ECO220Y1Y, Test #4, Prof. Murdock

March 6, 2020, 9:10 – 11:00 am

U of T E-MAIL: ________________________________@MAIL.UTORONTO.CA

SURNAME (LAST NAME):																			
GIVEN NAME (FIRST NAME):																			
UTORID: (e.g. LIHAO118)																			

Instructions:

- You have 110 minutes. Keep these test papers and the *Supplement* closed and face up on your desk until the start of the test is announced. You must stay for a minimum of 60 minutes.
- You may use a non-programmable calculator.
- There are 5 questions (most with multiple parts) with varying point values worth a total of 95 points.
- This test includes these 8 pages plus the *Supplement*. The *Supplement* contains the aid sheets, statistical tables (Standard Normal and Student t), readings, figures, tables, and other materials for some test questions. For each question referencing the *Supplement*, carefully review *all* materials. ***The Supplement will NOT be graded:*** write your answers on these test papers. When we announce the end of the test, hand these test papers to us (you keep the *Supplement*).
- Write your answers clearly, completely, and concisely in the designated space provided immediately after each question. An answer guide ends each question to let you know what is expected. For example, a quantitative analysis (which shows your work and reasoning), a fully labelled graph, and/or sentences.
    - Anything requested by the question and/or the answer guide is required. Similarly, limit yourself to the answer guide. For example, if the answer guide does not request sentences, provide only what is requested (e.g. quantitative analysis).
    - Marking TAs are instructed to accept all reasonable rounding.
- ***Your entire answer must fit in the designated space provided immediately after each question.*** No extra space/pages are possible. You *cannot* use blank space for other questions nor can you write answers on the *Supplement*. ***Write in PENCIL and use an ERASER as needed*** so that you can fit your final answer (including work and reasoning) in the appropriate space. Questions give more blank space than is needed for an answer (with typical handwriting) worth full marks. ***Follow the answer guides and avoid excessively long answers.***

(1) ***Supplement for Question (1)***: *Dizon-Ross (2019): Children's Educational Achievement.*

(a) [4 pts] In **Regression #1**, what is the missing value for "`R-squared`"? Answer with a quantitative analysis.

(b) [4 pts] In **Regression #1**, what is the missing value for "`Std. Err.`"? Answer with a quantitative analysis.

**>>

(c) [9 pts] In **Regression #2**, what is the missing value for "`P>|t|`"? What is the hypothesis test? What is the *conclusion in this context*? <u>Answer with hypotheses in formal notation, the missing value & 2 – 3 sentences.</u>

(2) ***Supplement for Question (2)***: *Household Electrification and Development.*

(a) [4 pts] Among the 138 countries in the World Bank DataBank, what is the coefficient of correlation between energy consumption per capita (kWh) and GDP per capita (USD)? <u>Answer with a quantitative analysis.</u>

(b) [10 pts] For **Regression #5**, what is the *interpretation* of 475.0389 and 4.2324? Answer with 2 – 3 sentences.

(c) [6 pts] For **Regression #4**, what is the *interpretation* of 0.8357? Answer with 1 precise sentence.

(d) [12 pts] For **<u>Regression #7</u>**, the s_e equals 9529.3. In plain English, what does the s_e measure in this context? Include the units of measurement of the s_e in this case. Is it big or small? For **<u>Regression #7</u>**, explain why the s_e is a *misleading* measure in this context. <u>Answer with 4 – 5 sentences.</u>

(3) ***Supplement for Question (3)***: *What People Think about Trump's Likelihood of Re-Election.*

(a) [15 pts] Suppose *The Varsity*, a U of T student newspaper, wants to prove a majority of U of T students think Trump is likely to win. If 55 percent of all U of T students think that and *The Varsity* surveys a random sample of 100, what is the power of the test? Compute power for a 10% significance level. <u>Answer with hypotheses in formal notation, TWO fully-labelled graphs, a quantitative analysis & the requested probability.</u>

(b) [7 pts] Suppose *El Universal*, a major Mexican newspaper, wishes to prove that a majority of Mexicans think Trump is likely to win. If 53 percent of all Mexicans think that and *El Universal* surveys a sample of 1,000, then for a 5% significance level the probability of a Type II error is 0.40. *Explain in plain language* (that a newspaper editor without statistics training could understand) what 0.40 means *in this context*. Answer with 1 precise sentence.

(c) [3 pts] Continue with Part **(b)**. For each of the below, assume everything else except for the underlined part is identical to Part **(b)**. Fill in the blanks with "smaller than," "larger than," or "equal to."

- For a 1% significance level, P(Type II error) will be ______________________ 0.40.
- For a sample of 2,000 Mexicans, P(Type II error) will be ______________________ 0.40.
- If 52% of all Mexicans think Trump is likely to win, P(Type II error) will be ______________________ 0.40.

(4) [4 pts] Recall "Sex ratios among Canadian liveborn infants of mothers from different countries" from 2012 in the *Canadian Medical Association Journal* (DOI:10.1503 /cmaj.120165). Recall also that absent interference, 51.2 percent of infants are male. A researcher wants to prove that the proportion male is above the natural rate. In a sample of 10,000, 5,050 are male yielding a P-value of 0.9193. Fill in the blanks with "smaller than," "larger than," or "equal to."

- For a sample of 10,000 births where 5,060 are male, the P-value will be ______________________ 0.9193.
- For a sample of 100,000 birth where 50,500 are male, the P-value will be ______________________ 0.9193.
- To prove $H_1: p < 0.512$ where 5,050 (of 10,000) are male, the P-value will be ______________________ 0.9193.
- To prove $H_1: p \neq 0.512$ where 5,050 (of 10,000) are male, the P-value will be ______________________ 0.9193.

