SOLUTIONS

1.3 Rate of change – Practice exercises

1. Sweet Rose Bakery makes cakes and cupcakes. Here are their prices.

Cake

Servings	10	20	50
Cost	$11.95	$19.95	$40.95

Cupcakes

Servings	12	24	48
Cost	$6.95	$13.90	$27.80

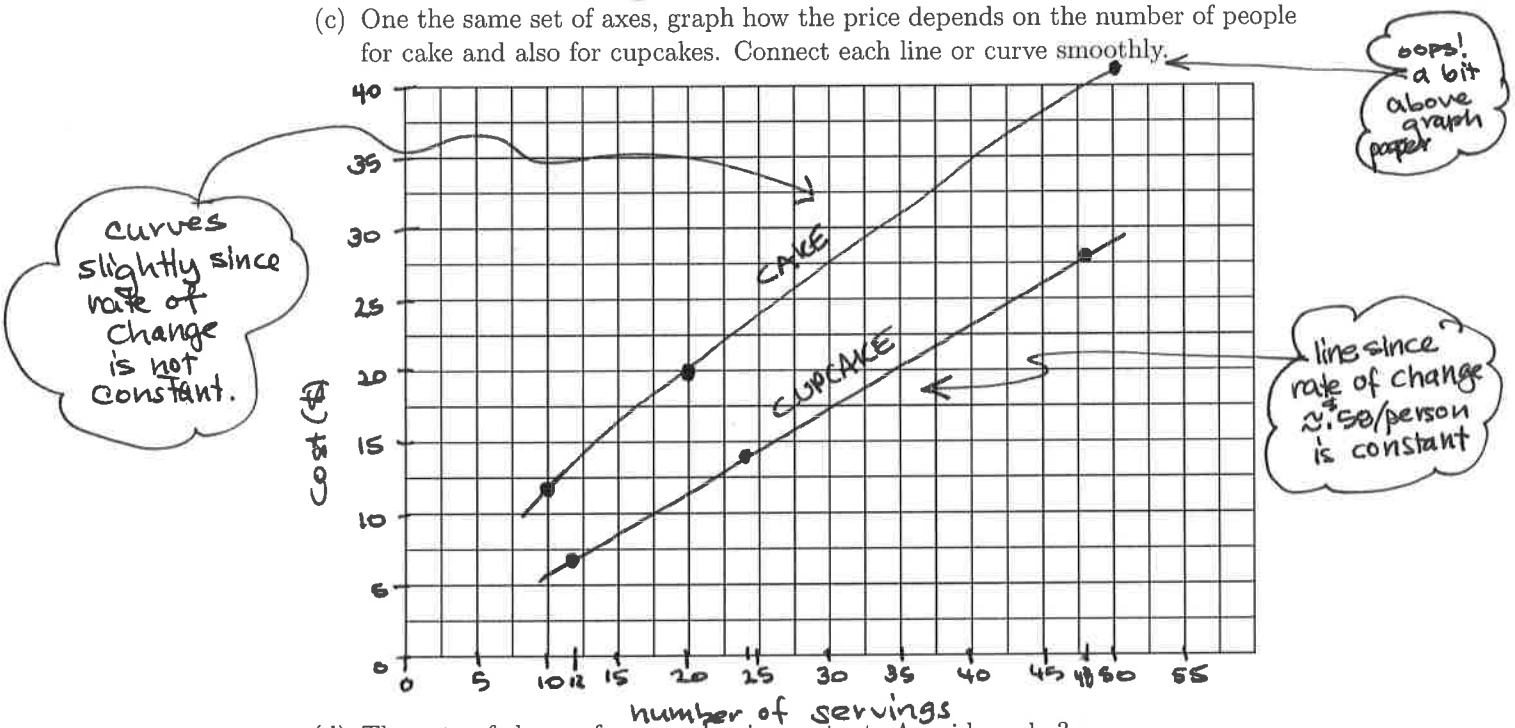
(a) Calculate the rate of change for cake prices, in $/person, if there are between 10 and 20 people. Repeat for between 20 and 50 people.

$\frac{\$19.95-\$11.95}{20-10 \text{ people}} = (19.95-11.95)\div(20-10) = \boxed{\$.80/\text{person}}$ || $\frac{\$40.95-\$19.95}{50-20 \text{ people}} = (40.95-19.95)\div(50-20) = \boxed{\$.70/\text{person}}$

(b) Calculate the rate of change for cupcake prices, in $/person, if there are between 12 and 24 people. Repeat for between 24 and 48 people.

$\frac{\$13.90-\$6.95}{24-12 \text{ people}} = (13.90-6.95)\div(24-12) \approx \boxed{\$.58/\text{person}}$ || $\frac{\$27.80-\$13.90}{48-24 \text{ people}} = (27.80-13.90)\div(48-24) = \boxed{\approx \$.58/\text{person}}$

(c) One the same set of axes, graph how the price depends on the number of people for cake and also for cupcakes. Connect each line or curve smoothly.



(d) The rate of change for cupcakes is constant. Any idea why?

Just $/cupcake — sold 1-at-a-time?

(e) The rate of change for cakes is not constant. Any idea why?

Some economy of scale?
For example doesn't take twice as long to ice twice as large a cake since not so much edging.

2. Anthony and Christina are trying to decide where to hold their wedding reception. The Metropolitan Club costs \$1,300 for the space and \$92 per person.

