1 01:00:45:19 01:00:48:29 MAN:
How is the data distributed
for the different years?
2 01:00:49:01 01:00:51:22 I want them
to experience statistics
3 01:00:51:24 01:00:53:25 as a problem-solving process.
4 01:00:53:27 01:00:57:10 WOMAN:
Statistics is detective work.
5 01:00:57:12 01:01:00:19 Will exercising
make you live longer?
6 01:01:00:21 01:01:02:21 Are hormones good or bad
for your heart?
7 01:01:03:23 01:01:04:25 170.
8 01:01:04:27 01:01:06:10 MAN:
Why aren't people, through time
9 01:01:06:12 01:01:07:26 getting taller?
10 01:01:07:28 01:01:10:09 What are
the socioeconomic causes?
11 01:01:12:17 01:01:15:12 Statistics is a process,
a vision of learning.
12 01:01:19:10 01:01:20:18 The problem I'd like
to study is
13 01:01:20:20 01:01:23:01 how do coins circulate
throughout the country?
14 01:01:23:03 01:01:24:10 I'm from the Southeast.
15 01:01:24:12 01:01:25:25 I live on the East Coast.
16 01:01:25:27 01:01:28:13 And what I've done is I've
collected a large collection
17 01:01:28:15 01:01:30:25 of nickels over time. Okay?
18 01:01:30:27 01:01:33:07 And I'd like to know-- where
did those nickels come from
19 01:01:33:09 01:01:34:25 and how did they end up
in my hands?
20 01:01:34:27 01:01:38:03 The activity is designed
to familiarize teachers
21 01:01:38:05 01:01:40:22 with different ways
to represent data.
22 01:01:40:24 01:01:43:05 NARRATOR:
The teachers begin the activity
23 01:01:43:07 01:01:47:17 by using magnifying glasses
to examine the coins.
24 01:01:47:19 01:01:48:28 KADER:
Just look to see
25 01:01:49:00 01:01:51:12 if there's anything on the coin
that might help you
26 01:01:51:14 01:01:53:24 and you might have to look
at more than one coin.
27 01:01:53:26 01:01:55:07 (*teachers conversing*)
28 01:01:55:09 01:01:57:10 KADER:
Sue, tell us what
you've discovered.
29 01:01:57:12 01:01:58:17 Well, I looked
on the back
30 01:01:58:19 01:02:00:07 and I just saw
the normal stuff.
31 01:02:00:09 01:02:02:00 And on the front

there's something--

32 01:02:02:02 01:02:03:09 I don't know
what it means.

33 01:02:03:11 01:02:07:06 There's a "D" on one
and a "P" on three of them.

34 01:02:07:08 01:02:08:18 Are any others finding those?

35 01:02:08:20 01:02:09:18 A "P"?

36 01:02:09:20 01:02:11:14 Okay, two Ps.

37 01:02:11:16 01:02:13:18 Anybody else finding these?

38 01:02:13:20 01:02:15:19 You've got all Ps.

39 01:02:15:21 01:02:19:06 KADER:
In today's session, I wanted
to introduce some of the ways

40 01:02:19:08 01:02:22:23 we analyze data in order
to focus on the variation

41 01:02:22:25 01:02:24:26 that's present in that data.

42 01:02:24:28 01:02:27:12 MAN:
One of those San Francisco
coins.

43 01:02:27:14 01:02:31:10 WOMAN:
Yeah, the older ones, so...

44 01:02:31:12 01:02:32:24 If all the data were the same

45 01:02:32:26 01:02:35:07 the solution to the...
to the problem would be easy.

46 01:02:35:09 01:02:36:07 But they're not.

47 01:02:36:09 01:02:37:21 The data values are different.

48 01:02:37:23 01:02:38:21 There is variation.

49 01:02:38:23 01:02:41:04 WOMAN:
1990s.

50 01:02:41:06 01:02:43:26 WOMAN 2:
So it had...
it depends on the year.

51 01:02:43:28 01:02:46:00 WOMAN:
These are all Ps.

52 01:02:46:02 01:02:50:23 KADER:
Okay, I think I've heard some Ps
and some Ds and some nothings.

53 01:02:50:25 01:02:54:28 Are... are all of you finding
some of those sorts of things?

54 01:02:55:00 01:03:00:14 I'd like to hear some hypotheses
about the "P" and the "D" coins.

55 01:03:00:16 01:03:03:10 I think maybe that the "P"
and the "D" is an initial.

56 01:03:03:12 01:03:04:20 KADER:
Uh-huh, an initial.

57 01:03:04:22 01:03:06:03 For maybe the place
it was minted.

58 01:03:06:05 01:03:07:09 "The place it was minted."

59 01:03:07:11 01:03:08:26 Turns out that's right.

60 01:03:08:28 01:03:12:00 NARRATOR:
Next, Professor Kader
asks the question

61 01:03:12:02 01:03:13:09 "Where are the coins minted?"

62 01:03:13:11 01:03:14:15 KADER:
Do you have any idea

63 01:03:14:17 01:03:16:04 what... what the "P"

might stand for?

64 01:03:16:06 01:03:17:04 CLASS:
Philadelphia.

65 01:03:17:06 01:03:18:04 "Philadelphia."

66 01:03:18:06 01:03:19:17 It turns out that Philadelphia

67 01:03:19:19 01:03:21:20 is one of the mint locations
in the United States.

68 01:03:21:22 01:03:23:00 What about the "D"?

69 01:03:23:02 01:03:25:00 Can anyone tell me where
the Ds are minted?

70 01:03:25:02 01:03:26:09 The "D" coin, from Denver.

71 01:03:26:11 01:03:28:02 From Denver--
that's exactly right.

72 01:03:28:04 01:03:30:19 What about the coins
without a mint mark?

73 01:03:30:21 01:03:31:28 Hmm.

74 01:03:32:00 01:03:34:01 Would you agree that
that may be a problem

75 01:03:34:03 01:03:36:28 if I want to know something
about how the coins circulate?

76 01:03:37:00 01:03:39:01 There's actually
another mint location

77 01:03:39:03 01:03:41:13 and we're going to see
this one on my coins.

78 01:03:41:15 01:03:43:13 Some coins will have
an "S" on them.

