Here is the **formatted content** you can **copy and paste into Word or Google Docs** and then export as a **PDF**:

📘 Machine Learning Models for Regression and Classification

🔵 REGRESSION MODELS (Predicting Continuous Values)

1. Linear Regression

- **Type:** Parametric (Simple/Multiple)
- **Concept:** Models the relationship between features and target as a straight line.
- **Equation:**
  $y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \dots + \beta_n x_n + \epsilon$
- **Assumptions:** Linearity, Homoscedasticity, No multicollinearity, Normality of errors

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2. Ridge Regression (L2 Regularization)

- **Concept:** Adds penalty on the square of coefficients.
- **Loss Function:** MSE + $\lambda \Sigma(\beta^2)$

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3. Lasso Regression (L1 Regularization)

- **Concept:** Shrinks some coefficients to zero (feature selection).
- **Loss Function:** MSE + $\lambda \Sigma|\beta|$

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4. Elastic Net Regression

- **Concept:** Combines L1 and L2 penalties for better balance when features are correlated.

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5. Polynomial Regression

- **Concept:** Fits non-linear data using polynomial terms.

- **Example:**
  y=β0+β1x+β2x2+…y = \beta_0 + \beta_1x + \beta_2x^2 + \dotsy=β0+β1x+β2x2+…

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6. Decision Tree Regression

- **Concept:** Splits data based on feature thresholds.
- **Pros:** Easy to interpret
- **Cons:** Overfitting risk

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7. Random Forest Regression

- **Type:** Ensemble (Bagging)
- **Concept:** Combines predictions of multiple decision trees.

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8. Gradient Boosting Regression (e.g., XGBoost, LightGBM)

- **Type:** Ensemble (Boosting)
- **Concept:** Sequentially builds trees to reduce errors.

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9. Support Vector Regression (SVR)

- **Concept:** Fits data within a margin of tolerance using kernels (RBF, Polynomial, etc.).

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10. K-Nearest Neighbors Regression

- **Concept:** Averages target values of k-nearest neighbors.

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11. Bayesian Regression

- **Concept:** Uses probability distributions to estimate parameters and predict values with uncertainty.

🔴 CLASSIFICATION MODELS (Predicting Categories)

1. Logistic Regression

- **Concept:** Estimates the probability of a class using a sigmoid function.
- **Use Case:** Binary classification

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2. K-Nearest Neighbors (KNN)

- **Concept:** Classifies based on the majority vote of k closest data points.

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3. Support Vector Machines (SVM)

- **Concept:** Finds the optimal hyperplane to separate classes with maximum margin.
- **Kernels:** Linear, Polynomial, RBF

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4. Decision Tree Classifier

- **Concept:** Uses feature splits to form a decision path.
- **Pros:** Interpretable
- **Cons:** Overfits without pruning

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5. Random Forest Classifier

- **Concept:** Aggregates predictions from many decision trees.
- **Pros:** Reduces variance and overfitting

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6. Gradient Boosting Classifier

- **Concept:** Sequentially improves predictions by learning from previous errors.
- **Examples:** XGBoost, LightGBM, CatBoost

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7. Naive Bayes

- **Concept:** Applies Bayes' theorem assuming independence between features.
- **Variants:** Gaussian NB, Multinomial NB, Bernoulli NB

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8. Neural Networks (MLP - Multilayer Perceptron)

- **Concept:** Learns non-linear patterns via layers of neurons.
- **Use Case:** Complex and high-dimensional data

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9. Linear Discriminant Analysis (LDA)

- **Concept:** Projects features to maximize class separability.
- **Assumes:** Equal covariance, Gaussian distribution

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10. Quadratic Discriminant Analysis (QDA)

- **Concept:** Similar to LDA but allows different covariance matrices for each class.

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11. Rule-Based Classifiers

- **Concept:** Uses domain or data-derived if-then rules.
- **Examples:** OneR, RIPPER

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12. Ensemble Methods

- **Bagging:** e.g., Random Forest (reduces variance)
- **Boosting:** e.g., XGBoost (reduces bias)
- **Stacking:** Combines outputs of multiple models via meta-learning

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📋 **Summary Table**

Task	Model Type	Example Models
Regression	Linear	Linear, Ridge, Lasso
	Non-linear	Polynomial, SVR, Tree-based
	Ensemble	Random Forest, Gradient Boosting
Classification	Linear	Logistic Regression, LDA
	Non-linear	SVM, Decision Tree, KNN
	Probabilistic	Naive Bayes, Bayesian
	Ensemble	Random Forest, Gradient Boosting (XGBoost)
	Neural Networks	MLP, Deep Learning