Costs of Running a Restaurant

Goals

- Create an equation to represent certain expenses for a restaurant, and interpret (orally and in writing) the solution.

- Determine whether or not a relationship is proportional and explain (orally) the reasoning.

- Determine whether or not a restaurant is making a profit using estimates of ongoing expenses, number of meals sold, average price per meal, and average cost per meal.

Lesson Narrative

In this optional lesson, students apply expressions and signed numbers to the context of balancing projected income and expenses for a restaurant. Then students perform a cost analysis on using reusable or disposable plates and forks. Through this lesson, students make sense of situations involved in running a restaurant. As students make decisions about running a restaurant, they construct arguments and critique others' reasoning. This lesson relies on skills developed in Unit 5, Unit 6, and Unit 8.

Student Learning Goal

Let's explore how much running a restaurant costs.

Access for Students with Diverse Abilities

- Action and Expression (Activity 1)

Access for Multilingual Learners

- MLR4: Information Gap Cards (Activity 1)

- MLR8: Discussion Supports (Activity 2)

Instructional Routines

- MLR4: Information Gap Cards

- Notice and Wonder

Required Materials

Materials to Copy

- Info Gap: Are We Making Money? (1 copy for every 4 students): Activity 1

Lesson Timeline

25 min	**20** min
Activity 1	Activity 2

Activity 1
Info Gap: Are We Making Money?

25 min

Activity Narrative

In this activity, students predict whether or not a restaurant will make a profit but do not initially have enough information to do so. To bridge the gap, they need to exchange questions and ideas.

The *Info Gap* structure requires students to make sense of problems by determining what information is necessary, and then to ask for information they need to solve it. This may take several rounds of discussion if their first requests do not yield the information they need. It also allows them to refine the language they use and ask increasingly more precise questions until they get the information they need.

Launch

Explain to students that the cost of food is only one expense for running a restaurant. Ask students to brainstorm other things restaurant owners need to spend money on. From their list, decide as a class which of these depend on the number of meals ordered and which are ongoing expenses. Tell students that restaurants charge more for their meals than just the cost of the ingredients in order to pay for these expenses. This increase in price is called "markup."

Tell students they will predict if a restaurant will make a profit. Display the *Info Gap* graphic that illustrates a framework for the routine for all to see.

Remind students of the structure of the *Info Gap* routine, and consider demonstrating the protocol if students are unfamiliar with it.

Arrange students in groups of 2. In each group, give a problem card to one student and a data card to the other student. After reviewing their work on the first problem, give students the cards for a second problem and instruct them to switch roles.

Student Task Statement

Your teacher will give you either a problem card or a data card. Do not show or read your card to your partner.

If your teacher gives you the problem card:

1. Silently read your card and think about what information you need to answer the question.

2. Ask your partner for the specific information that you need. "Can you tell me _____?"

3. Explain to your partner how you are using the information to solve the problem. "I need to know _____ because ..."
   Continue to ask questions until you have enough information to solve the problem.

4. Once you have enough information, share the problem card with your partner, and solve the problem independently.

5. Read the data card, and discuss your reasoning.

Instructional Routines

MLR4: Information Gap Cards

ilclass.com/r/10695522
Please log in to the site before using the QR code or URL.

Access for Multilingual Learners (Activity 1, Narrative)

MLR4: Information Gap Cards
This activity uses the *Information Gap* math language routine, which facilitates meaningful interactions by positioning some students as holders of information that is needed by other students, creating a need to communicate.

Access for Students with Diverse Abilities (Activity 1, Student Task)

Action and Expression: Internalize Executive Functions.
Check for understanding by inviting students to rephrase directions in their own words. Keep a display of the Info Gap graphic visible throughout the activity or provide students with a physical copy. *Supports accessibility for: Memory, Organization*

Student Workbook

If your teacher gives you the data card:

1. Silently read your card. Wait for your partner to ask for information.

2. Before telling your partner any information, ask, "Why do you need to know _____?"

3. Listen to your partner's reasoning and ask clarifying questions.
   Only give information that is on your card. Do not figure out anything for your partner!
   These steps may be repeated.

