LEVEL II SCHWESER'S QuickSheet

CRITICAL CONCEPTS FOR THE 2026 CFA® EXAM

QUANTITATIVE METHODS

MULTIPLE REGRESSION

Coefficient of Determination, R^2

$$R^2 = \frac{\text{total variation} - \text{unexplained variation}}{\text{total variation}}$$

$$= \frac{SST - SSE}{SST} = \frac{\text{explained variation}}{\text{total variation}} = \frac{RSS}{SST}$$

$$MSE = \frac{SSE}{n-k-1};\ MSR = \frac{RSS}{k};\ R^2 = \frac{RSS}{SST}$$

Adjusted R^2

$$R_a^2 = 1 - \left[\left(\frac{n-1}{n-k-1}\right) \times (1 - R^2)\right]$$

Akaike's information criterion (AIC) and Schwarz's Bayesian information criteria (BIC):

AIC is used if the goal is to have a better forecast, while BIC is used if the goal is a better goodness of fit. Lower values of each are better.

$$AIC = n \times \ln\left(\frac{SSE}{n}\right) + 2(k+1)$$

$$BIC = n \times \ln\left(\frac{SSE}{n}\right) + \ln(n) \times (k+1)$$

F-statistic to evaluate nested models:

$$F = \frac{(SSE_R - SSE_U) / q}{(SSE_U) / (n-k-1)}$$

with q and (n−k−1) degrees of freedom.

F-test statistic to evaluate *overall* model fit:

$$F = \frac{(RSS_U) / k}{(SSE_U) / (n-k-1)}$$

Model Misspecification

- Omitting a variable (that should be included).
- Variable should be transformed (for linearity).
- Inappropriate scaling of the variable.
- Incorrectly pooling data (e.g., different regimes).

Regression Analysis—Problems

- **Heteroskedasticity:** Non-constant error variance. Detect with scatter plots or Breusch–Pagan test. Correct with White-corrected standard errors.
- **Autocorrelation:** Correlation among error terms. Detect with Durbin–Watson (DW) test or Breusch–Godfrey (BG) test. Correct using robust (Newey–West corrected) standard errors.
- **Multicollinearity:** High correlation among Xs. (F-test significant, t-tests insig.). Detect using VIF. Correct by dropping correlated X variables.

Variance inflation factor (VIF) to quantify multicollinearity: $VIF_j = 1 / (1 - R_j^2)$

Logistic regression (logit) models:

$$\ln\left(\frac{P}{1-P}\right) = b_0 + b_1X_1 + b_2X_2 + .. + \varepsilon$$

$$\text{odds} = e^{\hat{y}}$$

$$P = \text{odds} / (1 + \text{odds}) = 1 / (1 + e^{-\hat{y}})$$

Likelihood ratio (LR) test for logistic regressions: LR = −2 (log likelihood restricted model − log likelihood unrestricted model)

TIME-SERIES ANALYSIS

Linear trend model: $y_t = b_0 + b_1 t + \varepsilon_t$

Log-linear trend model: $\ln(y_t) = b_0 + b_1 t + \varepsilon_t$

Covariance stationary: Mean and variance stable over time. To conclude a time series is covariance stationary: (1) plot data, (2) regress an AR model and test correlations, or (3) do Dickey-Fuller test.

Unit root: Coeff on lagged dependent variable = 1. Series with unit root is not covariance stationary. First differencing will often eliminate the unit root.

Autoregressive (AR) model: Specified correctly if autocorrelation of residuals not significant.

Mean-reverting level for AR(1) $= \frac{b_0}{(1 - b_1)}$

RMSE: Square root of average squared error.

Random Walk Time Series: $x_t = x_{t-1} + \varepsilon_t$

Seasonality: Indicated by statistically significant lagged error term. Correct by adding lagged term.

ARCH: Detected by estimating ARCH(1) model:

$$\hat{\varepsilon}_t^2 = a_0 + a_1\hat{\varepsilon}_{t-1}^2 + \mu_t$$

Variance of ARCH series:

$$\hat{\sigma}_{t+1}^2 = \hat{a}_0 + \hat{a}_1\hat{\varepsilon}_t^2$$

MACHINE LEARNING

Supervised learning: Algorithm uses labeled training data to model relationships.

