



Pedagogical Utilization and Assessment of the Statistics Online Computational Resource in Introductory Probability and Statistics Courses

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Juana Sanchez ⁽¹⁾,
Ivo Dinov^(1,2) and Nicolas Christou⁽¹⁾

⁽¹⁾UCLA Department of Statistics and

⁽²⁾Center for Computational Biology

<http://www.SOCR.ucla.edu>

<http://www.StatisticsResource.org>



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Outline

1. What is SOCR (Statistics Online Computational Resource)?
2. Quasi-experiment: Effects of SOCR on student learning, satisfaction and use of technology.
3. Conclusions



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1. What is SOCR?

- Ongoing, NSF-funded project created and managed by Ivo Dinov ([DUE 0442992](#)).
- Set of portable online aids for high school, and College Statistics education and research (multilingual)
- Tools for educators and researchers.



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1.1. SOCR Resources

- (a) Distributions
- (b) Simulation Experiments
- (c) Learning Assessment tools
- (d) Interactive Analyses
- (e) Games, (f). Modeler, (g). Charts, (h). More

SOCR is at <http://www.socr.ucla.edu>



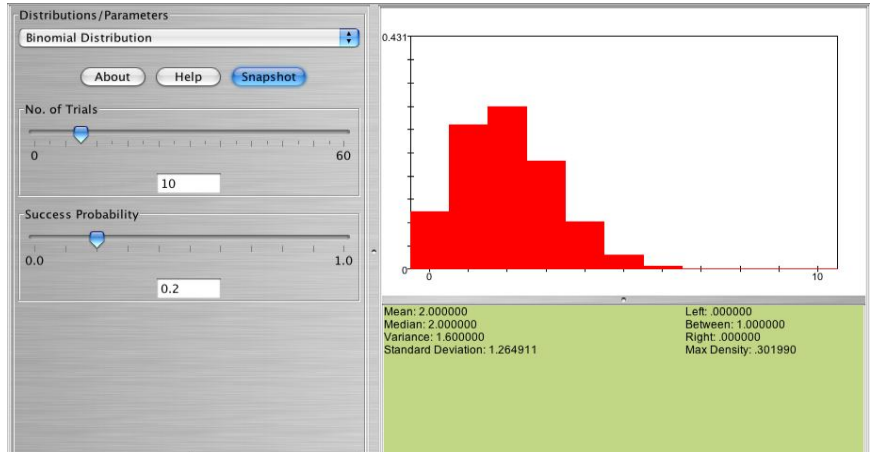
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(a) Distributions



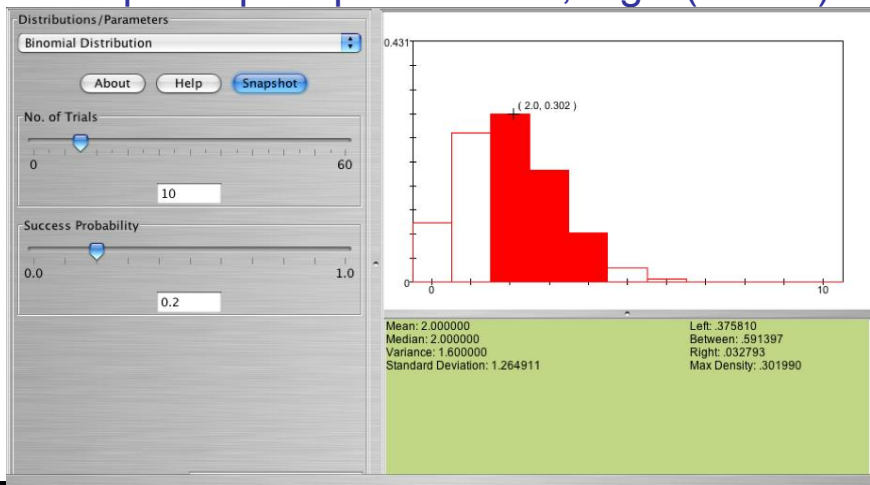
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...help compute probabilities, e.g. $P(1 < x < 5)$..



