BOOTSTRAP

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Data Science

Workbook v0.9b

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Unit 1

Numbers and Strings

Make sure you've loaded the Unit 1 Starter File, and clicked "Run".

1. Try typing `42` into the Interactions Area and hitting "Enter". What happens?

2. Try typing in other Numbers. What happens if you try a decimal like `0.5`? A fraction like `1/3`? Try really big Numbers, and really small ones.

3. String values are always in quotes. Try typing your name in quotes, and see what happens when you hit "Enter".

4. Try typing your name *without* the closing quote. What happens? Now try typing it without *any* quotes.

5. Is `42` the same as `"42"`? Why or why not? Write your answer below:

---

6. Just like in math, Pyret has *operators* like `+` and `-`. Try typing in `4 + 2`, and then `4+2` (without the spaces). What can you conclude from this? Write your answer below:

---

7. Try typing in `4 + 2 + 6`, `4 + 2 * 6`, and `4 + (2 * 6)`. What can you conclude from this? Write your answer below:

---

8. Try typing in `4 + "cat"`, and then `"dog" + "cat"`. What can you conclude from this? Write your answer below:

Booleans

Boolean expressions are yes-or-no questions, and you probably already know some Boolean operators from math class, which compare Numbers. What do you think each of the following expressions will evaluate to? Try typing some into Pyret to experiment.

`3 <= 4`	_____	`"a" > "b"`	_____
`3 == 2`	_____	`"a" <> "b"`	_____
`2 <> 4`	_____	`"a" == "b"`	_____
`3 <> 3`	_____	`"a" <> "a"`	_____

1. How many Number values are there? _____
2. How many String values are there? _____
3. How many Boolean values are there? _____

Boolean Operators

Pyret also has operators that work on *Booleans*. For each expression below, *write down your guess* about what it will evaluate to. Then type them in and see if you were right!

`(3 <= 4) and (3 == 2)` _____

`("a" == "b") and (3 <> 4)` _____

`(3 <= 4) or (3 == 2)` _____

`("a" == "b") or (3 <> 4)` _____

Unit 2

The Animals Dataset

1. My dataset is Animals from a pet store
2. Some of the columns in my dataset are :

Name (capitalization matters !)	**Datatype**	**Quantitative/Categorical**

3. Three questions I have about the animals dataset:

1.

2.

3.

The Design Recipe

Define a function called `birth-year`, which calculates the year an animal was born:

```
birth-year : (animal :: Row) → Number
name         domain            range
# Consumes an animal, subtracts age from the current year to produce the birth-year born
examples:
  birth-year(pet1) is 2018 - pet1["age"]
  _____(_____) is _____
end
fun _____ (_____) : _____
end
```

Define a function called `is-kitten`, which consumes a Row of the animals table and produces `true` if it's a cat less than 2 years old.

```
_____ : _____ → _____
name    domain    range
# _____
examples:
  _____(_____) is _____
  _____(_____) is _____
end
fun _____ (_____) : _____
end
```

Define a function called `nametag`, prints out each animal's name in big red letters.

```
_____:_____ → _____
 name          domain        range
# _____________________________________________________
```

examples:

```
    _____(_____) is _____

    _____(_____) is _____
end

fun _____ (_____) : _____

end
```

Define a function called `is-fixed`, which consumes a Row of the animals table and produces `true` if it's an animal that's been fixed.

```
_____:_____ → _____
 name          domain        range
# _____________________________________________________
```

examples:

```
    _____(_____) is _____

    _____(_____) is _____
end

fun _____ (_____) : _____

end
```

Define a function called `sentence`, which consumes a Row of the animals table and produces a String containing the animal's `name`, the string `" the "`, and the `species` of the animal. (For example, `"Nori the dog"`).

```
_____:_____ → _____
 name          domain          range
# _____________________________________________________________
```

examples:

```
_____(_____) is

_____

_____(_____) is

_____
```

end

fun _____ (_____) **:**

```
_____
```

end

What kind of animal would *you* adopt? Write a function called `adopt`, which consumes a Row of the animals table and produces `true` if it's an animal that you would adopt.

```
_____:_____ → _____
 name          domain          range
# _____________________________________________________________
```

examples:

```
_____(_____) is

_____

_____(_____) is

_____
```

end

fun _____ (_____) **:**

```
_____
```

end

My Dataset

1. My dataset is _____
2. Some of the columns in my dataset are :

Name (capitalization matters !)	**Datatype**	**Quantitative/Categorical**

3. Three questions I have about my dataset:

1. _____

_____

2. _____

_____

3. _____

_____

Unit 3

Reviewing Functions

1. How many functions are defined in this file? _____
2. What is the name of the last function? _____
3. What is the Domain of the last function? _____
4. What is the Range of the last function? _____
5. What is the Range of the last function? _____
6. What is the variable name that the last function uses? _____
7. Which function will tell us if an animal is a kitten? _____
8. Which function will print out "<name> the <species>"? _____
9. Which function will tell us if an animal is a dog older than 10? _____
10. Which function will tell us if an animal has been fixed? _____
11. Which function will draw a nametag for an animal? _____
12. One of the examples for the last function is broken. Fix this example in the Definitions Area.