(5) ***Supplement for Question (5)***: *House Characteristics in the Greater Austin (Texas) Area.*

(a) [8 pts] Among homes sold at least once during 1997-2014, how much do house sizes inside Austin differ from outside Austin? Find the *best answer* with the *most appropriate method*. <u>Answer with a quantitative analysis.</u>

(b) [9 pts] In testing whether the <u>number of times a home has sold</u> differs between Columns (2) and (3) the P-value is 6.08323E-18. The authors do *not* mention this as a significant difference when discussing Columns (2) and (3). *Explain* why not. Also, for <u>year built</u>, explain why they say there *is* a significant difference. <u>Answer with 3 – 4 sentences.</u>

This *Supplement* contains the aid sheets, statistical tables (Standard Normal and Student t), readings, figures, tables, and other materials for some test questions. For each question referencing this *Supplement*, carefully review *all* materials.

Sample mean: $\bar{X} = \frac{\sum_{i=1}^{n} x_i}{n}$ **Sample variance:** $s^2 = \frac{\sum_{i=1}^{n}(x_i - \bar{X})^2}{n-1} = \frac{\sum_{i=1}^{n} x_i^2}{n-1} - \frac{\left(\sum_{i=1}^{n} x_i\right)^2}{n(n-1)}$ **Sample s.d.:** $s = \sqrt{s^2}$

Sample coefficient of variation: $CV = \frac{s}{\bar{X}}$ **Sample covariance:** $s_{xy} = \frac{\sum_{i=1}^{n}(x_i - \bar{X})(y_i - \bar{Y})}{n-1} = \frac{\sum_{i=1}^{n} x_i y_i}{n-1} - \frac{(\sum_{i=1}^{n} x_i)(\sum_{i=1}^{n} y_i)}{n(n-1)}$

Sample interquartile range: $IQR = Q3 - Q1$ **Sample coefficient of correlation:** $r = \frac{s_{xy}}{s_x s_y} = \frac{\sum_{i=1}^{n} z_{x_i} z_{y_i}}{n-1}$

Expected value: $E[X] = \mu = \sum_{all\ x} x p(x)$ **Variance:** $V[X] = E[(X-\mu)^2] = \sigma^2 = \sum_{all\ x}(x-\mu)^2 p(x)$

Covariance: $COV[X,Y] = E[(X-\mu_X)(Y-\mu_Y)] = \sigma_{XY} = \sum_{all\ x}\sum_{all\ y}(x-\mu_X)(y-\mu_Y)p(x,y)$

Laws of expected value:

$E[c] = c$
$E[X + c] = E[X] + c$
$E[cX] = cE[X]$
$E[a + bX + cY] = a + bE[X] + cE[Y]$

Laws of variance:

$V[c] = 0$
$V[X + c] = V[X]$
$V[cX] = c^2 V[X]$
$V[a + bX + cY] = b^2 V[X] + c^2 V[Y] + 2bc * COV[X,Y]$
$V[a + bX + cY] = b^2 V[X] + c^2 V[Y] + 2bc * SD(X) * SD(Y) * \rho$
where $\rho = CORRELATION[X,Y]$

Laws of covariance:

$COV[X, c] = 0$
$COV[a + bX, c + dY] = bd * COV[X,Y]$

If *X* is Uniform $(X \sim U[a,b])$ **then** $f(x) = \frac{1}{b-a}$ **and** $E[X] = \frac{a+b}{2}$ **and** $V[X] = \frac{(b-a)^2}{12}$

Sampling distribution of $\bar{X}$:

$\mu_{\bar{X}} = E[\bar{X}] = \mu$
$\sigma_{\bar{X}}^2 = V[\bar{X}] = \frac{\sigma^2}{n}$
$\sigma_{\bar{X}} = SD[\bar{X}] = \frac{\sigma}{\sqrt{n}}$

Sampling distribution of $\hat{P}$:

$\mu_{\hat{P}} = E[\hat{P}] = p$
$\sigma_{\hat{P}}^2 = V[\hat{P}] = \frac{p(1-p)}{n}$
$\sigma_{\hat{P}} = SD[\hat{P}] = \sqrt{\frac{p(1-p)}{n}}$

Sampling distribution of $(\hat{P}_2 - \hat{P}_1)$:

$\mu_{\hat{P}_2 - \hat{P}_1} = E[\hat{P}_2 - \hat{P}_1] = p_2 - p_1$
$\sigma_{\hat{P}_2 - \hat{P}_1}^2 = V[\hat{P}_2 - \hat{P}_1] = \frac{p_2(1-p_2)}{n_2} + \frac{p_1(1-p_1)}{n_1}$
$\sigma_{\hat{P}_2 - \hat{P}_1} = SD[\hat{P}_2 - \hat{P}_1] = \sqrt{\frac{p_2(1-p_2)}{n_2} + \frac{p_1(1-p_1)}{n_1}}$

Sampling distribution of $(\bar{X}_1 - \bar{X}_2)$, independent samples:

$\mu_{\bar{X}_1 - \bar{X}_2} = E[\bar{X}_1 - \bar{X}_2] = \mu_1 - \mu_2$
$\sigma_{\bar{X}_1 - \bar{X}_2}^2 = V[\bar{X}_1 - \bar{X}_2] = \frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}$
$\sigma_{\bar{X}_1 - \bar{X}_2} = SD[\bar{X}_1 - \bar{X}_2] = \sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}$

Sampling distribution of $(\bar{X}_d)$, paired ($d = X_1 - X_2$):

