INDEX

A
AACN. See American Association of Critical-Care Nurses
A/B run. See Above/below run
Abbott, 364
A-B-C inventory items, 381–382
Above/below (A/B) run, 413–415
ACA. See Affordable Care Act
Accountable care organizations (ACOs), 298; cost control with, 5
Accounting systems, for inventory management, 372–373
ACOs. See Accountable care organizations
Activity on arc (AOA), 436–437
Activity on node (AON), 436–437
Acuity-adjusted standard, 255–256. See also Patient acuity systems
Acuity-based unit staffing, 266–270
Addams, H. L., 322
Additive model, 55
Adjusted hours, productivity adjustments using, 305–306
ADUs. See Automated distribution units
Affordable Care Act (ACA), 297–298; quality improvement with, 5
Altman, S. H., 298–299, 316, 321
American Association of Critical-Care Nurses (AACN), professional standards of, 270
American National Standards Institute (ANSI), 396
American Nurses Association: flexible scheduling statement of, 287; professional standards of, 270
Amerinet, 366
AmeriSourceBergen, 365
Anderson, T. D., 316
ANSI. See American National Standards Institute
Answer report: for integer programming, 354; for maximization model, 339, 342; for minimization model, 348
AOA. See Activity on arc
AON. See Activity on node
Arrival patterns: emergency room, 482; Excel-based simulated, 517–519; frequencies of, 511; measures of, 483; multiphase operations, 520–521; Poisson arrival, 486; Poisson distribution of, 483–484, 512; Poisson probabilities for, 514; probability distribution for, 511; queuing system and, 481–483
Ashby, J. L., Jr., 321
AstraZeneca, 364
Attributes, control charts for, 403–407
Automated distribution units (ADUs), 365
Autonomation, 202

B
B2B commerce. See Business-to-business commerce
B2C commerce. See Business-to-customer commerce
Baldrige Award, 396
Balking, 485
Bar code scanners, 4
Bar coding, 322
Baxter, 364
Bayer Schering, 364
Behavioral management school, 205–206
Benchmarking: new methods of, 316–321;
productivity, 300; for quality improvement, 417
Bendix, R., 294
Bergman, R., 198
Beta distribution, 442
Big data, 7–9
Binding constraint, 337, 340, 344–345
Block scheduling, 291–292
Boston Scientific, 365
Bounded rationality phenomenon, 87
Bowling, G. S., 294
Bracci, L., 322
Brainstorming, 415–416
Breslawski, S., 290, 293
Brill, A., 298
Bristol-Myers Squibb, 364
Burns, L. R., 365–366, 373
Business-to-business (B2B) commerce, 366–367
Business-to-customer (B2C) commerce, 366–367
Byerly, G. E., 369

C
Cancer mortality rate maps, 150–151
Capacity (queuing system), 494–496
Capacity costs, 478–479
Cardinal Health, 365–366
Carrying costs, 371, 373; in EOQ model, 374–377
Case mix productivity adjustments, 310–311
Casey, K. L., 291
Cause-and-effect diagram, 419–420
c-charts, 401, 403–405
CDS. See Clinical decision support
CEA. See Cost-effectiveness analysis
Census, staffing decisions based on, 253,
255–256, 259–261
Center-of-gravity method, 145–150
CEO. See Chief executive officer
Cerne, F., 322
Certificate of need (CON), 136–137
Certification, for quality of care, 396
Champy, J., 198
Channel (or waiting line), 480
Chassin, M. R., 393–395, 398
Check sheet, for quality improvement, 417–418
The Checklist Manifesto: How to Get Things Right (Gawande), 202
Chief executive officer (CEO), 3
Chief operating officer (COO), 3
Clinical decision support (CDS), 110–114
Clinical pathway, project management applications for, 461–463
Closeness rating chart, 171–173;
computer-based, 175–176
Compression, project. See Project compression
Computer information systems, productivity and, 322
Computer-based layout programs: Excel templates and final layout for hospital, 179–180; overview of, 175–176
Computerized Relative Allocation of Facilities Technique (CRAFT), 176
Computerized scheduling systems, 288
CON. See Certificate of need
Considerations for Professional Nurse Staffing in Perinatal Units, 270
Constraints, 334; binding, 337, 340, 344–345;
in integer linear programming, 348–355;
in maximization models, 335–345; in minimization models, 345–350
Consumption, production and simultaneous, 6
Continuous quality improvement (CQI), 395, 397–398; performance improved through, 3, 198
Continuous variables, control charts for, 407–412
COO. See Chief operating officer
Coronary Heart Disease Hospitalization Rate, 152
Corsi, L. A., 284
Cost containment, 4
Cost information (inventory), 373–374
Cost of labor, productivity adjustments using, 306–308
Cost-effectiveness analysis (CEA), 110
Cost-volume-profit (CVP) analysis, 137–140
Coverage factor, 281, 284; FTEs and, 268–269
CPM. See Critical path method
CQI. See Continuous quality improvement
CRAFT. See Computerized Relative Allocation of Facilities Technique
Crane, S., 298–299, 316
Critical path, 438
Critical path method (CPM), 435–436; computing ES and EF times in, 440; computing LS and LF times in, 440; Excel setup and solution for, 441; path assessment in, 438–439; project network for, 437–438; slack in, 440–441
Crosby, P. B., 396
CVP analysis. See Cost-volume-profit analysis
Cyclical scheduling, 285–286
D
Daily adjustments, reallocation through, 269–270
Daily indexes technique, 59
Dartmouth Atlas of Health Care, 149
Dartmouth Medical School, 149
Data envelopment analysis (DEA), 316, 318–321
Data flow, 7–9
Davies, D. C., 294
Davis, M. A., 314, 321
DEA. See Data envelopment analysis
Decision analysis: description and issues related to, 107–108; dominance procedure for, 108–109; minimum attribute satisfaction procedure for, 109; most important attribute procedure for, 109–110
Decision making: analysis with nonmonetary values and multiple attributes, 107–110; clinical, 110–114; decision tree approach to, 101–107; facility layout, 169–180; of future health care managers, 5; health care manager and, 3; historical background and development of techniques for, 2–3; information technology role in, 3; performance-measure-based managerial, 517; process of, 85–101; quantitative methods to aid in location, 137–154; sensitivity analysis in, 103–107; simulation to measure performance and managerial, 516–517. See also Health care management; Health care managers; Predictive analysis
Decision process: causes of poor decisions during, 87; considering alternatives
Direct care hours, productivity measures using, 312–314
Discretionary work schedule, 286–288
Distributors, in health care supply chain, 363–367
DMADV sequence, 399
DMAIC sequence, 399
DMUs. See Decision-making units
Dominance procedure: decision analysis using, 108–109; multi-attribute methods for location decisions, 144
Donabedian, A., 393–394
Donahoe, G., 364
Draper, D. A., 320
Du Pont, 436
Dupuy Synthes, 365
Dynamic block scheduling, 291

