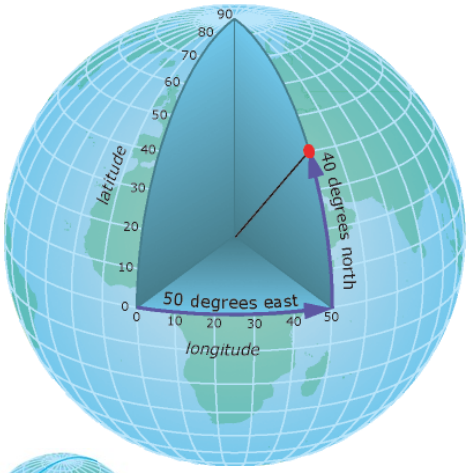
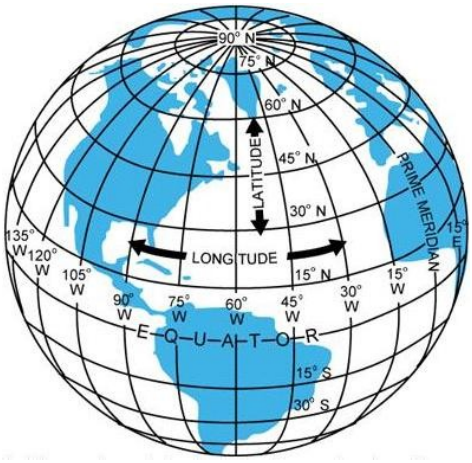
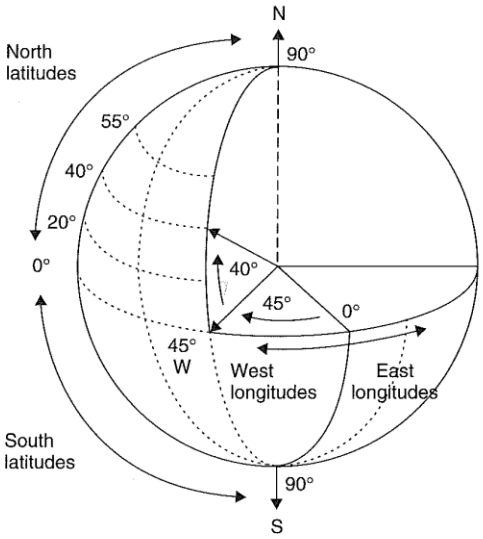
Geographic Coordinate Systems





http://www.dauntless-soft.com/PRODUCTS/Freebies/Library/books/AK/8-2.htm

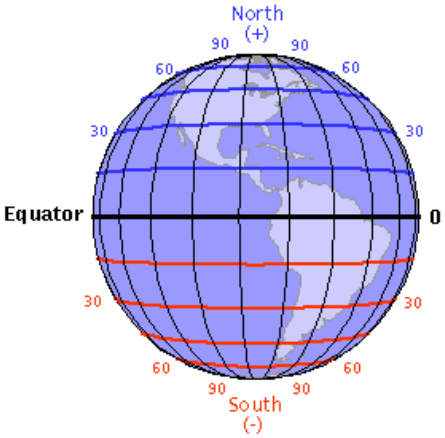


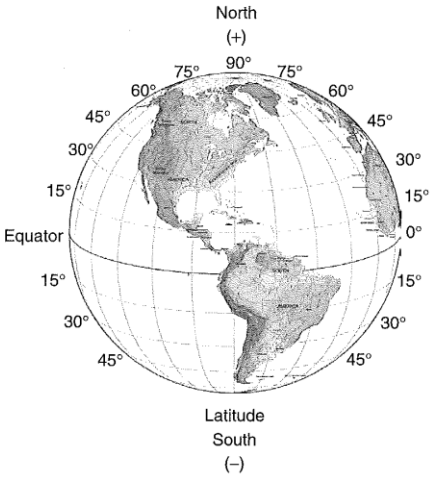
Waller & Gotway 2004; p.42, Figure. 3.2

Graticular network

Latitude

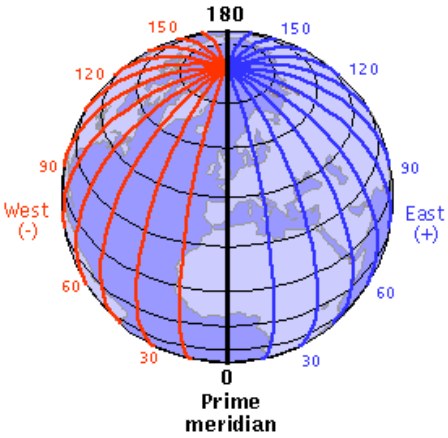
Parallels
lines of latitude

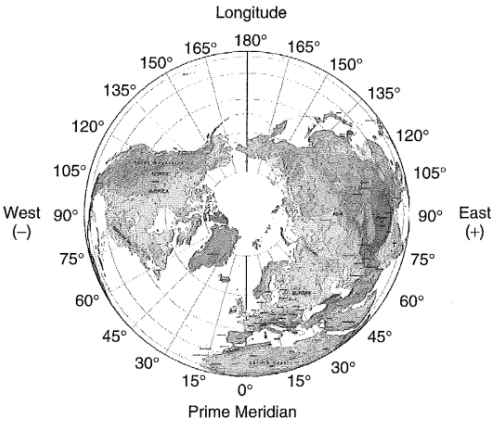




Longitude

Meridians
lines of longitude





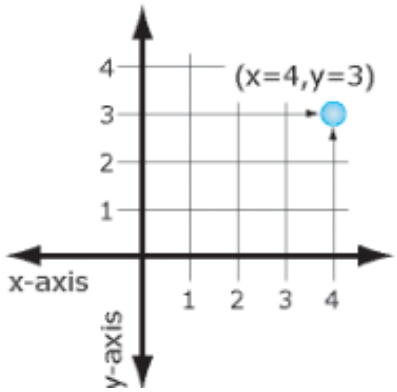
(http://webhelp.esri.com/arcgisdesktop/9.2/body.cfm?tocVisable=1&ID=24&TopicName=Georeferencing%20and%20coordinate%20systems)

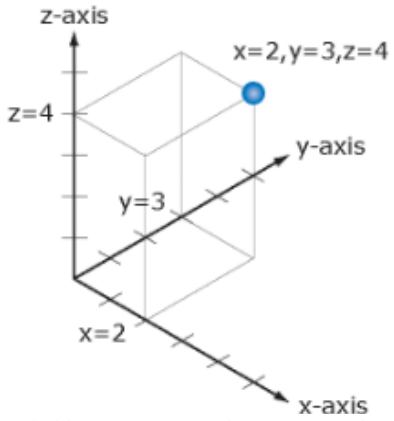
http://www.learner.org/jnorth/tm/mclass/Glossary.html

Geometric definitions of latitude and longitude on a spherical Earth

Waller & Gotway 2004; p.41, Figure. 3.1

Cartesian Coordinate System





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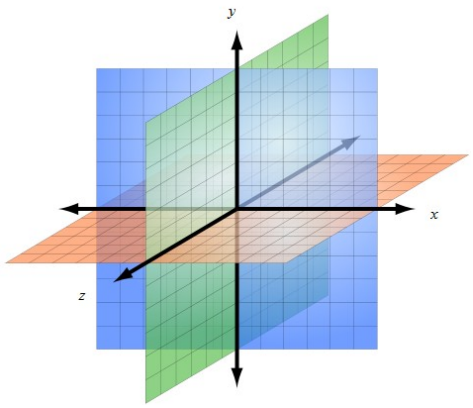
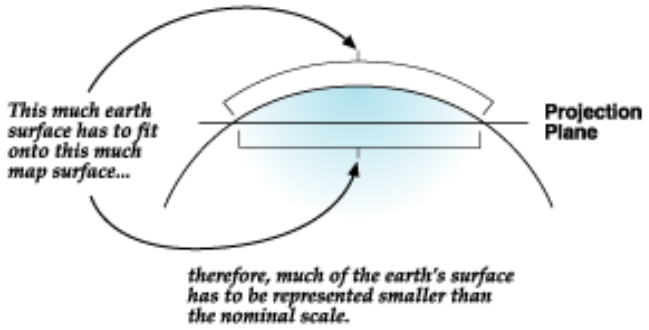
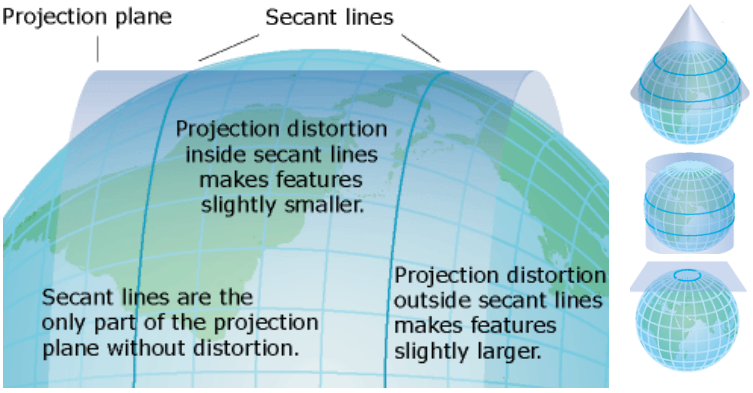


(http://commons.wikimedia.org/wiki/File:3D_coordinate_system.svg)

