Restriction: So far code requires that b be even

Other notes & code modifiers (This section doesn't run anything)

To use the code below you may uncomment them and then copy and paste where desired
To uncomment, highlight the desired selection then press Alt and / simultaneously. Or delete the outer (* and *) brackets manually.

```
(*{Wgenesample,basepairs,source,SpecialNote}=
  {StringJoin[ToString[InputString["What Gene is this?"]]," gene"]
   ,ToString[{InputString["Paste the base pair sequence (ex: AAGCTATGG ) here"]}]
   ,ToString[InputString["What's the source? (ex: GenBank: AB043895.5)"]]
   ,ToString[InputString["Any Special Notes? If not type 'no'. "]]};*)
```

```
(*infobutton=
  Button["Click here to enter info",{Wgenesample,basepairs,source,SpecialNote}=
    {StringJoin[ToString[InputString["What Gene is this?"]]," gene"]
     ,ToString[{InputString["Paste the base pair sequence (ex: AAGCTATGG ) here"]}]
     ,ToString[InputString["What's the source? (ex: GenBank: AB043895.5)"]]
     ,ToString[InputString["Any Special Notes? If not type 'no'. "]]}
   ,Method→"Queued"];*)
```

Dealing with other Nucleotide codes: Noting that sets of genetic data will often contain symbols denoting nucleotide pairs of the form

A	Adenine
G	Guanine
C	Cytosine
T	Thymine
U	Uracil
R	Purine (A or G)
Y	Pyrimidine (C or T)
N	Any nucleotide
W	Weak (A or T)
S	Strong (G or C)
M	Amino (A or C)
K	Keto (G or T)
B	Not A (G or C or T)
H	Not G (A or C or T)
D	Not C (A or G or T)
V	Not T (A or G or C)

We treat Uracil (U) the same as we treat Thymine (T), since U replaces T in RNA sequences.

We treat the rest probabilistically. For example, in the instance of the appearance of an R (indicating a Purine A or G in the sequence), we assign R to be *either* A or G randomly by

```
xx = 3;
If[xx > 4, xx - 2, Abort[]]

This code aborts the computation if the condition xx >
 4 is not met. May use this type of code to control the program below

(*StringReplace["RRRRRRRRRR","R"→ToString[RandomInteger[{0,1}]]]*)
```

Note that Log[2,x] = $\frac{\text{Log}[x]}{\text{Log}[2]}$, so any linearity of Log_2 plot implies lineaity of Log_e plot, just rescaled

Analysis

```
SetOptions[EvaluationNotebook[],
 CellEpilog :> (SelectionMove[EvaluationNotebook[], All, EvaluationCell];
   FrontEndTokenExecute["SelectionCloseUnselectedCells"])]
```

```
Wgenesample = StringJoin[ToString[InputString["What Gene is this?"]], " DNA sequence"];
basepairs =
  ToString[{InputString["Paste the base pair sequence (ex: AAGCTATGG ) here"]}];
source = ToString[InputString["What's the source? (ex: GenBank: AB043895.5)"]];
SpecialNote = ToString[InputString["Any Special Notes? If not type 'no'. "]];

(* OtherInput = ToString[InputString[" Enter Prompt for OtherInput Here "]];*)
```

```
lettersample = {basepairs} // ToString;
LetterDNAtoNum[Sample_] := ToExpression[StringReplace[ToString[
    {StringReplace[StringReplace[ToString[{Sample}], {"," → "", " " → "", "{" → "",
        "}" → "", "(" → "", ")" → "", "[" → "", "]" → "", ";" → "", ":" → "", "_" → "",
        "+" → "", "&" → "", "/" → "", "." → "", "RowBox" → "", "Null" → "", "
       " → "", "
" → ""}], {"0" → "0,", "1" → "1,", "2" → "2,",
       "3" → "3,", "A" → "0,", "C" → "1,", "G" → "2,", "T" → "3,", "a" → "0,",
       "c" → "1,", "g" → "2,", "t" → "3,", "U" → "3", "u" → "3", "N" → ""}]}
   ], ",}" → "}"]]

(* N Removed by/in the above code *)
numgenesample = LetterDNAtoNum[lettersample];
lengthofgeneitself = Length[Flatten[numgenesample]];
M = numgenesample;
```

In RNA samples thymine (T) is replaced by uracil (U). Some Samples may already replace T -> U, but if not it is necessary to do so here. If dealing with RNA, inlcude the following code. For this reason the code "U"→ "3","u"→ "3" was included in the above (yellow) cell.