$\mu_{\bar{X}_d} = E[\bar{X}_d] = \mu_1 - \mu_2$
$\sigma_{\bar{X}_d}^2 = V[\bar{X}_d] = \frac{\sigma_d^2}{n} = \frac{\sigma_1^2 + \sigma_2^2 - 2*\rho*\sigma_1*\sigma_2}{n}$
$\sigma_{\bar{X}_d} = SD[\bar{X}_d] = \frac{\sigma_d}{\sqrt{n}} = \sqrt{\frac{\sigma_1^2 + \sigma_2^2 - 2*\rho*\sigma_1*\sigma_2}{n}}$

Inference about a population proportion:

***z* test statistic:** $z = \frac{\hat{P} - p_0}{\sqrt{\frac{p_0(1-p_0)}{n}}}$ **CI estimator:** $\hat{P} \pm z_{\alpha/2}\sqrt{\frac{\hat{P}(1-\hat{P})}{n}}$

Inference about comparing two population proportions:

***z* test statistic under Null hypothesis of no difference:** $z = \frac{\hat{P}_2 - \hat{P}_1}{\sqrt{\frac{\bar{P}(1-\bar{P})}{n_1} + \frac{\bar{P}(1-\bar{P})}{n_2}}}$ **Pooled proportion:** $\bar{P} = \frac{X_1 + X_2}{n_1 + n_2}$

CI estimator: $(\hat{P}_2 - \hat{P}_1) \pm z_{\alpha/2}\sqrt{\frac{\hat{P}_2(1-\hat{P}_2)}{n_2} + \frac{\hat{P}_1(1-\hat{P}_1)}{n_1}}$

Inference about the population mean:

***t* test statistic:** $t = \frac{\bar{X}-\mu_0}{s/\sqrt{n}}$ **CI estimator:** $\bar{X} \pm t_{\alpha/2}\frac{s}{\sqrt{n}}$ **DoF (Degrees of Freedom):** $\nu = n-1$

Inference about a comparing two population means, independent samples, unequal variances:

***t* test statistic:** $t = \frac{(\bar{X}_1-\bar{X}_2)-\Delta_0}{\sqrt{\frac{s_1^2}{n_1}+\frac{s_2^2}{n_2}}}$ **CI estimator:** $(\bar{X}_1-\bar{X}_2) \pm t_{\alpha/2}\sqrt{\frac{s_1^2}{n_1}+\frac{s_2^2}{n_2}}$ **DoF:** $\nu = \frac{\left(\frac{s_1^2}{n_1}+\frac{s_2^2}{n_2}\right)^2}{\frac{1}{n_1-1}\left(\frac{s_1^2}{n_1}\right)^2+\frac{1}{n_2-1}\left(\frac{s_2^2}{n_2}\right)^2}$

Inference about a comparing two population means, independent samples, assuming equal variances:

***t* test statistic:** $t = \frac{(\bar{X}_1-\bar{X}_2)-\Delta_0}{\sqrt{\frac{s_p^2}{n_1}+\frac{s_p^2}{n_2}}}$ **CI estimator:** $(\bar{X}_1-\bar{X}_2) \pm t_{\alpha/2}\sqrt{\frac{s_p^2}{n_1}+\frac{s_p^2}{n_2}}$ **DoF:** $\nu = n_1+n_2-2$

Pooled variance: $s_p^2 = \frac{(n_1-1)s_1^2+(n_2-1)s_2^2}{n_1+n_2-2}$

Inference about a comparing two population means, paired data: (n is number of pairs and $d = X_1 - X_2$)

***t* test statistic:** $t = \frac{\bar{d}-\Delta_0}{s_d/\sqrt{n}}$ **CI estimator:** $\bar{X}_d \pm t_{\alpha/2}\frac{s_d}{\sqrt{n}}$ **DoF:** $\nu = n-1$

SIMPLE REGRESSION:

Model: $y_i = \beta_0+\beta_1 x_i+\varepsilon_i$ **OLS line:** $\hat{y}_i = b_0+b_1 x_i$ $b_1 = \frac{s_{xy}}{s_x^2} = r\frac{s_y}{s_x}$ $b_0 = \bar{Y}-b_1\bar{X}$

$SST = \sum_{i=1}^{n}(y_i-\bar{Y})^2 = SSR+SSE$ $SSR = \sum_{i=1}^{n}(\hat{y}_i-\bar{Y})^2$ $SSE = \sum_{i=1}^{n}{e_i}^2 = \sum_{i=1}^{n}(y_i-\hat{y}_i)^2$

$s_y^2 = \frac{SST}{n-1}$ **Coefficient of determination:** $R^2 = (r)^2 = \frac{SSR}{SST} = 1-\frac{SSE}{SST}$ **Residuals:** $e_i = y_i-\hat{y}_i$

Standard deviation of residuals: $s_e = \sqrt{\frac{SSE}{n-2}} = \sqrt{\frac{\sum_{i=1}^{n}(e_i-0)^2}{n-2}}$ **Standard error of slope:** $s.e.(b_1) = s_{b_1} = \frac{s_e}{\sqrt{(n-1)s_x^2}}$

Inference about the population slope:

***t* test statistic:** $t = \frac{b_1-\beta_{10}}{s.e.(b_1)}$ **CI estimator:** $b_1 \pm t_{\alpha/2}s.e.(b_1)$ **Standard error of slope:** $s.e.(b_1) = s_{b_1} = \frac{s_e}{\sqrt{(n-1)s_x^2}}$

