# Suggested Solution for Homework 3
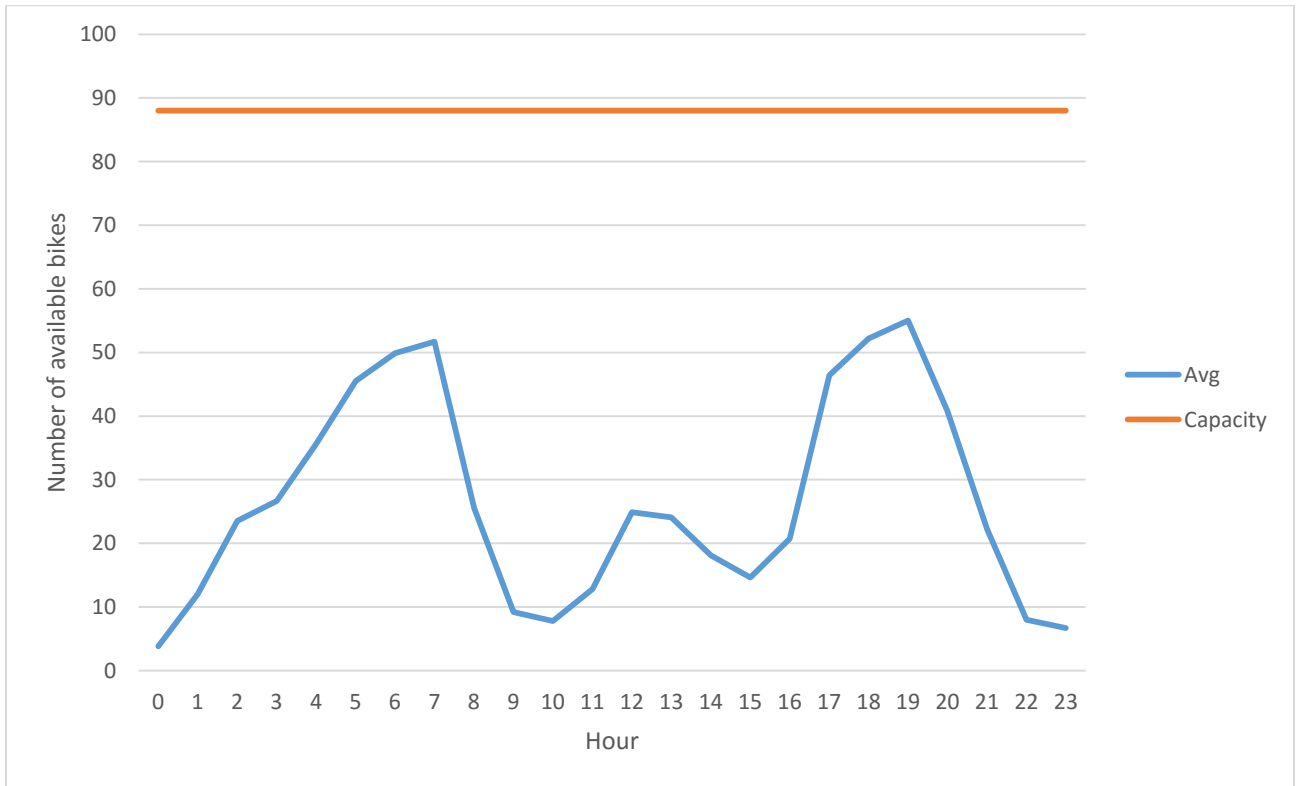
Statistics and Data Analysis, Fall 2015

1. (10 points)

