Online Appendix to:
A CAS Approach to Handle the Anisotropic Hooke's Law for Cancellous Bone & Wood

Sandeep Kumar, Government Post Graduate Degree College New Tehri

A. ELECTRONIC APPENDIX: MATHEMATICA
The Electronic Appendix A consisting of Mathematica codes regarding unfolding the Hooke's law has been submitted to Hindawi Publishing Corporation digital library and can be accessed from the link provided by the digital library of Hindawi Publishing Corporation.

B. ELECTRONIC APPENDIX: MAPLE
The Electronic Appendix B consisting of the full MAPLE codes concerning the analysis of anisotropic Hooke's law has been supplied to Hindawi Publishing Corporation and can be accessed from the link provided by Hindawi Publishing Corporation digital library.

APPENDIX

In this appendix, we explore the MAPLE code that empowered us to meet the objectives (included in the foregoing analysis) of the present research work. However, the MAPLE code being exposed herein is in its minimal form, i.e. without outputs. An Electronic Appendix 3 consisting of full MAPLE code has been also been supplied to Hindawi Publishing Corporation and Those who are interested in full MAPLE codes, can go through the link provided by Hindawi Publishing Corporation digital library.

```
> with(LinearAlgebra):

> with(plottools):

> with(plot):

> with(Student[LinearAlgebra]):

> # Step1: Maple code for calculating eigenvalues for the hardwoods, softwoods and cancellous species

> #Step2: Declaring the stiffness matrix C or S

> C:=Matrix(6, 6, [[g11, g12, g13, g14, g15, g16], [g12, g22, g23, g24, g25, g26], [g13, g23, g33, g34, g35, g36], [g14, g24, g34, g44, g45, g46], [g15, g25, g35, g45, g55, g56], [g16, g26, g36, g46, g56, g66]])

> #Step3: Prepare a list c1 of all the c[11] constants of hardwoods

> c1 := [0.45e-1, .159, .547, .631, .952, .765, .772, 1.451, .927, .898, 1.084, 1.350, 1.135, 1.439, 1.659]:

> #Step4: Prepare a list c2 of all the c[22] constants of hardwoods
```

```
> c2 := [.251, .427, 1.192, 1.381, 1.575, 1.538, 1.772, 2.565, 1.760, 1.623, 1.697, 2.983, 2.142, 2.439, 3.301]:

> #Step5: Prepare a list c3 of all the c[33] constants of hardwoods

> c3:=[1.075, 3.446, 10.041, 10.725, 11.996, 13.010, 12.240, 11.492, 12.432, 1.7173, 15.288, 16.958, 16.958, 17.000, 15.437]:

> #Step6: Prepare a list c4 of all the c[12] constants of hardwoods

> c4:=[0.27e-1, 0.69e-1, .399, .389, .571, .655, .558, 1.197, .707, .671, .777, 1.007, .827, 1.037, 1.279]:

> #Step7: Prepare a list c5 of all the c[13] constants of hardwoods

> c5:=[0.33e-1, .131, .360, .520, .682, .631, .530, 1.267, .936, .714, .883, 1.005, .917, 1.485, 1.433]:

> #Step8: Prepare a list c6 of all the c[23] constants of hardwoods

> c6:=[0.25e-1, .178, .555, .662, .790, .841, .871, 1.818, 1.312, 1.075, 1.191, 1.463, 1.427, 1.968, 2.142]:

> #Step9: Prepare a list c7 of all the c[44] constants of hardwoods

> c7:=[.226, .430, 1.442, 1.800, 1.960, 1.218, 2.318, 2.460, 1.922, 2.346, 2.120, 2.380, 2.684, 1.720, 3.216]:

> #Step10: Prepare a list c8 of all the c[55] constants of hardwoods

> c8:=[.118, .280, 1.344, 1.196, 1.498, .938, 1.582, 2.194, 1.400, 1.816, 1.942, 1.532, 1.784, 1.218, 2.112]:

> #Step11: Prepare a list c9 of all the c[66] constants of hardwoods

> c9:=[0.78e-1, .144, 0.22e-1, .420, .638, .300, .540, .584, .460, .372, .480, .784, .540, .500, .912]:

> #Step12: Prepare lists of all those constants like c[14] etc. which are null for hardwood

> c10:=[0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0]:

> c11:=[0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0]:

> c12:=[0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0]:

> c13:=[0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0]:

> c14:=[0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0]:

> c15:=[0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0]:
```

