What is analysis?

Analysis transforms raw data into information or knowledge.

*Spatial analysis* does this for geographic or spatial data.

Spatial analysis is used to answer questions with a *where* component.

Where is the most accessible location for a new community center?
Where is an area with statistically high crime rates?
Where has the landscape changed the most in the last 10 years?
What is geoprocessing?

**Geoprocessing** is a rich suite of tools for *processing* geographic data

Analysis + Data Management + Conversion + More

A typical geoprocessing tool processes input data and produces an output

For example, Buffer a map layer to create proximity areas around the layer’s features

Geoprocessing is also a framework you can use to model and automate processes using ModelBuilder or Python scripts
Analysis in ArcGIS Pro

ArcGIS Pro provides incredible analysis capabilities in 2D, 3D, and 4D (time)
Scalable 64-bit execution, non-blocking threading, 60 parallel tools, and improved viz

The *Analysis* ribbon tab provides access to

- Gallery of commonly-used tools
- Suite of all 1000+ geoprocessing tools
- ArcGIS Enterprise and Online analysis tools
- Geoprocessing History
- Python command line

- ModelBuilder
- Network Analysis
- Geostatistical modeling
- Raster Functions
- Data Interoperability Workbench
Geoprocessing in ArcGIS Pro

Rich user experience driven through the Geoprocessing pane
- Search for tools or explore Toolboxes
- Open tools and set parameter and environment settings
- Run the tool and track progress
- View recently run tools and history

Supports most tools, models, and Python scripts that work in ArcMap; esriurl.com/MissingTools

*ArcObjects-based custom tools are not supported

Supports traditional feature and raster data sources as well as web layers

History provides a log of all tools you run
- Share as a geoprocessing package or web tool
Model or script a geoprocessing workflow

Automate geoprocessing in a Python script

To get started, run the tool in Pro, then
*Copy Python command* and paste into script

```
arcpy.Buffer_analysis(input, output, "10 Miles")
```

Build a model of your workflow using ModelBuilder

Connect tools and data to make a diagram that represents your workflow
Batch Geoprocessing

Allows you to run the tool multiple times using many input datasets or different parameter settings

Makes it possible to run a given tool as many times as needed with very little interaction

For example, you can run the batch Clip tool to clip several layers to the same study area

Builds a model in the background so you can learn and extend your batch process
Python in ArcGIS Pro

Command line with syntax help and intellisense

Uses Conda environment manager and enhanced with built-in Python Package Manager

Makes it easy to find and install additional libraries, including Python API for ArcGIS for scripting portal operations

Pro includes new data analysis libs Pandas, SciPy, and NetCDF4; ArcGIS API For Python
Charts

Use charts to explore your data and communicate a message.

Include as part of your analysis workflow to:
- Understand patterns and relationships before running an analysis.
- Communicate information about your analysis results.

Create a bar chart, scatter plot, histogram, line chart, 3D profile graph, box plot, data clock, temporal profile (raster) or spectral profile (raster).

Fully interactive with the map layers and extent, attribute table, and range and time filters.
Demo
Statistical Analysis
Spatial Statistics and R integration
Spatial Statistics

Statistical tools for analyzing spatial distributions, patterns, processes and relationships

- Summarize key characteristics of a spatial distribution
- Identify significant clusters and outliers, hot and cold spots
- Model and explore spatial relationship through regression

Space-Time Pattern Mining

- Aggregate data into cube data structure
- Identifies hot and cold spot trends and outliers
- Visualize the cube in 3D
Spatial Statistics Advancements

Available only in ArcGIS Pro

Many new capabilities focusing on spatial machine learning

Clustering  Classification  Regression
Clustering

The grouping of observations based on similarities of values or locations
Clustering

The grouping of observations based on similarities of values or locations

New in ArcGIS Pro 2.1 - Density-based Clustering

Use machine learning techniques to find clusters based purely on spatial location and a specified cluster size
Clustering

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New in ArcGIS Pro 2.1 – Multivariate Clustering

Use machine learning techniques to find natural clusters of features based solely on feature attribute values
**Clustering**

The grouping of observations based on similarities of values or locations

**New in ArcGIS Pro 2.1 - Density-based Clustering**

Use machine learning techniques to find clusters based purely on spatial location and a specified cluster size

**New in ArcGIS Pro 2.1 – Multivariate Clustering**

Use machine learning techniques to find natural clusters of features based solely on feature attribute values

**New in ArcGIS Pro 2.1 – Spatially Constrained Multivariate Clustering**

Use machine learning techniques to find spatially contiguous clusters of features based on a set of feature attribute values and optional cluster size limits
Clustering

The grouping of observations based on similarities of values or locations

New in ArcGIS Pro 2.2 – Time Series Clustering

Use machine learning techniques to cluster features based on time series characteristics
Prediction and Classification

**Prediction:** Using the known to estimate the unknown

**Classification:** The process of deciding to which category an object should be assigned based on a training dataset

**New in ArcGIS Pro 2.2:** Forest-based Classification and Regression

Use Random Forest machine learning algorithm for classification and regression
R-ArcGIS Bridge