79 01:03:43:15 01:03:46:04 And you may not have found any
with an "S" on them.

80 01:03:46:06 01:03:49:10 Can anyone... anyone have any
idea what "S" might stand for?

81 01:03:49:12 01:03:50:10 Yes.

82 01:03:50:12 01:03:51:13 San Francisco?

83 01:03:51:15 01:03:53:13 KADER:
"San Francisco."

84 01:03:53:15 01:03:55:07 Why do those locations
make sense?

85 01:03:55:09 01:03:56:17 Coastal sections
of our country.

86 01:03:56:19 01:03:57:20 KADER:
And Denver, where?

87 01:03:57:22 01:03:58:10 MAN:
Middle.

88 01:03:58:12 01:03:59:12 In the middle.

89 01:03:59:14 01:04:00:24 It makes sense you would have

90 01:04:00:26 01:04:02:15 some coins minted
on the East Coast

91 01:04:02:17 01:04:05:19 maybe some towards the central,
and some towards the west.

92 01:04:05:21 01:04:07:03 Now, this is your task.

93 01:04:07:05 01:04:09:27 The data that we're collecting
is mint location.

94 01:04:09:29 01:04:12:11 Okay, it's either going to be

95 01:04:12:13 01:04:15:09 a "P," a "D," an "S"
or a nothing.

96 01:04:15:11 01:04:17:13 Your task right now

97 01:04:17:15 01:04:21:07 is to separate your collection

			of coins on your table
98	01:04:21:09	01:04:22:23	into the four groups.
99	01:04:25:12	01:04:28:28	I'm curious to see the relation between the dates and the...
100	01:04:29:00	01:04:29:28	and the mint.
101	01:04:30:00	01:04:30:29	Yeah, the older ones...
102	01:04:31:01	01:04:33:21	Well, like, I'm sure this is old.
103	01:04:33:23	01:04:35:23	I found an "S"!
104	01:04:35:25	01:04:39:13	NARRATOR: The teachers finish separating the coins by mint mark
105	01:04:39:15	01:04:41:22	and bring them to the front of the room.
106	01:04:41:24	01:04:47:01	The coins from Philadelphia are represented by the letter "P";
107	01:04:47:03	01:04:50:23	the coins without a mint mark by the letter "N" for "nothing";
108	01:04:50:25	01:04:54:28	the coins from Denver by a "D";
109	01:04:55:00	01:04:58:19	and the coins from San Francisco by an "S."
110	01:04:58:21	01:05:01:26	KADER: If we could all gather around.
111	01:05:01:28	01:05:03:20	What can you say about
112	01:05:03:22	01:05:08:17	the way the mint marks or the mint locations are distributed
113	01:05:08:19	01:05:11:24	among the four cities for this collection of coins?
114	01:05:11:26	01:05:13:22	We have a lot more from Philadelphia.
115	01:05:13:24	01:05:15:16	KADER: "A lot more from Philadelphia."
116	01:05:15:18	01:05:16:16	Okay.
117	01:05:16:18	01:05:18:15	Other observations?
118	01:05:18:17	01:05:21:15	WOMAN: San Francisco either doesn't produce many
119	01:05:21:17	01:05:22:20	or we don't have many here.
120	01:05:22:22	01:05:23:25	KADER: Okay.
121	01:05:23:27	01:05:26:01	WOMAN: You said that you have been
122	01:05:26:03	01:05:27:16	collecting these coins throughout...
123	01:05:27:18	01:05:29:04	KADER: Over time, for about 20 years
124	01:05:29:06	01:05:30:14	throughout your travels.
125	01:05:30:16	01:05:32:18	So if all the mints produced the same number
126	01:05:32:20	01:05:35:12	those piles should all be the same.
127	01:05:35:14	01:05:38:10	Okay, now that's another good

question right there, actually.

128 01:05:38:12 01:05:40:17 One of the issues
you've raised is:

129 01:05:40:19 01:05:43:28 Is there uniformity
in the way the coins are made?

130 01:05:44:00 01:05:46:12 So that's one of the fuzzy
things about this data.

131 01:05:46:14 01:05:47:19 Okay. Paul?

132 01:05:47:21 01:05:49:09 PAUL:
Where did you
collect all these?

133 01:05:49:11 01:05:51:00 Were they from this side
of the country?

134 01:05:51:02 01:05:53:15 KADER:
Okay, I have... I have lived

135 01:05:53:17 01:05:54:24 on the East Coast all my life.

136 01:05:54:26 01:05:56:00 And although
I have traveled

137 01:05:56:02 01:05:57:24 to the western part
of the United States

138 01:05:57:26 01:06:01:25 I have never been there
for an extended period of time.

139 01:06:01:27 01:06:04:13 Let's talk a little bit
about the "N" coins.

140 01:06:04:15 01:06:07:04 I will tell you one thing
about the "N" coins.

141 01:06:07:06 01:06:09:28 They come from one
of the three other cities.

142 01:06:10:00 01:06:12:08 They were made
in either Philadelphia

143 01:06:12:10 01:06:13:25 San Francisco or Denver.

144 01:06:13:27 01:06:15:10 Phil, what's
your hypothesis?

145 01:06:15:12 01:06:16:14 I said San Francisco.

146 01:06:16:16 01:06:17:14 "San Francisco."

147 01:06:17:16 01:06:18:24 Why do you say that?

148 01:06:18:26 01:06:21:00 Because I think it should
be close to Denver.

149 01:06:21:02 01:06:22:19 They're both West... West Coast

150 01:06:22:21 01:06:25:02 and if every mint
is making the same amount

151 01:06:25:04 01:06:27:13 then it would go to the one
that has very few.

152 01:06:27:15 01:06:29:24 KADER:
Okay, that... that's
a very reasonable answer.

153 01:06:29:26 01:06:32:02 WOMAN:
I think they're actually
from Philadelphia...

