

Index

- Accuracy for hydrological variables 57
- Accuracy of measurement 475
- Acoustic Doppler Current Profilers 105
- Active sensors 125
- Advection 759
- Aggradation 696
- Akaike information criterion 270
- Allocation of ground water 385
- Allocation of project cost 386
- Amazon River 16
- Analysis of errors 474
- Analysis of uncertainty 480
- Artificial Neural Networks 171-189
 - Applications 186
 - Cascade correlation algorithm 182
 - Classification 173
 - Data standardization 178
 - Definition 173
 - Error back propagation algorithm 178
 - Feed – forward 173
 - Issues in applications 187
 - Modular neural network 183
 - Overtraining 177
 - Radial basis function networks 184
 - Structure 173
 - Training 176
- Annual cost method 379
- Aquatic nuisance plants 410
- Atmosphere windows 124
- Automatic hydrologic stations 80

- Basic frequency curve 259
- Bayes' theorem 495
- Bayesian decision making 495
- Benefit-cost ratio 368
 - Method 367
- Bernoulli processes 221
- Binomial distribution 221

- Biochemical model 756
- Biochemical oxygen demand 766
- Blue water 798
- Brune curves 688

- Capacity inflow (CI) ratio 686
- Carryover storage 608
- Cash flow diagram 353
- Cautilya 4
- Central tendency 211
- Challenges in water resources 36
- Characteristics of water uses 558
- Check dams 728
- Chemical oxygen demand (COD) 768
- Chemical tracers 51
- Churchill curves 690
- Climate change impact on basin management 806
- Coefficient of skewness 212
- Complete duration series (CDS) 255
- Concept of rationality 461
- Conjugated gradient methods 303
- Conjunctive use 525, 802
- Constrained non-linear optimization methods 304
- Control of sediment inflow 727
- Conveyance of the channel 93
- Correlation 251
 - Auto 252
 - Cross 251
 - Serial 252
 - Kendall's rank test 253
- Cost allocation in Dharoi project 390
- Cost allocation practices in India 389
- Criteria of rationality 461
- Critical flood inflow (CFI) 645
- Current meter 87

Data

- Adequacy 514
- Collection and processing 513
- Dissemination 118
- Fill-in 59
- Gathered during operation 112
- Graphical presentation 213
- Population 207
- Quality control 515
- Sources 513
- Storage and retrieval 116
- Systems 515
- Transmission 115
- Dead storage zone 585
- Decision making – levels of 527
- Degradation 696
- Degree of freedom 238
- Demographic and social characteristics 110
- Density current 734
- Density slicing 140
- Design storm 75
- Detention period 686
- Dharoi reservoir 41, 412, 583, 609, 666
 - Sedimentation 725
- Difference between lakes and reservoirs 776
- Digital elevation model 167
- Digital image processing 135
- Digital number 136
- Digital terrain model 167
- Direct search method 301
- Disaggregation of rainfall data 75
- Discharge measurement
 - Dilution technique 90
 - Indirect method 90
 - Special problems 94
 - Structures 91
- Discount factors 355
- Discount rate 353
- Discounting techniques 366
 - Comparison 380
- Dispersion 760
- Dissolved oxygen (DO) 765
- DO sag curve 771
- Doppler radar 63
- Double mass analysis 65
- Dynamic programming 307 - 314
 - Control variables 307
 - Curse of dimensionality 312
 - Discrete differential 312
 - Monte Carlo 314
 - Recursive equation 309
 - For reservoir operation 658
 - Stage variables 307
 - State variables 307
 - Stochastic 316
 - System equation 308
- Decision support systems 809 - 817
 - Components 811
 - Definition and objectives 810
 - Designing 813
 - Need of 810
 - User interface 814
 - Waterware 815
- Dublin principles 23
- Dynamism of environment 396
- Ecological indices 429
- Ecology 395
- Economic risk 467
- Economics in systems engineering 33
- Environment 395
 - Hot spots 395
 - Physical impacts 406
 - Problems in command areas 413
- Environmental impacts 398
 - Acceptable and unacceptable 400
 - Adverse 401
 - Biological 409
 - Indices 419
 - Long and short-term 400
 - Of reservoirs 405
 - Primary and secondary 399
 - Units 431
- Environmental impact assessment 415
 - Adhoc method 419
 - Checklist method 422
 - ICOLD Matrix assessment 421
 - Indices 427
 - Network method 425
 - Overlay method 425
 - Scope 416
 - Techniques 416
- Elasticity of water demand 361
- Electro-magnetic spectrum 124

