DSA 8070 R Session 5: Comparisons of Several Mean Vectors

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Contents

Swiss Bank Notes Example

Read the data

```
url <- "https://online.stat.psu.edu/stat505/sites/stat505/files/lesson07/swiss3.txt"
dat <- read.table(url, header = F)
```

Calculate summary statistics

```
real <- which(dat$V1 == "real")
fake <- which(dat$V1 == "fake")
(xbar1 <- colMeans(dat[real, -1]))
```

```
##      V2      V3      V4      V5      V6      V7
## 214.969 129.943 129.720   8.305  10.168 141.517
```

```
(xbar2 <- colMeans(dat[fake, -1]))
```

```
##      V2      V3      V4      V5      V6      V7
## 214.823 130.300 130.193  10.530  11.133 139.450
```

```
Sigma1 <- cov(dat[real, -1])
Sigma2 <- cov(dat[fake, -1])
n1 <- length(real); n2 <- length(fake); p <- dim(dat[, -1])[2]
Sp <- ((n1 - 1) * Sigma1 + (n2 - 1) * Sigma2) / (n1 + n2 - 2)
```

Perform a two-sample Hotelling's T-Square test

```
# Test statistic
T.squared <- as.numeric(t(xbar1 - xbar2) %*% solve(Sp * (1 / n1 + 1 / n2)) %*% (xbar1 - xbar2))
Fobs <- T.squared * ((n1 + n2 - p - 1) / ((n1 + n2 - 2) * p))
# p-value
pf(Fobs, p, n1 + n2 - p - 1, lower.tail = F)
```

```
## [1] 3.378887e-105
```

Simultaneous Confidence Intervals

```
s1 <- diag(Sigma1); s2 <- diag(Sigma2)

xbar_diff <- xbar1 - xbar2
sp_diff <- ((n1 - 1) * s1 + (n2 - 1) * s2) / (n1 + n2 - 2)

multipler <- sqrt((p * (n1 + n2 - 2) / (n1 + n2 - p - 1)) * qf(0.95, p, n1 + n2 - p - 1))

sp <- sqrt((1 / n1 + 1 / n2) * sp_diff)

CIs <- cbind(xbar_diff + -1 * multipler * sp, xbar_diff + 1 * multipler * sp)
CIs
```

```
##           [,1]       [,2]
## V2 -0.04432667  0.3363267
## V3 -0.51856518 -0.1954348
## V4 -0.64159649 -0.3044035
## V5 -2.69809429 -1.7519057
## V6 -1.29523310 -0.6347669
## V7  1.80719722  2.3268028
```

MANOVA: Romano-British Pottery Example

```
dat <- read.table("pottery.txt", header = F)
out <- manova(cbind(V2, V3, V4, V5, V6) ~ V1, data = dat)
summary(out, test = "Wilks")
```

```
##           Df    Wilks approx F num Df den Df   Pr(>F)
## V1         3 0.012301   13.088     15 50.091 1.84e-12 ***
## Residuals 22
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
summary(out)
```

```
##           Df Pillai approx F num Df den Df    Pr(>F)
## V1         3 1.5539   4.2984     15     60 2.413e-05 ***
## Residuals 22
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```