154 01:06:32:04 01:06:33:26 because it seems
it would make more sense

155 01:06:33:28 01:06:35:20 if you collected them
on the East Coast

156 01:06:35:22 01:06:38:20 and also we were talking
about the mints themselves

157 01:06:38:22 01:06:41:27 and that perhaps... well,

why would they not even have
158 01:06:41:29 01:06:44:10 you know, a "P" or a "D"
or an "S" on it.
159 01:06:44:12 01:06:46:24 So we were thinking maybe
it might be because...
160 01:06:46:26 01:06:48:15 was Philadelphia the first mint?
161 01:06:48:17 01:06:51:03 And perhaps they didn't have
that "P" in their mold
162 01:06:51:05 01:06:53:25 because why would they if there
were no other mints?
163 01:06:53:27 01:06:55:24 KADER:
If you had to guess
fractionally....
164 01:06:55:26 01:06:58:18 statisticians like to think
in fractional terms
165 01:06:58:20 01:07:01:11 like... numbers like a half,
a third, a fourth
166 01:07:01:13 01:07:03:14 or percentage terms
are even better.
167 01:07:03:16 01:07:06:15 How would you say these are
distributed fractionally?
168 01:07:06:17 01:07:08:03 Yes.
169 01:07:08:05 01:07:11:10 WOMAN:
I think if we pulled all
the coins back in the middle
170 01:07:11:12 01:07:13:24 it looks as if half
have gone to Philadelphia
171 01:07:13:26 01:07:16:14 and then the other half
have been... maybe not evenly
172 01:07:16:16 01:07:18:06 but distributed
between these two.
173 01:07:18:08 01:07:20:03 Yeah, okay, so that's
about half and then...
174 01:07:20:05 01:07:22:11 KADER:
We try to think
in terms of fractions
175 01:07:22:13 01:07:25:02 or relative frequencies
in statistics
176 01:07:25:04 01:07:27:04 and not just actual *counts.*
177 01:07:27:06 01:07:29:25 And that... that's
one of the things
178 01:07:29:27 01:07:32:25 that many students
have difficulty with
179 01:07:32:27 01:07:36:01 is learning to...
to think proportionally.
180 01:07:36:03 01:07:38:11 So do you agree that
if I take the "S" coins off
181 01:07:38:13 01:07:39:25 it shouldn't matter
too much?
182 01:07:39:27 01:07:42:18 NARRATOR:
Professor Kader removes
the "S" coins.
183 01:07:42:20 01:07:44:06 Due to their small number
184 01:07:44:08 01:07:46:16 they will not affect
the analysis significantly.
185 01:07:46:18 01:07:49:08 KADER:

			So again, this is what I'd like to do, okay?
186	01:07:49:10	01:07:50:18	I'm going to take this string.
187	01:07:50:20	01:07:52:19	I agree, it looks to about half for over here
188	01:07:52:21	01:07:56:00	so I'm going to separate them with that string.
189	01:07:57:26	01:08:00:29	Okay, and I'm going to take this piece of string right here
190	01:08:01:01	01:08:04:05	and I'm going to separate them this way.
191	01:08:04:07	01:08:08:20	What I'd like you to do is try to form a circle with the coins
192	01:08:08:22	01:08:12:09	keeping them in their respective parts.
193	01:08:12:11	01:08:16:25	And again that point right here is the center of our circle.
194	01:08:16:27	01:08:17:29	Yes.
195	01:08:21:02	01:08:23:04	WOMAN: So, we're making a pie graph, basically.
196	01:08:23:06	01:08:25:14	KADER: Ah, Kim, you recognized the pie chart.
197	01:08:25:16	01:08:26:14	(*laughing*)
198	01:08:26:16	01:08:27:26	Yeah, once I got the nickel part
199	01:08:27:28	01:08:28:28	I could get the pie part.
200	01:08:29:00	01:08:30:13	(*all laughing*)
201	01:08:30:15	01:08:33:02	KADER: In this session, I wanted to introduce them
202	01:08:33:04	01:08:34:23	to some of the standard graphs
203	01:08:34:25	01:08:37:24	that we use to represent the distribution for that data.
204	01:08:37:26	01:08:41:21	By studying the distribution, we hope to identify patterns
205	01:08:41:23	01:08:44:05	that may be present in that variation
206	01:08:44:07	01:08:46:23	and that's the purpose of the analysis
207	01:08:46:25	01:08:49:08	is to try to draw out those patterns.
208	01:08:49:10	01:08:51:14	KADER: Now to go back to my question--
209	01:08:51:16	01:08:54:09	"how do coins circulate throughout the country?"
210	01:08:54:11	01:08:57:20	An answer to that question clearly depends on what?
211	01:08:57:22	01:08:58:29	CLASS: Where you live.
212	01:08:59:01	01:09:01:06	Where I live, but what is it about the coins
213	01:09:01:08	01:09:03:18	that really... to answer that question, I need to know?

214	01:09:03:20	01:09:05:09	MAN: Need to know how you collected them.
215	01:09:05:11	01:09:07:03	KADER: "Need to know how I collected them."
216	01:09:07:05	01:09:09:08	There's something else about those coins--
217	01:09:09:10	01:09:11:19	we're looking at it right there on that pie chart.
218	01:09:11:21	01:09:13:14	(*teachers giving* *different answers*)
219	01:09:13:16	01:09:15:05	KADER: Where these "N" coins come from
220	01:09:15:07	01:09:17:12	and they come from one of the other three cities
221	01:09:17:14	01:09:19:19	and we've already had some hypotheses about them.
222	01:09:19:21	01:09:21:05	One thing that was suggested was--
223	01:09:21:07	01:09:23:21	"Well, I noticed some of the dates on those coins were..."
224	01:09:23:23	01:09:24:22	CLASS: The '70s.
225	01:09:24:24	01:09:25:26	In the '70s, okay.
226	01:09:25:28	01:09:27:17	Well, so this is what I'd like to do.
227	01:09:27:19	01:09:29:06	I'd like to see, can we figure out
228	01:09:29:08	01:09:31:07	where the "N" coins come from
229	01:09:31:09	01:09:34:08	by looking at the dates on those "N" coins?
230	01:09:34:10	01:09:36:16	NARRATOR: In order to answer the question:
231	01:09:36:18	01:09:38:09	"Where are the 'N' coins minted?"
232	01:09:38:11	01:09:42:08	Professor Kader introduces the next step of the activity.
233	01:09:42:10	01:09:46:08	KADER: Your assignment is to separate the coins by date.
234	01:09:46:10	01:09:49:11	For the "S" coins on this particular graph
235	01:09:49:13	01:09:52:11	just place them and form a line plot.
236	01:09:52:13	01:09:55:02	So there will be four of these up here.
237	01:09:55:04	01:09:56:17	I'll put the Ss up top here.
238	01:09:56:19	01:09:58:07	And I'm just going to have one
239	01:09:58:09	01:10:00:06	for each of the other mint locations:
240	01:10:00:08	01:10:02:20	"P", "D" and "N", okay?
241	01:10:02:22	01:10:04:29	And... '77.
242	01:10:05:01	01:10:06:07	'77.
243	01:10:06:09	01:10:09:04	This is '76.