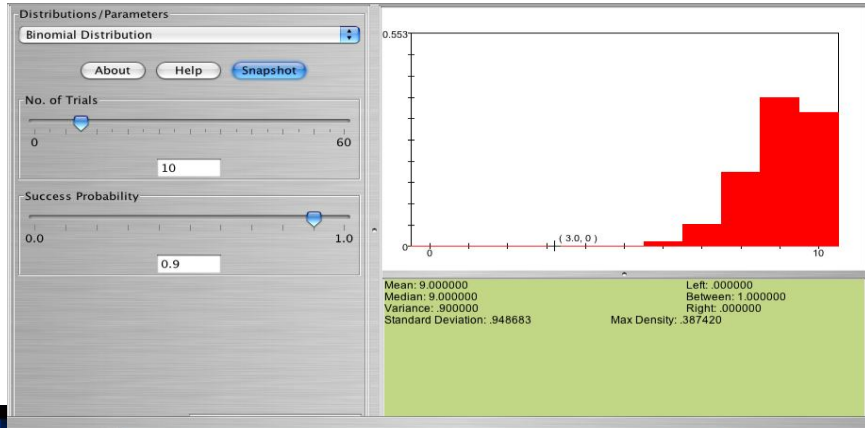
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...but also help to see changes in shape, mean and sd when parameters change



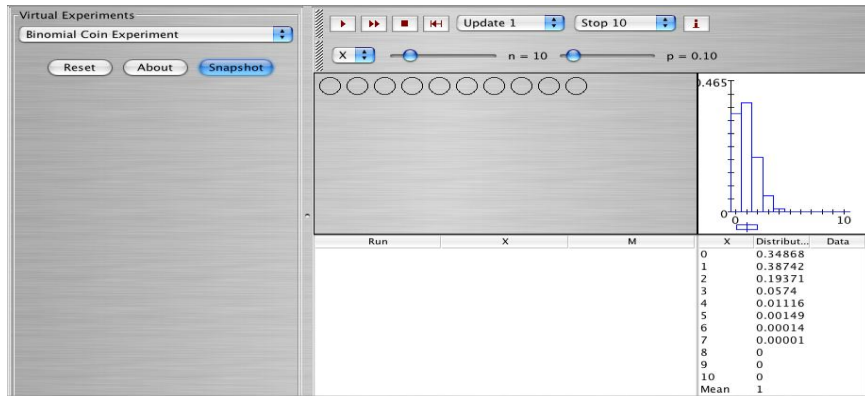
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(b) Simulation Experiments, e.g. binomial coin experiment, show theoretical distribution (e.g. for X =number of heads in $n=10$ tosses, $p=0.1$)



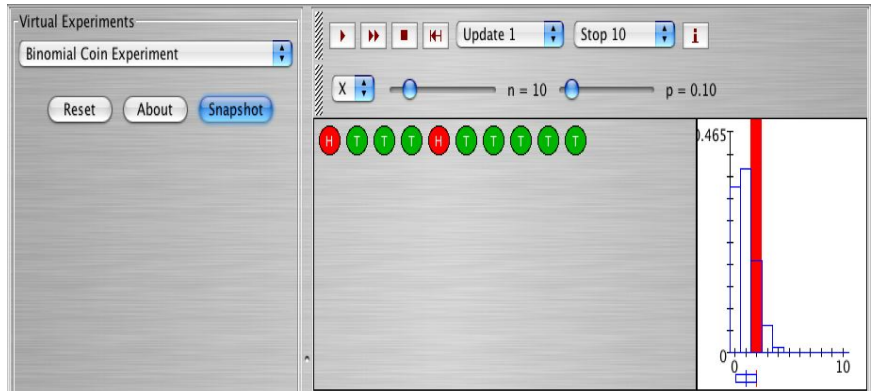
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.... Students can toss 10 coins at a time and see the red (heads) ones and the empirical distribution of the number of heads (in red over the theoretical distribution)