Plans for the `Animals` Dataset

What are two ways you might want to *order* this dataset?

1) _____

2) _____

If you wanted to split this dataset into subsets, what are two subsets you might want to look at?

1) _____

2) _____

If you wanted to compute new columns for this dataset, what are two things you would want to compute?

1) _____

2) _____

Methods

Methods are a lot like functions, but they differ in three important ways:

- They can only be called as **part of a value**, using the **dot-accessor**. For example: **`animals.`**`row-n(2)`
- Their Contracts are different, because they contain a **Type** as part of their name. For example: **`<Table>.`**`row-n :: (index :: Number) -> Row`
- They have a "secret argument", which is the value they are attached to. In the examples above, the `row-n` method consumes only a `Number` as part of its Domain, but it *also* consumes a `Table`.

Here is the Contract for a method, which consumes the name of a food and produces True if the person likes that food:

```
<Person>.likes :: (food :: String) -> Boolean
```

1. What is the name of this method? _____
2. How many things are in its Domain? _____
3. What is the name of the argument in its Domain? _____
4. What is the Type of the argument in its Domain? _____
5. What Type of data will this method will produce? _____
6. What Type of data is the method *attached to?* _____
7. Below are 3 expressions. Based on the contract above, circle the correct one.

   `emma.likes("pizza")` `likes("pizza")` `likes(emma, pizza)`

8. On the line below, write your own expression that uses this method, replacing `emma` and `"pizza"` with your own name and a food *you* like.

Table Plan

On Kitten Day, the shelter prints up a list of all the cats in their database that are less than 2 years old, and makes nametags for them. They need a function that will help them out! Define a function called `get-kittens-tags`, which takes in the dataset and produces the correct table.

Contract and Purpose

get-kittens-tags : *(animals :: Table)* → *Table*

 # Consume a table of animals, and produce a table containing kittens with nametags, sorted by name

Example Tables

Make a Start Table and a result based on that table.

`animals-table` → `get-kittens-tags(animals-table)`

name	species	age	fixed	legs	weight	adopt
Sasha	cat	1	FALSE	4	6.5	4
Toggle	dog	3	TRUE	4	48	3
Buddy	lizard	2	FALSE	4	0.3	12
Wade	cat	1	FALSE	4	3.2	4
Mittens	cat	2	TRUE	4	7.4	5

name	species	age	fixed	legs	weight	adopt	tag
Sasha	cat	1	FALSE	4	6.5	4	Sascha
Wade	cat	1	FALSE	4	3.2	4	Wade

Define the function

Use the relevant methods (circle your helper functions!), then produce a result with the new table.

```
fun get-kittens-tags ( pets ) :
  t = pets                                          Define the table
  .build-columns(                                   Are there more columns?
  .filter(                                          Are there fewer rows?
  .order-by(                                        Are the rows ordered?
  t                                                 Produce the result
end
```

Table Plan

The first weekend of every month, the shelter holds a "meet the dogs" picnic, to encourage families to adopt their dogs. Write a function called `get-dogs-by-age`, that takes their database and produces a table of all the dogs in the shelter, sorted from youngest to oldest.

Contract and Purpose

get-dogs-by-age : *(animals :: Table)* → *Table*

 # Consume a table of animals, and produce a table containing only the dogs, sorted by age

Examples

Make a Start Table and a result based on that table.

`animals-table` → `get-dog-by-age(animals-table)`

name	species	age	fixed	legs	weight	adopt
Snowcone	cat	2	TRUE	4	6.1	5
Wade	cat	1	FALSE	4	3.2	4
Hercules	cat	3	FALSE	4	13.4	7
Toggle	dog	3	TRUE	4	48	3
Fritz	dog	4	TRUE	4	92	6

name	species	age	fixed	legs	weight	adopt
Toggle	dog	3	TRUE	4	48	3
Fritz	dog	4	TRUE	4	92	6

Define the function

Use the relevant methods (circle your helper functions!), then produce a result with the new table.

fun _____ (_____) :

_____ *Define the table*

_.build-columns(_____) *Are there more columns?*

_.filter(_____) *Are there fewer rows?*

_.order-by(_____) *Are the rows ordered?*

_____ *Produce the result*

end

Table Plan

It's important for animals to stay healthy, especially when they get older. The veterinarians at the shelter want to put some of the dogs on a diet! They need a regular report of all the older dogs, sorted from heaviest-to-lightest. Define a function `old-dogs-diet`, which does just that!

