In [19]:
```python
# Logistic Regression on SUV dataset
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import StandardScaler
from sklearn.linear_model import LogisticRegression
from sklearn.metrics import confusion_matrix, classification_report, accuracy_score
```

In [20]:
```python
data = pd.read_csv(r"C:\Users\Admin\Downloads\archive\suv_data.csv")
data.head()
data.shape
data['Age'].unique()
```

Out[20]:
```
array([19, 35, 26, 27, 32, 25, 20, 18, 29, 47, 45, 46, 48, 49, 31, 21, 28,
       33, 30, 23, 24, 22, 59, 34, 39, 38, 37, 42, 40, 36, 41, 58, 55, 52,
       60, 56, 53, 50, 51, 57, 44, 43, 54])
```

In [21]:
```python
data.shape
```

Out[21]:
```
(400, 5)
```

In [22]:
```python
data['Age'].unique()
```

Out[22]:
```
array([19, 35, 26, 27, 32, 25, 20, 18, 29, 47, 45, 46, 48, 49, 31, 21, 28,
       33, 30, 23, 24, 22, 59, 34, 39, 38, 37, 42, 40, 36, 41, 58, 55, 52,
       60, 56, 53, 50, 51, 57, 44, 43, 54])
```

In [23]:
```python
for col in data.columns:
    print(f"Unique values in '{col}': {data[col].unique()}")
```

```
Unique values in 'User ID': [15624510 15810944 15668575 15603246 15804002 15728773 15598044 15
694829
 15600575 15727311 15570769 15606274 15746139 15704987 15628972 15697686
 15733883 15617482 15704583 15621083 15649487 15736760 15714658 15599081
 15705113 15631159 15792818 15633531 15744529 15669656 15581198 15729054
 15573452 15776733 15724858 15713144 15690188 15689425 15671766 15782806
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 15806901 15775335 15724150 15627220 15672330 15668521 15807837 15592570
 15748589 15635893 15757632 15691863 15706071 15654296 15755018 15594041]
Unique values in 'Gender': ['Male' 'Female']
Unique values in 'Age': [19 35 26 27 32 25 20 18 29 47 45 46 48 49 31 21 28 33 30 23 24 22 59
34
 39 38 37 42 40 36 41 58 55 52 60 56 53 50 51 57 44 43 54]
Unique values in 'EstimatedSalary': [ 19000  20000  43000  57000  76000  58000  84000 150000
33000  65000
  80000  52000  86000  18000  82000  25000  26000  28000  29000  22000
  49000  41000  23000  30000  74000 137000  16000  44000  90000  27000
  72000  31000  17000  51000 108000  15000  79000  54000 135000  89000
  32000  83000  55000  48000 117000  87000  66000 120000  63000  68000
 113000 112000  42000  88000  62000 118000  85000  81000  50000 116000
 123000  73000  37000  59000 149000  21000  35000  71000  61000  75000
```

```
  53000 107000  96000  45000  47000 100000  38000  69000 148000 115000
  34000  60000  70000  36000  39000 134000 101000 130000 114000 142000
  78000 143000  91000 144000 102000 126000 133000 147000 104000 146000
 122000  97000  95000 131000  77000 125000 106000 141000  93000 138000
 119000 105000  99000 129000  46000  64000 139000]
Unique values in 'Purchased': [0 1]
```

In [24]:
```
data.isnull().sum()
```

Out[24]:
```
User ID            0
Gender             0
Age                0
EstimatedSalary    0
Purchased          0
dtype: int64
```

In [25]:
```
data.duplicated().sum()
```

Out[25]:
```
np.int64(0)
```

In [26]:
```
data.describe()
```

Out[26]:

	User ID	Age	EstimatedSalary	Purchased
count	4.000000e+02	400.000000	400.000000	400.000000
mean	1.569154e+07	37.655000	69742.500000	0.357500
std	7.165832e+04	10.482877	34096.960282	0.479864
min	1.556669e+07	18.000000	15000.000000	0.000000
25%	1.562676e+07	29.750000	43000.000000	0.000000
50%	1.569434e+07	37.000000	70000.000000	0.000000
75%	1.575036e+07	46.000000	88000.000000	1.000000
max	1.581524e+07	60.000000	150000.000000	1.000000

In [27]:
```
# ---- STEP 2: Select Features and Target ----
X = data[['Age', 'EstimatedSalary']]  # Features
y = data['Purchased']                   # Target (0 = No, 1 = Yes)
```