- Electro-magnetic spectrum bands 125
- Empirical area reduction method 697
- Entropy 230
 - Principle of maximum 231
 - Based parameter estimation 232
- Equimarginal principal 384
- Errors
 - Measurement 55
 - Propagation 477
 - Random 55
 - Sources and types 64
 - Systematic 55
- Expert systems 189-198
 - Applications in water resources 196
 - Architecture 191
 - Definition 189
 - Development 192
 - Inference engine 195
 - Knowledge acquisition 195
 - Knowledge base 194
 - Techniques 193
 - Tools 193
- Estimation of future demands 516
- Eutrophic cycle 755
- Evaporation losses 575
- Evapotranspiration 76
- Expected monetary value (EMV) 487
- Extrapolation of rating curve 98
- False color composite 132
- Far-field models 774
- Farm budgets and net farm income 110
- Fick's law of dispersion 760
- Fisheries, flora and fauna 404, 409
- Fixing top of dam 606
- Floats for discharge measurement 86
- Flood control 404, 560
 - Reservation diagram 641
 - Reservoirs in parallel 647
 - Reservoirs in series 647
 - Storage capacity 595
- Flora and fauna 409
- Flow duration curves 566
 - Use of 568
 - Development of 567
- Flux 759
- Frequency analysis 254
 - Frequency-factor method 256
 - Graphical method 255
 - Index flood method 259
 - Multiple regression method 262
 - Plotting-position formulas 256
 - Point 255
 - Regional 259
- Funding needs in water sector 389
- Fuzzy theory 652
- Gaging equipment 51
- Gambler's ruin 485
- Gamma distribution 219
- Gamma ray sensors 127
- Geochemical processes 756
- Geographic data
 - Attributes 148
 - Line data 149
 - Point data 149
 - Polygons 149
 - Spaghetti 151
 - Types 148
- Geographic information systems (GIS)
 - 146 - 171
 - Application in water resources 169
 - Aspect maps 166
 - Data classification 163
 - Data editing and management 162
 - Data input 160
 - Data preparation 160
 - Data selection and query 163
 - Data structure 151
 - Geographic coordinate systems 157
 - Geometric transformation 165
 - Line of sight maps 166
 - Overlay operation 166
 - Quadtrees 155
 - Raster data 154
 - Registration by absolute position 166
 - Run-length encoding 156
 - Spatial aggregation 164
 - Time 157
 - Topologic data structure 152
 - Triangular irregular network 153
 - User interface 160
 - Vector data 151
 - Viewshed 166

