Transcript of Problem Solving Session 1/22/99

Note: Explanatory notes and brief descriptions of sections of transcript
not included here are enclosed in brackets.

1	T/R1:	We've been looking at the tapes, you know, and there's
2		some interesting ideas that different people have presented
3		and some questions that came out of looking at them that
4		we wanted to address again. We'ii start with something-
5		with a new problem. Is that okay?
6	Jeff:	That's fine.
7	Michael:	That's fine.
8	T/R1:	And- and you can use anything else, you could use each
9		other. The rule again for this ... [materials are distributed]...
10		you can use any tools you want, you know. We, we have
11		things around if you want to use them and you're welcome to
12		use them. But the idea of course, as you know, is not just to
13		tell us about what the probability is that these games will be
14		won, but you have to be able to convince us. I should, I
15		should introduce this by saying I've given this problem to a
16		bunch of folks lately and I have found people think about it in
17		very different ways. Is that good enough? And so, there
18		isn't a particular one way to think about it. It's just what
19		makes it interesting. So you may, you know, you may all
20		think about this initially differently and then you share your
21		thinking. But the important thing is, there is only one right
22		answer and what you ought to try to think about is, if
23		someone else is thinking about it differently than you are,
24		how do you connect your thinking? Do you see what I'm
25		saying? Does it come together? Does it make sense in any
26		way? That's all I have to say. Do you understand? Do you
27		all know about World Series?
28	Jeff:	Mm hm.
29	Brian:	Yeah.
30	T/R1:	You all know that the World Series is played in seven
31		games? Did you know that Romina because I didn't know
32		that.
33	Romina:	No, yeah, I know that.
34	T/R1:	And, you know, you can win in four games or five games or
35		six games or seven games. Right? There's certain
36		probabilities. Any questions? If you don't like the way
37		you're seated you can change it some, you know, if you
38		want to get into groups. But, you know, we want you to be
39		able to talk to each other, in any way you want.
40	Romina:	Couldn't we do like a – you know how we do, like –

41	T/R1:	We'll leave you alone. Would it be better if I left you alone?
42	Jeff:	That's what I'm saying-
43	T/R1:	Okay, I'm going to leave you alone.
44	Romina:	They can go all seven or they could go all four. So, it would
45		be A, A, A, A and B, B, B, B -Team A and Team B?
46	Jeff:	Wait, what's the – wait – wait –
47	Romina:	So those are the only possibilities for four?
48	Jeff:	Mm hm.
49	Romina:	So, in four games, would it be, like, one-half of a chance? Or
50		would we have to write it out with -- using all seven?
51	Jeff:	See, I think that it's the hardest to win it in four games.
52	Brian:	Four games.
53	Jeff:	Definitely the hardest.
54	Romina:	Yeah, exactly.
55	Jeff:	So, it wouldn't be one-half.
56	Brian:	Isn't it the odds – the odds of winning one game, times the
57		odds of winning one game, times the odds of winning one
58		game?
59	Jeff:	That's what I'm thinking.
60	Ankur:	Look, it's a fifty percent chance of winning the first game.
61	Brian:	All right.
62	Romina:	One-half.
63	Brian:	So, it's like, half times a half – no, wait – remember the odds
64		get harder to win two in a row, like a coin flip?
65	Ankur:	Yeah, so that's –
66	Romina:	Yeah, that's how you do it: a half times a half times a half
67		times a half.
68	Brian:	All right.
69	Jeff:	If that's the case, what is it?
70	Romina:	Four – hold on – four times –
71	Brian:	That's sixteen.
72	Romina:	Is it one thirty-two?
73	Brian:	Two times two is four, times two is eight. Three times three –
74	Romina:	Oh, never mind, I get it. Now, would you have, for five
75		games, like, would it be like that [writes $\frac{1}{2} \cdot \frac{1}{2} \cdot \frac{1}{2} \cdot \frac{1}{2} \cdot \frac{1}{2}$]?
76	Ankur:	Hopefully, the odds of winning are –
77	Jeff:	We're never going to get – it's never gonna equal up to one,
78		though.
79	Brian:	Does it have to?
80	Romina:	No, but, I was thinking, you know how we do, like, uh, like
81		A –
82	Jeff:	Yeah.
83	Romina:	For four – you know what I'm saying?
84	Jeff:	Mm hm.

85	Romina:	And it would be like B, A, B, A, A [writing this] – you know,
86		sort of, stuff like that?
87	Jeff:	What does that have to do –
88	Brian:	Find out the odds of not winning –
89	Romina:	That's like six.
90	Brian:	To get the probability.
91	Romina:	[Looks at her paper] Wouldn't you have easier odds of
92		winning in six games than in four?
93	Jeff:	Yeah.
94	Romina:	Doesn't it get less, though?
95	Jeff:	That's why it's wrong.
96	Romina:	Okay [crosses out what she has written].
97	Michael:	There's probably a different way to do it, than saying, just
98		multiplying. It's like –
99	Romina:	Mike, why don't you move, like, just move in a little.
100	Michael:	Okay, that's good enough. Two inches. There's gotta be a
101		different way of, um, of looking at it, then, 'cause if you just
102		say, multiply the probability in four games and seven games,
103		it'd be –
104	Romina:	It's gonna be too – it's too small.
105	Michael:	It's gonna be harder in seven, but actually, it's really not.
106	Brian:	'Cause you've got more chances.
107	Ankur:	Yeah, 'cause you could win one, lose one.
108	Brian:	So –
109	Ankur:	You could win three and lose three.
110	Brian:	The seven-sided thing, or something.
111	Michael:	Or you could think of it like –
112	Ankur:	Yeah, if you list them, like –
113	Romina:	That would be like seven different things. This one is two.
114	Brian:	Like a, a seven-sided –
115	Ankur:	I would say, like a win and a loss, like that.
116	Michael:	Then you go like this. You have – with the four games, you
117		have a maximum of four and you have to win four, so it's like
118		you have to be a hundred percent a winner. And, with seven
119		games, you have seven possible, all you have to do is win in
120		four. So you got a four out of seven chance of –
121	Jeff:	But then, so then –
122	Ankur:	But what's the overall probability?
123	Jeff:	But then, what's the probability of winning four games, if
124		that's the case?
125	Michael:	I don't know.
126	Jeff:	You can't say a hundred percent.
127	Michael:	Yeah.
128	Romina:	That one would be, like, kind of like half.

129	Michael:	The probability of a team winning – if there's seven games –
130		is one hundred percent. The only way to win in four games is
131		if – 'cause there's going to be a team –
132	Jeff:	Oh yeah, I understand that, but say, uh, Team A –
133	Michael:	I know. Probability of a team – obviously there is a
134		probability of--
135	Romina:	Would it make – would it make sense to be four-sevenths?
136	Ankur:	There's only two ways of winning in four games, either Team
137		A wins them all or Team B wins them all.
138	Jeff:	What?
139	Romina:	Like four-sevenths?
140	Jeff:	For what?
141	Romina:	Would that be a reason, like for [part] D?
142	Jeff:	Makes sense.
143	Brian:	You're saying that, then –
144	Romina:	Yeah, I know, that's the only – I think the first one is one--
145		sixteenth.
146	Brian:	Huh?
147	Romina:	I, I think the first one's one--sixteenth, but I don't think we
148		can do all of them like that.
149	Brian:	Didn't we do this one time?
150	Jeff:	We never did a problem like this.
151	Brian:	What if we did the probability of not winning? Remember we
152		did the probability of not winning times, like, the probability of
153		how many times that you win?
154	Romina:	That's if you win – if you – how many times you, like, uh, five
155		out of six plus five out of six plus five out of six. Is that it?
156	Brian:	Um –
157	Romina:	Yeah.
158	Brian:	Can't just someone figure out the probability? What I'm
159		saying, you can't just, I mean, because [inaudible]. If it lands
160		a certain way, then that goes to Team A. If it lands a certain
161		way, that goes to Team B. There's got –
162	Romina:	You know how we do this thing [indicates strings on her
163		paper]? Like, wouldn't we just do that?
164	Jeff:	Yeah, but what is that?
165	Ankur:	You know how many there's gonna be?
166	Romina:	Yeah, there's gonna be a lot. I'm saying, but, like, say we
167		did that, right? And whatever the probability would be –
168	Jeff:	Oh, yeah. Well, well – yeah, yeah, I'm thinking that. All
169		right.
170	Romina:	It'd be like, say what – the probability of someone winning
171		and then it would be like B, B, B, B.
172	Jeff:	Oh. Yeah.
173	Romina:	Any ones that had B, B, B, in it.

