Chapter 4

Regression Analysis and Forecasting

In Chapter 3 we examined the time series of daily marine fish catches at Pattani Fishery Port, over the period from January 1999 to December 2003, and compared them separately by day of week, month of year, and year. The objective in this chapter is to develop an appropriate statistical model for describing the marine fish catches, and to forecast the quantity of marine fish catches using these models.

In Section 4.1 we use multiple regressions to fit models to the transformed daily marine fish catches using the day of week, month of year, and year as joint categorical determinants. In Section 4.2 we fit multiple regression models to the transformed marine fish catches based on the monthly totals. In Section 4.3 we show the monthly marine fish catches as time series plots together with forecasts for each marine fish type.

4.1 Linear regression models of marine fish catches by day, month and year

In this section we fit linear regression models to the transformed daily marine fish catches with the day of the week, the month of the year and the year. Monday was treated as the baseline for day, January was treated as the baseline for month and 1999 was treated as the baseline for year.

Table 4.1 shows coefficients for days, months and years with their corresponding standard errors and overall p-values after fitting the regression model to the cube roots of the mackerel catches. There are differences in the coefficients on different days of the week with the highest on Friday and the lowest on Thursday. There are also monthly differences, with lows in December, January and March and peaks in September and October. The coefficients also decrease consistently with year. The r-squared is 11%.

Determinant	*Coefficient*	*St. Error*	*p-value*
Constant	29.5317	0.7781	
Day (baseline: Monday)			0.0000
Tuesday	-0.4296	0.6127	
Wednesday	-1.9296	0.6115	
Thursday	-2.3705	0.6122	
Friday	1.1013	0.6121	
Saturday	-1.7565	0.6152	
Sunday	0.9900	0.6121	
Month (baseline: January)			0.0000
February	2.8070	0.8284	
March	0.2494	0.8092	
April	2.3501	0.8133	
May	1.7120	0.7988	
June	3.2313	0.8065	
July	3.4396	0.8040	
August	3.3893	0.7988	
September	4.7209	0.8065	
October	4.9759	0.8027	
November	1.8704	0.8092	
December	-0.7801	0.8193	
Year (baseline: 1999)			0.0000
2000	0.9794	0.5181	
2001	-0.5135	0.5207	
2002	-1.2423	0.5200	
2003	-1.9267	0.5188	
r-squared: 0.110 df: 1743 RSS: 82,420.08 s: 6.8765			

Table 4.1: Linear regression model for cube root of mackerel catch

Table 4.2 shows coefficients for days, months and years with their corresponding standard errors and p-values after fitting the regression model to cube roots of the other food fish catches. There are differences in the coefficients on different days of the week with the highest on Friday and the lowest on Sunday. There are also monthly differences, with lows in December, January and February and peaks in September and October. The coefficients also increase with year at first and then decrease. The r-squared is 17%.

Determinant	*Coefficient*	*St. Error*	*p-value*
Constant	54.8564	1.2408	
Day (baseline: Monday)			0.0000
Tuesday	1.2698	0.9794	
Wednesday	-0.5100	0.9775	
Thursday	-3.6882	0.9766	
Friday	2.4903	0.9775	
Saturday	-3.7111	0.9834	
Sunday	-6.1061	0.9765	
Month (baseline: January)			0.0000
February	0.5005	1.3212	
March	1.2380	1.2869	
April	5.1532	1.2976	
May	3.3731	1.2787	
June	3.8899	1.2889	
July	3.9889	1.2807	
August	4.9803	1.2787	
September	8.1344	1.2911	
October	6.8427	1.2848	
November	0.6504	1.2932	
December	-4.7926	1.2999	
Year (baseline: 1999)			0.0000
2000	3.6017	0.8263	
2001	0.1889	0.8281	
2002	-0.5585	0.8281	
2003	-3.8409	0.8287	
r-squared: 0.172 df: 1763 RSS: 215,152.59 s: 11.0471			

Table 4.2: Linear regression model for cube root of other food fish catch

Table 4.3 shows coefficients for days, months and years with their corresponding standard errors and p-values after fitting regression model to the cube roots of the squid catches. There are differences in the coefficients on different days of the week with the highest on Thursday and the lowest on Saturday. There are also monthly differences, with lows in November, December and January and peaks in July and September. The coefficients generally decrease with year. The r-squared is 14%.

Determinant	*Coefficient*	*St. Error*	*p-value*
Constant	25.4655	0.7630	
Day (baseline: Monday)			0.0000
Tuesday	1.6804	0.5856	
Wednesday	1.7048	0.6047	
Thursday	3.0184	0.6000	
Friday	1.1354	0.5908	
Saturday	-2.5140	0.6053	
Sunday	0.7285	0.5990	
Month (baseline: January)			0.0025
February	0.6231	0.8208	
March	0.2548	0.8001	
April	0.7139	0.8246	
May	0.8897	0.7869	
June	0.9061	0.7815	
July	2.4539	0.7902	
August	1.7054	0.7766	
September	1.8724	0.7926	
October	1.6238	0.7926	
November	-0.4165	0.7858	
December	-0.2096	0.8099	
Year (baseline: 1999)			0.0000
2000	-2.1987	0.5108	
2001	-1.7960	0.5044	
2002	-2.3456	0.5063	
2003	-5.9731	0.5205	
r-squared: 0.142 df: 1545 RSS: 62,484.47 s: 6.3595			

Table 4.3: Linear regression model for cube root of squid catch

Table 4.4 shows coefficients for days, months and years with their corresponding standard errors and p-values after fitting regression model to the cube roots of scads catches. There are differences in the coefficients on different days of the week with the highest on Friday and the lowest on Saturday. There are also monthly differences, with lows in March, January and December and peaks in September and October. The coefficients generally increase with year. The r-squared is 26%.

