MTH208: Quiz 3

Instructions

- Download `q3_template.R` and rename it `q3_<ROLL>.R` (e.g., `q3_123456.R`).
- Each code block **contains bugs** (syntax and logic).
- **Fix the code** so it achieves the stated goal.
- You **may not** change the overall goals; only correct the code to meet them.
- Your script must run from a fresh R session without errors.
- Deadline: 3:00 pm. Submit `q3_<ROLL>.R` on helloIITK only.

Problem 1

Goal

1. Create a random numeric matrix `A` with 5 rows and 4 columns, where entries are drawn from the standard normal distribution `N(0,1)`.
2. Write a function `frobenius_norm(M)` that computes

$$\|M\|_F = \sqrt{\sum_{i,j} m_{ij}^2}$$

3. Verify by comparing with `norm`.
4. Write a function `one_norm(M)` that computes

$$\|M\|_1 = \max_j \sum_i |m_{ij}|$$

5. Verify by comparing with `norm`.

Buggy code (fix all issues)

```
# BUGGY CODE
set.seed(123)
A <- matrix(rnorm(20), ncol=5, nrow=4)

frobenius_norm <- function(M) {
  return(sum(M))
```

```
}

fn <- frobenius_norm(A)
print("Our norm:", fn)
print("Base R norm:", norm(A, "F"))

one_norm <- function(M) {
  return(max(sum(M)))
}

on <- one_norm(A)
print("Our norm:", on)
print("Base R norm:", norm(A, "one"))
```

Problem 2

Goal

Using the built-in `mtcars` dataset:

1. Create a factor column `cyl_f` from `cyl`.
2. Compute the mean mpg per cylinder group and store as a named numeric vector `mpg_by_cyl`.
3. Find the car name with the highest power-to-weight ratio, where `power_to_weight = hp / wt`.
4. Create a scatter plot of `wt (x)` vs `mpg (y)`, coloring points by `cyl_f` and adding a legend (base plotting).

Buggy code (fix all issues):

```
# BUGGY CODE
mtcars$cyl_f <- as.factor(mtcars$cly)

mpg_by_cyl <- tapply(mtcars$mpg, mtcars$cyl_f, mean(na.rm=TRUE))

mtcars$power_to_weight <- mtcars$wt / mtcars$hp
best_idx <- which.min(mtcars$power_to_weight)
best_car <- rownames(best_idx)
cat("Best car:", best_car, "\n")

cols <- c("red","blue","darkgreen")
plot(y = mtcars$mpg, x = mtcars$wt, col = cols[mtcars$cyl_f],
     xlab="Weight (1000 lbs)", ylab="MPG", main="MPG vs Weight")
legend("topright", legend=levels(mtcars$cyl_f), col=cols, pch=1)
```
