

Exam 1

ISE 453: Design of PLS Systems

Fall 2018

Name (print): _____

2 Oct

Format: Closed computer, one $8\frac{1}{2} \times 11$ in. double-sided page of notes, and a calculator.

1. (8 pts) Explain why the geometric mean is usually more appropriate for estimating parameters in a Fermi problem as compared to the use of the arithmetic mean.

2. (8 pts) Explain why it is not necessary to know the fixed cost of establishing a NF at a site when solving the p-median problem, while it is necessary for solving the UFL problem.

3. (8 pts) When one is determining the number of shipments per year from a DC to each different customer for use as part of a location analysis, explain why it is appropriate to use a fractional as opposed to an integral value.

4. (15 pts) What is the difference in the transport charge to ship 25 cartons of a product LTL from Raleigh to Detroit using the undiscounted tariff given below as compared to using the LTL rate estimation formula with a PPI of 182.9? Each carton weighs 70 pounds and occupies twenty cubic feet.

**Tariff (in \$/cwt) from Raleigh, NC (27606) to Detroit, MI (48234)
(691 mi, CzarLite DEMOCZ02 04-01-2000, minimum charge = \$95.71)**

Freight Class	Rate Breaks (<i>i</i>)								
	1	2	3	4	5	6	7	8	9&10
500	370.20	307.27	233.24	188.82	134.52	97.85	50.50	50.50	50.5
400	298.34	247.63	187.97	152.17	108.41	78.86	40.77	40.77	40.77
300	228.40	189.58	143.91	116.50	83.00	60.37	31.23	31.23	31.23
250	200.17	166.15	126.12	102.10	72.74	52.91	27.38	27.38	27.38
200	155.90	129.40	98.23	79.52	56.65	41.21	21.29	21.29	21.29
175	140.51	116.63	88.53	71.66	51.06	37.14	19.16	19.16	19.16
150	120.62	100.12	76.00	61.52	43.83	31.89	16.53	16.53	16.53
125	102.66	85.20	64.67	52.36	37.31	27.13	14.10	14.10	14.10
110	89.18	74.02	56.19	45.49	32.41	23.57	12.37	12.37	12.37
100	83.41	69.23	52.55	42.54	30.30	22.05	11.56	8.96	7.79
92	78.91	65.50	49.73	40.25	28.68	20.86	11.15	8.65	7.52
85	73.14	60.71	46.08	37.31	26.58	19.34	10.75	8.33	7.24
77	68.01	56.45	42.85	34.69	24.71	17.98	10.44	8.10	7.03
70	64.16	53.25	40.42	32.72	23.31	16.96	10.14	7.86	6.83
65	61.52	51.07	38.77	31.38	22.15	16.26	10.04	7.79	6.76
60	58.90	48.89	37.11	30.04	21.22	15.57	9.94	7.70	6.69
55	55.68	46.22	35.09	28.40	20.05	14.72	9.84	7.62	6.62
50	52.48	43.56	33.07	26.77	18.88	13.87	9.73	7.55	6.56
Tons (q_i^B)	0.25	0.5	1	2.5	5	10	15	20	∞

**Table 2.3. Class-Density Relationship
(italics indicate value at capacity)**

Class	Load Density (lb/ft^3)		Max Physical Weight (tons)	Max Effective Cube (ft^3)
	Minimum	Average		
500	–	0.52	0.72	2,750
400	1	1.49	2.06	2,750
300	2	2.49	3.43	2,750
250	3	3.49	4.80	2,750
200	4	4.49	6.17	2,750
175	5	5.49	7.55	2,750
150	6	6.49	8.92	2,750
125	7	7.49	10.30	2,750
110	8	8.49	11.67	2,750
100	9	9.72	13.37	2,750
92.5	10.5	11.22	15.43	2,750
85	12	12.72	17.49	2,750
77.5	13.5	14.22	19.55	2,750
70	15	18.01	24.76	2,750
65	22.5	25.50	25	1,961
60	30	32.16	25	1,555
55	35	39.68	25	1,260
50	50	56.18	25	890

5. (26 pts) On average, 300 tons of frozen foods are shipped 650 miles from your packaging plant to your distribution center each year. The foods are packaged and consumed at a constant rate throughout the year. Currently, each truckload shipment of foods is 1,250 ft³, which is the maximum cube of the freezer available at the distribution center for storage. How much should the freezer cube capacity increase in order to reduce total logistics costs? The PPI for TL is 138.6; a truck's cubic and weight capacities are 2,750 ft³ and 25 tons, respectively; each ton of foods is valued at \$15,000 and has a density of 9 lb per ft³; the annual inventory carrying rate is 0.3; and in-transit inventory costs can be ignored.

6. (35 pts) Traveling east, I-40 passes through or near the following cities: Albuquerque, NM; Amarillo, TX; Memphis, TN; Nashville, TN; and Greensboro, NC. It is expected that 24,000 and 2,500 cartons of products A and B, respectively, will be shipped each year from your DC to four customers located in Greensboro, Memphis, Albuquerque, and Amarillo, with each customer receiving 15, 30, 35, and 20 percent of the total demand, respectively. Full P2P truckloads of A and B will be shipped FOB origin to the DC from suppliers located in Nashville and Amarillo, respectively, and full P2P truckloads containing a mix of both products will be shipped FOB destination to each customer, with deliveries at least every month. Each carton of A and B weighs 25 and 80 lb, respectively, and occupies 5 and 4 ft³, respectively. Each truck's cubic and weight capacity is 2,750 ft³ and 25 tons, respectively. Assuming that I-40 will be used for all travel, where should the DC be located in order to minimize transportation costs?