5-1Eigenvalue Methods

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# Note:

This R repository is for demonstration of algorithms involved in the book Mathematical Modeling (4th Edition) written by Prof. Mark. M. Meerschaert

Use yacas() function in R to call Yacas interface in R. The PrettyForm() function in Yacas helps print more intuitive math expressions.

#Exp5-1 Eigenvalue Methods  
#Clear variables  
#rm(list = ls())  
library(Ryacas)  
#x1 = Sym('x1');x2 = Sym('x2')  
yacas("f1:=(10/100)\*x1-((10/100)/10000)\*x1^2-((5/100)/10000)\*x1\*x2")

## expression(x1/10 - x1^2/1e+05 - x2 \* x1/2e+05)

yacas("f2:=(25/100)\*x2-((25/100)/6000)\*x2^2-((25/200)/6000)\*x1\*x2")

## expression(x2/4 - x2^2/24000 - x2 \* x1/48000)

yacas("df1dx1:=D(x1) f1")

## expression(1/10 - x1/50000 - x2/2e+05)

yacas("df1dx2:=D(x2) f1")

## expression(-(x1/2e+05))

yacas("df2dx1:=D(x1) f2")

## expression(-(x2/48000))

yacas("df2dx2:=D(x2) f2")

## expression(1/4 - x2/12000 - x1/48000)

yacas("A:={{df1dx1,df1dx2},{df2dx1,df2dx2}}")

## expression(list(list(1/10 - x1/50000 - x2/2e+05, -(x1/2e+05)),   
## list(-(x2/48000), 1/4 - x2/12000 - x1/48000)))

yacas('PrettyForm(A)')

##   
## / \  
## | / 1 x1 x2 \ / / x1 \ \ |  
## | | -- - ----- - ------ | | -| ------ | | |  
## | \ 10 50000 200000 / \ \ 200000 / / |  
## | |  
## | / / x2 \ \ / 1 x2 x1 \ |  
## | | -| ----- | | | - - ----- - ----- | |  
## | \ \ 48000 / / \ 4 12000 48000 / |  
## \ /

yacas("PrettyForm(S)")

##   
## S

yacas("B:=Subst(x1,28000/3)A")

## expression(list(list(-(13/150 + x2/2e+05), -7/150), list(-(x2/48000),   
## 1/4 - x2/12000 - 7/36)))

yacas("B:=Subst(x2,4000/3)B")

## expression(list(list(-7/75, -7/150), list(-1/36, -1/18)))

yacas('PrettyForm(B)')

##   
## / \  
## | / 28000 4000 \ / / 7 \ \ |  
## | | ----- ---- | | -| --- | | |  
## | | 1 3 3 | \ \ 150 / / |  
## | | -- - ----- - ------ | |  
## | \ 10 50000 200000 / |  
## | |  
## | / / 1 \ \ / 4000 28000 \ |  
## | | -| -- | | | ---- ----- | |  
## | \ \ 36 / / | 1 3 3 | |  
## | | - - ----- - ----- | |  
## | \ 4 12000 48000 / |  
## \ /

yacas('E:=CharacteristicEquation(B,x)')

## expression((7/75 + x) \* (1/18 + x) - 7/5400)

yacas('E:=Simplify(E)')

## expression((1800 \* x^2 + 268 \* x + 7)/1800)

yacas('PrettyForm(E)')

##   
## 2   
## 1800 \* x + 268 \* x + 7  
## -----------------------  
## 1800

yacas('lambda:=Solve(E==0,x)')

## expression(list(x == (root(1339/202500, 2) - 67/450)/2, x ==   
## -(67/450 + root(1339/202500, 2))/2))

yacas('PrettyForm(lambda)')

##   
## / \  
## | / 1339 \ 67 |  
## | Sqrt| ------ | - --- |  
## | \ 202500 / 450 |  
## | x == -------------------- |  
## | 2 |  
## | |  
## | / 67 / 1339 \ \ |  
## | -| --- + Sqrt| ------ | | |  
## | \ 450 \ 202500 / / |  
## | x == ------------------------- |  
## | 2 |  
## \ /