J6/Ch9/Day 4B

Testing Flint's Water

In 2014, to save money, Flint city officials switched the water supply from the Detroit water system to the Flint River. The following years became a battle in Flint, between residents raising concerns about the safety of their tap water and government officials who insisted it was fine.

Today, we will simulate the investigation of Flint's water that was performed by outside researchers at Virginia Tech. We will perform a **significance test** to see if there is convincing evidence that the **proportion** of homes in Flint with high-lead content in their water supply passes the EPA threshold for safety.

2014	2014/2015	2015
Flint city officials celebrate as they cut costs by switching the water supply from Detroit to the Flint River.	Residents voice concerns about declining water quality.	Mayor drinks tap water on local television to "prove" the water is safe. Outside investigators start testing Flint's water systems.

Collect Data: Use a random number generator to select 5 homes from the population of Flint. For each home, record whether there was a high lead level (>15 parts per billion) or a low lead level (≤15 ppb). Write "H" for a high lead level and "L" for a low lead level.

_____ _____ _____ _____ _____

Class Sample:

Number of high-lead homes: _____ Number of low-lead homes: _____

Lead levels measured in parts per billion (ppb). Leads counts of 0 signify trace, insignificant amounts

Home	Lead	Home	Lead	Home	Lead	Home	Lead	Home	Lead	Home	Lead	Home	Lead	Home	Lead	Home	Lead	Home	Lead
1	1.6	101	0.0	201	6.0	301	33.3	401	9.5	501	62.1	601	0.0	701	20.8	801	19.1	901	0.0
2	0.0	102	0.0	202	0.0	302	0.0	402	0.0	502	0.0	602	22.9	702	0.0	802	6.3	902	0.0
3	8.8	103	6.6	203	13.5	303	0.0	403	0.0	503	6.2	603	13.9	703	6.8	803	0.0	903	51.2
4	0.0	104	0.0	204	0.0	304	0.0	404	18.9	504	0.0	604	0.0	704	19.5	804	10.8	904	0.0
5	0.0	105	0.0	205	11.1	305	2.5	405	4.0	505	0.0	605	0.0	705	0.6	805	0.0	905	3.2
6	0.0	106	3.1	206	0.0	306	0.0	406	0.0	506	0.0	606	2.0	706	22.4	806	0.0	906	0.0
7	0.0	107	0.0	207	0.0	307	0.0	407	0.0	507	1.7	607	20.8	707	0.0	807	0.0	907	0.0
8	0.0	108	0.2	208	0.0	308	34.3	408	0.0	508	28.3	608	2.9	708	1.5	808	31.6	908	0.0
9	29.7	109	0.0	209	11.9	309	0.0	409	0.0	509	0.0	609	16.9	709	12.6	809	0.0	909	15.4
10	0.0	110	2.1	210	17.8	310	5.2	410	15.1	510	22.7	610	0.0	710	0.0	810	4.6	910	0.0
11	4.0	111	0.0	211	0.0	311	0.0	411	0.0	511	0.0	611	44.1	711	0.0	811	0.0	911	3.7
12	0.0	112	3.6	212	0.0	312	0.0	412	0.0	512	10.3	612	0.0	712	0.0	812	7.4	912	8.1
13	0.0	113	0.0	213	17.8	313	0.8	413	0.0	513	3.9	613	0.0	713	8.1	813	0.0	913	14.0
14	0.0	114	8.7	214	42.7	314	0.0	414	11.5	514	0.0	614	0.0	714	27.5	814	0.0	914	45.6