Decision tree: description of, 101–102; Excel illustration of payoff and, 103–105; illustration of, 105; rollback procedure for using, 102–103; rollback procedure using Excel template, 105
Decision variables, 334; in integer linear programming, 348–355; in maximization models, 335–345; in minimization models, 345–350
Decision-making units (DMUs), 318–321
DeLellis, N. O., 320
Delphi method, 29
Demand rate, 374
Deming, W. E., 395–396
Deming Prize, 396
Deming wheel/Shewhart cycle, 397–398
Denbor, R. W., 294
Department of Labor, U.S., 4
Depletion rate, 374
DePuccio, M., 320
Dexter, F., 290–291, 293
Diabetes information booth: queuing system performance for expanded, 492–493; queuing system probability summary for, 490; staffing levels needed for, 488–489; summary analysis for M/M/s queue for, 496; system probability summary for, 491
Direct care activities, 262

e-Distributors, 363–364, 366–367
EDW. See Enterprise data warehouse
EDI. See Electronic data interchange
e-Distributors, 363–364, 366–367
EDW. See Enterprise data warehouse
EF. See Earliest finish time
Effectiveness, 316–317
Efficiency, 316–317; data envelopment analysis of, 318–321; economic, 318; technical, 317
EHR system. See Electronic health record system
Eight-hour shifts, 282–285