Leverage powerful statistical analysis in R with spatial methods in ArcGIS

Integration at every level
- R scripts supported across ArcGIS
- Accessible, reproducible science

Raster support (new)
Online Analytics
Leverage ArcGIS Online and Enterprise
Integration with Web GIS

ArcGIS Pro is designed to be connected to ArcGIS Online and ArcGIS Enterprise

Access information and layers stored in your web GIS

Share custom analytics as web tools to ArcGIS Enterprise

Leverage the full analytic power of ArcGIS, including ArcGIS Online and ArcGIS Enterprise tools and services
Leverage ArcGIS Online and ArcGIS Enterprise Analysis Tools

Ready to use tool hosted in ArcGIS Online

ArcGIS Enterprise Standard Feature tools

ArcGIS Enterprise GeoAnalytics Server

Process large feature data with both spatial and temporal components in distributed environment

ArcGIS Enterprise Image Server Raster Analytics

Enables distributed processing and analysis of imagery and raster data
Analysis Extensions
Analysis Extensions

Extensions build on the core analysis capabilities of ArcGIS Pro

- 3D Analyst
- Business Analyst
- Geostatistical Analyst
- Image Analyst
- Network Analyst
- Spatial Analyst

Comprised of additional geoprocessing toolboxes and interactive capabilities

Extension licensing is consistent between ArcMap and ArcGIS Pro

Same licensing models for ArcGIS Pro are used for extensions
(Named User, Single Use, Concurrent Use)
Elevation surface creation and analysis using 3D vector geometries, rasters, 3D TINs, terrains, and point clouds

Perform analysis, visualize, and classify Lidar and point-cloud data in the LAS dataset format

Measuring 3D distances and evaluating 3D spatial relationships

Volumetric and visibility analysis

NOTE: 3D mapping and visualization does not require 3D Analyst extension
3D Exploratory Analysis

Provides interactive exploration and visibility/field of view analysis capabilities in 3D

- Line of Sight
- View Dome
- Viewshed
- Slice

Analysis done on-the-fly using screen resolution, inputs and outputs are screen overlay graphics

For high-precision analysis and to persist or share results, use 3D Analyst geoprocessing tools

NOTE: Does NOT require the 3D Analyst extension
Network Analyst

20+ geoprocessing tools that automate network analysis

Ribbon-based workflow makes it interactive and easy
- Routing and Directions
- Closest Facility
- Location-Allocation
- Drive Times and Service Areas
- Vehicle Routing
- Origin-Destination Matrix

Workflow steps include
1. Create a network analysis layer
2. Add locations and set options
3. Solve

2D and 3D network analysis

Works with your network dataset or
Online network service
Analyze market trends, including customer and competitor analysis, site evaluation, and sales territory planning

Demographics and summary reports based on exhaustive Business Analyst datasets or ArcGIS services

Enrich your data with demographic, lifestyle, spending, or landscape attributes

Interactive site selection and suitability analysis

Not just for commercial or retail!
Image Analyst

Provides capabilities for image analysts, photogrammetrists, and geospatial analysts who focus on image processing, interpretation, analysis, and creation of information from imagery.

- **Image Classification**
- **Stereo Mapping**
- **Image Space**
- **Full Motion Video**

New in ArcGIS Pro 2.1

New in ArcGIS Pro 2.2
Spatial Analyst

Extension available across the ArcGIS platform
Provide spatial modeling and analysis tools for raster data
Spatial Analyst key features

- Suitability modeling
- Density analysis
- Distance and cost of travel analysis
- Hydrologic analysis, watersheds
- Powerful Map Algebra language & Raster Calculator

Leverage Image Server Raster Analytics for distributed spatial analyst workflows

Many Spatial Analyst workflows can also be achieved via raster functions
Spatial Analyst

New tools
Improved tool algorithms and parameters
More Spatial Analyst tools have been updated to support parallel processing
Improved hydrologic modeling scalability

New Polygon Option in the Contour tool
New Cost Path as a Polyline tool
Predicting flood levels for hurricane Harvey

Using Spatial Analyst, Image Server, and ArcGIS Online

National scale flood forecasting
Geostatistical Analyst

Statistical models and tools for spatial interpolation
   Predict values at new locations based on measurements in known locations
   Creates statistically valid prediction surfaces along with prediction uncertainty or error

Interactive Geostatistical Wizard

Advanced geostatistical interpolation methods
   Empirical Bayesian Kriging
   Areal Interpolation
   EBK regression prediction
EBK Regression Prediction

Available only in ArcGIS Pro

A geostatistical multivariate prediction tool

Used to predict values of phenomena using secondary variables

Provide improved predictions at un-sampled locations

Better results by combining regression and kriging
Learn more about spatial analysis & geoprocessing in Pro

esriurl.com/ProAnalysis
esriurl.com/AnalysisCaseStudies
esriurl.com/ArcGISAnalyticsBlog

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