When working Exam questions, it is assumed that non-simple estimating situations do not occur in the problem, unless they are mentioned explicitly. Specifically, unless mentioned otherwise:

- There is no Adapted (reused) software (i.e., all software is new);
- Requirements Volatility (REVL) is zero;
- There is no automatic translation;
- The Inception and Transition phases are not part of the estimate (i.e., the model equations give the effort and schedule directly); and
- No risk reserves are needed.

When all Scale Factors are Nominal, you should use 1.1 as the value for the exponent E.

Use at least 3 significant digits in all calculations.
1. COCOMO II Estimate, 30 points (usually graded by Anandi)

1.1 (15 points) During the MedFRS Initial Operational Capability (IOC) development, several factors caused the scope of the Full Operational Capability (FOC) to increase. The smart stents for the monitoring of blood chemistry received FDA approval and were added to the FOC, and a number of system-of-systems integration improvements were necessary. Further, the demand for medical software engineers was growing steeply, causing high personnel turnover and replacements with less expertise. As a result, the size of the FOC software increased to 70 KSLOC, and the CPLX ratings went from High to Very High. And with the personnel turnover, the ACAP, PCAP, and PLEX ratings went from High to Nominal, although their average cost decreased from $8K to $7K/person-month. As a result, the FOC budget was increased to $4000K, and the schedule increased to 26 months.

Compute the COCOMO II cost and schedule estimates for the revised FOC project, assuming that the RELY rating is Very High and the DATA rating is High, and that all the other cost driver and scale factors remained Nominal (use 1.1 for the Size exponent). Do the results fit within the revised budget and schedule?

\[
EAF = \text{Values of } VH-\text{RELY} \times H-\text{DATA} \times VH-\text{CPLX} = 1.26 \times 1.14 \times 1.34 = 1.92
\]

[3 points for correct answer. Otherwise, 2 points if 2 values are right; otherwise 1 point if 1 value is right.]

\[
\text{Effort} = 2.94 \times 70^{1.1} \times 1.92 = 604 \text{ PM.}
\]

[3 points for correct answer. Otherwise, 2 points if answer is right based on student EAF. Otherwise, 1 point if form of equation is right.]

\[
\text{Cost} = 604 \times 7K = 4228K
\]

[2 points for correct answer. Otherwise, 1 point if answer is right based on student Effort.]

\[
F = 0.28 + 0.2 \times (1.1 - 0.91) = 0.318
\]

\[
\text{Schedule} = 3.67 \times 604^{0.318} = 28.1 \text{ months}
\]

[5 points for correct answer. Otherwise, 4 points if answer is right based on student Effort; otherwise, 2 points if form of equation is right, plus another 1 point if F is correct.]

Does not meet project budget or schedule.

[2 points, with 1 point for each answer (budget and schedule). 1 point if answer is correct; otherwise, 0.5 points if answer is based on student Cost or Schedule respectively.]
1.2 (15 points) In the course’s Risk Management lecture, one of the strategies for reducing the risk of personnel turnover was to offer the team members a significant bonus for working on the project through completion. Suppose that a 10% completion bonus would cause the experienced team members to stay on the project, increasing the ACAP, PCAP, and PLEX ratings from Nominal to High, although the average cost per person-month would increase to $8K; and an additional 10% of the project expenditures is distributed for the 10% bonus.

Compute the resulting budgets and schedules for the proposed revised strategy. Do the results fit within the revised budget and schedule?

\[
EAF = 1.92 \times H-ACAP \times H-PCAP \times H-PLEX = 1.92 \times 0.85 \times 0.88 \times 0.91 = 1.31
\]

[3 points for correct answer. Otherwise, 2 points if right based on student 1.1 EAF; otherwise 1 point if at least one value is right.]

\[
Effort = 2.94 \times 70^{1.1} \times 1.31 = 412 \text{ PM}.
\]

[3 points for correct answer. Otherwise, 2 points if answer is right based on student Effort; otherwise, 1 point if form of equation is right.]

\[
\text{Cost} = 412 \times 8 = 3296 \text{K}
\]

\[
\text{Completion bonus} = 10\% \times 3296 = 330 \text{K}.
\]

\[
\text{Total cost with bonus} = 3296 + 330 = 3626 \text{K}
\]

[3 points for correct answer. Otherwise, 2 points if answer is right based on student Cost; otherwise, 1 point if form of any equation is correct.]

\[
\text{Schedule} = 3.67 \times 412^{0.318} = 24.9 \text{ months}.
\]

[4 points for correct answer. Otherwise, 3 points if answer is right based on student Schedule; otherwise, 2 points if form of equation is right.]

