

Estimate and Solve for Markup and Material Cost

Choose level of accuracy appropriate to limitations on measurement when reporting quantities

Program Task: Estimate job cost of a dining room custom built-in bookshelf to the nearest dollar

PA Core Standard: CC.2.1.HS.F.5

Program Associated Vocabulary

MATERIAL COSTS, LABOR COSTS, MARKUP, PERCENTAGE

Math Associated Vocabulary

ROUNDING, PLACE VALUE, MENTAL MATH, AVERAGE

Program Formulas and Procedures

A cabinetmaker is going to build a custom library for a customer. He/she estimates the materials below and goes to his supplier to obtain material prices to complete the project. The cabinetmaker also marks up the supplies 80% to bill customer, and charges \$40/hour for his 80 ½ hours of labor.

Description: Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

Estimate the cost of the supplies to the nearest whole dollar.

- 20 board feet of wood for shelves - \$10 each
- 1 ½ sheets of plywood for backer (\$60 per sheet)
- Stain – 1 qt. (\$10.50 per quart)
- Polyurethane – 1 qt. (\$18.90 per quart)
- 8 - 6' long upright shelving brackets at \$ 8.50 each
- 16 – shelving bracket clips at \$1.95 each

Formulas and Procedures

It is often more practical to use estimation to solve problems so that a calculator is not necessary to solve the problem. Usually the situations presented require you to either round to the nearest whole number, tens, hundreds, or thousands or require you to take an average of the range of numbers given. The two examples below demonstrate specific situations where rounding and averaging are useful:

Estimate the cost of the supplies to the nearest whole dollar.

20 board feet	20 x \$10 = \$200.00
1 ½ sheets (must est. 2)	2 x \$60 = \$120.00
Stain and Poly.	\$10.50 + \$18.90 = \$29.40
Shelving	(8 x \$8.50) + (16 x \$1.95) \$99.20
Total Cost (Est. to \$)	\$ 449

Rounding:

Henry just purchased a cell phone plan that will cost him \$38.99 per month. His friend, Elizabeth, just purchased a cell phone plan that will cost her \$59.99 per month. Estimate how much more money Elizabeth will spend on her cell phone plan in one year.

1. To estimate, round to the nearest 10s. Henry will spend about \$40/mo. and Elizabeth will spend \$60/mo.
2. Take the difference between the two: \$60-\$40=\$20 to determine how much more Elizabeth will spend in one month.
3. Multiply by 12. \$20 x 12 = \$240 more per year.

Linear Equation:

Materials +
Mark up on materials is 80% = 449 x 1.8 = \$ 808.20
(100% + 80%) = 180% to decimal is 1.80.

Averaging:

Billy notices that 4-6 cars pass by his house each hour. Estimate the number of cars that will pass by his house in 8 hours.

1. Take the number between 4 and 6. (5)
2. Multiply this by 8 hours: 5 x 8 = 40

Estimate about 80 ½ labor hours in this project at \$40 per hour. (80.5 x \$40 = \$ 3,220.00)

Approximately 40 cars should pass by his house.

The total estimated cost of this project is:
808.00 + \$ 3,220.00 = \$ 4,028.00

Teacher's Script - Comparing and Contrasting

In estimation, there are many ways that students can round and still obtain a reasonable answer. The purpose of rounding is to make mental math easier and to get a reasonable estimate quickly. For instance, the cabinet maker would need to take some accurate measurements of the project, but would need to estimate higher to assure the materials needed would be covered. Some materials need to be ordered as a whole. Estimation is limited in cabinetry because of the need for the estimated answer to be close to the actual answer. The closer the estimate the less money wasted on unnecessary supplies. Also, estimates in labor hours need to be fairly accurate. Good recordkeeping from all jobs completed in the past allow for better estimates of these factors. Estimation is a strategy that good problem solvers need to solve problems quickly and accurately for customer satisfaction.

Common Mistakes Made By Students

Not taking the time to understand the limitations of estimating and how the situation determines the estimate. For instance, it is not okay to round up 85 psi to 100 psi in the problem shown below. However, if the faulty component in the problem below will cost the customer \$85, it would be okay to round it to \$100 when estimating the cost.

Lab Teacher's Extended Discussion

Cabinetmakers need estimation skills in every facet of their career. It is important to be able to obtain estimates in 1-2 days for customers so that they do not choose to go elsewhere. If you estimate low on materials, you will run out of supplies and not make enough money on the job. If you estimate too high on supplies, you may overbid the job and risk losing the job to another contractor. In this economy, it is important to become an accurate estimator.