Projected Coordinate Systems





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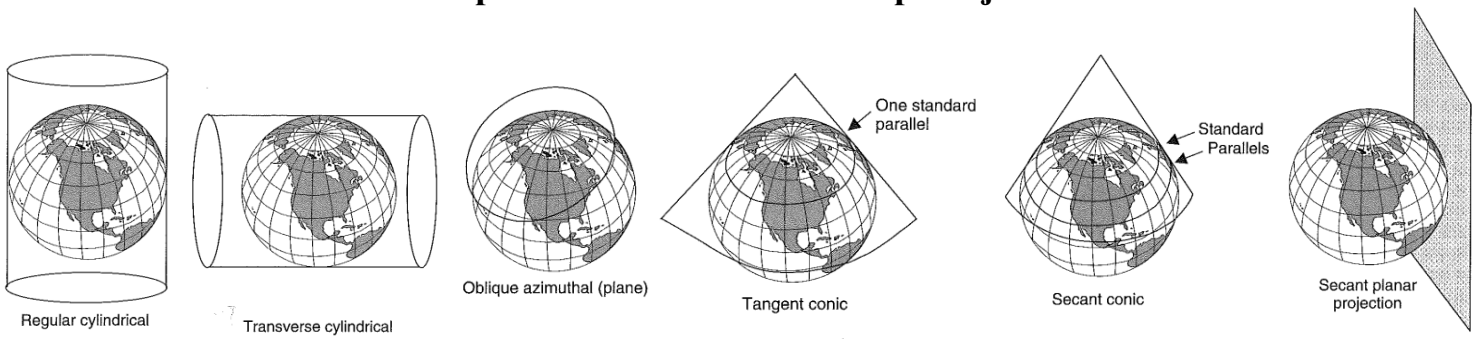
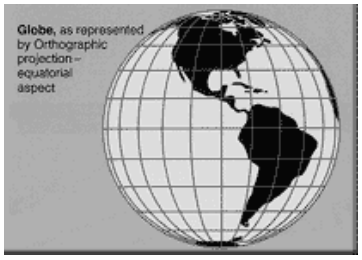
Developable Surfaces used in Map Projections



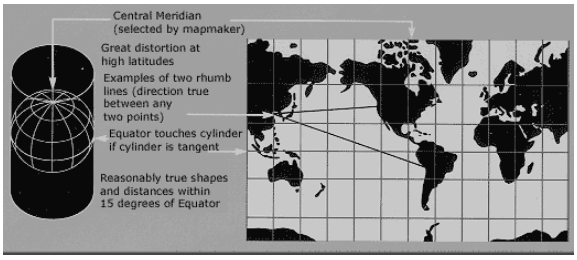
(*Waller & Gotway 2004; p.45, Figure. 3.4*)

