Probability approaches to assessing the Instantaneous Minimum Criteria. (my hammer)

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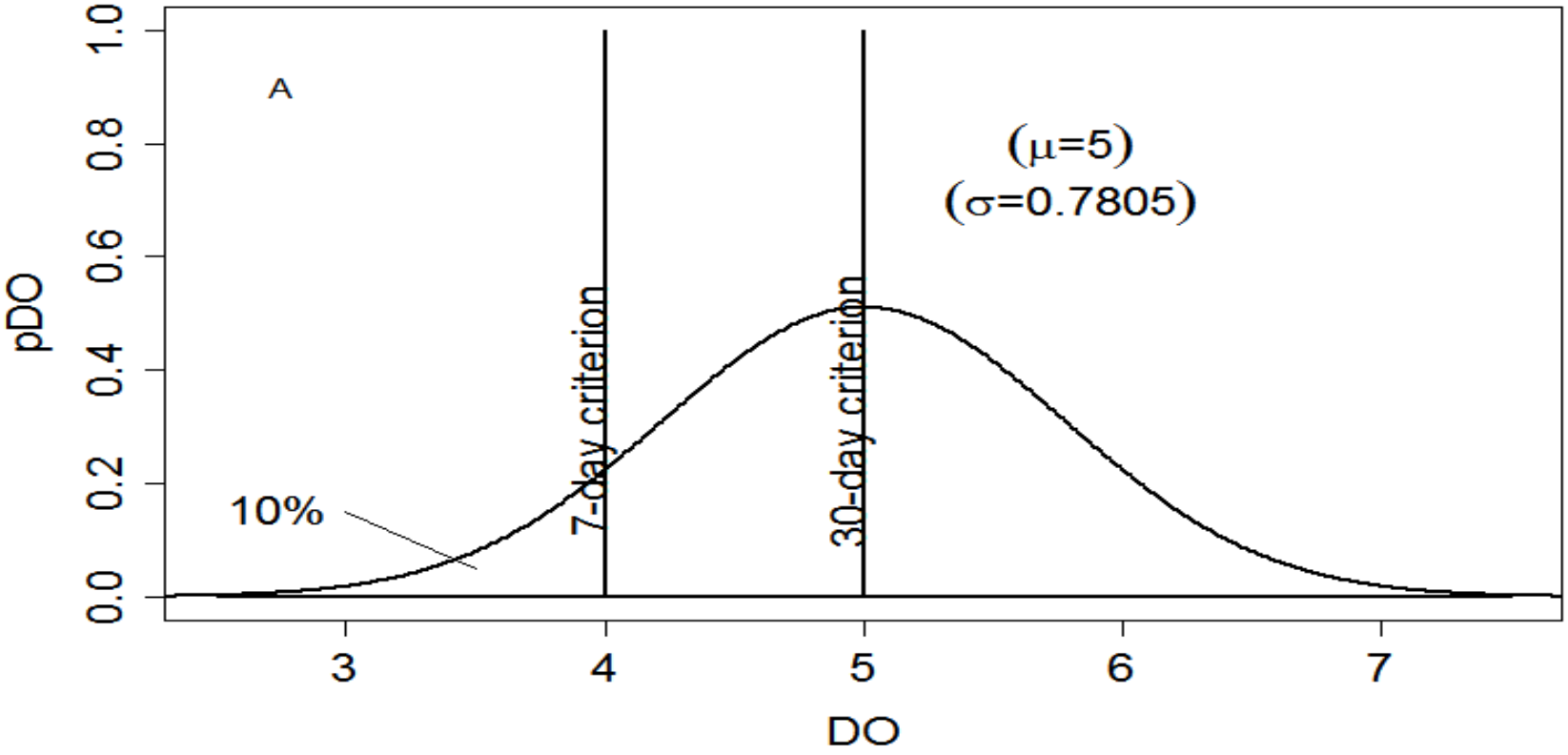
Two Part Talk

- Overview of methods
  - Simple distribution
  - Logistic regression
  - Spectral casting
  - Auto-regressive models
- Details on AR method with results

Estimating the standard deviation that creates an umbrella.



