Machine Tool Technology (48.0501) T-Chart

Estimate material needs	=	Choose a level of accuracy appropriate to limitations on measurements when reporting quantities

Program Task: Perform job planning & bench work.

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

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

Program Associated Vocabulary:
AVERAGE, ESTIMATE, ROUND

Math Associated Vocabulary:
ROUNDING, PLACE VALUE, MENTAL MATH, AVERAGE

Program Formulas and Procedures:
When planning for a machining operation, it is important to estimate the amount of material required to produce the required quantity of parts.

Example:
A small production run for the CNC milling department will be machined from ¼" thick by 1½" 4140 steel. The finished length of the parts is 27.5". If bar stock is available in 6, 8, 10, and 12 foot lengths, what length should be purchased to minimize waste?

Round the part length up to the nearest inch: 28".

Convert the available lengths from feet to inches:

6' = 72"
8' = 96"
10' = 120"
12' = 144"

Divide each bar length by the 28" length and record the remainder. That remainder is the waste amount from each length of bar.

For a 6' bar: 72 ÷ 28 = 2, remainder 16. 16" waste.

For an 8' bar: 96 ÷ 28 = 3, remainder 12. 12" waste.

For a 10' bar: 120 ÷ 28 = 4, remainder 8. 8" waste.

For a 12' bar: 144 ÷ 28 = 5, remainder 4. 4" waste.

The 12' bar would be the best choice because its use yields the least amount of waste.

Formulas and Procedures:
It is often more practical to use estimation to solve problems, using mental math, so that a calculator is not necessary. 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.

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 tens. 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.

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. Find the average of 4 and 6. Average = (4 + 6) ÷ 2 = 5.
2. Multiply this by 8 hours: 5 x 8 = 40
   Approximately 40 cars should pass by his house.

Instructor's Script – Comparing and Contrasting
Estimation is an important tool in the Machining profession, the math classroom and in your everyday life. In many situations you can use estimation to see if your answer seems reasonable. When you are taking tests or making purchases, ask yourself if your answer makes sense. Make an estimate to check your work. There are places where just an estimate is alright and there are places where an exact answer is necessary.

Common Mistakes Made By Students
Problems arise when the students do not consider the limitations of estimating and how the situation determines when to estimate. For instance, it is not okay to round up 85 psi to 100 psi. However, if a faulty component will cost the customer $85, it would be okay to round it to $100 when estimating the cost.

CTE Instructor's Extended Discussion
When estimating material as in the given example, the part length should always be rounded up to ensure that enough material exists to produce the proper part length. Loss from the material cutting process also demands rounding up.

Averaging can also be used for estimation of production time for machining operations as shown in sample problem #2.

Problems	Career and Technical Math Concepts	Solutions
1. A company needs to cut 25 pieces of aluminum 4.75" long. There is one 12' long bar available. Is there enough material on hand to complete the job?		
2. A company's lathe department machines 6-8 large cast flanges per day. How many working days should it take to complete the 100 piece order?		
3. Cycle time for parts you are running on a vertical machining center is 13 minutes, 38 seconds. How many parts should you finish if you work for eight hours?		

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 $1,495. Round each price to the nearest hundred dollars and estimate the savings for a two year commitment.		
5. Students want to raise $500 for a field trip. With fundraising, they collected $127 on Monday, $130 on Tuesday, $84 on Wednesday, and $90 on Thursday. Approximately how much money will they need to collect on Friday to reach their goal?		
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) $160 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, how much will 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?		

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	Problems	Career and Technical Math Concepts	Solutions
1.	A company needs to cut 25 pieces of aluminum 4.75" long. There is one 12' long bar available. Is there enough material on hand to complete the job?		Round 4.75 up to 5. Convert 12' to 144" and divide by 5. 144 ÷ 5 = 28.8 or 28. 28 is greater than 25, so there is enough material available.
2.	A company's lathe department machines 6-8 large cast flanges per day. How many working days should it take to complete the 100 piece order?		Divide the total order quantity of 100 by the average of 7 flanges machined per day. 100 ÷ 7 = 14.28. The order should be completed in 15 working days.
3.	Cycle time for parts you are running on a vertical machining center is 13 minutes, 38 seconds. How many parts should you finish if you work for eight hours?		Round cycle time up to 14 minutes. Convert 8 hours to 480 minutes, and then divide by 14. 480 ÷ 14 = 34.28. You should finish 34 parts in 8 hours.

	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 $1,495. Round each price to the nearest hundred dollars and estimate the savings for a two year commitment.		Rounding: One year ≈ $800, while two years ≈ $1,500. $1,500/2 = $750 per year $50 per year savings, or a $100.00 savings for the two year commitment.
5.	Students want to raise $500 for a field trip. With fundraising, they collected $127 on Monday, $130 on Tuesday, $84 on Wednesday, and $90 on Thursday. Approximately how much money will they need to collect on Friday to reach their goal?		Rounding the amounts to the nearest ten, 130 + 130 + 80 + 90 = 430 500 (their goal) – 430 (the approx. amt. collected) = $70 is approximate amount they would need to collect on Friday
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) $160 c) $200 d) $250		c) $200 $\quad$ C = Total Cost $\quad$ x = # of days $\quad$ y = # of miles $\quad$ Equation: $\qquad$ C = 37.99(x) + .39(y) $\quad$ Estimate Amounts: $\quad$ C= 40x + .40x $\quad$ Substitute and Solve: C = 40(4) + .40(100) $\qquad\qquad\qquad\qquad\quad$ C = 160 + 40 = $ 200

	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?		$50,000 salary estimate. 10% is $5,000, so 20% is $10,000. 5 years x $10,000 tax/year = $50,000 taxes in 5 years. $50,000 salary x 5 years = $250,000 estimated salary for 5 years $250,000 (estimated salary) – 50,000 (estimated taxes) = $200,000 (estimated net, or after tax, income for 5 years)
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?		45= Average of 40-50 5 = Average 1.99 and 7.99 45 items x $5 = $225 per hour $225 per hour x 10 days = $ 2,250.00 per 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?		Estimate a $40 bill. 15% is $6 and 20% is $8, so a fair tip would be any amount between $6 and $8.