# Geol 588

# -

# GIS for Geoscientists II

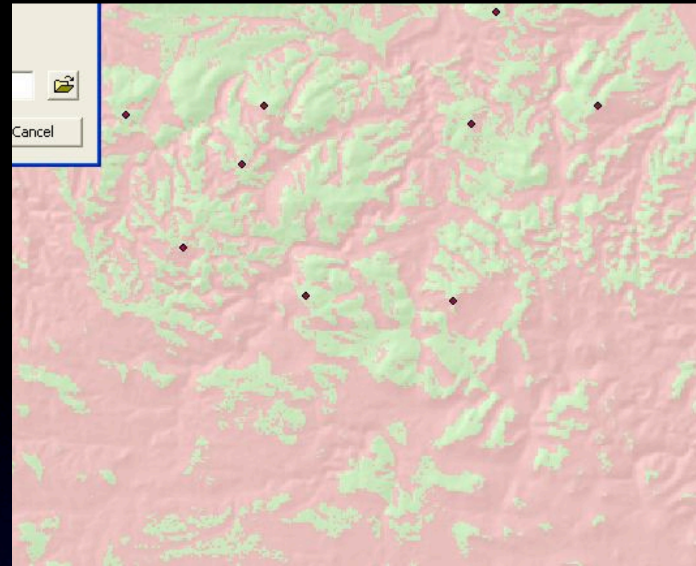
## Lecture 5 - Interpolation

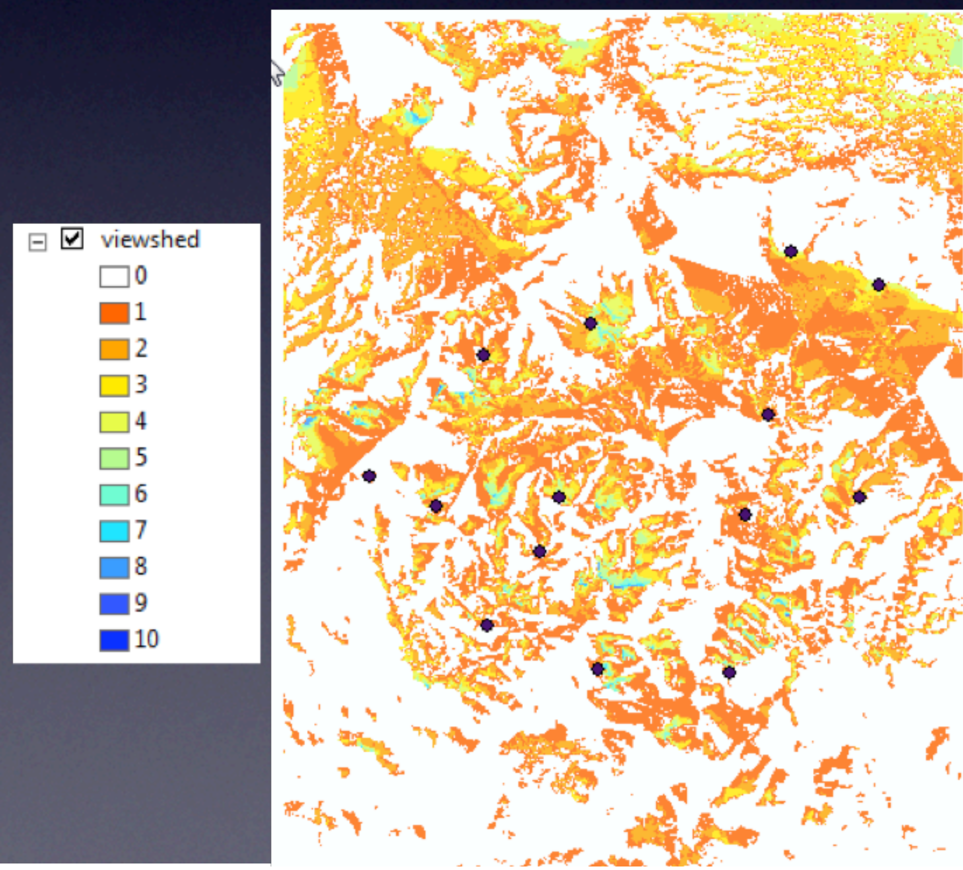
# Today

- Ex. 3 solution
- 2D spatial interpolation (theory)
- Pause
- Effects toolbar
- Interpolation in ArcGIS (examples)
- Away March 31 and April 2
- On Thursday - Intro to ArcScene?

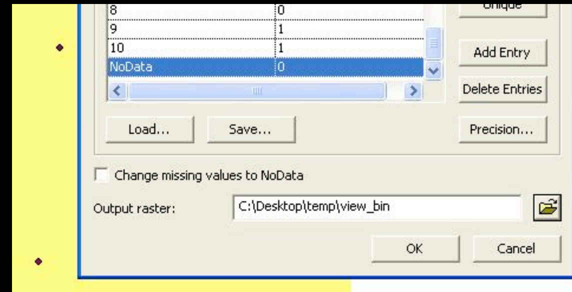
# Ex. 3 - Many Peaks

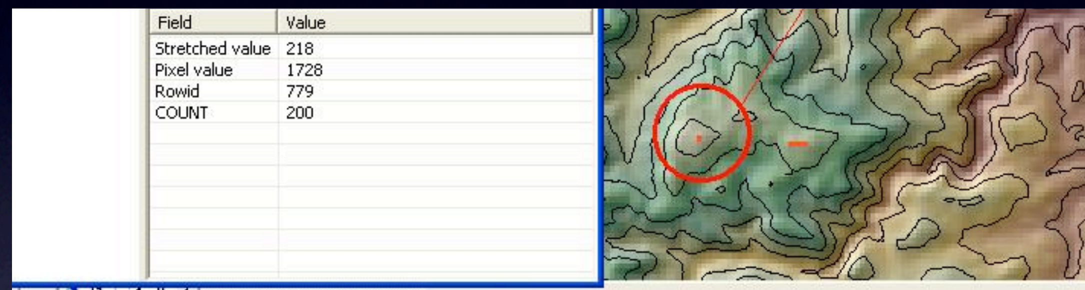
- Where to build a lodge?
  - has a view of as many peaks as possible
  - viewshed analysis uses canopy (elevation + trees)
  - also: need flat ground (< 5 deg. slope)
- possible cell values in initial viewshed: 0 to 10 (# of peaks)



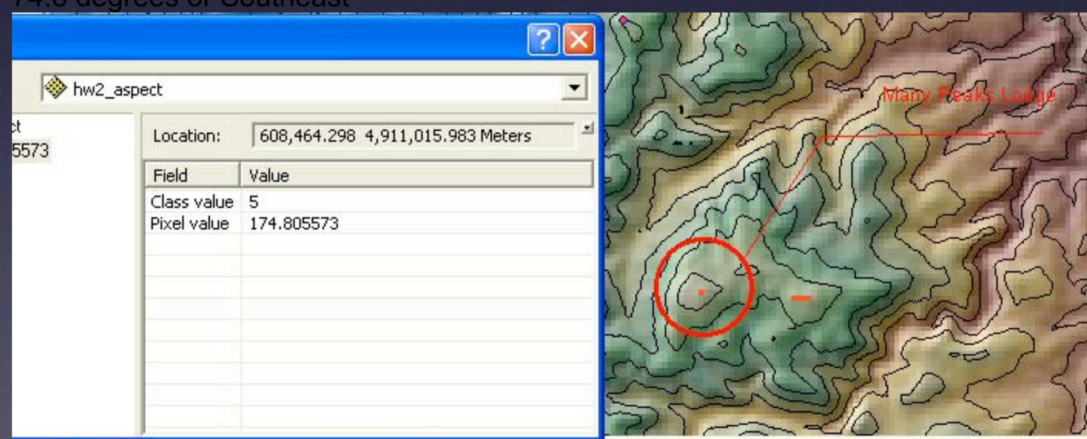



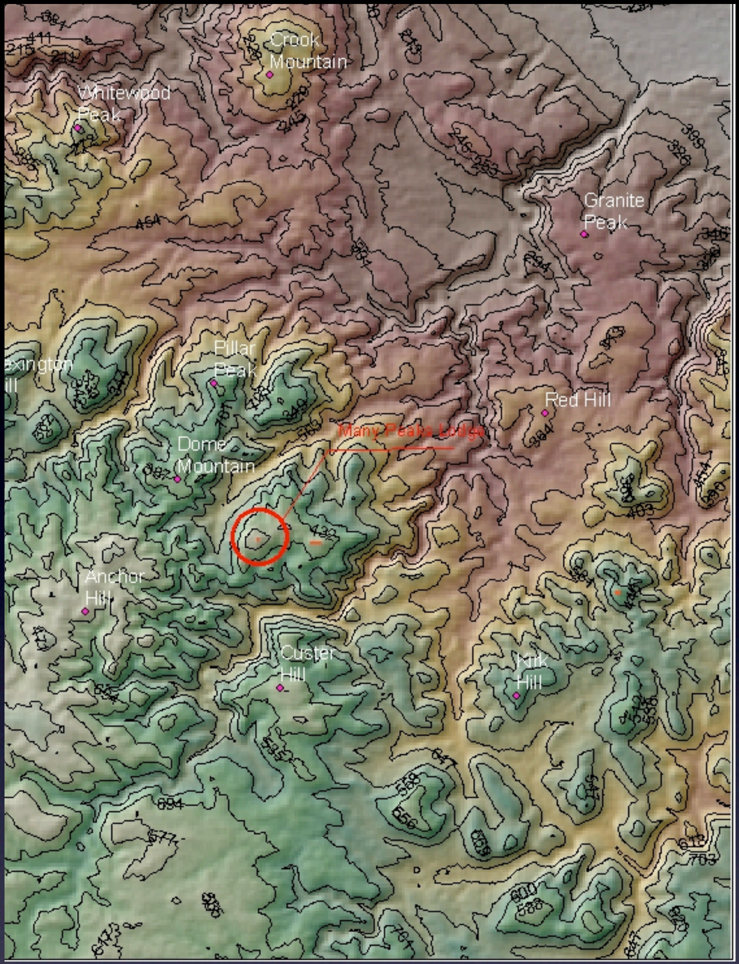
- reclass to
  0-8 => 0, 9-10 => 1
- show cells with 1 with good contrast
- use Identify tool to get slope, azimuth, coordinates
- Create final map (with hillshade and 50 ft contours)