To produce a .txt file of the gene run the following (grey) cell
To open the created file include *SystemOpen[txtfilename]*

```
txtfilename =
  StringReplace[StringJoin[StringReplace[StringJoin[Wgenesample, " ", source],
     {"gene" → "", "." → "_", " " → ""}], ".txt"], {"GenBank:" → "gb"}];
Export[txtfilename, Flatten[numgenesample]]
Print["This produced a .txt file with the name ", txtfilename]

SystemOpen[txtfilename]
```

```
pdffilename =
  StringReplace[StringJoin[StringReplace[StringJoin[Wgenesample, " ", source],
     {"gene" → "", "." → "_", " " → ""}], ".pdf"], {"GenBank:" → "gb"}];

For[npow = 1, npow < 1000, npow++, If[Length[M] < ((npow)^2), Break[]];
  FilledSize = ((npow + 1)^2)];
Filler[vecvar1_] := Table[4, {i, 1, FilledSize - lengthofgeneitself}]
FilledVec[vecvar2_] := Join[Flatten[vecvar2], Filler[vecvar2]]

Filler[vecvar4_] := Table[4, {i, 1, FilledSize - lengthofgeneitself}]
FilledVec[vecvar5_] := Join[Flatten[vecvar5], Filler[vecvar5]]
For[npow = 1, npow < 1000, npow++, If[lengthofgeneitself ≤ ((npow)^2), Break[]]];
(* gives npow such that  npow^2 > lengthofgeneitself > (npow -1)^2 *)
FilledSize = npow^2;
FilledM = FilledVec[M];
numrowsW = √Length[FilledM] ;

W = Table[Table[FilledM[[i]],
    {i, (((j - 1) * (numrowsW)) + 1), (j * (numrowsW))}], {j, 1, numrowsW}];

ρ = (W.Transpose[W]); (* ρ as inner product *)
rhoEigens = Sort[DeleteCases[Eigenvalues[ρ] // N, 0.], Greater];
(*DeleteCases Removes 0's from the set of Eigenvalues,
Sort puts the list in order of greatest to least *)
set = rhoEigens / Total[rhoEigens];
(* This is the set of nonzero normalized eigenvalues in order of greatest to least *)
n = Length[set];
H[α_] := 1/(1 - α) Log[2, Sum[(set[[i]])^α, {i, 1, n}]] // N
H0 = Log[n] // N ;(* H₀ = Hartley Entropy*)
H1 = -Sum[((set[[i]])) (Log[2, set[[i]]])), {i, 1, n}] // N;
(* H₁ = Shannon Entropy*)
H2onward = Table[H[a], {a, 2, 20}] // N ;(* H₂ onward *)
RenyiEntropyofEigenvalues = Join[{H0}, {H1}, H2onward];

linearfitEigens =
  Fit[Table[{i, Log[rhoEigens[[i]]]}, {i, 2, Length[rhoEigens]}], {1, x}, x];
```

```
(*linearfitEntropies=Fit[Table[{i,Log[rhoEigens[[i]]]},
    {i,2,Length[rhoEigens]}], {1,x},x];*)

button =
  Button["Click here for output and pdf", Print[Style[Wgenesample, Black, Bold, 28]] ×
    Print[Style["From ", Black, Bold, 18], Style[source, source, Black, Bold, 18]] ×
    Print[Style["The ", Blue, Italic, 18], Style[Wgenesample, Black, Italic, 18],
     Style["  has  ", Blue, Italic, 18], Style[lengthofgeneitself, Black, Italic, 18],
     Style["   base pairs   ", Blue, Italic, 18]] ×
    If[StringLength[SpecialNote] > 3, Print[Style["(Special Note): ", Black, Bold, 16],
      Style[SpecialNote, Black, Italic, 12]], Print["  "]] ×
    Print[Style["𝕎 is a   ", Blue, Italic, 18], Style[Length[W], Black, Italic, 18],
     Style["  by  ", Blue, Italic, 18], Style[Length[W[[1]]], Black, Italic, 18],
     Style["   matrix with   ", Blue, Italic, 18],
     Style[Length[W] * Length[W[[1]]], Black, Italic, 18],
     Style[" = 2^b elements", Blue, Italic, 18], Style["  for b = ", Blue, Italic, 18],
     Style[Log[2, Length[W] * Length[W[[1]]]], Black, Italic, 18]] ×
    If[(Length[W] * Length[W[[1]]]) == (Length[W])^2,
     Print[Style["(If statement safecheck):  ", Black, Bold, 12],
      Style[Length[W], Black, Italic, 12], Style["  times  ", Red, Italic, 12],
      Style[Length[W[[1]]], Black, Italic, 12],
      Style["   equals   ", Red, Italic, 12], Style[(Length[W]^2), Black, Italic, 12],
      Style["  𝕎 is of the right size, you may proceed ", Red, Italic, 12]],
     Print[Style["(If statement safecheck):  ", Black, Bold, 12],
      Style["Warning!!!", Red, Italic, 28],
      Style["   𝕎 is of wrong size, STOP and check 𝕎 ", Red, Italic, 12]]] ×
    Print["The number of nonzero eigenvalues is  =   ", Length[rhoEigens]] ×
    Print[Table[(rhoEigens)[[i]], {i, 1, Length[rhoEigens]}]] ×
    Do[Print["The i-th Eigenvalue " λᵢ, " is = ", (rhoEigens)[[i]]],
     {i, 1, Length[rhoEigens]}] ×
    Print[Graphics[ListPlot[rhoEigens // N, AxesLabel → {Style["i", Medium, Bold],
         Style["λᵢ", Medium, Bold]}, PlotLabel → "Eigenvalue PLOT"]]] ×
    Print[Graphics[ListLogPlot[rhoEigens // N], AxesLabel → {Style["i", Medium, Bold],
        Style["Log[λᵢ]", Medium, Bold]}, PlotLabel → "Eigenvalue Log PLOT"]] ×
    Print["Zooming in on the Log Plot so as to Exclude the first
       eigenvalue gives the following plot:"]
    ×
    Print[Graphics[
      Show[ListLogPlot[Table[{i, rhoEigens[[i]]}, {i, 2, Length[rhoEigens]}],
        AxesLabel → {Style["i", Medium, Bold], Style["Log[λᵢ]", Medium, Bold]},
        PlotRange → {{10, 2 * rhoEigens[[2]]}}, PlotStyle → Red,
        PlotLabel → Style["Logplot of Eigenvalues, excluding λ₁", Red, Bold, 16]],
       Plot[linearfitEigens, {x, 1, Length[rhoEigens]}]]]] ×
    Print[
     "The Blue line is a linear fit. The approximate linearity of the above plot tells
       us that the eigenvalues decrease exponentially. If it's
       nowhere near linear try adjusting the plot range. "]

    (*Print[Graphics[
      ListPlot[Table[{i,Log[2,rhoEigens[[i]]]},{i,2,Length[rhoEigens]}],AxesLabel→
```

```
        {Style["i",Medium,Bold],Style["Log[λi]",Medium,Bold]},PlotStyle→ Red,
       PlotLabel→Style["Log2plot of Eigenvalues, excluding λ1",Red,Bold,16]] ]]*)

    ×
    Print["  "] ×
    Print[Style[
      "[redacted]", 18]] ×
    Print["  "]
    ×
    Print[Style["The First normalized eigenvector is:   ", Blue, Italic, 18],
     Style[set[[1]], Blue, Italic, 18]] ×
    Print[Style["The Second normalized eigenvector is:   ", Blue, Italic, 18],
     Style[set[[2]], Blue, Italic, 18]] ×
    Print[Style["The Last (n-th) normalized (nonzero) eigenvector is:   ",
      Blue, Italic, 18], Style[set[[n]], Blue, Italic, 16]] ×
    If[Total[set] == 1, Print[Style["(If statement safecheck):  ", Black, Bold, 12],
      Style["Total[set] = ", Red, Italic, 12], Style[Total[set], Black, Italic, 12],
      Style[" = 1, so the Eigenvalue set is properly normalized", Red, Italic, 12]],
     Print[Style["(If statement safecheck):  ", Black, Bold, 12],
      Style["Warning!!!", Red, Italic, 28], Style["  Total[set] = ", Red, Italic, 12],
      Style[Total[set], Black, Italic, 12], Style[" ≠ 1, ", Red, Italic, 12],
      Style[" so the Eigenvalue set is NOT properly normalized.", Red, Italic, 12],
      Style[" This will render the entropies invalid. Fix it. ", Red, Italic, 12]]]
    ×
    Print["  "] ×
    Print[Style[
      "[redacted]", 18]] ×
    Print["  "]
    ×
    Do[Print["The α-th Renyi Entropy Hα ->  "Hi-1, " is = ",
      RenyiEntropyofEigenvalues[[i]]], {i, 1, Length[RenyiEntropyofEigenvalues]}] ×
    Print[Graphics[Show[
       ListPlot[RenyiEntropyofEigenvalues, PlotRange → All,
        AxesLabel → {Style["α", Large, Bold], Style["Hα", Large, Bold]}],
       ListLinePlot[RenyiEntropyofEigenvalues, PlotStyle → {Red, Thin}]
      ]]] ×
    Print[Graphics[ListPlot[Table[{i, Log[2, RenyiEntropyofEigenvalues[[i]]]},
        {i, 1, Length[RenyiEntropyofEigenvalues]}],
       AxesLabel → {Style["α", Large, Bold], Style["Log2[Hα]", Large, Bold]},
       PlotLabel → Style["Plot of Log2[Hα]", Black, Bold, 12]]]] ×
    Print[Graphics[ListPlot[Table[{i, Log[2, RenyiEntropyofEigenvalues[[i]]]},
        {i, 2, Length[RenyiEntropyofEigenvalues]}],
       AxesLabel → {Style["α", Large, Bold], Style["Log2[Hα]", Large, Bold]},
       PlotLabel → Style["Logplot of Hα, excluding H1", Black, Bold, 12]]]]
    ×
    Export[pdffilename, EvaluationNotebook[]] ×
    NotebookSave[EvaluationNotebook[], "rhoCalcOutput"];
   SystemOpen[pdffilename] ×
    NotebookClose[]
   , Background → Green];
nb = CreateDocument[];
```

```
Paste[nb, button]
NotebookEvaluate[nb];

CellPrint[Cell[StringJoin["Eigen Entropy Analysis for: W = ",
   StringJoin[Wgenesample, " ", source]], "Section", CellAutoOverwrite → False]]
CellPrint[Cell["gene data", "Subsubsection", CellAutoOverwrite → False]]
TextCell["The gene sequence is"]
ExpressionCell[numgenesample]
CellPrint[Cell["W data", "Subsubsection", CellAutoOverwrite → False]]
TextCell["The W is"]
ExpressionCell[W]

CellPrint[Cell["Eigenvalue Analysis", "Subsubsection", CellAutoOverwrite → False]]
Print["The number of nonzero eigenvalues is  =   ", Length[rhoEigens]]
Do[Print["The i-th Eigenvalue " λᵢ, " is = ", (rhoEigens)[[i]]],
 {i, 1, Length[rhoEigens]}]
Print[Graphics[ListPlot[rhoEigens // N,
   AxesLabel → {Style["i", Medium, Bold], Style["λᵢ", Medium, Bold]},
   PlotLabel → "Eigenvalue PLOT"]]]
Print[Graphics[ListLogPlot[rhoEigens // N,
   AxesLabel → {Style["i", Medium, Bold], Style["Log[λᵢ]", Medium, Bold]},
   PlotLabel → "Eigenvalue Log PLOT"]]]
Print["Zooming in on the Log Plot so as to Exclude the
   first eigenvalue gives the following plot:"]
Print[Graphics[ListLogPlot[Table[{i, rhoEigens[[i]]}, {i, 2, Length[rhoEigens]}]],
   AxesLabel → {Style["i", Medium, Bold], Style["Log[λᵢ]", Medium, Bold]},
   PlotRange → {{10, 2 * rhoEigens[[2]]}}, PlotStyle → Red,
   PlotLabel → Style["Logplot of Eigenvalues, excluding λ₁", Red, Bold, 16]] ]]
Print["The approximate linearity of the above plot tells us
   that the eigenvalues decrease exponentially. If it's
   nowhere near linear try adjusting the plot range. "]
Print["  "]
Print[
 Style["                                                                                ", 18]]
Print["  "]
Print[Style["The First normalized eigenvector is:   ", Blue, Italic, 18],
 Style[set[[1]], Blue, Italic, 18]]
Print[Style["The Second normalized eigenvector is:   ", Blue, Italic, 18],
 Style[set[[2]], Blue, Italic, 18]]
Print[Style["The Last (n-th) normalized (nonzero) eigenvector is:   ",
  Blue, Italic, 18], Style[set[[n]], Blue, Italic, 16]]
If[Total[set] == 1, Print[Style["(If statement safecheck):  ", Black, Bold, 12],
  Style["Total[set] = ", Red, Italic, 12], Style[Total[set], Black, Italic, 12],
  Style[" = 1, so the Eigenvalue set is properly normalized", Red, Italic, 12]],
 Print[Style["(If statement safecheck):  ", Black, Bold, 12],
  Style["Warning!!!", Red, Italic, 28], Style["  Total[set] = ", Red, Italic, 12],
  Style[Total[set], Black, Italic, 12], Style[" ≠ 1, ", Red, Italic, 12],
  Style[" so the Eigenvalue set is NOT properly normalized.", Red, Italic, 12],
  Style[" This will render the entropies invalid. Fix it. ", Red, Italic, 12]]]

CellPrint[Cell["Entropy Analysis", "Subsubsection", CellAutoOverwrite → False]]
```

```
Do[Print["The α-th Renyi Entropy Hα ->  " Hi-1, " is = ",
  RenyiEntropyofEigenvalues[[i]]], {i, 1, Length[RenyiEntropyofEigenvalues]}]
Print[Graphics[Show[
   ListPlot[RenyiEntropyofEigenvalues, PlotRange → All,
    AxesLabel → {Style["α", Large, Bold], Style["Hα", Large, Bold]}],
   ListLinePlot[RenyiEntropyofEigenvalues, PlotStyle → {Red, Thin}]
  ]]]

Print[Graphics[ListPlot[Table[{i, Log[2, RenyiEntropyofEigenvalues[[i]]]},
    {i, 1, Length[RenyiEntropyofEigenvalues]}],
   AxesLabel → {Style["α", Large, Bold], Style["Log2[Hα]", Large, Bold]},
   PlotLabel → Style["Plot of Log2[Hα]", Black, Bold, 12]]]]
Print[Graphics[ListPlot[Table[{i, Log[2, RenyiEntropyofEigenvalues[[i]]]},
    {i, 2, Length[RenyiEntropyofEigenvalues]}],
   AxesLabel → {Style["α", Large, Bold], Style["Log2[Hα]", Large, Bold]},
   PlotLabel → Style["Logplot of Hα, excluding H1", Black, Bold, 12]]]]
```

Eigen Entropy Analysis for: W = Homo sapiens isolate AF51 mitochondrion, complete genome DNA sequence GenBank: DQ112961 .2