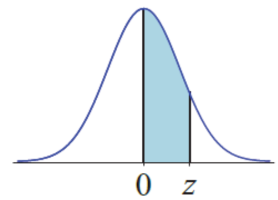
DoF: $\nu = n-2$

Prediction interval for y at given value of x (x_g):

$\hat{y}_{x_g} \pm t_{\alpha/2}s_e\sqrt{1+\frac{1}{n}+\frac{(x_g-\bar{X})^2}{(n-1)s_x^2}}$ **or** $\hat{y}_{x_g} \pm t_{\alpha/2}\sqrt{\left(s.e.(b_1)\right)^2\left(x_g-\bar{X}\right)^2+\frac{s_e^2}{n}+s_e^2}$ **DoF:** $\nu = n-2$

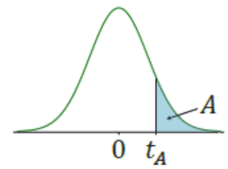
Confidence interval for predicted mean at given value of x (x_g):

$\hat{y}_{x_g} \pm t_{\alpha/2}s_e\sqrt{\frac{1}{n}+\frac{(x_g-\bar{X})^2}{(n-1)s_x^2}}$ **or** $\hat{y}_{x_g} \pm t_{\alpha/2}\sqrt{\left(s.e.(b_1)\right)^2\left(x_g-\bar{X}\right)^2+\frac{s_e^2}{n}}$ **DoF:** $\nu = n-2$



The Standard Normal Distribution:

z	*Second decimal place in z*									
	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.0000	0.0040	0.0080	0.0120	0.0160	0.0199	0.0239	0.0279	0.0319	0.0359
0.1	0.0398	0.0438	0.0478	0.0517	0.0557	0.0596	0.0636	0.0675	0.0714	0.0753
0.2	0.0793	0.0832	0.0871	0.0910	0.0948	0.0987	0.1026	0.1064	0.1103	0.1141
0.3	0.1179	0.1217	0.1255	0.1293	0.1331	0.1368	0.1406	0.1443	0.1480	0.1517
0.4	0.1554	0.1591	0.1628	0.1664	0.1700	0.1736	0.1772	0.1808	0.1844	0.1879
0.5	0.1915	0.1950	0.1985	0.2019	0.2054	0.2088	0.2123	0.2157	0.2190	0.2224
0.6	0.2257	0.2291	0.2324	0.2357	0.2389	0.2422	0.2454	0.2486	0.2517	0.2549
0.7	0.2580	0.2611	0.2642	0.2673	0.2704	0.2734	0.2764	0.2794	0.2823	0.2852
0.8	0.2881	0.2910	0.2939	0.2967	0.2995	0.3023	0.3051	0.3078	0.3106	0.3133
0.9	0.3159	0.3186	0.3212	0.3238	0.3264	0.3289	0.3315	0.3340	0.3365	0.3389
1.0	0.3413	0.3438	0.3461	0.3485	0.3508	0.3531	0.3554	0.3577	0.3599	0.3621
1.1	0.3643	0.3665	0.3686	0.3708	0.3729	0.3749	0.3770	0.3790	0.3810	0.3830
1.2	0.3849	0.3869	0.3888	0.3907	0.3925	0.3944	0.3962	0.3980	0.3997	0.4015
1.3	0.4032	0.4049	0.4066	0.4082	0.4099	0.4115	0.4131	0.4147	0.4162	0.4177
1.4	0.4192	0.4207	0.4222	0.4236	0.4251	0.4265	0.4279	0.4292	0.4306	0.4319
1.5	0.4332	0.4345	0.4357	0.4370	0.4382	0.4394	0.4406	0.4418	0.4429	0.4441
1.6	0.4452	0.4463	0.4474	0.4484	0.4495	0.4505	0.4515	0.4525	0.4535	0.4545
1.7	0.4554	0.4564	0.4573	0.4582	0.4591	0.4599	0.4608	0.4616	0.4625	0.4633
1.8	0.4641	0.4649	0.4656	0.4664	0.4671	0.4678	0.4686	0.4693	0.4699	0.4706
1.9	0.4713	0.4719	0.4726	0.4732	0.4738	0.4744	0.4750	0.4756	0.4761	0.4767
2.0	0.4772	0.4778	0.4783	0.4788	0.4793	0.4798	0.4803	0.4808	0.4812	0.4817
2.1	0.4821	0.4826	0.4830	0.4834	0.4838	0.4842	0.4846	0.4850	0.4854	0.4857
2.2	0.4861	0.4864	0.4868	0.4871	0.4875	0.4878	0.4881	0.4884	0.4887	0.4890
2.3	0.4893	0.4896	0.4898	0.4901	0.4904	0.4906	0.4909	0.4911	0.4913	0.4916
2.4	0.4918	0.4920	0.4922	0.4925	0.4927	0.4929	0.4931	0.4932	0.4934	0.4936
2.5	0.4938	0.4940	0.4941	0.4943	0.4945	0.4946	0.4948	0.4949	0.4951	0.4952
2.6	0.4953	0.4955	0.4956	0.4957	0.4959	0.4960	0.4961	0.4962	0.4963	0.4964
2.7	0.4965	0.4966	0.4967	0.4968	0.4969	0.4970	0.4971	0.4972	0.4973	0.4974
2.8	0.4974	0.4975	0.4976	0.4977	0.4977	0.4978	0.4979	0.4979	0.4980	0.4981
2.9	0.4981	0.4982	0.4982	0.4983	0.4984	0.4984	0.4985	0.4985	0.4986	0.4986
3.0	0.4987	0.4987	0.4987	0.4988	0.4988	0.4989	0.4989	0.4989	0.4990	0.4990
3.1	0.4990	0.4991	0.4991	0.4991	0.4992	0.4992	0.4992	0.4992	0.4993	0.4993
3.2	0.4993	0.4993	0.4994	0.4994	0.4994	0.4994	0.4994	0.4995	0.4995	0.4995
3.3	0.4995	0.4995	0.4995	0.4996	0.4996	0.4996	0.4996	0.4996	0.4996	0.4997
3.4	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4998
3.5	0.4998	0.4998	0.4998	0.4998	0.4998	0.4998	0.4998	0.4998	0.4998	0.4998
3.6	0.4998	0.4998	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999