174	Jeff:	Then that would be that number and that number. Yeah,
175		that's what I was thinking, but –
176	Ankur:	So then we got to do it like that.
177	Jeff:	But, how – all right, wait.
178	Romina:	How many possibilities?
179	Ankur:	There can only be two ways.
180	Jeff:	Well, wait. Just – so, wait. Before we do that, let's look at,
181		um, how do you get to that point in the first place? To finding
182		out? 'Cause there's like a lot of different combinations – two
183		to the seventh. Is that two to the seventh?
184	Romina:	Isn't it – yeah, two n?
185	Jeff:	Yeah. All right, so say it's two to the seventh.
186	Romina:	How much is that? I don't know.
187	Ankur:	For this, you've gotta find all possibilities with –
188	Romina:	Do you want to write down the possibilities so we just see it?
189	Jeff:	Wait. Do you know how many two to the seventh is?
190	Brian:	Yeah, it's the order you win, though, too.
191	Jeff:	Yeah, and we also have to look at the fact that [inaudible]
192	Romina:	Yeah, I know.
193	Jeff:	For like five to be – five – five –
194	Romina:	First we look at it like this and then we move over.
195	Jeff:	Five B's is not –
196	Ankur:	It's like, three A's, it could be a B and then –
197	Jeff:	Yeah. Like five B's – or five A's and then –
198	Romina:	Yeah, I know. I'm just saying, like, each time we'd look over
199		like, well five, we'll see how many – you know? [they are
200		writing strings]
201	Ankur:	To have –
202	Romina:	I can do the ones just having A winning, like having –
203	Ankur:	It would be eight, for the five.
204	Romina:	Do you understand, just like, you know, having [inaudible].
205	Jeff:	Yeah, but you're not going to know if you have them all,
206		though. How are you gonna know?
207	Ankur:	To have – this will be, five games will be eight.
208	Jeff:	Think so?
209	Ankur:	'Cause like it'd be these four, 'cause look, you can only lose
210		one game, right?
211	Jeff:	Mm. Oh, so it's only –
212	Ankur:	You can't lose the last one, or, 'cause, or they already won
213		four, you know what I mean?
214	Jeff:	Yeah, yeah, yeah, yeah.
215	Ankur:	So it'd be these, and then, like, A there and then B's in the
216		other place. You know what I mean?
217	Jeff:	All right. So after the four, for winning in four games –
218	Romina:	Should it be over seven, though?

219	Ankur:	Eight of these. It'd be over, like, total possibilities of –
220	Jeff:	Yeah, the total possibilities is eight, right?
221	Ankur:	They have eight ways of winning but it'd be over –
222	Jeff:	Oh. Eight over one – no – well, how do we find out?
223	Ankur:	I'd be over – the total possibilities of two, like two – two
224		colors and five things.
225	Jeff:	Yeah.
226	Romina:	It wouldn't – they wouldn't be over the whole thing, like a
227		seven?
228	Jeff:	It wouldn't be.
229	Michael:	It should be over – over seven, 'cause it's four out of seven
230		games.
231	Ankur:	But this one wouldn't be over seven.
232	Jeff:	It wouldn't be.
233	Ankur:	It wouldn't. None of this would be over seven.
234	Romina:	So why would it be eight? I missed that. See, I didn't hear
235		you.
236	Jeff:	Because he's going like this [writes out strings for B winning
237		in 5 games] – you're just moving it over and then –
238	Romina:	Eight?
239	Jeff:	Yeah, well, the last one would be B, B, B, B, A.
240	Romina:	Mm hm.
241	Jeff:	In that case, they would have won at this game right here.
242		But that would count, though.
243	Romina:	Wouldn't it only be four? How is that eight, though?
244	Ankur:	It'd count in the total possibilities, but it couldn't count in the
245		wins. I counted that one, the B and then the four A's, but
246		you can't do four B's and then an A.
247	Jeff:	No, it'd just be four B's.
248	Ankur:	You know what I mean?
249	Jeff:	Then B, A, A, A, A.
250	Romina:	Okay. So should we stick with one team winning or either
251		team winning?
252	Ankur:	It has to be either.
253	Jeff:	Well it's gotta be – what's the probability in the World Series
254		that they would win in five, four games? It's –
255	Ankur:	So it'd be either. Now you just gotta find the total
256		possibilities of – you know what I mean?
257	Jeff:	First of all –
258	Romina:	Wouldn't it be two to the fifth? Or would it be two to the
259		seventh?
260	Jeff:	Two to the seventh is a hundred twenty-eight. And, but, like
261		B, B, B, B, B – like B seven times wouldn't count. But on the
262		other hand, the sum –

263	Romina:	But, I'm saying for this one, it's eight over – would it be eight
264		over two to the seventh or two to the fifth? Maybe to the
265		fifth? Well, because –
266	Jeff:	It wouldn't be two to the fifth because some games would
267		have to go more than five games.
268	Ankur:	Well – well, what's the first one?
269	Jeff:	Than five slots. This only goes five slots, but then what
270		happens when it goes to six games?
271	Romina:	Yeah. Are you doing that for seven?
272	Brian:	For six.
273	Jeff:	Only – there's a total of two ways they could win in four
274		games, right?
275	Ankur:	Yeah, it's two over two to the fourth.
276	Jeff:	Why is it two to the fourth?
277	Ankur:	Because that's the total, like – two to the fourth will give you
278		the total possibilities of four things –
279	Jeff:	All right.
280	Ankur:	You know what I mean? It has to be over – do you know
281		what I'm talking about or not?
282	Jeff:	Yeah, it's got to be over two to the fourth – four spaces.
283	Ankur:	The total possibilities of A, B – yeah, four spaces.
284	Jeff:	Yeah, all right. It makes sense.
285	Ankur:	That's what –
286	Jeff:	And then that'd be eight over two to the fifth, you think?
287	Ankur:	That's four, eight, that's sixteen.
288	Jeff:	And then eight over two to the fifth?
289	Ankur:	I guess.
290	Jeff:	Which would be –
291	Ankur:	Thirty-two.
292	Jeff:	What does eight over thirty- two reduce to?
293	Ankur:	There's more than thirty-two, though.
294	Jeff:	Four, four over sixteen? One over eight? That's one eight,
295		right?
296	Michael:	But is there thirty-two possibilities in five games?
297	Jeff:	Yeah.
298	Ankur:	That's what I'm-- I think there's more.
299	Brian:	For how many games?
300	Jeff:	Five.
301	Romina:	Hold on. What do you – you got eight?
302	Brian:	How many possibilities?
303	Jeff:	Five spaces.
304	Brian:	Total possibilities?
305	Jeff:	Thirty-two for five.
306	Ankur:	Well, it could be –
307	Romina:	He –

308	Ankur:	Yeah, it is thirty-two.
309	Romina:	Brian –
310	Ankur:	'Cause remember you do the blanks, like the five blanks?
311	Jeff:	Yeah. Where you just go two –
312	Ankur:	Two, two – you can put either A or B, A or B, A or B.
313	Jeff:	Yeah, well then, it's just two to the fifth.
314	Ankur:	Yeah. And for six it'd be –
315	Jeff:	And that'd be sixty-four. And then the last one would be a
316		hundred – over a hundred and twenty--eight?
317	Ankur:	Yeah but we gotta find the other things. You know what I
318		mean?
319	Brian:	You can skim them out.
320	Jeff:	Yeah, how do you –
321	Ankur:	Five –
322	Jeff:	How do you skim them out?
323	Ankur:	Like, you see how I skimmed these out?
324	Jeff:	Yeah.
325	Ankur:	You've got to have two B's in this – just make sure that –
326	Romina:	Brian's doing them for six. How many did you get?
327	Brian:	It's not going to be what they got, 'cause I didn't get thirty-
328		two for five.
329	Ankur:	No, we got eight for five.
330	Jeff:	No, no.
331	Romina:	They got, they got eight for five. You got eight.
332	Brian:	Eighteen, for six.
333	Jeff:	Total?
334	Brian:	For six.
335	Ankur:	What about for five?
336	Brian:	Eight.
337	Ankur:	Yeah, okay. We'll do the same thing for six.
338	Jeff:	Two for four. Eight for five. Uh, eighteen for six.
339	Romina:	And seven – what's – wouldn't this be like one twenty-eight
340		over one twenty-eight?
341	Jeff:	Excuse me?
342	Romina:	Would that be one twenty-eight out of one twenty-eight?
343	Jeff:	One twenty-eight out of one twenty-eight?
344	Romina:	'Cause there's, there's – a team has to win by seven games.
345		Like one hundred percent?
346	Jeff:	I know, but it's not saying, what's the chances, what's the –
347		what's the probability that a World Series will be won in
348		seven games, not that someone will win in the seventh
349		game.
350	Romina:	No. Yeah. That – the World Series has to be won in the
351		seven games.

352	Jeff:	That's not the question. It's, what's the chances that it will be
353		won in the seventh, not in –
354	Romina:	The sixth.
355	Jeff:	Probable – well –
356	Brian:	They're saying, if it's won in seven games –
357	Ankur:	Yeah, but for six, wouldn't it be something like this?
358	Jeff:	See, I know what you're saying but it's – I don't think it's
359		being asked like that. It's like, of course –
360	Romina:	Do you want me to write out possibilities for seven? This will
361		take –
362	Michael:	No, it's saying, what's the possibility that's it's won –
363	Romina:	This is going to take forever.
364	Michael:	Let's say you just take the seventh game. Obviously, that
365		would be the hundred percent.
366	Jeff:	Yeah, that was--
367	Romina:	I'm going to write that.
368	Michael	It's not saying there's a probability that World Series is won
369		– is won in – you know, what's the probability that it's in one
370		of, you know, one of these four.
371	Romina:	All possibilities –
372	Jeff:	You see, well I had thought of –
373	Ankur:	Are we doing it right, then, or not?
374	Romina:	I'm going to write that.
375	Jeff:	Oh, well I thought it was.
376	Michael:	They're asking, will be won in seven games. And, obviously,
377		that's a hundred.
378	Jeff:	Yeah, but I –
379	Ankur:	How about this?
380	Michael:	The probability has to be a hundred, though.
381	Jeff:	I know, what's the chance that it, that out of – I thought that
382		all the games –
383	Ankur:	It – it will, it will.
384	Michael:	No, I'm not saying it has to add up to a – seven has to be a
385		hundred.
386	Jeff:	I don't –
387	Michael:	They're, they're not asking, like, what's the probability that
388		you win the World Series. What's the probability that it's in,
389		that it was won in the seventh game or the sixth game.
390	Ankur:	See I don't think that's what –
391	Jeff:	No, it's what's the probability it would of won in –
392	Michael:	It's easy if you really just read it how it is.
393	Ankur:	It can't be a hundred. Because then it can be won in four
394		games.
395	Jeff:	Well, yeah, what [inaudible].
396	Michael:	No, no. I'm saying what [inaudible].