Determinant	*Coefficient*	*St. Error*	*p-value*
Constant	36.8650	1.3018	
Day (baseline: Monday)			0.0000
Tuesday	1.0558	1.0171	
Wednesday	0.5821	1.0142	
Thursday	0.4748	1.0172	
Friday	1.4450	1.0161	
Saturday	-3.4814	1.0213	
Sunday	0.2507	1.0192	
Month (baseline: January)			0.0000
February	4.2310	1.3791	
March	-1.7863	1.3496	
April	4.1097	1.3541	
May	5.0957	1.3321	
June	7.1986	1.3428	
July	10.7304	1.3322	
August	13.8007	1.3321	
September	18.2504	1.3428	
October	14.6221	1.3406	
November	6.2892	1.3494	
December	1.0174	1.3590	
Year (baseline: 1999)			0.0000
2000	3.5476	0.8634	
2001	4.7515	0.8647	
2002	7.7665	0.8655	
2003	5.8650	0.8640	
r-squared: 0.2573 df: 1741 RSS: 227,321.81 s: 11.4267			

Table 4.4: Linear regression model for cube root of scads catch

Table 4.5 shows coefficients for days, months and years with their corresponding standard errors and p-values after fitting regression model to the cube roots of trash fish catches. There are differences in the coefficients on different days of the week with the highest on Tuesday and the lowest on Saturday. There are also monthly differences, with lows in December, February and January and peaks in September and October. The coefficients also decrease with year at first to a minimum in 2001, and then increase to a lesser extent. The r-squared is 57%.

Determinant	*Coefficient*	*St. Error*	*p-value*
Constant	40.0462	0.7985	
Day (baseline: Monday)			0.3631
Tuesday	1.1439	0.6302	
Wednesday	0.6368	0.6290	
Thursday	0.3746	0.6284	
Friday	0.7934	0.6290	
Saturday	-0.0384	0.6309	
Sunday	-0.0299	0.6277	
Month (baseline: January)			0.0000
February	-1.2549	0.8430	
March	2.6573	0.8272	
April	9.8429	0.8341	
May	10.5013	0.8220	
June	11.2911	0.8286	
July	13.5464	0.8246	
August	14.4940	0.8220	
September	23.1887	0.8299	
October	20.9236	0.8259	
November	9.0694	0.8341	
December	-1.4989	0.8328	
Year (baseline: 1999)			0.0000
2000	-3.9676	0.5323	
2001	-7.3930	0.5320	
2002	-3.8132	0.5320	
2003	-5.2863	0.5335	
r-squared: 0.5735 df: 1766 RSS: 89,062.28 s: 7.1015			

Table 4.5: Linear regression model for cube root of trash fish catch

Table 4.6 shows coefficients for days, months and years with their corresponding standard errors and p-values after fitting regression model to the logarithms of the shrimp catches. There are differences in the coefficients on different days of the week with the highest on Wednesday and the lowest on Friday. There are also monthly differences, with lows in March, February and December and peaks in April and September. The coefficients also decrease after one year and then level out.

The r-squared is 24%.

Determinant	*Coefficient*	*St. Error*	*p-value*
Constant	7.0372	0.2327	
Day (baseline: Monday)			0.0000
Tuesday	-0.0868	0.1991	
Wednesday	0.6624	0.1806	
Thursday	-0.0221	0.1928	
Friday	-0.1613	0.2100	
Saturday	-0.0450	0.1733	
Sunday	0.2141	0.1989	
Month (baseline: January)			0.0210
February	-0.5037	0.2279	
March	-0.5955	0.2316	
April	0.1530	0.2420	
May	-0.0839	0.2300	
June	-0.1159	0.2235	
July	-0.1866	0.2472	
August	-0.1100	0.2381	
September	0.0146	0.2472	
October	-0.1707	0.2633	
November	-0.3338	0.2557	
December	-0.4656	0.2452	
Year (baseline: 1999)			0.0000
2000	-0.7428	0.1286	
2001	-0.7657	0.1423	
2002	-0.4929	0.1815	
2003	-0.8377	0.2114	
r-squared: 0.2401 df: 356 RSS: 286.62 s: 0.8973			

Table 4.6: Linear regression model for logarithms of shrimp catch

Table 4.7 shows coefficients for days, months and years with their corresponding standard errors and p-values after fitting the regression model to the logarithms of the lobster catches. There are differences in the coefficients on different days of the week with the highest on Thursday and the lowest on Sunday. There are also monthly differences, with lows in December, July and November and peaks in January and June. The coefficients also decrease consistently with year. The r-squared is 22%.