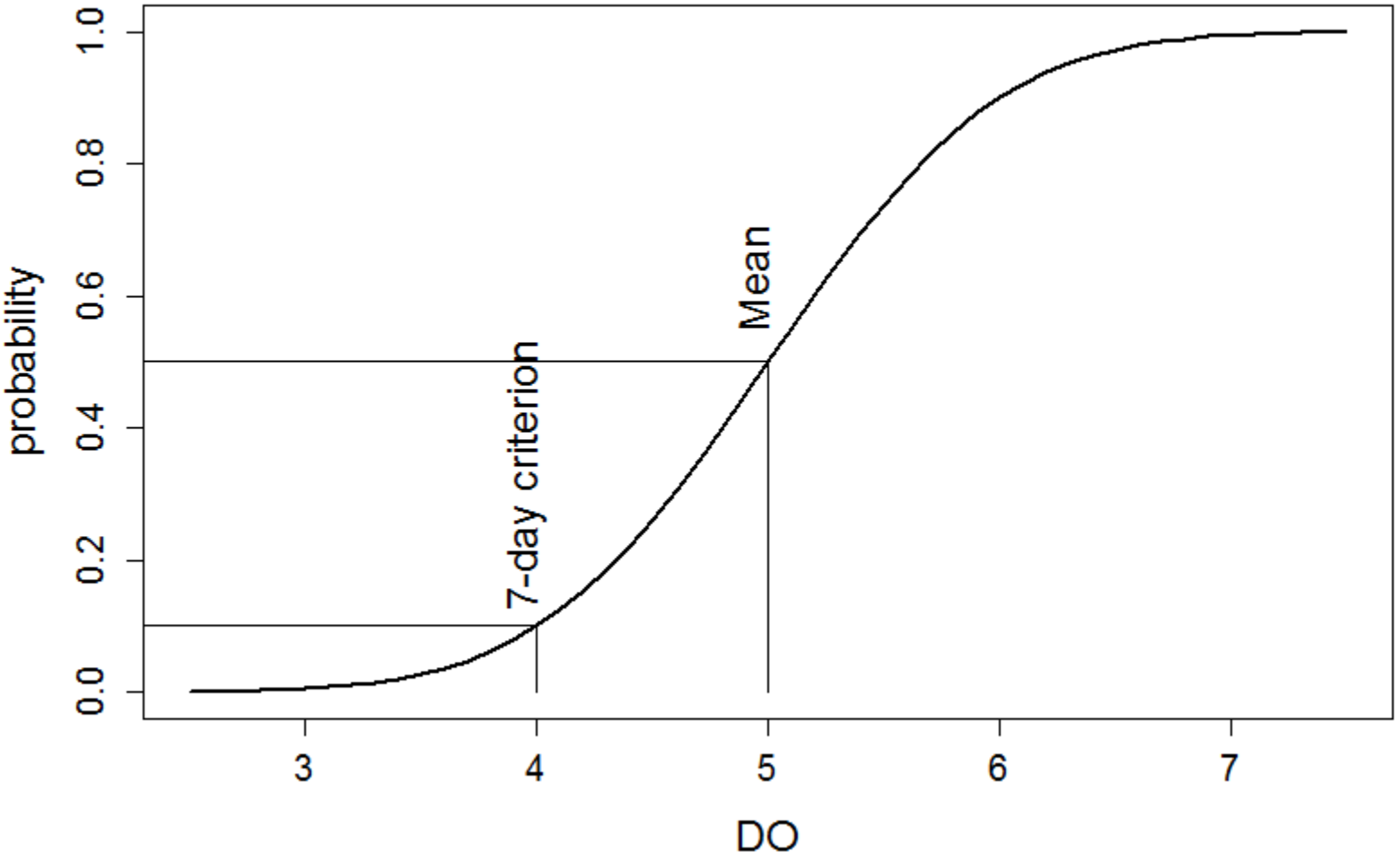
Risk of 7-day failure | 30-day

30-day mean DO	Prob(|sd=0.9649)	Prob(|sd=0.8439)
5.0	0.1500	0.1180
5.1	0.1271	0.0962
