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Role of Probability Models for Enhancing the Information of Temperature and Relative Humidity in Hoshangbad

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Abstract: In this paper, temperature and relative humidity are modeled using some well-known statistical distributions such as normal, logistic, Weibull, and gamma and lognormal. The mean minimum temperature, maximum temperature, morning relative humidity, and evening relative humidity were obtained monthly between 1996 and 2018. Parameter estimations are obtained by the maximum likelihood principle. The unknown parameter estimates of the distributions mentioned above are obtained by the principle of maximum likelihood. Data was combined on a monthly basis and modeled monthly. The minimum temperature, maximum temperature, morning relative humidity, and evening relative humidity are modeled and the best-fitted model is reported. For the best model, some information criterion and the Kolmogorov Smirnov statistic are reported.The best model for each month is given separately. With these models, modeling and desired probabilities can be calculated using the modeling results for any month.This weather infrormation helps farmers for makig plannning for farming of crops in the field.

Keywords: Humidity, Temperature, Statistical distribution, Kolmogorov-Smirnov test

1. Introduction

Climate change effects on the earth's atmosphere and various natural resources are highly significant. TheEarth's atmosphere plays host to numerous weather phenomena that affect life and shape the planet. Under these conditions, these phenomen require knowledge of the interaction between temperature and humidity. Rainfall, temperature and humidity are major parameters of climate affecting changes in the atmosphere. Humidity plays a key role in crop production and the water balance of a region, one of the major parameters affected by climate change. Temperature affects humidity, which in turn affects the potential for precipitation. The interaction of temperature and humidity also directly affects the health and well-being of humans. As air temperature rises, it can hold more water molecules,

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resulting in a decrease in relative humidity.When temperatures drop, relative humidity increases. High relative humidity in the air occurs when the air temperature approaches the dewpoint value. The temperature there directly relates to the amount of moisture the atmosphere can hold. These kinds of weather factors are directly related to crop production. If the amount of moisture our weather can not provide, then it causes less production of crops. In India, agricultural production is often determined by theim pulse of nature. The information about the seasonal forecast of weather allows farmers to make planning and management strategies for improvement in the production of crops. Humidity is important to make photosynthesis possible, and the temperature of a plant on a sunny day is mainly regulated by cooling through evaporation. Evapo transpiration plays a key role in crop production and the water balance of a region, one of the major parameters affected by climate change. Changes in the earth's average temperature can cause significant changes in the climate and weather.Smith *et al. (2009)* predicted the air temperature by using the time series model.Martínez *et. al* (2012) estimated and forecasted temperature and humidity by using an artificial neural network (ANN) for tobacco dry processing. Shukla et al. (2014) forecasted the climate parameters temperature, maximum temperature, and relative humidity using the GARCH model.Jang et al. (2016) developed the future precipitation forecasting program using probability forecasts and climatechange scenarios. Kundu et al (2016) discussed the futurechanges in rainfall, temperature and reference evapotranspiration in central India by the least square support vector machine.

2. Material and Methods

In this study, temperature and relative humidity are assessed by statistical distributions, such as normal, logistic, Weibull, gamma and lognormal. The probability density functions of these distributions given as follows:

Normal distribution

$$f(x)=\frac{1}{\sqrt{2\Pi}par_2}\exp\left(-\frac{(x-par_1)^2}{2par_2^{\,2}}\right),\ x\in\mathbb{R}, par_1\in\mathbb{R}, par_2>0$$

Weibull distribution

$$f(x)=\frac{par_1}{par_2}\left(\frac{x}{par_2}\right)^{par_1-1}\exp\left(-\left(\frac{x}{par_2}\right)^{par_1}\right),\ x>0, par_1, par_2>0$$

Gamma distribution

$$f(x)=\frac{1}{par_2^{\,par_1}\Gamma(par_1)}x^{par_1-1}\exp\left(-\frac{x}{par_2}\right),\ x>0, par_1, par_2>0$$

