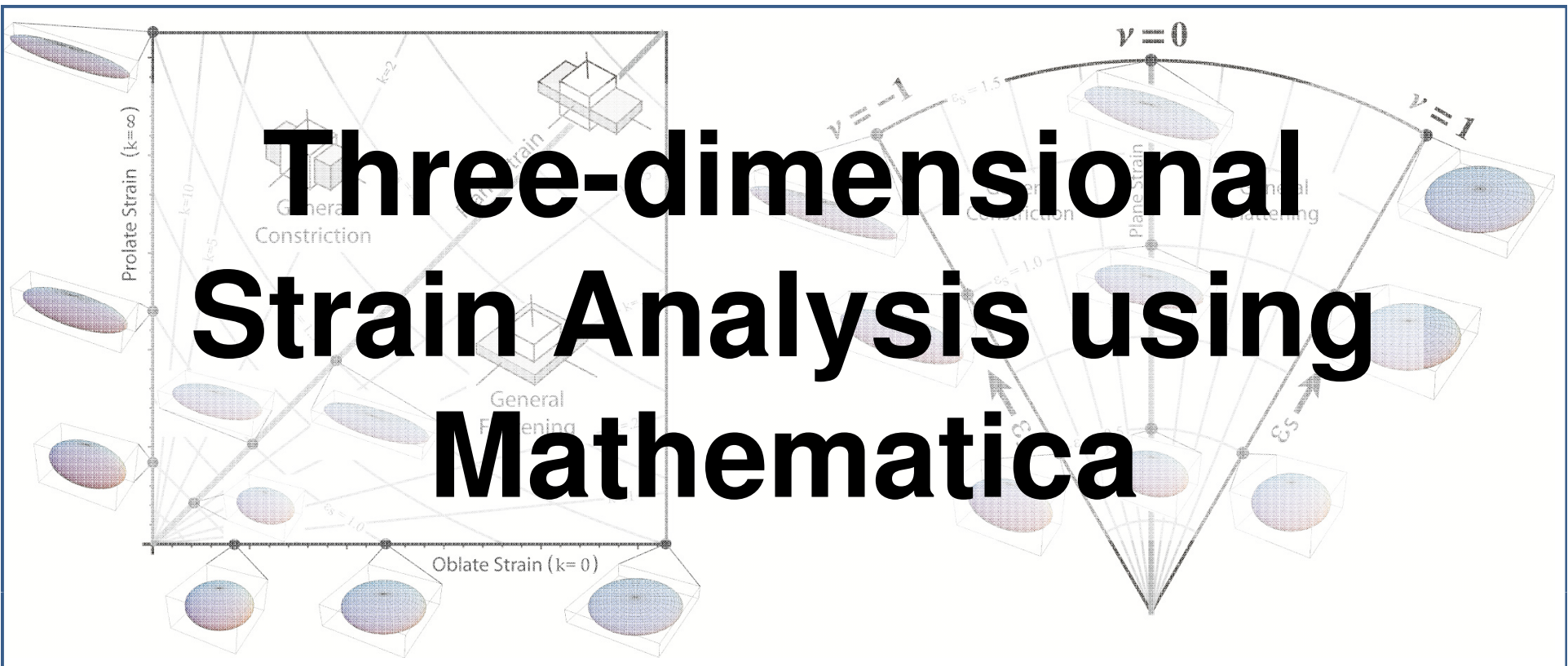
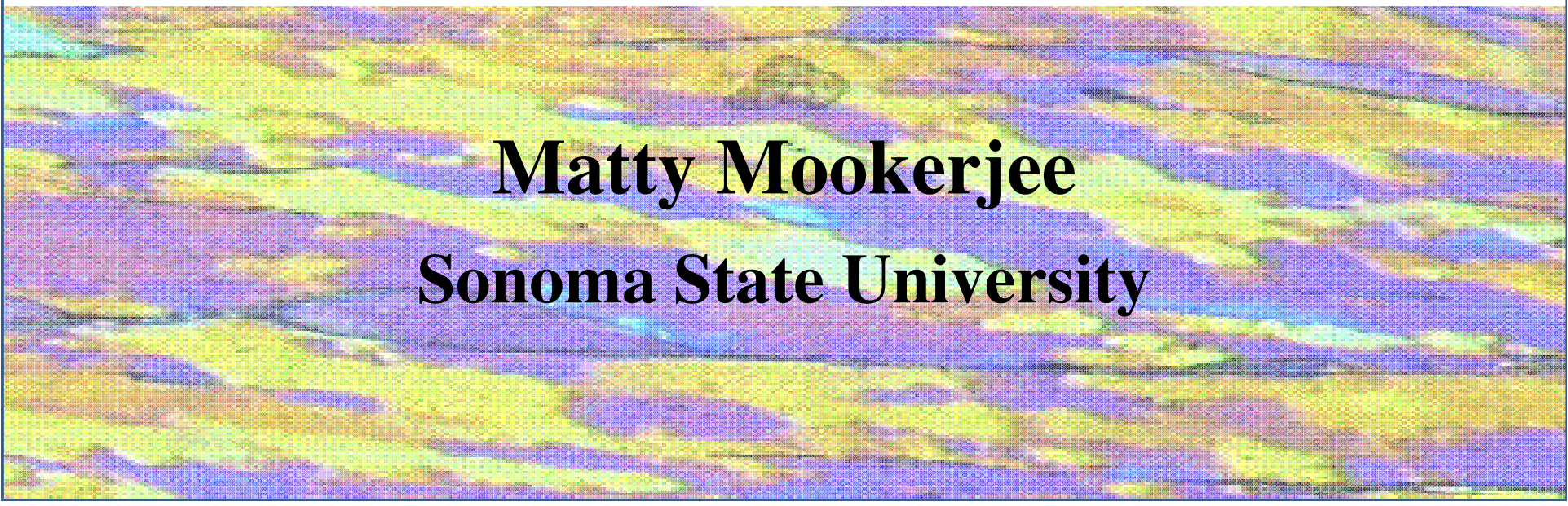




Three-dimensional Strain Analysis using Mathematica



Matty Mookerjee
Sonoma State University

www.sonoma.edu/users/m/mookerje/ProgramPage.htm

Matty Mookerjee

www.sonoma.edu/users/m/mookerje/ProgramPage.htm

SSU Login Pandora Yahoo Mail G-mail hulu Redwood Credit... Netflix Other bookmarks

[Click here to download the Geological Programs for Mathematica program suite](#)