397	Jeff:	You said if it reaches the seventh game, it's going to be won.
398	Ankur:	Yeah. That's obvious, but they're not asking that.
399	Jeff:	Can we factor this out [looks to T/R across the room]?
400	T/R1:	Yes?
401	Jeff:	We're not, uh, exactly sure what's being asked here.
402	T/R1:	What's the confusion?
403	Jeff:	I mean, are you saying that, like, in seven games, are you
404		saying, what's the chances that someone will win it all in
405		seven games? Like, for the, the just D part. Or are you
406		saying –
407	Ankur:	Are you saying, if it gets to the seventh game, then it's an
408		obvious answer. You won in the seventh game.
409	Jeff:	Then, then it's a hundred percent.
410	T/R1:	No, but –
411	Ankur:	But you're asking, you're asking it the other way. You're
412		asking, out of all the chances –
413	T/R1:	Out, out of all the games, what's the probability it's won in
414		the seventh. Right. You interpreted it the way I did.
415	Jeff:	Yeah, that's what – that's what I figured.
416	Ankur:	All right, so it's –
417	Jeff:	That way it all – you – it all adds up to, uh, it all adds up to
418		thirty-two.
419	Ankur:	It should add up to a hundred.
420	Jeff:	So, wait, wait. If eighteen out of sixty-four is right, then nine
421		thirty-two's, eight thirty-two's and two thirty-two's, is nineteen
422		thirty-two's –
423	Romina:	I'm not going to get that far.
424	Jeff:	Then, that means that that game will have to be won in ten –
425		in thirteen. That'll be – in seven, it's thirteen thirty--twos. If
426		we did everything else right. You know what I'm saying?
427	Ankur:	Yeah.
428	Jeff:	I don't know if that's right, but – are you going to write them
429		all out?
430	Ankur:	Just not all of them, but just like the ones that – you know
431		what I mean?
432	Jeff:	Yeah, I was looking at the two like that, you know how you're
433		looking at it there?
434	Ankur:	Yeah, I was trying to do something like that.
435	Jeff:	Yeah, but you got two. I mean –
436	Romina:	It's all messed up.
437	Jeff:	You got here – it could be two, if these are different or one if
438		they're all the same. It's like two [inaudible].
439	Ankur:	And then you've got to minus something out because you
440		can't have – you know what I mean?
441	Jeff:	Yeah. Exactly. It's, I think it's, uh –

442	Romina:	How many do you have so far?
443	Ankur:	But you really don't have two right here because you have
444		something like –
445	Romina:	Oh.
446	Ankur:	It's like you can have A or B, right?
447	Jeff:	Mm hm.
448	Ankur:	If you choose B –
449	Romina:	I messed up so bad. Like, I'm so lost.
450	Ankur:	You can only have another B here and you don't have a
451		choice of two any more.
452	Romina:	But, see, because it's so hard to organize them –
453	Jeff:	Yeah, I hear you. It's – but you could get either one. For
454		the next one it could be A or B, too.
455	Ankur:	Yeah.
456	Jeff:	And then for the next one, even if it is B, it could be A or B
457		again.
458	Ankur:	Yeah.
459	Jeff:	So right now, even if it could be B, B, B or A, A, A –
460	Ankur:	That's right.
461	Jeff:	But the fourth one, it could be either one, unless one of
462		these two were all three.
463	Ankur:	Yeah. That's what I was trying to [inaudible].
464	Jeff:	That's the thing. When you get to the next one, I think
465		there's so many different things that are pulling on this that it
466		doesn't –
467	Ankur:	I think these are it.
468	Jeff:	How many do you have there?
469	Ankur:	Ten, and then there's the others, so it's twenty. You know
470		what I mean?
471	Jeff:	Well then we messed up somewhere if that's the one.
472	Ankur:	How come? It'd be twenty out of sixty--four.
473	Jeff:	Oh.
474	Ankur:	You know what I mean?
475	Jeff:	So it'd be ten thirty--two's?
476	Ankur:	Guessing so far.
477	Jeff:	Then we're – then we still messed up somewhere. It's got to
478		be thirteen, if we did everything else right.
479	Ankur:	Thirteen out of what?
480	Jeff:	Thirty-two. Six, twenty-six.
481	Ankur:	How come?
482	Jeff:	If we did all the other ones right, they're gonna equal up to
483		thirty-two thirty-two's. So if [part] C is nine thirty-two's, like
484		they said – I don't know if that's right, though – then, that's
485		gotta be thirteen.

486	Ankur:	Oh. Well. I started by putting the two games together that
487		they would win.
488	Jeff:	Mm hm.
489	Ankur:	One, two, three, four.
490	Jeff:	Then you got four more.
491	Ankur:	Is that – and then – but I don't know. You can't put B on the
492		last game, obviously.
493	Jeff:	Yes.
494	Ankur:	Got two – one, two, three. I already got it together, then –
495		that's it. [He and Jeff examine his list of strings.] Unless we
496		don't do the opposite – you know what I mean? The other
497		team winning?
498	Jeff:	What do you mean?
499	Ankur:	Like, you know, how we're doing –
500	Jeff:	Oh, yeah.
501	Ankur:	Like, there's two out of sixteen; maybe just one out of
502		sixteen?
503	Jeff:	I hear you. Then that'd be what? Four out of thirty-two?
504	Ankur:	Right now this is coming to twenty out of sixty-four. So, ten –
505	Jeff:	It's still too short.
506	Romina:	I am so lost.
507	Jeff:	We're down by three. We only have twenty-nine.
508	Romina:	Are you doing the opposites?
509	Ankur:	Mm hm.
510	Jeff:	Is that for – how many games?
511	Romina:	See, I got eighteen, but I don't know if I have them all, I don't
512		know if I repeated some. I'm just so, like –
513	Jeff:	For seven?
514	Romina:	Because B can't and A can't be in the first four.
515	Brian:	I had thirty for seven.
516	Romina:	Oh.
517	Jeff:	Can I see that for one second? Because, you know, if you
518		look at something for long, you just –
519	Romina:	That's what I've been thinking about.
520	Brian:	Actually, I got thirty-two for seven.
521	Romina:	How many possibilities are there for that? Because all I did
522		was that. Sixteen.
523	Jeff:	So then, you're saying there's double this total because you
524		could do the opposites of each?
525	Ankur:	Should've got thir – should've got thirty, Bri.
526	Romina:	See, I don't know if we should do the opposite.
527	Ankur:	Brian –
528	Brian:	What?
529	Ankur:	You should have got thirty, I think.

530	Jeff:	No. It's, it's what's the probability that the World Series will
531		be won in a certain game.
532	Romina:	See, I would have, if I double mine –
533	Ankur:	There's like – when you add these up, what's six out of – six
534		and five, that's eleven. That's sixteen. If this comes to be
535		five out of sixteen, then you know it's right. You know what I
536		mean?
537	Jeff:	Oh yeah, you went – oh, I didn't even realize. See – wait.
538		But how come I had eighteen sixty-fours, too?
539	Ankur:	Out of where?
540	Jeff:	On the eight thirty-two's, uh –
541	Romina:	What did you guys do while I was doing this?
542	Ankur:	Was it five-sixteenths?
543	Jeff:	Well, that's weird, because I had – eighteen –
544	Romina:	What were you guys doing while I was doing this?
545	Jeff:	Um, nothing much.
546	Romina:	Uh, did you see doubles?
547	Jeff:	I really didn't look yet.
548	Romina:	I didn't – I have [inaudible] from there. I didn't do it for, like,
549		B's winning. I only did it for A's winning.
550	Jeff:	It's hard to read in this kind of set up, you know what I'm
551		saying? Do you see doubles in here?
552	Ankur:	[Looking at Romina's paper] Is that a seven?
553	Jeff:	Yeah.
554	Romina:	With A winning.
555	Ankur:	Did you just randomly write them or did you do them in some
556		order?
557	Romina:	I started in some order, then I – it's hard, though, because
558		you're just like – I don't know.
559	Ankur:	The only way I can think of, is do it again and see if you get
560		the same amount. [Hands paper back to Romina.] You know
561		what I mean?
562	Romina:	Thanks, Ank.
563	Jeff:	How sweet.
564	Romina:	Do it again.
565	Ankur:	Or, like, compare with Brian. See if you got the same
566		amount.
567	Romina:	No, we didn't.
568	Brian:	That was [inaudible].
569	Jeff:	Did he have more or less?
570	Romina:	He has less than I do. But see, like, I didn't switch them to
571		do the other.
572	Ankur:	Then I'll do it now.
573	Romina:	But I think his is, like, an organized – but I didn't have, like,
574		two B's to begin with.