Determinant	*Coefficient*	*St. Error*	*p-value*
Constant	6.5600	0.1819	
Day (baseline: Monday)			0.0071
Tuesday	0.2988	0.1614	
Wednesday	0.2886	0.1546	
Thursday	0.5810	0.1720	
Friday	0.2343	0.1524	
Saturday	0.1643	0.1656	
Sunday	-0.0495	0.1940	
Month (baseline: January)			0.0346
February	-0.2244	0.1735	
March	-0.1649	0.1709	
April	-0.1334	0.1786	
May	-0.2168	0.1671	
June	0.1349	0.1691	
July	-0.3597	0.1845	
August	-0.2257	0.1774	
September	-0.1566	0.1775	
October	-0.0199	0.1810	
November	-0.3559	0.1712	
December	-0.5010	0.1780	
Year (baseline: 1999)			0.0000
2000	-0.8044	0.1013	
2001	-0.9035	0.1093	
2002	-1.1215	0.1238	
2003	-1.2137	0.1379	
r-squared: 0.2162 df: 697 RSS: 652.79 s: 0.9678			

Table 4.7: Linear regression model for logarithms of lobster catch

Table 4.8 shows coefficients for days, months and years with their corresponding standard errors and p-values after fitting regression model to the logarithms of the crab catches. There are differences in the coefficients on different days of the week with the highest on Sunday and the lowest on Wednesday. There are also monthly differences, with lows in December and peaks in June. The coefficients decrease with year at first to a minimum in 2000, and then increase to a lesser extent. The r-squared is 22%.

Determinant	*Coefficient*	*St. Error*	*p-value*
Constant	7.1268	0.1727	
Day (baseline: Monday)			0.0000
Tuesday	0.7291	0.1470	
Wednesday	-0.2844	0.1520	
Thursday	-0.1265	0.1771	
Friday	-0.0195	0.1446	
Saturday	-0.0658	0.1557	
Sunday	0.9466	0.1552	
Month (baseline: January)			0.0221
February	-0.2745	0.1712	
March	-0.0863	0.1714	
April	-0.0808	0.1789	
May	-0.1250	0.1641	
June	0.1807	0.1638	
July	0.0605	0.1769	
August	-0.1044	0.1796	
September	0.0359	0.1709	
October	0.0679	0.1700	
November	-0.2418	0.1723	
December	-0.4585	0.1760	
Year (baseline: 1999)			0.0000
2000	-0.7192	0.1027	
2001	-0.5975	0.1104	
2002	-0.5149	0.1137	
2003	-0.5868	0.1211	
r-squared: 0.2162 df: 875 RSS: 978.73 s: 1.0576			

Table 4.8: Linear regression model for logarithms of crab catch

4.2 Trend+seasonal models of monthly marine fish catches

In this section we fit linear regression models of the form $y_t = a_t + bt$, where y_t is the transformed marine fish catch t months after December 1998 and a_t is a monthly seasonal effect. This type of model is call a *trend+seasonal* model and is useful for forecasting purposes. The total catch weights in each month are transformed using square roots for the marine fish and logarithms for the shellfish, based on the findings reported in Chapter 3.

Table 4.9 shows coefficients, standard errors and p-values from a fitted trend+seasonal model fitted to the square roots of mackerel catches. Both the trend and the seasonal effect are statistically significant. The negative estimate for the trend indicates that the quantity of mackerel catches has a decreasing trend. The seasonal effect has a minimum during the four months from December to March, rising to a maximum in September and October.

Determinant	*Coefficient*	*St Error*	*p-value*
Constant	940.0182	47.2512	0.0000
Trend (t)	-1.5715	0.7531	0.0425
Month (baseline: January)			0.0000
February	-14.1288	65.2213	
March	12.9332	61.3086	
April	101.8023	61.3317	
May	104.9206	61.3641	
June	156.3462	61.4056	
July	173.0609	61.4564	
August	185.0392	61.5164	
September	254.7031	61.5855	
October	253.2849	61.6637	
November	96.6679	61.7510	
December	-28.9344	61.8474	
r-squared: 0.5646 df: 46 RSS: 431,994.76 s: 96.9082			

Table 4.9: Trend+seasonal model for square roots of mackerel catch

Table 4.10 shows coefficients, standard errors and p-values from a fitted trend+seasonal model fitted to the square roots of other food fish catches. Both the trend and the seasonal effect are statistically significant. The negative coefficient for the trend indicates that the other food fish catches decreased over the five-year period. The seasonal effect has a minimum during the three months from December to February, rising to a maximum in September and October.

Determinant	*Coefficient*	*St Error*	*p-value*
Constant	2,449.0300	106.1795	0.0000
Trend (*t*)	-6.8489	1.6621	0.0002
Month (baseline: January)			0.0000
February	-75.5377	138.1945	
March	105.7869	138.2245	
April	330.9068	138.2744	
May	278.0951	138.3443	
June	267.6101	138.4342	
July	300.1880	138.5439	
August	404.4107	138.6734	
September	544.5767	138.8227	
October	518.1272	138.9918	
November	133.3908	139.1805	
December	-212.2368	139.3887	
r-squared: 0.6217 df: 47 RSS: 2,243,656.69 s: 218.4888			

Table 4.10: Trend+seasonal model for square roots of other food fish catch

Table 4.11 shows coefficients, standard errors and p-values from a fitted trend+seasonal model fitted to the square roots of squid catches. The trend is statistically significant but the seasonal effect is not statistically significant. The negative estimate for the trend indicates that the quantity of squid catches decreased over the period. When the seasonal component in the model is omitted, the r-squared decreases substantially, as shown in the lower panel of the figure.

Table 4.12 shows coefficients, standard errors and p-values from a fitted trend+seasonal model fitted to the square roots of scads catches. Both the trend and the seasonal effect are statistically significant. The positive estimate for the trend indicates that the scads catches increased. The seasonal effect has a minimum in March and December, rising to a maximum in September and October.

