equal initial proportion

Bobcats modelling

3/31/2019

```
# Leslie matrix for worst case
B1 = matrix(QQ, [[0.60,0.60,1.15,1.15,1.15,1.15,1.15,1.15,1.15,1.15,
                  1.15,1.15,1.15,1.15,1.15,1.15],
                 [0.32,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0],
                 [0,0.68,0,0,0,0,0,0,0,0,0,0,0,0,0,0],
                 [0,0,0.68,0,0,0,0,0,0,0,0,0,0,0,0,0],
                 [0,0,0,0.68,0,0,0,0,0,0,0,0,0,0,0,0],
                 [0,0,0,0,0.68,0,0,0,0,0,0,0,0,0,0,0],
                 [0,0,0,0,0,0.68,0,0,0,0,0,0,0,0,0,0],
                 [0,0,0,0,0,0,0.68,0,0,0,0,0,0,0,0,0],
                 [0,0,0,0,0,0,0,0.68,0,0,0,0,0,0,0,0],
                 [0,0,0,0,0,0,0,0,0.68,0,0,0,0,0,0,0],
                 [0,0,0,0,0,0,0,0,0,0.68,0,0,0,0,0,0],
                 [0,0,0,0,0,0,0,0,0,0,0.68,0,0,0,0,0],
                 [0,0,0,0,0,0,0,0,0,0,0,0.68,0,0,0,0],
                 [0,0,0,0,0,0,0,0,0,0,0,0,0.68,0,0,0],
                 [0,0,0,0,0,0,0,0,0,0,0,0,0,0.68,0,0],
                 [0,0,0,0,0,0,0,0,0,0,0,0,0,0,0.68,0]])
B1.eigenvectors_right()
```

[(-0.6170386639166548?, [(1, -0.5186060756206086?, 0.5715235560500431?,
-0.6298406256216766?, 0.6941082471301842?, -0.7649336024626794?, 0.8429858290774480?,
-0.9290023418209860?, 1.023795799810041?, -1.128261784199739?, 1.243387259375132?,
-1.370259897505052?, 1.510078354553959?, -1.664163594836566?, 1.833971371106362?,
-2.021105978086287?)], 1), (1.182851819242111?, [(1, 0.27053261853631?,
0.155524282595733?, 0.089408081760284?, 0.051399080263450?, 0.029548395519811?,
0.0169868358036137?, 0.0097654229875205?, 0.0056139640853482?, 0.00322736585930326?,
0.00185535394089546?, 0.00106660923987697?, 0.00061317425506524?, 0.00035250272828893?,
0.000202647408016036?, 0.000116498309602?)], 1), (-0.5717348421357248? -
0.2388734195638428?*I, [(1, -0.4765186187008895? + 0.1990916479914280?*I,
0.3982940830459046? - 0.4032012276569757?*I, -0.2327311674821774? + 0.5767885745609536?*I,
-0.00835773846376803? - 0.682518818823628?*I, 0.2972161306275758? + 0.6875840588252997?*I,
-0.5918576847811838? - 0.5705058829787945?*I, 0.8406800960572894? + 0.3272983511414076?*I,
-0.9897444332943624? + 0.0242433358339294?*I, 0.9919006355918512? -
0.4432797815619072?*I, -0.8169231204965705? + 0.8685345621423509?*I, 0.4597673367550007? -

