RAILROAD MODEL COMPETITION

MIDDLE SCHOOL COST ESTIMATION GUIDE

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RAILROAD MODEL COMPETITION

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FRESNO STATE TRANSPORTATION INSTITUTE

Created in 2017 to advance transportation sciences in Fresno County, the Institute results from a unique collaboration between the California State University, City of Fresno and the Fresno Council of Governments and funded through Fresno County's Measure C New Technology Reserve Fund.

In accordance with the Regional Transportation Plan and Sustainable Community Strategy, the Institute has the mission of instigating and developing transportation projects in the following areas:

Education: through courses, training, workshops, and conferences, the Institute seeks to develop and offer advanced education programs to create a skilled workforce that can potentially advance the city and regional transportation planning and other transportation-related fields.

Outreach: to better educate about the importance of local transportation solutions and increase the acceptance for advanced transportation projects in the Fresno County, the Institute organizes games, competitions and other events aimed at K-12 students and the general public.

Research: through the collaboration with graduate and undergraduate programs at Fresno State and other academic partners across the Central Valley, the Institute incentivize research projects that seek solutions to the unique transportation challenges faced by Fresno County and its neighbors, such as reduced mobility, poor air quality, traffic congestion, and high energy demand.

Technical Service: to facilitate the pursuit of transportation-related projects by local agencies and firms, the Institute provides resources and technical expertise to help its partner organizations prepare and submit proposals for obtaining project grants and other funding.

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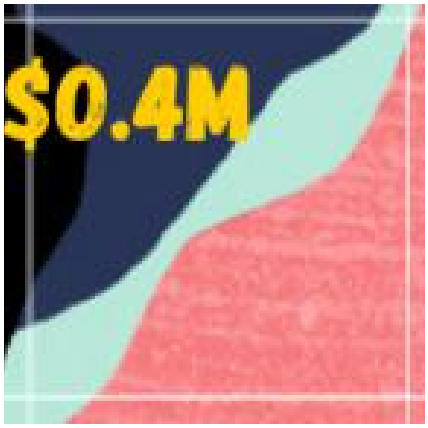
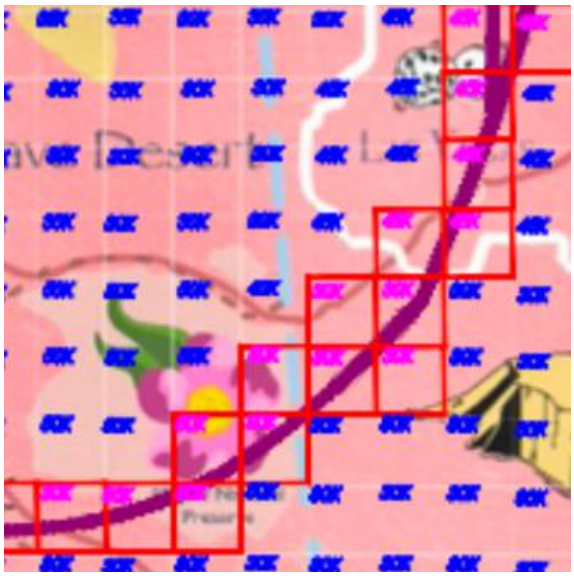
Land Costs

Once you finish making the railroad track, we will add up the costs of each square of land used. For example, each square will have a price in the top left corner, as shown below.



Remember, even if a little bit of the railroad touches the square, we will still consider it.



Construction Costs

After figuring out our land cost, we will move on to the construction cost, depending on the terrain. To find out how long we are making the tracks, we will use a piece of string to measure the length of each part. This will consist of different terrains:

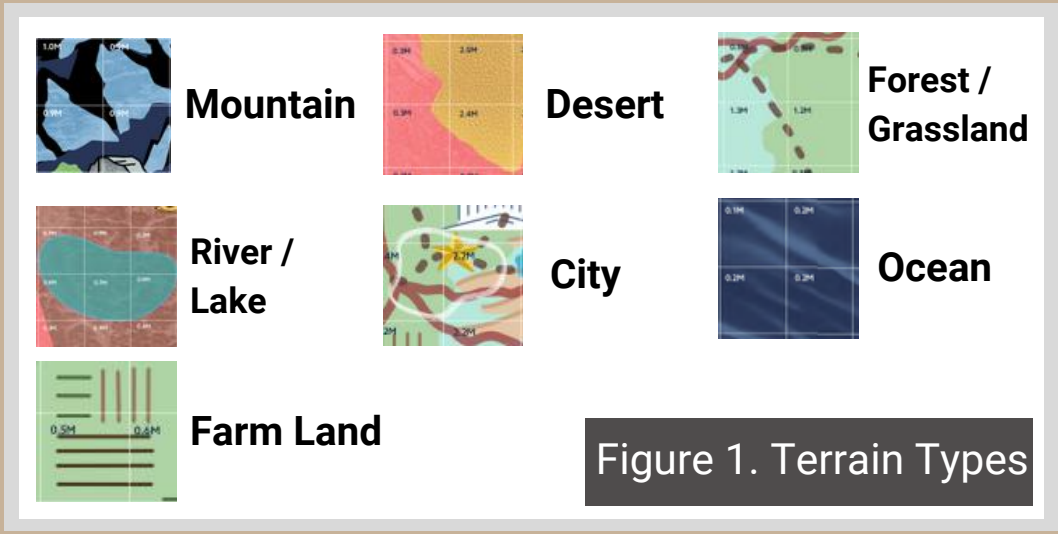


Figure 1. Terrain Types

From these categories, we can implement the costs for each part.

	FOREST	CITY	FARM LAND	DESERT	MOUNTAIN	RIVER	OCEAN
CONSTRUCTION	$8.0 M	$7.0 M	$4.0 M	$3.0 M	$12.0 M	$10.0 M	$24.0 M

Table 1: Construction Cost

Keep in mind that these costs are per mile **(1" on the map equals 7 miles in reality)**.

Construction Cost Example

Figure 2: Terrain Sections

Suppose we measured 11.6" of forest for the first section in **Figure 2**. After, look at **Table 1** and locate where the forest and construction column is. Based on the table, we can see that the cost per mile of forest construction is $8.0 Million. **Remember that 1" is equivalent to 7 miles**, so we would have first to take our measure value of 11.6" and **multiply** it by 7. This will give us 81.2 miles for that section. We will **multiply** 81.2 miles by $8.0 Million to get our construction cost. This is about $649.6 Million for the first section.

(Inches of the Section x 7 miles) x Construction Cost = Construction Cost of the Section

After each section has been calculated, we will take the sum of all section costs to get our total construction cost.

Maintenance Costs

Maintenance costs include **inspection**, **reparation**, and **maintenance** of railway tracks to keep the trains running smoothly and safely. Table 2 shows overall maintenance costs in an area. **Table 3**, located directly below **Table 2**, shows the curvature factor. We will now calculate maintenance and add curve factors into the mix.

	FOREST	CITY	FARM LAND	DESERT	MOUNTAIN	RIVER	OCEAN
MAINTENANCE	$5,500	$5,600	$5,700	$5,800	$6,000	$5,900	$20,000

Table 2: Maintenance Cost

SEGMENT	FACTOR
Curvilinear Segment	**CF = 2**
Great Radius/ Straight segment (Above 40")	**CF = 1**

Table 3: Curve Factor

Maintenance Cost Example

Consider the **curvature factor** for this problem.

Suppose the radius of the curvilinear segment in a forest is 17". Based on **Table 3** on the previous page, my curve factor would be 2. The actual curve length for the part is again 11.6", so we would have to calculate with the addition of the curve factor.

Again remember that every inch equals 7 miles. Therefore, we would do 11.6 **x** 7 to get 81.2 miles for that part. Then, we **multiply** our total miles by our curve factor and maintenance cost in **Table 2**.

This would look like this:

Cost **=** $5,500 **x** 2(CF) **x** 81.2(miles)

= $893,200

Or, in other words:

MAINTENANCE COST = **MAINTENANCE (AREA UNIT)** x **CURVE FACTOR** x **CURVE LENGTH**

Operation Costs

To calculate the operation cost, you need to create a train timetable. This table will contain all the departures and arrivals times in a 4 min timeframe, with an obligatory waiting time of 15 seconds in each train station for appropriate loading and unloading of passengers and cargo.

You will then be tasked to do a Time Schedule Table as shown below:

Time Schedule Table					
Departure City	Arrival City	Departure	Arrival	Waiting Time	Revenue/Profit
Las Vegas	Los Angeles	0:00:00	0:00:11	0:00:15	128000
Los Angeles	Fresno	0:00:26	0:00:35	0:00:15	120000

Table 4: Time Schedule Table

We will take two new factors for going through these areas: **VMT(Vehicle-Mile-Traveled) price per mile**. It will cost:

$500 per mile

Operation Cost Example

Suppose that our total track length is 61 inches from Fresno to Sacramento.

To get our Track Miles, we must multiply 61" by seven since every inch equals 7 miles. We should get our total to be 427 miles.

After getting our total miles for the part, we will multiply 427 miles by $500 since that is our VMT price. This means that our total will amount to $213,500.