E
Earliest finish time (EF), 439–440
Earliest start time (ES), 438–440
Easham, A., 294
East Texas Health System, 151–154
EBCT. See Electron beam computed tomography
Economic efficiency, 318
Economic order quantity (EOQ) model, 372, 377; example Excel solution for, 379–380; example problem for, 378–379; overview of, 374–377
EDI. See Electronic data interchange
e-Distributors, 363–364, 366–367
EDW. See Enterprise data warehouse
EF. See Earliest finish time
Electron beam computed tomography (EBCT), 138
Electronic data interchange (EDI), 365–366
Electronic health record (EHR) system, 7, 110
Eli Lilly, 364
Emergency room (ER): arrival patterns in, 482; service time for patients in, 477–478, 484
Emergency room specimen processing: flow chart for, 227; flow process chart for, 225
Empirical distribution, 511
Employees. See Health care workers
EMV. See Expected monetary value
Enterprise data warehouse (EDW), 7
EOL. See Expected opportunity loss
EOQ model. See Economic order quantity model
EQ-5D, 111
ER. See Emergency room
Errors: Type I, 402; Type II, 401–402
ES. See Earliest start time
EVPI. See Expected value of perfect information
Excel: clinical pathway solution in, 463; CPM setup and solution in, 441; for data analysis and visualization, 9; EOQ model solution using, 379–380; M/M/1 queue setup and solution in, 490–492; M/M/2 queuing system performance summary, 492; M/M/3 queuing system performance summary, 493; probabilistic project approach setup and solution in, 448; project cost compression solution in, 456; project incentive compression solution in, 461; queuing system capacity analysis using, 495; random numbers generated by, 512–513; simulated arrivals using, 517–519. See also PivotTable function of Excel
Excel Solver: Answer reports in, 339, 342, 348, 354; integer programming in, 351–355; Limits reports in, 339, 344, 350; maximization models in, 338–344; minimization models in, 346–350; Sensitivity reports in, 339, 343, 349
Excel templates: CRAFT-based layout, 176; for decision analysis, 103–105; facility layout, 179–180; final observation schedule, 223; linear regression for multihospital system, 44–45; moving average for OB/GYN clinic, 34; for multiphase simulation for urgent care clinic, 521; for multiple regression, 104; for performance-measure-based managerial decision making, 519; for public health clinic, 519; for regression analysis, 46–48; rollback procedure, 105; for SEST, 51; single exponential smoothing for OB/GYN clinic, 39, 41; stabilized dates and times, 221; valid dates and times, 222; weighted moving average for OB/GYN clinic, 37; work sampling random observation schedule, 219–223
Expected monetary value (EMV), 95, 101
Expected opportunity loss (EOL), 96, 101
Expected value model, 95, 101
Expected value of perfect information (EVPI), 96–97
Expenditures. See Health care expenditures
Exponential service time, 486
External data sources, 7–8
External workload standards, 270–271
F
Facility layout decisions: cost savings and, 170; Excel templates for, 179–180; for fixed-position layout, 176; functionality and, 169; planning for, 169–170; process layout and, 171–176; product layout and, 170–171; total cost of layout and, 179
Facility location: complex factors of decisions related to, 135–136; quantitative methods to decide, 137–154
Facility location methods: center-of-gravity, 145–150; cost-volume-profit analysis, 137–140; factor rating, 140–143; geographic information systems in healthcare, 149–151; multi-attribute, 143–145
Factor analysis system, 257
Factor rating method, 140–143
FCFS provided service. See First-come, first-served provided service
FC/FS scheduling. See First come, first served scheduling
Feasible solution space, 337
Findlay, J., 287
First come, first served (FC/FS) scheduling, 291
First-come, first-served (FCFS) provided service, 485
Fishbone diagram, 419–420
Fitzsimmons, J. A., 6
Fitzsimmons, M. J., 6
5S technique, 201
5W2H approach, 415
5-Why analysis, 201
Fixed activities, 262
Fixed-position layout, 176
Flexible scheduling, 286–288
Flexible staffing, 253
Flow (frequency of interactions), 175
Flow chart, 225–226; for quality improvement, 418–419
Flow process charts, 225
Flow process map, 225–226
Flu inoculation queuing, 480
Focus groups, 416
Frakt, A. B., 298
Frequency of interactions (flow), 175
From-to chart, 175–176
Front desk check-in spaghetti diagram, 229
Full time equivalents (FTEs): coverage factor and, 268–269; determination for nurse staffing, 266–268; reallocation through daily adjustments, 269–270; staff scheduling and, 281; staffing levels and utilization of, 263–270
G
Gantt, H., 2
Gantt chart, 434–436
Geographic information systems (GIS), 149–151
GHX, 367
Gilbreth, F., 2, 205
Gilbreth, L., 2, 205
GIS. See Geographic information systems
GlaxoSmiKline, 364
Global Trade Item Number (GTIN), 373
Goldberger, S., 298–299, 316
Goldman, H., 294
Goodman, D. C., 149
Google Maps, 146–147
Gordon, T., 290
GPOs. See Group purchasing organizations
GRASP system, 257–258
Gross, M., 322
Group purchasing organizations (GPOs), 363–364, 366
GS1 system, 373
GTIN. See Global Trade Item Number
Guidelines of Perinatal Care, 270
H
Hackey, B. A., 291
Hamilton, D., 290, 293
Hammer, M., 198
Harris, F. W., 2
Hawthorne effect, 207
HCAHP. See Hospital Consumer Assessment of Healthcare Providers and Systems
HCUP. See Healthcare Cost and Utilization Project

Heal-Me Hospital: alternative prediction methods and accuracy measured by MAD/MAPE, 62–63; average daily patient days, 56–57; daily indexes for, 58; error calculations on predictions for, 61–62; linear trend with tracking signal for patient visit predictions, 64; monthly and daily adjusted predictions for, 60–61; monthly indexes for, 58; quarterly indexes for, 58; seasonality removed trend data for patient demand of, 59; tracking signal for patient visit prediction, 65

Health care expenditures: cost of labor, 306–308; as GDP percentage for 30 OECD countries, 4; holding or carrying costs, 371, 373–377; inventory cost information, 373–374; queuing system capacity analysis and costs, 494–496; waiting costs as, 478–479

Health care management: information technology role in, 3; medical inventory, 368–383; productivity and, 297–323; project management component of, 431–463; resource allocation and, 333–355; simulation for measuring decisions of, 516–517

Health care managers: big data and, 7–9; bounded rationality phenomenon and, 87; decision making by, 3; as project managers. See Project managers; reengineering role of, 199; scheduling by, 281–295; staffing decisions by, 253–273; workload management by, 254–273

Health care organizations, big data and data flow in, 7–9

Health care outputs, intangible nature of, 6–7

Health care reform, productivity consequences of, 298–299

Health care services: capacity and costs of, 478–479; distinctive characteristics of, 5–7; first-come, first-served provided, 485; management of, 5; scope and recent trends of, 4–5. See also Queuing system; Waiting lines

Health care services components: intangible nature of health care outputs, 6–7; judgment requirements and heterogeneous nature of health care as, 7; patient participation as, 6; perishable capacity as, 6; simultaneous production and consumption as, 6


Health care workers: labor costs related to, 306–308; scheduling of, 281–295; staffing decisions and, 253–273; workload management and, 254–273. See also Nursing units

Health Industry Business Communications Council (HIBCC), 372

Health maintenance organizations (HMOs): enrollment growth of, 5; waiting lines at, 477