575	Brian:	What?
576	Romina:	Two B's don't start over here.
577	Brian:	What do you mean two B's?
578	Romina:	They could not have like B, B, A, B, A, A.
579	Brian:	Like the B – B, it'd be two B –
580	Jeff:	So wait, what'd you get for six? For [part] C?
581	Brian:	I got them somewhere. I got them over here.
582	Ankur:	Oh. Give me a second.
583	Brian:	The reason I've [inaudible]. I didn't want to –
584	Ankur:	I only have sixty –
585	Jeff:	Where'd you get that from?
586	Romina:	Yeah, that's what I'm saying. If you do like all A wins and all
587		B wins –
588	Ankur:	I got ten and then the other half is –
589	Jeff:	All right, so six –
590	Romina:	Because A could still win it.
591	Brian:	No, this is what I got. Start off with three – three to one team
592		–
593	Ankur:	Romina, let me see yours real fast.
594	Brian:	Three to one team, three of another team winning – and out
595		of – for the first team winning – I just moved the first B over.
596	Romina:	That's what I did.
597	Brian:	Not only do I do that, I keep it one spot over.
598	Ankur:	Sixteen.
599	Romina:	Okay, but this is like A winning, right?
600	Brian:	Okay.
601	Romina:	But couldn't A win if you did –
602	Ankur:	Ten, fifteen, twenty – oh.
603	Romina:	See like, if you went –
604	Jeff:	How many should have the –
605	Brian:	B, B, like A, A, A –
606	Romina:	B, A.
607	Brian:	B, A, A, or something like that. Something, something's still-
608	Ankur:	Eighteen? If this is included. I don't know.
609	Romina:	Yeah, that is. Eighteen.
610	Ankur:	Eighteen.
611	Romina:	I don't know why I did that.
612	Michael:	Are you sure that's it?
613	Romina:	No, I'm not at all. Because I couldn't do it, like, organized.
614		Hold on. I'll try.
615	Jeff:	Well, that explains it.
616	Romina:	Because A has to win the last game, or seven.
617	Jeff:	Looks organized. Oh boy, she's on the ball.
618	Ankur:	I know what you're saying.

619	Romina:	Yeah, like do it just from one team winning. You can always
620		double it after that.
621	Ankur:	Like four.
622	Jeff:	Do you have more now?
623	Ankur:	Hm?
624	Jeff:	Do you have more?
625	Ankur:	I only got seven so far.
626	Brian:	I only got five extras when I did it. Nine, ten, eleven, twelve,
627		thirteen, fourteen, and then –
628	Romina:	Five extras and how many do you have? Eighteen?
629	Brian:	I got forty-two.
630	Romina:	I mean, how many do you have just on the side of that?
631	Brian:	Twenty-one. What do you got?
632	Romina:	I only got eighteen, but I – I know I'm doing it wrong.
633	Brian:	This is like a second-grade technique.
634	Jeff:	I couldn't do it, dude.
635	Romina:	Hm.
636	Brian:	Did you do that whole, uh, seven games, exponent thing for
637		seven games? Did you come up with any number for seven
638		games, like total number of possibilities?
639	Romina:	One twenty-eight.
640	Jeff:	That's the total number of, of –
641	Romina:	Then I'm –
642	Jeff:	Of seven there could be. But that includes A seven times
643		which would never happen. Well, actually, it's one twenty-
644		eight minus four, minus five, minus six.
645	Romina:	If they – the bottom number [inaudible].
646	Jeff:	Exactly.
647	Romina:	They do two n.
648	Jeff:	So, yeah – you know, we could do this. Ankur –
649	Ankur:	Hm [still writing strings and checking lists]?
650	Jeff:	There's a hundred twenty-eight possibilities. You subtract
651		the possibilities from four games. You subtract, then, the
652		possibilities from five games, then the possibilities from six
653		games, and that leaves you with the only ones that are left.
654	Ankur:	Yeah, I know, but –
655	Jeff:	So what is –
656	Ankur:	The only way that we could prove that this, this holds true,
657		you know what I mean? I could of told – remember we –
658		didn't we say it's going to be five out of –
659	Jeff:	Yeah, but what I'm – but, all right, how many games do, how
660		many do, can you win in four games? How many
661		possibilities did you get? Two?
662	Ankur:	I got eighteen, too.

663	Jeff:	All right. We'll see if that checks out that way. And then –
664		how many total games did we have in five? Sixteen?
665	Ankur:	There it is. Four –
666	Jeff:	Ankur, how many different games are there in five? To win –
667	Ankur:	Yes?
668	Jeff:	In five?
669	Romina:	Yeah, because I really don't think that we're going to get it
670		[inaudible].
671	Brian:	It's All right. Hold on, just give me a second.
672	Ankur:	Thirty-six and one twenty-eight's, uh – it's sixty-four.
673	Romina:	[Inaudible] know better.
674	Brian:	Even though if you do this, that's [inaudilbe].
675	Romina:	Maybe.
676	Brian:	This – uh –
677	Michael:	It's kind of like the [inaudible].
678	Ankur:	What'd you say, now?
679	Brian:	Would you do, like, a half by a total number [inaudible]?
680	Jeff:	How many games do you have total, of five that equal one?
681	Ankur:	Eight.
682	Jeff:	Or – so – total eight.
683	Ankur:	Yeah.
684	Jeff:	And then in, uh, six?
685	Ankur:	Six, I got twenty.
686	Jeff:	Twenty?
687	Ankur:	Uh huh.
688	Romina:	You feel like each time you move up, like, every time they go
689		to five games they eliminate like most of the possibilities.
690	Jeff:	And then –
691	Michael:	This is kind of like the, um, the craps problem because I was
692		looking at the first game, you know, he has a one in sixteen
693		chance of winning, one in sixteen chance of losing –
694	Romina:	Mm hm.
695	Michael:	And the rest is going on to the next one.
696	Ankur:	Is going on to the next one, yeah.
697	Michael:	Remember doing that? And he just started making branches
698		out and branches out.
699	Ankur:	Mm hm.
700	Michael:	Do you remember how he ended that one?
701	Romina:	Does anyone have their notebook in here?
702	Brian:	Yeah, I didn't take notes.
703	Ankur:	I didn't take notes, so –
704	Romina:	I'm just so lost. Like, I completely messed this up [her
705		listing].
706	Brian:	Those are problem – possibilities, though.

707	Romina:	I – do you want me to go through some of mine to see if we
708		have them? You did the same. You went in the same pattern
709		I did.
710	Jeff:	Ankur, do you see what I'm saying, though, with that?
711	Romina:	You did. And then you moved the B over and then you
712		moved the other B over.
713	Jeff:	That these numbers are really odd.
714	Ankur:	Brian, did you get eighteen?
715	Brian:	For six.
716	Ankur:	For six?
717	Brian:	For the six games.
718	Romina:	He has twenty-one for seven.
719	Brian:	Actually –
720	Ankur:	Total like, like –
721	Brian:	Forty-two.
722	Romina:	Yeah.
723	Ankur:	Forty-two?
724	Brian:	Forty-two for game seven.
725	Romina:	For, for A and B. Like A winning and B winning.
726	Jeff:	See, because I'm just saying that –
727	Ankur:	Are you sure none of them are like –
728	Jeff:	I think it's a high number [inaudible].
729	Ankur:	Throw them down [his list of strings].
730	Brian:	What?
731	Ankur:	Throw them down.
732	Jeff:	Gee.
733	Romina:	I just completely lost myself here.
734	Ankur:	This is the, this is the sixteen. This is the four, oh, no, I mean
735		the sixth.
736	Brian:	The long one is seven, the one above that is six. The shorter
737		one's five and the one above that's four. The whole thing on
738		the bottom, even though the two were separated –
739	Ankur:	They're part of – oh, you wrote them both ways.
740	Brian:	It's getting blurry after a while.
741	Ankur:	Well, you got eight –
742	Romina:	I had – would you think that for four games it'd be like this?
743	Brian:	That's what I would think.
744	Romina:	Okay.
745	Ankur:	You got eighteen for six, Bri.
746	Brian:	That's what I said.
747	Ankur:	Oh. And I got twenty.
748	Brian:	Maybe there's one I forgot.
749	Romina:	Where did he take this –
750	Brian:	All I got to do is find one.
751	Ankur:	Yeah, I know what you mean.

752	Brian:	And then the opposite for it, so –
753	Romina:	Mike, you know how you were saying for that craps problem,
754		we can't – but how do you branch off the first one?
755	Michael:	I, I don't know. I left that idea a long time ago.
756	Romina:	[Inaudible] a half an hour. I don't know. Maybe you ought to
757		throw us in some direction here.
758	Brian:	I think this is the direction.
759	Romina:	Yeah. {To T/R] You want to throw us in some direction here?
760	T/R1:	[Inaudible].
761	Brian:	We're all coming up with relatively close numbers. Like,
762		Ankur's getting twenty for six.
763	Ankur:	[To Brian] I got the two that you missed.
764	Brian:	What?
765	Ankur:	I got the two that he missed.
766	Brian:	Oh, so you got twenty for that now, so if it's all right –
767	Jeff:	[Inaudible] do anything without that.
768	Romina:	Wait, Ankur what are you doing? I, I don't –
769	Brian:	However you got twenty, do that for seven games.
770	Ankur:	What? All right.
771	Romina:	Ank, what are you doing down there?
772	Ankur:	Just finding the two that Brian missed and I found them.
773	Romina:	I know, but, like, how did you get twenty? Like, did you write
774		them all out?
775	Ankur:	I wrote them out.
776	Romina:	Oh, you did?
777	Jeff:	This is, uh –
778	Ankur:	I wrote out ten, and then the other ten would be the other
779		half, like he said.
780	Jeff:	It'd be the only thing [inaudible], Ankur, except there's a
781		hundred and twenty-eight, twenty-eight total things for – you
782		know. You figure that if you subtract all these, then you'd get
783		the answer.
784	Ankur:	Yeah.
785	Jeff:	You'd get the last one. But you get like, um, ninety –
786	Ankur:	It should be forty out of one twenty-eight, I think.
787	Jeff:	No. But I'm not even saying like that. I'm saying that we
788		subtract all the –
789	Ankur:	And – all the – other possibilities.
790	Jeff:	You have twenty-eight here, so you'd subtract two because
791		of the four games. There's two that would cancel out, like –
792	Ankur:	What do you mean?
793	Jeff:	And then –
794	Ankur:	You'd subtract eight.
795	Jeff:	Eight. Ten – no, then eight, twenty –
796	Ankur:	Twenty.

