Formulae You Should Already Know

CEBoK Module	formula	parameters	usage / comments
8	$y = a + bx$	a (y-int), b (slope)	linear CER
8	$y = ax^b$ $y = ax^b + c$	a (coeff), b (exponent), c (y-int); plot ln Y vs. ln X	learning curve power CER
5 8	$y = ae^{bx} = ak^x = a(1+r)^n$ $y = ae^{bx} + c$	a (y-int), b (slope), r (rate); plot ln Y vs. X	exponential growth exponential CER
8	$y = a + b \ln x$	a (y-int), b (slope, log space); plot Y vs. ln X	logarithmic CER
3	$y = a + bx + cx^2 + \cdots$		polynomial CER
8	$SSE + SSR = SST$	Error + Regression = Total	ANOVA sums of squares

Formulae You Will Be Given (or not)

CEBoK ref	formula	parameters	usage / comments
8	$b = \frac{\sum_{i=1}^{n}(X_i - \bar{X})(Y_i - \bar{Y})}{\sum_{i=1}^{n}(X_i - \bar{X})^2}$ $b = \frac{\sum_{i=1}^{n} X_i Y_i - n\bar{X}\bar{Y}}{\sum_{i=1}^{n} X_i^2 - n\bar{X}^2}$	"four-column table": X, Y, X^2, XY	OLS regression slope ("easy to remember") OLS regression slope ("easy to compute")

Test-Taking Tips

- **Time management**: Work quickly but not hastily. Skip tough problems and come back to them later.
- **Eliminate answers**: If you can eliminate certain answers as implausible, you'll increase your chances, even if you have to guess.
- **Work backward from answers**: On a multiple-choice test, it is sometimes easier to test each answer to see whether it works than to solve directly for the correct answer.
- **Look for "sanity checks"**: Is your numerical answer reasonable when compared with the problem inputs? Use intuition, numeracy, or rules of thumb. If you're doing inflation, costs should be higher in the future and lower in the past; weighted indices should be greater than raw indices. If you're doing learning curve, CUMAV should produce steeper learning than Unit Theory with the same nominal LCS.
- **Always guess!** There is no penalty for guessing. Never leave a question blank.

Formulae to Memorize for the Exam

CEBoK Module	formula	parameters	usage / comments
5	$DT \cdot r \approx 70\ (or\ 72)$	DT = doubling time r = interest rate (in percentage points)	the "Rule of 70" or "Rule of 72"
6	$s^2 = \frac{\sum_{i=1}^{n}(X_i - \bar{X})^2}{n-1}$ $s^2 = \frac{\sum_{i=1}^{n} X_i^2 - n\bar{X}^2}{n-1}$	"two-column table": X, X^2; n = number of data points, n-1 = degrees of freedom	sample variance ("easy to remember") sample variance ("easy to compute")
7	$LCS = 2^b$ $b = \log_2 LCS$	LCS = learning curve slope, b = log space slope	improvement factor applied for doubling
7	$LMP \approx \frac{\frac{F+L}{2} + \sqrt{FL}}{2}$ $LMP \approx \frac{F + L + 2\sqrt{FL}}{4}$	LMP = lot midpoint F = first unit # of lot L = last unit # of lot	Lot Midpoint heuristic

7	$LMP \approx \left[\frac{(L + {}^1\!/_2)^{b+1} - (F - {}^1\!/_2)^{b+1}}{N(b+1)}\right]^{1/b}$	LMP = lot midpoint
		N = L-F+1 = # units in lot
		b = log space slope
			Lot Midpoint approximation (aka Asher's Approximation)

8	$R^2 = \frac{SSR}{SST}$ $R^2 = 1 - \frac{SSE}{SST}$	R = Pearson's product moment coefficient SSX = sums of squares	ANOVA Coefficient of Determination

8	$\hat{Y} \pm t_{(n-1)-k,\frac{\alpha}{2}} \cdot SEE \sqrt{\frac{1}{n} + \frac{(X - \bar{X})^2}{\sum_{i=1}^{n} X_i^2 - n\bar{X}^2}}$	Y-hat = regression line prediction at X
		t = right-tail probability
		n = # data points
		k = # ind. variables
		alpha = significance
		SEE = std err of estimate
		X-bar = mean of X
			Confidence Interval (OLS Regression)