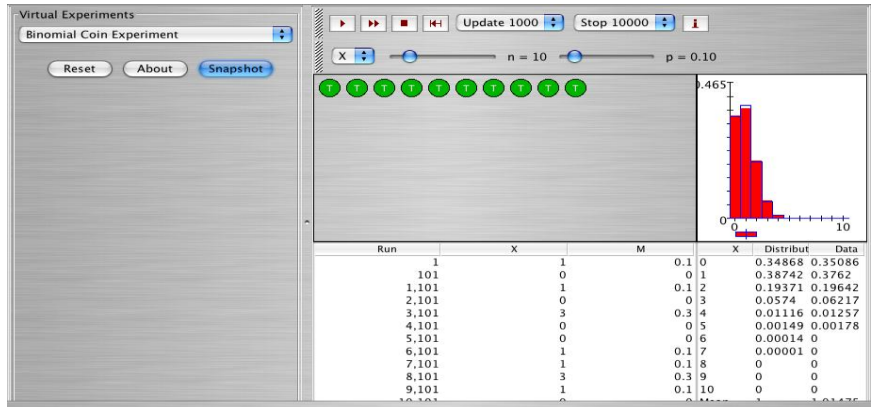
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.... Probability as a long term frequency can be discovered by realizing that many trials are needed to obtain close to the theoretical distribution.



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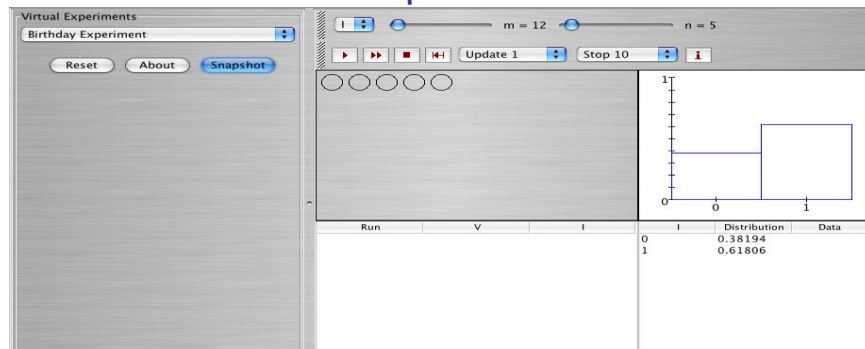
(c) Learning Assessment Tools

After teaching Students the applets via lectures, TA sessions and detailed handouts, they can do homework and exam questions with them . For example,

What is the probability that in a room with 5 people at least two people share the same birth month? Show work.



Students can use the previously learned Birthday experiment applet, to find the final answer of 0.61(blue distribution). Then they need to show computations.

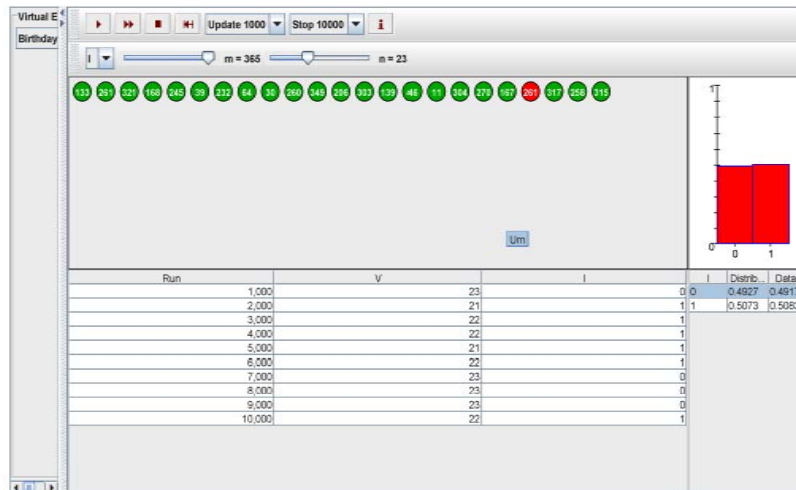




Better assessment of understanding is....

Determine empirically how large should the group of people observed be for the probabilities of at least two sharing the same birthdays and the probability of nobody sharing same birthday to be 50%-50%.

The answer for this question is not so straightforward





2. Effectiveness of SOCR in learning upper division probability and lower division Intro Stats: a quasi experiment:

- We designed a study to test whether required use of SOCR for homework and other activities was more effective than the conventional way of teaching those classes.
- Three different classes, three different instructors, three controlled studies.