797	Brian:	Those aren't the best [inaudible].
798	Jeff:	Thirteen.
799	Brian:	They can't be factors in the seventh game.
800	Ankur:	That's what I'm thinking.
801	Jeff:	Well that's why they're not – that's why you subtract them.
802	Ankur:	That's why you subtract them. Yeah.
803	Jeff:	But then you get like a number like ninety-six.
804	Brian:	Out of what? One twenty-eight?
805	Ankur:	Out of what?
806	Jeff:	I'm not sure.
807	Brian:	Because – that sounds right, though, because you've got
808		higher odds of winning in seven games. So find the total and
809		then subtract –
810	Jeff:	All right, wait, wait – it's – the first one's two over thirty-two
811		and eight out of thirty-two and –
812	Brian:	Yeah, but we – wouldn't you just take half of them, too?
813		Because one team's going to win, because we got
814		combinations in both teams. So we could just take that
815		team. You know, like, I could be –
816	Romina:	The only – that's what I was saying, like, only one team.
817	Brian:	And to the [inaudible] – that's the total number, but it's one
818		team that's going to be winning. So it's one--half.
819	Jeff:	See, the other thing is that if this is the case, the first three
820		games with, uh, [part] C being twenty out of thirty-two – is
821		that what [part] C is, Ankur?
822	Ankur:	Um –
823	Jeff:	Or is it ten?
824	Ankur:	Twenty out of sixty-four. It's like –
825	Jeff:	Ten out of thirty-two.
826	Ankur:	You know what I mean. Yeah.
827	Brian:	One – twenty out of sixty-four for six?
828	Romina:	How did we do that? What was the probability of sixty-four
829		coming before seven?
830	Brian:	How'd you get sixty-four?
831	Ankur:	Sixty-four total, two to the sixth.
832	Romina:	Jeff?
833	Jeff:	What?
834	Romina:	How did we do that probability with six?
835	Brian:	For four – for four, five and six?
836	Ankur:	Just six.
837	Jeff:	Oh, I don't know.
838	Romina:	How did we do that thing – you know, like, how it's the
839		probability of a six coming up before a seven.
840	Michael:	Because it's fifty-fifty.
841	Jeff:	Yeah, that's how you do it.

842	Ankur:	Mm hm.
843	Romina:	I, I don't know.
844	Jeff:	You know what I'm saying?
845	Brian:	That was, like, yesterday.
846	Romina:	[Laughs] I don't remember.
847	Brian:	You checking those answers good?
848	Ankur:	That's what I'm doing.
849	Romina:	Mine is not – I don't mind. Which one are you doing, Ank,
850		seven?
851	Ankur:	Mm hm.
852	Brian:	I know it's important to get more –
853	Jeff:	Yeah – like during the physics test, my hand was, like, blue.
854		Like, I was like all nervous and I was just, like, killing myself.
855	Brian:	Do you know what to do?
856	Romina:	Hm? Oh. Okay. I'm so lost.
857	Brian:	Oh, there's got to be a way to use the whole fraction thing
858		without even having to get involved in the stuff we're doing.
859		So how many total are there? Both teams winning.
860	Romina:	Let's look – can you do that, like, two at the end? You had to
861		take things out because, like, because you know we had
862		combinations where the first two letters would be A and that
863		wouldn't be a seven, that'd be a fifth.
864	Brian:	I thought we had [inaudible].
865	Romina:	What?
866	Brian:	I thought we had [inaudible].
867	Jeff:	Yeah, hold on, hold on. It's crazy.
868	Romina:	I think we're missing something really big.
869	Brian:	Are we missing something?
870	Romina:	Are we missing something?
871	Brian:	We always think we're missing something.
872	Romina:	What – oh [inaudible] miss something we're not getting here.
873	Brian:	We might have it. We're just checking it. You never know.
874	Romina:	Did you find more on his?
875	Michael:	No matter how many you find, they're going to ask you why.
876	Jeff:	Yeah, we can't prove just one combination.
877	Michael:	I know. No matter how many you find.
878	Romina:	Is that – is that like the – do we know out of how many? Did
879		you guys figure that part out?
880	Jeff:	I don't know. [Inaudible] It's – it's only ten for six games?
881		Ten thirty-two?
882	Romina:	That would [inaudible]. The twelve out of thirty-two.
883	Jeff:	Huh?
884	Romina:	Twelve out of thirty-two?
885	Jeff:	I don't know.
886	Romina:	Oh.

887	Jeff:	See, if it was, uh – this sixty-four, I reduced to – what's that?
888		Just [inaudible] them up and reduced them.
889	Romina:	How'd you get ten-thirteenths? I'm just asking. I don't know
890		what you guys were doing over here. I [inaudible].
891	Jeff:	I got ten because it was five-sixteenths that Ankur had, so it
892		was ten and thirty-two and if that's ten, that's eight and that's
893		two and that's –
894	Romina:	That would have been nice, two, eight, ten.
895	Jeff:	Yeah, well, say that is the case with twenty. That makes that
896		twelve out of thirty-two. It's got to be the only ones left.
897	Romina:	[To Ankur] Did you find more?
898	Ankur:	I don't know. I'm not done yet. Stop it.
899	Romina:	Do you want me to check 'em for you?
900	Ankur:	No, I'll do it.
901	Romina:	[Inaudible] winner or loser is, your chance of winning in three
902		games. We did this stuff.
903	Jeff:	We did? This?
904	Romina:	Huh?
905	Jeff:	And does it change it from [inaudible].
906	Romina:	What?
907	Jeff:	You know, who wins the first game, does that change
908		everything?
909	Brian:	That doesn't sound good [reference to noise in hallway].
910		How many do you got left?
911	Ankur:	Like four.
912	Jeff:	Did you check it? Are you taking this home?
913	Ankur:	No, because he's got four and I've got three. I'm trying to
914		find which one.
915	Jeff:	God bless Ankur. I just don't have the patience to do it now.
916	Ankur:	Look, got it doubled now.
917	Jeff:	Oh, you found one?
918	Ankur:	Yeah, it's near the end.
919	Brian:	Did you find one?
920	Ankur:	It's right there.
921	Jeff:	Yeah, it is one. How many more does he have than you?
922	Ankur:	No, we both have, three and three.
923	Romina:	I have no clue.
924	Ankur:	It's something [inaudible], Romina. Four, five, six, seven,
925		eight, nine, ten.
926	Romina:	What do you recommend?
927	Ankur:	Twenty. It is right. Forty out of one twenty-eight. Then the
928		whole thing adds up to one.
929	Jeff:	Do they match?
930	Ankur:	They match.
931	Jeff:	Wait, forty out of one twenty-eight?

932	Ankur:	Yeah, it works.
933	Jeff:	Wait, twelve is – six – twenty-four –
934	Ankur:	Just add those – if you add up all of those, it'll equal one.
935		Forty –
936	Romina:	Hold on. What did you –
937	Ankur:	Forty out of one twenty-eight will reduce to twenty out of
938		sixty-four, reduces to five-sixteenths.
939	Romina:	What'd you do? I, I can't see.
940	Jeff:	See – wait, wait, wait. That doesn't equal up, then.
941	Ankur:	Yeah, it does.
942	Jeff:	You got two, and four –
943	Ankur:	Mm hm.
944	Jeff:	That's six, and ten, sixteen.
945	Ankur:	Sixteen out of sixteen.
946	Jeff:	Yeah, you're right. But what – that's the same [referring to
947		the probabilities of a series ending in six and seven games]?
948	Ankur:	I guess. It turned out to be the same. 'Cause this was out,
949		'cause it was out of sixty-four.
950	Jeff:	Because you had – that one was two-sixteenths?
951	Ankur:	Yeah. All A's or all B's.
952	Jeff:	All right, that was two-sixteenths. You see, I had it as two
953		thirty-two's. Yeah, you're right. Two-sixteenths, in that case,
954		it's four thirty-two's.
955	Ankur:	You had two thirty-two's the whole time? That's why you
956		were coming up with, like, ninety-six or whatever, probably.
957	Jeff:	Yeah. And then I had ten – well, I said – in the beginning, I
958		was saying that it was ten thirty-two's, just as – well, I was
959		saying it was like twelve.
960	Ankur:	[To Michael] You're doing binary?
961	Michael:	I'm doing the same thing as you. It's just that I'm not using
962		A's and B's.
963	Romina:	Down here, what'd you do?
964	Ankur:	Binary numbers.
965	Michael:	How many did you win in five games? Eight?
966	Jeff:	He checked that and then he just said, all right, well, that's
967		ten because that's –
968	Romina:	Out of thirty-two? Is that it?
969	Jeff:	Yeah.
970	Romina:	Ten out of thirty-two. This one's ten. What'd you get for the
971		one above?
972	Ankur:	He got twenty-one, but he had a double, so it's twenty, and
973		then when you do the other side, it's another twenty, so it's
974		forty.
975	Romina:	And now, what – what is it for six games? Is it the same
976		thing?

