

INFT 877/CSI 877 Geometric Methods in Statistics

Instructor: Edward J. Wegman
Syllabus

This course is intended to survey a variety of geometric methods useful in statistics and related discipline areas. Generally, we will deal with selected topics in 1) n-dimensional Euclidian Geometry, 2) Differential Geometry including curves and surfaces, 3) Projective Geometry and 4) Computational Geometry. Discussion will include applications to statistics, computer graphics and scientific visualization.

Section 1: *Introduction* through *Polar Coordinates in n-Dimensions*, pp. 1-18 of *A Course in the Geometry of n Dimensions*, M. G. Kendall.

Section 2: *Equation of a Flat through Given Points* through *Content of a Hyperellipsoid* and *Content of a Simplex*, pp. 18-36 and 38-40 of *A Course in the Geometry of n Dimensions*, M. G. Kendall.

Section 3: *Concept of a Curve* and *Curvature and Torsion*, pp. 43-79 of *Differential Geometry*, Martin Lipschutz.

Section 4: *The Theory of Curves* and *Concept of a Surface*, pp. 80-101 and pp. 150-170 of *Differential Geometry*, Martin Lipschutz.

Section 5: *Convex hulls: Basic Algorithms* and *Applications to Statistics*, pp. 89-143 and pp. 165-175 of *Computational Geometry: An Introduction*, Franco Preparata and Michael Shamos.

Section 6: *Proximity: Fundamental Algorithms*, pp. 179-218 of *Computational Geometry: An Introduction*, Franco Preparata and Michael Shamos.

Section 7: *Proximity: Variants and Generalizations*, pp. 219-257 of *Computational Geometry: An Introduction*, Franco Preparata and Michael Shamos.

Section 8: *Spatial Tessellations: Voronoi and Delauney Tessellations*, pp. 65-121 of *Spatial Tessellations: Concepts and Applications of Voronoi Diagrams*, Atsuyuki Okabe, Barry Boots and Kokichi Sugihara.

Section 9: *Projective Geometry* and *Fundamentals of Synthetic Projective Geometry*, pp. 29-67 of *Projective and Euclidian Geometry*, W. T. Fishback.

Section 10: *Natural Homogeneous Coordinates* and *Conics*, pp. 68-82 and 139-169 of *Projective and Euclidian Geometry*, W. T. Fishback.

References

M. G. Kendall (1961), *A Course in the Geometry of n Dimensions*, Chapman and Hall, London (out of print)

Martin Lipschutz, *Differential Geometry*, McGraw-Hill Schaum's Outline Series

Franco Preparata and Michael Shamos (1978), *Computational Geometry: An Introduction*, Springer-Verlag, New York

W. T. Fishback (circa 1962), *Projective and Euclidian Geometry*, Wiley, New York

Atsuyuki Okabe, Barry Boots and Kokichi Sugihara (1992), *Spatial Tessellations: Concepts and Applications of Voronoi Diagrams*, Wiley, New York.