- GGI-3000 pan 76
 Global positioning system 719
 Global runoff data center 119
 Goal programming 328 - 336
 Governing advection-diffusion equation 763
 Green water 798
 Ground water data 107
 Ground water quality 781
 Ground water quality models 782
- Hardcore projects 21
 Hessian matrix 298
 High Aswan Dam 404, 412, 430
 Histogram equalization 137
 Homogeneity test 260
 Hurst phenomenon 578
 Hydrological data processing 48
 Hydrological database 117
 Hydrometeorological network design 52
 Hydropower 569 - 574
 Benefits 403
 Components of projects 571
 Development 9
 Generation 569
 Load of projects 572
 Potential 25, 573
 Pumped storage schemes 570
 Reservoirs 630
 Rules 634
 Sequential streamflow routing 574
 Hydrosystems 30
 Hypothesis testing 235
- ICOLD guidelines for planning 433
 Interbasin water transfer 827 - 832
 Evaluation of projects 829
 Examples 830
 Planning for 828
 Incremental benefit and cost 370
 Indian space program 130
 Indifference curves 362
 INFOHYDRO of WMO 119
 Information dissemination 663
 Instantaneous field of view (IFOV) 131
 Institutional set-up 525
 Intangible values 357
- Integrated planning 508
 Integrated water management 23
 Integrated water resources management 797
 Integration of environmental aspect in water resources planning 430
 Internal rate of return 375
 International hydrological programme 835
 International Standards Organization (ISO) 82
 Investigation for reservoir planning 562
 Irrigation 559
 Benefits 403
 Water requirements 517
 ISO 1100/2 98
- Kriging 72
 Kuhn - Tucker conditions 299
 Kurtosis 213
- Lagrange multipliers 299
 Lake eutrophication 777
 Lake mass balance 779
 Land use and crop yields 110
 LANDSAT program 129
 Leakage through dam 576
 Life of a reservoir 689
 Linear decision rule 315, 654
 Linear imaging self scanner - III (LISS-III) 130
 Linear programming 282 - 297
 Assumptions 283
 Canonical form 287
 Chance-constrained 315
 Conventional forms 283
 Duality 294
 Graphical solution 287
 Handling inequality constraints 286
 Matrix form 285
 Post optimality analysis 296
 Relations between primal and dual 295
 Reservoir operation 650
 Simplex method 290
 Standard form 284

- Storage-yield analysis 592
- Long-range planning schedules 621
- Loss of storage capacity 691
- Lysimeter 76

- Mahaweli reservoirs 701
- Management of international basins 832
- Map projection 158
 - Albers equal area conic 160
 - Polyconic 159
 - Universal transverse mercator 159
- Marginal return 358
- Markov models 271
- Marquardt algorithm 303
- Mass curve method 586, 599
- Max min strategy 486
- Mean annual flood (MAF) 260
- Measurement frequency 126
- Measurement Networks
 - Areal 53
 - Linear 53
 - Precipitation 53
 - Streamflow 54
- Measurement of discharge 85
- Measurement of snow 63
- Measurement of stage 83
- Measures of errors 476
- Median flood ratios 261
- Mekong River basin 824
- Micro wave sensors 128
- Mississippi River Commission 823
- Mathematical models
 - ANSWERS 774
 - CREAMS 774
 - CROPWAT 518
 - HEC-5 804
 - HEC-6 709
 - Mike basin 805
 - MODFLOW 783
 - MOUSE 773
 - MT3D 784
 - QUAL 2E 775, 805
 - RIBASIM 805
 - SHE 804
 - STORM 773
 - SWMM 773
 - TAMUWRAP 796
 - TERRA 805
 - WEPP 712
 - WQRRS 805
- Modeling of oxygen in rivers 765
- Models for water resources planning 535
 - Monte Carlo simulation 339, 650
 - Moving boat method 88
 - Multi-objective analysis 538
 - Constraint approach 325
 - Generating techniques 324
 - Non-inferior solution 321
 - Optimization 319
 - Surrogate worth trade off 326
 - Weighting method 325
- Multi-purpose reservoirs 648
- Multispectral scanners 127
- Municipal and industrial water supply 404, 559
- Municipal water use 519
- Murray-Darling Basin Commission 823
- Muskingum -Cunge routing method 673

- Narmada Sagar project 420
- Navigation 560
- Near-field models 774
- Need for water 6
- Network flow problem 296, 654
- New York city rules 633
- Nilometer 5
- Nonlinear programming 297
- Nonseparable cost 387
- Normalized difference vegetation index 138
- Normalized difference wetness index 139

- Objectives – articulation of 522
- Object-oriented modeling 540
- Off stream reservoirs 728
- Operation and maintenance costs 365
- Operation of a multi-reservoir system 627
- Operation phase 402
- Opportunity costs 368
- Optimal allocation of water 383
- Optimal solution 281