Map Projections

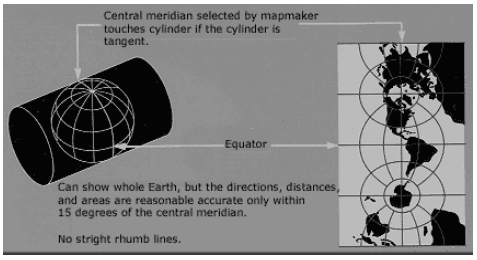
Globe



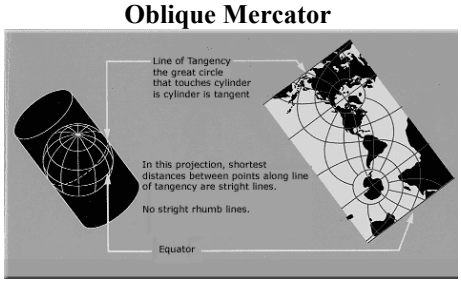
Mercator



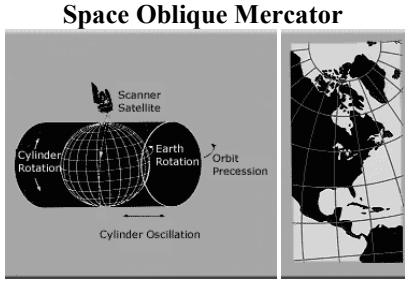
Transverse Mercator



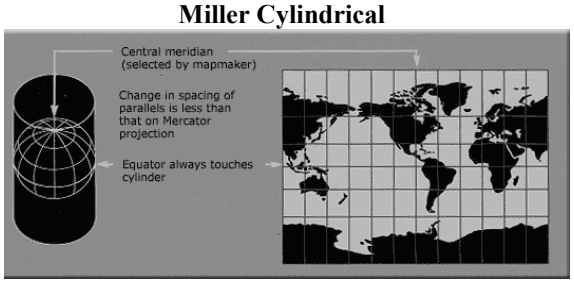
Oblique Mercator



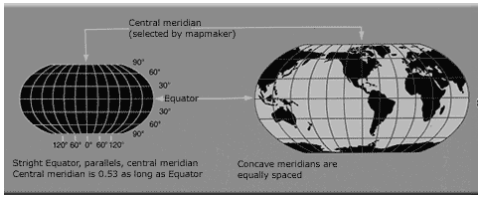
Space Oblique Mercator



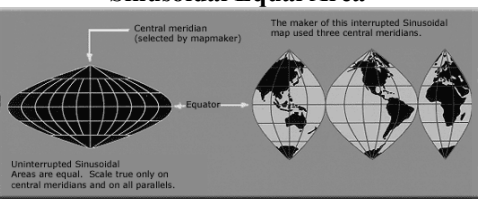
Miller Cylindrical



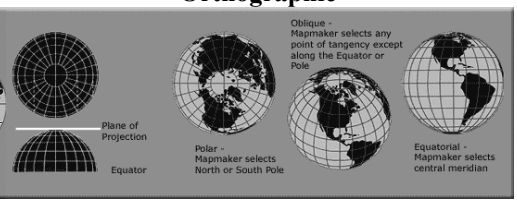
Robinson



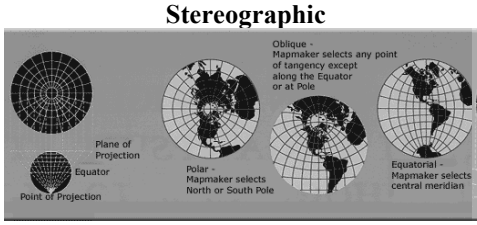
Sinusoidal Equal Area



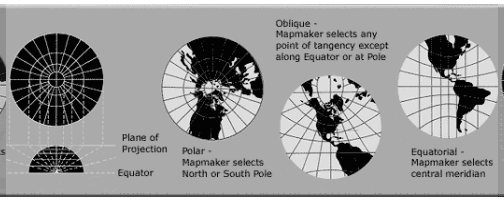
Orthographic



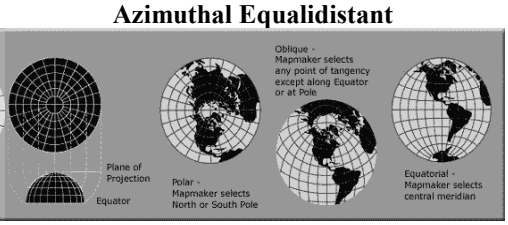
Stereographic



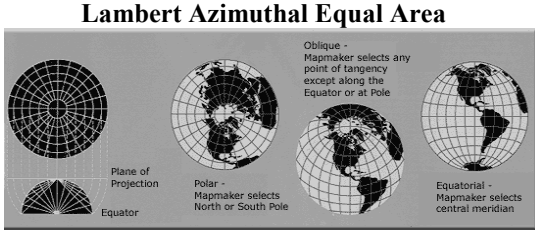
Gnomonic



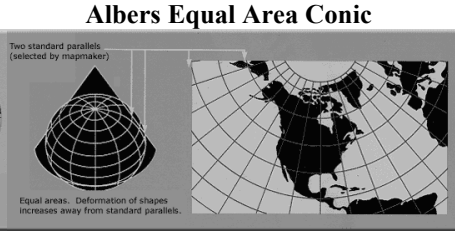
Azimuthal Equalidistant



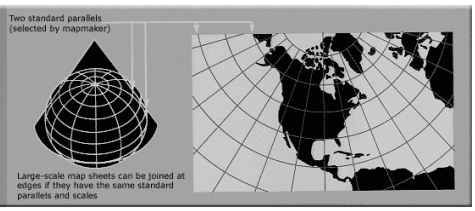
Lambert Azimuthal Equal Area



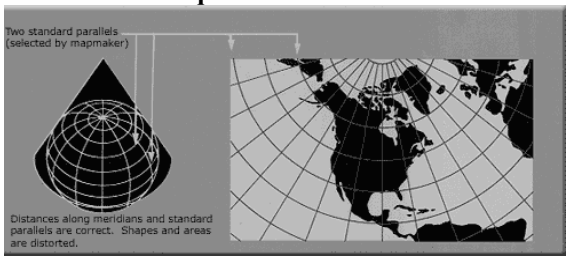
Albers Equal Area Conic



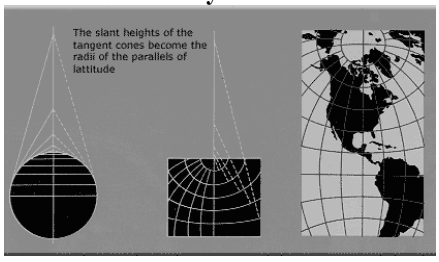
Lambert Conformal Conic



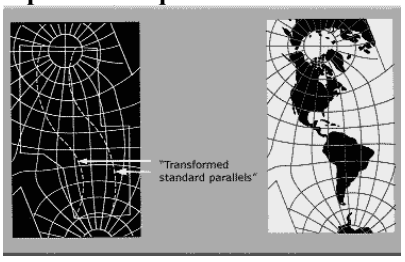
Equidistant Conic



Polyonic

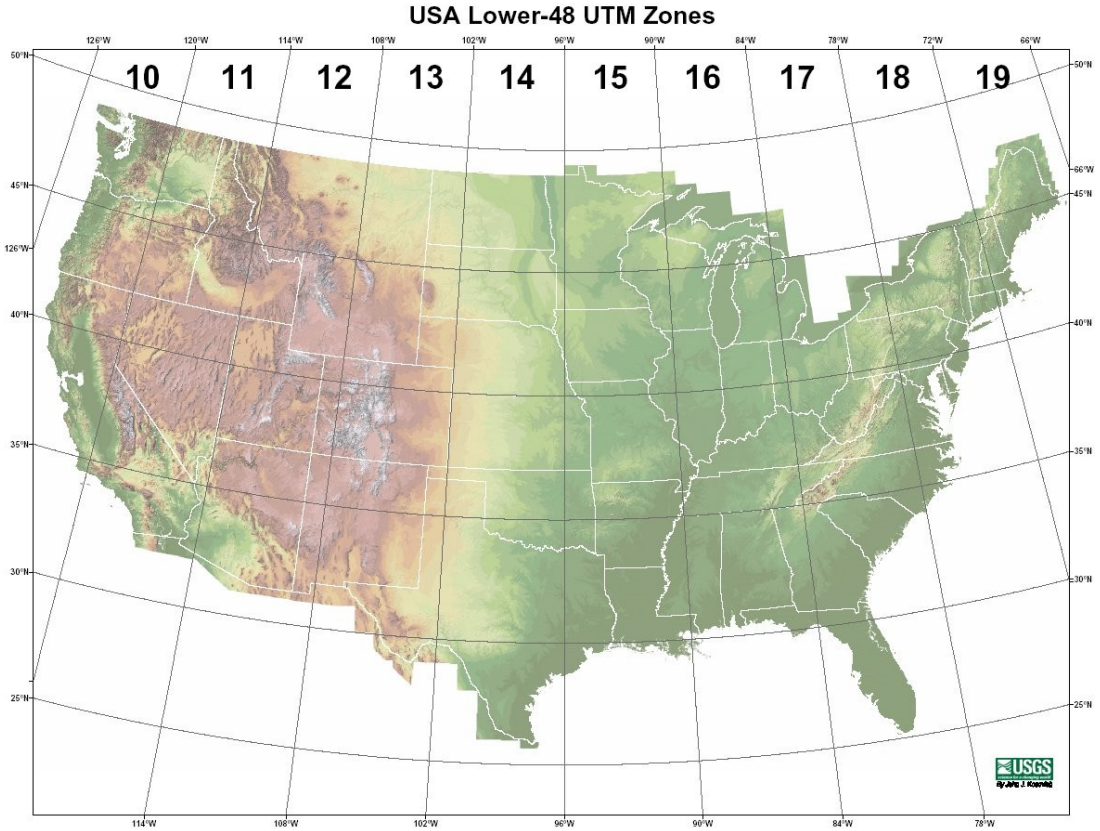


Biplolar Oblique Conic Conformal

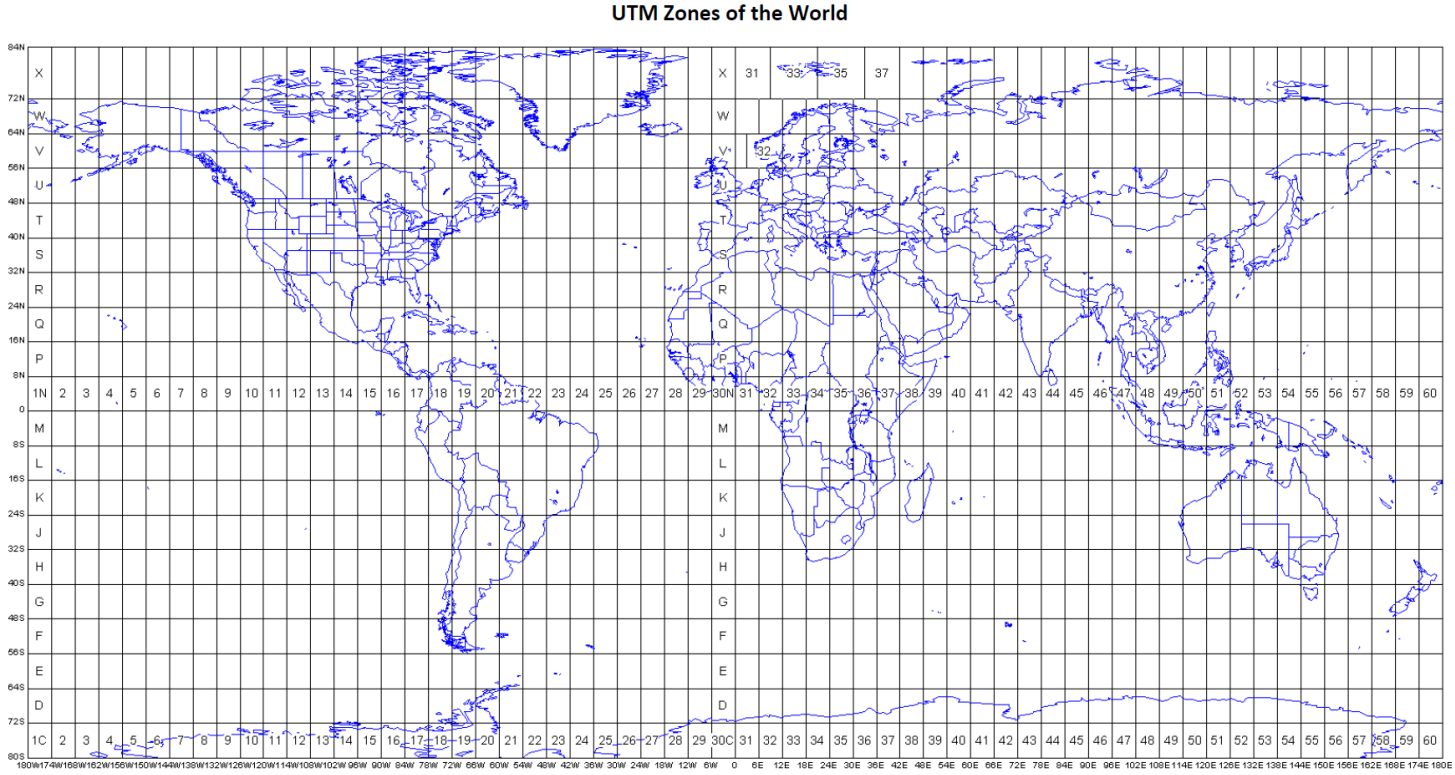


(http://egsc.usgs.gov/isb/pubs/MapProjections/projections.html)

Universal Transverse Mercator (UTM) Zones

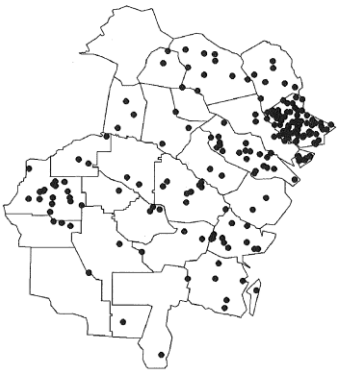


(United States Geological Survey (2005) *Educational Resources: GPS, Maps, & Compass.* http://rockyweb.cr.usgs.gov/outreach/gps/UTM_Zones_USA48.jpg)

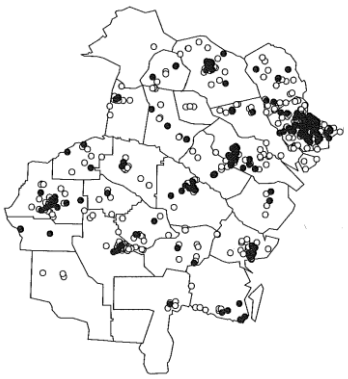


(compiled by Alan Morton, available online at: http://www.dmap.co.uk/utmworld.htm)

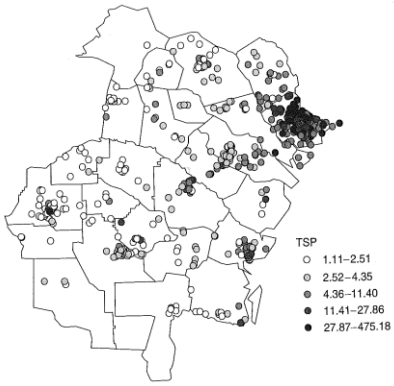
Ways of Displaying Data



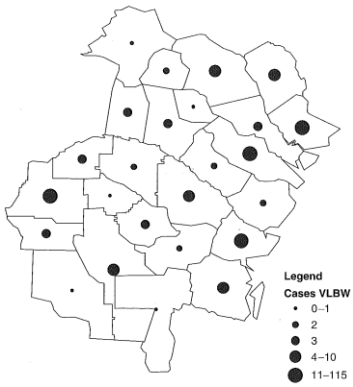
Waller & Gotway 2004; p.83, Figure. 4.13