Logistic distribution

$$f(x)=\frac{1}{par_2}\exp\left(-\frac{x-par_1}{par_2}\right)\frac{1}{\left\{1+\exp\left(-\frac{x-par_1}{par_2}\right)\right\}^2},\ x\in\mathbb{R},par_1\in\mathbb{R},par_2>0$$

Lognormal distribution

$$f(x)=\frac{1}{xpar_2\sqrt{2\Pi}}\exp\left(-\frac{(\log x-par_1)^2}{2par_2^{\ 2}}\right),\ x>0,par_1\in\mathbb{R},par_2>0$$

The maximum likelihood estimation (MLE) methodwas used to estimate the model parameters. The MLE is the most popular method used in parameter estimation.The MLE methodology is given as follow:

For a random sample $(x_1,x_2,\ldots,x_n)$ from the distributions given above, then the likelihood and log-likelihood function are given, respectively, by

$$L=L(par_1,par_2\,|\,x_1,x_2,\ldots,x_n)=\prod_{i=1}^{n}f(x_i\,|\,par_1,par_2),$$

and

$$\ell=\log\left(L(par_1,par_2\,|\,x_1,x_2,\ldots,x_n)\right)=\sum_{i=}^{n}\log\left(f(x_i\,|\,par_1,par_2)\right),$$

where $f(x_i\,|\,par_1,par_2)$ is the probability density function of the interested model. Then the likelihood equations are obtained, respectively, by

$$\frac{\partial\ell}{\partial par_1}=\frac{\partial\sum_{i=}^{n}\log\left(f(x_i\,|\,par_1,par_2)\right)}{\partial par_1},$$

and

$$\frac{\partial\ell}{\partial par_2}=\frac{\partial\sum_{i=}^{n}\log\left(f(x_i\,|\,par_1,par_2)\right)}{\partial par_1}.$$

The MLE is achieved by solving the above likelihood equations corresponding to 0, simultaneously with respect to par1 and par2. Since no analytical formulas are possible, numerical maximization ℓ with respect to par1 and par2 are conducted using the R function of optim.The $-\ell$, Akaike information criterion (AIC), Bayesian information criterion (BIC),consistent AIC (CAIC), Hannan-Quinninformation criterion (HQIC), Kolmogorov-Smirnovstatistic (KS Stat) and Kolmogorov-Smirnov p value (KS p val) and MLEs of model parameters are also calculated and they are presented in the Result Section. The mathematical expressions for the statistics above are given by

$$\text{KS Stat}=\max_{\text{i}=1,2,\ldots,\text{n}}\left\{\frac{i}{n}-F\left(x_{(i)};\widehat{par_1},\widehat{par_2}\right);F\left(x_{(i)};\widehat{par_1},\widehat{par_2}\right)-\frac{i-1}{n}\right\},$$

$$AIC=-2\ell+2k,$$

$$BIC=-2\ell+k\log(n),$$

$$CAIC=-2\ell+k\left\{\log(n)+1\right\},$$

$$HQIC=-2\ell+2k\log\left\{\log(n)\right\},$$

where k is the number of estimated parameters in the model,$n$denotes the number of observations, and F is the cumulative distribution function of the related model.The lowest values of KS Stat, AIC, BIC, CAIC and HQIC indicate that the model best-fitted the data. In this study, the results of the goodness of fit for the model with the lowest KS Stat for each month are presented in Tables 5-8 in detail.

