TRABAJO CONVOCATORIA EXTRAORDINARIA

POR: ALFONSO GIL GIRÓN Y EDUARDO PÉREZ MUÑOZ DE LUNA

Para el archivo de datos dado, seleccione todos los vuelos que llegan a un aeropuerto dado. (Por ejemplo, los vuelos que llegan a San Diego (SAN)). Este va a ser su conjunto de datos población).

```
clear all
clc
% Cargamos los datos
flights = importFlightsData("flightsNov.csv");

head(flights)
```

```
ans = 8×20 table
```

...

	AIRLINE	TAIL_NUMBER	FLIGHT_NUMBER	ORIGIN	DESTINATION
1	Spirit Airli...	N602NK	612	LAS	MSP
2	United Airli...	N76516	680	SFO	ORD
3	American Air...	N3KTAA	260	LAX	MIA
4	United Airli...	N76503	910	LAX	ORD
5	United Airli...	<undefined>	1888	LAS	IAH
6	Alaska Airli...	N795AS	108	ANC	SEA
7	United Airli...	<undefined>	1200	SFO	IAH
8	Delta Airlines	N361NB	2277	DEN	JFK

```
summary(flights)
```

```
Variables:

    AIRLINE: 467972×1 categorical

        Values:

            American Airlines                73871
            Alaska Airlines                  13950
            JetBlue Airways                  21697
            Delta Airlines                   72228
            Atlantic Southeast Airlines      42572
            Frontier Airlines                 7763
            Hawaiian Airlines                 6024
            American Eagle Airlines          20305
            Spirit Airlines                  10164
            Skywest Airlines                 47292
            United Airlines                  42647
            Virgin America                    5414
            Southwest Airlines           1.0405e+05
            US Airways                            0

    TAIL_NUMBER: 467972×1 categorical
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N378DA	21
N378HA	31
N378NW	119
N378SW	158
N379AA	8
N379DA	79
N379HA	30
N380AA	42
N380DA	68
N380HA	45
N380SW	183
N381AA	17
N381DN	86
N381HA	34
N38257	82
N38268	79
N382AA	25
N382DA	70
N382HA	40
N383AA	38
N383DN	78

N383HA	29
N383SW	180
N38403	86
N38417	80
N38424	61
N38443	81
N38446	50
N38451	88
N38454	92
N38458	81
N38459	57
N38467	85
N38473	78
N384AA	10
N384DA	68
N384HA	42
N384SW	161
N385AA	12
N385DN	78
N385HA	37
N385SW	195
N386AA	24
N386DA	85
N386HA	33
N386SW	177
N38727	83
N387AA	16
N387DA	47
N387SW	188
N388AA	13
N388DA	86
N388HA	38
N388SW	67
N38950	10
N38955	16
N389AA	17
N389DA	78
N389HA	58
N389SW	92
N390AA	12
N390DA	79
N390HA	43
N390SW	132
N391AA	19
N391CA	116
N391DA	68
N391HA	28
N391SW	183
N392AA	15
N392DA	85
N392HA	41
N392SW	180
N393AA	3
N393DA	72
N393HA	45
N39415	74
N39416	87
N39418	78
N39423	32
N39450	68
N39461	88
N39463	88
N39475	84
N394AA	20
N394DA	60

N394DL	11
N394SW	170
N395AA	15
N395DN	67
N395HA	33
N396AA	16
N396DA	63
N396HA	42
N396SW	158
N39726	53
N39728	81
N397AA	22
N397DA	96
N397SW	193
N398AA	16
N398CA	38
N398DA	85
N398SW	191
N399AA	13
N399DA	92
N399HA	31
N399WN	184
N3AAAA	70
N3ABAA	90
N3ACAA	97
N3ADAA	47
N3AEAA	83
N3AEMQ	124
N3AFAA	81
N3AGAA	79
N3AHAA	65
N3AJAA	79
N3AKAA	79
N3ALAA	85
N3AMAA	85
N3ANAA	98
N3APAA	64
N3ARAA	59
N3ASAA	90
N3ATAA	62
N3AUAA	65
N3AVAA	82
N3AWAA	80
N3AXAA	83
N3AYAA	81
N3BAAA	86
N3BBAA	77
N3BCAA	83
N3BDAA	88
N3BEAA	89
N3BFAA	86
N3BGAA	68
N3BHAA	102
N3BJAA	97
N3BKAA	93
N3BLAA	91
N3BMAA	88
N3BNAA	89
N3BPAA	75
N3BRAA	85
N3BSAA	76
N3BTAA	95
N3BUAA	57
N3BVAA	74
N3BWAA	72

N3BXAA	80
N3BYAA	75
N3CAAA	63
N3CBAA	95
N3CCAA	66
N3CDAA	59
N3CEAA	90
N3CFAA	76
N3CGAA	95
N3CHAA	83
N3CJAA	81
N3CKAA	71
N3CLAA	86
N3CMAA	81
N3CNAA	72
N3CPAA	79
N3CRAA	75
N3CSAA	79
N3CTAA	42
N3CUAA	69
N3CVAA	97
N3CWAA	61
N3CXAA	76
N3CYAA	80
N3DAAA	95
N3DBAA	87
N3DCAA	88
N3DDAA	95
N3DEAA	76
N3DFAA	94
N3DGAA	89
N3DHAA	67
N3DJAA	93
N3DLAA	63
N3DMAA	94
N3DNAA	80
N3DPAA	88
N3DRAA	99
N3DSAA	61
N3DTAA	81
N3DUAA	96
N3DVAA	81
N3DWAA	97
N3DXAA	82
N3DYAA	90
N3EAAA	85
N3EBAA	67
N3ECAA	81
N3EDAA	87
N3EEAA	88
N3EFAA	76
N3EGAA	75
N3EHAA	100
N3EJAA	85
N3EKAA	90
N3ELAA	69
N3EMAA	83
N3ENAA	75
N3EPAA	60
N3ERAA	83
N3ESAA	92
N3ETAA	35
N3EUAA	42
N3EVAA	40
N3EWAA	44

N3EXAA	43
N3EYAA	78
N3FAAA	80
N3FBAA	72
N3FCAA	90
N3FDAA	68
N3FEAA	86
N3FFAA	87
N3FGAA	98
N3FHAA	89
N3FJAA	93
N3FKAA	72
N3FLAA	93
N3FMAA	83
N3FNAA	76
N3FPAA	91
N3FRAA	87
N3FSAA	68
N3FTAA	81
N3FUAA	67
N3FVAA	96
N3FWAA	84
N3FXAA	90
N3FYAA	98
N3GAAA	96
N3GBAA	90
N3GCAA	81
N3GDAA	81
N3GEAA	82
N3GFAA	80
N3GGAA	80
N3GHAA	75
N3GJAA	85
N3GKAA	92
N3GLAA	73
N3GMAA	78
N3GNAA	80
N3GPAA	86
N3GRAA	97
N3GSAA	93
N3GTAA	91
N3GUAA	97
N3GVAA	94
N3GWAA	94
N3GXAA	86
N3GYAA	91
N3HAAA	74
N3HBAA	88
N3HCAA	85
N3HDAA	75
N3HEAA	84
N3HFAA	92
N3HGAA	75
N3HHAA	70
N3HJAA	70
N3HKAA	83
N3HLAA	81
N3HMAA	95
N3HNAA	75
N3HPAA	98
N3HRAA	77
N3HSAA	75
N3HTAA	75
N3HUAA	97
N3HVAA	92

N3HWAA	76
N3HXAA	85
N3HYAA	91
N3JAAA	82
N3JBAA	79
N3JCAA	66
N3JDAA	73
N3JEAA	91
N3JFAA	85
N3JGAA	84
N3JHAA	90
N3JJAA	76
N3JKAA	75
N3JLAA	87
N3JMAA	90
N3JNAA	104
N3JPAA	75
N3JRAA	86
N3JSAA	74
N3JTAA	94
N3JUAA	69
N3JVAA	98
N3JWAA	84
N3JXAA	92
N3JYAA	97
N3KAAA	43
N3KBAA	61
N3KCAA	43
N3KDAA	101
N3KEAA	88
N3KFAA	88
N3KGAA	108
N3KHAA	90
N3KJAA	86
N3KKAA	85
N3KLAA	89
N3KMAA	91
N3KNAA	88
N3KPAA	82
N3KRAA	86
N3KSAA	72
N3KTAA	82
N3KUAA	87
N3KVAA	87
N3KWAA	80
N3KXAA	74
N3KYAA	75
N3LAAA	99
N3LBAA	94
N3LCAA	70
N3LDAA	73
N3LEAA	69
N3LFAA	75
N3LGAA	78
N3LHAA	67
N3LJAA	81
N3LKAA	87
N3LLAA	96
N3LMAA	89
N3LNAA	84
N3LPAA	77
N3LRAA	88
N3LSAA	89
N3LTAA	93
N3LUAA	84

N3LVAA	92
N3LWAA	90
N3LXAA	90
N3LYAA	100
N3MAAA	95
N3MBAA	81
N3MCAA	87
N3MDAA	95
N3MEAA	88
N3MFAA	81
N3MGAA	88
N3MHAA	81
N3MJAA	98
N3MKAA	76
N3MLAA	67
N3MMAA	93
N3MNAA	85
N3MPAA	62
N3MRAA	97
N3MUAA	88
N3MVAA	99
N3MWAA	90
N3MXAA	93
N3MYAA	28
N3NAAA	18
N400WN	158
N401UA	96
N401WN	156
N402AS	93
N402UA	91
N402WN	176
N403AA	101
N403AS	94
N403UA	90
N403WN	159
N404UA	105
N404WN	160
N405UA	62
N405WN	113
N406UA	77
N406WN	144
N407AS	81
N407UA	84
N407WN	168
N408AS	100
N408UA	111
N408WN	159
N409AS	95
N409UA	84
N409WN	170
N410UA	106
N410WN	157
N41135	54
N41140	50
N411UA	87
N411WN	173
N412UA	98
N412WN	176
N413AS	120
N413UA	85
N413WN	166
N414UA	81
N414WN	165
N415UA	104
N415WN	167

N416SW	118
N416UA	96
N416WN	161
N417SW	71
N417UA	107
N417WN	156
N418SW	148
N418UA	98
N418WN	163
N419AS	98
N419UA	107
N419WN	168
N420UA	93
N420WN	98
N421LV	181
N421UA	90
N422UA	84
N422WN	175
N423AS	106
N423SW	152
N423UA	80
N423WN	161
N424AA	99
N424UA	72
N424WN	146
N425AA	106
N425LV	162
N425UA	93
N426AA	72
N426SW	115
N426UA	79
N426WN	161
N427SW	118
N427UA	99
N427WN	154
N428UA	57
N428WN	132
N429SW	164
N429UA	52
N429WN	176
N430SW	152
N430UA	76
N430WN	165
N431AS	111
N431SW	166
N431UA	104
N431WN	171
N432SW	138
N432UA	95
N432WN	163
N433AS	102
N433LV	160
N433SW	148
N433UA	97
N434AA	100
N434UA	100
N434WN	169
N435AS	114
N435SW	109
N435UA	76
N435WN	158
N436AA	110
N436UA	90
N436WN	161
N437AA	120

N437SW	180
N437UA	88
N437WN	160
N438AA	121
N438SW	154
N438UA	98
N438WN	160
N439AA	143
N439SW	146
N439UA	107
N439WN	179
N440AS	122
N440LV	166
N440SW	151
N440UA	98
N441SW	176
N441UA	98
N441WN	168
N442AS	115
N442SW	70
N442UA	85
N442WN	166
N443SW	164
N443UA	24
N443WN	161
N444WN	155
N445SW	151
N445UA	99
N445WN	51
N446SW	162
N446UA	92
N446WN	166
N447SW	158
N447UA	79
N447WN	184
N448SW	158
N448UA	90
N448WN	122
N449SW	147
N449UA	105
N449WN	166
N450WN	16
N451UA	99
N451WN	56
N452SW	173
N452UA	90
N452WN	170
N453AS	93
N453SW	140
N453UA	105
N453WN	177
N45440	90
N454SW	164
N454UA	97
N454WN	161
N455CA	79
N455SW	133
N455UA	98
N455WN	175
N456UA	98
N456WN	119
N457AS	110
N457SW	155
N457UA	88
N457WN	189

N458UA	42
N458WN	158
N45905	13
N45956	10
N459AS	104
N459SW	94
N459UA	17
N459WN	166
N460SW	132
N460UA	88
N460WN	158
N461AS	93
N461SW	165
N461UA	94
N461WN	167
N462AS	98
N462UA	97
N462WN	168
N463SW	149
N463UA	83
N463WN	166
N464AS	96
N464SW	194
N464UA	90
N464WN	170
N465SW	93
N465UA	86
N465WN	158
N466AA	117
N466SW	172
N466UA	86
N466WN	169
N467AA	135
N467AS	91
N467UA	82
N467WN	151
N468AA	126
N468AS	111
N468CA	196
N468UA	86
N468WN	155
N469AA	96
N469AS	99
N469UA	85
N469WN	172
N470AA	111
N470UA	100
N470WN	170
N471AA	129
N471AS	99
N471CA	181
N471UA	77
N472AA	125
N472AS	108
N472CA	184
N472UA	93
N472WN	173
N473AA	144
N473UA	94
N473WN	162
N47414	81
N474AA	134
N474AS	107
N474UA	102
N474WN	165

...