Cabinetmaking (48.0703) T-Chart

Problems	Occupational (Contextual) Math Concepts	Solutions
1. A cabinet is constructed by various cabinetmakers earning \$15.50 per hour, \$25 per hour, and \$45.75 per hour. All work equally on the project for 4 hours each. What is the average labor cost of the project?		
2. A cabinetmaker estimates that it will take supplies costing \$325.25 and 30 ¼ labor hours to complete a project. If 10 labor hours for the cabinetmaker are \$45 per hour and the remaining labor hours are for his apprentice earning \$24.75 per hour. Estimate the total cost of the project to the nearest dollar. (Round up to the whole dollar.)		
3. Estimate the number of cans of stain needed to cover the top and bottom of 17 shelves that measure 5/8" x 1 ¼' x 2' (1 qt. covers 75 sq. feet – 1 pint covers 37 ½ sq. feet).		
Problems	Related, Generic Math Concepts	Solutions
4. A software support contract is quoted for one or two years. One year would cost \$795 but two years would cost \$1495. Round each price to the nearest hundred dollars to estimate the savings for a two year commitment.		
5. You have 8 vacation days to use in 17 weeks. Your boss asks you to consider taking long weekends only so you can keep up with the weekly workload. You decide to take as many evenly spaced Fridays and Mondays off as possible. How many long weekends would you take and how often would you take a long weekend?		
6. A car can be rented for \$37.99/day plus \$0.39/mile. Which of the following is the best estimate for the cost of renting the car for 4 days if you are driving 100 miles? a. \$150 b. \$150 c. \$200 d. \$250		
Problems	PA Core Math Look	Solutions
7. A company is offering a salary of \$48,500 per year. If about 20% is taken from taxes, estimate how much a person have made in 5 years after taxes?		
8. Every hour, the store sells between 40-50 items that range from \$1.99 - \$7.99. What would be a good estimate for the amount of money the store generates in a 10 hour day?		
9. Two friends went to dinner. Their bill came to \$37.79. If a fair tip is between 15 and 20 percent, what would be a fair tip to leave their waiter?		

Cabinetmaking (48.0703) T-Chart

Problems	Occupational (Contextual) Math Concepts	Solutions
1. A cabinet is constructed by various cabinetmakers earning \$15.50 per hour, \$25 per hour, and \$45.75 per hour. All work equally on the project for 4 hours each. What is the average labor cost of the project?		<p><u>Average Cost per hour</u> = $\\$15.50 + \\$25 + \\$45.75 = \\86.25</p> <p>$\\$86.25 \div 3 \text{ cabinetmakers} = \\28.75 per hour</p> <p>$\\$28.75 \times 12 \text{ hours total (4 hrs. x 3)} = \underline{\\$345.00 \text{ average cost.}}$</p>
2. A cabinetmaker estimates that it will take supplies costing \$325.25 and 30 ¼ labor hours to complete a project. If 10 labor hours for the cabinetmaker are \$45 per hour and the remaining labor hours are for his apprentice earning \$24.75 per hour. Estimate the total cost of the project to the nearest dollar. (Round up to the whole dollar.)		<p>Supplies ----- \$325.25</p> <p>Labor $\\$45 \times 10 = \\450.00</p> <p>Labor $\\$24.75 \times 20.25 = \\$501.1875 \approx \\$501.19$</p> <p>Estimate of total project: $\\$325.25 + \\$450.00 + \\$501.19 = \\$1,276.44 \approx \\$1,277.00$</p>
3. Estimate the number of cans of stain needed to cover the top and bottom of 17 shelves that measure 5/8" x 1 ¼' x 2' (1 qt. covers 75 sq. feet – 1 pint covers 37 ½ sq. feet)		<p><u>Tops measure</u></p> <p>$1.25 \text{ ft.} \times 2 \text{ ft.} = 2.5 \text{ square feet} \times 17 \text{ shelves} = 42.5 \text{ square ft.}$ (Approx. 43 square feet)</p> <p><u>Bottoms measure</u> the same = Approx. 43 sq. feet</p> <p>You need about 86 square feet of coverage. You would need to buy 1 qt. and 1 pt. of stain. This would allow you some extra in the pint container.</p>
Problems	Related, Generic Math Concepts	Solutions
4. A software support contract is quoted for one or two years. One year would cost \$795 but two years would cost \$1495. Round each price to the nearest hundred dollars to estimate the savings for a two year commitment.		<p>Rounding off, one year = \$800, while two years = \$1,500. $\\$1,500 / 2 = \\$750 \text{ per year, or a } \\$50 \text{ per year savings for the two year commitment.}$</p>
5. You have 8 vacation days to use in 17 weeks. Your boss asks you to consider taking long weekends only so you can keep up with the weekly workload. You decide to take as many evenly spaced Fridays and Mondays off as possible. How many long weekends would you take and how often would you take a long weekend?		<p>$8 / 2 = 4 \text{ weekends. } 4 \text{ spread over 17 weeks (take one right away and then take one every 5 weeks = weekend 6, weekend 11, and weekend 16)}$</p>
6. A car can be rented for \$37.99/day plus \$0.39/mile. Which of the following is the best estimate for the cost of renting the car for 4 days if you are driving 100 miles? a. \$150 b. \$150 c. \$200 d. \$250		<p>c. \$200</p> <p>$40 \times 4 = 160$</p> <p>$.40 \times 100 = 40$</p> <p>$160 + 40 = 200$</p>
Problems	PA Core Math Look	Solutions
7. A company is offering a salary of \$48,500 per year. If about 20% is taken from taxes, how much will a person have made in 5 years after taxes?		<p>\$50,000 salary estimate. 10% is 5,000, so 20% is 10,000.</p> <p>$5 \times 10,000 = 50,000 \text{ taxes in 5 years. } 50,000 \times 5 = 250,000$</p> <p>$\\$250,000 - 50,000 = \underline{\\$200,000}$</p>
8. Every hour, the store sells between 40-50 items that range from \$1.99 - \$7.99. What would be a good estimate for the amount of money the store generates in a 10 hour day?		<p>$45 \times \\$5 = \\225 per hour.</p> <p>$\\$2250 \text{ per day. (10 hours x 225)}$</p>
9. Two friends went to dinner. Their bill came to \$37.79. If a fair tip is between 15 and 20 percent, what would be a fair tip to leave their waiter?		<p>Estimate a \$40 bill. 10% is \$4. 20% is \$8, so a fair tip would be any number between \$6 and \$8.</p>