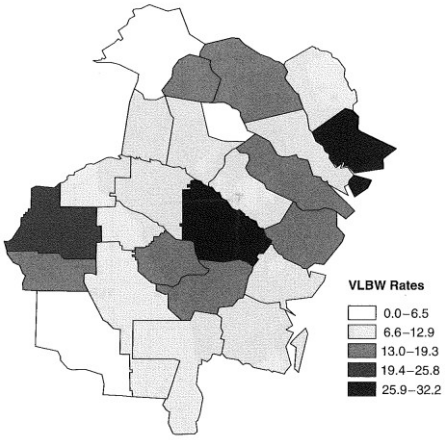
Waller & Gotway 2004; p.74, Figure. 4.4



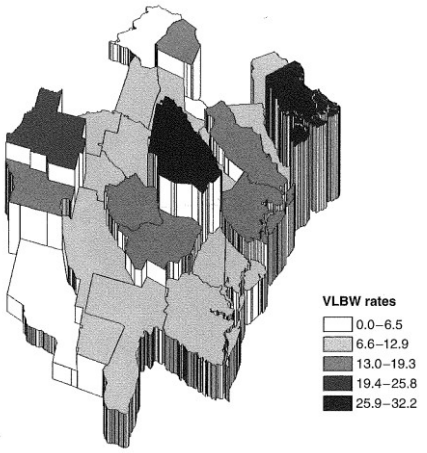
Waller & Gotway 2004; p.74, Figure. 4.4



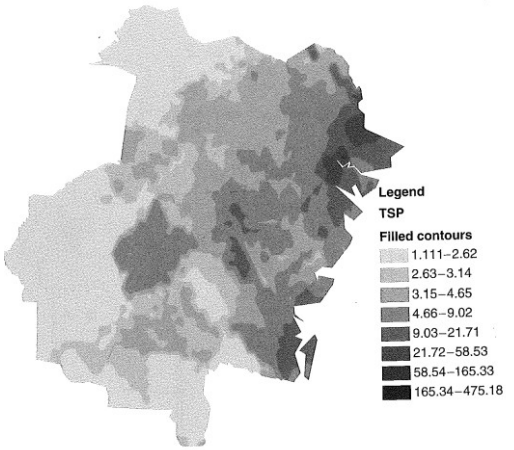
Waller & Gotway 2004; p.79, Figure. 4.9



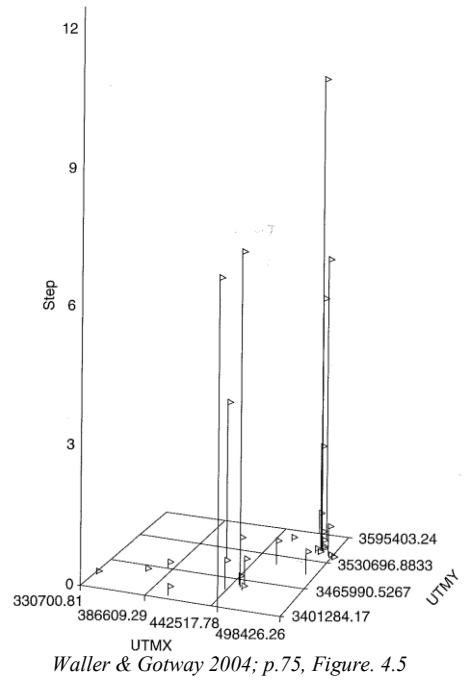
Waller & Gotway 2004; p.81, Figure. 4.11



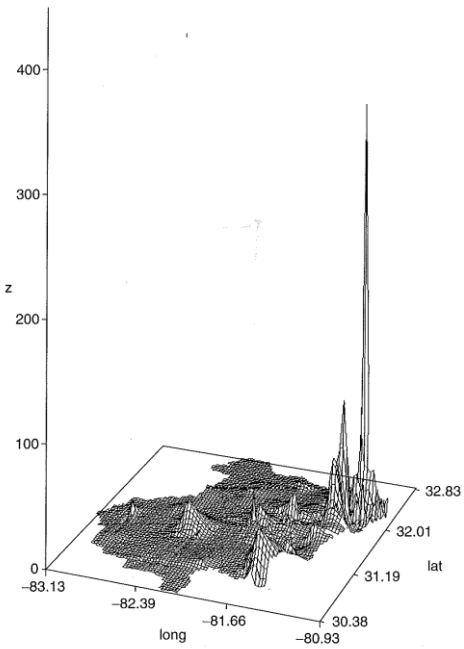
Waller & Gotway 2004; p.82 , Figure. 4.12



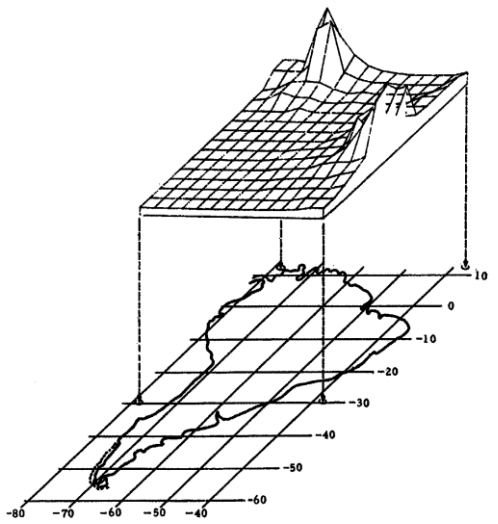
Waller & Gotway 2004; p.76 , Figure. 4.6



Waller & Gotway 2004; p.75, Figure. 4.5

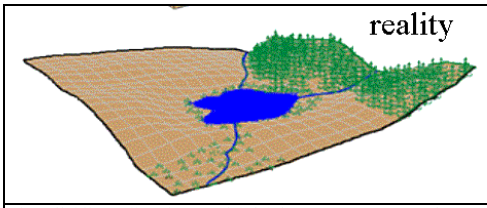


Waller & Gotway 2004; p.77, Figure. 4.7



Early three-dimensional computerized map of schistosomiasis data in South America using altitude to indicate intensity of occurrence

Koch 2005; p. 236, Figure 9.13



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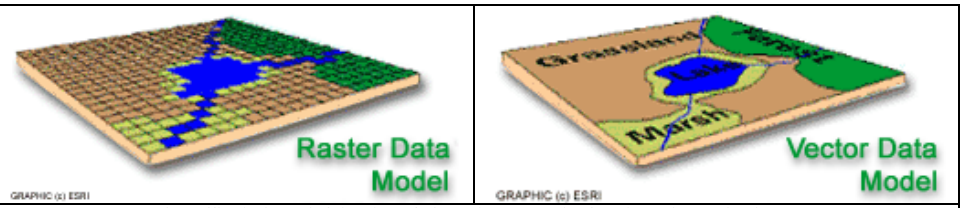

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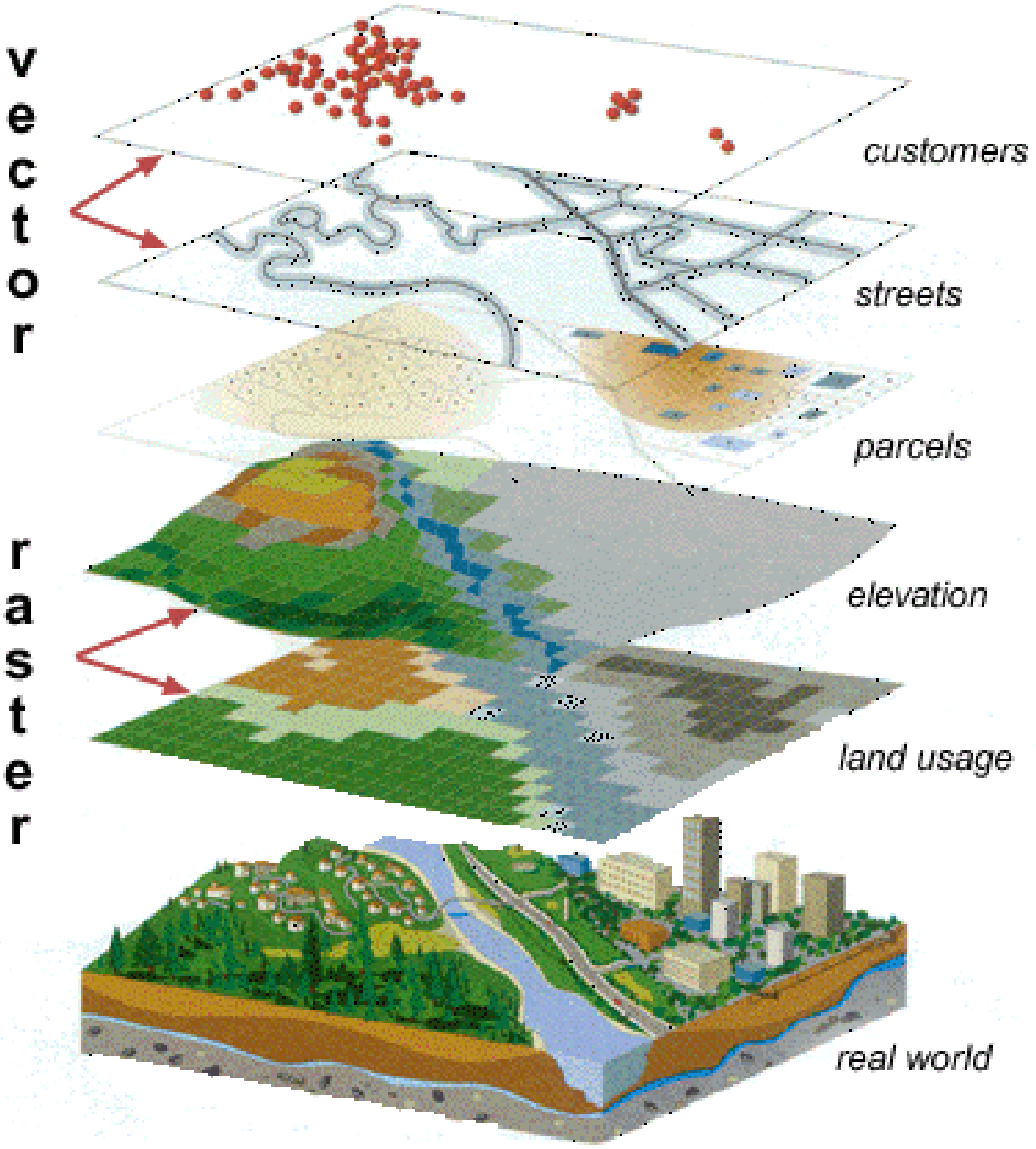
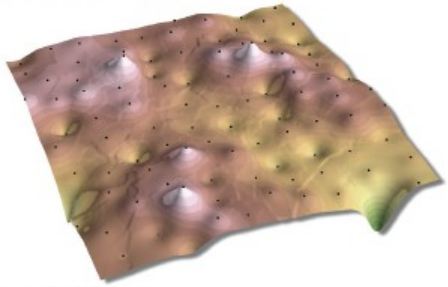


