Appendix: Mining Proximity and Residential Property Values in India

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1 Appendix

This appendix presents the complete raw output from all regression models discussed in the main text. Results are organized by distance radius (3km, 5km, 7km, 10km).

1.1 Full Sample Results

1.1.1 3km Radius - OLS Results

```
================================================================================
BASELINE OLS HEDONIC REGRESSION (Radius: 3.0km)
CORRECTED VERSION - Matches other analyses
Sample: 1,602,159 observations
================================================================================

                        OLS Regression Results
================================================================================
Dep. Variable:              Log_Price   R-squared:                    0.440
Model:                            OLS   Adj. R-squared:               0.440
Method:                 Least Squares   F-statistic:               2.135e+04
Date:                Tue, 03 Feb 2026   Prob (F-statistic):            0.00
Time:                        17:37:21   Log-Likelihood:           -1.7794e+06
No. Observations:             1602159   AIC:                       3.559e+06
Df Residuals:                 1602099   BIC:                       3.560e+06
Df Model:                          59
Covariance Type:            nonrobust
================================================================================
                           coef    std err          t      P>|t|      [0.025      0.975]
--------------------------------------------------------------------------------
const                    14.0886      0.072    195.263      0.000      13.947      14.230
Mining_Coverage_Percent  -0.0058      0.001     -4.456      0.000      -0.008      -0.003
Area_Sqft               1.83e-05   1.09e-07    168.257      0.000    1.81e-05    1.85e-05
Num_Bedrooms              0.4453      0.001    684.391      0.000       0.444       0.447
Landmark_School          -0.0217      0.000    -46.157      0.000      -0.023      -0.021
Landmark_Hospital         0.0045      0.000     10.116      0.000       0.004       0.005
Landmark_Restaurant      -0.0275      0.000    -63.829      0.000      -0.028      -0.027
Landmark_Mall            -0.0147      0.000    -30.702      0.000      -0.016      -0.014
```

```
City_Badlapur                       -0.5351     0.008    -64.434    0.000      -0.551     -0.519
City_Bangalore                       0.4204     0.004    108.938    0.000       0.413      0.428
City_Bhubaneswar                     0.0366     0.007      5.018    0.000       0.022      0.051
City_Chennai                         0.0301     0.004      7.881    0.000       0.023      0.038
City_Coimbatore                     -0.1417     0.006    -25.703    0.000      -0.153     -0.131
City_Faridabad                       0.5461     0.007     79.341    0.000       0.533      0.560
City_Ghaziabad                       0.1867     0.005     35.091    0.000       0.176      0.197
City_Greater Noida                   0.3331     0.005     67.893    0.000       0.323      0.343
City_Gurgaon                         1.1121     0.004    254.588    0.000       1.104      1.121
City_Hyderabad                       0.1982     0.004     52.820    0.000       0.191      0.206
City_Indore                          0.1252     0.006     19.264    0.000       0.112      0.138
City_Jaipur                         -0.2354     0.005    -48.700    0.000      -0.245     -0.226
City_Kalyan                          0.0122     0.008      1.465    0.143      -0.004      0.029
City_Kolkata                        -0.1904     0.004    -52.253    0.000      -0.198     -0.183
City_Lucknow                        -0.1764     0.006    -30.817    0.000      -0.188     -0.165
City_Mohali                          0.2529     0.007     33.752    0.000       0.238      0.268
City_Mumbai                          0.8390     0.004    215.652    0.000       0.831      0.847
City_Nagpur                         -0.3412     0.006    -57.413    0.000      -0.353     -0.330
City_Nashik                         -0.4668     0.007    -71.459    0.000      -0.480     -0.454
City_Navi Mumbai                     0.2609     0.005     55.224    0.000       0.252      0.270
City_New Delhi                       0.4868     0.005     89.823    0.000       0.476      0.497
City_Noida                           0.4380     0.006     77.415    0.000       0.427      0.449
City_Other                          -0.1433     0.003    -41.833    0.000      -0.150     -0.137
City_Pune                            0.1501     0.003     43.490    0.000       0.143      0.157
City_Raipur                         -0.3728     0.009    -41.426    0.000      -0.390     -0.355
City_Secunderabad                    0.1387     0.008     16.623    0.000       0.122      0.155
City_Surat                          -0.2503     0.008    -31.794    0.000      -0.266     -0.235
City_Thane                           0.1317     0.004     30.668    0.000       0.123      0.140
City_Vadodara                       -0.4151     0.007    -58.967    0.000      -0.429     -0.401
City_Visakhapatnam                  -0.1741     0.008    -22.181    0.000      -0.189     -0.159
PropType_Apartment                   0.4029     0.072      5.591    0.000       0.262      0.544
PropType_Builder Floor               0.3272     0.073      4.509    0.000       0.185      0.469
PropType_Bungalow                    0.3322     0.077      4.324    0.000       0.182      0.483
PropType_Condo                       0.7617     0.524      1.452    0.146      -0.266      1.790
PropType_Duplex                      0.4894     0.073      6.749    0.000       0.347      0.632
PropType_Farm House                  0.3724     0.075      4.934    0.000       0.224      0.520
PropType_Independent Floor           0.1758     0.072      2.436    0.015       0.034      0.317
PropType_Independent House           0.0782     0.072      1.085    0.278      -0.063      0.220
PropType_Penthouse                   0.9514     0.073     13.027    0.000       0.808      1.094
PropType_Plot                        0.4297     0.072      5.962    0.000       0.288      0.571
PropType_Row House                   0.2261     0.078      2.903    0.004       0.073      0.379
PropType_Serviced Apartment          0.3432     0.134      2.555    0.011       0.080      0.607
PropType_Studio                      0.2872     0.076      3.782    0.000       0.138      0.436
PropType_Studio Apartment            0.1990     0.074      2.689    0.007       0.054      0.344
PropType_Triplex                     0.8669     0.087     10.002    0.000       0.697      1.037
PropType_Villa                       0.6307     0.072      8.746    0.000       0.489      0.772
PropType_Villament                   0.8774     0.090      9.778    0.000       0.702      1.053
Furnish_Fully Furnished              0.1124     0.003     36.064    0.000       0.106      0.118
Furnish_Semi-Furnished               0.0176     0.002      8.669    0.000       0.014      0.022
Furnish_Unfurnished                  0.0013     0.002      0.674    0.500      -0.002      0.005
Rera_1.0                             0.2667     0.001    179.417    0.000       0.264      0.270
Rera_Missing                         0.3579     0.002    175.651    0.000       0.354      0.362
==============================================================================
Omnibus:                      285296.564   Durbin-Watson:                   0.943
Prob(Omnibus):                     0.000   Jarque-Bera (JB):          7154138.404
Skew:                             -0.088   Prob(JB):                         0.00
Kurtosis:                         13.351   Cond. No.                     5.08e+06
==============================================================================
```

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
[2] The condition number is large, 5.08e+06. This might indicate that there are strong multicollinearity or other numerical problems.

1.1.2 3km Radius - PSM Results

```
================================================================================
PROPENSITY SCORE MATCHING RESULTS (Radius: 3.0km)
================================================================================


ROBUSTNESS ACROSS TREATMENT THRESHOLDS
--------------------------------------------------------------------------------


THRESHOLD: Mining coverage > 0.3%
--------------------------------------------------------------------------------
Treated units: 103,056
Control units: 1,499,103
Matched pairs: 103,056
Match rate: 100.0%

AVERAGE TREATMENT EFFECT ON TREATED (ATT):
  ATT: 2.63%
  Standard Error: 0.38%
  95% CI: [1.99%, 3.54%]

Interpretation: Properties near mines (>0.3% coverage) are
2.63% more expensive than similar properties not near mines.


================================================================================

THRESHOLD: Mining coverage > 0.5%
--------------------------------------------------------------------------------
Treated units: 73,759
Control units: 1,528,400
Matched pairs: 73,759
Match rate: 100.0%

AVERAGE TREATMENT EFFECT ON TREATED (ATT):
  ATT: 5.56%
  Standard Error: 0.49%
  95% CI: [4.71%, 6.52%]

Interpretation: Properties near mines (>0.5% coverage) are
5.56% more expensive than similar properties not near mines.


================================================================================

THRESHOLD: Mining coverage > 1.0%
--------------------------------------------------------------------------------
Treated units: 46,229
Control units: 1,555,930
Matched pairs: 46,229
Match rate: 100.0%

AVERAGE TREATMENT EFFECT ON TREATED (ATT):
  ATT: 14.81%
  Standard Error: 0.61%
```

```
    95% CI: [13.75%, 16.08%]


Interpretation: Properties near mines (>1.0% coverage) are
14.81% more expensive than similar properties not near mines.


================================================================================


THRESHOLD: Mining coverage > 2.0%
--------------------------------------------------------------------------------
Treated units: 18,384
Control units: 1,583,775
Matched pairs: 18,384
Match rate: 100.0%


AVERAGE TREATMENT EFFECT ON TREATED (ATT):
  ATT: 2.96%
  Standard Error: 0.85%
  95% CI: [1.42%, 4.80%]


Interpretation: Properties near mines (>2.0% coverage) are
2.96% more expensive than similar properties not near mines.


================================================================================



SUMMARY TABLE

--------------------------------------------------------------------------------
Threshold     Treated       Matched       ATT           95% CI
--------------------------------------------------------------------------------
0.3%          103,056       103,056       2.63          % [1.99%, 3.54%]
0.5%          73,759        73,759        5.56          % [4.71%, 6.52%]
1.0%          46,229        46,229        14.81         % [13.75%, 16.08%]
2.0%          18,384        18,384        2.96          % [1.42%, 4.80%]
--------------------------------------------------------------------------------


NOTES:
- Method: 1:1 Nearest Neighbor Matching with caliper=0.1
- Standard errors computed via bootstrap (200 iterations)
- All matches achieved within caliper threshold
```

1.1.3   3km Radius - SAC Model

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================================================================================
SAC (SPATIAL AUTOREGRESSIVE COMBINED) - PRIMARY MODEL
Radius: 3.0km | Sample: 1,602,159 obs
================================================================================


MODEL SPECIFICATION:
--------------------------------------------------------------------------------
y = W*y + X* + u
u = W*u +


Where:
  y = Log(Price)
   = Spatial lag coefficient (spillover effects)
   = Spatial error coefficient (correlated shocks)
  W = 8-nearest neighbors matrix (row-standardized)
```

```
REGRESSION RESULTS
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SUMMARY OF OUTPUT: SPATIALLY WEIGHTED 2SLS- GM-COMBO MODEL (HET)
-------------------------------------------------------------
Data set            :     unknown
Weights matrix      :     unknown
Dependent Variable  :   Log_Price       Number of Observations:    1602159
Mean dependent var  :    15.7453        Number of Variables   :         61
S.D. dependent var  :     0.9819        Degrees of Freedom    :    1602098
Pseudo R-squared    :     0.7667
Spatial Pseudo R-squared:  0.4127
N. of iterations    :           1       Step1c computed       :         No


------------------------------------------------------------------------
            Variable    Coefficient    Std.Error    z-Statistic    Probability
------------------------------------------------------------------------
            CONSTANT       5.35927      0.10342      51.81975       0.00000
Mining_Coverage_Percent    0.01222      0.00206       5.92965       0.00000
            Area_Sqft       0.00001      0.00000       7.50905       0.00000
         Num_Bedrooms       0.28962      0.00116     249.85400       0.00000
      Landmark_School      -0.01162      0.00072     -16.22994       0.00000
    Landmark_Hospital       0.00064      0.00066       0.96876       0.33266
  Landmark_Restaurant      -0.01132      0.00066     -17.08331       0.00000
        Landmark_Mall      -0.00643      0.00071      -9.01180       0.00000
        City_Badlapur      -0.04340      0.00835      -5.19470       0.00000
       City_Bangalore       0.14172      0.00584      24.24734       0.00000
     City_Bhubaneswar      -0.02519      0.01146      -2.19923       0.02786
         City_Chennai      -0.05721      0.00608      -9.40891       0.00000
      City_Coimbatore      -0.18855      0.01004     -18.78211       0.00000
       City_Faridabad       0.13917      0.01206      11.53785       0.00000
       City_Ghaziabad       0.07740      0.00794       9.74377       0.00000
   City_Greater Noida       0.10266      0.00759      13.53207       0.00000
         City_Gurgaon       0.41582      0.00712      58.39457       0.00000
       City_Hyderabad      -0.01382      0.00572      -2.41631       0.01568
          City_Indore      -0.06856      0.01361      -5.03682       0.00000
          City_Jaipur      -0.18262      0.00854     -21.38505       0.00000
          City_Kalyan       0.15575      0.00879      17.72276       0.00000
         City_Kolkata      -0.05032      0.00524      -9.60363       0.00000
         City_Lucknow      -0.20207      0.01142     -17.69402       0.00000
          City_Mohali       0.02003      0.01043       1.92069       0.05477
          City_Mumbai       0.45013      0.00538      83.67225       0.00000
          City_Nagpur      -0.23501      0.00990     -23.73052       0.00000
          City_Nashik      -0.10926      0.00835     -13.08541       0.00000
      City_Navi Mumbai       0.23101      0.00680      33.95424       0.00000
       City_New Delhi       0.21625      0.00962      22.47424       0.00000
           City_Noida       0.19937      0.00984      20.26118       0.00000
           City_Other      -0.08859      0.00553     -16.02616       0.00000
            City_Pune       0.14107      0.00482      29.24106       0.00000
          City_Raipur      -0.33551      0.01622     -20.68180       0.00000
    City_Secunderabad      -0.04171      0.01413      -2.95139       0.00316
           City_Surat      -0.12091      0.01237      -9.77492       0.00000
           City_Thane       0.19171      0.00576      33.30247       0.00000
        City_Vadodara      -0.22532      0.01068     -21.09073       0.00000
   City_Visakhapatnam      -0.07955      0.01322      -6.01846       0.00000
   PropType_Apartment       0.32485      0.09429       3.44514       0.00057
PropType_Builder Floor      0.35284      0.09445       3.73580       0.00019
    PropType_Bungalow       0.55270      0.09743       5.67252       0.00000
       PropType_Condo       0.21151      0.14563       1.45243       0.14638
```

5

```
          PropType_Duplex            0.57541            0.09444            6.09289            0.00000
        PropType_Farm House          0.68153            0.10000            6.81563            0.00000
   PropType_Independent Floor           0.18207            0.09433              1.93007            0.05360
   PropType_Independent House           0.44562            0.09431              4.72494            0.00000
        PropType_Penthouse          0.68547            0.09437            7.26384            0.00000
             PropType_Plot          0.70659            0.09404            7.51385            0.00000
         PropType_Row House          0.44099            0.09647            4.57121            0.00000
   PropType_Serviced Apartment          -0.10061             0.11819             -0.85125             0.39463
           PropType_Studio          0.07765            0.09651            0.80460            0.42105
   PropType_Studio Apartment           0.01176             0.09470              0.12416             0.90119
          PropType_Triplex          0.59606            0.12152            4.90518            0.00000
            PropType_Villa          0.71087            0.09424            7.54341            0.00000
        PropType_Villament          0.52921            0.09627            5.49709            0.00000
     Furnish_Fully Furnished           0.08254             0.00231             35.71817             0.00000
    Furnish_Semi-Furnished          -0.00705            0.00131           -5.36976            0.00000
       Furnish_Unfurnished          -0.01245            0.00124          -10.00810            0.00000
                  Rera_1.0          0.15860            0.00179           88.43983            0.00000
              Rera_Missing          0.18876            0.00250           75.55870            0.00000
               W_Log_Price          0.58354            0.00262          222.32500            0.00000
                    lambda          0.62589            0.00333          187.80369            0.00000
------------------------------------------------------------------------------
Instrumented: W_Log_Price
Instruments: W_Area_Sqft, W_City_Badlapur, W_City_Bangalore,
             W_City_Bhubaneswar , W_City_Chennai, W_City_Coimbatore,
             W_City_Faridabad, W_City_Ghaziabad, W_City_Greater Noida,
             W_City_Gurgaon, W_City_Hyderabad, W_City_Indore, W_City_Jaipur,
             W_City_Kalyan, W_City_Kolkata, W_City_Lucknow, W_City_Mohali,
             W_City_Mumbai, W_City_Nagpur, W_City_Nashik, W_City_Navi
             Mumbai, W_City_New Delhi, W_City_Noida, W_City_Other,
             W_City_Pune, W_City_Raipur , W_City_Secunderabad, W_City_Surat,
             W_City_Thane, W_City_Vadodara, W_City_Visakhapatnam,
             W_Furnish_Fully Furnished, W_Furnish_Semi-Furnished,
             W_Furnish_Unfurnished, W_Landmark_Hospital, W_Landmark_Mall,
             W_Landmark_Restaurant, W_Landmark_School,
             W_Mining_Coverage_Percent, W_Num_Bedrooms,
             W_PropType_Apartment, W_PropType_Builder Floor,
             W_PropType_Bungalow, W_PropType_Condo, W_PropType_Duplex,
             W_PropType_Farm House, W_PropType_Independent Floor,
             W_PropType_Independent House, W_PropType_Penthouse,
             W_PropType_Plot, W_PropType_Row House, W_PropType_Serviced
             Apartment, W_PropType_Studio, W_PropType_Studio Apartment,
             W_PropType_Triplex, W_PropType_Villa, W_PropType_Villament,
             W_Rera_1.0, W_Rera_Missing
============================ END OF REPORT =====================================


===============================================================================
MINING COVERAGE EFFECTS
===============================================================================
Coefficient:    0.012221
Std. Error:     0.002061
P-value:        0.000000
Impact:         1.23% per 1pp mining coverage

Spatial lag (): 0.583537
Spatial error (): 0.625890
Pseudo R²:      0.7667
```

1.1.4 3km Radius - SAR Model (Robustness)

```
================================================================================
SAR (SPATIAL LAG) - ROBUSTNESS CHECK
Radius: 3.0km | Sample: 1,602,159 obs
================================================================================


MODEL SPECIFICATION:
--------------------------------------------------------------------------------
y = W*y + X* +


Where:
  y = Log(Price)
   = Spatial lag coefficient (spillover effects only)
  W = 8-nearest neighbors matrix (row-standardized)
  Estimation: GM (Generalized Method of Moments)


REGRESSION RESULTS
------------------


SUMMARY OF OUTPUT: SPATIAL TWO STAGE LEAST SQUARES
-------------------------------------------------
Data set            :     unknown
Weights matrix      :     unknown
Dependent Variable  :   Log_Price        Number of Observations:    1602159
Mean dependent var  :    15.7453         Number of Variables   :         61
S.D. dependent var  :     0.9819         Degrees of Freedom    :    1602098
Pseudo R-squared    :     0.7721
Spatial Pseudo R-squared:  0.4815