Healthcare Cost and Utilization Project (HCUP), 8

HealthTrust, 366

Heart Institute, 151–154

Henry Schein, 366

Herzberg, F., 206

HIBCC. See Health Industry Business Communications Council

Highfill, T., 320
Histogram, for quality improvement, 417–418
HMOs. See Health maintenance organizations
Hoffmann–La Roche, 364
Holding costs, 371, 373; in EOQ model, 374–377
Hospital Compare, 8
Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS), 7
Hospitals: emergency room arrival and service times, 482, 484; productivity and quality relationship in, 314–315; scheduling in, 281–295; staffing decisions in, 253–273; summary of productivity-related dilemmas in, 315–316; surgical suite resource scheduling in, 290–294. See also Facility location; Nursing units; Public health clinics
Hours, productivity adjustments using, 305–306
Hours of direct care, 312–313
Hours per patient day (HPPD), 261, 299–300, 302–304
Human relations school, 205–206
Human resources: reallocation of, 254, 269–270; scheduling of, 281–295; staffing decisions for, 253–273
Human resources management, 203
Hurwitz strategy, 88, 91–92, 100

I
IDS. See Integrated delivery systems
Incentive approach, project compression with, 451, 455–461
Incentive-based compensation, 237
Indirect care activities, 262
Industry standards, 270
Infinite-source models: formulations, 486–487; typical, 486
Information technology (IT): health care decision-making role of, 3; health care management role of, 3; management information systems reshaped by, 3
Inputs: adjustments for, 304–308; in productivity definitions and measurements, 299–304
Institute of Medicine (IOM), quality of care definition of, 393
Integer linear programming: description of, 346; for staff scheduling, 348–355
Integrated delivery systems (IDS): health care adoption of, 3; restructuring required to create, 5
Interactive Atlas of Heart Disease and Stroke (CDC), 152
Inter-arrival time, 483–484
Internal workload standards: development of, 261–263; FTE utilization and, 263–270
International Organization for Standardization (ISO), 396
Interviewing, 416
Inventory: cost information on, 373–374; definition of, 370; holding or carrying costs of, 371, 373–377
Inventory cycle, 374–377
Inventory management: accounting systems used in, 372–373; classification system used in, 379–382; contemporary issues in, 368–370; cost information issue of, 373–374; EOQ model of, 374–380; just-in-time and stockless inventories, 368–369; lead time and, 373; reorder point calculations for, 374–377, 382–383; requirements for effective, 371; single compared with multiple vendors in, 369–370; traditional approach to, 370–371; UPCs used in, 372–373. See also Health care supply chain
IOM. See Institute of Medicine
Ishikawa chart, 419–420
ISO. See International Organization for Standardization
ISO 9000 certification, 396
ISO 14000 certification, 396
Isoquant, 317
IT. See Information technology
Iyengar, R. I., 320

K
Kaizen teams, 416–417
Kanban, 202
Kelley, M. G., 294
Kerzner, H., 431
Ketcham, J. S., 294
Khushalani, J., 321
Kim, C. S., 199, 200
King, G., 364
Kinney, M., 287
Kirk, R., 255, 263, 270, 299
Kitting, 202
Klastorin, T., 431
Knappenberger, H. A., 294
Kowalski, J. C., 369
Krumrey, N. A., 369
Kubic, F. T., 294

L
Labor costs, productivity adjustments using, 306–308
Lamkin, L. R., 270
Laplace strategy, 88, 93, 100
Latest finish time (LF), 439–440
Latest starting time (LS), 439–440
Layouts. See Facility layout decisions
LCF scheduling. See Longest case first scheduling
Lead time, 373
Leahy, T. M., 363
Lean management: cycle repetition, 203; description of, 199–200; future state mapping for, 202; improvement identification for, 201–202; improvement implementation for, 202–203; for patient flow, 229–237; value definition in, 200; value stream map for, 200; waste identification for, 200–201
Lee, K., 321
Legg, J. S., 320
L.F. See Latest finish time
Limits report: for maximization model, 339, 344; for minimization model, 350
Linear programming (LP): description of, 333–335; integer, 346, 348–355; maximization models for, 335–345; minimization models of, 345–350; structure of, 334–335
Linear regression: predictive analysis techniques based on, 41–45; as trend line, 46–48
Longest case first (LCF) scheduling, 293
Long-term care facility: available space for, 172; closeness rating chart for, 173; layout solution for, 174
LP. See Linear programming
LS. See Latest starting time
Luke, R. D., 320
Lynch, J. R., 321