gene data

W data

Eigenvalue Analysis

The number of nonzero eigenvalues is = 125

The i-th Eigenvalue λ_1 is = 27776.2

The i-th Eigenvalue λ_2 is = 962.753

The i-th Eigenvalue λ_3 is = 751.971

The i-th Eigenvalue λ_4 is = 641.505

The i-th Eigenvalue λ_5 is = 563.544

The i-th Eigenvalue λ_6 is = 524.978

The i-th Eigenvalue λ_7 is = 515.712

The i-th Eigenvalue λ_8 is = 507.476

The i-th Eigenvalue λ_9 is = 476.687

The i-th Eigenvalue λ_{10} is = 469.564

The i-th Eigenvalue λ_{11} is = 458.692

The i-th Eigenvalue λ_{12} is = 437.925

The i-th Eigenvalue λ_{13} is = 427.838

The i-th Eigenvalue λ_{14} is = 426.225

The i-th Eigenvalue λ_{15} is = 418.411

The i-th Eigenvalue λ_{16} is = 411.344

The i-th Eigenvalue λ_{17} is = 393.475

The i-th Eigenvalue λ_{18} is = 372.737

The i-th Eigenvalue λ_{19} is = 369.724

The i-th Eigenvalue λ_{20} is = 358.539

The i-th Eigenvalue λ_{21} is = 343.116

The i-th Eigenvalue λ_{22} is = 340.388

The i-th Eigenvalue λ_{23} is = 331.919

The i-th Eigenvalue λ_{24} is = 324.226

The i-th Eigenvalue λ_{25} is = 315.412

The i-th Eigenvalue λ_{26} is = 307.898

The i-th Eigenvalue λ_{27} is = 297.592

The i-th Eigenvalue λ_{28} is = 292.272

The i-th Eigenvalue λ_{29} is = 281.952

The i-th Eigenvalue λ_{30} is = 275.785

The i-th Eigenvalue λ_{31} is = 272.602

The i-th Eigenvalue λ_{32} is = 266.739

The i-th Eigenvalue λ_{33} is = 252.556

The i-th Eigenvalue λ_{34} is = 249.638

The i-th Eigenvalue λ_{35} is = 245.233

The i-th Eigenvalue λ_{36} is = 237.885

The i-th Eigenvalue λ_{37} is = 232.821

The i-th Eigenvalue λ_{38} is = 232.054

The i-th Eigenvalue λ_{39} is = 227.499

The i-th Eigenvalue λ_{40} is = 210.748

The i-th Eigenvalue λ_{41} is = 209.347

The i-th Eigenvalue λ_{42} is = 205.111

The i-th Eigenvalue λ_{43} is = 195.265

The i-th Eigenvalue λ_{44} is = 188.818

The i-th Eigenvalue λ_{45} is = 181.753

The i-th Eigenvalue λ_{46} is = 178.935

The i-th Eigenvalue λ_{47} is = 170.307

The i-th Eigenvalue λ_{48} is = 168.475

The i-th Eigenvalue λ_{49} is = 158.005

The i-th Eigenvalue λ_{50} is = 156.346

The i-th Eigenvalue λ_{51} is = 150.35

The i-th Eigenvalue λ_{52} is = 147.295

The i-th Eigenvalue λ_{53} is = 146.699

The i-th Eigenvalue λ_{54} is = 137.623

The i-th Eigenvalue λ_{55} is = 132.898

The i-th Eigenvalue λ_{56} is = 127.567

The i-th Eigenvalue λ_{57} is = 124.123

The i-th Eigenvalue λ_{58} is = 122.638

The i-th Eigenvalue λ_{59} is = 120.297

The i-th Eigenvalue λ_{60} is = 112.268

The i-th Eigenvalue λ_{61} is = 108.909

The i-th Eigenvalue λ_{62} is = 105.949

The i-th Eigenvalue λ_{63} is = 102.189

The i-th Eigenvalue λ_{64} is = 98.7428

The i-th Eigenvalue λ_{65} is = 94.2229

The i-th Eigenvalue λ_{66} is = 89.4027

The i-th Eigenvalue λ_{67} is = 85.7937

The i-th Eigenvalue λ_{68} is = 82.4935

The i-th Eigenvalue λ_{69} is = 81.7823

The i-th Eigenvalue λ_{70} is = 77.3441

The i-th Eigenvalue λ_{71} is = 74.734

The i-th Eigenvalue λ_{72} is = 72.8503

The i-th Eigenvalue λ_{73} is = 72.0289

The i-th Eigenvalue λ_{74} is = 66.9844

The i-th Eigenvalue λ_{75} is = 66.4543

The i-th Eigenvalue λ_{76} is = 62.3326

The i-th Eigenvalue λ_{77} is = 58.9473

The i-th Eigenvalue λ_{78} is = 57.3468

The i-th Eigenvalue λ_{79} is = 54.6782

The i-th Eigenvalue λ_{80} is = 53.2034

The i-th Eigenvalue λ_{81} is = 50.4799

The i-th Eigenvalue λ_{82} is = 50.3162

The i-th Eigenvalue λ_{83} is = 46.1309

The i-th Eigenvalue λ_{84} is = 45.054

The i-th Eigenvalue λ_{85} is = 42.8022

The i-th Eigenvalue λ_{86} is = 38.6989

The i-th Eigenvalue λ_{87} is = 35.978

The i-th Eigenvalue λ_{88} is = 35.23

The i-th Eigenvalue λ_{89} is = 33.1314

The i-th Eigenvalue λ_{90} is = 31.3322

The i-th Eigenvalue λ_{91} is = 30.1446

The i-th Eigenvalue λ_{92} is = 29.0937

The i-th Eigenvalue λ_{93} is = 27.12

The i-th Eigenvalue λ_{94} is = 26.2301

The i-th Eigenvalue λ_{95} is = 24.5243

The i-th Eigenvalue λ_{96} is = 23.0644

The i-th Eigenvalue λ_{97} is = 20.6211

The i-th Eigenvalue λ_{98} is = 19.1888

The i-th Eigenvalue λ_{99} is = 18.8824

The i-th Eigenvalue λ_{100} is = 16.5693

The i-th Eigenvalue λ_{101} is = 15.1341

The i-th Eigenvalue λ_{102} is = 14.5547

The i-th Eigenvalue λ_{103} is = 13.7425

The i-th Eigenvalue λ_{104} is = 12.6369

The i-th Eigenvalue λ_{105} is = 10.5469

The i-th Eigenvalue λ_{106} is = 9.75235

The i-th Eigenvalue λ_{107} is = 8.77028

The i-th Eigenvalue λ_{108} is = 7.94535

The i-th Eigenvalue λ_{109} is = 6.73076

The i-th Eigenvalue λ_{110} is = 6.47943

The i-th Eigenvalue λ_{111} is = 5.37674

The i-th Eigenvalue λ_{112} is = 5.00616

The i-th Eigenvalue λ_{113} is = 4.25193

The i-th Eigenvalue λ_{114} is = 3.58972

The i-th Eigenvalue λ_{115} is = 2.8598

The i-th Eigenvalue λ_{116} is = 2.3459

The i-th Eigenvalue λ_{117} is = 1.83651

The i-th Eigenvalue λ_{118} is = 1.59967

The i-th Eigenvalue λ_{119} is = 1.32176

The i-th Eigenvalue λ_{120} is = 0.798869

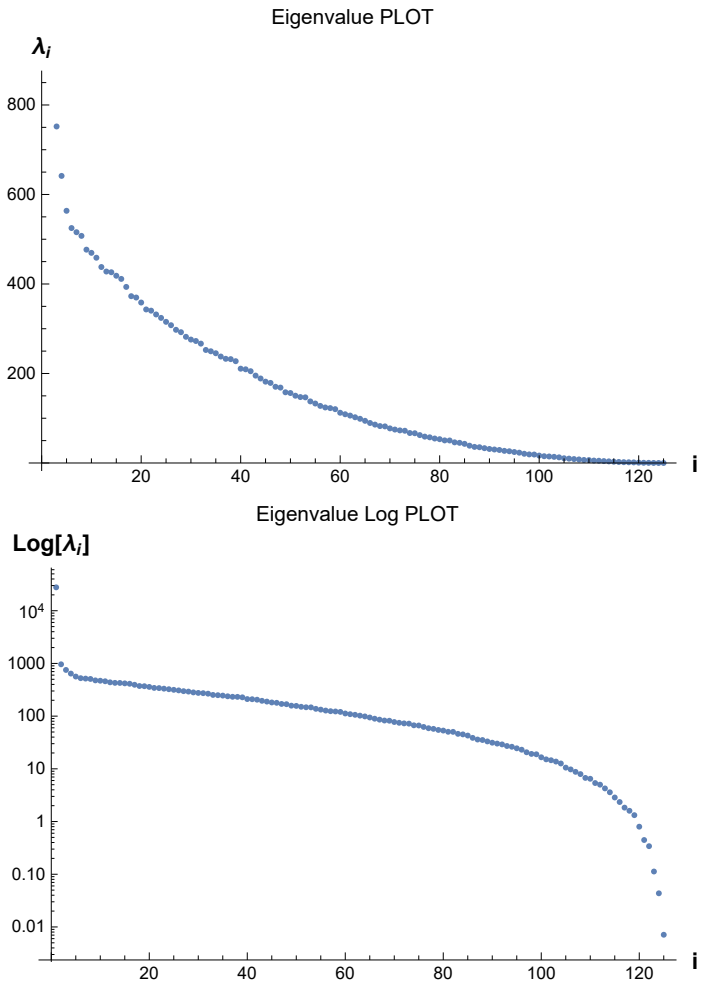
The i-th Eigenvalue λ_{121} is = 0.446036

The i-th Eigenvalue λ_{122} is = 0.340878

The i-th Eigenvalue λ_{123} is = 0.112689

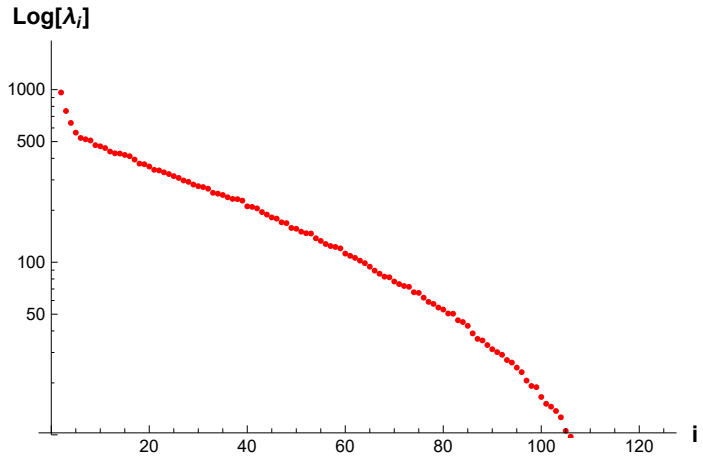
The i-th Eigenvalue λ_{124} is = 0.0434892

The i-th Eigenvalue λ_{125} is = 0.00711358



Zooming in on the Log Plot so as to Exclude the first eigenvalue gives the following plot:

Logplot of Eigenvalues, excluding λ_1



The approximate linearity of the above plot tells us that the eigenvalues
decrease exponentially. If it's nowhere near linear try adjusting the plot range.

The First normalized eigenvector is: 0.575256

The Second normalized eigenvector is: 0.019939

The Last (n-th) normalized (nonzero) eigenvector is:
1.47325×10^{-7}

(If statement safecheck): *Total[set] = 1. = 1, so the Eigenvalue set is properly normalized*

Entropy Analysis

The α-th Renyi Entropy H_α -> H_0 is = 4.82831

The α-th Renyi Entropy H_α -> H_1 is = 3.60657

The α-th Renyi Entropy H_α -> H_2 is = 1.58174

The α-th Renyi Entropy H_α -> H_3 is = 1.19646

The α-th Renyi Entropy H_α -> H_4 is = 1.06363

The α-th Renyi Entropy H_α -> H_5 is = 0.997155

The α-th Renyi Entropy H_α -> H_6 is = 0.957269

The α-th Renyi Entropy H_α -> H_7 is = 0.930678

The α-th Renyi Entropy H_α -> H_8 is = 0.911685

The α-th Renyi Entropy H_α -> H_9 is = 0.89744

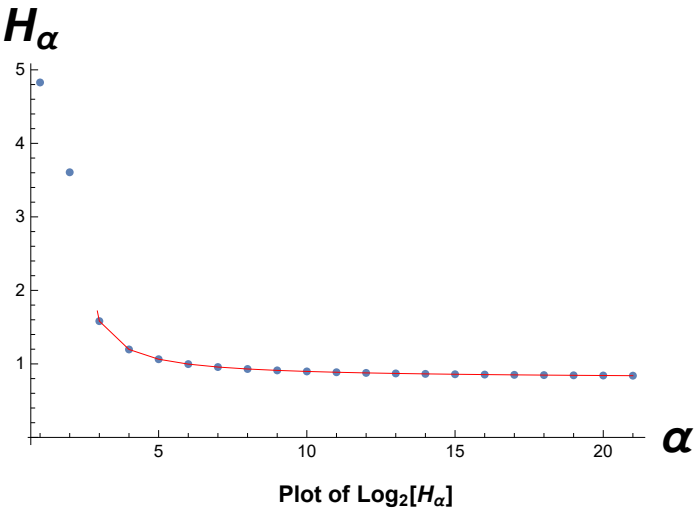
The α-th Renyi Entropy H_α -> H_{10} is = 0.88636

The α-th Renyi Entropy H_α -> H_{11} is = 0.877497

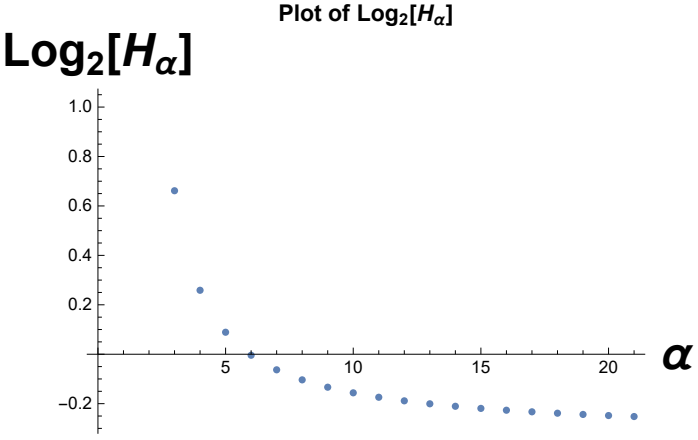
The α-th Renyi Entropy H_α -> H_{12} is = 0.870245

