Study Guide for Exam 1

ISE 453: Design of PLS Systems — Fall 2018

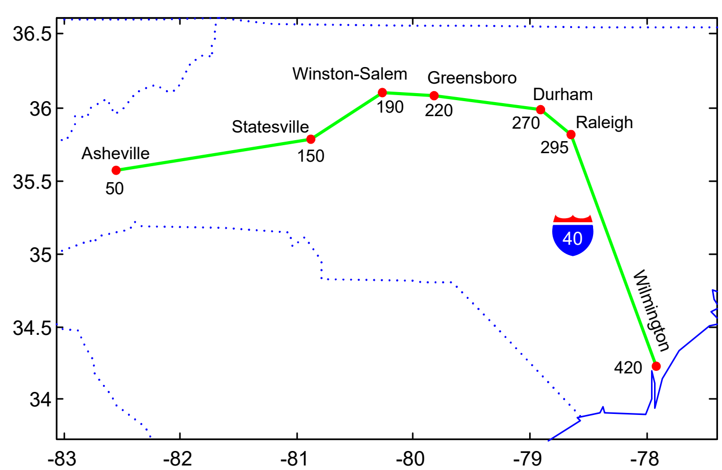
The exam will be from 11:45 a.m. to 1:00 p.m. It is closed computer. You can bring one 8½ × 11 in. double-sided page of notes and your calculator (any figures or tables needed from the notes to solve a question will be provided on the exam sheet). Study the parts of ICAs 1 to 7, HW 1, and Project 1 that can be solved without the use of a computer; and the following problems.

1. In solving Fermi problems, what is the goal with respect to solution quality?
2. A couple is looking to rent an apartment. One makes two trips a day to school and the other makes only one trip to work. Suggest a location where they should look for an apartment and what are the critical assumptions supporting the suggestion? (Multiple answers.)
3. List two possible reasons why might the location that minimizes the sum of the weighted distances between a new facility and several existing facilities might not be the best location for the new facility?
4. In locating restaurants in a region, describe a likely advantage and a likely disadvantage for customers when all of restaurants in the region are owned by the same firm.
5. Why is FOB usually not an important factor when making location decisions?
6. Why is the UFL problem formulated as a MILP as opposed to a LP or an ILP?
7. How is it possible for the maximum payload of a TL shipment to be less than its maximum weight capacity?
8. 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.
9. What is a possible advantage and disadvantage associated with shipping product in full truckloads as opposed to smaller, less-than-truckload quantities?
10. Under what circumstances would it be reasonable to assume that there are no inventory costs at a DC?
11. Why does the minimum charge for LTL shipments increase with increasing distance, while the minimum charge for TL is constant?
12. If the shipment size for P2P TL and LTL are the same, instead of having to consider differences in TLC, why is it necessary to only consider the differences in TC to decide between using TL vs. LTL?
13. Describe the difference between a "rate break" and a "weight break" in an LTL tariff.
14. Use the great circle formula to determine the distance, in miles, between Raleigh, NC (35:49:19 N, 78:39:32 W) and Rio de Janeiro, Brazil (22:57 S, 43:12 W). (Answer: 4,679 miles.)
15. On average, 200 tons of components are shipped 750 miles from your fabrication plant to your assembly plant each year. The components are produced and consumed at a constant rate

throughout the year. Currently, full truckloads of the material are shipped. What would be the impact on total annual logistics costs if shipments were made every two weeks? The revenue per loaded truck-mile is \$2.00; a truck's cubic and weight capacities are 3,000 ft^3 and 24 tons, respectively; each ton of the material is valued at \$5,000 and has a density of 10 lb per ft^3; the annual inventory carrying rate is 0.2; and in-transit inventory costs can be ignored. (Answer: \$46,800 – \$35,000 = \$11,800 increase in total logistics costs, assuming that there are 365.25 days per year.)

16. On average, 20 and 30 tons of components A and B are shipped 500 miles from your fabrication plant to your assembly plant each year. The components are produced in batches just prior to shipping and are consumed at a constant rate throughout the year. Currently, each component is shipped using independent P2P truckloads. What would be the impact on total annual logistics costs if the components are instead combined into mixed P2P truckloads? The revenue per loaded truck-mile is \$2.00; a truck's cubic and weight capacities are 2,750 ft^3 and 25 tons, respectively; each ton of A and B is valued at \$3,000; A and B have densities of 12 and 6 lb per ft^3, respectively; the annual inventory carrying rate is 0.3; and in-transit inventory costs can be ignored. (Answer: Total logistics costs would decrease from $TLC_A + TLC_B$ = \$6000 + \$7348 = \$13,348 to $TLC_{A\&B}$ = \$9489)

17. It is expected that 100 and 380 tons of products A and B, respectively, will be shipped each year from your DC to four customers located in Asheville, Durham, Wilmington, and Winston-Salem, 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 Statesville and Raleigh, respectively, and full P2P truckloads containing both products will be shipped FOB destination to each customer. Each carton of A and B weighs 30 and 120 lb, respectively, and occupies 10 and 4 ft^3, respectively. The revenue per loaded truck-mile is \$2.25 and each truck's cubic and weight capacity is 2,750 ft^3 and 25 tons, respectively. Where should the DC be located in order to minimize transportation costs? (Answer: Durham.)