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- Fall 2005. Two Introduction to Probability Classes (Sanchez), Two Intro Stats for Life and Health Sciences (Dinov), and One intro probability with separate honors session (Christou).
- One class (treatment group) subject to required SOCR in homework. The other class (control group) not exposed to required SOCR.



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Table 1. Demographics (Prob -Sanchez)

Group	Major %	Class %
SOCR (n=20) 9:00-9:50am	Math/Ap M 45%	Junior 65%
	Math/Ec 35%	Senior 15%
	Other 20%	Grad 15%
Control(n=39) 11-11:50am	Math/Ap M 13%	Junior 28%
	Math/Ec 24%	Senior 28%
	Biostat 33%	Grad 41%
	Eng,other 30%	*These grads biostats mostly



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Table 2. Demographics (Intro Stats-Dinov)

	Control	SOCR group
Freshmen	24	7
Sophomores	18	14
Juniors	16	14
Seniors	23	29
Graduates	2	0
Total	83	88



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Table 3. Demographics (Prob-Christou)

Majors	Control (class)	SOCR(subset)
Mathematics	25	8
Statistics	2	1
BioStatistics	3	0
BioChem	2	0
Psycho-Bio	0	1
Sociology	0	1
Business/econ	1	0
Total	35	11



2.1. Quantitative Learning Outcomes

- The treatment group did consistently better in the treatment group than in the control group in all outcomes (homework, midterms, finals and total score) in the three classes.
- In some case (Sanchez, Prob) the variability of scores is smaller in the treatment group than the control group (excludes grad students)

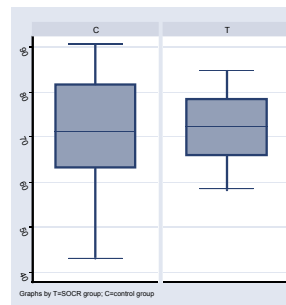




Table 4. Learning Outcomes (Prob-Sanchez)

	Group	High	Low	Median	Mean	Standard Deviation	Statistics
Midterm	Control	34	17.5	26.5	26.19	4.65	$t_0 = 0.63$ $t(38) p > 0.2$
	Treatment	33	17.5	28.5	27.08	4.25	
Homework	Control	19.74	4.69	16.92	15.76	4.44	$t_0 = 0.64$ $t(16) p > 0.2$
	Treatment	19.07	13.39	16.41	16.41	1.73	
Final	Control	37.2	18.4	29.4	28.48	5.31	$t_0 = 0.49$ $t(38) p > 0.2$
	Treatment	36.9	22.5	29.40	29.23	4.30	
Overall Performance	Control	90.55	43.19	71.22	70.45	12.24	$t_0 = 0.71$ $t(38) p > 0.2$
	Treatment	84.89	58.42	72.44	72.73	8.08	



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Table 5. Learning Outcomes (Intro Stats-Dinov)

	Group	High	Low	Median	Mean	Standard Deviation	Statistics
Midterm	Control	10 0	53	84. 33	83.9	10	$t_0 = 1.37$ $t(169)$ $p = 0.089$
	Treatment	10 0	58	88	86	10	
Final	Control	10 0	42	83	81.2	13	$t_0 = 1.34$ $t(169)$ $p = 0.093$
	Treatment	99	35	87	83.8	12	
Overall Performance	Control	96.89	53.6	86.82	84.57	9.1	$t_0 = 1.448$ $t(169)$ $p = 0.075$
	Treatment	98.05	42.32	88.26	86.68	9.9	



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Table 6. Learning Outcomes (Christou)

	Group	High	Low	Median	Mean	Standard Deviation	Statistics
Quiz1	Control	96	41	70	72.61	16.84	$t_0 = 2.644$ $t(42)$ $p=0.0058$
	Treatment	100	58	93	87.67	14.72	
Quiz2	Control	100	32	73	72.61	16.78	$t_0 = 2.063$ $t(42)$ $p<0.0227$
	Treatment	100	58	89	84.11	13.25	
Exam1	Control	100	40	89	85.74	13.64	$t_0=0.7617$ $t(42)$ $p=0.225$
	Treatment	100	47	96	89.56	16.62	
Exam2	Control	100	36	80	80.23	15.98	$t_0=1.342$ $t(42)$ $p=0.0935$
	Treatment	100	68	88	87.22	11.09	
Exam3	Control	100	46	82	82.45	14.13	$t_0=0.2725$ $t(42)$ $p=0.3933$
	Treatment	100	60	88	83.78	13.66	
Overall Performance	Control	94.31	44.93	80.09	80.23	11.87	$t_0=1.606$ $t(42)$ $p=0.058$
	Treatment	96.26	60.65	90.59	86.76	11.06	