```
cond1=find(flights.DESTINATION=="SAN");
Arr3 = flights(cond1,:);
cond2 = isnan(Arr3.ACTUAL_ELAPSED_TIME)
```

```
cond2 = 5965×1 logical array
   0
   0
   0
   0
   0
   0
   0
   0
   0
   0
     ⋮
```

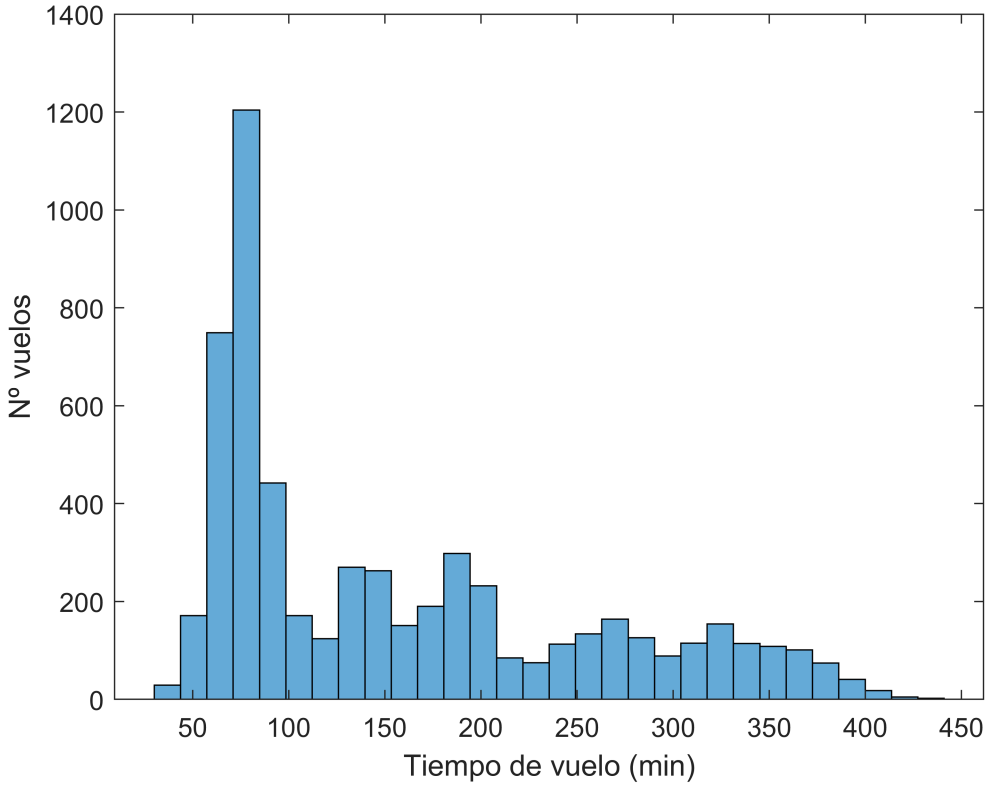
```
Datos = Arr3(cond2==0,:);
```

El conjunto de datos con el que vamos a trabajar es 'Datos' que son todos los vuelos que llegan a SAN.

Pinte en un histograma la duración real del vuelo, calcule la media, varianza, mediana, etc.

Ajústela a un modelo de probabilidad.