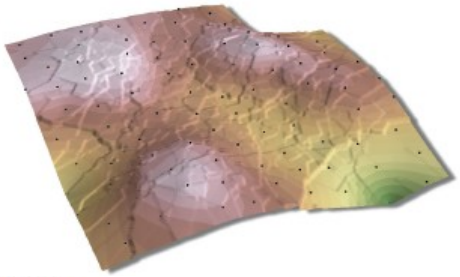
http://www.ibm.com/developerworks/architecture/library/ar-gis1/figure1.gif

Interpolation Methods

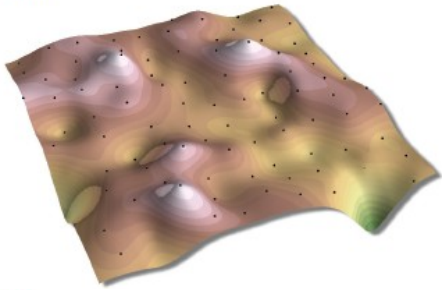
Inverse Distance Weighted



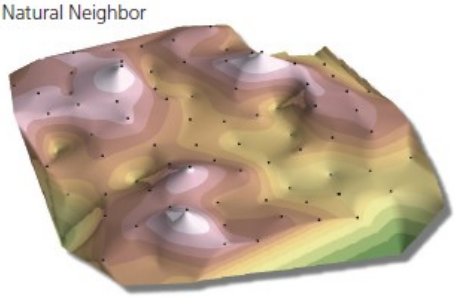
Kriging



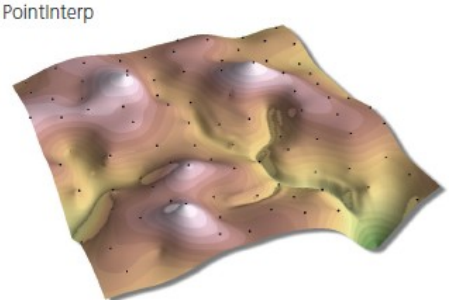
Spline



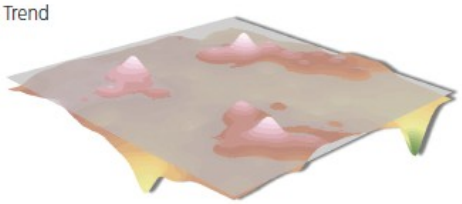
Natural Neighbor



PointInterp

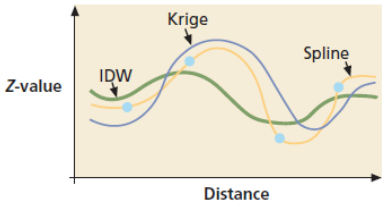


Trend



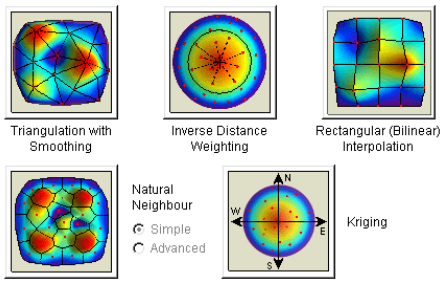
Topo to Raster

By interpolating elevation values for a raster, the Topo to Raster method imposes constraints that ensure a hydrologically correct digital elevation model that contains a connected drainage structure and correctly represents ridges and streams from input contour data. It uses an iterative finite difference interpolation technique that optimizes the computational efficiency of local interpolation without losing the surface continuity of global interpolation. It was specifically designed to work intelligently with contour inputs.



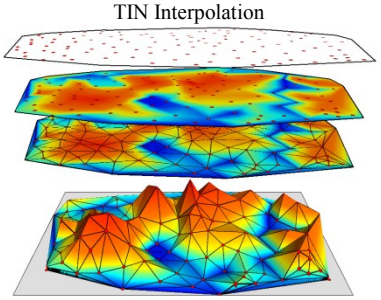
IDW and Spline are two deterministic methods that create surfaces from samples based on the extent of similarity or degree of smoothing. However, while a spline surface passes exactly through each sample point, an IDW will pass through none of the points. Kriging is a geostatistical method that uses a powerful statistical technique for predicting values derived from the measure of relationship in samples and employs sophisticated weighted average techniques.

http://www.esri.com/news/arcuser/0704/files/interpolating.pdf



http://www.geosolutions.com/3d/analyse/images/interpolate_dialog.gif

TIN Interpolation



Spatial interpolation of a DEM in GIS

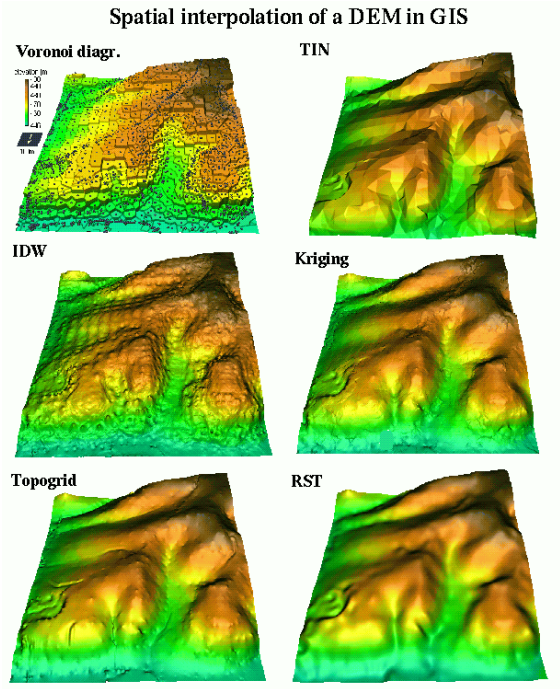
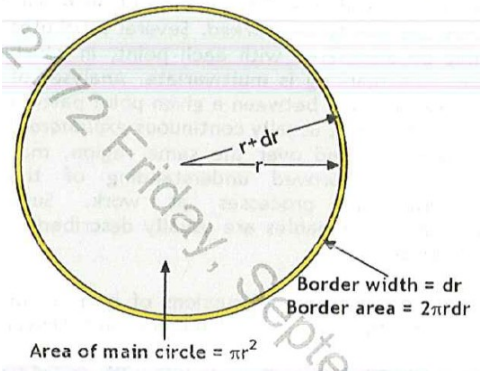


Figure 2. Bivariate interpolation methods available in GIS applied to computation of a 2m resolution DEM from scattered point measurements.