1.225095352899537?*I, 0.05273943260739934? + 1.435047736978966?*I, -0.6605293485171487? - 1.430819842791618?*I, 1.274189978149895? + 1.169401139427042?*I, -1.784985652769437? - 0.645066770258867?*I)], 1), (-0.5717348421357248? + 0.2388734195638428?*I, [(1, -0.4765186187008895? - 0.1990916479914280?*I, 0.3982940830459046? + 0.4032012276569757?*I, -0.2327311674821774? - 0.5767885745609536?*I, -0.00835773846376803? + 0.682518818823628?*I, 0.2972161306275758? - 0.6875840588252997?*I, -0.5918576847811838? + 0.5705058829787945?*I, 0.8406800960572894? - 0.3272983511414076?*I, -0.9897444332943624? - 0.02424333358339294?*I, 0.9919606355918512? + 0.4432797815619072?*I, -0.8169231204965705? - 0.8685345621423509?*I, 0.4597673367550007? + 1.225095352899537?*I, 0.05273943260739934? - 1.435047736978966?*I, -0.6605293485171487? + 1.430819842791618?*I, 1.274189978149895? - 1.169401139427042?*I, -1.784985652769437? + 0.645066770258867?*I)], 1), (-0.4421333010443795? - 0.4450491866074919?*I, [(1, -0.3595030574722337? + 0.3618739935060088?*I, -0.00363447004371826? - 0.5529029301116640?*I, 0.427949063171591? + 0.4195920315519411?*I, -0.6495879366013255? + 0.00854041383044330?*I, 0.4896813782482591? - 0.5060459819751660?*I, 0.01505122142105768? + 0.763147071471900?*I, -0.5983448318242162? - 0.5714275022712389?*I, 0.8965195410078412? - 0.02357793664081611?*I, -0.6667597072182924? + 0.7074198246028757?*I, -0.03462620279895279? - 1.053155499120020?*I, 0.836310350551537? + 0.7779248867361422?*I, -1.237104691038475? + 0.04881675608560995?*I, 0.9075394842795908? - 0.9886047994994965?*I, 0.0669101882649560? + 1.453120444171420?*I, -1.168539445299017? - 1.058649894232884?*I)], 1), (-0.4421333010443795? + 0.4450491866074919?*I, [(1, -0.3595030574722337? - 0.3618739935060088?*I, -0.00363447004371826? + 0.5529029301116640?*I, 0.427949063171591? -

0.4195920315519411?*I, -0.6495879366013255? - 0.00854041383044330?*I, 0.4896813782482591? + 0.5060459819751660?*I, 0.01505122142105768? - 0.763147071471900?*I, -0.5983448318242162? + 0.5714275022712389?*I, 0.8965195410078412? + 0.02357793664081611?*I, -0.6667597072182924? - 0.7074198246028757?*I, -0.03462620279895279? + 1.053155499120020?*I, 0.836310350551537? - 0.7779248867361422?*I, -1.237104691038475? - 0.04881675608560995?*I, 0.9075394842795908? + 0.9886047994994965?*I, 0.0669101882649560? -

1.453120444171420?*I, -1.168539445299017? + 1.058649894232884?*I)], 1), (-0.2464271129704083? - 0.5899047046492575?*I, [(1, -0.1929385800498309? + 0.4618622306118154?*I, -0.3741942768374130? - 0.3787219325497874?*I, 0.525116971592798? - 0.2119817794001402?*I, -0.00724400892478892? + 0.6022912136099746?*I, -0.5881530685249641? - 0.2540457595083171?*I, 0.4904745629964258? - 0.4730897276336802?*I, 0.2632254736923390? + 0.6753439890205871?*I, -0.7707422394437565? - 0.01854276243852857?*I, 0.3341989941290714? - 0.7488481208224398?*I, 0.5979426661937436? + 0.6350256202524301?*I, -0.8684036866681483? + 0.3264981582538347?*I, 0.03559673892730354? - 0.9861635290317164?*I, 0.9532828688825857? + 0.4392582829925332?*I, -0.8219539386995754? + 0.7555129010146757?*I, -0.4045070268291074? - 1.116687765077988?*I)], 1), (-0.2464271129704083? + 0.5899047046492575?*I, [(1, -0.1929385800498309? - 0.4618622306118154?*I, -0.3741942768374130? + 0.3787219325497874?*I, 0.525116971592798? + 0.2119817794001402?*I, -0.00724400892478892? - 0.6022912136099746?*I, -0.5881530685249641? + 0.2540457595083171?*I, 0.4904745629964258? + 0.4730897276336802?*I, 0.2632254736923390? - 0.6753439890205871?*I, -0.7707422394437565? + 0.01854276243852857?*I, 0.3341989941290714? + 0.7488481208224398?*I, 0.5979426661937436? - 0.6350256202524301?*I, -0.8684036866681483? - 0.3264981582538347?*I, 0.03559673892730354? +