```
histogram(Datos.ACTUAL_ELAPSED_TIME,30)
xlabel('Tiempo de vuelo (min)')
ylabel('Nº vuelos')
```




```
media = mean(Datos.ACTUAL_ELAPSED_TIME)
```

```
media = 157.7858
```

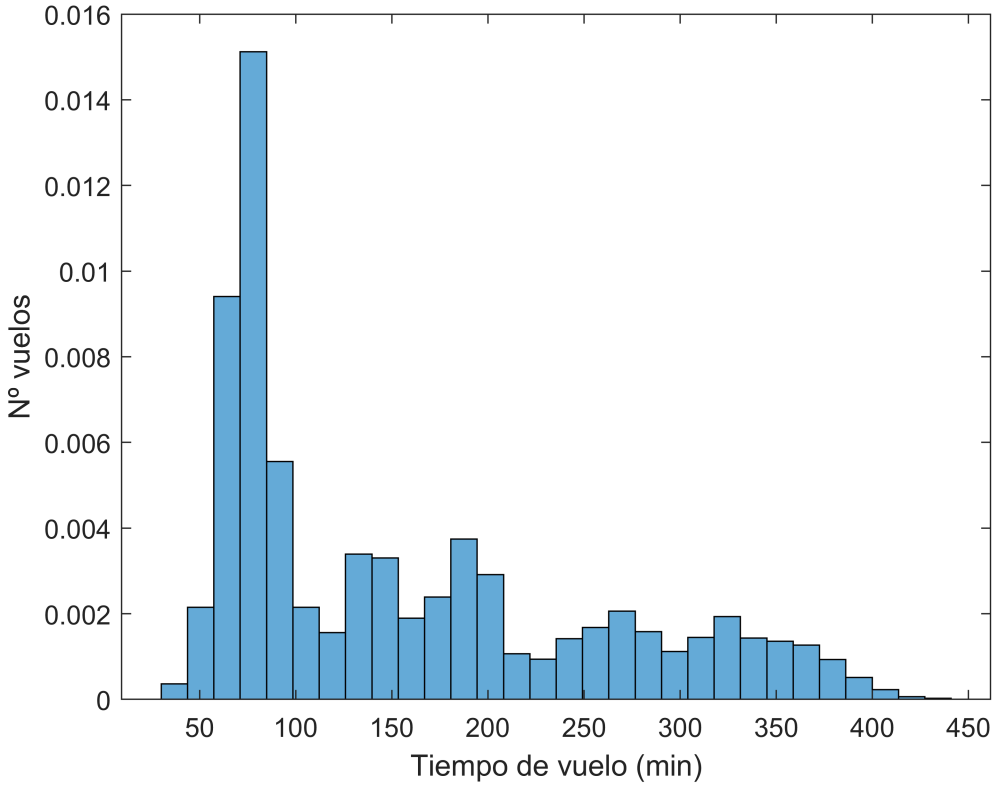
```
varianza = var(Datos.ACTUAL_ELAPSED_TIME)
```

```
varianza = 9.4856e+03
```

```
mediana = median(Datos.ACTUAL_ELAPSED_TIME)
```

```
mediana = 127
```

```
% Histograma Normalizado
histogram(Datos.ACTUAL_ELAPSED_TIME,30,"Normalization","pdf")
xlabel('Tiempo de vuelo (min)')
ylabel('Nº vuelos')
```



Calcule la diferencia entre el tiempo programado y el tiempo que realmente tarda. Dibuje esta nueva variable en un histograma y ajústela a un modelo de probabilidad. Calcule la media, varianza, mediana, moda…

```
% Duration Diff

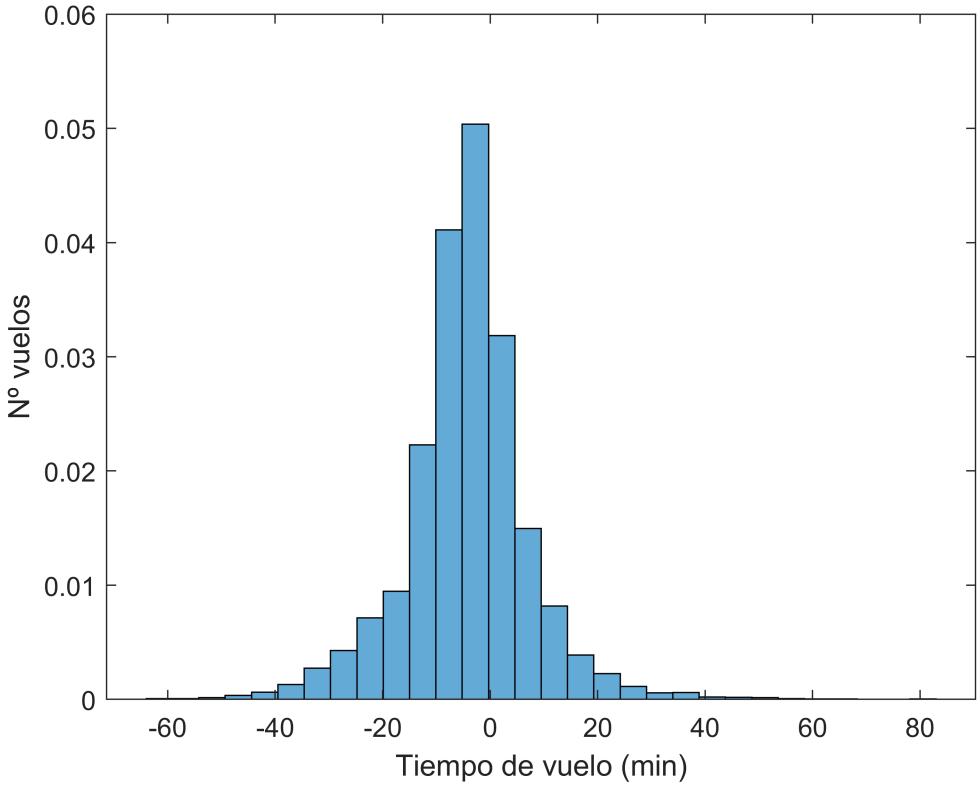
Duration_diff = Arr3.ACTUAL_ELAPSED_TIME-Arr3.SCHEDULED_ELAPSED_TIME;

cond3 = isnan(Duration_diff)
```

```
cond3 = 5965×1 logical array
   0
   0
   0
   0
   0
   0
   0
   0
   0
   0
    ⋮
```

```
Datos2 = Duration_diff(cond3==0,:);

histogram(Datos2,30,"Normalization","pdf")
xlabel('Tiempo de vuelo (min)')
ylabel('Nº vuelos')
```




```
media_diff=mean(Datos2)
```

```
media_diff = -4.4671
```

```
varianza_diff = var(Datos2)
```

```
varianza_diff = 134.6148
```

```
mediana_diff = median(Datos2)
```

```
mediana_diff = -4
```

```
moda_diff = mode(Datos2)
```

```
moda_diff = -5
```

Seleccione los vuelos que llegan desde una ciudad determinada (por ejemplo NY o SF). Para todos esos vuelos, represente un histograma con el tiempo que tardan, y ajústelo a un modelo de probabilidad.Calcule el tiempo medio que tardan. Obtenga una tabla con dichos vuelos agrupados por compañías aéreas.

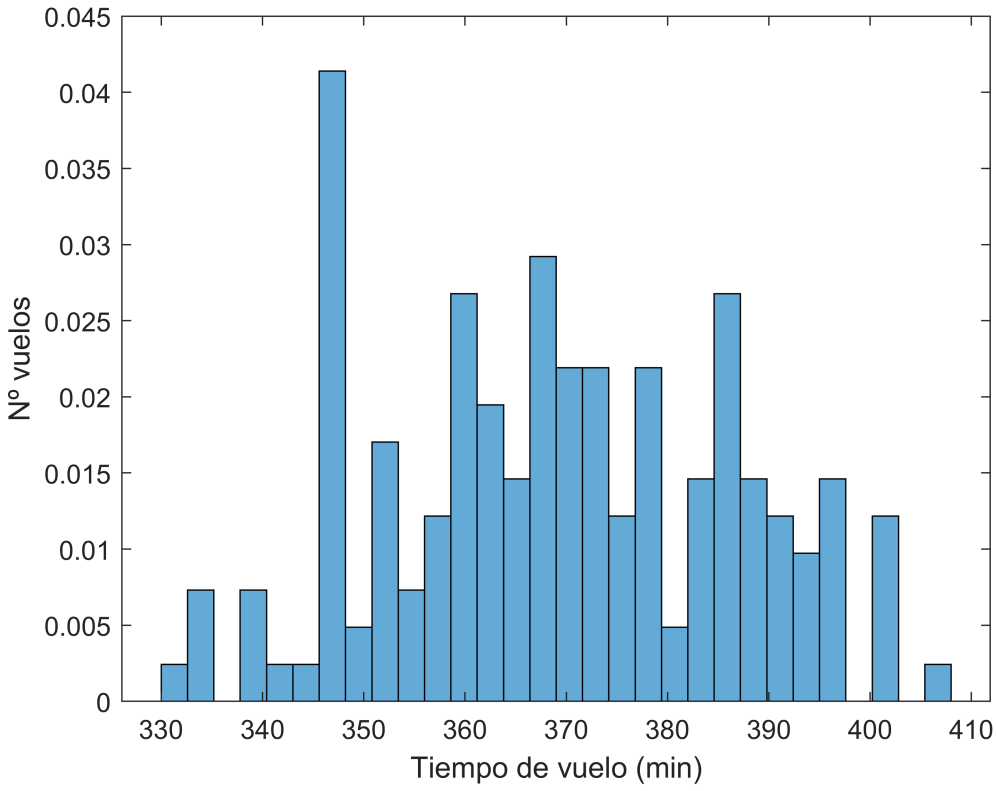
```
% implementamos la condicion para los vuelos que llegan desde Nueva York
cond4 = find(Arr3.ORIGIN=="JFK");
Arr4 = Arr3(cond4,:);
%implementamos la condición para quitar todos los valores Nan
cond5 = isnan(Arr4.ACTUAL_ELAPSED_TIME)
```

