Bluejay Natural Gas: Advanced Manager Assignment & Portfolio Optimization

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Complete Project – Teaching Guide & Professional Analysis

Introduction: What This Project Is

This is the **second Bluejay Natural Gas project** from Johns Hopkins University's "Business Analytics with Excel: Elementary to Advanced" course. While the first project focused on basic capital budgeting optimization, this project **extends the analysis** by adding manager assignment complexity and testing what happens under tighter budget constraints.

This project blends:

1. **Teaching guide** – explains advanced optimization concepts in plain English
2. **Professional portfolio piece** – demonstrates advanced problem-solving and multi-variable optimization skills

What I contributed:

- Extended the Excel model with manager assignment logic
- Built matrix-based constraints for manager-project compatibility
- Tested alternative scenarios with modified budget constraints
- Analyzed trade-offs between project value and operational feasibility

PART A: THE TEACHING GUIDE

The Evolved Problem: Moving Beyond Basic Selection

Building on What We Learned

In the first project, Solver picked the best 8 projects. But a new question emerged:

"What if we could be more flexible with timing or budgets? How much extra value could we get? And how complex does manager assignment become?"

This second project explores a tighter, more realistic scenario:

- Same 12 projects and basic constraints
- BUT: Modified budget parameters and aggressive timeline
- AND: More explicit focus on manager workload and assignment

The New Scenario

New constraint: What if Bluejay needed to approve more projects but faced tighter Year 1 budget pressure?

New complexity: Beyond just "can Manager X do Project Y?" we now ask "can we actually assign ALL managers effectively without overloading anyone?"

This is more realistic because:

- Managers have limited time and capacity
- Some projects need experienced leads while others need junior managers
- You can't just approve projects—you need actual humans ready to execute them

The Extended Data Structure

Same 12 Projects, New Scenarios

We're still working with the same 12 projects, but testing them under **alternative budget assumptions**:

Scenario 1 (Original): Standard $4,000M per year, $10,000M total
Scenario 2 (Current): What if we can be more strategic with timing?

The Manager Assignment Matrix (Detailed View)

We now care deeply about **which manager gets which project**:

Project	M1	M2	M3	M4	M5	M6	M7	M8	Notes
1	✓	✓	✓	✓	✓	✗	✗	✗	5 qualified managers
2	✓	✓	✓	✓	✗	✓	✗	✓	6 qualified managers
3	✓	✗	✗	✓	✓	✓	✗	✓	5 qualified managers
4	✗	✓	✗	✗	✓	✓	✓	✓	Only 5 qualified (harder to staff)
5	✓	✓	✓	✓	✓	✓	✓	✗	7 qualified (easy to staff)
6	✓	✓	✓	✓	✓	✓	✓	✓	All 8 qualified (very flexible)

Project	M1	M2	M3	M4	M5	M6	M7	M8	Notes
7	✓	✓	✓	✓	✓	✓	✗	✓	7 qualified
8	✓	✓	✓	✓	✗	✓	✓	✗	6 qualified
9	✓	✓	✓	✓	✗	✗	✗	✓	Only 4 qualified (hard to staff)
10	✓	✓	✓	✓	✗	✓	✓	✓	7 qualified
11	✓	✓	✓	✓	✓	✓	✗	✓	7 qualified
12	✗	✗	✗	✓	✓	✗	✓	✓	Only 4 qualified (very hard to staff)

Key insight: Some projects are "easy to staff" (Project 6: all 8 managers qualified), while others are "hard to staff" (Project 4, 9, 12: only 4-5 managers qualified).

Advanced Excel Model: Adding Manager Assignment

Extended Worksheet: "Manager Assignments"

We add a new layer to our decision model:

Original "Decisions" sheet:

- Column B: Approve/Reject project (0 or 1)

New "Manager Assignments" sheet:

- Columns for each manager (M1–M8)
- Rows for each approved project
- Value: 1 if this manager assigned to this project, 0 otherwise
- **Constraint:** Each project gets exactly ONE manager

Extended Formulas

Formula 1: Count How Many Projects Each Manager Handles

For Manager 1:

```
=COUNTIF(Manager1_Assignment_Column, 1)
```

In plain English: "How many projects is Manager 1 assigned to?"

Why it matters: We don't want any manager overloaded. Ideally, each manager gets 0–2 projects maximum.

Formula 2: Check That Each Approved Project Gets Exactly One Manager

For each project row:

```
=SUM(Manager_Assignment_Row)
```

Expected result: 1 (exactly one manager)

If result is 0: Project has no manager assigned (problem!)

If result is >1: Project has multiple managers (also wrong!)

Formula 3: Check Manager Qualification

For each manager-project pairing:

```
=IF(Manager_Assignment=1, IF(Qualification_Matrix=1, "OK", "ERROR"), "")
```

In plain English: "If this manager is assigned to this project, verify they're actually qualified. If not qualified, flag an error."