From the scatter plot, we may observe that there seems to be positive relation between the average number of available bikes between 8 am and 9 am (x_i) and that between 9 am and 10 am (y_i) across the 30 sites. More available bikes between 8 am and 9 am, more between 9 am and 10 am.
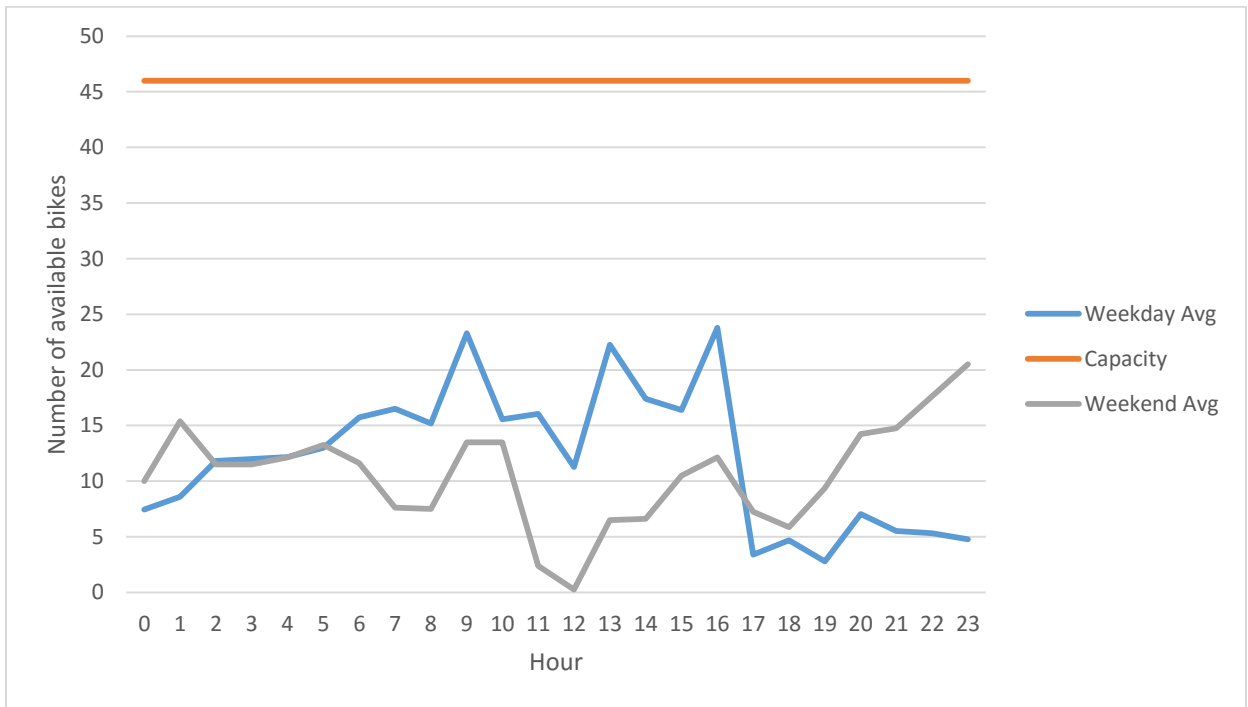

Scatter Plot for the 30 sites
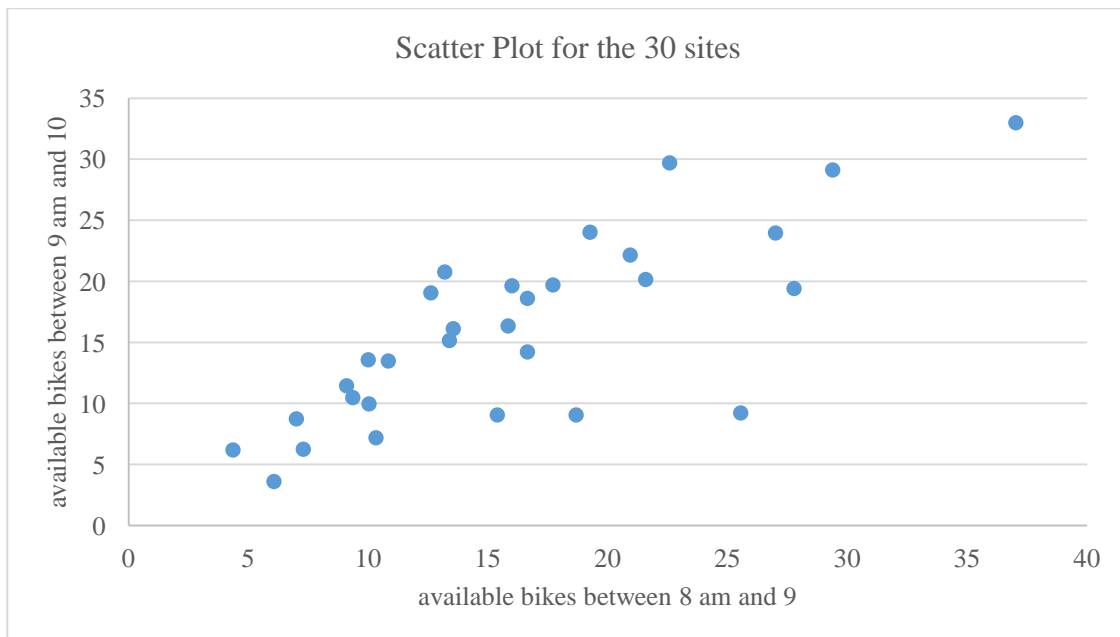
2. (10 points)