M
MA. See Moving averages
MAD. See Mean absolute deviation
Magerlein, J. M., 290, 291, 294
MAGNET, 366
Managed care programs: growth of prepaid, 4–5; HMOs, 5, 477
Management. See Health care management
Management information systems (MIS), 2
Managerial decisions. See Decision making
Manufacturers and suppliers, in health care supply chain, 363–365
MAPE. See Mean absolute percent error
Mark, B. A., 321
Martin, J. B., 290, 291, 294
Materials management information system (MMIS), 365
Mau, L. W., 320
Maximax strategy, 88, 90
Maximin strategy, 88, 90, 100
Maximization models, for linear programming, 335–345
McCue, Y. A., 320
McDougall, M. D., 261, 263, 266, 272
McFadden, C. D., 363
McKesson, 365–366
Mean absolute deviation (MAD), 61–63
Mean absolute percent error (MAPE), 61–63
Mean charts, 401; range approach to, 410–412; standard deviation approach to, 407–410
MedAssets, 366
Median Household Income, 153–154
Medical devices, manufacturers and suppliers of, 364–365
Medical Expenditure Panel Survey (MEPS), 8
Medical Group Management Association (MGMA), 396
Medical inventory management. See Inventory management
Medical-surgical supplies, manufacturers and suppliers of, 364
Medicare Prospective Payment System (PPS), 297–298
Medicus Systems Corporation, 258
Medtronic, 365
MEPS. See Medical Expenditure Panel Survey
Merck, 364
Merwin, E., 321
Meyer, D., 258
MGMA. See Medical Group Management Association
MHS. See Multihospital system
Microsoft Excel. See Excel
Minimax regret strategy, 88, 91–92, 98–99
Minimization models, for linear programming, 345–350
Minimizing distances and costs, 175–176
Minimum attribute satisfaction procedure: decision analysis using, 109; location decision using, 144–145
MIS. See Management information systems
Mistake-proofing, 202
Misutilization of health services, 394–395
M/M/1 queuing model, 486–492
M/M/2 queuing model, 492–493
M/M/3 queuing model, 486, 493
M/M/5/15 queuing model, 486
MMIS. See Materials management information system
M/M/s>1 queuing model, 486, 492–493, 496
Monte Carlo simulation method: description of, 510; empirical distribution of, 511; process of, 510–511; for public health clinic, 511, 513–516; random number look-up, 512–516; theoretical distribution of, 512
Monthly and daily adjusted predictions, 60–61
Index

Monthly indexes technique, 56, 58
Morrisey, J., 399
Morrisey, J. P., 321
Most important attribute procedure:
  decision analysis using, 109–110; location
decision using, 145–146
Most likely time, 442
Moving averages (MA): applications of, 33;
determining reasonable number of periods
for, 35; equation for, 32–33; example of,
33–34; weighted, 36–37
Multi-attribute method: description of,
143–144; dominance procedure, 144;
minimum attribute satisfaction procedure,
144–145; most important attribute proce-
dure, 145–146
Multifactor productivity, 300–302
Multihospital system (MHS), linear regres-
sion for, 43–45
Multiphase operations, 520–521
Multiple regression, 52–55
Multiple room system, 293
Multiple sourcing, 369–370
Multiple-line queuing system, 481–482
Multiplicative model, 55, 56
Muther, R., 171–172

N
Naïve extrapolation, 30
Naïve prediction, 32
Narasimhan, S. L., 291
National Cancer Institute, 150
National Drug Codes (NDCs), 372
Nayar, P., 321
NCU. See Nursing care unit
NDCs. See National Drug Codes
Networks. See Project networks
Newstrom, J. W., 282, 289
Nominal group technique, 416
Nonrandom variation, 400; control charts
  used to assess. See Control charts
Novartis, 364
Novation, 366
NPAQ system, 258–261
Nurse staffing: FTE determination for,
  266–268; GRASP system, 257; NPAQ
system, 258–261
Nurses Association of the American College
  of Obstetrics and Gynecology, professional
  standards of, 270
Nursing care unit (NCU), 257
Nursing Management (journal), 284
Nursing units: abridged patient care tasks
  in, 215; data collection form for, 216;
  observed and normal time calculations
  for, 213; observed times and performance
  ratings for nursing units, 212; partial work
distribution chart for, 224

O
OB/GYN clinic: moving averages for, 35;
prediction building for, 38–41; regression
analysis for, 46–48; volume prediction
for, 33–34; weighted moving averages for,
36–37
Objective function, 334; in integer linear
programming, 348–355; in maximization
models, 335–345; in minimization models,
345–350
Occupational Safety and Health
  Administration (OSHA), 204
OECD. See Organization for Economic
  Cooperation and Development
OmniCell, 367
Oncology Nursing Society (ONS), profes-
sional standards of, 270
Operating room (OR), scheduling for,
  290–294
Optimal solution, in linear programming,
  333, 337–338, 344–346
Optimistic time, 442
OR. See Operating room
Ordering costs: in EOQ model, 374–377; inventory, 373–374
Organization for Economic Cooperation and Development (OECD), health care expenditures, 4
OSHA. See Occupational Safety and Health Administration
Outcome Standards for Cancer Nursing Practice, 270
Output-based compensation, 237
Outputs: adjustments for, 308–310; in productivity definitions and measurements, 299–304
Overfelt, F., 322
Overutilization of health services, 394–395
Owens & Minor, 366
Ozcan, Y. A., 294, 320–321, 462–463
Ozgen, H., 321