--------------------------------------------------------------------------------
          Variable    Coefficient     Std.Error     z-Statistic    Probability
--------------------------------------------------------------------------------
          CONSTANT       5.68947        0.04919      115.67306        0.00000
Mining_Coverage_Percent  0.00609        0.00085        7.20376        0.00000
         Area_Sqft       0.00001        0.00000      186.89893        0.00000
      Num_Bedrooms       0.28861        0.00050      574.25134        0.00000
   Landmark_School      -0.00780        0.00031      -25.40773        0.00000
  Landmark_Hospital      0.00127        0.00029        4.42164        0.00001
Landmark_Restaurant     -0.01023        0.00028      -36.27411        0.00000
     Landmark_Mall      -0.00518        0.00031      -16.56036        0.00000
      City_Badlapur     -0.08260        0.00547      -15.11111        0.00000
     City_Bangalore      0.18565        0.00255       72.89085        0.00000
   City_Bhubaneswar      0.00848        0.00475        1.78558        0.07417
       City_Chennai      0.02993        0.00249       12.03019        0.00000
    City_Coimbatore     -0.06288        0.00360      -17.49018        0.00000
     City_Faridabad      0.22687        0.00452       50.21267        0.00000
      City_Ghaziabad     0.09289        0.00347       26.76608        0.00000
 City_Greater Noida      0.15038        0.00321       46.82165        0.00000
       City_Gurgaon      0.45693        0.00306      149.24453        0.00000
     City_Hyderabad      0.06843        0.00245       27.87849        0.00000
        City_Indore      0.07552        0.00424       17.83110        0.00000
        City_Jaipur     -0.12377        0.00316      -39.22627        0.00000
        City_Kalyan      0.13415        0.00545       24.60762        0.00000
       City_Kolkata     -0.06329        0.00238      -26.54646        0.00000
       City_Lucknow     -0.08845        0.00373      -23.69307        0.00000
        City_Mohali      0.09571        0.00489       19.57413        0.00000
        City_Mumbai      0.44705        0.00262      170.42988        0.00000
        City_Nagpur     -0.14239        0.00389      -36.63267        0.00000
```

7

City_Nashik	-0.12899	0.00430	-30.02626	0.00000
City_Navi Mumbai	0.21121	0.00308	68.59030	0.00000
City_New Delhi	0.22566	0.00356	63.39319	0.00000
City_Noida	0.19644	0.00371	52.95897	0.00000
City_Other	-0.03934	0.00224	-17.57290	0.00000
City_Pune	0.12917	0.00225	57.42039	0.00000
City_Raipur	-0.16420	0.00587	-27.94954	0.00000
City_Secunderabad	0.03116	0.00544	5.73129	0.00000
City_Surat	-0.10840	0.00513	-21.11291	0.00000
City_Thane	0.17089	0.00280	61.06645	0.00000
City_Vadodara	-0.21271	0.00460	-46.24293	0.00000
City_Visakhapatnam	-0.04395	0.00512	-8.58873	0.00000
PropType_Apartment	0.24180	0.04695	5.14970	0.00000
PropType_Builder Floor	0.20007	0.04728	4.23196	0.00002
PropType_Bungalow	0.24578	0.05006	4.90930	0.00000
PropType_Condo	0.17674	0.34172	0.51719	0.60502
PropType_Duplex	0.38947	0.04724	8.24369	0.00000
PropType_Farm House	0.45962	0.04917	9.34741	0.00000
PropType_Independent Floor	0.06928	0.04702	1.47330	0.14067
PropType_Independent House	0.18127	0.04700	3.85700	0.00011
PropType_Penthouse	0.61788	0.04758	12.98519	0.00000
PropType_Plot	0.36822	0.04696	7.84135	0.00000
PropType_Row House	0.18866	0.05074	3.71837	0.00020
PropType_Serviced Apartment	0.14833	0.08754	1.69443	0.09018
PropType_Studio	0.07384	0.04947	1.49256	0.13555
PropType_Studio Apartment	0.04544	0.04821	0.94254	0.34592
PropType_Triplex	0.45755	0.05647	8.10255	0.00000
PropType_Villa	0.42771	0.04699	9.10227	0.00000
PropType_Villament	0.44244	0.05847	7.56704	0.00000
Furnish_Fully Furnished	0.07488	0.00203	36.85768	0.00000
Furnish_Semi-Furnished	-0.01093	0.00132	-8.25051	0.00000
Furnish_Unfurnished	-0.01916	0.00125	-15.28279	0.00000
Rera_1.0	0.13410	0.00100	134.74253	0.00000
Rera_Missing	0.19793	0.00136	145.99204	0.00000
W_Log_Price	0.56987	0.00098	580.46441	0.00000

Instrumented: W_Log_Price
Instruments: W_Area_Sqft, W_City_Badlapur, W_City_Bangalore,
          W_City_Bhubaneswar , W_City_Chennai, W_City_Coimbatore,
          W_City_Faridabad, W_City_Ghaziabad, W_City_Greater Noida,
          W_City_Gurgaon, W_City_Hyderabad, W_City_Indore, W_City_Jaipur,
          W_City_Kalyan, W_City_Kolkata, W_City_Lucknow, W_City_Mohali,
          W_City_Mumbai, W_City_Nagpur, W_City_Nashik, W_City_Navi
          Mumbai, W_City_New Delhi, W_City_Noida, W_City_Other,
          W_City_Pune, W_City_Raipur , W_City_Secunderabad, W_City_Surat,
          W_City_Thane, W_City_Vadodara, W_City_Visakhapatnam,
          W_Furnish_Fully Furnished, W_Furnish_Semi-Furnished,
          W_Furnish_Unfurnished, W_Landmark_Hospital, W_Landmark_Mall,
          W_Landmark_Restaurant, W_Landmark_School,
          W_Mining_Coverage_Percent, W_Num_Bedrooms,
          W_PropType_Apartment, W_PropType_Builder Floor,
          W_PropType_Bungalow, W_PropType_Condo, W_PropType_Duplex,
          W_PropType_Farm House, W_PropType_Independent Floor,
          W_PropType_Independent House, W_PropType_Penthouse,
          W_PropType_Plot, W_PropType_Row House, W_PropType_Serviced
          Apartment, W_PropType_Studio, W_PropType_Studio Apartment,
          W_PropType_Triplex, W_PropType_Villa, W_PropType_Villament,
          W_Rera_1.0, W_Rera_Missing

```
DIAGNOSTICS FOR SPATIAL DEPENDENCE
TEST                            DF        VALUE          PROB
Anselin-Kelejian Test           1      43283.509        0.0000


SPATIAL LAG MODEL IMPACTS
Impacts computed using the 'simple' method.
              Variable       Direct        Indirect        Total
Mining_Coverage_Percent       0.0061        0.0081         0.0142
              Area_Sqft       0.0000        0.0000         0.0000
           Num_Bedrooms       0.2886        0.3824         0.6710
        Landmark_School      -0.0078       -0.0103        -0.0181
      Landmark_Hospital       0.0013        0.0017         0.0030
    Landmark_Restaurant      -0.0102       -0.0136        -0.0238
          Landmark_Mall      -0.0052       -0.0069        -0.0121
          City_Badlapur      -0.0826       -0.1094        -0.1920
         City_Bangalore       0.1856        0.2460         0.4316
       City_Bhubaneswar       0.0085        0.0112         0.0197
           City_Chennai       0.0299        0.0397         0.0696
        City_Coimbatore      -0.0629       -0.0833        -0.1462
         City_Faridabad       0.2269        0.3006         0.5274
         City_Ghaziabad       0.0929        0.1231         0.2160
     City_Greater Noida       0.1504        0.1992         0.3496
           City_Gurgaon       0.4569        0.6054         1.0623
         City_Hyderabad       0.0684        0.0907         0.1591
            City_Indore       0.0755        0.1001         0.1756
            City_Jaipur      -0.1238       -0.1640        -0.2878
            City_Kalyan       0.1341        0.1777         0.3119
           City_Kolkata      -0.0633       -0.0838        -0.1471
           City_Lucknow      -0.0885       -0.1172        -0.2056
            City_Mohali       0.0957        0.1268         0.2225
            City_Mumbai       0.4471        0.5923         1.0393
            City_Nagpur      -0.1424       -0.1886        -0.3310
            City_Nashik      -0.1290       -0.1709        -0.2999
        City_Navi Mumbai     0.2112        0.2798         0.4910
          City_New Delhi     0.2257        0.2990         0.5246
             City_Noida      0.1964        0.2603         0.4567
             City_Other     -0.0393       -0.0521        -0.0915
              City_Pune      0.1292        0.1711         0.3003
            City_Raipur     -0.1642       -0.2175        -0.3817
       City_Secunderabad     0.0312        0.0413         0.0725
             City_Surat     -0.1084       -0.1436        -0.2520
             City_Thane      0.1709        0.2264         0.3973
           City_Vadodara    -0.2127       -0.2818        -0.4945
      City_Visakhapatnam    -0.0440       -0.0582        -0.1022
       PropType_Apartment     0.2418        0.3204         0.5622
   PropType_Builder Floor     0.2001        0.2651         0.4651
        PropType_Bungalow     0.2458        0.3256         0.5714
           PropType_Condo     0.1767        0.2342         0.4109
          PropType_Duplex     0.3895        0.5160         0.9055
       PropType_Farm House    0.4596        0.6089         1.0686
 PropType_Independent Floor   0.0693        0.0918         0.1611
 PropType_Independent House   0.1813        0.2402         0.4214
       PropType_Penthouse     0.6179        0.8186         1.4365
            PropType_Plot     0.3682        0.4878         0.8561
        PropType_Row House    0.1887        0.2499         0.4386
PropType_Serviced Apartment   0.1483        0.1965         0.3449
          PropType_Studio     0.0738        0.0978         0.1717
  PropType_Studio Apartment   0.0454        0.0602         0.1056
         PropType_Triplex     0.4576        0.6062         1.0637


                                    9
```

```
         PropType_Villa         0.4277          0.5667          0.9944
     PropType_Villament         0.4424          0.5862          1.0286
 Furnish_Fully Furnished         0.0749          0.0992          0.1741
 Furnish_Semi-Furnished        -0.0109         -0.0145         -0.0254
   Furnish_Unfurnished         -0.0192         -0.0254         -0.0446
               Rera_1.0         0.1341          0.1777          0.3118
            Rera_Missing       0.1979          0.2622          0.4602
============================== END OF REPORT ======================================
```

```
================================================================================
MINING COVERAGE EFFECTS
================================================================================
Coefficient:     0.006087
Std. Error:      0.000845
P-value:         0.000000
Impact:          0.61% per 1pp mining coverage


Spatial lag (): 0.569867
Pseudo R²:       0.7721
```

1.1.5 3km Radius - SEM Model (Robustness)

```
================================================================================
SEM (SPATIAL ERROR) - ROBUSTNESS CHECK
Radius: 3.0km | Sample: 1,602,159 obs
================================================================================


MODEL SPECIFICATION:
--------------------------------------------------------------------------------
y = X* + u
u = W*u +


Where:
  y = Log(Price)
   = Spatial error coefficient (correlated shocks only)
  W = 8-nearest neighbors matrix (row-standardized)
  Estimation: GM (Generalized Method of Moments) with heteroskedasticity


REGRESSION RESULTS
------------------


SUMMARY OF OUTPUT: GM SPATIALLY WEIGHTED LEAST SQUARES (HET)
-----------------------------------------------------------
Data set            :      unknown
Weights matrix      :      unknown
Dependent Variable  :   Log_Price          Number of Observations:    1602159
Mean dependent var  :    15.7453           Number of Variables   :         60
S.D. dependent var  :     0.9819           Degrees of Freedom    :    1602099
Pseudo R-squared    :     0.3637
N. of iterations    :           1          Step1c computed       :         No


--------------------------------------------------------------------------------
           Variable    Coefficient      Std.Error     z-Statistic    Probability
--------------------------------------------------------------------------------
           CONSTANT       14.81712        0.09182       161.36993        0.00000
Mining_Coverage_Percent   -0.00357        0.00649        -0.55009        0.58225
           Area_Sqft        0.00001        0.00000         7.92559        0.00000
        Num_Bedrooms        0.29316        0.00110       267.64456        0.00000
```

Landmark_School	-0.02076	0.00154	-13.47457	0.00000
Landmark_Hospital	0.00112	0.00146	0.76325	0.44531
Landmark_Restaurant	-0.02344	0.00146	-16.08723	0.00000
Landmark_Mall	-0.01484	0.00158	-9.36543	0.00000
City_Badlapur	-0.65737	0.02707	-24.28394	0.00000
City_Bangalore	0.21147	0.01753	12.06583	0.00000
City_Bhubaneswar	-0.11087	0.03575	-3.10117	0.00193
City_Chennai	-0.29880	0.01722	-17.34851	0.00000
City_Coimbatore	-0.55622	0.02923	-19.02808	0.00000
City_Faridabad	0.28908	0.03935	7.34641	0.00000
City_Ghaziabad	0.11589	0.02451	4.72898	0.00000
City_Greater Noida	0.13445	0.02240	6.00222	0.00000
City_Gurgaon	1.02280	0.02043	50.06935	0.00000
City_Hyderabad	-0.04959	0.01679	-2.95370	0.00314
City_Indore	-0.39726	0.03882	-10.23428	0.00000
City_Jaipur	-0.41462	0.02539	-16.32721	0.00000
City_Kalyan	-0.13304	0.02405	-5.53305	0.00000
City_Kolkata	-0.22999	0.01526	-15.07601	0.00000
City_Lucknow	-0.56474	0.03437	-16.43071	0.00000
City_Mohali	-0.17933	0.02078	-8.63207	0.00000
City_Mumbai	0.68038	0.01629	41.77921	0.00000
City_Nagpur	-0.67103	0.02892	-23.20548	0.00000
City_Nashik	-0.56038	0.02372	-23.62709	0.00000
City_Navi Mumbai	0.12923	0.01999	6.46604	0.00000
City_New Delhi	0.41522	0.02951	14.06859	0.00000
City_Noida	0.40678	0.03036	13.40054	0.00000
City_Other	-0.34174	0.01583	-21.58599	0.00000
City_Pune	0.06210	0.01417	4.38245	0.00001
City_Raipur	-0.93499	0.04853	-19.26672	0.00000
City_Secunderabad	-0.06189	0.03760	-1.64579	0.09981
City_Surat	-0.31199	0.03598	-8.67235	0.00000
City_Thane	-0.02091	0.01682	-1.24284	0.21393
City_Vadodara	-0.43025	0.03092	-13.91418	0.00000
City_Visakhapatnam	-0.36160	0.03930	-9.20020	0.00000
PropType_Apartment	0.11774	0.09064	1.29890	0.19398
PropType_Builder Floor	0.18906	0.09085	2.08102	0.03743
PropType_Bungalow	0.48802	0.09471	5.15279	0.00000
PropType_Condo	0.15781	0.18771	0.84073	0.40050
PropType_Duplex	0.42158	0.09079	4.64354	0.00000
PropType_Farm House	0.56756	0.09651	5.88061	0.00000
PropType_Independent Floor	0.01602	0.09067	0.17668	0.85976
PropType_Independent House	0.31523	0.09062	3.47857	0.00050
PropType_Penthouse	0.46434	0.09076	5.11632	0.00000
PropType_Plot	0.66833	0.09038	7.39454	0.00000
PropType_Row House	0.33529	0.09315	3.59923	0.00032
PropType_Serviced Apartment	-0.31447	0.10759	-2.92285	0.00347
PropType_Studio	-0.11234	0.09286	-1.20975	0.22638
PropType_Studio Apartment	-0.21673	0.09106	-2.38016	0.01730
PropType_Triplex	0.48687	0.12162	4.00338	0.00006
PropType_Villa	0.63783	0.09059	7.04077	0.00000
PropType_Villament	0.35914	0.09283	3.86884	0.00011
Furnish_Fully Furnished	0.10369	0.00227	45.67587	0.00000
Furnish_Semi-Furnished	0.01434	0.00132	10.83840	0.00000
Furnish_Unfurnished	0.00830	0.00125	6.61518	0.00000
Rera_1.0	0.20997	0.00260	80.82158	0.00000
Rera_Missing	0.21080	0.00298	70.79393	0.00000
lambda	0.87774	0.00143	612.29609	0.00000

============================ END OF REPORT ===

```
================================================================================
MINING COVERAGE EFFECTS
================================================================================
Coefficient:      -0.003569
Std. Error:       0.006489
P-value:          0.582254
Impact:           -0.36% per 1pp mining coverage


Spatial error (): 0.877740
Pseudo R²:        0.3637
```

1.1.6   3km Radius - Machine Learning Results

```
================================================================================
ML ANALYSIS - HARMONIZED VERSION (FIXED) (Radius: 3.0km)
Date: 2026-02-04 11:37:24
================================================================================

FIXES IMPLEMENTED:
--------------------------------------------------------------------------------
 NO data leakage: City selection from TRAINING set only
 STANDARDIZED: Outlier removal BEFORE GeoDataFrame
 ERROR HANDLING: Geometry operations protected
 Imputation using TRAINING statistics only
 All feature engineering respects train/test boundary
 AUTO-DROP: Variables with >25% missing data excluded
 HYPERPARAMETER TUNING: GridSearchCV on XGBoost, RF, GB


HARMONIZATION:
--------------------------------------------------------------------------------
 Feature set IDENTICAL to lm_test.py, spatial_sdm_CORRECTED.py, final_CORRECTED.py
 Same 9 continuous variables across ALL analyses
 Top 30 cities (selected from training data only)


1. PREDICTIVE MODELS
--------------------------------------------------------------------------------
Model                 MAE           RMSE          R²
--------------------------------------------------------------------------------
XGBoost               0.272070      0.393293      0.8389
Random Forest         0.332190      0.468142      0.7718
Extra Trees           0.429521      0.582575      0.6466
Gradient Boosting     0.307000      0.433123      0.8047
LightGBM              0.343917      0.478622      0.7615
CatBoost              0.349735      0.485073      0.7550
Neural Network        0.334420      0.650266      0.5597
Ridge                 0.537417      0.731659      0.4426
Lasso                 0.541736      0.735699      0.4364
ElasticNet            0.539452      0.733203      0.4402


2. TOP 20 FEATURES
--------------------------------------------------------------------------------
  Area_Sqft                        : 140.281702
  Landmark_Mall                    : 84.678278
  Landmark_Restaurant              : 81.437615
  Landmark_Hospital                : 79.152488
  Landmark_School                  : 71.546150
  Num_Bedrooms                     : 66.294350
```

```
Mining_Coverage_Percent             : 54.119792
PropType_Plot                       : 42.911467
Rera_1.0                            : 28.301536
City_Mumbai                         : 26.529159
PropType_Apartment                  : 19.822529
City_Navi Mumbai                    : 17.250408
City_Gurgaon                        : 16.886920
City_Other                          : 15.867396
City_Thane                          : 15.737125
City_Pune                           : 15.450616
City_Kolkata                        : 14.254817
City_New Delhi                      : 12.564394
Rera_Missing                        : 12.299933
City_Greater Noida                  : 12.225021


3. HETEROGENEOUS EFFECTS (PARTIAL DEPENDENCE - FIXED)
--------------------------------------------------------------------------------
Effect across mining coverage range, controlling for:
  - Property size, bedrooms, bathrooms, balconies
  - Nearby amenities (schools, hospitals, restaurants, malls)
  - City location (top 30 cities from training set)
  - Property type, furnishing, RERA status
  - All other property characteristics
--------------------------------------------------------------------------------
Bungalow          :    6.87% (n=   615)
Studio            :    2.29% (n=   743)
Plot              :    0.36% (n=215,333)
Villa             :   -0.06% (n=54,536)
Row House         :   -1.31% (n=   497)
Triplex           :   -3.05% (n=   177)
Duplex            :   -3.17% (n= 6,865)
Agricultural Land :   -4.31% (n=    83)
Studio Apartment  :   -5.01% (n= 1,506)
Independent House :   -5.20% (n=64,700)
Villament         :   -6.14% (n=   150)
Builder Floor     :  -10.87% (n= 6,410)
Apartment         :  -12.66% (n=884,745)
Farm House        :  -16.00% (n=   852)


================================================================================
NOTES:
================================================================================
This analysis uses IDENTICAL feature engineering to:
  - lm_test.py (OLS with LM diagnostics)
  - spatial_sdm_CORRECTED.py (spatial econometric models)
  - final_CORRECTED.py (OLS + PSM pipeline)