Does meet project budget and 26-month schedule.

[2 points, with 1 point for each answer. 1 point if answer is correct; otherwise, 0.5 points if answer is based on student Cost or Schedule respectively.]
2. Present Value Analysis (40 points) (usually graded by Jim)

Another option for meeting the FOC budget and schedule is offered by a COTS vendor, who has provided a similar system for a regional confederation in Tennessee. They propose to satisfy the MedFRS FOC needs in 24 months, with an up-front payment of $3 million, and a $20K payment at the beginning of each of the 24 months.

Compute the total cost and the present-value cost of the COTS option and the option in question 1.2, assuming for simplicity that it has a 24 month duration, that salary payments are made at the beginning of each month, and that the bonus payments are paid at the end of the 24th month. Assume that the interest rate for discounting is 0.75% per month.

Which option is better from a total cost perspective? From a present-value perspective?

Discount rate \( D = 1 / 1.0075 = 0.993 \)

[2 points for correct answer. Otherwise, 1 point if form of equation is right.]

With-bonus (question 1.2) option:

[23 points total.]

Total Cost = $3626K (from question 1.2)

[1 point]

With-bonus salary per month, 24-month schedule = $3296K/24 = $137K

[2 points for right answer based on student 1.2 Cost.]

With-bonus salary \( PV = PV_s($137K, 0.993, 24) = $137K \times (1-0.993^{24}) / (1-0.993) = $137K \times 0.155 / 0.007 = $137K \times 22.1 = $3028K \)

[10 points for right answer based on student numbers above. Otherwise, 5 points if form of equation is right.]

\( PV (\text{bonus}) = $330K \times D^{24} = $330K \times 0.845 = $279K \)

[8 points for right answer based on student numbers above. Otherwise, 4 points if form of equation is right.]

Total PV = $3028K + $279K = $3307K

[2 points for right answer based on student numbers above. Otherwise, 1 point if form of equation is right.]

COTS option:

[11 points total.]
Total Cost = $3000K + 24 * $20K = $3480K
[3 points for correct answer. Otherwise, 2 points if form of equation is right.]

PV = $3000K + $20K * 22.1 = $3000K + $442K = $3442K
("22.1" is carried forward from PV calculation above.)
[8 points for right answer based on student numbers. Otherwise, 4 points if form of cash series equation is right; otherwise, 2 points if form of sum is right.]

Comparison:
[4 points total.]

COTS Option Total Cost lower: $3480K vs. $3626K
[2 points if answer is right based on student numbers.]

With-bonus PV lower: $3307K vs. $3442K
[2 points if answer is right based on student numbers.]
3. True-False Questions. 30 points; 3 points each. (usually graded by Anandi)
Put either “T” or “F” on the line preceding the statement. Grading will be based on this alone, not any additional statements or explanations provided.

1. __F___ According to Cayetano’s guest lecture, the five forces driving the new technological world order are social media, mobile, cloud, information, and risk. (Cayetano only gives the first four (slide 9).)

2. __T___ Len Cayetano persuaded his management to proceed on a cloud services IR&D project by citing the ICSM. (Cayetano slides 62, 68.)

3. __T___ One of the key steps in Win-Win negotiation is to define a glossary of key terms. (Kukreja slide 8.)

4. __T___ When addressing planning questions, such as "What should we work on next?", it’s important to plan around value. (Kukreja slide 24.)

5. __T___ Steven Hawking is an example of an estimation failure. (Reid slide 2.)

6. __F___ When making an estimate, it’s a good idea to provide a single number, so that the user focuses on a single date or amount. (Reid slide 6.)

7. __T___ According to Reid, types of risks that can be known before a project starts are people/resource risks, requirements risks, technology risks, project and technical management risks, process risks, and product & other risks. (Reid slide 9.)

8. __F___ It is a good practice to always build the software twice. (Chapter 20 p 299)

9. __T___ If the evidence does not accompany the specifications and plans, the specifications and plans are incomplete. (ICSM Chapter 13 p 214)

10. __T___ Opportunity Exposure = Probability (Gain) * Size (Gain) (ICSM Chapter 15 p 235)