STAT 201: Elementary Statistics Session 13 & 14
Final Exam
Instructor: Haigang Liu

1. *12 points* The Institute for Public Opinion Research at Florida International University has conducted the FIU/Florida Poll of about 1200 Floridians annually since 1988 to track opinions on a wide variety of issues. In 2006 the poll asked how concerned are you about the problem of global warming. The possible responses were very concerned, somewhat concerned, not very concerned, and have not heard about it. The poll reported percentages (44, 30, 21, 6) in these categories.

1) Identify the sample and the population.
2) Are the percentages quoted statistics or parameters? Why?
3) What type of variable that FIU collected in 2006's poll? Quantitative or Categorical?

2. *12 points* `cars` is a well known dataset in R package. The data were recorded in the 1920s. It contains 50 observations on 2 variables (the speed of cars and the distance to stop). We study the relationship, by linear regression, the relationship between Y, the distance to stop, and X, the speed of cars.

1) Read the output from StatCrunch in Figure 2 and and comment on strength, direction of the correlation between X and Y. Is it justifiable to apply a linear model in this scenario? Explain.

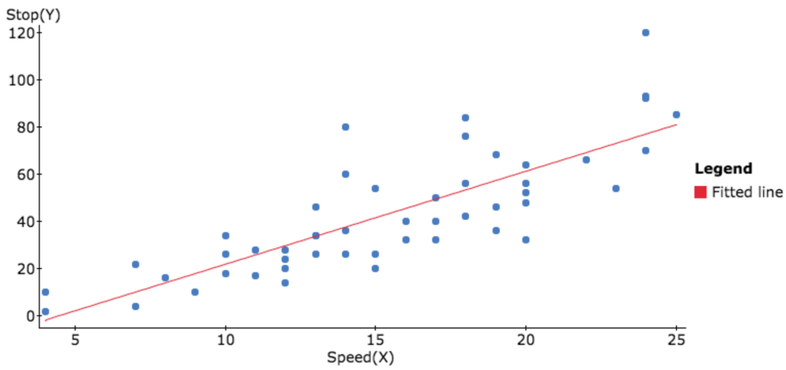

Figure 1: Scatter plot

2) Write down the linear regression model based on the output given by Figure 1.

Parameter	Estimate	Std. Err.	Alternative	DF	T-Stat	P-value
Intercept	-17.579095	6.7584402	≠ 0	48	-2.601058	0.0123
Slope	3.9324088	0.41551278	≠ 0	48	9.46399	<0.0001

Figure 2: Regression effects

3) Interpret the slope of the regression equation you obtain in 2) *in the context of* this problem.
4) Apply this equation to predict the stop distance for X = 20.

3. *12 points* Gasoline consumption for all families in Raleigh has a normal distribution with a mean of 16.9 gallons per week with a standard deviation of 3.2 gallons per week.

1) Find the probability that a randomly selected family consumes between 16 and 17 gallons of gasoline per week. *Hint:* The z-score table is attached at the end of the exam.
2) Find the probability that a random sample of 6 families exceeds a mean of 17.5 gallons of gasoline per week.
3) Would a sample mean of 17.5 be considered unusual? Justify your answer.

4. *12 points* A knowledge test is required to acquire driver's permit. In Washington DC, the first part of test has 6 questions for road signs. In each question there are 3 possible answers. Suppose each question is answered by random guess.

1) Name the distribution of the number of right answers, and specify parameters.
2) Exam takers will be marked as Fail unless he or she makes all 6 questions correct. Find the probability of passing that test by random guess. *Hint:* The probability calculation formula is given by

$$P(X = x) = \frac{n!}{(n-x)!\ x!} p^x (1-p)^{n-x}.$$

3) Give the mean, or expected value of the number of right answers based on random guess. *Hint*: The formula of expected value is given by $EX = np$.
4) Which of the following graph better describes the shape of the distribution given in 1)? The left one or the right one?

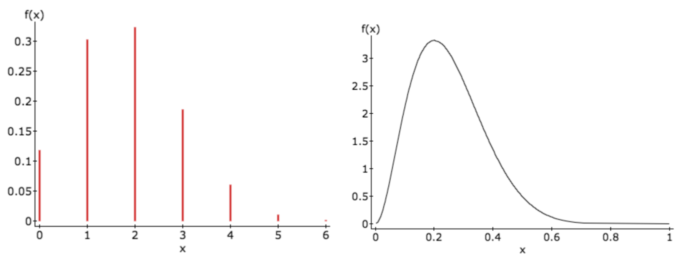

Figure 3: Regression effects

5. *16 points* How can we investigate how the percentage of foods carrying pesticide residuals compares for organic and conventionally grown foods? The Consumers Union led a study based on sampling carried out by the U.S. Department of Agriculture (USDA) and the state of California. The sampling was part of regulatory monitoring of foods for pesticide residues. For this study, Table 2 displays the frequencies of foods for all possible category combinations of the two variables, food type and pesticide status.