4. Once your partner says they have enough information to solve the problem, read the problem card, and solve the problem independently.

5. Share the data card, and discuss your reasoning.

   Problem Card I: Yes, the restaurant is making a profit.

   Problem Card 2: The restaurant needs to serve at least 647 meals each week to make a profit.

Activity Synthesis

After students have completed their work, share the correct answers and ask students to discuss the process of solving the problems. Here are some questions for discussion:

💬 *"In each situation, some of the given information was per meal, some was per week, and some was per month. How did you deal with these different units?"*

"Would it change your final answer if you had chosen a different unit for solving the problem?"

No, the final answer would be the same. The process of finding the answer would be different.

Remind students that markup is the extra money, above the cost of the ingredients, that restaurants charge to be able to cover their other expenses. Discuss:

💬 *"What percentage was the markup for the full-service restaurant?"*

about 270%

💬 *"What percentage was the markup for the fast-food restaurant?"*

about 264%

Explain that many restaurants include a markup of around 300% to cover the cost of their other expenses.

If students selected a recipe in the previous lesson and calculated the cost of the ingredients, consider giving them time to determine the markup they would need to make a profit at their imaginary restaurant.

💬 *"Estimate the monthly cost of your ongoing expenses."*

"Predict how many meals your restaurant would sell in one month."

"How much money would you need to charge for each meal to be able to cover all the ongoing costs of running a restaurant?"

"What percentage of the cost of the ingredients is the markup on your meal?"

Activity 2

Disposable or Reusable?

20 min

Activity Narrative

The purpose of this activity is for students to write and solve equations as a strategy to compare the projected costs of using reusable versus disposable plates and forks. First, students examine dot plots representing the average number of customers served per day at a sample of restaurants to make a prediction about how many customers they might serve per day. Then, students see that the cost of buying disposable plates and forks can be modeled with a proportional relationship, while the cost of buying and washing reusable plates and forks can be modeled with an equation in the form $px + q = r$. Finally, students construct arguments about which type of plates and forks would be better depending on the number of days the restaurant is open.

Launch

Tell students to close their books or devices (or to keep them closed). Display the dot plots about the number of customers served per day for all to see. Give students 1 minute of quiet think time and ask them to be prepared to share at least one thing they notice and one thing they wonder. Record and display responses without editing or commentary for all to see. If possible, record the relevant reasoning on or near the dot plots.

Students may notice:

- Many of the fast-food restaurants serve more customers per day than the full-service restaurants.
- There is a lot of overlap between the two distributions, from 300 to 600 customers.

Students may wonder:

- Were the restaurants included in the samples selected at random?
- Is there a meaningful difference between the average number of customers served at these two types of restaurants?
- About how many customers would my restaurant serve per day?

If the difference in the number of customers at each type of restaurant does not come up during the conversation, ask students to discuss this idea.

Tell students to open their books or devices and give students quiet work time followed by whole-class discussion.

Student Workbook

Student Workbook

Student Task Statement

A sample of full-service restaurants and a sample of fast-food restaurants were surveyed about the average number of customers they serve per day.

full-service restaurants

fast-food restaurants
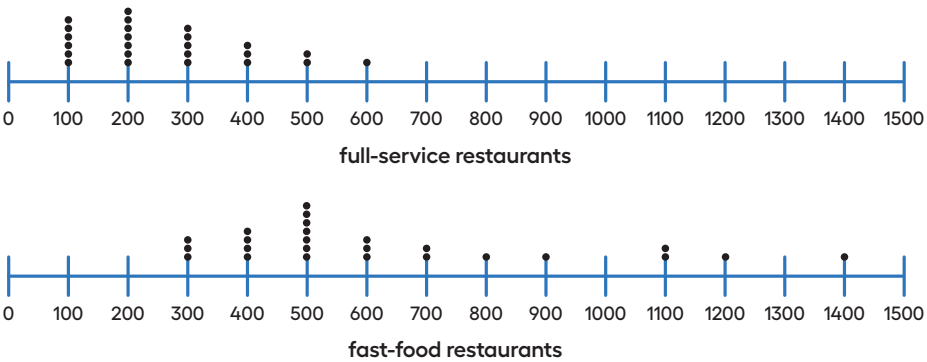
1. How does the average number of customers served per day at a full-service restaurant generally compare to the number served at a fast-food restaurant? Explain your reasoning.

