**Tests for Normality and Nonparametric Alternatives to t-tests and ANOVA**

1. **Tests for normality**

> x=rnorm(100)

* 1. **Normal quantile-quantile plot (Q-Q plot)**

> qqnorm(x)

* 1. **One sample Kolmogorov-Smirnov test**

> ks.test(x,"pnorm")

> ks.test(x,"pnorm",3,6)

> ks.test(a,"pnorm",mean=mean(x),sd=sd(x))

* 1. **Shapiro-Wilk’s W test for normality**

> shapiro.test(x)

* 1. **Anderson-Darling test (need package nortest or goftest)**

> library(nortest)

> ad.test(x)

> library(nortest)

> ad.test(x, "pnorm")

> ad.test(x, "pnorm", mean=2, sd=1)

* 1. **Cramer Von Mises test (need package goftest)**

> cvm.test(x, "pnorm")

> cvm.test(x, "pnorm", mean=2, sd=1)

> cvm.test(x,"pnorm",mean=mean(x),sd=sd(x),estimated=TRUE)

* 1. **Person Chi-square test for normality (need package nortest)**

> pearson.test(x)

1. **Nonparametric alternatives to t-tests and ANOVA**
   1. **Graph comparison of empirical CDF**

> x2 <- rnorm(100,2,4)

> plot(ecdf(x), xlim = range(c(x, x2)))

> plot(ecdf(x2), add = TRUE, lty = "dashed")

* 1. **Wilcoxon one sample signed rank test – nonparametric equivalent to one sample t-test**

> wilcox.test(x, mu=2, conf.int=TRUE, conf.level=0.99)

* 1. **Wilcoxon two sample signed rank test – nonparametric equivalent to paired t-test**

> wilcox.test(x,x2,paired=TRUE)

1. **Two sample Kolmogorov-Smirnov test – nonparametric equivalent to two sample t-test**

> ks.test(x,x2)

1. **Mann-Whitney U test, Mann-Whitney-Wilcoxon test, Wilcoxon Mann-Whitney test, Wilcoxon rank sum test – nonparametric equivalent to one and two independent sample t-tests**

> wilcox.test(x,x2,paired=FALSE)

1. **Kruskal-Wallis rank sum test – nonparametric equivalent to one-way ANOVA**

## Modified Hollander & Wolfe (1973), 116.

## Mucociliary efficiency from the rate of removal of dust in normal

## subjects, subjects with obstructive airway disease, and subjects

## with asbestosis.

x <- c(2.9, 3.0, 2.5, 2.6, 3.2, 2.1, 2.2, 3.3, 2.2) # normal subjects

y <- c(3.8, 2.7, 4.0, 3.4, 3.2, 4.1, 4.2) # with obstructive airway disease

z <- c(2.8, 3.4, 3.7, 2.2, 2.0, 3.1, 3.2, 3.0) # with asbestosis

kruskal.test(list(x, y, z))

## Equivalently using formula interface

x <- c(x, y, z)

g <- factor(rep(1:3, c(9, 7, 8)),

labels = c("Normal subjects",

"Subjects with obstructive airway disease",

"Subjects with asbestosis"))

kruskal.test(x, g)