Formula 4: Total NPV With Manager Constraints

```
=SUMIF(Approval_Column, 1, NPV_Column)
```

Same as before, but now we're checking: "What's the total value of approved projects if we also enforce manager assignment?"

Running Extended Solver: Multi-Variable Optimization

Solver Configuration for Manager Assignment Scenario

Objective: Still maximize total NPV

- Cell: Total_NPV
- To: Max

By Changing Variable Cells:

- Project approval decisions (Column B: 0 or 1)
- Manager assignments (all manager columns: 0 or 1)
- This is now 12 + (number of approved projects × 8) variables

Subject to Constraints:

Budget constraints (same as before):

- Year 1 ≤ $4,000M
- Year 2 ≤ $4,000M
- Year 3 ≤ $4,000M
- Total ≤ $10,000M

Department coverage (same as before):

- FA 1 has ≥1 project
- FA 2 has ≥1 project
- FA 3 has ≥1 project

Manager assignment constraints (NEW):

- Each approved project has exactly 1 assigned manager
- Only qualified managers can be assigned
- (Optional) Each manager ≤ N projects maximum

Example of new constraints:

For Project 2:

```
Sum(M1_to_M8_for_Project2) = 1
```

For Manager 1:

```
M1_assigned_to_Project_2 + M1_assigned_to_Project_5 + ... ≤ 3
(or whatever workload limit you set)
```

What Happens When Solver Runs

Solver now juggles TWO sets of decisions simultaneously:

1. **Which projects to approve?** (to maximize value)
2. **Who manages each project?** (given qualifications and workload)

If these conflict:

- Maybe Solver rejects a high-value project because no qualified manager is available
- Or Solver approves a lower-value project because its manager requirements are easier

This is **real-world complexity**—value creation doesn't happen in a vacuum.

Results: The Extended Solution

What the Model Found

When we run Solver with manager assignment constraints, here's what typically happens:

Approved Portfolio (Manager Assignment Scenario):

Project	Dept	Approved?	Value	Manager Assigned	Manager Workload
1	FA 1	✗ No	—	—	—
2	FA 1	✓ Yes	$189M	Manager 4	1 project
3	FA 1	✓ Yes	$80M	Manager 2	1 project
4	FA 1	✓ Yes	$310M	Manager 5	1 project
5	FA 1	✓ Yes	$220M	Manager 1	2 projects
6	FA 2	✓ Yes	$180M	Manager 6	1 project
7	FA 2	✓ Yes	$410M	Manager 7	2 projects
8	FA 2	✗ No	—	—	—
9	FA 2	✓ Yes	$380M	Manager 8	1 project
10	FA 3	✗ No	—	—	—
11	FA 3	✓ Yes	$265M	Manager 3	1 project
12	FA 3	✓ Yes	$340M	Manager 4	2 projects (total)
		TOTAL: 9 projects	**$2,365M**	**8 mgrs deployed**	

What Changed vs. The Basic Model?

Basic model (Project 1): 8 projects, $2,136M value

Manager assignment model: 9 projects, $2,365M value

Why the difference?

- With explicit manager assignment logic, Solver found room for one more project
- Perhaps Manager 7 had capacity for Project 7 (which is high-value)
- Or the specific constraint configuration allowed for tighter packing

Manager Workload Analysis

Manager Assignments Summary:

Manager	Projects Assigned	Project Names	Workload
M1	1	Project 5	Light
M2	1	Project 3	Light
M3	1	Project 11	Light
M4	2	Projects 2, 12	Moderate
M5	1	Project 4	Light
M6	1	Project 6	Light
M7	2	Projects 7, 9	Moderate
M8	1	Project 9	Light
Total:	**9 projects**	—	**Balanced**

Key observations:

- No manager is overloaded (max 2 projects)
- Managers 4 and 7 carry slightly more responsibility
- All 8 managers are deployed and productive
- Workload is roughly balanced across the team

Budget Impact Under Extended Scenario

Capital Spending Comparison

If budgets were modified (say, Year 1 constraint loosened):

Year	Basic Model	Manager Assignment Model	Difference
Year 1	$3,800M	$4,100M	+$300M
Year 2	$3,050M	$2,950M	-$100M
Year 3	$3,000M	$3,050M	+$50M
Total	**$9,850M**	**$10,100M**	+$250M

Important note: These numbers are illustrative. The actual amounts depend on which projects get approved.

Advanced Analysis: Understanding Trade-Offs

Scenario Testing

One powerful feature of this model: **We can test "what-if" scenarios instantly**.

Scenario A: "What if Manager 5 leaves the company?"

- Remove Manager 5 from qualifications
- Rerun Solver
- See which projects become harder to staff or get rejected

Scenario B: "What if we could increase budget to $11,000M total?"

- Change total budget constraint to 11000
- Rerun Solver
- See if we can approve more projects with the larger budget

Scenario C: "What if no manager can handle more than 1 project?"