5.2	0.1068	0.0775
5.3	0.0889	0.0617
5.4	0.0734	0.0486
5.5	0.0600	0.0377

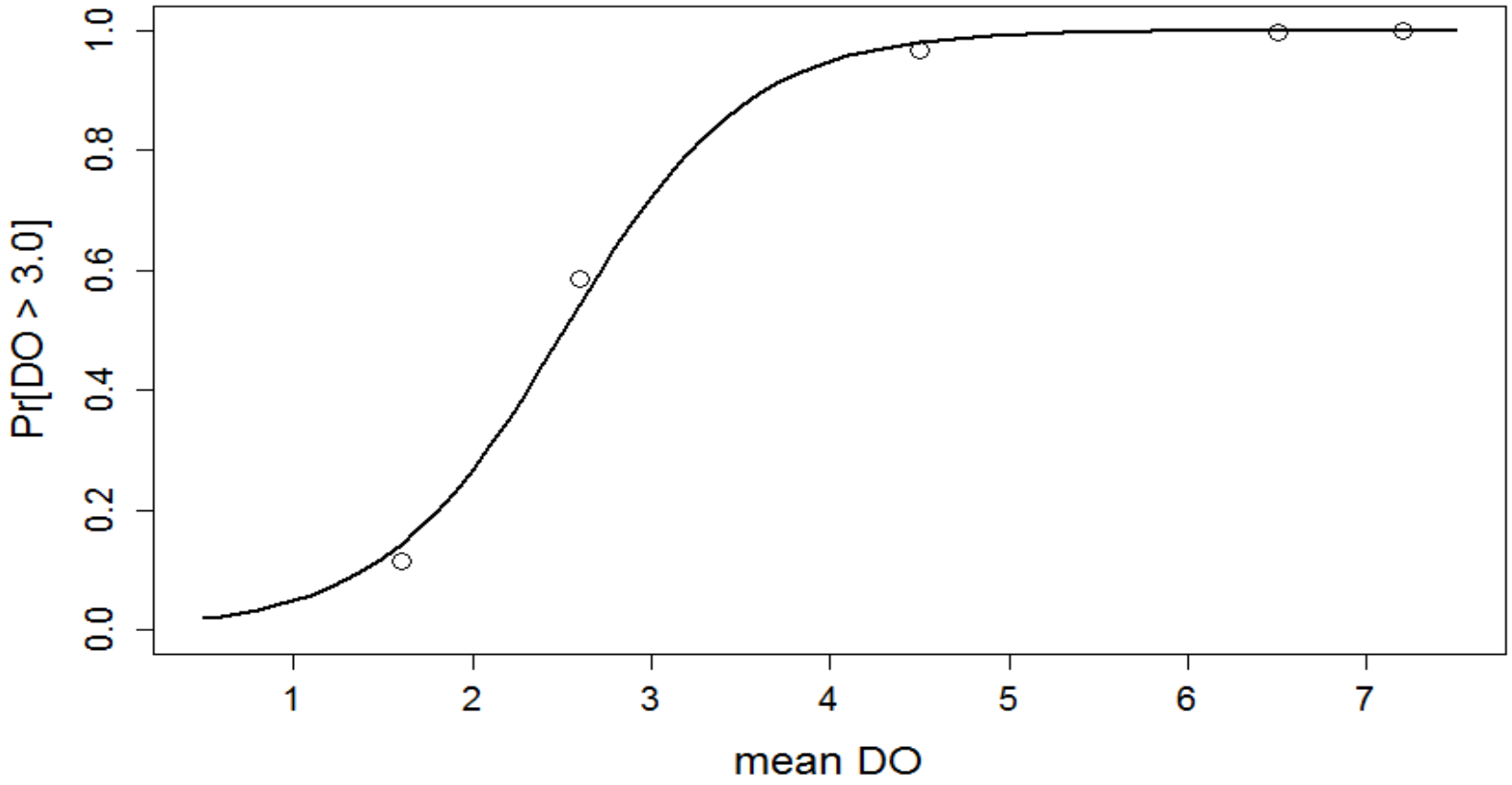
Risk of 7-day failure | 30-day with small sample uncertainty