3. (20 points)

(a) (10 points)
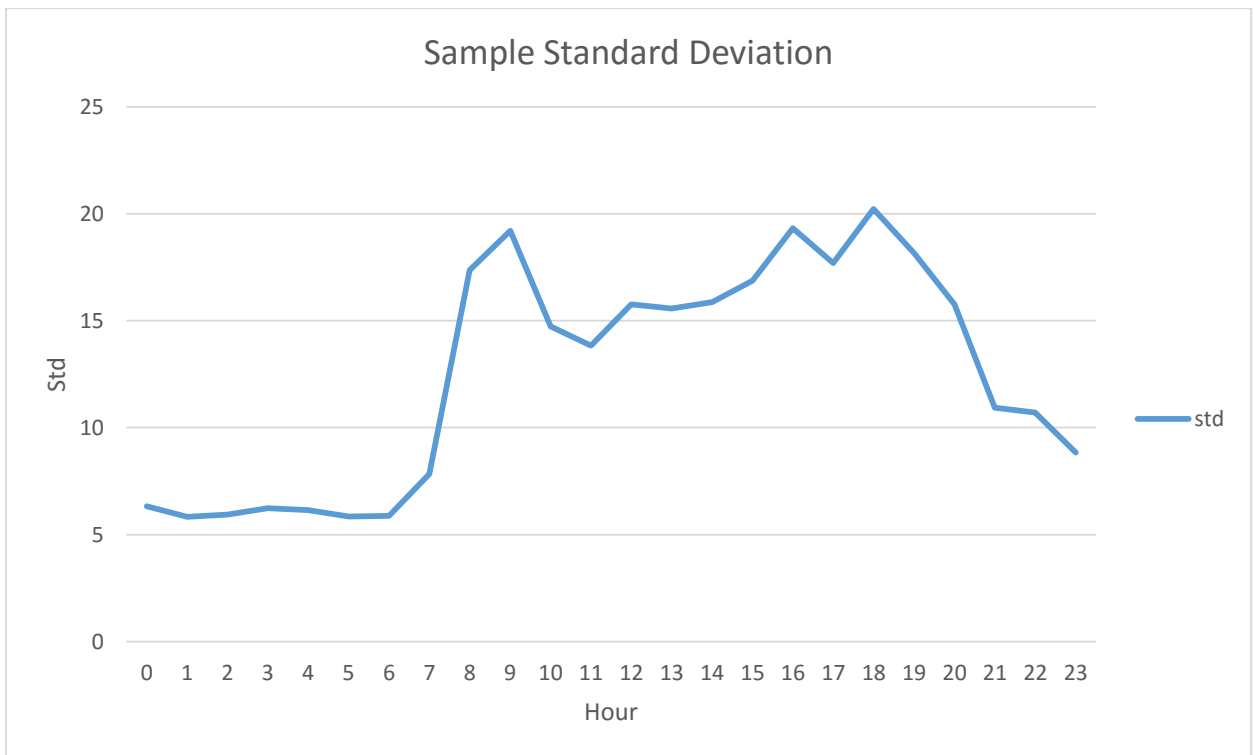
(b) (5 points)

There is a big drop at hour 17, it might be so because it's time for students to leave campus and ride the bike home.