Determinant	*Coefficient*	*St Error*	*p-value*
Constant	744.7592	38.7697	0.0000
Trend (t)	-3.3701	0.6069	0.0000
Month (baseline: January)			0.1087
February	0.5246	50.4594	
March	36.8274	50.4704	
April	21.2349	50.4886	
May	68.3295	50.5142	
June	91.6950	50.5470	
July	138.9775	50.5870	
August	98.7132	53.6848	
September	112.7481	50.6888	
October	114.2433	50.7506	
November	53.1553	50.8195	
December	37.3677	50.8955	
r-squared: 0.4973 df: 46 RSS: 292,765.49 s: 79.7776			

Determinant	*Coefficient*	*St Error*	*p-value*
Constant	803.0827	23.0719	0.0000
Trend (t)	-3.0749	0.6578	0.0000
r-squared: 0.2736 df: 58 RSS: 451,631.31 s: 88.2425			

Table 4.11: Trend+seasonal and reduced models for square roots of squid catch

Determinant	*Coefficient*	*St Error*	*p-value*
Constant	1,391.46	118.4630	0.0000
Trend (t)	7.8559	1.8544	0.0001
Month (baseline: January)			0.0000
February	102.3692	154.1816	
March	-101.9062	154.2151	
April	173.4724	154.2708	
May	305.9392	154.3488	
June	389.3581	154.4490	
July	595.2400	154.5714	
August	785.4849	154.7160	
September	1,027.8600	154.8826	
October	837.9930	155.0712	
November	287.8482	155.2817	
December	-43.7606	155.5140	
r-squared: 0.4973 df: 46 RSS: 292,765.49 s: 79.7776			

Table 4.12: Trend+seasonal model for square roots of scads catch

Table 4.13 shows coefficients, standard errors and p-values from a fitted trend+seasonal model fitted to the square roots of trash fish catches. The trend is not statistically significant but the seasonal effect is statistically significant. The seasonal effect has a minimum during the three months from December to February, rising to a maximum in September and October. The lower panel shows the reduced model after omitting the trend. The r-squared is only slightly reduced.

Determinant	*Coefficient*	*St Error*	*p-value*
Constant	1,343.3200	180.4689	0.0000
Trend (*t*)	-4.3466	2.8250	0.1306
Month (baseline: January)			0.0000
February	-90.2074	234.8834	
March	156.1282	234.9344	
April	538.0325	235.0193	
May	644.4359	235.1381	
June	628.9792	235.2908	
July	802.9820	235.4772	
August	897.2044	235.6974	
September	1,378.6200	235.9512	
October	1,267.3135	236.2386	
November	577.3223	236.5593	
December	-36.0511	236.9132	
r-squared: 0.6671 df: 47 RSS: 6,481,561.60 s: 371.3564			

Determinant	*Coefficient*	*St Error*	*p-value*
Constant	1,234.6520	168.4244	0.0000
Month (baseline: January)			0.0000
February	-94.5540	238.1881	
March	147.4351	238.1881	
April	524.9928	238.1881	
May	627.0496	238.1881	
June	607.2464	238.1881	
July	776.9026	238.1881	
August	866.7784	238.1881	
September	1,343.8467	238.1881	
October	1,228.1944	238.1881	
November	533.8566	238.1881	
December	-83.8633	238.1881	
r-squared: 0.6504 df: 48 RSS: 6,808,026.31 s: 376.6084			

Table 4.13: Trend+seasonal and reduced models for square roots of trash fish catch

Table 4.14 shows coefficients, standard errors and p-values from a fitted trend+seasonal model fitted to the logarithms of shrimp catches. The trend is statistically significant but the seasonal effect is not statistically significant. The negative estimate for the trend indicates that the quantity of shrimp catches decreased. The lower panel shows the reduced model with the seasonal component omitted. In this case the r-squared is not substantially reduced when the seasonal component is omitted.

Determinant	*Coefficient*	*St Error*	*p-value*
Constant	10.0742	0.4255	0.0000
Trend (t)	-0.0452	0.0069	0.0000
Month (baseline: January)			0.9072
February	-0.2965	0.5829	
March	-0.5739	0.5834	
April	-0.5713	0.5498	
May	-0.2329	0.5501	
June	-0.0327	0.5505	
July	-0.7921	0.5510	
August	-0.2943	0.5516	
September	-0.5290	0.5522	
October	-0.8191	0.5530	
November	-0.4197	0.5834	
December	-0.1714	0.5547	
r-squared: 0.5393 df: 44 RSS: 33.21 s: 0.8687			

Determinant	*Coefficient*	*St Error*	*p-value*
Constant	9.6991	0.2173	0.0000
Trend (t)	-0.0458	0.0064	0.0000
r-squared: 0.4843 df: 55 RSS: 37.1704 s: 0.8221			

Table 4.14: Trend+seasonal and reduced models for logarithms of shrimp catch

Table 4.15 shows similar results for the lobster catches. The trend is decreasing but, as in the case of the shrimp catch, the seasonal effect is not statistically significant. The lower panel shows the reduced model with the seasonal component omitted. Again the r-squared is not substantially reduced when the seasonal component is omitted.