The α-th Renyi Entropy H_α -> H_{13} is = 0.864201

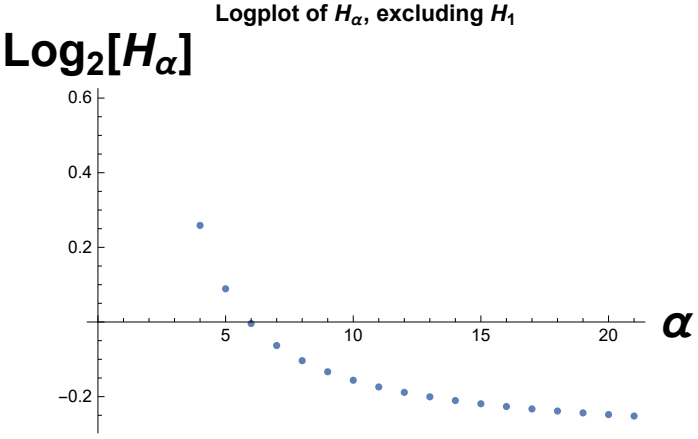
```
The α-th Renyi Entropy Hα ->  H14 is = 0.859088
The α-th Renyi Entropy Hα ->  H15 is = 0.854705
The α-th Renyi Entropy Hα ->  H16 is = 0.850906
The α-th Renyi Entropy Hα ->  H17 is = 0.847582
The α-th Renyi Entropy Hα ->  H18 is = 0.844649
The α-th Renyi Entropy Hα ->  H19 is = 0.842042
The α-th Renyi Entropy Hα ->  H20 is = 0.83971
```



Plot of $Log_2[H_\alpha]$



Logplot of H_α, excluding H_1



Eigen Entropy Analysis for: W = Gallus gallus isolate SQ endogenous virus Avian endogenous retrovirus EAV-HP genomic sequence DNA sequence GenBank: KY085958 .1

gene data

W data

Eigenvalue Analysis

The number of nonzero eigenvalues is = 62

The i-th Eigenvalue λ_1 is = 9183.96

The i-th Eigenvalue λ_2 is = 254.636

The i-th Eigenvalue λ_3 is = 240.269

The i-th Eigenvalue λ_4 is = 226.51

The i-th Eigenvalue λ_5 is = 208.131

The i-th Eigenvalue λ_6 is = 200.419

The i-th Eigenvalue λ_7 is = 189.047

The i-th Eigenvalue λ_8 is = 185.622

The i-th Eigenvalue λ_9 is = 182.218

The i-th Eigenvalue λ_{10} is = 173.033

The i-th Eigenvalue λ_{11} is = 170.889

The i-th Eigenvalue λ_{12} is = 151.198

The i-th Eigenvalue λ_{13} is = 138.936

The i-th Eigenvalue λ_{14} is = 135.811

The i-th Eigenvalue λ_{15} is = 130.008

The i-th Eigenvalue λ_{16} is = 120.165

The i-th Eigenvalue λ_{17} is = 116.416

The i-th Eigenvalue λ_{18} is = 110.838

The i-th Eigenvalue λ_{19} is = 97.9948

The i-th Eigenvalue λ_{20} is = 94.3576

The i-th Eigenvalue λ_{21} is = 92.4365

The i-th Eigenvalue λ_{22} is = 90.1322

The i-th Eigenvalue λ_{23} is = 88.8264

The i-th Eigenvalue λ_{24} is = 83.1563

The i-th Eigenvalue λ_{25} is = 73.9591

The i-th Eigenvalue λ_{26} is = 71.3354

The i-th Eigenvalue λ_{27} is = 65.8432

The i-th Eigenvalue λ_{28} is = 62.2285

The i-th Eigenvalue λ_{29} is = 59.1614

The i-th Eigenvalue λ_{30} is = 53.946

The i-th Eigenvalue λ_{31} is = 51.8255

The i-th Eigenvalue λ_{32} is = 48.7164

The i-th Eigenvalue λ_{33} is = 47.1773

The i-th Eigenvalue λ_{34} is = 43.4981

The i-th Eigenvalue λ_{35} is = 37.9749

The i-th Eigenvalue λ_{36} is = 34.9803

The i-th Eigenvalue λ_{37} is = 33.7745

The i-th Eigenvalue λ_{38} is = 31.4042

The i-th Eigenvalue λ_{39} is = 28.9003

The i-th Eigenvalue λ_{40} is = 27.4461

The i-th Eigenvalue λ_{41} is = 24.9996

The i-th Eigenvalue λ_{42} is = 22.9941

The i-th Eigenvalue λ_{43} is = 20.2956

The i-th Eigenvalue λ_{44} is = 16.9276

The i-th Eigenvalue λ_{45} is = 14.8208

The i-th Eigenvalue λ_{46} is = 13.3272

The i-th Eigenvalue λ_{47} is = 11.9063

The i-th Eigenvalue λ_{48} is = 10.0514

The i-th Eigenvalue λ_{49} is = 9.30551

The i-th Eigenvalue λ_{50} is = 8.45009

The i-th Eigenvalue λ_{51} is = 7.27305

The i-th Eigenvalue λ_{52} is = 5.20547

The i-th Eigenvalue λ_{53} is = 4.69746

The i-th Eigenvalue λ_{54} is = 4.30388

The i-th Eigenvalue λ_{55} is = 3.25927

The i-th Eigenvalue λ_{56} is = 2.44263

The i-th Eigenvalue λ_{57} is = 1.99413

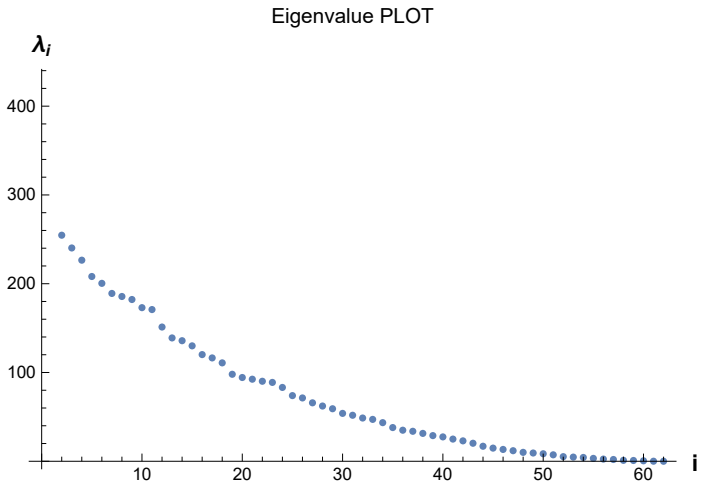
The i-th Eigenvalue λ_{58} is = 1.0508

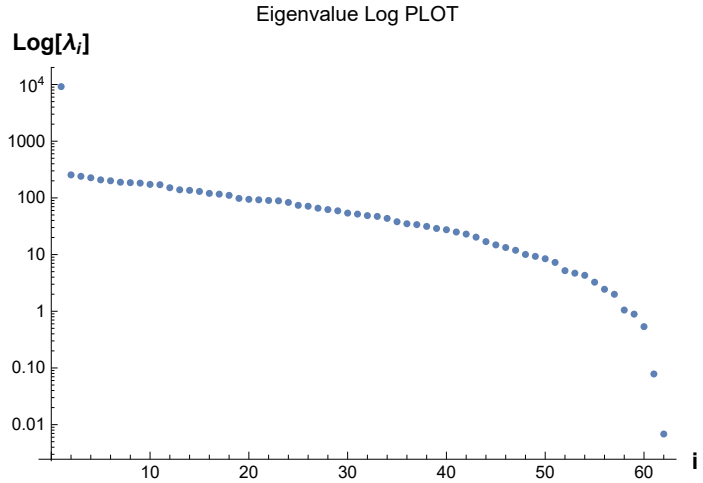
The i-th Eigenvalue λ_{59} is = 0.890141

The i-th Eigenvalue λ_{60} is = 0.53577

The i-th Eigenvalue λ_{61} is = 0.0783394

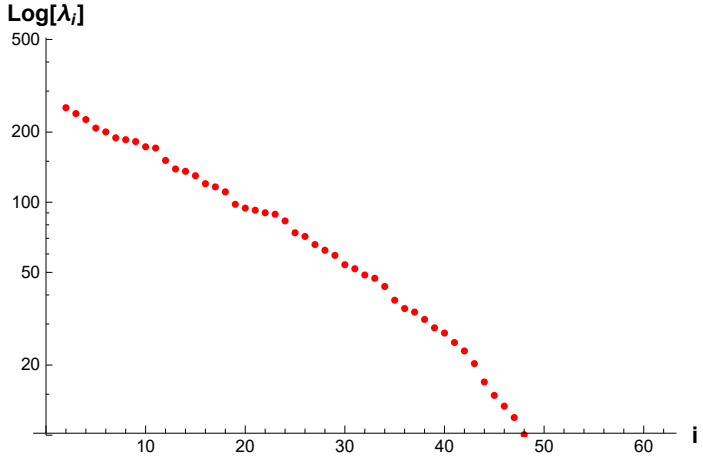
The i-th Eigenvalue λ_{62} is = 0.00683285





Zooming in on the Log Plot so as to Exclude the first eigenvalue gives the following plot:

Logplot of Eigenvalues, excluding λ_1



The approximate linearity of the above plot tells us that the eigenvalues
decrease exponentially. If it's nowhere near linear try adjusting the plot range.

The First normalized eigenvector is: 0.674201

The Second normalized eigenvector is: 0.018693

The Last (n-th) normalized (nonzero) eigenvector is:
5.01604×10^{-7}

(If statement safecheck): *Total[set] = 1. = 1, so the Eigenvalue set is properly normalized*

Entropy Analysis

The α-th Renyi Entropy H_α -> H_0 is = 4.12713

The α-th Renyi Entropy H_α -> H_1 is = 2.61545

The α-th Renyi Entropy H_α -> H_2 is = 1.12674

The α-th Renyi Entropy H_α -> H_3 is = 0.853021

The α-th Renyi Entropy H_α -> H_4 is = 0.758331

The α-th Renyi Entropy H_α -> H_5 is = 0.710937

The α-th Renyi Entropy H_α -> H_6 is = 0.682499

The α-th Renyi Entropy H_α -> H_7 is = 0.663541

The α-th Renyi Entropy H_α -> H_8 is = 0.65

The α-th Renyi Entropy H_α -> H_9 is = 0.639843

The α-th Renyi Entropy H_α -> H_{10} is = 0.631944

The α-th Renyi Entropy H_α -> H_{11} is = 0.625625

The α-th Renyi Entropy H_α -> H_{12} is = 0.620454

The α-th Renyi Entropy H_α -> H_{13} is = 0.616145

The α-th Renyi Entropy H_α -> H_{14} is = 0.6125

The α-th Renyi Entropy H_α -> H_{15} is = 0.609375

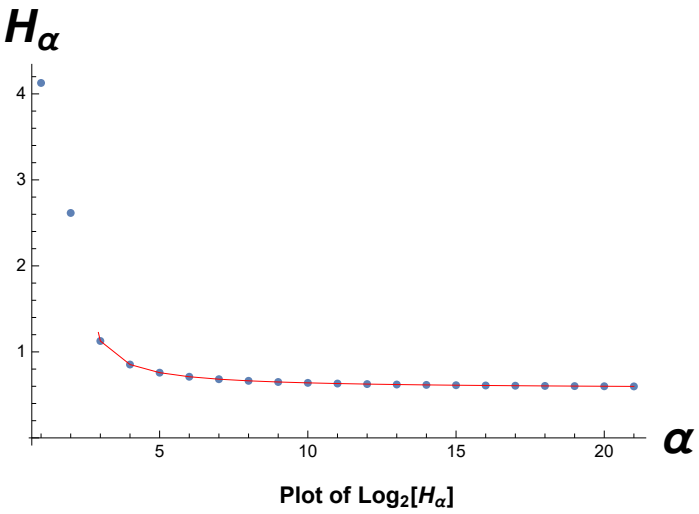
The α-th Renyi Entropy H_α -> H_{16} is = 0.606666