Long Axis Orientation

Rad = Flt. Blue = Input, Dip/DipSl = 15.225

Flinn Diagram

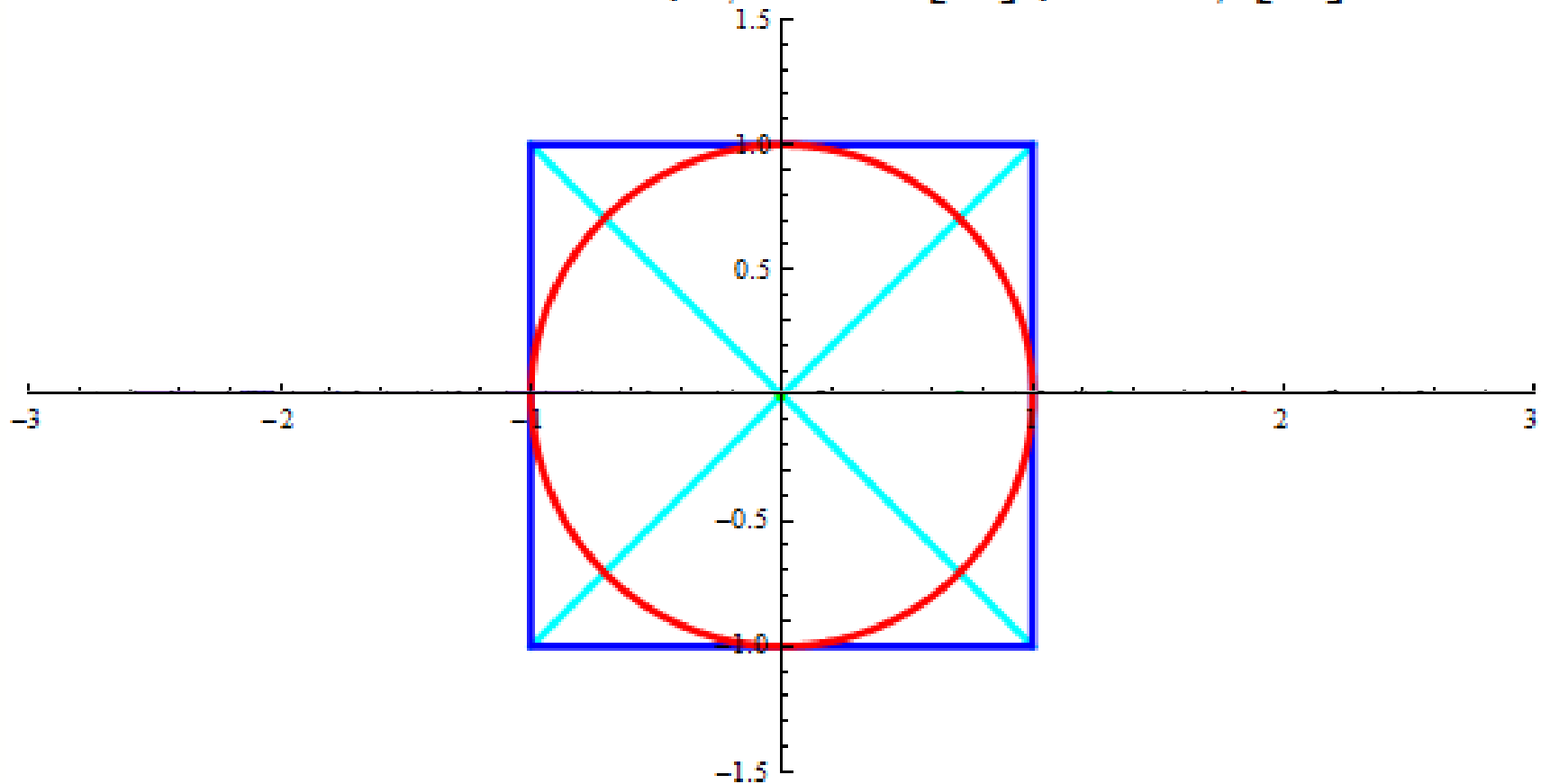
Hsu Diagram

www.sonoma.edu/users/m/mookerje/ProgramPage_files/Geological Programs for Mathematica v_1_1_5.zip

increment



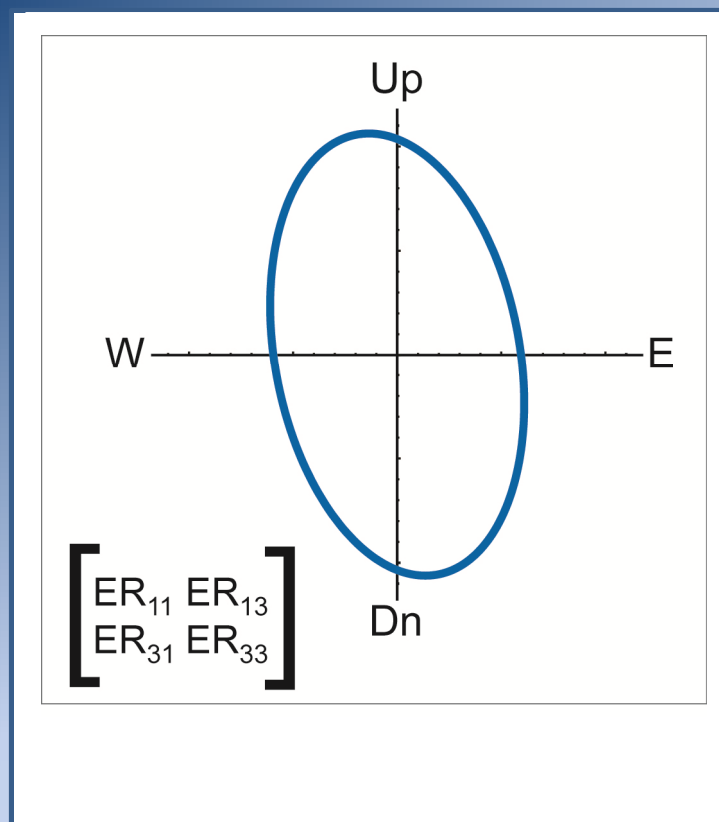
Axial Ratio = 1.; $\phi = \text{Phi}[0.]$; $\Psi = \psi[0.]$



Section Data th
2D Pure vs Sim

Plot Range for Lode's Ratio is -1 to 1
Lode's Ratio contour interval is 0.25

$$GE = \begin{bmatrix} \lambda_{xx} & \gamma_{xy} & \gamma_{xz} \\ \gamma_{xy} & \lambda_{yy} & \gamma_{yz} \\ \gamma_{xz} & \gamma_{yz} & \lambda_{zz} \end{bmatrix}$$



$$ER = \frac{\begin{bmatrix} \cos[DipDir - 90^\circ] & -\sin[DipDir - 90^\circ] & 0 \\ \sin[DipDir - 90^\circ] & \cos[DipDir - 90^\circ] & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} ER_{11} & ER_{13} \\ ER_{31} & ER_{33} \end{bmatrix}}{\left(\begin{bmatrix} \cos[DipDir - 90^\circ] & \sin[DipDir - 90^\circ] \\ -\sin[DipDir - 90^\circ] & \cos[DipDir - 90^\circ] \end{bmatrix} \right)}$$

(Mookerjee & Nickleach, 2011 – JSG)

Assembling the Error Function

$$DM = \begin{bmatrix} \cos[\phi] & -\sin[\phi] \\ \sin[\phi] & \cos[\phi] \end{bmatrix} \cdot \begin{bmatrix} \sqrt{\frac{1}{Rf^2}} & 0 \\ 0 & \frac{1}{\sqrt{\frac{1}{Rf^2}}} \end{bmatrix} \cdot \begin{bmatrix} \cos[\phi] & \sin[\phi] \\ -\sin[\phi] & \cos[\phi] \end{bmatrix}$$

$$\sum_{i=1}^n (DM_{11,i} - EM_{11,i})^2 + (DM_{12,i} - EM_{12,i})^2 + (DM_{22,i} - EM_{22,i})^2$$

n = number of sectional data planes

Minimize this function in terms of the elements of the general ellipsoid matrix, λ_{xx} , λ_{yy} , λ_{zz} , γ_{xy} , γ_{xz} , γ_{yz}