8	$\hat{Y} \pm t_{(n-1)-k,\frac{\alpha}{2}} \cdot SEE \sqrt{1 + \frac{1}{n} + \frac{(X - \bar{X})^2}{\sum_{i=1}^{n} X_i^2 - n\bar{X}^2}}$		Prediction Interval(OLS Regression)
10	$Cov(X,Y) = E[(X - \mu_X)(Y - \mu_Y)]$ $Cov(X,Y) = E[XY] - \mu_X\mu_Y$	mu-sub-X = mean of X mu-sub-Y = mean of Y	Covariance of two random variables
10	Var(X) = $(a^2+b^2+c^2$+-ab-ac-bc)/18	a=low, b=most likely, c=high	Variance of triangular distribution
11	$Std\ Time = \frac{Measured\ Time \cdot Pace}{1 - PF\&D}$	PF&D = Personal Fatigue and Delay	time standards
15	$EAC = ACWP + \frac{BAC - BCWP}{TCPI}$	BAC = Budget At Compl TCPI = future cost performance: CPI ("best case"), CPI * SPI ("worst	general EAC formula
15	$TCPI_{LRE} = \frac{BAC - BCWP}{LRE - ACWP}$		rearrangement of general EAC formula

		case”), 0.8CPI + 0.2SPI, etc.	

Formulae *Not* to Memorize (Just Understand the Concept)

CEBoK Module	formula	parameters	usage / comments
2	$C_2 = \left(\frac{T_2}{T_1}\right) C_1$ $C_2 = \left(\frac{C_1}{T_1}\right) T_2$	C = cost T = technical (scaling parameter)	analogy technique “dollars-per-ton”
2	$y = C_1 + b(x - T_1)$		adjusted analogy (“borrowed” slope)
3	$y = a + [C_1 - (a + bT_1)] + bx$		calibrated CER
	weighted average $\bar{x} = \frac{\sum_{i=1}^{n} w_i x_i}{\sum_{i=1}^{n} w_i}$	w = weights (usually sum to one)	composite index [5] comp. labor rate [11] ESLOC [12] UAC [13] Award Fee [14]
7	$LMP = \left(\frac{\sum_{i=F}^{L} i^b}{N}\right)^{1/b}$	N = L-F+1	Lot Midpoint formula (exact)
7	$TC_N = aN^{b+1}$	a = T1	total cost (CUMAV)
7	$UC_k = ak^{b+1} - a(k-1)^{b+1}$	b = log space slope	unit cost (CUMAV)
8	$a = \bar{Y} - b\bar{X}$	a = y-intercept b = slope	OLS regression y-intercept
8	$d.f.(SSE) = (n-1) - k$ $d.f.(SSR) = k$ $d.f.(SST) = n - 1$	k = # variables (*excluding* y-intercept)	ANOVA degrees of freedom
6	$CV = \frac{s_Y}{\bar{Y}}$	s = standard deviation	coefficient of variation (univariate)
8	$CV = \frac{SEE}{\bar{Y}}$	SEE = standard error of the estimate	coefficient of variation (bivariate)
8	$\ln y = \ln a + b \ln x$	plot ln Y vs. ln X	power in log space
8	$\ln y = a + bx$	plot ln Y vs. X	exponential in semi-log space
9	$CGF = \frac{Final\ Cost}{Initial\ Cost}$		Cost Growth Factor
9	$SGF = \frac{Final\ Schedule}{Initial\ Schedule}$		Schedule Growth Factor
11	$F_R = \frac{Actuals}{Standard}$		Realization Factor
11	$F_E = \frac{Standard}{Actuals}$		Efficiency Factor
13	$NPV = PV_B - PV_C$	B = Benefits, C = Costs	Net Present Value

13	$PV = \frac{FV}{(1+i)^n}$	FV = Future Value i = discount rate n = number of years	Present Value (year-end indices)
13	$PV = \frac{FV}{(1+i)^{n-\frac{1}{2}}}$		Present Value (mid-year) indices)
13	$0 = \sum \frac{CF_t}{(1+r)^t}$	CF = cash flow	Internal Rate of Return (solve for r)
14	$PTA = TC + \frac{CP - TP}{GS_{over}}$	CP = Ceiling Price TP = Target Price GS = Government Share	Point of Total Assumption
14	$RIE_{low} = TC - \frac{MF - TF}{CS_{under}}$ $RIE_{high} = TC + \frac{TF - mF}{CS_{over}}$	MF = Maximum Fee mF = Minimum Fee CS = Contractor Share	Range of Incentive Effectiveness
14	$Margin = \frac{Fee}{1 + Fee}$		Return On Sales (ROS)
14	$Fee = \frac{Margin}{1 - Margin}$		Return On Cost (ROC)
15	$CV = BCWP - ACWP$	BCWP = Budgeted Cost of Work Performed ACWP = Actual Cost… BCWS = Budgeted Cost of Work Scheduled	Cost Variance
15	$SV = BCWP - BCWS$		Schedule Variance
15	$CPI = \frac{BCWP}{ACWP}$		Cost Performance Index
15	$SPI = \frac{BCWP}{BCWS}$		Schedule Performance Index