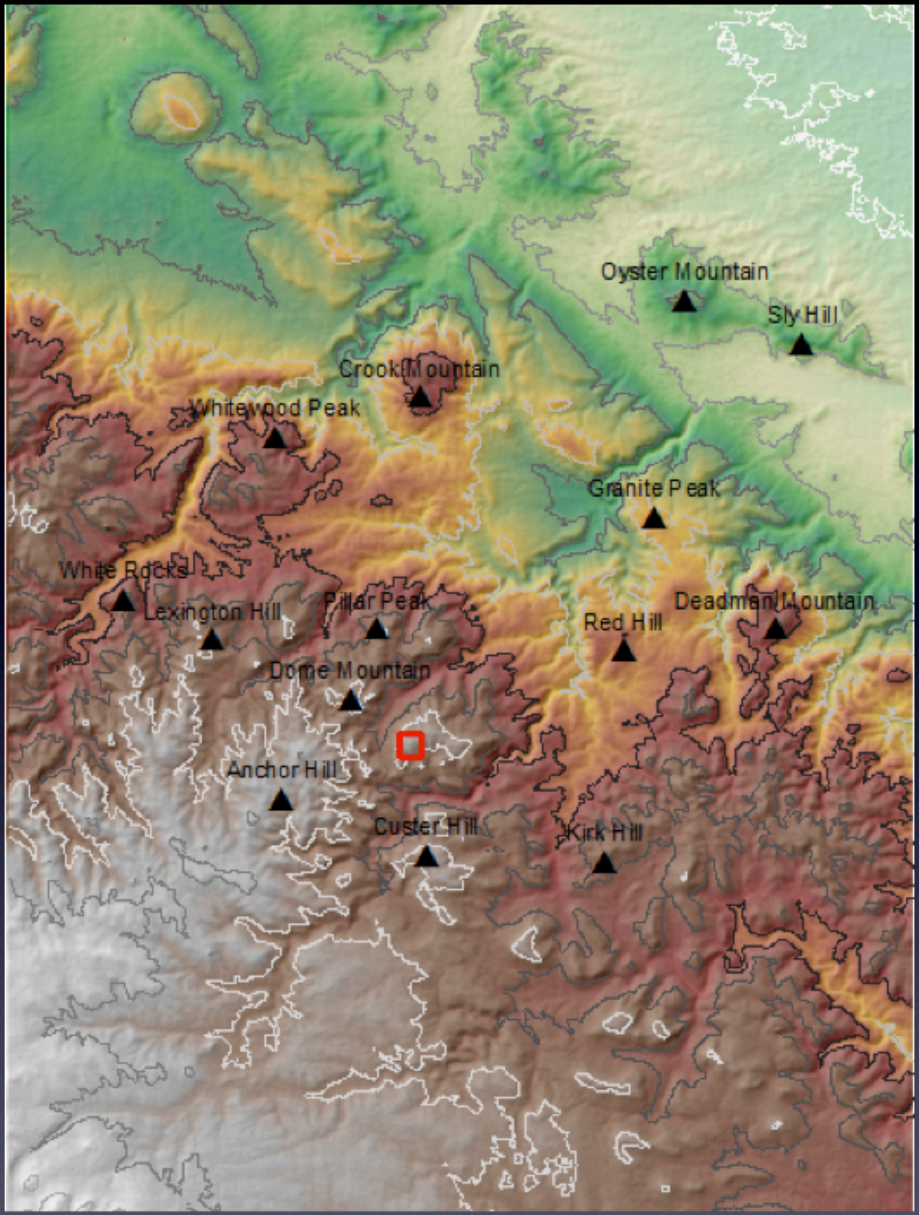




74.8 degrees or Southeast



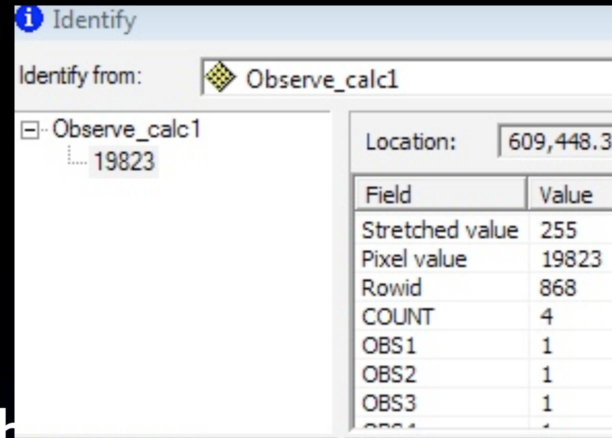



Green for low elevations?




contours in black?

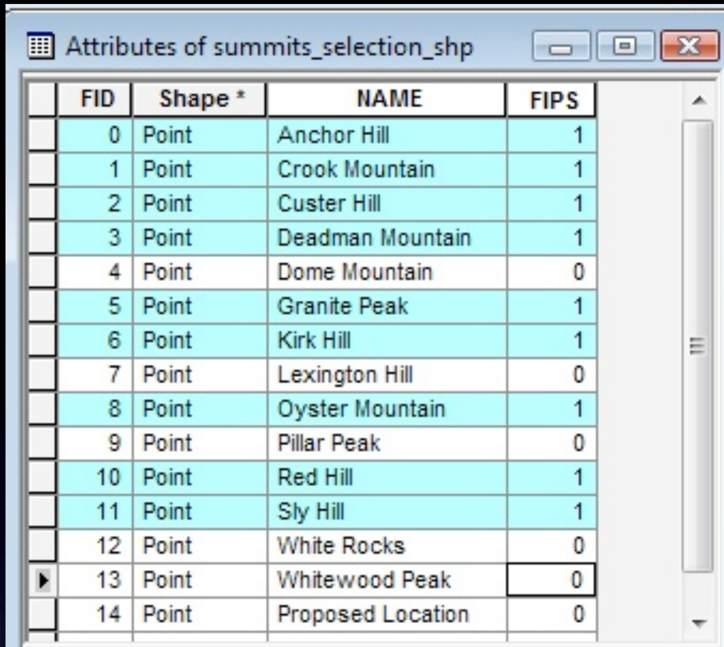
- Optional: Find out which (9) peaks are in sight from lodge




- Add lodge to summits point shape file (as FID=15)
- Run Observer points tool ( => new observer grid)
- Identify tool - what's value of observer grid at lodge location?
- Look up value in observer grid's attribute table
- Get all OBS*xx* with 1 (summit can see lodge and vice versa)