Input Data Screen Shot

Sample Strain Data for Stats.xls [Compatibility Mode] - Microsoft Excel

Home Insert Page Layout Formulas Data Review View

Clipboard Font Alignment Number Styles Cells Editing

C3 1

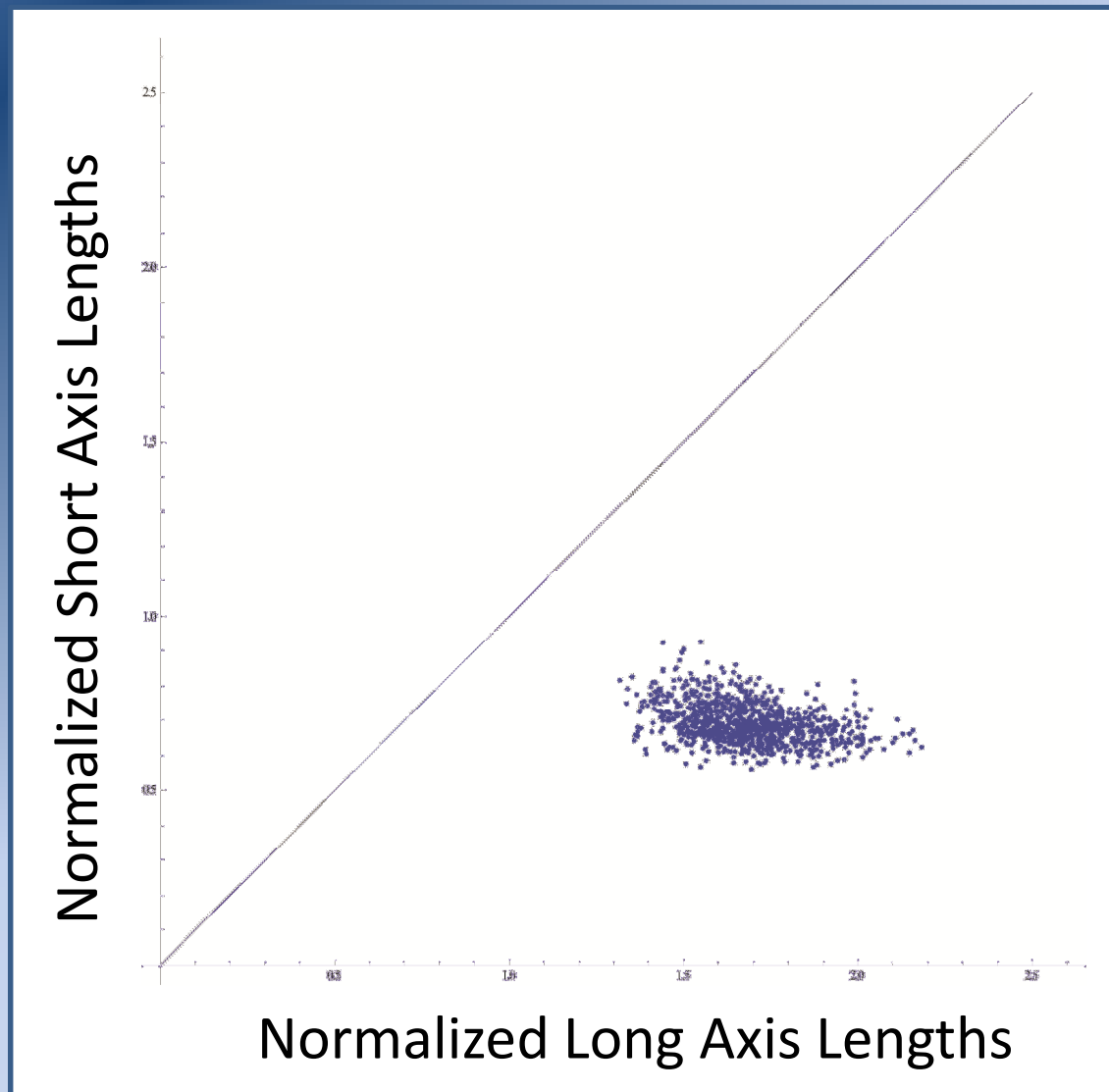
	A	B	C	D	E	F	G	H	I	J
1	Section #1	of:	8							
2	Dip	Dip Direction	Measurement Error							
3	90	90	1							
4	Long Axis	Short Axis	Angle							
5	3.40402	1	-63.4675							
6	3.30707446	1	-65.84164655							
7	3.27975472	1	-62.27171413							
8	3.18622321	1	-61.62402772							
9	3.41664597	1	-63.03749337							
10	3.8270464	1	-64.13161541							
11	3.18803234	1	-65.51987395							
12	3.10714636	1	-62.47460386							
13	3.41780946	1	-62.77188823							
14	3.47907475	1	-64.49563413							
15	3.85077164	1	-63.81478991							
16	Section #2									
17	Dip	Dip Direction	Measurement Error							
18	90	135	1							
19	Long Axis	Short Axis	Angle							
20	3.3888	1	-45							
21	3.1081405	1	-44.32176045							
22	3.18082114	1	-45.94337513							
23	3.69744317	1	-48.06718461							