P
PACU. See Post-anesthesia care unit
Page, J. A., 261, 263, 266, 272
Palmer, J., 285
PAR. See Periodic automated replenishment
Parameters, 334; in integer linear programming, 348–355; in maximization models, 335–345; in minimization models, 345–350
Pareto diagram, 420
Pareto principle, 198
Partial work distribution chart for nursing units, 224
Patient acuity systems: GRASP, 257–258; NPAQ, 258–261; staffing decisions related to, 256–261
Patient care unit (PCU), 258
Patient day, hours per. See Hours per patient day
Patient fall prediction, 52–55
Patient flow, 229–237
Patient Protection and Affordable Care Act. See Affordable Care Act
Patient Satisfaction Survey, 7
Patient satisfaction surveys, 393–394
Patient-focused care, 198
Patients: balking at queue and waiting times, 485; participation of, 6; reneging and leaving the queue, 485; service time for ER, 477–478. See also Arrival patterns; Hospitals; Quality of care; Queuing system; Waiting lines
Payoff table: decision making using, 88–90; for EMV, 95; Excel illustration of decision tree and, 104
p-charts, 401, 403, 405–407
PCU. See Patient care unit
PDAs. See Personal digital assistants
PDSA cycle, 397–398
Percentage of adjusted hours in direct care, 312–313
Percentage of hours in direct care, 312–313
Performance: measures of queuing system, 486; simulation to measure managerial decisions and, 516–517. See also Quality control
Performance improvement: CQI for, 3, 198; lean management for, 199–203; methods for, 197–198; reengineering for, 198–199; TQM for, 3, 198
Performance-measure-based managerial decision making, 517, 519
Periodic automated replenishment (PAR), 365
Periodic system, 372
Perishable capacity, 6
Permanent work schedule, 285–286
Perpetual system, 372
Personal digital assistants (PDAs), 4
PERT. See Program evaluation and review technique
Pessimistic time, 442
Predictive analysis seasonality: daily indexes technique, 59; description of, 55–56; employing seasonal indexes, 59–61; Heal-Me Hospital average daily patient days, 56–57; monthly and daily adjusted predictions, 60–61; monthly indexes technique, 56, 58; quarterly indexes technique, 56, 58

Predictive analysis techniques: accuracy of, 61–62; error calculations on, 61–62; judgmental predictions, 29–30; mean absolute deviation and, 61–63; mean absolute percent error, 61–63; naive extrapolation, 30; seasonal, cycle, and random variations, 30–31; for seasonality, 55–61; techniques for averaging, 31–41; techniques for seasonality, 55–61; techniques for trend, 41–55; time-series, 30–31

Predictive analysis trends: based on linear regression, 41–45; linear regression as trend line, 46–48; multiple regression, 52–55; overview of, 41; single exponential smoothing with trend, 48–51; trend-adjusted exponential smoothing, 48–51

Preferred provider organizations (PPOs), 5

Point-of-service (POS) programs, 5

Poisson arrival, 486

Poisson distribution: M/M/1 queuing model, 487–492; M/M/s>1 queuing model, 492–493; representing arrival patterns, 483–484, 512

Policy, productivity consequences of, 298–299

Population source, in queuing system, 480

POS programs. See Point-of-service programs

Post-anesthesia care unit (PACU), OR scheduling and, 290

PPOs. See Preferred provider organizations

PPS. See Medicare Prospective Payment System

Predetermined standards, 214


Predictive analysis averaging techniques: determining reasonable number of periods for moving average, 35; judgmental predictions, 29; moving averages, 32–35; naive prediction, 32; prediction control, 62–65; single exponential smoothing, 37–41; weighted moving average, 36–37

Predictive analysis seasonality: daily indexes technique, 59; description of, 55–56; employing seasonal indexes, 59–61; Heal-Me Hospital average daily patient days, 56–57; monthly and daily adjusted predictions, 60–61; monthly indexes technique, 56, 58; quarterly indexes technique, 56, 58

Predictive analysis techniques: accuracy of, 61–62; error calculations on, 61–62; judgmental predictions, 29–30; mean absolute deviation and, 61–63; mean absolute percent error, 61–63; naive extrapolation, 30; seasonal, cycle, and random variations, 30–31; for seasonality, 55–61; techniques for averaging, 31–41; techniques for seasonality, 55–61; techniques for trend, 41–55; time-series, 30–31

Predictive analysis trends: based on linear regression, 41–45; linear regression as trend line, 46–48; multiple regression, 52–55; overview of, 41; single exponential smoothing with trend, 48–51; trend-adjusted exponential smoothing, 48–51

Preferred provider organizations (PPOs), 5

Premier, 366

Prepaid managed care programs, 4–5

Preventive care, 4

The Principles of Scientific Management (Taylor), 2

Probabilistic approach, to project management, 441–449

Process improvement: methods for generating new ideas, 415–417; tools for investigating presence and causes of quality problems, 417–420