18. What is the difference in the transport charge to ship 9,000 lb of a Class 125 product LTL sometime during 2004 from Raleigh to Gainesville, FL using the undiscounted tariff given in the notes as compared to using the LTL rate estimation formula? The PPI_{LTL} for 2004 is 104.2. (Answer: \$3024 using tariff vs. \$2172.24 using the formula.)

Table 2.4. Tariff (in \$/cwt) from Raleigh, NC (27606) to Gainesville, FL (32606)
(532 mi, CzarLite DEMOCZ02 04-01-2000, minimum charge = \$95.23)

Freight Class	Rate Breaks (i) 1	2	3	4	5	6	7	8	9&10
500	341.42	314.14	245.80	201.48	158.60	112.37	55.66	55.66	55.66
400	273.88	251.99	197.19	161.61	127.22	91.12	45.10	45.10	45.10
300	206.34	189.85	148.56	121.76	95.85	69.47	34.43	34.43	34.43
250	172.56	158.77	124.23	101.83	80.15	58.03	28.79	28.79	28.79
200	138.78	127.69	99.92	81.89	64.47	47.19	23.40	23.40	23.40
175	121.37	111.68	87.39	71.62	56.38	41.27	20.39	20.39	20.39
150	104.49	96.13	75.22	61.66	48.53	35.96	17.75	17.75	17.75
125	87.59	80.60	63.07	51.69	40.69	30.24	15.00	15.00	15.00
110	77.57	71.37	55.85	45.77	36.04	28.61	14.40	14.40	14.40
100	71.23	65.55	51.29	42.04	33.09	27.58	14.03	10.80	9.90
92	66.48	61.18	47.88	39.24	30.89	25.75	13.68	10.52	9.66
85	61.74	56.80	44.45	36.43	28.68	23.91	13.20	10.15	9.32
77	56.99	52.44	41.04	33.63	26.48	22.07	12.60	9.68	8.89
70	52.77	48.55	37.99	31.14	24.51	20.43	12.00	9.23	8.47
65	50.07	46.08	36.05	29.56	23.04	19.39	11.87	9.14	8.39
60	47.44	43.64	34.15	28.00	21.82	18.37	11.76	9.04	8.30
55	44.75	41.17	32.22	26.40	20.59	17.32	11.64	8.96	8.22
50	41.57	38.26	29.94	24.54	19.12	16.10	11.52	8.85	8.14
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) Minimum	Average	Max Physical Weight (tons)	Max Effective Cube (ft^3)
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

19. On average, 175 tons of a product is to be shipped 750 miles each year from your manufacturing plant to your DC. The product is produced in batches just prior to shipping and is consumed at a constant rate throughout the year. If the shipment size is equal to one week's demand, then should P2P TL or LTL be used? The PPIs for TL and LTL are 111.9 and 121.4, respectively; a truck's cubic and weight capacities are 2,750 ft^3 and 25 tons, respectively; each ton of the product is valued at \$7,500; its density is 13 lb per ft^3; the inventory carrying rate is 0.3; and in-transit inventory costs can be ignored. (Answer: LTL should be used since TLC_{TL} = \$89,052.29 and TLC_{LTL} = \$84,944.02.)

20. It is expected that 150 thousand cubic feet of product weighing 3 million pounds will be shipped each year from your DC to six customers located in Raleigh, NC (35:49 N, 78:39 W), Houston, TX (29:46 N, 95:23 W), Memphis, TN (35:06 N, 90:00 W), Due West, SC (34:20 N, 82:23 W), Warren, MI (42:29 N, 83:01 W), and Gainesville, FL (29:40 N, 82:20 W), with each customer receiving 15, 30, 25, 10, 15, and 5 percent of the total demand, respectively. The trucks used for transport have cube and weight capacities of 2,750 ft^3 and 25 tons, respectively. Assuming that all distances are rectilinear, where should the DC be located in order to minimize transportation costs such that each customer receives a shipment *at least once a month*? (Answer: 34:20 N, 83:01 W.)