Sample Strain Data NO stats

Ready 100%

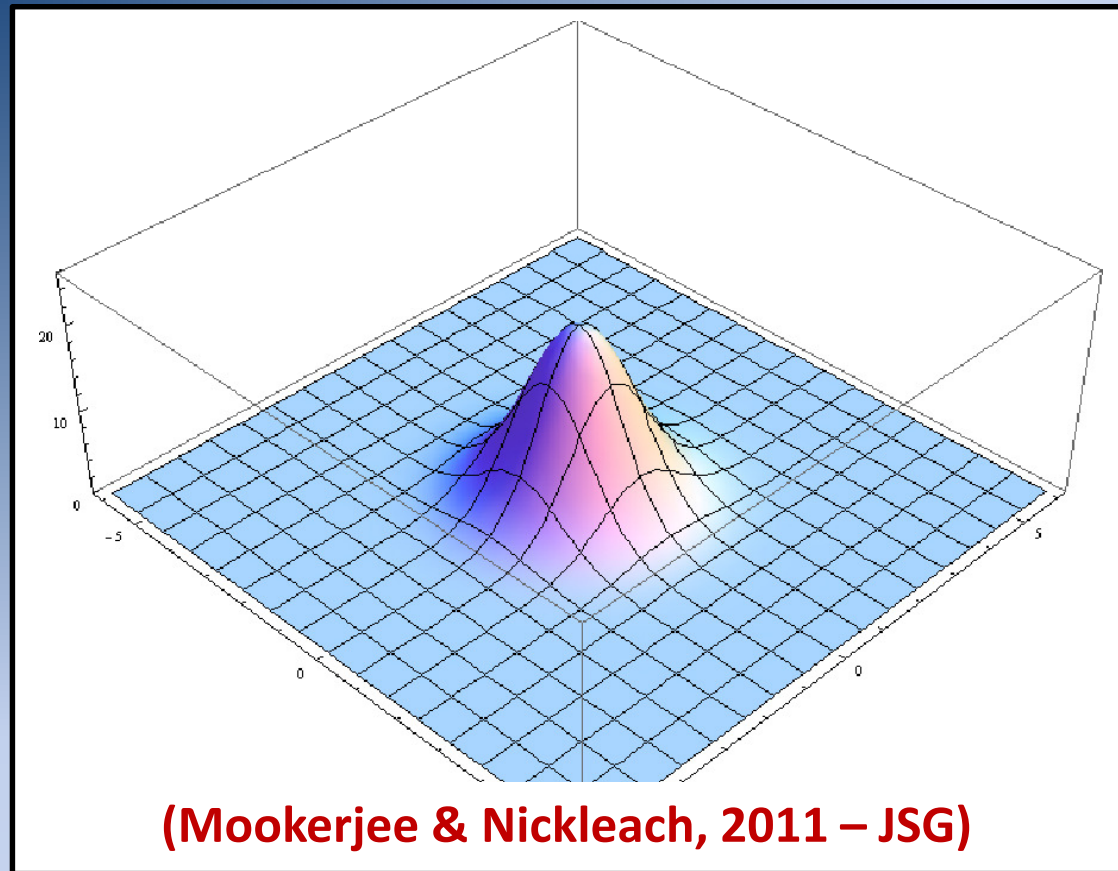
Statistical Analysis

Kernel Density Estimation



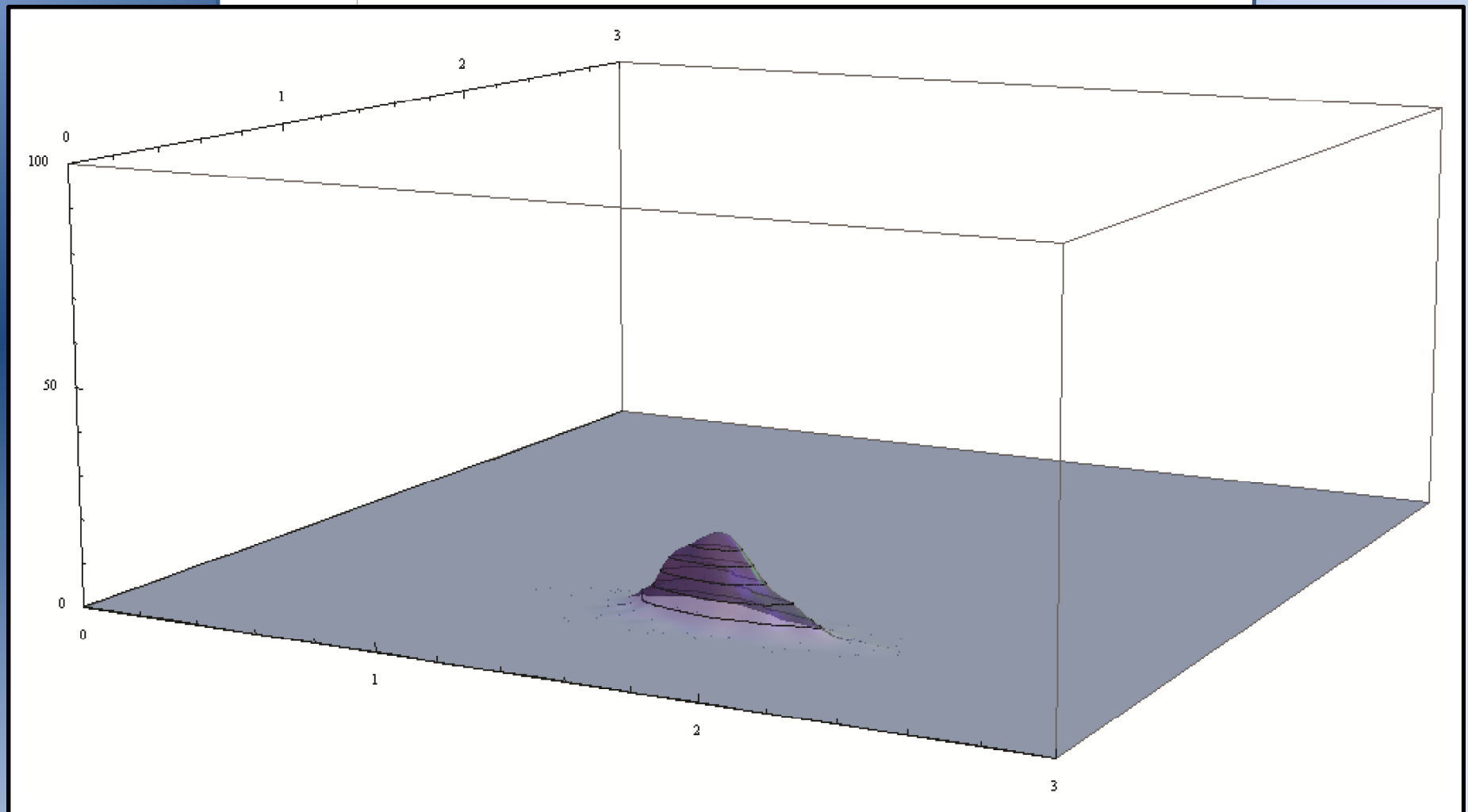
Kernel Density Estimation

$$KDE[\lambda_1, \lambda_3] = \frac{1}{2\pi \times N \times h_1 \times h_3} * \sum_{i=1}^N \exp \left[-\frac{1}{2} \left(\left(\frac{\lambda_1 - L_{1,i}}{h_1} \right)^2 + \left(\frac{\lambda_3 - L_{3,i}}{h_3} \right)^2 \right) \right]$$



$$h_i = 4 \times 1.06 \times \min\{\sqrt{\text{Var}(L_i)}, \text{IQR}_i / 1.34\} \times N^{-1/5}$$