CRITICAL: All feature engineering respects train/test boundary.
City selection uses TRAINING set only to prevent data leakage.
Results are directly comparable across all methodologies.
```

1.1.7   5km Radius - OLS Results

```
================================================================================
BASELINE OLS HEDONIC REGRESSION (Radius: 5.0km)
CORRECTED VERSION - Matches other analyses
Sample: 1,602,159 observations
================================================================================
```

```
                              OLS Regression Results
==============================================================================
Dep. Variable:             Log_Price   R-squared:                      0.440
Model:                           OLS   Adj. R-squared:                 0.440
Method:                Least Squares   F-statistic:                 2.135e+04
Date:               Tue, 03 Feb 2026   Prob (F-statistic):              0.00
Time:                       17:39:51   Log-Likelihood:            -1.7794e+06
No. Observations:            1602159   AIC:                         3.559e+06
Df Residuals:                1602099   BIC:                         3.560e+06
Df Model:                         59
Covariance Type:           nonrobust
===============================================================================
                            coef    std err          t      P>|t|      [0.025      0.975]
-------------------------------------------------------------------------------
const                    14.0893      0.072    195.273      0.000      13.948      14.231
Mining_Coverage_Percent   0.0053      0.002      3.081      0.002       0.002       0.009
Area_Sqft                1.83e-05   1.09e-07    168.248      0.000    1.81e-05    1.85e-05
Num_Bedrooms              0.4455      0.001    684.760      0.000       0.444       0.447
Landmark_School          -0.0216      0.000    -45.947      0.000      -0.023      -0.021
Landmark_Hospital         0.0045      0.000     10.259      0.000       0.004       0.005
Landmark_Restaurant      -0.0275      0.000    -63.892      0.000      -0.028      -0.027
Landmark_Mall            -0.0149      0.000    -31.176      0.000      -0.016      -0.014
City_Badlapur            -0.5380      0.008    -64.810      0.000      -0.554      -0.522
City_Bangalore            0.4187      0.004    108.244      0.000       0.411       0.426
City_Bhubaneswar          0.0362      0.007      4.969      0.000       0.022       0.050
City_Chennai              0.0292      0.004      7.651      0.000       0.022       0.037
City_Coimbatore          -0.1427      0.006    -25.883      0.000      -0.154      -0.132
City_Faridabad            0.5456      0.007     79.265      0.000       0.532       0.559
City_Ghaziabad            0.1865      0.005     35.053      0.000       0.176       0.197
City_Greater Noida        0.3331      0.005     67.897      0.000       0.323       0.343
City_Gurgaon              1.1116      0.004    254.421      0.000       1.103       1.120
City_Hyderabad            0.1972      0.004     52.530      0.000       0.190       0.205
City_Indore               0.1180      0.007     17.922      0.000       0.105       0.131
City_Jaipur              -0.2356      0.005    -48.738      0.000      -0.245      -0.226
City_Kalyan               0.0118      0.008      1.409      0.159      -0.005       0.028
City_Kolkata             -0.1904      0.004    -52.264      0.000      -0.198      -0.183
City_Lucknow             -0.1766      0.006    -30.843      0.000      -0.188      -0.165
City_Mohali               0.2528      0.007     33.738      0.000       0.238       0.267
City_Mumbai               0.8376      0.004    215.210      0.000       0.830       0.845
City_Nagpur              -0.3414      0.006    -57.438      0.000      -0.353      -0.330
City_Nashik              -0.4672      0.007    -71.504      0.000      -0.480      -0.454
City_Navi Mumbai          0.2482      0.005     49.026      0.000       0.238       0.258
City_New Delhi            0.4868      0.005     89.812      0.000       0.476       0.497
City_Noida                0.4380      0.006     77.421      0.000       0.427       0.449
City_Other               -0.1442      0.003    -42.086      0.000      -0.151      -0.137
City_Pune                 0.1497      0.003     43.348      0.000       0.143       0.156
City_Raipur              -0.3736      0.009    -41.504      0.000      -0.391      -0.356
City_Secunderabad         0.1384      0.008     16.594      0.000       0.122       0.155
City_Surat               -0.2503      0.008    -31.796      0.000      -0.266      -0.235
City_Thane                0.1305      0.004     30.371      0.000       0.122       0.139
City_Vadodara            -0.4151      0.007    -58.964      0.000      -0.429      -0.401
City_Visakhapatnam       -0.1747      0.008    -22.259      0.000      -0.190      -0.159
PropType_Apartment        0.4021      0.072      5.579      0.000       0.261       0.543
PropType_Builder Floor    0.3263      0.073      4.497      0.000       0.184       0.469
PropType_Bungalow         0.3319      0.077      4.319      0.000       0.181       0.482
PropType_Condo            0.7619      0.524      1.453      0.146      -0.266       1.790
PropType_Duplex           0.4887      0.073      6.740      0.000       0.347       0.631
PropType_Farm House       0.3714      0.075      4.921      0.000       0.223       0.519
```

14

```
PropType_Independent Floor      0.1750      0.072       2.425      0.015       0.034      0.316
PropType_Independent House      0.0775      0.072       1.075      0.282      -0.064      0.219
PropType_Penthouse              0.9507      0.073      13.018      0.000       0.808      1.094
PropType_Plot                   0.4295      0.072       5.959      0.000       0.288      0.571
PropType_Row House              0.2252      0.078       2.892      0.004       0.073      0.378
PropType_Serviced Apartment     0.3428      0.134       2.551      0.011       0.079      0.606
PropType_Studio                 0.2865      0.076       3.773      0.000       0.138      0.435
PropType_Studio Apartment       0.1986      0.074       2.683      0.007       0.054      0.344
PropType_Triplex                0.8633      0.087       9.962      0.000       0.693      1.033
PropType_Villa                  0.6299      0.072       8.735      0.000       0.489      0.771
PropType_Villament              0.8774      0.090       9.778      0.000       0.702      1.053
Furnish_Fully Furnished         0.1124      0.003      36.072      0.000       0.106      0.119
Furnish_Semi-Furnished          0.0176      0.002       8.644      0.000       0.014      0.022
Furnish_Unfurnished             0.0011      0.002       0.573      0.566      -0.003      0.005
Rera_1.0                        0.2666      0.001     179.346      0.000       0.264      0.270
Rera_Missing                    0.3580      0.002     175.709      0.000       0.354      0.362
==============================================================================
Omnibus:                   285249.325   Durbin-Watson:                   0.943
Prob(Omnibus):                  0.000   Jarque-Bera (JB):         7150947.730
Skew:                          -0.087   Prob(JB):                         0.00
Kurtosis:                      13.348   Cond. No.                     5.08e+06
==============================================================================
```

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
[2] The condition number is large, 5.08e+06. This might indicate that there are
strong multicollinearity or other numerical problems.

1.1.8   5km Radius - PSM Results

```
==============================================================================
PROPENSITY SCORE MATCHING RESULTS (Radius: 5.0km)
==============================================================================

ROBUSTNESS ACROSS TREATMENT THRESHOLDS
------------------------------------------------------------------------------

THRESHOLD: Mining coverage > 0.3%
------------------------------------------------------------------------------
Treated units: 155,191
Control units: 1,446,968
Matched pairs: 155,191
Match rate: 100.0%

AVERAGE TREATMENT EFFECT ON TREATED (ATT):
  ATT: 11.25%
  Standard Error: 0.34%
  95% CI: [10.53%, 11.93%]

Interpretation: Properties near mines (>0.3% coverage) are
11.25% more expensive than similar properties not near mines.


==============================================================================

THRESHOLD: Mining coverage > 0.5%
------------------------------------------------------------------------------
Treated units: 102,407
Control units: 1,499,752
```

```
Matched pairs: 102,407
Match rate: 100.0%

AVERAGE TREATMENT EFFECT ON TREATED (ATT):
  ATT: 19.52%
  Standard Error: 0.43%
  95% CI: [18.71%, 20.30%]

Interpretation: Properties near mines (>0.5% coverage) are
19.52% more expensive than similar properties not near mines.

===============================================================================

THRESHOLD: Mining coverage > 1.0%
-------------------------------------------------------------------------------
Treated units: 42,355
Control units: 1,559,804
Matched pairs: 42,355
Match rate: 100.0%

AVERAGE TREATMENT EFFECT ON TREATED (ATT):
  ATT: 14.35%
  Standard Error: 0.76%
  95% CI: [12.90%, 15.84%]

Interpretation: Properties near mines (>1.0% coverage) are
14.35% more expensive than similar properties not near mines.

===============================================================================

THRESHOLD: Mining coverage > 2.0%
-------------------------------------------------------------------------------
Treated units: 24,678
Control units: 1,577,481
Matched pairs: 24,678
Match rate: 100.0%

AVERAGE TREATMENT EFFECT ON TREATED (ATT):
  ATT: 13.24%
  Standard Error: 0.91%
  95% CI: [11.28%, 14.79%]

Interpretation: Properties near mines (>2.0% coverage) are
13.24% more expensive than similar properties not near mines.

===============================================================================


SUMMARY TABLE
-------------------------------------------------------------------------------

Threshold    Treated     Matched     ATT        95% CI
-------------------------------------------------------------------------------

0.3%         155,191     155,191     11.25      % [10.53%, 11.93%]
0.5%         102,407     102,407     19.52      % [18.71%, 20.30%]
1.0%         42,355      42,355      14.35      % [12.90%, 15.84%]
2.0%         24,678      24,678      13.24      % [11.28%, 14.79%]

-------------------------------------------------------------------------------


NOTES:
```

- Method: 1:1 Nearest Neighbor Matching with caliper=0.1
- Standard errors computed via bootstrap (200 iterations)
- All matches achieved within caliper threshold

1.1.9   5km Radius - SAC Model

```
================================================================================
SAC (SPATIAL AUTOREGRESSIVE COMBINED) - PRIMARY MODEL
Radius: 5.0km | Sample: 1,602,159 obs
================================================================================


MODEL SPECIFICATION:
--------------------------------------------------------------------------------
y = W*y + X* + u
u = W*u +


Where:
  y = Log(Price)
   = Spatial lag coefficient (spillover effects)
   = Spatial error coefficient (correlated shocks)
  W = 8-nearest neighbors matrix (row-standardized)


REGRESSION RESULTS
------------------


SUMMARY OF OUTPUT: SPATIALLY WEIGHTED 2SLS- GM-COMBO MODEL (HET)
----------------------------------------------------------------
Data set          :     unknown
Weights matrix    :     unknown
Dependent Variable :   Log_Price        Number of Observations:    1602159
Mean dependent var :   15.7453          Number of Variables   :         61
S.D. dependent var :    0.9819          Degrees of Freedom    :    1602098
Pseudo R-squared   :    0.7667
Spatial Pseudo R-squared:  0.4128
N. of iterations   :         1          Step1c computed       :         No


------------------------------------------------------------------------------
         Variable    Coefficient     Std.Error     z-Statistic    Probability
------------------------------------------------------------------------------
         CONSTANT        5.35985       0.10343       51.81954        0.00000
Mining_Coverage_Percent   0.02291     0.00288        7.94314        0.00000
         Area_Sqft        0.00001      0.00000        7.50902        0.00000
       Num_Bedrooms       0.28963      0.00116      249.84196        0.00000
    Landmark_School      -0.01145      0.00072      -15.97704        0.00000
   Landmark_Hospital      0.00067      0.00066        1.01712        0.30909
  Landmark_Restaurant    -0.01120      0.00066      -16.91215        0.00000
      Landmark_Mall      -0.00643      0.00071       -9.02127        0.00000
       City_Badlapur     -0.04440      0.00835       -5.31539        0.00000
      City_Bangalore      0.13923      0.00587       23.73455        0.00000
    City_Bhubaneswar     -0.02576      0.01146       -2.24835        0.02455
       City_Chennai      -0.05838      0.00609       -9.59156        0.00000
     City_Coimbatore     -0.18909      0.01004      -18.83201        0.00000
      City_Faridabad      0.13844      0.01206       11.47427        0.00000
      City_Ghaziabad      0.07731      0.00794        9.73155        0.00000
  City_Greater Noida      0.10243      0.00759       13.50049        0.00000
       City_Gurgaon       0.41496      0.00712       58.25427        0.00000
      City_Hyderabad     -0.01494      0.00572       -2.61064        0.00904
        City_Indore      -0.07878      0.01380       -5.70893        0.00000
```

City_Jaipur	-0.18295	0.00854	-21.42083	0.00000
City_Kalyan	0.15370	0.00879	17.47985	0.00000
City_Kolkata	-0.05034	0.00524	-9.60673	0.00000
City_Lucknow	-0.20224	0.01142	-17.70708	0.00000
City_Mohali	0.01967	0.01043	1.88526	0.05939
City_Mumbai	0.44902	0.00539	83.35073	0.00000
City_Nagpur	-0.23582	0.00991	-23.80709	0.00000
City_Nashik	-0.11042	0.00835	-13.22020	0.00000
City_Navi Mumbai	0.21340	0.00756	28.23396	0.00000
City_New Delhi	0.21631	0.00962	22.47898	0.00000
City_Noida	0.19938	0.00984	20.25995	0.00000
City_Other	-0.08952	0.00553	-16.18224	0.00000
City_Pune	0.14005	0.00483	29.00729	0.00000
City_Raipur	-0.33670	0.01623	-20.75126	0.00000
City_Secunderabad	-0.04224	0.01413	-2.98843	0.00280
City_Surat	-0.12095	0.01237	-9.77747	0.00000
City_Thane	0.19000	0.00577	32.94193	0.00000
City_Vadodara	-0.22538	0.01068	-21.09475	0.00000
City_Visakhapatnam	-0.08037	0.01322	-6.07989	0.00000
PropType_Apartment	0.32485	0.09430	3.44470	0.00057
PropType_Builder Floor	0.35289	0.09446	3.73595	0.00019
PropType_Bungalow	0.55307	0.09744	5.67573	0.00000
PropType_Condo	0.21149	0.14559	1.45262	0.14633
PropType_Duplex	0.57555	0.09445	6.09366	0.00000
PropType_Farm House	0.68154	0.10000	6.81515	0.00000
PropType_Independent Floor	0.18214	0.09434	1.93065	0.05353
PropType_Independent House	0.44566	0.09432	4.72489	0.00000
PropType_Penthouse	0.68556	0.09438	7.26409	0.00000
PropType_Plot	0.70672	0.09405	7.51446	0.00000
PropType_Row House	0.44128	0.09648	4.57366	0.00000
PropType_Serviced Apartment	-0.10054	0.11820	-0.85059	0.39500
PropType_Studio	0.07766	0.09652	0.80458	0.42106
PropType_Studio Apartment	0.01189	0.09471	0.12559	0.90006
PropType_Triplex	0.59655	0.12153	4.90844	0.00000
PropType_Villa	0.71085	0.09425	7.54241	0.00000
PropType_Villament	0.52942	0.09628	5.49890	0.00000
Furnish_Fully Furnished	0.08253	0.00231	35.71302	0.00000
Furnish_Semi-Furnished	-0.00705	0.00131	-5.37141	0.00000
Furnish_Unfurnished	-0.01251	0.00124	-10.05532	0.00000
Rera_1.0	0.15866	0.00179	88.48625	0.00000
Rera_Missing	0.18884	0.00250	75.58785	0.00000
W_Log_Price	0.58346	0.00262	222.31384	0.00000
lambda	0.62592	0.00333	187.83451	0.00000

Instrumented: W_Log_Price
Instruments: W_Area_Sqft, W_City_Badlapur, W_City_Bangalore,
W_City_Bhubaneswar , W_City_Chennai, W_City_Coimbatore,
W_City_Faridabad, W_City_Ghaziabad, W_City_Greater Noida,
W_City_Gurgaon, W_City_Hyderabad, W_City_Indore, W_City_Jaipur,
W_City_Kalyan, W_City_Kolkata, W_City_Lucknow, W_City_Mohali,
W_City_Mumbai, W_City_Nagpur, W_City_Nashik, W_City_Navi
Mumbai, W_City_New Delhi, W_City_Noida, W_City_Other,
W_City_Pune, W_City_Raipur , W_City_Secunderabad, W_City_Surat,
W_City_Thane, W_City_Vadodara, W_City_Visakhapatnam,
W_Furnish_Fully Furnished, W_Furnish_Semi-Furnished,
W_Furnish_Unfurnished, W_Landmark_Hospital, W_Landmark_Mall,
W_Landmark_Restaurant, W_Landmark_School,
W_Mining_Coverage_Percent, W_Num_Bedrooms,
W_PropType_Apartment, W_PropType_Builder Floor,

```
                    W_PropType_Bungalow, W_PropType_Condo, W_PropType_Duplex,
                    W_PropType_Farm House, W_PropType_Independent Floor,
                    W_PropType_Independent House, W_PropType_Penthouse,
                    W_PropType_Plot, W_PropType_Row House, W_PropType_Serviced
                    Apartment, W_PropType_Studio, W_PropType_Studio Apartment,
                    W_PropType_Triplex, W_PropType_Villa, W_PropType_Villament,
                    W_Rera_1.0, W_Rera_Missing
=============================== END OF REPORT ======================================


================================================================================
MINING COVERAGE EFFECTS
================================================================================
Coefficient:      0.022914
Std. Error:       0.002885
P-value:          0.000000
Impact:           2.32% per 1pp mining coverage


Spatial lag (): 0.583459
Spatial error (): 0.625924
Pseudo R²:        0.7667
```

1.1.10   5km Radius - SAR Model (Robustness)

```
================================================================================
SAR (SPATIAL LAG) - ROBUSTNESS CHECK
Radius: 5.0km | Sample: 1,602,159 obs
================================================================================


MODEL SPECIFICATION:
--------------------------------------------------------------------------------
y = W*y + X* +

Where:
  y = Log(Price)
   = Spatial lag coefficient (spillover effects only)
  W = 8-nearest neighbors matrix (row-standardized)
  Estimation: GM (Generalized Method of Moments)


REGRESSION RESULTS
------------------


SUMMARY OF OUTPUT: SPATIAL TWO STAGE LEAST SQUARES
-------------------------------------------------
Data set            :      unknown
Weights matrix      :      unknown
Dependent Variable  :   Log_Price         Number of Observations:    1602159
Mean dependent var  :    15.7453          Number of Variables   :         61
S.D. dependent var  :     0.9819          Degrees of Freedom    :    1602098
Pseudo R-squared    :     0.7721
Spatial Pseudo R-squared:  0.4815


