Homework #6 Answer Key
Part 1 (20 Points)

1. (5 points)

Changes:

• Switch for Uncertain Customer Requirements = 0
• Normal Quality = 0.8
• Willingness to Hire = 0
2. (5 Points)

Best estimate has project finishing at month 50 and costing 201 person-months.
3. **(10 Points)** A 15 percentage point increase in errors ...

- Feedback effects amplify the 0.95 to 0.80 reduction in normal quality to create the four-fold increase in additional work (see following charts).

- And because of the additional work without additional staff, the project takes longer.
Lower quality increases the total amount of work done by ~ 100%
While normal quality is 0.8 (vs. 0.95 in bosses hope), actual quality is far lower because of feedback effects ...

Graph for Quality

Quality : Capstone No Hire
Quality : Capstone Bosses Hope

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System Dynamics Capstone Question
Trying to meet an unrealistic plan creates significant schedule pressure ...

Graph for Anticipated Schedule Overrun

Anticipated Schedule Overrun: Capstone No Hire
Anticipated Schedule Overrun: Capstone Bosses Hope
Anticipated Schedule Overrun: Capstone Worst Case

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... which causes quality to fall ...
increasing rework and making the project perform worse
“Quality on quality” is the key driver -- undiscovered errors causes errors in downstream work

Graph for Effect of Prior Work Quality on Quality

Effect of Prior Work Quality on Quality: Capstone No Hire
Effect of Prior Work Quality on Quality: Capstone Bosses Hope

Dimensionless

Time (Month)

0 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 60
While schedule pressure also increases productivity, the net effect is more total work as shown in the first graph.

Graph for Productivity

Productivity: Capstone No Hire
Productivity: Capstone Bosses Hope

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Part 2 (40 Points)
## 1. (15 Points) Hiring/Schedule Slip Analyses

<table>
<thead>
<tr>
<th>Test</th>
<th>Finish</th>
<th>Dir. Cost</th>
<th>Total Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Hire</td>
<td>50.43</td>
<td>201.2</td>
<td>405.6</td>
</tr>
<tr>
<td>S0H100</td>
<td>40.68</td>
<td>271</td>
<td>377.9</td>
</tr>
<tr>
<td>S25H75</td>
<td>41.93</td>
<td>248</td>
<td>367.4</td>
</tr>
<tr>
<td>S50H50</td>
<td>44.0</td>
<td>218</td>
<td>358</td>
</tr>
<tr>
<td>S75H25</td>
<td>45.25</td>
<td>196.4</td>
<td>348.9</td>
</tr>
<tr>
<td>S100H0</td>
<td>46.5</td>
<td>184.2</td>
<td>349.2</td>
</tr>
</tbody>
</table>
2. (5 Points)

Graph for Staff Level

Staff Level: Capstone No Hire
Staff Level: Capstone S0H100
Staff Level: Capstone S25H75
Staff Level: Capstone S50H50
Staff Level: Capstone S75H25
Staff Level: Capstone S100H0

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3. (15 Points) Tradeoffs

- Direct cost falls as hiring is constrained and the schedule slipped, because (see graphs below) experience dilution is reduced and schedule pressure effects on quality reduced.

- Imputed cost increases with delay on the project. Given the numbers, schedule slip improves performance.
Quality improves

Graph for Quality

Time (Month)

Quality : Capstone No Hire
Quality : Capstone S0H100
Quality : Capstone S25H75
Quality : Capstone S50H50
Quality : Capstone S75H25
Quality : Capstone S100H0

Fraction
Fraction
Fraction
Fraction
Fraction
Fraction

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... because experience dilution is reduced

Graph for Effect of Experience on Quality

Effect of Experience on Quality:
- Capstone No Hire
- Capstone S0H100
- Capstone S25H75
- Capstone S50H50
- Capstone S75H25
- Capstone S100H0

Dimensionless

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Graph for Effect of Schedule Pressure on Quality