244 01:10:09:06 01:10:11:13 NARRATOR:
The teachers separate
the coins by year
245 01:10:11:15 01:10:13:25 and then place them
on the appropriate line plot.
246 01:10:13:27 01:10:16:07 (*teachers conversing*)
247 01:10:16:09 01:10:19:29 KADER:
For each location
248 01:10:20:01 01:10:24:18 how is the data distributed
for the different years?
249 01:10:24:20 01:10:28:20 WOMAN:
I noticed that the "S"
are '68, '69, '70
250 01:10:28:22 01:10:31:23 and then the "N" coins pick up
in '71 only till '79
251 01:10:31:25 01:10:35:14 and then the "P" coins pick up
in '80... for whatever reason.
252 01:10:35:16 01:10:36:29 KADER:
You got there so quickly.
253 01:10:37:01 01:10:39:20 (*class and Kader laughing*)
254 01:10:39:22 01:10:42:06 Well, okay, that's really what
I really want you to observe.
255 01:10:42:08 01:10:43:18 It's kind of an interesting...
256 01:10:43:20 01:10:45:25 Now wait, we've left one
of the groups of coins out.
257 01:10:45:27 01:10:46:23 Which one?
258 01:10:46:25 01:10:47:23 CLASS:
"D", Denver.
259 01:10:47:25 01:10:49:22 What about
the Denver coins?
260 01:10:49:24 01:10:52:09 SUE:
They've been minting all along.
261 01:10:52:11 01:10:53:20 They go all the way.
262 01:10:53:22 01:10:55:07 Okay?
263 01:10:55:09 01:11:00:22 So, my question is,
where do you think
the "N" coins are minted
264 01:11:00:24 01:11:03:23 based on what
we see here?
265 01:11:03:25 01:11:06:18 Well, in '68, '69 and '70
there's an "S" on them
266 01:11:06:20 01:11:10:00 so wouldn't it make sense
that they would continue to...
267 01:11:10:02 01:11:11:20 Why would they take
the "S" off, okay?
268 01:11:11:22 01:11:13:28 It turns out that's actually
what... exactly right.
269 01:11:14:00 01:11:16:14 So, where do you think the coins
were minted again...
270 01:11:16:16 01:11:18:16 of the three,
either San Francisco
271 01:11:18:18 01:11:20:00 Denver or Philadelphia?
272 01:11:20:02 01:11:21:00 CLASS:
Philadelphia.
273 01:11:21:02 01:11:22:08 "Philadelphia."
274 01:11:22:10 01:11:24:10 What does that say

275 01:11:24:12 01:11:26:13 about how the coins circulate?
276 01:11:26:15 01:11:29:14 Well, again, we don't know
how many were made at each mint
277 01:11:29:16 01:11:31:20 but I sure have a lot of coins
from where?
278 01:11:31:22 01:11:32:25 CLASS:
Philadelphia.
279 01:11:32:27 01:11:34:26 "Philadelphia"--
from the East Coast.
280 01:11:34:28 01:11:36:08 NARRATOR:
Since the "S" coins
281 01:11:36:10 01:11:38:05 were being minted
prior to the "N" coins
282 01:11:38:07 01:11:40:04 and the "D" coins
were minted throughout
283 01:11:40:06 01:11:41:20 the teachers eliminate
284 01:11:41:22 01:11:44:11 the San Francisco and
Denver mints from consideration.
285 01:11:44:13 01:11:46:13 Since the "P" coins
began minting
286 01:11:46:15 01:11:48:29 immediately after
the "N" coins stopped
287 01:11:49:01 01:11:50:13 the teachers conclude
288 01:11:50:15 01:11:54:02 that Philadelphia is where
the "N" coins were minted.
289 01:11:54:04 01:11:56:18 KADER:
These different representations
290 01:11:56:20 01:12:01:16 allow us to focus on potential
patterns in the variation.
291 01:12:01:18 01:12:04:09 There's no guarantee
when we look at a pie chart
292 01:12:04:11 01:12:07:29 or when we look at a line plot,
or when we look at a bar graph
293 01:12:08:01 01:12:10:02 that there will be
a pattern there.
294 01:12:10:04 01:12:14:10 That's why we have more
than one representation.
295 01:12:14:12 01:12:17:22 But hopefully we can see
something there
296 01:12:17:24 01:12:19:29 that helps us go back
and address our question
297 01:12:20:01 01:12:21:24 in a better way.
298 01:12:21:26 01:12:23:15 We want to move
up a level
299 01:12:23:17 01:12:26:27 in terms of the amount
of information in our data.
300 01:12:26:29 01:12:29:10 We want to look
at the problem
301 01:12:29:12 01:12:33:22 of how many raisins are in
a box of raisins this size?
302 01:12:33:24 01:12:35:01 Does anyone have any idea
303 01:12:35:03 01:12:37:18 about how many raisins
would be in this box?
304 01:12:37:20 01:12:38:29 I'd think about 23.
305 01:12:39:01 01:12:40:28 PAUL:
I think there'll be