3. Results

Data was handled from 1996 to 2018, and descriptive statistics and modeling results for each month and overall are given in Tables 1-8. Tables 1-4 give the average maximum temperature, maximum temperature, morning relative humidity, and evening relative humidity for each month from 1996 to 2018. From Table 1, the highest maximum temperature is seen in the month of May and the lowest maximum temperature is seen in the month of January. From Table 2, the highest minimum temperature is seen in the month of May, and the lowest maximum temperature is seen in the months of January and December. From Table 3, the highest minimum temperature is seen in the month of May, and the lowest maximum temperature is seen in the months of January and December. The goodness-of-fit results for the monthly data are given in Tables 5-8 in detail. From Tables 4-8, a guide is provided for those who will work on maximum temperature, minimum temperature, morning relative humidity and evening relative humidity. From Tables 4-8, probability calculations regarding maximum temperature, minimum temperature, morning relative humidity, and evening relative humidity variables can be made and regarding the estimated expected value and estimated variance can be obtained. The modeling results for the maximum temperature are presented in Table 5. From Table 5, the logistic distribution is selected as the best-fitted model for January, February, March, April, May, July, August, and November; the Weibull distribution is selected as the best-fitted model for June and September; the Gamma distribution is selected as the best-fitted model for October; and the lognormal distribution is selected as the best-fitted model for December. In addition, one can choose the Gamma distribution to model for the annual maximum temperature. The modeling results for the minimum temperature are presented in Table 6. From Table 6, the Weibull distribution is selected as the best-fitted model for January, February, March, April, May, July, November, and December; the normal distribution is selected as the best-fitted model for June and August; and the lognormal distribution is selected as the best-fitted model for September and October. Also, one can choose the Weibull distribution to model for the annual minimum temperature.

The modeling results for the morning relative humidity are presented in Table 7. From Table 7, the logistic distribution is selected best-fitted model for February, April, June, July, September, October and November; normal distribution is selected best-fitted model for March and August; Weibull distribution is selected best-fitted model for January; gamma distribution is selected best-fitted model for May; lognormal distribution is selected best-fitted model for December. Also, one can choose the Weibull distribution to model for the morning relative humidity.

The modeling results for the evening relative humidity are presented in Table 8. From Table 8, the Weibull distribution is selected best-fitted model for January, February, and March; the Gamma distribution is selected best-fitted model for April and May; the Logistic distribution is selected best-fitted model for June, July, August, September, October, November andDecember. Besides, one can choose the Logistic distribution to model for the evening relative humidity.

Table 1: Monthly average of maximum temperature between 1996 and 2018

						Month							
Year	*Jan.*	*Feb.*	*Mar.*	*April*	*May*	*June*	*July*	*Aug.*	*Sep.*	*Oct.*	*Nov.*	*Dec.*	*Annual*
1996	24.81	27.90	34.81	38.40	41.31	39.50	32.06	27.97	30.30	30.48	28.10	25.29	31.74
1997	23.23	25.36	31.13	34.57	33.55	35.53	28.61	28.35	28.47	28.52	27.00	23.65	29.00
1998	23.58	25.96	29.71	37.69	41.87	37.67	30.48	29.61	29.67	31.42	28.13	26.55	31.05
1999	24.79	26.36	32.25	40.07	40.55	32.09	29.32	27.65	27.95	30.02	29.19	24.77	30.43
2000	25.21	25.10	31.58	40.03	37.77	34.63	29.52	30.52	31.63	35.13	31.73	27.32	31.69
2001	24.10	28.25	33.10	38.00	40.29	33.40	27.52	28.74	32.57	32.10	30.13	26.97	31.26
2002	23.55	26.29	33.26	39.49	41.28	36.17	32.32	26.90	30.97	33.03	29.83	28.10	31.78
2003	23.35	26.50	33.55	39.27	41.35	37.07	30.19	28.45	27.69	30.74	30.37	26.84	31.30
2004	23.25	27.03	36.02	39.43	39.58	36.17	32.16	26.61	31.97	31.87	30.33	25.97	31.69
2005	23.26	26.20	33.87	38.57	40.91	38.20	29.82	28.97	30.37	31.77	29.50	24.21	31.32