Process layout: computer-based layout programs for, 175–176; Excel template solutions for, 179–180; fixed-position layout, 176; issues related to, 171; method
of minimizing distances and costs, 175–176; tools for designing, 171–174
Process variability, 399–401; control charts used to monitor. See Control charts
Product layout decisions, 170–171
Production, consumption and simultaneous, 6
Productivity adjustments: case mix, 310–311; cost of labor, 306–308; hours, 305–306; for inputs, 304–308; for outputs, 308–310; service mix, 308–310; skill mix, 304–305; standardized cost of labor, 306–308
“The Productivity Paradox” (Skinner), 321
Professional standards, 270
Program evaluation and review technique (PERT), 435–436. See also Probabilistic approach
Project compression: with incentive approach, 451, 455–461; with total cost approach, 450–456; trade-offs between reduced time and cost, 448–450
Project life cycle, 432
Project management: clinical pathway applications of, 461–463; compression for, 448–461; CPM for, 435–441; dominant critical path in, 447–449; Gantt charts for, 434–436; issues related to, 431–432; networks for, 436–437; PERT for, 435–436; planning and scheduling, 434; probabilistic approach to, 441–449; teams and relationships, 433
Project managers, 431; roles and responsibilities of, 432–433
Project networks, 436–437; for CPM, 437–438; dominant critical path in, 447–449; probabilistic approach to, 441–449
Projects: life cycle and phases of, 432; managing teams and relationship on, 433; planning and scheduling of, 434
Prototype systems, 257
Providers: in health care supply chain, 363–364; supply chain management issues for, 367
Public health clinics: Excel template animated simulation for, 519; Monte Carlo simulation experiment for, 513–516; simple simulation experiment for, 508–509; summary statistics for simulation experiment, 509–510, 515
“Pull’ system, 201
Q
QALY. See Quality-adjusted life-year
QC. See Quality control
Quality circles, 416–417
Quality control (QC), 395; total quality management used for, 2, 198
Quality improvement: 5W2H approach to, 415; benchmarking for, 417; brainstorming for, 415–416; cause-and-effect diagram for,
419–420; check sheet for, 417–418; flow chart for, 418–419; focus groups for, 416; histograms for, 417–418; interviewing for, 416; methods for generating new ideas, 415–417; nominal group technique for, 416; Pareto diagram for, 420; quality circles or kaizen teams for, 416–417; scatter diagram for, 418–419; tools for investigating presence and causes of quality problems, 417–420

Quality measurement and control techniques: control charts for attributes, 403–407; control charts for continuous variables, 407–412; investigation of control chart patterns, 412–415; monitoring variation through control charts, 401–402; process improvement, 415–420; process variability, 399–401; structure-process-outcome conceptualization for, 393–394

Quality of care: certifications and awards related to, 396; continuous quality improvement for, 395, 397–398; control of. See Quality measurement and control techniques; definition of, 393; experts on, 395–396; improvement of. See Quality improvement; measurement of. See Quality measurement and control techniques; productivity relationship to, 314–315; quality gaps in, 394–395; Six Sigma strategy for, 395, 398–399; total quality management for, 395, 397–398

Quality-adjusted life-year (QALY), 111–113

Quarterly indexes technique, 56, 58

Queue discipline, 485

Queue phenomenon, 478

Queuing analysis, 477, 479

Queuing models: classification of, 485; formulations of, 486–487; M/M/1, 486–492; M/M/2, 492–493; M/M/3, 486, 493; M/M/5/15, 486; M/M/s>1, 492–493, 496; notation for, 486–487; typical infinite-source, 486–487

Queuing system: capacity analysis and costs of, 494–496; characteristics of, 479–480, 485–486; diabetes information booth, 492, 495, 496; number of servers and, 480–481; patient balking at, 485; patient reneging, 485; performance measures of, 486; population source characteristic of, 480; service patterns, 483–484; single-line and multi-line, 481–482; steady state assumption of, 486. See also Waiting lines

Queuing theory, 477, 512

R

Radio frequency identification (RFID), 4, 7, 322

Random numbers: generated using Excel, 512–513; Monte Carlo simulation and look-up, 512–516; Poisson probabilities for arrivals and corresponding, 514

Random variation, 400; control charts used to assess. See Control charts

Range charts, 401, 407–408, 412

Range of feasibility, in linear programming, 342

Rasmussen, S. R., 287

Ratios, productivity, 299–304

Reallocation of human resources, 254; through daily adjustments, 269–270

Redinius, D. L., 398

Reengineering, 395; health care managers role in, 199; improving performance by, 198–199; work design and, 203–204; work measurement using time standards for, 207–214; work measurement using work sampling for, 214–223; work simplification for, 223–237; worker compensation issue and, 237. See also Lean management

Remington Rand Corporation, 436

Reneging, 485
Reorder point (ROP), 374–377, 382–383
Resource allocation, 333. See also Linear programming; Scheduling; Staff scheduling
RFID. See Radio frequency identification
Richmond Metropolitan Area blood banks: interaction with selected hospitals, 149; locations of, 150
Richmond Metropolitan Area Hospitals: list of selected, 148; map of, 148; selected hospitals and their blood bank interaction, 149
Risk: decision making under, 93–95; description of, 88
Risk (or uncertainty), Type I error, 402
Rodak, S., 201
Rollback procedure, 102–103, 105
Rollins, J., 320
Roos, D., 199
ROP. See Reorder point
Rose, M. B., 294
Rosenbaum, B. P., 322
Run-based pattern tests, 413–415