- Optimization 280
- Optimization methods 432, 592
 - Classification 282
 - Gradient based 302
- Pan coefficient 76
- Pan evaporation 76
- Panchet dam (India) 648
- Parameter estimation methods 222-230
 - L-Moments 227
 - Least squares 230
 - Maximum likelihood 229
 - Mixed moments 227
 - Moments - continuous systems 223
 - Moments - discrete systems 224
- Problems in parameter estimation
 - Bias 233
 - Consistency 233
 - Efficiency 234
 - Relative mean error 235
 - Robustness 235
 - Root mean square error 235
 - Standard error 234
 - Sufficiency 234
- Partial duration series (PDS) 255
- Passive sensors 125
- Pearson type-III (PT3) distribution 220
- Phosphorus 102
- Public involvement 528, 825
 - Activities 531
 - Advantages 530
 - Approaches 826
 - Information dissemination 826
- Pixel 135
- Planning – definition 507
- Planning and investigation phase 401
- Planning for operation 524
- Planning horizons 358
- Polar orbiting satellites 129
- Pollutant concentration 758
- Potential pareto superiority rule 368
- Precipitation - spatial interpolation 67
- Precipitation averaging
 - Arithmetic method 68
 - Distance power method 69
 - Isohyetal method 71
 - Normal ratio method 68
 - Thiessen polygon method 70
- Precipitation gages 59
- Precision of measurement 475
- Preliminary planning 520
- Present worth method 373
- Principal component analysis 137
- Priority ranking 332
- Probability distributions 208, 215-222
 - Continuous 217
 - Confidence limits 258
 - Chi-square 239
 - Discrete 221
 - Extreme value type 1 (EV1) 218
 - Gumbel 219, 257
 - Log-Normal 218, 257
 - Log-Pearson type 3 220, 257
 - Normal 217, 257
 - Poisson 222
- Probability weighted moments 226
- Probable Maximum Precipitation (PMP) 76
- Problem of weeds 414
- Processing of streamflow data 95
- Project
 - Benefits 366
 - Constraints 523
 - Construction phase 401
 - Cost 363
 - Feasibility 381
 - Installation cost 363
 - Optimality 385
- Project alternatives
 - Classification 533
 - Evaluation 534
 - Generation 534
 - Screening 534
- Quantity of water in hydrologic cycle 15
- Quoich dam (UK) 411
- Rain storm analysis 75
- Raingages - self-recording (SRRG) 61
 - Automatic 60
 - Ordinary (ORG) 60
- Random number generation 346
- Random number transformation 347
- Random variable 207
- Range analysis for storage 577

- Range survey 717
- Rate of return method 375
- Rating curve 96
- Rational decision making 459
- River basin management
 - Administrative model 818
 - Co-ordinated model 818
 - Decentralization and privatisation 819
 - Hydrological model 818
 - Institutional aspects 817
 - Models of 818
 - Operations 791
 - Practical aspects 821
 - Role of financiers 822
 - Scope of 790
- Reaeration 768
- Real-time control 661
- Real-time hydrologic forecasting 662
- Real-time reservoir operation 660
 - Advantages 664
 - Special considerations 662
- Recomposition - decomposition approach 656
- Recovery of storage capacity 737
- Recreation 405, 560
- Reflectance 132
- Reflectance of soil 133
- Regional frequency curve 261
- Regionalized variable 72
- Registration 136
- Regression
 - Confidence intervals 243
 - Determination of coefficients 242, 249
 - Extrapolation 247
 - Goodness 241
 - Inferences on coefficients 243
 - Linear 240
 - Mean square error (MSE) 242
 - Multiple linear 248
 - Significance of 250
 - Standard error 242
 - Stepwise 250
- Regulation regime function 581
- Rehabilitation and resettlement 364, 444
- Relative humidity 78
- Release by reservoir 619
- Release elevation 619
- Release of stored water 619
- Reliability 463
- Remote sensing 51, 123 - 146
 - Cost 146
 - Geometric correction 136
 - Image enhancement 137
 - Image processing 132
 - Platforms 128
 - Radiometric resolution 131
 - Sensors 127
 - Supervised classification 139
 - Training sites 139
- Remote sensing applications
 - Catchment modeling 144
 - Change detection 140
 - Crop coefficients 144
 - Evapotranspiration 143
 - Flood mapping 144
 - Leaf area index (LAI) 142
 - Precipitation estimation 141
 - Snow cover mapping 143
- Reservoir 13
 - Area elevation & storage curves 562
 - Buffer zone 165
 - Capacity computation 583
 - Classification of 558
 - Critical level (RCL) 645
 - Design flood 596
 - Drawdown 734
 - Drawdown refill cycle 620
 - In series 628
 - Induced seismicity 408
 - Losses 574
 - Need for 556
 - Parallel 632
 - Pre-depletion of 643
 - Submergence by 407
 - Trap efficiency 687
- Reservoir operation 615 - 680
 - Basic concepts of 620
 - Conditional rules 627
 - Conflicts among purposes 617
 - Conflicts in 616
 - Conflicts in space 616
 - Conflicts within same purpose 617
 - Critical issues in 617