Lubos Mitas and Helena Mitasova. Spatial Interpolation T4.1, to be published in "GIS: Principles, Techniques, Management and Applications"

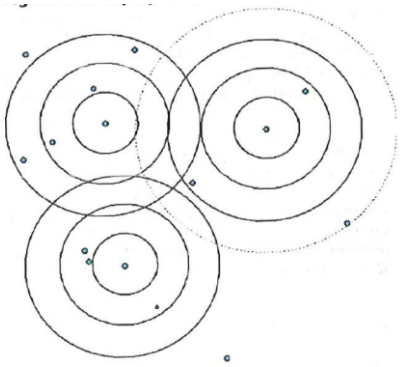
http://skagit.meas.ncsu.edu/~helena/gmslab/asae97/hasint.gif

Nearest Neighbor Distribution



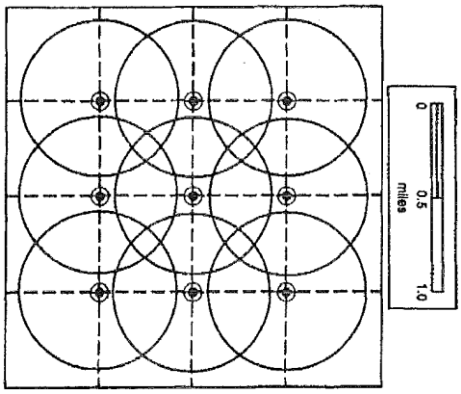
Smith et al. 2009; p. 260, Figure 5-17

Ripley's K function



Smith et al. 2009; p. 263, Figure 5-18

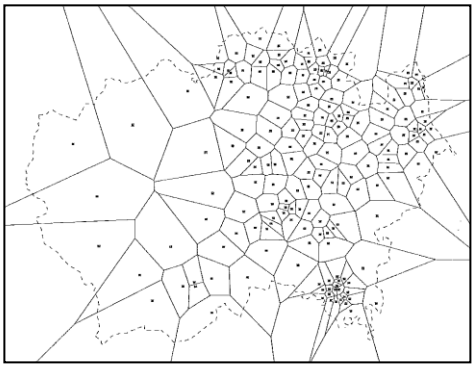
Disease Mapping & Analysis Program DMAP



The Regular lattice grid and the spatial filter areas to measure birth rates in the study area

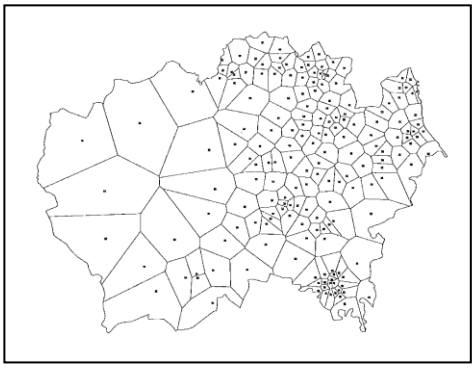
Rushton & Lolonis 1996; p. 721, Figure 3

Thiessen Polygons



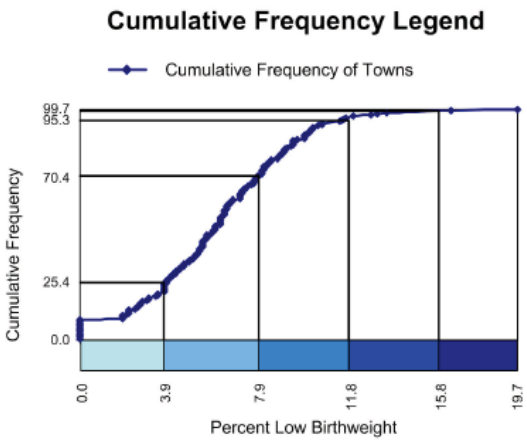
Thiessen polygon boundaries for Durham wards

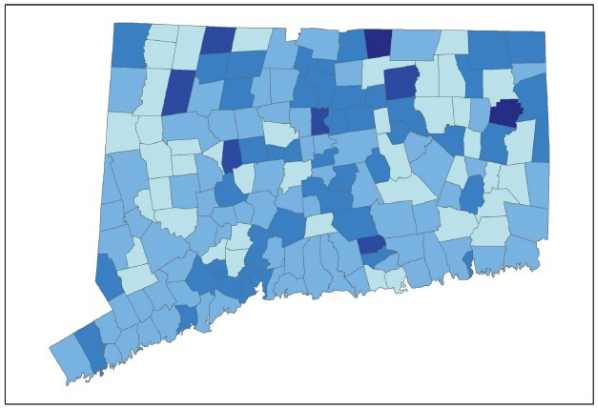
Fotheringham et al. 2000; p. 39, Fig. 3.6(a)

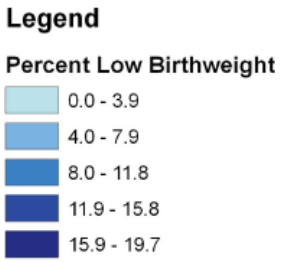


Thiessen polygons clipped into the country boundary

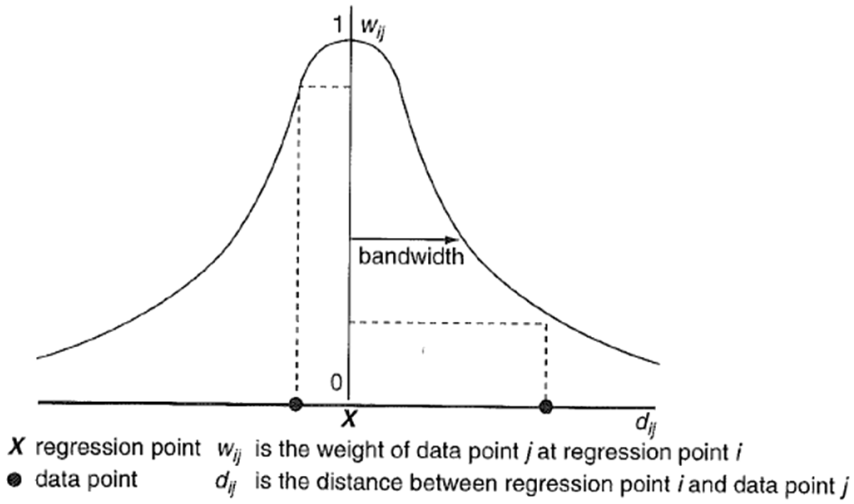
Fotheringham et al. 2000; p. 40, Fig. 3.6(b)





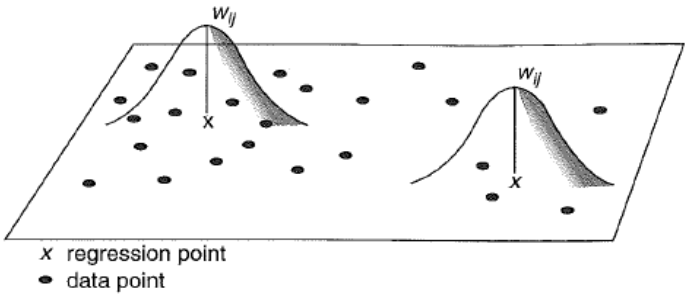


Cromley & Cromley 2009; p. 14, Fig. 1



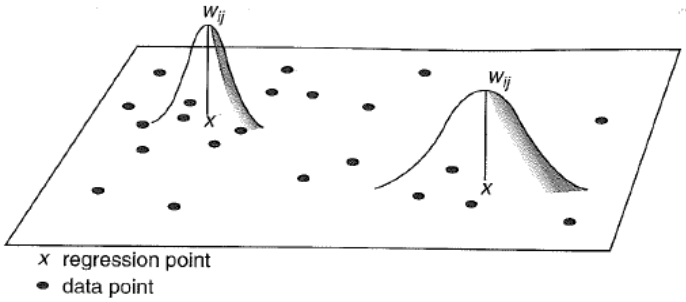
A spatial kernel
Fotheringham et al. 2002; p. 44, Fig. 2.10