Contract and Purpose

_____ : _____ → _____

_____

Examples

Make a Start Table and a result based on that table.

`animals-table` → `get-fixed-by-legs(animals-table)`

name	species	age	fixed	legs	weight	adopt
Snowcone	cat	2	TRUE	4	6.1	5
Lucky	dog	3	TRUE	3	45.4	9
Hercules	cat	3	FALSE	4	13.4	7
Toggle	dog	3	TRUE	4	48	3
Snuggles	tarantula	2	FALSE	8	0.1	1

name	species	age	fixed	legs	weight	adopt
Lucky	dog	3	TRUE	3	45.4	9
Snowcone	cat	2	TRUE	4	6.1	5
Toggle	dog	3	TRUE	4	48	3

Define the function

Use the relevant methods (circle your helper functions!), then produce a result with the new table.

```
fun _____ (_____) :
  t = _____                                   Define the table
  _.build-columns(_____)                      Are there more columns?
  _.filter(_____)                             Are there fewer rows?
  _.order-by(_____)                           Are the rows ordered?
  _____                                       Produce the result
end
```

Table Plan

The shelter is tracking birth-years for all the animals who've been fixed. They need a function that takes in their database and returns a table that contains the birth-year for each one. Define `get-fixed-birth` that will do this for them.

Contract and Purpose

_____ : _____ → _____

_____

Examples

Make a Start Table and a result based on that table.

`animals-table` → `get-fixed-by-legs(animals-table)`

name	species	age	fixed	legs	weight	adopt
Snowcone	cat	2	TRUE	4	6.1	5
Lucky	dog	3	TRUE	3	45.4	9
Hercules	cat	3	FALSE	4	13.4	7
Toggle	dog	3	TRUE	4	48	3
Snuggles	tarantula	2	FALSE	8	0.1	1

name	species	age	fixed	legs	weight	adopt	year
Snowcone	cat	2	TRUE	4	6.1	5	2015
Lucky	dog	3	TRUE	3	45.4	9	2014
Toggle	dog	3	TRUE	4	48	3	2014

Define the function

Use the relevant methods (circle your helper functions!), then produce a result with the new table.

```
fun _____ (_____) :
  t = _____                                          Define the table
  _.build-columns(_____)                             Are there more columns?
  _.filter(_____)                                    Are there fewer rows?
  _.order-by(_____)                                  Are the rows ordered?
  _____                                              Produce the result
end
```

My Dataset

What are two ways you might want to *order* this dataset?

1) _____

2) _____

If you wanted to *split this dataset into subsets*, what are two subsets you might want to look at?

1) _____

2) _____

If you wanted to *compute new columns* for this dataset, what are two things you would want to compute?

1) _____

2) _____

Unit 4

Measuring Center in `Animals`

Measures of Center

1. The column I choose to measure is _____
2. The **mean** of that column is _____
3. The **median** of that column is _____
4. The **mode(s)** of that column is/are _____
5. Based on the differences between mean and median, I conclude :

_____

_____

_____

_____

Table Plan

The shelter wants a function that will calculate the median age of all the dogs in the shelter. Write a function called `median-dog-age` that will take in a table of animals and do just that.

Contract and Purpose

_____ : _____ → _____

_____

Examples

Make a Start Table and a result based on that table.

`animals-table` → `median-dog-age(animals-table)`

name	species	age	fixed	legs	weight	adopt
Snowcone	cat	2	TRUE	4	6.1	5
Lucky	dog	3	TRUE	3	45.4	9
Hercules	cat	3	FALSE	4	13.4	7
Toggle	dog	3	TRUE	4	48	3
Snuggles	tarantula	2	FALSE	8	0.1	1

Define the function

Use the relevant methods (circle your helper functions!), then produce a result with the new table.

```
fun _____ (_____) :
  t = _____                                          Define the table
  _.build-columns(_____)                             Are there more columns?
  _.filter(_____)                                    Are there fewer rows?
  _.order-by(_____)                                  Are the rows ordered?
  _____                                              Produce the result
end
```

Table Plan

The shelter wants to know how long a kitten stays at the shelter before finding a "forever home". Define a function called `mean-kitten-adoption`, that will calculate the mean of the length of time it takes for kittens to be adopted when given the dataset.

Contract and Purpose

_____ : _____ → _____

_____

Examples

Make a Start Table and a result based on that table.

