HW 6: Warehousing

ISE 453: Design of PLS Systems   **Spring 2020**

Submit via Moodle all scanned handwritten solutions and any spreadsheets.   Due 11:30p, 23 Apr

1. A new shoe warehouse is being designed. A total of 120 different men and women's shoe styles will be stored in warehouse, and each style is available in three different colors and ten different sizes. At its peak during the year, the warehouse will hold 2.4 million pairs of shoes. Randomized block stacking will be used to store $36 \times 36 \times 36$ in. pallet loads of shoe cartons, one pair per carton. Each pallet can be used to store 24 cartons of the same SKU. The pallets can be stacked five-high along 10-foot-wide down aisles. Determine the minimum total 2-D area need for the warehouse assuming that the additional space needed for cross aisles, offices, and shipping/receiving docks will equal 20% of the total storage area.

2. What is the change in the minimum expected total distance traveled along a ten-foot-wide down aisle for single-command S/R operations if four-high dedicated, as compared to randomized, block stacking of 36×42 in. two-way pallet loads of products A, B, and C is used? All of the products are stored on one side of the aisle, and the opposite side of the aisle is used to store other products. The area used for randomized storage maximizes 2-D cube utilization, and the same storage depth is used for dedicated storage. The maximum inventory levels of the products are 70, 150, and 380, respectively, the levels are uncorrelated and retrievals occur at a constant rate, the products have throughput requirements of 40, 60, and 12, respectively, and the I/O port is located at the end of the aisle?

3. A new warehouse is being designed to store 5,000 different SKUs. At its peak during the year, the warehouse will hold 120,000 loads. Randomized block stacking will be used to store $40 \times 48 \times 36$ in. ($y \times x \times z$) two-way pallet loads and all of the slots in the warehouse are equally likely to be used. The pallets can be stacked six-high. The warehouse will have a rectangular shape with a single I/O point located along its perimeter. The investment costs for the building are $5.00 per square foot of area (with no perimeter costs), and will have a salvage value equal to 100% of its original cost at the end of 15 years. The area needed for cross aisles, offices, and shipping/receiving docks equals approximately 15% of the total storage area in the warehouse. Two types of trucks are being considered for all storage and retrieval operations: standup counterbalanced (UCBs) and narrow-aisle reach (NAR) trucks. Each UCB and NAR requires 12- and 8-foot-wide down aisles, respectively, requires 25 and 35 seconds for loading or unloading, respectively, has an investment cost of $25,000 and $30,000, respectively, and will have a salvage value equal to 25% of its original cost at the end of 15 years. Riding speed is 7 mph (5,280 ft/mile) and fuel cost is $2.00 per hour of operation. The fully burdened labor rate of a truck operator is $12.00 per hour. The number of operators is equal to the number of trucks and each operator is paid for an entire shift. If there are 250 eight-hour shifts per year and the real cost of capital is 10% per year with annual compounding, determine which type of truck should be selected assuming an expected annual demand of 500,000 single-command moves and enough trucks and operators to handle peak loads that are 25% above the average demand rate. In order to minimize maintenance costs, only a single type of truck will be selected. All additional costs (e.g., maintenance, administrative, site, and utility costs, etc.) can be ignored.