The Hotelling $T^2$ test isn’t available in the basic installation of R, but you can write a function yourself. To write a function, you need to store the function code itself as a variable.

For example:

```r
mean.na <- function(x) {
  #starts function w/ one input
  mean_val <- mean(x, na.rm=T) #calculates mean w/out NA
  mean_val #outputs result to screen
} #ends function
```

Because the mean is calculated on a single variable, this example function requires only a single input. It’s called `x` here: `function(x)` means that the object is a function requiring a single input that will be called `x` within the function. The choice of name for the input is arbitrary and doesn’t need to match any data or variables outside of the function.

All of the commands to be run within the function are enclosed within braces `{ }`.

In this example, the function first calculates the mean value after removing the NA values, and stores it as a temporary variable named `mean_val`. Variable `mean_val` is output on the next line (remember that typing the name of a variable displays it to the screen), but will not be stored permanently outside of the function.

You could then run:

```r
mean.na(georoc$NA2O)
```

You’ll need to know a few additional R functions to write your Hotelling $T^2$ test

```r
nrow(x) #counts the number of rows in a matrix or data frame x
ncol(x) #counts the number of columns in a matrix or data frame x
cov(x) #calculates the variance-covariance matrix of matrix x
colMeans(x) #calculates means of all columns of matrix x
mahalanobis(s1, s2, C) #calculates Mahalanobis distance between set of coordinates in sample s1 and set of coordinates in sample s2, given variance-covariance matrix C. Coordinates s1 and s2 should be vectors.
pf(F, df1, df2, lower.tail=F) #calculates the probability of observing an F statistic at least as large as observed, given degrees of freedom df1 and df2
list(c("a1" = x1, "a2" = x2, ..., "an" = xn)) #creates a list from variables x1, x2, ..., xn with labels "a1", "a2", ..., "an"
```

Because the Hotelling test compares only two samples, your function will require two arguments as the input. They will each need to be a matrix (because the number of variables is anything >1). You can use `cbind()` to bind the data columns, containing your variables, into a matrix:

```r
cbind(x1, x2, ..., xn) #binds multiple columns into a single matrix
```
Exercise

Check your function by testing for a difference in the combined Sc, V, and Cr content of basalts in convergent margin settings to intraplate settings.

*You should get a $T^2$ statistic of 2.084828, an F of 0.6682142, 3 and 50 degrees of freedom, and a p value of 0.5755409.*