```
cond5 = 164×1 logical array
```

```
0
0
0
0
1
0
0
0
0
0
  ⋮
```

```
Datos3 = Arr4(cond5==0,:);

histogram(Datos3.ACTUAL_ELAPSED_TIME,30,"Normalization","pdf")
xlabel('Tiempo de vuelo (min)')
ylabel('Nº vuelos')
```




```
media_NY = mean(Datos3.ACTUAL_ELAPSED_TIME)
```

```
media_NY = 369.1456
```

```
%tabal de todas las compañías aereas agrupadas
ArrCompany = groupsummary(Arr4,"AIRLINE");
sortrows(ArrCompany, "GroupCount","descend")
```

```
ans = 3×2 table
```

	AIRLINE	GroupCount
1	Delta Airlines	75
2	JetBlue Airw...	55
3	American Air...	34

```
sortrows(Datos3, "AIRLINE","descend")
```

ans = 158×20 table

...

	AIRLINE	TAIL_NUMBER	FLIGHT_NUMBER	ORIGIN	DESTINATION
1	Delta Airlines	N3743H	2788	JFK	SAN
2	Delta Airlines	N707TW	421	JFK	SAN
3	Delta Airlines	N3772H	463	JFK	SAN
4	Delta Airlines	N3755D	2788	JFK	SAN
5	Delta Airlines	N717TW	421	JFK	SAN
6	Delta Airlines	N375DA	463	JFK	SAN
7	Delta Airlines	N3739P	422	JFK	SAN
8	Delta Airlines	N373DA	463	JFK	SAN
9	Delta Airlines	N709TW	421	JFK	SAN
10	Delta Airlines	N375DA	463	JFK	SAN
11	Delta Airlines	N3743H	2788	JFK	SAN
12	Delta Airlines	N703TW	421	JFK	SAN
13	Delta Airlines	N3730B	463	JFK	SAN
14	Delta Airlines	N394DA	451	JFK	SAN
15	Delta Airlines	N375DA	421	JFK	SAN
16	Delta Airlines	N3762Y	463	JFK	SAN
17	Delta Airlines	N717TW	2789	JFK	SAN
18	Delta Airlines	N372DA	463	JFK	SAN
19	Delta Airlines	N395DN	2788	JFK	SAN
20	Delta Airlines	N723TW	421	JFK	SAN
21	Delta Airlines	N3734B	463	JFK	SAN
22	Delta Airlines	N3730B	2788	JFK	SAN
23	Delta Airlines	N722TW	421	JFK	SAN
24	Delta Airlines	N395DN	2807	JFK	SAN
25	Delta Airlines	N3730B	420	JFK	SAN
26	Delta Airlines	N3733Z	463	JFK	SAN

	AIRLINE	TAIL_NUMBER	FLIGHT_NUMBER	ORIGIN	DESTINATION
27	Delta Airlines	N396DA	2788	JFK	SAN
28	Delta Airlines	N624AG	421	JFK	SAN
29	Delta Airlines	N390DA	463	JFK	SAN
30	Delta Airlines	N3740C	420	JFK	SAN
31	Delta Airlines	N721TW	421	JFK	SAN
32	Delta Airlines	N395DN	463	JFK	SAN
33	Delta Airlines	N388DA	420	JFK	SAN
34	Delta Airlines	N396DA	421	JFK	SAN
35	Delta Airlines	N3735D	463	JFK	SAN
36	Delta Airlines	N710TW	437	JFK	SAN
37	Delta Airlines	N37700	463	JFK	SAN
38	Delta Airlines	N376DA	2788	JFK	SAN
39	Delta Airlines	N721TW	421	JFK	SAN
40	Delta Airlines	N399DA	463	JFK	SAN
41	Delta Airlines	N381DN	2788	JFK	SAN
42	Delta Airlines	N704X	421	JFK	SAN
43	Delta Airlines	N388DA	2807	JFK	SAN
44	Delta Airlines	N3743H	420	JFK	SAN
45	Delta Airlines	N3730B	463	JFK	SAN
46	Delta Airlines	N3755D	2788	JFK	SAN
47	Delta Airlines	N717TW	421	JFK	SAN
48	Delta Airlines	N3743H	463	JFK	SAN
49	Delta Airlines	N3731T	420	JFK	SAN
50	Delta Airlines	N705TW	421	JFK	SAN
51	Delta Airlines	N374DA	2788	JFK	SAN
52	Delta Airlines	N392DA	420	JFK	SAN
53	Delta Airlines	N373DA	421	JFK	SAN
54	Delta Airlines	N396DA	463	JFK	SAN
55	Delta Airlines	N723TW	2788	JFK	SAN
56	Delta Airlines	N392DA	463	JFK	SAN
57	Delta Airlines	N3747D	2788	JFK	SAN
58	Delta Airlines	N375DA	421	JFK	SAN
59	Delta Airlines	N3731T	2788	JFK	SAN
60	Delta Airlines	N3759	465	JFK	SAN

	AIRLINE	TAIL_NUMBER	FLIGHT_NUMBER	ORIGIN	DESTINATION
61	Delta Airlines	N381DN	463	JFK	SAN
62	Delta Airlines	N3735D	437	JFK	SAN
63	Delta Airlines	N3747D	463	JFK	SAN
64	Delta Airlines	N391DA	2784	JFK	SAN
65	Delta Airlines	N371DA	421	JFK	SAN
66	Delta Airlines	N710TW	421	JFK	SAN
67	Delta Airlines	N394DA	463	JFK	SAN
68	Delta Airlines	N679DA	2788	JFK	SAN
69	Delta Airlines	N722TW	421	JFK	SAN
70	Delta Airlines	N3741S	2802	JFK	SAN
71	Delta Airlines	N392DA	2788	JFK	SAN
72	Delta Airlines	N713TW	421	JFK	SAN
73	Delta Airlines	N3759	2786	JFK	SAN
74	JetBlue Airw...	N599JB	189	JFK	SAN
75	JetBlue Airw...	N703JB	89	JFK	SAN
76	JetBlue Airw...	N807JB	189	JFK	SAN
77	JetBlue Airw...	N547JB	89	JFK	SAN
78	JetBlue Airw...	N516JB	189	JFK	SAN
79	JetBlue Airw...	N649JB	89	JFK	SAN
80	JetBlue Airw...	N651JB	89	JFK	SAN
81	JetBlue Airw...	N662JB	189	JFK	SAN
82	JetBlue Airw...	N589JB	89	JFK	SAN
83	JetBlue Airw...	N662JB	189	JFK	SAN
84	JetBlue Airw...	N536JB	89	JFK	SAN
85	JetBlue Airw...	N712JB	89	JFK	SAN
86	JetBlue Airw...	N615JB	189	JFK	SAN
87	JetBlue Airw...	N591JB	89	JFK	SAN
88	JetBlue Airw...	N639JB	189	JFK	SAN
89	JetBlue Airw...	N746JB	89	JFK	SAN
90	JetBlue Airw...	N807JB	189	JFK	SAN
91	JetBlue Airw...	N632JB	89	JFK	SAN
92	JetBlue Airw...	N796JB	189	JFK	SAN
93	JetBlue Airw...	N821JB	89	JFK	SAN
94	JetBlue Airw...	N712JB	189	JFK	SAN

	AIRLINE	TAIL_NUMBER	FLIGHT_NUMBER	ORIGIN	DESTINATION
95	JetBlue Airw...	N521JB	89	JFK	SAN
96	JetBlue Airw...	N651JB	189	JFK	SAN
97	JetBlue Airw...	N789JB	89	JFK	SAN
98	JetBlue Airw...	N607JB	89	JFK	SAN
99	JetBlue Airw...	N516JB	189	JFK	SAN
100	JetBlue Airw...	N591JB	89	JFK	SAN

⋮

De la tabla anterior, selecciona la segunda y tercera compañía más vuelos, y haz un contraste comparando sus medias. Por otro lado, selecciona la compañía con más vuelos. Calcula el tiempo medio que tardan los aviones. Haz un contraste comparando dicha media con la media calculada para todas las compañías.