--------------------------------------------------------------------------------
           Variable    Coefficient      Std.Error      z-Statistic     Probability
--------------------------------------------------------------------------------
           CONSTANT        5.68961        0.04918        115.68028        0.00000
Mining_Coverage_Percent    0.01248        0.00111         11.19266        0.00000
           Area_Sqft        0.00001        0.00000        186.88600        0.00000
        Num_Bedrooms        0.28864        0.00050        574.31328        0.00000
```

Landmark_School	-0.00769	0.00031	-25.04539	0.00000
Landmark_Hospital	0.00129	0.00029	4.50537	0.00001
Landmark_Restaurant	-0.01017	0.00028	-36.03869	0.00000
Landmark_Mall	-0.00520	0.00031	-16.61263	0.00000
City_Badlapur	-0.08327	0.00546	-15.23628	0.00000
City_Bangalore	0.18418	0.00255	72.15740	0.00000
City_Bhubaneswar	0.00813	0.00475	1.71247	0.08681
City_Chennai	0.02923	0.00249	11.74081	0.00000
City_Coimbatore	-0.06324	0.00360	-17.59151	0.00000
City_Faridabad	0.22636	0.00452	50.09788	0.00000
City_Ghaziabad	0.09279	0.00347	26.73857	0.00000
City_Greater Noida	0.15023	0.00321	46.77592	0.00000
City_Gurgaon	0.45636	0.00306	149.03586	0.00000
City_Hyderabad	0.06774	0.00246	27.58172	0.00000
City_Indore	0.06957	0.00429	16.21184	0.00000
City_Jaipur	-0.12399	0.00316	-39.29558	0.00000
City_Kalyan	0.13308	0.00545	24.40823	0.00000
City_Kolkata	-0.06328	0.00238	-26.54670	0.00000
City_Lucknow	-0.08858	0.00373	-23.72787	0.00000
City_Mohali	0.09555	0.00489	19.54282	0.00000
City_Mumbai	0.44637	0.00262	170.13135	0.00000
City_Nagpur	-0.14286	0.00389	-36.75259	0.00000
City_Nashik	-0.12961	0.00430	-30.16843	0.00000
City_Navi Mumbai	0.20103	0.00330	60.94237	0.00000
City_New Delhi	0.22564	0.00356	63.38928	0.00000
City_Noida	0.19642	0.00371	52.95364	0.00000
City_Other	-0.03991	0.00224	-17.81804	0.00000
City_Pune	0.12861	0.00225	57.15040	0.00000
City_Raipur	-0.16489	0.00588	-28.06496	0.00000
City_Secunderabad	0.03084	0.00544	5.67155	0.00000
City_Surat	-0.10840	0.00513	-21.11302	0.00000
City_Thane	0.16993	0.00280	60.67809	0.00000
City_Vadodara	-0.21273	0.00460	-46.24939	0.00000
City_Visakhapatnam	-0.04443	0.00512	-8.68107	0.00000
PropType_Apartment	0.24128	0.04695	5.13871	0.00000
PropType_Builder Floor	0.19963	0.04728	4.22265	0.00002
PropType_Bungalow	0.24571	0.05006	4.90788	0.00000
PropType_Condo	0.17650	0.34171	0.51650	0.60550
PropType_Duplex	0.38915	0.04724	8.23722	0.00000
PropType_Farm House	0.45905	0.04917	9.33591	0.00000
PropType_Independent Floor	0.06886	0.04702	1.46432	0.14311
PropType_Independent House	0.18081	0.04700	3.84721	0.00012
PropType_Penthouse	0.61757	0.04758	12.97899	0.00000
PropType_Plot	0.36789	0.04696	7.83451	0.00000
PropType_Row House	0.18830	0.05074	3.71146	0.00021
PropType_Serviced Apartment	0.14794	0.08754	1.68994	0.09104
PropType_Studio	0.07342	0.04947	1.48412	0.13778
PropType_Studio Apartment	0.04520	0.04821	0.93763	0.34843
PropType_Triplex	0.45690	0.05647	8.09128	0.00000
PropType_Villa	0.42711	0.04699	9.08979	0.00000
PropType_Villament	0.44228	0.05847	7.56456	0.00000
Furnish_Fully Furnished	0.07485	0.00203	36.84368	0.00000
Furnish_Semi-Furnished	-0.01096	0.00132	-8.27457	0.00000
Furnish_Unfurnished	-0.01932	0.00125	-15.41016	0.00000
Rera_1.0	0.13415	0.00100	134.81239	0.00000
Rera_Missing	0.19804	0.00136	146.07159	0.00000
W_Log_Price	0.56986	0.00098	580.63494	0.00000

Instrumented: W_Log_Price

```
Instruments: W_Area_Sqft, W_City_Badlapur, W_City_Bangalore,
             W_City_Bhubaneswar , W_City_Chennai, W_City_Coimbatore,
             W_City_Faridabad, W_City_Ghaziabad, W_City_Greater Noida,
             W_City_Gurgaon, W_City_Hyderabad, W_City_Indore, W_City_Jaipur,
             W_City_Kalyan, W_City_Kolkata, W_City_Lucknow, W_City_Mohali,
             W_City_Mumbai, W_City_Nagpur, W_City_Nashik, W_City_Navi
             Mumbai, W_City_New Delhi, W_City_Noida, W_City_Other,
             W_City_Pune, W_City_Raipur , W_City_Secunderabad, W_City_Surat,
             W_City_Thane, W_City_Vadodara, W_City_Visakhapatnam,
             W_Furnish_Fully Furnished, W_Furnish_Semi-Furnished,
             W_Furnish_Unfurnished, W_Landmark_Hospital, W_Landmark_Mall,
             W_Landmark_Restaurant, W_Landmark_School,
             W_Mining_Coverage_Percent, W_Num_Bedrooms,
             W_PropType_Apartment, W_PropType_Builder Floor,
             W_PropType_Bungalow, W_PropType_Condo, W_PropType_Duplex,
             W_PropType_Farm House, W_PropType_Independent Floor,
             W_PropType_Independent House, W_PropType_Penthouse,
             W_PropType_Plot, W_PropType_Row House, W_PropType_Serviced
             Apartment, W_PropType_Studio, W_PropType_Studio Apartment,
             W_PropType_Triplex, W_PropType_Villa, W_PropType_Villament,
             W_Rera_1.0, W_Rera_Missing
```

```
DIAGNOSTICS FOR SPATIAL DEPENDENCE
TEST                          DF        VALUE          PROB
Anselin-Kelejian Test          1      43302.009        0.0000


SPATIAL LAG MODEL IMPACTS
Impacts computed using the 'simple' method.
            Variable        Direct      Indirect        Total
Mining_Coverage_Percent      0.0125       0.0165         0.0290
            Area_Sqft        0.0000       0.0000         0.0000
         Num_Bedrooms        0.2886       0.3824         0.6711
      Landmark_School       -0.0077      -0.0102        -0.0179
     Landmark_Hospital       0.0013       0.0017         0.0030
   Landmark_Restaurant      -0.0102      -0.0135        -0.0236
        Landmark_Mall       -0.0052      -0.0069        -0.0121
         City_Badlapur      -0.0833      -0.1103        -0.1936
        City_Bangalore       0.1842       0.2440         0.4282
      City_Bhubaneswar       0.0081       0.0108         0.0189
          City_Chennai       0.0292       0.0387         0.0679
       City_Coimbatore      -0.0632      -0.0838        -0.1470
        City_Faridabad       0.2264       0.2999         0.5262
        City_Ghaziabad       0.0928       0.1229         0.2157
    City_Greater Noida       0.1502       0.1990         0.3493
          City_Gurgaon       0.4564       0.6046         1.0610
        City_Hyderabad       0.0677       0.0897         0.1575
           City_Indore       0.0696       0.0922         0.1617
           City_Jaipur      -0.1240      -0.1643        -0.2883
           City_Kalyan       0.1331       0.1763         0.3094
          City_Kolkata      -0.0633      -0.0838        -0.1471
          City_Lucknow      -0.0886      -0.1174        -0.2059
           City_Mohali       0.0956       0.1266         0.2222
           City_Mumbai       0.4464       0.5914         1.0377
           City_Nagpur      -0.1429      -0.1893        -0.3321
           City_Nashik      -0.1296      -0.1717        -0.3013
      City_Navi Mumbai       0.2010       0.2663         0.4674
        City_New Delhi       0.2256       0.2989         0.5246
            City_Noida       0.1964       0.2602         0.4566
            City_Other      -0.0399      -0.0529        -0.0928
```

```
          City_Pune            0.1286          0.1704          0.2990
        City_Raipur           -0.1649         -0.2184         -0.3833
   City_Secunderabad           0.0308          0.0409          0.0717
          City_Surat          -0.1084         -0.1436         -0.2520
          City_Thane           0.1699          0.2251          0.3951
       City_Vadodara          -0.2127         -0.2818         -0.4946
  City_Visakhapatnam          -0.0444         -0.0589         -0.1033
  PropType_Apartment           0.2413          0.3197          0.5609
PropType_Builder Floor         0.1996          0.2645          0.4641
   PropType_Bungalow           0.2457          0.3255          0.5712
       PropType_Condo           0.1765          0.2338          0.4103
      PropType_Duplex          0.3892          0.5156          0.9047
  PropType_Farm House          0.4590          0.6082          1.0672
PropType_Independent Floor     0.0689          0.0912          0.1601
PropType_Independent House     0.1808          0.2395          0.4204
   PropType_Penthouse          0.6176          0.8182          1.4358
        PropType_Plot          0.3679          0.4874          0.8553
   PropType_Row House          0.1883          0.2495          0.4378
PropType_Serviced Apartment    0.1479          0.1960          0.3439
       PropType_Studio          0.0734          0.0973          0.1707
PropType_Studio Apartment      0.0452          0.0599          0.1051
     PropType_Triplex          0.4569          0.6053          1.0622
        PropType_Villa          0.4271          0.5659          0.9930
   PropType_Villament          0.4423          0.5860          1.0282
Furnish_Fully Furnished        0.0748          0.0992          0.1740
Furnish_Semi-Furnished        -0.0110         -0.0145         -0.0255
 Furnish_Unfurnished          -0.0193         -0.0256         -0.0449
            Rera_1.0           0.1341          0.1777          0.3119
        Rera_Missing           0.1980          0.2624          0.4604
============================== END OF REPORT ====================================


================================================================================
MINING COVERAGE EFFECTS
================================================================================
Coefficient:    0.012479
Std. Error:     0.001115
P-value:        0.000000
Impact:         1.26% per 1pp mining coverage

Spatial lag (): 0.569864
Pseudo R²:      0.7721
```

1.1.11   5km Radius - SEM Model (Robustness)

```
================================================================================
SEM (SPATIAL ERROR) - ROBUSTNESS CHECK
Radius: 5.0km | Sample: 1,602,159 obs
================================================================================

MODEL SPECIFICATION:
--------------------------------------------------------------------------------
y = X* + u
u = W*u +

Where:
  y = Log(Price)
   = Spatial error coefficient (correlated shocks only)
  W = 8-nearest neighbors matrix (row-standardized)
```

Estimation: GM (Generalized Method of Moments) with heteroskedasticity

REGRESSION RESULTS

SUMMARY OF OUTPUT: GM SPATIALLY WEIGHTED LEAST SQUARES (HET)

Data set   :   unknown
Weights matrix   :   unknown
Dependent Variable :   Log_Price   Number of Observations: 1602159
Mean dependent var :   15.7453   Number of Variables   :   60
S.D. dependent var :   0.9819   Degrees of Freedom   :   1602099
Pseudo R-squared   :   0.3637
N. of iterations   :   1   Step1c computed   :   No

            Variable   Coefficient   Std.Error   z-Statistic   Probability
----
            CONSTANT   14.81705   0.09183   161.35963   0.00000
Mining_Coverage_Percent   0.02550   0.00932   2.73587   0.00622
            Area_Sqft   0.00001   0.00000   7.92564   0.00000
         Num_Bedrooms   0.29318   0.00110   267.66607   0.00000
      Landmark_School   -0.02060   0.00154   -13.36820   0.00000
    Landmark_Hospital   0.00118   0.00146   0.80761   0.41932
  Landmark_Restaurant   -0.02344   0.00146   -16.09079   0.00000
        Landmark_Mall   -0.01509   0.00158   -9.52487   0.00000
        City_Badlapur   -0.66409   0.02709   -24.51429   0.00000
       City_Bangalore   0.20660   0.01759   11.74425   0.00000
     City_Bhubaneswar   -0.11175   0.03575   -3.12565   0.00177
         City_Chennai   -0.30099   0.01724   -17.46163   0.00000
      City_Coimbatore   -0.55812   0.02923   -19.09274   0.00000
       City_Faridabad   0.28800   0.03936   7.31787   0.00000
       City_Ghaziabad   0.11571   0.02450   4.72201   0.00000
    City_Greater Noida   0.13442   0.02240   6.00123   0.00000
         City_Gurgaon   1.02143   0.02042   50.01735   0.00000
       City_Hyderabad   -0.05204   0.01680   -3.09686   0.00196
          City_Indore   -0.41733   0.03929   -10.62264   0.00000
          City_Jaipur   -0.41495   0.02539   -16.34061   0.00000
          City_Kalyan   -0.13596   0.02407   -5.64938   0.00000
         City_Kolkata   -0.23006   0.01526   -15.08024   0.00000
         City_Lucknow   -0.56475   0.03437   -16.43122   0.00000
          City_Mohali   -0.18106   0.02079   -8.70970   0.00000
          City_Mumbai   0.67653   0.01632   41.46317   0.00000
          City_Nagpur   -0.67164   0.02892   -23.22615   0.00000
          City_Nashik   -0.56202   0.02373   -23.68814   0.00000
     City_Navi Mumbai   0.09262   0.02248   4.11953   0.00004
       City_New Delhi   0.41526   0.02952   14.06932   0.00000
           City_Noida   0.40682   0.03036   13.40116   0.00000
           City_Other   -0.34418   0.01585   -21.71232   0.00000
            City_Pune   0.06028   0.01418   4.25060   0.00002
          City_Raipur   -0.93689   0.04853   -19.30452   0.00000
    City_Secunderabad   -0.06272   0.03760   -1.66785   0.09535
           City_Surat   -0.31208   0.03598   -8.67432   0.00000
           City_Thane   -0.02484   0.01686   -1.47326   0.14068
        City_Vadodara   -0.43021   0.03092   -13.91587   0.00000
   City_Visakhapatnam   -0.36327   0.03931   -9.24177   0.00000
    PropType_Apartment   0.11795   0.09065   1.30115   0.19321
 PropType_Builder Floor   0.18930   0.09086   2.08349   0.03721
    PropType_Bungalow   0.48840   0.09472   5.15655   0.00000

```
          PropType_Condo         0.15828        0.18767        0.84342        0.39900
         PropType_Duplex         0.42185        0.09079        4.64614        0.00000
      PropType_Farm House        0.56765        0.09652        5.88112        0.00000
 PropType_Independent Floor      0.01627        0.09068        0.17947        0.85757
 PropType_Independent House      0.31548        0.09063        3.48104        0.00050
     PropType_Penthouse         0.46457        0.09076        5.11844        0.00000
          PropType_Plot         0.66873        0.09039        7.39845        0.00000
      PropType_Row House         0.33564        0.09316        3.60277        0.00031
 PropType_Serviced Apartment    -0.31413        0.10760       -2.91948        0.00351
        PropType_Studio        -0.11215        0.09287       -1.20762        0.22719
 PropType_Studio Apartment      -0.21646        0.09106       -2.37710        0.01745
       PropType_Triplex         0.48610        0.12161        3.99705        0.00006
         PropType_Villa         0.63807        0.09060        7.04286        0.00000
      PropType_Villament        0.35954        0.09283        3.87304        0.00011
   Furnish_Fully Furnished       0.10371        0.00227       45.68687        0.00000
   Furnish_Semi-Furnished        0.01438        0.00132       10.86703        0.00000
    Furnish_Unfurnished          0.00831        0.00125        6.62192        0.00000
                 Rera_1.0        0.20989        0.00260       80.79140        0.00000
             Rera_Missing        0.21079        0.00298       70.79137        0.00000
                   lambda        0.87774        0.00143      612.28933        0.00000
------------------------------------------------------------------------------
============================== END OF REPORT ==================================


==============================================================================
MINING COVERAGE EFFECTS
==============================================================================
Coefficient:    0.025501
Std. Error:     0.009321
P-value:        0.006222
Impact:         2.58% per 1pp mining coverage

Spatial error (): 0.877737
Pseudo R²:        0.3637
```

1.1.12   5km Radius - Machine Learning Results

```
==============================================================================
ML ANALYSIS - HARMONIZED VERSION (FIXED) (Radius: 5.0km)
Date: 2026-02-04 02:18:41
==============================================================================

FIXES IMPLEMENTED:
------------------------------------------------------------------------------
 NO data leakage: City selection from TRAINING set only
 STANDARDIZED: Outlier removal BEFORE GeoDataFrame
 ERROR HANDLING: Geometry operations protected
 Imputation using TRAINING statistics only
 All feature engineering respects train/test boundary
 AUTO-DROP: Variables with >25% missing data excluded
 HYPERPARAMETER TUNING: GridSearchCV on XGBoost, RF, GB

HARMONIZATION:
------------------------------------------------------------------------------
 Feature set IDENTICAL to lm_test.py, spatial_sdm_CORRECTED.py, final_CORRECTED.py
 Same 9 continuous variables across ALL analyses
 Top 30 cities (selected from training data only)

1. PREDICTIVE MODELS
```

```
--------------------------------------------------------------------------------
Model                 MAE          RMSE         R²
--------------------------------------------------------------------------------
XGBoost               0.266051     0.387356     0.8438
Random Forest         0.327856     0.464554     0.7753
Extra Trees           0.428963     0.581592     0.6478
Gradient Boosting     0.325436     0.456467     0.7830
LightGBM              0.339452     0.474506     0.7655
CatBoost              0.346745     0.482549     0.7575
Neural Network        0.329739     0.467540     0.7724
Ridge                 0.537450     0.731651     0.4426
Lasso                 0.541736     0.735699     0.4364
ElasticNet            0.539452     0.733202     0.4402


2. TOP 20 FEATURES
--------------------------------------------------------------------------------
  Area_Sqft                      : 133.224791
  Landmark_Mall                  : 78.890151
  Mining_Coverage_Percent        : 75.678026
  Landmark_Restaurant            : 69.763734
  Landmark_Hospital              : 68.860601
  Num_Bedrooms                   : 67.584935
  Landmark_School                : 67.231602
  PropType_Plot                  : 44.263379
  Rera_1.0                       : 31.108729
  City_Mumbai                    : 28.194046
  PropType_Apartment             : 19.309746
  City_Other                     : 18.025013
  City_Pune                      : 17.639245
  City_Gurgaon                   : 16.720928
  City_Thane                     : 16.258575
  City_Navi Mumbai               : 16.218813
  City_Kolkata                   : 15.744851
  City_New Delhi                 : 12.728579
  City_Bangalore                 : 12.339864
  Rera_Missing                   : 11.972935


3. HETEROGENEOUS EFFECTS (PARTIAL DEPENDENCE - FIXED)
--------------------------------------------------------------------------------
Effect across mining coverage range, controlling for:
  - Property size, bedrooms, bathrooms, balconies
  - Nearby amenities (schools, hospitals, restaurants, malls)
  - City location (top 30 cities from training set)
  - Property type, furnishing, RERA status
  - All other property characteristics
--------------------------------------------------------------------------------
Bungalow            :   18.45% (n=   615)
Independent Floor   :    2.14% (n=41,350)
Row House           :    1.70% (n=   497)
Farm House          :   -2.36% (n=   852)
Agricultural Land   :   -3.32% (n=    83)
Apartment           :   -4.34% (n=884,745)
Plot                :   -6.10% (n=215,333)
Villament           :   -6.54% (n=   150)
Penthouse           :   -6.91% (n= 3,130)
Studio              :   -7.08% (n=   743)
Villa               :   -7.68% (n=54,536)
Studio Apartment    :   -8.37% (n= 1,506)
Triplex             :   -8.66% (n=   177)
```

```
Duplex            :    -9.16% (n= 6,865)
Independent House  :    -9.72% (n=64,700)


================================================================================
NOTES:
================================================================================
This analysis uses IDENTICAL feature engineering to:
  - lm_test.py (OLS with LM diagnostics)
  - spatial_sdm_CORRECTED.py (spatial econometric models)
  - final_CORRECTED.py (OLS + PSM pipeline)


CRITICAL: All feature engineering respects train/test boundary.
City selection uses TRAINING set only to prevent data leakage.
Results are directly comparable across all methodologies.
```

1.1.13   7km Radius - OLS Results