306 01:12:41:00 01:12:42:13 approximately 65.
307 01:12:42:15 01:12:44:00 KADER:
Sixty-five.
308 01:12:44:02 01:12:45:24 Any other guesses?
309 01:12:45:26 01:12:47:02 I was going to say around 50.
310 01:12:47:04 01:12:48:09 That's what
we want to know.
311 01:12:48:11 01:12:50:14 Get the basket
under your table.
312 01:12:50:16 01:12:53:21 NARRATOR:
The teachers divide
into four groups.
313 01:12:53:23 01:12:56:03 Each group has a different brand
of raisins.
314 01:12:56:05 01:12:57:17 So, do all boxes of raisins--
315 01:12:57:19 01:12:59:05 one-half-ounce boxes
of raisins--
316 01:12:59:07 01:13:00:27 have the same number of raisins?
317 01:13:00:29 01:13:02:27 And we're sort of getting
experienced of this--
318 01:13:02:29 01:13:04:13 we would expect
the answer to be...
319 01:13:04:15 01:13:05:13 CLASS:
No.
320 01:13:05:15 01:13:06:23 Now that we're
doing statistics
321 01:13:06:25 01:13:07:18 we know we have...
322 01:13:07:20 01:13:08:18 CLASS:
Variation.
323 01:13:08:20 01:13:10:16 Variation, variation in data.
324 01:13:10:18 01:13:13:14 So we sort of expect
the answer to be "no."
325 01:13:13:16 01:13:15:11 KADER:
The main point of the activity
326 01:13:15:13 01:13:17:22 is to recognize that
when I asked the question
327 01:13:17:24 01:13:19:29 "How many raisins
are in a box of raisins?"
328 01:13:20:01 01:13:21:08 there isn't *one* answer.
329 01:13:21:10 01:13:23:15 That's because there's
variation present
330 01:13:23:17 01:13:24:26 in the number of raisins
331 01:13:24:28 01:13:27:00 in the boxes of raisins
that we have.
332 01:13:27:02 01:13:28:22 KADER:
Okay.
333 01:13:28:24 01:13:32:26 So I want you to, for each box,
find the number of raisins.
334 01:13:32:28 01:13:38:17 And I want you to create
a line plot for the results.
335 01:13:40:18 01:13:42:07 KADER:
By looking at a line plot--
336 01:13:42:09 01:13:44:25 which is a pretty basic way
of representing the idea
337 01:13:44:27 01:13:47:08 of what's called
the distribution for the data--

338	01:13:47:10	01:13:50:04	we're starting to focus our attention
339	01:13:50:06	01:13:51:26	on the variation present in that data.
340	01:13:51:28	01:13:53:12	Twenty-seven.
341	01:13:53:14	01:13:54:25	MAN: Okay, thank you.
342	01:13:54:27	01:13:56:28	27 and 17...
343	01:13:57:00	01:14:00:12	KADER: Seventeen, hmm.
344	01:14:00:14	01:14:02:11	I guessed 19.
345	01:14:02:13	01:14:03:16	Did you guess before?
346	01:14:03:18	01:14:04:28	If they were M&M's
347	01:14:05:00	01:14:06:14	we'd be eating them.
348	01:14:06:16	01:14:08:19	But I had very, very plump raisins.
349	01:14:08:21	01:14:10:27	KADER: So that meant you had what?
350	01:14:10:29	01:14:12:19	Less.
351	01:14:10:29	01:14:12:19	Fewer raisins, ah.
352	01:14:12:21	01:14:15:10	KADER: How's it going over here, guys?
353	01:14:15:12	01:14:17:07	Very good.
354	01:14:15:12	01:14:17:07	I'm consuming about a box
355	01:14:17:09	01:14:18:09	every 30 seconds.
356	01:14:18:11	01:14:19:20	KADER: Are they good?
357	01:14:18:11	01:14:19:20	Delicious!
358	01:14:19:22	01:14:21:13	WOMAN: Can we check the question first?
359	01:14:21:15	01:14:23:28	How many raisins-- based on the distribution--
360	01:14:24:00	01:14:24:28	are in each box?
361	01:14:25:00	01:14:26:05	Is that what the question is?
362	01:14:26:07	01:14:27:13	That's a good enough phrasing.
363	01:14:27:15	01:14:29:24	So I guess we need to do the graph, the line plot
364	01:14:29:26	01:14:31:26	before we can actually answer the question?
365	01:14:31:28	01:14:33:02	KADER: That's exactly right
366	01:14:33:04	01:14:34:26	because you're trying to determine an answer
367	01:14:34:28	01:14:36:23	based on what you see on the line plot.
368	01:14:38:02	01:14:39:26	NARRATOR: Professor Kader invites a group
369	01:14:39:28	01:14:41:28	to bring its results to the front of the room.

370 01:14:42:00 01:14:44:26 WOMAN:
Our observations were
371 01:14:44:28 01:14:49:01 that the sizes range
from 17 through 32
372 01:14:49:03 01:14:53:00 and 17 is really
by itself.
373 01:14:53:02 01:14:57:23 We found that 29 was
the typical size
374 01:14:57:25 01:15:01:19 or the one that was
most frequently used.
375 01:15:01:21 01:15:03:18 27 is also typical
376 01:15:03:20 01:15:06:23 if you really
want to find out
377 01:15:06:25 01:15:08:05 what the middle
of the set was.
378 01:15:08:07 01:15:11:01 And we concluded
that the size of
the individual raisins
379 01:15:11:03 01:15:14:01 definitely varied.
380 01:15:14:03 01:15:16:04 Your first comment
up there is
381 01:15:16:06 01:15:19:19 "The range for the number
of raisins was 17 to 32."
382 01:15:19:21 01:15:22:03 Meaning, we have what
in this data?
383 01:15:22:05 01:15:23:03 CLASS:
Variation.
384 01:15:23:05 01:15:24:12 Variation.
385 01:15:24:14 01:15:27:07 What we're trying to do
by looking at this graph
386 01:15:27:09 01:15:30:02 is say something about
that variation.
387 01:15:30:04 01:15:32:07 And that's what we want
to focus our attention on
388 01:15:32:09 01:15:33:14 when we look
at these graphs.
389 01:15:33:16 01:15:37:02 And we want to think
about it in two ways.
390 01:15:37:04 01:15:40:03 Overall here, would you say
we have a lot of variation?
391 01:15:40:05 01:15:42:11 You have almost half a box...
392 01:15:42:13 01:15:45:00 of the number
of raisins in there.
393 01:15:45:02 01:15:46:16 KADER:
Mm-hmm.
394 01:15:46:18 01:15:47:25 PAUL:
Out of 32,
from 17--
395 01:15:47:27 01:15:49:02 17 is a small box.
396 01:15:49:04 01:15:52:17 If I was a kid,
I'd feel I'd been cheated.
397 01:15:52:19 01:15:53:24 But are there places
398 01:15:53:26 01:15:56:02 where there is not much
variation in the data?
399 01:15:56:04 01:15:57:08 PAUL:
Oh, the middle range