Monthly Mean DO		SD=1.7358[2]	SD=1.6054[3]	SD=1.9287[4]
5.0	0.1598	0.2822	0.2666	0.3020
5.1	0.1368	0.2631	0.2466	0.2842
5.2	0.1162	0.2446	0.2273	0.2669
5.3	0.0979	0.2269	0.2090	0.2501
5.4	0.0818	0.2099	0.1915	0.2339
5.5	0.0677	0.1937	0.1750	0.2183
6.2	0.0142	0.1024	0.0852	0.1269
6.3	0.0110	0.0925	0.0759	0.1165

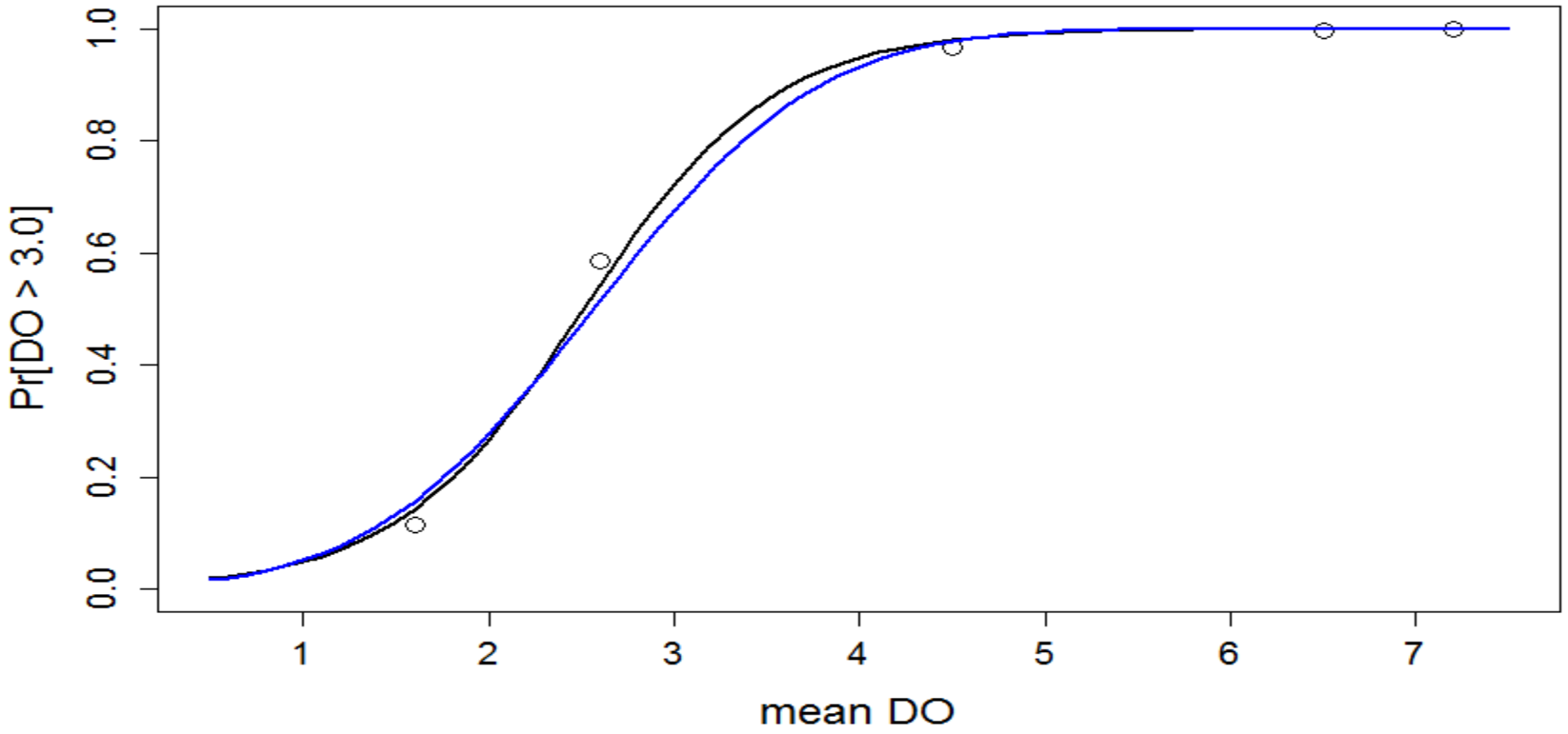
Cumulative Distribution