```
================================================================================
BASELINE OLS HEDONIC REGRESSION (Radius: 7.0km)
CORRECTED VERSION - Matches other analyses
Sample: 1,602,159 observations
================================================================================


                         OLS Regression Results
==============================================================================
Dep. Variable:          Log_Price    R-squared:                     0.440
Model:                        OLS    Adj. R-squared:                0.440
Method:             Least Squares    F-statistic:                2.135e+04
Date:            Tue, 03 Feb 2026    Prob (F-statistic):             0.00
Time:                    17:42:23    Log-Likelihood:            -1.7794e+06
No. Observations:         1602159    AIC:                        3.559e+06
Df Residuals:             1602099    BIC:                        3.560e+06
Df Model:                      59
Covariance Type:        nonrobust
==================================================================================
                            coef    std err          t      P>|t|     [0.025     0.975]
----------------------------------------------------------------------------------
const                    14.0892      0.072    195.274      0.000     13.948     14.231
Mining_Coverage_Percent   0.0171      0.002      6.857      0.000      0.012      0.022
Area_Sqft               1.83e-05   1.09e-07    168.242      0.000   1.81e-05   1.85e-05
Num_Bedrooms              0.4456      0.001    684.788      0.000      0.444      0.447
Landmark_School          -0.0216      0.000    -45.909      0.000     -0.022     -0.021
Landmark_Hospital         0.0045      0.000     10.232      0.000      0.004      0.005
Landmark_Restaurant      -0.0276      0.000    -64.014      0.000     -0.028     -0.027
Landmark_Mall            -0.0149      0.000    -31.174      0.000     -0.016     -0.014
City_Badlapur            -0.5393      0.008    -64.968      0.000     -0.556     -0.523
City_Bangalore            0.4165      0.004    107.215      0.000      0.409      0.424
City_Bhubaneswar          0.0358      0.007      4.911      0.000      0.022      0.050
City_Chennai              0.0284      0.004      7.426      0.000      0.021      0.036
City_Coimbatore          -0.1433      0.006    -25.988      0.000     -0.154     -0.132
City_Faridabad            0.5451      0.007     79.193      0.000      0.532      0.559
City_Ghaziabad            0.1864      0.005     35.037      0.000      0.176      0.197
City_Greater Noida        0.3332      0.005     67.913      0.000      0.324      0.343
City_Gurgaon              1.1104      0.004    253.894      0.000      1.102      1.119
City_Hyderabad            0.1963      0.004     52.279      0.000      0.189      0.204
City_Indore               0.1081      0.007     15.984      0.000      0.095      0.121
City_Jaipur              -0.2357      0.005    -48.766      0.000     -0.245     -0.226
City_Kalyan               0.0082      0.008      0.978      0.328     -0.008      0.025
```

```
City_Kolkata                    -0.1904    0.004    -52.258    0.000    -0.198    -0.183
City_Lucknow                    -0.1766    0.006    -30.852    0.000    -0.188    -0.165
City_Mohali                      0.2528    0.007     33.731    0.000     0.238     0.267
City_Mumbai                      0.8368    0.004    214.982    0.000     0.829     0.844
City_Nagpur                     -0.3418    0.006    -57.517    0.000    -0.353    -0.330
City_Nashik                     -0.4684    0.007    -71.661    0.000    -0.481    -0.456
City_Navi Mumbai                 0.2355    0.005     43.928    0.000     0.225     0.246
City_New Delhi                   0.4867    0.005     89.798    0.000     0.476     0.497
City_Noida                       0.4379    0.006     77.413    0.000     0.427     0.449
City_Other                      -0.1452    0.003    -42.325    0.000    -0.152    -0.138
City_Pune                        0.1489    0.003     43.086    0.000     0.142     0.156
City_Raipur                     -0.3751    0.009    -41.662    0.000    -0.393    -0.357
City_Secunderabad                0.1381    0.008     16.554    0.000     0.122     0.154
City_Surat                      -0.2503    0.008    -31.798    0.000    -0.266    -0.235
City_Thane                       0.1289    0.004     29.944    0.000     0.120     0.137
City_Vadodara                   -0.4151    0.007    -58.970    0.000    -0.429    -0.401
City_Visakhapatnam              -0.1755    0.008    -22.358    0.000    -0.191    -0.160
PropType_Apartment               0.4020    0.072      5.578    0.000     0.261     0.543
PropType_Builder Floor           0.3262    0.073      4.495    0.000     0.184     0.468
PropType_Bungalow                0.3324    0.077      4.326    0.000     0.182     0.483
PropType_Condo                   0.7628    0.524      1.454    0.146    -0.265     1.791
PropType_Duplex                  0.4888    0.073      6.741    0.000     0.347     0.631
PropType_Farm House              0.3712    0.075      4.918    0.000     0.223     0.519
PropType_Independent Floor       0.1749    0.072      2.424    0.015     0.033     0.316
PropType_Independent House       0.0774    0.072      1.073    0.283    -0.064     0.219
PropType_Penthouse               0.9508    0.073     13.021    0.000     0.808     1.094
PropType_Plot                    0.4296    0.072      5.961    0.000     0.288     0.571
PropType_Row House               0.2255    0.078      2.896    0.004     0.073     0.378
PropType_Serviced Apartment      0.3433    0.134      2.555    0.011     0.080     0.607
PropType_Studio                  0.2865    0.076      3.774    0.000     0.138     0.435
PropType_Studio Apartment        0.1984    0.074      2.681    0.007     0.053     0.343
PropType_Triplex                 0.8630    0.087      9.958    0.000     0.693     1.033
PropType_Villa                   0.6298    0.072      8.733    0.000     0.488     0.771
PropType_Villament               0.8780    0.090      9.785    0.000     0.702     1.054
Furnish_Fully Furnished          0.1123    0.003     36.048    0.000     0.106     0.118
Furnish_Semi-Furnished           0.0175    0.002      8.628    0.000     0.014     0.022
Furnish_Unfurnished              0.0010    0.002      0.517    0.605    -0.003     0.005
Rera_1.0                         0.2666    0.001    179.365    0.000     0.264     0.270
Rera_Missing                     0.3582    0.002    175.774    0.000     0.354     0.362
==============================================================================
Omnibus:                    285229.217   Durbin-Watson:                   0.943
Prob(Omnibus):                   0.000   Jarque-Bera (JB):        7149124.702
Skew:                           -0.087   Prob(JB):                         0.00
Kurtosis:                       13.347   Cond. No.                     5.08e+06
==============================================================================

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
[2] The condition number is large, 5.08e+06. This might indicate that there are
strong multicollinearity or other numerical problems.
```

1.1.14   7km Radius - PSM Results

```
==============================================================================
PROPENSITY SCORE MATCHING RESULTS (Radius: 7.0km)
==============================================================================


ROBUSTNESS ACROSS TREATMENT THRESHOLDS
```

```
--------------------------------------------------------------------------------

THRESHOLD: Mining coverage > 0.3%
--------------------------------------------------------------------------------
Treated units: 146,842
Control units: 1,455,317
Matched pairs: 146,842
Match rate: 100.0%

AVERAGE TREATMENT EFFECT ON TREATED (ATT):
  ATT: 1.39%
  Standard Error: 0.29%
  95% CI: [0.83%, 1.85%]

Interpretation: Properties near mines (>0.3% coverage) are
1.39% more expensive than similar properties not near mines.

================================================================================

THRESHOLD: Mining coverage > 0.5%
--------------------------------------------------------------------------------
Treated units: 90,728
Control units: 1,511,431
Matched pairs: 90,728
Match rate: 100.0%

AVERAGE TREATMENT EFFECT ON TREATED (ATT):
  ATT: 10.94%
  Standard Error: 0.43%
  95% CI: [10.03%, 11.76%]

Interpretation: Properties near mines (>0.5% coverage) are
10.94% more expensive than similar properties not near mines.

================================================================================

THRESHOLD: Mining coverage > 1.0%
--------------------------------------------------------------------------------
Treated units: 49,786
Control units: 1,552,373
Matched pairs: 49,786
Match rate: 100.0%

AVERAGE TREATMENT EFFECT ON TREATED (ATT):
  ATT: 18.14%
  Standard Error: 0.73%
  95% CI: [16.74%, 19.49%]

Interpretation: Properties near mines (>1.0% coverage) are
18.14% more expensive than similar properties not near mines.

================================================================================

THRESHOLD: Mining coverage > 2.0%
--------------------------------------------------------------------------------
Treated units: 5,280
Control units: 1,596,879
Matched pairs: 5,280
Match rate: 100.0%
```

AVERAGE TREATMENT EFFECT ON TREATED (ATT):
  ATT: -0.27%
  Standard Error: 1.79%
  95% CI: [-3.61%, 3.24%]

Interpretation: Properties near mines (>2.0% coverage) are
0.27% less expensive than similar properties not near mines.

==

SUMMARY TABLE

Threshold   Treated   Matched   ATT   95% CI

0.3%   146,842   146,842   1.39   % [0.83%, 1.85%]
0.5%   90,728   90,728   10.94   % [10.03%, 11.76%]
1.0%   49,786   49,786   18.14   % [16.74%, 19.49%]
2.0%   5,280   5,280   -0.27   % [-3.61%, 3.24%]

NOTES:
- Method: 1:1 Nearest Neighbor Matching with caliper=0.1
- Standard errors computed via bootstrap (200 iterations)
- All matches achieved within caliper threshold

1.1.15   7km Radius - SAC Model

==
SAC (SPATIAL AUTOREGRESSIVE COMBINED) - PRIMARY MODEL
Radius: 7.0km | Sample: 1,602,159 obs
==

MODEL SPECIFICATION:
----
y = W*y + X* + u
u = W*u +

Where:
  y = Log(Price)
   = Spatial lag coefficient (spillover effects)
   = Spatial error coefficient (correlated shocks)
  W = 8-nearest neighbors matrix (row-standardized)

REGRESSION RESULTS

SUMMARY OF OUTPUT: SPATIALLY WEIGHTED 2SLS- GM-COMBO MODEL (HET)

Data set   :   unknown
Weights matrix   :   unknown
Dependent Variable :   Log_Price   Number of Observations: 1602159
Mean dependent var :   15.7453   Number of Variables   :   61
S.D. dependent var :   0.9819   Degrees of Freedom   :   1602098
Pseudo R-squared   :   0.7668
Spatial Pseudo R-squared: 0.4128
N. of iterations   :   1   Step1c computed   :   No

```
-------------------------------------------------------------------------
          Variable     Coefficient     Std.Error    z-Statistic    Probability
-------------------------------------------------------------------------
            CONSTANT       5.35726        0.10341       51.80446       0.00000
Mining_Coverage_Percent    0.03818        0.00460        8.30642       0.00000
            Area_Sqft       0.00001        0.00000        7.50898       0.00000
          Num_Bedrooms      0.28965        0.00116      249.85432       0.00000
       Landmark_School     -0.01150        0.00072      -16.05579       0.00000
      Landmark_Hospital     0.00059        0.00066        0.89918       0.36856
    Landmark_Restaurant    -0.01133        0.00066      -17.11541       0.00000
         Landmark_Mall     -0.00627        0.00071       -8.80987       0.00000
        City_Badlapur      -0.04488        0.00835       -5.37604       0.00000
       City_Bangalore       0.13621        0.00591       23.04942       0.00000
      City_Bhubaneswar     -0.02624        0.01145       -2.29129       0.02195
          City_Chennai     -0.05921        0.00609       -9.72474       0.00000
       City_Coimbatore     -0.18942        0.01004      -18.87178       0.00000
        City_Faridabad      0.13796        0.01206       11.43912       0.00000
        City_Ghaziabad      0.07730        0.00794        9.73353       0.00000
     City_Greater Noida     0.10264        0.00758       13.53416       0.00000
          City_Gurgaon      0.41281        0.00713       57.87460       0.00000
        City_Hyderabad     -0.01576        0.00573       -2.75221       0.00592
           City_Indore     -0.09231        0.01405       -6.56899       0.00000
           City_Jaipur     -0.18291        0.00854      -21.42550       0.00000
           City_Kalyan      0.14678        0.00885       16.58364       0.00000
          City_Kolkata     -0.05023        0.00524       -9.59064       0.00000
          City_Lucknow     -0.20210        0.01142      -17.70298       0.00000
           City_Mohali      0.01942        0.01043        1.86201       0.06260
           City_Mumbai      0.44842        0.00539       83.19828       0.00000
           City_Nagpur     -0.23641        0.00990      -23.87490       0.00000
           City_Nashik     -0.11253        0.00836      -13.46447       0.00000
      City_Navi Mumbai      0.19983        0.00836       23.90888       0.00000
        City_New Delhi      0.21615        0.00962       22.47182       0.00000
            City_Noida      0.19922        0.00984       20.25315       0.00000
            City_Other     -0.09061        0.00554      -16.36547       0.00000
             City_Pune      0.13888        0.00483       28.74134       0.00000
           City_Raipur     -0.33918        0.01622      -20.90963       0.00000
     City_Secunderabad     -0.04263        0.01413       -3.01751       0.00255
            City_Surat     -0.12092        0.01236       -9.77955       0.00000
            City_Thane      0.18772        0.00579       32.42249       0.00000
          City_Vadodara    -0.22539        0.01068      -21.10481       0.00000
     City_Visakhapatnam    -0.08137        0.01322       -6.15679       0.00000
     PropType_Apartment     0.32526        0.09429        3.44948       0.00056
  PropType_Builder Floor    0.35330        0.09445        3.74076       0.00018
     PropType_Bungalow      0.55378        0.09743        5.68364       0.00000
        PropType_Condo      0.21262        0.14565        1.45985       0.14433
       PropType_Duplex      0.57597        0.09444        6.09885       0.00000
    PropType_Farm House     0.68188        0.09999        6.81936       0.00000
PropType_Independent Floor  0.18259        0.09433        1.93564       0.05291
PropType_Independent House  0.44602        0.09431        4.72915       0.00000
     PropType_Penthouse     0.68601        0.09437        7.26967       0.00000
         PropType_Plot      0.70707        0.09404        7.51905       0.00000
     PropType_Row House     0.44198        0.09647        4.58149       0.00000
PropType_Serviced Apartment -0.09995        0.11821       -0.84551       0.39783
        PropType_Studio     0.07836        0.09651        0.81194       0.41683
PropType_Studio Apartment   0.01208        0.09470        0.12761       0.89846
       PropType_Triplex     0.59754        0.12153        4.91700       0.00000
         PropType_Villa     0.71120        0.09424        7.54702       0.00000
     PropType_Villament     0.53010        0.09627        5.50655       0.00000
-------------------------------------------------------------------------
```

```
Furnish_Fully Furnished          0.08247         0.00231         35.68888         0.00000
Furnish_Semi-Furnished          -0.00708         0.00131         -5.38846         0.00000
 Furnish_Unfurnished            -0.01253         0.00124        -10.07380         0.00000
               Rera_1.0          0.15870         0.00179         88.54375         0.00000
            Rera_Missing         0.18892         0.00250         75.62744         0.00000
             W_Log_Price         0.58360         0.00262        222.47422         0.00000
                  lambda        0.62575         0.00333        187.71167         0.00000
------------------------------------------------------------------------------
Instrumented: W_Log_Price
Instruments: W_Area_Sqft, W_City_Badlapur, W_City_Bangalore,
             W_City_Bhubaneswar , W_City_Chennai, W_City_Coimbatore,
             W_City_Faridabad, W_City_Ghaziabad, W_City_Greater Noida,
             W_City_Gurgaon, W_City_Hyderabad, W_City_Indore, W_City_Jaipur,
             W_City_Kalyan, W_City_Kolkata, W_City_Lucknow, W_City_Mohali,
             W_City_Mumbai, W_City_Nagpur, W_City_Nashik, W_City_Navi
             Mumbai, W_City_New Delhi, W_City_Noida, W_City_Other,
             W_City_Pune, W_City_Raipur , W_City_Secunderabad, W_City_Surat,
             W_City_Thane, W_City_Vadodara, W_City_Visakhapatnam,
             W_Furnish_Fully Furnished, W_Furnish_Semi-Furnished,
             W_Furnish_Unfurnished, W_Landmark_Hospital, W_Landmark_Mall,
             W_Landmark_Restaurant, W_Landmark_School,
             W_Mining_Coverage_Percent, W_Num_Bedrooms,
             W_PropType_Apartment, W_PropType_Builder Floor,
             W_PropType_Bungalow, W_PropType_Condo, W_PropType_Duplex,
             W_PropType_Farm House, W_PropType_Independent Floor,
             W_PropType_Independent House, W_PropType_Penthouse,
             W_PropType_Plot, W_PropType_Row House, W_PropType_Serviced
             Apartment, W_PropType_Studio, W_PropType_Studio Apartment,
             W_PropType_Triplex, W_PropType_Villa, W_PropType_Villament,
             W_Rera_1.0, W_Rera_Missing
============================== END OF REPORT ==================================


==============================================================================
MINING COVERAGE EFFECTS
==============================================================================
Coefficient:    0.038184
Std. Error:     0.004597
P-value:        0.000000
Impact:         3.89% per 1pp mining coverage

Spatial lag (): 0.583595
Spatial error (): 0.625754
Pseudo R²:       0.7668
```

1.1.16   7km Radius - SAR Model (Robustness)

```
==============================================================================
SAR (SPATIAL LAG) - ROBUSTNESS CHECK
Radius: 7.0km | Sample: 1,602,159 obs
==============================================================================


MODEL SPECIFICATION:
------------------------------------------------------------------------------
y = W*y + X* +


Where:
  y = Log(Price)
   = Spatial lag coefficient (spillover effects only)
```

31

```
   W = 8-nearest neighbors matrix (row-standardized)
   Estimation: GM (Generalized Method of Moments)


REGRESSION RESULTS
------------------


SUMMARY OF OUTPUT: SPATIAL TWO STAGE LEAST SQUARES
--------------------------------------------------
Data set          :     unknown
Weights matrix    :     unknown
Dependent Variable :    Log_Price        Number of Observations:     1602159
Mean dependent var :    15.7453          Number of Variables   :          61
S.D. dependent var :     0.9819          Degrees of Freedom    :     1602098
Pseudo R-squared   :     0.7722
Spatial Pseudo R-squared:  0.4816