> c16:=[0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0]:

> c17:=[0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0]:

> c18:=[0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0]:

> c19:=[0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0]:

> c20:=[0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0]:

> c21:=[0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0]:

> #Step13: Develop a loop that automatically generates stiffness matrices T[i] for various hardwood species

> for i to nops(c1) do T[i] := Matrix(subs(g11 = c1[i], g22 = c2[i], g33 = c3[i], g12 = c4[i], g13 = c5[i], g23 = c6[i], g44 = c7[i], g55 = c8[i], g66 = c9[i], g14 = c10[i], g15 = c11[i], g16 = c12[i], g24 = c13[i], g25 = c14[i], g26 = c15[i], g34 = c16[i], g35 = c17[i], g36 = c18[i], g45 = c19[i], g46 = c20[i], g56 = c21[i], C), datatype = float[8]) end do:

> #Step14: compliance matrices corresponding to stiffness matrices of hardwood species

> for i to nops(c1) do S[i] := 1/T[i]; end do:

> #Step15: Factors of the characteristic polynomials of each of the 15 hardwood species

> for i to nops(c1) do factor(CharacteristicPolynomial(T[i], lambda[i])) end do:

> #Step16: Calculating eigenvalues and eigenvectors for each of the T[i]

> for i to nops(c1) do Lambda[i] := Eigenvalues(T[i]); V[i] := Eigenvectors(T[i]) end do:

> #Step16:separating the eigenvectors according to their corresponding eigenvalues

> for i to nops(c1) do lambda[i] := Lambda[i]; v[i] := Column(V[i], [1 .. 6]) end do:

> #Step17:The nominal average of eigenvector and average eigenvector for the two measurements (S.No. 1 & 2 of Table 5) of Quipo

> NomQuipo := 1/2*(v[1][1]+v[2][1]), 1/2*(v[1][2]+v[2][2]), 1/2*(v[1][3]+v[2][3]), 1/2*(v[1][4]+v[2][4]), 1/2*(v[1][5]+v[2][5]), 1/2*(v[1][6]+v[2][6]):

> #Step18:The average Eigenvectors for Quipo

> for i to nops(NomQuipo) do AQ[i] := 1/Norm(OuterProductMatrix(NomQuipo[i], NomQuipo[i]), 2).NomQuipo[i] end do:

> #Step19:The average Eigenvalue for the two measurements of (S.No. 1 & 2 of Table 5)Quipo

> NomQuipo := $1/2 * (\lambda[1][1].((v[1][1].AQ[1])^2) + \lambda[1][2].((v[1][2].AQ[2])^2) + \lambda[1][3].((v[1][3].AQ[3])^2) + \lambda[1][4].((v[1][4].AQ[4])^2) + \lambda[1][5].((v[1][5].AQ[5])^2) + \lambda[1][6].((v[1][6].AQ[6])^2) + \lambda[2][1].((v[2][1].AQ[1])^2) + \lambda[2][2].((v[2][2].AQ[2])^2) +$

$\lambda[2][3].\left((v[2][3].AQ[3])^2\right) + \lambda[2][4].\left((v[2][4].AQ[4])^2\right) + \lambda[2][5].\left((v[2][5].AQ[5])^2\right) + \lambda[2][6].\left((v[2][6].AQ[6])^2\right))$:

