Python Scripting for Regional Land Use Data Management and QC Workflow

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Research & Analysis
Southern California Association of Governments

Southern California Association of Governments (SCAG)

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Nation's largest Metropolitan Planning Organization (MPO)

6 counties and 191 cities

18.4 million people within 38,000+ square miles

GRP in 2013: $924 Billion
(16th largest economy in the world)

Overview

§ Background

§ Objectives

§ Methodology

§ Conclusions

BACKGROUND

2016 RTP/SCS and Senate Bill 375

§ 2016-2040 Regional Transportation Plan / Sustainable Communities Strategy (RTP/SCS)
- A long-range transportation plan

§ SB375 – California's Sustainable Communities Strategy (SCS) and Climate Protection Act
- Integration of transportation, land use, housing and environmental planning to meet the regional GHG emission reduction targets
- Requirements for land use, resource areas and farmland information

Bottom-Up Local Input Process

§ Bottom-up local input process

- Participation and cooperation of all 197 local government partners within the SCAG Region

§ To facilitate and assist in the local review of SCAG's land use, resource areas datasets and socioeconomic growth forecast information

- SCAG Data/Map Book

- One-on-one meeting

- Collect data changes, answer questions, provide technical guidance

Regional Land Use Database

§   Development of regional land use database in preparation for the 2016 RTP/SCS

- General plan land use & Zoning code (GPZN)
- Existing land use (LU)
- Specific plan land use (SP)

§   Updated and reviewed thru the bottom-up local input process

§   Base data for integrated growth forecast, scenario planning model, planning and policy analysis, etc.

Regional Land Use Database
(Dataset Overview)

§ City-level parcel dataset

- General plan land use and zoning (GPZN)

- Existing land use (LU)

- Specific plan land use (SP)

§ County-level parcel dataset

- General plan land use and zoning (GPZN)

- Existing land use (LU)

§ Regional-level dataset

- Specific plan land use and boundary (SP)

Regional Land Use Database (Attribute Information)

§ General plan and zoning (GPZN) / Specific plan (SP)
- City's GP/SP designations and zoning
- SCAG's standardized code
- Residential density (average, min/max)
- Adoption year, specific plan name

§ Existing land use (LU)
- SCAG's standardized LU code

§ SCAGUID12, APN, county, city, etc.