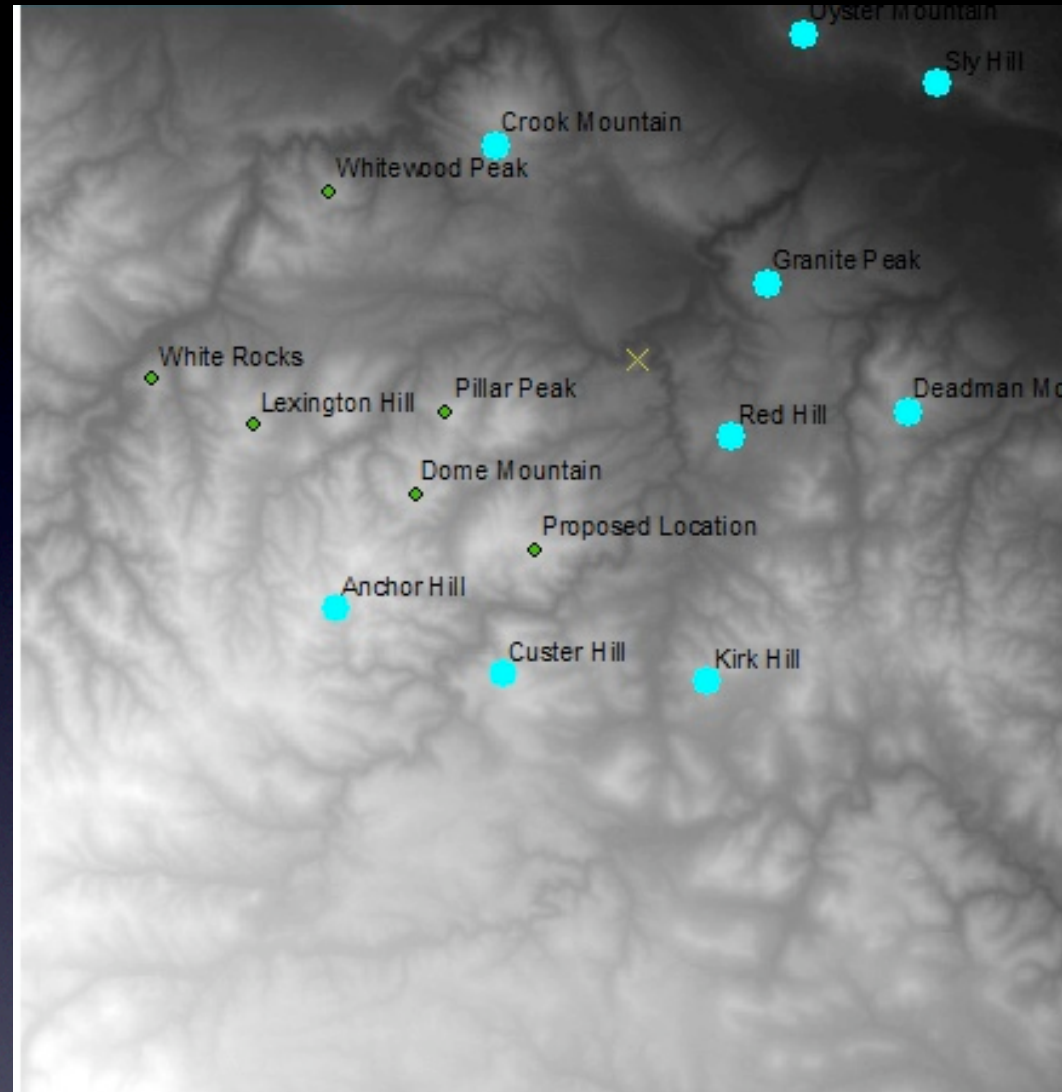
Attributes of Observe_calc1

| Rowid | VALUE * | COUNT | OBS1 | OBS2 | OBS3 | OBS4 | OBS5 | OBS6 | OBS7 | OBS8 | OBS9 | OBS10 | OBS11 | OBS12 | OBS13 | OBS14 | OBS15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 863 | 19816 | 36 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 1 |
| 864 | 19817 | 5 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 1 |
| 865 | 19818 | 2 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 1 |
| 866 | 19820 | 8 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 1 |
| 867 | 19821 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 1 |
| 868 | 19823 | 4 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 1 |
| 869 | 19880 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 1 |
| 870 | 19884 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 1 |



Attributes of summits_selection_shp

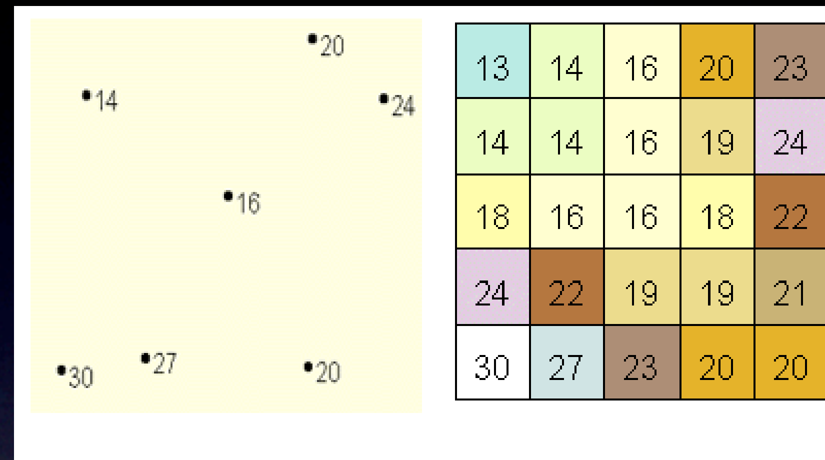
| FID | Shape * | NAME | FIPS |
|---|---|---|---|
| 0 | Point | Anchor Hill | 1 |
| 1 | Point | Crook Mountain | 1 |
| 2 | Point | Custer Hill | 1 |
| 3 | Point | Deadman Mountain | 1 |
| 4 | Point | Dome Mountain | 0 |
| 5 | Point | Granite Peak | 1 |
| 6 | Point | Kirk Hill | 1 |
| 7 | Point | Lexington Hill | 0 |
| 8 | Point | Oyster Mountain | 1 |
| 9 | Point | Pillar Peak | 0 |
| 10 | Point | Red Hill | 1 |
| 11 | Point | Sly Hill | 1 |
| 12 | Point | White Rocks | 0 |
| 13 | Point | Whitewood Peak | 0 |
| 14 | Point | Proposed Location | 0 |

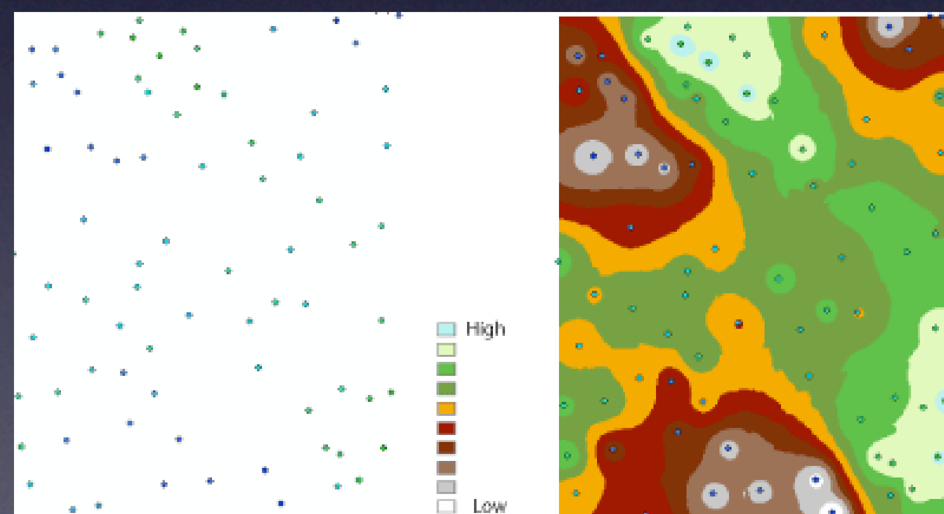



- Figure out which OBS*xx* is which peak name
- Select and show on map (or use special symbol)

# Spatial Interpolation

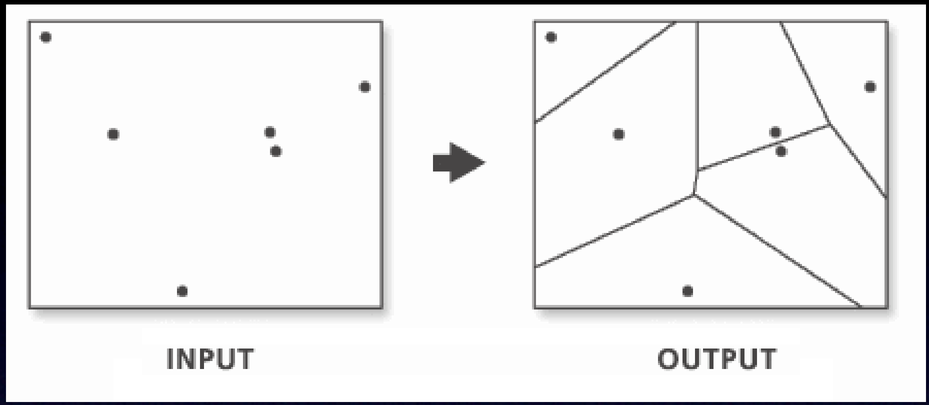
- point samples (x,y, "value")
- fill each cell (center) in raster with an "appropriate" value
- Principle: the *closer* together points are, the *more similar* their value (should be)
- (depends on many factors: type of underlying phenomenon, etc.)
- Examples?
- in general: distance **and** sample value matter