In [28]:
```
# ---- STEP 3: Split Dataset ----
X_train, X_test, y_train, y_test = train_test_split(
    X, y, test_size=0.25, random_state=42
)
```

In [29]:
```
# ---- STEP 4: Feature Scaling ----
# -3 to +3
scaler = StandardScaler()
X_train_scaled = scaler.fit_transform(X_train)
X_test_scaled = scaler.transform(X_test)
```

In [30]:
```
X_train_scaled
```

```
Out[30]: array([[ 1.8925893 ,  1.52189404],
                [ 0.1250379 ,  0.03213212],
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```

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       [ 0.5178271 ,  1.84321524],
       [ 0.1250379 ,  0.20739823],
       [-0.56234321,  0.47029739]])
```

In [31]:
```
# ---- STEP 5: Train Logistic Regression Model ----
model = LogisticRegression()
model.fit(X_train_scaled, y_train)
```

Out[31]:
```
▾ LogisticRegression
LogisticRegression()
```

In [32]:
```
# ---- STEP 6: Predictions ----
y_pred = model.predict(X_test_scaled)
```

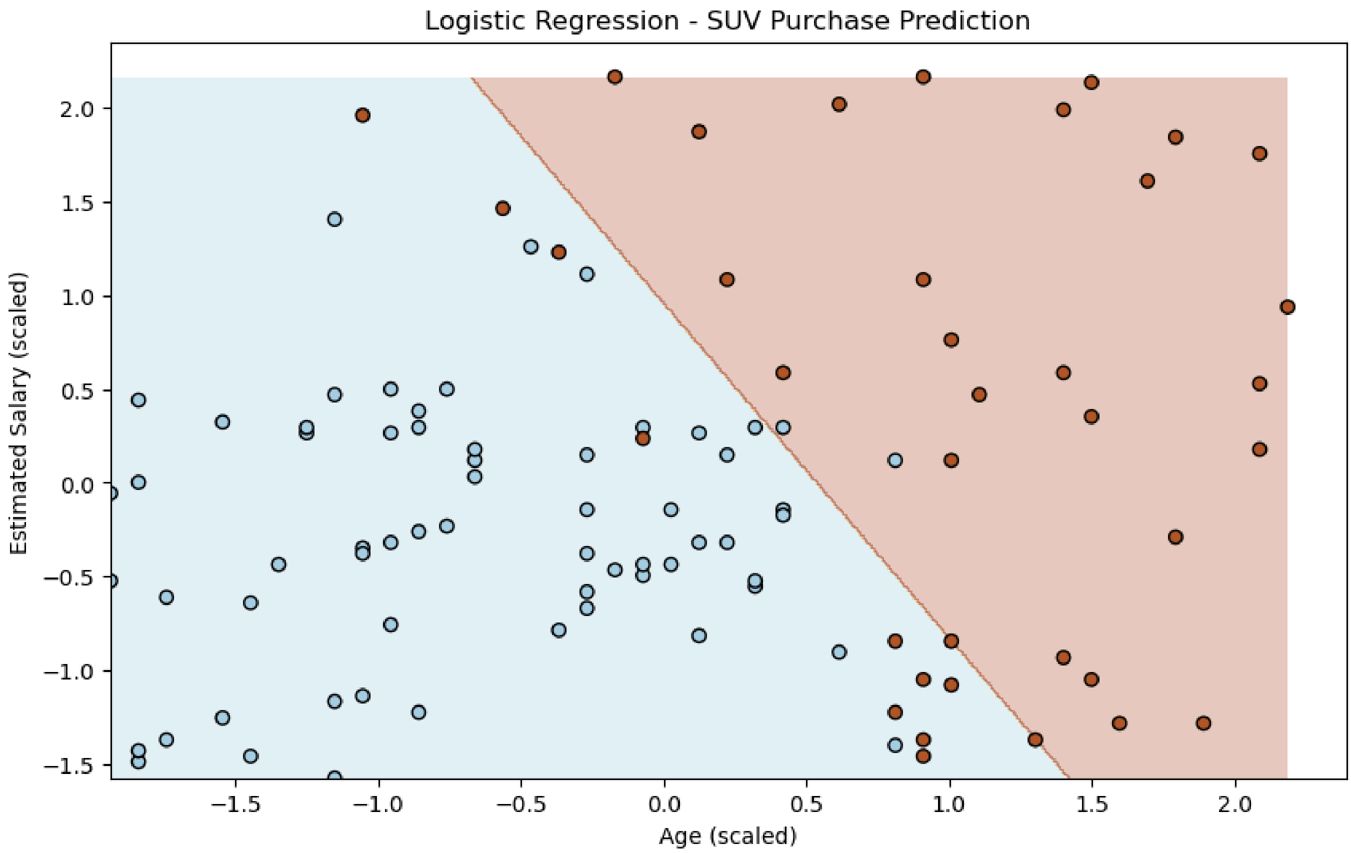
In [33]:
```
# ---- STEP 7: Evaluation ----
cm = confusion_matrix(y_test, y_pred)
```

```python
print("Confusion Matrix:\n", cm)
print("\nClassification Report:\n", classification_report(y_test, y_pred))
accuracy = accuracy_score(y_test, y_pred)
print(f"\nAccuracy: {accuracy:.2f}")
```

```
Confusion Matrix:
 [[61  2]
 [12 25]]

Classification Report:
               precision    recall  f1-score   support

           0       0.84      0.97      0.90        63
           1       0.93      0.68      0.78        37

    accuracy                           0.86       100
   macro avg       0.88      0.82      0.84       100
weighted avg       0.87      0.86      0.85       100


Accuracy: 0.86
```