	P	P^c
O	29	98
O^c	19,485	7,086

Table 1: The contingency table of Pesticide and Organic/Conventional

Note that P denotes that the pesticide is present, and P^c denotes the pesticide is not there. Similarly, O denotes that the food is from organic farming, and O^c denotes that the food is from conventional farming. Read Table 2 and answer the following questions. *Hint*: The formula of conditional probability is $P(A|B) = \frac{P(A \cap B)}{P(B)}$, or equivalently, $P(A \cap B) = P(A)P(A|B)$.

1) For this sample, what is the probability that a randomly selected food sample has pesticide residue i.e., $P(P)$?
2) For this sample, given that a food sample is organic food, what is the probability that it has pesticide residue, i.e. $P(P|O)$?
3) For this sample, what is the probability of a randomly selected food sample is both organic food and has pesticide, i.e. $P(P \cap O)$?
4) Are containing pesticide (P) and Organic way of farming (O) independent? Justify your answer by comparing quantities in 1) and 2).

6. *12 points* A pediatrician records the number of ear infections that his patients have during the winter. A distribution of probabilities for number of ear infections is displayed below.

Number of ear infections	0	1	2	3	4	5	6
Probability	0.05	0.16	0.25	0.33	0.15	0.04	0.02

Table 2: The probability distribution of ear infections

1) Verify that Table 2 gives a valid probability distribution.
2) What is the probability that a patient has more than three ear infections during the winter?
3) What is the mean of the probability distribution?

7. *12 points* A movie theater is interested in the proportion of Columbia Pictures films that are R-rated. A random sample of 60 films are considered, of which 35 are R-rated.

a) Compute a 95% confidence interval for the proportion of all Columbia pictures that are R-rated. *Hint:* The formula to calculate the standard error of sample proportion is given by

$$\mathrm{sd}(\hat{p}) = \sqrt{\frac{\hat{p}(1-\hat{p})}{n}},$$

and the confidence interval follows a format of $(\hat{p} - 1.96 \times \mathrm{sd}(\hat{p}), \quad \hat{p} + 1.96 \times \mathrm{sd}(\hat{p}))$
b)Interpret(Explain) the 95% confidence interval from a) *in the context of* the problem.

8. *12 points* An obstetrician is studying twin pregnancies. He is interested in whether there is a difference in mean birth weight between the first born twin (twin A) and the second born twin (twin B). Data are available from 32 randomly selected sets of twins. A hypothesis test will be conducted using a 0.10 level of significance ($\alpha = 0.10$). The output of hypothesis testing is given as follows. Using the output, give the five steps of the hypothesis test.

$\mu_A - \mu_B$: mean of the paired difference between TwinA and TwinB
$H_0 : \mu_A$ - $\mu_B = 0$
$H_A : \mu_A - \mu_B \neq 0$

```
Difference        Sample Diff.    Std. Err.    DF    T-Stat    P-value
TwinA - TwinB      -0.18092105    0.16087063   31    -1.124637 0.2755
```

Z Score Table- chart value corresponds to area below z score.