(c) (5 points)

After hour 20, the average goes down in weekdays but goes up in the weekend. It might be so because there are fewer students in campus during weekend nights, so there are more bikes available.

4. (25 points)

(a) (10 points)

(b) (10 points)
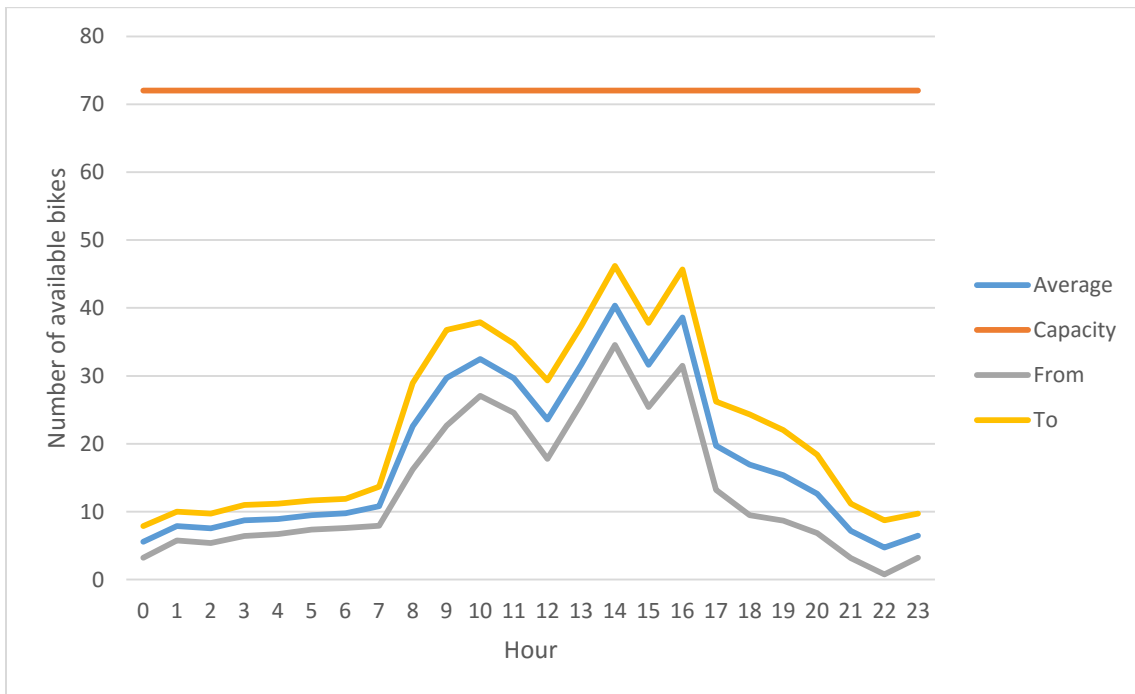
Since we don't know the variance of the population, and the sample size is larger than 30, we may use the t-distribution to calculate the confidence interval.

(c) (5 points)

From hour 17 to 7 (5pm to 8 am), we are not 95% confident that the population mean is within 20% and 80% of the capacity.