`animals-table` → `median-dog-age(animals-table)`

name	species	age	fixed	legs	weight	adopt
Snowcone	cat	2	TRUE	4	6.1	5
Lucky	dog	3	TRUE	3	45.4	9
Hercules	cat	3	FALSE	4	13.4	7
Toggle	dog	3	TRUE	4	48	3
Snuggles	tarantula	2	FALSE	8	0.1	1

Define the function

Use the relevant methods (circle your helper functions!), then produce a result with the new table.

```
fun _____ (_____) :
  t = _____                                   Define the table
  _.build-columns(_____)                      Are there more columns?
  _.filter(_____)                             Are there fewer rows?
  _.order-by(_____)                           Are the rows ordered?
  _____                                       Produce the result
end
```

My Dataset

Measures of Center

1. The column(s) I choose to measure is/are _____
2. The **mean(s)** of that column is/are _____
3. The **median(s)** of that column is/are _____
4. The **mode(s)** of that column is/are _____
5. Based on the differences between mean and median, I conclude :

_____

_____

_____

_____

Unit 5

Statements about Columns

Use the Table below to help you answer the questions.

name	species	age	pounds
Sasha	cat	1	6.5
Felix	cat	16	9.2
Wade	cat	1	3.2
Boo-boo	dog	11	123
Maple	dog	3	51.6
Nori	dog	6	35.3
Nibblet	rabbit	6	4.3

1. Which animal(s) is/are the heaviest? _____
2. Which animal(s) is/are the youngest? _____
3. How much of the *total weight* comes from Maple? _____
4. How much of the *combined age* comes from Nori? _____
5. Would these questions be harder to answer if the table had 100 rows? If so, why?

_____

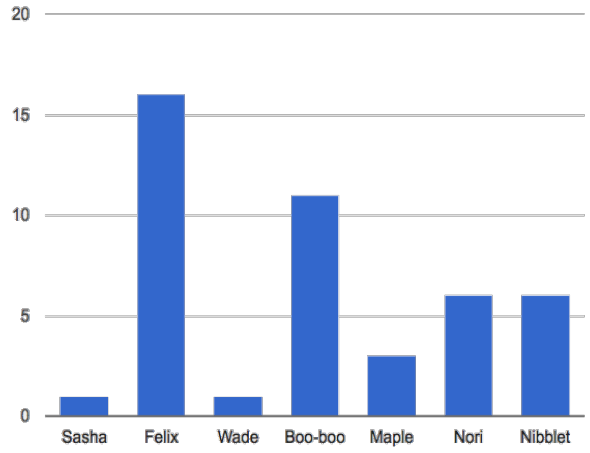
_____

_____

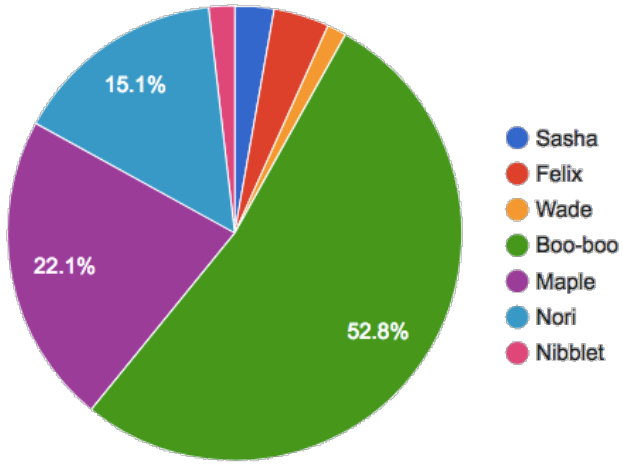
_____

Visualizing Quantity

In the table below, there are two observations drawn from the following charts. Add two more.



Animals Ages (yrs)



Animals Weights (lbs)

Based on a _____ chart of _____	**I notice that _____**
Based on a bar chart of 7 animals' ages	Felix is the oldest
Based on a pie chart of 7 animals' weights	Boo-boo weighs more than the other six animals combined!
Based on a bar chart of 7 animals' ages	
Based on a pie chart of 7 animals' weights	

Table Plan

Dogs are generally a lot bigger heavier than cats, so the shelter wants to look at a chart of *only* the dogs to determine who needs more exercise time. Define a function `pie-dog-weight`, which will make a pie chart showing the relative weights of all the dogs in the shelter.

Contract and Purpose

_____ : _____ → _____

_____

Examples

Make a Start Table and a result based on that table.

`animals-table` → `pie-dog-weight(animals-table)`

name	...	weight
Snowcone	…	6.1
Lucky	…	45.4
Hercules	…	13.4
Toggle	…	48
Snuggles	…	0.1

Define the function

Use the relevant methods (circle your helper functions!), then produce a result with the new table.

fun _____ (_____) :

Define the table

t = _____

_____

Are there more columns?

_____

Are there fewer rows?

_____

Are the rows ordered?

_____

Produce the result

end

Bad Sample Tables!