contd. table 1

Year	*Jan.*	*Feb.*	*Mar.*	*April*	*May*	*June*	*July*	*Aug.*	*Sep.*	*Oct.*	*Nov.*	*Dec.*	*Annual*
2006	32.85	29.16	35.93	40.97	42.33	37.59	29.19	28.43	30.21	34.25	31.55	24.85	33.12
2007	32.89	33.75	38.52	39.97	32.68	27.87	28.65	32.84	31.93	29.84	26.97	25.34	31.75
2008	23.77	25.10	33.84	38.67	40.00	33.20	30.02	28.45	31.43	32.83	29.27	27.29	31.16
2009	24.94	28.25	33.97	39.43	41.81	38.67	29.84	28.39	30.50	31.73	26.93	25.86	31.70
2010	22.93	26.74	35.13	40.11	42.21	38.53	31.06	29.48	29.57	30.90	29.11	24.61	31.71
2011	22.39	25.89	33.00	38.50	41.29	33.93	33.84	28.68	29.67	32.23	30.27	25.45	31.28
2012	22.35	25.76	32.97	39.23	41.02	37.25	30.65	28.13	31.54	33.86	30.19	28.78	31.82
2013	24.13	27.23	34.07	38.83	43.36	33.59	27.74	28.48	33.27	32.60	31.03	28.20	31.89
2014	24.86	27.99	33.30	39.39	41.08	40.33	32.31	31.51	31.76	33.84	32.35	27.45	33.02
2015	22.56	29.39	30.47	37.05	41.31	36.57	31.03	29.58	32.42	33.98	35.72	28.50	32.37
2016	26.92	29.58	35.41	40.04	41.70	39.17	29.57	28.15	31.48	32.07	30.00	27.11	32.59
2017	27.14	30.39	35.93	40.97	42.33	37.51	29.52	30.17	33.00	34.99	31.34	28.61	33.49
2018	27.74	30.15	37.02	41.15	43.57	36.82	29.19	28.43	30.21	34.25	31.55	24.85	32.91
General	24.94	27.59	33.80	39.12	40.57	36.15	30.20	28.89	30.81	32.28	30.03	26.37	31.70

Table 2: Monthly average of minimum temperature between 1996 and 2018

	Month												
Year	*Jan.*	*Feb.*	*Mar.*	*April*	*May*	*June*	*July*	*Aug.*	*Sep.*	*Oct.*	*Nov.*	*Dec.*	*Annual*
1996	13.23	13.03	18.39	20.28	26.80	28.14	25.58	24.23	24.57	19.71	13.00	8.97	19.68
1997	10.26	10.25	15.50	19.67	23.84	24.53	23.74	24.47	24.90	21.92	19.89	16.47	19.67
1998	11.96	12.25	15.62	21.64	27.13	27.93	25.23	25.00	24.60	22.00	16.20	9.90	19.99
1999	9.61	15.00	15.21	20.63	27.16	25.33	24.71	24.01	23.42	20.46	14.33	11.86	19.33
2000	10.29	11.28	13.74	21.77	26.90	25.57	24.15	24.23	23.20	18.06	14.67	9.45	18.62
2001	10.13	10.89	16.71	20.93	27.06	25.50	24.74	24.35	23.37	20.06	14.10	11.52	19.16
2002	9.61	12.64	15.71	22.32	28.66	26.80	25.97	24.03	22.90	19.19	15.00	13.65	19.74
2003	10.42	14.25	15.48	22.60	26.26	27.40	24.42	24.52	23.68	18.87	17.07	12.50	19.80
2004	11.94	10.93	16.45	23.15	26.61	26.75	24.90	23.97	23.73	19.13	15.27	11.48	19.54
2005	10.61	11.75	16.55	19.77	26.23	27.27	24.97	24.48	24.27	19.47	12.97	10.15	19.06
2006	20.18	17.96	17.97	22.85	27.71	26.36	23.89	23.44	21.54	17.44	13.75	8.98	20.18
2007	18.96	17.00	21.48	27.10	25.26	24.83	24.32	23.45	19.60	13.77	11.53	10.45	19.83
2008	10.32	9.24	16.39	22.03	25.97	25.60	25.10	24.48	23.63	19.00	14.93	12.94	19.16
2009	13.23	12.32	16.42	20.57	26.10	27.13	25.03	24.65	23.83	18.80	15.93	13.80	19.85
2010	8.93	12.29	16.36	22.99	29.13	28.43	25.90	25.19	23.97	21.74	18.80	11.26	20.45
2011	8.16	12.61	15.45	21.13	27.52	26.30	26.26	24.84	24.23	20.32	15.23	11.19	19.47
2012	9.26	10.79	13.71	21.93	26.23	27.01	24.70	23.26	23.88	19.84	15.05	12.96	19.07
2013	10.05	15.88	16.71	22.31	25.94	24.05	23.88	24.04	23.75	21.63	14.75	11.92	19.59
2014	12.73	12.86	17.22	21.36	24.46	25.76	22.49	21.55	20.33	18.96	14.13	9.67	18.49
2015	8.65	11.76	16.93	27.02	26.56	26.14	24.71	24.08	23.04	21.17	19.60	13.39	20.28
2016	11.83	13.85	19.05	23.93	27.17	26.46	23.94	23.17	22.76	19.57	12.76	10.57	19.60
2017	12.47	14.74	17.97	22.85	27.71	26.35	24.45	24.28	24.17	21.12	15.70	13.48	20.47
2018	11.48	14.97	19.20	24.03	28.12	26.58	23.89	23.44	21.54	17.44	13.78	8.98	19.47
General	**11.49**	**12.97**	**16.71**	**22.30**	**26.72**	**26.36**	**24.65**	**24.05**	**23.26**	**19.55**	**15.15**	**11.55**	**19.59**