Determinant	*Coefficient*	*St Error*	*p-value*
Constant	10.0696	0.2783	0.0000
Trend (*t*)	-0.0426	0.0044	0.0000
Month (baseline: January)			0.6900
February	-0.2846	0.3622	
March	-0.4786	0.3623	
April	-0.4509	0.3625	
May	-0.0661	0.3626	
June	0.1981	0.3629	
July	-0.5624	0.3632	
August	-0.1913	0.3635	
September	-0.2575	0.3639	
October	-0.0493	0.3643	
November	-0.0937	0.3648	
December	-0.1219	0.3654	
r-squared: 0.6920 df: 47 RSS: 15.42 s: 0.5727			

Determinant	*Coefficient*	*St Error*	*p-value*
Constant	9.8595	0.1461	0.0000
Trend (*t*)	-0.0421	0.0042	0.0000
r-squared: 0.6382 df: 58 RSS: 18.1067 s: 0.5587			

Table 4.15: Trend+seasonal and reduced model for logarithms of lobster catch

Table 4.16 shows coefficients, standard errors and p-values from a fitted trend+seasonal model fitted to the logarithms of crab catches. Neither the trend nor the seasonal effect is statistically significant. The lower panel shows the reduced model with both the trend and the seasonal pattern omitted. Because the model is just a constant term, the r-squared is zero.

Determinant	*Coefficient*	*St Error*	*p-value*
Constant	10.1186	0.2567	0.0000
Trend(t)	-0.0073	0.0040	0.0747
Month (baseline: January)			0.6354
February	-0.1560	0.3341	
March	-0.1515	0.3342	
April	-0.0944	0.3343	
May	0.2532	0.3345	
June	0.4712	0.3347	
July	0.1776	0.3350	
August	-0.0834	0.3353	
September	0.2804	0.3356	
October	0.3085	0.3360	
November	-0.0582	0.3365	
December	-0.0553	0.3370	
r-squared: 0.2006 df: 47 RSS: 13.11 s: 0.5282			

Determinant	*Coefficient*	*St Error*	*p-value*
Constant	9.9695	0.0681	0.0000
r-squared: 0 df: 59 RSS: 16.40 s: 0.5273			

Table 4.16: Trend+seasonal and reduced models for logarithms of crab catch

4.3 Forecasting the marine fish catches

In this section we use the multiple regression models in Section 4.2 to plot the fitted values from January 1999 to December 2003 and to forecast the monthly catch quantities from January 2004 until December 2005. The forecasts are calculated using the formulas given in Chapter 2.

Figure 4.1 shows monthly mackerel fish catch for 1999-2003 and forecasts for these years with 24 months ahead. We see that the mackerel fish catch has a seasonal effect and the mackerel catch decreases. There was an unusually high catch in February 1999.

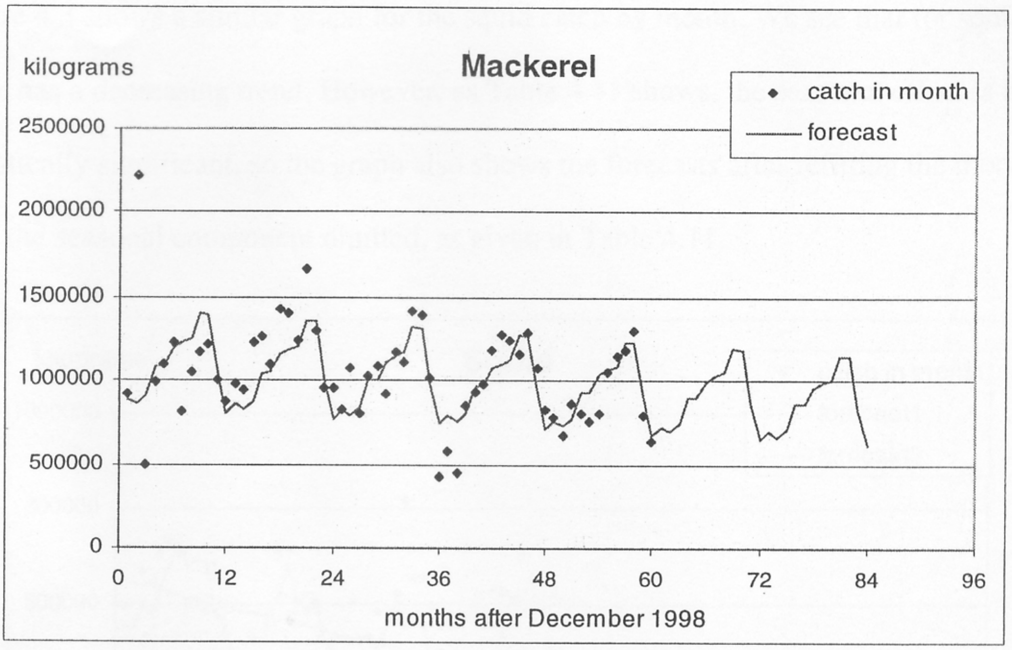

Figure 4.1: Fitted model for forecasting the mackerel catch at Pattani Fishery Port

Figure 4.2 shows a similar graph for the other food fish catch by month. We see that for other food fish catch has a seasonal effect and decreasing trend.