For each word problem, a Sample Table must have (1) all the columns that matter, (2) a representative sample of the rows, and be in (3) random order. For each problem below, check the boxes to determine if the Sample Table meets those criteria.

1. The shelter wants to know the median age of all the cats

name	species	age	fixed	legs	pounds	weeks
Sasha	cat	1	FALSE	4	6.5	3
Mittens	cat	2	TRUE	4	7.4	5
Sunfower	cat	5	TRUE	4	8.1	10

- ☐ Relevant columns
- ☐ Representative sample of rows
- ☐ Random order

2. The shelter wants a pie chart showing all the dogs' weight

name	species	age
Fritz	dog	4
Wade	cat	2
Nibblet	rabbit	6
Daisy	dog	5

- ☐ Relevant columns
- ☐ Representative sample of rows
- ☐ Random order

3. Sort all the animals alphabetically by name

name	species	age	fixed	legs	pounds	weeks
Ada	dog	2	TRUE	4	32	3
Bo	dog	4	TRUE	4	76.1	10
Boo-boo	dog	11	TRUE	4	123	10

- ☐ Relevant columns
- ☐ Representative sample of rows
- ☐ Random order

4. Make a bar chart for all the fixed animals

name	species	age	fixed	legs	pounds	weeks
Sasha	cat	1	FALSE	4	6.5	3

- ☐ Relevant columns
- ☐ Representative sample of rows
- ☐ Random order

Table Plan

Define a function `bar-kitten-adoption`, which takes in a Table of animals and creates a bar chart showing how many weeks it took for each kitten to be adopted

Contract and Purpose

_____ : _____ → _____

_____

Examples

Make a Start Table and a result based on that table.

_____ → _____

Define the function

Use the relevant methods (circle your helper functions!), then produce a result with the new table.

fun _____ (_____) :

t = _____

_____

_____

_____

_____

end

Define the table

Are there more columns?

Are there fewer rows?

Are the rows ordered?

Produce the result

Table Plan

Contract and Purpose

_____ : _____ → _____

_____

Examples

Make a Start Table and a result based on that table.

_____ → _____

Define the function

Use the relevant methods (circle your helper functions!), then produce a result with the new table.

fun _____ (_____) :

t = _____

_____

_____

_____

_____

end

Define the table

Are there more columns?

Are there fewer rows?

Are the rows ordered?

Produce the result

Table Plan

Contract and Purpose

_____ : _____ → _____

_____

Examples

Make a Start Table and a result based on that table.

_____ → _____

Define the function

Use the relevant methods (circle your helper functions!), then produce a result with the new table.

fun _____ (_____) :

t = _____

_____

_____

_____

_____

end

Define the table

Are there more columns?

Are there fewer rows?

Are the rows ordered?

Produce the result

My Dataset

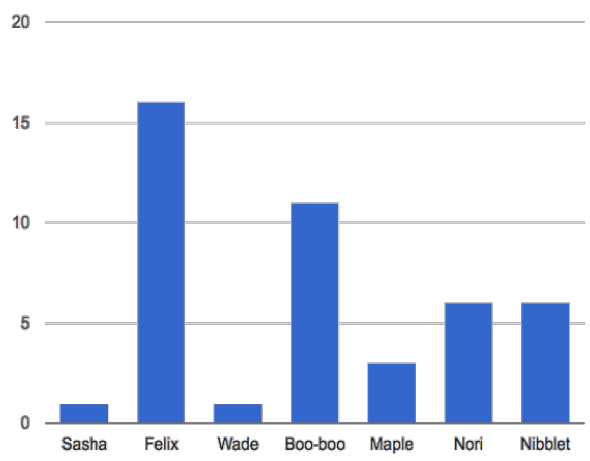
What charts did you make, and what do you notice about them? Fill in the table below.

Based on a _____ chart of _____	**I notice that _____**

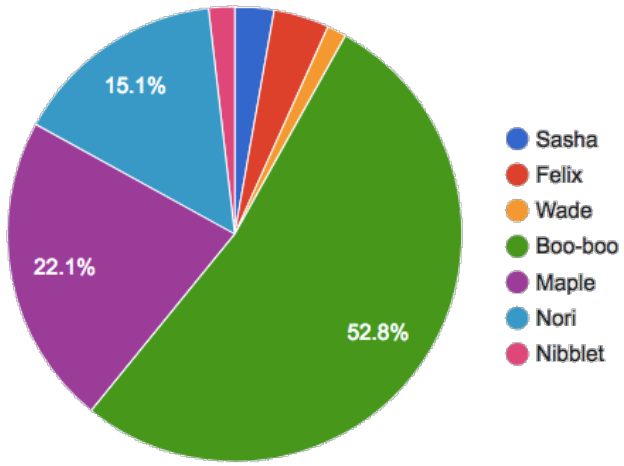
Unit 6

Visualizing Quantity (Review)

Use the charts below to help you answer the questions.