Table 3: Monthly average of morning relative humidity between 1996 and 2018

	Month												
Year	*Jan.*	*Feb.*	*Mar.*	*April*	*May*	*June*	*July*	*Aug.*	*Sep.*	*Oct.*	*Nov.*	*Dec.*	*Annual*
1996	66.77	58.41	52.94	39.93	37.13	50.78	76.03	88.23	83.30	76.74	65.23	52.52	62.38
1997	61.26	65.82	60.52	54.97	65.52	79.07	86.32	86.55	85.10	78.26	81.50	77.55	73.58
1998	70.29	65.75	61.26	55.57	47.61	64.90	87.03	88.00	87.40	78.90	75.23	68.52	70.92
1999	73.55	83.75	54.84	33.30	43.35	76.23	82.13	91.45	92.03	84.35	70.03	75.94	71.69
2000	77.32	71.55	53.26	38.00	54.32	80.93	90.48	90.16	87.80	71.90	67.07	75.19	71.53
2001	80.45	73.93	60.00	46.13	49.29	81.43	90.94	93.39	87.10	79.10	68.83	81.48	74.38
2002	79.45	80.71	64.61	42.33	54.94	72.50	81.29	93.19	90.00	75.68	77.07	82.74	74.54
2003	82.55	84.64	65.90	42.93	36.29	68.50	90.39	93.94	95.00	84.19	77.17	83.35	75.38
2004	83.97	79.79	61.00	47.07	57.58	73.03	88.23	92.87	91.33	80.90	75.07	88.42	76.64
2005	88.65	88.29	75.19	51.37	38.52	63.80	92.23	92.55	89.90	78.32	79.33	78.97	76.39
2006	74.48	82.15	47.49	30.29	39.85	70.52	91.21	91.60	88.04	74.72	67.34	68.70	68.81
2007	66.13	59.32	44.45	52.03	82.61	90.87	93.29	86.94	78.77	69.13	81.33	77.10	73.59
2008	85.10	84.59	80.94	65.50	68.55	81.83	89.87	91.61	91.43	77.33	72.73	86.10	81.33
2009	89.52	85.21	82.10	63.70	74.39	71.77	92.00	94.26	92.60	85.06	88.53	89.13	84.07
2010	90.77	89.64	66.16	33.41	41.32	63.60	90.68	94.35	91.73	87.03	80.50	83.19	76.02
2011	82.35	84.79	78.16	60.17	48.52	75.23	90.77	92.74	91.97	78.97	72.03	80.58	78.00
2012	83.61	78.86	68.19	57.83	50.61	69.63	92.61	90.94	89.50	54.42	80.30	77.77	74.50
2013	80.58	84.46	66.87	45.77	45.16	70.33	88.48	88.45	74.57	81.71	50.50	65.77	70.21
2014	77.19	74.00	63.58	34.57	35.55	42.13	77.81	87.81	87.97	57.90	56.07	64.45	63.25
2015	78.26	85.10	78.03	60.80	46.52	80.13	94.19	99.00	99.00	74.09	67.10	68.98	77.55
2016	77.19	73.72	62.84	34.23	36.03	42.43	78.94	87.65	87.37	58.60	54.87	65.39	63.32
2017	75.90	68.74	47.49	30.29	39.75	71.26	91.11	91.47	88.04	74.72	67.34	68.70	67.93
2018	75.90	68.74	47.49	30.29	39.14	71.26	91.24	91.60	88.04	74.72	67.34	68.70	67.90
General	**78.32**	**77.02**	**62.75**	**45.67**	**49.24**	**70.10**	**88.14**	**91.25**	**88.61**	**75.56**	**71.41**	**75.18**	**72.78**