- Derivation of rules curves 623
- Emergency 645, 646
- For flood control 639
- Hedging rule 637
- Initial rule curves 668
- Normal 645, 646
- Pack rule 636
- Rationing rule 622
- Rigid operation schedules 621
- Rule curves 623
- Space rule 634
- Standard linear operating policy 621
- Using rule curves 624
- Reservoir planning 433, 561
- Reservoir routing 598 – 605
 - Applications 602
 - Coefficient method 601
 - Mass curve method 599
 - Modified puls method 600
- Reservoir screening 595
- Reservoir sedimentation 681 - 742
 - Mathematical model 706
 - Assessment using remote sensing 721
 - Economics of 701
 - Factors influencing 686
 - Problems due to 686
- Reservoir sizing 555 - 612
 - Sequent peak method 589
 - Critical period techniques 585
- Reservoir surveys 715
 - Contour survey 717
- Reservoirs and lakes data 108
- Resettlers from major projects 446
- Resiliency 463
- Resource indices 428
- Return period 470
- Risk 462 - 471
 - Acceptable 469
 - Analysis and management 462
 - And uncertainty analysis 541
 - Classification 466
 - Estimation 469
 - Evaluation 472
 - Identification 472
 - Index 465
 - Management 471
 - Qualification 472
 - Sources of 467
- River basin
 - Definition 789
 - Management 24, 787
 - Management planning 796
 - Planning system 797
- River water quality modeling 752
- Rivers- maximum observed discharges 16
- Rule of 72 356
- Sabarmati system 41, 214
 - Operation rules 664
- Salvage value 358
- Sampling frequency 126
- Sampling program 748
- Sardar Sarovar project 448 - 454
- Sediment bypass 736
- Sediment
 - Data 105
 - Delivery ratio 703
 - Dredging 737
 - Flushing 737
 - Rating curve 106
 - Routing 734
 - Samplers 105
 - Yield 702
- Sedimentation index 687
- Seepage losses 576
- Selection of a gauging site 82
- Semi-variogram 73
- Sensitivity analysis in planning 541
- Separable cost, remaining benefits 387
- Shadow price 373
- Sigmoid function 174
- Siltation 409
- Simulation 337, 593, 652
 - Design of sampling strategy 341
 - Inputs of models 343
 - Outputs 344
 - Stochastic 494
 - Time management 340
- Site selection for a reservoir 561
- Slope-area method 92
- Small dams versus big dams 410
- Social impacts 442