z	**0.09**	**0.08**	**0.07**	**0.06**	**0.05**	**0.04**	**0.03**	**0.02**	**0.01**	**0.00**
–3.4	0.0002	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003
–3.3	0.0003	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0005	0.0005	0.0005
–3.2	0.0005	0.0005	0.0005	0.0006	0.0006	0.0006	0.0006	0.0006	0.0007	0.0007
–3.1	0.0007	0.0007	0.0008	0.0008	0.0008	0.0008	0.0009	0.0009	0.0009	0.0010
–3.0	0.0010	0.0010	0.0011	0.0011	0.0011	0.0012	0.0012	0.0013	0.0013	0.0013
–2.9	0.0014	0.0014	0.0015	0.0015	0.0016	0.0016	0.0017	0.0018	0.0018	0.0019
–2.8	0.0019	0.0020	0.0021	0.0021	0.0022	0.0023	0.0023	0.0024	0.0025	0.0026
–2.7	0.0026	0.0027	0.0028	0.0029	0.0030	0.0031	0.0032	0.0033	0.0034	0.0035
–2.6	0.0036	0.0037	0.0038	0.0039	0.0040	0.0041	0.0043	0.0044	0.0045	0.0047
–2.5	0.0048	0.0049	0.0051	0.0052	0.0054	0.0055	0.0057	0.0059	0.0060	0.0062
–2.4	0.0064	0.0066	0.0068	0.0069	0.0071	0.0073	0.0075	0.0078	0.0080	0.0082
–2.3	0.0084	0.0087	0.0089	0.0091	0.0094	0.0096	0.0099	0.0102	0.0104	0.0107
–2.2	0.0110	0.0113	0.0116	0.0119	0.0122	0.0125	0.0129	0.0132	0.0136	0.0139
–2.1	0.0143	0.0146	0.0150	0.0154	0.0158	0.0162	0.0166	0.0170	0.0174	0.0179
–2.0	0.0183	0.0188	0.0192	0.0197	0.0202	0.0207	0.0212	0.0217	0.0222	0.0228
–1.9	0.0233	0.0239	0.0244	0.0250	0.0256	0.0262	0.0268	0.0274	0.0281	0.0287
–1.8	0.0294	0.0301	0.0307	0.0314	0.0322	0.0329	0.0336	0.0344	0.0351	0.0359
–1.7	0.0367	0.0375	0.0384	0.0392	0.0401	0.0409	0.0418	0.0427	0.0436	0.0446
–1.6	0.0455	0.0465	0.0475	0.0485	0.0495	0.0505	0.0516	0.0526	0.0537	0.0548
–1.5	0.0559	0.0571	0.0582	0.0594	0.0606	0.0618	0.0630	0.0643	0.0655	0.0668
–1.4	0.0681	0.0694	0.0708	0.0721	0.0735	0.0749	0.0764	0.0778	0.0793	0.0808
–1.3	0.0823	0.0838	0.0853	0.0869	0.0885	0.0901	0.0918	0.0934	0.0951	0.0968
–1.2	0.0985	0.1003	0.1020	0.1038	0.1056	0.1075	0.1093	0.1112	0.1131	0.1151
–1.1	0.1170	0.1190	0.1210	0.1230	0.1251	0.1271	0.1292	0.1314	0.1335	0.1357
–1.0	0.1379	0.1401	0.1423	0.1446	0.1469	0.1492	0.1515	0.1539	0.1562	0.1587
–0.9	0.1611	0.1635	0.1660	0.1685	0.1711	0.1736	0.1762	0.1788	0.1814	0.1841
–0.8	0.1867	0.1894	0.1922	0.1949	0.1977	0.2005	0.2033	0.2061	0.2090	0.2119
–0.7	0.2148	0.2177	0.2206	0.2236	0.2266	0.2296	0.2327	0.2358	0.2389	0.2420
–0.6	0.2451	0.2483	0.2514	0.2546	0.2578	0.2611	0.2643	0.2676	0.2709	0.2743
–0.5	0.2776	0.2810	0.2843	0.2877	0.2912	0.2946	0.2981	0.3015	0.3050	0.3085
–0.4	0.3121	0.3156	0.3192	0.3228	0.3264	0.3300	0.3336	0.3372	0.3409	0.3446
–0.3	0.3483	0.3520	0.3557	0.3594	0.3632	0.3669	0.3707	0.3745	0.3783	0.3821
–0.2	0.3859	0.3897	0.3936	0.3974	0.4013	0.4052	0.4090	0.4129	0.4168	0.4207
–0.1	0.4247	0.4286	0.4325	0.4364	0.4404	0.4443	0.4483	0.4522	0.4562	0.4602
–0.0	0.4641	0.4681	0.4721	0.4761	0.4801	0.4840	0.4880	0.4920	0.4960	0.5000