0.9861635290317164?*I, 0.9532828688825857? - 0.4392582829925332?*I, -0.8219539386995754? - 0.7555129010146757?*I, -0.4045070268291074? + 1.116468765077988?*I)], 1), (-0.01206036372980488? - 0.6517931756061995?*I, [(1, -0.00908117616081966? + 0.4907852516481049?*I, -0.5116738528840134? - 0.01894185614123176?*I, 0.02962884105924857? - 0.5332686784236346?*I, 0.5555840928485787? + 0.04119122317837475?*I, -0.05368047893677295? + 0.5786341298911242?*I, -0.6024324322259981? - 0.06715056488827998?*I, 0.08165801659921474? - 0.6269921868266807?*I, 0.6523260556388260? + 0.0972620505422430?*I, -0.11402466902556022? + 0.6784461013119831?*I, -0.7053637077189512? - 0.1320107681923034?*I, 0.1512882491213734? - 0.7330894949798135?*I, 0.761633228694949? + 0.1719281320567340?*I, -0.1940046737877016? + 0.7910037230781020?*I, -0.821208737666920? - 0.2175954881977520?*I, 0.2427816699938901? - 0.8522548672741366?*I)], 1), (-0.01206036372980488? + 0.6517931756061995?*I, [(1, -0.00908117616081966? - 0.4907852516481049?*I, -0.5116738528840134? + 0.01894185614123176?*I, 0.02962884105924857? + 0.5332686784236346?*I, 0.5555840928485787? - 0.04119122317837475?*I, -0.05368047893677295? - 0.5786341298911242?*I, -0.6024324322259981? + 0.06715056488827998?*I, 0.08165801659921474? + 0.6269921868266807?*I, 0.6523260556388260? - 0.0972620505422430?*I, -0.11402466902556022? - 0.6784461013119831?*I, -0.7053637077189512? + 0.1320107681923034?*I, 0.1512882491213734? + 0.7330894949798135?*I, 0.761633228694949? - 0.1719281320567340?*I, -0.1940046737877016? - 0.7910037230781020?*I, -0.821208737666920? + 0.2175954881977520?*I, 0.2427816699938901? + 0.8522548672741366?*I)], 1), (0.2296964917450732? - 0.618458865220886?*I, [(1, 0.1688743608669247? + 0.4546949968333629?*I, -0.3787366045725441? + 0.3263418896633957?*I, -0.4512329688575264? - 0.2488350799985350?*I, 0.07850257172488551? - 0.5252898816888348?*I, 0.5357204745247985? - 0.11265319118118942?*I, 0.3010961271854627? + 0.4772010155904660?*I, -0.3530336837490205? + 0.4621745781087906?*I, -0.5732544628291545? - 0.1752555781079461?*I, -0.03638031129457345? - 0.6167857335420823?*I, 0.5828995813512606? - 0.2564901394043585?*I, 0.4570058519209096? + 0.4711696942392137?*I, -0.2912566043832865? + 0.610654355153851?*I, -0.6945504126174721? - 0.06228174584990596?*I, -0.1890666874258497? - 0.6934435738408070?*I, 0.602175716174214? - 0.4315290989863212?*I)], 1), (0.2296964917450732? + 0.618458865220886?*I, [(1, 0.1688743608669247? - 0.4546949968333629?*I, -0.3787366045725441? - 0.3263418896633957?*I, -0.4512329688575264? + 0.2488350799985350?*I, 0.07850257172488551? + 0.5252898816888348?*I, 0.5357204745247985? + 0.11265319118118942?*I, 0.3010961271854627? -