977	Jeff:	Yeah.
978	Ankur:	It's twenty out of sixty-four.
979	Romina:	And for five games?
980	Jeff:	It's – four-sixteenths.
981	Ankur:	It's eight out of thirty-two, or four-sixteenths.
982	Brian:	So, reduce that –
983	Jeff:	Yeah, you could even reduce them again and do all eighths,
984		couldn't we?
985	Ankur:	Mm hm.
986	Jeff:	We could do, uh – no, you couldn't.
987	Romina:	Why are [parts] C and D the same?
988	Ankur:	Oh, no, you couldn't.
989	Romina:	How did you guys get those numbers [for parts C and D]?
990	Ankur:	Five-sixteenths?
991	Jeff:	Yeah, it's five-sixteenths.
992	Romina:	How'd you guys get – did you guys just guess 'em or what?
993	Ankur:	Well, five-sixteenths –
994	Jeff:	That equals – fifteen –
995	Ankur:	This one was supposed to be two.
996	Jeff:	Yeah, [inaudible].
997	Brian:	[Inaudible] five-sixteenths. What about four sixteenths or
998		something?
999	Ankur:	Both. Six [game series] and seven [game series].
1000	Jeff:	Six and seven.
1001	Brian:	They're both the same thing.
1002	Romina:	How did you guys get that? I'm just curious.
1003	Jeff:	Once you got a possibility of six –
1004	Ankur:	[Inaudible] the possibilities –
1005	Jeff:	Once you finish getting six, then we just went, five – ten,
1006		eight, two –
1007	Romina:	Oh, okay, so –
1008	Ankur:	Like, the top number is, like, the games that you can win –
1009		like, the ways that you can win – and the bottom number is
1010		the total possibilities for that number.
1011	Jeff:	Two and [inaudible].
1012	Romina:	I put two sixteenths.
1013	Ankur:	Exactly.
1014	Jeff:	Wait, Ankur. Of course not –
1015	Brian:	That's five-sixteenths, like –
1016	Jeff:	The first one's not two out of sixteen.
1017	Ankur:	Why not?
1018	Jeff:	So – now, why is it two-sixteenths?
1019	Ankur:	'Cause, like, there's –
1020	Romina:	Isn't it supposed to be, like, one-sixteenth?
1021	Ankur:	[Inaudible] the one sixteenth. Why wouldn't it be?

1022	Jeff:	Why – why is it two-sixteenths?
1023	Ankur:	Because it's four numbers, right?
1024	Jeff:	Mm hm.
1025	Ankur:	There's only two ways that you can win, all A's or all B's.
1026	Jeff:	Mm hm.
1027	Ankur:	And then, the total way – total possibilities of four numbers
1028		for either – this could be A or B, A or B, or A or B.
1029	Jeff:	All right.
1030	Ankur:	Two times two times two times two. Two to the fourth is –
1031		two-sixteenths.
1032	Jeff:	All right.
1033	Ankur:	Two for the sixteen and then you get the total.
1034	Jeff:	All right.
1035	Romina:	I hope we can discuss it.
1036	Ankur:	I don't know how to explain it.
1037	Romina:	We just, we just –
1038	Jeff:	Well, we can explain it – we explain up to six.
1039	Romina:	We went through the method with it.
1040	Jeff:	Yeah.
1041	Ankur:	But then we'll be – then we can't prove that – we have all the
1042		possibilities, you know what I mean?
1043	Jeff:	Right.
1044	Ankur:	Um –
1045	Jeff:	We should – uh, [to T/R] you want to talk?
1046	T/R1:	[Inaudible].
1047	Ankur:	Do you want to come and talk to us?
1048	T/R1:	Um, do all of you agree? Some people are [inaudible] each
1049		other too.
1050	Jeff:	I'm convinced.
1051	Romina:	Yeah, I'm – I asked. They told me. I understand.
1052	Brian:	Now they're going to ask you.
1053	Ankur:	No, that [inaudible] How we going to prove that?
1054	Brian:	Jeff.
1055	Ankur:	Why – how do you have all the possibilities?
1056	T/R1:	Say Brian.
1057	Ankur:	And I'm starting to ask Brian and Mike.
1058	Jeff:	Who do you think they'll ask first? Brian and Mike.
1059	Romina:	How did you – how'd you get the bottom denominator?
1060	Ankur:	Oh. Romina, they're not going to ask me anything – I
1061		guarantee you that.
1062	Brian:	Everybody get in here. Group discussion.
1063	Romina:	How'd you get the bottom number? How'd you get the
1064		denominator, because I didn't understand it.
1065	Jeff:	It's like this: one, two, three, four. You got a chance of two
1066		for this, two for this, two for this and two for this.

1067	Romina:	No, I did that too, but I just thought –
1068	Jeff:	Two for this, two for this, two for this and then you multiply
1069		them together, then the two to the n thing –
1070	Romina:	Mm hm.
1071	Jeff:	So then, only two out of those entire ones can win. So that's
1072		two- sixteenths.
1073	Romina:	Can I say something?
1074	Jeff:	That's the first one.
1075	Romina:	Yeah, I understood, I understood that, but how'd you get the
1076		same one [inaudible].
1077	Jeff:	Then we just reduced terms.
1078	Ankur:	Okay.
1079	T/R1:	Jeff, do you want to go to the blackboard and show me?
1080	Jeff:	All right.
1081	T/R1:	And we're all going to ask questions, aren't we, Brian?
1082	Brian:	Yes, we are.
1083	T/R1:	Romina, we're going to ask –
1084	Brian:	I'm ready to tear him apart.
1085	Jeff:	Yeah, that'd be cool, huh? All right, what we did is we took,
1086		uh – [draws four horizontal lines on board]. All right, so –
1087		For the first one, out of four games, you could have – this
1088		could be, um, an A or a B. That could be an A or a B and,
1089		you know, so on. So, basically what we did was this: that
1090		could be two possibilities, that could be two possibilities, that
1091		could be two and that could be two. And that was like when
1092		– we went back to the old days and it was like, two to the n.
1093		And then, four. So two times two, times two, times two, and
1094		that's how we got to sixteen. And that would be the bottom
1095		number. And then in order to win in four games, these have
1096		to either be all A's or all B's, so we got two out of sixteen for
1097		winning in four games, which is the probability of winning in
1098		four games. Does that make sense?
1099	T/R1:	I think so.
1100	Ankur:	Well, we all agree.
1101	T/R1:	Brian, does that make sense?
1102	Brian:	Yeah.
1103	Michael:	Yeah.
1104	T/R1:	Questions? Alice?
1105	Jeff:	You all okay with this?
1106	Alice:	That makes sense to me. I wonder if – did, did all the others
1107		of you come up with the same thing?
1108	Ankur:	[inaudible]
1109	Romina:	Yeah that's –
1110	Alice:	In the same way?
1111	Ankur:	Same way –

1112	Jeff:	I don't think we went in the same way.
1113	Brian:	Just little bits of information from everybody helped create
1114		the answer.
1115	T/R3:	Yeah.
1116	T/R1:	But some of you didn't write numbers like you did.
1117	Brian:	The numbers are right here.
1118	T/R1:	I see strings of A's and B's.
1119	Brian:	Well, these just show, like, like, what can happen.
1120	Romina:	The first one, they had to win them straight, so we couldn't
1121		really —
1122	Brian:	Couldn't put them into numbers.
1123	T/R3:	Okay. And Michael, did you get [inaudible]?
1124	Michael:	Um —
1125	T/R1:	What did you do, Michael?
1126	Michael:	Something else. I don't know, I'm still trying to — you see,
1127		they have something that works for that first one, but does it
1128		work for every —
1129	Jeff:	[inaudible] Do you want to go on that?
1130	T/R1:	Do you buy that one, Michael?
1131	Jeff:	That was the first one, so for the first one, it's two-sixteenths.
1132		All right, for the next one, we're going to do the same
1133		situation, but this will be two to the fifth, so it's gonna be out
1134		of thirty-two, and thirty-two is the bottom number. And then
1135		for — I think, for these we were just kind of — we went through
1136		'em. We were — that's why there's strings of A's and B's on
1137		everyone's paper. And in order to get these, we went
1138		through all the possibilities where there was only — there was
1139		five, five different, five places, and A or B was in four of
1140		them. And we went through all of them and that's how we
1141		got that. And then we ended up with, um, eight of thirty-two
1142		for that. Now, that's not too convincing 'cause we just went
1143		through 'em, but we went through all the ones that were out
1144		of five with four A's and so we got that. I don't think we have
1145		a really concrete mathematical backing for that.
1146	T/R1:	Is that right? You don't have a very concrete mathematical
1147		backing?
1148	Brian:	I don't think we ever have a concrete mathematical backing
1149		for anything.
1150	Ankur:	Like, we can — we can convince ourselves that we did it.
1151	T/R1:	How is — how is —
1152	Ankur:	But I don't think we can —
1153	T/R1:	How did you convince yourselves?
1154	Ankur:	Just by how we —
1155	Romina:	We looked at all these.