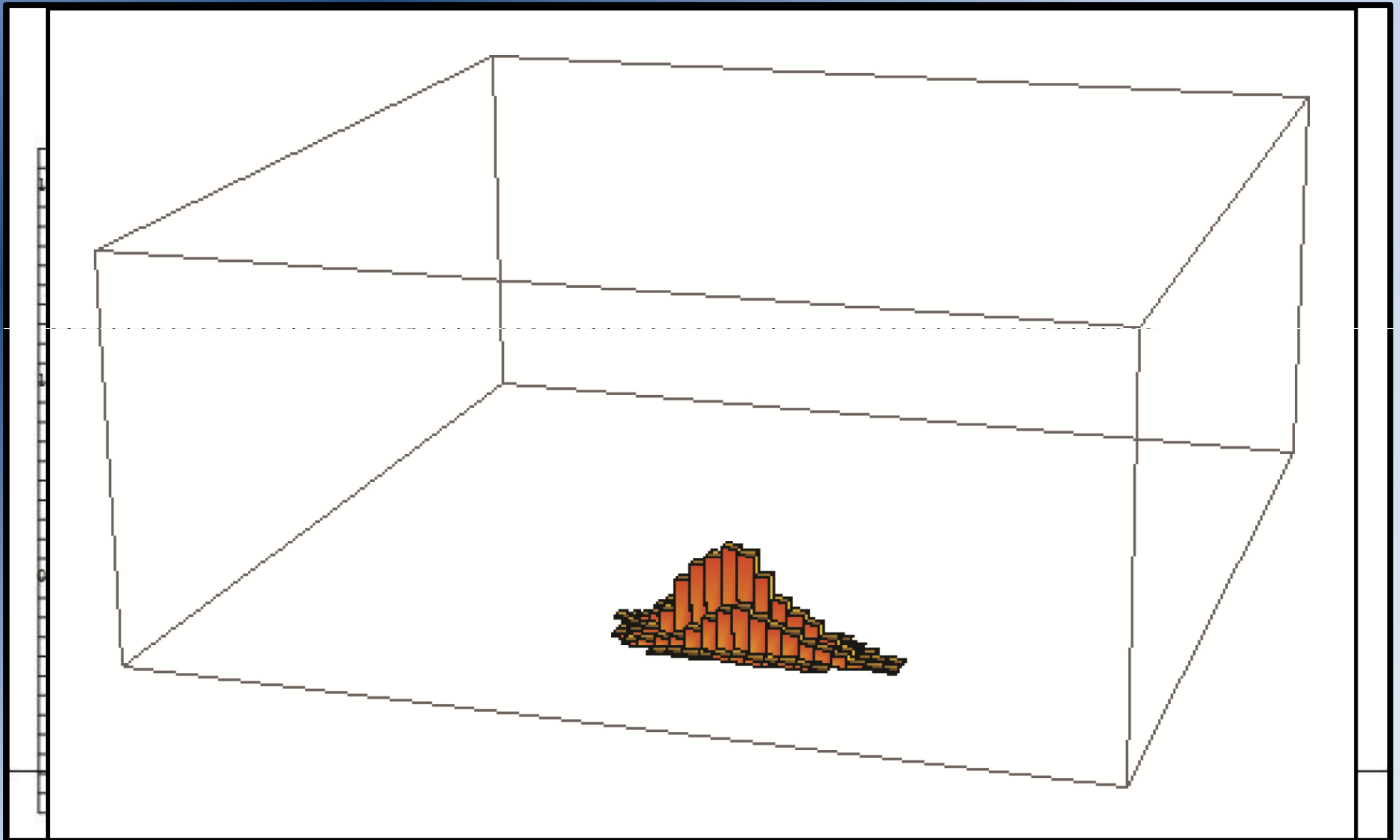
Kernel Density Estimation



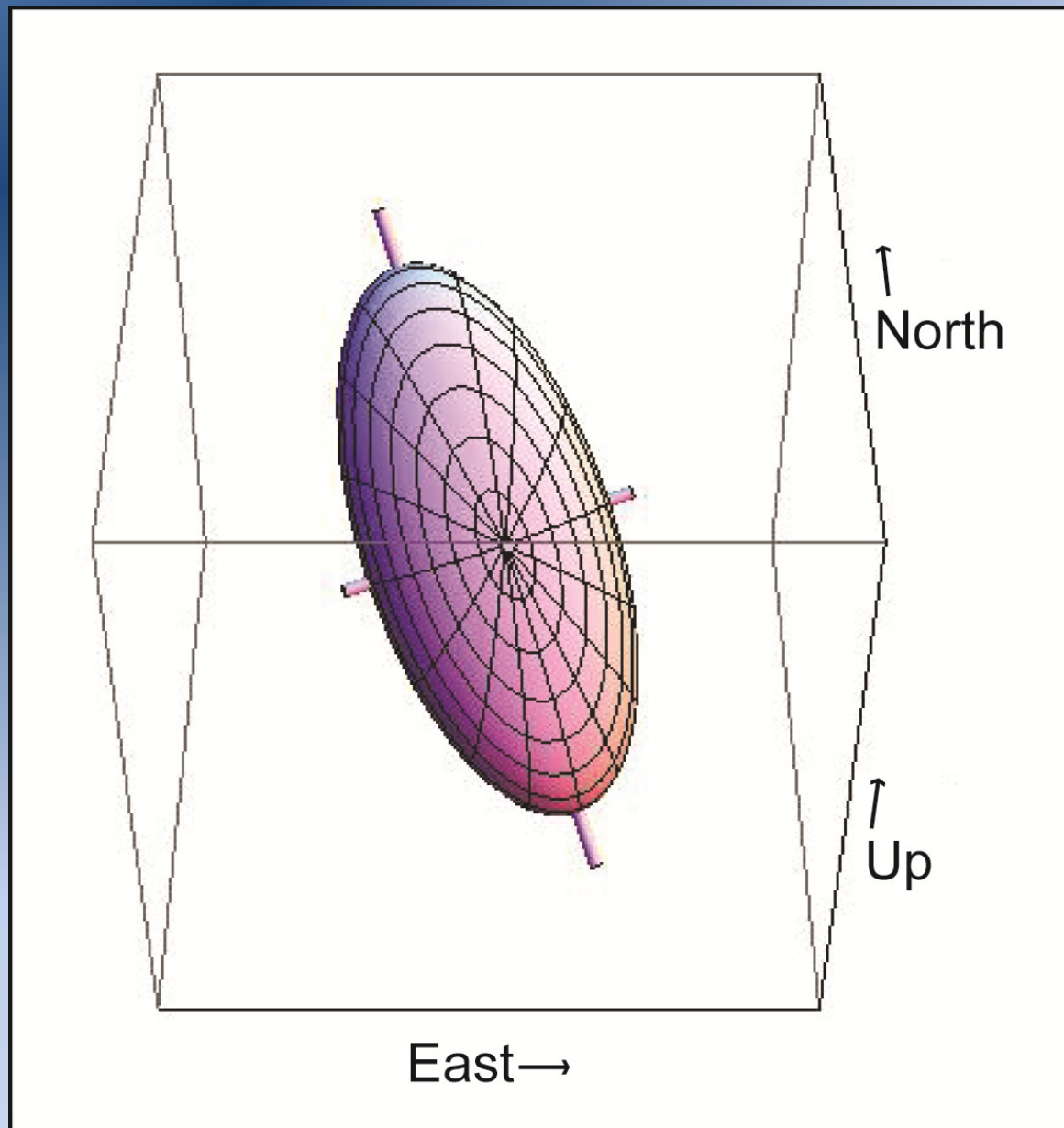
Normalized Long Axis Lengths

Kernel Density Estimation

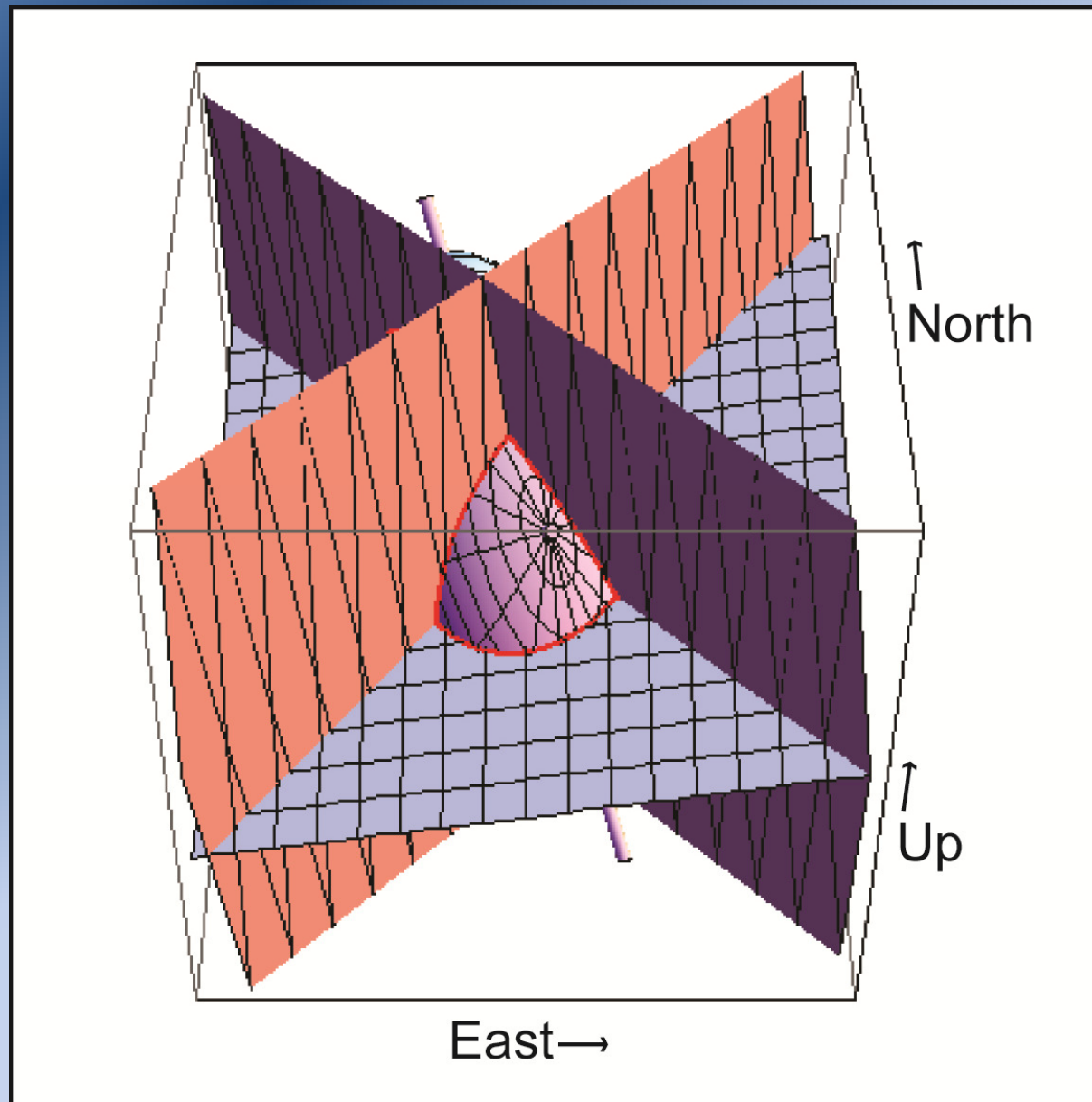
95% Volume



Graphical Output

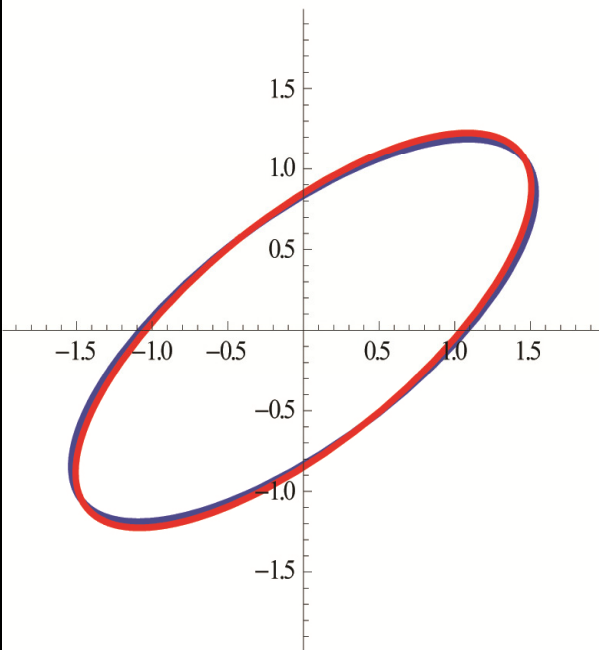


Graphical Output