```
%ponemos la condición para solo los de la compañia indicada
cond6 = find(Datos3.AIRLINE=="JetBlue Airways");
cond7 = find(Datos3.AIRLINE=="American Airlines");

Jetblue = Datos3(cond6,:);
American = Datos3(cond7,:);

media_jet=mean(Jetblue.ACTUAL_ELAPSED_TIME)
```

```
media_jet = 368.7170
```

```
media_american=mean(American.ACTUAL_ELAPSED_TIME)
```

```
media_american = 367.9063
```

```
%contraste de las medias
[h,p] = ttest2(media_jet,media_american)
```

```
h = NaN
p = NaN
```

```
%ponemos la condición para solo los de la compañia indicada
cond8 = find(Datos3.AIRLINE=="Delta Airlines");
Delta = Datos3(cond8,:);
media_delta= mean(Delta.ACTUAL_ELAPSED_TIME)
```

```
media_delta = 370
```

```
%contraste de las medias
[h,p] = ttest2(media_delta,media_NY)
```

```
h = NaN
p = NaN
```

Propón otros 2 contrastes parecidos al anterior, y calcula la probabilidad de cometer error tipo I y error tipo II.

En el primer ejemplo hemos seleccionado un contraste de hipotesis en la cual la media de la compañía American Airlines es igual a la media total de todos los vuelos que vienen de Nueva York. La cual sería un contraste de hipótesis por Simulaciones de Monte Carlo de 2 colas, en la cual calculamos tanto el contraste como los Errores Tipo I y II.

```
%desviaciones típicas
des_jet=std(Jetblue.ACTUAL_ELAPSED_TIME)
```

```
des_jet = 16.9415
```

```
des_american=std(American.ACTUAL_ELAPSED_TIME)
```

```
des_american = 16.7878
```

```
des_delta=std(Delta.ACTUAL_ELAPSED_TIME)
```

```
des_delta = 17.8528
```

```
des_NY=std(Datos3.ACTUAL_ELAPSED_TIME)
```

```
des_NY = 17.2508
```

```
%errores y tests
%AMERICAN-TODOS
%media american=media de todos
% Datos poblacionales
mu_0 = media_american;
sigma0 =des_american;

% Muestra
Xbar = media_NY; % Media muestral
N = 100;
sigma_bar = sigma0/sqrt(N) % Teorema varianza de la media simple
```

```
sigma_bar = 1.6788
```

```
Tobs = (Xbar - mu_0)/sigma_bar; % Normalización de la muestra

% Modelo para la simulación MC
M = 1000; % Nº experimentos Monte Carlo
Tm = zeros(1,M); % Resultados
rng('default') % Semilla

for i =1:M
   Xm = sigma0*randn(N,1) + mu_0; % Creamos muestras de la población
   Tm(i) = (mean(Xm) - mu_0)/sigma_bar; % Normalización
end

alpha = 0.05;
VCHi_mc = quantile(Tm,1-alpha) % Cuantil 9.95
```

```
VCHi_mc = 1.5177
```

```
VCLo_mc = quantile(Tm,alpha) % Cuantil 0.05
```

```
VCLo_mc = -1.5033
```

```
VC_teo = norminv(1-alpha)
```

```
VC_teo = 1.6449
```

```
x = norminv(1-alpha,mu_0)
```

```
x = 369.5511
```

```
disp('Si Tobs > Valor crítico obtenido por MC, rechazamos H0')
```

```
Si Tobs > Valor crítico obtenido por MC, rechazamos H0
```

```
sprintf('Tobs = %0.5f',Tobs)
```

```
ans =
'Tobs = 0.73823'
```

```
sprintf('T_c_MC = %0.5f',VCLo_mc)
```

```
ans =
'T_c_MC = -1.50330'
```

```
if(Tobs>VCLo_mc)
    disp('Se rechaza la hipótesis')
else
    disp('No se rechaza la hipótesis')
end
```

```
Se rechaza la hipótesis
```

```
%ERROR 2
% Datos poblacionales
mu_0 = media_american;
sigma0 =des_american;

% Muestra
Xbar = media_NY; % Media muestral
N = 100;
sigma_bar = sigma0/sqrt(N) % Teorema varianza de la media simple
```

```
sigma_bar = 1.6788
```

```
Tobs = (Xbar - mu_0)/sigma_bar; % Normalización de la muestra

%Simulación MC bajo H0
rng('default') %semilla
M = 5000; %n experimentos

for i =1:M
   Xm = sigma0*randn(N,1) + mu_0;
   Tm(i) = (mean(Xm) - mu_0)/sigma_bar; %5000 estadisticos de muestras de la población
end

alpha = 0.05;
```

```
VC_hi = quantile(Tm,1-alpha) % 95%
```

```
VC_hi = 1.6415
```

```
VC_lo = quantile(Tm,alpha) % 5%
```

```
VC_lo = -1.6085
```

```
%Simulación MC bajo H1
M = 5000; %nº experimentos

%medias alternativas
%Cola superior
mualt1 = 2400:5:2800;
%Cola inferior
mualt2 = 2000:5:2400;

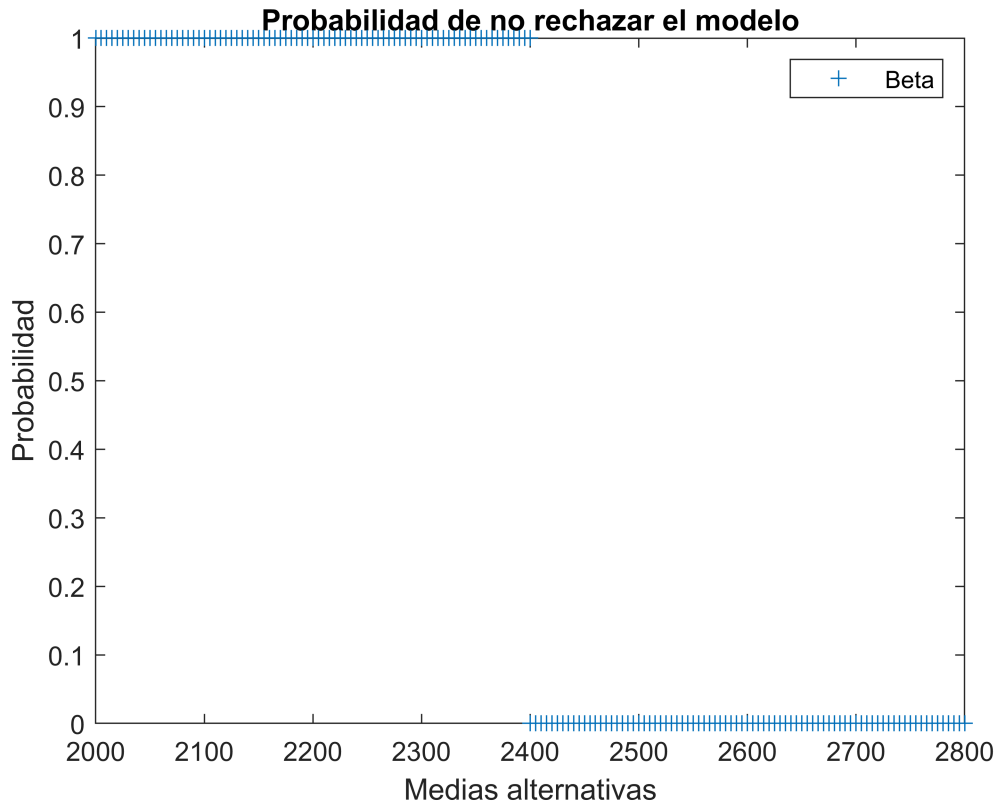
%beta1
betahat1 = zeros(size(mualt1));
for j =1:length(mualt1);
   Tm = zeros(1,M);
   for i =1:M
       xs = sigma0*randn(N,1) + mualt1(j);
       Tm(i) = (mean(xs) - mu_0)/sigma_bar;
   end
   Tm_s =Tm;
   betahat1(j) = sum(Tm_s < VC_hi)/M; % no se rechaza H0
end