15	0.0	115	0.0	215	8.7	315	27.0	415	1.4	515	0.0	615	2.2	715	0.0	815	3.5	915	7.1
16	1.7	116	12.9	216	2.9	316	0.0	416	0.0	516	0.0	616	0.0	716	75.7	816	0.0	916	9.6
17	12.3	117	0.0	217	0.0	317	0.9	417	14.5	517	0.0	617	0.0	717	19.9	817	0.0	917	17.6
18	0.0	118	15.9	218	0.0	318	0.0	418	28.1	518	0.0	618	8.0	718	0.0	818	1.1	918	0.0
19	0.0	119	0.0	219	2.8	319	0.0	419	3.0	519	2.1	619	0.0	719	0.0	819	0.0	919	55.5
20	49.3	120	8.4	220	0.0	320	0.0	420	0.0	520	13.5	620	3.4	720	7.5	820	0.0	920	0.0
21	1.6	121	0.0	221	0.0	321	7.4	421	47.9	521	25.3	621	0.0	721	0.0	821	0.0	921	51.5
22	3.4	122	15.1	222	0.0	322	4.0	422	0.0	522	11.5	622	2.1	722	0.0	822	2.5	922	0.0
23	11.2	123	15.3	223	0.0	323	19.2	423	0.0	523	15.0	623	14.3	723	0.0	823	1.9	923	16.9
24	9.1	124	1.6	224	27.8	324	0.0	424	6.9	524	0.0	624	10.3	724	24.7	824	0.0	924	0.0
25	6.4	125	0.0	225	19.9	325	0.0	425	16.9	525	0.0	625	0.0	725	50.7	825	0.0	925	0.0
26	13.0	126	38.2	226	0.0	326	0.0	426	4.7	526	0.0	626	0.0	726	18.1	826	0.0	926	6.7
27	11.3	127	0.0	227	30.3	327	0.0	427	0.0	527	0.0	627	12.6	727	0.0	827	0.0	927	14.6
28	12.4	128	5.4	228	10.7	328	0.0	428	0.0	528	0.0	628	0.0	728	7.4	828	49.6	928	38.2
29	0.0	129	8.8	229	30.2	329	41.2	429	0.0	529	0.0	629	4.0	729	0.0	829	65.0	929	0.0
30	0.0	130	0.0	230	11.1	330	38.2	430	0.0	530	0.0	630	0.0	730	0.0	830	10.4	930	4.2
31	21.3	131	0.0	231	0.0	331	0.0	431	0.0	531	0.0	631	1.8	731	0.0	831	49.5	931	0.0
32	0.0	132	0.0	232	0.2	332	0.0	432	0.0	532	0.0	632	23.2	732	0.0	832	27.1	932	0.0
33	0.0	133	0.0	233	4.7	333	0.0	433	47.6	533	15.5	633	7.8	733	0.0	833	1.4	933	1.0
34	27.7	134	40.7	234	0.0	334	8.0	434	9.3	534	0.0	634	61.2	734	9.3	834	11.3	934	40.7
35	7.3	135	8.0	235	3.3	335	0.0	435	0.0	535	0.0	635	0.0	735	0.0	835	0.0	935	5.6
36	0.8	136	5.1	236	0.0	336	0.0	436	15.3	536	0.0	636	0.0	736	7.2	836	1.8	936	0.0
37	0.0	137	0.0	237	12.5	337	0.0	437	3.3	537	0.0	637	0.0	737	0.0	837	13.8	937	7.7
38	7.7	138	0.0	238	17.7	338	0.0	438	0.0	538	44.9	638	0.9	738	18.4	838	0.0	938	3.4
39	0.0	139	33.1	239	0.0	339	6.7	439	0.0	539	7.2	639	0.0	739	0.0	839	12.5	939	0.0
40	5.8	140	18.4	240	46.4	340	9.1	440	12.5	540	39.7	640	12.7	740	29.2	840	16.1	940	1.4
41	0.0	141	0.0	241	0.0	341	43.3	441	39.0	541	0.0	641	15.4	741	34.7	841	4.7	941	7.7
42	96.6	142	13.0	242	3.6	342	0.0	442	0.0	542	0.0	642	2.7	742	1.7	842	16.7	942	0.0
43	1.6	143	0.0	243	0.0	343	7.7	443	3.6	543	0.0	643	6.5	743	64.2	843	8.6	943	11.4
44	0.0	144	0.0	244	7.6	344	6.4	444	0.0	544	0.0	644	23.7	744	1.0	844	0.0	944	21.0
45	5.4	145	0.0	245	13.9	345	0.0	445	0.0	545	0.0	645	0.0	745	3.8	845	0.0	945	0.0
46	22.5	146	15.3	246	0.0	346	0.0	446	21.6	546	0.0	646	0.0	746	0.0	846	0.0	946	0.0
47	9.3	147	0.0	247	4.1	347	0.0	447	0.0	547	0.0	647	11.0	747	10.1	847	6.7	947	5.8
48	0.0	148	3.0	248	0.0	348	0.0	448	0.0	548	72.3	648	0.0	748	3.0	848	0.0	948	49.8
