**Introduction**

The 532d Training Squadron (532 TRS) is a unit in the United States Air Force (USAF). The 532 TRS trains the nation’s intercontinental ballistic missile (ICBM) operators and maintenance forces for ICBM and air launched cruise missile (ALCM) systems. 532 TRS instructors receive professional development (ProD) to increase their knowledge of nuclear enterprise. Professional development involves sending one or more instructors on a trip to a nuclear facility in the United States. While on their trip, instructors receive tours and briefings from onsite personnel. One purpose of providing professional development is to increase effectiveness of instructors. Instructors can help motivate students by illuminating the importance of what students are learning. However, instructors also perform jobs that do not involve actively teaching students. When in these other jobs instructors are not in the best position to integrate what they learned into their instruction.

**Problem Definition**

Some instructors do not receive professional development until most of their instructing time is over. As a result, they never get a chance to share what they have learned with the students. Since the goal of ProD is, in part, to increase the effectiveness of instructors, the unit may be able to do a better job assigning instructors to professional development trip in a way that balances several objectives (goals).

**Objectives/Goals**

The squadron has several objectives for the professional development program. Objectives include (listed roughly in priority order):

1. (Budget) ProD budget should fully utilize remaining travel funds after all mission required trips are funded; ProD Budget = Total Budget - Mission Required Trips Costs.

2. (Improve Instruction) ProD should help instructors be more effective teaching.

3. (Fairness) Each instructor is to be given the opportunity to go on at least one ProD trip per year.

4. (Merit): Instructors merit is considered when assigning instructors to ProD opportunities that are tagged as being a “glory trip”. A glory trip is does something that is extra special. The idea is to reward high performing instructors with a special trip.

**Goal Programming Model**

Goal programming is an optimization techniques to solve problems with multiple objectives. Additionally, Goal programming allows for flexibility in meeting constraints by allowing constraints to be deviated/broken in order to balance multiple goals. The model will determine which instructors to send on which ProD trip for each quarter (3 month period).

**Decision Variables**

The model will have a decision variable for each instructor and ProD trip. For example, for each ProD trip there will be a decision do we send each instructor. The decision variables will be captured in a decision matrix, DV[i,j]. Where, DV[i,j] indicates the decision to send the j th instructor on the i th Pro-D trip. For example, DV[1,2] indicates the decision to send instructor 2 to Pro-D trip 1.

**Goal Constraints**

1. Budget:

Target

Where TDYCostPerPerson[i] is the cost to send one individual on the i th Pro-D trip. DV[i,j] is previously defined, BDminus = the budget deviation (BD) in the minus direction (meaning how much the squadron is under the ProD budget). BDpostive = Budget deviation in the positive direction (meaning how much the squadron is over the ProD budget).

2. Improving Instruction:

Where InstructorStatus[j] indicates the instructor status of the j th instructor as either active (1) or non-active (0). The equation is set to 2 times the total number of active instructors because the target goal is to send all active instructors on two Pro-D trips a year.

3. (Fairly development instructors: Minimum Trips):

Every instructor going on a trip is added up and set to the goal of sending every instructor on at least one TDY indicates the Trip Deviation for the j-th instructor in the minus direction from the target goal. While TDpostive indicates the same but deviations in positive direction.

4. (Fairly development, max trips for single instructor per year):

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For each instructor j. All trips that the instructor is going on are summed and set to a value indicate the max trips target.

5. Merit Goal:

TargetNumOfInstructorsToSendOnMeritTrips= Min(NumOfInstructorsWithMeritStatus,NumOfMeritTripsSlotsAvailable). (whichever is smaller). The idea is that if there are 10 instructors that deserve a merit trip but only 6 slots merit based trips open. Then the target is to send 6. While if there is 6 slots open but only 4 instructors deserving merit, then the target is to send 4.

**Hard Constraints**

1. Hard Budget Constraint:

Where travel budget is a hard constraint that limits all unit funding for travel. Pro-D travel must not result in the unit going over on the total Travel Budget. Mission related travel is all travel that is not considered Pro-D related. Mission related travel currently is given priority over Pro-D travel funding. Available funding for Pro-D trips is the difference between the total travel budget and the mission related travel costs already incurred.

2. Slots Open for Trip Constraint

**Objective Constraints**

1. Budget

Weight[1]\*(BDminus + BDpostive)/ProDTripBudgetTarget <= Q)

2. Improve Instruction

Weight[2]\*(IDminus + IDpostive)/TotalNumOfProDTripsForActiveInstructorsTarget <= Q)

3. Fairly Develop Instructors (min Trips target)

Weight[3]\*(MinTDminus[j] + MinTDpostive[j])/MiniumTripsTarget <= Q, j=1:NumOfInstructors)

4. Fairly Develop Instructors (max Trips Target)

Weight[4]\*(MaxTDminus[j] + MaxTDpostive[j])/MaxTripsTarget <= Q, j=1:NumOfInstructors)

5. Instructor Merit

Weight[5]\*(MDminus + MDpostive)/TargetNumOfInstructorsToSendOnMeritTrips <= Q)

**Assumptions**

1. For TDY data we assumed that the number people that could be sent is equal to the number that were sent last year. This may or may not be the case, ideally, a database would be built that better projects what slots will be available. However, even if a better estimated existed there would still be unknowns because slots could open up last minute because of cancellations from other organizations.

2. The Model doesn’t account for the high probability that a fair number of Pro-D get cancelled for various reasons. (~10-20% of Pro-D may never occur). As a result, future model may want to assume plan for this by planning additional trips to offset the cancelled trips. (Similar to how the airlines over book with the assumption that some passengers will not be able to make it)