Table 4: Monthly average of evening relative humidity between 1996 and 2018

	Month												
Year	*Jan.*	*Feb.*	*Mar.*	*April*	*May*	*June*	*July*	*Aug.*	*Sep.*	*Oct.*	*Nov.*	*Dec.*	*Annual*
1996	40.13	34.62	20.32	23.10	21.58	30.77	34.39	69.19	71.30	67.61	57.00	29.90	41.66
1997	45.81	51.54	48.10	39.43	35.39	42.97	52.04	77.13	66.73	61.55	67.20	68.45	54.73
1998	54.84	47.14	40.94	34.97	30.00	44.37	69.87	77.00	76.60	57.97	51.27	30.94	51.35
1999	37.13	55.46	32.71	15.77	22.68	50.17	75.06	80.90	81.70	60.48	40.81	31.25	48.64
2000	40.90	42.38	28.55	16.47	31.71	53.00	75.84	71.32	63.50	38.19	38.03	43.23	45.30
2001	54.58	40.21	33.10	22.80	29.77	60.07	78.90	80.81	67.27	60.16	59.30	59.87	54.03
2002	56.94	61.21	40.58	27.60	25.00	52.00	57.74	84.55	69.40	48.90	56.70	53.90	52.82
2003	62.65	68.32	43.26	25.73	19.19	45.77	74.81	84.23	83.37	55.03	61.47	64.55	57.31
2004	70.13	63.79	39.87	29.70	36.65	50.53	70.32	83.00	69.93	62.19	57.30	59.06	57.74
2005	61.87	59.75	48.16	28.97	26.16	41.93	77.16	79.06	76.60	60.61	59.70	62.42	56.90
2006	53.52	63.28	22.77	15.49	19.59	52.19	82.97	82.74	73.24	49.58	42.16	45.09	50.16
2007	37.34	32.43	22.77	30.60	62.32	78.43	80.97	67.03	59.57	58.97	58.70	41.00	52.63
2008	77.26	72.45	56.55	38.17	30.84	59.47	74.65	76.94	73.10	57.13	59.70	62.74	61.58
2009	72.94	63.32	44.70	31.23	25.52	32.40	73.71	78.77	73.17	58.61	69.73	66.81	57.63
2010	47.32	48.36	22.52	11.60	22.48	41.43	67.00	74.68	68.57	70.39	67.90	62.32	50.43
2011	63.39	66.50	54.16	34.97	20.10	46.20	67.61	67.55	64.83	54.19	56.00	58.42	54.44
2012	59.42	55.24	42.81	27.73	21.84	35.70	62.19	69.10	64.03	42.35	63.10	59.26	50.23
2013	47.94	56.18	36.23	23.97	15.68	38.33	64.94	65.68	46.17	50.29	23.97	26.42	41.28
2014	32.52	28.46	19.68	9.93	11.16	10.87	50.03	60.00	54.53	25.42	24.30	24.39	29.33
2015	30.71	56.67	44.19	18.43	13.55	43.67	81.97	98.19	60.50	48.84	42.14	45.09	48.68
2016	32.52	28.17	19.29	9.87	11.23	11.67	51.23	59.71	53.40	25.43	24.07	24.77	29.35
2017	51.51	41.13	22.77	15.49	19.59	51.46	82.93	82.74	73.24	49.58	42.16	45.09	48.23
2018	51.51	41.13	22.77	15.49	19.59	51.49	83.10	82.74	73.24	49.58	42.16	45.09	48.24
General	**51.43**	**51.19**	**35.06**	**23.80**	**24.85**	**44.56**	**69.11**	**76.22**	**68.00**	**52.79**	**50.65**	**48.26**	**49.68**