Critical Values of Student t Distribution:

ν	$t_{0.10}$	$t_{0.05}$	$t_{0.025}$	$t_{0.01}$	$t_{0.005}$	$t_{0.001}$	$t_{0.0005}$	ν	$t_{0.10}$	$t_{0.05}$	$t_{0.025}$	$t_{0.01}$	$t_{0.005}$	$t_{0.001}$	$t_{0.0005}$
1	3.078	6.314	12.71	31.82	63.66	318.3	636.6	38	1.304	1.686	2.024	2.429	2.712	3.319	3.566
2	1.886	2.920	4.303	6.965	9.925	22.33	31.60	39	1.304	1.685	2.023	2.426	2.708	3.313	3.558
3	1.638	2.353	3.182	4.541	5.841	10.21	12.92	40	1.303	1.684	2.021	2.423	2.704	3.307	3.551
4	1.533	2.132	2.776	3.747	4.604	7.173	8.610	41	1.303	1.683	2.020	2.421	2.701	3.301	3.544
5	1.476	2.015	2.571	3.365	4.032	5.893	6.869	42	1.302	1.682	2.018	2.418	2.698	3.296	3.538
6	1.440	1.943	2.447	3.143	3.707	5.208	5.959	43	1.302	1.681	2.017	2.416	2.695	3.291	3.532
7	1.415	1.895	2.365	2.998	3.499	4.785	5.408	44	1.301	1.680	2.015	2.414	2.692	3.286	3.526
8	1.397	1.860	2.306	2.896	3.355	4.501	5.041	45	1.301	1.679	2.014	2.412	2.690	3.281	3.520
9	1.383	1.833	2.262	2.821	3.250	4.297	4.781	46	1.300	1.679	2.013	2.410	2.687	3.277	3.515
10	1.372	1.812	2.228	2.764	3.169	4.144	4.587	47	1.300	1.678	2.012	2.408	2.685	3.273	3.510
11	1.363	1.796	2.201	2.718	3.106	4.025	4.437	48	1.299	1.677	2.011	2.407	2.682	3.269	3.505
12	1.356	1.782	2.179	2.681	3.055	3.930	4.318	49	1.299	1.677	2.010	2.405	2.680	3.265	3.500
13	1.350	1.771	2.160	2.650	3.012	3.852	4.221	50	1.299	1.676	2.009	2.403	2.678	3.261	3.496
14	1.345	1.761	2.145	2.624	2.977	3.787	4.140	51	1.298	1.675	2.008	2.402	2.676	3.258	3.492
15	1.341	1.753	2.131	2.602	2.947	3.733	4.073	52	1.298	1.675	2.007	2.400	2.674	3.255	3.488
16	1.337	1.746	2.120	2.583	2.921	3.686	4.015	53	1.298	1.674	2.006	2.399	2.672	3.251	3.484
17	1.333	1.740	2.110	2.567	2.898	3.646	3.965	54	1.297	1.674	2.005	2.397	2.670	3.248	3.480
18	1.330	1.734	2.101	2.552	2.878	3.610	3.922	55	1.297	1.673	2.004	2.396	2.668	3.245	3.476
19	1.328	1.729	2.093	2.539	2.861	3.579	3.883	60	1.296	1.671	2.000	2.390	2.660	3.232	3.460
20	1.325	1.725	2.086	2.528	2.845	3.552	3.850	65	1.295	1.669	1.997	2.385	2.654	3.220	3.447
21	1.323	1.721	2.080	2.518	2.831	3.527	3.819	70	1.294	1.667	1.994	2.381	2.648	3.211	3.435
22	1.321	1.717	2.074	2.508	2.819	3.505	3.792	75	1.293	1.665	1.992	2.377	2.643	3.202	3.425
23	1.319	1.714	2.069	2.500	2.807	3.485	3.768	80	1.292	1.664	1.990	2.374	2.639	3.195	3.416
24	1.318	1.711	2.064	2.492	2.797	3.467	3.745	90	1.291	1.662	1.987	2.368	2.632	3.183	3.402
25	1.316	1.708	2.060	2.485	2.787	3.450	3.725	100	1.290	1.660	1.984	2.364	2.626	3.174	3.390
26	1.315	1.706	2.056	2.479	2.779	3.435	3.707	120	1.289	1.658	1.980	2.358	2.617	3.160	3.373
27	1.314	1.703	2.052	2.473	2.771	3.421	3.690	140	1.288	1.656	1.977	2.353	2.611	3.149	3.361
28	1.313	1.701	2.048	2.467	2.763	3.408	3.674	160	1.287	1.654	1.975	2.350	2.607	3.142	3.352
29	1.311	1.699	2.045	2.462	2.756	3.396	3.659	180	1.286	1.653	1.973	2.347	2.603	3.136	3.345
30	1.310	1.697	2.042	2.457	2.750	3.385	3.646	200	1.286	1.653	1.972	2.345	2.601	3.131	3.340
31	1.309	1.696	2.040	2.453	2.744	3.375	3.633	250	1.285	1.651	1.969	2.341	2.596	3.123	3.330
32	1.309	1.694	2.037	2.449	2.738	3.365	3.622	300	1.284	1.650	1.968	2.339	2.592	3.118	3.323
33	1.308	1.692	2.035	2.445	2.733	3.356	3.611	400	1.284	1.649	1.966	2.336	2.588	3.111	3.315
34	1.307	1.691	2.032	2.441	2.728	3.348	3.601	500	1.283	1.648	1.965	2.334	2.586	3.107	3.310
35	1.306	1.690	2.030	2.438	2.724	3.340	3.591	750	1.283	1.647	1.963	2.331	2.582	3.101	3.304
36	1.306	1.688	2.028	2.434	2.719	3.333	3.582	1000	1.282	1.646	1.962	2.330	2.581	3.098	3.300
37	1.305	1.687	2.026	2.431	2.715	3.326	3.574	∞	1.282	1.645	1.960	2.326	2.576	3.090	3.291