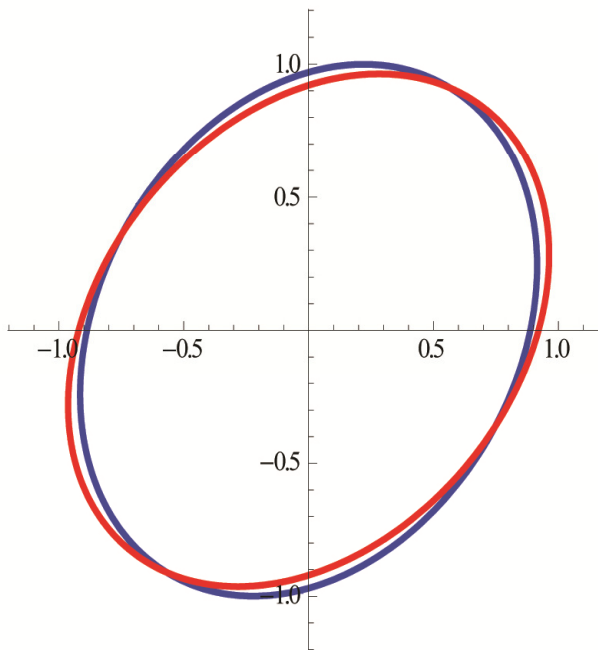


Graphical Output

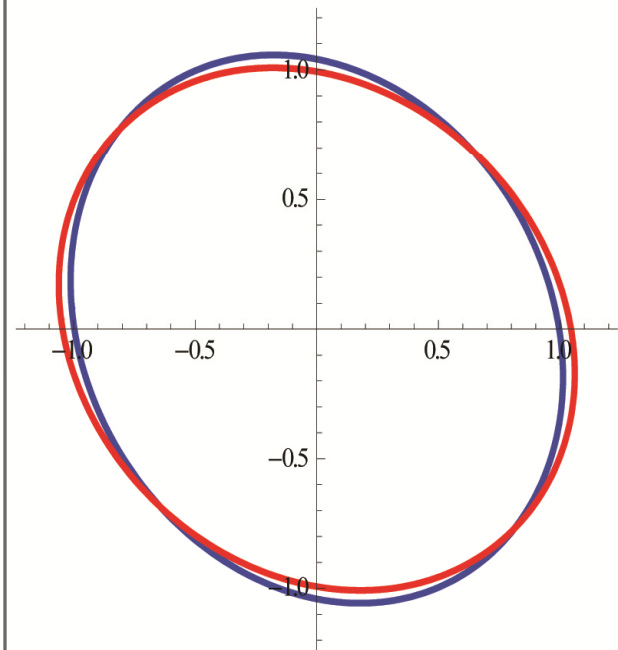
Red = fit. Blue = input. Dip:DipDir = 85.:45.



Red = fit. Blue = input. Dip:DipDir = 85.:135.

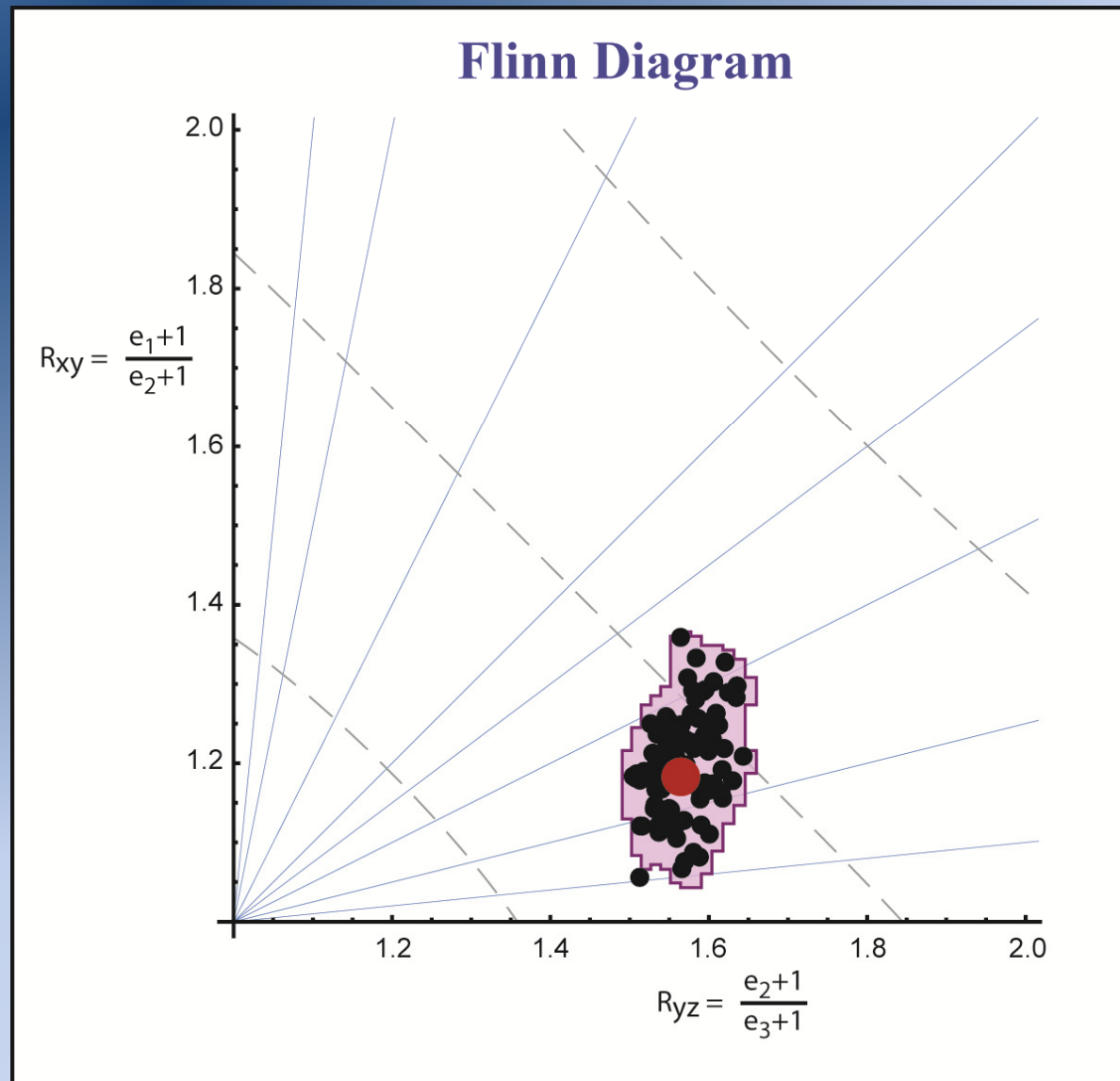


Red = fit. Blue = input. Dip:DipDir = 15.:225.



