RAINFALL DISTRIBUTION USING JOINT PROBABILITY

INTRODUCTION:

Rainfall and temperature are important climatic inputs for agricultural production , especially in the context of climate change. However , accurate analysis and simulation of joint distribution of rainfall and temperature are difficult due to possible interdependence between them. Thanjavur is a leading agricultural district in TamilNadu . Historical climate data for Thanjavur district is used to demonstrate the modelling process.

ABSTRACT:

This project investigates the combined influence of rainfall and extreme temperatures. The estimation of rainfall may depend on the temperatures and the main focus of our study is to analyse the relationship between temperature and rainfall. The

inference would be whether temperature and rainfall are related or not .

JOINT PROBABILITY DISTRIBUTION:

A joint probability distribution shows a probability distribution for two (or more) random variables. Instead of events being labelled A and B, the norm is to use X and Y. The formal definition is:

f(x,y) = P(X = x, Y = y)

The whole point of the joint distribution is to look for a relationship between two variable

JOINT PROBABILITY MASS FUNCTION:

When variables are discrete(like in the above table example), their distribution can be described by a joint probability mass function (Joint PMF). Basically, if you have found all probabilities for all possible combinations of X and Y, then you have created a joint PM

JOINT PROBABILITY DENSITY FUNCTION:

If you have continuous variables, they can be described with a probability density function (PDF). Unlike the discrete variable example above, you can't write out every combination of every variable because you would have infinite possibilities to write out (which is, of course, impossible). What you can do is create a formula; The formula that describes all possible combinations of X and Y is called a joint PDF.

CORRELATION:

Correlation is used to test relationships between quantitative variables or categorical variables. In other words, it's a measure of how things are related. The study of how variables are correlated is called correlation analysis.

CORRELATION-COFFECIENT:

A [correlation coefficient](#) is a way to put a value to the relationship. Correlation coefficients have a value of between -1 and 1. A "0" means there is no relationship between the variables at all, while -1 or 1 means that there is a perfect negative or positive

correlation (negative or positive correlation here refers to the type of graph the relationship will produce).

RESEARCH METHODOLOGIES:

Monthly data of maximum temperature , minimum temperature and rainfall of Thanjavur district from the year 1901 to 2002 was taken. The months at which

1) Rainfall and maximum temperature

2) Rainfall and minimum temperature &

3) Maximum temperature and minimum temperature

are correlated to the maximum was found and the discrete probability distribution table was formed for the same. Joint probability and marginal pmf's were calculated.

DATA ANALYSIS AND INTERPRETATION:

TABLE 1: DATA OF MAXIMUM TEMPERATURE (1901-2002) –THANJAVUR DISTRICT

MAXIMUM TEMPERATURE

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1901	30.338	31.352	32.072	33.349	34.33	33.933	33.042	32.674	32.403	31.416	29.556	28.386
1902	29.365	29.577	32.16	33.941	34.661	34.153	32.983	32.842	32.248	30.652	29.498	28.92
1903	29.714	31.232	32.482	33.989	34.355	33.949	33.025	32.341	32.129	31.465	29.525	28.066
1904	28.827	29.664	31.674	33.986	34.248	33.41	32.639	32.289	32.703	31.45	29.904	27.98
1905	28.742	30.835	33.082	33.247	34.247	34.105	34.147	32.836	32.905	31.253	29.787	28.584
1906	29.735	31.642	32.285	34.55	35.028	33.878	33.438	32.029	32.436	31.028	29.373	28.775
1907	29.109	30.358	32.479	33.402	34.746	33.897	33.102	32.221	32.703	31.038	29.609	28.662
1908	29.222	29.95	31.784	34.676	34.547	33.869	32.721	32.289	31.72	31.038	29.207	27.977
1909	29.122	30.434	32.341	33.785	34.053	33.409	32.316	31.714	31.583	31.161	30.065	29.077
1910	29.277	30.117	31.669	33.45	34.941	33.721	32.706	31.895	31.816	30.93	29.288	28.104
1911	29.024	29.874	32.06	33.469	34.152	32.993	32.811	32.332	32.474	30.753	29.514	28.478
1912	28.522	31.047	32.951	34.156	34.955	33.756	33.055	32.659	32.093	30.945	29.899	28.176
1913	28.593	30.742	32.751	34.338	34.805	34.341	32.703	32.514	32.278	30.946	29.014	28.542
1914	28.916	30.566	32.326	33.872	34.523	34.206	32.834	32.115	32.089	30.567	29.399	28.751
1915	29.286	30.624	32.052	33.56	34.635	33.634	32.72	33.116	32.293	31.635	30.212	28.778
1916	28.817	30.645	32.351	34.288	34.485	32.94	32.498	32.129	31.687	30.968	29.812	27.756
1917	28.318	29.664	31.401	33.463	33.851	32.753	33.006	32.329	31.801	30.72	29.695	27.977
1918	28.542	29.055	30.887	33.472	33.741	32.601	32.695	32.511	31.694	31.129	29.583	28.394
1919	30.014	31.426	31.943	33.979	34.755	33.411	32.638	32.179	31.898	30.949	29.585	28.591
1920	29.206	30.862	32.648	33.775	34.642	34.048	33.402	32.808	32.481	31.427	29.573	27.88
1921	29.343	30.385	32.583	33.851	35.338	34.431	32.823	32.726	32.098	30.974	29.334	28.179
1922	29.185	29.85	32.046	33.643	34.333	33.962	33.105	32.669	32.177	30.752	29.811	27.889
1923	28.425	30.263	32.004	34.005	34.428	34.046	32.934	32.514	32.313	31.062	29.915	28.326

The above table shows the sample data of maximum temperature at thanjavur district. This monthly data is taken for the years from 1901 to 2002.

TABLE 2: DATA OF RAINFALL – (1901-2002) – THANJAVUR DISTRICT

PRECIPITATION

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1901	8.368	34.904	19.132	37.816	40.771	38.36	21.428	83.241	237.624	74.147	196.799	96.618
1902	78.516	34.738	15.417	10.853	65.934	41.491	39.916	101.122	162.81	176.187	186.665	202.242
1903	22.602	5.189	0.089	3.878	85.601	52.459	56.606	122.2	294.266	134.662	127.327	303.012
1904	39.86	0.053	0.089	8.717	73.32	9.607	76.303	22.425	49.3	101.212	18.965	92.706
1905	1.666	0.057	5.043	55.346	77.861	13.011	42.894	128.898	79.59	209.44	128.234	6.579
1906	43.204	15.354	21.04	6.252	23.903	21.64	42.473	147.802	19.421	206.691	260.737	177.946
1907	6.358	1.933	1.432	116.674	59.971	22.94	23.98	44.295	138.143	186.469	369.875	57.976
1908	3.659	49.188	7.286	17.832	21.499	20.477	31.636	61.592	176.772	207.865	27.146	36.955
1909	44.06	11.387	0.558	23.268	78.227	15.506	15.604	185.711	103.423	89.146	41.916	25.9
1910	4.114	50.06	0.089	9.885	12.622	33.799	153.162	117.958	90.946	213.043	125.941	1.485
1911	0.815	3.211	7.263	15.011	48.041	40.199	17.353	41.431	170.052	117.12	213.607	145.916
1912	3.817	0.103	1.507	28.044	64.519	53.959	15.121	56.354	138.6	165.902	251.998	56.276
1913	1.342	0.645	0.09	30.344	68.722	28.512	28.105	61.417	124.042	298.066	303.798	165.383
1914	6.756	1.035	0.1	37.489	9.795	77.506	12.46	76.887	121.071	231.088	117.715	146.238
1915	11.135	37.984	21.569	52.1	47.165	30.752	91.163	118.282	201.576	115.445	231.628	88.416
1916	0.073	3.028	1.515	27.949	43.36	22.917	194.384	126.668	128.517	154.185	151.726	65.348
1917	18.536	46.065	14.828	1.554	87.84	40.426	47.251	192.682	132.127	83.467	226.27	43.358
1918	38.604	7.115	17.378	4.06	31.506	68.887	48.51	39.781	23.147	21.485	361.73	126.729
1919	4.708	0.053	9.528	6.211	66.295	54.516	86.571	112.487	152.883	119.921	317.533	247.546

The above table shows the sample data of rainfall at thanjavur district. This monthly data is taken for the years from 1901 to 2002.