5. (35 points)
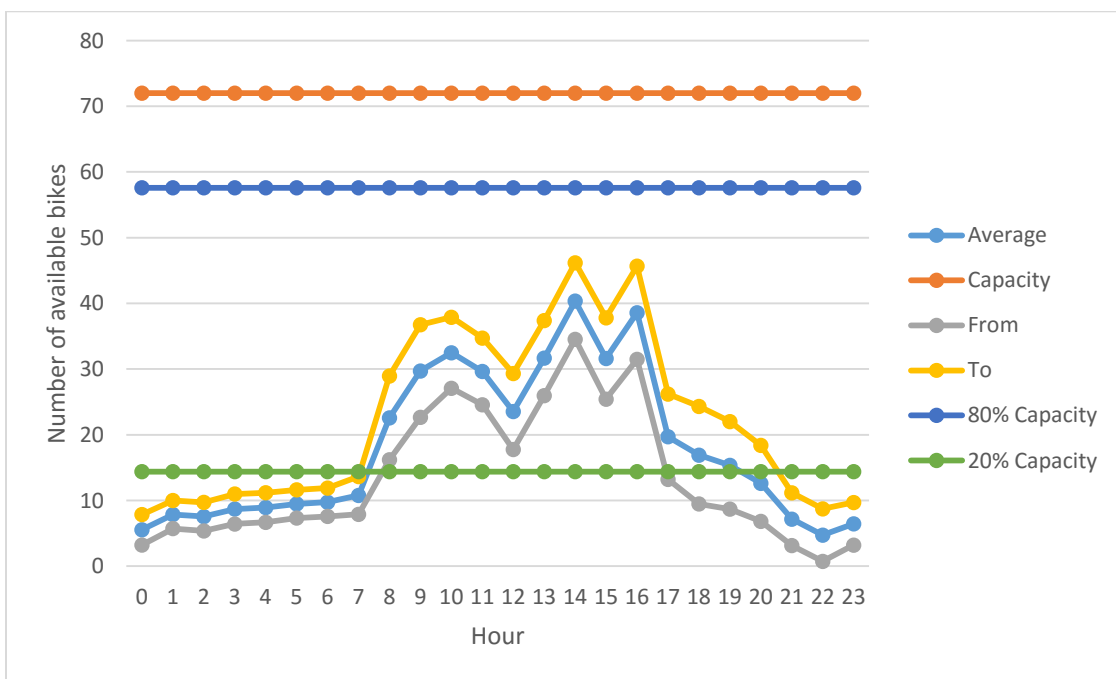
(a) (5 points)

There are 11 sites whose availability rates are lower than 30%, which are LiuGong Park, MRT Dongmen Sta. (Exit 4), MRT Gongguan Sta.(Exit 2), MRT Taipower Building Sta. (Exit 2), MRT Technology Bldg. Sta., MRT Xinyi Anhe Sta., MRT Zhongxiao Fuxing Sta.(Exit 2), N.T.U.S.T, Roosevelt & Xinsheng S. Intersection, Taipei Public Library, Xinsheng & Heping Intersection.

Site Name	Capacity	Average at 8-9 am	Proportion
LiuGong Park	30.00	7.00	0.2333
MRT Dongmen Sta. (Exit 4)	46.00	10.03	0.2180
MRT Gongguan Sta.(Exit 2)	30.00	6.06	0.2021
MRT Taipower Building Sta. (Exit 2)	40.00	10.32	0.2580
MRT Technology Bldg. Sta.	56.00	15.39	0.2747
MRT Xinyi Anhe Sta.	30.00	7.29	0.2430
MRT Zhongxiao Fuxing Sta.(Exit 2)	54.00	13.39	0.2479
N.T.U.S.T	46.00	13.19	0.2868
Roosevelt & Xinsheng S. Intersection	88.00	25.55	0.2903
Taipei Public Library	30.00	4.35	0.1451
Xinsheng & Heping Intersection	46.00	10.84	0.2356
Chengong Public Housing	36.00	13.55	0.3763
Dunhua & Keelung Intersection	30.00	10.00	0.3333
JianGuo & Heping Intersection	52.00	19.26	0.3703
Jinshan & Aiguo Intersection	54.00	20.94	0.3876
Keelung & Changxing Intersection	74.00	29.39	0.3971
Longmen Square	52.00	16.00	0.3076
MRT Daan Park Sta.	74.00	27.77	0.3753
MRT Daan Sta.	58.00	27.00	0.4655
MRT Linguang Sta. (Exit 2)	72.00	37.03	0.5143
MRT Liuzhangli Sta.	30.00	9.35	0.3118
MRT S.Y.S Memorial Hall Stataion(Exit 2.)	48.00	21.58	0.4495
MRT Zhongxiao Xinsheng Sta.(Exit 3)	40.00	12.61	0.3153
NTNU Library	34.00	17.71	0.5208
NTU Information Bldg.	72.00	22.58	0.3136
Renai & Yanji Intersection	34.00	16.65	0.4895
Taipei City Hospital Renai Branch	36.00	15.84	0.4399
Xinhai & Xinsheng Intersection	30.00	9.10	0.3032
Xinyi & Dunhua Intersection	46.00	16.65	0.3618
Xinyi & Jianguo Intersection	46.00	18.68	0.4060

