**Packages:**

**Kendall**

**https://cran.r-project.org/web/packages/Kendall/Kendall.pdf**

**Openair**

**https://cran.r-project.org/web/packages/openair/openair.pdf**

**Zyp**

**https://cran.r-project.org/web/packages/zyp/zyp.pdf**

**Code:**

#lake data 1995 to 2008

> bubble\_doc=read.table(file('clipboard'),head=TRUE)

> summary(Kendall(bubble\_doc$V1,bubble\_doc$V2))

Score = 52 , Var(Score) = 2556.021

denominator = 374.9987

tau = 0.139, 2-sided pvalue =0.31309

> eagle\_doc=read.table(file('clipboard'),head=TRUE)

> summary(Kendall(eagle\_doc$StartDate,eagle\_doc$DOC\_mgL))

Score = 10 , Var(Score) = 65.33334

denominator = 28

tau = 0.357, 2-sided pvalue =0.26551

> echo\_doc=read.table(file('clipboard'),head=TRUE)

> summary(Kendall(echo\_doc$StartDate,echo\_doc$DOC\_mgL))

Score = 105 , Var(Score) = 1827.667

denominator = 297.4895

tau = 0.353, 2-sided pvalue =0.014988

> jordan\_doc=read.table(file('clipboard'),head=TRUE)

> summary(Kendall(jordan\_doc$StartDate,jordan\_doc$DOC\_mgL))

Score = 374 , Var(Score) = 10397.7

denominator = 972.36

tau = 0.385, 2-sided pvalue =0.00025422

LONG POND

Score = 1 , Var(Score) = 90.02778

denominator = 35

tau = 0.0286, 2-sided pvalue =1

SEAL COVE

Score = 144 , Var(Score) = 2296.011

denominator = 348.4968

tau = 0.413, 2-sided pvalue =0.0028419

Bubble 2014 significant, 2008 not sig

Eagle 2014 not sig, 2008 not sig

Echo 2014 not sig, 2008 yes sig

Jordan 2014 yes sig, 2008 yes sig

Long 2014 not sig, 2008 not sig

Seal 2014 not sig, 2008 sig

#Chlorophyll a data 1995-2008:

BUBBLE

Score = 2 , Var(Score) = 92

denominator = 36

tau = 0.0556, 2-sided pvalue =0.91697

EAGLE

Score = 0 , Var(Score) = 261.0769

denominator = 74.45804

tau = 0, 2-sided pvalue =1

ECHO

Score = 30 , Var(Score) = 2816

denominator = 395.8737

tau = 0.0758, 2-sided pvalue =0.58473

JORDAN

Score = 3 , Var(Score) = 3424.783

denominator = 450.3266

tau = 0.00666, 2-sided pvalue =0.97274

LONG

Score = 13 , Var(Score) = 44.33333

denominator = 21

tau = 0.619, 2-sided pvalue =0.071505

SEAL

Score = 48 , Var(Score) = 2830.667

denominator = 400.9688

tau = 0.12, 2-sided pvalue =0.37702

#Secchi Depth 1995-2008

BUBBLE

Score = -485 , Var(Score) = 45895.69

denominator = 2691.995

tau = -0.18, 2-sided pvalue =0.023869

EAGLE

Score = -625 , Var(Score) = 45895.68

denominator = 2691.991

tau = -0.232, 2-sided pvalue =0.003583

ECHO

Score = -821 , Var(Score) = 62327.38

denominator = 3306.494

tau = -0.248, 2-sided pvalue =0.0010215

JORDAN

Score = -1451 , Var(Score) = 82298.03

denominator = 3993.498

tau = -0.363, 2-sided pvalue =4.3165e-07

LONG

Score = -330 , Var(Score) = 25810.68

denominator = 1823.996

tau = -0.181, 2-sided pvalue =0.040576

SEAL

Score = -579 , Var(Score) = 57896.71

denominator = 3144.984

tau = -0.184, 2-sided pvalue =0.016299

#Secchi 83-95 using all available data from file “New ACAD\_6 Lakes chem and secchi to 2014” tab titled “SLR Secchi 90s-2014” (so individual sampling events not yearly averages)

> x=read.table(file('clipboard'),head=FALSE)