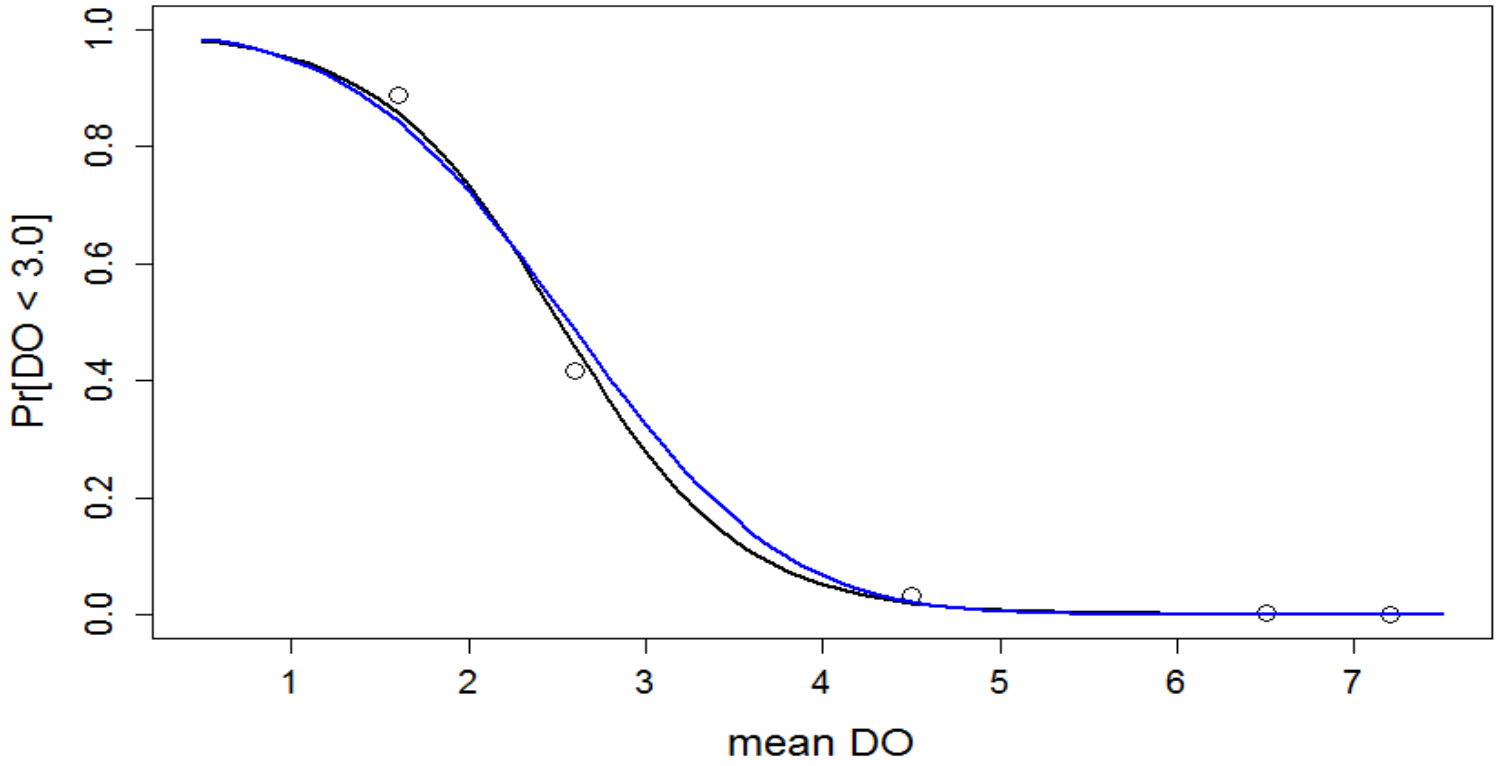
Logistic Regression



Logit - Probit



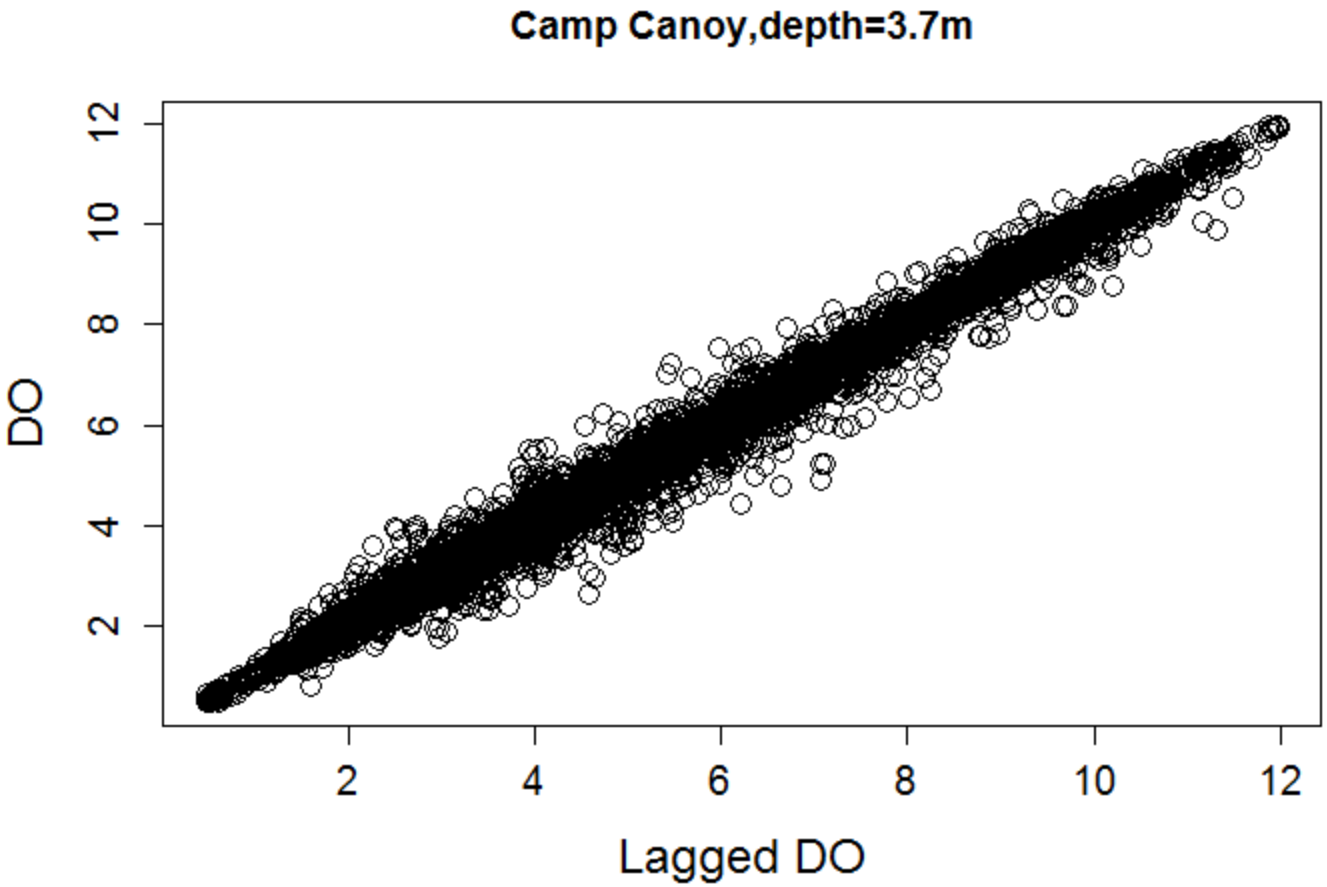
Inverted response



Simulation approaches to assessing Instantaneous Minimum Criterion

- Issue:
  - High degree of autocorrelation
  - Difficult to analytically obtain marginal EDF.
  - Use simulation
    - Spectral Casting
    - AutoRegressive model.