Degrees of freedom: ν

Supplement for Question (1): Recall "Parents' Beliefs About Their Children's Academic Ability: Implications for Educational Investments" (https://www.aeaweb.org/articles?id=10.1257/aer.20171172). Dizon-Ross (2019) does a field experiment with 5,268 children from 39 randomly selected primary schools in two districts in Malawi. Table 1 (below) is an excerpt from a larger table. It reports some summary statistics for the sample. All scores are out of 100 possible points. Chichewa is the local language.

Table 1. Baseline summary statistics

	Mean
Academic Performance (Average Achievement Scores)	
Overall score	46.8
Math score	44.9
English score	44.2
Chichewa score	51.2
Sample size (number of kids)	5,268

Source: Excerpt from Table 1 on page 19 of Dizon-Ross (2019).

The Stata output below shows simple regressions where the y-variable is a child's academic performance in English (`engl`). The x-variable is a child's academic performance in Chichewa (`chich`). The only difference between Regression #1 and Regression #2 is that Regression #2 uses a subset of the data: female students only. Some numbers are intentionally erased from the output. You will be asked about the missing values highlighted in grey (__________).

<u>Regression #1:</u> Uses full sample of children.

```
      Source |       SS           df       MS      Number of obs   =     5,268
-------------+----------------------------------   F(1, 5266)      =
       Model |  782410.694         1               Prob > F        =
    Residual |  1347480.86     5,266               R-squared       = __________
-------------+----------------------------------   Adj R-squared   =
       Total |                                     Root MSE        =    15.996

------------------------------------------------------------------------------
        engl |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       chich |   .5407256  __________                      .5215554    .5598959
       _cons |   16.46191                                  15.38872     17.5351
------------------------------------------------------------------------------
```

<u>Regression #2:</u> Uses subset of female children.

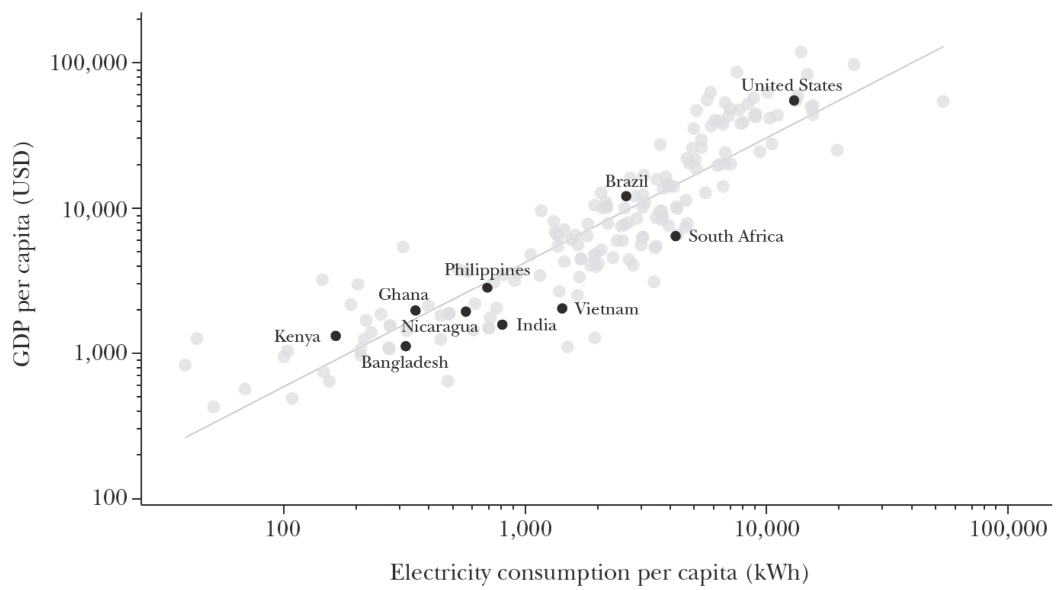
```
      Source |       SS           df       MS      Number of obs   =     2,585
-------------+----------------------------------   F(1, 2583)      =
       Model |  365106.212         1               Prob > F        =
    Residual |  620525.295     2,583               R-squared       =
-------------+----------------------------------   Adj R-squared   =
       Total |                                     Root MSE        =    15.499

------------------------------------------------------------------------------
        engl |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       chich |   .5357671                38.98  __________
       _cons |   16.53842                21.93
------------------------------------------------------------------------------
```

Supplement for Question (2): Consider a 2020 academic article "Does Household Electrification Supercharge Economic Development?" (https://pubs.aeaweb.org/doi/pdfplus/10.1257/jep.34.1.122).