400 01:15:57:10 01:15:59:00 where they're all
grouped together.
401 01:15:59:02 01:16:00:07 That's right,
for example
402 01:16:00:09 01:16:01:07 she pointed out
403 01:16:01:09 01:16:02:25 that 29 happened
most frequently.
404 01:16:02:27 01:16:05:09 And how much variation
is there for those boxes?
405 01:16:05:11 01:16:09:03 There's no variation
among those boxes, okay?
406 01:16:09:05 01:16:11:24 So when we look at these graphs
407 01:16:11:26 01:16:13:06 one sense of variation
408 01:16:13:08 01:16:15:07 is comparing
those two numbers.
409 01:16:15:09 01:16:17:12 That indicates
a lot of variation.
410 01:16:17:14 01:16:20:15 But thinking about the fact
that she had six boxes
411 01:16:20:17 01:16:23:00 where they all had
the same amount of raisins
412 01:16:23:02 01:16:27:05 that says those boxes have
no variation.
413 01:16:27:07 01:16:28:29 There are two sides
of this coin.
414 01:16:29:01 01:16:32:14 NARRATOR:
On the next day, the class
revisits the raisin activity.
415 01:16:32:16 01:16:34:14 KADER:
The last question
we looked at yesterday
416 01:16:34:16 01:16:37:25 "How many raisins are in a
one-half-ounce box of raisins?"
417 01:16:37:27 01:16:40:08 Just looking at
the representation
418 01:16:40:10 01:16:43:13 what kinds of answers can you
provide to that question?
419 01:16:43:15 01:16:45:06 KADER:
In the raisin activity
420 01:16:45:08 01:16:48:00 I wanted the teachers to
come away from that recognizing
421 01:16:48:02 01:16:51:26 that there's not just one answer
to a statistics question
422 01:16:51:28 01:16:55:20 and that different answers
provide different information
423 01:16:55:22 01:16:58:29 about the question
that you're trying to address.
424 01:16:59:01 01:17:02:06 And I didn't think
we had gotten to the point
425 01:17:02:08 01:17:05:11 where we were able to complete
that in the previous session
426 01:17:05:13 01:17:08:17 so I wanted to come back
and have them reexamine that.
427 01:17:08:19 01:17:11:03 Do you feel that we answered
the question adequately?
428 01:17:11:05 01:17:12:15 PAUL:

		If your question was:	
429	01:17:12:17	01:17:14:09	"How many raisins are in the box?"
430	01:17:14:11	01:17:15:20	KADER: So what's the answer?
431	01:17:15:22	01:17:16:26	It's different;
432	01:17:16:28	01:17:19:18	it depends on the box that you open.
433	01:17:19:20	01:17:20:26	Okay, I agree it's different;
434	01:17:20:28	01:17:22:15	it depends on the box that you open.
435	01:17:22:17	01:17:24:20	So what answer would you give to that question?
436	01:17:24:22	01:17:26:22	When we ask our kids this question
437	01:17:26:24	01:17:29:21	when we do this experiment with our children
438	01:17:29:23	01:17:32:16	their first feeling is to say
439	01:17:32:18	01:17:36:05	"Well, somewhere between 25 and 38."
440	01:17:36:07	01:17:41:15	Let's look at that as an answer to the question, for starters.
441	01:17:41:17	01:17:43:09	"Interpreting Graphical
442	01:17:43:11	01:17:45:14	"and Tabular Representations of the Distribution.
443	01:17:45:16	01:17:47:21	How many raisins would you predict"--
444	01:17:47:23	01:17:49:26	I've added the little phrase here--
445	01:17:49:28	01:17:51:27	"predict for the number of raisins
446	01:17:51:29	01:17:53:03	in a ½ ounce box?"
447	01:17:53:05	01:17:55:05	And I think what you said is
448	01:17:55:07	01:18:00:08	"Well, okay, if I predicted somewhere between 23 and 38"--
449	01:18:00:10	01:18:01:27	I'm going to write that down--
450	01:18:04:09	01:18:07:00	how certain do you feel that you're right?
451	01:18:07:02	01:18:08:28	I feel very certain that I'm right.
452	01:18:09:00	01:18:11:25	So, if I said, what's the good part of that answer?
453	01:18:11:27	01:18:15:01	What would you say the good part of the answer is?
454	01:18:15:03	01:18:16:07	That I'm going to be right.
455	01:18:16:09	01:18:17:24	KADER: That you're going to be right.
456	01:18:17:26	01:18:20:28	Can you tell me the bad part of the answer?
457	01:18:21:00	01:18:22:19	It's a safe answer, but not very specific.
458	01:18:22:21	01:18:24:14	Can you tell me

why it's not specific?

459 01:18:24:16 01:18:27:10 Because there's a whole host
of numbers of raisins

460 01:18:27:12 01:18:28:24 that it could be.

461 01:18:28:26 01:18:30:25 Okay, it's a
very wide difference.

462 01:18:30:27 01:18:33:17 In fact, it represents
the largest difference

463 01:18:33:19 01:18:36:01 between any two data values

464 01:18:36:03 01:18:39:21 because I'm looking
at the minimum value

465 01:18:39:23 01:18:41:21 and the maximum value

466 01:18:41:23 01:18:45:11 and I'll just say
the range equals 15.

467 01:18:45:13 01:18:48:15 And that's quite a few raisins.

468 01:18:48:17 01:18:50:27 So, there's answer one.

469 01:18:50:29 01:18:53:15 Answer number two, Phil.

470 01:18:53:17 01:18:55:16 PHIL:
I'd say
27 to 29.

471 01:18:55:18 01:18:57:08 KADER:
Why would you
say that?

472 01:18:57:10 01:18:59:02 You are getting closer
to a number

473 01:18:59:04 01:19:02:20 and it has maybe
60% or 70% of the data.

474 01:19:02:22 01:19:04:29 It's got
a lot of data.

475 01:19:05:01 01:19:06:11 Okay?

476 01:19:06:13 01:19:08:05 Why is that in a way
a better answer?