Unsupervised learning: Algorithm uses unlabeled data to determine the structure of the data.

Deep learning algorithms: E.g., neural networks and reinforced learning. Learn from their own prediction errors. Used in image recognition, etc.

BIG DATA PROJECTS

Preparing Data

Normalization: Scales values between 0 and 1.

$$\text{normalized } X_i = \frac{X_i - X_{min}}{X_{max} - X_{min}}$$

Standardization: Centered at 0; scaled as std devs.

$$\text{standardized } X_i = \frac{X_i - \mu}{\sigma}$$

Fit of a Machine Learning Algorithm

$$\text{precision (P)} = \frac{\text{true positives}}{(\text{true positives} + \text{false positives})}$$

$$\text{recall (R)} = \frac{\text{true positives}}{(\text{true positives} + \text{false negatives})}$$

$$\text{accuracy} = \frac{(\text{true positives} + \text{true negatives})}{(\text{all positives and negatives})}$$

F1 score = (2 × P × R) / (P + R)
true positive rate (TPR) = TP / (TP + FN)
false positive rate (FPR) = FP / (FP + TN)

Receiver operating characteristic (ROC): Shows tradeoff between false positives and true positives.

Root mean square error (RMSE): Used when the target variable is continuous.

$$RMSE = \sqrt{\frac{\sum_{i=1}^{n}(\text{predicted}_i - \text{actual}_i)^2}{n}}$$

ECONOMICS

CURRENCY EXCHANGE RATES

Bid-ask spread = ask quote − bid quote

Cross rates with bid-ask spreads:

$$\left(\frac{A}{C}\right)_{bid} = \left(\frac{A}{B}\right)_{bid} \times \left(\frac{B}{C}\right)_{bid}$$

$$\left(\frac{A}{C}\right)_{offer} = \left(\frac{A}{B}\right)_{offer} \times \left(\frac{B}{C}\right)_{offer}$$

Currency arbitrage: "Up the bid and down the ask."

Forward premium = (forward price) − (spot price)

Value of fwd currency contract prior to expiration:

$$V_t = \frac{(FP_t - FP)(\text{contract size})}{\left[1 + R_A\left(\frac{days}{360}\right)\right]}$$

Covered interest rate parity:

$$F = \frac{\left[1 + R_A\left(\frac{days}{360}\right)\right]}{\left[1 + R_B\left(\frac{days}{360}\right)\right]} S_0$$

Uncovered interest rate parity:

$$E(\%\Delta S)_{(A/B)} = R_A - R_B$$

Fisher relation:

$$R_{nominal} = R_{real} + E(\text{inflation})$$

International Fisher relation:

$$R_{nominal\ A} - R_{nominal\ B} = E(\text{inflation}_A) - E(\text{inflation}_B)$$

Relative purchasing power parity: High inflation rates lead to currency depreciation.

$$\%\Delta S_{(A/B)} = \text{inflation}_{(A)} - \text{inflation}_{(B)}$$

where: $\%\Delta S_{(A/B)}$ = change in spot price (A/B)

Profit on FX carry trade = interest differential – change in the spot rate of investment currency

Mundell-Fleming model: Impact of monetary & fiscal policies on interest rates & exchange rates.

Dornbusch overshooting model: Restrictive monetary policy → short-term appreciation of currency, then slow depreciation to PPP value.

ECONOMIC GROWTH

Cobb-Douglas production function:

$$Y = TK^{\alpha}L^{(1-\alpha)}$$

Labor productivity:

output per worker $Y/L = T(K/L)^{\alpha}$

Growth accounting:

growth rate in potential GDP
= long-term growth rate of technology
+ α (long-term growth rate of capital)
+ (1 − α) (long-term growth rate of labor)

growth rate in potential GDP
= long-term growth rate of labor force
+ long-term growth in labor productivity

Classical Growth Theory

- Real GDP/person reverts to subsistence level.

Neoclassical Growth Theory

- Sustainable growth rate is a function of population growth, labor's share of income, and the rate of technological advancement.
- Growth rate in labor productivity driven only by improvement in technology.