GPZN Attribute Table

GeneralPlan_poly_IM_2012

APN	FIPS	X_CENTER	Y_CENTER	Shape_Leng	Shape_Area	CITY	COUNTY	DENSITY	LOW	HIGH	YEAR_ADOPT	ZONE_CODE	CITY_GP_CO	SCAG_GP_CO	NOTES	ACRES
037-140-011	06025	638511.3907	3654162.91866	867.94793	38760.070408	Brawley	Imperial	0	0	0	9/1/2008	P-F	Public Facilities	1240		9.577822
037-140-017	06025	638595.999944	3654473.75361	1812.635074	118042.283834	Brawley	Imperial	0	0	0	9/1/2008	P-F	Public Facilities	1240		29.168884
037-160-045	06025	638041.062908	3652403.85166	285.334168	5133.691849	Brawley	Imperial	0	0	0	9/1/2008	M-1	Industrial	1300		1.26854
037-160-059	06025	637921.155732	3652554.56655	165.468035	997.060951	Brawley	Imperial	0	0	0	9/1/2008	M-1	Industrial	1300		0.246379
037-160-061	06025	637989.556365	3652537.32488	129.962566	687.650531	Brawley	Imperial	0	0	0	9/1/2008	M-1	Industrial	1300		0.169922
037-160-062	06025	638004.2586	3652522.24847	57.056496	132.771006	Brawley	Imperial	0	0	0	9/1/2008	M-1	Industrial	1300		0.032808
037-160-063	06025	637937.948128	3652381.99157	109.25227	382.189054	Brawley	Imperial	0	0	0	9/1/2008	M-1	Industrial	1300		0.094435
037-160-064	06025	638021.856001	3652459.28663	578.685552	14021.979706	Brawley	Imperial	0	0	0	9/1/2008	M-1	Industrial	1300		3.46489
037-160-065	06025	637957.38317	3652440.92265	131.069994	575.675568	Brawley	Imperial	0	0	0	9/1/2008	M-1	Industrial	1300		0.142253
037-160-066	06025	637901.711136	3652460.24545	598.816962	22186.776359	Brawley	Imperial	0	0	0	9/1/2008	M-1	Industrial	1300		5.482461
037-160-067	06025	637837.984264	3652373.12774	101.655653	523.578065	Brawley	Imperial	0	0	0	9/1/2008	M-1	Industrial	1300		0.129379
037-160-068	06025	637732.136451	3652585.937	439.827889	10386.666588	Brawley	Imperial	0	13	17	9/1/2008	R-3	Medium Density Residential	1120		2.566601
037-160-069	06025	637960.201947	3652609.10518	1208.85293	44769.09197	Brawley	Imperial	0	13	17	9/1/2008	R-3	Medium Density Residential	1120		11.062884
037-160-070	06025	637733.987673	3652444.80238	440.450656	12527.401026	Brawley	Imperial	0	13	17	9/1/2008	R-3	Medium Density Residential	1120		3.095588
037-160-071	06025	637833.540848	3652498.00581	216.087925	1451.313029	Brawley	Imperial	0	13	17	9/1/2008	R-3	Medium Density Residential	1120		0.358627
040-130-008	06025	636784.741195	3647114.55746	953.938872	53790.613387	Brawley	Imperial	0	0	0	9/1/2008	M-1	Industrial	1300		13.29195
040-130-009	06025	636809.938224	3647320.64962	526.890606	16889.522459	Brawley	Imperial	0	0	0	9/1/2008	M-1	Industrial	1300		4.173492
040-130-011	06025	636763.787475	3646941.74893	657.526047	20325.357819	Brawley	Imperial	0	0	0	9/1/2008	M-1	Industrial	1300		5.022505
046-050-028	06025	635805.571326	3650917.67922	215.433814	1949.176497	Brawley	Imperial	0	5.5	9	9/1/2008	R-E	Low Density Residential	1110		0.481652
046-050-029	06025	635639.581791	3650878.58522	349.806291	6670.000252	Brawley	Imperial	0	5.5	9	9/1/2008	R-E	Low Density Residential	1110		1.648193
046-050-030	06025	635625.890428	3650787.54154	402.263718	8855.781884	Brawley	Imperial	0	5.5	9	9/1/2008	R-E	Low Density Residential	1110		2.188311
046-050-034	06025	635299.792737	3650890.03907	959.768199	24728.807589	Brawley	Imperial	0	0	0	9/1/2008	A-1	Open Space	1800		6.110621

(0 out of 85929 Selected)

LU Attribute Table

landuse_poly_IM_2012

FID	Shape	SCAGUID12	APN	FIPS	X_CENTER	Y_CENTER	Shape_Leng	Shape_Area	CITY	COUNTY	LU12	ACRES
0	Polygon	0250037925	037-140-011	06025	638511.3907	3654162.91866	867.94793	38760.070408	Brawley	Imperial	1433	9.577822
1	Polygon	0250037930	037-140-017	06025	638595.999944	3654473.75361	1812.635074	118042.283834	Brawley	Imperial	1433	29.168884
2	Polygon	0250037971	037-160-045	06025	638041.062908	3652403.85166	285.334168	5133.691849	Brawley	Imperial	1510	1.26854
3	Polygon	0250037980	037-160-059	06025	637921.155732	3652554.56655	165.468035	997.060951	Brawley	Imperial	1510	0.246379
4	Polygon	0250037981	037-160-061	06025	637989.556365	3652537.32488	129.962566	687.650531	Brawley	Imperial	1311	0.169922
5	Polygon	0250037982	037-160-062	06025	638004.2586	3652522.24847	57.056496	132.771006	Brawley	Imperial	1311	0.032808
6	Polygon	0250037983	037-160-063	06025	637937.948128	3652381.99157	109.25227	382.189054	Brawley	Imperial	1311	0.094435
7	Polygon	0250037984	037-160-064	06025	638021.856001	3652459.28663	578.685552	14021.979706	Brawley	Imperial	3100	3.46489
8	Polygon	0250037985	037-160-065	06025	637957.38317	3652440.92265	131.069994	575.675568	Brawley	Imperial	3100	0.142253
9	Polygon	0250037986	037-160-066	06025	637901.711136	3652460.24545	598.816962	22186.776359	Brawley	Imperial	1311	5.482461
10	Polygon	0250037987	037-160-067	06025	637837.984264	3652373.12774	101.655653	523.578065	Brawley	Imperial	1450	0.129379
11	Polygon	0250037988	037-160-068	06025	637732.136451	3652585.937	439.827889	10386.666588	Brawley	Imperial	3100	2.566601
12	Polygon	0250037989	037-160-069	06025	637960.201947	3652609.10518	1208.85293	44769.09197	Brawley	Imperial	3100	11.062884
13	Polygon	0250037990	037-160-070	06025	637733.987673	3652444.80238	440.450656	12527.401026	Brawley	Imperial	3100	3.095588
14	Polygon	0250037991	037-160-071	06025	637833.540848	3652498.00581	216.087925	1451.313029	Brawley	Imperial	1300	0.358627
15	Polygon	0250039055	040-130-008	06025	636784.741195	3647114.55746	953.938872	53790.613387	Brawley	Imperial	1300	13.29195
16	Polygon	0250039056	040-130-009	06025	636809.938224	3647320.64962	526.890606	16889.522459	Brawley	Imperial	1300	4.173492
17	Polygon	0250039058	040-130-011	06025	636763.787475	3646941.74893	657.526047	20325.357819	Brawley	Imperial	1300	5.022505
18	Polygon	0250045973	046-050-028	06025	635805.571326	3650817.67922	215.433814	1949.176497	Brawley	Imperial	1800	0.481652
19	Polygon	0250045974	046-050-029	06025	635639.581791	3650878.58522	349.806291	6670.000252	Brawley	Imperial	1110	1.648193
20	Polygon	0250045975	046-050-030	06025	635625.890428	3650787.54154	402.263718	8855.781884	Brawley	Imperial	3100	2.188311
21	Polygon	0250045978	046-050-034	06025	635299.792737	3650890.03907	959.768199	24728.807589	Brawley	Imperial	1800	6.110621
22	Polygon	0250045979	046-050-035	06025	635205.242367	3650747.61545	239.232766	2440.783677	Brawley	Imperial	1820	0.603131