TABLE 3: DATA OF MINIMUM TEMPERATURE – (1901-2002) – THANJAVUR DISTRICT

MINIMUM TEMPERATURE

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1901	22.863	23.02	23.396	25.313	26.051	25.899	25.129	24.843	24.676	24.257	22.883	21.83
1902	21.899	21.241	23.524	25.903	26.372	26.07	25.069	24.981	24.521	23.496	22.816	22.365
1903	22.245	22.895	23.844	25.95	26.076	25.908	25.111	24.494	24.376	24.31	22.843	21.538
1904	21.353	21.329	23.05	25.938	25.958	25.37	24.725	24.461	24.978	24.291	23.23	21.424
1905	21.256	22.499	24.402	25.201	25.958	26.033	26.234	24.986	25.179	24.098	23.064	22.053
1906	22.27	23.308	23.608	26.465	26.737	25.844	25.525	24.196	24.71	23.875	22.699	22.219
1907	21.641	22.023	23.842	25.367	26.468	25.875	25.188	24.384	24.978	23.884	22.936	22.131
1908	21.753	21.616	23.11	26.638	26.269	25.847	24.808	24.461	23.967	23.884	22.524	21.423
1909	21.66	22.1	23.703	25.748	25.764	25.388	24.401	23.895	23.857	24.006	23.383	22.547
1910	21.813	21.783	23.036	25.404	26.661	25.698	24.795	24.041	24.064	23.77	22.564	21.573
1911	21.56	21.539	23.383	25.422	25.871	24.971	24.897	24.5	24.747	23.599	22.831	21.922
1912	21.043	22.712	24.315	26.12	26.674	25.735	25.142	24.828	24.367	23.792	23.224	21.647
1913	21.119	22.409	24.067	26.302	26.526	26.32	24.791	24.655	24.551	23.793	22.338	21.985
1914	21.441	22.23	23.699	25.833	26.232	26.185	24.921	24.292	24.364	23.411	22.725	22.221
1915	21.821	22.289	23.374	25.465	26.346	25.551	24.808	25.285	24.541	24.475	23.538	22.223
1916	21.343	22.312	23.723	26.251	26.196	24.909	24.583	24.307	23.963	23.815	23.089	21.226
1917	20.855	21.329	22.766	25.417	25.572	24.733	25.094	24.472	24.05	23.568	23.02	21.423
1918	21.069	20.719	22.253	25.438	25.462	24.518	24.782	24.664	23.969	23.974	22.902	21.838
1919	22.543	23.093	23.32	25.94	26.477	25.39	24.726	24.326	24.145	23.796	22.91	22.058
1920	21.737	22.527	24.013	25.738	26.362	26.017	25.489	24.978	24.753	24.267	22.899	21.324
1921	21.88	22.049	23.896	25.813	27.06	26.41	24.91	24.895	24.373	23.816	22.602	21.652
1922	21.717	21.516	23.361	25.607	26.043	25.941	25.191	24.849	24.451	23.598	23.078	21.335