Pooled Learning Outcomes – all 3 courses

- Treatment effects within each class are marginally significant.
- Pooling the results from all 3 studies, however, yields strong evidence suggesting the SOCR-based instruction did potentiate learning. None of the examinations in any class had the control groups scoring \geq treatment groups.
- Using the *sign test* and assuming independence of the examinations and the sections we obtain a $p\text{-value} < 0.00098$, $x_0=10$, $X \sim B(n=10, p=0.5)$ – evidence that SOCR utilization impacts students' learning and their attitude towards technology-based instruction.





2.2. “Use of Technology” outcome (Sanchez)

- Final exam conducted in computer lab with centrally monitored terminals
- Treatment group could use SOCR or R;
Control group could use SOCR or R
- Use of technology to answer questions:
95% in the SOCR group (65% SOCR)
65% in the control group (mostly R)



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2.3. Satisfaction Outcome

End of quarter questionnaire:

- (a) SOCR made the class more effective than in other classes not using technology (79% vs. 67% of Sanchez's)
- (b) Almost all students believed that SOCR helped them understand the material better (Dinov, Christou).
- (c) Almost all students recommended using SOCR in other Statistics Classes (Christou)



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3. Conclusions...

In the treatment group:

- (a) Students were more at ease using technology when assessing their learning
- (b) Students were more homogeneous in the performance.
- (c) Students were, overall, more satisfied.
- (d) Consistent (statistically significant) improvement throughout the quarter



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References

- More information on this material can be found in the forthcoming publication

Dinov, I. Sanchez, J. and Christou, N. (2006) *Pedagogical Utilization and Assessment of the Statistic Online Computational Resource in Introductory Probability and Statistics Courses*, to appear. *Journal of Computers and Education*. Elsevier Publishers

<http://www.elsevier.com/locate/compedu>



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SOCR is not only in English...

それはオンラインである、従ってである!

SOCRは何であるか。

SOCR資源の目的は設計すること知識を認可し、そして自由に広める。 私達の資源は確率および統計量の教育にとりわけ特別有用オンライン援助、技術によって基づく指示および統計的な計算を提供する。 SOCRの用具および資源相互アプレットの貯蔵場所を、計算および図示することは用具の、教育およびコース材料を含んでいる。

SOCR資源を使用する方法か。

SOCRのユーザーの3つの主要なタイプがある: 教育者、学生および用具の開発者。 コース教育および教師は有用な学生の刺激、概念デモンストレーションをと変化および不確実性のあらゆる調査への彼らの技術によって基づいた教育学上のアプローチを高めるためのSOCRのクラスのノートそして相互用具見つける。 学生およびトレイニーはSOCRのクラスのノート、分析、計算および図示を彼らの学ぶか、または練習の追求に有用な用具の非常に見つかるかもしれない。 モデル開発者、ソフトウェアプログラマーおよび他の工学の、生物医学的な

[追加SOCR用具](#)
 SOCRの配分
 SOCRは実験する
 SOCRの分析
 SOCRのゲーム
 SOCRデータModeler
 SOCRのプロット及び図表
 付加的なSOCR資源

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 フォーラム
 承認
 国際化

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http://socr.stat.ucla.edu/htmls/SOCR_Languages.html

Feedback Forum

 SOCR English (default)	 SOCR in German	 SOCR in Spanish
 SOCR in French	 SOCR in Italian	 SOCR in Portuguese
 SOCR in Japanese	 SOCR in Korean	 SOCR in Chinese
 SOCR in Traditional Chinese	 SOCR in Russian	 SOCR in Dutch
 SOCR in French	 SOCR in Greek	

Indirect translation of SOCR applet content (copy and paste text from any applet component to the translation text area)

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