



All of us like to eat food that tastes good, is visually pleasing, and has a pleasant aroma. Professional chefs and good cooks have a knack of for doing just that. But, most of us must follow a recipe to accomplish that. There is some math involved in applying a recipe to different circumstances. In this cuisine excursion, we investigate the use of math in cooking.

Modifying a Recipe

Let's examine a recipe for the ingredients of Beef Stroganoff.

<u>Beef Stroganoff</u>	
1 1/2 lb	round steak
1/2 lb	sliced mushrooms
12 fl oz	sour cream
4 fl oz	white wine
2 tbsp	chopped onion
1 1/2 tsp	nutmeg
2 tsp	minced garlic
8 cups	cooked pasta
	salt, pepper to taste
<i>(Serves 6 people.)</i>	

The procedure for preparing the ingredients looks like something you could make. If you want to make the dish for a group of 15 people and have the same taste, texture, aroma, and appearance of the dish for 6 people, you need to use a proportional amount of each ingredient. By doing this you should have enough for the 15 people without much leftover. We can find these amounts by setting up and solving proportions.

The basic proportion we will set up equates the ratio of 6 people to 15 people and the amounts in the original recipe to the unknown amounts in the modified recipe designated by x .

round steak:	mushrooms:	sour cream:	white wine:
$\frac{6}{15} = \frac{1\frac{1}{2}}{x}$ $6x = 22.5$ $x = 3.75 \text{ lb}$	$\frac{6}{15} = \frac{\frac{1}{2}}{x}$ $6x = 7.5$ $x = 1.25 \text{ lb}$	$\frac{6}{15} = \frac{12}{x}$ $6x = 180$ $x = 30 \text{ fl oz}$	$\frac{6}{15} = \frac{4}{x}$ $6x = 60$ $x = 10 \text{ fl oz}$
chopped onion:	nutmeg:	minced garlic:	pasta:
$\frac{6}{15} = \frac{2}{x}$ $6x = 30$ $x = 5 \text{ tbsp}$	$\frac{6}{15} = \frac{1\frac{1}{2}}{x}$ $6x = 22.5$ $x = 3.75 \text{ tsp}$	$\frac{6}{15} = \frac{2}{x}$ $6x = 30$ $x = 5 \text{ tsp}$	$\frac{6}{15} = \frac{8}{x}$ $6x = 120$ $x = 20 \text{ cups}$

If you wanted to make beef stroganoff for only two people, you would use the ratio of 6 to 2 instead of 6 to 15 in the previous computation. The recipe could be modified to serve any number of people by setting up and solving the appropriate proportions.

Adjusting Roasting Time

Math can also be used to find the cooking time for various kinds of meats. A roast of a certain weight can be cooked to achieve a desired level such as rare, medium, or well done. The chart below gives suggested cooking times for beef, pork, lamb, and chicken roasts weighing over 2.5 pounds.

	Degree of cooking	Minutes per pound	Oven Temperature
Chicken		20min/lb + 20 min	350° F
Beef	Rare Medium Well Done	20min/lb + 20 min 25min/lb + 20 min 30min/lb + 30 min	350° F
Pork	Medium Well Done	30min/lb + 30 min 35min/lb + 35 min	350° F
Lamb	Medium Well Done	25min/lb + 25 min 30min/lb + 30 min	350° F

(Source: Graig Farm Organics: www.graigfarm.co.uk)

Example 1

A roasted chicken should be served well done. How long will it take to cook a 7.5 lb hen?

Solution: Determine the actual cooking time using the above chart.

Cooking time: $7.5 \times 20 + 20 = 150 + 20 = 170 \text{ min} = 2 \text{ hours } 50 \text{ minutes}$

Example 2

At what time should you put a 9.8 pound beef rib roast in the oven if you plan to serve it done medium for a dinner at 6:00 PM?

Solution: Determine the actual cooking time using the above chart and then subtract the number of hours from 6:00 PM to get the time to start cooking.

$$9.8 \times 25 + 20 = 245 + 20 = 265 \text{ min} = 4 \text{ hours } 25 \text{ minutes}$$

Starting time: 4:25 before 6:00 PM = 1:35 PM

Metric Recipes

Many countries in the world use the metric system of measurement instead of the U.S. Customary System. If you get a recipe from one of these countries the ingredients may be given using metric units. If you are going to use the recipe, you would have to convert the amounts to U.S. Customary units. The chart below gives some of the basic conversions from metric to U.S. Customary units used in recipes.