The above table shows the sample data of minimum temperature at thanjavur district. This monthly data is taken for the years from 1901 to 2002.
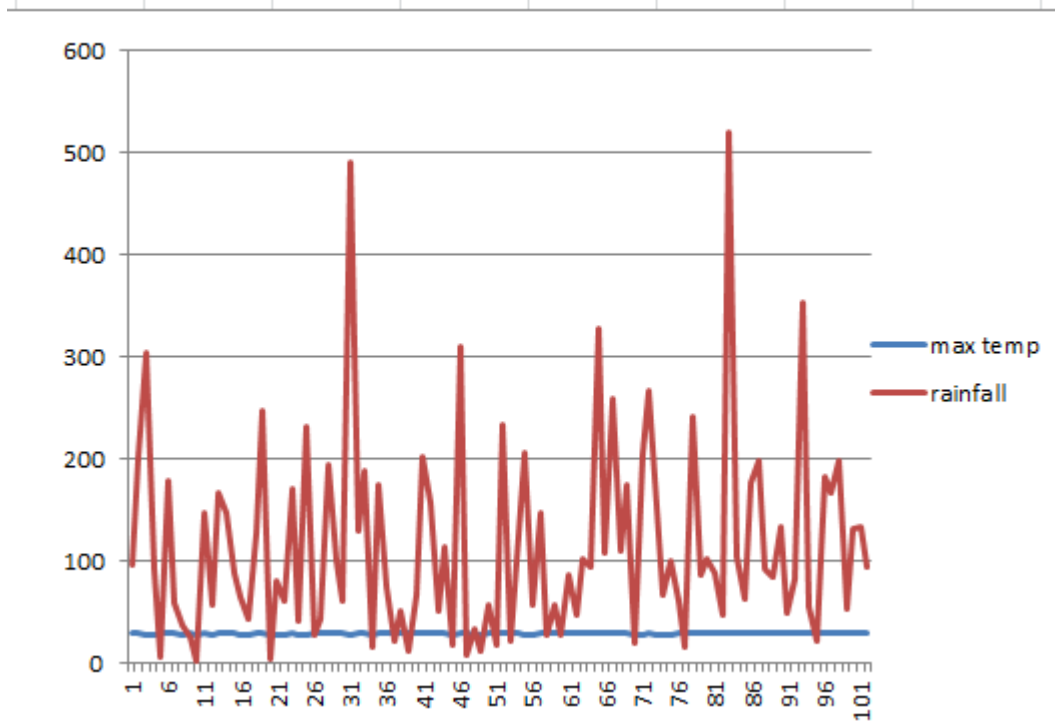
Correlation coefficient is found for 1) rainfall and maximum temperature
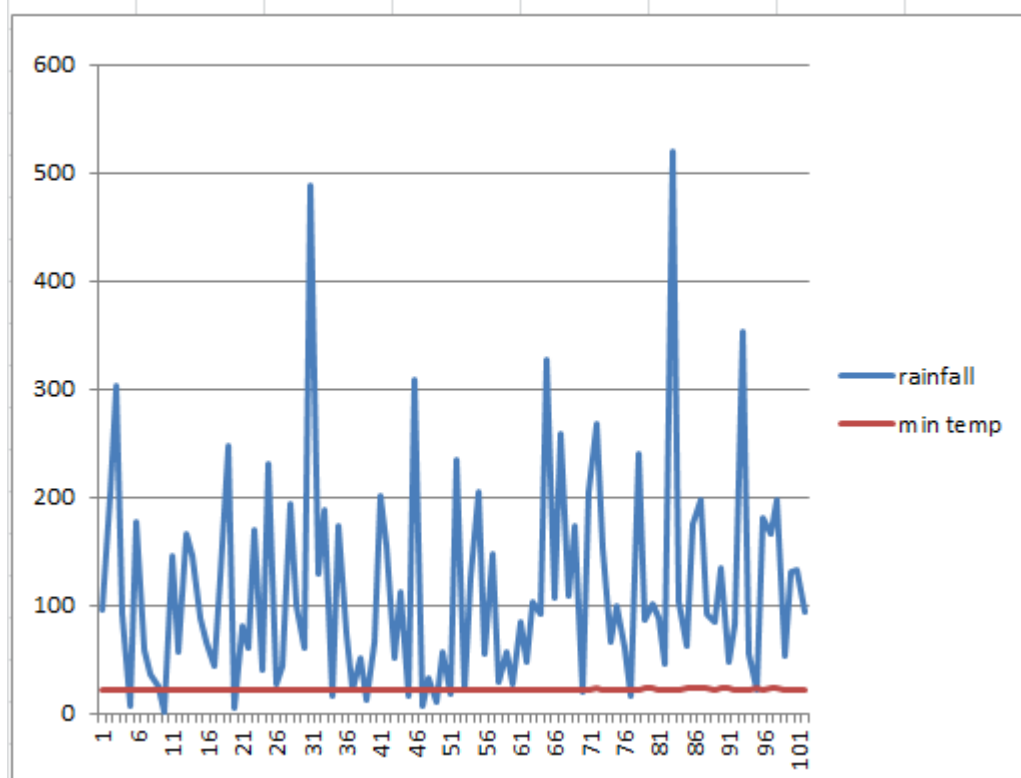
2) rainfall and minimum temperature