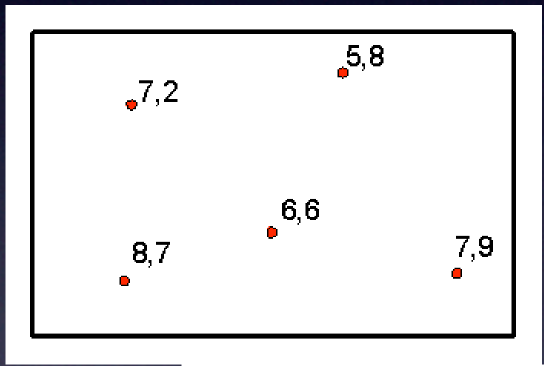


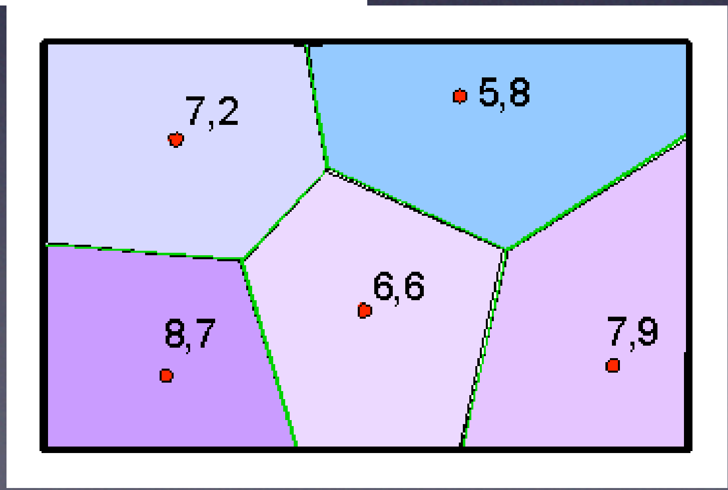



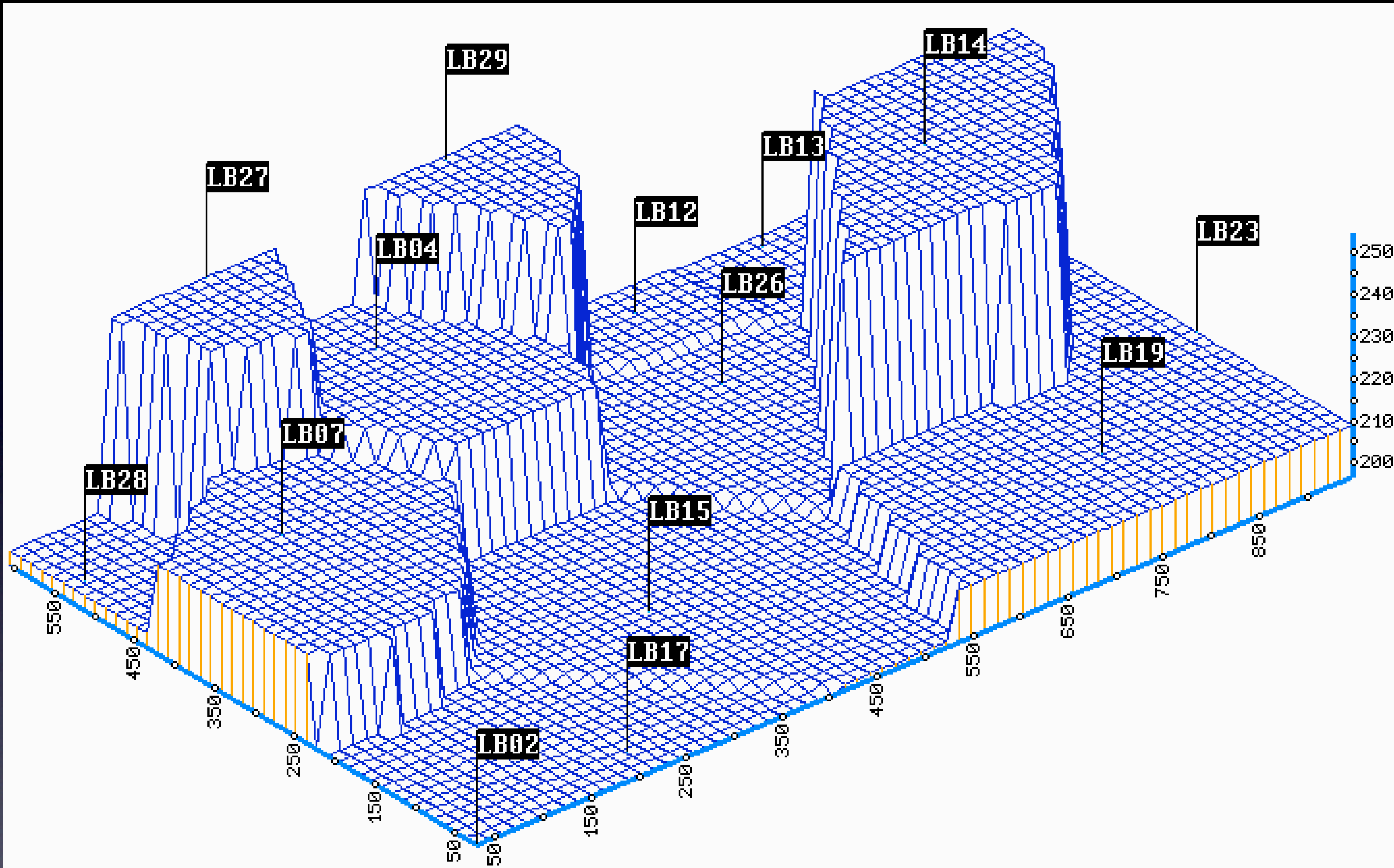
# Thiessen (Voronoi) polygons

- Interpolation? Space division scheme?
- Assign each sample "its fair share" of space around it
- Raster: fill this space (polygon) with **same** value
- Problem?



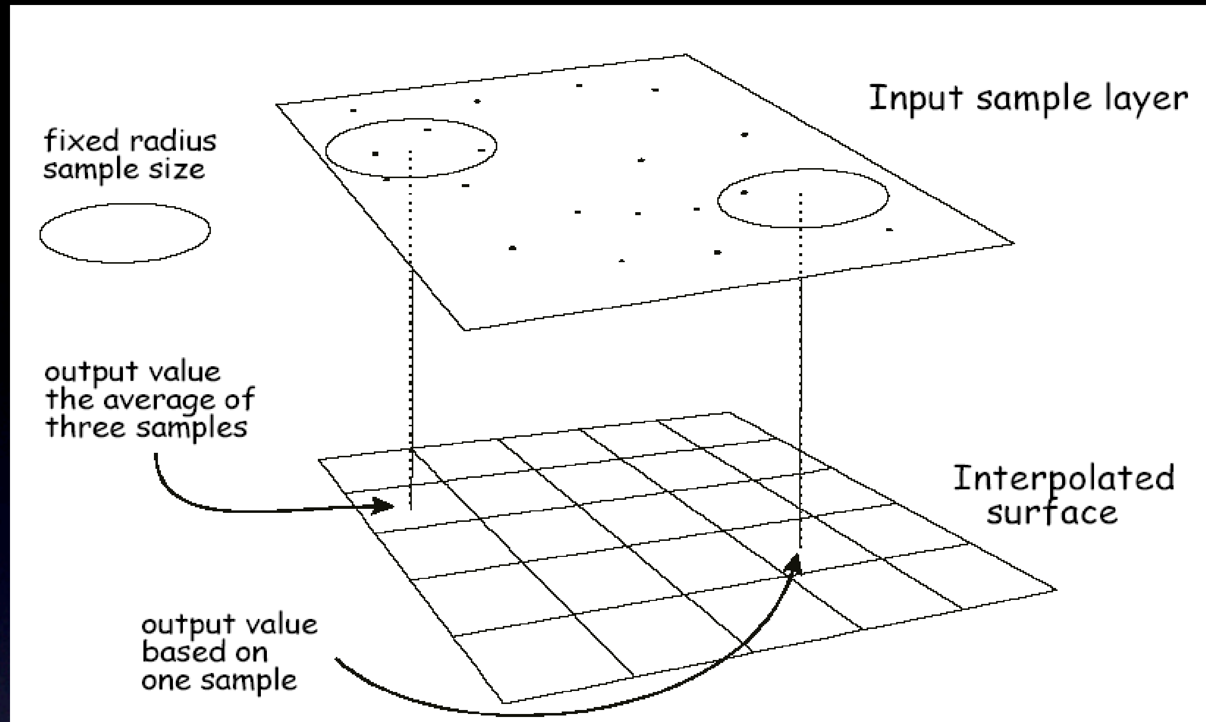



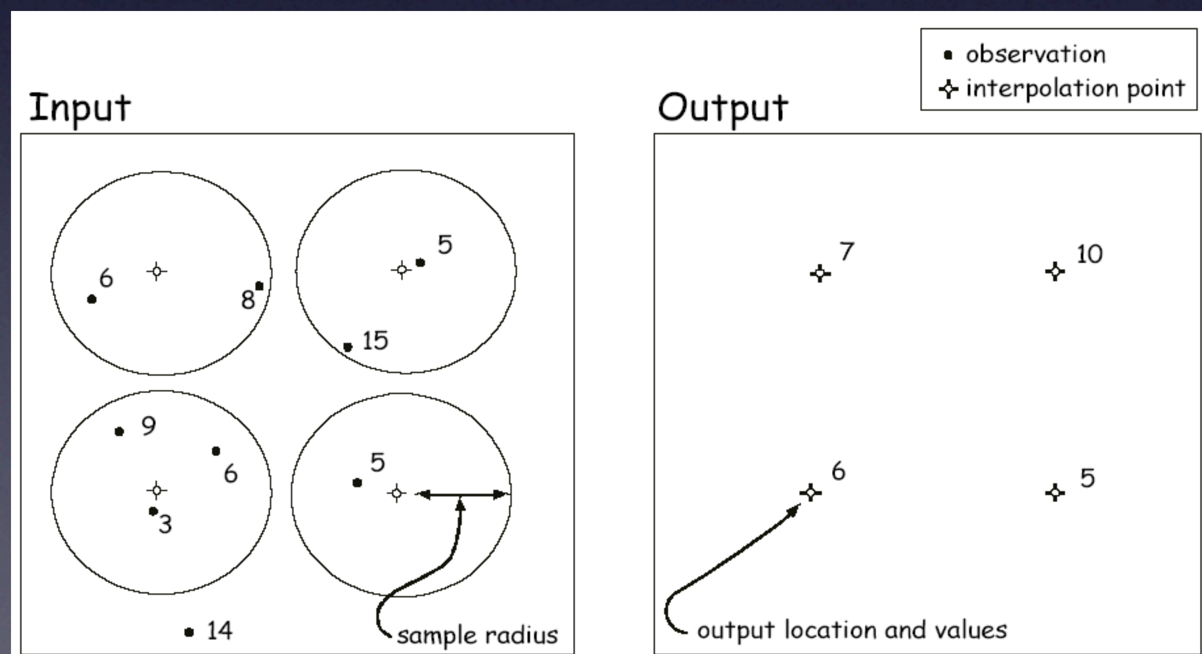



(Thiessen polygons: not in spatial analyst but keep in mind for later)