Fixed Bandwidth Spatial Kernels

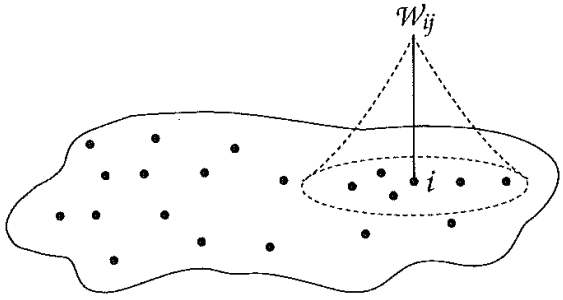


GWR with fixed spatial kernels
Fotheringham et al. 2002; p. 45, Fig. 2.11

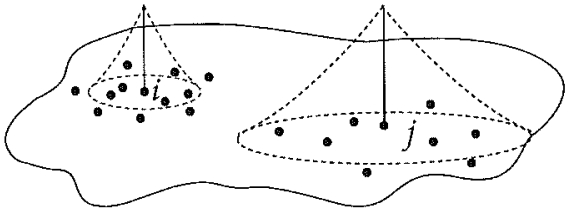
Adaptive Bandwidth Spatial Kernels



GWR with adaptive spatial kernels
Fotheringham et al. 2002; p. 47, Fig. 2.13



Example of a spatial kernel in GWR
Fotheringham et al. 2000; p. 091, Fig. 5.4



Point i is in a relatively dense cluster of data and the kernel is steep

Point j is in a relatively sparse cluster of data and the kernel is gentle

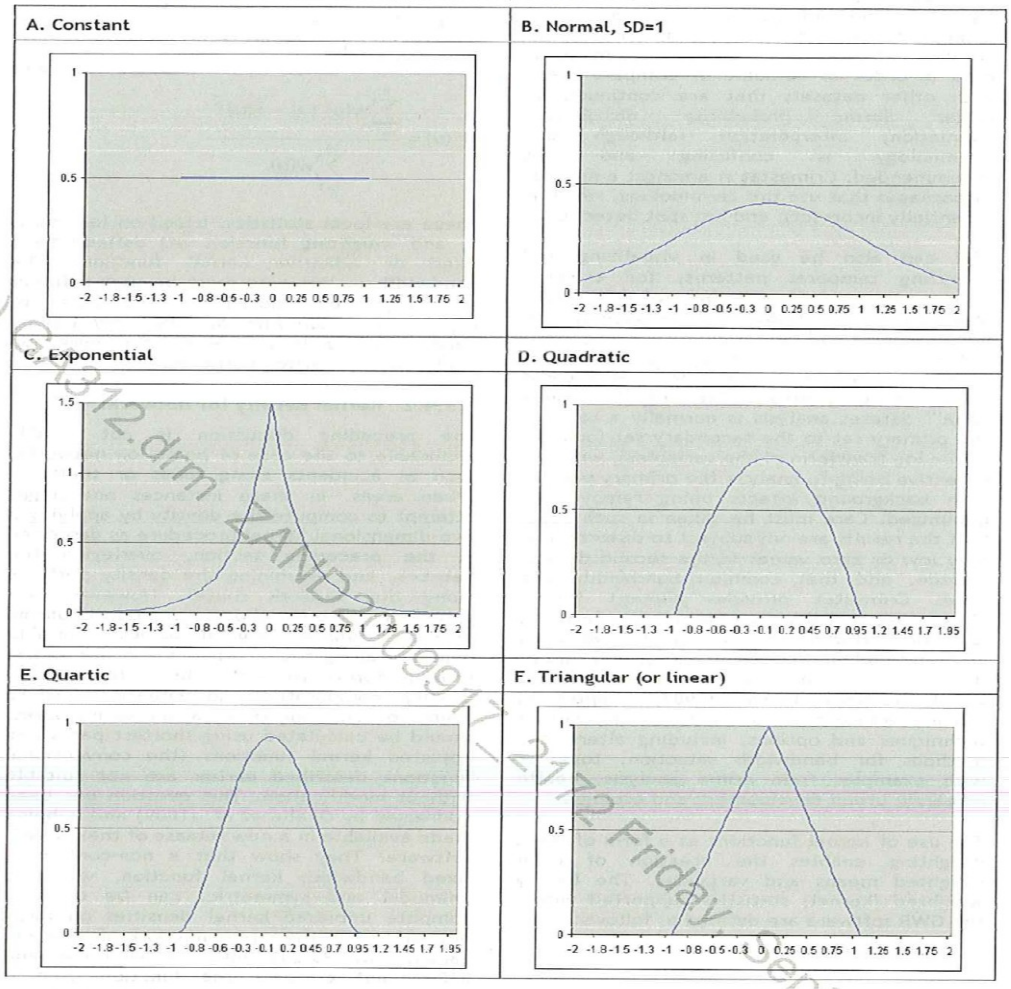
Example of an adaptive spatial kernel in GWR
Fotheringham et al. 2000; p. 111, Fig. 5.5

Kernel Density Functions

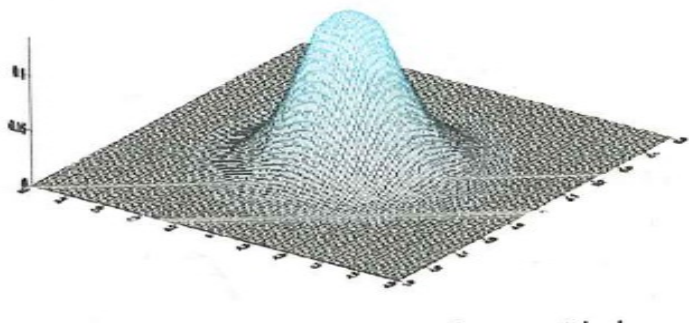
Table 4-8 Widely used univariate kernel density functions

Kernel	Formula	Comments. Note $t=d_{ij}/h$, h is the bandwidth
Normal (or Gaussian)	$\frac{1}{2k}e^{-\frac{t^2}{2}}$	Unbounded, hence defined for all t. The standard kernel in Crimestat; bandwidth h is the standard deviation (and may be fixed or adaptive)
Quartic (spherical)	$\frac{3}{k}\left(1-t^2\right)^2, t \le 1$ $= 0, t > 1$	Bounded. Approximates the Normal. k is a constant
(Negative) Exponential	$Ae^{-k\lvert t\rvert}, \lvert t\rvert \le 1$ $= 0, t > 1$	Optionally bounded. A is a constant (e.g. $A=3/2$) and k is a parameter (e.g. $k=3$). Weights more heavily to the central point than other kernels
Triangular (conic)	$1-\lvert t\rvert, \lvert t\rvert \le 1$ $= 0, t > 1$	Bounded. Very simple linear decay with distance.
Uniform (flat)	$k, \lvert t\rvert \le 1$ $= 0, t > 1$	Bounded. k=a constant. No central weighting so function is like a uniform disk placed over each event point
Epanechnikov (paraboloid/quadratic)	$\frac{3}{4}\left(1-t^2\right), \lvert t\rvert \le 1$ $= 0, t > 1$	Bounded; optimal smoothing function for some statistical applications; used as the smoothing function in the Geographical Analysis Machine (GAM/K) and in ArcGIS

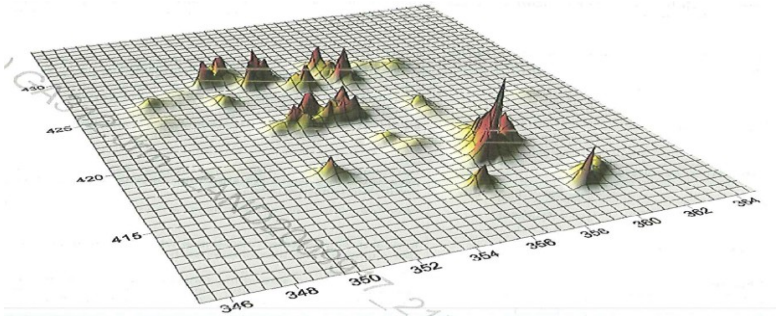
Figure 4-47 Univariate kernel density functions, unit bandwidth



Smith et al. 2009; p. 176-177

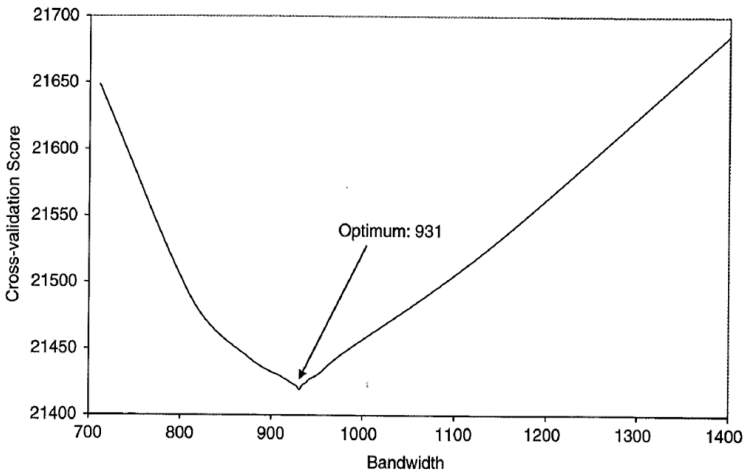


2D Normal Kernel
Smith et al. 2009; p. 174, Figure 4-45

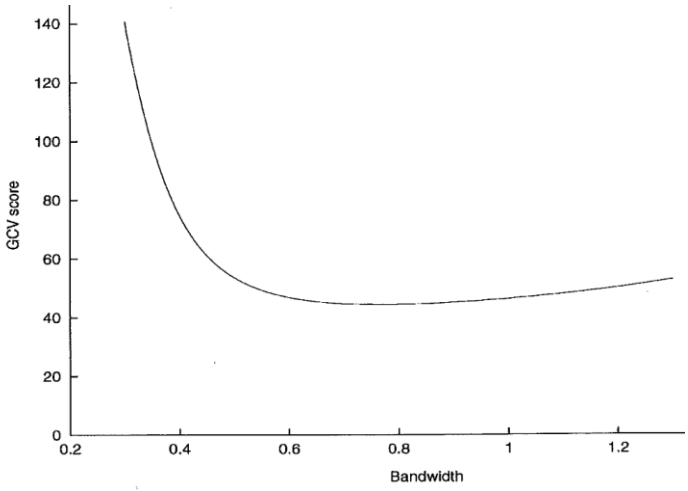


Kernel density map, Lung Case data, 3D visualization
Smith et al. 2009; p. 175, Figure 4-46

Kernel Parameter & Model Calibrations



Cross-validation scores for the bi-square nearest neighbor weighting function applied to the London housing data
Fotheringham et al. 2002; p. 60, Fig. 2.20



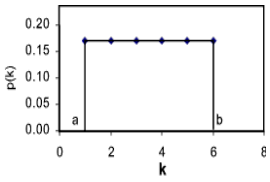
Plot of GCV vs. *h* for the home ownership model
Fotheringham et al. 2000; p. 181, Fig. 7.8

Probability Density Functions

Continuous

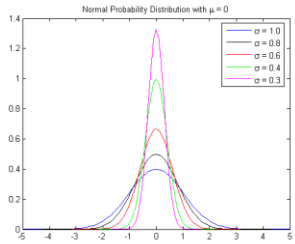
Uniform

Describes the probability that all values in the range are equally alike



Probability Density Function	$a \le x \le b \quad f(x) = \frac{1}{b-}$
Probability Distribution Function	$-\infty < x < a \quad f(x) = 0$ $a \ll x \ll b \quad f(x) = \frac{x-}{b-}$
Distribution Mean	$(a+b)/2$
Variance	$(b-a)^2/12$

Normal (Gaussian)



Probability Density Function	
Probability Distribution Function	
Distribution Mean	
Variance	

Standard Normal

Probability Density Function	
Probability Distribution Function	
Distribution Mean	
Variance	

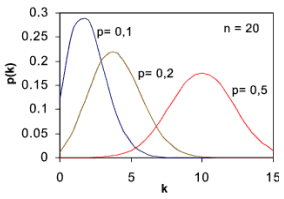
Discrete

Uniform

Probability Density Function	$a < k < b \quad p(k) = \frac{1}{n}$
Probability Distribution Function	$k < a \quad p(k) = 0$ $a < k < b \quad p(k) = \frac{k-a+1}{n}$ $k > a \quad p(k) = 1$
Distribution Mean	$(n+1)/2$
Variance	$(n^2-1)/12$

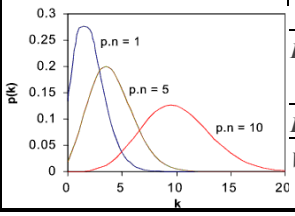
Binomial

describes the probability that k successes in n independent trials, in a model designed such that the result of each trial is either success or failure.