The α-th Renyi Entropy H_α -> H_{17} is = 0.604296

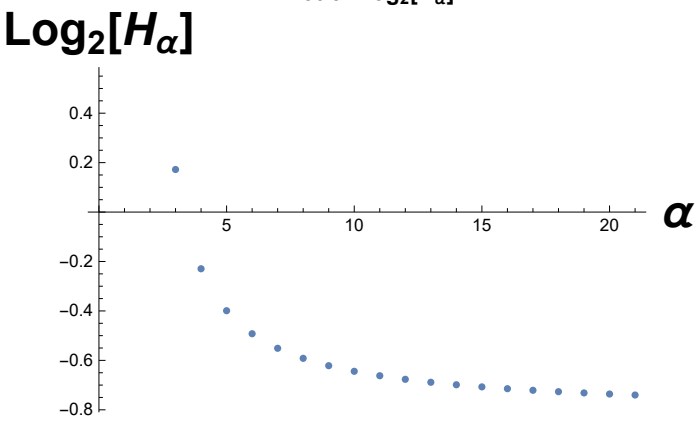
The α-th Renyi Entropy H_α -> H_{18} is = 0.602205

The α-th Renyi Entropy H_α -> H_{19} is = 0.600347

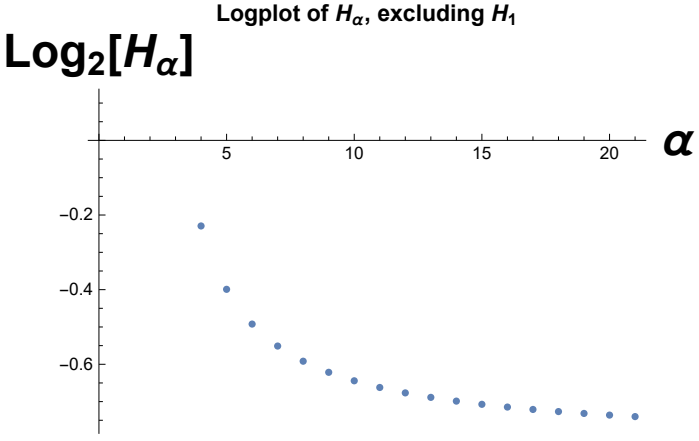
The α-th Renyi Entropy H_α -> H_{20} is = 0.598684



Plot of $\text{Log}_2[H_\alpha]$



Logplot of H_α, excluding H_1



Eigen Entropy Analysis for: W = Escherichia phage Sloth, partial genome DNA sequence GenBank: KX534339 .1

gene data

W data

Eigenvalue Analysis

The number of nonzero eigenvalues is = 213

The i-th Eigenvalue λ_1 is = 105 815.