# Moving "Averaging"

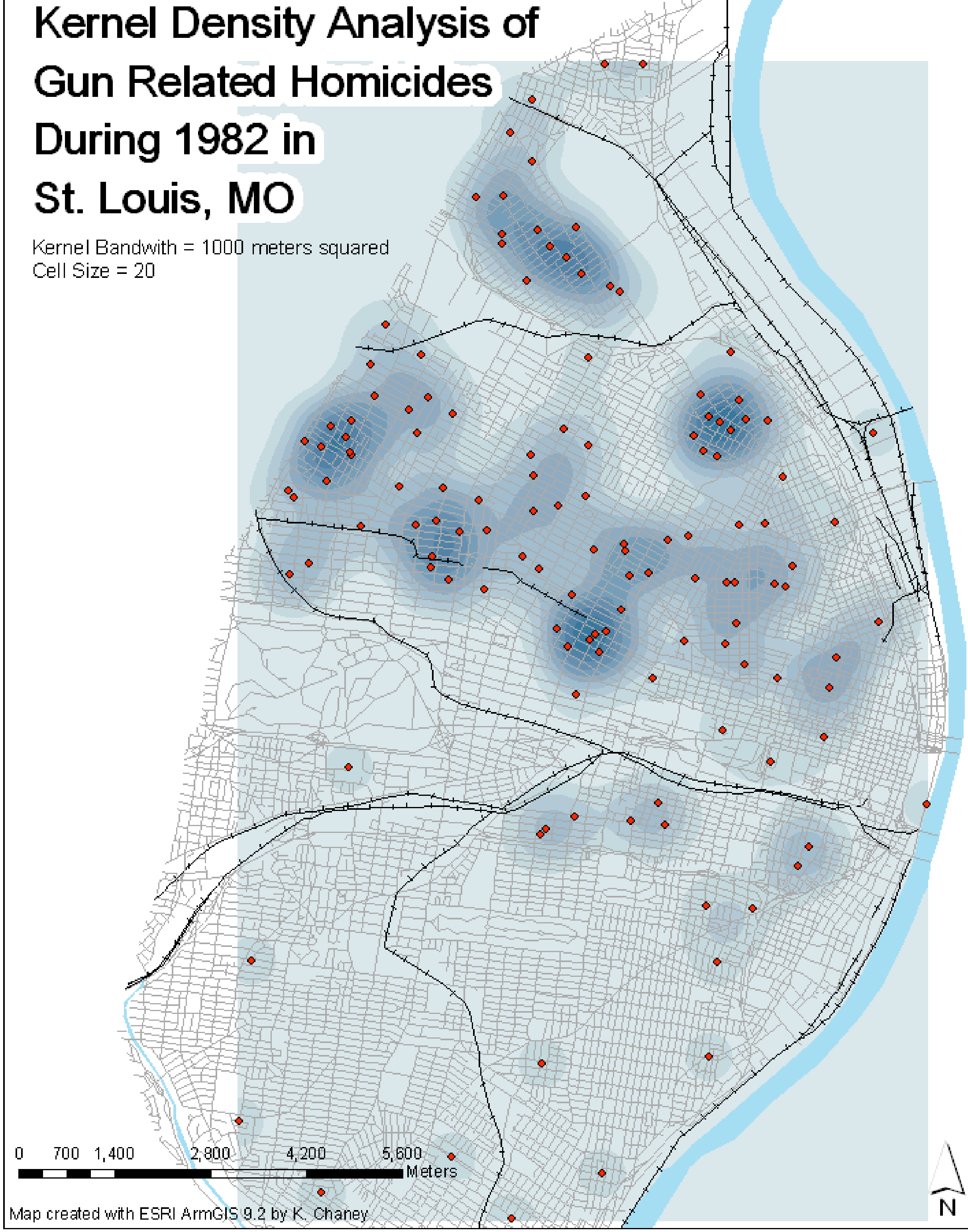
- Simple form: grab all the point samples within the sample radius
- Cell value is Sum of these points' values divided by their number (mean)
- problem?
- (interpolated value at sample location?)

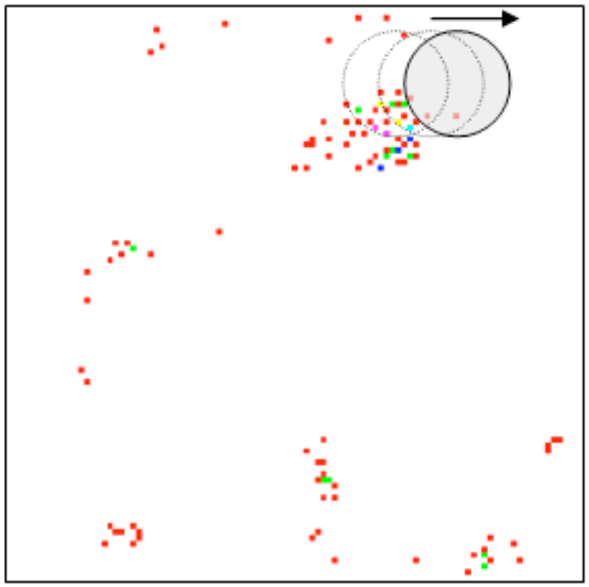


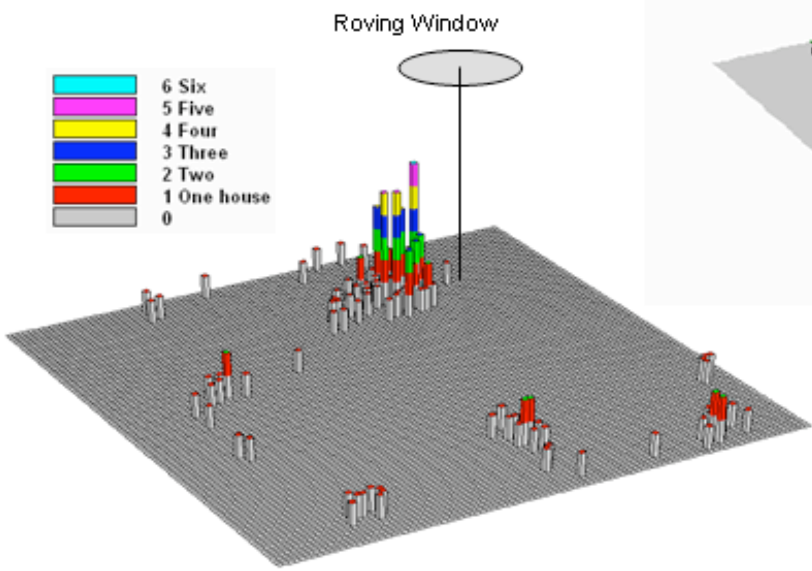



# Related topic: point density

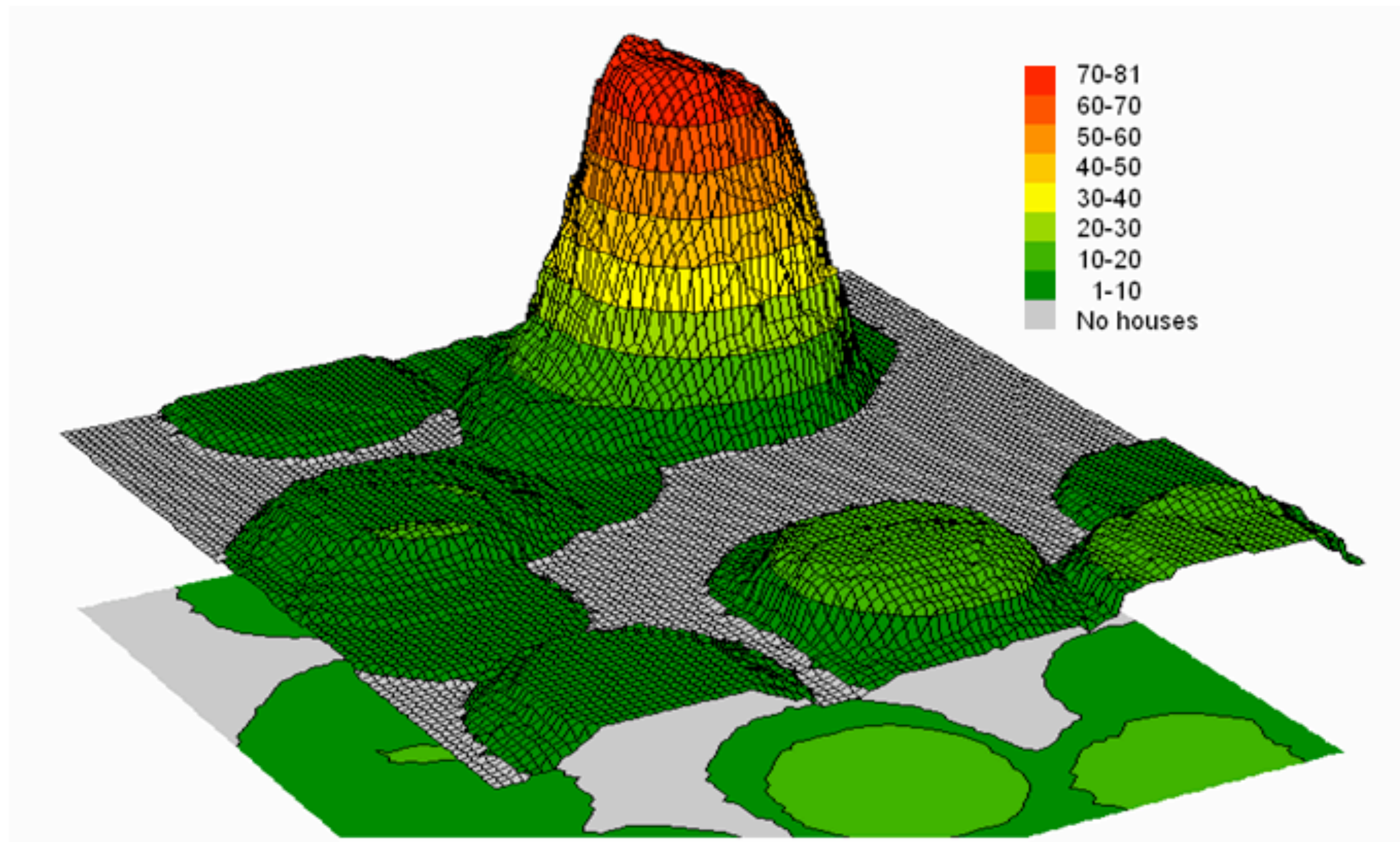
- NOT a value interpolation scheme!
- How dense are the samples together?
- simply **count** all the point samples within the "circle", divide by circle's area
- "kernel" method: different math, smoother