S
Safety stock, 383
Sanders, T., 368
Scatter diagram, for quality improvement, 418–419
SCF scheduling. See Shortest case first scheduling
Schedule quality, 281
Schedule stability, 281
Scheduling, 254, 281. See also Staff scheduling
Schlanser, M. R., 202
Schultz, B., 399
Seasonal variations, 55
Sensitivity analysis, 344–345; for cost-volume-profit analysis, 139–140; in decision making, 103–107
Sensitivity report: for maximization model, 339, 343; for minimization model, 349
Servers: definition of, 477; queuing systems and number of, 480–481. See also Queuing system
Service level, 383
Service mix productivity adjustments, 308–310
Service patterns, 483–484
SES. See Single exponential smoothing
SEST. See Single exponential smoothing with trend
Shadow price, in linear programming, 342–345
Sharon, A. T., 294
Sheehan, P. E., 370
Shewhart, W., 2
Short turnaround time (STAT) laboratory tests, 225
Shortage costs, inventory, 374
Shortest case first (SCF) scheduling, 293
Sikka, V., 320
Simplex method, 338–344
Sinclair, V. G., 322
Single exponential smoothing (SES), 37–41
Single exponential smoothing with trend (SEST), 48–51
Single sourcing, 369–370
Single-line health care systems, 480–481
Six Sigma, 395, 398–399
Skill mix productivity adjustments, 304–305
Skinner, W., 321
SKUs. See Stock keeping units
Slack: in CPM, 440–441; in linear programming, 342–343
Sleven, M., 270
SLP. See Systematic layout planning
Smoothing constant α, 39–41
Social Security Death Index, 7
Socio-technical school approach, 206
Solti, I., 320
Solver. See Excel Solver
Spaghetti diagram, 226–227, 229; bottlenecks, 235; for patient flow, 230, 232
Stack, R. T., 135–136
Staff scheduling: computerized systems for, 288; cyclical, 285–286; flexible, 286–288; implementation of new system for, 288–290; integer linear programming for, 348–355; overview of, 281–283; shift length considerations in, 282–285; shift pattern studies and, 283–288; surgical suite resources, 290–294
Staff utilization, 254–255
Staffing: acuity-based, 266–270; challenges related to, 253–254; FTEs for. See Full time equivalents; patient acuity systems for, 256–261; procedurally based, 263–266; productivity and, 271–273; three components of, 256; workload management and, 254–273; workload standards for. See Workload standards
Staggered scheduling, 286
Stahl, R., 399
Standard elemental times, 214
Standardized cost of labor, 306–308
Standards for Nursing Care of the Critically Ill, 270
Standards for Obstetric, Gynecological, and Neonatal Nursing, 270
STAT laboratory tests. See Short turnaround time laboratory tests
Steady state assumption, 486
Stock keeping units (SKUs), 370
Stockless inventories, 368–369
Stopwatch time studies, 207
Sub-optimization phenomenon, 88
Suppliers. See Manufacturers and suppliers
Supply chain. See Health care supply chain
Surgical suite resource scheduling: assessment of systems for, 293–294; block approach to, 291–292; estimation of procedure times for, 294; FC/FS approach to, 291; issues and goals of, 290; LCF approach to, 293; multiple room system of, 293; SCF approach to, 293; top down/bottom up approach to, 293
Surplus, in linear programming, 342
Systematic layout planning (SLP), 171

T
Tanzini, E., 462–463
Taylor, F. W., 2, 204–205, 207
TC function. See Total cost function
Technical efficiency, 317
Technology. See Information technology
Templates. See Excel templates
Ten-hour shifts, 282–285
Testi, A., 462–463
Theoretical distribution, 512
3M, 364
Time-based compensation, 237
Time-series technique, 30–31
Top down/bottom up scheduling, 293
Total cost approach, project compression with, 450–456
Total cost (TC) function, 175; of facility layout, 177–180
Total quality management (TQM), 395, 397–398; improving performance through, 3, 198
Toyota Production System, 199
TQM. See Total quality management
Traub, R. D., 290–291, 293
Trend-adjusted exponential smoothing, 48–51
Twelve-hour shifts, 282–285
Two-bin inventory system, 365
Type I error, 402
Type II error, 401–402

W
Waiting costs, 478–479
Waiting lines: number and capacity of servers at, 480–481; patient balking at, 485; patient reneging queue or, 485; queue phenomenon and analysis of, 478; queuing conceptualization of flu inoculation, 480; queuing theory on, 477
Walker, E. K., 256
Warner, M. D., 256
Waste identification in lean management, 200–201
Weighted moving average (WMA), 36–37
West Broad Medical Center, 99–101
Wheeler, J., 172
Wholesalers, in health care supply chain, 363–367
Williams, W. L., 290
WMA. See Weighted moving average
Wogen, S. E., 320
Womack, J. P., 199
Work design: description of, 203; job design component of, 204–207; socio-technical school approach to, 206; systems perspective on, 204
Work measurement using time standards: allowance percentages for varying working conditions, 211; determination of number of cycles (sample size), 207–213; observed and normal time calculations for nursing units, 213; observed times and performance ratings for nursing units, 212; overview of, 207; predetermined standards, 214; standard elemental times, 214; stopwatch time studies, 207
Work measurement using work sampling: abridged patient care tasks in nursing unit, 215; data collection form for nursing unit, 216; development of random observation schedule, 218–219; overview of, 214–216; random observation schedule using Excel,
resources, 254, 269–270; scheduling. See Scheduling; staffing. See Staffing; standards for. See Workload standards; three components of, 254–255
Workload stability index (WSI), 269–270
Workload standards: examples of, 255; external, 270–271; FTE utilization and, 263–270; internal, 261–270; staffing levels and, 254–256; tolerance ranges of, 271
WSI. See Workload stability index

Z
Zimmer, 365