0.4772010155904660?*I, -0.3530336837490205? - 0.4621745781087906?*I, -0.5732544628291545? + 0.1752555781079461?*I, -0.03638031129457345? + 0.6167857335420823?*I, 0.5828995813512606? + 0.2564901394043585?*I, 0.4570058519209096? - 0.4711696942392137?*I, -0.2912566043832865? - 0.610654355153851?*I, -0.6945504126174721? + 0.06228174584990596?*I, -0.1890666874258497? + 0.6934435738408070?*I, 0.602175716174214? + 0.4315290989863212?*I)], 1), (0.4480233481886804? - 0.4905486220869980?*I, [(1, 0.3248290257076663? + 0.355660997622052?*I, -0.0445843047355574? + 0.4909983151940973?*I, -0.4018613571237908? + 0.3052214128521496?*I, -0.5080696187512142? - 0.09303597866435028?*I, -0.2803862918112459? - 0.4482078342651012?*I, 0.1452064339075642? - 0.521290937566024?*I, 0.4942115036373340? - 0.2500830947070934?*I, 0.5301429688654378? + 0.2008922053931059?*I, 0.2141071414901631? + 0.5393394426455976?*I, -0.2598318038795215? + 0.5341031635939500?*I, -0.5830162233603078? + 0.1722953648112392?*I, -0.5326510829231643? - 0.3217028918072455?*I, -0.12453214184875220? - 0.6246260114562606?*I,