> #Step20: Average Elasticity Matrix for Quipo

> MQ := QL*(OuterProductMatrix(AQ[1], AQ[1])+OuterProductMatrix(AQ[2], AQ[2])+OuterProductMatrix(AQ[3], AQ[3])+OuterProductMatrix(AQ[4], AQ[4])+OuterProductMatrix(AQ[5], AQ[5])+OuterProductMatrix(AQ[6], AQ[6])):

> #Step21: the histogram of average elasticity matrix of Quipo

> matrixplot(MQ, heights = histogram, axes = boxed, gap = .25):

> #Step22: The nominal average of eigenvector and average eigenvector for the single measurement (S. No. 3 of Table 5) of White

> NomWhite := (1/1)*(v[3][1], v[3][2], v[3][3], v[3][4], v[3][5], v[3][6]):

> #Step23:The average Eigenvectors for White

> for i to nops(NomWhite) do AW[i] := 1/Norm(OuterProductMatrix(NomWhite[i], NomWhite[i]), 2).NomWhite[i] end do:

> #Step24:The average eigenvalue for the single measurement of (S.No. 3 of Table 5)White

> $WL := (1/1) * (\lambda[3][1].\left((v[3][1].AW[1])^2\right) + \lambda[3][2].\left((v[3][2].AW[2])^2\right) + \lambda[3][3].\left((v[3][3].AW[3])^2\right) + \lambda[3][4].\left((v[3][4].AW[4])^2\right) + \lambda[3][5].\left((v[3][5].AW[5])^2\right) + \lambda[3][6].\left((v[3][6].AW[6])^2\right))$:

> #Step25: The Average Elasticity Matrix for White

> MW := WL.(OuterProductMatrix(AW[1], AW[1])+OuterProductMatrix(AW[2], AW[2])+OuterProductMatrix(AW[3], AW[3])+OuterProductMatrix(AW[4], AW[4])+OuterProductMatrix(AW[5], AW[5])+OuterProductMatrix(AW[6], AW[6])):

> #Step26: the histogram of average elasticity matrix of White

> matrixplot(MW, heights = histogram, axes = boxed, gap = .25):

> #Step27:The nominal average of eigenvector and average eigenvector for the single measurement (S. No. 4 of Table 5) of Khaya

> NomKhaya := (1/1)*(v[4][1], v[4][2], v[4][3], v[4][4], v[4][5], v[4][6]):

> #Step28:The average Eigenvectors for Khaya

> AK[i]:=1/(Norm((OuterProductMatrix(NomKhaya[i],NomKhaya[i])),2)).NomKhaya[i]; od:

> #Step29:The average eigenvalue for the single measurement of (S.No. 4 of Table 5)Khaya

> KL := $(1/1) * (\lambda[4][1].((v[4][1].AK[1])^2) + \lambda[4][2].((v[4][2].AK[2])^2) + \lambda[4][3].((v[4][3].AK[3])^2) + \lambda[4][4].((v[4][4].AK[4])^2) + \lambda[4][5].((v[4][5].AK[5])^2) + \lambda[4][6].((v[4][6].AK[6])^2))$:

> #Step30:The Average ElasticityMatrix for Khaya

> MK := KL.(OuterProductMatrix(AK[1], AK[1])+OuterProductMatrix(AK[2], AK[2])+OuterProductMatrix(AK[3], AK[3])+OuterProductMatrix(AK[4], AK[4])+OuterProductMatrix(AK[5], AK[5])+OuterProductMatrix(AK[6], AK[6])):

> #Step31:the histogram for average elasticity matrix of Khaya

> matrixplot(MK, heights = histogram, axes = boxed, gap = .25):

> #Step32:The nominal average of eigenvector and average eigenvector for the two measurement (S. No. 5 & 6 of Table 5) of Mahogany

> Mahogany := 1/2*(v[5][1]+v[6][1]), 1/2*(v[5][2]+v[6][2]), 1/2*(v[5][3]+v[6][3]), 1/2*(v[5][4]+v[6][4]), 1/2*(v[5][5]+v[6][5]), 1/2*(v[5][6]+v[6][6]):