477 01:19:08:07 01:19:09:23 PAUL:
It's narrowing.

478 01:19:09:25 01:19:12:08 Because in this case
it's narrowing.

479 01:19:12:10 01:19:14:22 We have a range of only two.

480 01:19:14:24 01:19:17:09 Here's another representation
for what's going on here.

481 01:19:17:11 01:19:20:10 How many raisins?

482 01:19:20:12 01:19:22:26 This is a tabular representation

483 01:19:22:28 01:19:25:15 that displays
the same information

484 01:19:25:17 01:19:27:24 that's in the line plot here.

485 01:19:27:26 01:19:32:06 Again, all this table does
for me is it takes the graph

486 01:19:32:08 01:19:35:28 and gives me a table
that summarizes the graph.

487 01:19:36:00 01:19:40:01 So, for example, I can see
I have one 23, one 24

488 01:19:40:03 01:19:41:23 three 25s and so on.

489 01:19:41:25 01:19:44:04 Now, I'd like to convert
each of those to percentages.

490 01:19:44:06 01:19:46:07 In order to do that,
what do I have to do?

491 01:19:46:09 01:19:47:07 WOMAN:

Divide them?

492 01:19:47:09 01:19:48:07 Divide them by what?

493 01:19:48:09 01:19:50:03 CLASS:
The total number.

494 01:19:50:05 01:19:52:04 KADER:
By the total number.

495 01:19:52:06 01:19:54:04 So I have 37 in total.

496 01:19:54:06 01:19:55:07 2.7 percent.

497 01:19:55:09 01:19:57:02 KADER:
Okay, and this one
will be...

498 01:19:57:04 01:19:59:07 8.1 percent.

499 01:19:59:09 01:20:01:23 This one will be zero percent.

500 01:20:01:25 01:20:07:13 All right...
5.4, zero and 2.7 percent.

501 01:20:07:15 01:20:10:17 Now, this will help us provide
some gauge

502 01:20:10:19 01:20:14:24 of how certain we are that
the answer to the question

503 01:20:14:26 01:20:17:23 "How many raisins are
in this box of raisins?"

504 01:20:17:25 01:20:20:15 is in the interval
suggested by Phil.

505 01:20:20:17 01:20:25:19 Phil suggested that, "Oh, there
are between 27 and 29 raisins"

506 01:20:25:21 01:20:28:12 and that's a better answer
than this one in what way?

507 01:20:28:14 01:20:32:01 It's more precise,
but I'm not as certain.

508 01:20:32:03 01:20:33:27 If I say, "What percent
are between there?"

509 01:20:33:29 01:20:35:29 About 46%.

510 01:20:36:01 01:20:37:14 We'll say about 46%.

511 01:20:37:16 01:20:42:04 So almost half of my data
is in that range, okay?

512 01:20:42:06 01:20:45:08 I could give an exact answer to
the question if what happened?

513 01:20:45:10 01:20:48:06 If they all had the same number
of raisins in the boxes?

514 01:20:48:08 01:20:50:00 If they all had
the same number of raisins.

515 01:20:50:02 01:20:51:00 That's exactly right.

516 01:20:51:02 01:20:52:16 Now, that didn't happen.

517 01:20:52:18 01:20:55:08 But there is a value where I had
the same answer a lot of times.

518 01:20:55:10 01:20:57:14 And that value is what?

519 01:20:57:16 01:21:00:18 What's the value where I got
the same answer a lot of times?

520 01:21:00:20 01:21:02:19 CLASS:
Twenty-seven.

521 01:21:02:21 01:21:04:02 Twenty-seven.

522 01:21:04:04 01:21:05:25 27 occurred how often?

523 01:21:05:27 01:21:07:16 WOMAN:
Eight times.

524 01:21:07:18 01:21:09:24 Eight times or...

525 01:21:09:26 01:21:11:06 CLASS:

21.6%.

526 01:21:11:08 01:21:14:29 KADER:
21.6% of the time, okay.

527 01:21:15:01 01:21:19:24 I don't have as much confidence
but I have absolutely no what?

528 01:21:19:26 01:21:21:22 PAUL:
No margin
of error.

529 01:21:21:24 01:21:22:26 KADER:
No variation.

530 01:21:22:28 01:21:24:06 This answer gives me

531 01:21:24:08 01:21:26:09 a real precise answer

532 01:21:26:11 01:21:29:21 but I'm not as certain that
that answer is going to occur.

533 01:21:29:23 01:21:30:29 So it's kind of like

534 01:21:31:01 01:21:33:09 I am balancing
these two things out, okay?

535 01:21:33:11 01:21:36:25 All of these give me
some sense, some idea

536 01:21:36:27 01:21:41:07 of how many raisins are in a
one-half-ounce box of raisins.

537 01:21:41:09 01:21:43:22 So, these are
the kinds of things

538 01:21:43:24 01:21:47:00 that statisticians at least
initially start thinking about

539 01:21:47:02 01:21:49:15 in terms of trying
to answer a question.

540 01:21:49:17 01:21:52:12 There's more than one answer
to the question;

541 01:21:52:14 01:21:53:28 they have strengths
and weaknesses

542 01:21:54:00 01:21:55:29 and that's what you
kind of want to remember.

543 01:21:56:01 01:21:58:02 KADER:
That's what statistics is about;

544 01:21:58:04 01:22:01:25 it's about drawing out
these patterns.

545 01:22:01:27 01:22:03:09 There are no guarantees--

546 01:22:03:11 01:22:06:13 we look at a graph, we may
see something, we may not.

547 01:22:06:15 01:22:10:14 It's an investigation.

548 01:22:10:16 01:22:12:17 WOMAN:
I don't think I can go

549 01:22:12:19 01:22:15:00 and see any kind of
statistical information

550 01:22:15:02 01:22:16:23 and not have variation be
in my forefront

551 01:22:16:25 01:22:18:25 because I see how much
of an effect it can have

552 01:22:18:27 01:22:20:05 on your answers.

