Estimating the Fair Insurance Premium for Dungeness Crab Yields in the Western U.S. Coast

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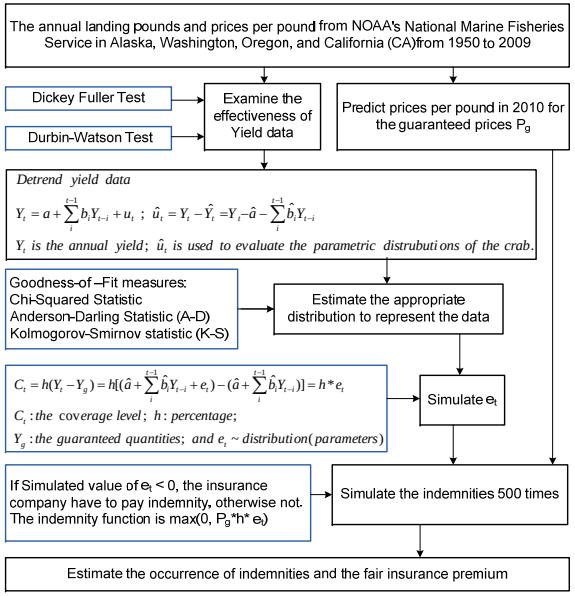
Introduction and Motivation

The Dungeness is a popular food and the most commercially important crab in the western states in the U.S. Like all agricultural production, the crab fisherman face yield risks and must manage these risks. In addition to weather risk, crab fisherman may experience low yields if the crabs are over fished in previous years. Farmers for many traditional agricultural crops can purchase crop insurance to insure against low yields. However, crab fishermen at this time do not have this option. The purpose of this paper is to estimate a fair insurance premium based on the historical yields of the Dungeness crab. This information can then be used in risk/return models for crab fishing to determine if it would be optimal for fisherman to purchase crop insurance.

An important input into the fair insurance premium estimation is the yield distribution. Sherrick et al. estimated alternative yield distributions to evaluate traditional crop insurance. However, no one has looked at the yield distributions for the Dungeness crab nor explored possible crop insurance. Much of the past literature for the fishing industry has focused on production functions, cost function models, and optimal catching yields for specific fish species. Moreover, most research has focused on the endangered commercial ocean species such as tuna and swordfish.

Data and Method



Results

Table 1. Yield Data Summaries, 1950-2009

State	obs.(n)	Time Series Data Mean	Std. Dev.	Skewness	kurtosis	Detrended Data Mean	Std. Dev.	Skewness	kurtosis
Alaska	59	6,518,320	3,443,387	0.73	0.04	0	2,436,552	1.14	2.19
Washington	58	12,728,635	7,213,322	0.93	0.38	0	4,947,707	0.60	0.95
Oregon	59	10,685,030	6,048,295	1.47	2.80	0	4,943,273	1.21	2.49
California	59	10,564,518	6,308,023	1.16	2.35	0	5,786,362	1.21	2.34
Average	58.75	10,124,126	5,753,257	1.07	1.39	0	4,528,474	1.04	1.99
Minimum	58	6,518,320	3,443,387	0.73	0.04	0	2,436,552	0.60	0.95
Maximum	59	12,728,635	7,213,322	1.47	2.80	0	5,786,362	1.21	2.49

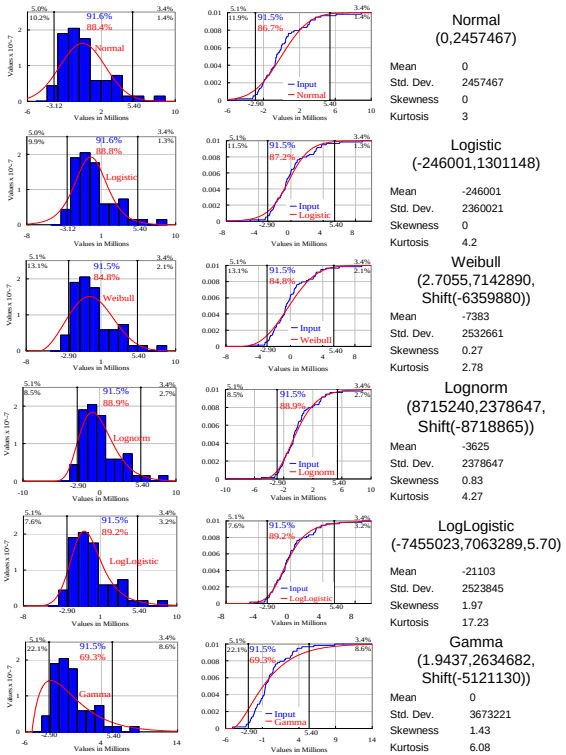


Figure 1. Probability and cumulative distribution functions and empirical distribution for *Dungeness crab* detrended yield data in Alaska, 1950-2009

Table 2. Goodness-of –Fit measures and Ranking of Alternative Distributions

States	Tests	Distributions and ranks: LogLogistic	Lognormal	Logistic	Normal	Weibull	Gamma
Alaska	Chi-Square	1	2	3	4	5	6
	A-D statistic	1	2	3	5	4	6
	K-S Statistic	1	2	3	5	4	6
	Sum	3	6	9	14	13	18
	Rank	**1**	**2**	**3**	**5**	**4**	**6**
Washington	Chi-Square	4	5	3	1	2	6
	A-D statistic	4	1	2	6	5	3
	K-S Statistic	2	3	1	6	5	4
	sum	10	9	6	13	12	13
	rank	**3**	**2**	**1**	**5**	**4**	**5**
Oregon	Chi-Square	1	3	2	5	4	6
	A-D statistic	1	2	3	5	4	6
	K-S Statistic	1	3	2	5	4	6
	sum	3	8	7	15	12	18
	rank	**1**	**3**	**2**	**5**	**4**	**6**
California	Chi-Square	1	2	5	3	4	6
	A-D statistic	2	1	4	5	3	6
	K-S Statistic	1	2	4	5	3	6
	sum	4	5	13	13	10	18
	rank	**1**	**2**	**4**	**4**	**3**	**6**
The industry	sum	20	28	35	55	47	67
	rank	**1**	**2**	**3**	**5**	**4**	**6**

Table3. The result of 500 simulated indemnities for the crab industry supposed the insurance company compensates 80, 70, 60, and 50% of loss

States		Alaska	Washington	Oregon	California
The fitted distributions		LogLogistic	Logistic	LogLogistic	LogLogistic
The fair insurance premium	80%	1,380,924	702,344	2,823,855	3,470,998
	70%	1,208,531	615,453	2,471,322	3,037,152
	60%	1036812	526,962	2,120,126	2,604,553
	50%	863,454	439,135	1,765,671	2,169,759
The occurrence of indemnities	80%	57.6%	74.8%	57.4%	58.8%
	70%	57.6%	74.6%	57.2%	58.8%
	60%	57.6%	74.8%	57.4%	58.6%
	50%	57.6%	74.8%	57.4%	58.8%

Conclusion

The detrended yields of each state have positive skweness. They are very different from the negative skewness of the crop yields. Further, goodness-fit- measures indicated that the Gamma and normal fail to describe the sample data. The loglogistic distribution is best to estimate the indemnities of Alaska, Oregon, and California respectively while the logistic is best for Washington. If the insurance compensates 80, 70, 60, 50% of loss yields, we find that the occurrence of indemnities is over 50%.

References

Bruce J. S., C.Z. Fabio, D. S. Gary, and H. I. Scott. "Crop Insurance Valuation under Alternative Yield Distribution." *American Journal of Agricultural Economics* 86(May,2004) 406-419.