> #Step33:The average Eigenvectors for Mahogany

> for i to nops(Mahogany) do AM[i] := 1/Norm(OuterProductMatrix(Mahogany[i], Mahogany[i]), 2).Mahogany[i] end do:

> #Step34:The average eigenvalue for the two measurements of (S.no. 5 & 6 of table 5) of Mahogany

> $ML := 1/2 * (\lambda[5][1].((v[5][1].AM[1])^2) + \lambda[5][2].((v[5][2].AM[2])^2) + \lambda[5][3].((v[5][3].AM[3])^2) + \lambda[5][4].((v[5][4].AM[4])^2) + \lambda[5][5].((v[5][5].AM[5])^2) + \lambda[5][6].((v[5][6].AM[6])^2) + \lambda[6][1].((v[6][1].AM[1])^2) + \lambda[6][2].((v[6][2].AM[2])^2) + \lambda[6][3].((v[6][3].AM[3])^2) + \lambda[6][4].((v[6][4].AM[4])^2) + \lambda[6][5].((v[6][5].AM[5])^2) + \lambda[6][6].((v[6][6].AM[6])^2))$:

> #Step35:The Average Elasticity Matrix for Mahogany

> MM := ML.(OuterProductMatrix(AM[1], AM[1])+OuterProductMatrix(AM[2], AM[2])+OuterProductMatrix(AM[3], AM[3])+OuterProductMatrix(AM[4], AM[4])+OuterProductMatrix(AM[4], AM[5])+OuterProductMatrix(AM[6], AM[6])):

> #Step36: the histogram for average elasticity matrix of Mahogany

> matrixplot(MM, heights = histogram, axes = boxed, gap = .25):

> #Step37: The nominal average of eigenvector and average eigenvector for the single measurement (S. No. 7 of Table 5) of S. Germ

> SGerm := (1/1)*(v[7][1], v[7][2], v[7][3], v[7][4], v[7][5], v[7][6]):

> #Step38:The average Eigenvectors for S. Germ

> for i to nops(SGerm) do AS[i] := 1/Norm(OuterProductMatrix(SGerm[i], SGerm[i]), 2).SGerm[i] end do:

> #Step39:The average eigenvalue for the single measurement of (S. no. 7 of table 5) S. Germ

> SL := $(1/1) * (\lambda[7][1].((v[7][1].AS[1])^2) + \lambda[7][2].((v[7][2].AS[2])^2) + \lambda[7][3].((v[7][3].AS[3])^2) + \lambda[7][4].((v[7][4].AS[4])^2) + \lambda[7][5].((v[7][5].AS[5])^2) + \lambda[7][6].((v[7][6].AS[6])^2))$:

> #Step40:The Average Elasticity Matrix for S. Germ

> SM := SL.(OuterProductMatrix(AS[1], AS[1])+OuterProductMatrix(AS[2], AS[2])+OuterProductMatrix(AS[3], AS[3])+OuterProductMatrix(AS[4], AS[4])+OuterProductMatrix(AS[4], AS[5])+OuterProductMatrix(AS[6], AS[6])):

> #Step41:the histogram for average elasticity matrix of S. Germ

> matrixplot(SM, heights = histogram, axes = boxed, gap = .25):

> #Step42:The nominal average of eigenvector and average eigenvector for the single measurement (S. No. 8 of Table 5) of Maple

> maple := (1/1)*(v[8][1], v[8][2], v[8][3], v[8][4], v[8][5], v[8][6]):

> #Step43:The average Eigenvectors for Maple

> for i to nops(maple) do MP[i] := 1/Norm(OuterProductMatrix(maple[i], maple[i]), 2).maple[i] end do:

> #Step44:The average eigenvalue for the single measurement of (S. no. 8 of table 5) Maple