Animals Ages (yrs)



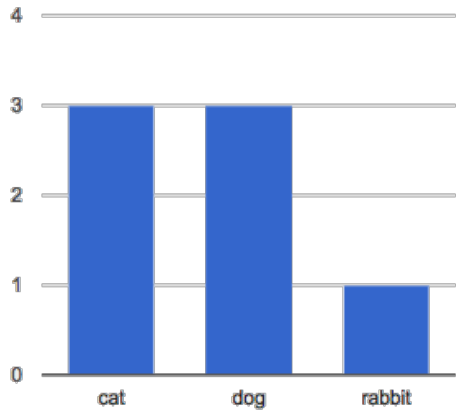
Animals Weights (lbs)

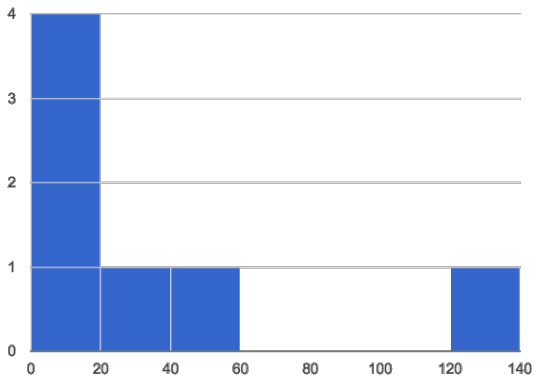
1. Which animal(s) is the heaviest? _____
2. Which animal(s) is the youngest? _____
3. How much of the *total weight* comes from Maple? _____
4. How much of the *combined age* comes from Nori? _____
5. Which chart did you use for questions 1 and 2? _____
6. Which chart did you use for questions 3 and 4? _____
7. Why are some questions easier to answer with one kind of chart or another?

Visualizing Frequency

name	species	age	pounds
"Sasha"	"cat"	1	6.5
"Boo-boo"	"dog"	11	123
"Felix"	"cat"	16	9.2
"Buddy"	"lizard"	2	0.3
"Nori"	"dog"	6	35.3
"Wade"	"cat"	1	3.2
"Nibblet"	"rabbit"	6	4.3
"Maple"	"dog"	3	51.6

1. How many cats are there? _____
2. How many dogs are there? _____
3. How many animals are between 3-6 years old? _____
4. How many weigh between 0-5 pounds? _____
5. Are there more animals weighing 0-5 than 6-10 pounds? _____
6. The charts below are based on the Sample Table above. What is each one measuring? Write down your guess underneath each one.





_____ _____

_____ _____

_____ _____

_____ _____

Table Plan

Define a function `bar-gender`, which takes in a Table of animals and creates a frequency bar chart showing how many animals are male v. female.

Contract and Purpose

_____ : _____ → _____

_____

Examples

Make a Start Table and a result based on that table.

_____ → _____

Define the function

Use the relevant methods (circle your helper functions!), then produce a result with the new table.

fun _____ (_____) :

t = _____

_____

_____

_____

_____

end

Define the table

Are there more columns?

Are there fewer rows?

Are the rows ordered?

Produce the result

Table Plan

Define a function `histogram-adoption`, which takes in a Table of animals and creates a histogram showing how long it took for animals to get adopted

Contract and Purpose

_____ : _____ → _____

_____

Examples

Make a Start Table and a result based on that table.

_____ → _____

Define the function

Use the relevant methods (circle your helper functions!), then produce a result with the new table.

fun _____ (_____) :

t = _____

_____

_____

_____

_____

end

Define the table

Are there more columns?

Are there fewer rows?

Are the rows ordered?

Produce the result

Frequency in my Dataset

What charts did you make, and what do you notice about them? Fill in the table below.

Based on a _____ chart of _____	**I notice that _____**

Unit 7

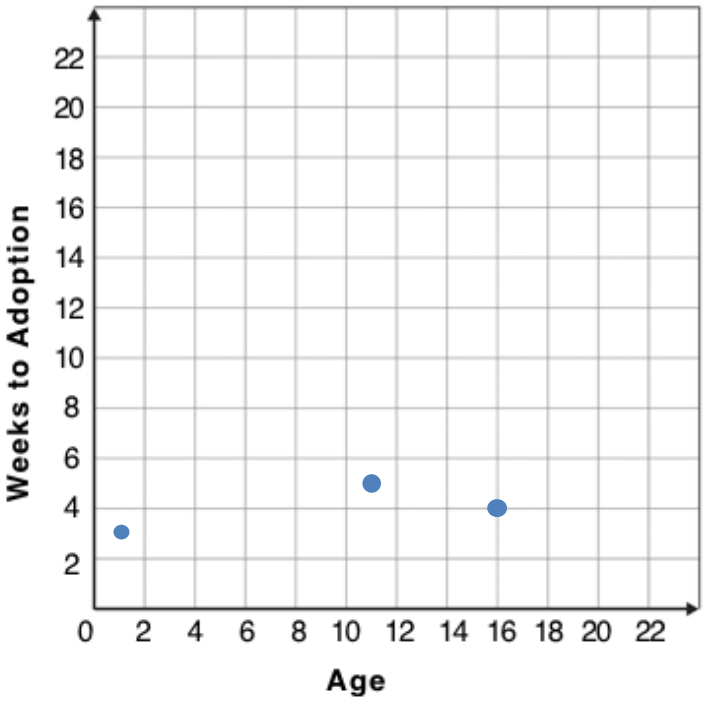
"Younger animals are cuter, so they get adopted faster."
Do you agree?