-------------------------------------------------------------------------------
          Variable    Coefficient    Std.Error    z-Statistic    Probability
-------------------------------------------------------------------------------
          CONSTANT       5.68730        0.04918      115.64672       0.00000
Mining_Coverage_Percent  0.02402        0.00163       14.75455       0.00000
          Area_Sqft      0.00001        0.00000      186.88287       0.00000
       Num_Bedrooms      0.28869        0.00050      574.39851       0.00000
    Landmark_School     -0.00771        0.00031      -25.10230       0.00000
   Landmark_Hospital     0.00125        0.00029        4.35159       0.00001
 Landmark_Restaurant    -0.01025        0.00028      -36.33661       0.00000
      Landmark_Mall     -0.00511        0.00031      -16.34516       0.00000
      City_Badlapur     -0.08389        0.00546      -15.35317       0.00000
     City_Bangalore      0.18187        0.00256       70.97622       0.00000
   City_Bhubaneswar      0.00774        0.00475        1.62971       0.10316
       City_Chennai      0.02850        0.00249       11.44417       0.00000
    City_Coimbatore     -0.06364        0.00359      -17.70315       0.00000
     City_Faridabad      0.22590        0.00452       49.99965       0.00000
     City_Ghaziabad      0.09274        0.00347       26.72617       0.00000
 City_Greater Noida      0.15033        0.00321       46.81341       0.00000
       City_Gurgaon      0.45483        0.00306      148.42010       0.00000
     City_Hyderabad      0.06699        0.00246       27.26855       0.00000
        City_Indore      0.05954        0.00441       13.50423       0.00000
        City_Jaipur     -0.12403        0.00316      -39.31175       0.00000
        City_Kalyan      0.12852        0.00546       23.51952       0.00000
       City_Kolkata     -0.06321        0.00238      -26.51821       0.00000
       City_Lucknow     -0.08855        0.00373      -23.72155       0.00000
        City_Mohali      0.09552        0.00489       19.53714       0.00000
        City_Mumbai      0.44575        0.00262      169.90416       0.00000
        City_Nagpur     -0.14332        0.00389      -36.87309       0.00000
        City_Nashik     -0.13101        0.00430      -30.48304       0.00000
    City_Navi Mumbai     0.18994        0.00349       54.37313       0.00000
      City_New Delhi     0.22549        0.00356       63.35311       0.00000
         City_Noida      0.19629        0.00371       52.92555       0.00000
         City_Other     -0.04077        0.00224      -18.18987       0.00000
          City_Pune      0.12776        0.00225       56.74208       0.00000
        City_Raipur     -0.16663        0.00588      -28.35374       0.00000
   City_Secunderabad     0.03052        0.00544        5.61305       0.00000
         City_Surat     -0.10838        0.00513      -21.11129       0.00000
         City_Thane      0.16830        0.00281       59.99498       0.00000
       City_Vadodara    -0.21274        0.00460      -46.25651       0.00000
  City_Visakhapatnam    -0.04519        0.00512       -8.83058       0.00000
   PropType_Apartment    0.24146        0.04695        5.14296       0.00000
PropType_Builder Floor   0.19979        0.04727        4.22655       0.00002
```

32

```
              PropType_Bungalow         0.24655          0.05006          4.92519          0.00000
                PropType_Condo          0.17776          0.34168          0.52025          0.60289
               PropType_Duplex          0.38955          0.04724          8.24643          0.00000
            PropType_Farm House         0.45925          0.04917          9.34100          0.00000
     PropType_Independent Floor              0.06908          0.04702          1.46928              0.14176
     PropType_Independent House              0.18094          0.04699          3.85048              0.00012
             PropType_Penthouse         0.61798          0.04758         12.98897          0.00000
                 PropType_Plot          0.36824          0.04695          7.84277          0.00000
             PropType_Row House         0.18914          0.05073          3.72837          0.00019
     PropType_Serviced Apartment             0.14890          0.08753          1.70116              0.08891
               PropType_Studio          0.07377          0.04946          1.49148          0.13584
       PropType_Studio Apartment             0.04509          0.04821          0.93538              0.34959
              PropType_Triplex          0.45757          0.05646          8.10391          0.00000
                 PropType_Villa          0.42728          0.04698          9.09426          0.00000
             PropType_Villament          0.44309          0.05846          7.57905          0.00000
          Furnish_Fully Furnished         0.07473          0.00203         36.79259          0.00000
          Furnish_Semi-Furnished        -0.01099          0.00132         -8.29662          0.00000
            Furnish_Unfurnished        -0.01938          0.00125        -15.45500          0.00000
                     Rera_1.0          0.13417          0.00099        134.85759          0.00000
                  Rera_Missing          0.19814          0.00136        146.15409          0.00000
                   W_Log_Price          0.56999          0.00098        580.93366          0.00000
------------------------------------------------------------------------------------
Instrumented: W_Log_Price
Instruments: W_Area_Sqft, W_City_Badlapur, W_City_Bangalore,
             W_City_Bhubaneswar , W_City_Chennai, W_City_Coimbatore,
             W_City_Faridabad, W_City_Ghaziabad, W_City_Greater Noida,
             W_City_Gurgaon, W_City_Hyderabad, W_City_Indore, W_City_Jaipur,
             W_City_Kalyan, W_City_Kolkata, W_City_Lucknow, W_City_Mohali,
             W_City_Mumbai, W_City_Nagpur, W_City_Nashik, W_City_Navi
             Mumbai, W_City_New Delhi, W_City_Noida, W_City_Other,
             W_City_Pune, W_City_Raipur , W_City_Secunderabad, W_City_Surat,
             W_City_Thane, W_City_Vadodara, W_City_Visakhapatnam,
             W_Furnish_Fully Furnished, W_Furnish_Semi-Furnished,
             W_Furnish_Unfurnished, W_Landmark_Hospital, W_Landmark_Mall,
             W_Landmark_Restaurant, W_Landmark_School,
             W_Mining_Coverage_Percent, W_Num_Bedrooms,
             W_PropType_Apartment, W_PropType_Builder Floor,
             W_PropType_Bungalow, W_PropType_Condo, W_PropType_Duplex,
             W_PropType_Farm House, W_PropType_Independent Floor,
             W_PropType_Independent House, W_PropType_Penthouse,
             W_PropType_Plot, W_PropType_Row House, W_PropType_Serviced
             Apartment, W_PropType_Studio, W_PropType_Studio Apartment,
             W_PropType_Triplex, W_PropType_Villa, W_PropType_Villament,
             W_Rera_1.0, W_Rera_Missing


DIAGNOSTICS FOR SPATIAL DEPENDENCE
TEST                        DF        VALUE          PROB
Anselin-Kelejian Test        1      43292.755        0.0000


SPATIAL LAG MODEL IMPACTS
Impacts computed using the 'simple' method.
           Variable       Direct        Indirect        Total
Mining_Coverage_Percent     0.0240         0.0318          0.0559
          Area_Sqft         0.0000         0.0000          0.0000
        Num_Bedrooms        0.2887         0.3827          0.6714
     Landmark_School       -0.0077        -0.0102         -0.0179
    Landmark_Hospital       0.0012         0.0017          0.0029
   Landmark_Restaurant     -0.0102        -0.0136         -0.0238
       Landmark_Mall       -0.0051        -0.0068         -0.0119
```

```
           City_Badlapur           -0.0839          -0.1112              -0.1951
           City_Bangalore           0.1819           0.2411               0.4230
        City_Bhubaneswar            0.0077           0.0103               0.0180
            City_Chennai            0.0285           0.0378               0.0663
         City_Coimbatore           -0.0636          -0.0844              -0.1480
           City_Faridabad           0.2259           0.2994               0.5253
           City_Ghaziabad           0.0927           0.1229               0.2157
       City_Greater Noida           0.1503           0.1993               0.3496
            City_Gurgaon            0.4548           0.6029               1.0577
          City_Hyderabad            0.0670           0.0888               0.1558
             City_Indore            0.0595           0.0789               0.1385
             City_Jaipur           -0.1240          -0.1644              -0.2884
             City_Kalyan            0.1285           0.1704               0.2989
            City_Kolkata           -0.0632          -0.0838              -0.1470
            City_Lucknow           -0.0885          -0.1174              -0.2059
             City_Mohali            0.0955           0.1266               0.2221
             City_Mumbai            0.4457           0.5909               1.0366
             City_Nagpur           -0.1433          -0.1900              -0.3333
             City_Nashik           -0.1310          -0.1737              -0.3047
         City_Navi Mumbai           0.1899           0.2518               0.4417
           City_New Delhi           0.2255           0.2989               0.5244
              City_Noida            0.1963           0.2602               0.4565
              City_Other           -0.0408          -0.0540              -0.0948
               City_Pune            0.1278           0.1694               0.2971
             City_Raipur           -0.1666          -0.2209              -0.3875
        City_Secunderabad           0.0305           0.0405               0.0710
              City_Surat           -0.1084          -0.1437              -0.2520
              City_Thane            0.1683           0.2231               0.3914
            City_Vadodara           -0.2127          -0.2820              -0.4947
      City_Visakhapatnam           -0.0452          -0.0599              -0.1051
       PropType_Apartment           0.2415           0.3201               0.5615
   PropType_Builder Floor           0.1998           0.2648               0.4646
        PropType_Bungalow           0.2465           0.3268               0.5734
           PropType_Condo           0.1778           0.2356               0.4134
          PropType_Duplex           0.3895           0.5164               0.9059
      PropType_Farm House           0.4593           0.6088               1.0680
 PropType_Independent Floor          0.0691           0.0916               0.1607
 PropType_Independent House          0.1809           0.2398               0.4208
       PropType_Penthouse           0.6180           0.8192               1.4371
            PropType_Plot           0.3682           0.4881               0.8563
        PropType_Row House           0.1891           0.2507               0.4399
 PropType_Serviced Apartment         0.1489           0.1974               0.3463
          PropType_Studio           0.0738           0.0978               0.1716
  PropType_Studio Apartment          0.0451           0.0598               0.1049
         PropType_Triplex           0.4576           0.6065               1.0641
           PropType_Villa           0.4273           0.5664               0.9937
       PropType_Villament           0.4431           0.5873               1.0304
    Furnish_Fully Furnished          0.0747           0.0991               0.1738
   Furnish_Semi-Furnished          -0.0110          -0.0146              -0.0255
     Furnish_Unfurnished           -0.0194          -0.0257              -0.0451
                 Rera_1.0           0.1342           0.1778               0.3120
             Rera_Missing           0.1981           0.2626               0.4608
=============================== END OF REPORT =======================================


================================================================================
MINING COVERAGE EFFECTS
================================================================================
Coefficient:    0.024021
Std. Error:     0.001628
```

```
P-value:          0.000000
Impact:           2.43% per 1pp mining coverage


Spatial lag (): 0.569992
Pseudo R²:        0.7722
```

1.1.17   7km Radius - SEM Model (Robustness)

```
================================================================================
SEM (SPATIAL ERROR) - ROBUSTNESS CHECK
Radius: 7.0km | Sample: 1,602,159 obs
================================================================================


MODEL SPECIFICATION:
--------------------------------------------------------------------------------
y = X* + u
u = W*u +


Where:
  y = Log(Price)
   = Spatial error coefficient (correlated shocks only)
  W = 8-nearest neighbors matrix (row-standardized)
  Estimation: GM (Generalized Method of Moments) with heteroskedasticity


REGRESSION RESULTS
------------------


SUMMARY OF OUTPUT: GM SPATIALLY WEIGHTED LEAST SQUARES (HET)
-------------------------------------------------------------
Data set           :     unknown
Weights matrix     :     unknown
Dependent Variable :   Log_Price          Number of Observations:     1602159
Mean dependent var :    15.7453           Number of Variables   :          60
S.D. dependent var :     0.9819           Degrees of Freedom    :     1602099
Pseudo R-squared   :     0.3637
N. of iterations   :           1          Step1c computed       :          No


------------------------------------------------------------------------------
          Variable    Coefficient     Std.Error    z-Statistic    Probability
------------------------------------------------------------------------------
          CONSTANT       14.81689       0.09182      161.36546        0.00000
Mining_Coverage_Percent   0.04001       0.01437        2.78322        0.00538
          Area_Sqft        0.00001       0.00000        7.92568        0.00000
       Num_Bedrooms        0.29319       0.00110      267.68317        0.00000
    Landmark_School       -0.02064       0.00154      -13.39775        0.00000
  Landmark_Hospital        0.00113       0.00146        0.77072        0.44088
Landmark_Restaurant       -0.02353       0.00146      -16.15499        0.00000
      Landmark_Mall       -0.01497       0.00158       -9.45745        0.00000
       City_Badlapur       -0.66457       0.02708      -24.54218        0.00000
      City_Bangalore        0.20379       0.01773       11.49727        0.00000
   City_Bhubaneswar       -0.11229       0.03575       -3.14064        0.00169
        City_Chennai       -0.30184       0.01725      -17.49405        0.00000
     City_Coimbatore       -0.55846       0.02923      -19.10304        0.00000
      City_Faridabad        0.28754       0.03936        7.30619        0.00000
      City_Ghaziabad        0.11568       0.02450        4.72090        0.00000
  City_Greater Noida        0.13457       0.02240        6.00806        0.00000
        City_Gurgaon        1.01941       0.02044       49.86783        0.00000
      City_Hyderabad       -0.05278       0.01682       -3.13819        0.00170
```

```
          City_Indore           -0.43024         0.04017       -10.71043       0.00000
          City_Jaipur           -0.41500         0.02539       -16.34326       0.00000
          City_Kalyan           -0.14256         0.02428        -5.87217       0.00000
         City_Kolkata           -0.23002         0.01526       -15.07758       0.00000
         City_Lucknow           -0.56473         0.03437       -16.43109       0.00000
          City_Mohali           -0.18183         0.02081        -8.73892       0.00000
          City_Mumbai            0.67619         0.01632        41.43278       0.00000
          City_Nagpur           -0.67235         0.02892       -23.24923       0.00000
          City_Nashik           -0.56423         0.02376       -23.74387       0.00000
      City_Navi Mumbai           0.08066         0.02479         3.25380       0.00114
        City_New Delhi           0.41517         0.02951        14.06817       0.00000
           City_Noida           0.40675         0.03036        13.39907       0.00000
           City_Other           -0.34530         0.01588       -21.73886       0.00000
            City_Pune           0.05917         0.01420         4.16634        0.00003
          City_Raipur           -0.93967         0.04851       -19.37222       0.00000
     City_Secunderabad          -0.06323         0.03760        -1.68139       0.09269
           City_Surat           -0.31214         0.03598        -8.67583       0.00000
           City_Thane           -0.02713         0.01696        -1.60000       0.10960
         City_Vadodara          -0.43027         0.03091       -13.91916       0.00000
    City_Visakhapatnam          -0.36423         0.03931        -9.26586       0.00000
     PropType_Apartment          0.11812         0.09065         1.30306       0.19255
 PropType_Builder Floor          0.18949         0.09085         2.08570       0.03701
     PropType_Bungalow          0.48871         0.09471         5.15999       0.00000
        PropType_Condo          0.15882         0.18774         0.84595       0.39758
       PropType_Duplex          0.42201         0.09079         4.64820       0.00000
    PropType_Farm House          0.56775         0.09651         5.88253       0.00000
PropType_Independent Floor       0.01647         0.09068         0.18163       0.85587
PropType_Independent House       0.31564         0.09062         3.48305       0.00050
    PropType_Penthouse          0.46472         0.09076         5.12037       0.00000
         PropType_Plot          0.66888         0.09038         7.40052       0.00000
     PropType_Row House          0.33590         0.09316         3.60575       0.00031
PropType_Serviced Apartment      -0.31400         0.10760        -2.91829       0.00352
       PropType_Studio          -0.11183         0.09286        -1.20423       0.22850
PropType_Studio Apartment        -0.21639         0.09106        -2.37635       0.01749
       PropType_Triplex          0.48656         0.12161         4.00092       0.00006
         PropType_Villa          0.63825         0.09059         7.04518       0.00000
     PropType_Villament          0.35978         0.09283         3.87583       0.00011
 Furnish_Fully Furnished         0.10370         0.00227        45.68164       0.00000
 Furnish_Semi-Furnished          0.01437         0.00132        10.85880       0.00000
  Furnish_Unfurnished           0.00830         0.00125         6.61496       0.00000
              Rera_1.0           0.20991         0.00260        80.80233       0.00000
          Rera_Missing           0.21083         0.00298        70.80122       0.00000
                lambda           0.87773         0.00143       612.28621       0.00000
--------------------------------------------------------------------------------

============================ END OF REPORT =====================================


================================================================================
MINING COVERAGE EFFECTS
================================================================================
Coefficient:    0.040006
Std. Error:     0.014374
P-value:        0.005382
Impact:         4.08% per 1pp mining coverage


Spatial error (): 0.877731
Pseudo R²:        0.3637
```

1.1.18 7km Radius - Machine Learning Results

```
================================================================================
ML ANALYSIS - HARMONIZED VERSION (FIXED) (Radius: 7.0km)
Date: 2026-02-04 02:06:51
================================================================================


FIXES IMPLEMENTED:
--------------------------------------------------------------------------------
 NO data leakage: City selection from TRAINING set only
 STANDARDIZED: Outlier removal BEFORE GeoDataFrame
 ERROR HANDLING: Geometry operations protected
 Imputation using TRAINING statistics only
 All feature engineering respects train/test boundary
 AUTO-DROP: Variables with >25% missing data excluded
 HYPERPARAMETER TUNING: GridSearchCV on XGBoost, RF, GB


HARMONIZATION:
--------------------------------------------------------------------------------
 Feature set IDENTICAL to lm_test.py, spatial_sdm_CORRECTED.py, final_CORRECTED.py
 Same 9 continuous variables across ALL analyses
 Top 30 cities (selected from training data only)


1. PREDICTIVE MODELS
--------------------------------------------------------------------------------
Model                    MAE         RMSE        R²
--------------------------------------------------------------------------------
XGBoost                  0.262120    0.382051    0.8480
Random Forest            0.324652    0.460865    0.7788
Extra Trees              0.427091    0.580421    0.6492
Gradient Boosting        0.347196    0.482141    0.7579
LightGBM                 0.337600    0.472240    0.7678
CatBoost                 0.344101    0.479256    0.7608
Neural Network           0.327572    0.464608    0.7752
Ridge                    0.537459    0.731638    0.4426
Lasso                    0.541736    0.735695    0.4364
ElasticNet               0.539447    0.733176    0.4403


2. TOP 20 FEATURES
--------------------------------------------------------------------------------
  Area_Sqft                      : 143.483076
  Mining_Coverage_Percent        : 100.323232
  Landmark_Mall                  : 77.176414
  Landmark_Hospital              : 70.007105
  Landmark_Restaurant            : 68.245211
  Landmark_School                : 66.236279
  Num_Bedrooms                   : 64.116548
  PropType_Plot                  : 45.731609
  Rera_1.0                       : 28.948371
  City_Mumbai                    : 26.661900
  PropType_Apartment             : 18.132059
  City_Gurgaon                   : 17.713406
  City_Navi Mumbai               : 15.032973
  City_Other                     : 14.849666
  City_Thane                     : 14.711315
  City_Pune                      : 14.616885
  Rera_Missing                   : 13.990231
  City_New Delhi                 : 12.900044
  City_Bangalore                 : 11.996538
```

```
   City_Kolkata                          : 11.223190


3. HETEROGENEOUS EFFECTS (PARTIAL DEPENDENCE - FIXED)
--------------------------------------------------------------------------------
Effect across mining coverage range, controlling for:
   - Property size, bedrooms, bathrooms, balconies
   - Nearby amenities (schools, hospitals, restaurants, malls)
   - City location (top 30 cities from training set)
   - Property type, furnishing, RERA status
   - All other property characteristics
--------------------------------------------------------------------------------
Agricultural Land  :    5.85% (n=     83)
Triplex            :    5.84% (n=    177)
Studio             :    4.84% (n=    743)
Farm House         :    3.36% (n=    852)
Bungalow           :    2.54% (n=    615)
Row House          :    2.25% (n=    497)
Plot               :    1.06% (n=215,333)
Studio Apartment   :   -2.97% (n= 1,506)
Duplex             :   -3.60% (n= 6,865)
Villa              :   -3.67% (n=54,536)
Villament          :   -6.12% (n=    150)
Apartment          :   -7.52% (n=884,745)
Penthouse          :   -8.45% (n= 3,130)
Builder Floor      :   -9.60% (n= 6,410)
Independent Floor  :   -9.90% (n=41,350)
Independent House  :  -10.22% (n=64,700)


================================================================================
NOTES:
================================================================================
This analysis uses IDENTICAL feature engineering to:
   - lm_test.py (OLS with LM diagnostics)
   - spatial_sdm_CORRECTED.py (spatial econometric models)
   - final_CORRECTED.py (OLS + PSM pipeline)

CRITICAL: All feature engineering respects train/test boundary.
City selection uses TRAINING set only to prevent data leakage.
Results are directly comparable across all methodologies.
```

1.1.19   10km Radius - OLS Results