49	29.7	149	0.0	249	28.8	349	0.0	449	13.8	549	0.0	649	0.0	749	23.8	849	3.0	949	0.0
50	8.6	150	8.2	250	14.0	350	4.6	450	22.2	550	7.3	650	0.0	750	3.6	850	23.2	950	43.4
51	0.0	151	0.0	251	1.3	351	0.0	451	0.0	551	3.5	651	0.6	751	0.0	851	0.0	951	0.2
52	0.0	152	12.4	252	0.0	352	0.0	452	0.0	552	0.0	652	44.4	752	2.2	852	0.0	952	0.0
53	4.9	153	0.0	253	0.0	353	11.5	453	19.1	553	35.5	653	7.8	753	0.0	853	0.0	953	0.0
54	0.0	154	0.0	254	14.5	354	0.0	454	0.0	554	6.1	654	15.3	754	35.6	854	6.2	954	0.0
55	3.5	155	14.8	255	0.0	355	12.2	455	14.7	555	0.0	655	3.5	755	17.5	855	0.0	955	7.7
56	17.2	156	8.6	256	12.3	356	0.0	456	0.0	556	5.2	656	9.1	756	0.0	856	10.3	956	2.9
57	0.0	157	8.3	257	5.8	357	4.2	457	12.0	557	0.0	657	0.0	757	0.0	857	1.9	957	0.0
58	27.4	158	0.0	258	0.0	358	6.7	458	12.2	558	11.1	658	0.6	758	0.0	858	0.0	958	4.0
59	4.6	159	0.0	259	0.0	359	0.0	459	9.0	559	0.0	659	20.3	759	0.0	859	0.0	959	23.2
60	4.3	160	0.0	260	5.3	360	28.2	460	0.0	560	0.0	660	0.2	760	84.8	860	0.0	960	0.0
61	4.3	161	4.5	261	10.3	361	46.8	461	0.0	561	0.0	661	21.4	761	11.9	861	16.6	961	16.0
62	0.0	162	5.1	262	0.0	362	0.0	462	0.0	562	0.0	662	0.0	762	0.0	862	0.0	962	0.0
63	12.3	163	44.9	263	13.3	363	0.0	463	0.0	563	0.0	663	0.0	763	0.0	863	0.0	963	2.0
64	0.0	164	0.0	264	21.7	364	0.0	464	10.0	564	0.0	664	0.0	764	30.6	864	3.1	964	0.0
65	0.0	165	0.0	265	0.0	365	0.0	465	0.0	565	27.3	665	0.0	765	12.2	865	0.0	965	20.5
66	0.0	166	14.4	266	0.6	366	6.9	466	4.2	566	14.1	666	17.4	766	0.0	866	4.5	966	0.0
67	0.0	167	0.0	267	12.6	367	35.5	467	8.7	567	8.6	667	0.0	767	20.8	867	0.0	967	5.1
68	0.0	168	0.0	268	0.0	368	6.2	468	0.0	568	4.8	668	0.0	768	0.0	868	0.0	968	9.5
69	3.5	169	0.0	269	27.5	369	0.8	469	0.0	569	9.2	669	0.0	769	0.0	869	8.9	969	7.9
70	2.8	170	0.0	270	0.0	370	0.0	470	0.0	570	2.6	670	22.4	770	50.6	870	2.4	970	0.0
71	13.5	171	11.1	271	6.2	371	0.0	471	0.0	571	0.0	671	0.0	771	0.0	871	0.0	971	5.0
72	13.2	172	8.1	272	0.0	372	0.0	472	55.8	572	13.4	672	2.4	772	5.2	872	0.0	972	0.0
73	26.8	173	10.3	273	11.9	373	0.4	473	19.0	573	0.0	673	12.4	773	0.0	873	7.5	973	48.6
74	11.7	174	20.6	274	0.0	374	17.5	474	43.7	574	0.0	674	0.0	774	0.0	874	7.2	974	35.2
75	0.0	175	10.2	275	2.8	375	0.0	475	1.3	575	8.9	675	18.9	775	0.0	875	0.0	975	0.0
76	0.0	176	2.2	276	0.0	376	9.4	476	0.0	576	4.0	676	17.8	776	3.0	876	0.0	976	0.0
77	0.0	177	29.1	277	0.0	377	0.0	477	14.7	577	0.0	677	0.0	777	7.8	877	12.5	977	0.0
78	0.0	178	22.3	278	0.0	378	0.0	478	8.7	578	11.5	678	3.1	778	18.9	878	0.0	978	9.7
79	0.0	179	0.0	279	8.0	379	0.0	479	29.9	579	0.0	679	11.3	779	0.0	879	35.5	979	0.0
80	0.0	180	0.0	280	21.9	380	0.0	480	1.2	580	25.0	680	36.2	780	0.0	880	0.0	980	0.0
81	0.0	181	0.0	281	0.2	381	0.0	481	6.0	581	0.0	681	25.6	781	0.9	881	0.0	981	0.0