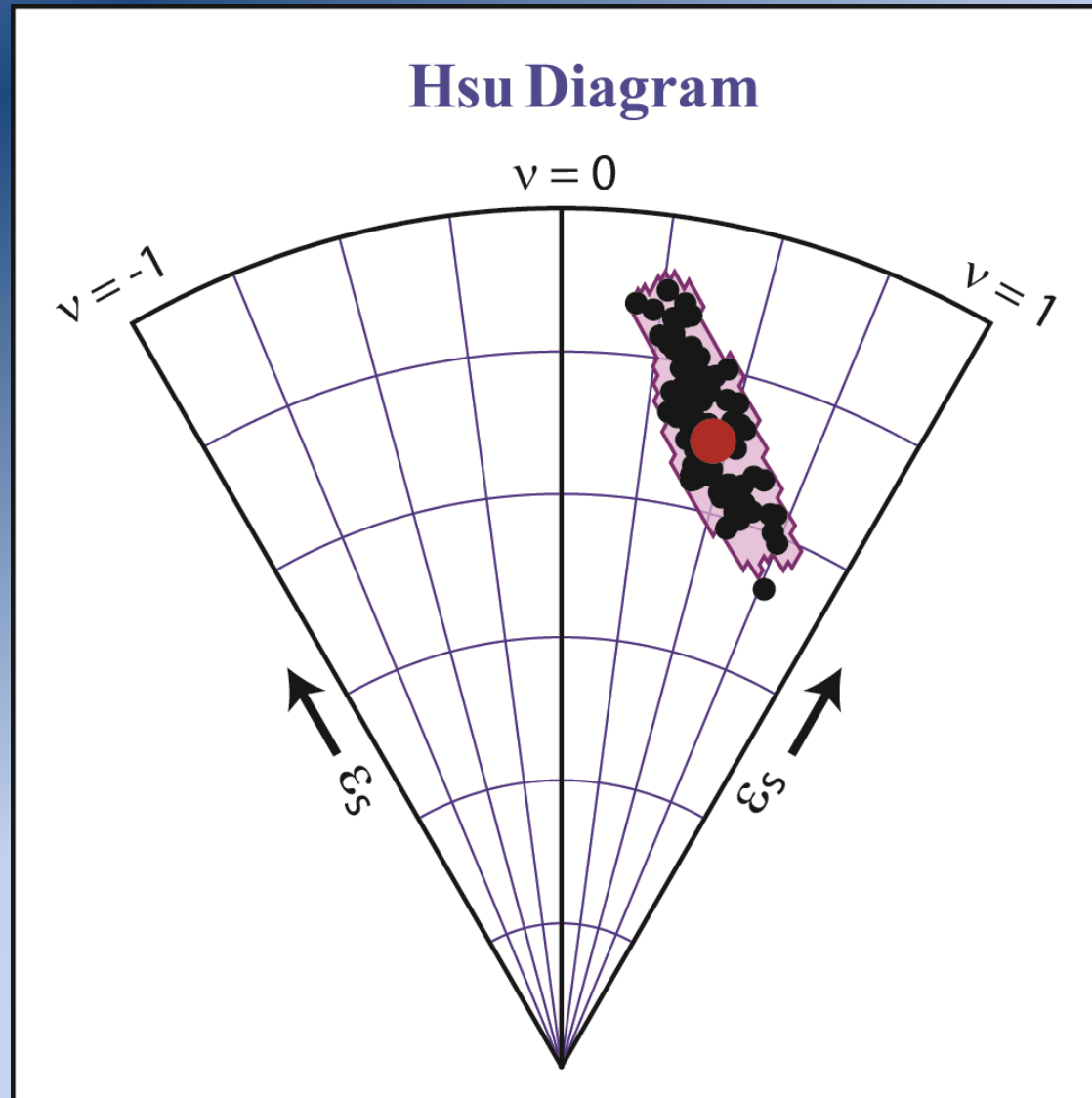
Graphical Output

Flinn Diagram with Error Region



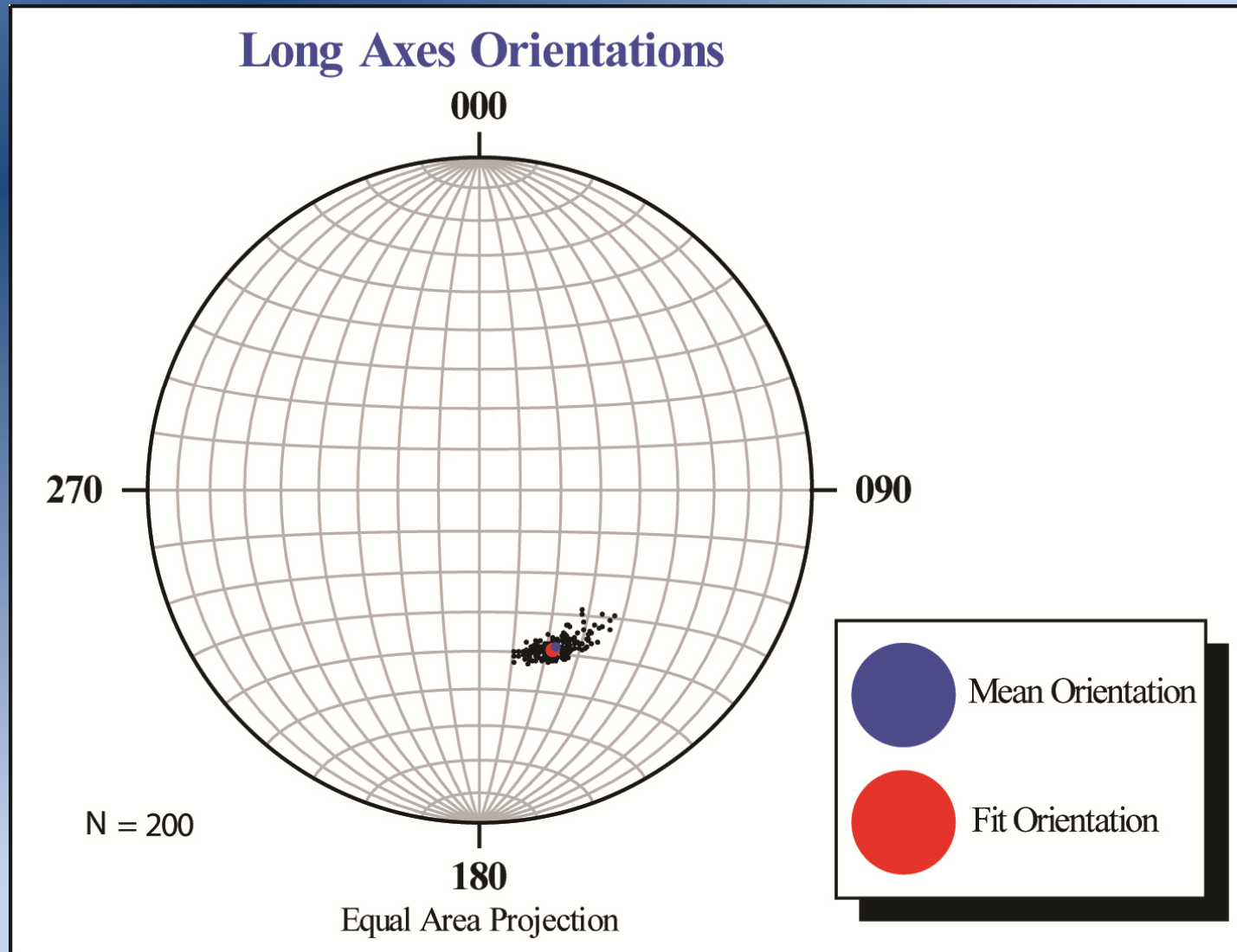
Graphical Output

Hsu Diagram with Error Region

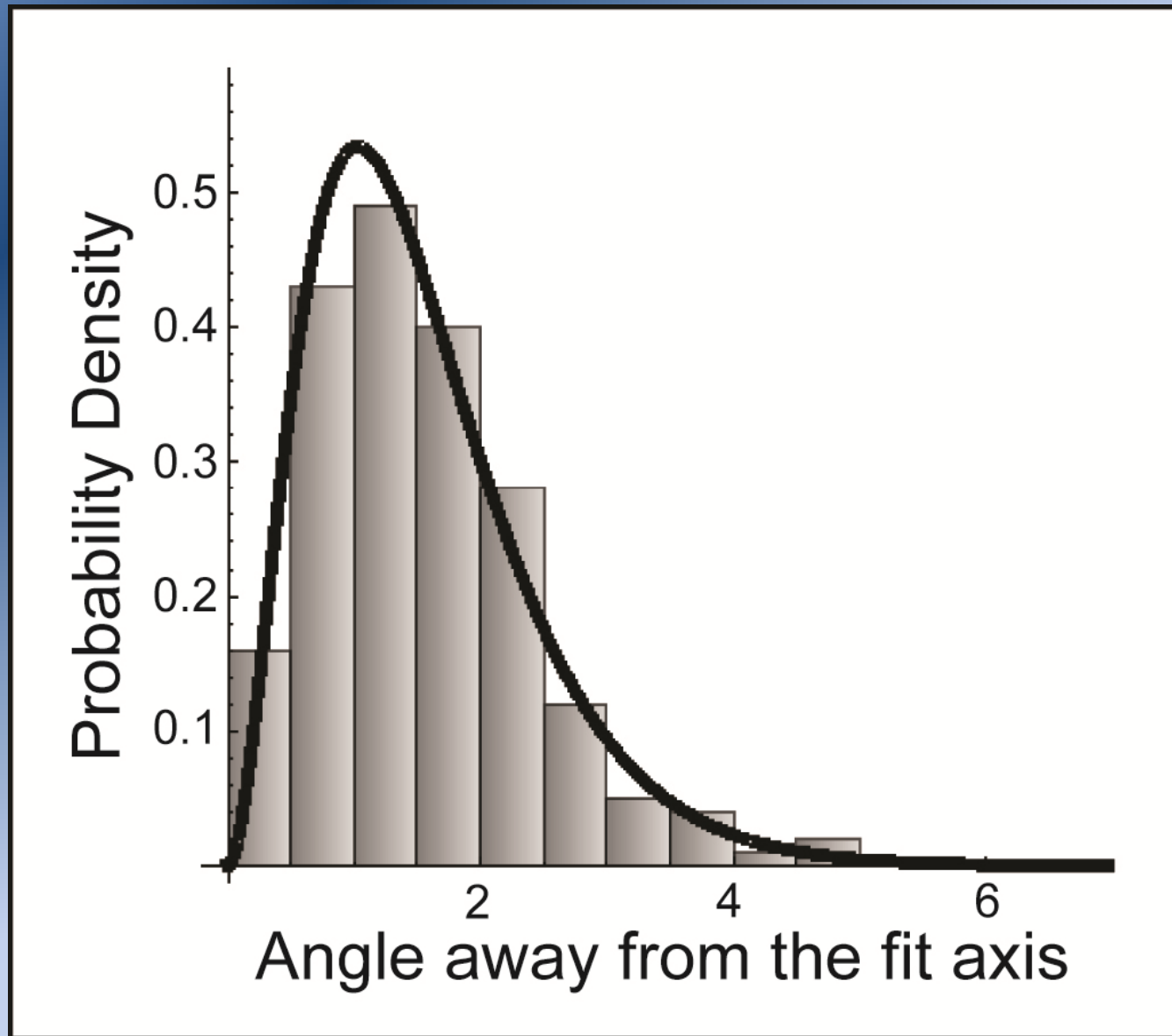


Graphical Output

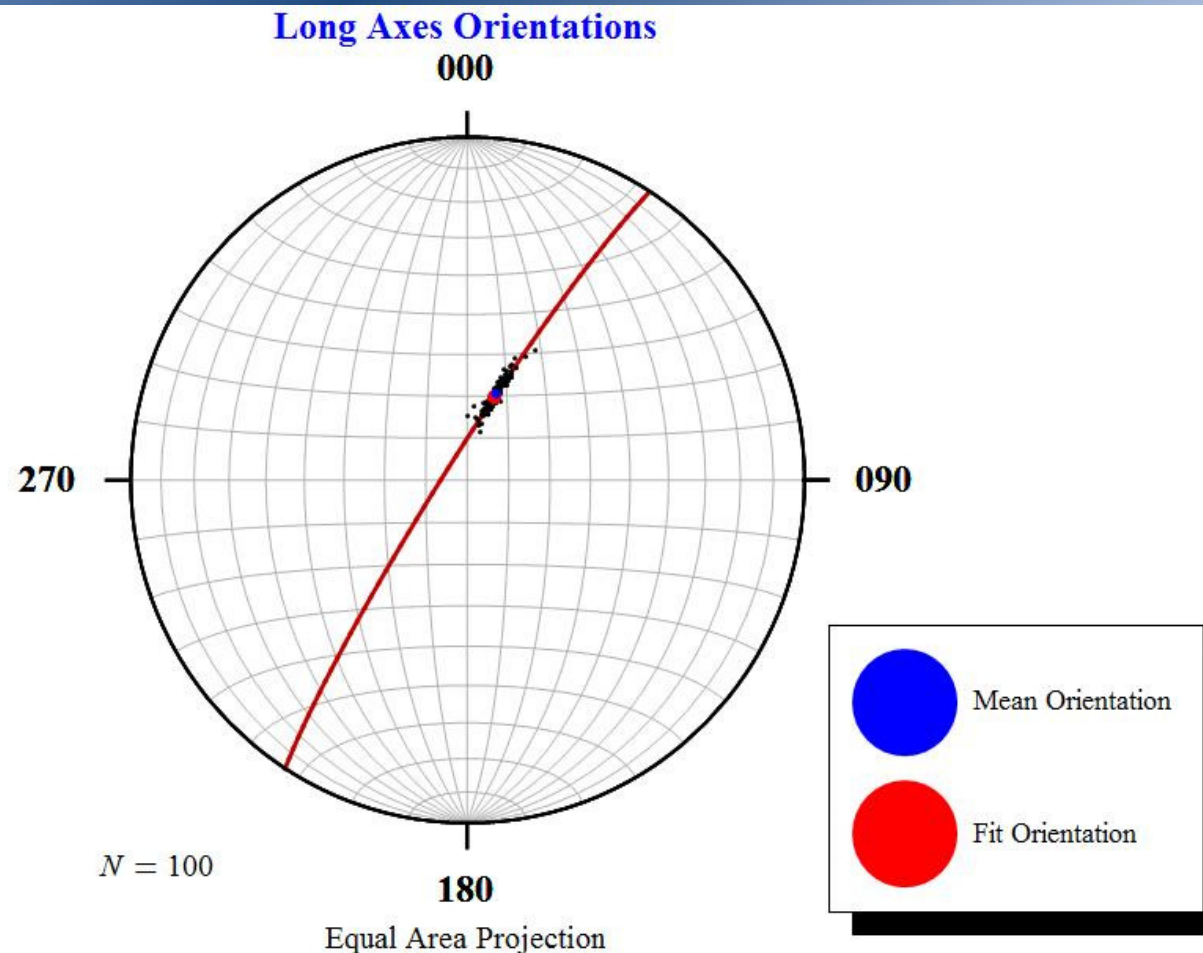
Axes Orientation Data



Best-Fit Gamma Distributions



Best-Fit Plane for Axes Distributions