Table 5: Best fitted monthly results of maximum temperature

	Month												
Year	*Jan.*	*Feb.*	*Mar.*	*April*	*May*	*June*	*July*	*Aug.*	*Sep.*	*Oct.*	*Nov.*	*Dec.*	*Annual*
Best-fitted model	*Logistic*	*Logistic*	*Logistic*	*Logistic*	*Logistic*	*Weibull*	*Logistic*	*Logistic*	*Weibull*	*Gamma*	*Logistic*	*Lognormal*	*Gamma*
ℓ	-54.37	-48.77	-49.34	-39.19	-51.55	-54.03	-42.18	-38.66	-41.27	-44.89	-47.21	-41.95	-31.17
AIC	112.74	101.54	102.67	82.38	107.10	112.05	88.37	81.32	86.53	93.79	98.42	87.91	66.33
BIC	115.01	103.81	104.95	84.65	109.37	114.32	90.64	83.59	88.81	96.06	100.69	90.18	68.61
CAIC	113.34	102.14	103.27	82.98	107.70	112.65	88.97	81.92	87.13	94.39	99.02	88.51	66.93
HQIC	113.31	102.11	103.25	82.95	107.67	112.62	88.94	81.89	87.11	94.36	98.99	88.48	66.91
KS Stat.	0.17	0.12	0.10	0.11	0.16	0.09	0.11	0.16	0.11	0.12	0.10	0.12	0.17
KS p val.	0.43	0.90	0.96	0.96	0.56	0.99	0.96	0.63	0.93	0.87	0.97	0.92	0.50
Par1	24.45	27.36	33.85	39.25	41.06	17.13	3.41	28.74	24.55	358.23	29.98	3.27	1144.14
Par2	1.35	1.13	1.16	0.73	1.16	37.33	0.05	0.71	31.49	11.10	1.04	0.06	36.04

Table 6: Best fitted monthly results of minimum temperature

	Month												
Year	*Jan.*	*Feb.*	*Mar.*	*April*	*May*	*June*	*July*	*Aug.*	*Sep.*	*Oct.*	*Nov.*	*Dec.*	*Annual*
Best-fitted model	*Weibull*	*Weibull*	*Weibull*	*Weibull*	*Weibull*	*Normal*	*Weibull*	*Normal*	*Lognormal*	*Lognormal*	*Weibull*	*Weibull*	*Weibull*
ℓ	-58.37	-51.42	-47.66	-50.65	-37.13	-34.77	-29.11	-26.01	-39.77	-47.72	-51.27	-48.47	-17.41
AIC	120.73	106.85	99.33	105.3	78.26	73.54	62.23	56.01	83.55	99.44	106.54	100.93	38.83
BIC	123	109.12	101.6	107.57	80.53	75.81	64.5	58.28	85.82	101.71	108.81	103.2	41.1
CAIC	121.33	107.45	99.93	105.9	78.86	74.14	62.83	56.61	84.15	100.04	107.14	101.53	39.43
HQIC	121.3	107.42	99.9	105.87	78.83	74.11	62.8	56.58	84.12	100.01	107.11	101.5	39.4
KS Stat.	0.22	0.17	0.18	0.21	0.14	0.09	0.13	0.2	0.2	0.19	0.2	0.13	0.13
KS p val.	0.23	0.5	0.48	0.29	0.74	0.99	0.86	0.34	0.34	0.38	0.29	0.85	0.81
Par1	3.78	6.21	9.18	10.64	24.55	26.36	32.03	24.05	3.14	2.97	7.18	6.24	42.83
Par2	12.62	13.91	17.51	23.22	27.28	1.1	25.05	0.75	0.06	0.1	16.08	12.36	19.83