In [34]:

```python
import matplotlib.pyplot as plt
import numpy as np

# Use test set features
X_set, y_set = X_test_scaled, y_test

# Create mesh grid directly from feature values
X1, X2 = np.meshgrid(
    np.arange(start=X_set[:, 0].min(), stop=X_set[:, 0].max(), step=0.01),
    np.arange(start=X_set[:, 1].min(), stop=X_set[:, 1].max(), step=0.01)
)

# Predict on the grid
Z = model.predict(np.array([X1.ravel(), X2.ravel()]).T)
Z = Z.reshape(X1.shape)

# Plot decision boundary
plt.figure(figsize=(10, 6))
plt.contourf(X1, X2, Z, alpha=0.3, cmap=plt.cm.Paired)

# Plot test points
plt.scatter(X_set[:, 0], X_set[:, 1], c=y_set, cmap=plt.cm.Paired, edgecolors='k')
plt.title("Logistic Regression - SUV Purchase Prediction")
plt.xlabel("Age (scaled)")
plt.ylabel("Estimated Salary (scaled)")
plt.show()
```



In [35]:
```
test_data = pd.DataFrame({
    "Age": [25, 40, 50],
    "EstimatedSalary": [30000, 70000, 90000]
})
```

In [36]:
```
# Scale and predict
test_scaled = scaler.transform(test_data)
predictions = model.predict(test_scaled)
probs = model.predict_proba(test_scaled)
```

In [37]:
```
print("\n--- Test Data Predictions ---")
for i, row in test_data.iterrows():
    print(f"Age: {row['Age']}, Salary: {row['EstimatedSalary']} -> "
          f"{'Buys SUV' if predictions[i] else 'No Purchase'} "
          f"(Prob: {probs[i][1]*100:.1f}%)")
```

```
--- Test Data Predictions ---
Age: 25, Salary: 30000 -> No Purchase (Prob: 0.9%)
Age: 40, Salary: 70000 -> No Purchase (Prob: 35.5%)
Age: 50, Salary: 90000 -> Buys SUV (Prob: 87.2%)
```

In [38]:
```
# Simple plot with legend + probability annotations (on top)
plt.figure(figsize=(8, 5))

# Decision boundary
plt.contourf(
    X1, X2,
    model.predict(np.c_[X1.ravel(), X2.ravel()]).reshape(X1.shape),
    alpha=0.3, cmap=plt.cm.Paired
)

# Original test set points
plt.scatter(X_set[:, 0], X_set[:, 1], c=y_set, cmap=plt.cm.Paired, alpha=0.5, label="Test set

# Test points (new data)
plt.scatter(
```

```
    test_scaled[:, 0], test_scaled[:, 1], c=predictions,
    cmap=plt.cm.coolwarm, marker='X', s=200, edgecolors='black', label="New test data"
)



plt.title("Logistic Regression - Test Data with Probabilities")
plt.xlabel("Age (scaled)")
plt.ylabel("Salary (scaled)")
plt.legend()
plt.show()
```