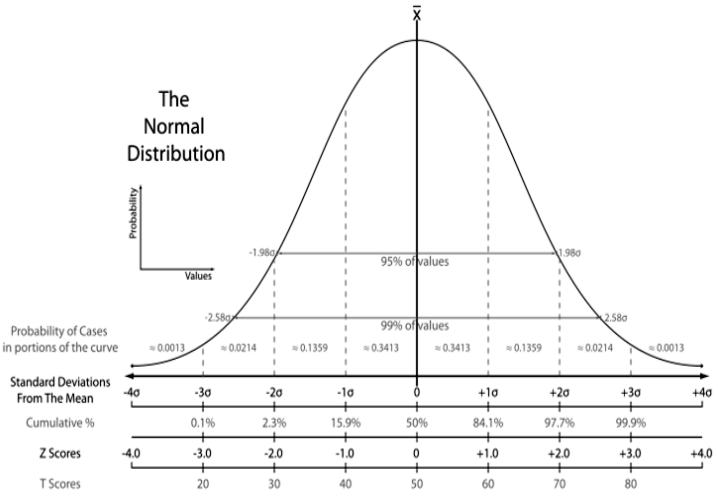


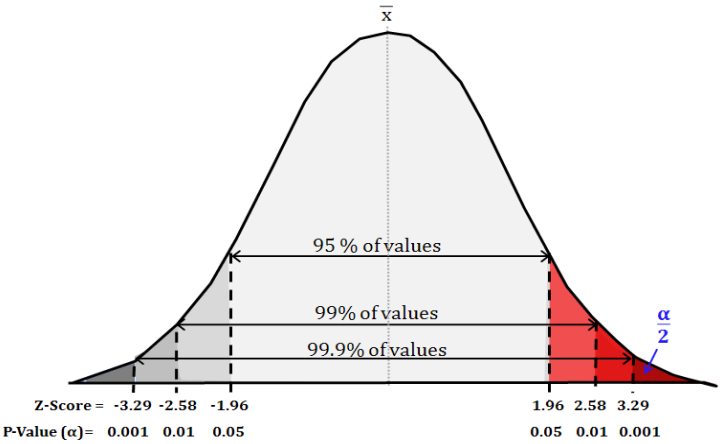
Probability Density Function	$p(k) = \binom{n}{k} p^k (1-p)^{n-k}$
Probability Distribution Function	$f(x) = \sum_{k \le x} \binom{n}{k} p^k (1-p)^n$
Distribution Mean	$\mu = np$
Variance	$\sigma^2 = n.p.(1-p)$

Poisson



Probability Density Function	$p(k) = \frac{(np)^k}{k!} e^{-np}$
Probability Distribution Function	$\sum_{k \le x} \frac{(np)^k}{k!} e^{-np}$
Distribution Mean	$\mu = n.p$
Variance	$\sigma^2 = n.p$





Z-tables : Probability of a larger value										
	0.00	**0.01**	**0.02**	**0.03**	**0.04**	**0.05**	**0.06**	**0.07**	**0.08**	**0.09**
0.00	0.5000	0.4960	0.4920	0.4880	0.4840	0.4801	0.4761	0.4721	0.4681	0.4641
0.10	0.4602	0.4562	0.4522	0.4483	0.4443	0.4404	0.4364	0.4325	0.4286	0.4247
0.20	0.4207	0.4168	0.4129	0.4090	0.4052	0.4013	0.3974	0.3936	0.3897	0.3859
0.30	0.3821	0.3783	0.3745	0.3707	0.3669	0.3632	0.3594	0.3557	0.3520	0.3483
0.40	0.3446	0.3409	0.3372	0.3336	0.3300	0.3264	0.3228	0.3192	0.3156	0.3121
0.50	**0.3085**	**0.3050**	**0.3015**	**0.2981**	**0.2946**	**0.2912**	**0.2877**	**0.2843**	**0.2810**	**0.2776**
0.60	0.2743	0.2709	0.2676	0.2643	0.2611	0.2578	0.2546	0.2514	0.2483	0.2451
0.70	0.2420	0.2389	0.2358	0.2327	0.2296	0.2266	0.2236	0.2206	0.2177	0.2148
0.80	0.2119	0.2090	0.2061	0.2033	0.2005	0.1977	0.1949	0.1922	0.1894	0.1867
0.90	0.1841	0.1814	0.1788	0.1762	0.1736	0.1711	0.1685	0.1660	0.1635	0.1611
1.00	**0.1587**	**0.1562**	**0.1539**	**0.1515**	**0.1492**	**0.1469**	**0.1446**	**0.1423**	**0.1401**	**0.1379**
1.10	0.1357	0.1335	0.1314	0.1292	0.1271	0.1251	0.1230	0.1210	0.1190	0.1170
1.20	0.1151	0.1131	0.1112	0.1093	0.1075	0.1056	0.1038	0.1020	0.1003	0.0985
1.30	0.0968	0.0951	0.0934	0.0918	0.0901	0.0885	0.0869	0.0853	0.0838	0.0823
1.40	0.0808	0.0793	0.0778	0.0764	0.0749	0.0735	0.0721	0.0708	0.0694	0.0681
1.50	**0.0668**	**0.0655**	**0.0643**	**0.0630**	**0.0618**	**0.0606**	**0.0594**	**0.0582**	**0.0571**	**0.0559**
1.60	0.0548	0.0537	0.0526	0.0516	0.0505	0.0495	0.0485	0.0475	0.0465	0.0455
1.70	0.0446	0.0436	0.0427	0.0418	0.0409	0.0401	0.0392	0.0384	0.0375	0.0367
1.80	0.0359	0.0351	0.0344	0.0336	0.0329	0.0322	0.0314	0.0307	0.0301	0.0294
1.90	0.0287	0.0281	0.0274	0.0268	0.0262	0.0256	0.0250	0.0244	0.0239	0.0233
2.00	**0.0228**	**0.0222**	**0.0217**	**0.0212**	**0.0207**	**0.0202**	**0.0197**	**0.0192**	**0.0188**	**0.0183**
2.10	0.0179	0.0174	0.0170	0.0166	0.0162	0.0158	0.0154	0.0150	0.0146	0.0143
2.20	0.0139	0.0136	0.0132	0.0129	0.0125	0.0122	0.0119	0.0116	0.0113	0.0110
2.30	0.0107	0.0104	0.0102	0.0099	0.0096	0.0094	0.0091	0.0089	0.0087	0.0084
2.40	0.0082	0.0080	0.0078	0.0075	0.0073	0.0071	0.0069	0.0068	0.0066	0.0064
2.50	**0.0062**	**0.0060**	**0.0059**	**0.0057**	**0.0055**	**0.0054**	**0.0052**	**0.0051**	**0.0049**	**0.0048**
2.60	0.0047	0.0045	0.0044	0.0043	0.0041	0.0040	0.0039	0.0038	0.0037	0.0036
2.70	0.0035	0.0034	0.0033	0.0032	0.0031	0.0030	0.0029	0.0028	0.0027	0.0026
2.80	0.0026	0.0025	0.0024	0.0023	0.0023	0.0022	0.0021	0.0021	0.0020	0.0019
2.90	0.0019	0.0018	0.0018	0.0017	0.0016	0.0016	0.0015	0.0015	0.0014	0.0014
3.00	**0.0013**	**0.0013**	**0.0013**	**0.0012**	**0.0012**	**0.0011**	**0.0011**	**0.0011**	**0.0010**	**0.0010**
3.10	0.0010	0.0009	0.0009	0.0009	0.0008	0.0008	0.0008	0.0008	0.0007	0.0007
3.20	0.0007	0.0007	0.0006	0.0006	0.0006	0.0006	0.0006	0.0005	0.0005	0.0005
3.30	0.0005	0.0005	0.0005	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0003
3.40	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0002
3.50	**0.0002**	**0.0002**	**0.0002**	**0.0002**	**0.0002**	**0.0002**	**0.0002**	**0.0002**	**0.0002**	**0.0002**
3.60	0.0002	0.0002	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
3.70	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
3.80	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
3.90	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4.00	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

$\frac{\alpha}{2}$