1156	Ankur:	Like, how we wrote out the pos – like, just the possibilities of
1157		– not all the possible –
1158	T/R1:	Yeah.
1159	Romina:	And they all add up right.
1160	Ankur:	Just the ones that would allow you to win.
1161	T/R1:	So – so, you tried to write the strings of the wins?
1162	Ankur:	Mm hm.
1163	T/R1:	Okay. In five?
1164	Jeff:	All right. So once we did that, we did the same thing for six,
1165		too. Six times – it, it would be out of sixty-four.
1166	Ankur:	We got twenty out of sixty-four.
1167	Jeff:	And, and then we got twenty out of that.
1168	Ankur:	And then –
1169	Jeff:	And like –
1170	Ankur:	Before we did seven, we –
1171	Jeff:	We counted all of them up and –
1172	Ankur:	We added them up, the two [for four games], five [game
1173		result] and six [game result], and then seven should have
1174		been the remainder.
1175	Jeff:	Of them.
1176	Ankur:	And so – and –
1177	Jeff:	If they're all right.
1178	T/R1:	What if they're not?
1179	Jeff:	Then it's wrong.
1180	Ankur:	But then –
1181	T/R1:	So, you didn't actually compute seven?
1182	Ankur:	No, but then we did compute seven and it matched.
1183	T/R1:	Oh, you did.
1184	Ankur:	Yeah.
1185	T/R1:	So, that was a double-check.
1186	Ankur:	Mm hm.
1187	T/R1:	How do you know you're not double-counting?
1188	Jeff:	[inaudible]
1189	Ankur:	[inaudible]
1190	Romina:	We individually worked through them.
1191	Brian:	How do you know you're not missing any?
1192	Jeff:	That's the big question.
1193	T/R1:	Mm hm.
1194	Jeff:	That's why we're kind of –
1195	Brian:	From the information we were given, it seems like we have
1196		them all.
1197	T/R1:	Okay. Is there a way of coming up with a representation or a
1198		way of writing it, so that you could persuade somebody else
1199		that you really do have them all, and they don't just believe

1200		you that, "I sort of went through them and it looks like I have
1201		them all"?
1202	Ankur:	Do an equation or –
1203	Jeff:	Yeah, I mean, I think that's what we didn't know.
1204	Michael:	Listen to this [showing his paper to Ankur] You have – well,
1205		let's go to the fourth one from each one [fourth coefficient in
1206		rows 3 - 6]. One team has one and the other team also has
1207		one, so that's two. The second one, you get double that and
1208		get an eight. A twenty –
1209	T/R1:	Mm hm.
1210	Michael:	And –
1211	Ankur:	Ten and ten, and then the –
1212	Michael:	What'd you get for the seven games?
1213	Jeff:	Same thing as –
1214	Ankur:	Forty.
1215	Michael:	Twenty.
1216	Ankur:	Yeah, it's twenty.
1217	Michael:	So, obviously, you have some kind of connection with the
1218		[makes a triangle with his hands].
1219	Ankur:	Yeah, I know.
1220	Romina:	They – they did the triangle?
1221	T/R1:	You want to show us up there what you're doing, Michael,
1222		please?
1223	Michael:	I don't know what type of connection this displays, but-
1224	T/R1:	Well, put it up and show us –
1225	Ankur:	The ones that are crossed out?
1226	Jeff:	Yeah.
1227	T/R1:	Michael you always say you don't know how to explain it, but
1228		when you're done, I do understand what you're saying.
1229	Michael:	All right. You're all familiar with this [writes the first rows of
1230		Pascal's Triangle on board].
1231	Ankur:	Yeah, this is how you – this is how you prove that we didn't
1232		miss any.
1233	T/R1:	Oh, okay.
1234	Michael:	I don't know how to prove it. I'm actually just saying that--
1235	Ankur:	Actually, it does because you did it – watch.
1236	T/R1:	All right. Ankur's going to prove what you have.
1237	Jeff:	Oh, gee.
1238	Ankur:	Because you have, you actually taught us this one day.
1239	Michael:	One, right [writing on board]?
1240	T/R1:	You give me more credit than I deserve.
1241	Michael:	I'm going to run out of room
1242	Jeff:	Five.
1243	Romina:	Five.

1244	Michael:	All right, um, I just found, like, if you take the fourth number
1245		in each one [circles these entries]-- that way, if you double
1246		each number, 'cause you have two teams, you can get the
1247		possibilities of four games. Four games, um, equals two,
1248		right? You got eight, twenty and forty, like they said.
1249	Ankur:	It makes sense. It makes sense from what you said that one
1250		time.
1251	Michael:	I don't know – I don't know if you, she, she, she – we found
1252		a connection between binary numbers and this. [To T/R]
1253		You remember that, right?
1254	T/R1:	Help me remember.
1255	Michael:	Remember we found a connection between the binary
1256		numbers, you know, and then this triangle?
1257	T/R1:	Mm hm.
1258	Michael:	I don't know how I'm going to explain it.
1259	T/R1:	If you show me –
1260	Michael:	It's just like binary numbers 'cause you're just writing A's and
1261		B's, ones and zeros, so, like – all right.
1262	Jeff:	Exactly.
1263	Michael:	So – I'm just going to just tell you – like, I don't want to, to
1264		explain it because it will take too long. This is – if you have,
1265		um, bin – like four places that, um, yeah, four places, it
1266		would be one out of those sixteen –
1267	Jeff:	Yeah.
1268	Michael:	One out of those sixteen, that has all zeros – nothing, all
1269		right? This is the three. There will be three of them that have
1270		two, three of them that have –
1271	Jeff:	Two.
1272	Michael:	Three of them have one.
1273	Ankur:	Three. There's three.
1274	Jeff:	All right.
1275	Michael:	Three of them that have two and one of them will have
1276		three. Um, now when you go to the next step, those, uh, that
1277		last – those last – those three games that they won – The
1278		first three games, if they win that, that'll be like, those three
1279		possibilities without – would be – if they win the next game
1280		or those three – if they win – Uh, I don't know how to
1281		explain it. Uh, on the third game – I don't know. I – I have
1282		trouble explaining things. I don't even know what I'm trying to
1283		do now.
1284	T/R1:	You're – you're doing fine.
1285	Michael:	But, um – Do you guys see anything?
1286	Jeff:	Well, obviously, there's something going on with the one,
1287		four, ten and twenty.
1288	Romina:	Well, I missed you.

1289	Michael:	Yeah, there's obviously something going on.
1290	Jeff:	I mean, that's not – they wouldn't be like that. And I guess
1291		you were gonna say if it was out of eight games, it would be
1292		thirty-five? The probability would be thirty-five out of –
1293	Michael:	I think [inaudible].
1294	Jeff:	Do you know what I'm saying?
1295	Ankur:	Yeah.
1296	Michael:	It would be one, seven [writing next row of triangle] –
1297	Ankur:	You just add the fifteen and the twenty, and you get thirty-
1298		five.
1299	Jeff:	So, I mean, there's gotta be something there, because it
1300		wouldn't all –
1301	Michael:	No, it wouldn't be – it would be thirty-five, doubled.
1302	Ankur:	Yeah, seventy.
1303	Jeff:	That's what it would be. Yeah.
1304	Michael:	Right.
1305	Jeff:	Thirty-five from one team.
1306	Michael:	Eighty, seventy. But it only goes – but the limits of the
1307		problem are to win four out of seven, not four out of eight.
1308	Jeff:	Oh yeah, I know. What I'm saying all along.
1309	T/R1:	Okay. Um, don't go away Michael.
1310	Michael:	I won't.
1311	T/R1:	Because one of the other questions I wanted to ask is that
1312		Michael showed me something last time, when we talked
1313		ourselves, that I guess you all didn't hear and I wasn't sure
1314		how much of it he was going to share with this. And I guess
1315		a little bit of it I connect to from what you talked about the
1316		last time. But – but what you explained to me, Michael, I
1317		remember the last time, is – you see that addition of ten, you
1318		know, the six and four?
1319	Michael:	Yeah. No, no. Why do you add them together? Then why is–
1320	T/R1:	Or the twenty. Why you add them together and you had an
1321		explanation –
1322	Michael:	Yeah.
1323	T/R1:	And you were using pizzas to explain it to me. Any of you
1324		ever heard this before?
1325	Ankur:	Yes.
1326	T/R1:	You were talking about toppings on pizzas.
1327	Romina:	Oh yeah, I remember that.
1328	T/R1:	Is that right?
1329	Michael:	Why are they adding on –
1330	T/R1:	And so, um, you took a road there –
1331	Michael:	Yeah, uh –
1332	T/R1:	[To Jeff, who has to leave] I'll see you next week.
1333	Jeff:	Yes. I'm very sorry.