%beta2
betahat2 = zeros(size(mualt2));
for j =1:length(mualt2);
   Tm = zeros(1,M);
   for i =1:M
       xs = sigma0*randn(N,1) + mualt2(j);
       Tm(i) = (mean(xs) - mu_0)/sigma_bar;
   end
   Tm_s =sort(Tm);
   betahat2(j) = sum(Tm_s > VC_lo)/M; %no se rechaza H0
end
%ERROR TIPO I
%beta1
betahat12 = zeros(size(mualt1));
for j =1:length(mualt1);
   Tm2 = zeros(1,M);
   for i =1:M
       xs2 = sigma0*randn(N,1) + mualt1(j);
       Tm2(i) = (mean(xs2) - mu_0)/sigma_bar;
   end
   Tm_s2 =sort(Tm2);
   betahat12(j) = sum(Tm_s2 > VC_hi)/M; % no se rechaza H0
end

%beta2
```

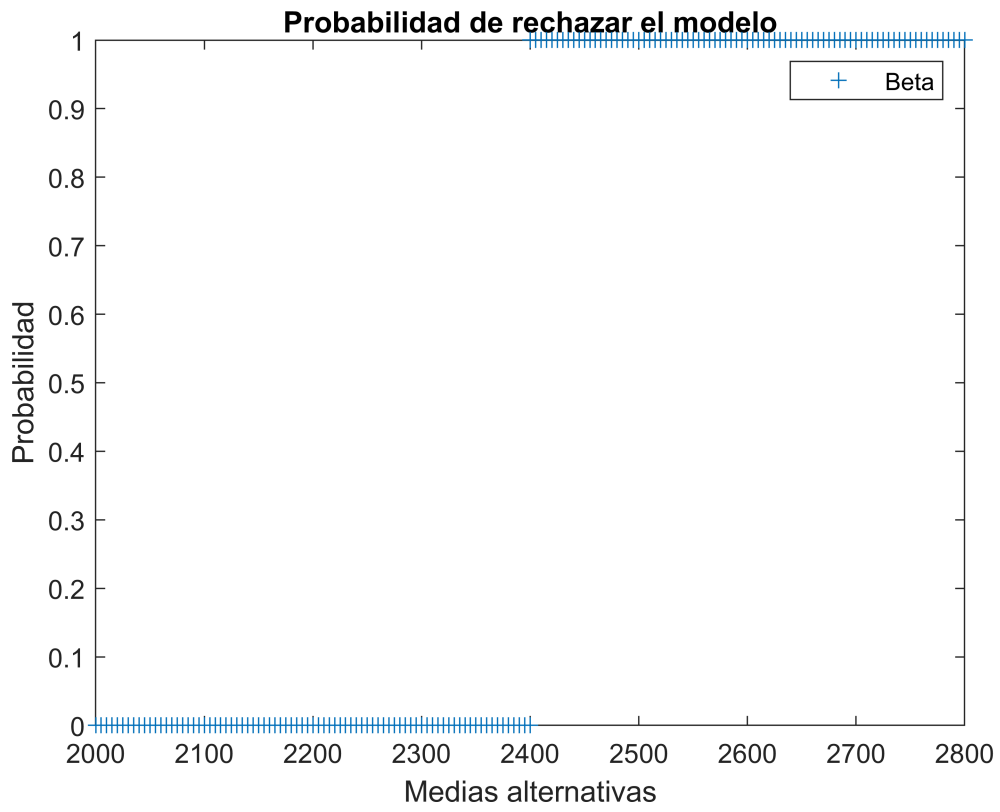
```
betahat22 = zeros(size(mualt2));
for j =1:length(mualt2);
   Tm2 = zeros(1,M);
   for i =1:M
       xs2 = sigma0*randn(N,1) + mualt2(j);
       Tm2(i) = (mean(xs2) - mu_0)/sigma_bar;
   end
   Tm_s2 =sort(Tm2);
   betahat22(j) = sum(Tm_s2 < VC_lo)/M; %no se rechaza H0
end

plot ([mualt1,mualt2],[betahat1,betahat2],'+')
hold on
axis tight
legend('Beta')
title('Probabilidad de no rechazar el modelo')
xlabel('Medias alternativas')
ylabel('Probabilidad')
hold off
```




```
plot ([mualt1,mualt2],[betahat12,betahat22],'+')
hold on
axis tight
legend('Beta')
title('Probabilidad de rechazar el modelo')
xlabel('Medias alternativas')
ylabel('Probabilidad')
```

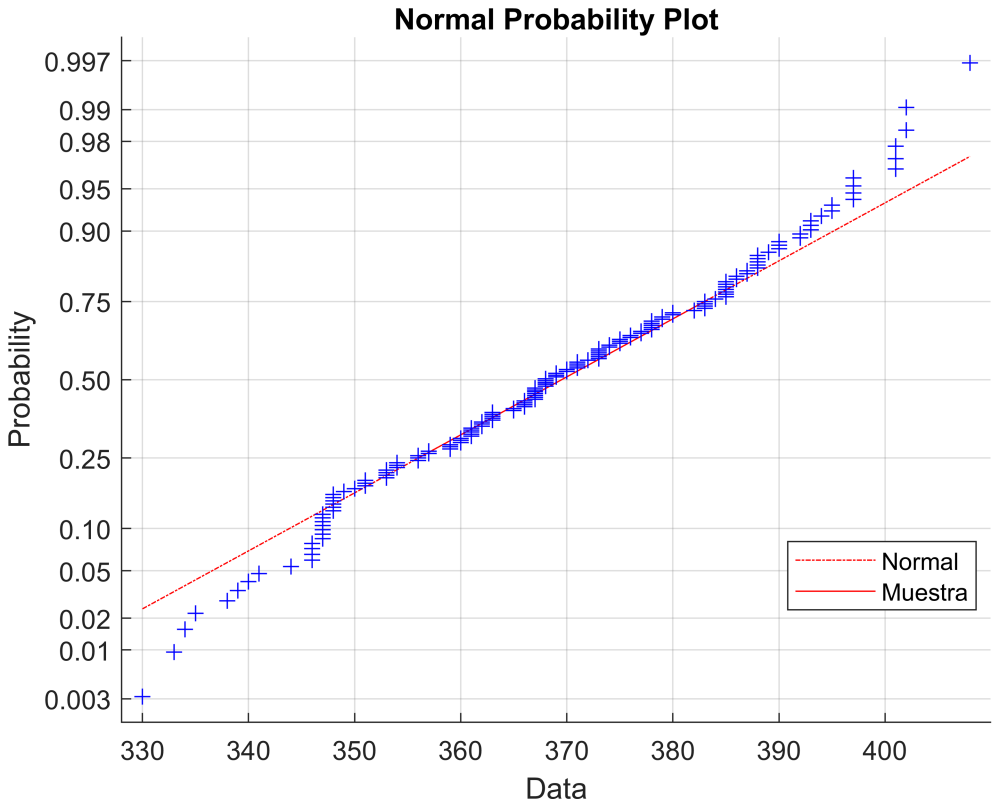
```
hold off
```



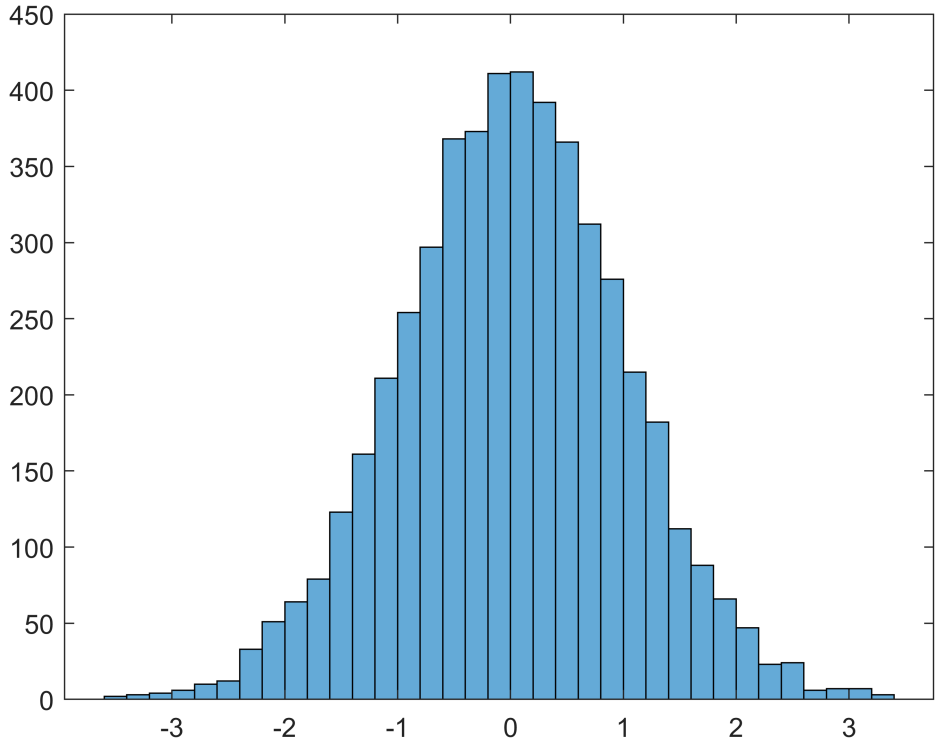
En el segundo contraste lo que vamos a tener como hipotesis nula es que la media de American Airlines es mayor, es decir que el tiempo de vuelo medio es mayor. Por tanto realizamos un contraste de hipotesis por Simulaciones Monte Carlo de 1 cola.