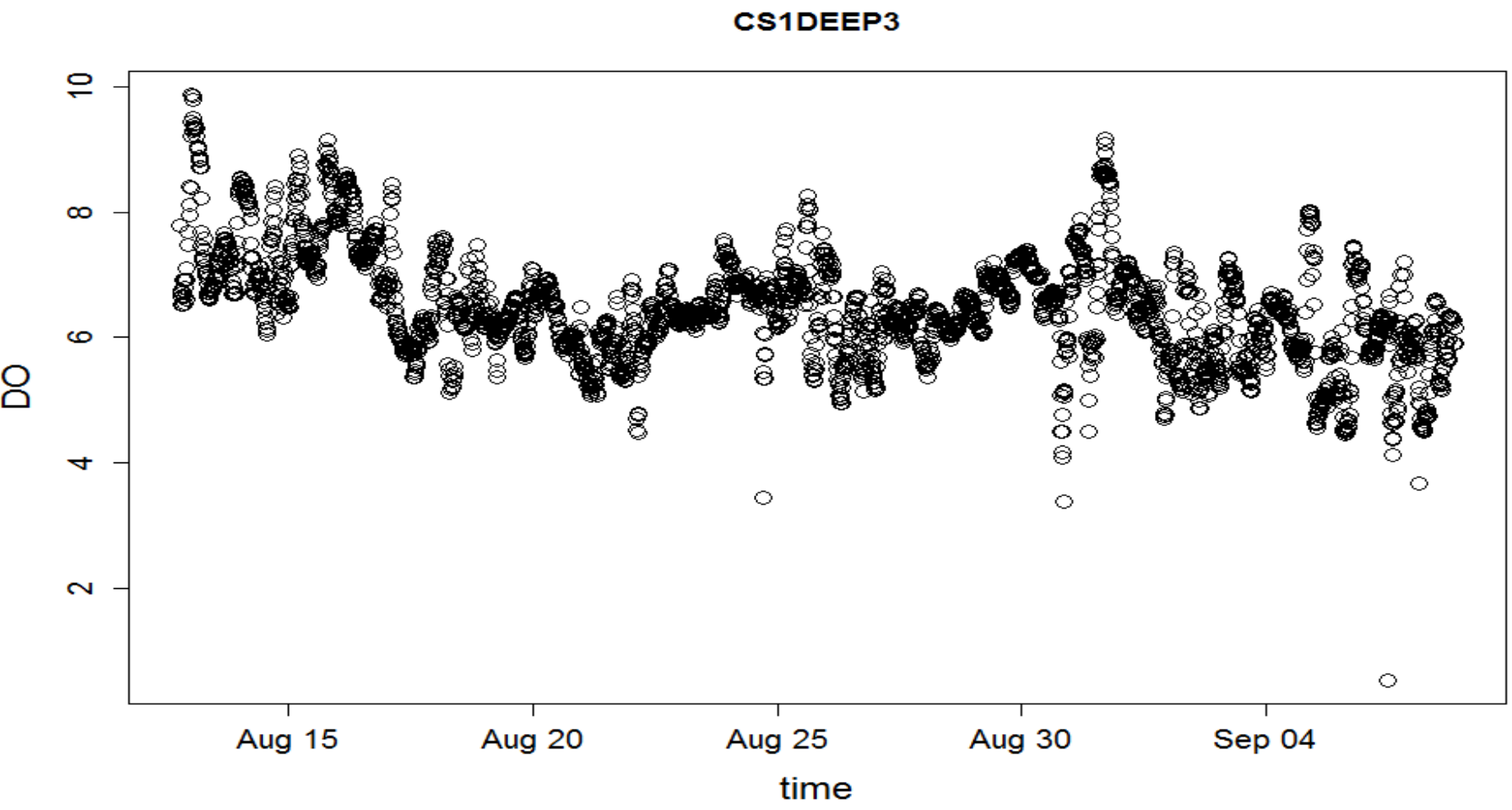
Near Continuous Data Autocorrelation



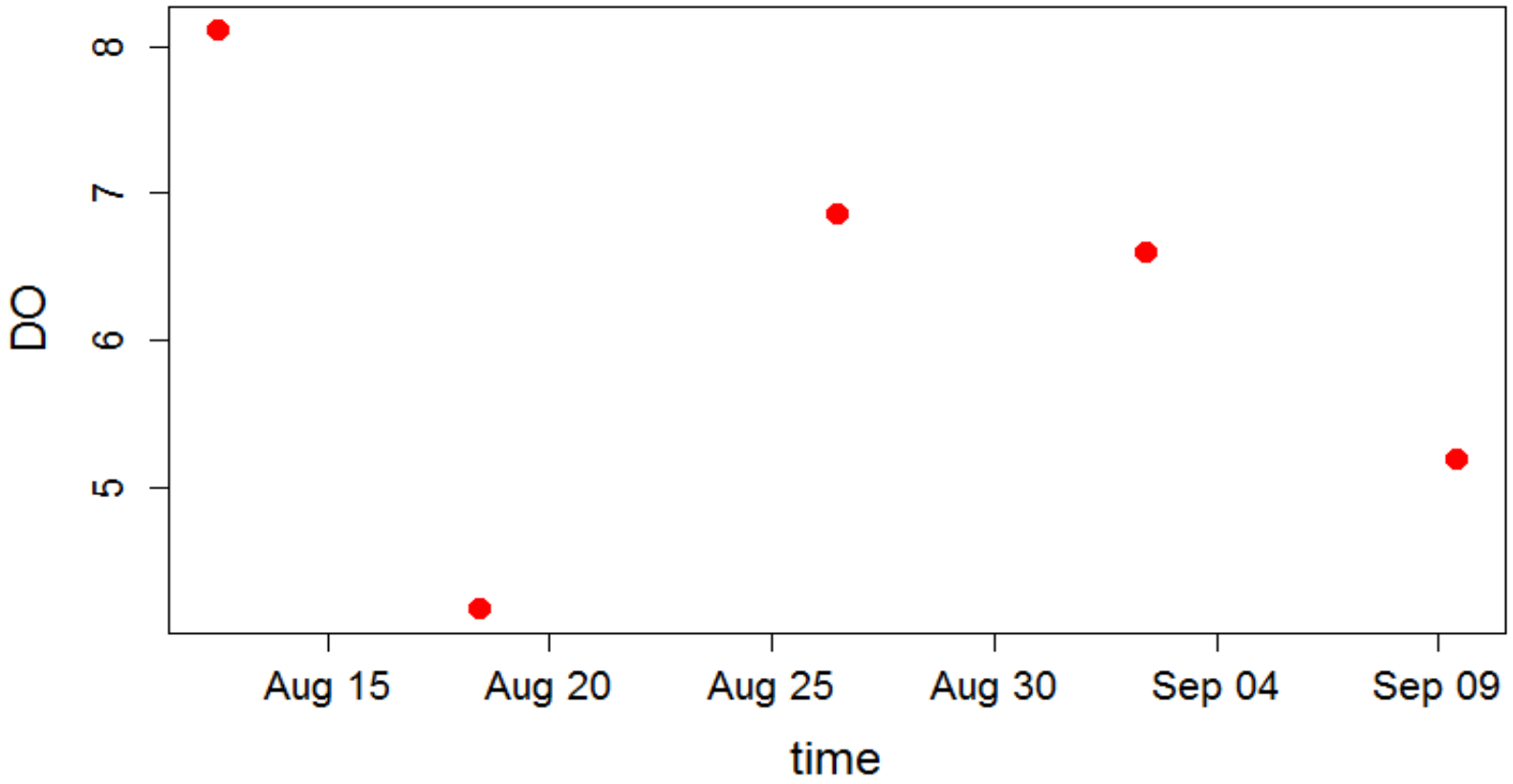
Spectral Casting

- Identify high frequency sending site
- Interpolate low frequency data at a receiving site.
- Superimpose detrended high frequency variation with low frequency interpolation to approximate high frequency distribution at receiving site.