- Socio-economic and agriculture data 109
- Softcore projects 21
- Soil adjusted vegetation index (SAVI) 139
- Solute 759
- Sorption-desorption 757
- Spatial consistency check 66
- Spatial resolution 131
- Spectral indices 138
- Spectral reflectance 132
- Spectral resolution 131
- Spectral signature 132
- SPOT program 129
- Springs 14
- Staff gauge 83
- Stage-discharge relationship 96
- Stakeholders 529
- Standard deviation 211
- Standard error of the estimate 213
- Station characteristics 74
- Stochastic optimization 314, 492
- Storage effectiveness index 631
- Storage yield analysis 584
- Storage zones in a reservoir 584, 625
- Stream gauging stations 81
- Stretched thread rule 590
- Sunk cost 357
- Sunshine duration 80
- Sustainability index 438
- Sustainable development 436 - 442
 Definition 437
 Issues in 440
- Synergistic gain 22
- System – definition 26
- System decomposition 536
- System engineering - reservoir management 650
- Systems analysis 27, 32
- Systems analysis techniques 29, 279-350
- Technology for meeting water needs 18
- Temperature and Humidity data 78
- Temporal resolution 132
- Tennessee Valley Authority 823
- Thames Water Authority 823
- The Mahaweli Authority 824
- The t-Test 238
- Thermal power generation 560
- Thermal sensors 127
- Three Gorges project 404, 409
- Time series 262 - 271
 Autoregressive integrated moving average 266
 Autoregressive models 264
 Autoregressive-moving average models 265
 Components 263
 Dependence 579
 Fitting of ARMA models 267
 Models 264
 Moving average models 265
 Partial autocorrelation function 266
 Porte Manteau lack of fit test 270
 Stationary process 264
 Yule-Walker equations 267
- Total annual cost 365
- Transformation techniques 220
- Transition probability matrix 272
- Transport of goods by water 10
- Transport of solutes in river 759
- Transportation problem 296
- Uncertainty 472
 Analysis 472
 Classification of 472
 Epistemic 473
 Intrinsic 473
 Sensitivity analysis 489
 Sources of 474
- Unit weight of deposited sediment 694
- Universal soil loss equation (USLE) 706
- U.S. Weather Bureau Class A pan 76
- Use of available water 619
- Use of flood storage 618
- Use of total storage 618
- Utility theory 361, 485
- Validation
 Hydrological 58
 Levels 56
 Primary 58
 Secondary 58

- Value of information 484
- Variance 211
- Vegetative measures 728
- Velocity-area method 86
- Visual image processing 135
- Vulnerability 464

- Water and ecosystems 11
- Water availability 13
- Water balance
 - India 17
 - Of a reservoir 576
 - World 17
- Water banks 795
- Water borne diseases 409
- Water changes 792
- Water demand and cost 359
- Water demand data 111
- Water demands -- future trends 10
- Water equivalent of snow 63
- Water in environment 397
- Water level recorder 84
- Water poverty index 26
- Water quality
 - Algae 104
 - Bacteria 104
 - Biological parameters 103
 - Catchment-scale models 772
 - Classification of river 749
 - Critical parameters 748
 - Index (WQI) 424
 - Lakes and reservoirs 775
 - Loading function 772
 - Monitoring 746
 - Organic compounds 102
 - pH 102
 - Standards 749
 - Toxic Metals 102
 - Viruses 105
- Water quality data 99
 - Color 99
 - Fungi 104
 - Hardness 101
 - Ionic species 101
 - Nitrogen 102
 - Non-ionic species 101
 - Odor 99
 - Temperature 99
 - Total dissolved solids 99
 - Turbidity 99
- Water requirements for irrigation 517
- Water resource information system 114
- Water resources – Ganga basin 17
- Water resources assessment 14
- Water resources data 48
 - Relation-oriented 50
 - Sources 52
 - Space-oriented 50
 - Time-oriented 50
 - Types of 48
 - Validation 55
- Water resources development 20
- Water resources management 21
- Water resources planning 19, 505 – 553
 - Stages 509, 512
- Water resources problems -- causes 13
- Water resources planning case studies
 - Egypt 549
 - North Atlantic regional study 545
 - Rio Colorado basin 545
 - Ganga-Brahmaputra-Barak study 545
- Water resources systems 26
 - Characteristics 30
 - Defined 30
 - Engineering 28
- Water rights 794
- Water sources 12
- Water use – categories 506
- Water use data 111
- Water withdrawal, consumption 8
- Watershed management to reduce soil erosion 728
- Watershed prioritization 731
- Weather radar 60
- Wind speed and direction 79
- Within year storage 608