

Part I. (125 points) Do all calculations in Minitab. Use a word processor of your choice to write a report. Insert computer text output and graphics to support what you are saying, but you need to write something that looks like an academic paper — not a pile of computer output. Turn in a hard copy of your HW in class (i.e., don't email me your HW). Also:

1. Clearly define population parameters in each problem. That is, give a verbal description of what the population mean is in the context of the problem.
2. Clearly specify hypotheses when appropriate (not every problem involves a test of hypothesis).
3. Write a coherent conclusion based on each CI or test.

(25^{pts})

1. Parallax: The following determinations of the parallax of the sun (the angle spanned by the earth's radius as if it were viewed and measured from the sun's surface) were made in 1761 by noted astronomer James Short. The units are in seconds of a degree (1/360 degree).

8.50	8.06	8.65	9.71	8.80	7.99	8.50	8.43	8.35
8.50	8.40	8.58	7.33	8.44	8.71	8.28	8.82	8.34
8.64	8.14	8.31	9.87	9.02	9.64	9.27	7.68	8.36
8.86	10.57	8.34	9.06	10.34	8.58	5.76	9.11	8.55
9.25	8.07	7.80	8.44	8.66	9.54	9.09	8.36	7.71
8.23	8.34	9.07	8.50	9.71	8.30	8.50	8.60	

With a careful determination of the radius of the earth and a good average value of the parallax, the average distance of the earth to the sun can be obtained. The currently accepted value of the parallax is 8.798.

Within this framework, define

μ = the population mean of all potential measurements of the parallax using Short's device.

We are interested in whether μ could be the currently accepted value of the parallax of the sun, that is, we wish to test whether $\mu = 8.798$.

- (a) (5 pts) Describe the distribution of determinations of the parallax. Be complete.
- (b) (10 pts) Perform the standard *t*-test on these data, at the 5% level, and construct a 95% CI for μ . Interpret the results, given the question of interest.
- (c) (10 pts) Repeat the analysis using a suitable non-parametric method, and contrast the results with part (b). Which analysis seems most reasonable, and what are your conclusions based on that analysis, given the question of interest?

(50^{pts})

2. Guinea pigs: The data below are the survival times in hours of 72 guinea pigs after they were injected with a given dose of tubercule bacilli in a medical experiment. The data are from the article "Acquisition of resistance of guinea pigs injected with different doses of virulent tubercule bacilli," by T. Bjerkedal in the American Journal of Hygiene, (1960), pp. 130–148.

43	45	53	56	56	57	58	66	67	73	74
79	80	80	81	81	81	82	83	83	84	88
89	91	91	92	92	97	99	99	100	100	101
102	102	102	103	104	107	108	109	113	114	118
121	123	126	128	137	138	139	144	145	147	156
162	174	178	179	184	191	198	211	214	243	249
329	380	403	511	522	598					

- (a) (10 pts) Obtain a 95% *t*-CI for the mean survival time.
- (b) (10 pts) Repeat part (a) using a suitable nonparametric method.
- (c) (10 pts) Take the log of survival time and find a 95% *t*-CI for mean log survival time.
- (d) (10 pts) Repeat part (c) using a suitable nonparametric method.
- (e) (10 pts) Compare your 4 CIs, and contrast the nonparametric with the *t*-CIs. If they differ much, explain why they differ. Which analysis appears most appropriate? Explain.

25 pts

50 pts

75 pts

(50^{pts})

3. Humerus sparrows: In an 1898 Biology lecture at Woods Hole, Massachusetts, Hermon Bumpus reminded the audience that the process of natural selection for evolutionary change was an unproved theory. As evidence in support of natural selection, he presented measurements on house sparrows brought to his Brown University laboratory after an uncommonly severe winter storm. Some of the birds had died, and some had survived. Bumpus asked whether those that perished did so because they lacked physical characteristics enabling them to withstand the intensity of that particular instance of selective elimination.

The data we will look at are the humerus (arm bone) lengths for the 24 adult male sparrows that perished and the 35 adult males that survived. You will see that the data are in two columns. The first column contains the humerus lengths for the 59 birds. The second column identifies whether the birds perished (0) or survived (1). (Stack the 3rd column under the 1st, and the 4th under the 2nd.)

humerus	survived		
659	0	687	1
689	0	703	1
703	0	709	1
702	0	715	1
709	0	728	1
713	0	721	1
720	0	729	1
729	0	723	1
726	0	728	1
726	0	723	1
720	0	726	1
737	0	728	1
739	0	736	1
731	0	733	1
738	0	730	1
736	0	733	1
738	0	730	1
744	0	739	1
745	0	735	1
743	0	741	1
754	0	741	1
752	0	749	1
752	0	741	1
765	0	743	1
*	*	741	1
*	*	752	1
*	*	752	1
*	*	751	1
*	*	756	1
*	*	755	1
*	*	766	1
*	*	767	1
*	*	769	1
*	*	770	1
*	*	780	1

- (a) (10 pts) Make appropriate graphical displays to compare the humerus lengths in the two samples
- (b) (10 pts) Test at the 5% level whether there is any difference in the population mean humerus lengths for those that perished and those that survived. Use both the *t*-test and an appropriate nonparametric procedure.
- (c) (10 pts) Compute and interpret a 95% CI for the difference in population mean humerus lengths for those that perished and those that survived. Repeat for an appropriate nonparametric procedure.
- (d) (10 pts) Discuss any statistical assumptions that you have made in carrying out the analyses, and whether the assumptions seem reasonable.
- (e) (10 pts) Write a short summary for the problem. What analysis seems most appropriate?

4. (50 pts) REM with ethanol treatment: Protoporphrin levels were determined for three groups of people — a control group of normal workers, a group of alcoholics with sideroblasts in their bone marrow, and a group of alcoholics without sideroblasts. The given data appeared in the paper "Erythrocyte Coproporphyrin and Protoporphrin in Ethanol-Induced Sideroblastic Erythropoiesis" (Blood, 1974, p. 291-295).

Analyze the data, assuming you are interested in comparing the typical protoporphrin level across groups. Quantify any differences you find. Make sure to clearly define all population parameters, and assess the assumptions underlying your chosen method of analysis.

Normal	Alc_w_sb	Alc_wo_sb
22	78	37
27	172	28
47	286	38
30	82	45
38	453	47

50 pts

50 pts

78	513	29
28	174	34
58	915	20
72	84	68
56	153	12
30	780	37
39	*	8
53	*	76
50	*	148
36	*	11