> $mL := (1/1) * (\lambda[8][1].((v[8][1].MP[1])^2) + \lambda[8][2].((v[8][2].MP[2])^2) + \lambda[8][3].((v[8][3].MP[3])^2) + \lambda[8][4].((v[8][4].MP[4])^2) + \lambda[8][5].((v[8][5].MP[5])^2) + \lambda[8][6].((v[8][6].MP[6])^2))$:

> #Step45:The Average Elasticit Matrix for Maple

> mM := mL.(OuterProductMatrix(MP[1], MP[1])+OuterProductMatrix(MP[2], MP[2])+OuterProductMatrix(MP[3], MP[3])+OuterProductMatrix(MP[4], MP[4])+OuterProductMatrix(MP[4], MP[5])+OuterProductMatrix(MP[6], MP[6])):

> #Step46: the histogram for average elasticity matrix of Maple

> matrixplot(mM, heights = histogram, axes = boxed, gap = .25)

> #Step47:The nominal average of eigenvector and average eigenvector for the single measurement (S. No. 9 of Table 5) of Walnut

> Walnut := (1/1)*(v[9][1], v[9][2], v[9][3], v[9][4], v[9][5], v[9][6]):

> #Step48:The average Eigenvectors for Walnut

> for i to nops(Walnut) do AW[i] := 1/Norm(OuterProductMatrix(Walnut[i], Walnut[i]), 2).Walnut[i] end do:

> #Step49: The average eigenvalue for the single measurement of (S. no. 9 of table 5) Walnut

> WL := $(1/1) * (\lambda[9][1].((v[9][1].AW[1])^2) + \lambda[9][2].((v[9][2].AW[2])^2) + \lambda[9][3].((v[9][3].AW[3])^2) + \lambda[9][4].((v[9][4].AW[4])^2) + \lambda[9][5].((v[9][5].AW[5])^2) + \lambda[9][6].((v[9][6].AW[6])^2))$:

> #Step50: The Average Elasticity Matrix for Walnut

> WM := WL.(OuterProductMatrix(AW[1], AW[1])+OuterProductMatrix(AW[2], AW[2])+OuterProductMatrix(AW[3], AW[3])+OuterProductMatrix(AW[4], AW[4])+OuterProductMatrix(AW[4], AW[5])+OuterProductMatrix(AW[6], AW[6])):

> #Step51: the histogram for average elasticity matrix of Walnut

> matrixplot(WM, heights = histogram, axes = boxed, gap = .25):

> #Step52: The nominal average of eigenvector and average eigenvector for the single measurement (S. No. 10 of Table 5) of Birch

> Birch := (1/1)*(v[10][1], v[10][2], v[10][3], v[10][4], v[10][5], v[10][6]):

> #Step53: The average Eigenvectors for Birch

> for i to nops(Birch) do AB[i] := 1/Norm(OuterProductMatrix(Birch[i], Birch[i]), 2).Birch[i] end do:

> #Step54: The average eigenvalue for the single measurement of (S. no. 10 of table 5) Birch

> BL := $(1/1) * (\lambda[10][1].((v[10][1].AB[1])^2) + \lambda[10][2].((v[10][2].AB[2])^2) + \lambda[10][3].((v[10][3].AB[3])^2) + \lambda[10][4].((v[10][4].AB[4])^2) + \lambda[10][5].((v[10][5].AB[5])^2) + \lambda[10][6].((v[10][6].AB[6])^2))$:

> #Step55: The Average Elasticity Matrix for Birch

> BM := BL.(OuterProductMatrix(AB[1], AB[1])+OuterProductMatrix(AB[2], AB[2])+OuterProductMatrix(AB[3], AB[3])+OuterProductMatrix(AB[4], AB[4])+OuterProductMatrix(AB[4], AB[5])+OuterProductMatrix(AB[6], AB[6])):

> #Step56:the histogram for average elasticity matrix of Birch

> matrixplot(BM, heights = histogram, axes = boxed, gap = .25)