   Fast-food restaurants generally have more customers per day than full-service restaurants, but there is a lot of overlap. The difference in means is about 366 customers, which is 1.6 times the larger mean absolute deviation.

2. Estimate how many customers you think your restaurant will serve per day. Explain your reasoning.

   Sample response: 240 customers per day because 240 is close to the center of the distribution for full-service restaurants, and I think my restaurant will be a typical full-service restaurant.

3. Here are prices for plates and forks:

 | | plates | forks |
   |------------|------------------------------|----------------------------|
   | disposable | 165 paper plates for $12.50 | 600 plastic forks for $10 |
   | reusable | 12 ceramic plates for $28.80 | 24 metal forks for $30 |

   a. Using your estimated number of customers per day, write an equation for the total cost, d, of using disposable plates and forks for every customer for n days.

   Sample response for 240 customers per day: $d = 22.18n$

   b. Is d proportional to n? Explain your reasoning.

   Sample response for 240 customers per day: The equation represents a proportional relationship because it is in the for m $y = kx$, and the constant of proportionality is 22.18. This was using an average of 240 customers per day, and in real life the restaurant serves a different number of people each day, so it could be close to proportional, but not exactly.

   c. Use your equation to predict the cost of using disposable plates and forks for 1 year. Explain any assumptions you make with this calculation.

   Sample response for 240 customers per day: Assuming the restaurant is open 365 days in the year and serves an average of 240 customers per day, it would cost $8,095.70 to use disposable plates and forks for every customer. This also assumes that each customer uses exactly one plate and one fork.

4. a. How much would it cost to buy enough reusable plates and forks for your predicted number of customers per day?

$876 to buy 240 reusable plates and 240 reusable forks

b. If it costs $10.75 a day to wash the reusable plates and forks, write an expression that represents the total cost, r, of buying and washing reusable plates and forks after n days. $10.75d + 876 = r$

c. Is r proportional to n? Explain your reasoning.

No, this equation does not represent a proportional relationship. It cannot be rewritten in the form $y = kx$, and if graphed, it would go through the point $(0, 876)$ instead of $(0, 0)$.

d. How many days can the reusable plates and forks be used for the same cost that you calculated for using disposable plates and forks for 1 year?

If $10.75d + 876 = 8095.70$, then $d = 671.6$, which is about 1 year and 10 months.

Activity Synthesis

Ask the class how many days they can use the reusable plates and forks for the same cost as using disposable plates and forks for 1 year. Select students to share what this reveals about the situation.

If their answer is greater than the number of days they planned for their restaurant to be open during the year, then this means that buying and washing reusable plates and forks is cheaper than using disposable plates and forks.

Select students to share their reasoning about whether or not there is a proportional relationship between the cost of using disposable or reusable and the number of days.

Students might share the following ideas:

- The relationship for the cost of using disposable looks like it is proportional, because it is written in the form $y = kx$.
  - The relationship for the cost of using disposable is not exactly proportional, because the equation is assuming an average number of customers per day, and in real life the restaurant serves a different number of people each day.
- The relationship for the cost of using reusable is not proportional because:
  - There is a start-up cost of buying the reusable plates and forks.
  - The equation cannot be written in the form $y = kx$. There has to be a term that is added that represents the start-up costs.
  - If the relationship was graphed, it would not go through the origin, but it would cross the y-axis at a point that represents the start-up costs.

Access for Multilingual Learners (Activity 2), Synthesis

MLR8: Discussion Supports. Display sentence frames to support students' reasoning about whether there is a proportional relationship between the cost of using disposable or reusable and the number of days: "The relationship between the cost of using disposable dishes is/is not proportional because _____." "I agree because …" "I disagree because …" *Advances: Speaking, Conversing*

Student Workbook