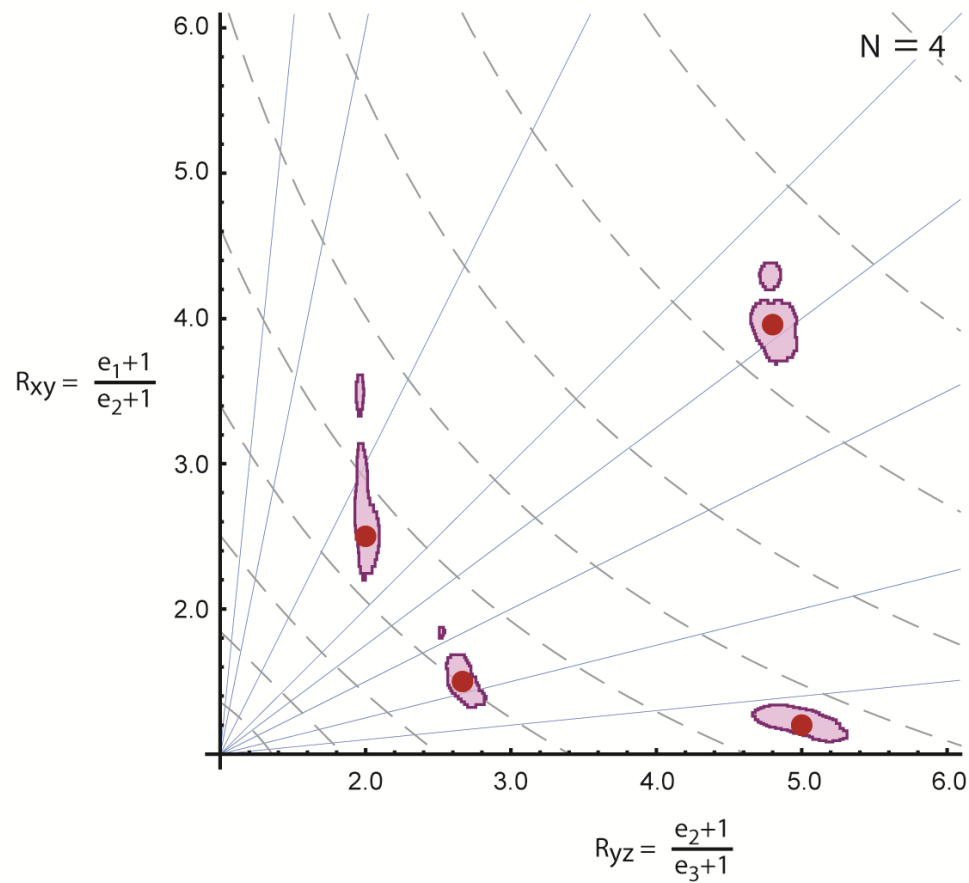
The Trend:Plunge of the Mean Orientation = $18.9049^\circ:68.325^\circ$

The Trend:Plunge of the Fit Orientation = $18.2759^\circ:69.1741^\circ$ with a 95% error angle = 9.22132°

The Dip:Dip Direction of the Fit Plane = $84.5979^\circ:302.759^\circ$ and a Mean Difference Angle of: 0.657062°

Example Data Set with Error Regions

Flinn Diagram



Hsu Diagram