Table 7: Best fitted monthly results of morning relative humidity

	Month												
Year	*Jan.*	*Feb.*	*Mar.*	*April*	*May*	*June*	*July*	*Aug.*	*Sep.*	*Oct.*	*Nov.*	*Dec.*	*Annual*
Best-fitted model	*Weibull*	*Logistic*	*Normal*	*Logistic*	*Gamma*	*Logistic*	*Logistic*	*Normal*	*Logistic*	*Logistic*	*Logistic*	*Lognormal*	*Weibull*
ℓ	-78.00	-83.86	-87.45	-89.53	-89.21	-88.29	-70.01	-57.25	-68.09	-80.58	-83.49	-83.67	-71.65
AIC	160.01	171.71	178.91	183.07	182.41	180.57	144.02	118.5	140.18	165.17	170.99	171.34	147.31
BIC	162.28	173.98	181.18	185.34	184.68	182.85	146.29	120.77	142.45	167.44	173.26	173.61	149.58
CAIC	160.61	172.31	179.51	183.67	183.01	181.17	144.62	119.1	140.78	165.77	171.59	171.94	147.91
HQIC	160.58	172.28	179.48	183.64	182.98	181.15	144.59	119.07	140.75	165.74	171.56	171.91	147.88
KS Stat.	0.08	0.14	0.1	0.13	0.12	0.12	0.19	0.14	0.15	0.14	0.11	0.13	0.11
KS p val.	1	0.72	0.98	0.81	0.83	0.87	0.36	0.79	0.69	0.77	0.96	0.81	0.89
Par1	12.55	77.79	62.75	45.37	17.02	71.39	89.01	91.25	88.98	76.67	71.92	4.31	72.98
Par2	81.55	5.34	10.84	6.91	0.35	6.11	2.8	2.92	2.52	4.35	5.14	0.12	3.07

Table 8: Best fitted monthly results of evening relative humidity

	Month												
Year	*Jan.*	*Feb.*	*Mar.*	*April*	*May*	*June*	*July*	*Aug.*	*Sep.*	*Oct.*	*Nov.*	*Dec.*	*Annual*
Best-fitted model	*Weibull*	*Weibull*	*Weibull*	*Gamma*	*Gamma*	*Logistic*	*Logistic*	*Logistic*	*Logistic*	*Logistic*	*Logistic*	*Logistic*	*Logistic*
ℓ	-91.49	-90.83	-88.52	-82.71	-83.34	-92.69	-90.56	-82.81	-82.6	-87.61	-93.39	-95.11	-79.39
AIC	186.97	185.67	181.04	169.43	170.68	189.38	185.12	169.62	169.19	179.22	190.78	194.22	162.78
BIC	189.24	187.94	183.31	171.7	172.95	191.65	187.39	171.89	171.47	181.49	193.05	196.49	165.05
CAIC	187.57	186.27	181.64	170.03	171.28	189.98	185.72	170.22	169.79	179.82	191.38	194.82	163.38
HQIC	187.54	186.24	181.61	170	171.25	189.95	185.69	170.19	169.77	179.79	191.35	194.79	163.35
KS Stat.	0.09	0.13	0.2	0.13	0.13	0.14	0.14	0.13	0.11	0.12	0.19	0.18	0.14
KS p val.	0.99	0.86	0.3	0.82	0.84	0.75	0.69	0.82	0.96	0.87	0.39	0.48	0.71
Par1	4.42	4.72	3.41	6.55	6.79	45.42	70.65	76.47	68.6	54	51.93	48.99	50.68
Par2	56.45	56.14	39.18	0.28	0.27	7.38	6.94	5.01	4.92	6.01	8.01	8.81	4.16

4. Conclusion

In this study, maximum temperature, minimum temperature, morning relative humidity and evening relative humidity data from 1996 to 2018 were modeled using normal, logistic, Weibull, gamma and lognormal distributions.The average maximum temperature, minimum temperature, morning relative humidity, and evening relative humidity values for each month in these years have been tabulated in detail. Modeling tables are given for maximum temperature, minimum temperature, morning relative humidity and evening relative humidity data by using some goodness of fit statistics.This study is a guide to be used for future studies for this region, thanks to this extensive modeling..

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