```
% La media, la desviación típica del enunciado y la longitud de la muestra
sigma=des_american;
mu=media_american;
N=length(Datos3.ACTUAL_ELAPSED_TIME);

% Definimos el estadístico y calculamos su z (To)
mediamuestral =media_NY;
sigma_bar = sigma/sqrt(N);
To= (mediamuestral - mu)/sigma_bar;
normplot(Datos3.ACTUAL_ELAPSED_TIME)
legend('Normal', 'Muestra','Location',"best")
```




```
% Simulamos una normal
Tm= zeros(1,M);
rng('default')
for i= 1:M
    Xm= sigma*randn(1,N) + mu;
    Tm(i) = (mean(Xm) - mu)/ sigma_bar;
end
histogram(Tm)
```




```
%Comprobamos la hipótesis comparando la z del estadístico con la del
%intervalo
alpha= 0.05;
VC_mc= quantile(Tm, 1-alpha);
if (To>VC_mc)
    disp('Se rechaza H0')
else
    disp('No se rechaza H0')
end
```

```
No se rechaza H0
```

```
n=length(Datos3.ACTUAL_ELAPSED_TIME);
mu0= media_american;
mediamuestral = media_NY;
sigma=des_american;

% Simulación Monte Carlo con una normal
M=1000;
Im= 0;
rng('default')
for k = 1:M
    % Random Sample under H_0
    xs= sigma*randn(1,n) + mu0;
    Tm= mean(xs);
    if Tm>= mediamuestral
```

```
        Im= Im+1;
    end
end
Laplace= Im/M
```

```
Laplace = 0.1760
```

```
sprintf('Probabilidad = %0.2f%%', Laplace*100)
```

```
ans =
'Probabilidad = 17.60%'
```

```
%Error tipo I-II

N = length(Datos3.ACTUAL_ELAPSED_TIME);

% Datos poblacionales
sigma = des_american;
mu_0 = media_american;

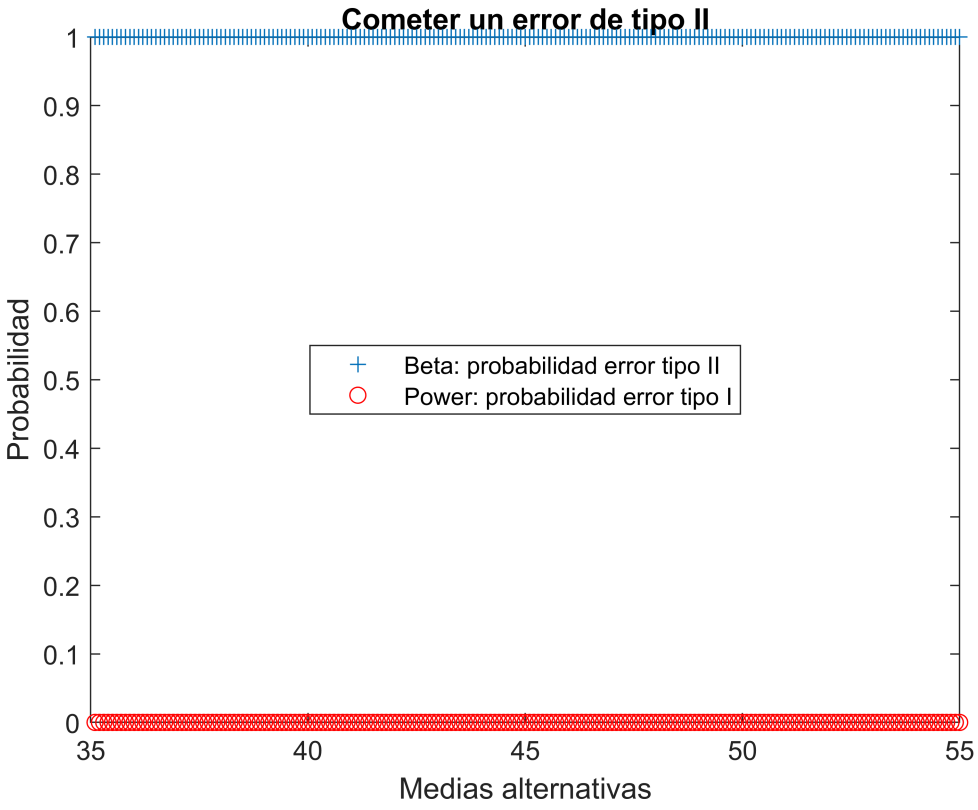
%Calculamos estadístico normalizado
X_bar = mean(Datos3.ACTUAL_ELAPSED_TIME); %media muestral
sigma_bar = sigma/sqrt(N); % varianza de la media simple
Tobs = (X_bar - mu_0)/sigma_bar;

%Simulación MC bajo H1
M = 1000; %nº experimentos
mualt = 35.1:0.1:55; %medias alternativas
betahat = zeros(size(mualt)); %beta

for j = 1:length(mualt) %mil experimentos para cada media alternativa
    Tm = zeros(1,M); %lista de estadísticos
    for i = 1:M;
        xs = sigma*randn(N,1) + mualt(j); %nueva muestra de poblacion con media mj
        Tm(i) = (mean(xs)-mu_0)/sigma_bar; %añadimos estadístico a la lista
    end

