## **Case Study**

### Introduction

Building T is the corporate headquarters of the XYZ Corporation. The water used in Building T comes from two sources. The first source is through The Water Co., where like other businesses in the area, the XYZ Corporations has a contract in place with The Water Co. to provide water to their Building T at a contracted price per gallon.

The second source is through XYZ’s own Water Storage Tank. Precipitation is collected, treated, stored, and used to supply water to Building T, and there is a per-gallon cost associated with this process.

XYZ Corporation has hired your team of consultants to provide solutions to water allocation at Building T.

### Objective 1 - Forecasting

The **rawdata\_BldgT** data set contains over a year and a half of historical weekly gallon usage data from Building T.

The gallons used in Building T each week are broken down into two categories: Cooling and Main. The Cooling category represents the gallons used to regulate the temperature in the building. The Main category represents the gallons used by the employees. Together, Cooling and Main make up the total amount of gallons used per week in Building T. There is no difference in the quality of water between the two categories.

The date range begins on the week of March 29, 2020 and runs through the end of the week beginning January 02, 2022. There is no partial or missing data for the weeks.

XYZ Corporation needs ***total*** weekly water demand forecasts for the next four weeks. These forecasts will be used as parameters in an optimization model.

For Objective 1, provide answers to the following question:

1. How many total gallons of water is Building T expected to use in each of the next four weeks?

### Objective 2 - Optimization

Contracts between the XYZ Corporation and The Water Co. are renewed every four weeks. The current four weeks has concluded, and XYZ Corporation has received two contract proposals from The Water Co. to supply water for the next four weeks.

The *first contract* from The Water Co. will supply water at 15 cents ($0.15) per gallon with a minimum of 25,000 gallons purchased per week.

The *second contract* will supply water at 12 cents ($0.12) per gallon with a minimum of 35,000 gallons purchased per week.

Both contracts do not have a capped amount, meaning XYZ Corporation can purchase as many gallons as needed from The Water Co. at or above the minimum gallon threshold at the contracted price.

Currently there are 62,500 gallons in the Water Storage Tank. The President of XYZ Corporation insists that the Water Storage Tank must not drop below 30,000 gallons during any week over the next four weeks.

For the next two weeks, the treatment cost from Water Storage is 18 cents ($0.18) per gallon. Due to expected gains in water treatment efficiency, the treatment cost will drop to 10 cents ($0.10) per gallon in weeks three and four.

The amount of gallons in the Water Storage Tank depends on the amount of gallons remaining from the prior week, plus the difference between how many gallons of precipitation accumulated in the current week and how many gallons are used to supply Building T from the Water Storage Tank in the current week. The amount of expected precipitation in that region over the next four weeks has already been estimated. Based on expected precipitation and accumulation methods used by XYZ Corporation, they expect to add 12,000 gallons to the Water Storage Tank in the first week, 18,000 gallons in the second week, 20,000 gallons in the third week, and 22,000 gallons in the fourth week. There is no cap on the amount of water that can be stored at any one time.

XYZ Corporation is also a proud member of the *Elite Environmental Corporate Sustainer Initiative*. The primary environmental sustainability project that granted XYZ Corporation membership into EECSI is their investment in renewable water usage (via the Water Storage Tank). One of the requirements for XYZ to remain a member of EECSI is that at least 25% of all water supplied to Building T each week must come from the Water Storage Tank.

Using your team’s total water demand forecasts from Objective 1, along with the information above, construct an optimization model that minimizes total water cost over the next four weeks by finding the optimal combination of gallons to purchase from The Water Co. and to use from the Water Storage Tank. The sum of these two values must be greater than or equal to forecasted water demand for each week.

Total water cost over the next four weeks equals the sum of (Price\*Quantity bought from The Water Co.) + (Treatment Cost\*Quantity used from the Water Storage Tank) for each week.

For Objective 2, provide answers to the following questions:

1. Which of the two proposed contracts provides XYZ Corporation with the lowest total water cost over the next four weeks?
   1. 15 cents ($0.15) per gallon with a minimum of 25,000 gallons purchased per week
   2. 12 cents ($0.12) per gallon with a minimum of 35,000 gallons purchased per week

Having chosen the contract recommended by your team:

1. How many gallons will XYZ buy from The Water Co. each week?
2. How many gallons will XYZ use from their Water Storage Tank each week?
3. What is XYZ’s projected total water cost at the end of the next four weeks?
4. What is XYZ’s projected ending Water Storage Tank inventory at the end of each week?
5. How much money will XYZ save by choosing the recommended contract over the alternative contract?
6. How many more/less gallons will be in the Water Storage Tank at the end of the four-week period compared to if the alternative contract was chosen?