(b) (10 points)

H_0: $\mu = 9$

H_1: $\mu < 9$

$\frac{\sigma}{\sqrt{n}} = \frac{8.5}{\sqrt{31}} = 1.5266$.

With 95% confidence level, 6.4886 is the critical value for rejection. As the observed sample mean 6.0645 is more extreme than (in this case, below) the critical value, p-value 0.0272 is smaller than significance level 0.05, we reject H_0. There is strong evidence showing that the average number of available bikes between 8 am and 9 am is lower than 9, 30% of its capacity. Thus, a worker should be allocated to this site.

(c) (10 points)

H_0: $\mu = $ capacity*30%

H_1: $\mu < $ capacity*30%

With 95% confidence interval, there are strong evidences showing that the average number of available bikes between 8 am and 9 am is lower than 30% of its capacity for LiuGong Park, MRT Dongmen Sta. (Exit 4), MRT Gongguan Sta.(Exit 2), MRT Xinyi Anhe Sta., Taipei Public Library. Workers should be allocated to those sites.

Site Name	Average at 8-9 am	Critical value (95%)
LiuGong Park	7.00	7.2046
MRT Dongmen Sta. (Exit 4)	10.03	11.1015
MRT Gongguan Sta.(Exit 2)	6.06	6.4886
MRT Xinyi Anhe Sta.	7.29	7.3042
Taipei Public Library	4.35	7.8418
Xinsheng & Heping Intersection	10.84	11.2176
Chengong Public Housing	13.55	8.6671
Dunhua & Keelung Intersection	10.00	6.9789
JianGuo & Heping Intersection	19.26	12.5204
Jinshan & Aiguo Intersection	20.94	13.4119
Keelung & Changxing Intersection	29.39	17.6254
Longmen Square	16.00	12.6724
MRT Daan Park Sta.	27.77	18.4000
MRT Daan Sta.	27.00	13.6221
MRT Linguang Sta. (Exit 2)	37.03	17.3314

MRT Liuzhangli Sta.	9.35	6.4036
MRT S.Y.S Memorial Hall Stataion(Exit 2.)	21.58	11.3017
MRT Taipower Building Sta. (Exit 2)	10.32	9.2104
MRT Technology Bldg. Sta.	15.39	12.6056
MRT Zhongxiao Fuxing Sta.(Exit 2)	13.39	12.9035
MRT Zhongxiao Xinsheng Sta.(Exit 3)	12.61	10.1196
N.T.U.S.T	13.19	10.5419
NTNU Library	17.71	7.3375
NTU Information Bldg.	22.58	16.4684
Renai & Yanji Intersection	16.65	7.8053
Roosevelt & Xinsheng S. Intersection	25.55	20.9330
Taipei City Hospital Renai Branch	15.84	8.2908
Xinhai & Xinsheng Intersection	9.10	7.0383
Xinyi & Dunhua Intersection	16.65	10.7493
Xinyi & Jianguo Intersection	18.68	11.0324

(d) (10 points)

In Part (c), we conduct hypothesis testing to examine if the average is lower than 30% of the capacities to determine whether a worker should be allocated to this site. Since that hypothesis conclusion can be made only if we have a strong evidence, more rigorous criteria is required than in Part (a) with only sample means. Thus, we may say Part (c) is a subset of Part (a).