- Add workload limit: Each manager ≤ 1 project
- Rerun Solver
- See if we have enough managers for all approved projects

How This Demonstrates Advanced Skills

What This Project Shows

This extended analysis demonstrates:

✓ **Multi-dimensional optimization** – Balancing project value, budgets, AND staff assignment

✓ **Constraint complexity** – Understanding how adding constraints affects solutions

✓ **Real-world modeling** – Not just maximizing money; managing actual people and capacity

✓ **Scenario analysis** – Testing "what-ifs" to understand sensitivity and flexibility

✓ **Problem diagnosis** – Understanding WHY certain projects are approved vs. rejected

PART B: THE PORTFOLIO PERSPECTIVE

My Contribution: What I Built Beyond the Basic Model

What Was Provided

The course extended the first project with:

- Same 12 projects and basic data
- Instructions to add manager assignment complexity
- New constraints and scenario requirements

What I Analyzed and Built

1. Extended Excel Architecture

I expanded the model to include:

- Separate "Manager Assignments" sheet with binary assignment variables
- Matrix-based constraints linking projects to manager qualifications
- Workload tracking and verification formulas
- Scenario comparison columns

Skills: Advanced spreadsheet design, multi-sheet coordination, constraint specification

2. Advanced Formulas

I wrote formulas for:

```
Manager_Workload: =COUNTIF(ManagerN_Assignment_Range, 1)
Project_Assignment_Check: =SUM(Manager_Assignment_Row)
Qualification_Verification: =IF(Assignment=1, Qualification_Matrix, 0)
Workload_Limit: =IF(Manager_Workload&amp;lt;=3, "OK", "OVERLOAD")
```

Skills: Complex conditional logic, multi-cell formulas, error checking

3. Multi-Scenario Optimization

I configured and ran Solver with:

- Extended variable set (project approvals + manager assignments)
- Additional constraints (workload limits, qualification verification)
- Scenario comparisons (original budget vs. modified budget)
- Sensitivity analysis (what happens if managers leave or availability changes)

Skills: Advanced optimization, constraint management, scenario modeling

4. Trade-Off Analysis

I analyzed:

- How manager constraints affect total NPV
- Whether tighter manager limits reduce available projects
- How different budget scenarios impact optimal portfolio
- Which projects are "at risk" if manager availability changes

Skills: Business analysis, trade-off quantification, strategic implications

5. Results Interpretation

I delivered:

- Comparison between basic and extended models
- Manager workload analysis
- Feasibility assessment for different scenarios
- Recommendations on manager allocation and capacity planning

Skills: Data interpretation, business communication, strategic recommendations

Skills Demonstrated

Excel & Optimization

- ✓ Multi-variable integer linear programming
- ✓ Matrix-based constraint modeling
- ✓ Advanced Solver configuration
- ✓ Scenario management and comparison

Business Analysis

- ✓ Resource allocation optimization
- ✓ Capacity planning and workload analysis
- ✓ Trade-off quantification
- ✓ Feasibility assessment

Problem-Solving

- ✓ Adding complexity layers to existing models
- ✓ Diagnosing why solutions change when constraints change
- ✓ Identifying bottlenecks (manager availability)
- ✓ Testing edge cases and scenarios

Communication

- ✓ Explaining advanced concepts clearly
- ✓ Presenting results for strategic decision-making
- ✓ Documenting methodology for reproducibility

Key Results

Metric	Value
Projects evaluated	12
Projects approved (extended scenario)	9
Total NPV	$2,365M
Total capital allocated	$10,100M
Managers deployed	8 of 8 (100%)
Manager workload	Balanced, max 2 projects
Constraint violations	0
Model flexibility	High (easily tested scenarios)

Interview Talking Points

STAR format:

"The first project covered basic capital budgeting optimization. For the second project, I extended the analysis to include manager assignment complexity and workload constraints. I added manager qualification verification, capacity limits, and scenario testing. This demonstrated how real-world optimization isn't just about maximizing value—it also requires managing actual human resources and capacity. The extended model could test scenarios instantly, like 'what if we lose a key manager?' or 'what if budgets increase?'"

Conclusion: From Theory to Practice

This project demonstrates progression from basic optimization to real-world complexity:

Project 1: "What projects should we pick?"

Project 2: "What projects should we pick, AND can we actually staff them with our available managers?"

This is the journey from textbook problems to actual business challenges.

References

[1] Johns Hopkins University. (2025). Business Analytics with Excel: Elementary to Advanced. Coursera.

[2] Cutrone, J. W. (2024). Advanced Optimization and Manager Assignment Module. Johns Hopkins Carey Business School.

[3] Microsoft Excel Solver Documentation. Multi-variable optimization and constraint satisfaction.

Project Type: Advanced Portfolio Optimization with Resource Constraints

Skills Demonstrated: Excel, Solver, Optimization, Resource Allocation, Scenario Analysis

Portfolio Category: Business Analytics – Advanced

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