I hypothesize…

I found…

Creating a Scatter Plot

name	species	age	weeks
"Sasha"	"cat"	1	3
"Boo-boo"	"dog"	11	5
"Felix"	"cat"	16	4
"Buddy"	"lizard"	2	24
"Nori"	"dog"	6	9
"Wade"	"cat"	1	2
"Nibblet"	"rabbit"	6	12
"Maple"	"dog"	3	2



1. **For each row in the Sample Table on the left, add a point to the scatter plot on the right**. The first 3 rows have been completed for you. Use the values from the `age` column for the x-axis, and values from the `weeks` column for the y-axis.

2. Do you see a pattern *(or "correlation")*? Do the points seem to shift up or down as age increases? **Draw a line on the scatter plot to show this pattern**.

3. Is this correlation positive or negative? _____

4. Is this correlation strong or weak? _____

Table Plan

Define a function `dogs-age-weeks`, which takes in a Table of animals and creates a scatter plot of all the dogs, tracking their `age` on the x-axis and the number of `weeks` it took for them to be adopted on the y-axis.

Contract and Purpose

_____ : _____ → _____

_____

Examples

Make a Start Table and a result based on that table.

_____ → _____

Define the function

Use the relevant methods (circle your helper functions!), then produce a result with the new table.

```
fun _____ (_____) :
  t = _____
      _____
      _____
      _____
      _____
end
```

Define the table

Are there more columns?

Are there fewer rows?

Are the rows ordered?

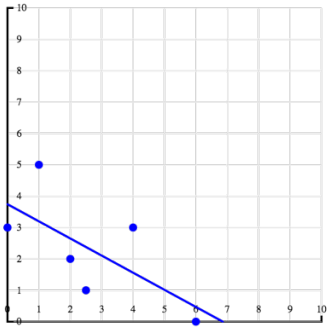
Produce the result

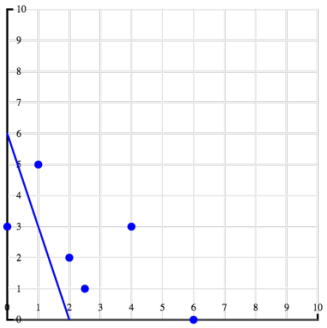
Grading Correlations

Below are the scatterplots for data sets A-D, with two different lines drawn to show possible correlations. For each data set,

1. **Circle the plot with the line that fits better**
2. **Give it a grade between 0 (no correlation) and 1 (perfect correlation)**