    betahat(j) = sum(Tm<Tobs)/M; %no rechazar
end

plot(mualt,betahat,'+')
hold on
plot(mualt,1-betahat,'or')
title('Cometer un error de tipo II')
legend('Beta: probabilidad error tipo II','Power: probabilidad error tipo I',"Location","best")
xlabel('Medias alternativas')
ylabel('Probabilidad')
hold off
```



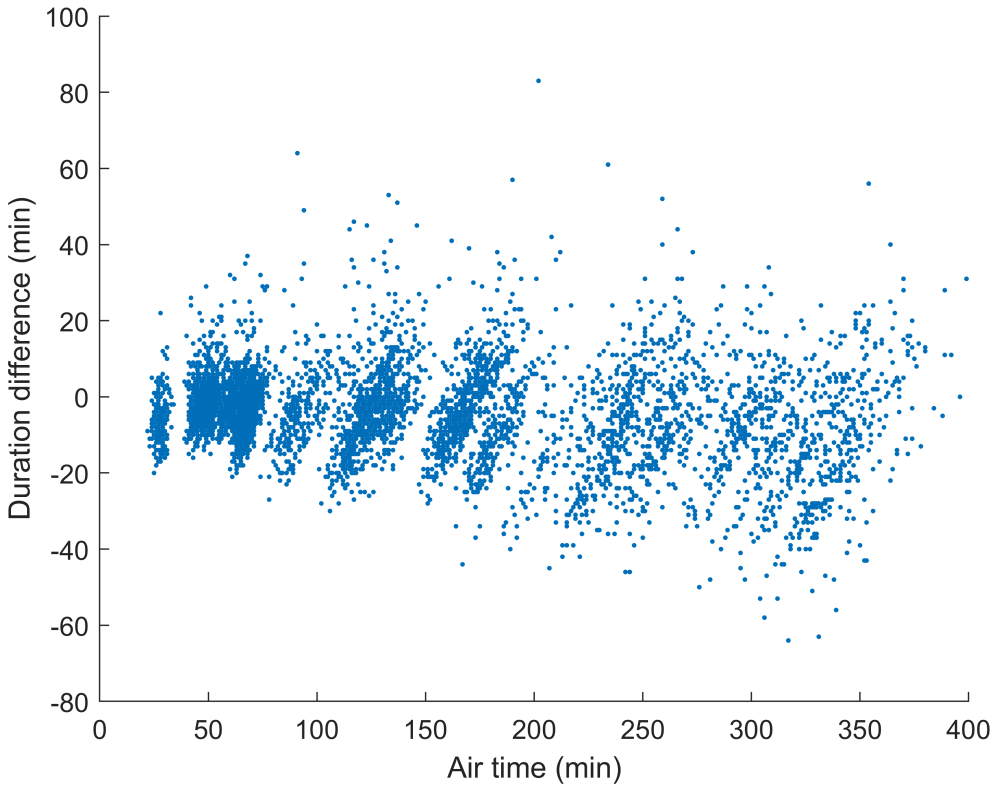

```
sprintf('Probabilidad de %0.2f%% de cometer un error de tipo II para una media de 45', betahat(
```

```
ans =
'Probabilidad de 100.00% de cometer un error de tipo II para una media de 45'
```

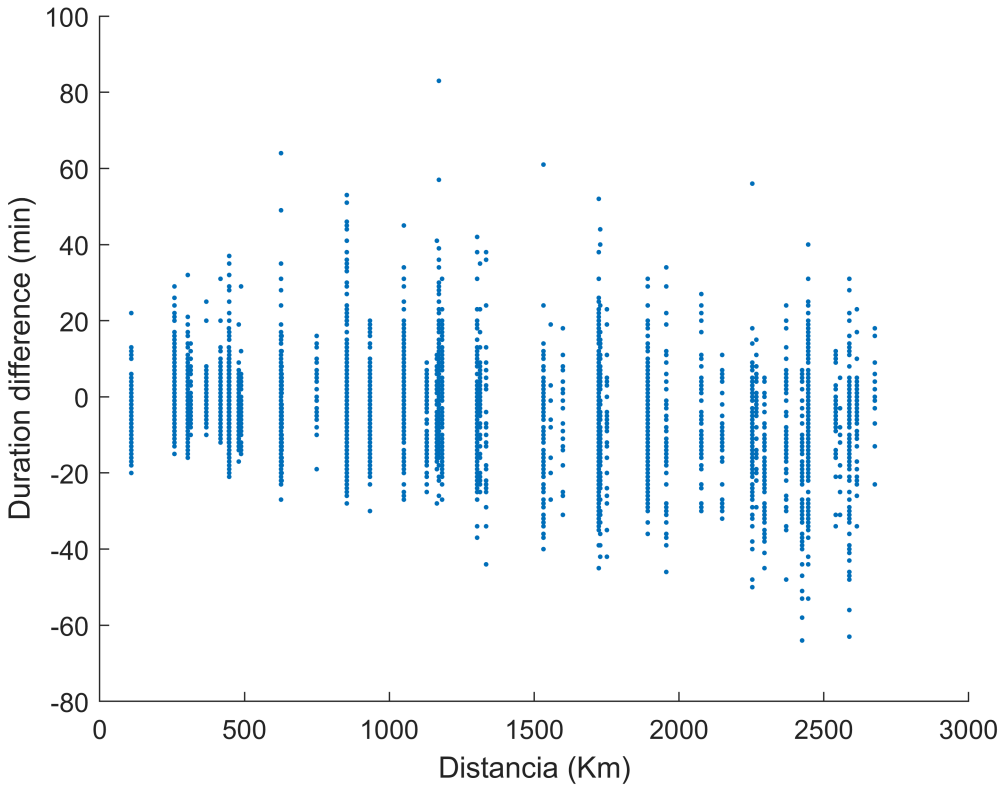
Para todos los vuelos que llegan a la ciudad seleccionada, represente la duración total del vuelo en función de la distancia, en función del tiempo en aire, en función del tiempo de taxi (antes y después del vuelo). Plantee un modelo de regresión lineal multivariable para predecir el tiempo de vuelo en función de la distancia y el tiempo de taxi.

Realizamos la representación en función que representa la duración total del vuelo en función de la distancia, en función del tiempo en aire y en función del tiempo en taxi.

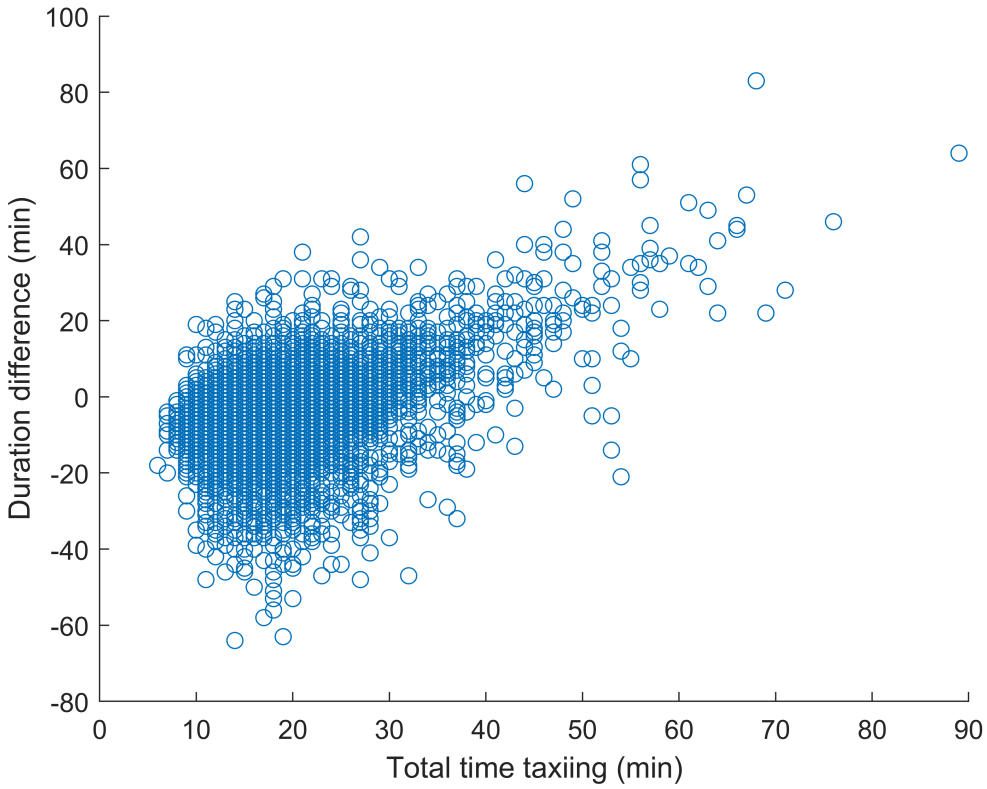
```
scatter(Datos.AIR_TIME, Datos2,'.')
xlabel('Air time (min)')
ylabel('Duration difference (min)')
```




```
scatter(Datos.DISTANCE, Datos2,'.')
xlabel('Distancia (Km)')
ylabel('Duration difference (min)')
```




```
Datos.TAXI_TOTAL = Datos.TAXI_OUT + Datos.TAXI_IN;
scatter(Datos.TAXI_TOTAL, Datos2)
xlabel('Total time taxiing (min)')
ylabel('Duration difference (min)')
```



Realizamos un modelo de regresión lineal multivariable para predecir el tiempo en función de la distancia y el tiempo en taxi

```
p = polyfit(Datos.DISTANCE,Datos.TAXI_TOTAL,2)
```

```
p = 1×3
    0.0000    0.0017   16.5243
```

```
% p= 0 + 0.0017x +16.5243x^2
```

He realizado este tipo de modelo de regresión debido a que no conseguía sacarlo mediante otro.