> #Step57: The nominal average of eigenvector and average eigenvector for the single measurement (S. No. 11 of Table 5) of Y. Birch

> YBirch := (1/1)*(v[11][1], v[11][2], v[11][3], v[11][4], v[11][5], v[11][6]):

> #Step58: The average Eigenvectors for Y.Birch

> for i to nops(YBirch) do YB[i] := 1/Norm(OuterProductMatrix(YBirch[i], YBirch[i]), 2).YBirch[i] end do:

> #Step59: The average eigenvalue for the single measurement of (S. No. 11 of Table 5) Y. Birch

> YL := $(1/1) * (\lambda[11][1].((v[11][1].YB[1])^2) + \lambda[11][2].((v[11][2].YB[2])^2) + \lambda[11][3].((v[11][3].YB[3])^2) + \lambda[11][4].((v[11][4].YB[4])^2) + \lambda[11][5].((v[11][5].YB[5])^2) + \lambda[11][6].((v[11][6].YB[6])^2))$:

> #Step60: The Average Elasticity Matrix for Y. Birch

> YM := YL.(OuterProductMatrix(YB[1], YB[1])+OuterProductMatrix(YB[2], YB[2])+OuterProductMatrix(YB[3], YB[3])+OuterProductMatrix(YB[4], YB[4])+OuterProductMatrix(YB[4], YB[5])+OuterProductMatrix(YB[6], YB[6])):

> #Step61: the histogram for average elasticity matrix of Y. Birch

> matrixplot(YM, heights = histogram, axes = boxed, gap = .25)

> #Step62: The nominal average of eigenvector and average eigenvector for the single measurement (S. No. 12 of Table 5) of Oak

> Oak := (1/1)*(v[12][1], v[12][2], v[12][3], v[12][4], v[12][5], v[12][6]):

> #Step63: The average Eigenvectors for Oak

> for i to nops(Oak) do AO[i] := 1/Norm(OuterProductMatrix(Oak[i], Oak[i]), 2).Oak[i] end do:

> #Step64: The average eigenvalue for the single measurement (S. No. 12 of Table 5) of Oak

> OL := $(1/1) * (\lambda[12][1].((v[12][1].AO[1])^2) + \lambda[12][2].((v[12][2].AO[2])^2) + \lambda[12][3].((v[12][3].AO[3])^2) + \lambda[12][4].((v[12][4].AO[4])^2) + \lambda[12][5].((v[12][5].AO[5])^2) + \lambda[12][6].((v[12][6].AO[6])^2))$

> #Step65:The Average Elasticity Matrix for Oak

> OM := OL.(OuterProductMatrix(AO[1], AO[1])+OuterProductMatrix(AO[2], AO[2])+OuterProductMatrix(AO[3], AO[3])+OuterProductMatrix(AO[4], AO[4])+OuterProductMatrix(AO[4], AO[5])+OuterProductMatrix(AO[6], AO[6])):

> #Step66: the histogram for average elasticity matrix of Oak

> matrixplot(OM, heights = histogram, axes = boxed, gap = .25):

> #Step69: The nominal average of eigenvector and average eigenvector for the two measurements (S. No. 13 & 14 of Table 5) of Ash

> Ash := 1/2*(v[13][1]+v[14][1]), 1/2*(v[13][2]+v[14][2]), 1/2*(v[13][3]+v[14][3]), 1/2*(v[13][4]+v[14][4]), 1/2*(v[13][5]+v[14][5]), 1/2*(v[13][6]+v[14][6]):

> #Step70: The average Eigenvectors for Ash

> for i to nops(Ash) do AA[i] := 1/Norm(OuterProductMatrix(Ash[i], Ash[i]), 2).Ash[i] end do:

> #Step71: The average eigenvalue for two measurements (S. No. 13 & 14 of Table 5) of Ash