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Regional Land Use Database (Dataset Size)

County	Parcel No.	GPZN Size	LU Size
Imperial	85,929	62 MB	33 MB
Los Angeles	2,092,552	1,620 MB	965 MB
Orange	661,051	682 MB	471 MB
Riverside	810,948	749 MB	490 MB
San Bernardino	804,529	615 MB	358 MB
Ventura	252,602	238 MB	158 MB
SCAG Region	4,707,611	3.92 GB	2.41 GB

OBJECTIVES

Objectives

§ Development of an effective workflow for regional land use database

- To develop an efficient regional land use data management and QC process
- To develop a standardized and reliable workflow

METHODOLOGY

Base Data Development Process

§ Data source

- 2008 GPZN and LU datasets
- DMP LPS property data
- DMP new construction data

§ Data processing

- Property data processing thru Statistical Analysis Software (SAS)
- Geoprocessing thru ArcGIS applications and Python scripting

Data Entry and Update Process

§ Manual data entry and update by staff
- Inputs received from jurisdictions

§ Correspondence table
- City's GP code vs. SCAG's land use code
- Residential density (average, min/max)

§ Potential human errors/mistakes
- Incorrect attribute field value – land use, city name, density info, etc.
- Incorrect parcel shape & location

Data Review Process

§ Work Plan for data QC process

- City-level GPZN and LU datasets

- County-level GPZN and LU datasets

- Data standardization

§ Types of QC

- Attribute field information

- Feature comparison

- Spatial match

§ Development of Python-based workflow

Work Plan for Data QC Process (City-Level Datasets)

§ QC for City-Level GPZN and LU Datasets

- Geographic comparison
  - Parcel location with city boundary data
- Feature comparison
  - Geometry
  - Feature count
  - Attribute field count
- Attribute field information
  - Field value accuracy, e.g. city name match, residential density, null values

Work Plan for Data QC Process (County-Level Datasets)

§ QC for County-Level GPZN and LU Datasets

- Feature comparison
  - Feature count
  - New SCAGUID12
- Attribute field information
  - Field value accuracy, e.g. incorrect land use codes, duplicate SCAGUID12, null value
- School locations in Orange County

Work Plan for Data QC Process (Data Standardization)

§ Data Standardization

- Convert old GPZN & LU codes to new codes
- Standardization of attribute field properties
  - Field value type and lengths
- Standardization of GPZN & LU datasets
  - Merge city-level datasets to county-level
  - Disaggregate county-level datasets to city-level.
  - Feature Comparison between old version and newly disaggregated version

Sample Python Scripts
(Feature Comparison)

