Purdue University
School of Civil Engineering
CE 361 Introduction to Transportation Engineering

Homework 9

AIRPORT FORECASTS, CAPACITY, AND DELAY

Posted: Mon. 1 December 2003
Due: Wed. 10 December 2003

Dear Consultant(s):

Georgetown Airport (GTN) is becoming a popular destination for business and leisure air travel. Please demonstrate your facility with basic airport analysis methods by completing and submitting the exercises below.

Note: You must submit this HW as a member of a group of at least two and no more than four CE361 students. As usual, the top sheet of the material submitted must be signed by each group member.

1. (20 points) **Forecasting air travel using the FAA "Share Model".** Forecast the *total operations and total passenger traffic* at Georgetown Airport for the years 2005, 2010, 2015, 2020, and 2025. A spreadsheet file "gtn03.xls" with *exactly* the *format* of CNotes Table 11.6 will be emailed to you. It will contain historical data for GTN, along with FAA and local forecasts. Attach a hardcopy of your completed spreadsheet to your HW. Notes: (1) Because Georgetown is a smaller airport, use four digits after the decimal point for GTN's stature. (2) Your choice of *Planning Factors* may differ from other analysts', so you must provide a brief explanation for each of the values you chose and show the values clearly.

2. **Airport capacity with known a sequence of operations.** Because of scheduled flights and filed general aviation flight plans, the expected sequence of operations at GTN for the time period beginning 5:30PM today can be given below. Subscript "a" means the aircraft (H, M, or L) is arriving (landing) and "d" means departing (taking off).

   M_d, M_d, M_a, M_a, M_d, H_d, M_a, M_a, M_d, M_d, H_a, M_a, M_a, M_a, M_d, L_d, M_a, L_a, M_a, M_a

   A. (12 points) Using information* in Tables 11.14, 11.16, and 11.17, create a table that summarizes the time between operations for each pair of consecutive aircraft. What is the total elapsed time between the first and last operations listed above? (* This information has been synthesized in the "Runway Ops Times" posted on the CE361 website.)
   B. (8 points) What is the capacity (ops/hr) of GTN during the period studied?

3. **Runway configurations and capacity.** For a certain future year, GTN's operations are expected to be 38% Class A, 12% Class B, 39% Class C, and 11% Class D aircraft.
   A. (10 points) Calculate the Mix Index for GTN in that year. If GTN's runway-use configuration is No. 2, what will GTN's Hourly Capacity be under VFR and IFR conditions? What will GTN's Annual Service Volume be?
   B. (10 points) If GTN is expected to have 131,000 operations in that year, calculate GTN's Delay Factor for that year. Use Fig 11.24 to estimate average aircraft delay.

4. **Runway orientation.** In anticipation of the next phase of US231 construction, the Purdue Airport (LAF) is planning to move its terminal to a new location. If federal funds can be obtained, the runways may also be relocated.
   A. (6 points) Wind data. Hourly wind data for the Lafayette area are stored at http://shadow.agry.purdue.edu. For each hour of the day that was the most recent birthday for each member of your group, enter the data into one copy of the spreadsheet "windrose03.xls" that will be emailed to you and return it by email to oware@purdue.edu. If there are three members in your group, there must be three days of wind data in the single spreadsheet you submit. Entries must first be raw counts, which are then converted to percentages automatically (I hope) by the spreadsheet. Also attach a hardcopy of the spreadsheet and a printout of the wind data page for each birthday. Include the "000" direction and 0 speeds in your summary. List the "VAR" directions as a separate line of entries in your spreadsheet, but do not include them in your wind rose analysis. If a wind gust is listed with an hourly average, use the velocity of the gust in your data set.
   B. (6 points) Wind rose. Create a wind rose for the data in the file "windrose03.xls" that was sent to you.
   C. (2 points) Allowable crosswind. If the new runway(s) would be 80 feet wide, what is the allowable crosswind for landing?
   D. (6 points) Runway orientation. Regardless of your answer to Part C, use 10.5 knots as the allowable crosswind. Using the wind rose you drew in Part B, show clearly how you determined the maximum percent of time a single runway could meet the crosswind standards. What would be that runway's orientation (using the numbers that would appear at either end of the runway) and what was the percent value you found?

5. **Runway length and takeoff weight.** LVT Airport lies at elevation 6000 ft. Its temperature in the summer seldom exceeds 80°F. An airline has expressed an interest in serving LVT with Boeing 727-200 aircraft. The airport management wants to know if LVT's 8156-foot runway is long enough for a 727. If not, how long must the runway be? Note that one end of the runway is 52 ft higher than the other end.
   A. (2 points) What is the MATOW for a 727 at 6000 ft and 80°F? What is the Reference Factor for a 727 at 6000 ft and 80°F?
   B. (4 points) How long must the runway be to permit the MATOW found in Part A? What is the MATOW for the current runway at LVT? Show how you found these values.
   C. (14 points) If the 727 will be offering service to an airport 500 miles away, how many passengers can be carried, given the current runway? Show the steps in your analysis.