z	**0.00**	**0.01**	**0.02**	**0.03**	**0.04**	**0.05**	**0.06**	**0.07**	**0.08**	**0.09**
0.0	0.5000	0.5040	0.5080	0.5120	0.5160	0.5199	0.5239	0.5279	0.5319	0.5359
0.1	0.5398	0.5438	0.5478	0.5517	0.5557	0.5596	0.5636	0.5675	0.5714	0.5753
0.2	0.5793	0.5832	0.5871	0.5910	0.5948	0.5987	0.6026	0.6064	0.6103	0.6141
0.3	0.6179	0.6217	0.6255	0.6293	0.6331	0.6368	0.6406	0.6443	0.6480	0.6517
0.4	0.6554	0.6591	0.6628	0.6664	0.6700	0.6736	0.6772	0.6808	0.6844	0.6879
0.5	0.6915	0.6950	0.6985	0.7019	0.7054	0.7088	0.7123	0.7157	0.7190	0.7224
0.6	0.7257	0.7291	0.7324	0.7357	0.7389	0.7422	0.7454	0.7486	0.7517	0.7549
0.7	0.7580	0.7611	0.7642	0.7673	0.7704	0.7734	0.7764	0.7794	0.7823	0.7852
0.8	0.7881	0.7910	0.7939	0.7967	0.7995	0.8023	0.8051	0.8078	0.8106	0.8133
0.9	0.8159	0.8186	0.8212	0.8238	0.8264	0.8289	0.8315	0.8340	0.8365	0.8389
1.0	0.8413	0.8438	0.8461	0.8485	0.8508	0.8531	0.8554	0.8577	0.8599	0.8621
1.1	0.8643	0.8665	0.8686	0.8708	0.8729	0.8749	0.8770	0.8790	0.8810	0.8830
1.2	0.8849	0.8869	0.8888	0.8907	0.8925	0.8944	0.8962	0.8980	0.8997	0.9015
1.3	0.9032	0.9049	0.9066	0.9082	0.9099	0.9115	0.9131	0.9147	0.9162	0.9177
1.4	0.9192	0.9207	0.9222	0.9236	0.9251	0.9265	0.9279	0.9292	0.9306	0.9319
1.5	0.9332	0.9345	0.9357	0.9370	0.9382	0.9394	0.9406	0.9418	0.9429	0.9441
1.6	0.9452	0.9463	0.9474	0.9484	0.9495	0.9505	0.9515	0.9525	0.9535	0.9545
1.7	0.9554	0.9564	0.9573	0.9582	0.9591	0.9599	0.9608	0.9616	0.9625	0.9633
1.8	0.9641	0.9649	0.9656	0.9664	0.9671	0.9678	0.9686	0.9693	0.9699	0.9706
1.9	0.9713	0.9719	0.9726	0.9732	0.9738	0.9744	0.9750	0.9756	0.9761	0.9767
2.0	0.9772	0.9778	0.9783	0.9788	0.9793	0.9798	0.9803	0.9808	0.9812	0.9817
2.1	0.9821	0.9826	0.9830	0.9834	0.9838	0.9842	0.9846	0.9850	0.9854	0.9857
2.2	0.9861	0.9864	0.9868	0.9871	0.9875	0.9878	0.9881	0.9884	0.9887	0.9890
2.3	0.9893	0.9896	0.9898	0.9901	0.9904	0.9906	0.9909	0.9911	0.9913	0.9916
2.4	0.9918	0.9920	0.9922	0.9925	0.9927	0.9929	0.9931	0.9932	0.9934	0.9936
2.5	0.9938	0.9940	0.9941	0.9943	0.9945	0.9946	0.9948	0.9949	0.9951	0.9952
2.6	0.9953	0.9955	0.9956	0.9957	0.9959	0.9960	0.9961	0.9962	0.9963	0.9964
2.7	0.9965	0.9966	0.9967	0.9968	0.9969	0.9970	0.9971	0.9972	0.9973	0.9974
2.8	0.9974	0.9975	0.9976	0.9977	0.9977	0.9978	0.9979	0.9979	0.9980	0.9981
2.9	0.9981	0.9982	0.9982	0.9983	0.9984	0.9984	0.9985	0.9985	0.9986	0.9986
3.0	0.9987	0.9987	0.9987	0.9988	0.9988	0.9989	0.9989	0.9989	0.9990	0.9990
3.1	0.9990	0.9991	0.9991	0.9991	0.9992	0.9992	0.9992	0.9992	0.9993	0.9993
3.2	0.9993	0.9993	0.9994	0.9994	0.9994	0.9994	0.9994	0.9995	0.9995	0.9995
3.3	0.9995	0.9995	0.9995	0.9996	0.9996	0.9996	0.9996	0.9996	0.9996	0.9997
3.4	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9998

Answer Sheet Page One

First Name: Last Name:

Answer Sheet Page Two

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Answer Sheet Page Three

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Answer Sheet Page Four

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Answer Sheet Page Five

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