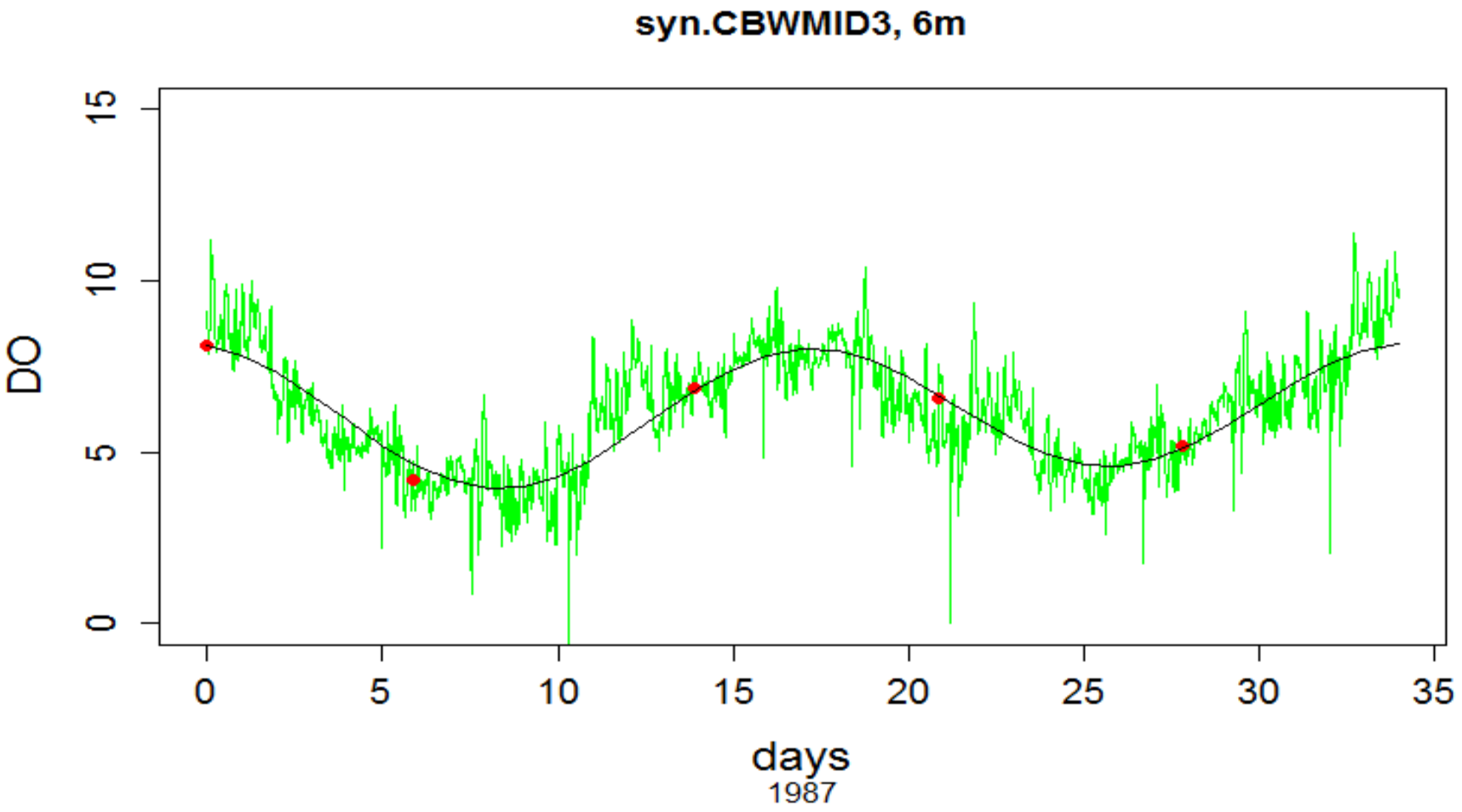
Sending Data



Receiving Site



Synthetic Data



AR(2) model

- Parse Buoy data into 1-week (or less) time series.
- Fit 7 parameter time series model to each location/week (n=251)
- Use MANOVA to estimate mean and V/C matrix for time- series parameter vectors.

2 step simulation

- First - simulate Vector of time-series parameters – based on multivariate normal mean and V/C matrix.

- Second – simulate a one-week time-series based on Vector from step 1.

Time-Series Model – 7 parameters

b_Int - the intercept,
b_cday - linear trend term,
b_sin, b_cos - diel trend coefficients
b_ar1,b_ar2 - autoregressive terms
mse - residual mean square error

MANOVA of Time-Series Vectors – Just CB4

(b_int,b_cday,b_sin,b_cos,b_AR1,b_AR2,mse)

Source	Pillai's Trace	Pr > F
month	1.9229	<.0001
TotDep	0.6465	<.0001
SampDep	0.5022	<.0001