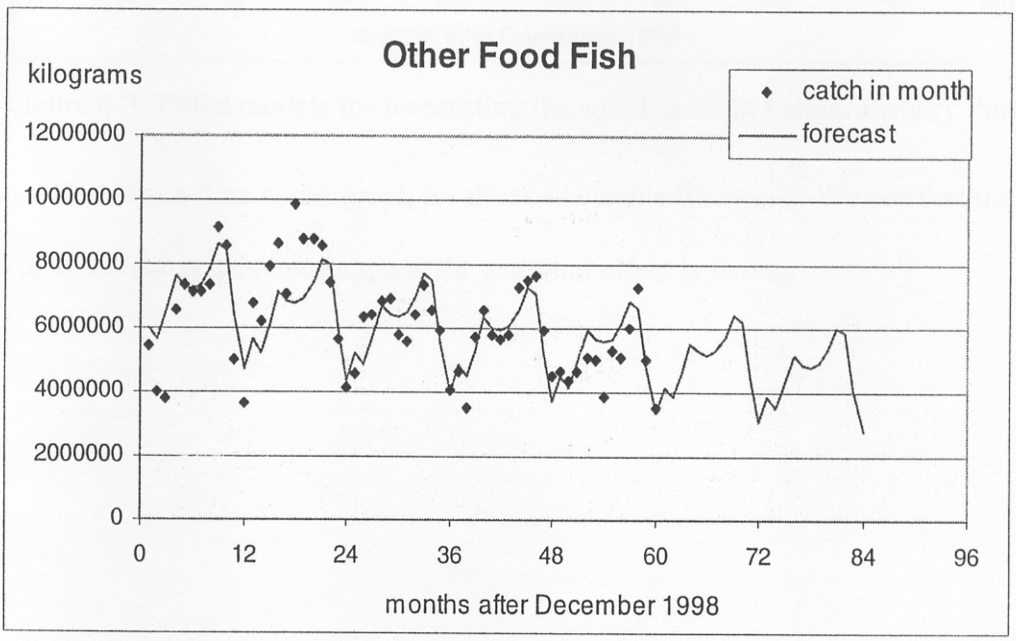

Figure 4.2: Fitted model for forecasting the other food fish catch at Pattani Fishery Port

Figure 4.3 shows a similar graph for the squid catch by month. We see that for squid catch has a decreasing trend. However, as Table 4.11 shows, the seasonal effect is not statistically significant, so the graph also shows the forecasts after refitting the model with the seasonal component omitted, as given in Table 4.11.

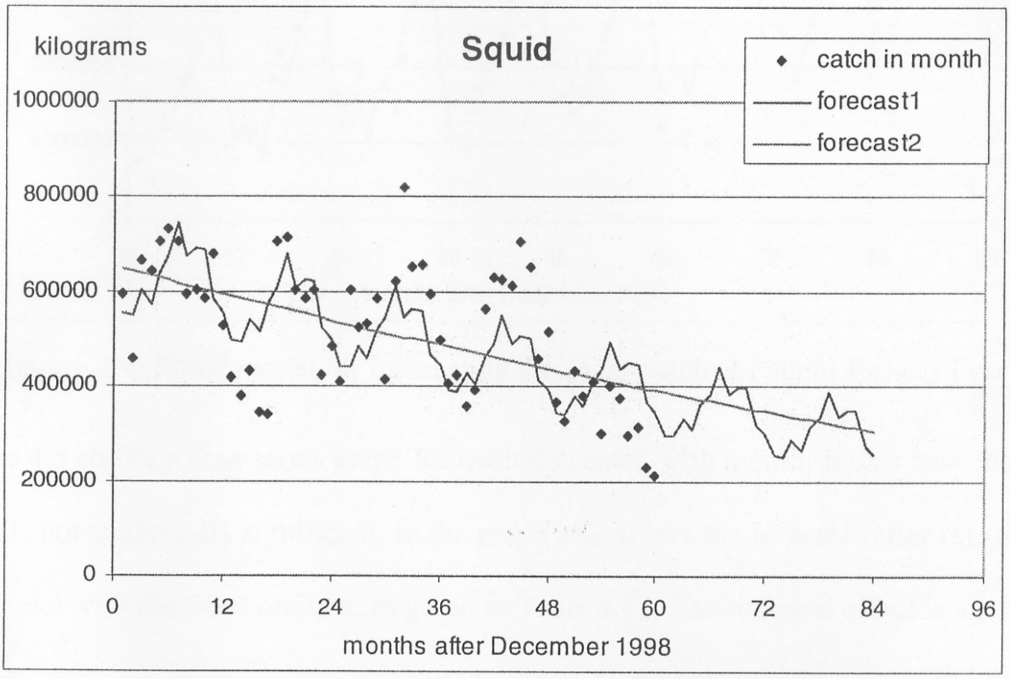

Figure 4.3: Fitted models for forecasting the squid catch at Pattani Fishery Port

Figure 4.4 shows a time series graph for the scad catch with month. We see that the trend of scads catch is increasing, and the seasonal effect is strong.