# Housing Density



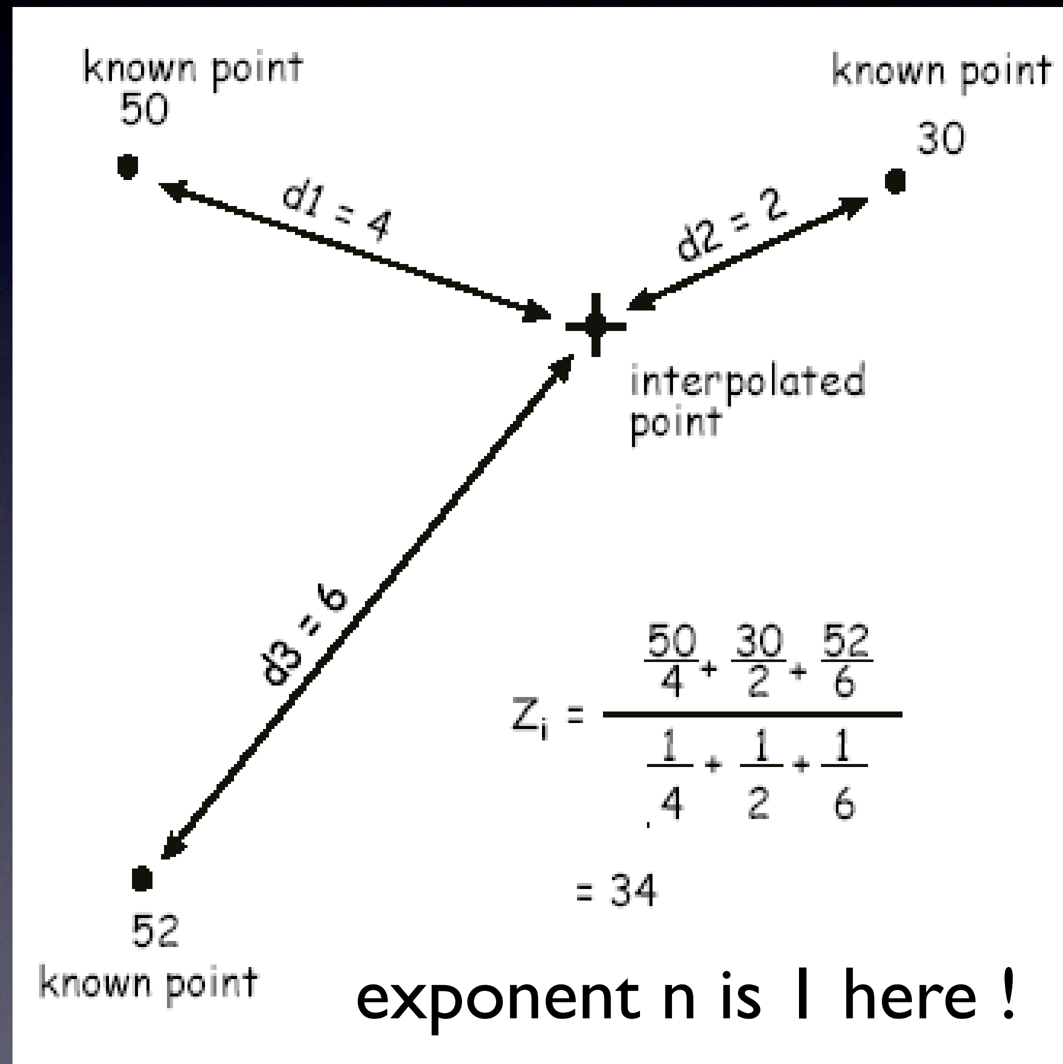

*… the Point Density technique passes a "roving window" over a project area calculating the total number of houses within a specified distance*

# Inverse Distance Weighted (IDW) interpolation

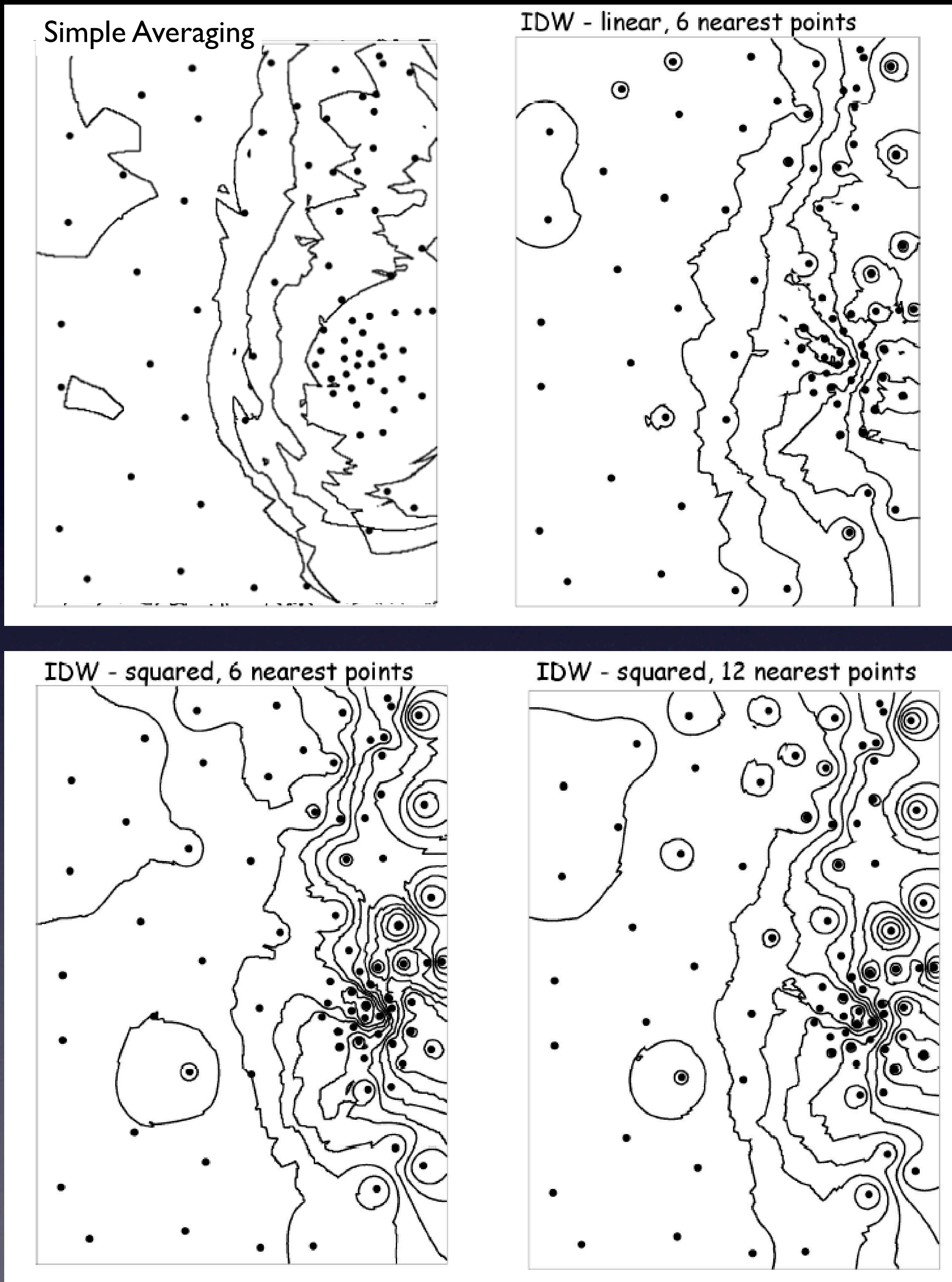
Zi is value of known point
Dij is distance to known point
Zj is the cell value (unknown)
n is a user selected exponent or power (often 1,2 or 3)

$$Z_j = \frac{\sum_i \frac{Z_i}{d^n_{ij}}}{\sum_i \frac{1}{d^n_{ij}}}$$

- grab all the point samples inside a radius
- When calculation the cell's value, take the sample distances into account ("weight")
- Weight of each sample point is an inverse proportion to its distance to the cell
- The further away the point, the less the weight it gets (contributes less)
- effect of exponent (1,2,3, ..)?



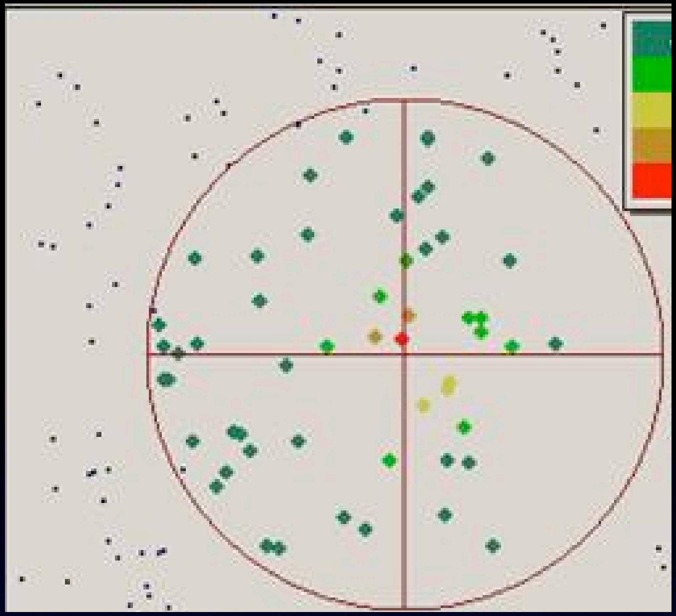

exponent n is 1 here !