Lead levels measured in parts per billion (ppb). Leads counts of 0 signify trace, insignificant amounts

82	0.0	182	54.1	282	0.0	382	25.5	482	0.0	582	37.4	682	0.0	782	0.0	882	0.5	982	21.2
83	56.1	183	0.0	283	0.0	383	2.4	483	0.6	583	0.0	683	0.0	783	0.0	883	0.0	983	0.0
84	16.7	184	0.0	284	5.5	384	0.0	484	37.9	584	0.5	684	0.0	784	5.1	884	0.0	984	0.0
85	0.0	185	0.0	285	6.3	385	0.0	485	0.1	585	1.3	685	0.0	785	0.0	885	0.0	985	0.0
86	10.5	186	0.0	286	1.6	386	0.0	486	0.0	586	0.0	686	0.0	786	0.0	886	26.0	986	0.0
87	14.8	187	3.4	287	24.2	387	0.0	487	0.0	587	0.0	687	7.2	787	0.0	887	17.2	987	0.0
88	7.6	188	0.0	288	6.2	388	0.0	488	39.0	588	9.4	688	1.6	788	19.0	888	27.8	988	0.9
89	10.8	189	5.6	289	16.0	389	0.0	489	0.0	589	6.7	689	0.0	789	0.0	889	0.0	989	0.0
90	11.9	190	0.0	290	0.0	390	5.3	490	6.1	590	0.0	690	0.0	790	0.0	890	17.4	990	5.7
91	0.0	191	0.0	291	0.0	391	0.0	491	0.0	591	0.0	691	0.0	791	0.0	891	50.6	991	7.3
92	5.5	192	13.3	292	0.0	392	0.0	492	2.0	592	13.1	692	8.6	792	0.0	892	0.0	992	30.7
93	0.0	193	0.0	293	24.8	393	22.5	493	9.8	593	17.6	693	22.4	793	0.0	893	4.1	993	0.0
94	6.8	194	0.0	294	0.0	394	23.0	494	0.0	594	0.2	694	0.0	794	50.9	894	20.8	994	20.8
95	5.6	195	29.9	295	15.3	395	0.0	495	0.0	595	0.0	695	0.0	795	5.0	895	0.0	995	0.0
96	0.0	196	31.5	296	0.0	396	15.5	496	0.0	596	8.3	696	0.0	796	0.0	896	8.0	996	0.0
97	0.0	197	0.0	297	0.0	397	44.9	497	3.0	597	0.0	697	4.0	797	22.6	897	4.2	997	0.0
98	12.4	198	0.0	298	2.4	398	0.0	498	0.0	598	0.0	698	11.3	798	11.1	898	0.0	998	8.3
99	0.0	199	0.0	299	6.2	399	25.7	499	0.0	599	0.0	699	0.0	799	0.0	899	0.0	999	0.0
100	16.7	200	3.2	300	3.0	400	1.3	500	33.9	600	7.8	700	0.0	800	28.9	900	0.0	1000	1.5

1. According to EPA regulations, if more than 10% of homes in a city have high lead content in their water (>15 parts per billion), the city's water supply is unsafe. Based on the sample your class collected, is there convincing evidence that the water system in Flint is unsafe?

2. A Virginia Tech study** randomly sampled water from 252 homes in Flint. Of those, 42 had high lead content. $\hat{p} = \frac{42}{252} = 0.17$. Compared to our class data, does this study give more or less convincing evidence of an unsafe water supply in Flint. Why?

Check Your Understanding

1. Sometimes parents and grandparents like to recount how difficult life was when they were kids, such as having to walk 10+ miles to school (in the snow, uphill both ways). A random sample of 180 teenagers were selected and 40% had heard stories from their parents or grandparents about how difficult life was when they were kids. Do these data provide convincing evidence at the $\alpha = 0.05$ significance level that the proportion of all teenagers who have heard stories from their parents or grandparents about how difficult life was when they were kids differs from 0.50?

2. A 95% confidence interval for the proportion of all teenagers who have heard stories from their parents or grandparents about how difficult life was when they were kids is (0.328, 0.472). Explain how the confidence interval is consistent with, but gives more information than, the test.