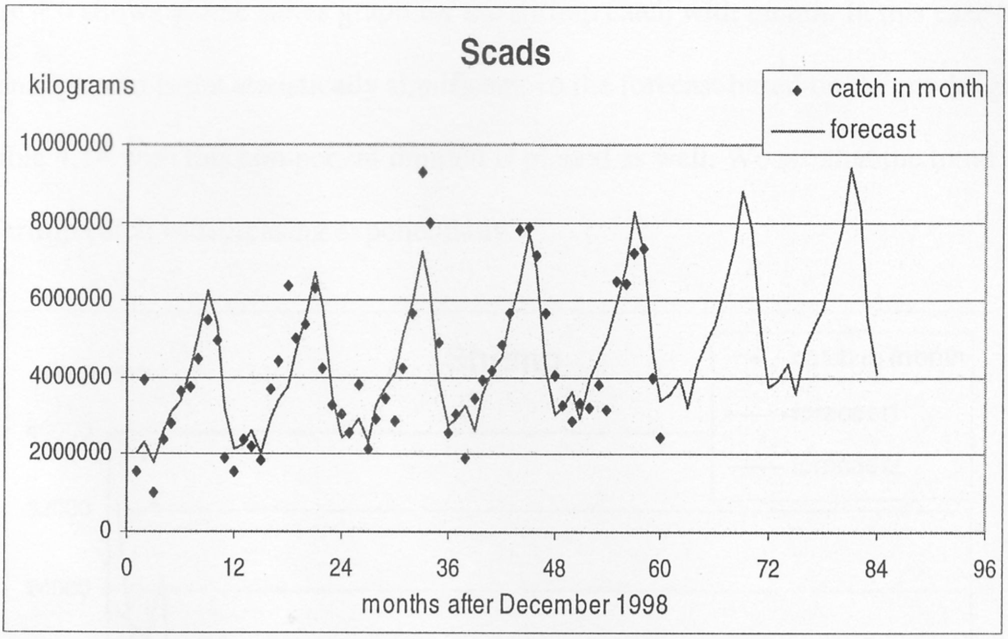

Figure 4.4: Fitted model for forecasting the scads catch at Pattani Fishery Port

Figure 4.5 shows a time series graph for trash fish catch with month. In this case the trend is not statistically significant, so the graph also shows the forecasts after refitting the model with the trend omitted, as given in Table 4.13. The seasonal effect is again strong.

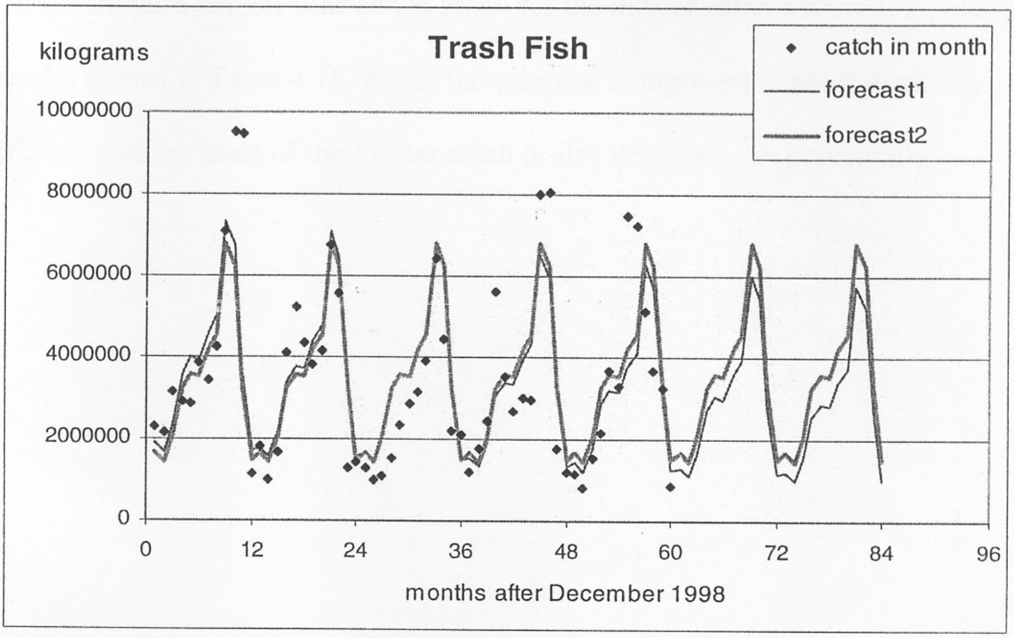

Figure 4.5: Fitted models for forecasting the trash fish catch at Pattani Fishery Port

Figure 4.6 shows a time series graph for the shrimp catch with month. In this case the seasonal pattern is not statistically significant, so the forecast based on the model given in Table 4.14 with this component omitted is plotted as well. We see that the trend of the shrimp catch is decreasing exponentially.

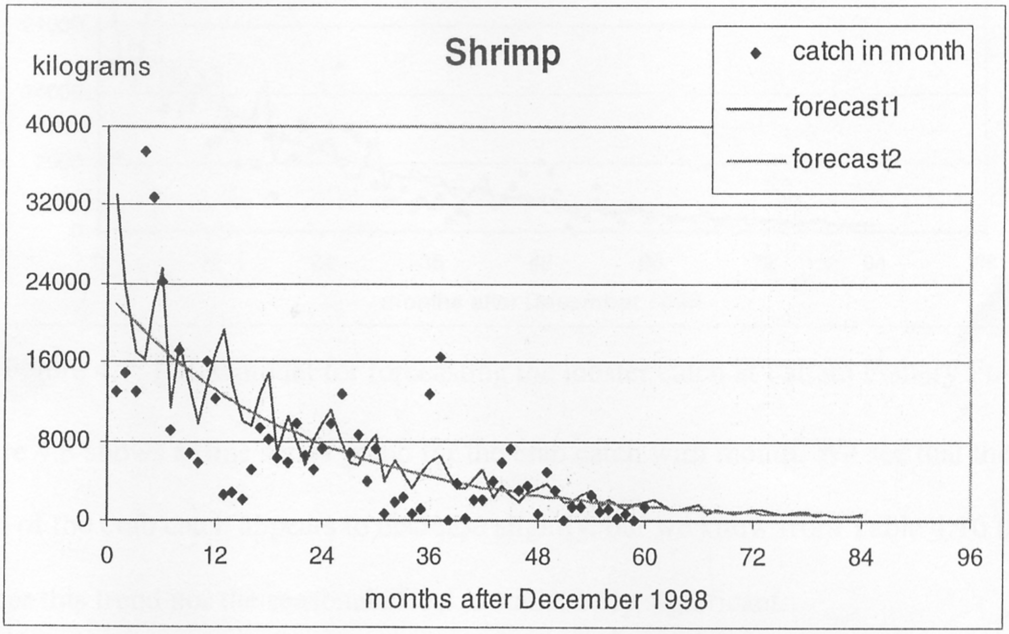

Figure 4.6: Fitted model for forecasting the shrimp catch at Pattani Fishery Port

Figure 4.7 shows a similar time series graph for the lobster catch with month, based on the results shown in Table 4.15. Again the seasonal component is not statistically significant, and the trend of the lobster catch is also decreasing exponentially.