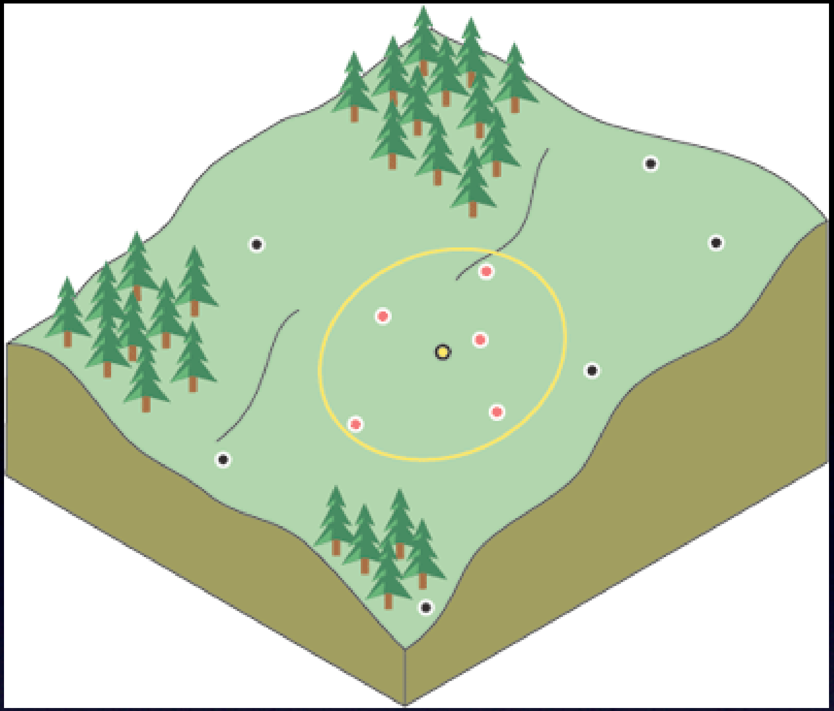



- Higher exponents: less weight to distant points (point that are farther away)
- (closer point are more important)
- Use more samples: “smoother” distribution
- interpolated value at sample location?

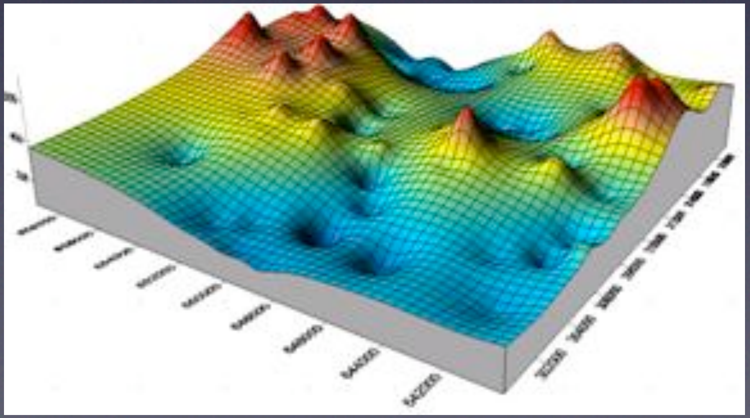
“linear”: exponent = 1
“squared”: exponent = 2

# IDW: search radius



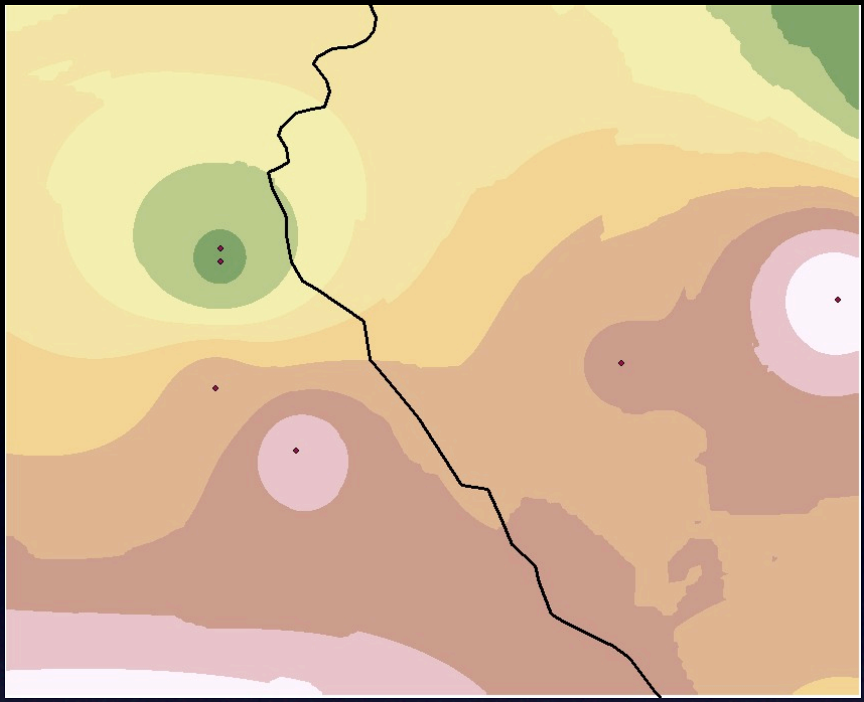


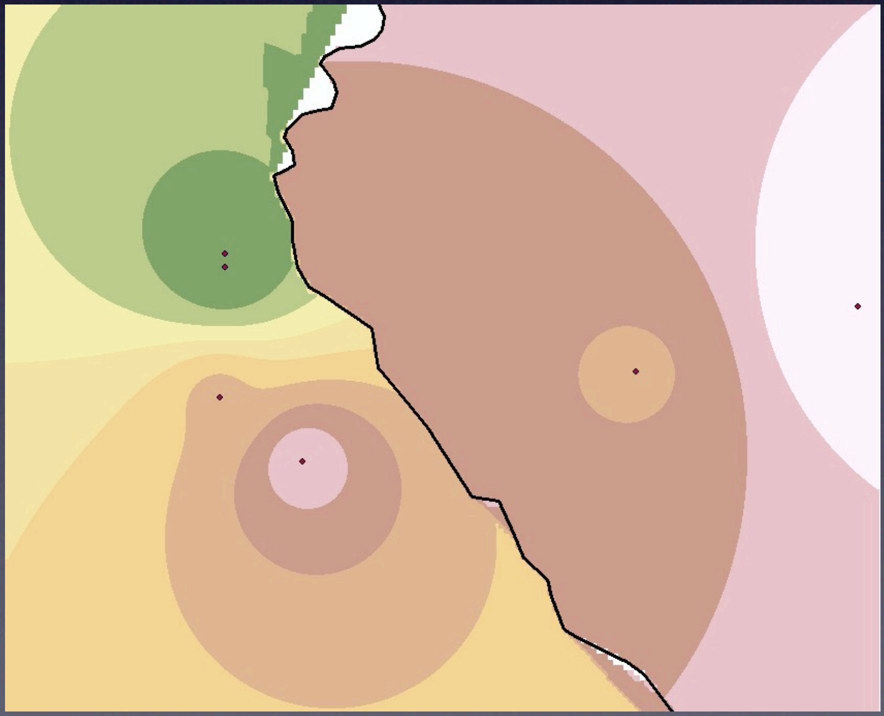
- **variable** search radius:
  grab n (12) closest points, up to a distance of d (default 0, => no distance limit)
- **fixed** search radius:
  grab ALL points within a distance of (250) units, use at least n points (default 0, => use all)



# IDW: using break lines

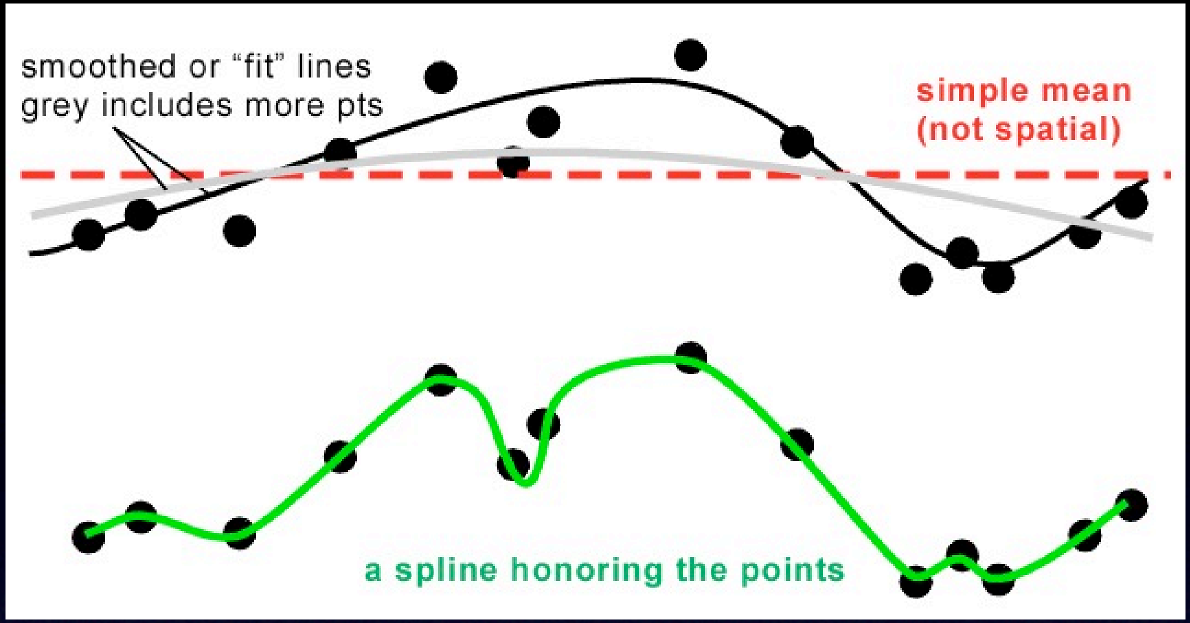
- line features to limit (block) point “grabbing”
- samples “from the other side” of the break line will NOT be used
- use for: ridges, faults, ...
- Caveats: much slower, some NoData values (extrapolation issues?)