§ *FeatureCompare_Management*

```
# Set variables for feature comparison
baseFeature = "P:/=general_plan_2012/shapes/=updates/City/" + cnty + "/" + cityName + "_GPZN.shp"
testFeature = "P:/=existing_landuse 2012/shapes/City/=updates/" + cnty + "/" + cityName + "_LU.shp"
sortField = "SCAGUID12"
xyTolerance = "1 METERS"
compareType = "GEOMETRY_ONLY"
continueCompare = "CONTINUE_COMPARE"

# Compare feature and print the results
compareResult = arcpy.FeatureCompare_management(baseFeature, testFeature, sortField, compareType, "",
xyTolerance, "", "",     "", "", continueCompare)
print compareResult
print arcpy.GetMessages()
```

§ *output*

```
===== Begin of Feature Comparison for IM =====
Brawley (Total Features: 7319)

Executing: FeatureCompare P:/=general_plan_2012/shapes/=updates/City/IM/Brawley_GPZN.shp
"P:/=existing_landuse   2012/shapes/City/=updates/IM/Brawley_LU.shp" SCAGUID12 GEOMETRY_ONLY # "1 Meters"
0.001 0.001 # # CONTINUE_COMPARE #
Start Time: Mon Sep 08 17:08:44 2014
Table: Tables have different number of fields (Base: 24, Test: 13).
Table: Table row counts are the same.
SpatialReference: Spatial references are the same.
FeatureClass: Geometries are the same.
Succeeded at Mon Sep 08 17:08:45 2014 (Elapsed Time: 1.00 seconds)
```

Sample Python Scripts (Attribute Fields)

§ *SearchCursor, getValue*

```python
cursor = arcpy.SearchCursor(fc)
for row in cursor:
    citynameRow = row.getValue(cityField)
    citygpRow = row.getValue(citygpField)
    scaggpRow = row.getValue(scaggpField)
    zoneRow = row.getValue(zoneField)

    if citynameRow != cityName:
        citynameNull = citynameNull + 1
    if citygpRow == " ":
        citygpNull = citygpNull + 1
    if scaggpRow == " ":
        scaggpNull = scaggpNull + 1
    if zoneRow == " ":
        zoneNull = zoneNull + 1
parcelNum = parcelNum + 1
```

```python
cursor = arcpy.SearchCursor(fc)
for row in cursor:
    cityRow = row.getValue(cityField)
    gpRow = row.getValue(gpField)
    uidRow = row.getValue(uidField)

    if cityValue == cityRow:
        if gpRow not in correctGP:
            incorrectGP = incorrectGP + 1
            parcelNum = parcelNum + 1
            print cityValue + " (" + uidRow
            + "): " + gpRow
    else:
        parcelNum = parcelNum + 1
```

§ *CalculateField_management*

```python
if luRow == "1113":
    luRow_before = luRow
    arcpy.CalculateField_management (fc, luField, "1150")
```

Sample Python Scripts (Standardization)

§ *SelectLayerByAttribute_management*

```
# Make a layer from the feature class
arcpy.MakeFeatureLayer_management(fc, "test")

# Select features by 'CITY' name
whereClause = '"' + cityField + '"= ' + "'" + cityValue + "'"
arcpy.SelectLayerByAttribute_management("test","NEW_SELECTION",whereClause)

# Write the selected features to a new featureclass
newFC = "P:/=general_plan_2012/shapes/=updates/County/GPZN_County_Feb2015/
=breakdown/" + cnty + "/" + cityName + "_GPZN.shp"
arcpy.CopyFeatures_management("test", newFC)
```

§ *Merge_management, AddField_management*

```
# Merge city-level shapefiles to county-level shapefiles
fcList = arcpy.ListFeatureClasses("*.shp", "")
fcMerged = "P:/=general_plan_2012/shapes/=updates/County/GPZN_County_Feb2015/GeneralPlan
_poly_" + cnty + "_2012.shp"
arcpy.Merge_management(fcList, fcMerged)

# Add a field to include parcel acreage and calculate acreage
arcpy.AddField_management (fcMerged, "ACRES", "DOUBLE", 15, 10, "", "ACRES", "NULLABLE")
arcpy.CalculateField_management(fcMerged, "ACRES", "!shape.area@acres!", "PYTHON_9.3")
```

CONCLUSIONS

Benefits of Python Scripting for Data Management and QC Workflow

§ More effective and efficient data management and review process

- By processing a large number of datasets faster
  By processing a individual dataset with a lot of features faster

§ More consistent and reliable data production

- Consistent chain of data management and review process
- Conformity with standardized data format

§ More effective file and directory management system development thru various Python modules

Thank you!

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