0.3861198441470447? - 0.5252742546452492?*I, 0.663515308702603? - 0.0707551802137970?*I)],
1), (0.4480233481886804? + 0.4905486220869980?*I, [(1, 0.3248290257076663? -
0.355660997622052?*I, -0.0445843047355574? - 0.4909983151940973?*I, -0.4018613571237908? -
0.3052214128521496?*I, -0.5080696187512142? + 0.09303597866435028?*I, -0.2803862918112459?
+ 0.4482078342651012?*I, 0.1452064339075642? + 0.521290937566024?*I, 0.4942115036373340? +
0.2500830947070934?*I, 0.5301429688654378? - 0.2008922053931059?*I, 0.2141071414901631? -
0.5393394426455976?*I, -0.2598318038795215? - 0.5341031635939500?*I, -0.5830162233603078?
- 0.1722953648112392?*I, -0.5326510829231643? + 0.3217028918072455?*I,
-0.12453214184875220? + 0.6246260114562606?*I, 0.3861198441470447? +
0.5252742546452492?*I, 0.663515308702603? + 0.0707551802137970?*I)], 1),
(0.6117292022838359? - 0.2789075711948191?*I, [(1, 0.4330806567042759? +
0.1974557919450146?*I, 0.3157113890573946? + 0.3634357071938415?*I, 0.1380527719234958? +
0.4669390363240705?*I, -0.0688751431762434? + 0.4876483657927030?*I, -0.2679996588032750?
+ 0.4198814669337936?*I, -0.4228186785909181? + 0.2739644702062513?*I,
-0.5040722326432663? + 0.07471652073552703?*I, -0.4952464295395850? -
0.1427441168079426?*I, -0.3958789921495007? - 0.3391691075761374?*I, -0.2220128369560805?
- 0.4782443819733200?*I, -0.00364935183483579? - 0.5332817370506738?*I,
0.2204030960637036? - 0.4923085049122395?*I, 0.4094056520159779? - 0.3605900232972150?*I,
0.5280757966586827? - 0.1600657245455996?*I, 0.5531487990712071? +
0.0742692930101340?*I)], 1), (0.6117292022838359? + 0.2789075711948191?*I, [(1,
0.4330806567042759? - 0.1974557919450146?*I, 0.3157113890573946? - 0.3634357071938415?*I,
0.1380527719234958? - 0.4669390363240705?*I, -0.0688751431762434? - 0.4876483657927030?*I,
-0.2679996588032750? - 0.4198814669337936?*I, -0.4228186785909181? -
0.2739644702062513?*I, -0.5040722326432663? - 0.07471652073552703?*I, -0.4952464295395850?
+ 0.1427441168079426?*I, -0.3958789921495007? + 0.3391691075761374?*I,
-0.2220128369560805? + 0.4782443819733200?*I, -0.00364935183483579? +
0.5332817370506738?*I, 0.2204030960637036? + 0.4923085049122395?*I, 0.4094056520159779? +
0.3605900232972150?*I, 0.5280757966586827? + 0.1600657245455996?*I, 0.5531487990712071? -
0.0742692930101340?*I)], 1)]

```
v1 = vector([1, 0.27053261853631, 0.155524282595733, \
    0.089408081760284, 0.051399080263450, 0.029548396519811, \
    0.0169868358036137, 0.0097654229875205, 0.0056139640853482, \
    0.00322736585930326, 0.00185535394089546, 0.00106660923987697, \
    0.00061317425506524, 0.00035250272828893, 0.000202647408016036, \
    0.000116498309602])
print(v1/(1 + 0.27053261853631 + 0.155524282595733 + \
    0.089408081760284 + 0.051399080263450 + 0.029548396519811 + \
    0.0169868358036137 + 0.0097654229875205 + 0.0056139640853482 + \
    0.00322736585930326 + 0.00185535394089546 + 0.00106660923987697 +\
     0.00061317425506524 + 0.00035250272828893 + 0.000202647408016036\
    + 0.000116498309602))
```
(0.611167434358882, 0.165340726381227, 0.0950513767745399, 0.0546433079403819,
0.0314134440130190, 0.0180590176904318, 0.0103818008559702, 0.00596830851271216,
0.00343107202662517, 0.00197246091196782, 0.00113393190788472, 0.000651876832599085,
0.000374752136283142, 0.000215438188052852, 0.000123851496436638, 0.0000711999729866011)

```
# Leslie matrix for best case
B2 = matrix(QQ, [[0.63,0.63,1.20,1.20,1.20,1.20,1.20,1.20,1.20,1.20,
                   1.20,1.20,1.20,1.20,1.20,1.20],
                  [0.34,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0],
                  [0,0.71,0,0,0,0,0,0,0,0,0,0,0,0,0,0],
                  [0,0,0.71,0,0,0,0,0,0,0,0,0,0,0,0,0],
                  [0,0,0,0.71,0,0,0,0,0,0,0,0,0,0,0,0],
                  [0,0,0,0,0.71,0,0,0,0,0,0,0,0,0,0,0],
                  [0,0,0,0,0,0.71,0,0,0,0,0,0,0,0,0,0],
                  [0,0,0,0,0,0,0.71,0,0,0,0,0,0,0,0,0],
                  [0,0,0,0,0,0,0,0.71,0,0,0,0,0,0,0,0],
                  [0,0,0,0,0,0,0,0,0.71,0,0,0,0,0,0,0],
                  [0,0,0,0,0,0,0,0,0,0.71,0,0,0,0,0,0],
                  [0,0,0,0,0,0,0,0,0,0,0.71,0,0,0,0,0],
                  [0,0,0,0,0,0,0,0,0,0,0,0.71,0,0,0,0],
                  [0,0,0,0,0,0,0,0,0,0,0,0,0.71,0,0,0],
                  [0,0,0,0,0,0,0,0,0,0,0,0,0,0.71,0,0],
                  [0,0,0,0,0,0,0,0,0,0,0,0,0,0,0.71,0]])
B2.eigenvectors_right()
```

[(-0.6448978264908420?, [(1, -0.5272152983521154?, 0.5804374684697710?,
-0.639032395032254?, 0.7035424556192748?, -0.7745647806068061?, 0.8527567804396095?,
-0.9388422308796859?, 1.033617972558081?, -1.137961286843721?, 1.252838016303216?,
-1.379311504917772?, 1.518552440811374?, -1.671849692598377?, 1.840622239655981?,
-2.026432306752866?)], 1), (1.241440224150576?, [(1, 0.273875449969922?,
0.156633856142122?, 0.089581468118611?, 0.051233109034898?, 0.029301054297372?,
0.0167577529279498?, 0.0095840334052211?, 0.0054812656987677?, 0.0031348256407495?,
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    0.0031348256407495, 0.00179285813495777, 0.00102536493586793, \
    0.00058642300314085, 0.00033538492158564, 0.000191812130534706, \
    0.000109700499493])
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    0.0167577529279498 + 0.0095840334052211 + 0.0054812656987677 + \
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