> **Excerpt:** While launching the *Sustainable Energy for All* program to promote rural electrification in 2011, then-United Nations Secretary General Ban Ki-moon described energy as "the golden thread that connects economic growth, increased social equity, and an environment that allows the world to thrive" (SEFA 2012). Reinforcing this perspective is the strong, positive cross-country correlation between electricity consumption and GDP per capita documented in the macroeconomic literature (for example, Burke, Stern, and Bruns 2018), which we present in Figure 1. Today, nearly a billion people still live without access to electricity (IEA 2018). Thus, access to energy has re-emerged as a key priority for policymakers and donors in low-income countries. Electrification could allow poor households to have easy access to lighting for evening chores or studying and power for phone charging and possibly for a range of new small business activities, both on and off the farm.

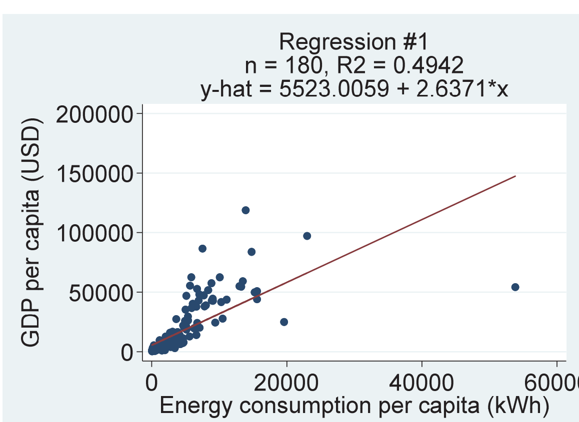
Figure 1

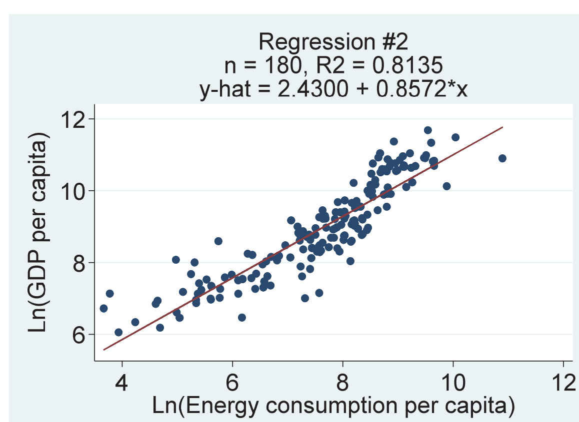
The Positive Correlation between Electricity Consumption and GDP per Capita



Source: 2014 data obtained from the World Bank DataBank.
Note: Both variables are presented on a logarithmic scale. GDP per capita data are in current US dollars.

Regressions #1 and #2 below include all 180 observations in Figure 1. Note the OLS regression results in the titles.

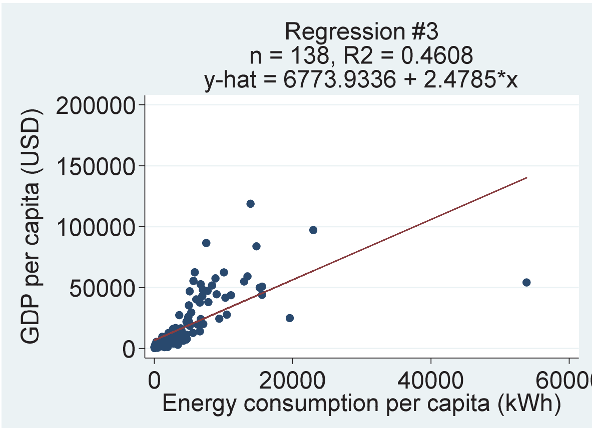


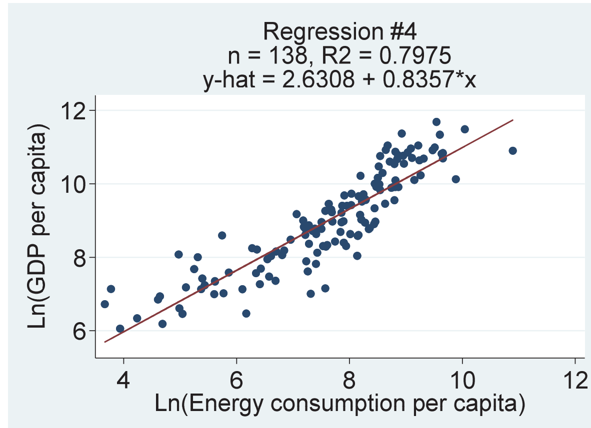


Supplement for Question (2), continues on the next page >>>>>

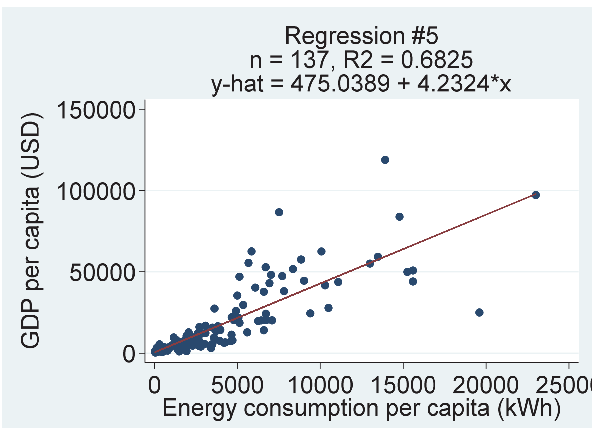
Supplement for Question (2), cont'd:

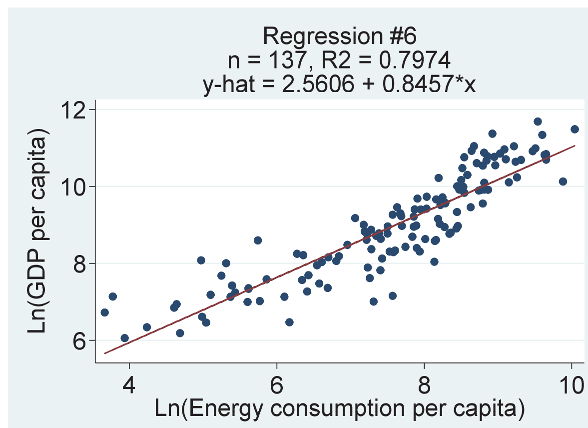
Regressions #3 and #4 below use only the 138 observations in the World Bank DataBank that are actual countries (hence, they are a subset of the 180 observations in Figure 1 and Regressions #1 and #2 above). These exclude observations like "North America," "Euro area," "Arab World," "Sub-Saharan Africa," and "OECD members."



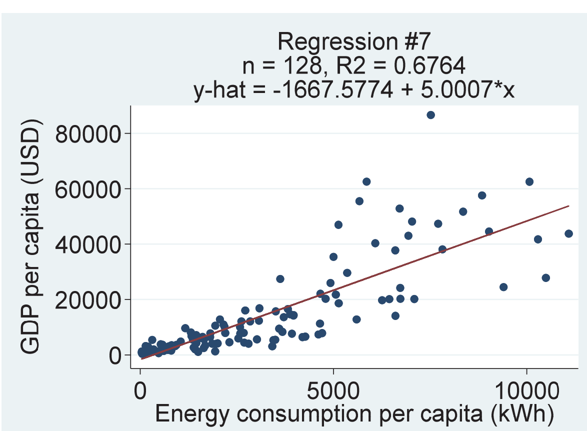


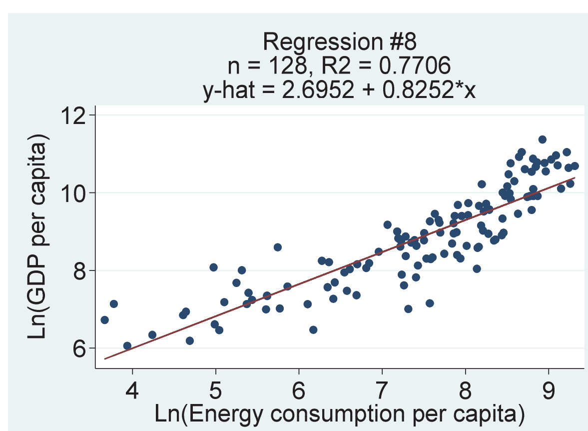
Regressions #5 and #6 below are like Regressions #3 and #4 except that they exclude Iceland, which has energy consumption per capita of 53,832.48 kWh.





Regressions #7 and #8 below are like Regressions #3 and #4 except that they exclude 10 countries – Bahrain, Canada, Finland, Iceland, Kuwait, Luxembourg, Norway, Qatar, Sweden, and the United States – with energy consumption per capita above 12,500 kWh.





Supplement for Question (3): On February 21, 2020 the Angus Reid Institute posted “Canadians Big on Bernie, but think regardless of who Democrats nominate, Trump is likely to win” (http://angusreid.org/democratic-primary-trump/). It reports the results from a survey that includes the following question:

- Ultimately, do you think President Trump is going to win the 2020 election?
    - Yes, almost certainly
    - Probably
    - Doubtful
    - No chance
    - Not sure/Can’t say

In reporting the results, Angus Reid combines the first two answers (“Yes, almost certainly” and “Probably”) to find the fraction that think Trump is likely to win.

Supplement for Question (5): Consider a 2019 *NBER Working Paper* “Effects of Mandatory Energy Efficiency Disclosure in Housing Markets” (https://www.nber.org/papers/w26436.pdf). The authors study homes located in or around the city of Austin (a major city in Texas).

> **Excerpt:** Table 1 presents summary statistics for selected attributes of the homes in our empirical sample. The “full sample” in Column (1) includes all homes in the sample, regardless of whether or not the home was ever sold during our sample period. Columns (2) and (3) include, respectively, only the subset of these homes that are inside or outside the Austin city limits and were sold at least once during 1997-2014. Overall, homes in the sample are sold on average 0.8 times each. The average vintage is 1973 and average size is 1839 square feet.

Table 1. Summary statistics and covariate comparison of homes

	Full sample	Properties sold	
		Inside Austin	Outside Austin
Attribute	(1)	(2)	(3)
Within Austin city limits (dummy)	0.835	1.000	0.000
# Times sold: 1997-2014	0.809 (1.001)	1.606 (0.827)	1.681 (0.856)
Year built (vintage)	1973 (17.52)	1972 (17.33)	1987 (9.45)
Square feet (house size)	1839 (931.1)	1780 (759.7)	2421 (1143.4)
Sale price ($)		228,003 (185,280)	315,452 (311,946)
Properties	131,028	53,752	11,702

Notes: Table 1 presents means and standard deviations (in parentheses) for selected attributes of single family residential properties in the greater Austin area during 1997-2014. The “full sample” in Column (1) includes all homes constructed in 1998 or earlier, regardless of whether or not the home was ever sold during our sample period. Columns (2) and (3) include, respectively, only the subset of these homes that are inside (outside) the city limits and were sold at least once during 1997-2014.