The i-th Eigenvalue λ_2 is = 957.176

The i-th Eigenvalue λ_3 is = 916.249

The i-th Eigenvalue λ_4 is = 905.396

The i-th Eigenvalue λ_5 is = 900.35

The i-th Eigenvalue λ_6 is = 855.146

The i-th Eigenvalue λ_7 is = 839.325

The i-th Eigenvalue λ_8 is = 831.716

The i-th Eigenvalue λ_9 is = 806.893

The i-th Eigenvalue λ_{10} is = 782.207

The i-th Eigenvalue λ_{11} is = 762.335

The i-th Eigenvalue λ_{12} is = 758.481

The i-th Eigenvalue λ_{13} is = 748.259

The i-th Eigenvalue λ_{14} is = 729.942

The i-th Eigenvalue λ_{15} is = 721.939

The i-th Eigenvalue λ_{16} is = 718.208

The i-th Eigenvalue λ_{17} is = 700.229

The i-th Eigenvalue λ_{18} is = 692.513

The i-th Eigenvalue λ_{19} is = 683.066

The i-th Eigenvalue λ_{20} is = 663.083

The i-th Eigenvalue λ_{21} is = 659.994

The i-th Eigenvalue λ_{22} is = 644.282

The i-th Eigenvalue λ_{23} is = 639.902

The i-th Eigenvalue λ_{24} is = 636.912

The i-th Eigenvalue λ_{25} is = 624.275

The i-th Eigenvalue λ_{26} is = 609.483

The i-th Eigenvalue λ_{27} is = 598.336

The i-th Eigenvalue λ_{28} is = 590.004

The i-th Eigenvalue λ_{29} is = 583.172

The i-th Eigenvalue λ_{30} is = 572.984

The i-th Eigenvalue λ_{31} is = 569.251

The i-th Eigenvalue λ_{32} is = 563.477

The i-th Eigenvalue λ_{33} is = 550.554

The i-th Eigenvalue λ_{34} is = 534.526

The i-th Eigenvalue λ_{35} is = 522.351

The i-th Eigenvalue λ_{36} is = 519.383

The i-th Eigenvalue λ_{37} is = 503.817

The i-th Eigenvalue λ_{38} is = 500.691

The i-th Eigenvalue λ_{39} is = 493.741

The i-th Eigenvalue λ_{40} is = 484.919

The i-th Eigenvalue λ_{41} is = 481.963

The i-th Eigenvalue λ_{42} is = 474.291

The i-th Eigenvalue λ_{43} is = 469.023

The i-th Eigenvalue λ_{44} is = 460.449

The i-th Eigenvalue λ_{45} is = 456.376

The i-th Eigenvalue λ_{46} is = 444.584

The i-th Eigenvalue λ_{47} is = 436.004

The i-th Eigenvalue λ_{48} is = 431.325

The i-th Eigenvalue λ_{49} is = 427.994

The i-th Eigenvalue λ_{50} is = 418.45

The i-th Eigenvalue λ_{51} is = 416.223

The i-th Eigenvalue λ_{52} is = 406.103

The i-th Eigenvalue λ_{53} is = 397.777

The i-th Eigenvalue λ_{54} is = 392.903

The i-th Eigenvalue λ_{55} is = 388.171

The i-th Eigenvalue λ_{56} is = 385.268

The i-th Eigenvalue λ_{57} is = 377.915

The i-th Eigenvalue λ_{58} is = 370.854

The i-th Eigenvalue λ_{59} is = 367.364

The i-th Eigenvalue λ_{60} is = 363.559

The i-th Eigenvalue λ_{61} is = 361.791

The i-th Eigenvalue λ_{62} is = 350.646

The i-th Eigenvalue λ_{63} is = 347.366

The i-th Eigenvalue λ_{64} is = 343.976

The i-th Eigenvalue λ_{65} is = 337.836

The i-th Eigenvalue λ_{66} is = 334.674

The i-th Eigenvalue λ_{67} is = 330.129

The i-th Eigenvalue λ_{68} is = 324.153

The i-th Eigenvalue λ_{69} is = 316.679

The i-th Eigenvalue λ_{70} is = 307.634

The i-th Eigenvalue λ_{71} is = 305.312

The i-th Eigenvalue λ_{72} is = 300.651

The i-th Eigenvalue λ_{73} is = 300.304

The i-th Eigenvalue λ_{74} is = 290.296

The i-th Eigenvalue λ_{75} is = 286.831

The i-th Eigenvalue λ_{76} is = 284.018

The i-th Eigenvalue λ_{77} is = 275.922

The i-th Eigenvalue λ_{78} is = 270.246

The i-th Eigenvalue λ_{79} is = 267.623

The i-th Eigenvalue λ_{80} is = 265.308

The i-th Eigenvalue λ_{81} is = 258.354

The i-th Eigenvalue λ_{82} is = 251.602

The i-th Eigenvalue λ_{83} is = 245.994

The i-th Eigenvalue λ_{84} is = 242.363

The i-th Eigenvalue λ_{85} is = 240.236

The i-th Eigenvalue λ_{86} is = 233.92

The i-th Eigenvalue λ_{87} is = 228.724

The i-th Eigenvalue λ_{88} is = 225.89

The i-th Eigenvalue λ_{89} is = 221.001

The i-th Eigenvalue λ_{90} is = 218.668

The i-th Eigenvalue λ_{91} is = 213.382

The i-th Eigenvalue λ_{92} is = 212.691

The i-th Eigenvalue λ_{93} is = 210.731

The i-th Eigenvalue λ_{94} is = 207.089

The i-th Eigenvalue λ_{95} is = 198.58

The i-th Eigenvalue λ_{96} is = 194.398

The i-th Eigenvalue λ_{97} is = 188.377

The i-th Eigenvalue λ_{98} is = 183.465

The i-th Eigenvalue λ_{99} is = 181.402

The i-th Eigenvalue λ_{100} is = 180.283

The i-th Eigenvalue λ_{101} is = 176.056

The i-th Eigenvalue λ_{102} is = 170.865

The i-th Eigenvalue λ_{103} is = 169.764

The i-th Eigenvalue λ_{104} is = 168.141

The i-th Eigenvalue λ_{105} is = 163.743

The i-th Eigenvalue λ_{106} is = 162.322

The i-th Eigenvalue λ_{107} is = 161.266

The i-th Eigenvalue λ_{108} is = 155.636

The i-th Eigenvalue λ_{109} is = 148.968

The i-th Eigenvalue λ_{110} is = 145.073

The i-th Eigenvalue λ_{111} is = 143.676

The i-th Eigenvalue λ_{112} is = 141.843

The i-th Eigenvalue λ_{113} is = 137.887

The i-th Eigenvalue λ_{114} is = 135.66

The i-th Eigenvalue λ_{115} is = 134.059

The i-th Eigenvalue λ_{116} is = 131.85

The i-th Eigenvalue λ_{117} is = 131.63

The i-th Eigenvalue λ_{118} is = 128.11

The i-th Eigenvalue λ_{119} is = 125.871

The i-th Eigenvalue λ_{120} is = 118.468

The i-th Eigenvalue λ_{121} is = 116.358

The i-th Eigenvalue λ_{122} is = 115.668

The i-th Eigenvalue λ_{123} is = 113.791

The i-th Eigenvalue λ_{124} is = 112.208

The i-th Eigenvalue λ_{125} is = 107.404

The i-th Eigenvalue λ_{126} is = 106.112

The i-th Eigenvalue λ_{127} is = 105.009

The i-th Eigenvalue λ_{128} is = 101.564

The i-th Eigenvalue λ_{129} is = 99.6839

The i-th Eigenvalue λ_{130} is = 98.7898

The i-th Eigenvalue λ_{131} is = 92.5732

The i-th Eigenvalue λ_{132} is = 91.0531

The i-th Eigenvalue λ_{133} is = 89.9294

The i-th Eigenvalue λ_{134} is = 84.8674

The i-th Eigenvalue λ_{135} is = 84.1164

The i-th Eigenvalue λ_{136} is = 81.9354

The i-th Eigenvalue λ_{137} is = 80.955

The i-th Eigenvalue λ_{138} is = 77.9368

The i-th Eigenvalue λ_{139} is = 76.2947

The i-th Eigenvalue λ_{140} is = 73.6796

The i-th Eigenvalue λ_{141} is = 71.7029

The i-th Eigenvalue λ_{142} is = 70.0536

The i-th Eigenvalue λ_{143} is = 66.1184

The i-th Eigenvalue λ_{144} is = 65.6947

The i-th Eigenvalue λ_{145} is = 63.7168

The i-th Eigenvalue λ_{146} is = 62.0176

The i-th Eigenvalue λ_{147} is = 61.6468

The i-th Eigenvalue λ_{148} is = 59.377

The i-th Eigenvalue λ_{149} is = 56.9121

The i-th Eigenvalue λ_{150} is = 56.274

The i-th Eigenvalue λ_{151} is = 54.1117

The i-th Eigenvalue λ_{152} is = 53.1847

The i-th Eigenvalue λ_{153} is = 49.8341

The i-th Eigenvalue λ_{154} is = 48.8197

The i-th Eigenvalue λ_{155} is = 47.5296

The i-th Eigenvalue λ_{156} is = 46.5257

The i-th Eigenvalue λ_{157} is = 43.3888

The i-th Eigenvalue λ_{158} is = 42.4546

The i-th Eigenvalue λ_{159} is = 38.2819

The i-th Eigenvalue λ_{160} is = 37.1963

The i-th Eigenvalue λ_{161} is = 36.437

The i-th Eigenvalue λ_{162} is = 35.1961

The i-th Eigenvalue λ_{163} is = 33.8031

The i-th Eigenvalue λ_{164} is = 32.561

The i-th Eigenvalue λ_{165} is = 31.6356

The i-th Eigenvalue λ_{166} is = 29.945

The i-th Eigenvalue λ_{167} is = 29.9002

The i-th Eigenvalue λ_{168} is = 28.6454

The i-th Eigenvalue λ_{169} is = 26.4814

The i-th Eigenvalue λ_{170} is = 25.9503

The i-th Eigenvalue λ_{171} is = 25.1992

The i-th Eigenvalue λ_{172} is = 24.4659

The i-th Eigenvalue λ_{173} is = 22.3118

The i-th Eigenvalue λ_{174} is = 21.4294

The i-th Eigenvalue λ_{175} is = 20.667

The i-th Eigenvalue λ_{176} is = 20.0219

The i-th Eigenvalue λ_{177} is = 17.7845

The i-th Eigenvalue λ_{178} is = 16.7375

The i-th Eigenvalue λ_{179} is = 14.9323

The i-th Eigenvalue λ_{180} is = 14.4875

The i-th Eigenvalue λ_{181} is = 13.3367

The i-th Eigenvalue λ_{182} is = 12.5614

The i-th Eigenvalue λ_{183} is = 12.1164

The i-th Eigenvalue λ_{184} is = 11.3046

The i-th Eigenvalue λ_{185} is = 10.9525

The i-th Eigenvalue λ_{186} is = 9.85105

The i-th Eigenvalue λ_{187} is = 9.53192

The i-th Eigenvalue λ_{188} is = 8.10915

The i-th Eigenvalue λ_{189} is = 7.60805

The i-th Eigenvalue λ_{190} is = 7.14287

The i-th Eigenvalue λ_{191} is = 6.20801

The i-th Eigenvalue λ_{192} is = 5.61251

The i-th Eigenvalue λ_{193} is = 5.34042

The i-th Eigenvalue λ_{194} is = 5.13908

The i-th Eigenvalue λ_{195} is = 4.22584

The i-th Eigenvalue λ_{196} is = 3.67045

The i-th Eigenvalue λ_{197} is = 3.29192

The i-th Eigenvalue λ_{198} is = 3.05582

The i-th Eigenvalue λ_{199} is = 2.56509

The i-th Eigenvalue λ_{200} is = 1.88898

The i-th Eigenvalue λ_{201} is = 1.61311

The i-th Eigenvalue λ_{202} is = 1.39531

The i-th Eigenvalue λ_{203} is = 1.11775

The i-th Eigenvalue λ_{204} is = 0.95345

The i-th Eigenvalue λ_{205} is = 0.80627

The i-th Eigenvalue λ_{206} is = 0.663343

The i-th Eigenvalue λ_{207} is = 0.39026

The i-th Eigenvalue λ_{208} is = 0.336363

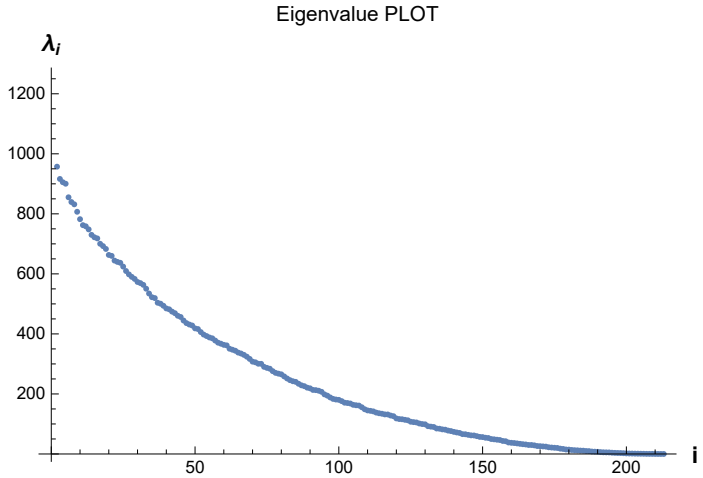
The i-th Eigenvalue λ_{209} is = 0.299751

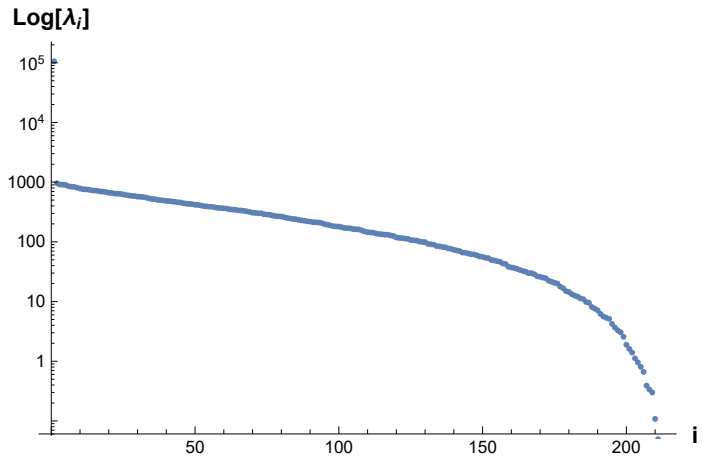
The i-th Eigenvalue λ_{210} is = 0.10804

The i-th Eigenvalue λ_{211} is = 0.0493492

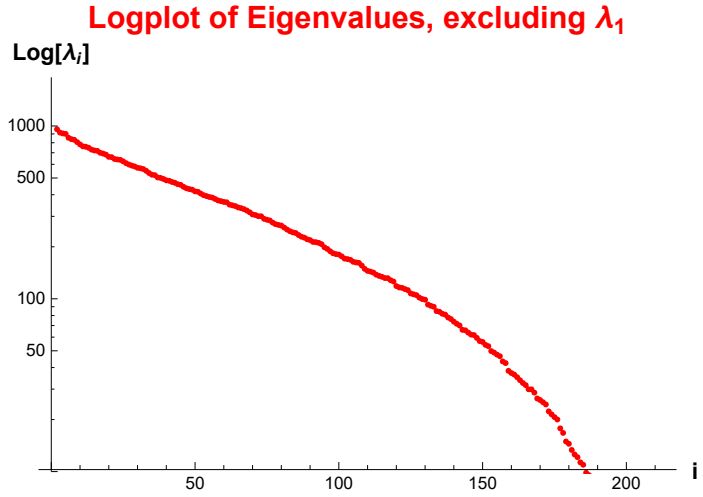
The i-th Eigenvalue λ_{212} is = 0.0111244

The i-th Eigenvalue λ_{213} is = 0.00132852





Zooming in on the Log Plot so as to Exclude the first eigenvalue gives the following plot:



The approximate linearity of the above plot tells us that the eigenvalues
decrease exponentially. If it's nowhere near linear try adjusting the plot range.

The First normalized eigenvector is: 0.670945

The Second normalized eigenvector is: 0.00606922

The Last (n-th) normalized (nonzero) eigenvector is:
8.42381×10^{-9}

(If statement safecheck): *Total[set] = 1. = 1, so the Eigenvalue set is properly normalized*

Entropy Analysis

The α-th Renyi Entropy H_α -> H_0 is = 5.36129

The α-th Renyi Entropy H_α -> H_1 is = 3.21671

The α-th Renyi Entropy H_α -> H_2 is = 1.14817

The α-th Renyi Entropy H_α -> H_3 is = 0.86359

The α-th Renyi Entropy H_α -> H_4 is = 0.767644

The α-th Renyi Entropy H_α -> H_5 is = 0.719666

The α-th Renyi Entropy H_α -> H_6 is = 0.69088

The α-th Renyi Entropy H_α -> H_7 is = 0.671688

The α-th Renyi Entropy H_α -> H_8 is = 0.657981

The α-th Renyi Entropy H_α -> H_9 is = 0.6477

The α-th Renyi Entropy H_α -> H_{10} is = 0.639703

The α-th Renyi Entropy H_α -> H_{11} is = 0.633306

The α-th Renyi Entropy H_α -> H_{12} is = 0.628072

The α-th Renyi Entropy H_α -> H_{13} is = 0.623711

The α-th Renyi Entropy H_α -> H_{14} is = 0.62002

The α-th Renyi Entropy H_α -> H_{15} is = 0.616857

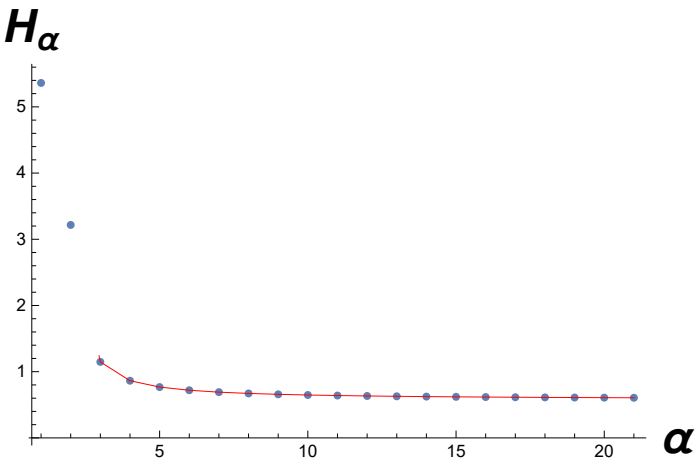
The α-th Renyi Entropy H_α -> H_{16} is = 0.614115

The α-th Renyi Entropy H_α -> H_{17} is = 0.611716

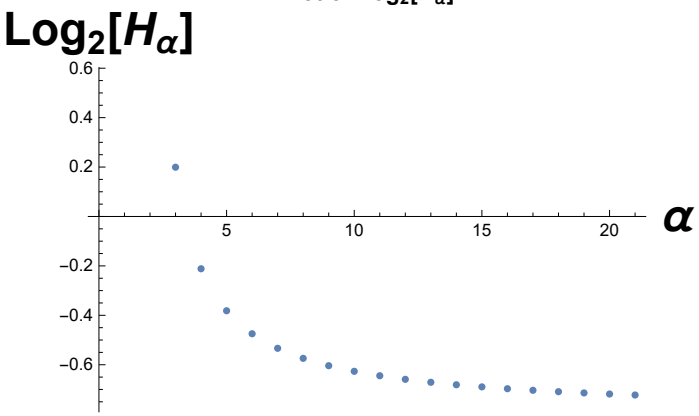
The α-th Renyi Entropy H_α -> H_{18} is = 0.6096

The α-th Renyi Entropy H_α -> H_{19} is = 0.607718

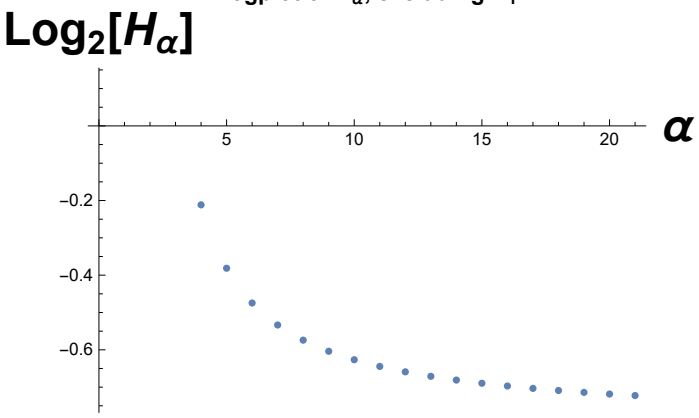
The α-th Renyi Entropy H_α -> H_{20} is = 0.606035



Plot of $\text{Log}_2[H_\alpha]$



Logplot of H_α, excluding H_1



Eigen Entropy Analysis for: W = Canis lupus familiaris breed boxer unplaced genomic scaffold, CanFam3 .1, whole genome shotgun sequence DNA sequence NCBI Reference Sequence: NW_ 003726289.1

gene data

W data

Eigenvalue Analysis

The number of nonzero eigenvalues is = 250

The i-th Eigenvalue λ_1 is = 146836.

