MGT 441 Healthcare Management II: Managing Processes
The Midterm Exam Formula Sheet

Chapter 2 Predictive Analytics:

Simple Moving Average (3-period): $F_t = (A_{t-1} + A_{t-2} + A_{t-3})/3$

Weighted Moving Average (3-period): $F_t = w_{t-1}A_{t-1} + w_{t-2}A_{t-2} + w_{t-3}A_{t-3}$

Exponential Smoothing: $F_t = F_{t-1} + \alpha(A_{t-1} - F_{t-1}) = \alpha A_{t-1} + (1-\alpha) F_{t-1}$

Forecast Error: $FE_t = A_t - F_t$

Mean Forecast Error (MFE): $MFE = \frac{\sum_{i=1}^{n}(FE_i)}{n}$ Mean Absolute Deviation (MAD): $MAD = \frac{\sum_{i=1}^{n}|FE_i|}{n}$

Mean Squared Error (MSE): $MSE = \frac{\sum_{i=1}^{n}(FE_i)^2}{n}$

Mean Absolute Percentage Error (MAPE) = $\frac{\sum_{i=1}^{n} 100\%\left|\frac{FE_i}{D_i}\right|}{n}$ Tracking Signal = $\frac{\sum_{i=1}^{n} FE_i}{MAD}$

where F = Forecast, A = Actual Demand,
w = weight for weighted moving average,
α = weight for exponential smoothing,
and t = the current period.

Chapter 3 Decision Making in Health Care:

Hurwitz Solution: $HV(A_i) = \alpha$ (row minimum) + (1 – α) (row maximum)
Laplace Solution: Expected Value $E(A_i) = \sum_j p_j O_{ij}$
Expected Monetary Value (EMV) $E(A_i) = \sum_j p_j O_{ij}$
Expected Opportunity Loss (EOL) EOL $(A_i) = \sum_j p_j R_{ij}$

Chapter 4 Facility Location

Profit = Revenue (R) - Total Cost (TC)
Where,
Revenue = unit price (p) × quantity (Q)
Total Cost = fixed cost (FC) + variable cost (VC)
Variable Cost = variable cost per unit (v) × quantity (Q)

Breakeven point (BEP) quantity = FC / (p – v)

Relative Scores
(1) The lower the better: Relative Score = Most Desirable Outcome/Evaluated Outcome × 100
(2) The higher the better: Relative Score = Evaluated Outcome/ Most Desirable Outcome × 100

Center of Gravity:
Example 3: Center of Gravity Method

$$\bar{x} = \frac{\sum x_i}{n} \quad \bar{y} = \frac{\sum y_i}{n}$$

Weighted Center of Gravity:

$$\bar{x} = \frac{\sum x_i Q_i}{\sum Q_i} \quad \bar{y} = \frac{\sum y_i Q_i}{\sum Q_i}$$

Chapter 5: Facility Location:

Method of Minimizing Distances and Costs

$$Minimize\ TC = \sum_{ij} \mathrm{D_{ij}} * \mathrm{W_{ij}} * \mathrm{C_{ij}}$$

Where D_{ij}, W_{ij}, and C_{ij} represent the distance, interdepartmental traffic, and cost, respectively.

Chapter 6 Flow Process Improvement: Reengineering and Lean Management:

Sample Size): $n = \left(\frac{zs}{a\bar{x}} \right)^2$

An Alternative Formula (when desired accuracy is expressed as an amount): $n = \left(\frac{zs}{e} \right)^2$

Observed Time (OT) = $\sum x_i / n$
Where x_i = observed time for worker *i*
N = number of observations for worker *i*

Normal Time (NT) = OT × PR (for a single performance)
Normal Time (NT) = $\sum OT_j \times PR_j$ (for a combination of elements or tasks)
Where PR = Performance Rating
OT_j = the observed time of element j
PR_j = performance rating of element j

Standard Time (ST) = NT × AF
Where AF = allowance factor

Chapter 7 Staffing:

Hours of Care Required = (Average Census)×(Average Required Hours per Patient)

Unadjusted Full Time Equivalents (FTEs) = Hours of Care Required / Available Hours

Core Level FTEs = Hours of Care Required / ((Utilization Standard)×(Available Hours))

(Suppose that the administration has established a utilization standard of 0.75; that is 25 percent of each employee's time will be spent in unproductive activities or activities unrelated to direct patient care)

Chapter 9 Productivity and Performance Benchmarking:

Productivity = Output / Input

hours per patient day (HPPD) = Hours Worked (Total Hours) / Patient Days

Adjustments for Inputs

1) Skill Mix Adjustment: To differentiate the skill mix of the nursing care providers, we can weigh the ours of personnel of different skill levels by calculating weights based on the average wage or salary of each skill class.
2) Adjusted Hours = $\sum w_i X_i$ where w_i indicates the weight for skill level i, and X_i represent hours worked by skill class i.
3) Standardized Cost of Labor
   Labor Cost = $\sum c_i X_i$ where where c_i indicates the wage for skill level i, and X_i represent hours worked by skill class i.

   Nursing Labor Cost = RN wages (RN hours) + LPN wages (LPN hours) + NA wages (Aide hours). (where RN stands for Registered Nurses, LPN means Licensed Practical Nurses, and NA indicates nursing aides.)

$$Labor\ Cost\ per\ Visit = \frac{Labor\ Cost\ of\ Care}{Patient\ Visits}$$

$$Labor\ Cost\ Patient\ Day = \frac{Labor\ Cost\ of\ Care}{Patient\ Days}$$

Adjustments for outputs

Service-Mix Adjustment: is useful tool for comparison of, for instance, two community hospitals that provide different services or have significantly different distributions of patients among their services. The service-mix adjusted volume is weighted by a normalized service-intensity factor.

$$W_i = \frac{H_i}{\sum H_i / n}$$

$$Adjusted\ Volume = \sum W_i \times X_i$$

where w_i indicates the weight for ith service, H_i represents the number of hours care required for per patient day in service i, and n is the number of services.

Case-Mix Index:

$$Case-Mix\ Index_j = \sum W_i \times P_{ij}$$

where w_i indicates the weight for ith category and P_{ij} represents percent of patients for acuity category i in unit j.

Adjusted Patient Days = Patient Days * Case-mix index.
Adjusted Discharges = Discharges * Case-mix index.
Adjusted Visits = Visits * Case-mix index.

Productivity Measures Using Direct Care Hours:
"Hours of direct care" is an important component of productivity ratios. It serves as a building block for other ratios.

$$\text{Hours of Direct Care}_j = \sum_{i=1}^{n} H_i * P_{ij} * N_j$$

"Percentage of Hours in Direct Care" is an additional measure and can be derived from the "Hours of Direct Care" calculation, as the ratio of direct care hours to total care hours.

$$\text{Percent of Hours in Direct Care} = \frac{\text{Hours in Direct Care}}{\text{Hours Worked}}$$

"Percentage of Adjusted Hours in Direct Care" can be determined as the percentage of adjusted nursing hours as adjusted for skill-mix in direct patient care.

$$\text{Percentage of Adjusted Hours in Direct Care} = \frac{\text{Hours in Direct Care}}{\text{Adjusted Hours}}$$

Chapter 10 Resource Allocation:

Linear Programming:
Objective Function & Constraints will be set up based on the given condition.