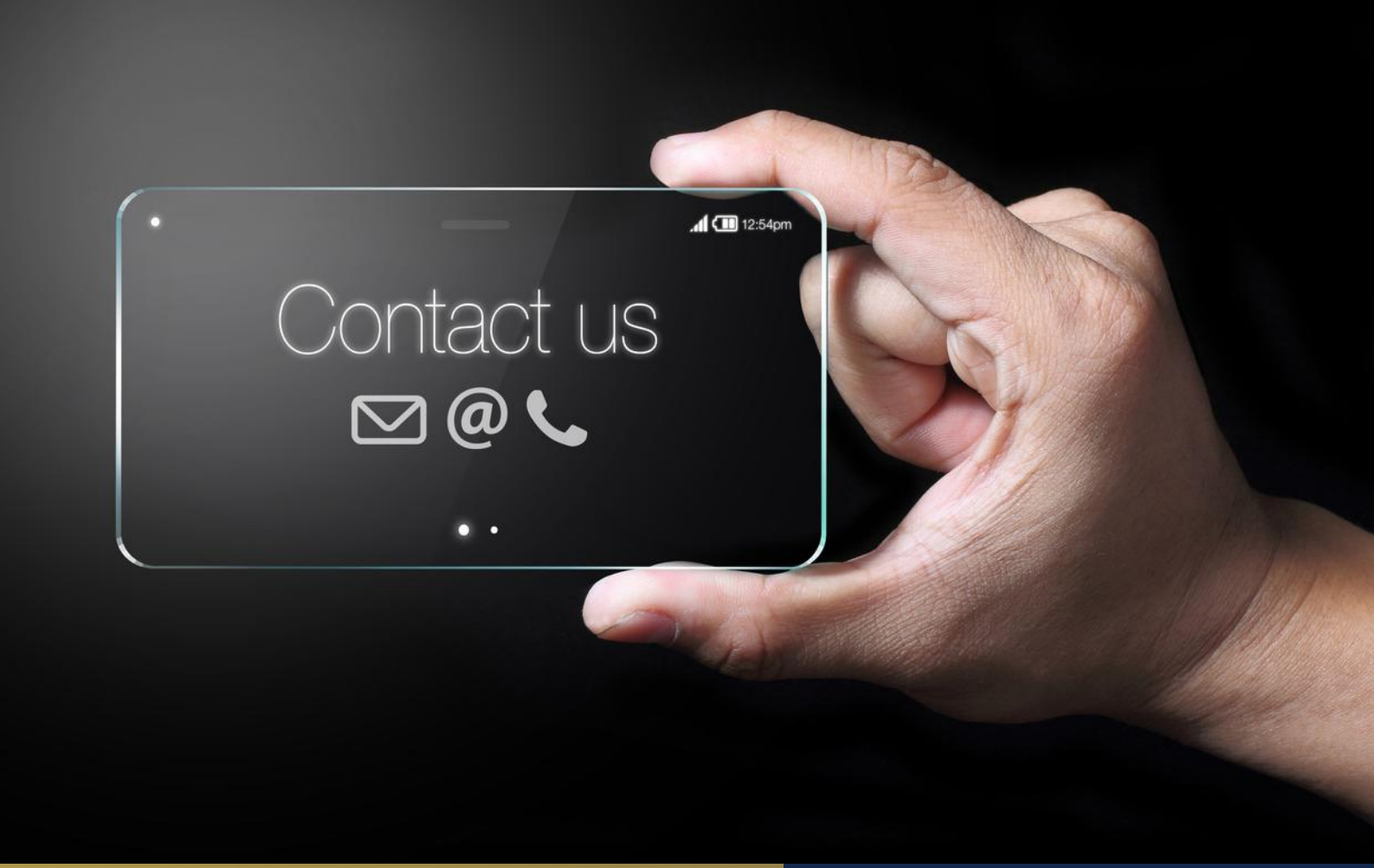
Continue to next page ---->

Revenue

Table 5 will give you the revenue for each trip based on the locations our train travels. For example, if our train goes from Fresno to Sacramento without any stops in between, we will earn $104K. Depending on the cities we have chosen to stop at, we will sum up all the track revenue costs between each proposed station to determine the total revenue.

	FRESNO	LAS VEGAS	LOS ANGELES	SACRAMENTO	SAN FRANCISCO
FRESNO		$136K	$120K	$104K	$112K
LAS VEGAS	$136K		$128K	$184K	$200K
LOS ANGELES	$120K	$128K		$165K	$144K
SACRAMENTO	$104K	$184K	$165K		$92K
SAN FRANCISCO	$112K	$200K	$144K	$92K	

Table 5: Revenue Matrix



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