The i-th Eigenvalue λ_2 is = 1306.88

The i-th Eigenvalue λ_3 is = 1046.52

The i-th Eigenvalue λ_4 is = 989.349

The i-th Eigenvalue λ_5 is = 948.989

The i-th Eigenvalue λ_6 is = 936.011

The i-th Eigenvalue λ_7 is = 925.724

The i-th Eigenvalue λ_8 is = 903.262

The i-th Eigenvalue λ_9 is = 884.141

The i-th Eigenvalue λ_{10} is = 882.386

The i-th Eigenvalue λ_{11} is = 864.526

The i-th Eigenvalue λ_{12} is = 861.245

The i-th Eigenvalue λ_{13} is = 832.796

The i-th Eigenvalue λ_{14} is = 822.954

The i-th Eigenvalue λ_{15} is = 805.522

The i-th Eigenvalue λ_{16} is = 800.687

The i-th Eigenvalue λ_{17} is = 789.906

The i-th Eigenvalue λ_{18} is = 765.827

The i-th Eigenvalue λ_{19} is = 761.63

The i-th Eigenvalue λ_{20} is = 743.741

The i-th Eigenvalue λ_{21} is = 735.711

The i-th Eigenvalue λ_{22} is = 728.508

The i-th Eigenvalue λ_{23} is = 720.587

The i-th Eigenvalue λ_{24} is = 700.051

The i-th Eigenvalue λ_{25} is = 690.307

The i-th Eigenvalue λ_{26} is = 685.544

The i-th Eigenvalue λ_{27} is = 670.109

The i-th Eigenvalue λ_{28} is = 662.501

The i-th Eigenvalue λ_{29} is = 651.427

The i-th Eigenvalue λ_{30} is = 646.796

The i-th Eigenvalue λ_{31} is = 635.943

The i-th Eigenvalue λ_{32} is = 621.01

The i-th Eigenvalue λ_{33} is = 618.785

The i-th Eigenvalue λ_{34} is = 612.251

The i-th Eigenvalue λ_{35} is = 603.912

The i-th Eigenvalue λ_{36} is = 598.255

The i-th Eigenvalue λ_{37} is = 583.339

The i-th Eigenvalue λ_{38} is = 571.945

The i-th Eigenvalue λ_{39} is = 558.588

The i-th Eigenvalue λ_{40} is = 556.799

The i-th Eigenvalue λ_{41} is = 550.737

The i-th Eigenvalue λ_{42} is = 541.767

The i-th Eigenvalue λ_{43} is = 538.525

The i-th Eigenvalue λ_{44} is = 525.347

The i-th Eigenvalue λ_{45} is = 518.844

The i-th Eigenvalue λ_{46} is = 509.215

The i-th Eigenvalue λ_{47} is = 503.891

The i-th Eigenvalue λ_{48} is = 502.728

The i-th Eigenvalue λ_{49} is = 493.412

The i-th Eigenvalue λ_{50} is = 483.86

The i-th Eigenvalue λ_{51} is = 479.323

The i-th Eigenvalue λ_{52} is = 476.931

The i-th Eigenvalue λ_{53} is = 467.336

The i-th Eigenvalue λ_{54} is = 461.696

The i-th Eigenvalue λ_{55} is = 458.497

The i-th Eigenvalue λ_{56} is = 450.6

The i-th Eigenvalue λ_{57} is = 449.412

The i-th Eigenvalue λ_{58} is = 445.475

The i-th Eigenvalue λ_{59} is = 436.798

The i-th Eigenvalue λ_{60} is = 433.725

The i-th Eigenvalue λ_{61} is = 427.012

The i-th Eigenvalue λ_{62} is = 421.152

The i-th Eigenvalue λ_{63} is = 417.051

The i-th Eigenvalue λ_{64} is = 411.022

The i-th Eigenvalue λ_{65} is = 406.557

The i-th Eigenvalue λ_{66} is = 398.028

The i-th Eigenvalue λ_{67} is = 393.657

The i-th Eigenvalue λ_{68} is = 388.071

The i-th Eigenvalue λ_{69} is = 379.457

The i-th Eigenvalue λ_{70} is = 374.676

The i-th Eigenvalue λ_{71} is = 370.341

The i-th Eigenvalue λ_{72} is = 368.463

The i-th Eigenvalue λ_{73} is = 367.729

The i-th Eigenvalue λ_{74} is = 354.797

The i-th Eigenvalue λ_{75} is = 353.678

The i-th Eigenvalue λ_{76} is = 347.185

The i-th Eigenvalue λ_{77} is = 346.117

The i-th Eigenvalue λ_{78} is = 342.507

The i-th Eigenvalue λ_{79} is = 332.422

The i-th Eigenvalue λ_{80} is = 328.09

The i-th Eigenvalue λ_{81} is = 322.547

The i-th Eigenvalue λ_{82} is = 321.131

The i-th Eigenvalue λ_{83} is = 319.316

The i-th Eigenvalue λ_{84} is = 316.465

The i-th Eigenvalue λ_{85} is = 313.39

The i-th Eigenvalue λ_{86} is = 303.915

The i-th Eigenvalue λ_{87} is = 302.589

The i-th Eigenvalue λ_{88} is = 299.944

The i-th Eigenvalue λ_{89} is = 292.957

The i-th Eigenvalue λ_{90} is = 289.736

The i-th Eigenvalue λ_{91} is = 284.3

The i-th Eigenvalue λ_{92} is = 279.601

The i-th Eigenvalue λ_{93} is = 276.434

The i-th Eigenvalue λ_{94} is = 271.025

The i-th Eigenvalue λ_{95} is = 268.262

The i-th Eigenvalue λ_{96} is = 262.671

The i-th Eigenvalue λ_{97} is = 261.698

The i-th Eigenvalue λ_{98} is = 252.871

The i-th Eigenvalue λ_{99} is = 250.778

The i-th Eigenvalue λ_{100} is = 250.301

The i-th Eigenvalue λ_{101} is = 246.568

The i-th Eigenvalue λ_{102} is = 241.909

The i-th Eigenvalue λ_{103} is = 237.712

The i-th Eigenvalue λ_{104} is = 236.222

The i-th Eigenvalue λ_{105} is = 232.119

The i-th Eigenvalue λ_{106} is = 230.056

The i-th Eigenvalue λ_{107} is = 226.329

The i-th Eigenvalue λ_{108} is = 222.119

The i-th Eigenvalue λ_{109} is = 215.347

The i-th Eigenvalue λ_{110} is = 214.223

The i-th Eigenvalue λ_{111} is = 209.153

The i-th Eigenvalue λ_{112} is = 207.399

The i-th Eigenvalue λ_{113} is = 205.644

The i-th Eigenvalue λ_{114} is = 202.342

The i-th Eigenvalue λ_{115} is = 200.882

The i-th Eigenvalue λ_{116} is = 196.973

The i-th Eigenvalue λ_{117} is = 193.528

The i-th Eigenvalue λ_{118} is = 189.754

The i-th Eigenvalue λ_{119} is = 186.81

The i-th Eigenvalue λ_{120} is = 185.422

The i-th Eigenvalue λ_{121} is = 180.679

The i-th Eigenvalue λ_{122} is = 177.161

The i-th Eigenvalue λ_{123} is = 172.922

The i-th Eigenvalue λ_{124} is = 167.751

The i-th Eigenvalue λ_{125} is = 166.002

The i-th Eigenvalue λ_{126} is = 164.993

The i-th Eigenvalue λ_{127} is = 163.628

The i-th Eigenvalue λ_{128} is = 161.594

The i-th Eigenvalue λ_{129} is = 151.851

The i-th Eigenvalue λ_{130} is = 150.909

The i-th Eigenvalue λ_{131} is = 147.676

The i-th Eigenvalue λ_{132} is = 145.064

The i-th Eigenvalue λ_{133} is = 141.309

The i-th Eigenvalue λ_{134} is = 140.245

The i-th Eigenvalue λ_{135} is = 136.668

The i-th Eigenvalue λ_{136} is = 134.436

The i-th Eigenvalue λ_{137} is = 133.609

The i-th Eigenvalue λ_{138} is = 131.405

The i-th Eigenvalue λ_{139} is = 129.734

The i-th Eigenvalue λ_{140} is = 126.919

The i-th Eigenvalue λ_{141} is = 124.485

The i-th Eigenvalue λ_{142} is = 120.282

The i-th Eigenvalue λ_{143} is = 119.074

The i-th Eigenvalue λ_{144} is = 117.26

The i-th Eigenvalue λ_{145} is = 116.993

The i-th Eigenvalue λ_{146} is = 112.496

The i-th Eigenvalue λ_{147} is = 111.558

The i-th Eigenvalue λ_{148} is = 106.309

The i-th Eigenvalue λ_{149} is = 105.905

The i-th Eigenvalue λ_{150} is = 101.958