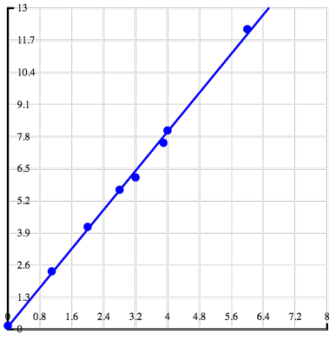
A

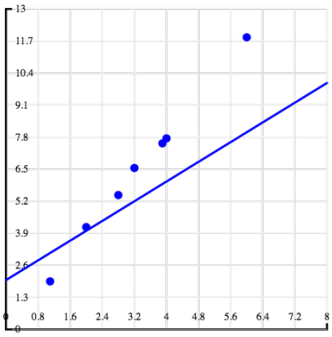




Strength of Correlation: _____

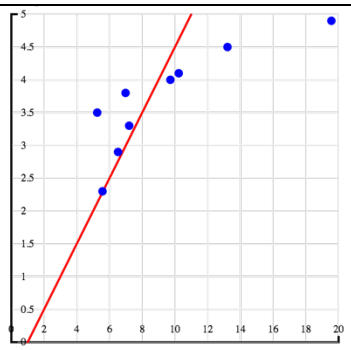
B

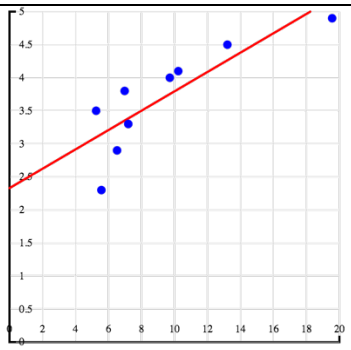




Strength of Correlation: _____

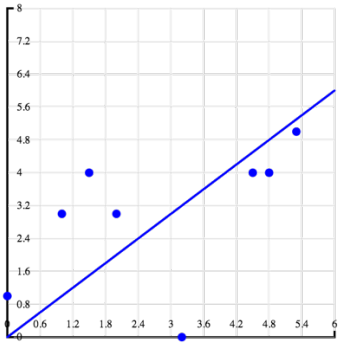
C

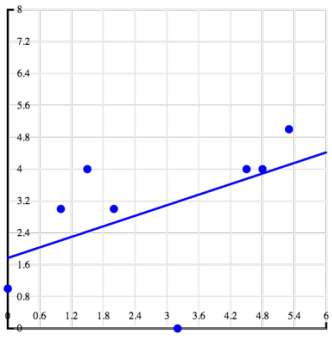




Strength of Correlation: _____

C





Strength of Correlation: _____

Possible Correlations

1) I believe there may be a correlation between _____ and
column

_____ in my dataset. I think it is a _____,
column strong / weak

_____ correlation, because _____
positive / negative

_____. I also

want to look at _____.
a subset or extension of my data

---

2) I believe there may be a correlation between _____ and
column

_____ in my dataset. I think it is a _____,
column strong / weak

_____ correlation, because _____
positive / negative

_____. I also

want to look at _____.
a subset or extension of my data

---

3) I believe there may be a correlation between _____ and
column

_____ in my dataset. I think it is a _____,
column strong / weak

_____ correlation, because _____
positive / negative

_____. I also

want to look at _____.
a subset or extension of my data

Unit 8

Unit 9

Contracts

Name	Domain		Range
triangle	:: (side :: *Number*, style :: *String*, color :: *String*)	→	*Image*
circle	:: (radius :: *Number*, style :: *String*, color :: *String*)	→	*Image*
star	:: (radius :: *Number*, style :: *String*, color :: *String*)	→	*Image*
rectangle	:: (width :: *Num*, height :: *Num*, style :: *Str*, color :: *Str*)	→	*Image*
ellipse	:: (width :: *Num*, height :: *Num*, style :: *Str*, color :: *Str*)	→	*Image*
square	:: (size :: *Number*, style :: *String*, color :: *String*)	→	*Image*
text	:: (str :: *String*, size :: *Number*, color :: *String*)	→	*Image*
overlay	:: (img1 :: *Image*, img2 :: *Image*)	→	*Image*
rotate	:: (degree :: *Number*, img :: *Image*)	→	*Image*
scale	:: (factor :: *Number*, img :: *Image*)	→	*Image*
string-repeat	:: (text :: *String*, repeat :: *Number*)	→	*String*
num-sqr	:: (n :: *Number*)	→	*Number*
num-sqrt	:: (n :: *Number*)	→	*Number*
num-min	:: (a :: *Number, b:: Number*)	→	*Number*
num-max	:: (a :: *Number, b:: Number*)	→	*Number*
get-row	:: (t :: *Table, index :: Number*)	→	*Row*

Contracts

Name	Domain		Range
<Table>.row-n	:: (n :: *Number*)	→	*Row*
<Table>.filter	:: (test :: *(Row → Boolean)*)	→	*Table*
<Table>.build-column	:: (col :: *String*, *builder* :: *(Row → Value)*)	→	*Table*
mean	:: (t :: *Table*, col :: *String*)	→	*Number*
median	:: (t :: *Table*, col :: *String*)	→	*Number*
modes	:: (t :: *Table*, col :: *String*)	→	*List<Number>*
bar-chart	:: (t :: *Table*, labels :: *String*, values :: *String*)	→	*Image*
pie-chart	:: (t :: *Table*, labels :: *String*, values :: *String*)	→	*Image*
freq-bar-chart	:: (t :: *Table*, values :: *String*)	→	*Image*
histogram	:: (t :: *Table*, values :: *String*, bin-width :: *Number*)	→	*Image*
scatter-plot	:: (t :: *Table*, xs :: *String*, ys :: *String*)	→	*Image*
labeled-scatter-plot	:: (t :: *Table*, labels :: *String*, xs :: *String*, ys :: *String*)	→	*Image*
labeled-lr-plot	:: (t :: *Table*, labels :: *String*, xs :: *String*, ys :: *String*)	→	*Image*
lr-plot	:: (t :: *Table*, xs :: *String*, ys :: *String*)	→	*Image*
	::	→	
	::	→	