3) minimum temperature and maximum temperature

And the month where maximum correlation occurs is found for each case and the graph is plotted for that particular month.
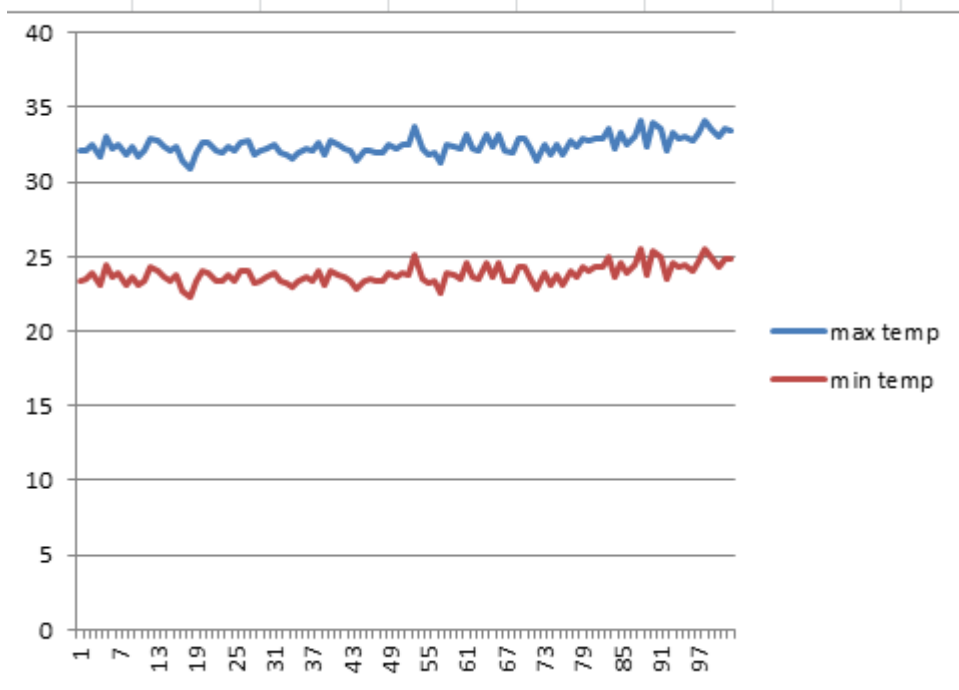
CORRELATION BETWEEN MAXIMUM TEMPERATURE AND RAINFALL(DEC)

CORRELATION BETWEEN MINIMUM TEMPERATURE AND RAINFALL(DEC)

CORRELATION BETWEEN MAXIMUM AND MINIMUM TEMPERATURE(MARCH)

Discrete probability distribution table is formed for the

months with maximum correlation and the joint probability and conditional pmf's are found.

CONCLUSION:

This paper presents a model for the joint distribution of temperature and rainfall, which are of utmost importance for agricultural production especially in the context of climate change. It has been found that a positive correlation exists between rainfall and temperature .

REFERENCE:

Data collected from:

http://www.indiawaterportal.org/met_data

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