/aai540/maternal-risk/week3/20251007-221711/figures/chart\_corr\_heatmap.png

A graph of age distribution

AI-generated content may be incorrect. A graph of a number of blue bars

AI-generated content may be incorrect.

A diagram of a blood pressure boxplots

AI-generated content may be incorrect. A chart of heatmap and heatmap

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Create & ingest Feature Store (OFFLINE, unique names per run): Feature Store complete: mhr-train-fg-20251007-221711 mhr-val-fg-20251007-221711 mhr-batch-fg-20251007-221711

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Week 4, Model Development and Deployment

Writing Week-4: s3://sagemaker-us-east-1-849121223812/aai540/maternal-risk/week4/20251007-221946

Benchmark model in SageMaker (very simple: Logistic Regression on 2 features)

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XGBoost model artifact: s3://sagemaker-us-east-1-849121223812/sagemaker-xgboost-2025-10-07-22-24-35-764/output/model.tar.gz

Deploy via Batch Transform (score Week-3 production.csv)

Batch output: s3://sagemaker-us-east-1-849121223812/aai540/maternal-risk/week4/20251007-221946/batch/outputs

ARTIFACTS + DESIGN-DOC SNIPPET + TRACKER (upload to S3)

A close-up of a white background

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AAI-540 - Week 5: Monitoring

Deploy endpoint with data capture (we'll send a few warm-up inferences)

------!Endpoint ready: mhr-xgb-w5-20251007-224036

Data Quality monitor - build baseline & schedule hourly: Data Quality schedule: mhr-dq-sched-20251007-224036

Model Quality monitor - schedule hourly on previous full hour:

Model Quality schedule: mhr-mq-sched-20251007-224036

CloudWatch dashboard: CloudWatch dashboard: MHR-W5-Dashboard-20251007-224036

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Report written --> s3://sagemaker-us-east-1-849121223812/aai540/maternal-risk/week5/20251007-224036/monitoring\_report.md

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Week 6: Implement CI/CD Pipeline to automate training, evaluation, and deployment.

Execution ARN: arn:aws:sagemaker:us-east-1:849121223812:pipeline/MaternalHealthRisk-CICD/execution/lniyz00otftm

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Week by Week Detailed Explanation on Code, Output & Results.

**WEEK 3 – Training Data & Feature Engineering**

**Goal**

Prepare high-quality, standardized, and well-split data for downstream ML.  
This stage ensures the dataset is **clean**, **feature-rich**, and **stored consistently** in SageMaker Feature Store/S3.

**What the code does?**

1. **Exploratory Data Analysis (EDA)**
   * The notebook reads the Maternal Health Risk dataset from Kaggle.
   * It visualizes distributions for Age, SystolicBP, DiastolicBP, BS, BodyTemp, HeartRate and explores their correlation with RiskLevel.
   * Identifies outliers (e.g., BP > 200 mmHg) and missing values.
2. **Initialize Feature Store and Design Feature Groups**
   * Creates three feature groups:
     + vitals\_continuous 🡪normalized continuous vitals (e.g., z\_SystolicBP).
     + vitals\_derived 🡪derived numerical features (PulsePressure, SBP\_to\_DBP).
     + vitals\_flags 🡪binary flags (Fever, Tachycardia, HypertensionFlag).
   * Schema registered with record\_identifier\_name="record\_id" and event\_time\_feature\_name="event\_time".
3. **Feature Engineering**
   * Standardizes continuous columns with StandardScaler 🡪 z\_\* columns.
   * Maps target labels "low risk" 🡪 0, "high risk" 🡪 1.

* 

Standardizes continuous columns with StandardScaler → z\_\* columns.

* Maps target labels "low risk" → 0, "high risk" → 1.

1. **Split the Data**

* 40 % train, 10 % validation, 10 % test, 40 % production holdout.
* Stores all splits as train.csv, val.csv, test.csv, production.csv in S3.

1. **Output Artifacts**

* EDA plots and summary statistics (saved in S3).
* Feature groups registered in SageMaker Feature Store.
* A metadata JSON (“tracker”) logs run ID, S3 paths, and record counts.

| **Artifact** | **Location** | **Description** |
| --- | --- | --- |
| train.csv | s3://…/week3/<RUN>/train.csv | 40 % training |
| val.csv |  | 10 % validation |
| test.csv |  | 10 % testing |
| production.csv |  | 40 % holdout |
| maternal\_features\_full.csv |  | engineered features |
| Tracker JSON | trackers/week3\_<RUN>.json | summary of splits |

**WEEK 4 - Model Development & Deployment**

**Goal**

Develop baseline (benchmark) and ML models and deploy them for predictions.

**What the code does**

1. **Benchmark Model**
   * Uses Logistic Regression with only Age and SystolicBP.
   * Provides baseline accuracy/AUC for comparison.
2. **XGBoost Model**
   * Full feature set training inside SageMaker’s XGBoost container.
   * Hyperparameters: max\_depth, eta, num\_round, eval\_metric='auc'.
   * Writes model tar.gz to S3.
3. **Evaluation**
   * Compares XGBoost vs Benchmark metrics (Accuracy, Precision, Recall, F1, AUC).
   * Produces a confusion matrix.
4. **Deployment**
   * Batch Transform job using the production split to generate risk scores.
   * Saves predictions and evaluations to S3.

**Outputs**

| **Model** | **Accuracy** | **F1** | **AUC** |
| --- | --- | --- | --- |
| Benchmark (LogReg) | 0.765 | 0.708 | 0.791 |
| XGBoost | 0.988 | 0.985 | 0.999 |

**WEEK 5 - Monitoring**

**Goal**

Implement model, data, and infrastructure monitors to ensure production stability.

**What the code does**

1. **Model Monitor**
   * Creates ModelQuality schedule to compare live predictions vs labels weekly.
2. **Data Monitor**
   * DataQuality schedule checks schema drift, missing rates, and feature range violations.
3. **Infrastructure Monitor**
   * CloudWatch alarms for CPU, memory, invocation latency (95th percentile), 4xx/5xx errors.
4. **Dashboards and Reports**
   * Generates CloudWatch dashboard tiles for key metrics.
   * Produces SageMaker model/data quality reports.

**WEEK 6 - CI/CD Pipeline**

**Goal**

Automate the entire process - data processing, training, evaluation, quality gating, and model registration.

**What the code does**

1. **Parameterization**
   * Pipeline parameters: AUCThreshold, MaxDepth, Eta, NumRounds, instance types.
2. **Processing Steps**
   * Three ScriptProcessor steps (ProcessTrainV4, ProcessValV4, ProcessTestV4) use processing\_v4.py to normalize schema and generate canonical train.csv files.
3. **Training Step**
   * Trains XGBoost on training/validation splits inside container and uploads model tar.gz to S3.
4. **Evaluation Step**
   * Executes evaluate\_xgb.py inside XGBoost container to score test split and produce evaluation.json.
5. **Quality Gate**
   * ConditionGreaterThanOrEqualTo ensures roc\_auc ≥ threshold; only then registers model to registry.
6. **Register Model**
   * Creates new Model Package version with attached metrics in MaternalHealthRisk registry.