ECO 420Y — Homework 5

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Questions

Given: risk-free rate $r_f = 3\%$, market expected return $E[R_m] = 9\%$, stock beta $\beta = 1.2$.
1) Compute the expected return by CAPM.
2) If actual return is 8%, does it under/over-perform? By how much?
3) Compute alpha and plot the stock on the SML.

Answers

CAPM: $E[R_i] = r_f + \beta \left(E[R_m] - r_f\right)$.
Alpha: $\alpha = R_{\text{actual}} - E[R_i]$.

$$E[R_i] = 0.03 + 1.2(0.09 - 0.03) = 0.102 \; (= 10.2\%) \,.$$

$$\alpha = 0.08 - 0.102 = -0.022 \; (= -2.2\%) \,.$$

Code and Plot

```
# Inputs
rf   <- 0.03
Rm   <- 0.09
beta <- 1.2
Ract <- 0.08

# CAPM expected return and alpha
Ecapm <- rf + beta * (Rm - rf)
alpha <- Ract - Ecapm

cat(sprintf("CAPM expected return: %.2f%%\n", 100*Ecapm))
```

```
## CAPM expected return: 10.20%
```

```
cat(sprintf("Actual return: %.2f%%\n", 100*Ract))
```

```
## Actual return: 8.00%
```

```
cat(sprintf("Performance gap (Actual - CAPM): %.2f%%\n", 100*(Ract - Ecapm)))
```

Performance gap (Actual - CAPM): -2.20%

```
cat(sprintf("Alpha: %.2f%%\n", 100*alpha))
```

Alpha: -2.20%

```
if (alpha > 0) print("Over-performs (above SML).") else print("Under-performs (below SML).")
```
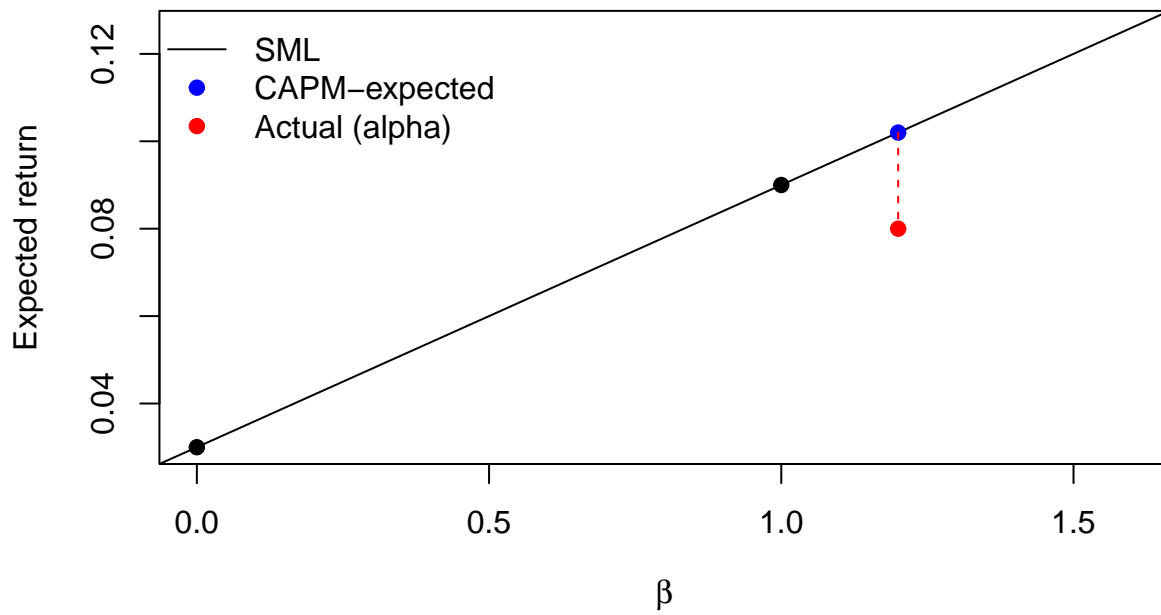
[1] "Under-performs (below SML)."

```
# Security Market Line plot
plot(c(0, 1.6), c(rf, rf + 1.6*(Rm - rf)), type = "n",
     xlab = expression(beta), ylab = "Expected return",
     main = "Security Market Line (SML)")
abline(a = rf, b = (Rm - rf))                    # SML
points(0, rf, pch = 19)                          # risk-free
points(1, Rm, pch = 19)                          # market
points(beta, Ecapm, pch = 19, col = "blue")    # CAPM-expected for the stock
points(beta, Ract,  pch = 19, col = "red")     # actual point
segments(beta, Ecapm, beta, Ract, col = "red", lty = 2)  # alpha gap
legend("topleft",
       legend = c("SML", "CAPM-expected", "Actual (alpha)"),
       lty = c(1, NA, NA), pch = c(NA, 19, 19),
       col = c("black", "blue", "red"), bty = "n")
```

Security Market Line (SML)

Answers

1) Expected return (CAPM): 10.2%.
2) Actual return 8% is below 10.2% → under-performs by 2.2 percentage points
3) Alpha $= -2.2\%$ (point lies below** the SML at $\beta = 1.2$).