> summary(Kendall(x$V1,x$V2))

Jordan:

Score = 1624 , Var(Score) = 141601.1

denominator = 5703.052

tau = 0.285, 2-sided pvalue =1.6101e-05

Bubble:

Score = 721 , Var(Score) = 99599.66

denominator = 4497.065

tau = 0.16, 2-sided pvalue =0.022524

Eagle:

Score = 821 , Var(Score) = 203749

denominator = 7273.228

tau = 0.113, 2-sided pvalue =0.069274

Echo:

Score = -608 , Var(Score) = 355651.7

denominator = 10547.09

tau = -0.0576, 2-sided pvalue =0.30876

Long:

Score = 643 , Var(Score) = 229453.9

denominator = 7839.821

tau = 0.082, 2-sided pvalue =0.18016

#Secchi 81-94 using all available data from sigmaplot file “JGR Revision\_Secchi Plot”

Bubble

Score = 752 , Var(Score) = 93525.34

denominator = 4310.076

tau = 0.174, 2-sided pvalue =0.014061

Eagle

Score = 751 , Var(Score) = 170744.4

denominator = 6454.241

tau = 0.116, 2-sided pvalue =0.069517

Eagle without ZERO OUTLIER!

Score = 2640 , Var(Score) = 743513.4

denominator = 17430.4

tau = 0.151, 2-sided pvalue =0.0022095

Echo

Score = -733 , Var(Score) = 313917.3

denominator = 9694.104

tau = -0.0756, 2-sided pvalue =0.19139

Jordan

Score = 1520 , Var(Score) = 130152.4

denominator = 5385.025

tau = 0.282, 2-sided pvalue =2.5483e-05

Long  
Score = 641 , Var(Score) = 224117.9

denominator = 7718.888

tau = 0.083, 2-sided pvalue =0.17641

Seal Cove

Score = 1222 , Var(Score) = 99422.7

denominator = 4470.134

tau = 0.273, 2-sided pvalue =0.0001078

#EPI THICKNESS

Tau p

Jordan 0.39 0.0559\*

Seal 0.395 0.0583\*

Bubble 0.27 0.32

Eagle 0.405 0.127

Echo 0.121 0.579

Long 0.464 0.1229

#BUOYANCY FREQUENCY

Tau p

Jordan -0.219 0.276

Seal 0.124 0.553

Bubble 0.111 0.721

Eagle -0.0667 0.858

Echo 0.276 0.166

Long 0.167 0.60217

SEN SLOPE FOR SECCHI 1995-2008

> x=read.table(file('clipboard'),head=FALSE)

> zyp.sen(V2~V1,data=x)

BUBBLE

Coefficients:

Intercept V1

21.0581186 -0.0003079

#ANNUAL DATA

Coefficients:

Intercept V1

316.3122 -0.1531

EAGLE

Coefficients:

Intercept V1

21.8369240 -0.0002863

#ANNUAL DATA

Coefficients:

Intercept V1

379.0026 -0.1836

ECHO

Coefficients:

Intercept V1

19.6897581 -0.0002977

#ANNUAL DATA

Coefficients:

Intercept V1

280.2611 -0.1357

JORDAN

Coefficients:

Intercept V1

47.5512877 -0.0009073

#ANNUAL DATA

Coefficients:

Intercept V1

708.3653 -0.3471

LONG

Coefficients:

Intercept V1

17.7049669 -0.0002237

#ANNUAL DATA

Coefficients:

Intercept V1

250.4911 -0.1204

SEAL

Coefficients:

Intercept V1

14.1745079 -0.0001969

#ANNUAL DATA

Coefficients:

Intercept V1

293.7808 -0.1433

\*Checked on Systat Mann Kendall under Time Series Trend Analysis: same slope estimate -0.143

SEN SLOPE FOR REMAINING LAKES IN RATE OF CHANGE FIGURE:

Sens slope Mann Kendall p

Bowl 0.1255 0.386

Upper Hadlock 0.0536 0.324

Witch Hole 0.0044 0.8267

Hodgdon 0.05094 0.8065

Lower Hadlock -0.09985 0.84831

Upper Breakneck 0.01597 0.8065