```
================================================================================
BASELINE OLS HEDONIC REGRESSION (Radius: 10.0km)
CORRECTED VERSION - Matches other analyses
Sample: 1,602,159 observations
================================================================================


                        OLS Regression Results
==============================================================================
Dep. Variable:           Log_Price   R-squared:                      0.440
Model:                         OLS   Adj. R-squared:                 0.440
Method:              Least Squares   F-statistic:                 2.136e+04
Date:             Tue, 03 Feb 2026   Prob (F-statistic):              0.00
Time:                   17:45:21   Log-Likelihood:             -1.7793e+06
No. Observations:          1602159   AIC:                        3.559e+06
Df Residuals:              1602099   BIC:                        3.560e+06
Df Model:                       59
```

```
Covariance Type:          nonrobust
===================================================================================
                            coef    std err          t      P>|t|      [0.025      0.975]
-----------------------------------------------------------------------------------
const                    14.0900      0.072    195.291      0.000      13.949      14.231
Mining_Coverage_Percent   0.0423      0.003     12.181      0.000       0.036       0.049
Area_Sqft               1.83e-05   1.09e-07    168.257      0.000    1.81e-05    1.85e-05
Num_Bedrooms              0.4457      0.001    684.958      0.000       0.444       0.447
Landmark_School          -0.0215      0.000    -45.870      0.000      -0.022      -0.021
Landmark_Hospital         0.0044      0.000     10.077      0.000       0.004       0.005
Landmark_Restaurant      -0.0276      0.000    -64.159      0.000      -0.028      -0.027
Landmark_Mall            -0.0148      0.000    -30.965      0.000      -0.016      -0.014
City_Badlapur            -0.5464      0.008    -65.593      0.000      -0.563      -0.530
City_Bangalore            0.4117      0.004    105.259      0.000       0.404       0.419
City_Bhubaneswar          0.0333      0.007      4.566      0.000       0.019       0.048
City_Chennai              0.0264      0.004      6.898      0.000       0.019       0.034
City_Coimbatore          -0.1445      0.006    -26.200      0.000      -0.155      -0.134
City_Faridabad            0.5425      0.007     78.763      0.000       0.529       0.556
City_Ghaziabad            0.1858      0.005     34.925      0.000       0.175       0.196
City_Greater Noida        0.3332      0.005     67.926      0.000       0.324       0.343
City_Gurgaon              1.1081      0.004    253.049      0.000       1.100       1.117
City_Hyderabad            0.1944      0.004     51.713      0.000       0.187       0.202
City_Indore               0.0947      0.007     13.861      0.000       0.081       0.108
City_Jaipur              -0.2360      0.005    -48.821      0.000      -0.245      -0.227
City_Kalyan               0.0006      0.008      0.072      0.943      -0.016       0.017
City_Kolkata             -0.1903      0.004    -52.236      0.000      -0.197      -0.183
City_Lucknow             -0.1767      0.006    -30.870      0.000      -0.188      -0.166
City_Mohali               0.2526      0.007     33.717      0.000       0.238       0.267
City_Mumbai               0.8354      0.004    214.540      0.000       0.828       0.843
City_Nagpur              -0.3470      0.006    -58.200      0.000      -0.359      -0.335
City_Nashik              -0.4739      0.007    -72.261      0.000      -0.487      -0.461
City_Navi Mumbai          0.2169      0.006     39.339      0.000       0.206       0.228
City_New Delhi            0.4866      0.005     89.782      0.000       0.476       0.497
City_Noida                0.4378      0.006     77.393      0.000       0.427       0.449
City_Other               -0.1471      0.003    -42.825      0.000      -0.154      -0.140
City_Pune                 0.1474      0.003     42.616      0.000       0.141       0.154
City_Raipur              -0.3807      0.009    -42.201      0.000      -0.398      -0.363
City_Secunderabad         0.1366      0.008     16.373      0.000       0.120       0.153
City_Surat               -0.2503      0.008    -31.796      0.000      -0.266      -0.235
City_Thane                0.1228      0.004     28.244      0.000       0.114       0.131
City_Vadodara            -0.4152      0.007    -58.983      0.000      -0.429      -0.401
City_Visakhapatnam       -0.1768      0.008    -22.524      0.000      -0.192      -0.161
PropType_Apartment        0.4007      0.072      5.560      0.000       0.259       0.542
PropType_Builder Floor    0.3247      0.073      4.476      0.000       0.183       0.467
PropType_Bungalow         0.3316      0.077      4.315      0.000       0.181       0.482
PropType_Condo            0.7638      0.524      1.456      0.145      -0.264       1.792
PropType_Duplex           0.4877      0.073      6.726      0.000       0.346       0.630
PropType_Farm House       0.3703      0.075      4.907      0.000       0.222       0.518
PropType_Independent Floor 0.1737     0.072      2.407      0.016       0.032       0.315
PropType_Independent House 0.0761     0.072      1.055      0.291      -0.065       0.218
PropType_Penthouse        0.9501      0.073     13.011      0.000       0.807       1.093
PropType_Plot             0.4289      0.072      5.951      0.000       0.288       0.570
PropType_Row House        0.2246      0.078      2.884      0.004       0.072       0.377
PropType_Serviced Apartment 0.3418    0.134      2.544      0.011       0.078       0.605
PropType_Studio           0.2857      0.076      3.763      0.000       0.137       0.435
PropType_Studio Apartment 0.1971      0.074      2.663      0.008       0.052       0.342
PropType_Triplex          0.8627      0.087      9.955      0.000       0.693       1.033
PropType_Villa            0.6286      0.072      8.716      0.000       0.487       0.770
PropType_Villament        0.8783      0.090      9.788      0.000       0.702       1.054
```

39

```
Furnish_Fully Furnished           0.1123      0.003      36.050      0.000       0.106       0.118
Furnish_Semi-Furnished            0.0175      0.002       8.628      0.000       0.014       0.022
Furnish_Unfurnished               0.0008      0.002       0.426      0.670      -0.003       0.005
Rera_1.0                          0.2667      0.001     179.424      0.000       0.264       0.270
Rera_Missing                      0.3582      0.002     175.817      0.000       0.354       0.362

==================================================================
Omnibus:                        285220.285   Durbin-Watson:                    0.943
Prob(Omnibus):                       0.000   Jarque-Bera (JB):           7149465.336
Skew:                               -0.087   Prob(JB):                          0.00
Kurtosis:                           13.347   Cond. No.                      5.08e+06
==================================================================

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
[2] The condition number is large, 5.08e+06. This might indicate that there are
strong multicollinearity or other numerical problems.
```

1.1.20 10km Radius - PSM Results

```
================================================================================
PROPENSITY SCORE MATCHING RESULTS (Radius: 10.0km)
================================================================================

ROBUSTNESS ACROSS TREATMENT THRESHOLDS
--------------------------------------------------------------------------------

THRESHOLD: Mining coverage > 0.3%
--------------------------------------------------------------------------------
Treated units: 151,530
Control units: 1,450,629
Matched pairs: 151,530
Match rate: 100.0%

AVERAGE TREATMENT EFFECT ON TREATED (ATT):
  ATT: -0.86%
  Standard Error: 0.31%
  95% CI: [-1.37%, -0.20%]

Interpretation: Properties near mines (>0.3% coverage) are
0.86% less expensive than similar properties not near mines.


================================================================================

THRESHOLD: Mining coverage > 0.5%
--------------------------------------------------------------------------------
Treated units: 80,676
Control units: 1,521,483
Matched pairs: 80,676
Match rate: 100.0%

AVERAGE TREATMENT EFFECT ON TREATED (ATT):
  ATT: 3.65%
  Standard Error: 0.43%
  95% CI: [2.83%, 4.44%]

Interpretation: Properties near mines (>0.5% coverage) are
3.65% more expensive than similar properties not near mines.
```

```
================================================================================

THRESHOLD: Mining coverage > 1.0%
--------------------------------------------------------------------------------
Treated units: 34,772
Control units: 1,567,387
Matched pairs: 34,772
Match rate: 100.0%

AVERAGE TREATMENT EFFECT ON TREATED (ATT):
  ATT: 19.19%
  Standard Error: 0.74%
  95% CI: [17.85%, 20.67%]

Interpretation: Properties near mines (>1.0% coverage) are
19.19% more expensive than similar properties not near mines.

================================================================================

THRESHOLD: Mining coverage > 2.0%
--------------------------------------------------------------------------------
Treated units: 846
Control units: 1,601,313
Matched pairs: 846
Match rate: 100.0%

AVERAGE TREATMENT EFFECT ON TREATED (ATT):
  ATT: -22.20%
  Standard Error: 3.77%
  95% CI: [-29.46%, -14.69%]

Interpretation: Properties near mines (>2.0% coverage) are
22.20% less expensive than similar properties not near mines.

================================================================================


SUMMARY TABLE
--------------------------------------------------------------------------------
Threshold    Treated     Matched     ATT          95% CI
--------------------------------------------------------------------------------
0.3%         151,530     151,530     -0.86        % [-1.37%, -0.20%]
0.5%         80,676      80,676      3.65         % [2.83%, 4.44%]
1.0%         34,772      34,772      19.19        % [17.85%, 20.67%]
2.0%         846         846         -22.20       % [-29.46%, -14.69%]
--------------------------------------------------------------------------------

NOTES:
- Method: 1:1 Nearest Neighbor Matching with caliper=0.1
- Standard errors computed via bootstrap (200 iterations)
- All matches achieved within caliper threshold
```

1.1.21   10km Radius - SAC Model

```
================================================================================
SAC (SPATIAL AUTOREGRESSIVE COMBINED) - PRIMARY MODEL
Radius: 10.0km | Sample: 1,602,159 obs
================================================================================
```

```
MODEL SPECIFICATION:
-------------------------------------------------------------------------
y = W*y + X* + u
u = W*u +

Where:
  y = Log(Price)
   = Spatial lag coefficient (spillover effects)
   = Spatial error coefficient (correlated shocks)
  W = 8-nearest neighbors matrix (row-standardized)


REGRESSION RESULTS
------------------


SUMMARY OF OUTPUT: SPATIALLY WEIGHTED 2SLS- GM-COMBO MODEL (HET)
------------------------------------------------------------------
Data set            :     unknown
Weights matrix      :     unknown
Dependent Variable  :   Log_Price         Number of Observations:    1602159
Mean dependent var  :    15.7453          Number of Variables   :         61
S.D. dependent var  :     0.9819          Degrees of Freedom    :    1602098
Pseudo R-squared    :     0.7668
Spatial Pseudo R-squared:  0.4130
N. of iterations    :         1           Step1c computed       :         No


------------------------------------------------------------------------------
          Variable    Coefficient    Std.Error    z-Statistic    Probability
------------------------------------------------------------------------------
          CONSTANT       5.35604       0.10342      51.79044       0.00000
Mining_Coverage_Percent  0.06219       0.00673       9.24548       0.00000
          Area_Sqft      0.00001       0.00000       7.50918       0.00000
       Num_Bedrooms      0.28968       0.00116     249.86751       0.00000
     Landmark_School    -0.01152       0.00072     -16.09838       0.00000
   Landmark_Hospital     0.00049       0.00066       0.74548       0.45598
 Landmark_Restaurant    -0.01138       0.00066     -17.20238       0.00000
       Landmark_Mall    -0.00609       0.00071      -8.57511       0.00000
      City_Badlapur     -0.05345       0.00845      -6.32494       0.00000
     City_Bangalore      0.13166       0.00598      22.01745       0.00000
   City_Bhubaneswar     -0.02942       0.01146      -2.56801       0.01023
       City_Chennai     -0.06108       0.00610     -10.01034       0.00000
    City_Coimbatore     -0.19033       0.01004     -18.96343       0.00000
     City_Faridabad      0.13470       0.01207      11.15967       0.00000
      City_Ghaziabad     0.07654       0.00794       9.63872       0.00000
 City_Greater Noida      0.10269       0.00758      13.54451       0.00000
        City_Gurgaon     0.41053       0.00715      57.41314       0.00000
      City_Hyderabad    -0.01747       0.00574      -3.04479       0.00233
         City_Indore    -0.10140       0.01412      -7.18063       0.00000
         City_Jaipur    -0.18302       0.00853     -21.44369       0.00000
         City_Kalyan     0.13867       0.00897      15.45877       0.00000
        City_Kolkata    -0.05014       0.00524      -9.57512       0.00000
        City_Lucknow    -0.20207       0.01141     -17.70518       0.00000
         City_Mohali     0.01896       0.01043       1.81825       0.06903
         City_Mumbai     0.44733       0.00540      82.90632       0.00000
         City_Nagpur    -0.24326       0.00994     -24.46551       0.00000
         City_Nashik    -0.11931       0.00842     -14.17051       0.00000
    City_Navi Mumbai     0.18737       0.00892      21.01060       0.00000
      City_New Delhi     0.21599       0.00962      22.46128       0.00000
          City_Noida     0.19906       0.00983      20.24226       0.00000
```

```
           City_Other         -0.09232         0.00554        -16.65558         0.00000
            City_Pune          0.13749         0.00484         28.41611         0.00000
           City_Raipur        -0.34563         0.01625        -21.27517         0.00000
      City_Secunderabad       -0.04443         0.01413         -3.14482         0.00166
            City_Surat        -0.12089         0.01236         -9.77964         0.00000
            City_Thane         0.18040         0.00593         30.43645         0.00000
          City_Vadodara       -0.22542         0.01068        -21.11439         0.00000
      City_Visakhapatnam      -0.08242         0.01321         -6.23699         0.00000
       PropType_Apartment      0.32528         0.09430          3.44928         0.00056
   PropType_Builder Floor      0.35325         0.09446          3.73984         0.00018
        PropType_Bungalow      0.55369         0.09744          5.68237         0.00000
           PropType_Condo      0.21356         0.14572          1.46555         0.14277
          PropType_Duplex      0.57605         0.09445          6.09895         0.00000
       PropType_Farm House     0.68217         0.10000          6.82172         0.00000
  PropType_Independent Floor   0.18264         0.09434          1.93590         0.05288
  PropType_Independent House   0.44602         0.09432          4.72861         0.00000
        PropType_Penthouse     0.68612         0.09438          7.26993         0.00000
            PropType_Plot      0.70720         0.09405          7.51951         0.00000
        PropType_Row House     0.44195         0.09648          4.58072         0.00000
 PropType_Serviced Apartment  -0.10015         0.11817         -0.84750         0.39672
          PropType_Studio      0.07870         0.09652          0.81532         0.41489
  PropType_Studio Apartment    0.01215         0.09471          0.12832         0.89789
         PropType_Triplex      0.59837         0.12154          4.92335         0.00000
           PropType_Villa      0.71121         0.09425          7.54627         0.00000
        PropType_Villament     0.53060         0.09627          5.51147         0.00000
   Furnish_Fully Furnished     0.08248         0.00231         35.69564         0.00000
   Furnish_Semi-Furnished     -0.00706         0.00131         -5.37717         0.00000
      Furnish_Unfurnished     -0.01255         0.00124        -10.09279         0.00000
               Rera_1.0        0.15878         0.00179         88.61352         0.00000
           Rera_Missing        0.18886         0.00250         75.61541         0.00000
           W_Log_Price         0.58366         0.00262        222.58627         0.00000
               lambda          0.62565         0.00333        187.63197         0.00000
--------------------------------------------------------------------------------
Instrumented: W_Log_Price
Instruments: W_Area_Sqft, W_City_Badlapur, W_City_Bangalore,
             W_City_Bhubaneswar , W_City_Chennai, W_City_Coimbatore,
             W_City_Faridabad, W_City_Ghaziabad, W_City_Greater Noida,
             W_City_Gurgaon, W_City_Hyderabad, W_City_Indore, W_City_Jaipur,
             W_City_Kalyan, W_City_Kolkata, W_City_Lucknow, W_City_Mohali,
             W_City_Mumbai, W_City_Nagpur, W_City_Nashik, W_City_Navi
             Mumbai, W_City_New Delhi, W_City_Noida, W_City_Other,
             W_City_Pune, W_City_Raipur , W_City_Secunderabad, W_City_Surat,
             W_City_Thane, W_City_Vadodara, W_City_Visakhapatnam,
             W_Furnish_Fully Furnished, W_Furnish_Semi-Furnished,
             W_Furnish_Unfurnished, W_Landmark_Hospital, W_Landmark_Mall,
             W_Landmark_Restaurant, W_Landmark_School,
             W_Mining_Coverage_Percent, W_Num_Bedrooms,
             W_PropType_Apartment, W_PropType_Builder Floor,
             W_PropType_Bungalow, W_PropType_Condo, W_PropType_Duplex,
             W_PropType_Farm House, W_PropType_Independent Floor,
             W_PropType_Independent House, W_PropType_Penthouse,
             W_PropType_Plot, W_PropType_Row House, W_PropType_Serviced
             Apartment, W_PropType_Studio, W_PropType_Studio Apartment,
             W_PropType_Triplex, W_PropType_Villa, W_PropType_Villament,
             W_Rera_1.0, W_Rera_Missing
================================ END OF REPORT ========================================


================================================================================
MINING COVERAGE EFFECTS
```

```
================================================================================
Coefficient:      0.062190
Std. Error:       0.006726
P-value:          0.000000
Impact:           6.42% per 1pp mining coverage


Spatial lag (): 0.583659
Spatial error (): 0.625650
Pseudo R²:        0.7668
```

1.1.22 10km Radius - SAR Model (Robustness)

```
================================================================================
SAR (SPATIAL LAG) - ROBUSTNESS CHECK
Radius: 10.0km | Sample: 1,602,159 obs
================================================================================


MODEL SPECIFICATION:
--------------------------------------------------------------------------------
y = W*y + X* +

Where:
  y = Log(Price)
   = Spatial lag coefficient (spillover effects only)
  W = 8-nearest neighbors matrix (row-standardized)
  Estimation: GM (Generalized Method of Moments)


REGRESSION RESULTS
------------------


SUMMARY OF OUTPUT: SPATIAL TWO STAGE LEAST SQUARES
--------------------------------------------------
Data set            :     unknown
Weights matrix      :     unknown
Dependent Variable  :   Log_Price        Number of Observations:    1602159
Mean dependent var  :    15.7453         Number of Variables   :         61
S.D. dependent var  :     0.9819         Degrees of Freedom    :    1602098
Pseudo R-squared    :     0.7722
Spatial Pseudo R-squared:  0.4817