The i-th Eigenvalue λ_{151} is = 101.414

The i-th Eigenvalue λ_{152} is = 98.4873

The i-th Eigenvalue λ_{153} is = 96.6594

The i-th Eigenvalue λ_{154} is = 94.0711

The i-th Eigenvalue λ_{155} is = 91.4456

The i-th Eigenvalue λ_{156} is = 90.8642

The i-th Eigenvalue λ_{157} is = 87.8895

The i-th Eigenvalue λ_{158} is = 84.8424

The i-th Eigenvalue λ_{159} is = 83.987

The i-th Eigenvalue λ_{160} is = 83.6707

The i-th Eigenvalue λ_{161} is = 81.5147

The i-th Eigenvalue λ_{162} is = 80.0057

The i-th Eigenvalue λ_{163} is = 76.5473

The i-th Eigenvalue λ_{164} is = 75.4132

The i-th Eigenvalue λ_{165} is = 74.0153

The i-th Eigenvalue λ_{166} is = 72.0788

The i-th Eigenvalue λ_{167} is = 71.1526

The i-th Eigenvalue λ_{168} is = 69.8712

The i-th Eigenvalue λ_{169} is = 66.6794

The i-th Eigenvalue λ_{170} is = 65.1462

The i-th Eigenvalue λ_{171} is = 64.5244

The i-th Eigenvalue λ_{172} is = 62.4191

The i-th Eigenvalue λ_{173} is = 56.8682

The i-th Eigenvalue λ_{174} is = 56.7442

The i-th Eigenvalue λ_{175} is = 56.6489

The i-th Eigenvalue λ_{176} is = 55.1069

The i-th Eigenvalue λ_{177} is = 52.5971

The i-th Eigenvalue λ_{178} is = 51.2407

The i-th Eigenvalue λ_{179} is = 49.3241

The i-th Eigenvalue λ_{180} is = 49.1159

The i-th Eigenvalue λ_{181} is = 47.5609

The i-th Eigenvalue λ_{182} is = 46.1567

The i-th Eigenvalue λ_{183} is = 45.1553

The i-th Eigenvalue λ_{184} is = 44.0564

The i-th Eigenvalue λ_{185} is = 41.7157

The i-th Eigenvalue λ_{186} is = 40.7812

The i-th Eigenvalue λ_{187} is = 40.0958

The i-th Eigenvalue λ_{188} is = 38.457

The i-th Eigenvalue λ_{189} is = 36.9389

The i-th Eigenvalue λ_{190} is = 35.6729

The i-th Eigenvalue λ_{191} is = 34.704

The i-th Eigenvalue λ_{192} is = 33.4259

The i-th Eigenvalue λ_{193} is = 32.6633

The i-th Eigenvalue λ_{194} is = 31.1053

The i-th Eigenvalue λ_{195} is = 30.0484

The i-th Eigenvalue λ_{196} is = 28.6647

The i-th Eigenvalue λ_{197} is = 27.6615

The i-th Eigenvalue λ_{198} is = 26.7026

The i-th Eigenvalue λ_{199} is = 26.1678

The i-th Eigenvalue λ_{200} is = 25.3917

The i-th Eigenvalue λ_{201} is = 23.443

The i-th Eigenvalue λ_{202} is = 21.8123

The i-th Eigenvalue λ_{203} is = 21.3548

The i-th Eigenvalue λ_{204} is = 20.8615

The i-th Eigenvalue λ_{205} is = 19.6617

The i-th Eigenvalue λ_{206} is = 19.498

The i-th Eigenvalue λ_{207} is = 18.3371

The i-th Eigenvalue λ_{208} is = 17.4305

The i-th Eigenvalue λ_{209} is = 16.5531

The i-th Eigenvalue λ_{210} is = 16.1394

The i-th Eigenvalue λ_{211} is = 15.4673

The i-th Eigenvalue λ_{212} is = 15.4197

The i-th Eigenvalue λ_{213} is = 14.699

The i-th Eigenvalue λ_{214} is = 13.8092

The i-th Eigenvalue λ_{215} is = 12.7673

The i-th Eigenvalue λ_{216} is = 11.9365

The i-th Eigenvalue λ_{217} is = 11.3576

The i-th Eigenvalue λ_{218} is = 10.7667

The i-th Eigenvalue λ_{219} is = 10.3835

The i-th Eigenvalue λ_{220} is = 9.55166

The i-th Eigenvalue λ_{221} is = 9.27497

The i-th Eigenvalue λ_{222} is = 7.92206

The i-th Eigenvalue λ_{223} is = 7.09931

The i-th Eigenvalue λ_{224} is = 6.62117

The i-th Eigenvalue λ_{225} is = 6.39553

The i-th Eigenvalue λ_{226} is = 5.75278

The i-th Eigenvalue λ_{227} is = 5.45777

The i-th Eigenvalue λ_{228} is = 5.03591

The i-th Eigenvalue λ_{229} is = 4.36342

The i-th Eigenvalue λ_{230} is = 4.08928

The i-th Eigenvalue λ_{231} is = 3.6739

The i-th Eigenvalue λ_{232} is = 3.50455

The i-th Eigenvalue λ_{233} is = 3.00849

The i-th Eigenvalue λ_{234} is = 2.73564

The i-th Eigenvalue λ_{235} is = 2.51786

The i-th Eigenvalue λ_{236} is = 2.14858

The i-th Eigenvalue λ_{237} is = 1.92828

The i-th Eigenvalue λ_{238} is = 1.53738

The i-th Eigenvalue λ_{239} is = 1.29642

The i-th Eigenvalue λ_{240} is = 1.21172

The i-th Eigenvalue λ_{241} is = 0.976616

The i-th Eigenvalue λ_{242} is = 0.747839

The i-th Eigenvalue λ_{243} is = 0.526189

The i-th Eigenvalue λ_{244} is = 0.507367

The i-th Eigenvalue λ_{245} is = 0.284191

The i-th Eigenvalue λ_{246} is = 0.147904

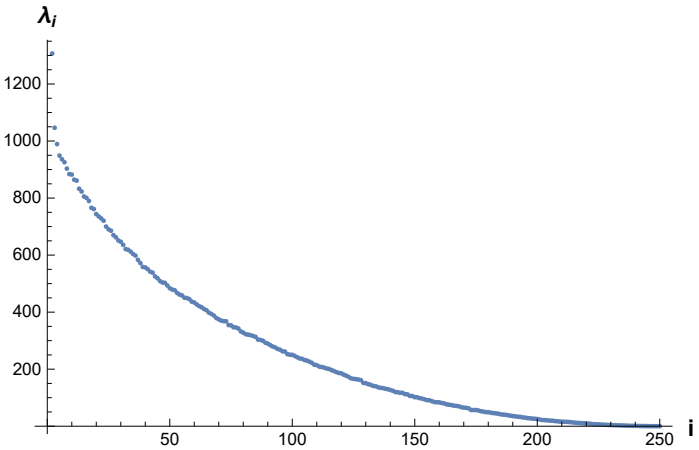
The i-th Eigenvalue λ_{247} is = 0.121052

The i-th Eigenvalue λ_{248} is = 0.0399042

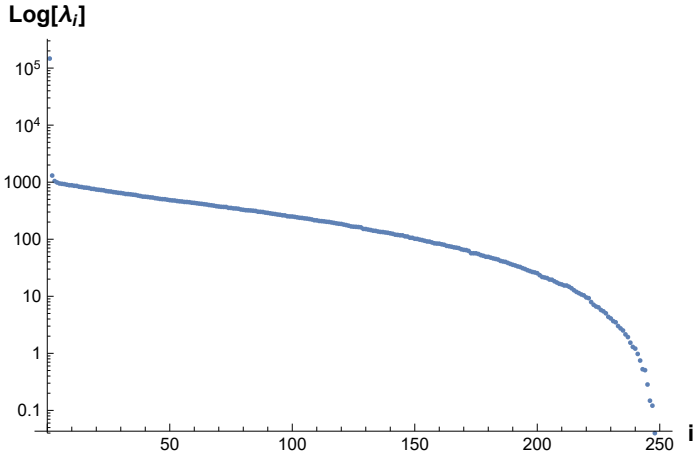
The i-th Eigenvalue λ_{249} is = 0.0297408

The i-th Eigenvalue λ_{250} is = 0.000782993

Eigenvalue PLOT

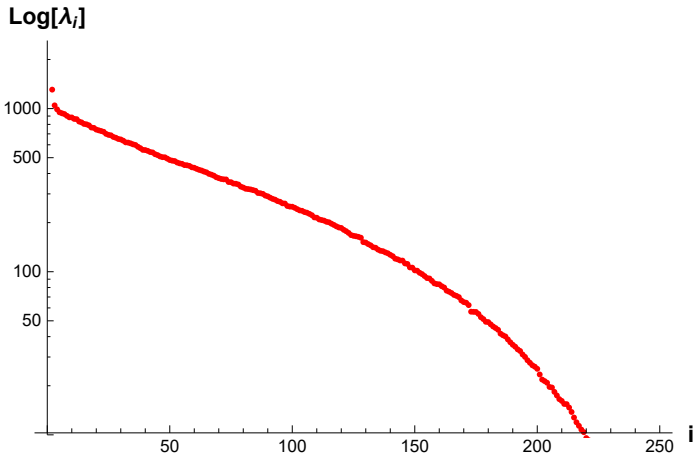


Eigenvalue Log PLOT



Zooming in on the Log Plot so as to Exclude the first eigenvalue gives the following plot:

Logplot of Eigenvalues, excluding λ_1



The approximate linearity of the above plot tells us that the eigenvalues
decrease exponentially. If it's nowhere near linear try adjusting the plot range.

The First normalized eigenvector is: *0.694847*

The Second normalized eigenvector is: *0.00618429*

The Last (n-th) normalized (nonzero) eigenvector is:
3.70521 × 10^-9

(If statement safecheck): *Total[set] = 1. = 1, so the Eigenvalue set is properly normalized*

Entropy Analysis

The α-th Renyi Entropy H_α -> H_0 is = 5.52146

The α-th Renyi Entropy H_α -> H_1 is = 3.08734

The α-th Renyi Entropy H_α -> H_2 is = 1.04815

The α-th Renyi Entropy H_α -> H_3 is = 0.787844

The α-th Renyi Entropy H_α -> H_4 is = 0.700311

The α-th Renyi Entropy H_α -> H_5 is = 0.656541

The α-th Renyi Entropy H_α -> H_6 is = 0.63028

The α-th Renyi Entropy H_α -> H_7 is = 0.612772

The α-th Renyi Entropy H_α -> H_8 is = 0.600266

The α-th Renyi Entropy H_α -> H_9 is = 0.590887

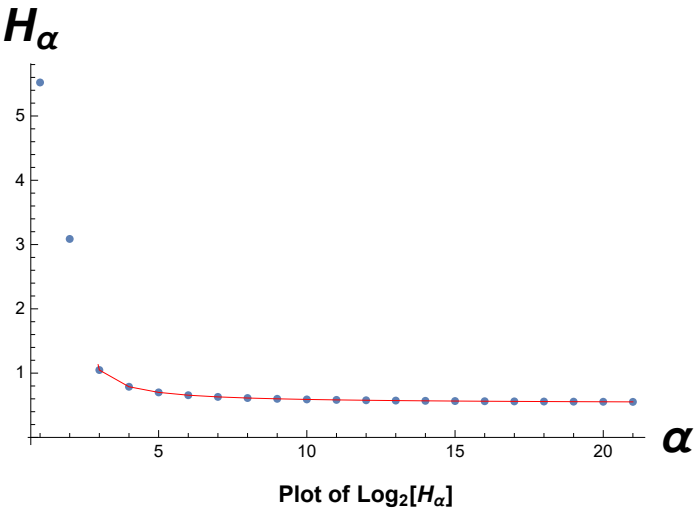
The α-th Renyi Entropy H_α -> H_{10} is = 0.583592

The α-th Renyi Entropy H_α -> H_{11} is = 0.577756

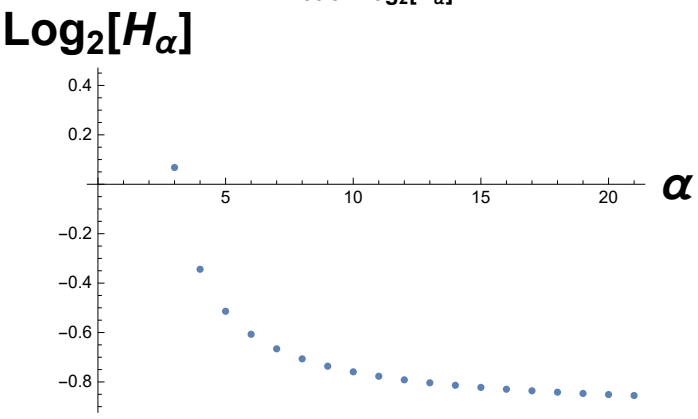
The α-th Renyi Entropy H_α -> H_{12} is = 0.572982

The α-th Renyi Entropy H_α -> H_{13} is = 0.569003

```
The α-th Renyi Entropy Hα ->  H14 is = 0.565636
The α-th Renyi Entropy Hα ->  H15 is = 0.56275
The α-th Renyi Entropy Hα ->  H16 is = 0.560249
The α-th Renyi Entropy Hα ->  H17 is = 0.55806
The α-th Renyi Entropy Hα ->  H18 is = 0.556129
The α-th Renyi Entropy Hα ->  H19 is = 0.554413
The α-th Renyi Entropy Hα ->  H20 is = 0.552877
```



Plot of $Log_2[H_\alpha]$



Logplot of H_α, excluding H_1