1334	T/R1:	At twelve.
1335	Jeff:	Twelve o'clock.
1336	Brian:	We're on at twelve o'clock.
1337	T/R1:	Uh, twelve. We'll have one.
1338	Jeff:	All right.
1339	Alice:	Good luck.
1340	T/R1:	Good luck in your game.
1341	Jeff:	Thank you very much.
1342	Michael:	All right. Um –
1343	T/R1:	Do you remember?
1344	Michael:	Yeah, I remember. Right. You have, what? Three toppings
1345		and this one has four?
1346	T/R1:	Okay, which one is this?
1347	Michael:	Three toppings.
1348	T/R1:	If you're thinking –
1349	Michael:	[Pointing to the row with entries 1 3 3 1] This is like a three-
1350		topping pizza. There will be one with, uh –
1351	Ankur:	Plain?
1352	Romina:	Plain.
1353	Michael:	Plain, right? Three with just two toppings, three with, uh, just
1354		one topping, three with just two and one with all toppings.
1355		And when you have that one pizza, what – if you don't add
1356		on a – a topping, it'll still stay in that zero place. But then you
1357		add, you add, a mush – if you do add a topping, that – those
1358		ones will become into four different pizza pies.
1359	T/R1:	Show me the one and the three giving you the four, in terms
1360		of pizzas. Can you tell me that?
1361	Michael:	All right. Hold on. I'm trying.
1362	T/R1:	Sure. Just tell me that in pizza toppings.
1363	Michael:	In pizza toppings –
1364	T/R1:	How one plus three equals four.
1365	Michael:	I'm trying to think – I – I had it. Last time I talked to you, I
1366		had, had it so good.
1367	Ankur:	Why don't you just roll the tape?
1368	Michael:	Yeah, you got it on tape.
1369	T/R1:	Well, why don't you help him figure it out? Yeah. Let's –
1370		let's go back and – and think of what that means. Can you
1371		show me – can you show the one and the three being a four,
1372		so everyone knows what we're focusing on, Michael?
1373	Michael:	What – what are you talking about?
1374	Ankur:	How the –
1375	T/R1:	Draw the lines. Okay. Now, why – I'm asking you why that
1376		works, with pizzas.
1377	Michael:	All right. You're going to add a topping to every single pizza
1378		on there, right? There's going to be twice as many pizzas.

1379		But these three pizzas – three of them got a topping, went
1380		there, and three of them didn't, went there. One of them had
1381		a topping, right there, and one of them didn't, went there.
1382		'Cause these three pizzas are going to turn into six pizzas. –
1383		Now I got it, right? And three of them, which had three
1384		toppings and gained another one, are in the next category.
1385		They moved a step up. These guys stayed in the same
1386		place 'cause they didn't get one.
1387	Ankur:	[inaudible]
1388	Michael:	That's why they had –
1389	Ankur:	Mm hm.
1390	Michael:	Did I get that, like the last time?
1391	T/R1:	I don't know. Did they – Brian doesn't understand.
1392	Brian:	I grasped it. Yeah.
1393	Michael:	This pizza –
1394	T/R1:	Can you tell it to me, then, with some toppings? Make up
1395		some toppings and see what it says.
1396	Michael:	All right, you got, um – cheese pizza, no, plain pizza and you
1397		got a pizza with mushrooms. You're going to add a topping –
1398		is that right? You have three toppings in this one [row of
1399		entries 1 3 3 1]. You have, uh, you can have one plain, one
1400		with peppers and mushrooms and sausage. And then you're
1401		going to add another topping – I don't know, more cheese?
1402		Uh, you're gonna – you're either gonna add more cheese to,
1403		to one of them, either – you're going to – when you add
1404		another topping – you're gonna, like – the possibilities are
1405		going to double because some of them you're going to add,
1406		you're going to add cheese to them, and some of them
1407		you're not. Like, you're going to have this one pizza, it's
1408		plain. The one that's not going to get another topping is
1409		gonna go here. The one that's going to get the cheese is
1410		going to go here. And three of these which only had the
1411		mushrooms, three are going to get cheese. They're going to
1412		go here.
1413	T/R1:	Wait a minute. Is cheese the plain?
1414	Michael:	Cheese – well, I think –
1415	Ankur:	Extra cheese.
1416	Michael:	Extra cheese. Anchovies. Whatever you want.
1417	T/R1:	That helps a lot.
1418	Michael:	These with the mushrooms, if they get anchovies, they're
1419		gonna be three different, three different pizzas with two
1420		toppings. They're gonna go here. If they don't, they're still
1421		going to be three different pizzas –
1422	T/R1:	Mm hm.

1423	Michael:	That have one topping. So, do you understand? Like, um,
1424		when you add – . When you add a topping or whatever, uh,
1425		this many is gonna – is like – if you think of it as steps, like
1426		one, two – this one's going to, like, move up a step – 'cause
1427		it's –
1428	Ankur:	[inaudible]
1429	Michael:	Either gonna get one or not, all right? So there's twice as
1430		many possibilities now. And three of them will have, and
1431		three then will not have, that extra one.
1432	T/R1:	Does that make sense?
1433	Romina:	Yeah, we understood this.
1434	Brian:	You got something, you move up one.
1435	Michael:	I – I don't know if that makes sense.
1436	Brian:	If you don't, you join with the one of those over there.
1437	Michael:	I can't explain it any other way.
1438	T/R1:	Could you say that again, Brian? One more time. If you've
1439		got something –
1440	Romina:	If you move up –
1441	Brian:	If you get something, you move up, and if you don't, then
1442		you just join the other one.
1443	Ankur:	If you got something you go on.
1444	Romina:	You join in.
1445	Michael:	You stay – you stay –
1446	Ankur:	Is that's what you're trying to say?
1447	Michael:	Yeah, I – but then –
1448	Romina:	You could have helped him out there, Brian.
1449	Brian:	That wouldn't have done anything.
1450	Michael:	Now with the – with the one, three, three, one
1451		[entries 1 3 3 1], that circled one is, um, I guess you win
1452		those three games in a row. There's only one possibility.
1453		Now, your next time you either win a game or you don't. And
1454		that's how it goes with that, you know?
1455	T/R1:	So, that's the two possibilities there?
1456	Michael:	That – the one would be –
1457	Ankur:	One –
1458	Michael:	You know what I'm saying, like to – in order to – how many
1459		is up there? One plus three –
1460	Ankur:	Eight.
1461	Michael:	Eight up there? What was our probability? Two out of
1462		sixteen. All right.
1463	Ankur:	And that's one out of eight.
1464	Michael:	Yeah, it's one out of eight. You have a – you have a one out
1465		of eight possibility of, uh, winning three in a row. And then –
1466		the next game, there's a fifty-fifty – All right, you would either
1467		win, or you can go to that four category. I'm saying, like, the

1468		probability of, uh, I guess getting – of winning, would, would
1469		have to – you – you have to count the number before it.
1470		Like, winning, uh, three – let's see. It's confusing.
1471	Brian:	Uh, huh. Right.
1472	Michael:	I – I know what it means in my – I can see it in my head.
1473	T/R1:	I – I can – someone want to help Michael out? Do you know
1474		what he's saying here? He's trying to summarize this. He's
1475		sort of suggesting, gosh, if you follow sort of that path you
1476		can get those probabilities pretty fast, right?
1477	Ankur:	Mm hm.
1478	T/R1:	Kind of handy on tests, the SAT or –
1479	Ankur:	Do they ask this on the SAT?
1480	Brian:	That's a good question, is that going to –
1481	Romina:	Forget it.
1482	T/R1:	The advanced math one –
1483	T/R3:	Mike, that circled one is?
1484	Michael:	Is the – all right, is the, uh –
1485	Ankur:	Is the – in the four games, that's winning all four.
1486	Michael:	Let's say in – in the games – no, no that's just three games.
1487		All right. Your probability of winning three times in three
1488		games. The first one you have a one out of eight chance
1489		losing all three.
1490	Romina:	So that's the one, three, three, one there?
1491	Michael:	And the second one, you have three possibilities of winning
1492		one: you could win it the first time, the second time or the
1493		third time. Uh, the third one would be winning twice.
1494	T/R1:	Okay.
1495	Michael:	The first one, you – you can understand. And there's only
1496		one other, one way to win three times.
1497	T/R1:	Okay, there's one way to win –
1498	Michael:	Now, if you win those three games – uh –
1499	T/R3:	If you go to the, if you went to the right, what would that
1500		indicate?
1501	Michael:	If you went to the right –
1502	Ankur:	Then you won.
1503	Michael:	No, you see that – that wouldn't –
1504	Ankur:	No, if you –
1505	Michael:	Don't think of going over there like going on to the next
1506		game, 'cause, 'cause, um, the – you know, the one and the
1507		four, that'd be like you lost, then, 'cause you stayed in the
1508		same place, but it's not. It's like you won those three games
1509		and now you have a – like, you have a fifty-fifty chance of
1510		winning the next one – which might be why we double it. I
1511		don't know.

1512	Ankur:	Actually, I was going to say, like, that one represents the,
1513		like, winning three games in a row, or like three A's.
1514	Michael:	That's the probability.
1515	T/R1:	Okay.
1516	Ankur:	And then, if you go to the right, that's like getting another A,
1517		and there's only one way to get four A's. If you go to the left
1518		that's like getting a B, and that's like three A's and a B, and
1519		there's four different ways you can write that.
1520	T/R1:	Now, you said, Michael, that you have a fifty-fifty chance –
1521	Michael:	I don't think that has anything to do with it, though. I don't
1522		know if it does.
1523	T/R1:	Well, that's an interesting question. Is that an assumption in
1524		this problem?
1525	Michael:	Yeah.
1526	T/R1:	Does all this work if this one team has a higher chance of
1527		winning than the other?
1528	Michael:	If one team is better than the other.
1529	Romina:	Yeah, then they have a –
1530	T/R1:	You said it twice and you sort of – you said it almost as if,
1531		well, if you have a fifty--fifty chance, either the other team
1532		could win or the other.
1533	Michael:	Of winning. I mean if, if –
1534	T/R1:	Are you retracting that? Because you did say that.
1535	Michael:	If one team is better than the other, then probably the thing
1536		[Pascal's Triangle] wouldn't even matter.
1537	T/R1:	So this may not work if one team is better than the other.
1538	Michael:	Probably not.