Story also appears in 1.2 #3 and 3.2 #3

(a) Make a table showing the cost for 20, 50, 75, or 100 people.

people	20	50	75	100
cost	3,140	5,900	8,200	10,500

1300+92×20=

(b) Calculate the extra cost for each additional person between 20 and 50 people.

$\frac{\$5,900 - \$3,140}{50-20 \text{ people}} = (5900-3140)\div(50-20) =$ \$92/guest

(c) Calculate the extra cost for each additional person between 75 and 100 people.

$\frac{\$8,200 - \$5,900}{100-75 \text{ people}} = (8200-5900)\div(100-75) =$ \$92/guest

(d) What do you notice?

always \$92/person
(we knew that from story!)

(e) Explain why the graph of this cost function is a line.

because the rate of change is constant

(f) Is the cost function increasing, decreasing, or neither?

3. Rashad measured his heart rate several times after football practice. Right after practice his heart rate was 178 beats per minute. Two minutes later, it had dropped to 153 beats per minute, and by ten minutes after practice it was down to 120 beats per minute.

   (a) Make a table showing how Rashad's heart rate changed.

time (min)	0	2	10
heart rate (bpm)	178	153	120

   (b) Identify the variables, including units and dependence.

T = time (minutes after practice) ~ indep
H = heart rate (beats/min) ~ dep

   (c) How quickly was Rashad's heart rate dropping during the first two minutes following practice? *Hint: the units are beats per minute per minute.*

$\frac{153-178 \text{ bpm}}{2 \text{ min}} = (153-178) \div 2 = \boxed{-12.5 \text{ bpm/min}}$

   (d) How quickly was his heart rate dropping during the next time period?

$\frac{120-153 \text{ bpm}}{10-2 \text{ min}} = (120-153) \div (10-2) = \boxed{-4.125 \text{ bpm/min}}$

   (e) Rashad does not like hitting the showers until his heart rate is closer to normal, or at least below 100. He usually waits 15 minutes after practice. Do you think that's long enough? Explain.

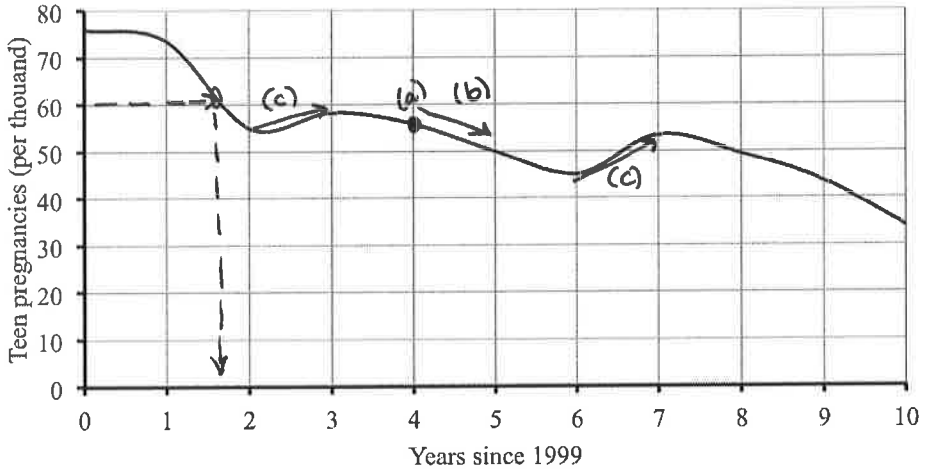
Yes, but close. Another 5 min @ −4 bpm/min would bring his heart rate down 120 − 20 = 100.

   (f) Did Rashad's heart rate increase, decrease, or neither?

4. Teen pregnancy rates for Minneapolis (pregnancies per thousand teens) are summarized in the graph and table. Minnesota Department of Health

(c) (a) (b) (c)

Year	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Teen preg	76.0	73.5	54.9	58.2	55.7	49.9	45.1	53.3	49.4	43.5	34.0



(a) What was the teen pregnancy rate in 2003?

from table → 55.7 preg per th. teens

(b) Did the teen pregnancy rate increase or decrease from 2003 to 2004?

decrease

$\frac{-1999}{4}$ $\frac{-1999}{5}$

(c) While the teen pregnancy rate has generally decreased, from 2001 to 2002 it actually increased. Were there other times when it increased? $\frac{-1999}{2}$ $\frac{-1999}{3}$

1999+6 = 2006
1999+7 = 2006

Yes, increased 2005 to 2006

(d) When did the teen pregnancy rate first fall below 60 pregnancies per thousand teens?

1999+1 = 2000

First fell below 60 preg per th teens in 2000.

(e) How fast was the teen pregnancy rate dropping on average per year from 2002 to 2005? How does that compare to 2006 to 2009?

2002-5: $\text{roc} = \frac{45.1-58.2}{2005-2002} = (45.1-58.2) \div (2005-2002) =$

≈ -4.4 preg per th teens/year

2006-9: $\text{roc} = \frac{34.0-53.3}{2009-2006} = (34.0-53.3) \div (2009-2006) =$

≈ -6.4 preg per th teens/year

Teen pregnacies per thousand teens dropped ≈4.4/year from 2002 to 2005 and even faster, 6.4/year 2006 to 2009.