553 01:22:22:15 01:22:24:17 MAN:
It's very important to see
the connectedness

554 01:22:24:19 01:22:26:26 you know, between
making plots and graphs

555 01:22:26:28 01:22:29:00 and making that

next ordered step
556 01:22:29:02 01:22:31:07 to "Okay, now I see the numbers,
what does this mean?
557 01:22:31:09 01:22:32:29 It's not just numbers
that are a string
558 01:22:33:01 01:22:34:25 but there's numbers
that have a pattern.
559 01:22:40:10 01:22:41:27 This is another storm
that's brewing.
560 01:22:41:29 01:22:43:18 This one I'm going
to keep my eye on
561 01:22:43:20 01:22:45:17 because I think it has
the best potential
562 01:22:45:19 01:22:47:21 not just for bringing us a storm
563 01:22:47:23 01:22:51:00 but bringing us one that has
accumulating snowfall.
564 01:22:51:02 01:22:52:24 WOMAN:
The more computer models
I look at
565 01:22:52:26 01:22:56:13 the more data I look at,
the better chances I have
566 01:22:56:15 01:22:58:10 of getting a more
accurate forecast.
567 01:22:58:12 01:22:59:26 So we definitely have a line
568 01:22:59:28 01:23:02:04 an activity contrasting
temperatures...
569 01:23:02:06 01:23:03:21 NARRATOR:
To forecast the weather
570 01:23:03:23 01:23:08:22 meteorologist Kim Martucci
interprets statistical data.
571 01:23:08:24 01:23:12:09 MARTUCCI:
Meteorologists need statistics
to live.
572 01:23:12:11 01:23:16:08 When we forecast, we rely
on data from the past
573 01:23:16:10 01:23:19:25 and we look at data that's
projected into the future.
574 01:23:19:27 01:23:22:11 And we have to look
at all types of data:
575 01:23:22:13 01:23:26:01 numbers representing
air temperature
576 01:23:26:03 01:23:30:26 barometric pressure,
wind speed, humidity.
577 01:23:30:28 01:23:33:27 NARRATOR:
Meteorologists analyze
a variety of data
578 01:23:33:29 01:23:37:16 represented in
a variety of ways.
579 01:23:37:18 01:23:39:06 Knowing how to
recognize patterns
580 01:23:39:08 01:23:42:26 and interpret the variation in
these graphical representations
581 01:23:42:28 01:23:46:06 is an important part
of forecasting weather.
582 01:23:46:08 01:23:48:20 MARTUCCI:
The first thing

			I'm going to look at
583	01:23:48:22	01:23:50:07	is cloud cover and humidity.
584	01:23:50:09	01:23:52:15	The dark magenta are the clearest skies...
585	01:23:52:17	01:23:55:18	Baja, California, Florida looks like it has
586	01:23:55:20	01:23:57:06	a lot of clear skies.
587	01:23:57:08	01:24:01:18	The light magenta to the dark blue is, I would say
588	01:24:01:20	01:24:03:10	a partly cloudy scenario.
589	01:24:03:12	01:24:05:21	And that would be right up in, over New England.
590	01:24:05:23	01:24:09:15	And, over here, this is the forecast for tomorrow
591	01:24:09:17	01:24:10:29	for precipitation.
592	01:24:11:01	01:24:13:10	And notice the brighter colors for precipitation
593	01:24:13:12	01:24:14:26	for that other storm to the west
594	01:24:14:28	01:24:17:01	the one that might bring us snow on Thursday
595	01:24:17:03	01:24:18:21	that everybody is talking about.
596	01:24:18:23	01:24:21:00	Now, it's 47 degrees outside.
597	01:24:21:02	01:24:22:16	The dew point is 41...
598	01:24:22:18	01:24:24:21	MARTUCCI: So, after I look at where the clouds are
599	01:24:24:23	01:24:26:07	and where the humidity will be high
600	01:24:26:09	01:24:27:21	and where the rain's going to be
601	01:24:27:23	01:24:29:25	I now have to look at a different type of data.
602	01:24:29:27	01:24:31:20	I have to look at the temperature data.
603	01:24:31:22	01:24:35:01	And these colors have numbers that match them.
604	01:24:35:03	01:24:38:05	For Boston, the low temperature this morning so far has been 43.
605	01:24:38:07	01:24:41:13	MARTUCCI: We have to use these computer models to make a forecast
606	01:24:41:15	01:24:44:24	but the computer models vary, so we're looking at data
607	01:24:44:26	01:24:47:18	and we're looking at how the data varies, every single day.
608	01:24:47:20	01:24:51:15	NARRATOR: In preparation for making a forecast
609	01:24:51:17	01:24:55:09	Ms. Martucci creates a chart that summarizes the predictions
610	01:24:55:11	01:24:57:15	from all the different computer models.
611	01:24:57:17	01:24:59:28	This allows her to compare the similarities
612	01:25:00:02	01:25:02:00	and differences in the predictions

613 01:25:02:02 01:25:03:26 from these different models.
614 01:25:03:28 01:25:07:23 MARTUCCI:
So here's all the data from all
the different computer models--
615 01:25:07:25 01:25:09:19 you can see the "MRF,"
"NGM," the "AVN"--
616 01:25:09:21 01:25:14:04 and at the bottom, I'll average
all the data for each day.
617 01:25:14:06 01:25:16:11 So now it's time
to transcribe the numbers
618 01:25:16:13 01:25:18:12 and put them into
the English language
619 01:25:18:14 01:25:20:16 which will be my forecast
that airs tonight.
620 01:25:20:18 01:25:23:24 So I'm going to go through this
and weigh each day out
621 01:25:23:26 01:25:26:16 by judging what I looked
at on the computer
622 01:25:26:18 01:25:28:16 what I've looked at
with my charts
623 01:25:28:18 01:25:30:09 and this is decision time
for me.
624 01:25:30:11 01:25:31:26 This temperature change
is a sign
625 01:25:31:28 01:25:33:13 that the atmosphere
is spinning--
626 01:25:33:15 01:25:35:22 warm air is coming up this way,
cold air that way...
627 01:25:35:24 01:25:38:03 MARTUCCI:
Our goal is to be
as accurate as possible.
628 01:25:38:05 01:25:40:29 So, we want to use every tool
possible at our disposal
629 01:25:41:01 01:25:42:16 to understand what's going on
630 01:25:42:18 01:25:45:03 and then, hopefully, we can make
a more accurate forecast.