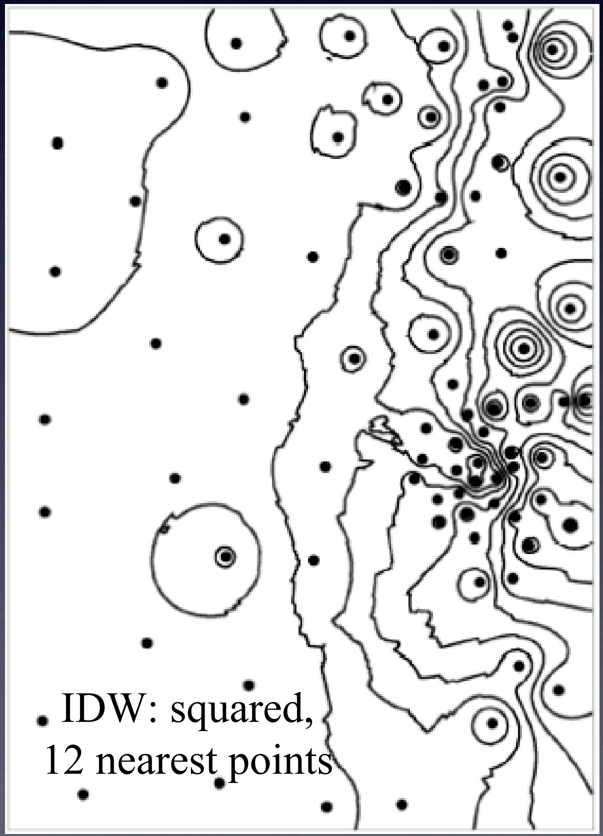


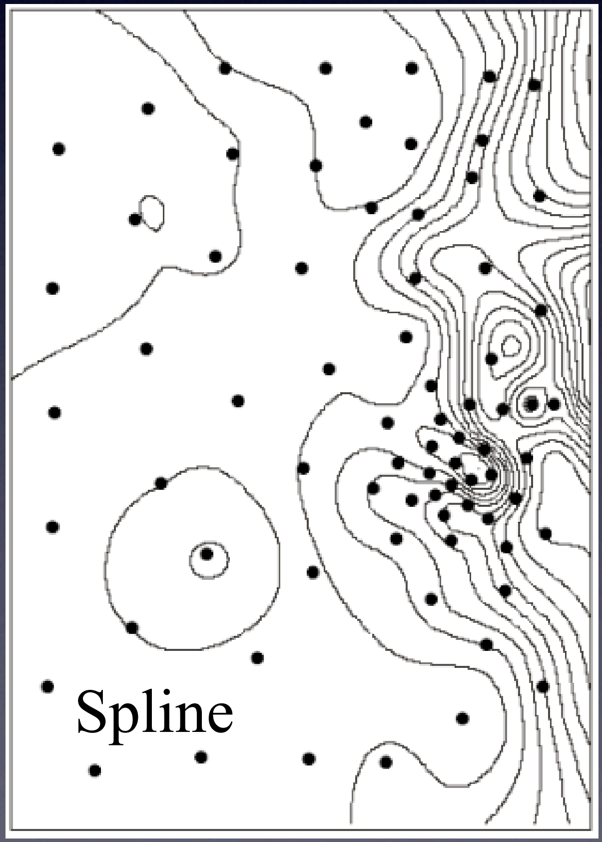


# Splines

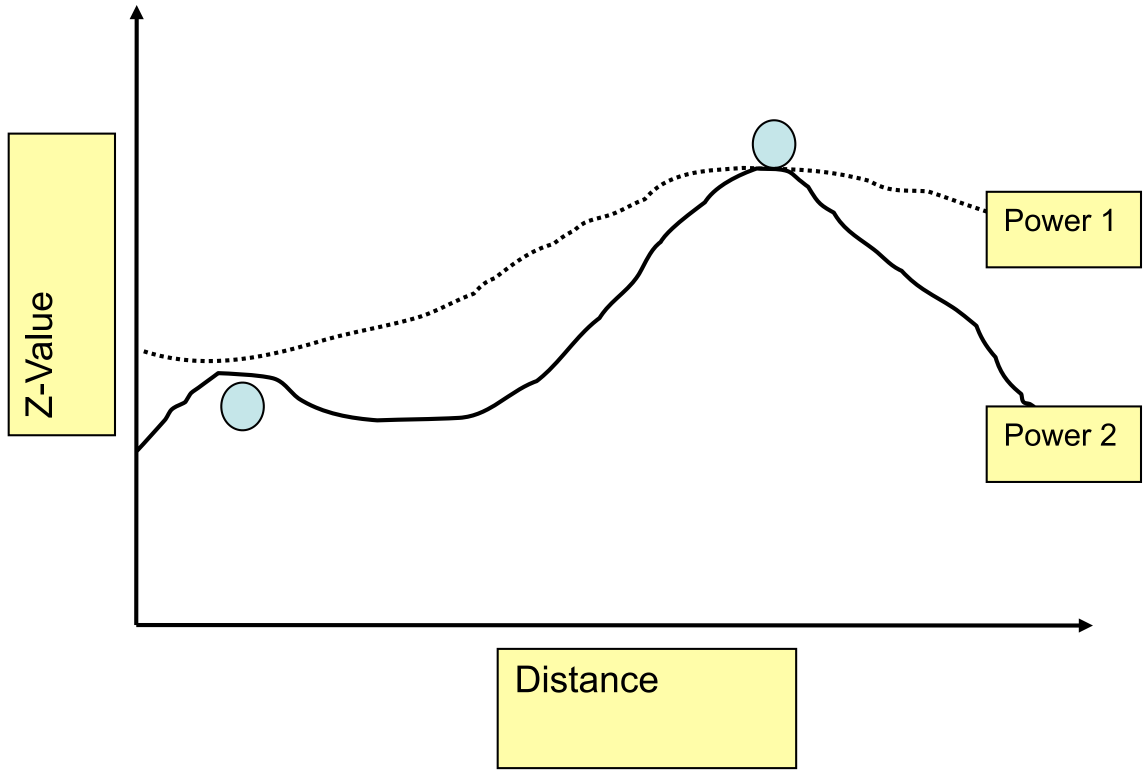
- smooth surface, non-exact
- based on minimizing curvature
- rubber sheet “bent” around samples
- can over-shoot / under-shoot
- ArgGIS: 2 types - regularized and tension
- ArcGIS: Weight - smoothness “tweak” factor
- gotcha: both have different meaning of weight
- tension (0.1 - 15):
  low = smooth, high = coarse)

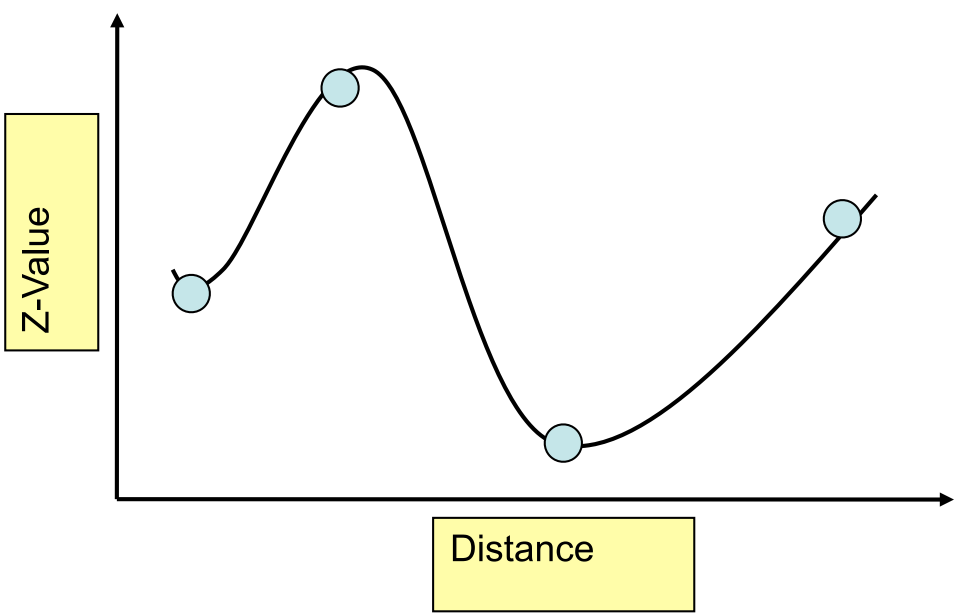


IDW:




Spline

# Interpolation class exercise

- new ArcMap, add **elev_pts_samples_100 from** geol588\data\
- 100 random points, elevation extracted from dem_steep with Extract by Points tool
- IDW fixed: fixed search radius 5000 m
- IDW variable: variable search radius (12 pts)
- Tension spline, weight 0.1
- Tension spline, weight 10
- Color all with Temperature (spectral) color ramp (smooth)
- Activate **Effects** tool - compare results
- compare to “true” data (dem_steep)