> AL := $1/2 * (\lambda[13][1].((v[13][1].AA[1])^2) + \lambda[13][2].((v[13][2].AA[2])^2) + \lambda[13][3].((v[13][3].AA[3])^2) + \lambda[13][4].((v[13][4].AA[4])^2) + \lambda[13][5].((v[13][5].AA[5])^2) + \lambda[13][6].((v[13][6].AA[6])^2) + \lambda[14][1].((v[14][1].AA[1])^2) + \lambda[14][2].((v[14][2].AA[2])^2) + \lambda[14][3].((v[14][3].AA[3])^2) + \lambda[14][4].((v[14][4].AA[4])^2) + \lambda[14][5].((v[14][5].AA[5])^2) + \lambda[14][6].((v[14][6].AA[6])^2))$:

> #Step72: The Average Elasticity Matrix for Ash

> aM := AL*(OuterProductMatrix(AA[1], AA[1])+OuterProductMatrix(AA[2], AA[2])+OuterProductMatrix(AA[3], AA[3])+OuterProductMatrix(AA[4], AA[4])+OuterProductMatrix(AA[5], AA[5])+OuterProductMatrix(AA[6], AA[6])):

> #Step73: the histogram for average elasticity matrix of Ash

> matrixplot(aM, heights = histogram, axes = boxed, gap = .25):

> #Step74: The nominal average of eigenvector and average eigenvector for the single measurement (S. No. 15 of Table 5) of Beech

> Beech := (1/1)*(v[15][1], v[15][2], v[15][3], v[15][4], v[15][5], v[15][6]):

> #Step75: The average Eigenvectors for Beech

> for i to nops(Beech) do BE[i] := 1/Norm(OuterProductMatrix(Beech[i], Beech[i]), 2).Beech[i] end do:

> #Step76: The average eigenvalue for single measurement (S. No. 15 of Table 5) of Beech

> BL := $(1/1) * (\lambda[15][1].((v[15][1].BE[1])^2) + \lambda[15][2].((v[15][2].BE[2])^2) + \lambda[15][3].((v[15][3].BE[3])^2) + \lambda[15][4].((v[15][4].BE[4])^2) + \lambda[15][5].((v[15][5].BE[5])^2) + \lambda[15][6].((v[15][6].BE[6])^2))$:

> #Step77: The Average Elasticity Matrix for Beech

> bM := BL.(OuterProductMatrix(BE[1], BE[1])+OuterProductMatrix(BE[2], BE[2])+OuterProductMatrix(BE[3], BE[3])+OuterProductMatrix(BE[4], BE[4])+OuterProductMatrix(BE[4], BE[5])+OuterProductMatrix(BE[6], BE[6])):

> #Step80: the histogram for average elasticity matrix of Beech

> matrixplot(bM, heights = histogram, axes = boxed, gap = .25):

> #Step81: Preparing List of Apparent densities of Hardwoods as given in Table and drawing graphics for I,II,III,IV,V,VI eigenvalues of each hardwood species against this list

> ρ := [.1, .2, .38, .44, .50, .53, .54, .58, .59, .62, .64, .67, .68, .80, .74]:

```
> for i to nops(c1) do l[i] := Λ[i][1]; t[i] := Λ[i][2]; n[i] := Λ[i][3]; p[i] := Λ[i][4]; q[i] := Λ[i][5]; r[i] := Λ[i][6] end do:

> u := convert(l, list); alpha := convert(t, list); w := convert(n, list); x := convert(p, list); y := convert(q, list); z := convert(r, list):

> h1 := plot(rho, u); h2 := plot(rho, alpha); h3 := plot(rho, w); h4 := plot(rho, x); h5 := plot(rho, y); h6 := plot(rho, z):

> display(h1, h2, h3, h4, h5, h6, axes = boxed):

> plot(rho, u); plot(rho, alpha); plot(rho, w); plot(rho, x); plot(rho, y); plot(rho, z):

> # ***End of the MAPLE Program***
```