Metric	U.S. equivalent
5 ml (milliliter)	1 tsp (teaspoon)
15 ml	1 tbsp (tablespoon)
240 ml	1 c (cup)
1 l (liter)	1.06 qt (quart)
28 1/3 g (gram)	1 oz (ounce)
454 g (gram)	1 lb (pound)

Example 3

Convert this recipe for the ingredients of Portuguese Bean Soup into U.S. measurements.

Portuguese Bean Soup	
250 g	dry kidney beans
120 g	smoked boneless ham hocks
200 g	linguista (spicy garlic sausage)
2.5 l	water
120 ml	chopped onions
20 ml	chopped garlic
300 ml	canned tomatoes
100 g	sliced carrots
10 ml	ground cumin
2	Bay leaves
	salt to taste
<i>(Serves 10 people.)</i>	

Solution: Set up and solve proportions using the conversion facts from metric to U.S. customary units. Round off results for ease of measuring.

kidney beans: $\frac{454 \text{ g}}{1 \text{ lb}} = \frac{250 \text{ g}}{x}$ $454x = 250$ $x \approx 0.55 \text{ lb}$	ham hocks: $\frac{454 \text{ g}}{1 \text{ lb}} = \frac{120 \text{ g}}{x}$ $454x = 120$ $x \approx 0.26 \text{ lb}$	linguisa: $\frac{454 \text{ g}}{1 \text{ lb}} = \frac{200 \text{ g}}{x}$ $454x = 200$ $x \approx 0.44 \text{ lb}$
water: $\frac{1 \text{ l}}{1.06 \text{ qt}} = \frac{2.5 \text{ l}}{x}$ $x = 250$ $x \approx 2.65 \text{ qt}$	onion: $\frac{240 \text{ ml}}{1 \text{ c}} = \frac{120 \text{ ml}}{x}$ $240x = 120$ $x = 0.5 \text{ c}$	garlic: $\frac{15 \text{ ml}}{1 \text{ tbsp}} = \frac{20 \text{ ml}}{x}$ $15x = 20$ $x = 1\frac{1}{3} \text{ tbsp}$
tomatoes: $\frac{240 \text{ ml}}{1 \text{ c}} = \frac{300 \text{ ml}}{x}$ $240x = 300$ $x = 1.25 \text{ c}$	carrots: $\frac{454 \text{ g}}{1 \text{ lb}} = \frac{100 \text{ g}}{x}$ $454x = 100$ $x \approx 0.22 \text{ lb}$	cumin: $\frac{5 \text{ ml}}{1 \text{ tsp}} = \frac{10 \text{ ml}}{x}$ $5x = 10$ $x = 2 \text{ tsp}$

As you can see most of the mathematics involved with cooking is centered around determining the correct amount of ingredients to use and the amount of time needed to obtain the desired results. The exercises that follow will give you practice enjoying math and cooking.

Exercises

1. What mathematics is used in modifying the amount of each ingredient of a recipe?
2. How is the time to obtain a well done pork roast determined?
3. How are metric recipe measurements converted to U.S. Customary measurements?

In Problems 4 – 6, use the recipe for the ingredients of Korean Barbeque Ribs (kalbi) given below.

4. Determine the ingredient list for serving 2 people.
5. Determine the ingredient list for serving 8 people.
6. Determine the ingredient list for serving 25 people.

Kalbi	
4 lb	flanken style short ribs
3/4 c	shoyu sauce
1/2 c	sugar
1/4 c	sesame oil
3 tbsp.	sesame seeds
3/4 c	green onion (chopped)
6 cloves	garlic (minced)
1 tsp	crushed red pepper
<i>(Serves 6 people.)</i>	

7. At what time should you put an 8.5 pound leg of lamb into the oven to have it medium done and served at 5:30 PM?
8. If the meat in Problem 7 was a pork roast, at what time should it have been put in the oven?

9. Convert the ingredients of the muffin recipe to U.S. Customary units.
10. What U.S. customary amounts would you use to make 30 Apple Bran Muffins with the recipe in Problem 9.

Apple Bran Muffins

1	egg
1	apple (chopped)
420 ml	cream
180 ml	vegetable oil
60 g	wheat bran
15 ml	baking powder
240 g	wheat flour
200 ml	maple syrup
5 ml	nutmeg

(Makes 12 muffins.)

11. Find the ingredients for a recipe in a cookbook or on the internet. If you want to serve 9 people how much of each ingredient should you use?