--------------------------------------------------------------------------------
          Variable    Coefficient    Std.Error    z-Statistic    Probability
--------------------------------------------------------------------------------
          CONSTANT       5.68665       0.04917     115.64682       0.00000
Mining_Coverage_Percent  0.04195       0.00226      18.53630       0.00000
          Area_Sqft      0.00001       0.00000     186.91122       0.00000
        Num_Bedrooms     0.28874       0.00050     574.49066       0.00000
     Landmark_School    -0.00771       0.00031     -25.14150       0.00000
   Landmark_Hospital     0.00118       0.00029       4.09463       0.00004
 Landmark_Restaurant    -0.01029       0.00028     -36.49332       0.00000
      Landmark_Mall     -0.00498       0.00031     -15.95030       0.00000
       City_Badlapur    -0.08984       0.00548     -16.38626       0.00000
      City_Bangalore     0.17843       0.00258      69.18065       0.00000
    City_Bhubaneswar     0.00552       0.00475       1.16222       0.24515
        City_Chennai     0.02707       0.00249      10.85787       0.00000
     City_Coimbatore    -0.06440       0.00360     -17.91309       0.00000
      City_Faridabad     0.22357       0.00452      49.45744       0.00000
      City_Ghaziabad     0.09221       0.00347      26.57542       0.00000
```

44

City_Greater Noida	0.15034	0.00321	46.82009	0.00000
City_Gurgaon	0.45306	0.00307	147.71676	0.00000
City_Hyderabad	0.06564	0.00246	26.69182	0.00000
City_Indore	0.05191	0.00445	11.65771	0.00000
City_Jaipur	-0.12416	0.00315	-39.35710	0.00000
City_Kalyan	0.12267	0.00549	22.36150	0.00000
City_Kolkata	-0.06311	0.00238	-26.47964	0.00000
City_Lucknow	-0.08858	0.00373	-23.73140	0.00000
City_Mohali	0.09544	0.00489	19.52274	0.00000
City_Mumbai	0.44485	0.00262	169.53917	0.00000
City_Nagpur	-0.14807	0.00390	-37.98265	0.00000
City_Nashik	-0.13571	0.00431	-31.47924	0.00000
City_Navi Mumbai	0.17955	0.00359	49.97894	0.00000
City_New Delhi	0.22539	0.00356	63.33098	0.00000
City_Noida	0.19614	0.00371	52.89020	0.00000
City_Other	-0.04207	0.00224	-18.74723	0.00000
City_Pune	0.12672	0.00225	56.23775	0.00000
City_Raipur	-0.17126	0.00589	-29.09082	0.00000
City_Secunderabad	0.02923	0.00544	5.37504	0.00000
City_Surat	-0.10833	0.00513	-21.10313	0.00000
City_Thane	0.16315	0.00283	57.60174	0.00000
City_Vadodara	-0.21277	0.00460	-46.26666	0.00000
City_Visakhapatnam	-0.04602	0.00512	-8.99130	0.00000
PropType_Apartment	0.24040	0.04694	5.12091	0.00000
PropType_Builder Floor	0.19858	0.04727	4.20125	0.00003
PropType_Bungalow	0.24558	0.05005	4.90639	0.00000
PropType_Condo	0.17817	0.34165	0.52151	0.60201
PropType_Duplex	0.38856	0.04723	8.22639	0.00000
PropType_Farm House	0.45868	0.04916	9.33026	0.00000
PropType_Independent Floor	0.06802	0.04701	1.44671	0.14798
PropType_Independent House	0.17994	0.04699	3.82940	0.00013
PropType_Penthouse	0.61728	0.04757	12.97542	0.00000
PropType_Plot	0.36749	0.04695	7.82748	0.00000
PropType_Row House	0.18817	0.05073	3.70954	0.00021
PropType_Serviced Apartment	0.14729	0.08752	1.68283	0.09241
PropType_Studio	0.07302	0.04946	1.47649	0.13981
PropType_Studio Apartment	0.04392	0.04820	0.91125	0.36216
PropType_Triplex	0.45788	0.05646	8.11017	0.00000
PropType_Villa	0.42626	0.04698	9.07346	0.00000
PropType_Villament	0.44308	0.05846	7.57969	0.00000
Furnish_Fully Furnished	0.07476	0.00203	36.80912	0.00000
Furnish_Semi-Furnished	-0.01097	0.00132	-8.28350	0.00000
Furnish_Unfurnished	-0.01947	0.00125	-15.52634	0.00000
Rera_1.0	0.13423	0.00099	134.93476	0.00000
Rera_Missing	0.19807	0.00136	146.12599	0.00000
W_Log_Price	0.57009	0.00098	581.24280	0.00000

Instrumented: W_Log_Price
Instruments: W_Area_Sqft, W_City_Badlapur, W_City_Bangalore,
          W_City_Bhubaneswar , W_City_Chennai, W_City_Coimbatore,
          W_City_Faridabad, W_City_Ghaziabad, W_City_Greater Noida,
          W_City_Gurgaon, W_City_Hyderabad, W_City_Indore, W_City_Jaipur,
          W_City_Kalyan, W_City_Kolkata, W_City_Lucknow, W_City_Mohali,
          W_City_Mumbai, W_City_Nagpur, W_City_Nashik, W_City_Navi
          Mumbai, W_City_New Delhi, W_City_Noida, W_City_Other,
          W_City_Pune, W_City_Raipur , W_City_Secunderabad, W_City_Surat,
          W_City_Thane, W_City_Vadodara, W_City_Visakhapatnam,
          W_Furnish_Fully Furnished, W_Furnish_Semi-Furnished,
          W_Furnish_Unfurnished, W_Landmark_Hospital, W_Landmark_Mall,

```
                W_Landmark_Restaurant, W_Landmark_School,
                W_Mining_Coverage_Percent, W_Num_Bedrooms,
                W_PropType_Apartment, W_PropType_Builder Floor,
                W_PropType_Bungalow, W_PropType_Condo, W_PropType_Duplex,
                W_PropType_Farm House, W_PropType_Independent Floor,
                W_PropType_Independent House, W_PropType_Penthouse,
                W_PropType_Plot, W_PropType_Row House, W_PropType_Serviced
                Apartment, W_PropType_Studio, W_PropType_Studio Apartment,
                W_PropType_Triplex, W_PropType_Villa, W_PropType_Villament,
                W_Rera_1.0, W_Rera_Missing


DIAGNOSTICS FOR SPATIAL DEPENDENCE
TEST                            DF          VALUE           PROB
Anselin-Kelejian Test           1        43298.254         0.0000


SPATIAL LAG MODEL IMPACTS
Impacts computed using the 'simple' method.
             Variable       Direct        Indirect         Total
Mining_Coverage_Percent      0.0420         0.0556         0.0976
              Area_Sqft      0.0000         0.0000         0.0000
           Num_Bedrooms      0.2887         0.3829         0.6716
        Landmark_School     -0.0077        -0.0102        -0.0179
      Landmark_Hospital      0.0012         0.0016         0.0027
    Landmark_Restaurant     -0.0103        -0.0136        -0.0239
          Landmark_Mall     -0.0050        -0.0066        -0.0116
          City_Badlapur     -0.0898        -0.1191        -0.2090
         City_Bangalore      0.1784         0.2366         0.4150
       City_Bhubaneswar      0.0055         0.0073         0.0128
           City_Chennai      0.0271         0.0359         0.0630
        City_Coimbatore     -0.0644        -0.0854        -0.1498
         City_Faridabad      0.2236         0.2965         0.5200
         City_Ghaziabad      0.0922         0.1223         0.2145
      City_Greater Noida      0.1503         0.1994         0.3497
           City_Gurgaon      0.4531         0.6008         1.0538
         City_Hyderabad      0.0656         0.0870         0.1527
            City_Indore      0.0519         0.0688         0.1207
            City_Jaipur     -0.1242        -0.1646        -0.2888
            City_Kalyan      0.1227         0.1627         0.2853
           City_Kolkata     -0.0631        -0.0837        -0.1468
           City_Lucknow     -0.0886        -0.1175        -0.2060
            City_Mohali      0.0954         0.1266         0.2220
            City_Mumbai      0.4449         0.5899         1.0347
            City_Nagpur     -0.1481        -0.1963        -0.3444
            City_Nashik     -0.1357        -0.1800        -0.3157
       City_Navi Mumbai      0.1795         0.2381         0.4176
         City_New Delhi      0.2254         0.2989         0.5243
             City_Noida      0.1961         0.2601         0.4562
             City_Other     -0.0421        -0.0558        -0.0979
              City_Pune      0.1267         0.1680         0.2948
            City_Raipur     -0.1713        -0.2271        -0.3984
      City_Secunderabad      0.0292         0.0388         0.0680
             City_Surat     -0.1083        -0.1436        -0.2520
             City_Thane      0.1632         0.2164         0.3795
          City_Vadodara     -0.2128        -0.2821        -0.4949
     City_Visakhapatnam     -0.0460        -0.0610        -0.1070
      PropType_Apartment      0.2404         0.3188         0.5592
  PropType_Builder Floor      0.1986         0.2633         0.4619
      PropType_Bungalow      0.2456         0.3257         0.5712
          PropType_Condo      0.1782         0.2363         0.4144
```

```
          PropType_Duplex           0.3886              0.5153              0.9038
     PropType_Farm House            0.4587              0.6082              1.0669
PropType_Independent Floor           0.0680              0.0902              0.1582
PropType_Independent House           0.1799              0.2386              0.4185
      PropType_Penthouse            0.6173              0.8185              1.4358
           PropType_Plot            0.3675              0.4873              0.8548
       PropType_Row House           0.1882              0.2495              0.4377
PropType_Serviced Apartment          0.1473              0.1953              0.3426
         PropType_Studio            0.0730              0.0968              0.1699
PropType_Studio Apartment            0.0439              0.0582              0.1022
        PropType_Triplex            0.4579              0.6072              1.0650
          PropType_Villa            0.4263              0.5652              0.9915
      PropType_Villament           0.4431              0.5875              1.0306
Furnish_Fully Furnished              0.0748              0.0991              0.1739
Furnish_Semi-Furnished              -0.0110             -0.0145             -0.0255
 Furnish_Unfurnished                -0.0195             -0.0258             -0.0453
               Rera_1.0             0.1342              0.1780              0.3122
          Rera_Missing              0.1981              0.2627              0.4607
============================== END OF REPORT =====================================


================================================================================
MINING COVERAGE EFFECTS
================================================================================
Coefficient:    0.041951
Std. Error:     0.002263
P-value:        0.000000
Impact:         4.28% per 1pp mining coverage


Spatial lag (): 0.570085
Pseudo R²:       0.7722
```

1.1.23   10km Radius - SEM Model (Robustness)

```
================================================================================
SEM (SPATIAL ERROR) - ROBUSTNESS CHECK
Radius: 10.0km | Sample: 1,602,159 obs
================================================================================


MODEL SPECIFICATION:
--------------------------------------------------------------------------------
y = X* + u
u = W*u +

Where:
  y = Log(Price)
   = Spatial error coefficient (correlated shocks only)
  W = 8-nearest neighbors matrix (row-standardized)
  Estimation: GM (Generalized Method of Moments) with heteroskedasticity


REGRESSION RESULTS
------------------


SUMMARY OF OUTPUT: GM SPATIALLY WEIGHTED LEAST SQUARES (HET)
-------------------------------------------------------------
Data set            :      unknown
Weights matrix      :      unknown
Dependent Variable  :   Log_Price              Number of Observations:     1602159
Mean dependent var  :     15.7453              Number of Variables   :          60
```

```
S.D. dependent var   :      0.9819        Degrees of Freedom   :      1602099
Pseudo R-squared     :      0.3638
N. of iterations     :         1          Step1c computed      :         No


--------------------------------------------------------------------------------
           Variable    Coefficient    Std.Error    z-Statistic    Probability
--------------------------------------------------------------------------------
            CONSTANT     14.81655       0.09183      161.35087       0.00000
Mining_Coverage_Percent   0.07075       0.01969        3.59351       0.00033
            Area_Sqft      0.00001       0.00000        7.92578       0.00000
         Num_Bedrooms      0.29320       0.00110      267.69747       0.00000
      Landmark_School     -0.02064       0.00154      -13.40158       0.00000
    Landmark_Hospital      0.00105       0.00146        0.71878       0.47227
  Landmark_Restaurant     -0.02357       0.00146      -16.18455       0.00000
        Landmark_Mall     -0.01487       0.00158       -9.39278       0.00000
        City_Badlapur     -0.67479       0.02740      -24.62324       0.00000
       City_Bangalore      0.19814       0.01790       11.06818       0.00000
     City_Bhubaneswar     -0.11604       0.03577       -3.24417       0.00118
         City_Chennai     -0.30421       0.01729      -17.59401       0.00000
      City_Coimbatore     -0.55972       0.02924      -19.14253       0.00000
       City_Faridabad      0.28378       0.03941        7.20032       0.00000
       City_Ghaziabad      0.11479       0.02451        4.68417       0.00000
   City_Greater Noida      0.13461       0.02240        6.00923       0.00000
         City_Gurgaon      1.01664       0.02048       49.63975       0.00000
       City_Hyderabad     -0.05493       0.01685       -3.26025       0.00111
          City_Indore     -0.44301       0.04027      -11.00098       0.00000
          City_Jaipur     -0.41522       0.02540      -16.34999       0.00000
          City_Kalyan     -0.15248       0.02463       -6.19105       0.00000
         City_Kolkata     -0.22998       0.01526      -15.07389       0.00000
         City_Lucknow     -0.56474       0.03437      -16.43104       0.00000
          City_Mohali     -0.18343       0.02083       -8.80770       0.00000
          City_Mumbai      0.67467       0.01633       41.31080       0.00000
          City_Nagpur     -0.68014       0.02905      -23.41388       0.00000
          City_Nashik     -0.57217       0.02396      -23.87886       0.00000
     City_Navi Mumbai      0.06293       0.02570        2.44905       0.01432
       City_New Delhi      0.41498       0.02952       14.05934       0.00000
           City_Noida      0.40663       0.03036       13.39418       0.00000
           City_Other     -0.34757       0.01592      -21.83726       0.00000
            City_Pune      0.05741       0.01422        4.03635       0.00005
          City_Raipur     -0.94722       0.04861      -19.48458       0.00000
     City_Secunderabad     -0.06536       0.03761       -1.73766       0.08227
           City_Surat     -0.31220       0.03598       -8.67680       0.00000
           City_Thane     -0.03584       0.01735       -2.06558       0.03887
        City_Vadodara     -0.43034       0.03091      -13.92329       0.00000
   City_Visakhapatnam     -0.36564       0.03932       -9.30016       0.00000
    PropType_Apartment      0.11833       0.09065        1.30538       0.19176
PropType_Builder Floor      0.18973       0.09086        2.08815       0.03678
     PropType_Bungalow      0.48886       0.09472        5.16132       0.00000
        PropType_Condo      0.15952       0.18779        0.84946       0.39563
       PropType_Duplex      0.42226       0.09080        4.65063       0.00000
    PropType_Farm House      0.56816       0.09652        5.88643       0.00000
PropType_Independent Floor   0.01672       0.09068        0.18440       0.85370
PropType_Independent House   0.31587       0.09063        3.48528       0.00049
    PropType_Penthouse      0.46494       0.09077        5.12245       0.00000
         PropType_Plot      0.66917       0.09039        7.40320       0.00000
     PropType_Row House      0.33618       0.09316        3.60848       0.00031
PropType_Serviced Apartment  -0.31378       0.10758       -2.91660       0.00354
       PropType_Studio     -0.11142       0.09287       -1.19974       0.23024
PropType_Studio Apartment    -0.21613       0.09106       -2.37339       0.01763
```

```
       PropType_Triplex          0.48707          0.12162          4.00480          0.00006
         PropType_Villa          0.63850          0.09060          7.04745          0.00000
      PropType_Villament        0.36018          0.09283          3.87996          0.00010
  Furnish_Fully Furnished        0.10370          0.00227         45.68646          0.00000
  Furnish_Semi-Furnished         0.01438          0.00132         10.86716          0.00000
    Furnish_Unfurnished          0.00830          0.00125          6.61177          0.00000
                Rera_1.0          0.20996          0.00260         80.82352          0.00000
            Rera_Missing         0.21084          0.00298         70.80480          0.00000
                  lambda         0.87773          0.00143        612.22048          0.00000
-------------------------------------------------------------------------------------

============================== END OF REPORT =======================================


================================================================================
MINING COVERAGE EFFECTS
================================================================================
Coefficient:    0.070749
Std. Error:     0.019688
P-value:        0.000326
Impact:         7.33% per 1pp mining coverage


Spatial error (): 0.877732
Pseudo R²:        0.3638
```

1.1.24   10km Radius - Machine Learning Results

```
================================================================================
ML ANALYSIS - HARMONIZED VERSION (FIXED) (Radius: 10.0km)
Date: 2026-02-04 11:46:41
================================================================================


FIXES IMPLEMENTED:
--------------------------------------------------------------------------------
 NO data leakage: City selection from TRAINING set only
 STANDARDIZED: Outlier removal BEFORE GeoDataFrame
 ERROR HANDLING: Geometry operations protected
 Imputation using TRAINING statistics only
 All feature engineering respects train/test boundary
 AUTO-DROP: Variables with >25% missing data excluded
 HYPERPARAMETER TUNING: GridSearchCV on XGBoost, RF, GB


HARMONIZATION:
--------------------------------------------------------------------------------
 Feature set IDENTICAL to lm_test.py, spatial_sdm_CORRECTED.py, final_CORRECTED.py
 Same 9 continuous variables across ALL analyses
 Top 30 cities (selected from training data only)


1. PREDICTIVE MODELS
--------------------------------------------------------------------------------

Model                 MAE         RMSE        R²
--------------------------------------------------------------------------------

XGBoost               0.260505    0.379619    0.8499
Random Forest         0.324604    0.460209    0.7795
Extra Trees           0.425466    0.577864    0.6523
Gradient Boosting     0.296478    0.421149    0.8153
LightGBM              0.334759    0.468752    0.7712
CatBoost              0.343548    0.478329    0.7618
Neural Network        0.329004    0.465466    0.7744
Ridge                 0.537492    0.731603    0.4427
```

```
Lasso                     0.541731    0.735666    0.4364
ElasticNet                0.539454    0.733130    0.4403


2. TOP 20 FEATURES
--------------------------------------------------------------------------------
  Mining_Coverage_Percent            : 129.307497
  Area_Sqft                          : 125.344751
  Landmark_Mall                      : 73.092297
  Landmark_Restaurant                : 64.404792
  Num_Bedrooms                       : 64.086416
  Landmark_School                    : 61.890056
  Landmark_Hospital                  : 60.310952
  PropType_Plot                      : 45.236993
  Rera_1.0                           : 26.928341
  City_Mumbai                        : 26.754545
  PropType_Apartment                 : 21.329744
  City_Gurgaon                       : 20.202857
  City_Other                         : 15.687132
  City_Navi Mumbai                   : 15.361167
  City_Thane                         : 15.175643
  City_Pune                          : 14.931092
  Rera_Missing                       : 13.971358
  City_New Delhi                     : 13.906977
  City_Kolkata                       : 13.349134
  City_Noida                         : 11.597193


3. HETEROGENEOUS EFFECTS (PARTIAL DEPENDENCE - FIXED)
--------------------------------------------------------------------------------
Effect across mining coverage range, controlling for:
  - Property size, bedrooms, bathrooms, balconies
  - Nearby amenities (schools, hospitals, restaurants, malls)
  - City location (top 30 cities from training set)
  - Property type, furnishing, RERA status
  - All other property characteristics
--------------------------------------------------------------------------------
Farm House         :   17.85% (n=   852)
Row House          :   13.34% (n=   497)
Studio Apartment   :   12.00% (n= 1,506)
Bungalow           :    7.01% (n=   615)
Triplex            :    2.78% (n=   177)
Plot               :    0.58% (n=215,333)
Agricultural Land  :   -1.18% (n=    83)
Villa              :   -1.28% (n=54,536)
Penthouse          :   -1.48% (n= 3,130)
Apartment          :   -3.72% (n=884,745)
Duplex             :   -5.91% (n= 6,865)
Studio             :   -6.35% (n=   743)
Independent Floor  :   -6.42% (n=41,350)
Builder Floor      :   -6.90% (n= 6,410)
Independent House  :   -8.31% (n=64,700)
Villament          :   -8.98% (n=   150)


================================================================================
NOTES:
================================================================================

This analysis uses IDENTICAL feature engineering to:
  - lm_test.py (OLS with LM diagnostics)
  - spatial_sdm_CORRECTED.py (spatial econometric models)
  - final_CORRECTED.py (OLS + PSM pipeline)
```

CRITICAL: All feature engineering respects train/test boundary.
City selection uses TRAINING set only to prevent data leakage.
Results are directly comparable across all methodologies.