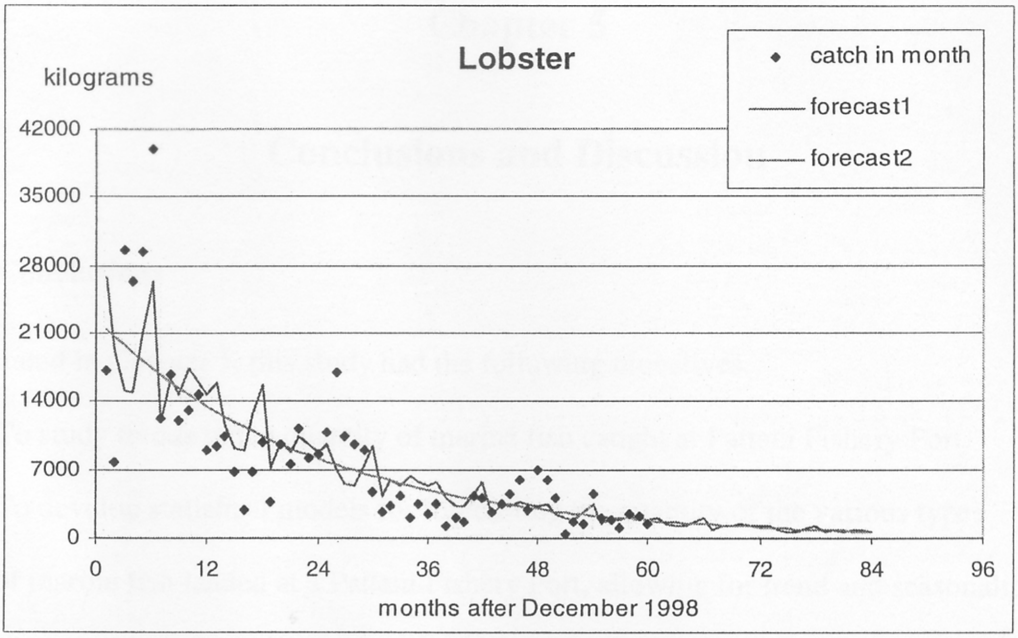

Figure 4.7: Fitted model for forecasting the lobster catch at Pattani Fishery Port

Figure 4.8 shows a time series graph for the crab catch with month. We see that the trend of the crab catch appears to decrease slightly, but we know from Table 4.16 that neither this trend nor the seasonal effect is statistically significant.

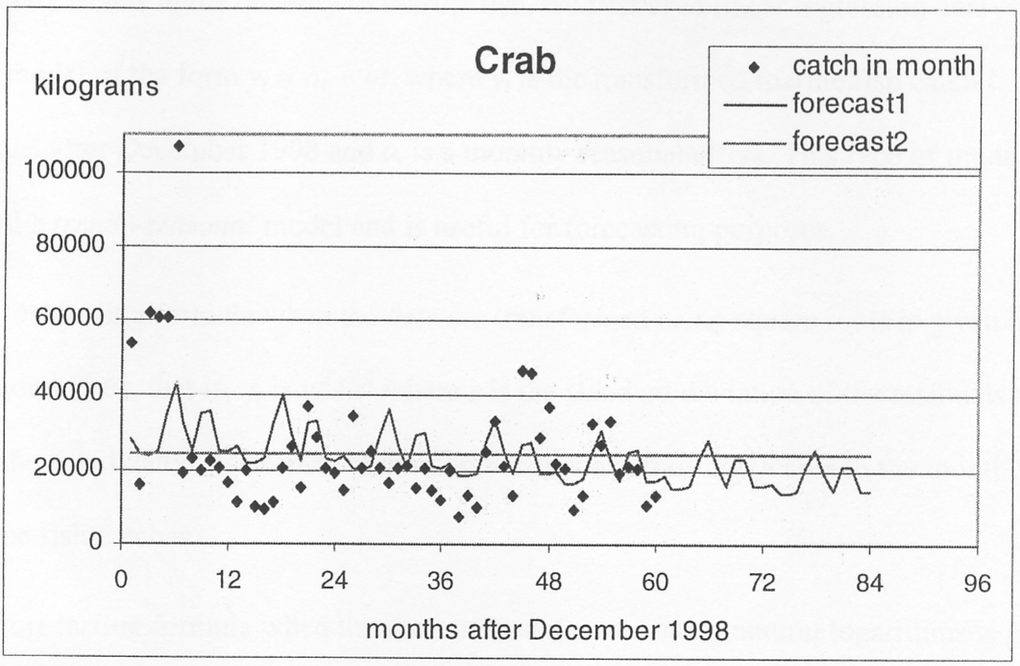

Figure 4.8: Fitted model for forecasting the crab catch at Pattani Fishery Port