Vector Mean for DO > 5.0

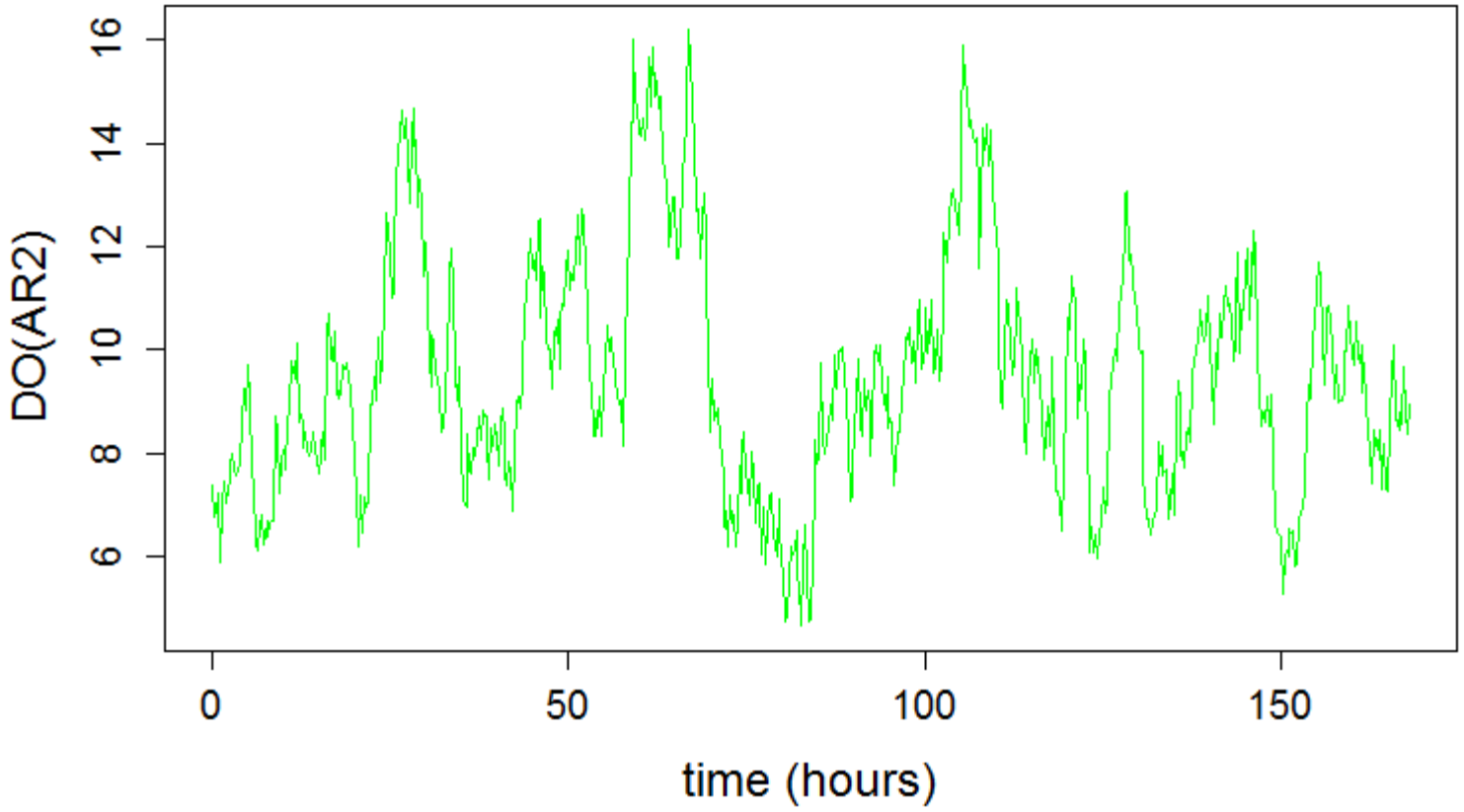
May	Jun	Jul	Aug	Sep	Oct	WaterDepth	SensorDepth
0	0	1	0	0	0	10	6

b_Int	b_cday	b_sin	b_cos	b_AR1	b_AR2	mse
5.0058	-0.0493	-0.4072	-0.0527	0.9333	-0.0319	0.3164

Adjusting mean DO

Sensor Depth	b_Int	b_cday	b_sin	b_cos	b_AR1	b_AR2	mse
6	5.0058	-0.0493	-0.4072	-0.0527	0.9333	-0.0319	0.3164
5	5.6733	-0.0476	-0.5114	0.0094	0.9328	-0.0294	0.4112
4	6.3408	-0.0460	-0.6156	0.0714	0.9324	-0.0268	0.5060
3	7.0082	-0.0443	-0.7198	0.1335	0.9320	-0.0243	0.6008

DO simulated by AR(2)



		7-day mean >= 4.0	7-day mean < 4.0	row marginal
Table 10a. Sensor Depth = 6 mean DO = 5.0058	failure Instantaneous minimum < 10%	542 65.86 %	9 5.08 %	551 55.1 %
	failure Instantaneous minimum > 10%	281 34.14 %	168 94.9 %	449 44.9 %
	column marginal	823 100%	177 100%	1000 100%

		7-day mean >= 4.0	7-day mean < 4.0	row marginal
Table 10b. Sensor Depth = 5 mean DO = 5.6733	failure Instantaneous minimum < 10%	656 69.42 %	1 1.8 %	657 65.7 %
	failure Instantaneous minimum > 10%	289 30.58 %	54 98.2 %	343 34.3 %
	column marginal	945 100%	55 100%	1000 100%

		7-day mean >= 4.0	7-day mean < 4.0	row marginal
Table 10d. Sensor Depth = 3 mean DO = 7.0082	failure Instantaneous minimum < 10%	834 83.6 %	0 0 %	834 83.4 %
	failure Instantaneous minimum > 10%	164 16.4 %	2 100 %	166 16.6 %
	column marginal	998 100%	2 100%	1000 100%