Effect of Schedule Pressure on Quality: Capstone No Hire
Effect of Schedule Pressure on Quality: Capstone S0H100
Effect of Schedule Pressure on Quality: Capstone S25H75
Effect of Schedule Pressure on Quality: Capstone S50H50
Effect of Schedule Pressure on Quality: Capstone S75H25
Effect of Schedule Pressure on Quality: Capstone S100H0

Time (Month)
So total work done is reduced …

Graph for Cumulative Work Done

Cumulative Work Done: Capstone No Hire Tasks
Cumulative Work Done: Capstone S0H100 Tasks
Cumulative Work Done: Capstone S25H75 Tasks
Cumulative Work Done: Capstone S50H50 Tasks
Cumulative Work Done: Capstone S75H25 Tasks
Cumulative Work Done: Capstone S100H0 Tasks

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4. (5 Points)

• Best is WTS = .75, WTH = .25, as it provides the lowest total cost.

• To be thorough, they might want to test this with a quality of .7 and also .95. This was not specifically requested, so perhaps we should give extra credit if they did some sensitivity tests.
Part 3 (40 points)

1. (5 Points) For Changes and some explanation --

Normal pdy = .9
Max rwdd = 6 mos
2. (10 Points) for what happened & why

The performance of the project improves --

• completion date is 43.5 (vs. 45.25)
• direct expenditures fall to 180.11 (vs. 196.4)
• total cost improves to 313.11 (vs. 348.9)

Why -- as shown in graphs following, a shorter rework discovery time reduces the amount of undiscovered rework and thereby decreases the quality on quality effect; quality improves, and less total work is done. Doing less work offsets the productivity hit.
3. **Sensitivity (15 Points)**

The benefit of the proposed review process decreases as the rework discovery reduction decreases. If the rework discovery time is only cut to 8 months from 12 months (rather than to 6 months), the review process produces no net benefit -- the quality improvement and work reduction is offset by the lower productivity.

The “breakeven” point for rework discovery delay increases to 9-10 months if normal quality (technical risk) falls to 0.7.
Sensitivity

The advisability of adopting the review process would depend on your confidence in getting at least a reduction to 8 months, or less if technical uncertainty might be higher.
# Sensitivity Analyses

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<td>45.25</td>
<td>196.4</td>
<td>348.9</td>
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<td>RWDD = 6</td>
<td>43.5</td>
<td>180.1</td>
<td>315.1</td>
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<tr>
<td>RWDD = 7</td>
<td>44.6</td>
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<td>315.1</td>
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<td>RWDD = 8</td>
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<tr>
<td>RWDD = 9</td>
<td>46.6</td>
<td>198.2</td>
<td>364.5</td>
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</table>
## Sensitivity Analyses (Worst Case NQ=.7) [not asked Fall 2003]

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<th>Test</th>
<th>Finish</th>
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<th>Total Cost</th>
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<tr>
<td>Worst Case</td>
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<tr>
<td>S75H25</td>
<td>60.6</td>
<td>285.3</td>
<td>591.6</td>
</tr>
<tr>
<td>RWDD = 6</td>
<td>54.7</td>
<td>234.5</td>
<td>481.4</td>
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<tr>
<td>RWDD = 9</td>
<td>60.4</td>
<td>269.8</td>
<td>573.6</td>
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<tr>
<td>RWDD = 10</td>
<td>62.4</td>
<td>281.8</td>
<td>602.4</td>
</tr>
</tbody>
</table>
4. Delay Progress? (10 Points)

As shown in the following graphs, the review process delays perceived progress, but not real progress --

• perceived progress is lower because more total work is getting done without the review, because of the higher productivity

• However, because this work contains more errors which will need to be reworked, real progress is actually lower.
Graph for Fraction Perceived to be Complete

Fraction Perceived to be Complete : Capstone S75H25 Review
Fraction Perceived to be Complete : Capstone S75H25
Graph for Fraction Really Complete

Fraction Really Complete: Capstone S75H25 Review
Fraction Really Complete: Capstone S75H25

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